CHAPTER ONE
INTRODUCTION

1.1 RESEARCH BACKGROUND & MOTIVATION

The integration of various new functions into mobile phones became an endless competition between mobile phone manufacturers these years. Multicolor display panels replaced the mono-color displays and brought a variety of new appliances, for instance, digital camera, video recording, large capacity storage, mobile games, Multimedia Message Service (MMS), caller id with photographs, video playback, GPS navigation, and more developing fantasies. Most of these add on functions hardly make additional profits for mobile network operators but attracts consumers to purchase new devices for a period of time.

In 2001, the Japanese Telecom giant NTT DoCoMo launched the first commercial 3G Mobile network based on the WCDMA standard, aiming on the market of video calls and high speed data services (384 kbps). With the launch of WCDMA network, more applications which used to be done on personal computers are now realized on mobile phones, such as MP3, video downloading, video calls, live broadcasting & TV streaming, file transferring, and more E-commerce appliance.

The commercial roll-out of 3G WCDMA systems is certainly an enormous investment for mobile network operators (MNOs). First, the required frequencies are different from the 2G/2.5G GSM (900/1800 MHz) system, which is the major cellular standard nowadays used by more than 2 billion users. Upgrading to the WCDMA/UMTS

(2100 MHz) network involved acquiring license for the new frequencies, whereas the license fees are particularly high in most countries. For instance, the average 3G license fee of five MNOs in Taiwan is NTD 10 billion. Second, a 3G network with high population coverage rate is essential to attract existing and new subscribers to make use of the new service. This thrust MNOs to purchase large quantity of new 3G base stations for good reception. Third, supplements for the high priced 3G phones are the additional huge cost for MNOs.

On the other hand, for countries applying 2G CDMA 1x standard, such as USA and Korea, are able to upgrade their systems to 3G CDMA 2000/EVDO/EVDV comparatively easier and costless since the 2G/2.5G and 3G system used the same frequencies.

Though it is expensive to construct the 3G networks, 160 WCDMA/UMTS networks were already launched in the world till May 2007. Moreover, most of the operators planned to increase the capacity and speed of their networks by upgrading to HSDPA networks, which supports 14.4 Mbps in downlink. MNOs expected to increase the overall ARPU (average revenue per user) by raising the portion of data services based revenues, since the vocal based market was already saturated. However, the huge investments on 3G networks did not break-even for most of the MNOs up to the present, for the reason that 3G users increased sluggishly; and 3G services did not increase the revenue as predicted. For some undeveloped and emerging countries, the necessity of launching 3G networks is not even taken into considered for the high costs.

After all there are still successful cases for 3G. The 3G pioneering countries- Japan and Korea experienced the 2G/3G transition complexity and now brought 3G services into consumers' daily life seamlessly. In Japan, data services based revenue reached 50% of overall revenue, and 30% for Korea. Based on its high percentage 3G network subscribers, NTT DoCoMo is ready to shutdown its 2G network in June, 2008, to use the spectrum for more purposes. This achievement is difficult for other countries to attain in a short period; it depends highly on the penetration of 3G subscribers.

After the maturity of 3G, both Japan and Korea developed its own Mobile TV standards in purchase of more appliances for mobiles. TV services on mobile devices are predicted to be the next killer application for consumers, a new source of revenue for MNOs, and an opportunity for new players. Broadcast network operators (BNOs), content aggregators, content providers and advertisers are now able to enter the mobile device market, while only staying in the conventional TV market in the past.

According to several market research results, the demand on Mobile TV devices will be extremely strong compared to other functions on mobile phones. Figure 1 is a forecast of Mobile TV devices shipment by MIC.

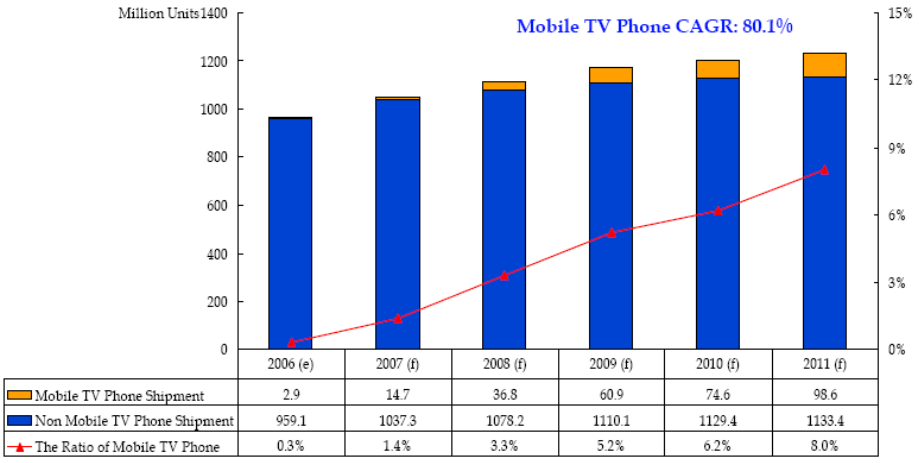
-Strategy Analytic: 8 million Mobile TV devices were sold in 2006, and 1.2 hundred million in 2010.

-Informa Telecoms & Media: In 2010, 70 million Mobile TV devices will be sold per year. Mobile TV users will reach 1.2 hundred million.

-ABI Research: In 2006, Mobile TV related revenue is about 2 hundred million. In 2010, it will reach 27 billion.

-Shosteck Group: In 2010, Mobile TV related value of output reaches at least 10 billion.

Figure 1: A forecast of Mobile TV devices shipment



	2006 (e)	2007 (f)	2008 (f)	2009 (f)	2010 (f)	2011 (f)
Mobile TV Phone Shipment	2.9	14.7	36.8	60.9	74.6	98.6
Non Mobile TV Phone Shipment	959.1	1037.3	1078.2	1110.1	1129.4	1133.4
The Ratio of Mobile TV Phone	0.3%	1.4%	3.3%	5.2%	6.2%	8.0%

Note: Mobile TV包含DVB-H、T-DMB、S-DMB、MediaFLO、ISDB-T及CMMB

Source：MIC, April 2007

Source: 熊嘉彬(2007), 行動電視市場發展趨勢, MIC

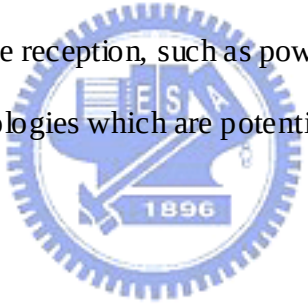
Integrating Mobile TV function into mobile phones will be pulled by the market and become a new lifestyle in the following years. This is the inspiration of doing this research.

1.2 RESEARCH SCOPE & OBJECTIVE

Mobile devices possessing TV receiving ability- in another word, devices unlimited by electric wires or television cords and Ethernet cables, can be defined as Mobile TV. Currently various devices such as notebooks, PDA, Personal Multimedia Player (PMP), automobile navigators and mobile phones are able to receive TV signals with either integrated solutions or external attachments. In this thesis, mobile phones are the primarily focused Mobile TV terminal receivers, for the reason that mobile phones

possess the highest mobility; in addition, interactivity is a highly emphasized aspect in the Mobile TV service, while mobile phones can take advantage in this aspect by using the high connectivity of mobile networks. Thus, mobile phones will be the main discussed device.

Mobile TV can be realized through several technologies and standards, including analog TV broadcasting, video-on-demand (VOD) streaming, digital terrestrial TV broadcasting (DVB-T) and the latest broadcasting technologies specialized for mobile devices, for example, DVB-H, which will be introduced in Chapter 3. In this thesis, we will focus on the latest feasible technologies on Mobile TV. Analog and digital terrestrial TV broadcasting are excluded for several disadvantages of these standards were not appropriate for mobile reception, such as power consumption and interactive connection. Developing technologies which are potentially the platform of Mobile TV will be also discussed.



The objective of this thesis is listed as below:

1. Introduce the advantages and disadvantages of the current Mobile TV technologies and standards.
2. Analyze the up to date global Mobile TV environment and business models.
3. Figuring out the difficulties in deploying Mobile TV based on the analysis above.
4. A statement of the current Mobile TV deployment progress in Taiwan.
5. Forecast the future movement of Mobile TV in Taiwan.
6. Predict the future platform and appliances of Mobile TV.

1.3 RESEARCH METHODOLOGY

The research methodology used in this thesis contains literature reviews, secondary research. Since Mobile TV is an emerging and rapid developing technology, the data collection work relies on information from international and national forums, seminars, databases, and news blogs. Case studies methods were applied to learn from the Mobile TV pioneering countries and find suitable business models for Mobile TV in Taiwan.

A literature review discusses published information in a particular subject area, and sometimes information in a particular subject area within a certain time period, and sometimes information in a particular subject area within a certain time period. (Writing Center, UNC)

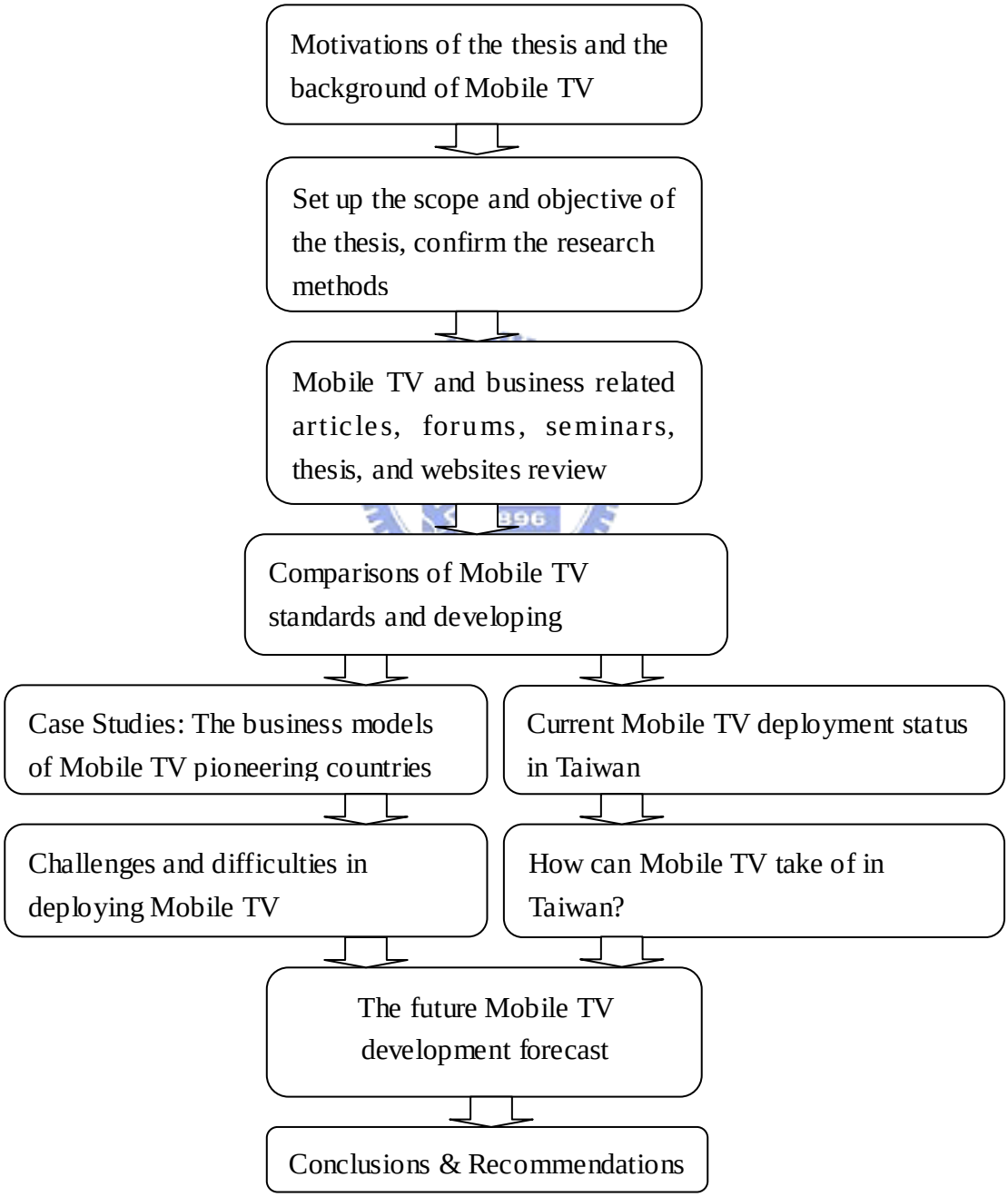
Secondary research is sometimes referred to as desk research; it consists of data and information that already exist and can be accessed by an organization. If secondary research is available that answers the question or solves the problem, then that is the quickest and most efficient way of gathering the necessary data. However, secondary data were collected for another purpose they are not always in a form that is useful or appropriate, and thus they often have to be reanalyzed to convert them into a form that can be used for a particular project. (Saunders M., Lewis P., Thornhill A., 2003)

Rather than using large samples and following a rigid protocol to examine a limited number of variables, case study methods involve an in-depth, longitudinal examination of a single instance or event: a case. They provide a systematic way of looking at events, collecting data, analyzing information, and reporting the results. As

a result the researcher may gain a sharpened understanding of why the instance happened as it did, and what might become important to look at more extensively in future research. (Flyvbjerg, 2006)

1.4 THESIS STRUCTURE

Figure 2. Structure of this thesis



CHAPTER TWO
LITERATURE REVIEW

In this chapter, Mobile TV related literature and key words will be discussed.

