Practical Recommendations to Digital Migration in ASEAN

Vietnam case study and regional comparisons

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1 Executive Summary

Digital migration is an enormous spectrum management undertaking in both scale and scope. It involves the transition from analogue to digital broadcasting, as well as the release of the digital dividend for new mobile services. It is a monumental change that impacts broadcasters, mobile operators, and, most importantly, end users of broadcast and broadband services. The digital migration affects not only the broadcasts viewed by households every day, but restructures markets and frees additional spectrum resources that can be redirected to uses providing greater value to consumers.

1.1 Report overview

This report presents practical recommendations for the Association of Southeast Asian Nations (ASEAN) members based on the lessons learned from undertaking digital migration processes in the Asia-Pacific region. Vietnam is highlighted as a strong example of a Southeast Asian country that is implementing a careful plan for this transition. Although Vietnam's digital migration is not scheduled to be completed until 2020—with the digital dividend to be licensed for mobile at some point after that—the country has made sufficient progress to identify certain key lessons.

Vietnam's digital migration experience is compared and contrasted against examples from other countries in the Asia-Pacific region, including ASEAN members Indonesia and Thailand. The three countries exhibit a mix of similarities in their approaches (e.g., choice of a phased migration plan) and some differences (e.g., the mechanism for awarding broadcasting licences).

A review of digital migration plans and progress in these countries is timely. The 700 MHz digital dividend will enable mobile broadband providers to improve coverage, with excellent propagation characteristics allowing coverage of a wide area with fewer base stations than in higher frequency bands, while its penetration characteristics also enable better in-building service. In 2013, the ASEAN Telecommunications and Information Technology Ministers Meeting highlighted the harmonisation of the 700 MHz band and the acceleration of the shift from analogue to digital television as two key areas for regional cooperation.[1] Most recently, Singapore identified the provisional winning bidders of its 700 MHz auction in May 2017.[2]

Lessons learned in Vietnam are identified in the report, accompanied by a checklist of relevant issues and questions to be addressed by governments planning their digital migrations.

1.2 Key challenges and how to address them

While the digital dividend holds great promise for expanding and improving mobile broadband coverage, governments and regulators in ASEAN and beyond need to carefully and strategically plan for its use. To varying degrees, experiences in Vietnam, Thailand, Indonesia, Australia, and Japan demonstrate the challenges that policymakers face when preparing for the digital migration

[1] ASEAN, "Joint Media Statement of the 13th ASEAN Telecommunications and IT Ministers Meeting (TELMIN) and its Related Meetings," (November 15, 2013), available at http://www.asean.org/uploads/2013/11/04%20--%20final_telmin-13-jms%20__151113.pdf.

[2] Infocomm Media Development Authority (IMDA), "700 MHz Spectrum Rights (2016), 900 MHz Spectrum Rights (2016), 2.3 GHz Spectrum Rights (2016) and 2.5 GHz Spectrum Rights (2016) Auction ("2016 Spectrum Auction")," available at https://www.imda.gov.sg/regulations-licensing-and-consultations/frameworks-and-policies/spectrum-management-and-coordination/spectrum-rights-auctions-and-assignment/700-mhz-spectrum-rights-900-mhz-spectrum-rights-2-3-ghz-spectrum-rights.

and releasing the digital dividend for mobile broadband use. These challenges typically include the following four key issues:

- **Digital migration planning:** A key prerequisite for access to the digital dividend for mobile broadband is a clear and well-planned digital television migration plan. As seen in Indonesia, for example, the uncertainty surrounding migration means that the digital dividend access timeline is also unclear.
- **Digital migration implementation:** Even a carefully considered plan can encounter unexpected obstacles or delays, such as the delays witnessed in Vietnam and Indonesia (described in Section 3.4.2).
- **Stakeholder buy-in:** Any technology migration or spectrum refarming initiative has its greatest chance of success if the majority of stakeholders support the proposed plan. Vietnam, for example, established a steering committee composed of multiple stakeholders to develop the migration plan.
- **Appropriate assignment mechanisms:** Regulators are responsible for developing a digital dividend assignment mechanism – including pricing – that is well-suited to the market and stakeholders, typically through an auction due to the high value of the digital dividend spectrum. In the case of Australia, for example, the first 700 MHz auction did not garner substantial interest, which was likely caused by a high reserve price.

However, governments can take proactive steps to minimise the impact of such challenges.

- **Consultation with stakeholders** is an important tool that can be used to address multiple challenges, including the development of achievable digital migration plans and increased stakeholder buy-in, with such feedback improving the chances of success for the sector.
- More generally, **transparency** with respect to development of policies and regulatory instruments helps to ensure that policymakers and regulators are accountable and not discriminating in favour or against any particular groups or parties.
- In addition, **studying and learning from other countries** that have already executed their plans to free up the digital dividend can help countries in earlier stages of the process, such as identifying the best order of events or milestones, avoiding common obstacles, and understanding the benefits and drawbacks of different approaches to various issues.
- Finally, it is important to **balance government policy and overarching goals with market situations**. The release of digital dividend spectrum has the potential to significantly impact the mobile sector in ASEAN nations. As such, policymakers should carefully consider expected spectrum demand, the likely impacts of releasing new spectrum, and appropriate rules for spectrum pricing.

1.3 Digital migration process in Vietnam and its relevance for ASEAN

Vietnam's digital migration process largely exemplifies how other ASEAN members can plan and carry out their respective migration processes. Comparisons with Indonesia, Thailand, Australia, and Japan illustrate similarities and differences in approaches to key aspects of the process.

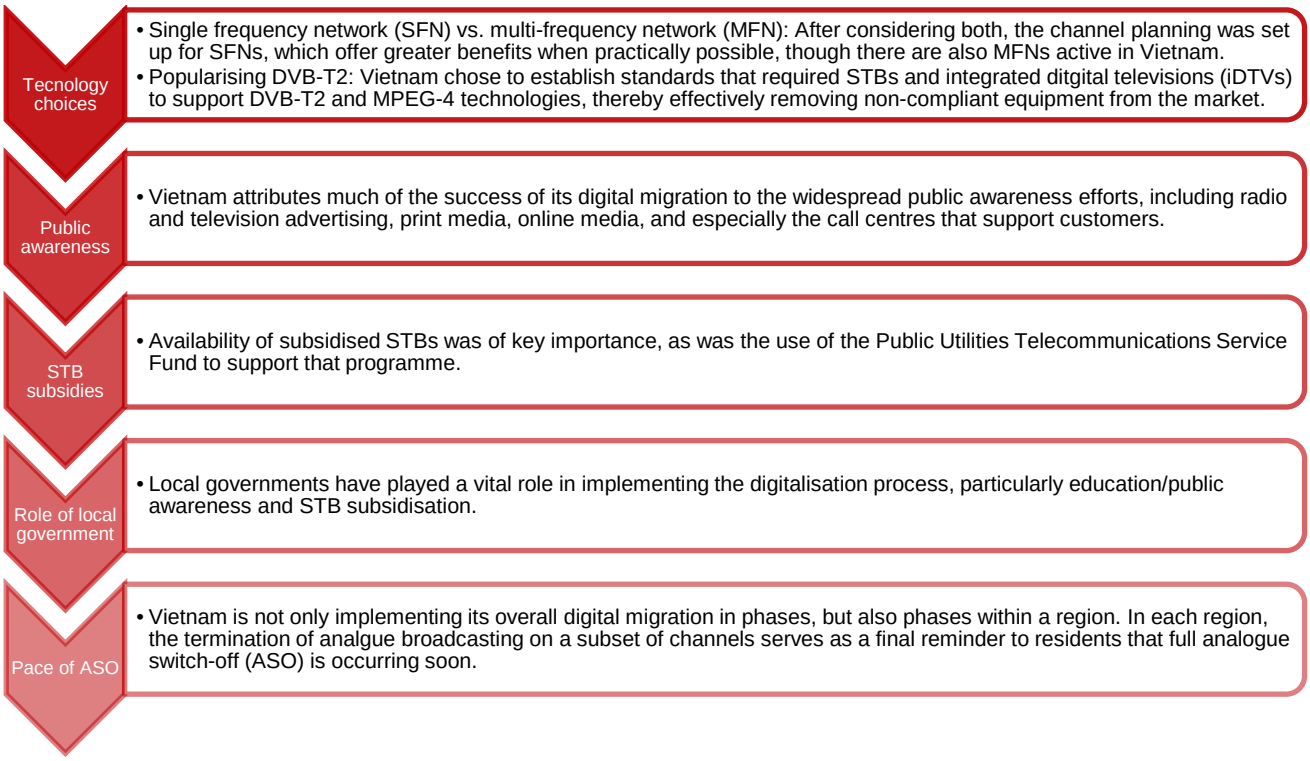
In Vietnam, as in other countries, the digital migration process includes several core components:

- **Digital switchover and digital dividend planning,** including consideration of the appropriate transition model, desired market structure, migration timing, and use of the digital dividend. The plan should enable efficiency improvements that result from a reduction in the number of transmission towers, all using less spectrum than analogue equivalents.

- **Digital television network decisions**, such as technology choice, human capacity building, coordination with neighbouring countries, and how to fund the transition.
- **Consumer awareness and support,** including educating consumers about the impact of the transition, assisting viewers during the transition, and ensuring availability of digital television reception equipment.
- **Plan implementation,** in which the government, broadcasters, and other stakeholders execute the plan and address challenges that arise. In a phased plan, stakeholders can apply lessons learned in early phases to improve later phases.

Several lessons applicable to other ASEAN members can be learned from Vietnam's digital migration process, ranging from technology choice to migration implementation to public awareness.

Figure 1: Lessons learned so far in Vietnam's digital migration



Each of the lessons identified has played an important role in improving Vietnam's digital migration process, and avoiding potential problems.

1.4 Recommendations

As discussed in this report, key recommendations can be drawn from the digital migration experiences of Vietnam, Indonesia, Thailand, Australia, and Japan. These recommendations highlight crucial points to address in forming and executing both digital migration plans and digital dividend plans. The recommendations are followed by a checklist highlighting potential approaches to address these key issues.

- **Recommendation 1: Develop a comprehensive migration plan.** Migration plans should include a combination of overall policy goals and priorities, technology guidance, and an

implementation strategy and schedule. The plan should incorporate relevant stakeholders and their roles, consumer awareness plans, and consideration of regional or global harmonisation.

- **Recommendation 2: Address key costs and identify funding sources.** Digital migration plans should take into account costs of the transition, as well as consider available funding resources and the best uses for them.
- **Recommendation 3: Outline a clear spectrum usage plan.** The digital migration plan should have a clear vision of spectrum arrangements both during and after the migration period. The plan should consider the spectrum to be used for DTTV, harmonisation and coordination, the channel restacking plan, and the size and arrangement of the digital dividend. The digital dividend plan provides an important input to mobile operators planning for expansion of mobile broadband coverage and services.
- **Recommendation 4: Plan for licensing of operators, broadcasters, and digital dividend users.** The digital migration process should include a clear, workable licensing framework for the various types of service providers, including transmitters of DTTV signals, content aggregators and producers, and users of digital dividend spectrum. The specific licensing model for DTTV may need to consider the existing legal framework, existing licence obligations, and market structure goals. Governments should carefully determine appropriate values for digital dividend spectrum, as well as develop suitable competitive safeguards and licensing mechanisms.
- **Recommendation 5: Ensure consumer awareness.** Governments should ensure that appropriate consumer awareness and education programmes are implemented in order to minimise the disruption to consumer viewing habits.

2 Introduction

Over the past several years, a fundamental change in television broadcasting has been taking place around the world. The advent of DTTV has enabled two simultaneous changes: improved quality of broadcasts available to consumers and more efficient spectrum usage to deliver an equal or better selection of programming channels. The improved spectral efficiency has created the opportunity for nations to reconsider the use of certain spectrum and repurpose it for consumer-focused uses, such as mobile broadband.

Vietnam has undertaken careful planning and implementation of an analogue-to-digital broadcasting migration over the past few years. Vietnam's broadcasters began tests of digital broadcasting as early as 2002, with a planning process feeding into the publication of a digital migration plan in 2011. When complete, Vietnam's migration plan will result in improved broadcast quality, a re-evaluation and reconfiguration of the broadcasting market, a massive outreach effort to citizens, and the refarming of a block of spectrum – the "digital dividend" – that is ideally suited to expanding mobile broadband capacity in urban, suburban, and rural regions. With Vietnam now approximately midway through implementation of its plan, now is a good time to identify and share digital migration lessons learned.

Vietnam's regional neighbours are also implementing DTTV migration plans, each with its own unique characteristics that result in similarities to, and differences from Vietnam's approach. This study considers key aspects of Vietnam's migration process to identify central decisions and issues that should be considered by all countries developing digital migration plans.

In addition, Vietnam's approach and experience is compared and contrasted with examples from two ASEAN members – Indonesia and Thailand. Both Indonesia and Thailand have also undertaken considerable digital migration planning efforts and have begun their migration processes. Between the three countries, there are some similarities, such as the choice of a phased migration plan, and some differences, such as the mechanism for awarding broadcasting licences. Further, experiences from two countries in the Asia-Pacific region that have completed their digital migrations, and digital dividend awards – Australia and Japan – are included as potential models for Vietnam and other ASEAN nations.

The implementation of a digital migration plan, including development of plans for the digital dividend, will have far-reaching consequences for ASEAN members. The release of additional spectrum for mobile broadband, in full alignment with the Asia-Pacific Telecommunity (APT) band plan (referred to as APT700), will create opportunities to not only improve terrestrial television technology and choice, but also to improve and expand mobile broadband throughout the region.

The digital migration process and other key issues related to the ASO and release of the digital dividend are addressed below.

Section 3 examines the main characteristics of the migration process in Vietnam and ASEAN, and is sub-divided into five focus areas.

Section 3.1 focuses on the digital switchover (DSO) transition models (such as taking a phased approach) and digital dividend planning.

Section 3.2 explains the decision-making processes regarding digital television networks and plans, such as technology choice, technical training, cross-border co-ordination, and funding mechanisms.

Section 3.3 reviews consumer considerations, highlighting the importance of consumer outreach to raise awareness about the ASO, as well as to ensure the availability and affordability of set-top boxes (STBs).

Section 3.4 assesses the execution of the digital migration plan to date, noting the successes and challenges that Vietnam and other countries in the region face.

Section 3.5 highlights the benefits of releasing the digital dividend for mobile broadband use.

Section 4 presents conclusions, lessons learned, and results achieved in Vietnam and other ASEAN countries. Also included is a checklist of key digital migration issues and challenges in order to provide guidance on the digital migration process for policy makers and other stakeholders in ASEAN.

3 Key characteristics of the digital migration process in Vietnam and ASEAN

The digital migration process is a significant undertaking requiring long-term planning in a sector known for rapid technological change. It requires co-ordination and consideration of a wide variety of stakeholders that oftentimes have competing interests. Thought also has to be given to the

various costs, such as the need to purchase STBs or the cost to migrate incumbent users to different frequency bands. Thus, careful planning at the highest level of government is critical to minimise the challenges that can arise from this lengthy and complex process.

