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**Conference Paper**

## Analysis of digital terrestrial television development in Taiwan

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# **The 19th ITS Biennial Conference 2012**

## **“Moving Forward with Future Technologies: Opening a Platform for All”**

18 - 21 November 2012, Thailand

**Analysis of Digital Terrestrial Television Development in Taiwan**

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## **Abstract**

The development of digital terrestrial television (DTT) plays an important role of digital convergence. However, a regulator need not only select a suitable DVB standard but also decide timing of transition between existing standard and new standard.

Although there are four major standards of digital terrestrial television in the world (ATCS, DVB-T, ISDB, DTMB), Taiwan, without its own standard, requires careful study to choose a suitable standard to enable digital convergence. According to the digitalization development and the technology evolution, the national communication commission (NCC) adopts a popular European standard, digital video broadcast-terrestrial (DVB-T) established by European Broadcast Union (EBU) in 1997, to develop its digital television systems.

However, demand for extra broadcasting channels with high definition quality pushes the NCC to evaluate feasible DTT upgrading technologies. Implementing a new DTT standard may have influence on distributing and receiving equipment and require upgrade a new setup box. Whether it is necessary to upgrade DTT standard and when would be the right time to move to the new standard are critical issues to be discussed.

In order to gain insight of previous DTT implementation and to analyze the timing of DTT standard transition, this study carries this research out in three steps. The first, the research undertakes a systematic study of existing DTT projects with different standards. And then, we apply the benchmarking approach to study the standard transition experiences in other countries and take a stakeholder analysis to consider Taiwan wireless TV standard adoption.

The outcome of this research is designed to assist policy makers and broadcast stations to decide the suitable switchover timing and offer some insight of a new DTT standard implementation.

Keywords: DTT, DVB-T, DVB-T2, ICT, benchmarking, stakeholder analysis

## Background

Owing to digital convergence, countries have paid attention to switch over digital terrestrial television technology to accelerate digitalization and enhance welfares.. With four major standards all over the world, decision making is not an easy job.

Among these standards, the DVB-T is the most widely with adoption of 120 countries because of the technology characteristics and the benefits of economy of scale. As the public demand for high-definition TV rises, the cost to adopt DVB-T falls and DVB-T offers more effective operation experience (DVB Project Office, 2012).

### **Digital terrestrial broadcasting standard adoption in Taiwan**

The process of determination of digital terrestrial standard adoption was tortuous in Taiwan. The Directorate General of Telecommunications (DGT) didn't decide to use DVB-T when it implemented digital switching at first. In the "digital terrestrial television broadcasting standard public hearing" in 1998, the DGT determined to adopt ATSC, developed by the U.S. Experts and scholars suggested that since Taiwan use NTSC as our analogous standard launched by the U.S., it would be much smooth transition if Taiwan adopts ATSC for digital switching. With different voice from broadcasting operators, the Association of Terrestrial Television Networks (ATTNT) authorized Tatung University to examine and compare performance between DVB-T and ATSC in 2001. The result indicated that DVB-T might meet the developmental need in Taiwan and the world trend better. Operators recommended DGT to alter the standard from ATSC to DVB-T. After the DGT surveyed the operators need and the differences between the two standards, it follows the principle of technology neutrality, allowing operators to decide the adoption of the standard by themselves (Chang, 2009). With practical experiment, operators prefer adopting DVB-T as the DTT standard.

There were some factors concerning the switching from ATSC to DVB-T in Taiwan. On the one hand, DVB-T was widely used for lots of countries. The supply for digital devices built in European standard has surpassed the supply for those built in other standards. If the National Regulatory Authorities (NRA) adopts European standard, the equipment manufacturers could benefit from not only foreign markets but also domestic market as well. Besides, DVB-T supports mobile reception; it would enrich and integrate related applications with mobility and convenience. On the other hand, Taiwan is a mountainous country and there are lots of tall buildings in cities. This kind of environment would make multipath problems more serious. DVB-T utilizes guard band to be more robust by preventing from multipath problem. Moreover, the systems and products of the European standard are completed and mature to reduce the cost of investment for the DVB-T receiver manufacturers.