2.1 BUSINESS MODELS

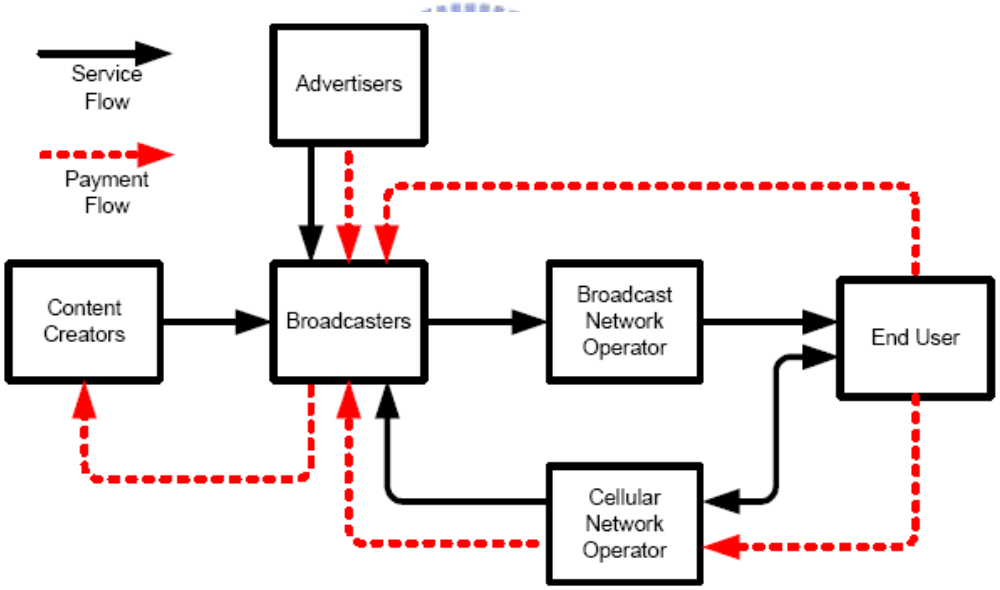
The term business model can be defined variously in different industries or ages. The oldest most essential business model is said to be the shop keeper model: the shop keeper makes profit by selling goods or services to buyers in a store. New business models emerge as new innovations or technologies were developed. For example, the business model of eBay emerged in the 1990s as the Internet penetrates into publics' daily life. iPod +iTunes successfully created a new business model of online music retailing in the beginning of 21st century. The innovation of new business models may either be threats to the old ones or brings new business opportunities into the market.

There are many informal definitions of business model in modern business literatures, for example the following general description by Ostenwalder, Pigneur and Tucci, 2005: "A business model is a conceptual tool that contains a big set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams."

Sattler defined the three major business models of Mobile TV and introduced the cases of Mobile TV pioneering countries in Europe (Sattler, 2006). Figure 3, 4, and 5 are the major business models of Mobile TV.

BNO led model: Broadcast network operator dominate the operation of the broadcast network, customer relationship and content purchase. The BNO must cooperate with the MNO to provide interactive services. Revenue comes from advertisements or monthly fee of subscribers. BNO takes the investment risk, since it invests in the broadcasting network and owns the spectrum for Mobile TV broadcasting.

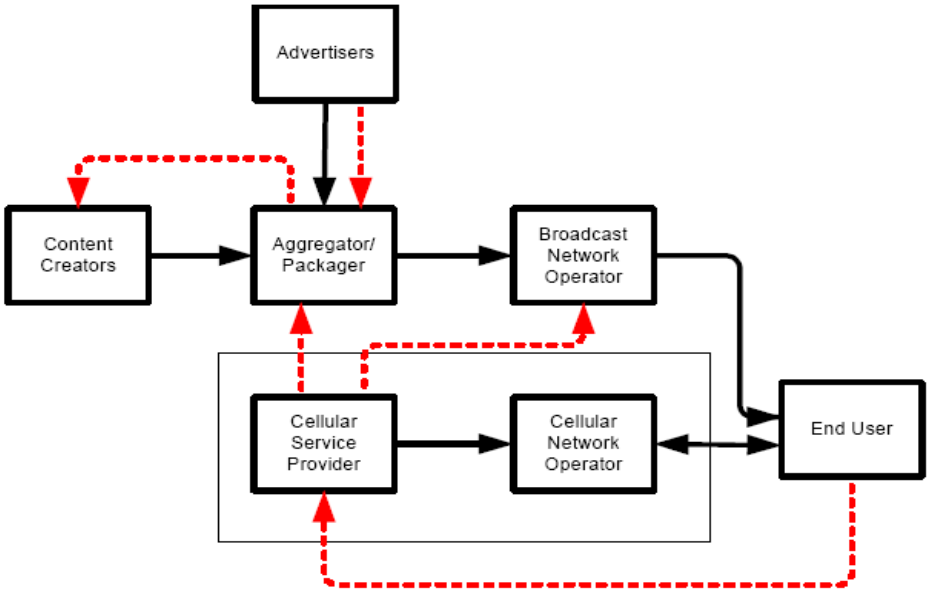
Figure 3: BNO led model



Source: Sattler(2006), Mobile TV business models study, BMCO forum

MNO led model: MNOs dominate the operation of the broadcast network, customer relationship and content purchase. Revenue comes from subscribers' monthly fees. MNO takes the investment risk, since it's in charge of the broadcast service and have to acquire a broadcasting license if necessary. MNOs are usually less-experienced in the TV contents and broadcasting field, therefore this model is less applied.

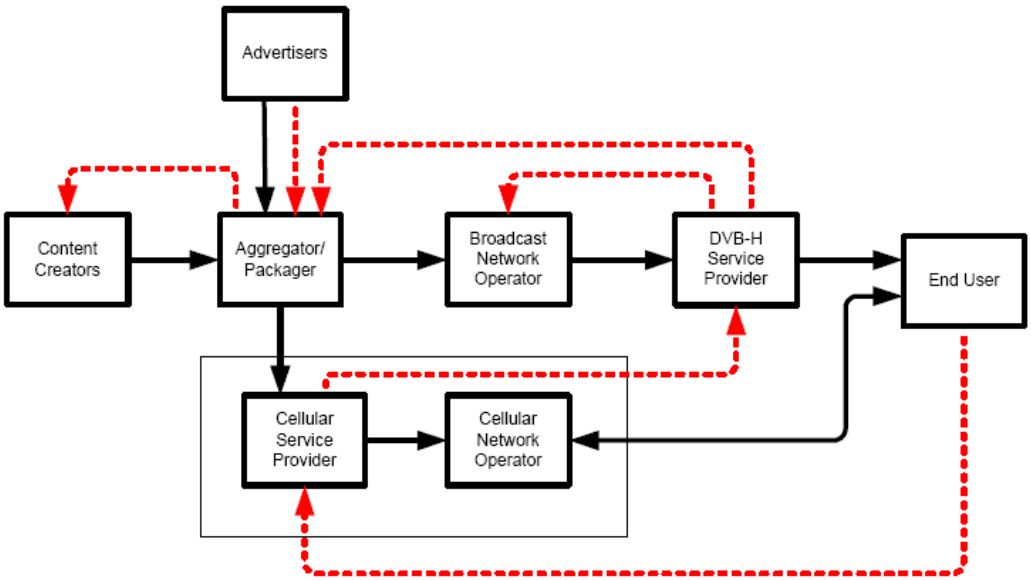
Figure 4: MNO led model



Source: Sattler(2006), Mobile TV business models study, BMCO forum

Wholesale Model: A third party wholesales the Mobile TV contents to the MNO or MNVOs. The party may be formed with a consortium of broadcasters and MNOs, or other independent interest group. The wholesaler is in charge of the contents, the advertisements, the required spectrum, a broadcasting license and constructing infrastructures. Subscriber relationship is managed by MNOs and MNVOs. A proportion of the Mobile TV service based revenue is paid to the wholesaler as the fee of purchasing contents. While the Mobile TV environment is still unstable, this model is the most applied one, since the wholesaler usually consists of more than one member, and the average risks for each member are diminished.

Figure 5: Wholesale model



Source: Sattler(2006), Mobile TV business models study, BMCO forum

2.2 SUPPLY CHAIN & SUPPLY CHAIN MANAGEMENT, VALUE CHAIN

Stevenson (2005) defined the supply chain as: "The sequence of organizations- their facilities, functions, and activities- that are involved in producing and delivering a product or service. The sequence begins with basic suppliers of raw materials and extends all the way to the final customer."

The term "supply chain management" was first coined by Booz Allen Hamilton in 1982. Afterwards, Palevich (1997) defined it as encompasses all of those activities associated with moving goods from raw materials through the end user. This includes sourcing and procurement, production scheduling, order processing, inventory management, transportation, warehousing, and customer service. Importantly, it also embodies the information systems used to monitor these systems.

Meredith and Shafer (1999) define supply chain management similarly as "the supply, storage, and movement of materials, information, personnel, equipment, and finished goods within the organization and between it and its environment." The goal of supply chain management is to integrate the entire process of satisfying the customer's needs all along the supply chain. (Singh, 2006)

The term "value chain", also known as "value chain analysis", was first described by Michael Porter in 1985, coming after the supply chain. "Value" was defined as "any achievement that enhances the market appearance or function of the manufactured goods or service." The scope of value chain analysis is even larger than the supply chain management. It focuses on adding value and reducing cost at each step of the supply chain, targeting to deliver the maximum value to customers. Turning a supply chain into a value chain was the goal of most corporations.

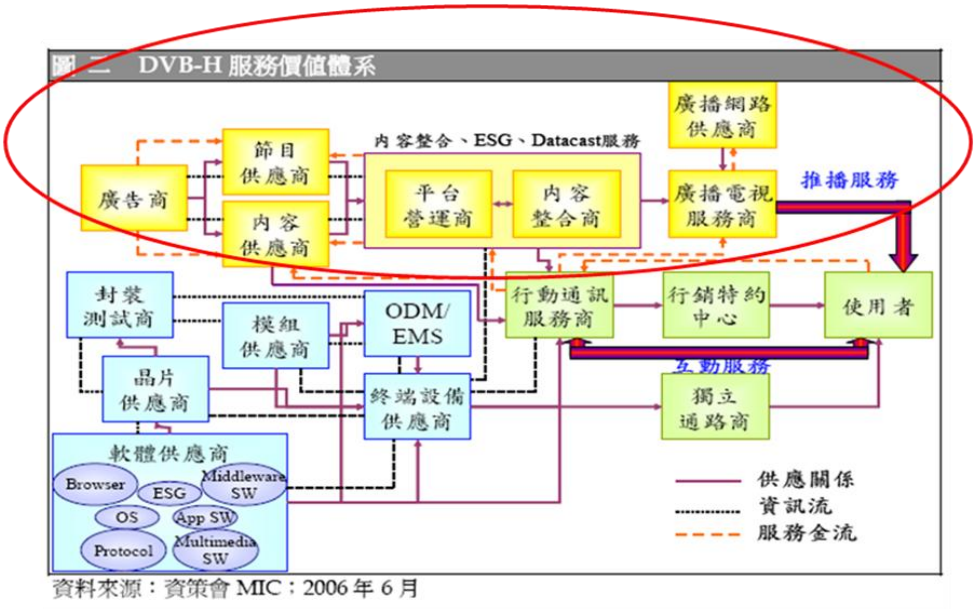
The form of value chain varies in different businesses. For the value chain in multimedia field, Wirtz (1999) proposed five stages:

1. The content and services creators who provide program contents and services
2. The content and services aggregators who combine various contents and services
3. Access and connecting facilitators who provides the connecting infrastructures
4. Value added service providers
5. Navigation and interfacing suppliers who designs the multimedia interfaces

Chan-Olmsted and Kang (2001) projected the value chain of broadband TV which was similar to Wirtz's. In this thesis, the Mobile TV value chains are made up by subscribers, MNOs, MNVOs, BNOs, content and services aggregators, content

providers, advertisement buyer and mobile broadcast service provider. The role differs by cases. We focus on non-hardware manufacturers of this value chain in this research, as the circled part shown on Figure 6. It is an example of Mobile TV value chain applied in the DVB-H standard. This value chain works as well for the other standards such as T-DMB, MediaFLO.

Figure 6: DVB-H value chain



Source: 蔡華展(2006), DVB-H 行動影視服務體系與業者布局分析, MIC

2.3 MOBILE TV RELATED LITERATURES

Shih (2006) discussed the difficulties of developing Mobile TV in Taiwan. He found that the Taiwanese broadcast industry is in need of the government's assistance to promote the Mobile TV services, for example, regulations on program quantity control and frequency integration. Constructing a common transmit platform and the concept of produce-broadcast separation should be executed properly. He also suggested that low pricing will increase the popularity of Mobile TV.

For the case in South Korea, Kloeden figured out that among the three types of Mobile TV in Korea, S-DMB, T-DMB and Mobile TV over 3G, the latter is the most successful model in the Korea market (gaining over 8 million subscriers), for the reason that most handsets supports the streaming function. However, flat-rate pricing of Mobile TV on 3G has resulted in very low revenue per megabyte and little effect on ARPU. Obtaining significant increases in ARPU from the service is a challenge for Mobile TV operators, since it is difficult to attract high take-up without offering attractive flat-rate pricing. Kloeden found from the example of Korea that to success in the Mobile TV business, creating a business model that is attractive to all players in the value chain, and to ensure the availability of sufficient content, handsets and distribution channels are the most important issues. (Kloeden, 2006)

Shin observed the emerging progress of DMB in Korea and made a socio-technical analysis. He found that socio-technically (socio-technical ensemble) the advancement of DMB technologies will debilitate current regulatory structure, destruct current markets and gradually introduce a new structure of market, industry, and regulation, that is, a layered model of next generation network. (Shin, 2005)

Hsu analyzed the development of Mobile TV in China and found that the status is still indeterminate in standards; however various broadcasters retail TV contents to mobile users through 2.5G network currently. Since "Watching Olympic games on Mobile TV in 2008" is a consensus of the Chinese industry, efforts are expected to be made to reach this goal. (Hsu, 2006)

Lin made a research about the status and the value chain of the Japanese Mobile TV industry. Japan was one of the most successful Mobile TV markets worldwide

currently; she introduced the details about its history, the business model, and the government policies. She found the success factors of the Japanese market were rich contents, totality of supporting handsets, and successful consumer educating and promotion. (Lin, 2006)

Lin (2006) studied the Mobile TV development case of NTT DoCoMo in Japan and SK Telecom in Korea and concluded that both of them highly emphasize on the enrichment of content. They plan to develop exclusive programs, enrich the content, and accumulate related digital contents. She also extracted six key success factors from the Japan & Korea experience: the government's attitude, good signal coverage, design of hand-held device, business model accepted by all involved parties, attractive content, and acceptable price.

