Ericsson's responses to IMDA's Second Consultation on 5G Mobile Services and Networks Info-communications Media Development Authority

SECOND CONSULTATION ON 5G MOBILE SERVICES AND NETWORKS

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2 Ericsson's responses to IMDA’s second consultation paper on 5G Mobile Services and Networks

Ericsson welcomes the opportunity to provide comments to IMDA’s second consultation paper on 5G Mobile Services and Networks.

Ericsson supports and appreciates the new bands being made available to the mobile industry and would like to invite IMDA to consider the bands 600 MHz and 4.5 GHz for future allocation as this would secure the evolution of mobile broadband services further into the future. All these bands would support valuable public mobile broadband communication services and applications for consumers in Singapore. Ericsson has taken the approach of providing comments with a view on the operational and technical opportunities as well as the socio-economic aspects based on our experiences.

5G networks are currently being deployed in several regions worldwide and commercial launches are already taking place. One of the first 5G use cases will be fixed wireless access, as devices with form factors suitable for customer premises equipment will be early to the market, and will not have the stringent size, weight and power consumption requirements that come with smartphones. As 5G smartphones become available during 2019, several providers have already launched 5G commercially.

On a global level, major 5G network deployments are anticipated from 2020, and by the end of 2024 we project 1.5 billion 5G subscriptions for enhanced mobile broadband. This will account for close to 17 percent of all mobile subscriptions at that time. With global mobile data traffic forecast to increase by a factor of 5 between 2018 and 2024, key drivers for 5G deployment include increased network capacity and decreased cost per byte. 5G subscription uptake is expected to be faster than that of 4G during the corresponding period of its lifecycle, which in turn is the mobile communication technology with the fastest subscription uptake so far.

Growth of 5G is linked to growth of the complete ecosystem. Network development and rollout need to happen at pace with the development of devices, and this will be influenced by access to and licensing of suitable spectrum bands in a timely manner.

3 Ericsson’s Responses

3.1 Question 1

IMDA would like to seek the industry’s views on skills requirements and the potential job demands in the future of networks and next generation of application/use-cases with 5G technology.

Ericsson’s Response:

Regarding the next generation of application/use-cases with 5G technology, Ericsson is of the view that the new 5G standard will enable the expansion of digital operations, addressing the challenges of manufacturing while exploiting the potential of Industry 4.0.

The traditional connectivity paradigm is being challenged by flexible production and wireless Industrial IoT (IIoT). Currently, production and most use cases in IIoT on manufacturing sites are based on wired connections. However, as the evolving cellular capabilities are challenging industrial ethernet solutions, wires will in many cases become redundant, introducing opportunities for more flexible production and faster line changes.

In addition, consumer behaviours are shifting, with low- and standard-definition video formats being overtaken by HD and Full HD formats. It is expected that Augmented Reality (AR) has many potential applications. Industrial manufacturing and maintenance, sports events, architecture, navigation and tourism are just a few of the areas where AR is expected to have a big impact.

3.2 Question 2

IMDA would like to seek views on:
i) The types of innovative use-cases that could capitalise and further enhance Singapore’s competitive advantages, trigger new growth potential and/or strengthen Singapore’s existing strategic pillars; and
ii) Areas of government support that the industry require in order to enable innovation and development in 5G.

Ericsson’s Response:

Ericsson is of the view that:

i) The new 5G standard will further enable expansion of digital operations, addressing the challenges of manufacturing while exploiting the potential of Industry 4.0.

   5G has the ability to drive a digital society where everything

that can benefit from being connected will be connected. All-digital infrastructure can be a catalyst for competitiveness, driving new and sustainable business models and use cases as well as changing industries and society. It has the potential to level the playing field within and between countries as well as around the world.

In the Ericsson Mobility Report - Special edition World Economic Forum[1], a study was done on the most important 5G use cases according to approximately 100 senior decision-makers from large companies globally across 10 key industries. Based on the wide range of use cases identified, 5G will make an impact far beyond the consumer-based mobile broadband market. While the consumer is well represented even here – in the media and entertainment, retail and financial services industries – the impact of 5G will be much deeper as more industry use cases are implemented.