### **Transition form DVB-T to DVB-T2**

The National Communications Commission (NCC) claimed that overall digitalization of wireless digital television should be implemented since July, 1<sup>st</sup>, 2012, and it would shut down the wireless analogy signal in all regions continually from May, 7<sup>th</sup> to June, 30<sup>th</sup> (Table 1). If the viewers would like to watch digital TV programs, they need to install a DVB setup box over traditional television or purchase a new television with the capability of digital signal reception. To accelerate the development of the digital television industry and to meet the customers' demand for more high definition TV programs, the NCC held the public hearing in 2012, discussing the "The second stage

license release draft plan of wireless digital television”. In the new project, the NCC recommended operators to adopt DVB-T2 as the technical standard, which is incompatible with the DVB-T standard. According to “The second stage license release draft plan of wireless digital television”, there are three critical objectives. The NCC intends to: 1. Speed up the development of television industry. 2. Follow up the world trend of digitalization. 3. Spur wireless television industry-upgrading through the transition to DVB-T2 (NCC, 2011).

The NCC does not announce a specific schedule for DVB-T to DVB-T2 standard transition, but the NCC will inquire and consult the Bureau of Standards, Metrology & Inspection (BSMI) to take DVB-T2 as national television standard once the policy is established. Setup box Manufacturers also need to monitor the development of this DTT standard transition to produce relevant products. According to draft proposal, if “The second stage license release draft plan of wireless digital television” is approved by 2012, then the operators can launch the DVB-T2 services between 2015 and 2016. (NCC, 2012)

Table 1: Timetable of Digital Terrestrial Switchover in Taiwan

<b>Time</b>	<b>Area</b>	<b>Regions</b>
May 7 <sup>th</sup> 12:00 p.m.	Central Taiwan	Hsinchu ( Xiangshan, Emei), Miaoli Country, Taichung City, Changhua Country, Nantou Country, Yunlin Country, Chiayi City, Chiayi Country (Dalin, Shikou, Minshiung, Shingang, Lioujiau, Dungshr, Putz, Taibau, Meishan, Juchi, Fanlu, Alishan, Dapu )
May 28 <sup>th</sup> 12:00 p.m.	Eastern Taiwan	Ilan Country, Hualien Country, Taitung Country, and Kinmen, Penghu, Lienchiang)
Jun. 11 <sup>th</sup> 12:00 p.m.	Southern Taiwan	Chiayi City, Chiayi Cuntry(Lioujiau, Dungshr, Putz, Taibau, Budai, Yiju, Lutsau, Shueishang, Jungpu ), Tainan, Kaohsiung, Pingtung
Jun. 30 <sup>th</sup> 12:00 p.m.	Northern Taiwan	Keelung, Taipei, New Taipei, Taoyuan, Hsinchu

(Resources: Taiwan Digital Television Committee, 2012)

### Motivation

There are many issues can affect DTT standard switchover process. The changes for equipment suppliers, content industries, consumers, government policies, and etc. are factors to be considered. For example, most people have purchased the setup box

with the first generation broadcast standard, but the NCC held the public hearing on March, 22<sup>nd</sup>, 2012, to discuss the “The second stage license release draft plan of wireless digital television”. The new standard regulation requires the new equipment with the DVB-T2 standard. Viewers could be reluctant to buy a new set top box. In the consideration of standard transition, some factors should be taken into concern. The value chain and the environment in the industry may also be affected.

Issues related to the DTT standard upgrading can affect the development of digital broadcasting and the response from citizens for purchasing a new setup box also needs handle carefully. So this research collect relevant information to analyze and give some suggestions for the adoption of digital terrestrial broadcast standard in Taiwan by studying related literatures and analyzing the current development of Taiwan television industry.

### Research objective

The study compares four major wireless digital television standards and discusses the standard adoption in the world from the technology, trend of the world, and market scale. Following issues would be discussed: (1) why does Taiwan government still adopt DVB-T as the next generation wireless digital television standard in Taiwan? (2) The appropriate timing for Taiwan to switchover from DVB-T1 to DVB-T2.

### Research process

According to the research background, motivation, and objective, the study conducts an overall study of digital terrestrial broadcasting development and probe the state of play of DVB-T and the digital transition process in Taiwan. Literature review introduces the four major digital terrestrial television standards. In the latter sessions we will give some suggestion for future development in Taiwan according to other countries’ experience through the benchmarking approach and the stakeholder analysis.

### Literature review

In this part, the study surveys four major digital terrestrial television standards, and the digital terrestrial television standard adoption in Taiwan.