Yang (2006) also studied the key success factors and the development strategies of Mobile TV. He found the most decisive driving factors of Mobile TV are "sound government policy and the according enforcement of it" as well as "adequate service fee". He suggested that strategically, MNOs should look for cooperation with all members in the value chain and differentiation with competitors in the industry. Content providers should manage to seek competitive advantage by enriching the TV content and integrating different content and channel providers. For terminal manufacturers, they ought to reinforce the core technology of terminals and also marketing ability and product design in order to gain higher brand equity.

Kobayashi gave several comments to the One Seg Mobile TV in Japan. First, the Mobile TV infrastructure must be focus on the coverage rate of the people, providing better usability for consumers. A deep understanding of consumer need is essential,

and this should be done by region and age. Second, legislative reforms aimed at convergence of communications and broadcasting is necessary to provide the appropriate environment for Mobile TV. Furthermore, establishing an appropriate business model for all players to engage in friendly competition is the most important issue. (Kobayashi, 2007)

Wang made a research of Mobile TV business models in five pioneering countries, based on the latest information in 2007. She suggested that the wholesale model is a suitable model for the Taiwanese environment. The appropriate monthly fee in Taiwan is estimated as 200-300 NTD, according to the foreign Mobile TV price and the GDP per capita of Taiwan. She also mentioned the role of WiMax service providers in the Mobile TV value chain can be similar to MNOs. (Wang, 2007)

You (2007) found that besides the developing Mobile TV business models, the iPod+ iTunes business model was the most successful online-retail model among all. However it lacks of real-time videos and can only be done through PC or MAC. The place-shifting business model provided by Sling Media, Orb Networks and Sony, are only used in PC similarly. In the future, new business models may emerge from these existing models, which will be some of the new opportunities for Mobile TV.

Morrish (2007) projected that consumers do not care about the technologies, there is no technical reason why Mobile TV viewers should be affiliated with any particular MNO, especially considering the growth of alternative wireless technologies. (Particularly WiFi, possibly WiMAX) Besides, some of the contents do not necessarily have to be broadcasted in real-time: for example, soap operas, movies. The download-and-cache model will work as well for these contents, such as video

podcasting, and Moore's Law dictates that an ever-expanding number of devices will be able to support this method of watching Mobile TV. Morrish made several suggestions for MNOs to reduce the risks of developing Mobile TV; contents that really requires real-time broadcasting are news and sports, therefore the smaller the role of a dedicated broadcast network in the provision of Mobile TV services in the early stage, the lower the risk may be for an MNO, as long as the alternative solutions will not impact the customer experience.

CHAPTER THREE
STANDARD WARS

In this chapter contemporary Mobile TV standards are introduced and compared. Each of the standards has its own advantage and uniqueness. However, the standards a were still far from convergence in the world. More than five Mobile TV standards are on air commercially in different countries. Spectrum availability, licensing fees, government regulations issues are the major difficulties of reaching unified Mobile TV standard. The European DVB-H may become the most adopted standard in the future, since it owns the majority of trial members currently.

3.1 DIGITAL BROADCASTING STANDARDS

3.1.1 DVB-H

On the basis of DVB-T, the DVB Project developed the DVB-H (Digital Video Broadcasting on Handhelds) standard which delivers audio and video content to mobile handheld devices, DVB-H is totally backward compatible to DVB-T, and designed to work in the following bands: VHF-III (170-230 MHz), UHF-IV/V (470-862 MHz), and L band (1.452-1.492 GHz). MPEG4 and H.264 are applied as its codec solution. DVB-H overcomes the limitations of the DVB-T standard when used for handheld devices by applying the following techniques. (ETSI, 2004)

1. Time slicing: Reducing the average power consumption of the terminal and enable smooth and seamless service handover.
2. MPE-FEC: Improve the C/N and Doppler performance in mobile channels and to improve the tolerance to impulse interference.
3. 4K Mode & in-depth interleaver: Improving network planning flexibility by trading off mobility and SFN size
4. TPS: Providing a robust and easy-to-access signaling to the DVB-H receivers, thus enhancing and speeding up service discovery.

These techniques lower battery power consumption and improves robustness in the very poor reception environments for indoor and outdoor portable use in devices with built-in antennas. DVB-H can be used alongside mobile telephone technology and thus benefit from access to a mobile telecom network and a broadcast network.

DVB-H is hopefully to be the most adopted Mobile TV standard in the future since various countries are having trials based on the standard. Moreover, The European Commission (EC) mandates DVB-H as the unified Mobile TV standard across the European Union to avoid market fragmentation. The outcome isn't that surprising since the EC did invest £27 million in the development of DVB-H.

3.1.2 MEDIAFLO

MediaFLO is an innovation of the American company QUALCOMM Corporation, supported by the FLO forum and its industry members, working on 698-746 MHz. The "F-L-O" in MediaFLO stands for Forward Link Only, meaning that the data transmission path is one-way, from the broadcast station to the device. MPEG4, H.264

codecs solution was applied by MediaFLO, supporting 20 channels of 30 fps (frames per second) QVGA video in a single 6 MHz spectrum allocation, while DVB-H is only able to support 9 channels (both at 300kbps). The average channel switching time is 1.5 sec- 2sec, which is the fastest among all standards. The theoretical power consumption is also lower compared to DVB-H. However the deployment rate of MediaFLO is still low outside U.S.A.

3.1.3 ISDB-T, ONE SEG,

Integrated Services Digital Broadcasting, ISDB, is the digital television and digital radio format developed by Japan allowing radio and television stations to convert to digital. ISDB-T is the terrestrial version of ISDB, using the frequency 558- 566 MHz. ISDB-T was adopted for commercial transmissions by NHK Japan in December, 2003. The most exclusive feature of ISDB-T is that a HDTV channel and a mobile phone channel can be transmitted within the 6 MHz bandwidth usually reserved for TV transmissions, which is efficient in spectrum allocation compared to other standards.

ISDB-T in Japan is designed so that each channel is divided into 13 segments (plus one segment for separating channels). HDTV broadcast occupies 12 segments, and the remaining (13th) one segment is used for mobile receivers; thus named: 'One Seg'. One Seg broadcasting uses H.264 video codec encapsulated in MPEG2 Transport stream and the maximum video resolution is 320*240 pixels (320*180 pixels for actual broadcasted contents) at the video bit rate of 220-320 kbit/s. Besides Japan, Brazil announced ISDB-T as the nationwide standard for Digital TV transmissions in 2006. Some of the South America countries are strongly considering ISDB-T as their national Mobile TV standard in order to enjoy common market benefits.

3.1.4 T-DMB

T-DMB was the abbreviation of "Terrestrial Digital Media Broadcasting". It was developed in South Korea, on the basis of EUREKA 147 DAB (Digital Audio Broadcasting, which was introduced in 1995 with the intention of digitizing radio services) from Europe. T-DMB was an advanced version of DAB, therefore the working frequencies were the same (band III, 174MHz- 240MHz and L band, 1452-1492 MHz), which means no extra spectrum are required if there are existing DAB services on air. Commercialized T-DMB devices can receive not only T-DMB multimedia signals but also DAB audio and date signals. Similar to DVB-H, MPEG4 and H.264 are applied as its codec solution; the encoded results are multiplexed into MPEG-2 TS packets. Korea and Germany are the only countries that commercially launched T-DMB Mobile TV services currently. Several countries using DAB are interested in upgrading their systems to T-DMB, which uses the original spectrums.

3.1.5 DAB-IP

DAB-IP was an enhanced version of DAB developed in UK. DAB used Mpeg2 as its audio codec solution and included no video codec solution, while DAB-IP chose WMA9 & WMV9 (Windows Media Audio & Video 9) as its audio and video codec solution, which was more advanced and capable of broadcasting Mobile TV.

The technology enables Mobile TV to share multiplex capacity with DAB digital audio services and therefore allows operators to benefit from the considerable DAB frequencies and infrastructure investments that have been made across Europe. DAB-IP could be upgraded from DAB easier and cheaper than adapting to other

standards. United Kingdom is the only country which applied DAB-IP as its Mobile TV standard currently.

3.1.6 S-DMB

Satellite digital multimedia broadcasting, known as S- DMB, is a new form of satellite broadcasting service that utilizes personal portable receivers or automobile receivers to allow reception of TV, radio, and data broadcasts of multi channel broadcasts. In Japan, NHK and its related institutions formed an organization called 'mobile digital audio broadcast research association' in 1989, to begin research into DMB technology. They began standardization in 1997 and completed standards in November 1999. Its bandwidth (S-Band: 2.630~2.655GHz) is not regulated by the ITU's output regulations, high output transmission allows small antennas to receive satellite signals directly, and its high bandwidth diffraction of satellite broadcasting is suitable for mobile reception. Indoor, basement reception relies on additional gap fillers. Japan and Korea are providing commercial S-DMB services since 2004.

3.2 DEVELOPING STANDARDS

3.2.1 ATSC-M/H

ATSC is the digital television standard for the United States, also adopted by Canada, Mexico, South Korea. ATSC-M/H is a Mobile and Handheld Standard of ATSC announced in April, 2007. It is fully compatible and works on the same frequency with ATSC. The standard is still developing, and the Mobile TV service might be provided by the existing ATSC broadcasters.

3.2.2 CMMB

CMMB, an abbreviation of China multimedia Mobile broadcasting, was developed and announced by SARFT, the State Administration of Radio, Film, and Television in November 2006, based on the Chinese technology STiMi (Satellite and Terrestrial Interactive Multi-service Infrastructure), working on S-band and UHF/VHF. Due to the large and varied topography territory of China, the government planned to cover the country with a hybrid adoption of satellite and terrestrial broadcast stations. CMMB is only one of the nation developed Mobile TV standards currently and there are still no exact evidence showing that it will become the unified standard in China.

3.2.3 DVB-SH

According to DVB Project, DVB-SH is a hybrid satellite/terrestrial system that uses the satellite to achieve coverage of large regions, or even a whole country. In areas where direct reception of the satellite signal is not possible, terrestrial gap fillers can be used to provide coverage. It is designed to use frequencies below 3GHz, typically S-Band frequencies (2170-2200MHz). A similar architecture is already being used in S-DMB, however DVB-SH promises to be more powerful. The development of the standard is likely to be completed in 2007.

3.3 STREAMING STANDARDS

3.3.1 MBMS

Multimedia Broadcast Multicast Service (MBMS), standardized in 3GPP (3rd Generation Partnership Project) release 6 in Q4 2004, is a broadcasting service that can be offered via existing GSM or UMTS cellular networks. MBMS deliver contents to subscribers more efficiently than the existing 3G network. MBMS enables MNOs to deliver rich contents to a huge number of subscribers by broadcasting over the radio frequencies assigned to W-CDMA. The feature of MBMS is that it broadcast contents to subscribers consuming the network bandwidth only once, while UMTS network unicasts the same contents to subscribers consuming the bandwidth numerous times according to the demand. The comparison of UMTS and MBMS network is explained in Figure 6. Thus subscribers are able to enjoy rich multimedia contents such as Mobile TV, video delivery services and music download services at a lower price.

UMTS networks can be upgraded to MBMS networks via software upgrade, which is an insignificant cost compared to the cost of additional base stations and spectrum licenses. MBMS can be used not only for Mobile TV, but also mass content push. New sort of multimedia services and business models can be produced via applying MBMS, potentially bringing a great growth of revenue to MNOs. Practical network implementations and supporting terminals may be expected by the end of 2007.

Figure 7: A comparison of UMTS Release 99 (Released in 2000 Q1) and MBMS network

Figure 1: Bearers in Release '99

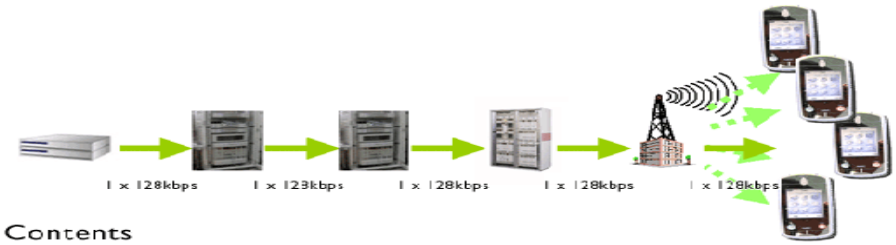


Figure 2: Bearers in MBMS

Source: NEC, 2007

The specifications of current commercial Mobile TV standards are compared in the table 1 as a summary of this chapter.

