Securing the digital dividend across the entire ASEAN:

A report on the status of the implementation of the APT700 band for ATRC

Executive Summary and Overview
August 2018

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Contents

1. Executive Summary

In ASEAN countries, which form part of the International Telecommunication Union (ITU) Region 3, significant work remains to be done to secure the benefits of the 'digital dividend' in the 700 MHz band. Following the initial step of conversion to digital television, spectrum bands must be cleared, the Asia-Pacific Telecommunity ('APT') APT700 band plan needs to implemented, and the provisioning of wireless broadband services using the digital dividend spectrum must be rolled out.

As shown in Exhibit 1, only a few ASEAN countries have completed the digital television switch-over (DSO) and have moved to the next step – auctioning the freed-up spectrum. There are some examples of commercial mobile network deployments, for example, in the Philippines but this is, as yet far from widespread. Some other countries, however, are still considering DSO with no clear analogue television switch-off date yet specified.

EXHIBIT 1: STATUS OF APT700 IMPLEMENTATION IN ASEAN

Country	Operational	700 MHz allocation date or expected allocation date	Comments
Brunei Darussalam	No	Post 2019	Band currently vacant and ready for mobile broadband service. AITI and MCMC have not agreed on any technical parameters yet. Malaysian APT700 implementation should facilitate APT700 in Brunei
Cambodia	No	Post 2019	Band licensed to digital television and Government has tried to clear but still negotiating with existing licensees. More clarity in Q3, 2018 after Cambodian election
Indonesia	No	Post 2022, unless able to allocated regionally	In part of the country including Java the usage of the 700 MHz spectrum is blocked by Supreme Court injunctions. SDPPI seeking alternative approaches to secure spectrum including legislative changes, regional licences etc
Lao PDR	No	Post 2019	MPT supported 700 MHz band for IMT and APT700 band plan since 2015. Interference concerns with digital television in neighbouring countries delaying implementation
Malaysia	No	2018 with use from Q1, 2019	The MCMC is evaluating a beauty contest for 8 lots of 2 x 5 MHz of the spectrum and will announce more information after the Malaysian election. DSO not finalised but scheduled for the end of 2018 unless changed by new incoming Government
Myanmar	No	Early 2019	Proposed for allocation under Ministry/PTD spectrum roadmap by late 2018. Likely to be post February 2019
Philippines	Yes	June 2016	Acquired from San Miguel Corp. 2 x 10 MHz available for allocation to successful 3rd new market player in 2018
Singapore	No	Early 2019	Auctioned by IMDA in late 2017. DSO delayed and will be completed end of 2018. In discussions with neighbouring country regulators, the MCMC and SDPPI regarding its use in Singapore
Thailand	No	Post 2020/21	Still being used by digital TV, then subject to refarming and repacking. Government may try and bring forward to 2020/21 depending on analogue TV concession issues and other transition issues
Vietnam	No	2020	APT700 allocation supported by ARFM after clearance of television broadcasting. DSO completed in major urban cities and soon in Delta region. MIC/VNTA also strongly supportive

The analogue to digital television switch-over process was the focus of last year's GSMA report[1], primarily covering the key aspects for re-planning the band for DTT and freeing-up the 700 MHz band for mobile services. In continuation of this important work for the region, this is a detailed follow-up report covering the assignment and deployment of 700 MHz services in ASEAN and highlighting a range of possible interference issues. It has been prepared for the ASEAN Telecommunications Regulators' Council ('ATRC') meeting scheduled for August 2018.

There are considerable and compelling benefits for all ASEAN countries to deploy APT700 including improved wide and indoor coverage, increased wireless broadband speeds and more efficient IoT deployments. The ability of mobile operators to quickly utilise 700 MHz spectrum in their service provisioning due to their modern LTE networks will have material benefits in terms of operator capex and opex. These benefits have been highlighted in this report by case studies of successful APT700 implementations in the Philippines and in Australia.

The report finds that there are three key factors which are holding back the availability and allocation of 700 MHz to IMT services in ASEAN, namely delays in the DSO; cross-border co-ordination issues; and how the 700 MHz band, once it is available, should be allocated.