#### **Global digital terrestrial television standards**

There are four major digital terrestrial television standards in the world. They are ATSC, DVB-T, ISDB, and DMB-T. Their bandwidth is between 6~8MHz. All the standards above support mobile reception, but ATSC is excluded. DVB-T is the most widely used by countries within Europe, New Zealand, Australia, and Taiwan. ATSC is adopted by the U.S., Canada, Argentina, Singapore, and etc. ISDB and DMB-T are rarely used. ISDB is adopted in Japan and Brazil; and DMB-T is used in China, Macau, and Hong Kong. The detailed specifications of the four standards are coordinated in the following table (Table 2).

Table 2: Four major digital terrestrial television standards

	<b>DVB-T</b>	<b>ATSC</b>	<b>ISDB-T</b>	<b>DMB-T/H</b>
<b>Bandwidth</b>	6,7,8Mhz	6Mhz	6Mhz	

<b>Modulation</b>	COFDM	8VSB	BST-OFDM	TSD-OFDM
	DQPSK/QPSK /16QAM/64QAM/MR-16QAM/MR-64QAM	8VSB	DQPSK/QPSK /16QAM/64QAM	QPSK/16QAM/64QAM
<b>Interleaving</b>	frequency	time	frequency/ time	frequency/ time
<b>Multiplexing</b>	MPEG-2	MPEG-2	MPEG-2	
<b>Video</b>	MPEG-2	MPEG-2	MPEG-2	MPEG-2 Part2, H.264
<b>Audio</b>	MPEG-2	DolbyAC-3	MPEG-2	MPEG-2, DolbyAC-3
<b>Bitrate (Mbps)</b>	4.35~31.67	19.39	5.6Mhz:3.68~ 21.46 432Khz:283~1 .65K	
<b>Single Frequency Network</b>	YES	YES	YES	single frequency network/ multi- frequency network
<b>Mobile Reception</b>	YES	NO	YES	YES
<b>Adoption</b>	countries within Europe, New Zealand, Australia, Taiwan	the U.S., Canada, Argentina, Singapore	Japan, Brazil	China, Macau, Hong Kong

(Resources: Summarized by the authors)

### Introduction of DVB-T

The DVB Project is an alliance of about 230 companies, originally of European countries but now worldwide. Its objective is to ratify specifications for digital media delivery systems, including broadcasting. The DVB Project established the standards of digital broadcast systems, such as DVB-T, DVB-S, DVB-H, DVB-C, and etc. DVB-T is a technical standard, which specifies the framing structure, channel coding and modulation for digital terrestrial television broadcasting. The first version of the standard was published in March 1997 and in the twelve years since then it has become the most widely adopted DTT system in the world. It is a flexible system that allows networks to be designed for the delivery of a wide range of services, from HDTV to multichannel SDTV, fixed, portable, mobile, and even handheld reception. DVB-T benefits from massive economies of scale and very low receiver prices. The DVB Project has published a next generation terrestrial specification in 2009, DVB-T2. DVB-T2 offers an increased efficiency of 30-50% in its use of spectrum compared to DVB-T (DVB Fact Sheet, 2011). In other words, there will be 1 to 2 more HD programs in the same bandwidth if DVB-T2 is adopted. The cost of

adopting DVB-T is lower than DVB-T2, but DVB-T2 performs more efficiently than DVB-T. The bandwidth of DVB-T in Taiwan is 6MHz; each channel supports a H.264 coded HD program at most. If DVB-T2 was adopted, two HD programs and a SD program could be streamed in one channel.

### Technical Characteristics of DVB-T and DVB-T2

There are similarities and dissimilarities between DVB-T and DVB-T2. They both use OFDM modulation with a large number of viewers delivering a robust signal that has the ability to deal with severe channel conditions. Also, DVB-T and DVB-T2 are flexible standards due to the fact that they offer a range of different modes. The use of OFDM modulation with the appropriate “guard interval” allows DVB-T to provide a valuable tool for regulators and operators in the form of the “single frequency network” (SFN). An SFN is a network where a number of transmitters operate on the same radio frequency. An SFN can cover a country or be used to enhance in-door coverage using a simple “gap-filler”. Table 3 shows the main characteristics of DVB-T and DVB-T2 (DVB Project Office, 2012).