Table 1: Mobile TV standards comparisons

Specification	DVB-H	T-DMB	S-DMB	ISDB-T	MediaFLO	MBMS
Region	Europe/Asia/US	South Korea	South Korea	Japan	USA	WCDMA area
Frequency	470~650MHz	170~240MHz	KT:2605~2630 MHz SKT:2630~265 5MHz	558~566MHz	716~722/ 698~746MHz	1920~1980 2110~2170
Modulation	QPSK and up to 64 QAM COFDM	DQPSK COFDM	DQPSK COFDM	QPSK, 16/32 QAM COFDM (13-seg/ch)	QPSK or 16 QAM, COFDM	QPSK
Codec	MPEG 4/H.264 ACC	MPEG 4 /H.264 BASC	MPEG 4 /H.264 BSAC	MPEG 4 /H.264 ACC	MPEG 4/H.264	MPEG 4/H.264
Transport Stream	IP Datacast	MPEG 2 TS	MPEG 2 TS	MPEG 2 TS	N/A	N/A
Power Reduction Method	Time Slicing	Bandwidth Shrinking	None	Bandwidth Shrinking	N/A	Open/ Inner Loop Power Control
Bandwidth	5/6/7/8MHz	6MHz	5MHz	6/7/8MHz	5.5MHz	5MHz
Data Rate per Channel	200kbps	400kbps	1.5~384kbps	280.85~1787.28 kbps per segment	50k~1Mbps	3*128kbps
Mobility	Up to 200km/h	120~200km/h	Up to 150km/h	N/A	Up to 200km/h	200km/h
Cell Size	40~60km	140km	From Satellite	N/A	60km	2~3km

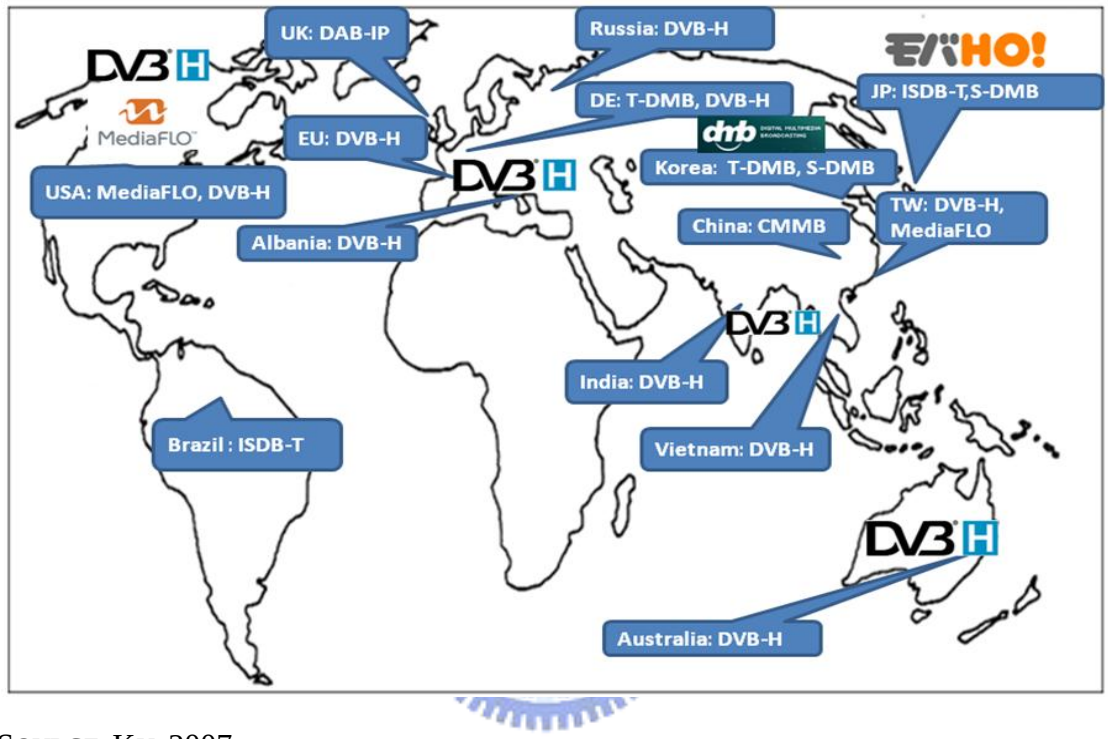
Source：MIC, April 2007

Source: 熊嘉彬(2007), 行動電視市場發展趨勢, MIC

CHAPTER FOUR

CURRENT WORLDWIDE MOBILE TV DEPLOYMENT

Figure 8: Worldwide Mobile TV standards



SOURCE: KU, 2007

Figure 7 shows the current Mobile TV standard distribution in the world. In this chapter, several case studies of Mobile TV pioneering countries will be introduced. Not all of the cases were successful, whereas some of the cases attracted numerous subscribers in a short period. The business models applied can be generally categorized to three types which were introduced in Chapter 2. However, each case was somewhat different in detail, depending on the authority of the local government and the relationship between MNOs and BNOs, and the spectrum holder. We will find out these success factors in these cases as references for the Mobile TV deployment in Taiwan.

4.1 JAPAN & KOREA

4.1.1 JAPAN & KOREA, S-DMB

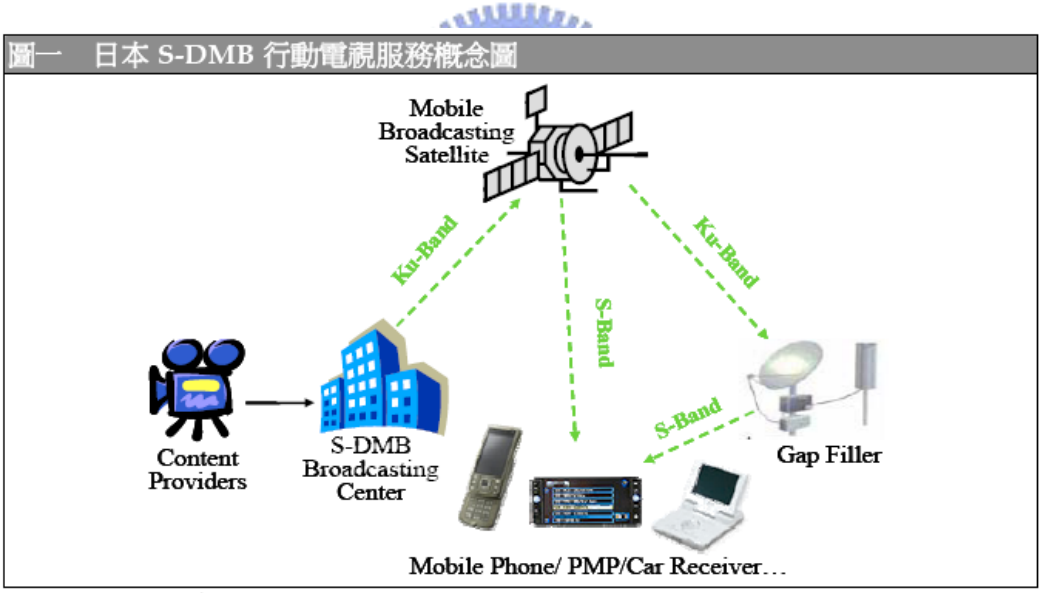
The largest Telecom service provider in Korea, SK Telecom, found its subsidiary TU Media in late 2003 in charge of the S-DMB service. TU Media engages in the field of TV content aggregation & management and broadcast network maintenance. SK Telecom formed a strategic alliance with the Japanese based firm MBCO (Mobile Broadcasting Corporation) and co-invested in the development of telecommunication satellite, MB Star, working on the S band (2630-2655 MHz) and KU band (12- 13 GHz) . Signals from the satellite were transferred to terrestrial satellite control stations and then converted to S band signals, receiving by terminal devices. The construction of the gap fillers (terrestrial repeaters) were also completed before the launch of the service, therefore reception quality on handheld devices was excellent.

In March 2004, the alliance successfully launched the satellite. 7 months later, MBCO launched its S-DMB service as the first commercial S-DMB service in the world. It was named 'Mobaho', meaning the service brings surprise to users in Japanese.

Mobaho provides 8 video channels, 40 audio channels and data services to subscribers, including news, sports, music, animation, and entertainments. Fisheries are able to receive weather and disaster forecast offshore using the function of satellite broadcast. Initiating Mobaho service costs ￥2,500 for signing up, and basic fee ￥400 per month plus the package fee, depending on the package chosen (from ￥580 to ￥2080). The Mobaho applies the broadcaster led model, which operates without direct link with MNOs.

The subscribers of Mobaho are by far fewer than TU Media currently, though Mobaho launched the service earlier than TU Media. The availability of Mobaho receivers was limited, which is one of the major difficulties promoting the service. Till May, 2007, only two cell phone models made by Mitsubishi (audio receivers only, unable to play the video channel) was functioned with Mobaho, compared to more than 10 One Seg models in Japan and more than 30 S-DMB models in Korea. Most of the devices of Mobaho were specialized PMP or on board vehicle receivers. The sales volumes of these devices were much smaller compared to cell phones, resulting in the sluggish growth of subscribers. Figure 8 shows the business model of Mobaho.

Figure 9: Operate model of Mobaho

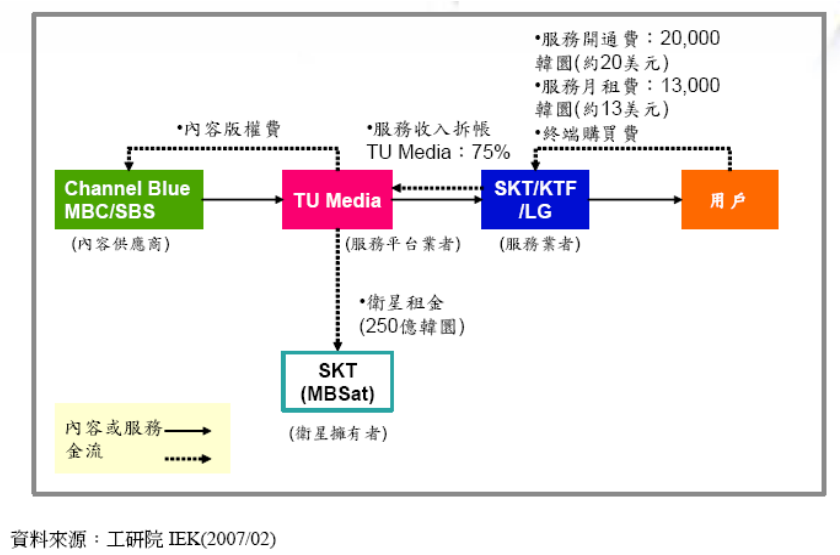


Source: 林羿分, (2006) 日本行動電視服務發展現況, MIC

Another difficulty that Mobaho faced was the payments. Compared to Mobaho, One Seg was broadcasted free-to-air; moreover, a variety of fancy One Seg compatible handsets were already available in the market. Providing differentiated and high quality contents is another approach to persuade users to pay. However, the business

scale of Mobaho was incomparable with One Seg TV service providers, which were existing digital TV broadcasters. Mobaho can neither compare with TU Media which was supported by SK Telecom. Cooperating with MNOs, mobile phone manufacturers and launch more mobile phone S-DMB receivers will be the solution to attract new subscribers.

Figure 10: Business model of TU media



資料來源：工研院 IEK(2007/02)

圖一、韓國 TU Media 現行營運模式

Source: 王韻筑, (2007) 行動電視商用服務個案分析, IEK

Another challenge of promoting S-DMB is that the peak of the daily mobile TV watching interval (noon break, traffic hours) overlaps with the peak of data services. Consumers may watch Mobile TV instead of using data services. For SKT it was a benefit, since it's the largest shareholder of TU Media. However, the S-DMB service penetrates to the mobile subscribers of the other two MNOs, KTF and LGT, withdrawing their data based revenues. Therefore, KTF and LGT held passive attitude toward S-DMB; on the other hand, KTF launched its own streaming VOD service as the challenger to S-DMB, named 'Fimm Free'. Using Fimm free does not claim users

to buy new S-DMB phones for the TV function. It works perfectly on most of the existing 3G phones in Korea. What's more, it provides more TV channels (36 channels) and the monthly fee is 20% lower. This service indeed shocked the heavily invested satellite based service with their existing mobile network.

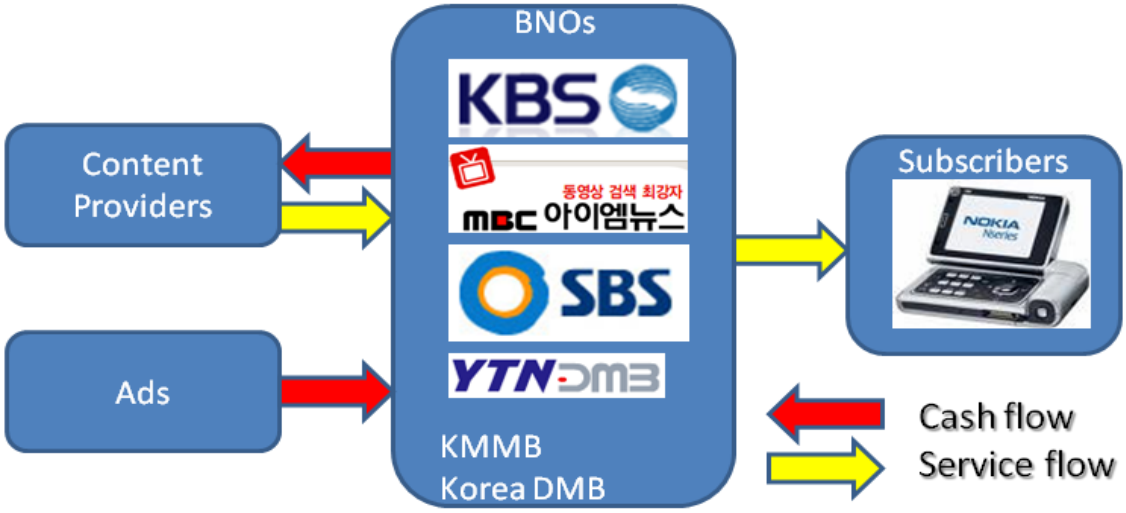
4.1.2 KOREA, T-DMB

The Korean T-DMB service commercially launched in December 2005, working on 174-216 MHz, just a few months after S-DMB take off. The contents contained 7 video channels and 13 audio channels provided by three major broadcasters, KBS/MBC/SBS and 3 new players, YTN DMB/Korea DMB/KMMB. The six companies all applied the broadcaster led model and joint constructed the broadcasting network. End users are not charged by TV or MNOs in this model and the contents are broadcasted free-to-air, the same as the Japan One Seg model. Broadcasters completely rely on advertisement incomes.

Due to free monthly fees, the sales of Korean T-DMB compatible devices increased rapidly just like One Seg did. 3.5 million T-DMB handsets were sold till April 2007, outnumbering the S-DMB devices distantly. The devices were provided similarly by Samsung/LG/Pantech & Curitel.

However, the strong sales of T-DMB receivers sold did not bring profits to broadcasters as well. According the survey by Korea Radio Promotion Association, the combined revenue of the six broadcasters generated by advertisements were 133 million won during March to October 2006, which were the only source of revenue

Figure 11: Business model of Korean T-DMB Mobile TV



Source: Ku(2007)

stream. The cost reached 700 million a month for each of them, causing an enormous loss eventually, while TU-Media's pay service is driving on its way to the break even point gradually by acquiring better contents and filling up the weak reception area. On the other hand, T-DMB broadcasters retarded the investments due to great loss and become incapable of presenting stylish contents and filling up shadow areas such as tunnels or underground regions, resulting in users turning their back from the service though the service is free. Moreover, none of MNOs sponsored the T-DMB service, since it brought no additional revenue for them. The function was like an integrated FM radio, just another fancy attraction to end users to purchase the phone. Kim Kyung-mo, Mirae Asset analyst projected, when the user pool reaches 5 million, possibly in 2009, and before then DMB broadcasters will continue to suffer setbacks.