This report argues that these three factors can be addressed by:

- Understanding the cost savings and societal and economic benefits from deploying APT700 services;
- Resolving cross-border co-ordination issues to minimise harmful interference; and
- ASEAN regulators commencing consultations in their markets about how the 700 MHz spectrum band should be optimally allocated.

In the coming 6 to 12 months, the successful resolution of key cross-border co-ordination bottlenecks will do much to accelerate the adoption of APT700 in ASEAN. Similar to the broader consensus model which underpins ASEAN and the interaction between its members, it is hoped that with considerable goodwill these co-ordination issues can be resolved.

1. See the report and executive summary https://www.gsma.com/spectrum/rural-connectivity-in-southeast-asia/

2. Societal, Economic and Commercial Benefits

Cost Savings

Firstly, spectrum in the 700 MHz range provides significant cost advantages over high-frequency spectrum because of its propagation characteristics. It operates over a greater range than higher frequencies, provides superior performance inside buildings and is attenuated less by terrain and foliage. The increased range means that 700 MHz coverage can be up to 300 percent greater than 2.6 GHz.

These propagation characteristics deliver substantial costs savings for operators and benefit consumers too. Operators require fewer base stations and therefore face significantly lower capital cost per unit area covered and therefore they can achieve a more rapid rollout. Consumers enjoy larger coverage areas, fewer blackspots, better in-building coverage and, if markets are sufficiently competitive, will likely see lower prices for services. In practice, propagation characteristics will depend on local topography, and nature of foliage cover, which in ASEAN countries can be relatively dense.

Benefits also arise if operators aggregate 1800 and 700 MHz bands. This combination delivers capacity in urban areas but also good propagation distances and in-building coverage. Optimising layering of services requires careful technical implementation including the use of good quality high-gain antenna enabling signal focusing to avoid spill-over into neighbouring cells.

Societal and Economic Benefits

Secondly, telecommunications users benefit from greater service speed and reliability as 700 MHz services add to the overall capacity of the mobile network. The economic and social benefits of 700 MHz deployment arise from several sources, as outlined in Exhibit 2.

The economic benefits, however, are not restricted to mobile consumers alone. Improved availability and quality of mobile services positively influences economic growth which delivers even more widespread benefits across all of society.

Further, 700 MHz spectrum is very well suited to providing coverage in regional and remote locations where population density is low and where communications infrastructure investment may not be commercially viable. In these situations, governments wishing to address 'digital divide' and social inclusion issues will be able to bring services to these areas at lower levels of subsidies than would be the case at higher frequencies. Case studies on APT700 deployment in the Philippines and Australia also highlight the significant benefits of adopting this technology.

EXHIBIT 2: DEPLOYMENT: BENEFITS OF APT700 GENERALLY AND COUNTRY CASE STUDIES

1 COVERAGE BENEFITS

- The coverage utilising the 700 MHz spectrum is more extensive and of better quality
- The indoor coverage is often better (due the lower indoor propagation loss)

2 FASTER SPEEDS – CARRIER AGGREGATION OPTIONS WITH APT700

- The increase in bandwidth is achieved by utilising LTE carrier aggregation/channel aggregation which combines multiple LTE carriers to increase bandwidth and achieve higher data rates of LTE-A and LTE-A Pro
- This improves the wireless broadband speeds and QoS provided to subscribers

3 WIDER IoT SERVICE DEPLOYMENT USING APT700

- Narrow-Band- Internet of Things (NB-IoT) and LTE-M are set to become the global dominant Low Power Wide Area technologies
- The use of low bands (below 1 GHz) should be a primary goal for mobile operators when offering NB-IoT solutions, with APT700 being an obvious candidate band for deployment of such services

4 SOCIETAL BENEFITS

- Benefits of increased capacity that flow from increased IMT spectrum use in general
- Greater range and propagation characteristics from APT700 which mean improved coverage and service improvements for consumers
- Rural communities are connected quicker with better services as a result of expanding coverage due to APT700 deployment
- Lower capital costs of APT700 deployment mean that consumers pay lower prices for connectivity
- Benefits arising from the revenues to governments from allocation of the 700 MHz band spectrum