Table 3: DVB-T vs. DVB-T2

	<b>DVB-T</b>	<b>DVB-T2</b>
<b>Forward Error Correction</b>	<b>Convolutional Coding + Reed Solomon</b> 1/2, 2/3, 3/4, 5/6, 7/8	<b>LDPC + BCH</b> 1/2, 3/5, 2/3, 3/4, 4/5, 5/6
<b>Modes</b>	<b>QPSK, 16QAM, 64QAM</b>	<b>QPSK, 16QAM, 64QAM, 256QAM</b>
<b>Guard Interval</b>	1/4, 1/8, 1/16, 1/32	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
<b>FFT Size</b>	2k, 8k	1k, 2k, 4k, 8k, 16k, 32k
<b>Bandwidth</b>	6, 7, 8 MHz	1.7, 5, 6, 7, 8, 10 MHz
<b>Typical data rate(UK)</b>	24 Mbps	40 Mbps
<b>Max. data rate (@20 dB C/N)</b>	31.7 Mbps	45.5 Mbps
<b>Required C/N ratio (@24 Mbps)</b>	16.7 dB	10.8 dB

(Resources: DVB Project Office, 2012)

DVB-T2 offers a higher data rate and a more robust signal than DVB-T. Multiple Physical Layer Pipes allow separate adjustment of the robustness of each delivered service within a channel to meet the required reception conditions (for example in-door or roof-top antenna). It also allows receivers to save power by decoding only a single service rather than the whole multiplex of services. And Alamouti coding is a transmitter diversity method that improves coverage in small-scale single-frequency networks. Constellation Rotation provides additional robustness for low order constellations. Future Extension Frames (FEF) allows the standard to be compatibly enhanced in the future (DVB Project Office, 2012).

### Research Method

In this section, the study introduces the methods used in the analysis of the appropriate timing for Taiwan to switch from DVB-T1 to DVB-T2. The benchmarking approach will be taken so as to check other countries' experiences to determine the appropriate timing for Taiwan to switch from DVB-T1 to DVB-T2.



Stakeholder analysis discusses relevant groups which affect or be affected in the digital standard transition understood.

### **Benchmarking approach**

Benchmarking is commonly applied to a wide variety of activities that organizations undertake to compare their performance levels with others and/or identify, adapt, and adopt practices that they believe will improve their performance. Benchmarking method can apply to the products, services, and practices or any area of an organization where we want to compare performance and/or learn from others. The definition also specifies that we want to benchmark against either our toughest competitors, so that we know where our strengths and weaknesses are in relation to them, or industry leaders so that we are aware of the highest performance levels currently being achieved (Stapenhurst, 2009).

This research to survey other countries' experience in digital terrestrial television adoption and transition and we also check the environment for digital terrestrial television development in Taiwan. We will discuss things we should notice in Taiwan when we implement digital standard switching and the appropriate timing to switch from DVB-T1 to DVB-T2 according previous research.

### **Stakeholder analysis**

Stakeholders are individuals and organizations that are actively involved in the project, or whose interest may be affected as a result of project execution or project completion. (S. Babou, 2008) Stakeholder analysis is an important technique for stakeholder identification & analyzing their needs. It is used to identify all key stakeholders who have a vested interest in the issues with which the project is concerned. The purpose of stakeholder analysis process is to develop a strategic view of the human and institutional landscape, and the relationships between the different stakeholders and the issues they care about most.

In this research, stakeholders of the digital terrestrial standard transition are taken into consideration to check how the standard policy would influence or be influenced by these stakeholders. And we will recommend the policy makers make proper decision according to the report.

### Market deployment of DVB-T worldwide

There are many countries adopt and deploy DVB-T or DVB-T2. DVB-T services have been deployed in 71 countries but there are 45 countries adopt it with no deployment. If the figures combined with advanced trials and serious deployment plans can bring the total number of DVB-T adoption countries up to 120. 34 countries have adopted DVB-T2 and 16 countries have deployed DVB-T2 (Figure 1). The dark blue area shows the countries adopting DVB-T; the blue area indicates the adoption of DVB-T2 countries; the areas with green color are countries adopting ATSC; and countries with pink area adopt ISDB-T.