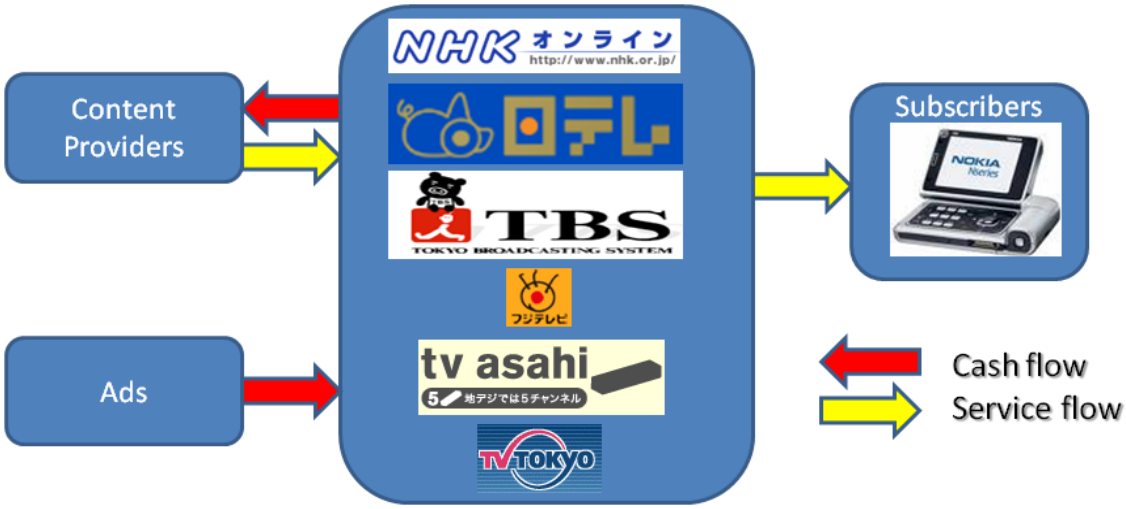
4.1.3 JAPAN, ONE SEG

Japan launched its free-to-air Mobile TV service "One Seg", in April, 2006, applying the Japanese ISDB-T standard (558- 566 MHz). The source of the name "One Seg was from the following technical issues: The terrestrial digital broadcasting format in Japan divides one channel (6 MHz) into 13 segments (divisions). Among these 13 divisions, 12 segments are used for television transmission and 1 segment for mobile devices; the complete TV contents were broadcasted simultaneously (simulcast). Therefore the program contents are currently the same as Digital Terrestrial Broadcasting, provided by six different broadcasters. The number of channels and contents depends on the receiver's location.

One Seg service is free and doesn't incur any communication charges from end users. It applies the broadcaster led model and relies completely on revenues from advertisements. Till December 2006, 3.41 million (14% of all 3G phones) One Seg mobile phone devices and 260 thousand in car receivers were sold. The major MNOs, NTT DoCoMo, KDDI Au and Softbank, provided more than 10 phones featuring One Seg receivers (till Q1 2007), manufactured by ten different Japanese firms. The major mobile phone manufacturers, Nokia, Motorola and Samsung did not launch any One Seg featured phone, though several 3G models of these firms are available in Japan. The reason might be that ISDB-T phones are functionless outside Japan.

The Japanese One Seg service faced a similar problem to the Korean T-DMB service currently; no appropriate business model was established. Although commercials advertisements were broadcasted via One Seg just as the digital terrestrial broadcast, broadcasters are not able to collect additional advertising fees from advertisers for the

Figure 12: One Seg Business model



Source: Ku(2007)

extra service, unless the view rate can be measured. Furthermore, the act of TV on mobile phones may lead to a fall in number of calls and data service usage. (For example, i-mode, the renowned mobile searching service.) As the viewers of One Seg increase, more time will be spent on TV watching and the other data services may be ignored. Besides, new handsets were subsidized by MNOs heavily in Japan, the more handsets functioned with One Seg sold, the greater the cost burden for them.

In attempt to produce contents fitted to One Seg, NTT DoCoMo announced to secure a 2.6% stake in Fuji Television, KDDI and TV Asahi are also engaged in joint empirical trials aimed at the launch of three new collaborative services utilizing One Seg: TV content, E-commerce and advertising and sales promotion. For instance, when watching a shopping channel or an advertisement, interactive links will be showed on the screen for viewers to buy the merchandises online immediately. When watching sport channels or talk shows, on line votes can be done through the 3G network, generating revenues for MNOs.

One Seg is restricted to broadcast the same program as the digital terrestrial broadcast by the Japanese government until 2008, the renewal of One Seg's license being released. The mechanisms of payment and content protection were not applied currently. However this system has already been developed by KDDI and NHK, proprietary pay contents suited to small sized screen, short period viewing can be launched then. Before the launch of pay services, the infrastructure still needs to be enhanced. The current population coverage rate is 82%; more gap fillers are required in order to grant continuous reception for vehicles, trains, underground areas and emergency broadcasts. (Note: Japan suffers from frequent earthquakes, typhoons and tsunamis. The government regards One Seg as an emergency precautionary measure to broadcast disasters in advance and prevent expansions of damages.)

4.1.4 JAPAN, MEDIAFLO

MediaFLO Japan, a company co-established by KDDI Corporation & Qualcomm announced a market research result conducted by Accenture Japan Ltd. recently, which was quite encouraging to the pay mobile TV market in Japan. Though One Seg Mobile TV was already launched, only 5-7 free-to-air channels were available depending on regions. 84% of the users felt the service should provide more than 11 channels and 67% require for more than 20 channels.

The research also clearly showed that Mobile TV is an experience-driven service in that people's intention to use the service increased the more they understood the service: 41% of the participants said that they intended to use Mobile TV services, while 83% of focus group testers - users who were given the opportunity to try out the service - responded that they intended to use the service. *T*he fast switching time (1.5

sec) of MediaFLO is the major advantage over ISDB-T (6- 7 sec).

The potential Japanese market size for paid Mobile TV within five years of service launch is estimated to be as large as $3.8 billion with about 40 million users. The potential economic benefit to the market of a Mobile TV service launch is estimated to be some $16 billion. Focusing on this large potential market, MediaFLO Japan is encouraged to move forward with preparations for the launch of the commercial service. The model led by Qualcomm used in America may possibly be applied.

4.2 EUROPE

4.2.1 ITALY

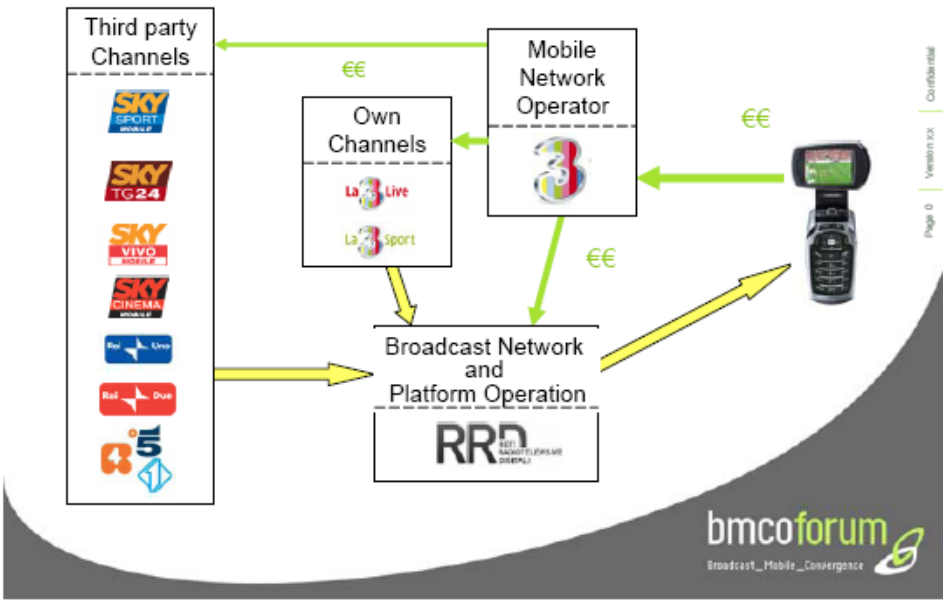
The development of Mobile TV in Italy is definitely the fastest among EU nations, thanks to the passion for football anytime and anywhere. In 2005, MNOs H3G (a subsidiary of Hutchison Whampoa Ltd.) Vodafone, and TIM launched a series of VOD and live TV services based on 3G streaming, providing football fans live games on mobile phones. On the other hand, the technical trial of DVB-H services launched in February 2006, broadcasting the winter Olympics games in Turin, and the result was successful. The goal of these efforts made was to meet the strong demand for watching the 2006 FIFA world cup on Mobile TVs.

H3G

H3G aimed at the large market of Mobile TV in Italy. It's first action was merging the fourth largest TV broadcaster 'Canale 7' in 2005, and acquired the license and

frequencies (474-746 MHz) for both DVB-T and DVB-H services. A few months later, the MNO 3 Italia launched their commercial Mobile TV service 'Walk TV' on late May, 2006, as the world's first commercial mobile TV service using DVB-H technology. In the beginning, nine channels are provided, including one free channel and the others were protected through CA (By NagraVision). TV packages varies from 2€ a day to 59€ for six months. A bundled package of TV, phones calls and data service is also provided for 29€ per month. Subscribers reached 111,000 in the first six weeks of operation thanks to the football fever; and attained 400,000 at the end of 2006. According to Alessandro Floris, the Mobile TV director of H3G, more than 90% usage was outdoors with peaks before dinner and during the lunch break. Watching sport is the most popular activity both in terms of penetration and viewing times. The handsets were provided by Samsung and LG. The business model of H3G is shown in Figure 13.

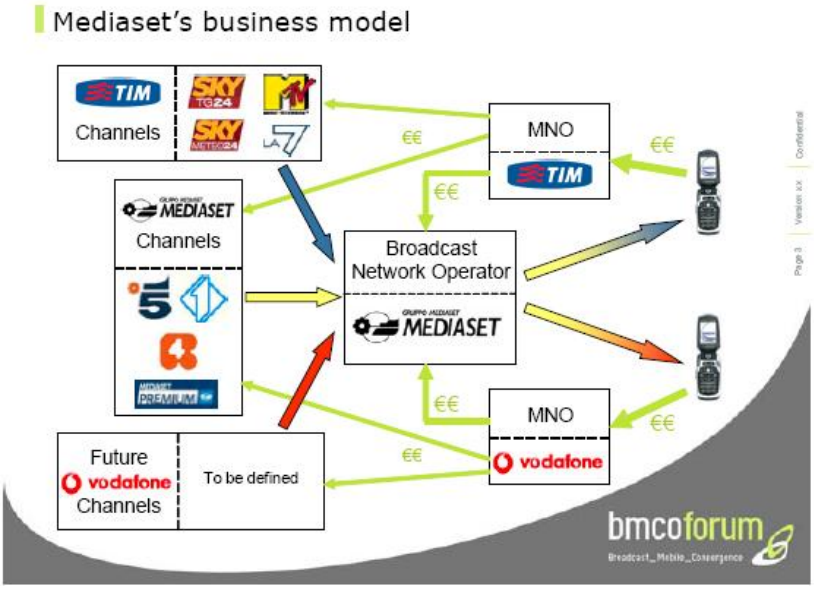
Figure 13: H3G business model



Source: Sattler(2006), Mobile TV Business Models, BMCO forum

H3G applied the MNO led model, receiving both the TV and mobile phone call payments by itself. Content packaging and the DVB-H broadcast network operating works were outsourced to Reti Radiotelevisive Digitali (RRD), the BNO. It aggregates 9 channels from various content providers (Mediaset, BSkyB, and H3G itself) forming the TV package. H3G pays content providers and RRD for contents, network and platform operation.

Figure 14: Mediaset Business model



Source: Sattler(2006), Mobile TV Business Models, BMCO forum

Mediaset

Mediaset, the nation's largest TV broadcaster, was controlled by former Italian Prime Minister Silvio Berlusconi. It acquired the spectrums for DVB-H broadcasting from Europa TV and invested €250 million in network infrastructures, covering 75% of the Italian population by the end of 2006. The company adopted the wholesale model, renting 25% of the network's capacity to Telecom Italia and another 25% to Vodafone.

Each operator paid around €75 million for a five-year lease, with the option to renew for five more years. Besides, Mediaset also offer its own channel bouquet to all MNOs.

TIM & Vodafone

TIM launched its commercial Mobile TV service 'TIM TV' in June, 2006 in the major cities of Italy and expanded its coverage areas progressively as Mediaset enhances the coverage. Currently 8 channels are comprised for €5 per month. Similar TV+ phone calls+ SMS bundled package were also provided. The billing systems were done by TIM and it shares 50% of the Mobile TV generated revenue with Mediaset.

Vodafone launched its Mobile TV service in December, 2006 at €9.90 per month for 9 channels. A business model similar to TIM was adopted and the difference was just the contents.

A survey by TIM shows that half of the users watch their Mobile TV indoors and outdoors, 2-4 days a week on average. They found the video quality brought by DVB-H is quite good and the contents were interesting. Battery consumption was acceptable, and what most users asked for is better coverage.

The spectrums available for mobile phones or Mobile TV in each country are limited, therefore the service provider, which possesses this resource may be in great advantage, sometimes in a monopoly position. However, we can find the a variety of business models applied in the Italian Mobile TV, and the interactions between MNOs and broadcasters are quite affirmative, stimulating the growth of this new market. The

initial results of the DVB-H service in Italy seem good and can be an outstanding example for the other countries. Nevertheless the undeveloped market in the nation is still large, awaiting for more investments in infrastructures and specified contents.