Country case studies

Philippines

- 700 MHz Band 28 deployments in the Philippines since June 2016, had by end of Q1, 2018 resulted in significant improvements in LTE service experience for customers with APT700-capable devices
- APT700 deployments using pre-existing site and tower infrastructure have resulted in significantly improved service provision and coverage
- The ability of APT700 to support NB-IoT/LTE-M services is excellent given coverage and lower costs

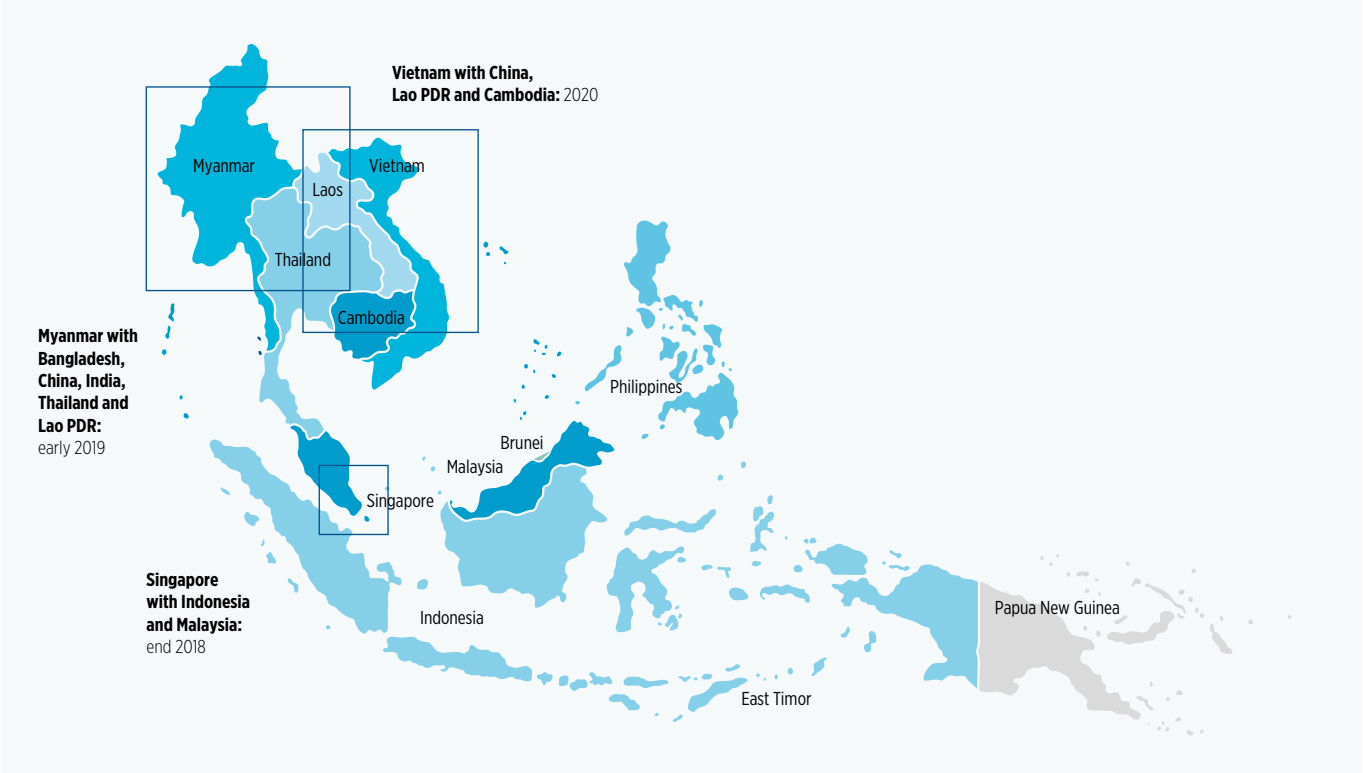
Australia

- In Australia APT700 spectrum has been instrumental in extending 4G coverage to regional and remote areas of Australia that otherwise would not have been possible to cover economically, or at all
- Prior to APT700 deployment, Telstra's networks covered approximately 85% of population and 100,000 sq. km. The use of APT700 with existing and new 4G sites has helped push Telstra's 4G coverage to over 99% of the population and more than 1.6m sq. km of Australia
- Telstra considers that APT700 improves 4G in-building coverage. APT700 means that most urban buildings can now get reasonable in-building 4G coverage without augmentation like dedicated antennas
- Telstra confirms that there are material cost benefits in deploying 700 MHz over 1800 MHz spectrum. The benefits are most fully realised in lower population density areas of regional, rural and remote Australia