The following are some of the key use cases identified:

Public safety
- Quickly transfer of more data and higher resolution imagery to/from first responders
- Multi-angle high resolution video streaming with smart analytics and alerts
- Real-time smart video surveillance
- Visor/helmet computer with augmented reality (AR) or virtual reality (VR)

Manufacturing
- Large network of sensors for predictive maintenance of machines/robots on the factory floor
- Cloud robotics (processing in the cloud for smaller, cheaper robots that can be centrally controlled and untethered in any environment)
- Identification and tracking of goods in the end-to-end value chain
- Remote quality inspection/diagnostics with high-resolution/3D video or haptic feedback, thermal and other sensors

Media and entertainment
- Broadband to the home through high-density gigabit wireless fixed internet
- High-quality streaming to mobile devices
- Live personal 3D broadcast from mobile services
- 4K streaming to mobile devices

Automotive
- Better customer experience during the sales process, such as a mobile app with 4K, 360-degree images of vehicles
- VR/AR to assist or train service technicians
- Infotainment
- AR dashboards

[1] Ericsson Mobility Report - Special edition World Economic Forum (https://www.ericsson.com/assets/local/mobility-report/documents/2019/ericsson-mobility-report-world-economic-forum.pdf)

Public transport
- High-speed internet access on public transport
- Connected traffic cloud aggregates and analyses real-time data from connected vehicles, infrastructure and devices to assist operational decision making
- Real-time high-resolution vehicle video surveillance
- AR way-finding applications

Financial services
- Next-generation user-based insurance (sensors in connected cars, for example)
- High-security cloud-based services
- Real-time mobile trading
- Secure, remote sessions with financial advisors

Retail
- AR/VR shopping from anywhere
- AR/VR to visualize a product in a specific setting
- In-store AR-enabled customer care, with access to graphic rich product information
- Automated warehouses

Healthcare
- Real-time mobile delivery of rich medical data sets
- Cloud robotics (processing in the cloud for smaller, cheaper robots that can be centrally controlled) for assisted living or rehabilitation
- Ambulance drones
- Smart objects, such as syringes, cabinets and beds

ii) Advanced 5G services are expected to provide significantly higher peak data rates and capacity at very high quality, requiring spectrum resources to be allocated in very wide bandwidths. Licensing of the right spectrum in sufficient amounts is fundamental to build the momentum for 5G services.

Significant efforts are still needed to align allocations between countries to secure the right spectrum. Alignment is crucial for the economics of the emerging 5G ecosystem, as it directly affects costs of devices and infrastructure.

Ericsson would like to highlight the following areas where the government could accelerate for early introduction of 5G services:
- Urgent need of 5G spectrum harmonisation in the region
- Re-farming of 3.5 GHz and 28 GHz bands for 5G use

3.3 Question 3

IMDA would like to seek views and comments on the suitable technical parameters, including the reasonable amount of guard band needed to reduce potential interference between IMT and FSS use in the 3.5 GHz band.

Ericsson's Response:

Ericsson understands that the 3.5 GHz band is currently used for satellite signals reception for TV Receive-Only stations to individual sites across different parts of Singapore. It is also noted that IMDA has decided that the primary allocation of the 3.4 – 3.7 GHz band will be changed from FSS (space-to-Earth) to mobile service while that of the 3.7 – 4.2 GHz band will be retained as FSS (space-to-Earth).

IMT and FSS coexistence studies have been done in various forums. The reports, ITU-R S.2368 by ITU, and Considerations for the 3.5 GHz IMT range: getting ready for use[2] by GSMA could be used as references.

It should be noted that co-existence between IMT and FSS is a national issue and the extent of the issue could be different for each country. In view of this, Ericsson would recommend that a comprehensive technical study followed by a field trial to be done to determine the relevant protection measures needed for co-existence between IMT and FSS services in Singapore.

3.4 Question 4

IMDA would like to seek views and comments on the following:
i) Whether the industry agrees with the timelines on the expected availability of the next wave of 5G spectrum; and
ii) Whether current deployments in the 2.5 GHz FDD spectrum band (based on 3GPP Band 7) and in the 2.5 GHz TDD spectrum band (based on 3GPP Band 38), should be refarmed to 3GPP Band 41 for future 5G services in Singapore, and the views on the associated cost and challenges.