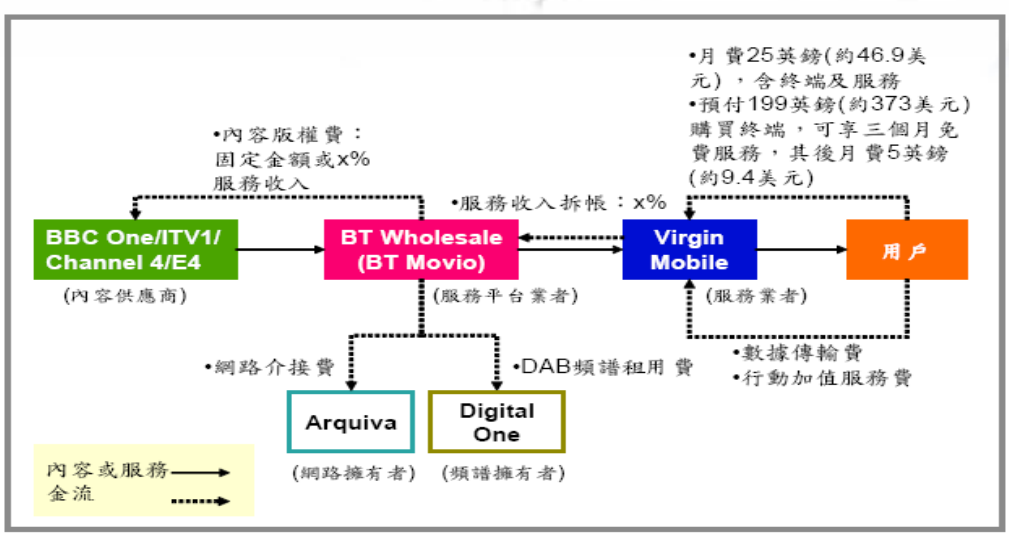
4.2.2 UNITED KINGDOM

BT Movio dominated the trial of the UK Mobile TV initiating in June 2005 and ran through till December 2005 in London. Samples of receivers were given to consumers to test the technical interoperability and consumer behavior. The results encouraged Virgin Mobile UK to launch its commercial Mobile TV service in October 2006. It retails BT Movio's wholesale service to its subscribers with four TV channels and up to 50 audio channels by DAB-IP technology. The TV contents of BBC1, ITV1 and the digital channel E4 are the same with the ordinary television, only Channel 4 provides Mobile TV tailored contents. However, it's only delivering its short cuts linking to made- for-mobile channel at the moment. Broadcasting is expected to come along later. Listening to the audio channels is free, while the TV service is also free bundled in the duration of the phone contract. When the duration ends, the service is for £5 per month. Besides, BBC One will be available for free till the end 0f 2007, since it's still trialing.

Virgin Mobile is the largest MVNO (Mobile Virtual Network Operator) and uses T-Mobile's network for its more than 4 million subscribers (Estimated in Q4 2006). The payment collections of and Mobile phone & TV fees were both done by Virgin Mobile. BT Movio, the wholesaler in this wholesale model, will charge Virgin Mobile each time a consumer request the license for the service. The license is used for distinguishing pay contents from free-to-air contents.

BT Movio buys and transfers contents from content providers to Arqiva, which is the contractual BNO under BT Movio. The coverage of the DAB network constructed and maintained by Arqiva currently reaches over 85% of the UK population. Contents were then transferred to customers through the network supervised by BT Movio.

Figure 15: Business model of BT Movio



資料來源：工研院 IEK(2007/02)

Source: 王韻筑, (2007) 行動電視商用服務個案分析, IEK

The terminal Mobile TV device, Lobster 700TV, was exclusively provided by the Taiwanese company HTC (High Tech Company) with Windows Mobile installed. A red button was attached on the phone, which connects to the 3G network directly taking users to the interactive websites. Online vote, search and music downloading service related to the TV programs are provided.

However, the up-to-date figures show that the promotion of Mobile TV in UK was not successful. According to Digitimes, less than ten thousand Lobster 700TVs were sold till January 2007, due to lack of contents (channels) and poor service quality. Since

BT Movio took the largest investment risk in this chain since its the Mobile TV service provider. The only income was from charging its retailer, Virgin Mobile, while the revenue share depends on the quantity of TV subscribers.

The structure of this business model was fine, however the service and contents seemed unattractive enough to users, and the availability of terminal devices was too less. Moreover, the service was exclusively bundled with one MNO, which restricts its deployment. In the future, the release of new frequencies (L band, also used for DAB) which makes new space for more channels might be a stimulation for new subscribers to join in. Embracing other MNOs to join in the market will definitely be a plus to enlarge the market.

4.2.3 GERMANY, T-DMB

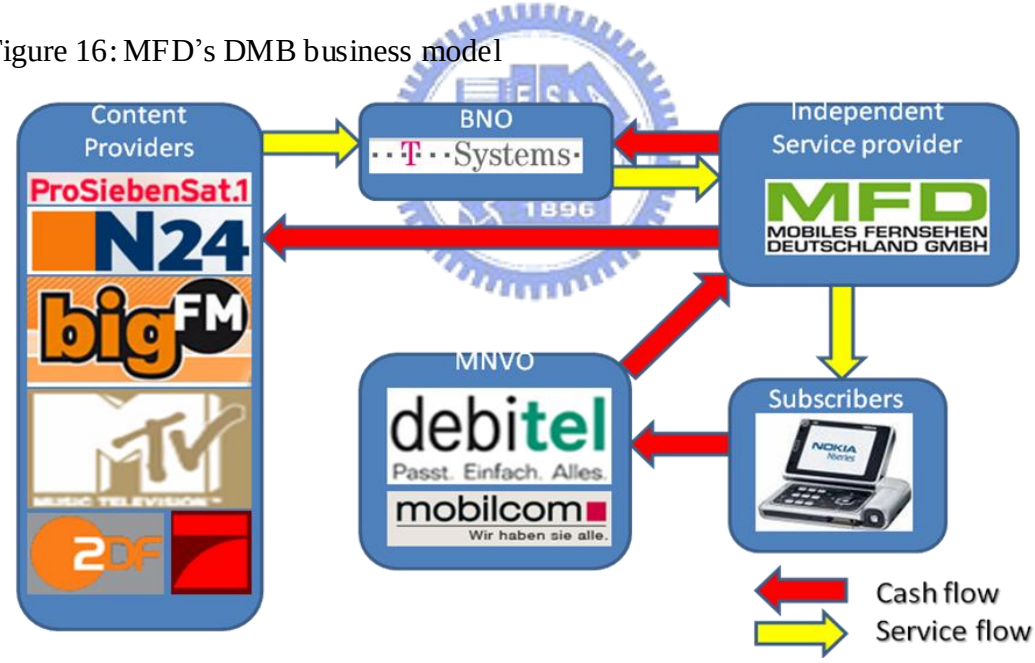
Mobile Fernsehen Deutschland (MFD) was the first German Mobile TV service provider founded in September, 2005. It was granted long-term (3-8 years) test licenses for an L-band based T-DMB service by 15 German regional media authorities. Contents included ZDF, ProSiebenSat.1 Mobile, N24, MTV and one visual radio Music Radio channel (bigFM2see). 'Watcha' is available in 15 Germany cities, 16% in population coverage at present, retailed by Debitel and Mobilcom, two major Mobile Network Virtual Operators (MNVOs) in Germay. (Information in May, 2007)

The service is a wholesale model led by MFD, the independent TV service provider. The L-band license holder was T-Systems, (the business customer brand of Deutsche Telekom) which also constructed the national T-DMB network for MFD. MFD had a long-term contract with T-systems for network setup, operation and maintenance.

T-systems played the role of BNO. The content fees were also paid from MFD to the content providers. Contents were all provided by existing players in the TV contents field.

Debitel was the first retailer of 'watcha' starting in June, 2006, whereas Mobilcom provided it after 4 months. The price of 'watcha' ranges from €5 to €9 depending on the contract type and were bundled with devices offered by Samsung & LG. Customer payment collection was done by Debitel and Mobilcom from their original subscribers, and MFD charges the MNOs a portion of the service revenue generated by Mobile TV usage as the service fees. This is the main income of MFD.

Figure 16: MFD's DMB business model



Source: Sattler(2006), Mobile TV Business Models, BMCO forum, redraw by Ku

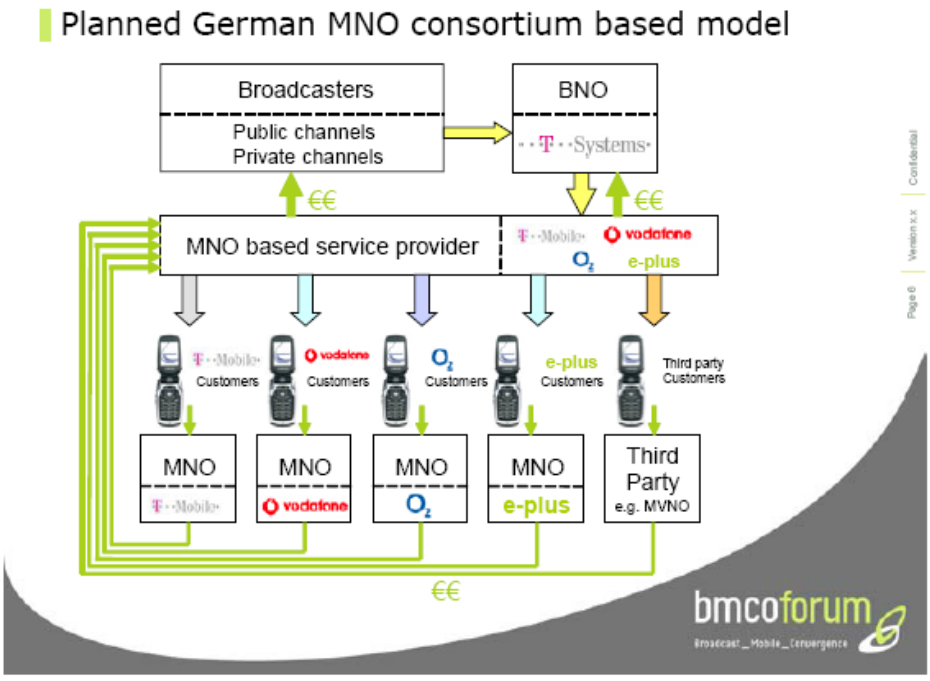
MFD is the largest investor in this model, thus taking the risk. The revenue depended mainly on the number of subscribers; however, there were about only 5,000 Debitel subscribers till Jan, 2007, not to mention the late comer Mobilcom. These numbers showed that German users were not too satisfied to the service, though the Live FIFA

World cup games is provided, it's still incomparable with the Italian success.

4.2.4 GERMANY, DVB-H

Three German MNOs O2, Vodafone and T-Mobile have set up a consortium that plans to launch at least 16 Mobile TV channels via DVB-H standard in Q1 2008. Under German telecommunication law, the broadcast network license is granted to BNOs directly. However, the MNOs intend to form the DVB-H consortium and finance the BNO to construct the infrastructures. This assures the efficient usage of the limited spectrum resources by different MNOs. Figure 17 shows the German DVB-H business model.

Figure 17: German MNO consortium based model



Source: Sattler(2006), Mobile TV Business Models, BMCO forum

The DVB-H consortium will apply the B2B wholesale model, wholesaling the TV contents to its origin MNOs and on the non-discriminatory basis and to the other MNVOs and interested parties. The TV contents were bought by the consortium directly, and then sent to the BNO. Contents are then broadcasted under the monitor of the consortium to different MNO and MNVOs. Monthly fees are paid from subscribers to their MNOs or MNVOs, which are used for covering the network costs. Afterwards, MNOs and MNVOs share a portion of the Mobile TV monthly fees to the consortium. Obviously the consortium takes the investment risk in this model since it engaged in the network investment and content purchase. However, unlike the other cases in this chapter, this Mobile TV service provider is composited by three MNOs, which makes the risk lower for its stakeholders.

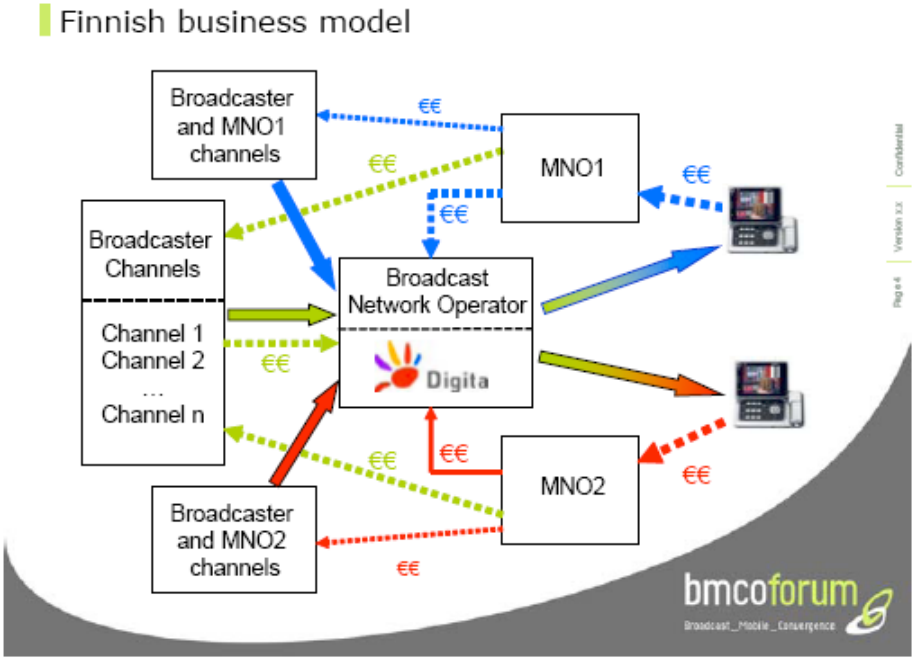
The contents wholesaled by the consortium may consist of three parts. First, the free-to-air channels and the basic package, which will be available at the same price for each MNO. Second, MNOs can provide specified channels differentiating from the others by use of CA (Condition Access). The price structure can be managed by MNOs depending on the contents. Third, the interactive services are formulated by each MNO through their own mobile networks. Interactive services contain accessing to additional information, such as online voting, and related video clip viewing by streaming. The extended services can be even more differentiated through the mobile network.

4.2.5 FINLAND

The trial of the Mobile TV in Finland was conducted during March to June, 2005, using the DVB-H technology on UHF band. The DVB-H network was constructed by

Digita, the developer of data communication networks and network infrastructure in Finland. The service management solution and DVB-H equipments were provided by Nokia. Elisa and TeliaSonera, two largest Finnish MNOs acted as service providers selling Mobile TV service to consumers, applying a B2B model. The project tested the attractiveness of mobile TV to the consumers, and the results were positive: most Finnish were interested in the services and willing to pay for the services. Figure 18 shows the Finnish Mobile TV business model.