3. Potential Cross-Border Interference Issues

Unmanaged cross-border interference is very likely to occur in the absence of any cross-border frequency coordination. Such interference can result in an interrupted reception of the wanted signal and some specific receiver (RX) problems. In the coming 6 to 12 months, the successful resolution of key cross-border coordination bottlenecks will do much to accelerate the adoption of APT700 in ASEAN. Exhibit 3 highlights the key cross-border coordination areas and their likely timing for resolution.

EXHIBIT 3: CRITICAL DECISION POINTS FOR CROSS-BORDER CO-ORDINATION CONCERNING THE IMPLEMENTATION OF THE APT 700 BAND



Cross-border frequency coordination cannot be addressed without considering the results of international and regional spectrum management and harmonisation. These spectrum management results provide important guidelines and restrictions on the implementation of IMT (in the 700 MHz Band) and consequently on the cross-border frequency coordination between countries (who ultimately assign spectrum and implement IMT).

Further, identifying cross-border interference cases is a key step in resolving and managing harmful interference. Exhibit 4 provides a general overview of possible incompatibility between IMT and other services in the range 470 to 694/698 MHz, while Exhibit 5 provides an overview of interference cases between IMT and digital terrestrial television broadcasting.

EXHIBIT 4: GENERAL OVERVIEW OF POSSIBLE INCOMPATIBILITIES BETWEEN IMT AND OTHER SERVICES IN THE RANGE 470 TO 694/698 MHz

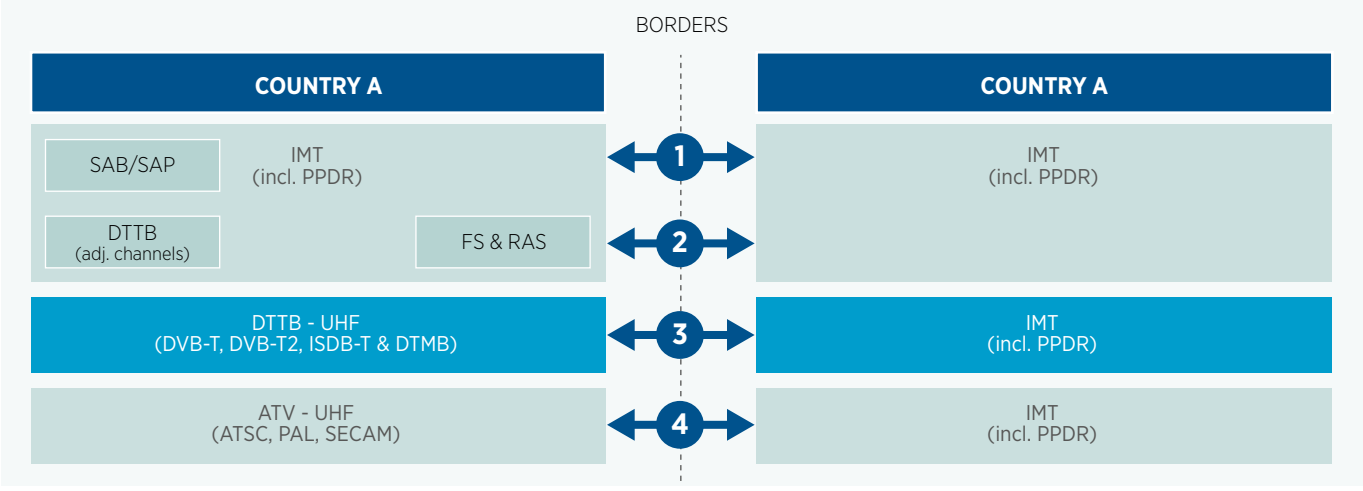
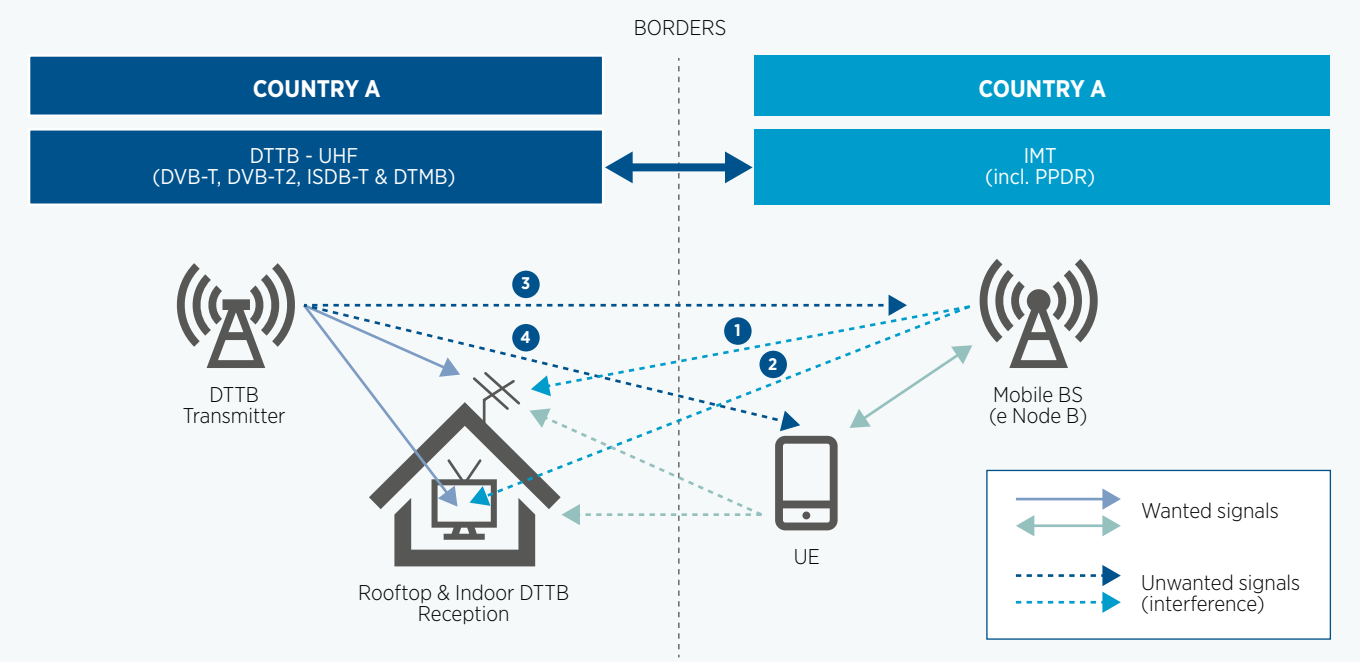


EXHIBIT 5: OVERVIEW OF INTERFERENCE CASES BETWEEN IMT AND DTTB.



Addressing cross-border interference issues and the likely impact of unmanaged cross-border interference, the following recommendations are provided:

1. **Incorporate cross-border frequency coordination in the national licence assignment procedure.** NRAs should assign spectrum only when the necessity of cross-border frequency coordination has been checked, and if deemed necessary, has been conducted.
2. **Formalise cross-border frequency coordination.** In this respect, it is for NRAs to agree on the best coordination process, suited to their needs and possibilities.
3. **Identify, agree and calculate interference levels.**
4. **Balance licence obligations against operational mitigation.** NRAs should explicitly balance these two options so as to assess the best way forward.
5. **Plan spectrum for the future.** To minimise potential interference and promote efficiency, it is advisable to accommodate DTTB operations in the lower part of the band to begin with, avoiding unnecessarily scattered channel use. This would also allow an orderly ongoing review and planning of DTTB frequency assignments in relation to future demand.

