Ericsson's Responses to iDA's Proposed Allocation of Spectrum for IMT and IMT-Advanced Services

PROPOSED ALLOCATION OF SPECTRUM FOR INTERNATIONAL MOBLE TELECOMMUNICATIONS ("IMT") AND IMT-ADVANCED SERVICES AND OPTIONS TO ENHANCE MOBILE COMPETITION

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2 Ericsson's Responses to iDA's Proposed Allocation of Spectrum for International Mobile Telecommunications (“IMT”) and IMT-Advanced Services and Options to Enhance Mobile Competition

Ericsson welcomes the opportunity to provide responses and comments to iDA’s initiative on the Proposed Allocation of Spectrum for International Mobile Telecommunications (“IMT”) and IMT-Advanced Services and Options to Enhance Mobile Competition consultation paper.

Ericsson supports and appreciates that the bands 800 MHz, 900 MHz, 2.3 GHz and 2.5 GHz are available to the mobile industry, as well as the possible future bands 700 MHz, 1.4 GHz and 3.5 GHz. These bands will 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.

As a global provider of public mobile telecommunication solutions, Ericsson understands and promotes the benefits of international spectrum harmonisation. International spectrum harmonisation brings economies of scale in network equipment and terminal devices, thereby reducing the end user costs and providing for affordable services and applications to all. In addition, it enables international roaming and handover capabilities, which contribute to a common market in the region and easy border coordination. The current successes of GSM/EDGE, WCDMA/HSPA and LTE are results of a common global view on the allocation of spectrum to International Mobile Telecommunications (IMT), defined and standardised by International Telecommunication Union (ITU) as well as technical specifications developed within the framework of the international Third Generation Partner Project (3GPP).

Ericsson believes that the IMT family of standards including GSM/EDGE, WCDMA/HSPA and the LTE technologies, as well as LTE-Advanced (IMT-Advanced) technology, will remain the relevant technologies for mass market public mobile broadband usage in the foreseeable future. The vast ecosystem of these technologies is being developed under an open international standardisation scheme together with the harmonised spectrum. It is providing economies of scale which have proven to be the best drivers to deliver increased user values.

LTE offers new and enhanced opportunities to operators wanting to use both paired and unpaired spectrum in an integrated service offering to their

consumers. The LTE architecture allows for such integration due to the similarities of both access schemes. Therefore LTE is particularly well suited for usage in the harmonised bands including 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 1.4 GHz, 2.3 GHz, 2.5 GHz and 3.5 GHz, which consist of both paired (FDD) and unpaired (TDD) spectrum arrangements.

3 Ericsson's Responses

3.1 Question 1

IDA seeks views on whether the 700 MHz band should be allocated as a standalone, or coupled with other bands such as the 900 MHz, 800 MHz or the 1.9/2.1 GHz bands.

Ericsson's Response:

Ericsson is not providing comments to this question.

3.2 Question 2

IDA seeks views on:
(a) whether the 800 MHz band should be re-farmed for mobile services;
(b) the band plan that should be preferred by Singapore and the underlying reasons;
(c) details of transitional issues to migrate existing services and systems in the 800 MHz band to the revised band plan;
(d) possible impact to end users of digital trunked radio and SRD/RFID, if, as a result of the eventual 800 MHz band plan: (i) the end users do not have to be migrated but will have to coexist with mobile broadband services; or (ii) the end users have to be migrated; and
(e) possible co-existence issues between mobile broadband, and digital trunked radio and SRD/RFID.

Ericsson's Response:

Ericsson is of the view that:

(a) Taking appropriate account of current usage, the band 800 MHz could be considered for re-farming to Mobile broadband services including Broadband Public Protection and Disaster Relief (PPDR) subject to national circumstances due to its good coverage properties especially for deep indoor penetration.

(b) A phased approach could be taken to develop a band plan between 806 and 829 MHz paired with 851 and 874 MHz i.e.

