SingTel

Our Ref: 20130816/05/5B/STG/TV White Space

16 August 2013

Ms Aileen Chia
Deputy Director – General (Telecoms & Post)
Info-communication Development Authority of Singapore

Dear Ms Chia

CONSULTATION ON THE PROPOSED REGULATORY FRAMEWORK FOR TV WHITE SPACE OPERATIONS IN THE VHF/UHF BANDS

1. We refer to the IDA's consultation paper issued on 17 June 2013 on the proposed regulatory framework for TV white space operations in the VHF/UHF bands (the **Consultation Paper**).

2. Singapore Telecommunications Limited, SingTel Mobile Singapore Pte Ltd and SingNet Pte Ltd are pleased to provide, in Annex 1, our views and comments on the Consultation Paper.

Yours sincerely

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Annex 1

SINGAPORE TELECOMMUNICATIONS LIMITED, SINGTEL MOBILE SINGAPORE PTE LTD AND SINGNET PTE LTD

RESPONSE TO CONSULTATION ON THE PROPOSED REGULATORY FRAMEWORK FOR TV WHITE SPACE OPERATIONS IN THE VHF/UHF BANDS

1. Introduction

1.1 Singapore Telecommunications Limited, SingTel Mobile Singapore Pte Ltd and SingNet Pte Ltd (collectively **SingTel**) are licensed to provide various info-communications services in Singapore. SingTel is committed to the provision of state-of-the-art info-communications technologies and services in Singapore.

1.2 SingTel has a comprehensive portfolio of services that includes voice and data services over fixed, wireless and Internet platforms. SingTel services both corporate and residential customers and is committed to bringing the best of global info-communications to its customers in the Asia Pacific and beyond.

1.3 SingTel is pleased to submit its views and comments on the proposed regulatory framework for TV white space (**TVWS**) operations in the VHF/UHF bands issued on 17 June 2013 (the **Consultation Paper**).

1.4 This submission is structured as follows:

Section 1 – Introduction
Section 2 – Executive Summary
Section 3 – Specific Comments

2. EXECUTIVE SUMMARY

2.1 SingTel welcomes the IDA's initiative to standardise and regulate the use of vacant TVWS spectrum by WSDs.

2.2 SingTel does not support the use of vacant TVWS spectrum for WSDs in the VHF band or in the 694MHz - 806MHz spectrum band.

2.3 SingTel supports the adoption of a license-exempt approach for the use of the remaining vacant TVWS spectrum for private use. If the vacant TVWS spectrum is

used for commercial purposes, a license approach needs to be adopted to ensure that the service provided to end users meets the minimum quality of service standards.

2.4 SingTel recommends that further research and trials be conducted across various locations and terrains in Singapore to better understand the propagation characteristics of WSDs in order to determine the optimal transmission power and channel assignment matrix for WSDs. The IDA may wish to involve relevant research agencies and industry players to conduct dimensioning studies to gauge the number of UHF channels required for TVWS in Singapore and to propose the geographical re-use methodology etc.

2.5 It is critical that the rules and methodology how TVWS spectrum is made available to WSDs via the database be clear and fair to discourage potential abuse e.g. hoarding of spectrum by any user to the expense of other users. Hence, we would propose that the IDA consult the industry on the approach on how it will allocate the TVWS spectrum via the database to ensure that spectrum assignment will be fair and transparent to all interested parties.

2.6 SingTel specific comments are provided in the next section.

3. SPECIFIC COMMENTS

Question 1: *IDA invites views on adopting a licence-exempt approach for WSDs in Singapore, subject to the devices meeting the conditions set by IDA.*

3.1 The utilisation of vacant TVWS spectrum will increase the spectrum availability within the currently limited RF frequency bands. SingTel welcomes the IDA's initiative to standardise and regulate the use of TVWS spectrum to provide certain public or private services such as super-Wifi, M2M communications etc.

3.2 However, in consideration of the radio frequency propagation characteristics in the VHF and UHF band, strict controls need to be imposed by the IDA on all TVWS operators, users and devices. A centralised and controlled database, geo-location capability, power-control mechanisms etc will also be required to further mitigate potential interference issues within the TVWS band.