In Vietnam, the digital terrestrial TV rollout began in 2002 — well before a digital migration process was put into place.[3] By 2009, digital television (DTV) services were available in about half of the country's provinces.[4] To spearhead the development of a digital migration plan, among other tasks, the government established the steering committee for digitising Vietnam's television (Steering Committee). It was led by the Minister of Information and Communications (MIC) and included representatives of the Authority of Radio Frequency Management (ARFM), the Ministry of Finance, the Ministry of Planning and Investment, Ministry of Industry and Trade, Ministry of Science and Technology, and the broadcasting industry.[5] The migration plan was formally approved on December 27, 2011, with the Prime Minister setting the ASO for 2020.[6]

By comparison, Thailand's first DTTV trial was conducted in early 2013, approximately one year after the adoption of the digital roadmap. In Indonesia, the first trials occurred shortly after a 2008 decree regarding field trials.

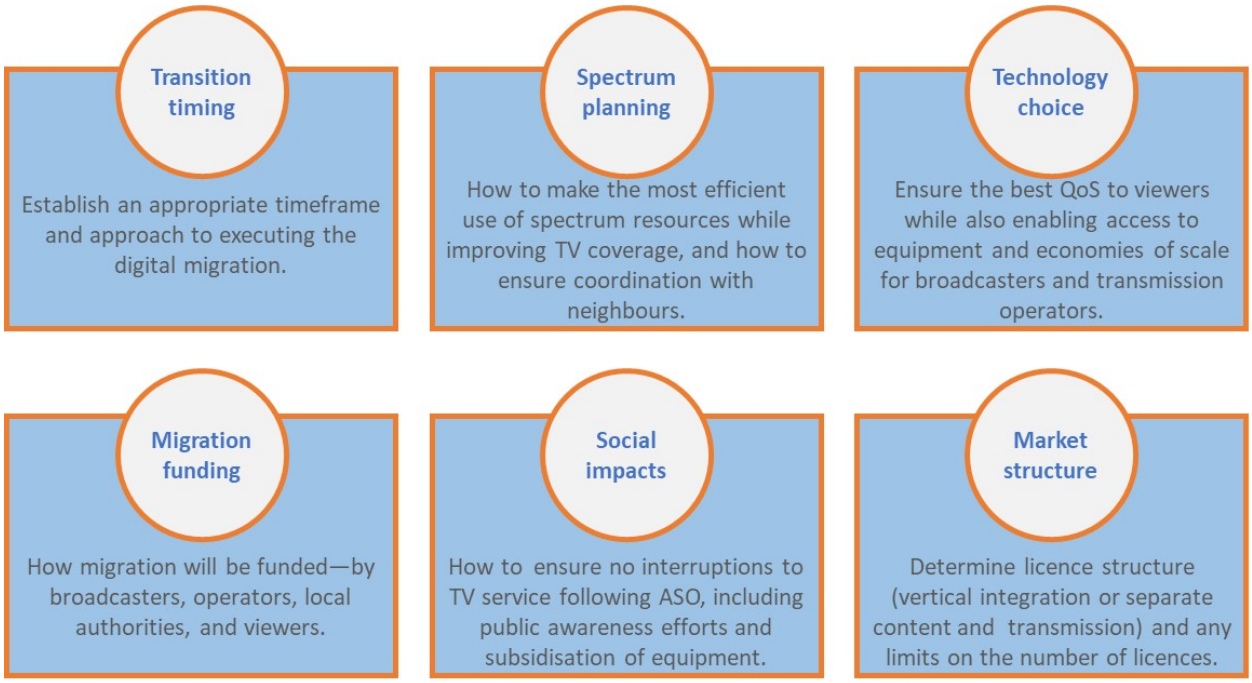
Separate from the digital migration plan, the government simultaneously worked on allocating the 694-806 MHz band for mobile services by 2020.[7] The following sections build on this timeline by identifying the range of planning and policy decisions related to DSO and the digital dividend.

3.1 Digital switch over and digital dividend planning

The government of Vietnam considered six key policy issues as outlined in Figure 2.

[3] Asia-Pacific Telecommunity, APT Report on UHF band usage and considerations for realizing the UHF digital dividend, Document APT/AWF/REP-11 , September 2009. http://www.aptsec.org/sites/default/files/APT-AWF-REP-11UHF_DD_reportr1_1-rev1.doc.
[4] Asia-Pacific Telecommunity, APT Report on UHF band usage and considerations for realizing the UHF digital dividend, Document APT/AWF/REP-11 , September 2009.
[5] ARFM, Interview with Le Van Tuan, Deputy Director General – Spectrum Planning, 18 May 2017.
[6] Government of Vietnam, Prime Minister's issuance on December 27, 2011 of Decision No. 2451/QD-TTg on approving the scheme for the digitisation of terrestrial television broadcasting by 2020, http://hethongphapluatvietnam.com/decision-no-2451-qd-ttg-of-december-27-2011-on-approving-the-scheme-for-digitization-of-terrestrial-television-broadcasting-by-2020.html.
[7] Circular No. 26/2013/TT-BTTTT (27 December 2013), Article 5, available at http://english.mic.gov.vn/Pages/VanBan/11325/Circular-No.-26_2013_TT-BTTTT.html.

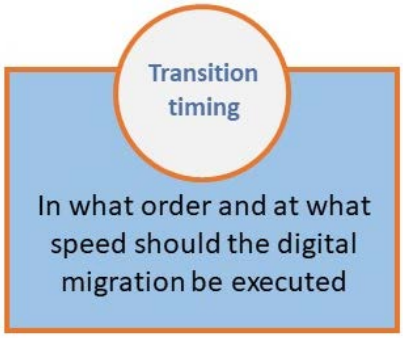
Figure 2: Policy considerations to develop Vietnam's digital migration plan



Vietnam's digital migration plan incorporated these policy considerations into a set of key principles. In summary, the principles encouraged:

- continuity of broadcasting service,
- infrastructure sharing and efficiency,
- prioritising deployment in developed areas with spectrum shortages,
- migrating when 95% of the population is capable of viewing TV services by means other than analogue terrestrial broadcasting,
- mobilising social and enterprise resources, and a portion of the government budget, in support of the digitalisation plan, and
- leveraging existing broadcasting infrastructure.

3.1.1 Transition timing—models and considerations



Establishing an ambitious, yet achievable, timeframe is critical to enabling a smooth transition from analogue to digital broadcasting. This involves setting a reasonable timeframe to begin and complete the transition from analogue to digital transmission, and typically includes a simulcast period.[8] Enabling a smooth transition also involves deciding whether to complete the ASO on a nationwide basis simultaneously, or to take a phased approach wherein certain regions (such as urban areas) complete the digital migration before other regions.

Vietnam's digital migration plan offered a clear path forward within achievable markers. While the official plan was announced in late 2011, it began in 2012 and is slated to conclude by 2020. The

[8] During the simulcast period, the same content is transmitted over both analogue and digital platforms in order to accommodate end users with digital STBs and those who are still receiving analogue signals only.

plan divided the transition period into four phases, and includes a simulcast period of three years. As shown in Figure 3, the four phases focus on completing the transition in urban and developed areas first, then expanding into more rural and less developed areas.[9]

Figure 3: Vietnam's phased approach to nationwide ASO

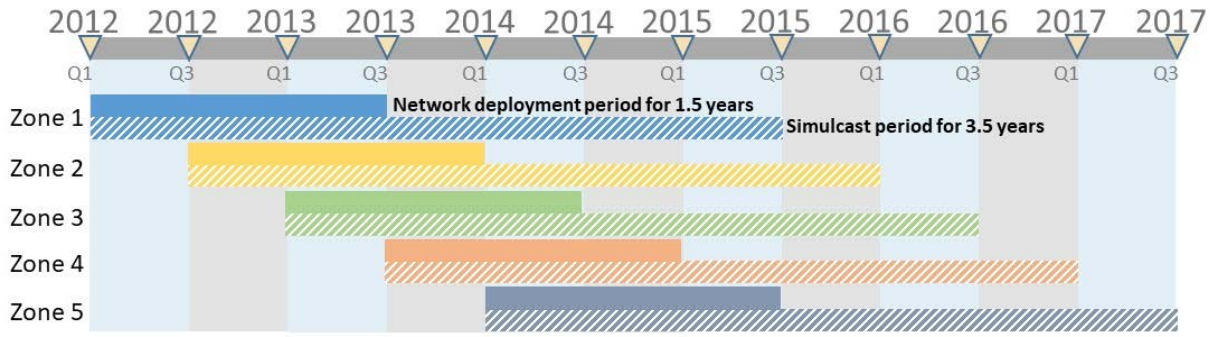
Source: Vietnam, Decision of the Prime Minister on approving the scheme for digitisation of terrestrial television broadcasting by 2020

[9] Decision No. 2451/QĐ-TTg of December 27, 2011, on approving the scheme for digitisation of terrestrial television broadcasting by 2020, Article 1, Section IV.

Box 1: Indonesia DTTV migration plan

Indonesia's DTTV migration timeline and coverage goals

Figure 4: Indonesia staggered DTTV deployment



Indonesia also set milestones for population coverage for DTV services, as seen in Table 1.

Table 1: Indonesia DTTV population coverage goals

Date	Q3 2011	Q3 2012	Q3 2013	Q4 2014	Q4 2016	Q4 2018
Population Coverage	10%	20%	35%	50%	75%	100%

Like Vietnam, Indonesia developed a phased implementation plan for DTTV. For each of five zones, beginning with the economically developed regions plus Jakarta, a one-and-a-half-year network deployment period began simultaneously with a three-and-a-half-year simulcast period. See Box 1 for more information. The phased DTTV implementation plans in Vietnam and Indonesia both began with their major population centres and areas of greatest economic development, and both planned for simulcast periods of 42-48 months. Similarly, Thailand adopted a three-phase approach to deploy digital coverage and a multi-stage approach for ASO.[10]

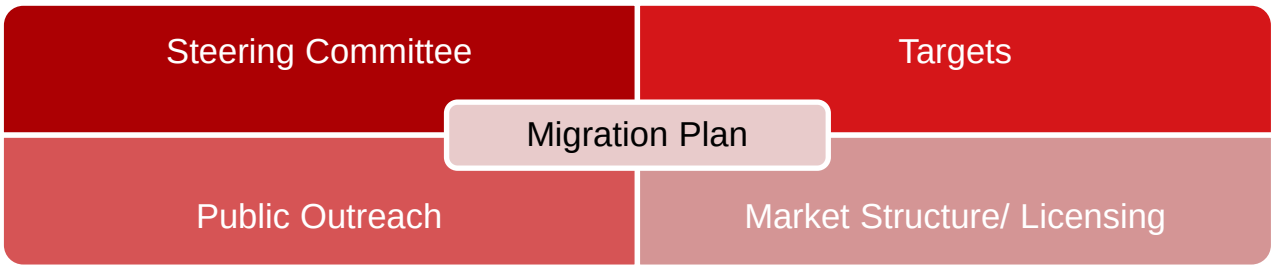
Phased migration plans have been employed in most countries around the world, as they allow for an iterative deployment, enabling the application of lessons from early phases to later phases. In addition, phased approaches allow for accommodation of differing levels of difficulty for infrastructure deployment. In Vietnam, as well as in Thailand and Indonesia, the variety of topographies require different network deployment approaches and planning periods. This allows the processes to be divided into discrete work-packages that can be customised as necessary.

3.1.2 Overview of the structure, planning and major milestones

In order to meet the deadlines in the transition period, Vietnam's digital migration plan included several important elements, as illustrated in Figure 5.

[10] Orasri Srirasa (NBTC), "DTTB implementation in Thailand," (23 May 2016), available at https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2016/May-PreAMS/S5_Orasri_SRIRASA.pdf.

Figure 5: Key migration plan components



The digital migration plan also included a roadmap, which is addressed in Section 3.4

3.1.2.1 Steering Committee

The Steering Committee has been – and continues to be – essential to the development of the migration plan, and keeping the plan's implementation on track. In particular, the most critical component of the migration plan's development was the Steering Committee's decision on the ASO dates for each phase of the migration process.[11] Crucial to the Committee's success is that members meet at least once every six months, most recently in February 2017.[12] Although committee members occasionally disagree, the MIC, as the head of the Steering Committee, makes the final decision in such cases.[13]

Other countries in Asia utilised advisory or steering committees to provide stakeholder input into the digital migration process. Indonesia established a steering committee and working group in 2007, followed by a more formal Regulatory Working Team (NRT) in 2011. The NRT is responsible for the management of the migration and ASO process. In each case, the steering committee serves the simultaneous roles of ensuring an appropriately wide range of inputs, increasing transparency, and facilitating stakeholder buy-in for the approaches decided. As such, the incorporation of a steering committee into the migration planning has been a valuable addition for Vietnam and other countries.

3.1.2.2 General and specific targets

Important to the plan's success is the creation of both general and specific targets to facilitate monitoring, evaluation, and course-correction, if necessary. Vietnam set several general and specific targets for their digital migration process, as summarised in Figure 6 and Figure 7.

[11] ARFM, Interview with Le Van Tuan, Deputy Director General – Spectrum Planning, 18 May 2017.
[12] MIC, Digital Television Transition in 2017, 14 February 2017, http://english.mic.gov.vn/Pages/TinTuc/tinchitiet.aspx?tintucid=133792.
[13] ARFM, Interview with Le Van Tuan, Deputy Director General – Spectrum Planning, 18 May 2017.