Phase 1:

- Trunked Radio between 806 to 814 MHz Uplink paired with 851 to 859 MHz Downlink
- Mobile Broadband between 814 to 821 MHz Uplink paired with 859 to 866 MHz Downlink (2 x 5 MHz within this block)

- Mobile Broadband between 824 to 829 MHz Uplink paired with 869 to 874 MHz Downlink
- SRD between 866 to 869 MHz
- Mobile Broadband between 880 to 915 MHz Uplink paired with 925 to 960 MHz Downlink

Phase 2:

- Trunked Radio between 806 to 809 MHz Uplink paired with 851 to 854 MHz
- Mobile Broadband between 809 to 821 MHz Uplink paired with 854 to 866 MHz Downlink (2 x 10 MHz within this block)
- Mobile Broadband between 824 to 829 MHz Uplink paired with 869 to 874 MHz Downlink
- SRD between 866 to 869 MHz
- Mobile Broadband between 880 to 915 MHz Uplink paired with 925 to 960 MHz Downlink

For Mobile Broadband allocation, iDA could possibly also consider Broadband PPDR in some of these bands or a combination of dedicated PPDR and PPDR in commercial bands.

(c) Please refer to our proposed phased approach in (b), taking in account the need to ensure that the requirements of existing users in this range are met and that existing users are given a reasonable migration timeframe upon IDA's decision to re-farm the band.

(d) Please refer to our proposed phased approach above where the Trunked Radio usage could be reduced over time subject to demand. SRD/RFID usage could remain in the band after the introduction of Mobile Broadband.

(e) Please refer to our proposed phased approach above where we suggest that the Mobile Broadband in the range 809/814 to 821 MHz (5 MHz and 10 MHz channel blocks respectively) could be allocated so as to acquire e.g. 1 MHz guard band (if iDA finds it appropriate) on each side of the channel blocks used to alleviate co-existence with Trunked Radio usage and SRD/RFID respectively.

3.3 Question 3

IDA seeks views on the allocation approach for the 900 MHz spectrum band, particularly:
(a) whether the band should be re-allocated as a standalone band in a market-based allocation framework, and if so, the preferred timeframe for such an allocation exercise;
(b) whether the band should be coupled with other spectrum bands for allocation, and if so, which bands and the preferred timeframe for such an allocation exercise; and
(c) the underlying reasons for your views on the above.

Ericsson's Response:

Ericsson is not providing comments to this question.

3.4 Question 4

IDA seeks views and proposals on the technical issues relating to the allocation of the Sub-1 GHz bands for mobile broadband services, in particular, the guard band requirements between the adjacent bands (e.g., 700, 800 and 900 MHz bands) for mobile broadband services.

Ericsson's Response:

Co-existence between bands APT700 MHz (Band 28) and 800 MHz (Band 27)
3GPP has developed specifications for the band APT700 MHz (Band 28, 703 – 748 MHz / 758 – 803 MHz) and for the band 800 MHz (Band 27, 807 – 824 MHz / 852 – 869 MHz) providing a guard band of 4 MHz between 803-807 MHz. Some considerations need to be taken with this implementation and this has been investigated both in 3GPP and in APT (Reference: Report approved in the recent AWG meeting AWG-16/OUT-02, "DRAFT NEW APT/AWG REPORT ON Co-Existence between services at the boundary of the 700 MHz and 800 MHz bands"). With the introduction of APT700 MHz (Band 28) and 800 MHz (Band 27), there are considerable opportunities to introduce commercial economy-of-scale products for public mobile broadband infrastructure and terminals, as well as Broadband Public Protection and Disaster Relief (PPDR), based on LTE.

Co-existence between APT700 MHz (Band 28) and Trunked Radio (800 MHz)
The AWG report (referenced above) also contains some studies on the co-existence with Trunked Radio used in some countries. In this case, there would be some co-existence issues with 803-807 MHz being the guard band.