Ericsson's Response:

i) Ericsson agrees with IMDA that the early 5G bands in this region are 3.5 GHz and 28 GHz.

   Based on device ecosystem readiness and considering that devices will grow in volumes going forward for these bands, Ericsson is of the view

[2] Considerations for the 3.5 GHz IMT range: getting ready for use (https://www.gsma.com/spectrum/wp-content/uploads/2017/06/Considerations-for-the-3.5-GHz-IMT-range-v2.pdf)

that IMDA should accelerate the allocation the 3.5 GHz band. For the primary band 3400 – 3700 MHz being identified by IMDA for mobile services, it is noted that it is also being used for satellite services currently. Ericsson is of the view that this frequency range should be re-farmed as much as possible for introduction of 5G services as these bands offer the best compromise between coverage and capacity for the 5G technology.

In addition, most of the current 3GPP bands including low bands (700 MHz and 900 MHz) and mid-bands (1.8 GHz, 2.1 GHz, 2.3 GHz and 2.5 GHz) have been standardized for 5G services. These bands will eventually be central to delivering 5G coverage and capacity for enhanced mobile broadband, IoT, industrial automation and mission-critical services.

ii) It is noted that Band 41 is starting to gain traction as a 5G band. However, Ericsson agrees with IMDA's view that it will be technically challenging to adopt Band 41 in Singapore at this juncture due to the current extensive use of 2.5 GHz FDD for 4G and the need for border coordination with neighbouring countries.

3.5 Question 5

IMDA would like to seek views, comments and suggestions on:
i) Whether Singapore should have two nationwide networks as a start given the considerations and trade-offs;
ii) The proposed 3.5 GHz lot sizes and spectrum packages;
iii) Whether 5G equipment would be able to support 3.5 GHz bandwidths in multiples of 50 MHz;
iv) The value, if any, in assigning the remaining 50 MHz restricted 3.5 GHz spectrum in the same assignment exercise as the unrestricted lots;
v) The proposed mmWave lot sizes and preferred band plan option; and
vi) The rank order preference of the 3.5 GHz spectrum package and mmWave lot combinations.

Ericsson's Response:

i) Ericsson has no comment to this question.

ii) Ericsson is of the view that the 3.5 GHz band should be re-farmed to achieve at least 200 MHz of bandwidth and made available for allocation.

Ericsson is of the view that IMDA's baseline regulatory requirements should not be restricting the 5G bands to providing purely 5G standalone networks. Any designated 5G band should not be bound by regulatory requirements in terms of 5G architecture deployments. It is our view that IMDA should allow for a flexible deployment architecture which includes both Non-Standalone Architecture (NSA) and Standalone Architecture (SA).

Based on current deployments, the clear majority is based on NSA due to the benefits of reducing time to market and ensuring good coverage and mobility. 5G at mid and high bands is well suited for deployment at existing site grids, especially when combined with the lower band LTE. Adding new frequency bands to existing deployments is a future-proof and cost-efficient way to improve performance, meet the growing needs of mobile broadband subscribers and deliver new 5G-based services. As the majority of 5G commercial devices currently available are based on NSA, it offers operators the opportunity to offer 5G services early.

5G SA could co-exist with an NSA deployment when the device ecosystem is ready. With that, it offers the greatest potential for future evolution, with many new capabilities introduced including advanced network slicing support.

By enabling the use of 5G bands for both NSA and SA deployments, operators could achieve the best time to market solution, maximize the reuse of existing network resources and ensure the full potential of 5G can be achieved as quickly as needed.

iii) As specified in the 3GPP standards, 5G equipment should be able to support 3.5 GHz bandwidths in multiples of 50 MHz.

iv) As per our earlier response, Ericsson is of the view that the 3.5 GHz band should be re-farmed to achieve at least 200 MHz of bandwidth and made available for allocation. The remaining 50 MHz restricted spectrum should be freed up for allocation as well.

v) Ericsson agrees with IMDA’s approach of assigning mmWave bands in blocks of 800 MHz. It is also our view that the full n257 band should be made available where possible and the auction in South Korea during 2018 could be used as a good reference for IMDA to consider for channelling arrangement. This is a similar arrangement to IMDA’s proposed Option C which provides a good alignment with the 3GPP bands n257 and n258.

vi) Ericsson has no comment to this question.