Figure 6: General targets in Vietnam's digital migration plan

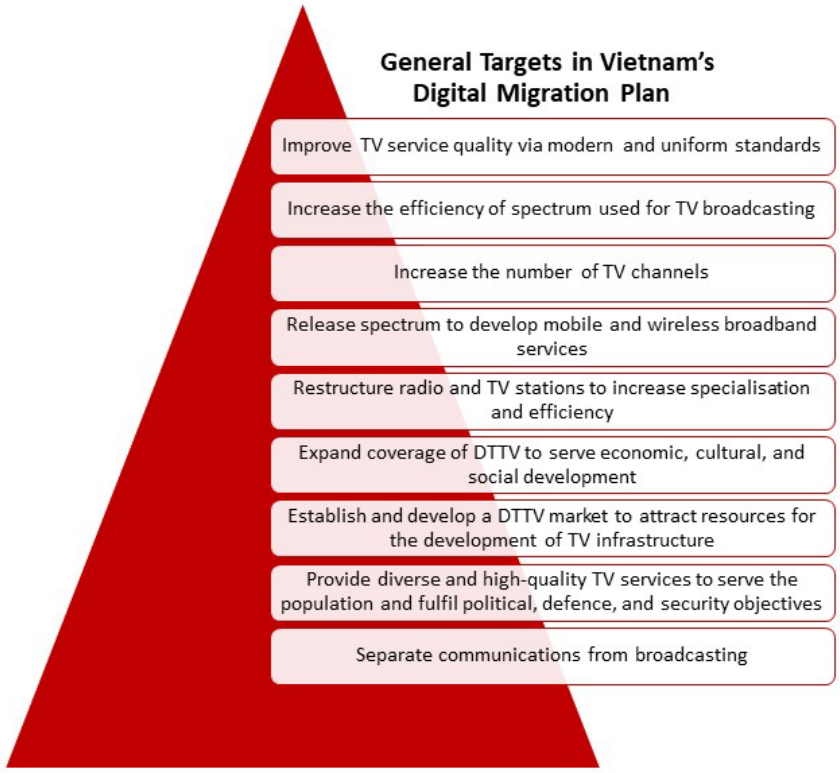
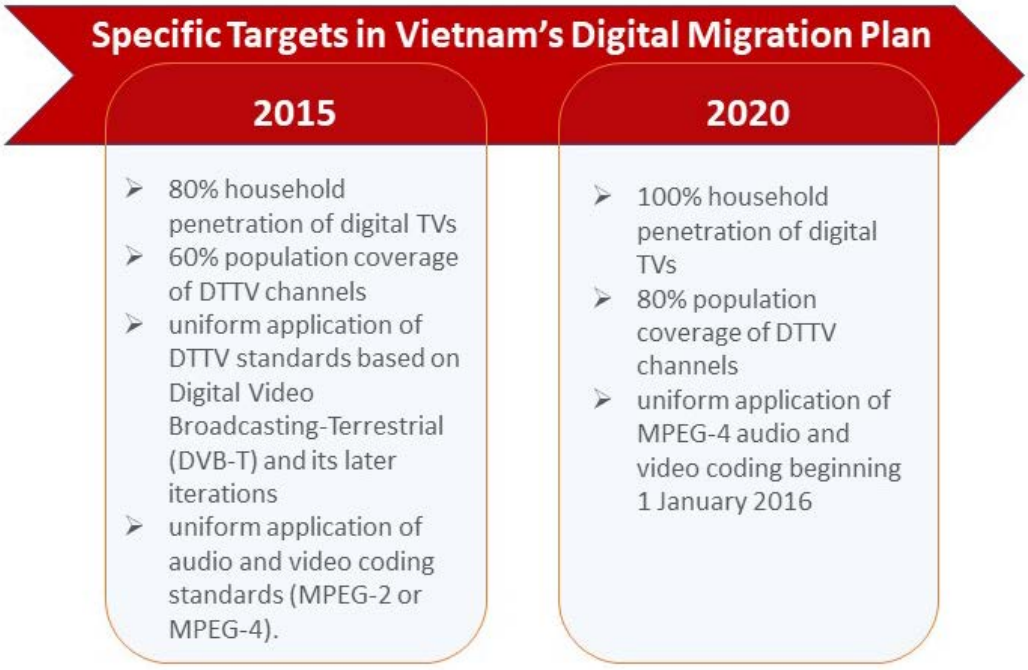


Figure 7: Specific targets in Vietnam's digital migration plan



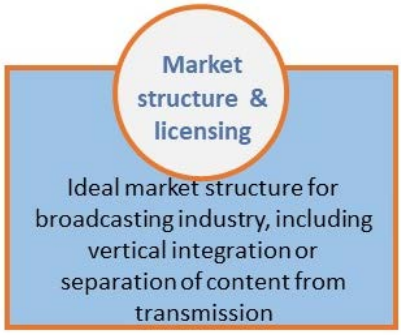
Vietnam accomplished all of its 2015 goals on schedule. DTTV upgrades already implemented by nationwide broadcasters before 2011 and the licensing of regional transmission operators were instrumental. They deployed compliant equipment, as well as ensuring that all new TV reception

equipment sold in Vietnam met the DVB-T2 and MPEG-4 standards by mid-2015.[14] In addition, Vietnam's phased implementation of its migration plan began with five major cities, resulting in 50% population coverage simply by completing Phase I.[15] Vietnam's implementation progress is further discussed in Section 3.4.

3.1.2.3 Public outreach

Under the plan, the MIC is charged with formulating and launching efforts to improve awareness to organisations and individuals regarding the migration plan. The MIC has used various vehicles to increase awareness, including a range of printed materials, commercials and broadcast programmes, conferences and seminars, and word-of-mouth efforts.[16] Further, Vietnam's public awareness programmes are supported by a web portal and a call centre designed to provide further information to the public. Based on MIC guidelines, the local governments develop individualised plans and budgets for education and awareness of TV digitalisation using different communications means.

3.1.2.4 Market structure and licensing



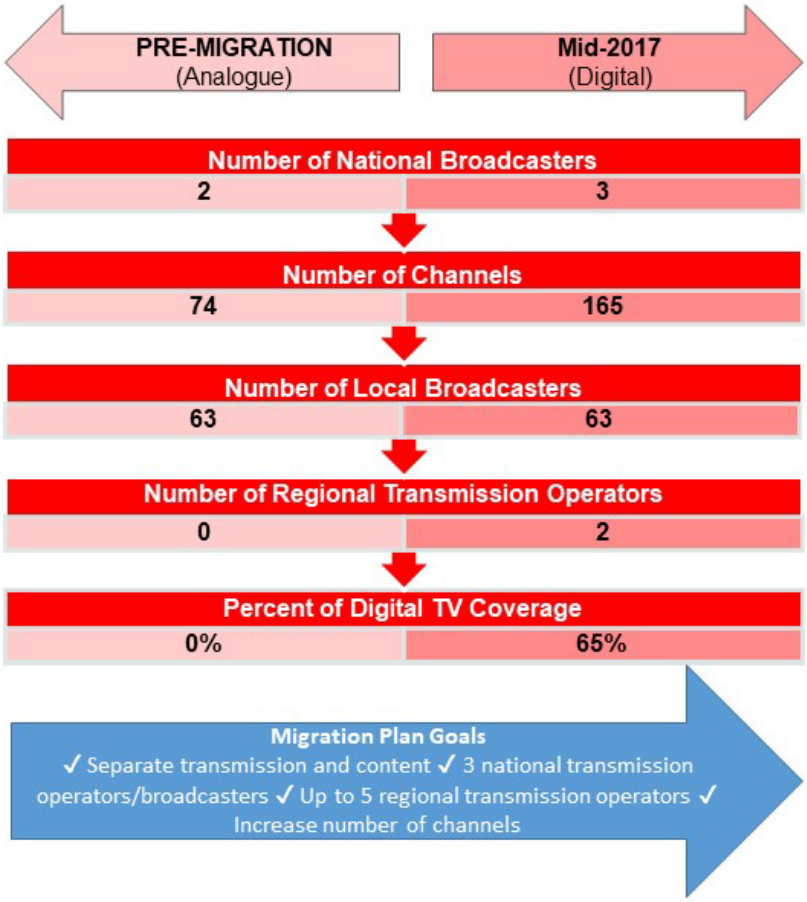
The development of Vietnam's digital migration plan provided an opportunity to consider the current market and any potential restructuring that could be encouraged or facilitated. Consistent with the digital migration plan, Vietnam licensed three nationwide transmission operators. The three operators are the same three entities that broadcast nationwide before the initiation of the migration plan: Vietnam Television (VTV), Vietnam Television Corporation (VTC), and Audio Visual Global (AVG). VTV and VTC also serve as broadcasters, providing content for transmission, while AVG is a pay TV service provider.

The plan also provided for up to five regional transmission operators to be licensed. Vietnam has licensed two regional transmission operators: Southern Delta Television (SDTV) and Red River Delta Transmission Broadcasting (RTB). Broadcasting licences are provided to the transmission operators at no cost, but are subject to spectrum usage fees and a maximum term of 10 years.[17]

Content providers, other than the three nationwide broadcasters, retain their existing licences, but are no longer responsible for digital transmission.[18] Figure 8 compares Vietnam's broadcast market structure before implementation of the migration plan and at present. As can be seen, Vietnam has already made significant progress toward restructuring its market and achieving goals set in the migration plan.

[14] Circular No. 07/2013/TT-BTTTT (18 March 2013), available at http://english.mic.gov.vn/Upload/Store//VanBan/6392/07-2013-TT-BTTTT.doc.
[15] ARFM, "Transition from ATV to DTV in Vietnam," (April 2016).
[16] Circular No. 145 /2014/TTLT-BTC-BTTTT (3 October 2014), Article 3, available at http://english.mic.gov.vn/Pages/VanBan/13551/145_2014_TTLT-BTC-BTTTT.html.
[17] ARFM, GSMA interview with Nguyen Hong Tuan, Deputy Head, Frequency Policy & Planning Division, 8 June 2017.
[18] ARFM, Email interview with Nguyen Hong Tuan, Deputy Head, Frequency Policy & Planning Division, 9 June 2017.

Figure 8: Vietnam market structure before migration and today



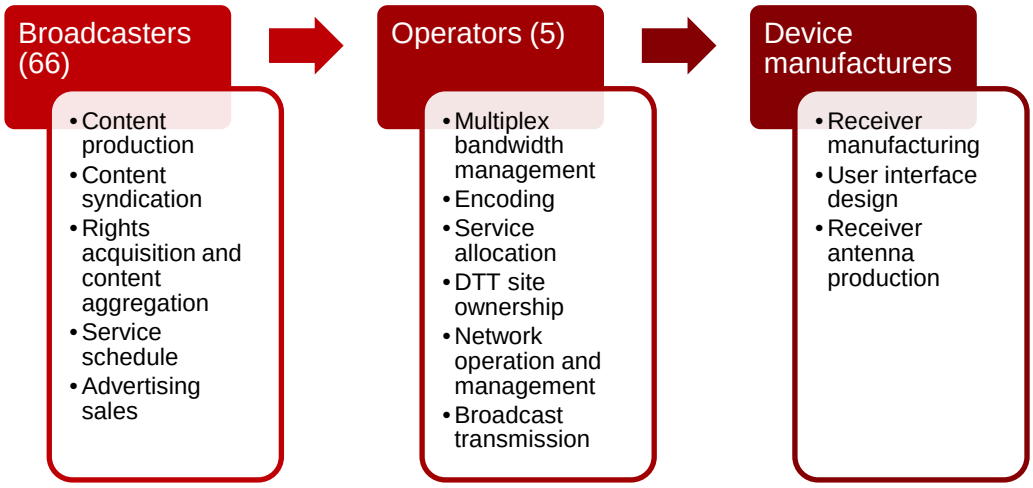
Source: ARFM

One of the plan's key goals was separating the content production/aggregation functions from the transmission function. At the same time, the number of entities transmitting broadcast television was drastically reduced – from 66 to a maximum of eight – in line with the plan's general targets. In Indonesia, the plan was also to reduce the number of transmission operators to an expected maximum of six per region in a total of 15 regions, or up to 90 transmission operators.[19] In practice, certain operators were expected to operate in multiple zones, reducing the total number of transmission operators. By comparison, prior to the digital migration, Indonesia's market included 297 free-to-air broadcasters and 121 public TV broadcasters. In Thailand, the number of transmission operators expected after the transition is six, the same as the number of broadcasters before digitalisation. However, the number of broadcasters is markedly increased, to 22.

The ARFM detailed the new value chain for Vietnam's broadcasting industry, as presented in Figure 9. A similar separation of content and transmission was undertaken in Indonesia and Thailand. In all three cases, however, there are some entities that both produce or aggregate content and transmit signals.

[19] ITU, "Roadmap for the transition from analogue to digital terrestrial television broadcasting in the Republic of Indonesia," (2013), available at http://www.itu.int/net4/ITU-D/CDS/gq/generic/asp-reference/file_download.asp?FileID=4380.

Figure 9: Vietnam digital broadcast value chain



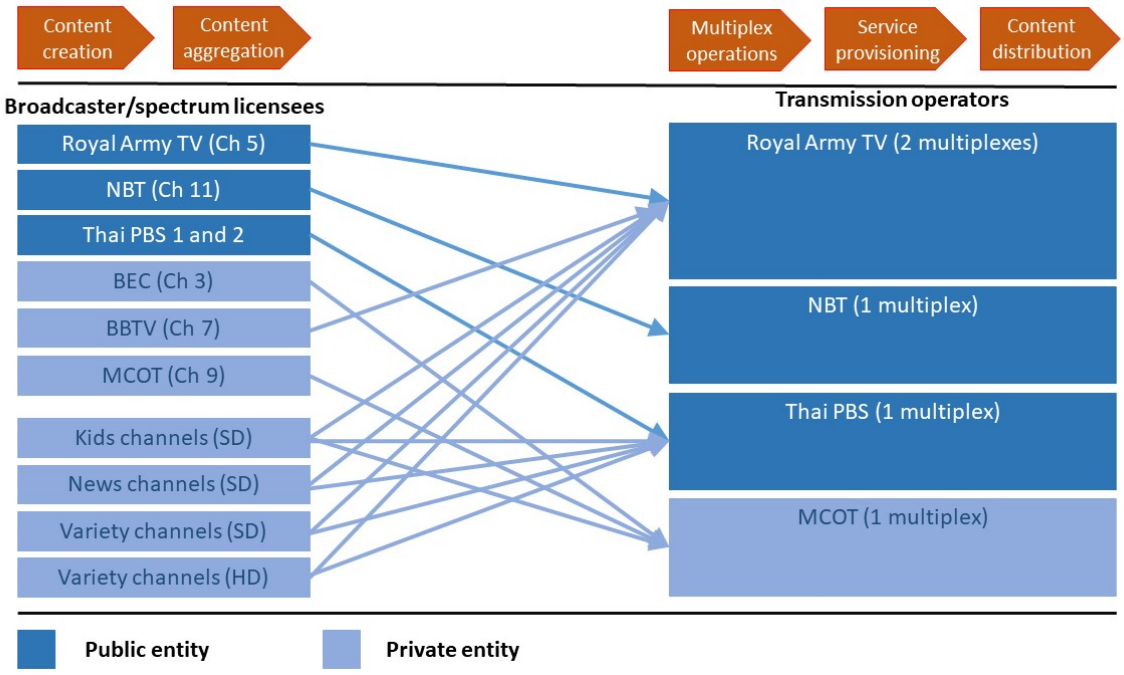
Source: Vietnam ARFM

It is also important to note that Vietnam's broadcasters and mobile operators are state-owned. This minimises the competition and potential for conflict that is often a characteristic of broadcasting markets or the interaction between broadcasting and telecommunications markets. Close coordination between stakeholders is an important means of minimising friction between competing interests.

Countries in the ASEAN region have had similar objectives but have implemented them differently. Like Vietnam, Thailand separated content creation/aggregation from signal transmission. The initial four transmission (or network) licences were issued administratively to incumbent broadcasters in June 2013, with licensee Royal Army Television receiving a second multiplex licence in September 2013, carrying additional broadcast channels.[20] All licensees agreed to share common facilities. The National Broadcasting and Telecommunications Commission (NBTC) awarded licences administratively in order to avoid the potential delays of a competitive tender and negotiations between transmission licensees and content providers.[21] Thailand's DTTV market structure is illustrated in Figure 10.