Co-existence between 3GPP Band 27 (800 MHz) and Band 5 (850 MHz)
If Band 27, which is above the band APT700 MHz (Band 28) and below 850 MHz (Band 5, 824 – 849 MHz / 869 – 894 MHz) is available, it is recommended to implement 3GPP Band 27 (fully or partially) to maximise the possibility for the use of commercial Mobile Broadband services and/or Broadband Public Protection and Disaster Relief (PPDR) services. The main interference issue is the 2 MHz frequency gap (guard band) between 849 – 851 MHz, creating BS-to-BS interference as well as UE-to-UE interference, which is the rationale for suggesting "fully or partially" above as for iDA to consider its options in managing the national, as well as possible international, co-existence issues.

Co-existence between 3GPP Band 27 (800 MHz) and Trunked Radio (800 MHz)
For co-existence between 3GPP Band 27 (fully or partially) and Trunked Radio in the band 800 MHz (803 – 824 MHz / 849 – 869 MHz), the needed guard band depends on what Trunked Radio technology is used. 3GPP compliant UEs would be manufactured for the full Band 27, hence the permanent receiver front-end filter has a fixed tuning open to the whole band, while the transmitter of the BSs would need special filters subject to the national circumstances in order to limit emissions in the band where the Trunked Radio would be used.

Co-existence between 3GPP Band 5 (850 MHz) and Band 8 (900 MHz, 880 – 915 MHz / 925 – 960 MHz)
This has been studied in some APT countries. In Australia and New Zealand, there are implementations with a part of the 3GPP Band 5 (2 x 20 MHz, 824 – 844 MHz / 869 – 889 MHz) and part of 3GPP Band 8 "GSM900 MHz" (2 x 25 MHz, 890 – 915 MHz / 935 – 960 MHz) with successful implementation while implementing individual coordination conditions and procedures. Some other countries including Vietnam, Cambodia and Malaysia, have 2 x 10 MHz (849 – 859 MHz / 869 – 879 MHz) implementations in Band 5 together with Band 8 implementations of 2 x 35 MHz (880 – 915 MHz / 925 – 960 MHz). In both cases, the interference situations are very similar and there is vast experience and information related to this implementation with encouraging and successful results. Ericsson has implemented networks in several countries with different arrangements and combinations of Band 5 and Band 8 where, for example, 1 MHz or 2 MHz guard bands were used together with additional transmitter and receiver filters in the base stations of Band 5 and Band 8 implementations respectively.

3.5 Question 5

IDA seeks an indication of any industry interest in the use of the 1.4 GHz band.

Ericsson's Response:

Supplemental downlink (SDL) is a new scheme that could be used to increase downlink capacity on both HSPA and LTE networks. This scheme represents a significant step forward in traditional spectrum aggregation systems that are already used for HSPA and LTE networks by the 3GPP standardisation group. SDL could be used in combination with different bands specified by 3GPP.

This scheme would allow network operators to manage the ever-increasing demand for multimedia services on wireless networks and provides significantly improved performance for end users.

In Europe, CEPT and European Commission are currently harmonising the 1.4 GHz band (1452 to 1492 MHz, divided in eight 5 MHz channel blocks) for SDL. Countries outside of CEPT are also considering implementing this frequency arrangement. This plan would provide significant economies of scale in consumer devices and infrastructure equipment production, which would then drive industry interest. Devices are expected to be available during 2015/2016 timeframe.

3.6 Question 6

IDA seeks views on IDA's proposal to allow the deployment of 4G and IMT-Advanced systems and services in the 3G bands.

Ericsson's Response:

Ericsson is of the view that the 3G bands, including 900 MHz, 1800 MHz and 2.1 GHz bands, should be technology neutral and be allowed for the deployment of 4G services as appropriate.