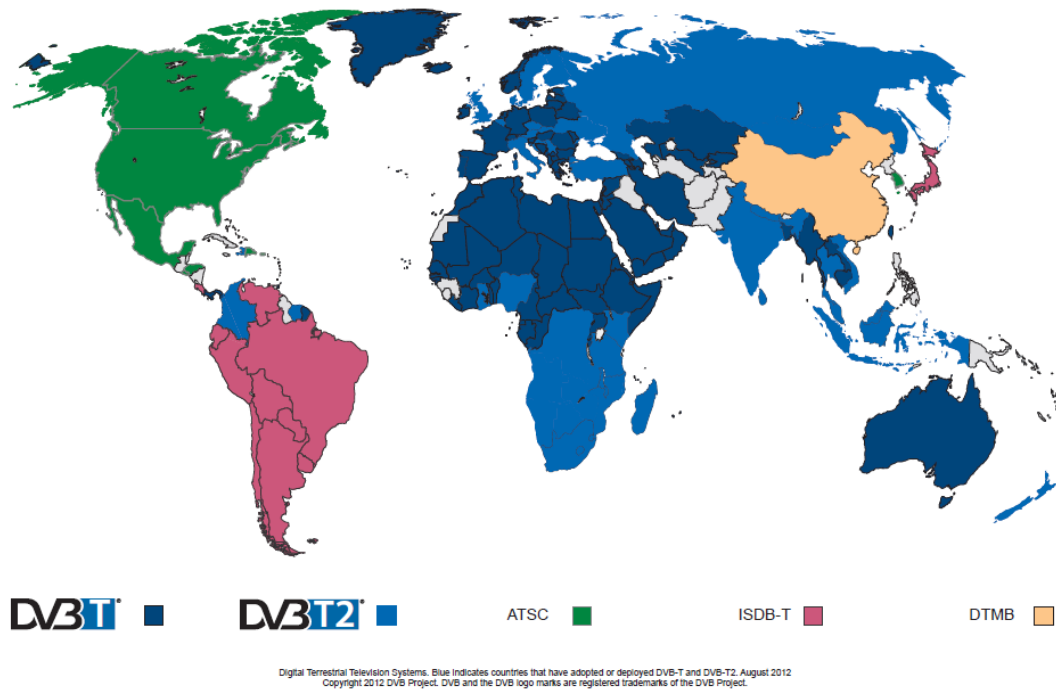


Figure 1: World Adoption of Different Standards  
(Resources: DigiTAG, 2012)

In 2006 more than a 100 countries in Europe, Africa and the Middle East signed the ITU international frequency planning agreement, agreeing to ultimately deploy DVB-T or DVB-T2. In addition, this standard is also being adopted extensively outside these areas. Services are on air in Taiwan and Vietnam, and the system has been adopted in Colombia, Malaysia, Indonesia and elsewhere. Following an April 2007 agreement amongst ASEAN broadcasters, DVB-T will be adopted right across Southeast Asia, a region with a population of more than 500 million people (DVB Project Office, 2012).

However, countries are in various stages of digital switchover and the status of digital television adoption is also quite different. With dissimilarities among these countries, Thailand, Nepal, and Swaziland, which haven't launched or be about to launch digital terrestrial television, it could be a good choice to leap-frog the DVB-T standard and directly implement the DVB-T2 standard. Some countries such as Montenegro, Serbia, Turkey and the Ukraine have already planned to launch DTT platforms with DVB-T standard but delayed the deployment. And then they immediately adopted DVB-T2 as it was first launched. The others are countries like France, which have already adopted DVB-T for years and consider switching to the next generation standard for more robust service.

UK is the first country deployed DVB-T2, where DVB-T2 services were launched in March 2010, next to an existing DVB-T service. 2010 and 2011 also saw the launch of DVB-T2 services in Italy, Sweden, and Finland, all of which will be nationwide in the short term. Outside of Europe DVB-T2 services were launched in Zambia, Namibia, Nigeria, Kenya and Uganda and many more are expected to follow soon. In 2010 the Southern African Development Community (SADC) adopted DVB-T2 for the region and its 14 member countries. Advanced trials are currently taking place

across the globe and more countries are considering DVB-T2 services, bringing the total of DVB-T2 countries to 57 (DVB Project Office, 2012).

## UK

“Digital Television Action Plan” was announced in the United Kingdom in 2001 and the digital switchover was initiated from 2008. The digital switchover across the UK was expected to be completed in 2012. The UK government asked the BBC and other broadcasting company to establish a non-profit institution, Digital UK. Digital UK was founded to propagate the concepts of digital switchover and was responsible for contacting and guiding related vendors in the industry.

The first area facing the switchover in UK is Border, followed by 14 areas (Figure 2). UK was committed to starting T2-based HD service by end 2009. When the UK government established the DVB-T2, they decided to make DVB-T and DVB-T2 totally different in the technologies characteristics. Therefore, they are incompatible so that it could avoid the problems DVB-T faced and improve its quality.