[20] Col. Dr. Natee Sukonrat (NBTC), "Thailand's Digital Switch Over," (April 2016).
[21] ITU-D Document SG1RGQ/227(Rev.1)-E, "Thailand Case Study: Transition to Digital Terrestrial Television Broadcasting," (7 April 2016), available at https://broadcast.nbtc.go.th/data/academic/file/590500000001.pdf.

Figure 10: Thailand DTTV market structure



Source: ITU

However, two aspects of Thailand's approach set it apart from Vietnam and others. The service licence awarded to content providers also includes spectrum rights, while transmission operators themselves do not hold spectrum rights.[22] In addition, Thailand's legal framework states that if spectrum rights are to be used for business or commercial purposes – including broadcaster service licences – they must be auctioned.[23] An auction is also a more efficient and transparent method for assigning spectrum as compared to administrative assignments. In December 2013, Thailand conducted an auction for a total of 24 national business broadcasting licences.[24] As noted further in Section 3.3, a portion of the broadcast licence auction proceeds were used to fund Thailand's DTV/STB coupon programme. While Thailand's approach was driven, at least in part, by the requirement to auction spectrum licences, the auction enabled a more widespread subsidy programme.

Indonesia, on the other hand, is implementing an approach similar to Vietnam's. As reflected in the roadmap developed by the ITU and Indonesia's NRT in 2013, Indonesia plans to separate content production and aggregation from signal transmission. This was accompanied by developing separate licences for content providers and multiplex operators.[25] Modifying an approach presented in the ITU Guidelines for Transition from Analogue to Digital Broadcasting, Indonesia awarded spectrum rights to the transmission operators, who each decide the appropriate capacity to allocate to individual broadcasters. The transmission operators were

[22] ITU-D Document SG1RGQ/227(Rev.1)-E, "Thailand Case Study: Transition to Digital Terrestrial Television Broadcasting," (7 April 2016), available at https://broadcast.nbtc.go.th/data/academic/file/590500000001.pdf.
[23] Act on Organisation to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunications Services (2010), Section 41, available at https://broadcast.nbtc.go.th/data/document/law/doc/th/5803000000001.pdf.
[24] Orasri Srirasa (NBTC), "DTTB implementation in Thailand," (23 May 2016), available at https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2016/May-PreAMS/S5_Orasri_SRIRASA.pdf.
[25] ITU, "Roadmap for the transition from analogue to digital terrestrial television broadcasting in the Republic of Indonesia," (2013), p. 20, available at http://www.itu.int/net4/ITU-D/CDS/gq/generic/asp-reference/file_download.asp?FileID=4380.

selected from among existing free-to-air analogue broadcasters via a beauty contest approach in which key evaluation criteria included capability and commitment to deploy infrastructure and the number of STBs to be delivered.[26] The Ministry of Communications and Information Technology (MCIT) ceased awarding additional broadcasting licences – which would have also included spectrum rights under the existing regulatory framework – in 2016. This left the broadcasters to continue to operate under the existing 10-year broadcasting licences.

Efficiency – in content production and distribution, infrastructure maintenance, and spectrum usage – is a driving force behind the revised market structure. The efficiency improvements in infrastructure maintenance and spectrum usage are fairly straightforward to observe, due to fewer competing transmission towers, all using less spectrum than analogue equivalents. The economic efficiencies gained from separating content production and distribution in Vietnam and other mid-migration countries are more difficult to judge at this stage, and are likely to differ depending on the market.

3.1.3 Digital dividend planning

Because one of the main reasons for the digital migration is to free up spectrum from broadcasters and reallocate it for other high-demand services – particularly mobile broadband – developing a process for assigning the digital dividend is a distinct, but complementary, process to the ASO. The digital dividend – the 700 MHz band in the Asia-Pacific region – represents the largest potential release of new sub-1 GHz spectrum in many years.

Vietnam is currently in the early stages of its digital dividend planning. In 2013, the MIC initially set out its plan for the 470-806 MHz band.[27] At that time, the government also indicated that the digital dividend band would continue to be used for broadcasting – both analogue and digital – until July 2017. After the ASO in 2020, in accordance with the Digitisation Plan and Vietnam's national frequency allocation plan, the digital dividend would then be released for the development of "IMT mobile communication and other radio information services." While the government has not yet announced the details of how it plans to assign the digital dividend spectrum, in 2009, it indicated a preference for a beauty contest or auction process.[28]

Vietnam's choice of digital dividend size and boundaries is also influenced by international and regional developments. The ITU Radio Regulations include a footnote stating that Vietnam, along with several other Region 3 countries, has identified the 698-790 MHz for use by IMT, and that all of Region 3 has identified 790-960 MHz for IMT.[29] The Asia Pacific region, or ITU Region 3, has had a long-standing co-primary allocation for the mobile service between 440 MHz and 960 MHz.[30] Countries in the region worked together successfully to develop a harmonised band plan in the 700 MHz band which is now commonly referred to as the APT700 band plan.

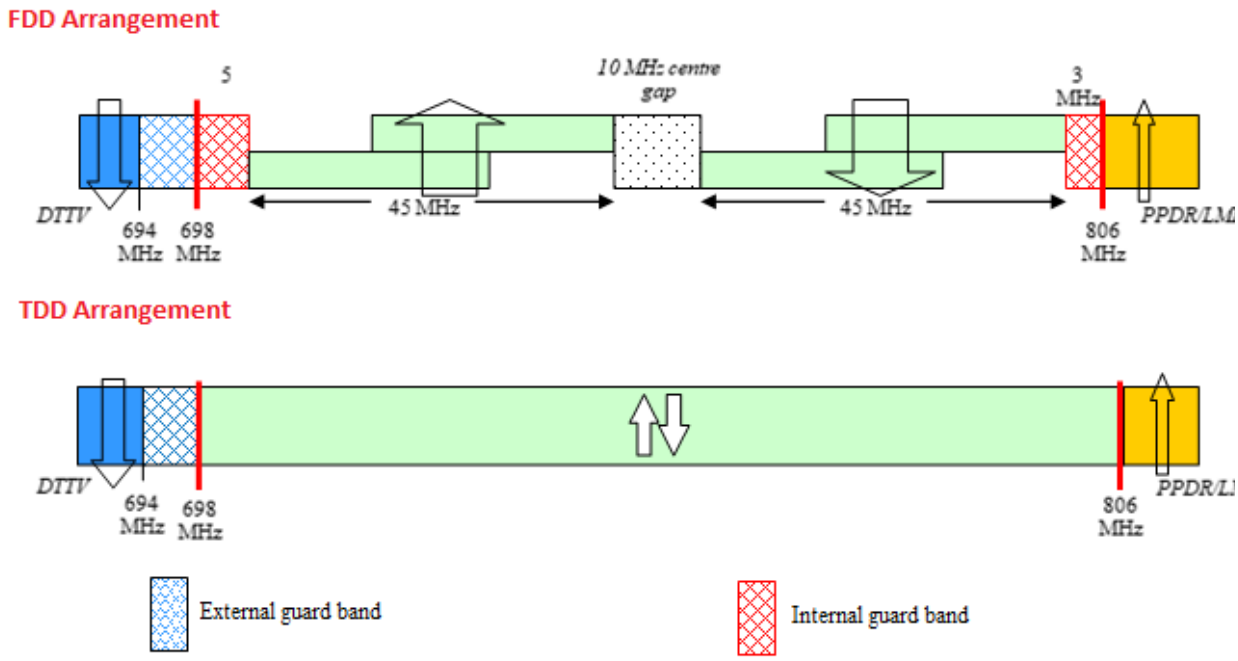
[26] MCIT, Email interview with Denny Setiawan, Acting Deputy Director General for Spectrum Policy and Planning, Directorate General of Resources and Standards, Ministry of Communications and IT, 7 June 2017.
[27] Circular No. 26/2013/TT-BTTTT (27 December 2013), Article 5, available at http://english.mic.gov.vn/Pages/VanBan/11325/Circular-No.-26_2013_TT-BTTTT.html.
[28] APT, "Document APT/AWF/REP-11: APT Report on UHF band usage and considerations for realizing the UHF digital dividend," (September 2009).
[29] ITU Radio Regulations, WRC-15, Footnotes 5.313A and 5.317A.
[30] APT, "Document APT/AWF/REP-11: APT Report on UHF band usage and considerations for realizing the UHF digital dividend," (September 2009).

Box 2: APT700 band plan

APT700: Asia-Pacific's Digital Dividend Band Plan

In September 2010, the APT Wireless Forum (AWF) defined the APT700 plan as the most efficient arrangement of the digital dividend for mobile services, as shown in Figure 11. In December 2016, the APT approved a recommendation encouraging administrations to adopt a harmonised band plan for IMT in the 698-806 MHz band. However, the APT700 plan had already gained worldwide support by the time that the APT released its recommendation.

Figure 11: APT recommended 700 MHz band arrangements



Sources: APT Report on harmonised frequency arrangements for the band 698-806 MHz, No. APT/AWF/REP-14 Edition: September 2010, APT, "Document APT/AWG/REC-08: APT Recommendation on 'Frequency arrangements for the implementation of IMT in the band 698-806 MHz,'" (December 2016).

Individual countries' use of the digital dividend may pose challenges, however. In Thailand, for example, a 2014 case study identified the country's digital dividend as consisting of 92 MHz, located between 698 MHz and 790 MHz.[31] But, at that time, a number of steps still remained before Thailand could move forward with more detailed digital dividend planning, including updates to the Spectrum Management Master Plan and Thailand Frequency Allocation Table, the expiration of analogue broadcasting concessions, ASO, and the refarming of 470-510 MHz to broadcasting.[32] Indonesia is currently considering the ultimate use of the spectrum between 694 MHz and 806 MHz after the ASO. However, it is unclear how the digital dividend spectrum will be

[31] Kitti Wongthavarawat, National Electronics and Computer Technology Centre, "Digital Broadcasting Trends and Digital Dividend: Thailand Case Study," (April 2014), available at http://www.supinya.com/wp-content/uploads/2014/04/session8.1Digital-Dividend-Kitti.pdf.
[32] ITU-D Document SG1RGQ/227(Rev.1)-E, "Thailand Case Study: Transition to Digital Terrestrial Television Broadcasting," (7 April 2016), available at https://broadcast.nbtc.go.th/data/academic/file/590500000001.pdf.

allocated or assigned due to complications in the implementation of Indonesia's digital migration process caused by lawsuits, as described in more detail in Section 3.4.2.

Adoption of similar, compatible approaches to the digital dividend will be beneficial to Vietnam, other ASEAN members, and the entire Asia-Pacific region. In particular, it will enable mobile operators and equipment manufacturers to more cost-effectively offer services, infrastructure, and devices that expand access to mobile broadband and the benefits it brings. The benefits of the digital dividend are further addressed in Section 3.5.

3.2 Digital television network decisions and plans

3.2.1 Technology choice and planning

In considering the appropriate technology choices and network plan for digital broadcasting, Vietnam made key decisions that impacted the deployment of DTTV nationwide. These included the standards to be employed, DTTV multiplexer planning, and ensuring equipment availability.

Vietnam's digital migration plan clearly states that digital broadcasting would be based on the DVB-T standard and its later versions, and that MPEG-2 or MPEG-4 encoding must be employed. [33] Taking advantage of the fact that the migration process began after the DVB-T system had been deployed in other regions, the result was that Vietnam deployed its second generation, known as the DVB-T2 standard, and required use of MPEG-4 or later versions by January 2016. The DTTV standards adopted in ASEAN member states are listed in Table 2.

Table 2: DTTV standards adopted in ASEAN member states

	Terrestrial Broadcasting Standards	
ASEAN Member	**DVB-T-based Standard**	**Additional Standards**
Brunei	DVB-T/DVB-T2	
Cambodia	DVB-T	T-DMB[34] and DTMB[35]
Indonesia	DVB-T2	
Laos		DTMB
Malaysia	DVB-T2	
Myanmar	DVB-T/DVB-T2	
Philippines	DVB-T2	ISDB-T[36]
Singapore	DVB-T2	
Thailand	DVB-T2	
Vietnam	DVB-T/DVB-T2	

As noted, Vietnam's digital migration plan calls for no more than three nationwide transmission service providers and no more than five regional or local service providers.[37] During the planning process, Vietnam considered the merits of both single-frequency networks (SFNs) and multi-frequency networks (MFNs), deciding to plan the frequency assignments for SFNs in order to

[33] Decision No. 2451/QĐ-TTg of December 27, 2011, on approving the scheme for digitisation of terrestrial television broadcasting by 2020, Article 1, Section II.
[34] Terrestrial - Digital Multimedia Broadcasting, Korea's DTV standard.
[35] Digital Terrestrial Multimedia Broadcast, China's DTV standard
[36] Integrated Services Digital Broadcasting, Japan's DTV standard
[37] Decision No. 2451/QĐ-TTg of December 27, 2011, on approving the scheme for digitisation of terrestrial television broadcasting by 2020, Article 1, Section V.

optimise the use of spectrum, but still allowing for MFNs when necessary. Vietnam also mandated deployment of SFNs in the northern and southern delta areas.[38] The mix of SFN and MFN is established in the digital migration plan, which calls for combining MFNs and widespread SFNs, complemented with local SFNs that suit actual conditions.[39] As a result, VTV and VTC each operate two multiplexes to provide nationwide coverage using MFNs, while AVG also provides nationwide coverage using three multiplexes and an SFN.[40] Both regional transmission operators – SDTV and RTB – employ SFNs to provide service.

With regard to equipment availability, Vietnam adopted several technical regulations intended to ensure that equipment sold and used in Vietnam was DVB-T2 and MPEG-4 compliant.[41] In addition, MIC set deadlines to ensure that televisions manufactured or imported for use in Vietnam were capable of receiving DVB-T2 signals and compatible with MPEG-4 audio and video coding no later than April 1, 2015.[42] Vietnam also has a steady supply of STBs to allow older televisions to receive DVB-T2 signals, stemming from the combination of domestic STB production and proximity to China, another major manufacturer.[43]

In addition, Vietnam was a member of the task force that developed the DVB-T2 Integrated Receiver Decoder Technical Specification for ASEAN, first published in June 2014.[44] The common specification is intended to create a mandatory baseline standard for manufacturers and suppliers to provide receivers – whether in STBs or integrated digital televisions (iDTVs) that include digital tuners – that will provide high-quality DTTV reception.

An additional consideration with respect to the technical planning aspects of the digital migration is the need to consider the potential for harmful interference between adjacent channels, particularly during the transition period from analogue to digital broadcasting. Because the analogue/digital protection ratio is higher than the protection ratio once all broadcasting is digital, Vietnam's plans had to be developed so as to avoid interference between the analogue and digital systems.

3.2.2 Technical Training

Vietnam's broadcasters began DTTV planning as early as 2002, creating a base of technical staff with DTTV experience by the time the government's digital migration plan was published in 2011. In addition, according to the ARFM, broadcasters have contracted staff from other countries with the requisite experience and skills to build domestic capacity for developing digital content and operating DTTV transmission equipment.[45] Broadcasters developed their in-house technical expertise at their own expense, as opposed to via subsidisation or other funding by the central government. However, it is worth noting that Vietnam's broadcasters are state-owned.