3.3 With the proliferation of IMT LTE technology worldwide, there is an increasing demand and interest in the use of the 700MHz spectrum band for LTE services. SingTel has previously expressed its interest in using the 700MHz spectrum band for LTE services to the IDA. The United States of America has already allocated the 700MHz spectrum band to LTE operators. Adoption in the Asia Pacific region for LTE in the 700MHz spectrum band has also picked-up with Australia having concluded its frequency auction recently and several other countries like Japan and New Zealand have indicated their intention to assign the 700MHz spectrum band for LTE use. Singapore has also announced a regional harmonisation plan with neighboring countries at the recent CommunicAsia 2013. In light of this, we do not support the assignment of the 694MHz - 806MHz spectrum for WSDs.

3.4 SingTel also does not support the use of TVWS spectrum in the VHF band for WSDs. The VHF band can cover large distance easily even at a low transmission power. The propagation characteristics in the VHF band limits the potential for geographical re-use and increases the likelihood of interference with other WSDs and secondary devices.

3.5 Notwithstanding the above, SingTel supports the adoption of a license-exempt approach for the use of the remaining TVWS spectrum for WSDs for private use. If the TVWS spectrum is used for commercial purposes, a license approach need to be adopted to ensure that the service provided to end users meets the minimum quality of service standards.

Question 2: *IDA invites views on designating a restricted number of TVWS channels to support the deployment of services that require certainty of spectrum access.* *Question 3:* *In the event where IDA designates channels to support such services, IDA invites views on the appropriate regulatory approach in designating and managing these TVWS channels and the regulatory framework for the operations of prioritised WSDs.*

3.6 Although TVWS technologies in general can operate in an unlicensed environment, subject to the implementation of interference mitigation measures to coordinate the use of the spectrum by WSDs, we understand that some applications such as real-time video surveillance may require certainty of spectrum access for optimal performance.

The IDA's proposal to designate a restricted number of TVWS channels will address requirement for such use.

3.7 However, it is very important to conduct extensive research and trials to determine the exact channel bandwidth needed, in order not to waste scarce TVWS spectrum by reserving such specturm for such designated services and applications.

3.8 A strict transmitting power control and advanced interference cancellation techniques should be adopted to increase the possibility of channel re-use in different geographical areas. This will reduce the number of restricted channels required.

3.9 In the event that the IDA decides to reserve a certain amount of TVWS specturm to support the deployment of designated services and applications that require certainty of spectrum access, we would propose that the IDA consult the industry to further clarify the approach on how it will determine the exact TVWS channels to be designated and the eligibility crieria for the assignment of such spectrum to ensure that spectrum assignment will be fair and transparent to all interested parties.

Question 4: *IDA invites views on allowing operation of WSDs in the 694 MHz – 806 MHz band until IDA allocates these frequencies for IMT deployment.*

3.10 SingTel has serious concerns over possible interference between WSDs and future IMT LTE devices operating in the 694MHz – 806MHz spectrum band. It will severely affect the service quality on both WSDs and LTE devices.

3.11 IMT LTE in the 700MHz spectrum band has become a popular worldwide standard in recent years, with many countries already using it for commercial deployment. SingTel foresees the need to have additional frequency spectrum for IMT LTE deployment with the rapid growth of mobile data traffic and requests the IDA to consider to officially allocate the 700MHz spectrum band for IMT LTE in Singapore soon.

3.12 If the WSD devices are deployed in this spectrum band and certain services are commercial in nature, it will be extremely difficult to recall these devices and it will cause disruption to such businesses in the future when the 700MHz spectrum band is needed for IMT LTE.

3.13 In addition, substantial coordination work among companies and likely regulatory intervention will be required to shutdown WSDs in this spectrum band in order to meet the targeted timeline for re-allocating the 694MHz - 806MHz spectum band for IMT LTE use.

3.14 Therefore, SingTel does not support the operation of WSDs in the 694MHz - 806MHz spectrum band. This spectrum band should be reserved and protected for IMT LTE or equivalent public mobile communications technology deployment in Singapore. SingTel further propose to the IDA to consider liaising with neighboring countries to reserve this frequency band under the regional frequency harmonisation initiative.

Question 5: *IDA invites views on adopting a database approach as the mandated method to access white space spectrum.*

3.15 There are shortcomings in relying solely on a database approach to access white space spectrum. A database approach requires connectivity between WSDs and the database to update information on channel allocation and availability in a specific geographical area. In certain deployment scenarios such as in basements etc, WSDs may not be able to establish a connection with the database. For such deployment, a spectrum sensing approach would be necessary. Therefore, we would propose that both database and spectrum sensing approach be mandated for accurate channel assignment and effective interference control.