3.7 Question 7

IDA seeks:
(a) indications of industry interest in the allocation of long term rights in the TDD bands, as well as planned services (including small cells) and target market segments for the use of these bands;
(b) views on whether the use of the TDD bands solely for the deployment of in-building TDD systems is feasible, and the underlying considerations thereof;
(c) views on whether the use of TDD bands for partial deployment of outdoor and in-building TDD systems is feasible, and the underlying considerations thereof;
(d) views on the use of TDD bands for small cell deployment as part of a HetNet;
(e) views on the mitigation techniques requirement for co-existence (e.g., separation distance, transmit power, and UL-DL configuration21);
(f) views on the implication of the TDD bands on a half-band sharing basis with neighbouring jurisdictions; and
(g) views on the implication of the TDD bands on a full-band sharing basis (primarily for in-building deployment) with neighbouring jurisdictions.

Ericsson's Response:

(a) Ericsson agrees fully with the proposed allocation of the 2.3 GHz and 2.5 GHz bands. However, Ericsson is of the view that the usage of Mobile Broadband communications should be considered for use in the whole of the 2.3 GHz and 2.5 GHz bands due to the considerable current and future demands by consumers.

TDD services should be looked upon as a complement to existing FDD deployments, addressing the consumer needs for more advanced, richer Internet and Multimedia based services and applications.

The use of TDD should not be viewed solely for the purpose of small cells deployments. In doing so, it would limit the use of the TDD technology from reaching its full potential. TDD networks have similar capabilities as FDD networks and are suitable for both macro and small cells deployments in a Heterogeneous Network configuration.

Heterogeneous Network deployment is a strategy comprising a suite of solutions for improving network performance through a combination of improving and densifying of the macro cellular layer for general coverage and capacity, and adding small cells together with Wi-Fi in strategic locations. The objective is to address increasing demand for higher data rates by providing a seamless user experience for smartphones and Mobile Broadband services – whether on the move, in the office or at home.

In view of the above, TDD deployments should not be limited to the use of small cells.

(b) Ericsson is of the view that Full-band sharing with neighbouring jurisdictions would be the preferred option. The demands for Mobile Broadband services and applications in Singapore suggest that the whole 2.3 GHz and 2.5 GHz should be made available to all interested parties where possible.

However, as highlighted in our response to (a), TDD deployments should not be limited to in-building small cells. In this case, it would also be inefficient to use the TDD bands solely for the deployment of in-building TDD systems.

For the 2.3 GHz band, it is noted that the 2300 MHz to 2350 MHz band is available to Singapore operators for priority access. Therefore it could be used for both outdoor and in-building deployments. As for the rest of the 2.3 GHz band, it could be considered for in-building deployments (not limiting to small cells) until this portion of the spectrum is fully harmonised with the neighbouring countries.

For the 2.5 GHz band, since it is coordinated on a “full-band” sharing basis, the full 2570 MHz to 2620 MHz band could be allocated in Singapore. To ensure the highest quality, it should be noted that guard bands of minimum 5 MHz are required at both ends of this band.

In addition, Ericsson suggests that iDA consider taking into account the fact that operators would need to plan for future evolutions where there would be a need for more and contiguous spectrum. Notably, one technical opportunity to satisfy the increasing market demands in the future, while considering the use of LTE and LTE Advanced, is the opportunity to use aggregation of carriers and channel blocks.

Therefore the most favourable arrangement would be to make available spectrum lots in channel blocks of 20 MHz whenever possible. In doing so, this would ensure fair competition among all interested stakeholders to acquire the spectrum lots, as deem viable to businesses, while taking into consideration the technical, economic, competitive, societal and regulatory aspects that concern the market and consumers in Singapore.

(c) Please refer to our response to (a) and (b).

(d) Please refer to our response to (a) and (b).