The actions taken to develop domestic expertise in DTTV production and operation are in line with the migration plan, which requires broadcasters to implement downsizing and train personnel to

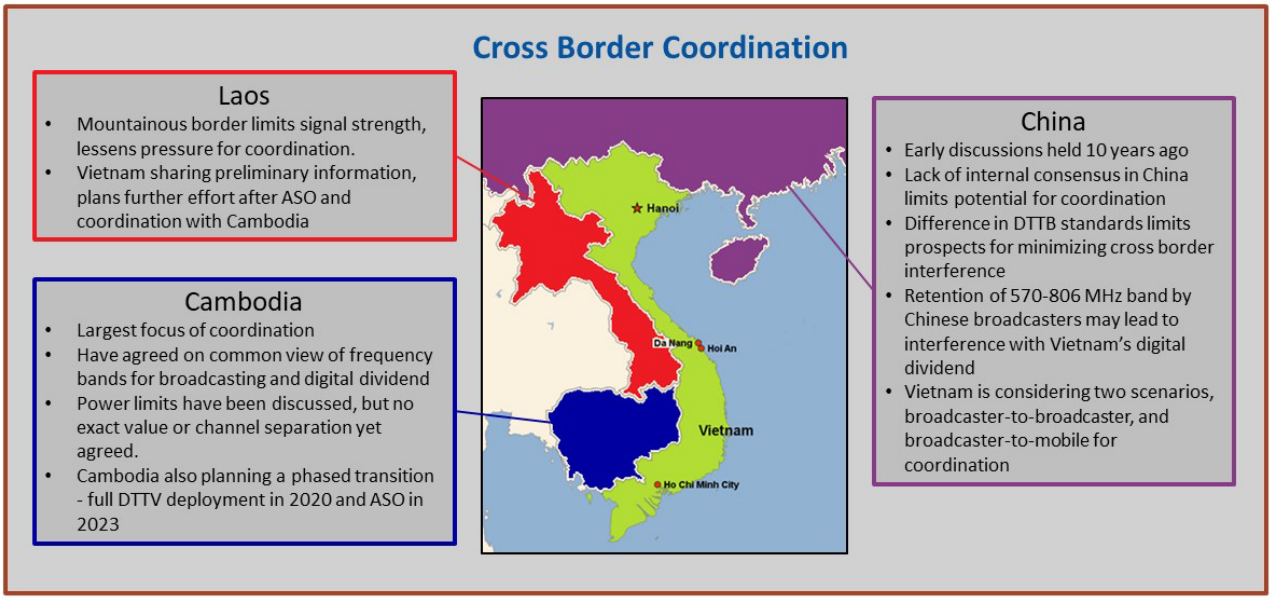
[38] ARFM, Interview with Phung Nguyen Phuong, Deputy Director General – International, 21 May 2017.
[39] Decision No. 2451/QĐ-TTg of December 27, 2011, on approving the scheme for digitisation of terrestrial television broadcasting by 2020, Article 1, Section V.
[40] Le Van Tuan (ARFM), "Transition to Digital Broadcasting: Vietnam's Roadmap" presentation (May 2011), available at https://www.itu.int/ITU-D/tech/events/2011/Broadcasting_Hanoi_May11/Presentations/Hanoi_May11_Session2_Vietnam.pdf.
[41] See, for example, QCVN 63: 2012/BTTTT, QCVN 64: 2012/BTTTT, QCVN 77: 2013/BTTTT, and QCVN 77: 2013/BTTTT.
[42] Circular No. 07/2013/TT-BTTTT (18 March 2013), available at http://english.mic.gov.vn/Upload/Store//VanBan/6392/07-2013-TT-BTTTT.doc.
[43] ARFM, Interview with Le Van Tuan, Deputy Director General – Spectrum Planning, 18 May 2017.
[44] Available at http://cultureandinformation.asean.org/wp-content/uploads/2013/11/ANNEX-15b.-ASEAN-DVB-T2-Receiver-Baseline-Specification-v1-0_June-2014-Final-copy.pdf.
[45] ARFM, Interview with Le Van Tuan, Deputy Director General – Spectrum Planning, 18 May 2017.

suit the roadmap for digitalisation.[46] Although not explicitly required in Vietnam's migration plan, technical expertise will continue to be critical when the restacking process is designed and implemented, a key step in creating the digital dividend.

3.2.3 Cross-border coordination

Vietnam has taken different approaches to cross-border coordination with each of its neighbours – China to the north, Cambodia to the southwest, and Laos to the west. One common factor, however, is Vietnam's effort to hold one meeting per year with each of the three countries.[47] Vietnam's cross-border coordination efforts are summarised in Figure 12.

Figure 12: Vietnam cross-border coordination activities



Source: ARFM

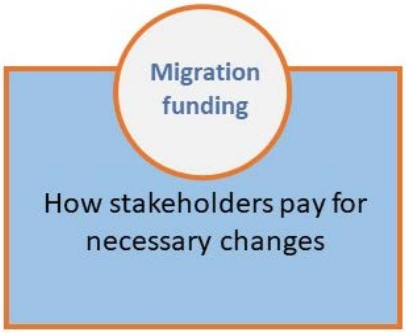
The fact that the 470-806 MHz band is tentatively being retained by broadcasters in China may lead to interference issues in the 700 MHz band that Vietnam intends to use for IMT services.

Vietnam has the greatest engagement on cross-border coordination issues with Cambodia.[48] The Vietnam-Cambodia coordination effort is based on the following principles:

- establish a bilateral technical group;
- update each other on broadcasting digitalisation process and new licensed stations in border areas;
- address interference on a case-by-case basis (especially because solutions may vary depending on the topography of the region – flat or mountainous); and
- carry out a study on a broadcasting coordination roadmap.

[46] Decision No. 2451/QĐ-TTg of December 27, 2011, on approving the scheme for digitisation of terrestrial television broadcasting by 2020, Article 1, Section V.
[47] ARFM, Interview with Phung Nguyen Phuong, Deputy Director General – International, 21 May 2017.
[48] ARFM, Interview with Phung Nguyen Phuong, Deputy Director General – International, 21 May 2017.

3.2.4 Funding the digital migration



In its 2011 digital migration plan, Vietnam's government estimated that the digital migration would cost VND 3,946 billion (USD 186.3 million).[49] The budget was divided into four major components, with funding provided by various sources, as indicated in Table 3. Given state ownership of Vietnam's broadcasters, however, all funds ultimately were supplied by the Vietnamese government and overseas development assistance.

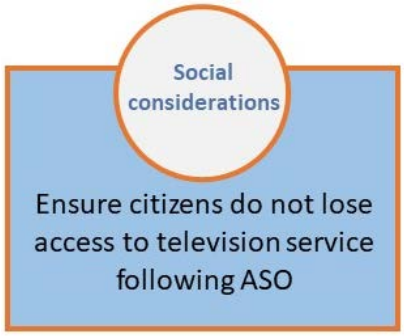
Table 3: Vietnam digital migration budget

Programme	Leading Entity	Cooperating Entities	Capital Sources	Budget (million USD)
Support for provision of DTTV receivers	MIC	Ministry of Finance, People's Committees of cities and provinces	Public Utility Telecommunications Service Fund	80.7
Construction and conversion into DTTV broadcasting infrastructure	VTV, VTC, AVG, local broadcasters	MIC, Ministry of Planning and Investment	Corporate capital	65.2
			Overseas development assistance and government budget (for remote, disadvantaged, border, and island areas)	34.6
Investigation into methods of watching television and supported services	MIC	Ministry of Planning and Investment, Ministry of Labour, War Invalids and Social Affairs, People's Committees of cities and provinces	Government budget/ Public Utility Telecommunications Service Fund	3.4
Public awareness about digitisation of terrestrial television broadcasting	MIC	Mass media agencies	Government budget/ Public Utility Telecommunications Service Fund	2.4
Total:				186.3

Source: Vietnam, Decision of the Prime Minister

3.3 Consumer considerations

3.3.1 Consumer awareness and support



Among the most important components of a country's digital migration is ensuring that consumers – television viewers – are aware of the migration process and how it will affect them. This is particularly important in Vietnam due to high reliance on free-to-air TV.

The MIC's outreach encompasses a range of activities including educating consumers about the reasons for the migration, how it will directly affect them, what action(s) they need to take to ensure continued access to their broadcast content, and how they

[49] USD 1 = VND 21,177.7 as of 27 December 2011.

can obtain additional information or support. Without a strong consumer awareness and support plan, a country runs the risk of viewers losing access to content at the time of ASO.

Figure 13: Vietnam - Authorities responsible for public awareness efforts

A joint circular issued by the Ministry of Finance and MIC addressing use of funding referenced specific awareness activities, which broadly include production and editorial content of materials, distribution of content to various communications media, and the establishment of information systems (i.e., web portals and switchboards) to support the digitalisation effort.[50]

While MIC was responsible for funding and providing guidance for such efforts, the bulk of the work was carried out by local government agencies.[51] Local government efforts included:

- **Advertising:** Public service announcements and advertisements were placed in radio and television programming, newspapers, e-newspapers, billboards, and community wireless networks.
- **Printed material:** Leaflets, guidebooks, other materials for consumers to keep.
- **Local influencers and meetings:** Village meetings, training of local communicators, on-the-street promotional campaigns, outdoor loudspeakers, support events.

The use of a widespread, multi-platform consumer awareness effort has been implemented in countries around the world, including in the Asia-Pacific region. In Australia, the government developed a communications program as part of the Digital Switchover Initiative.[52] The initiative included television, radio, and print advertising and a central website, among other approaches.

[50] Joint Circular 145/2014/TTLT-BTC-BTTTT (3 October 2014), available at http://english.mic.gov.vn/Upload/Store//VanBan/6429/TT145-2014.doc.
[51] ARFM, Email interview with Nguyen Hong Tuan, Deputy Head, Frequency Policy & Planning Division, 25 May 2017.
[52] See, for example, Australian National Audit Office, "Administration of the Digital Television Switchover Household Assistance Scheme," (28 June 2012), available at https://www.anao.gov.au/work/performance-audit/administration-digital-television-switchover-household-assistance-scheme.

The aim was to help raise awareness, understanding and support television viewers as they planned, prepared for, and made the transition to digital-only television.

Governments have also employed websites, call centres, and other support centres to provide more detailed information and support.

- **Websites:** Vietnam and Australia both used of websites to provide information and assistance. In Australia, the MySwitch website was a key tool for raising awareness and support to consumers, and the tool is still in use more than three years after final ASO.[53]
- **Call centres:** Telephone support is another key component for awareness raising and proving assistance. In addition to Vietnam, Japan employed call centres and support personnel to assist consumers with the digital transition.[54] Both the Ministry of Internal Affairs and Communications (MIC) and broadcaster NHK established or expanded call centres to address inquiries regarding the transition and to support viewer preparations in terms of the adoption of digital receivers.
- **Support centres:** Japan's MIC established Digital Television Support Centres (known as Digi-Suppo) in order to provide detailed advice and information – taking into account local conditions – to consumers in advance of the transition. At their peak, there were 52 Digi-Suppo locations across the country, operated by the Association for Promotion of Digital Broadcasting and including staff from NHK.

In addition, in Vietnam village meetings and loudspeaker broadcasts on community radio in rural areas have been identified as key components of the public awareness effort.

The approaches of Vietnam and Japan, in particular, include an element of local control and customisation, with Vietnamese local governments responsible for implementing campaigns and Japan's Digi-Suppo locations focused on individual community needs. These plans were designed from the outset to ensure that consumers received information and support tailored to local conditions and priorities.

3.3.2 STB availability and affordability

Table 4: Indonesia STB penetration goals

Date	STB Penetration
Q2 2012	> 20%
Q2 2013	> 30%
Q2 2014	> 40%
Q4 2018	> 50%

In addition to encouraging or funding broadcasters' transition to digital service and educating consumers about the upcoming change, governments also routinely take steps to ensure that consumers have access to the equipment required to view DTTV broadcasts – namely STBs or televisions with integrated digital tuners. Vietnam's primary vehicle for ensuring STB availability and affordability has been to allocate VND 1,710 billion (USD 80.7 million) from the Public Utilities Telecommunications Service Fund for subsidies to disadvantaged households. Using those funds, provincial governments fully subsidised STBs for eligible households. To date, the government has subsidised the distribution of more than 900,000 STBs.[55] This responsibility was delegated to the provincial

[53] ACMA, Interview with Christopher Hose, Manager spectrum planning and engineering, and Giles Tanner, General manager, communication infrastructure branch, 5 June 2017.
[54] ITU, "Field study on digitalisation of terrestrial television in Japan," (2015), available at http://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Publications-Reports/Digit_Japan_374675_EBAT.PDF.
[55] MIC, 2017 data.

governments specifically because they are best equipped to accurately identify disadvantaged citizens in their region.[56]

In comparison to Vietnam, Thailand developed a subsidisation programme that distributed coupons to all households in order to assist with DTTV-compatible equipment purchases.[57] Each coupon was valued at THB 690, or USD 19.10.[58] The DTV Coupon Programme was funded by a portion of the revenue raised from Thailand's digital broadcasting frequency auction. Coupons could be exchanged for a basic STB or used as a credit toward the purchase of other compatible equipment. As of 31 January 2016, 13.57 million coupons had been distributed, with 8.7 million (or 64%) redeemed. In February 2016, the government approved a second subsidy programme covering additional households. In Indonesia, in addition to network deployment/ASO timelines, the NRT also set milestones for STB penetration, as seen in Table 4.

The decision regarding how widely to offer equipment subsidies reflects a difference in overall policy, and perhaps available budget resources between the two countries. Thailand opted to subsidise the entire population, while Vietnam chose to subsidise the population most affected by a required equipment purchase. The correct policy approach depends on national priorities and resources.