Question 6: *IDA invites views on the proposed general requirements for the database query and registration.* *Question 7:* *IDA invites views on the three situations in which a WSD must query the database. In particular, IDA invites views on defining 50m as the maximum distance that WSDs are allowed to move from its original location, without contacting the geolocation database.*

3.16 SingTel supports the IDA's proposal to impose a set of detail requirements for WSD to register and query the centralised database to ensure minimum interference in TVWS networks.

3.17 In order to have such registration and regular query for channel information in the database, all WSDs must have in-built GPS and other location-deterministic algorithm to report exact location. A technical study and trial should be conducted to further fine-tune the requirements in various scenarios. The maximum allowable distance for WSD to move may vary depending on the actual transmitting power, geographical and terrain types etc. This should be tested and confirmed in the technical study/trial.

Question 8:
IDA invites views on the output power transmission of WSDs as shown in Table 2.

Question 9:
IDA invites views on allowing Fixed Devices to have tuneable output power that is capped at a maximum of 4Watts EIRP.

3.18 It is absolutely necessary to restrict the output power transmission for each device category.

3.19 According to the Annex A, Table 1, with a 4 Watts (36dBm) WSD in the UHF band, the secondary service receiver needs to be at least 7km to 8km away from the WSD in order to avoid interference. This distance requirement will be even further (>13km) in the VHF band. This high transmission power will reduce the possibility of channel geographical re-use and increase the interference to other transmitters/receivers.

3.20 SingTel recommends to limit Fixed Device to a maximum transmission power of 1 Watt. Fixed Devices must come with in-built geolocation capability (either GPS or other methods) and only operate in UHF band.

3.21 If Mode 1 device (portable) is unable to query the database and does not have in-built geolocation capability, it should be required to completely cease transmission and operation once it cannot get the accurate channel information from its associated Fixed Device or Mode 2 device.

3.22 All WSDs should have tuneable output power level and be capped at 1 Watt for Fixed Devices and 100mW for portable devices (Mode 1 and Mode 2) . There should be dynamic power control algorithm in WSD to always tune the output power to as low as possibly.

Question 10: *IDA invites views on the requirement of a unique WSD identifier and for this identifier to be based on standards developed by recognised standards organisations.*

3.23 SingTel supports the IDA's view of standardising and tracking unique WSD identifier for reasons such as security, interference management, device control etc. This should be enforced before any operation of WSDs.

Question 11: *IDA invites views on the maximum transmission level of 100mW EIRP for WSDs operating in channels adjacent to a local broadcast channel.* *Question 12:* *IDA invites views on the proposed OOB emission limit of -56.8dBm, which will be imposed on WSDs operating in channels that are directly adjacent to a local broadcast service.* *Question 13:* *IDA invites views on defining OOB emissions for WSD to WSD operations.*

3.24 SingTel supports the IDA's proposal of setting the maximum transmission power level of 100mW EIRP for all WSDs (including Fixed, Mode 1 and Mode 2 devices) operating in the channels adjacent to an existing local broadcast channel. In addition, there should also be a maximum transmission power level set for channels adjacent to the IMT LTE 700MHz spectrum band as well. The exact maximum allowable power level will depend on the adjacent channel leakage ratio (or out-of-band emission) of the WSDs and trial/live networks experience.

Question 14:
IDA invites views on the proposed approach to manage coexistence between a WSD and the other secondary services within the TVWS spectrum.

3.25 All WSDs (including WSD Fixed, Mode 1 and Mode 2 devices) and secondary service devices will need to be registered and tracked in the database so that database algorithm can determine the separation distance and maximum transmission power allowed when queried by the WSDs.

3.26 If secondary service devices cannot be tracked in the database, all WSDs should have the automatic scanning capability to report such detections to the centralised database so that these channels can be excluded from assignment at that specific location.

Question 15:
IDA invites views on the proposed propagation model and parameters used to determine the maximum transmission power level of a WSD.

3.27 As a propagation model will be used to determine the transmission power and channel assignment, the accuracy of such parameters will be important. SingTel suggests the actual propagation model should be fine-tuned with a proper test transmitter and receiver setup at various Singapore location/terrains, before the algorithm is fixed in the database.