Heterogeneous Network deployments are applicable to both FDD and TDD technologies, and involve the following steps in the deployment strategy:

• Improve existing macro cell sites – by enhancing macro cells with more spectrum, advanced antennas, increased order of diversity on the receiver and/or the transmitter, and greater baseband processing capacity within and between nodes. Continued evolution of HSPA and LTE technology would drive macro network efficiency through specialised features, such as higher-order modulation, higher sectorisation, multi-carrier and multi-

antenna solutions, as well as spectrum re-farming using hybrid radio solutions. Increasing capacity and data rates in this way eliminates the need for new sites.

• Densify the macro network – the capacity and data rates achieved by enhancing the macro network alone would eventually prove insufficient to meet demand. The targeted addition of strategically located small cells could improve capacity. This approach keeps the total number of sites relatively low, while network performance becomes less sensitive to traffic location. A simple way to densify a network could be a cell-split, which enables a site to transition from a three-sector site to a six-sector site. These strategic cells could use macro equipment or even micro equipment.

• Add small cells – complement macro cells with small cells and dedicated indoor solutions based on the 3GPP standard. This approach could include the use of micro cells, pico cells or low-power remote radio units, as well as Wi-Fi. It delivers high per-user capacity and coverage in areas covered by the small cells, with the potential to improve performance in the macro network by offloading traffic generated in hotspots. The degree of integration that could be achieved throughout the heterogeneous networks would determine the overall network performance.

(e) International border coordination is a crucial issue for the success of mobile broadband services and applications in Singapore. The mixture of radio-communication services in the different bands makes border coordination very complex. Thus, correct and timely coordination procedures would safeguard the use of spectrum in border areas, while considering the technical issues involved.

Coordination decisions must be taken with all involved countries so as not to compromise the options available to Singapore. Co-existence requires coordination with the neighbouring countries along the whole border where a predicted, measured or agreed field strength at the border exceeds certain levels.

The following are the technical and operational coordination aspects in border areas to be considered:

- Technical RF optimisation options should be applied on both sides
- Service providers could coordinate without direct involvement of regulators so as to speed up the process

For unpaired operations, there would be a need to optimise the RF planning in border areas and coordination options include RF power and antenna system alignment and re-alignment as well as synchronisation of the operations on the two sides of the border. Another option is to establish significant separation distances while taking into account the need for coverage, capacity, quality and an uninterrupted level of service.

(f) With regard to the option of half-band sharing basis with neighbouring jurisdictions, this is feasible especially for the 2300 MHz to 2350 MHz band which is available to Singapore operators for priority access.

However, iDA should not limit the spectrum allocation to 25 MHz since the 2570 MHz to 2620 MHz band could potentially be allocated fully in Singapore.

(g) Please refer to our response to (b).

Ericsson is of the view that full-band sharing with neighbouring jurisdictions would be the preferred option, applying special conditions and restrictions where applicable.

3.8 Question 8

IDA seeks:
(a) indications of industry interest in the allocation of long term rights in the 3.5 GHz band, as well as planned services and target market segments for the use of these bands;
(b) views on whether the use of the 3.5 GHz bands solely for the deployment of in-building mobile systems is feasible, and the underlying considerations thereof;
(c) views on possible impact to end users of FSS and TVRO, if (i) the end users do not have to be migrated; or (ii) the end users have to be migrated; and
(d) views on possible co-existence issues between TDD systems, and FSS and/or TVRO systems.

Ericsson's Response:

(a) The 3.5 GHz band offers the holder of this spectrum with many opportunities. To maximise the use of the band while minimising the lead time for deployment, it is best to start with 3.5 GHz deployments on the macro grid. This band could also be used to provide additional capacity to "hot spots" with small cells, both outdoor at street level and indoors. The 3GPP specifications harmonise spectrum utilisation, thereby maximising the value of the 3.5 GHz band.

In summary, the 3.5 GHz band should be considered as a valuable spectrum to be used for providing Mobile Broadband services. This band also offers additional bandwidth for the favourable implementation of LTE Advanced providing very high peak data rates and inter-layered Carrier Aggregation.