4. Key Spectrum Licensing Considerations

In bringing 700 MHz services to consumers, there are four core sets of decisions regarding licensing that will need to be addressed:

- **Lot sizes for spectrum allocation;**
- **Establishment of rules for coexistence of adjacent services and related guard bands;**
- **Programs for the phase-out of other incumbent users in the 700 MHz band (for example, wireless microphones); and**
- **Arrangements for Public Protection and Disaster Relief (PPDR).**

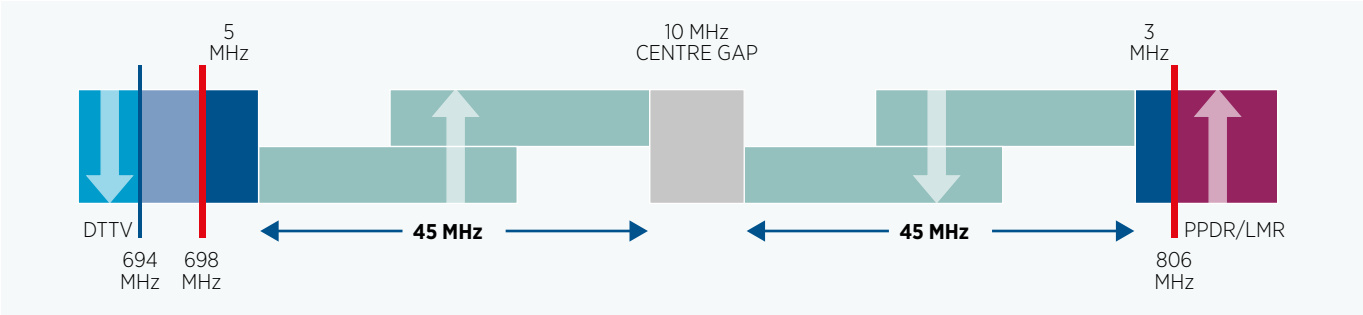
Lot sizes for spectrum allocation

The report recommends 2 x 5 MHz lots to be allocated, which would allow a total of 9 lots in the available spectrum. While LTE supports flexible usage, this allocation model is the most common practice in the region for the APT700 band and will encourage competition for spectrum licenses (assuming that demand for services is sufficient and reserve prices are set appropriately). If spectrum licensing conditions are to include coverage requirements, it is recommended that sub-1 GHz spectrum should be used because of its excellent propagation characteristics.

Rules for coexistence of adjacent services and related guard bands

In order to optimise non-interference between adjacent services, best practice suggests a 5 to 9 MHz guard band at the bottom of the APT700 band with a 3 MHz band at the top end, as well as a 10 MHz guard band between the APT700 uplink and downlink lots. This is shown in Exhibit 6.

EXHIBIT 6: 700 MHz ALLOCATION: RECOMMENDED OPTIONS FOR CO-EXISTENCE



Phase-out of other incumbent users in the 700 MHz band

A number of incumbent users in the APT700 band will need to be migrated to lower frequencies once the 700 MHz band is exclusively assigned to APT700 services. These devices include wireless audio equipment such as wireless microphones which have traditionally operated using a "class licence"; low power device exceptions and operate in the gaps or "white spaces" between licenced bands. It is critical that these changes are communicated to businesses and users who may be affected, and an effort is made to restrict the sale of non-conforming devices and ensure that vendors of the relevant products are fully informed.

Arrangements for Public Protection and Disaster Relief (PPDR)

Finally, the ITU has sought to promote global and regional harmonisation of frequency bands for PPDR and has recommended that regulators across ASEAN consider allocations in the range 694 to 894 MHz. Governments could therefore consider APT700 lots for broadband wireless PPDR systems. Globally, however, several countries have already allocated spectrum to PPDR-broadband including Australia, Hong Kong, Malaysia, Singapore, South Korea and Thailand and these countries have made allocations in the 800 MHz band. Given implementation issues for PPDR Broadband in the United Kingdom and the high cost estimates from markets like Australia, waiting until the technology to mature would seem to be prudent.