Question 16:
IDA invites views on its proposal for the protection of licence-exempt and licensed wireless microphones. IDA also invites views and comments on the optimal number of safe harbour channels required to ensure that licence-exempt wireless microphones can continue to be used once WSDs are deployed.

Question 17:
IDA invites views on the need to develop a registration process for users of licence-exempt wireless microphones that require additional channels beyond the safe harbour channels.

3.28 If the number of channels in UHF band can still serve the TVWS capacity and re-use requirement, then a safe harbor channel can be reserved. The exact number of safe

harbor channels will depend on the number of secondary service devices and bandwidth required by each device.

3.29 For big events with many wireless microphones requiring additional safe harbor channels beyond what is currently allocated in the database, then a proper registration process should be adopted to avoid co-channel interference if there is channel assignment collision between WSD and microphones.

Question 18: *IDA invites views on whether that proposed demarcation zone approach is sufficient in terms of managing cross border interference issue and if there are any other factors IDA should consider.*

3.30 The demarcation zone concept proposed by the IDA is an acceptable approach to manage cross-border interference issues. However, this needs to be agreed and enforced by both countries in order to be effective. The demarcation zone distance (e.g. 7km used in the IDA POC trials) shall be calculated based on the actual maximum transmission power of the WSDs.

3.31 SingTel would also like to highlight that it would also be prudent for the IDA to coordinate with the neighbouring countries to reserve the 694MHz - 806MHz spectrum band for future IMT LTE use and not allocate it for WSDs in the meantime.

Question 19: *IDA invites views on the aggregate interference effect of WSD and whether any adjustment in terms of technical requirement is needed.*

3.32 The WSDs should have in-built automatic frequency scanning function to report the received signal and noise level in the TVWS channels. If there is no specified limit of WSDs operating in the same location, then the database should stop the assignment of the specific channels once WSDs report strong interference in these channels.

Question 20:
IDA invites views on using GPS as the method to determine location accuracy, and on whether 50m is a sufficient location accuracy for the operation of WSDs.

3.33 GPS should be the primary method to determine the WSD location and should be built in as a mandatory capability. Other methods can be optional to complement the GPS location capability in the WSD when GPS is not available. If a WSD is only equipped with GPS capability and it operates at times in an environment where GPS information is not available, then this WSD location must be registered into the centralised database before it is in operational mode.

3.34 The exact location accuracy requirement can be further refined based on the trial/live network experience obtained from research and other countries.

Question 21:
IDA invites views on allowing the manual input and internal storage of geographic coordinates for indoor Fixed Devices.

Question 22:
IDA invites views on the requirement of an approval process for the installer of indoor Fixed Devices and the necessary conditions for approval.

3.35 SingTel supports the IDA's proposal of manual input and internal storage of geographic coordinates for indoor Fixed Devices. The specific location or set of locations where indoor WSDs operate must be properly registered, updated, tracked and audited by the IDA or the IDA's appointed independent party (which should not be a TVWS operator or user).

3.36 SingTel agrees that an approval process for installer of indoor Fixed Devices is necessary in order to control and keep the accuracy of the geolocation database. Indoor WSDs cannot start transmission, until the complete information is registered in the database and the channel assignment with maximum power limit is properly keyed into the WSD according to the output of the database algorithm. These installers and the indoor WSDs should also be audited regularly.

Question 23: *IDA invites views on the possible types of TVWS network topologies and use case scenarios.*

3.37 For the connection between Fixed Devices the Geolocation Database, we would recommend that it be provided over a secured connection to protect the integrity of the database

3.38 Due to the limited channels available and the relatively low data throughput possible per channel, the use cases scenarios for TVWS will be more for localised or campus-type depoyment. We also see TVWS being more suitable for low data applications such a smart metering, M2M communications.

Question 25: *IDA invites views on both approaches in managing the database (i.e. industry-managed or government-managed database).*

3.39 SingTel supports the approach of a government-managed database rather than industry-managed. Besides the industry interest and business continuity concerns pointed out in the consultation paper, government-managed approach will ensure business confidentiality and avoid perception of a private entity managing the database providing preferential treatment to any user.

3.40 It is critical that the rules and methodology how TVWS spectrum is made available to WSDs via the database be clear and fair to discourage potential abuse e.g. hoarding of spectrum by any user to the expense of other users. Hence, we would propose that the IDA consult the industry on the approach on how it will allocate the TVWS spectrum via the database to ensure that spectrum assignment will be fair and transparent to all interested parties.