(b) The 3.5 GHz band should not be solely used for the deployment of in-building mobile systems.

Operators utilising the 3.5 GHz LTE system would be able to deploy 3.5 GHz on both the macro layer and small cells. In addition, LTE Advanced Carrier Aggregation would be supported with the 3.5 GHz system, thereby providing the end-user with increased peak rates as well as enabling full utilisation of all spectrum bands in both indoor and outdoor circumstances.

Furthermore, LTE Advanced Supplemental downlink could be used on 3.5 GHz as an option. With this, the 3.5 GHz band would be optimised for downlink capacity relief, and the uplink (which is particularly weak for TDD), would not be a limiting factor since the uplink would be supported by a lower existing band.

(c) Ericsson understands that 3.4 to 3.6 GHz band (3.5 GHz) is not used by satellite networks in the Fixed Satellite Service (FSS), and further understands that at least one market study is showing that the demand of satellite services is decreasing in this spectrum range. Therefore the band in Singapore should be fully re-farmed for Mobile Broadband services, which is also in line with international harmonisation.

Possible requirements for the continued use of systems in the FSS and TVRO could be maintained in Ka and Ku bands.

(d) Co-existence between Mobile Broadband and FSS/TVRO in a country of the size of Singapore is offering a particular challenge. As already suggested in (c), possible requirements for continuing operations use of systems in the FSS and TVRO could be maintained in Ka and Ku bands.

3.9 Question 9

IDA seeks:
(a) views on key policy areas related to technical, service provisioning or end-user impact that should be considered in the deployment of HetNet; and
(b) other policy implications that may arise with HetNet.

Ericsson's Response:

(a) Ericsson is of the understanding that any technical implementation of Heterogeneous Network deployments would not require any new or additional regulations; since Heterogeneous Network deployments are built on the operator's existing network infrastructure and the same spectrum is re-used, existing policies governing the network operators should still be applicable.

(b) Please refer to our response to (a).

3.10 Question 10

IDA seeks:
(a) views and comments from potential MVNOs on their level of interest to enter the mobile market and the target market segments of potential MVNOs (e.g. pre-paid or post-paid, niche or general consumer segments); and
(b) views from the industry on the interest and viability for a new MNO to enter the market, and whether the market environment, or technology or spectrum developments have changed since the 2013 4G spectrum auction that have made the business case attractive for a new MNO to enter.

Ericsson's Response:

Ericsson is not providing comments to this question.

3.11 Question 11

IDA seeks views on the 'depth' of MVNO deployment envisaged by new entrants, in particular, the viability of a 'Heavy/Full' MVNO deployment model versus the other models, given that the former would have the most flexibility to differentiate its services to compete with the MNOs.

Ericsson's Response:

Ericsson is not providing comments to this question.

3.12 Question 12

IDA seeks views on:
(a) possible mechanisms to implement an MVNO-hosting framework, and the relative merit and usefulness of each of these approaches; and
(b) the viability of a regulatory and/or voluntary commitment approach for MVNO-hosting, and the kinds of regulatory or incentives required and which spectrum bands to tie-in the MVNO-hosting incentives.

Ericsson's Response:

Ericsson is not providing comments to this question.

3.13 Question 13

IDA seeks feedback on:
(a) the output/outcome indicators to be imposed on MNOs that would be relevant for MVNOs;
(b) the level of wholesale pricing to the MNO's access network (in unit rates) that would justify the business case for market entry;
(c) the non-price terms and conditions imposed by MNOs, such as minimum volume or revenue commitments, that would be acceptable for a positive MVNO business case;
(d) details of the business and financial model of potential MVNOs;
(e) the ability of MNOs to differentiate classes of service and allow priorities to cater to the needs of government demand or other MNVOs; and
(f) any other relevant considerations that IDA should take into account in structuring a framework to encourage the hosting of MVNOs.

Ericsson's Response:

Ericsson is not providing comments to this question.