3.6 Question 6

IMDA would like to seek views, comments and suggestions on:
i) The proposed network rollout and performance obligations to be imposed on the spectrum right holders;
ii) The methodology and measurement criteria for the coverage obligation;
iii) The network design and resilience challenges of 5G (in particular, enabling technologies, such as SDN, NFV and Cloud Computing that may fundamentally change how the network would be designed and deployed) and possible measures to address them, and whether there are other aspects that should be considered to enable trusted and resilient 5G network; and
iv) The framework for the provision of 5G wholesale services.

Ericsson's Response:

i) Ericsson is of the view that IMDA's baseline regulatory requirements should not be restricting the 5G bands to providing purely 5G standalone networks. Any designated 5G band should not be bound by regulatory requirements in terms of 5G architecture deployments.

   It is our view that IMDA should allow for a flexible deployment architecture which includes both Non-Standalone Architecture (NSA) and Standalone Architecture (SA).

ii) Ericsson has no comment to this question.

iii) Ericsson believes that the 5G Core Network should be based on Cloud Native. Cloud Native is a term that describes the patterns of organisations, architectures and technologies that consistently, reliably and at scale fully take advantage of the possibilities of the cloud to support cloud-oriented business models. Cloud native applications are developed specifically for deployment in and being managed by cloud environments, delivering on the characteristics associated with cloud.

   As described in the Ericsson paper - Cloud native design for telecom applications[3], Cloud native applications adhere to the Cloud Native best practices to become elastic, resilient and dynamically composed with automated management.

   Ericsson believes that cloud native applications for 5G should adhere to the following design principles:
   – Being Agnostic
     A cloud-native application must be agnostic to the underlying infrastructure and resources.
   – Software Decomposition and Life Cycle Management

[3] Cloud native design for telecom applications (https://www.ericsson.com/en/digital-services/trending/cloud-native)

Decompose software into smaller and more manageable pieces, utilising microservice architectures. Each piece can be individually deployed, scaled, and upgraded using a CaaS (Container as a Service) environment.

- Resiliency
  In legacy applications, the meantime between failure of hardware has been the base metric for resiliency. In the cloud, it is reliant on distribution and independence of software components that utilise auto-scaling and healing. This means that failures within an application should cause only temporary capacity loss and never escalate to a full restart and loss of service.
- State-optimised Design
  The management of states depends on the type of state/data and the context of the states. There is no “one size fits all” way of state/data handling but there should be a balance in terms of performance, resiliency and flexibility.
- Orchestration and Automation
  A huge benefit of cloud native applications is increased automation through, for example, a Kubernetes-based CaaS layer. A CaaS enables auto-scaling of microservices, auto-healing of failing containers and software upgrades including canary testing (i.e. small-scale testing) prior to larger deployments.

iv) Ericsson has no comment to this question.

3.7 Question 7

IMDA would like to seek views, comments and suggestions on the spectrum assignment framework, including:
i) The proposed assignment approach;
ii) The spectrum right duration of the 3.5 GHz package and mmWave lots;
iii) The evaluation criteria, sub-criteria and weights to assess the proposals;
iv) The assessment methodology, including evidence (documentary or otherwise) to evaluate the proposals; and
v) The enforcement and/or audit mechanisms to ensure that applicants are able to deliver on their proposals.

Ericsson’s Response:

Ericsson has no comment to the above questions.

3.8 Question 8

IMDA would like to seek views and comments on the trade-offs (particularly on resilience, 5G capabilities) and technical feasibility of the various levels of infrastructure sharing.

Ericsson's Response:

Ericsson agrees with IMDA's view that the benefits of infrastructure sharing will have to be weighed against the potential impact on network resilience with reduced network diversity, service differentiation and technology innovation due to technical complexities, and competitiveness of the telecommunication markets.