Figure 2: Switchover in UK  
(Resources: Digital UK, 2012)

## **France**

The television digitalization in France was launched in 2005. The Conseil Supérieur de l'Audiovisuel (CSA) declared the operators who were responsible for the switchover. The digital switchover process started in October 2009 and involved 24 regions in mainland France and 11 overseas territories. Digital switchover did not only happen in mainland France, but also in the overseas territories and departments. The last region in France to switch off analogue was Languedoc-Roussillon, and in overseas France French Guyana, Martinique, Guadeloupe and Mayotte. The analog switch-off was accomplished in France by 2011 (Broadband TV News, 2011).

The head of the CSA, Michel Boyon, issued his recommendations to the Prime Minister on the future of the importance of high-definition (HD) DTT platform and called for the introduction of DVB-T2. There is no timetable for the launch of DVB-T2 in France, but CSA president Michel Boyon hinted that this could be at the end of 2015 or the beginning of 2016 (Broadband TV News, 2011).

There are pros and cons of standard transition. The advocates claimed that there were countries had adopted or in the trial for DVB-T2 continually and the technique of DVB-T2 was in mature. It might raise the economic value in France from the increased frequency capacity. However, the issues of viewers' rights and the balance between cost and benefit of the stakeholders in the industry are much more important (Lee, 2011).

## **Potential influence during the digital standard transition in Taiwan**

If the transition of DTT standard can bring as much benefits as expected would speed up digitalization development, however, viewers might consider that it is irrational for them to spend extra money buying new set top boxes due to the policy. Also, adoption the standard of the next generation DTT may have some effects on operators' rights. In the transitional time, the incompatibility between the TV programs and the equipment may cause a problem. If only few viewers install new set top box, there would be a tough course of DVB-T2 diffusion. The influence and the stakeholders related to the digital standard switchover are summarized in the following table 4.

### **Broadcasters**

Before DVB-T2, broadcasters have made their television programs contents available on the DTT platform. So the cost of transmission can be reduced for broadcasters in Taiwan. Nevertheless, the launch of services using DVB-T2 will likely require the simultaneous transmission of both DVB-T and DVB-T2 standards for a significant period of time in those countries where digital switchover has been completed. The cost of this dual transmission will need to be borne by broadcasters (DigiTAG).

### **Broadcast network operators**

In order to allow for the launch of DVB-T2, broadcast network operators will need to roll out a DVB-T2 transmission network. However, the cost of the network roll out is reduced significantly since broadcast network operators can use their existing transmitter infrastructure. Therefore, not whole systems need to be replaced only a

DVB-T2 modulator is necessary to replace the DVB-T unit. At gap-filler sites, the re-transmitter will need to be adapted for DVB-T2.

### **Manufacturers**

Manufacturers of consumer devices and professional system components need to make new equipment available for DVB-T2. The timeline for the launch of services using DVB-T2 will depend on the speed at which manufacturers can begin to mass produce the necessary equipment. Manufacturers will need to ensure that their DVB-T2 devices comply with the receiver specifications determined by national administrations and/or industry groups.

### **Viewer**

Viewers may be unwilling to purchase new television receiving equipment. Depending on the services launched on the DVB-T2 platform, viewers may neither understand the new service offering clearly, nor what equipment is necessary to receive the new service. In addition, the resentment may be exacerbated should viewers have only recently upgraded their television equipment as part of digital switchover. In cases where a new frequency channel is used to launch DVB-T2, it may be necessary for viewers to change or upgrade their aerials. This can be an additional, and unexpected, cost. Should DVB-T2 be launched on a network that previously provided DVB-T, it will be necessary for all viewers to rescan their DTT receivers.

### **Competitors**

The main sources of TV programs viewers watch in Taiwan are cable TV, wireless TV, or MOD. Once the digitalization of wireless TV is completed, it may cause some competition effects on cable TV and MOD. The number of cable TV or MOD viewers may be decreased because of the emergence of much more HD programs of wireless TV.