3.4 Roadmap and execution

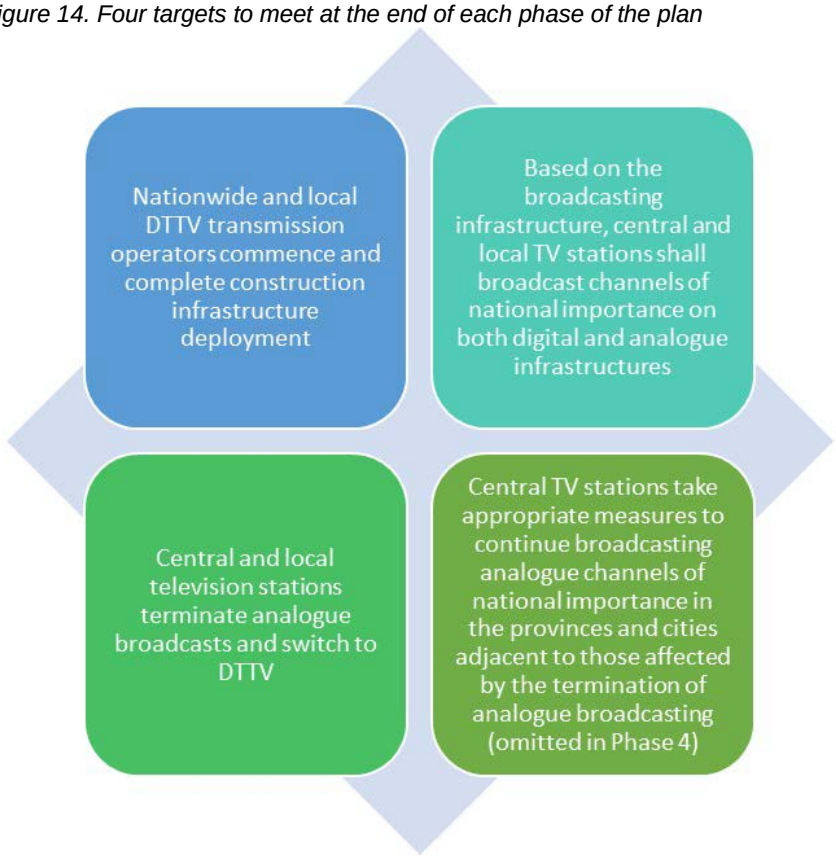
While planning and key decisions are critical to a successful digital migration, it is also important to review Vietnam's implementation of the migration plan. This includes noting variances from the roadmap, as well as implementation experiences in other markets. The progress made regarding digital migration will directly influence the availability of – and ability to plan – the digital dividend.

3.4.1 Deployment plan and status of implementation

As noted in Section 3.1.1, the transition plan was divided into four sequential phases. In each phase, the roadmap outlines four basic steps and targets, as shown in Figure 14. Vietnam is meeting these targets, as well as the general and specific targets outlined in the digital migration plan, although not always on schedule.

[56] ARFM, Interview with Phung Nguyen Phuong, Deputy Director General – International, 21 May 2017.
[57] Orasri Srirasa (NBTC), "DTTB implementation in Thailand," (23 May 2016), available at https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2016/May-PreAMS/S5_Orasri_SRIRASA.pdf.
[58] THB 1 = USD 0.02767 as of 1 January 2016.

Figure 14. Four targets to meet at the end of each phase of the plan



Source: Vietnam, Decision of the Prime Minister on approving the scheme for digitisation of terrestrial television broadcasting by 2020

Like Thailand and Indonesia, Vietnam has begun the digital migration process, but has not completely transitioned to nationwide DTTV. In addition, these countries have had a range of experiences regarding adherence to timelines, facing challenges towards the smooth implementation of the process.

While Danang's ASO was completed slightly ahead of schedule on 1 November 2015 (see Box 3), the ASO in Vietnam's remaining Phase I cities was delayed by eight months, due to STB subsidy fraud as described in Section 3.4.2.

Box 3: Danang digitalisation pilot project

Danang: First city in ASEAN to end analogue broadcasting

Danang was selected as Vietnam's first city to migrate to digital broadcasting. Its five-point process had the potential to inform governments in other cities and provinces:

- Establishment of the local steering board
- Consolidating broadcasting infrastructure and human resources
- Public awareness efforts
- STB distribution to low-income households
- Extending broadcast coverage

Danang's ASO occurred on 1 November 2015, two months ahead of the Phase I target. The city's steering board identified four key lessons learned:

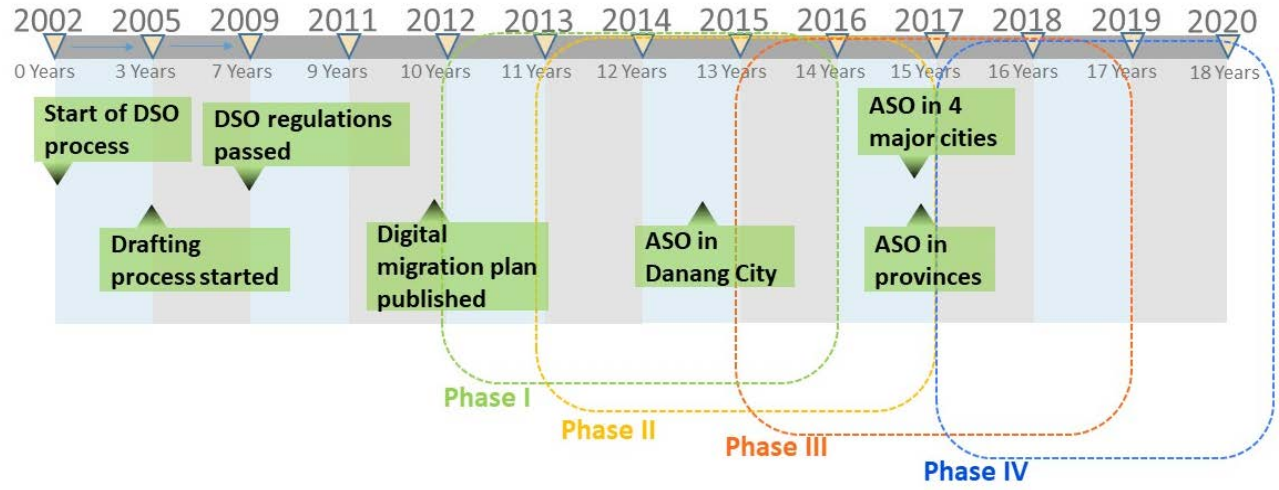
1. Timely issuance of policies and documents is critical to ensuring stakeholder buy-in
2. Emphasise communications to the community are important, including training for local authorities and the staff in support centres
3. Equipment quality is an important factor in ensuring access to DTTV broadcasts. There may also be opportunities to create infrastructure- or equipment-related jobs
4. Procure subsidised STBs via a transparent and well-inspected process

Source: Danang City Digitalisation in Terrestrial Television Broadcasting Steering Board

With respect to Phase II, the first eight provinces completed the ASO at the end of 2016, the scheduled ASO date for the phase. However, in February 2017, MIC indicated that the ASO was scheduled for 15 Phase II cities by 1 July 2017, six months behind schedule.[59] Despite the delays in Phases I and II, Vietnamese officials are optimistic that the overall migration plan will stay on schedule and may even conclude ahead of schedule.[60] The country's migration progress is seen in Figure 15.

[59] MIC, "Digital television transition in 2017," (February 15, 2017), available at http://english.mic.gov.vn/pages/tintuc/printpage.aspx?tintucID=133792.
[60] ARFM, Interview with Phung Nguyen Phuong, Deputy Director General – International, 21 May 2017.

Figure 15: Vietnam digital migration progress



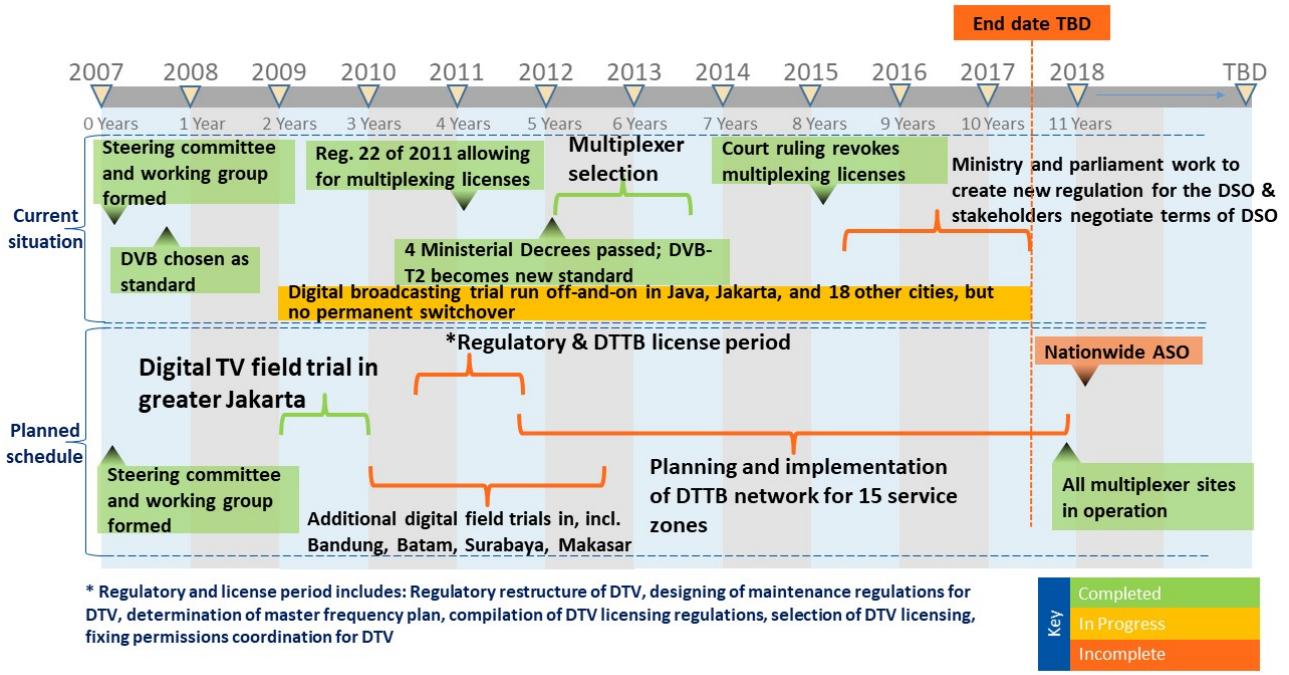
Source: TMG, based on MIC/ARFM data

As noted above, Vietnam has three nationwide operators and two regional providers. According to MIC, the regions included in Phase I of the migration plan now have between 26 and 70 channels available, including 5 to 7 high-definition channels.[61] While the deployment of DTTV in the regions covered in Phases II, III, and IV is still underway, 65% of Vietnam's population is already in digital coverage areas.[62]

In contrast to Vietnam, Indonesia has faced some uncertainty due to legal and commercial challenges, as described in Section 3.4.3. However, this has not prevented the provision of digital broadcasting. Despite a broadcaster lawsuit, digital transmission operators unaffected by the lawsuit are currently providing DTTV services.[63] For example, Jakarta currently has approximately 22 digital program channels, plus the existing 15 analogue channels.[64] The major questions facing Indonesia are when and how the government will be able to advance the migration process. Indonesia's migration roadmap and an illustration of major implementation milestones to date are presented in Figure 16.

[61] MIC, "Digital television transition in 2017," (February 15, 2017), available at http://english.mic.gov.vn/pages/tintuc/printpage.aspx?tintucID=133792.
[62] ARFM, Interview with Phung Nguyen Phuong, Deputy Director General – International, 21 May 2017.
[63] ATSI, Interview with Sutrisman, Executive Director, 22 May 2017 and MCIT, Interview with Denny Setiawan, Acting Deputy Director General for Spectrum Policy and Planning, Directorate General of Resources and Standards, Ministry of Communications and IT, 24 May 2017.
[64] MCIT, Email interview with Denny Setiawan, Acting Deputy Director General for Spectrum Policy and Planning, Directorate General of Resources and Standards, Ministry of Communications and IT, 7 June 2017.

Figure 16: Indonesia DSO roadmap and implementation



Source: TMG, based on MCIT and ITU data

Thailand, like Indonesia, has encountered some legal challenges as described in Section 3.4.2, but overall its digital migration process has remained on schedule.[65] As of February 2016, 86% of households are covered by DTTV, and the NBTC expected that coverage would reach 95% of households by June 2017, in line with the DTTV deployment plan.[66] As of March 2016, five multiplexes were in operation, broadcasting 26 channels (4 public broadcasters and 22 commercial channels). One legal complaint remains pending; the potential impact of a decision is unknown.

The NBTC has reached agreements with four of Thailand's six analogue broadcasters to terminate analogue broadcasts within five years of the issuance of transmission licences, or 2018.[67] Two broadcasters are implementing phased ASOs, while the other two each set a single ASO date. The two remaining broadcasters planned to continue their analogue broadcasts until their concessions expire in 2020 and 2023, but as of May 2017 both were planning to accelerate their ASO plans.[68] The planned community broadcasting licences have not yet been issued, but Thailand is developing a framework to introduce them after the digital transition is complete.[69] This will be facilitated by the launch of a sixth multiplex for community broadcasters.

[65] NBTC, Email interview with Siwat Chonlavorn, Senior Operation Official, Broadcasting Policy and Research Bureau, 7 June 2017.
[66] ITU-D Document SG1RGQ/227(Rev.1)-E, "Thailand Case Study: Transition to Digital Terrestrial Television Broadcasting," (7 April 2016), available at https://broadcast.nbtc.go.th/data/academic/file/590500000001.pdf.
[67] ITU-D Document SG1RGQ/227(Rev.1)-E, "Thailand Case Study: Transition to Digital Terrestrial Television Broadcasting," (7 April 2016), available at https://broadcast.nbtc.go.th/data/academic/file/590500000001.pdf.
[68] See, for example, "Analogue TV well on the way out, NBTC says," (6 May 2017), available at http://www.nationmultimedia.com/news/business/EconomyAndTourism/30314378.
[69] ITU-D Document SG1RGQ/227(Rev.1)-E, "Thailand Case Study: Transition to Digital Terrestrial Television Broadcasting," (7 April 2016), available at https://broadcast.nbtc.go.th/data/academic/file/590500000001.pdf.

Both Vietnam and Thailand can be expected to continue their digital migrations in line with plans, while Indonesia's migration process will depend to a large extent on the progress of the new broadcasting law and on continued developments in the commercial broadcasting market.

3.4.2 Legal Challenges

The planning and implementation of a wholesale change to the delivery of television broadcasts across an entire country is a complex undertaking. There can be multiple potential points of failure, including changes to the legal and regulatory framework, and coordination and cooperation among stakeholders.

In the case of Vietnam, attempted STB subsidy fraud has been identified by ARFM officials as the only significant challenge encountered to date.[70] Specifically, some individuals have the economic means to purchase their own DTTV equipment but still attempted to obtain subsidised STBs. The time and effort involved in ensuring that only qualified households receive subsidised STBs has led to the delays in Phases I and II noted above. This raises the question of whether a different subsidy approach – perhaps a smaller, but universal subsidy – would have reduced the likelihood of fraud, but also raises the question of whether it would have served Vietnam's viewers as well as the existing plan.

In Indonesia, legal challenges and the existing market structure have disrupted the migration process. In perhaps the most important development, an association of local commercial broadcasters filed suit against the government over the digital migration process on the grounds that it is not mandated in current Indonesian law.[71] The association prevailed in court in March 2015, resulting in the invalidation of 33 multiplex licences. The lawsuit did not affect all transmission operators and some DTTV service in Indonesia continues. However, the lawsuit and decision have led the government to need to reconsider the entire digital migration process and its legal basis.[72] In order to address the underlying concerns, Indonesia's legislature is in the process of developing a new broadcasting law that should provide a clearer legal basis for the digital migration plan. The date of implementation of this law is unknown at this time.