Multi-Operator Core Network (MOCN) is the only 3GPP specified 5G network sharing solution currently. One key trade-off for network sharing is the reduction of service differentiation due to similarities in network coverage and quality of service between MNOs. This could potentially impact competitiveness, innovation and investment from the MNOs.

It should be noted that active sharing will require a high level of coordination and effort between sharing MNOs, especially in terms of service level agreements, new capacity needs and during network disruptions.

3.9 Question 9

IMDA would like to seek views and comments on the following:
i) The synchronisation approach for 5G TDD networks in a multi-operator environment for the 3.5 GHz and mmWave bands, specifically for the following:
a. Synchronised networks: the required frame alignment, compatible frame structures and BEM specifications for AAS and non-AAS base stations; and
b. Unsynchronised networks: the amount of guard band, geographical separation and BEM specifications for AAS and non-AAS base stations;
ii) The adoption of other suitable mitigation measures to mitigate interference between unsynchronised networks; and
iii) The need for IMDA to mandate a regulatory requirement for synchronisation across the 5G TDD networks or leave it to operators to co-ordinate their network deployment and parameters in order to reduce interference between networks.

Ericsson's Response:

i) Ericsson is of the view that all operators with spectrum in the same band in the same geographical area should mutually agree on the way to operate in terms of the synchronisation approach. The is aligned with the

draft ECC Report 296[4] on the studied solutions and options for coexisting MFCN networks in synchronized, non-synchronized and semi-synchronized operation.

We would like to share our observation from around the world, that countries seem to mostly go for mandating synchronised operation. For example, China, Korea and Japan mandate TDD pattern synchronization among operators in the same band. Ofcom (UK) mandates that the TDD pattern for 5G NR aligns with LTE that is in the same band.

Ericsson recommends synchronised UL/DL slot arrangements among operators for NR mid band deployment, both for spectrum efficiency reasons as well as for cost efficiency reasons. We would like to highlight that unsynchronized operation results in cross-link interference. Based on the findings of draft Report 296, the cross-link interference deriving from unsynchronized operation could be managed with the adoption of the ECC restricted baseline out of block power limit. Such adoption, based on currently available technology, would imply not only the adoption of inter-operator guard bands, but also the use of operator-specific filters. It is expected that it will be challenging to implement operator-specific filters in a cost-effective manner, in the case of Adaptive Antenna System Base Stations (AAS BS). In addition, it will be highly undesirable to implement the significant guard bands that would be needed in such a case of unsynchronized operation (i.e. in the case of implementation of the ECC restrictive out of block power limits), as this would result in wasting valuable spectrum.

It is noted that the draft Report 296 emphasizes on the need to implement a framework that would not require the implementation of the ECC restrictive out of block power limits. Ericsson’s view is in line with the findings of the report that unsynchronised operation requires a combination of several challenging measures of ambiguous effectiveness to minimise interference and therefore should be avoided.

As for the mmWave bands, it is our view that operators could have the flexibility to coordinate their network deployments and synchronisation amongst themselves where needed.

ii) As specified in our earlier response, Ericsson’s view is in line with the findings of the report that unsynchronised operation requires a combination of several challenging measures of ambiguous effectiveness to minimise interference and therefore should be avoided.

iii) Ericsson noted that operators coordinate the synchronisation amongst themselves for current 4G TDD networks, including coordinating with cross-border TDD operators at the national borders. This practice could still be applicable and IMDA could render assistance to the operators as appropriate.

[4] Draft ECC Report 296: National synchronization regulatory framework options in 3400-3800 MHz: a toolbox for the coexistence of MFCNs in synchronized, unsynchronized and semi-synchronized operation in 3400-3800 MHz

3.10 Question 10

IMDA would like to seek views and comments on the following:
i) The interest from industry players to leverage 5G spectrum or other mobile spectrum bands for fixed-wireless services that support mobile connectivity; and
ii) The policies (e.g., spectrum allocation, numbering) that should be considered to facilitate such use-cases.

Ericsson's Response:

i) Ericsson agrees with IMDA's proposal to allow MNOs to use existing and upcoming 5G spectrum rights for fixed-wireless services, as long as the spectrum is still primarily used for the intended mobile service.

ii) Ericsson has no comment to this question.