Table 4: The stakeholders and influence related to digital standard switchover

<b>Stakeholder</b>	<b>Influence</b>
<b>Broadcasters</b>	1. Cost of DVB-T&DVB-T2 dual transmission
<b>Broadcast network operators</b>	1. Cost of DVB-T2 transmission network roll out
<b>Manufacturers</b>	1. Inventory of set top box with the current standard 2. Cost of investing in the development of new equipment
<b>Viewer</b>	1. More HD TV programs 2. Need to install set top box with new standard 3. Need to rescan their DTT receivers
<b>Competitors</b>	1. Number of cable TV or MOD viewers may decrease

(Resources: Summarized by the authors)

## Analysis of Digital Standard Upgrading

With the information above, due to the technology characteristics and the world trend, the number of DVB-T2 adoption is increasing worldwide. There would be some

implications from DVB transition. In this chapter the study describes the real and potential changes from DVB-T to DVB-T2 across France and Taiwan. Also, some viewpoints from the professions would be coordinated below.

There were 18 free programs, including four HD programs and ten pay programs including one HD channel on the France DTT platform before October, 2011. The penetration rate of MPEG-4 as the compress technology rises gradually. The NRA in France considered to adopt MPEG-4 and to increase one to two multiple access spectrum to produce more HD programs. There are six multiple access spectrum in France. Suppose two multiple access spectrum is added, DVB-T can broadcast three HD programs over one multiplex channel. And four HD programs can be broadcasted by DVB-T2. After the transition from DVB-T to DVB-T2 is completed, there will be eight multiple access spectrum with 32 HD channels in France. As for Taiwan, the bandwidth of DVB-T is 6MHz; each channel supports a H.264 coded HD program at most. If DVB-T2 was adopted, two HD programs and a SD program could be streamed in one channel.

Some professions have opinions about the development of DVB-T2. For instance, Rohde & Schwarz (R&S), a company which provides measure instrument solution in the DVB-T2 trial for the UK, was optimistic about the commercial potential that DVB-T2 will inspire in the near future. The Sales Manager of R&S Taiwan, Liu En Hung, thought the process of transition from DVB-T to DVB-T2 couldn't reach the goal in one step (Micro-Electronics, 2009). In response to the standard transition, the broadcasting equipment should be upgraded, and the receiver should also be redesigned. Therefore, the devices with the ability to receive DVB-T2 signal are rarely seen in the market and the price is quite high. It is always the problem when every new technology is introduced. Once the broadcasting service is launched and more terminal equipment manufacturers invest in the production, the price will be cut down. Some STB vendors considered that before the emergence of DVB-T2 solution which is compatible with DVB-T standard, the popularization of DVB-T2 may be low. Based on the UK's experience, it is possible that lots of people are confused about the details of switchover (Awakening News Networks, 2011). So it is essential to let viewers understand about the need and the process of digital terrestrial standard transition.

## Conclusion and Suggestion

According to the materials collected and analyzed, DVB-T2 indeed provides much more robust service. And it also enables the frequency spectrum allocation more efficient. However, the switchover background and different deployment status among DVB countries would be valuable information that NRAs needs to consider seriously. Some countries leap-frog to the DVB-T2 and the others which have deployed DVB-T as the terrestrial broadcasting standard would move on to the next generation standard. Most countries like Taiwan which are in the introduction or developing stages of digital television had better wait and see how DVB-T2 develops.

The system capacity of DVB-T2 is higher than DVB-T by 30%. Higher capacity means that the broadcasters can stream more video contents under the same bandwidth, and it helps to reduce the need of radio band of HD video broadcasting.

Despite the advantages DVB-T2 possesses, there are also some matters needing attention.

1. The incompatibility of DVB-T and DVB-T2 and the price of devices with new standard could be an issue for consumer market. As the wireless digital television switchover is completed in Taiwan in the end of June, 2012, the NCC has just subsidized the installation of the set top box with DVB-T standard. Suppose the NCC decides to transit to DVB-T2 in the near future, the set top boxes formally used was useless. It would be a waste of government expenditure. And it would be an issue that the government should take into consideration whether to subsidize in the next stage.
2. As we can see, people are mainly used to watch cable TV programs. The survey of Taiwan digital television service market in 2010 showed that 71.5% of the public considered that HD was the most essential in the service requirement (Taiwan Communication Society, 2011). However, the contents of cable TV programs are more attractive than DTT programs at this stage. Therefore, it would improve the digital content before transmitting to the DVB-T2, because even if DVB-T2 will provide more HD programs but be lack of attractive contents, it is futile to upgrade to the next generation standard
3. Suppose the transition to DVB-T2 is determined, it is better to broadcast by the two modes synchronously in the initial stage of switchover. The NCC should take response to educate viewers how to prepare for the switchover, to minimize related protests and speed up the transition process.

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