In addition, the strong influence of major incumbent broadcasters has been cited as a cause for the slow pace of DTTV migration.[73] These companies have an interest in retaining the status quo and avoiding a reduction in spectrum holdings. Further, the incumbents who also hold the DTTV transmission licences have little incentive to reach transmission agreements with local broadcasters, whose survival is endangered if their content is not available to viewers. These factors have created a divide in the Indonesian broadcasting sector that is hindering the migration effort, regardless of the impact of the lawsuit.

In Thailand, the digital migration process has been affected by two legal challenges: one related to broadcaster Thai TV and one challenging the legality of the migration process. In 2015 and 2016, Thai TV sued the NBTC over slow DTTV coverage expansion, and the NBTC and another broadcaster each sued a bank due to non-payment of Thai TV's licence payments.[74] The dispute

[70] ARFM, Interview with Le Van Tuan, Deputy Director General – Spectrum Planning, 18 May 2017.
[71] MCIT, Email interview with Denny Setiawan, Acting Deputy Director General for Spectrum Policy and Planning, Directorate General of Resources and Standards, Ministry of Communications and IT, 24 May 2017.
[72] MCIT, Interview with Denny Setiawan, Acting Deputy Director General for Spectrum Policy and Planning, Directorate General of Resources and Standards, Ministry of Communications and IT, 24 May 2017.
[73] MCIT, Interview with Denny Setiawan, Acting Deputy Director General for Spectrum Policy and Planning, Directorate General of Resources and Standards, Ministry of Communications and IT, 24 May 2017.
[74] See, for example, http://englishnews.thaipbs.or.th/nbtc-sued-for-alleged-failure-to-expand-digital-tv-coverages-as-it-stated/, http://www.nationmultimedia.com/news/business/corporate/30279647, http://www.bangkokpost.com/tech/local-news/946533/regulator-

resulted in revocation of Thai TV's broadcasting licence, but had no effect on the overall migration plan. In 2015, six broadcasters brought a complaint alleging that the digital migration process was improperly initiated, and are seeking damages of THB 9.55 billion (USD 280.3 million) plus interest. That complaint is still being adjudicated.[75] In the meantime, the official migration schedule has not been affected.

Awareness of the challenges faced in other markets and remedies imposed can inform the decisions made and approaches taken by governments and regulators as they develop or refine their own digital migration plans.

3.4.3 Restacking and digital dividend

One of the key drivers of the digital broadcasting migration in all countries is the creation of the digital dividend, resulting from more efficient spectrum usage. This spectrum is particularly valuable to mobile operators facing increasing demand for mobile broadband services, as it enables coverage over relatively wide areas and into buildings more cost effectively than spectrum in higher bands.

During the simulcast period in which content is broadcast via both analogue and digital networks, enough spectrum must be made available to accommodate both transmission types. Once a region or country completes the ASO, the spectrum used for analogue broadcasting becomes available, enabling a reorganisation of DTTV channels in order to create larger contiguous blocks of used and unused spectrum. This restacking of channels is a key step in releasing the digital dividend.

3.4.3.1 Restacking

Vietnam has not yet published any official guidance on its channel restacking plans. The MIC's plan for the 470-806 MHz band does not address the arrangement of spectrum after 2020, the scheduled end of the digital migration process.[76] However, the restacking activities undertaken by other countries in the Asia-Pacific region may provide some insight into how Vietnam – as well as other ASEAN members – may approach the process. It is reasonable to expect that Vietnam will soon provide further information on its restacking approach, given the goal of a nationwide ASO in approximately three years, to be preceded by a digital dividend auction.

Restacking may sound relatively simple in theory, but the logistics of reorganizing channels and avoiding new interference can be quite complex. Japan, which completed its DTTV migration in July 2011, employed two types of channel restacking: rearrangement and improvement.[77] Rearrangement was performed to reassign certain channels within one year after the termination of analogue broadcasting, making spectrum available for other uses.[78] The rearrangement restacking concluded in January 2013 affected 65 stations and 130 channels serving 540,000

to-sue-bbl-for-payment and http://www.scmp.com/business/companies/article/2054427/fox-networks-sues-bangkok-bank-unpaid-us21m-guarantee-after.

[75] NBTC, Email interview with Siwat Chonlavorn, Senior Operation Official, Broadcasting Policy and Research Bureau, 7 June 2017.

[76] Circular No. 26/2013/TT-BTTTT (27 December 2013), Article 5, available at http://english.mic.gov.vn/Pages/VanBan/11325/Circular-No.-26_2013_TT-BTTTT.html.

[77] ITU, "Field study on digitalisation of terrestrial television in Japan," (2015), available at http://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Publications-Reports/Digit_Japan_374675_EBAT.PDF.

[78] Although Japan's migration plan called for analogue transmissions to cease on 24 July 11 and the reassignment restacking to be completed exactly one year later, the Great East Japan Earthquake and Tsunami on 11 March 2011 resulted in a law modifying the timetable in affected provinces.

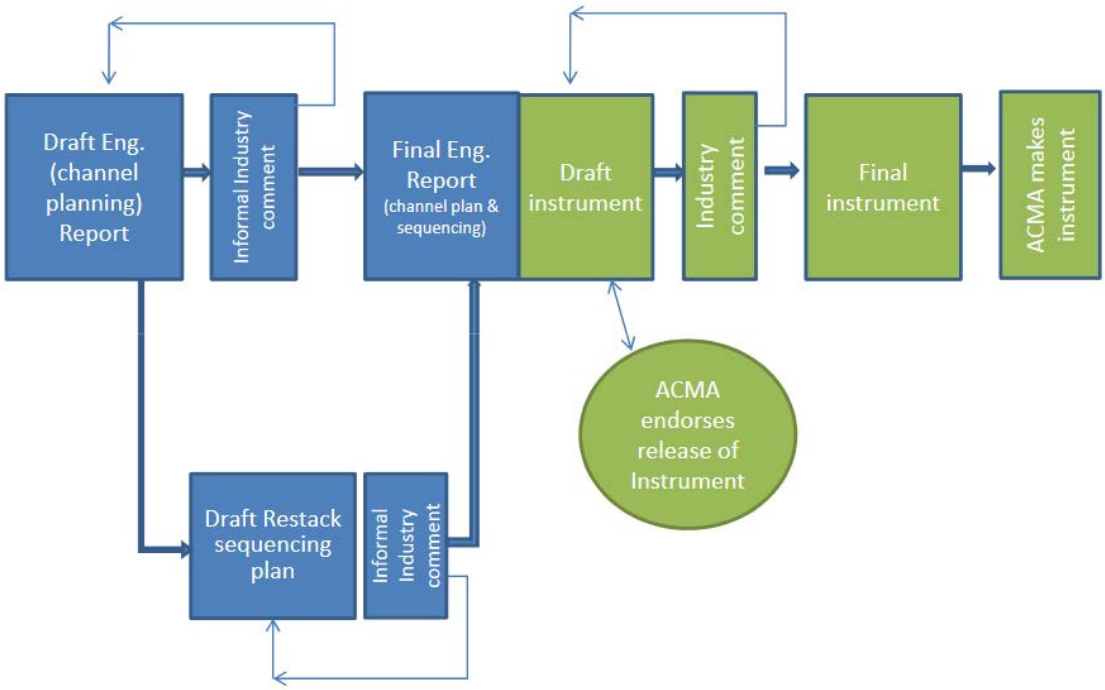
households. Improvement restacking was performed to mitigate the problem of digital interference created by frequency congestion. Led by local councils, improvement restacking was carried out in two regions in 2013.[79]

Similarly, in Australia, the Minister for Broadband, Communications and the Digital Economy directed the Australian Communications and Media Authority (ACMA) in 2010 to address restacking and set the deadline for clearing spectrum at 12 months after the final ASO, and to report to the minister on a quarterly basis.[80] Australia began the detailed restacking work in 2011 and ultimately affected 1,476 DTTV services at 426 sites, requiring 20 million viewers to retune their televisions or STBs.[81] The end result of the digital restacking process was clearance of the 694-820 MHz band, Australia's digital dividend.

As with digital migration planning and any other significant sector or spectrum reform, transparency and stakeholder engagement are critical to the development of a robust plan with broad support. In Australia, for example, the restacking and digital dividend planning process included the release of a green paper in January 2010, seeking input to assist the government in its decision-making and planning processes.[82] The comments on the green paper fed into the restacking direction to the regulator, as well as into the overall digital dividend approach. For the specific restacking plans, the ACMA conducted public consultations and codified proposals for channel restacking. This created plans that identified the channel allotments to which each digital television service would need to move, and the deadline for such changes. The ACMA's illustration of its planning process is presented in Figure 17.

[79] ITU, "Field study on digitalisation of terrestrial television in Japan," (2015), available at http://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Publications-Reports/Digit_Japan_374675_EBAT.PDF.
[80] Australian Communications and Media Authority (Realising the Digital Dividend) Direction 2010, (9 July 2010), available at http://www.acma.gov.au/~/media/Broadcasting%20Spectrum%20Planning/Regulation/pdf/RPAG2%20Ministerial%20Direction%20and%20Explanatory%20Statement.PDF.
[81] Department of Communications and the Arts, "The Retune Story," (8 December 2014), available at https://www.youtube.com/watch?v=Ig5zxvOXRMk.
[82] Digital Dividend Green Paper, (January 2010).

Figure 17: ACMA restack planning process



Source: ACMA

Although not ASEAN members, Japan and Australia may provide models of how nations such as Vietnam could approach certain aspects of their restacking process, such as improving spectral efficiency, reducing interference, and enhancing stakeholder communications.

3.4.3.2 Progress on the digital dividend

As outlined in Section 3.1, Vietnam's frequency plan for the 470-806 MHz band notes that the 700 MHz band will be used for IMT and other services after ASO.[83] Vietnam's draft 700 MHz band plan is currently being studied, and is expected to be in line with the APT700 band plan.[84] While no firm date or auction process has been published, the 700 MHz auction is expected to occur in late 2019. Similarly, in Thailand there is a tentative plan to auction the 700 MHz band in 2020.[85] The fact that both countries are already progressing toward digital dividend auction plans is a positive development that underscores the importance of releasing spectrum to key services, such as mobile broadband.

Other Asia-Pacific nations that have already assigned their digital dividend spectrum may serve as useful illustrations of the planning and assignment process. While not all countries in the region are expected to free up spectrum exactly matching the APT700 plan, the majority are expected to harmonise on this band. For example, Japan's 700 MHz band plan allocates 718-748 MHz paired with 773-803 MHz to mobile, as compared to the recommended allocation of 703-748 MHz paired with 758-803 MHz.[86] Australia, a key contributor to the development of the APT700 plan, identified

[83] Circular No. 26/2013/TT-BTTTT (27 December 2013), Article 5, available at http://english.mic.gov.vn/Pages/VanBan/11325/Circular-No.-26_2013_TT-BTTTT.html.
[84] ARFM, Email interview with Nguyen Hong Tuan, Deputy Head, Frequency Policy & Planning Division, 25 May 2017.
[85] NBTC, Email interview with Siwat Chonlavorn, Senior Operation Official, Broadcasting Policy and Research Bureau, 7 June 2017.
[86] NTT DoCoMo, Email interview with Hiroyuki Atarashi, Manager of Radio System Group, 6 June 2017.

its digital dividend as 694-820 MHz.[87] Both plans overlap the APT700 plan, enabling compatibility of mobile services.

In addition to choosing the digital dividend band, governments have considered how to assign the spectrum to new users. In Japan, mobile licences in the digital dividend were awarded to incumbents NTT DoCoMo, KDDI, and e-mobile through a beauty contest mechanism in June 2012.[88] In Australia, 2 x 45 MHz of spectrum in the digital dividend was offered at auction, resulting in spectrum awards to two incumbents and 2 x 15 MHz remaining unsold.[89] The ACMA decided to hold the unsold spectrum temporarily, ultimately offering it in a new auction in April 2017.[90]

Australia's digital dividend auction experience highlights additional important considerations for other nations planning licence awards. Following the first auction, commenters attributed the low interest level to the high reserve price.[91] Prior to the second auction, Australia's competition regulator advised the government to limit the amount of 700 MHz spectrum an entity could obtain, in order to ensure more fair competition in the mobile market.[92] The spectrum cap excluded one incumbent from the auction, resulting in awards to the two other major incumbents and a third player.[93]

As Vietnam and other ASEAN nations make decisions regarding the use of their digital dividend spectrum, the experiences of Japan and Australia – in particular band planning, spectrum awards, and questions of pricing and competition related to such awards – provide an indication of the issues they can expect to face. Continued work and stakeholder engagement on these issues will benefit all parties.

3.5 Benefits of using the digital dividend for mobile broadband

3.5.1 Digital dividend

The digital television migration and the resulting availability of the digital dividend is critically important for the continued growth and improvement of mobile broadband services in southeast Asia. The mobile industry in the region and globally is experiencing significant growth, requiring operators to obtain additional spectrum. As 4G continues to be deployed and the introduction of 5G takes hold, multiple spectrum bands will be required to provide service in different settings: dense urban areas, suburban areas, and more rural or sparsely populated areas. Vietnam, as well as multiple other countries, has targeted existing mobile spectrum, such as the 1800 MHz band initially used for 2G services – for use by 4G services. However, the increasing demand for mobile data, in particular, will require additional spectrum for capacity and coverage. In its plans for LTE network deployment, Vietnam's Viettel has expressed interest in bands including the 700 MHz band. Viettel noted that access to this additional spectrum and the resulting improvements to mobile broadband coverage would contribute to Vietnam's overall economic productivity, as well

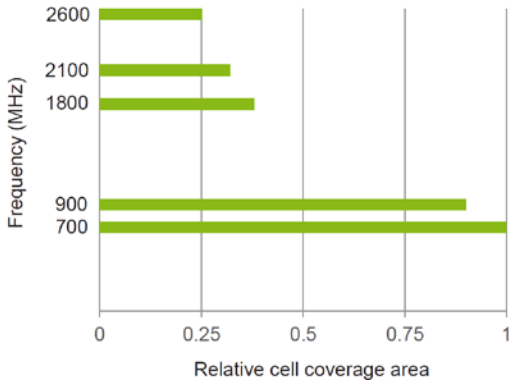
[87] Department of Communication and the Arts, "Digital dividend spectrum," available at https://www.communications.gov.au/what-we-do/spectrum/digital-dividend-spectrum.
[88] NTT DoCoMo, Email interview with Hiroyuki Atarashi, Manager of Radio System Group, 6 June 2017.
[89] ACMA, "Digital dividend auction – results," (7 May 2013), available at http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/digital-dividend-auction-results.
[90] ACMA, "700 MHz auction overview," (16 January 2016), available at http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/700-MHz-band/700-mhz-auction-overview.
[91] See, for example, "Telstra, Optus, TPG buy $2bn of mobile spectrum," https://www.itnews.com.au/news/telstra-optus-tpg-buy-2bn-of-mobile-spectrum-342277.
[92] ACCC, "ACCC advice on allocation limits for the auction of unsold 700 MHz spectrum—executive summary," (14 December 2016), available at https://www.communications.gov.au/file/22291/download?token=1k3HVpnQ.
[93] Department of Communications and the Arts, "Spectrum 700MHz auction results," (13 April 2017), available at https://www.communications.gov.au/departmental-news/spectrum-700mhz-auction-results.

as promote social benefits through improved broadband availability.[94] The social benefits include narrowing the digital gap between cities and rural areas, as well as improving education and health services.