Figure 18: Finnish Mobile TV business model



Source: Sattler(2006), Mobile TV Business Models, BMCO forum

The Ministry of Transport and Communications granted the first DVB-H netwrok license to Digita for 20 years in March, 2006, as the first commercial Mobile TV license in Europe. The network was forced opened to commercial operations in December, 2006 by the license terms. The population coverage reached 29% at launch date, and is expected to reach at least 40% by the end of 2007. Nokia N92 was the

first handset available. Nokia N77 will be launched in Q2 2007.

The Digita's B2B business model includes open, shared networks, which Digita offers as a neutral operator selling its capacity with equal, fair terms to all customers. According to the license terms, Digita is not allowed to be either a TV service provider or a content provider. Digita can only be a network operator and its customer will be either content providers or service providers, and no single entity can purchase more than one third of the capacity. Afterwards different business models can be applied on the network depending on the characteristic of its customer. Since the policy allows several parties to utilize the same network, the business model could be sensible and cost-efficient.

Currently, the Mobile TV service in Finland is in a promotion phase, 4 free-to air contents were broadcasted. SBS Finland Oy, one of the radio networks in Finland, started broadcasts in its Voice-TV channel, and as the first in the world, Enhanced Radio broadcasts in the Voice channel in December, 2006. Elisa-TV channel also operates in the mobile TV network during the ice hockey world championship tournament, and it broadcasts the live matches of the Finnish national team. MTV MEDIA, as a TV content provider, started the distribution of its MTV3 channel in the Mobile TV network in May 2007. The programs of the MTV3 channel are broadcasted simultaneously in both digital and Mobile TV networks. Nelonen Media (Channel 4), a Finnish National TV channel also started parallel broadcasting in the Mobile TV network and the digital television network in May 2007.

PlusTV, a pay TV provider in Finland, planed to be the first pay Mobile TV supplier in 2007 by broadcasting a couple of channels on Mobile TV network, and extend to a

diverse content package of channels according to the market response.

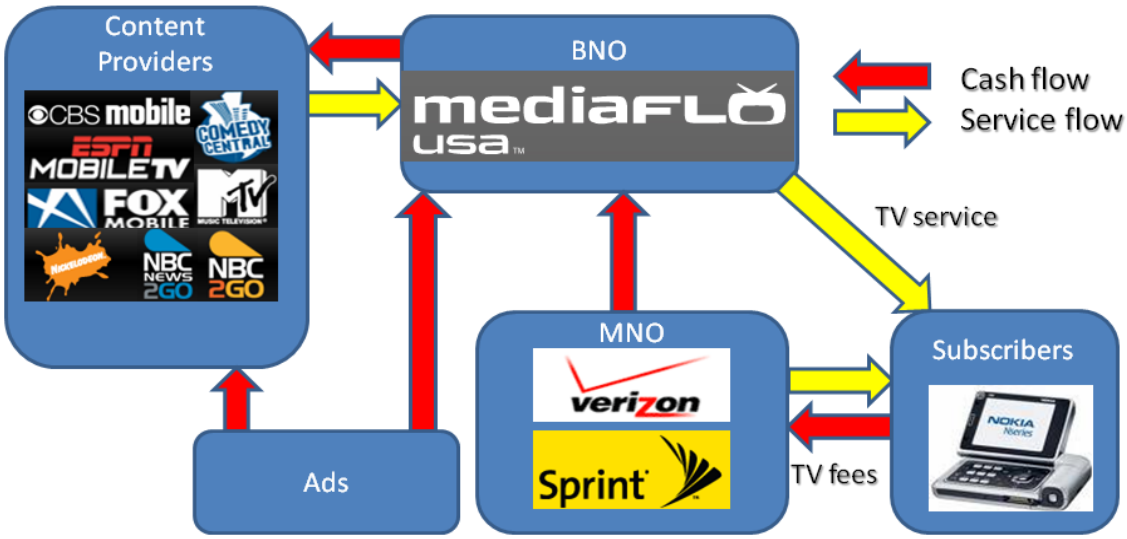
4.3 USA

4.3.1 U.S.A. , MEDIAFLO

Verizon, one of the major MNOs in U.S. launched its commercial Mobile TV service 'V cast Mobile TV' in March 1st, 2007, based on the MediaFLO technology (700 MHz, UHF Channel 55). Verizon plays the role of retailer in the model, and MediaFLO USA (a wholly owned subsidiary of Qualcomm) as the wholesaler, providing eight channels to Verizon including some of the renowned channels, ESPN Mobile TV version, FOX Mobile, NBC, CBS, and MTV. Handsets were made by Samsung and LG. Currently, the signal coverage reaches 21 states and 32 major cities. The package of watching all eight channels is available for $15 per month, while a limited package provides five channels for $13. Another MNO Cingular is expected to retail the service in October, 2007. Sprint Nextel has been testing the MediaFLO's network, yet announced its adoption. (Information in May, 2007)

The model is a typical wholesale model. What's special, the wholesaler was not a conventional broadcaster like the Italian model, but a subsidiary of the MediaFLO standard creator- Qualcomm. MediaFLO USA owns the national broadcast network and spectrums, being the BNO itself. Moreover, it takes the role of content aggregator and TV service provider. MediaFLO profits from revenue share of retailers (Verizon & Cingular), or advertisements. Advertisements can be sold from content providers for dedicated channels or from MediaFLO USA for cross network advertising on multiple channels in a one-stop buy, which is easier but more expensive.

Figure 19: MediaFLO USA business model



Source: Ku(2007)

MediaFLO USA's did a research based on its own subscribers in the United States, with more than 4,000 participants. The result revealed that the desires for Mobile TV surpassed any other cell phone feature.

Besides, MediaFLO analyzed the consumer habits according to the usage statistics and reversed some of the preconceived idea of Mobile TV. Not only young men enjoy the service, but a wide variety of viewers in all ages and genders showed interest in it. In addition to news and sports, all kinds of channels are well-liked, and people watch it indoors and outdoors, wherever they went all the time. It became an embedded action in their daily life, just like listening to iPod. Moreover, thanks to the MediaFLO technology, more than 80% of participants scored the video quality as 'clear'.

Table 2: MediaFLO USA research result

Functions	Camera	Internet Connection	Push to Talk	Instant Messaging	Games
Preference Ratio	1.5	1.6	2.3	3	6

Source: MediaFLO USA, 2007

Preference Ratio: Number of Users preferring the Mobile TV feature/ compared function

4.3.2 U.S.A., DVB-H

Modeo

Modeo, a company 98 percent owned and controlled affiliate company by Crown Castle International (The largest company providing infrastructure for broadcasting and mobile telephony in the U.S.) planned to launch its DVB-H Mobile TV service (working on 1670-1675 MHz, L band) in 2007 in more than 30 major U.S. cities. It will play the role of BNO and the content aggregator once the service takeoff.

Trial service took place in Pittsburgh since 2005 and in New York since December, 2006, with 6 video and 8 audio channels. Live video contents of several renowned channels, like Fox News, sports, Discovery Channel and CNBC were delivered. 99% and 64% of users were satisfied and very satisfied with picture clarity, and 87% and 37% of users were satisfied and very satisfied with the availability of service in the New York trail, on the basis of 138 users.

On February 2007, Modeo received permission from FCC (Federal Communications Commission) to increase transmission power on their base stations, which increases the coverage area and reduces the cost of network infrastructure. This permission may greatly accelerate the rollout of Modeo's commercial service.

T-mobile and Sprint Nextel will be the possible retailers of its TV service, and the Modeo Mobile TV handset was a Windows Mobile based Smartphone, co-developed and exclusively provided by HTC.

Hiwire

Hiwire is a division of Aloha Partners, the nation's largest 700 MHz spectrum owner, with 12 MHz of channel capacity in all of its markets. In December 2006, the company launched a trial service companioning T-Mobile in Las Vegas. DVB-H technology was adopted, using two 6 MHz UHF channels owned by Aloha: 54 and 59. Hiwire planned to launch and expand its commercial service to other regions as soon as possible. The wholesale model will be the probable adopted model.

Hiwire was considered to have the best spectrum advantages, and has a strong "second-mover" advantage; it can learn from MediaFLO USA and Modeo's marketing strategies and then pick and choose its partners.

4.4 EMERGING COUNTRIES

4.4.1 EMERGING COUNTRIES- ALBANIA, VIETNAM

Some of the emerging countries launched their commercial Mobile TV service even faster than developed countries by cooperating with equipment or system providers. VTC, a Vietnamese national broadcaster and operator in digital broadcasting, launched its Mobile TV service in November, 2006, as the second country in the world to launch the commercial DVB-H based Mobile TV service working on Channel 21 (564- 570MHz) & 49 (632- 638 MHz). Nokia was VTC's partner to jointly propel the consumer adoption of Mobile TV services in Vietnam. The initial handset was the N92 provided by Nokia. Nine video channels as well as a video-on-demand service on a pay-per-view basis from a catalogue of selected titles are available. Besides, four audio channels and one free-to-air demo channel is provided.

VTC charges a monthly fee of VND 90,000 ($5.60) for the service, and an additional VND 2,000 ($0.12) per day for content that is produced specifically for mobile phones. Bills can also be paid by pre-paid card. The target of VTC is to reach 100,000 subscribers by Q2 2007. However, the price of the device and the service fee is relatively high compared to the GDP of Vietnam, which may become an obstacle penetrating the service.

VTC is the independent Mobile TV service provider in this broadcaster-led model, which charges its own subscribers without any transactions with MNOs. In addition, the broadcast network was constructed by Nokia & VTC. It also plays the role of

content provider and content aggregator, since half of the contents were self-made and the others were externally purchased.

DigitALB, the Albanian pay-DTV operator, launched its Mobile TV service commercially in December 2006. DigitALB is part of Topmedia Group which owns a wide range of media enterprises including newspapers, radio and video post production facilities as well as terrestrial and satellite channels. It also runs a DVB-T service using a trial frequency license currently. 14 channels are currently available, mostly the same with the existing DigiALB TV contents. The coverage contains the capital city Tirana and covers 50% of the population. It is planned to be expanded to 80% in the second phase. DVB-H compatible handsets were provided by Sagem, Samsung and LG.

Being Europe's second-poorest country, Albania was the third country in the world to launch the DVB-H based Mobile TV service, thanks to the support of Grass Valley's Mobile TV system from Thomson. The service adopting the broadcaster-led model is broadcasted free-to-air during 2007, profiting by advertisement incomes. Since DigitALB is experienced in the pay-TV field and possesses the national spectrum resources, it might charge its Mobile TV users in the future. DigitALB will adopt the BNO-led model working separately from the MNOs and charges its own subscribers.

Table 3 shows a status comparison of the Mobile TV pioneering countries.

Table 3: Comparison of Commercial launched Mobile TV businesses

	Japan	Korea	Italy	USA	Germany	Albania	Vietnam
Standard	ISDB-T/ S-DMB	S-DMB/ T-DMB	DVB-H (H3G/ Mediaset)	MediaFLO, DVB-H	T-DMB, DVB-H	DVB-H	DVB-H
Business Model	BNO led	BNO led	MNO led/ Wholesale	Wholesale/ Wholesale	Wholesale	BNO led	BNO led
Date of Launch	Oct,04/ Apr,06	May, 05/ Dec,05	May, 06/ Jun,06	Mar, 07/ 07	Jun, 06/ 08	Dec, 06	Nov, 06
Prices (Month)	Free/ ¥400+¥ 580~2080	$10/ Free	€29/ €5.5~€9	$15	€5~9/trial	Free	$5.6 + $0.12/day
Channels (Video)	8 video/ varies by region	15/7	9/9	8/Trial	5/trial	14	9
Subscribers or devices sold	3.5million /NA	3.5 Million/ 1 million	400K/ NA	NA	<10k/trial	NA	NA

Source: Ku (2007), data acquired in Q2, 2007

4.5 TAIWAN & CHINA

4.5.1 CHINA

Similar to the case of 3G development, China intended to pursue its home-grown standard for the deployment of Mobile TV. SARFT China announced CMMB as its recommended national Mobile TV standard in October, 2006. It is based on the STiMi technology, also developed by China. The technology transmits TV signals both from the satellite and terrestrial broadcast stations to cover the large continent and population of the country.

In order to accelerate the deployment of this new standard, local trials of other Mobile TV standards are restricted by the Chinese government after this statement. Before the announcement, trials using DVB-H, DAB and T-DMB standards progressed in several major cities.

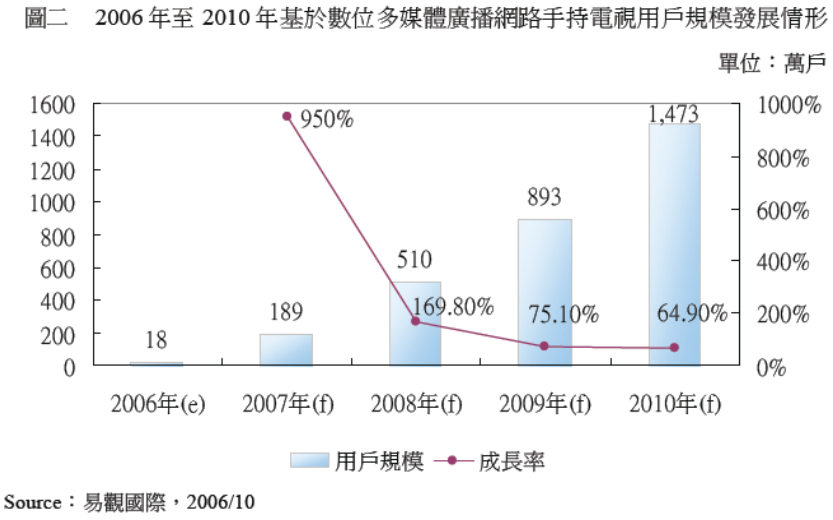
The adoption of its own standard creates large business opportunities for the Chinese mobile phone and infrastructure manufacturers. Though the 3G license was not approved by the Chinese government yet, the construction of TD-SCDMA network had already initiated, targeting to launch 3G services before the 2008 Olympics games, which was guaranteed by the government. Since TD-SCDMA was the Chinese dominated standard and strongly supported by the government, local telecommunication equipment manufacturers benefits the most, such as ZTE, Huawei, Datang, Potevio. Moreover, the high cost of intellectual license fees can be waived.