5. Recommended Six-Step Plan

In conclusion, a six-step plan is recommended in order to secure the digital dividend across the entire ASEAN, as outlined in Exhibit 7.[2] Ministries and national regulators should:

1. Accelerate the DSO process where it is not completed, potentially prioritising those areas of the country where cross-border co-ordination arrangements are required;
2. Review and revise, if necessary, the national frequency allocation table arising from the adoption for the harmonised APT700 Band for 698-806 MHz considering co-existence issues;
3. Undertake internal reviews (and market consultation processes with licensed mobile operators, if required) to determine the optimal allocation processes in accordance with national law for the APT700 spectrum. Such a review should address inter alia spectrum management, PPDR, competition, and universal service issues;
4. Engage with fellow ASEAN regulators (and non-ASEAN neighbouring regulators as required) in order to establish agreed cross-border co-ordination processes for the allocation of the 700 MHz spectrum band for IMT services and deployment of APT700 compliant network infrastructure and services. Resolution of the key bottlenecks to the implementation of APT700 highlighted including but not limited to Singapore/Johor/Bintan and Bantam should be the focus over the next 6 to 12 months;
5. Make public announcements (including specifically to industry and key equipment distributors) in accordance with national law that the 700 MHz spectrum band will not be available for use by short range devices including wireless microphones after a specified date. This date should be based on the DSO finalisation and assignment process of 700 MHz spectrum; and
6. Address any additional national only spectrum management issues which may slow or restrict the adoption of APT700 in a particular ASEAN market (eg Indonesia's court decisions, Cambodia's existing 700 MHz allocations, Thailand's digital television licences and legacy concessions etc). In addressing such issues, the national economic, societal and commercial benefits of making the 700 MHz spectrum band as soon as practicable should be highlighted.

2. Refer to the complete GSMA report, Securing the digital dividend across the entire ASEAN: A report on the status of the implementation of the APT700 band for ATRC, August 2018 for more details.

EXHIBIT 7: RECOMMENDED SIX-STEP PLAN

STEP 1: ACCELERATE DSO

Accelerate the DSO process where it is not completed, potentially prioritising those areas of the country where cross-border co-ordination arrangements are required.

STEP 2: CONSIDER NATIONAL FREQUENCY TABLE

Review and revise, if necessary, the national frequency allocation table arising from the adoption of the harmonised APT700 band considering co-existence issues.

STEP 3: ENGAGE AND CONSULT

Undertake intemal reviews (and market consultation processes with licensed mobile operators, if required) to determine the optimal allocation processes in accordance with national law for the APT700 spectrum.

STEP 4: DETERMINE OPTIMAL ALLOCATION

Engage with ASEAN regulators (and non-ASEAN regulators as required) in order to establish agreed cross-border co-ordination processes for the allocation of the 700 MHz spectrum band for IMT services and deployment of APT700 network infrastructure.

STEP 5: PUBLIC ANNOUNCEMENTS

Make public announcements in accordance with national law that the 700 MHz spectrum band will not be available for use by short range devices including wireless micro-phones after a specified date.

STEP 6: ADDRESS SPECTRUM MANAGEMENT ISSUES

Address any additional national only spectrum management issues which may slow or restrict the adoption of APT700 in a particular ASEAN market.

6. Glossary of Abbreviations

APT	Asia-Pacific Telecommunity
ASEAN	Association of South East Asian Nations
DSO	Digital television switch-over
DTMB	Digital Television Multimedia Broadcast a Chinese digital television standard
DTTB	Digital Terrestrial Television Broadcasting
DVB-T	Digital Video Broadcasting-Terrestrial
DVB-T2	Digital Video Broadcasting-Terrestrial, 2nd generation
IMT	International Mobile Telecommunications
ISDB-T	Integrated Services Digital Broadcasting - Terrestrial
IoT	Internet of Things
ITU	International Telecommunications Union
ITU-RR	ITU Radio Regulations
LTE	Long Term Evolution – A 4G mobile communications standard
LTE-M	LTE-Cat M1 or category M1 for Internet of Things
MIFR	Master International Frequency Register
PMSE	Programme Making and Special Events (CEPT terminology)
PAL	Phase Alternating Line – an analogue television standard
PPDR	Public Protection and Disaster Relief (service/system)
PR	Protection Ratio
RAS	Radio astronomy service
RX	Receiver
SAB/SAP	Services Ancillary to Broadcasting/Programme making
SECAM	A French analogue television standard
UE	User equipment
WRC	(ITU) World Radio Conference

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