Further, such technologies and the resulting use of additional spectrum may be tied to targets for broadband coverage, such as national broadband plans. Vietnam and Indonesia, for example, each have national strategies that include the expansion of mobile broadband coverage by 2020, with further goals likely to be set as those plans near their conclusions.[95]

The digital dividend in the 700 MHz is a key input for mobile broadband providers seeking to improve coverage in an economical fashion. Spectrum below 1 GHz, such as the 700 MHz band, is particularly desirable because it enables each site to provide service across a larger radius than a comparable site employing a higher frequency, as illustrated in Figure 18. In addition, 700 MHz spectrum has superior penetration characteristics, making it ideal for providing or improving coverage into buildings. Taken together, the excellent propagation characteristics allow coverage of a wider area with relatively fewer base stations, while the penetration characteristics enable better in-building service, making the 700 MHz band a key input to promote broadband development.

Figure 18: Relative cell coverage area



Source: Ericsson

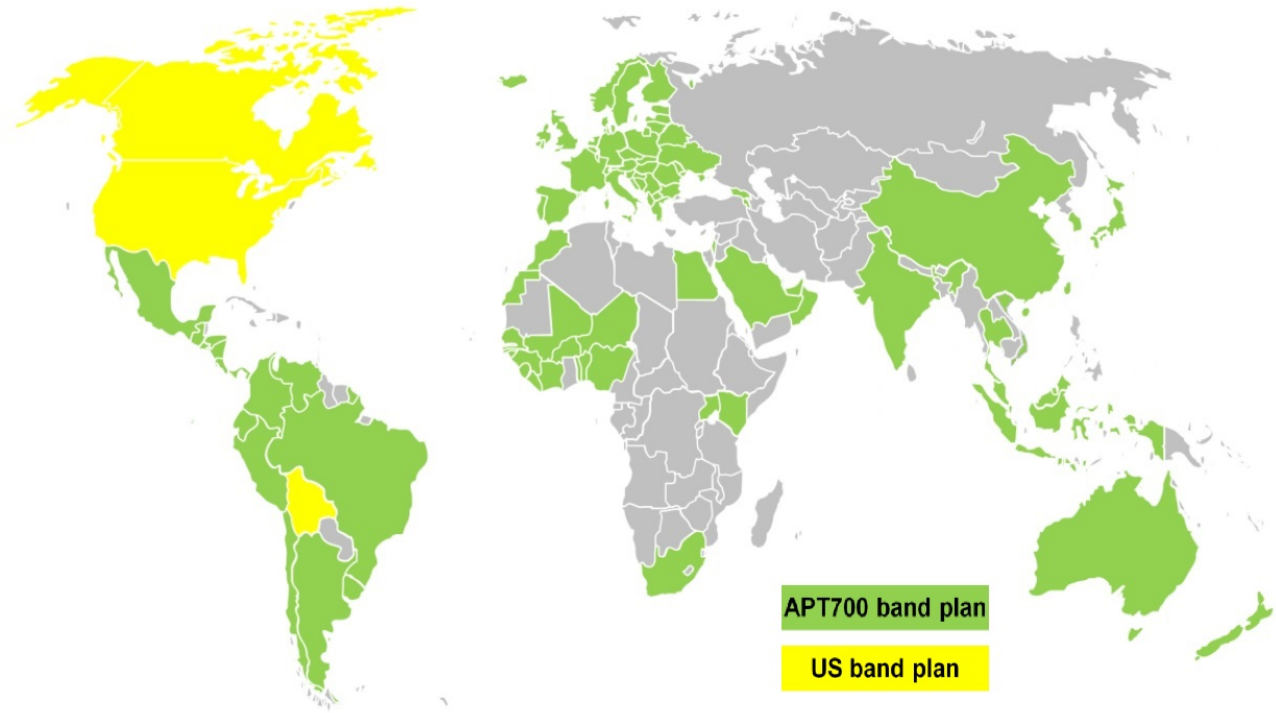
Adoption of the APT700 band plan or compatible plans, creates significant opportunities for economies of scale with respect to infrastructure and devices, as does adoption of compatible band plans outside the Asia-Pacific region. At the 2015 ITU World Radiocommunication Conference (WRC-15), delegates approved a decision allocating the 694-790 MHz band to the mobile service in Region 1 (Europe and Africa) and identified it for IMT, similar to the decisions taken at WRC-07 for Regions 2 and 3.[96] Further, WRC-15 saw additional Asia-Pacific countries – Vietnam, as well as Australia, Brunei Darussalam, Cambodia, Fiji, Indonesia, Kiribati, Laos, Malaysia, Myanmar, Solomon Islands, Samoa, Thailand, Tonga, Tuvalu, and Vanuatu – identify the 700 MHz band for IMT.[97]

With countries in Latin America, Europe, and the Middle East, such as Argentina, Brazil, Chile, Colombia, Ecuador, Egypt, France, Germany, Panama, Peru, Mexico, Suriname, and the United Arab Emirates already awarding spectrum based on the APT700 plan or preparing to do so, the potential market for compatible equipment is expanded beyond the Asia-Pacific region (see Figure 19). Economies of scale reduce prices, resulting in more cost-effective network deployments for operators, and lower prices and greater selection of devices for users, driving service adoption and

[94] Nguyen Thanh Xuan (Viettel), "Digital Dividend Benefit from Spectrum Allocation," (9 June 2011), available at http://www.itu.int/ITU-D/tech/events/2011/Broadcasting_Hanoi_May11/Presentations/Hanoi_May11_Session5_Viettel.pdf.
[95] Le Van Tuan (ARFM), "Transition to Digital Broadcasting: Vietnam's Roadmap" presentation (May 2011), available at https://www.itu.int/ITU-D/tech/events/2011/Broadcasting_Hanoi_May11/Presentations/Hanoi_May11_Session2_Vietnam.pdf and Mira Tayyiba (Coordinating Ministry for Economic Affairs), "Indonesia Broadband Plan: Lessons Learned," (9 September 2015), available at https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2015/Sep-WABA/Presentations/Indonesia%20Broadband%20Plan%20(ITU%20Jakarta,%20090915).pdf.
[96] Resolution 760 (WRC-15), "Provisions relating to the use of the frequency band 694-790 MHz in Region 1 by the mobile, except aeronautical mobile, service and by other services."
[97] Radio Regulations, Footnote 5.313A (WRC-15).

use. This choice will benefit mobile service users in Vietnam, across ASEAN, and in the broader Asia-Pacific region.

Figure 19: Adoption of APT700 and US 700 MHz band plans, 2016



Source: Adapted from Huawei

4 Conclusions

Key recommendations can be drawn from the digital migration experiences of Vietnam, Indonesia, Thailand, Australia, and Japan discussed in this report. These recommendations highlight crucial issues that must be addressed in the formation and execution of digital migration plans and digital dividend planning. The recommendations are followed by a checklist highlighting potential approaches to addressing these key issues.

4.1 Recommendation 1: Develop a comprehensive migration plan

The development of a comprehensive digital migration plan is perhaps the most important step in guiding the process and measuring progress. Migration plans should include a combination of overall policy goals and priorities, technology guidance or selection, and an implementation strategy and schedule. The plan should also identify relevant stakeholders and their roles, as well as plans for ensuring consumer awareness. The overarching planning process is also the ideal opportunity to consider the importance of regional or global harmonisation, for example with respect to technologies and spectrum. To the extent that new or revised legal and regulatory instruments are required, they should be harmonised with the migration plan. The digital migration

plans adopted in Vietnam, Indonesia, and Thailand are each wide-ranging, but incorporate each of these elements.

Stakeholders should be included in the migration planning process, both to foster stakeholder support for the plan and to ensure that the government is incorporating the best possible information. In addition, all stakeholders can then use the comprehensive digital migration plan as the basis against which all parties can measure implementation progress and success. The execution of the plan should be guided by the policies, priorities, and plans outlined in the migration plan.

4.2 Recommendation 2: Address key costs and identify funding sources

Digital migration plans incur significant costs, including new and upgraded broadcasting and transmission equipment, end user STBs and iDTVs, and consumer awareness programs. Digital migration plans should take into account available funding resources and the best uses for them. As seen in Vietnam, significant portions of the migration budget were provided by the universal service fund, as well as the treasury, and the broadcasters themselves. By comparison, Thailand's auction of broadcasting licences raised funds used for STB/iDTV subsidies. Such subsidies are an important consideration for planners and are potentially necessary to ensure that the greatest number of viewers maintain access to broadcast programming following the ASO.

4.3 Recommendation 3: Outline a clear spectrum usage plan

The refarming of spectrum previously used for analogue broadcasting is a major driver of digital migration plans. As such, the digital migration plan should have a clear vision of spectrum arrangements both during and after the migration period. Planners must take into account the spectrum to be used for DTTV – including suitability for the DTTV technology chosen and number of channels envisioned – harmonisation and coordination, the channel restacking plan, and the size and arrangement of the digital dividend. Clear and early spectrum planning eases the work of transmission operators deploying networks. Looking forward, the digital dividend plan provides an important input to mobile operators planning for expansion of mobile broadband coverage and services.

4.4 Recommendation 4: Plan for licensing of operators, broadcasters, and digital dividend users

The digital migration process requires a clear plan for licensing the entities that will transmit DTTV signals, aggregate and produce content, and make use of the digital dividend. The exact licensing models for DTTV may be informed by obligations imposed by existing licences, the interest in separating transmission from content aggregation/production, or simply the existing legal framework for licensing broadcasting services. As seen in Indonesia, a legal framework that predated digital broadcasting created the opportunity for legal challenges that disrupted the migration process. Considering the digital dividend, governments should carefully determine the appropriate value and reserve price for spectrum, the need for competitive safeguards, and the appropriate licensing mechanism.

4.5 Recommendation 5: Ensure consumer awareness

It is crucial that consumers are aware of the migration process, and specifically the effect that it will have on them in terms of new equipment requirements, as well as the timeline. Governments should ensure that appropriate consumer awareness and education programmes are implemented

in order to minimise the disruption to consumer viewing habits. As was the case in Vietnam, there may be significant value in decentralizing consumer awareness efforts and enabling customisation for particular regions or populations. Governments can also learn from the examples of Japan, Australia, and Vietnam, which placed considerable emphasis on migration support in the form of call centres or education resources.

Table 5 provides a checklist of key issues and challenges faced by governments and regulators with respect to the digital migration process. The checklist is arranged in line with the recommendations above, and for each issue identified it provides potential approaches or steps to be taken to help the government identify its best response to the issue or challenge. The checklist also identifies likely key stakeholders that should be consulted or involved in crafting a position or response to the issue.

Table 5: Checklist of key digital migration issues and challenges

Category	Issue/Challenge	Potential Approaches	Key Stakeholders
DSO migration planning	Develop a robust, realistic migration plan	• Identify priorities (e.g., changes to market structure, competition, quality of service) that should shape the plan • Identify appropriate funding sources • Examine approaches taken by countries with similar priorities • Invite stakeholder input (e.g., steering committee, stakeholder input)	• Relevant ministries (e.g., communications/ICT, finance, science, planning, trade) • Regulator • Broadcasters • Potential digital dividend users • Consumers
	Selection of DTTV technology	• Comparison of benefits and drawbacks of available technologies • Consideration of economies of scale derived from widespread technologies • Ensure adequate supply of affordable, good-quality STBs and iDTVs • Coordination with neighbouring countries • Consider impact on band planning	• Regulator • Ministry of trade • Broadcasters • Equipment manufacturers • Customs
	Implementation strategy	• Identify priorities for introduction of new broadcasting regime (e.g., begin in populated or affluent areas vs. remote or underserved areas) • Consult with experts regarding time and effort necessary to deploy new broadcasting infrastructure • Consider time and effort required to achieve critical mass of new technology adoption by consumers • Consider necessity of subsidies for broadcasters and/or consumers	• Ministry of communications/ICT • Regulator • Broadcasters • Local government • International experts
Financing	Digital migration funding	• Identify aspects or activities suitable for government support (e.g., equipment subsidies, consumer awareness, training) • Identify existing government sources of financing (e.g., universal service fund, treasury, licence fees)	• Ministry of finance • Ministry of communications/ICT • Regulator

		• Identify possible future government sources of funding (auction/licence fees) • Determine ability of broadcasters to fund part of migration	
	Subsidies	• Determine suitability of subsidy programme for population, including which segment(s) of population • Determine suitability of subsidy programme for transmission operators or broadcasters to support equipment upgrades • Determine funding source for subsidies	• Ministry of communications/ICT • Ministry of finance • Regulator
Spectrum planning	Broadcasting band planning	• Ensure compatibility/suitability to technology chosen • Consider impact of band planning on channel availability (number of multiplexes) and market structure • Consider benefits of regional harmonisation • Coordinate with immediate neighbours regarding border areas	• Ministry of communications/ICT • Regulator • Broadcasters
	Digital channel restacking	• Identify most efficient channel arrangement • Balance minimising interference and maximising contiguous spectrum for digital dividend • Careful consideration of each channel move and impact on users and other channels	• Ministry of communications/ICT • Regulator • Broadcasters
	Digital dividend band planning	• Identify highest-demand use(s) of spectrum • Evaluate current spectrum uses and allocations, what the digital dividend could improve • Consider benefits of regional harmonisation • Consider international trends in spectrum allocations • Coordinate with immediate neighbours regarding border areas	• Ministry of communications/ICT • Regulator • Mobile operators
Licensing	Transmission operator licensing	• Consider benefits and drawbacks of administrative assignment vs. competitive tender, inclusion of incumbents and new entrants • Consider likely relationship between transmission operators and content providers • Determine appropriate licence fees and fee structure	• Ministry of communications/ICT • Regulator • Broadcasters

	Broadcaster/content provider licensing	• Consider benefits and drawbacks of administrative assignment vs. competitive tender, inclusion of incumbents and new entrants • Consider likely relationship between transmission operators and content providers • Determine appropriate licence fees and fee structure	• Ministry of communications/ICT • Ministry of education • Ministry of culture • Regulator • Broadcasters
	Digital dividend licensing	• Determine appropriate value and reserve price of digital dividend spectrum • Determine applicability of competitive safeguards in licensing process • Identify appropriate licensing mechanism (auction, beauty contest, etc.) • Identify appropriate licensee obligations (coverage, universal service, etc.)	• Ministry of communications/ICT • Regulator • Mobile operators
Consumer Awareness	Consumer awareness efforts	• Identify multiple avenues to reach TV viewing population • Consider necessity of efforts in multiple languages • Consider effectiveness of local vs. nationally driven campaigns • Incorporate support resources (e.g., call centres, online support resources, etc.)	• Ministry of communications/ICT • Broadcasters • Local government

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