The Chinese government expects to apply the same mode on Mobile TV similarly to nourish the local industry and save the high license fees. The goal of the government is also launching commercial Mobile TV services in the major cities before the 2008 Beijing Olympics games.

However, CMMB was only a recommended standard by the Chinese government, not a mandatory order. Other Chinese developed standards such as DMB-TH, TMMB are also the competitors of CMMB; it does not domain the market. DMB-TH was an enhanced version of DAB, which can also be upgraded from DAB. TMMB provide TV services by streaming using the existing mobile network. Though developing its national standard is helpful for the local industry, China is facing the difficulties of standard war inside the nation and dissipation of resources. Interest groups behind

these standards are battling for their benefits which may result in setback of the unified standard services.

Figure 20: A forecast of Mobile TV subscribers in China based on digital broadcasting



Source: MIC (2006)

4.5.2 TAIWAN

National Communications Commission (NCC) announced the 'Selection of Business of Businesses for Handling Handheld Mobile TV trial Project' on August 4, 2006, and released the Mobile TV trail licenses to five teams, as shown in the Table 4. Ch 35(596-602 MHz), 36(602-608 Mhz) and 53 (704-710 MHz), were assigned for these teams to conduct trial tests, and the bandwidth is 6 Mhz each. Technical-neutral principle is adopted for this project, and up to the present only two standards were applied by the project teams: DVB-H and MediaFLO. The project divides the nation into northern region (Keelung to Miaoli) and southern region (Taichung to Pingdung).

The trial teams are composed of local MNOs (including type 1 and type 2 telecommunications businesses), BNOs (including cable, satellite and terrestrial broadcasters), equipment providers, value-added service providers and content providers. The detailed members of the trial project teams are listed below:

1. Public television service team: Public Television Service Foundation, Chunghwa Telecom CO., Taiwan Mobile CO., Far Eastone Telecommunications CO., BENQ CO., Motorola Electronics CO., Cyberlink CO.,
2. CTV team: China Television CO., China Times International Television, Eastern Broadcasting CO., CTV Infotech CO., Chunghwa Telecom CO., Taiwan Mobile CO., Vibo Telecom CO., Far Eastone Telecommunications CO., Motorola Electronics CO., Quanta Microsystems INC., Cyberlink CO., Intervideo Digital Technology CO.
3. Qualcomm team: Qualcomm International INC., Asia Pacific Broadband Wireless Communications INC., China Network Systems CO., Taiwan Television Enterprise.
4. Chunghwa Wideband Team: Chuunghwa Wideband Best Network CO., Far Eastone Telecommunications CO., Eastern Broadcasting CO., Formosa Television Chunghwa Digi-Image Alliance CO.
5. Dawn TV team: Chinese Television System, Nokia CO., Eastern Broadcasting CO., Vibo Telecom INC., Cyberlink CO., Dawn TV Technology CO., Far Eastone Telecommunications CO.

The trial teams gave their mid-term reports to NCC in June, 2007. Afterwards, the trial teams will have to issue their final reports in December, 2007. NCC will held a hearing for Handheld TV licensing scheme in November, 2007, and the scheme for

issuing handheld TV licenses will be completed around the end of December, 2007. Table 5 is an example of the trial timetable plotted by PTS.

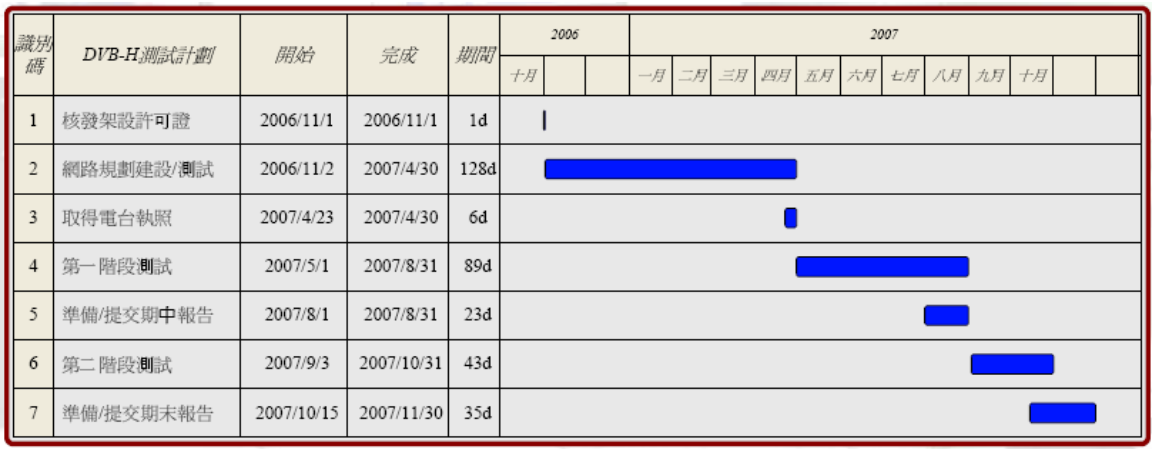
Handheld TV licenses will be released in the end of 2007 at best. However, none of the trial teams guarantee the date of launching commercial service after acquiring the license. In my opinion, providing instant Olympic Games in 2008 is a great opportunity for Mobile TV to take off.

Table 4: Taiwanese Mobile TV trial members and spectrum allocation

Teams	Channel	Location	Technology
Public Television Service	36	Northern Taiwan	DVB-H
CTV	35	Northern Taiwan	DVB-H
Chunghwa wideband	36	Southern Taiwan	DVB-H
Qualcomm	53	Northern Taiwan	MediaFLO
Dawn TV	35	Southern Taiwan	DVB-H

Source: Francesca Lai, PTS, Adopted by Ku

Table 5: PTS trial timetable



Source: PTS

CHAPTER FIVE

TRENDS, CHALLENGES AND DIFFICULTIES IN DEPLOYING MOBILE TV

In this chapter, several challenges and difficulties in deploying Mobile TV will be discussed. Though some of the countries mentioned in Chapter 4 launched their Mobile TV service commercially and numerous countries are having trials or planning to launch the service, the development of Mobile TV has not reach maturity yet. Besides regional business model complexities, still a lot of industrial challenges need to be solved.

5.1 TRENDS- MOBILE TV DISPLAYS

The size of mobile phone displays is a critical issue for users. Larger mobile displays provide better Mobile TV watching experiences. On the other hand, it raises the cost and the size of the phone, at the same times reduces the standby and talking time.

Several alternative solutions are taken into considered to overcome the limited size of mobile phone displays.

First, the head mounted displays. It is capable of excellent video quality if the optical design and display technology are well chosen and implemented. However, the cost of the device is still high, and the ergonomics design may not be accepted by everyone since it's heavier than typical glasses; the TV contents can neither be shared to others. Moreover, users are not able to see the environment when using the device unless the HMD is a see-through type. HMD is not a fashionable device nowadays, but may be a

good solution if the above deficits are conquered.

The micro projector is another solution. Although the size and the power consumption of projectors are still not fitted into mobile phones, some of the manufacturers demonstrated prototypes of micro projector phones recently showing the possibility of integration. If the device overcomes the problems of heat and power and success in the future, mobile phone display sizes will be comparable with laptops or even desktops. However, the outdoor Mobile TV usability under sunlight or in a moving vehicle is doubted. Leakage of privacy may occur when projecting videos to an open surface. Otherwise the micro projector is a feasible solution for entertainment.

The solutions mentioned above were not applied practically at present. Besides the technical issues, users' habits are not easily changed; therefore most of the Mobile TV phone developer equips larger and higher resolution displays onto the device in order to provide better Mobile TV experiences.

In Japan, the popularization of One Seg urged the Japanese mobile phone manufacturers to redesign the phones. Over 90% of the Japanese phones are clamshell type and the user interface is always operated vertically, which is better for text reading such as phonebook searching and web-browsing. On the contrary, people tend to watch horizontally when watching images or videos, such as taking pictures, gaming, movies and TV watching. In order to meet the demand of both text and image viewing, mobile phone developers made the displays rotatable for different needs. Other phone types such as PDA phone, slider or bar type phone do not have the problem since it's less complicated than clamshell phones.

Before the launch of One Seg in 2006, the mainstream Japanese mobile phones display size is 2.4 square-inches. One Seg was well-accepted after its launch, and One Seg phones with large display were especially favorable. The mobile display war thus begins. Since the second half of 2006 till June 2007, among the 27 released One Seg phones, 18 phones were equipped with displays larger than 2.8 square-inches, and 10 of the 18 phones are even equipped with displays above 3".

Equipping wide aspect ratio displays (widescreens) is another trend in the Japanese market. Hitachi launched the world's first widescreen phone, W41H in February, 2006. Afterwards more and more One Seg phones are equipped with widescreens; 23 out of the 27 released One Seg phones are widescreen designed.

Most of the display resolutions of One Seg phone are QVGA (320*240) and WQVGA (400*240), whereas some of the high end products reached WVGA (800*480). Although the recommended resolution of One Seg is only 320*180, larger displays indeed give users better experiences.

Most of the phones in other regions of the world are not equipped with such large displays, except PDA phones or Smartphones. Since Mobile TV is hardly successful or deployed excluding Japan and Korea, phones with large displays (more than 2.4") will not popularize soon. Though Mobile TV is quite successful in Korea, the mainstream display sizes of Korean mobiles are still 2.2" QVGA resolution, due to the consumer preference on mobile phone size.

Thanks to the progressive display technologies and Mobile TV chipsets, power consumption can be decrease effectively. Transflective type LCD is a solution which Japanese companies applied most; it has the advantages of lower power consumption, high saturation and wider view angle. Sharp's ASV and Hitachi's IPS technology are used on transflective type LCD, for instance. Average continuous watching time of One Seg phones reached 4 hours per charge nowadays by applying this new technology.

Besides displays, digital TV image processing technologies were brought into mobile phones targeting better video qualities. Giving the name "Bravia phone", Sony Ericsson installed the 'Reality Max' chip into its product W44s to guarantee higher quality video; Sharp equipped the 'Super Vivid' chip into its One Seg phones similarly.

As the display size and functionalities of mobile phones increase, battery capacities increase as well which lead to bigger phone size. This goes against the demand for thinner and smaller phones; nevertheless, LCD manufacturers are able to produce LCD panels less than 1mm thick currently and improving progressively.

Japanese companies possess the leading display technology and demonstrate the future possibility of Mobile TV display. Similar to home TVs, watching TV on mobile phones is a strong driving force for consumers to purchase new phones with larger displays. The demand for enhanced mobile display is strongly related to the regional Mobile TV development. Figure 21 shows the development trend of mobile devices displays.

Figure 21: The development trend of mobile devices displays

Source: Ku (2007)

5.2 MOBILE TV ON IPHONE

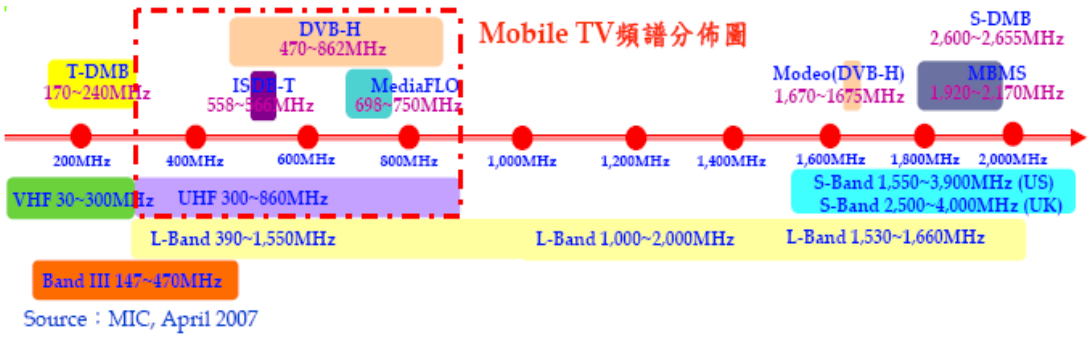
The launch of the Apple iPhone will probably lead a new trend of equipping even larger displays on mobile phones, though the early iPhone was only a GSM phone equipped with no TV receiving ability except through the EDGE network. The historical case of Sony's digital camera model DSC-T1 (launched in 2003) can be compared in this place. DSC-T1 is equipped with extra large display (2.5 square-inches) while the display of its competitors' products are mostly under 2 square-inches. The enlarged display gave users new experiences of taking pictures thus stimulated its rivals to produce similar products, and initiated the display size competition. Today the largest display on DSC reaches 3.5 square-inches, also produced by Sony.

The pre-sales of iPhone reached 1 million units in 6 months since its announcement in January, 2007. The estimated sales reached 10 million in 2008, which will be a strong threat to any similar models of its rivals. The evolutional user interface and the 3.5 square-inches multi-touch screen, the keypad-less design will be the main attractions of this new device.

Since iPod+ iTunes is an overwhelming successful digital downloading business model, it is believed that Apple will shift its digital downloading business to mobile phones sooner or later. Over 2.5 billion songs were already downloaded from iTunes acquiring 5.5% of the music market in the U.S. Apple will be able to put in more applications into iPhone in the future once the high speed connection functions are integrated into the phone. The main advantages of Apple are its software and the innovative display; moreover, its large iTunes based customers. The possible strategy of Apple may be selling video clips or VOD services through its website cooperating with the MNOs, which is another approach to Mobile TV services.

5.3 SPECTRUM, STANDARDS AND REGULATORY ISSUES

Figure 22: Frequency distribution of Mobile TV standards



Source: 熊嘉彬, (2007) 行動電視發展趨勢, MIC

In this section, the difficulties of standard adoption, spectrum allocating and regulation issues are discussed. Cases in Europe are focused on for the reason that DVB-H will be the most applied standard in the world, and the unified Mobile TV standard in EU. The solutions in EU will be significant to other Mobile TV developing countries.

Spectrums are limited resources globally, and usually spectrum licenses are granted by national governments. Each kind of wireless telecommunication works on different frequencies, for instance GSM network uses 900MHz and 1800MHz, while WCDMA network works on 2100MHz. Typically one spectrum section allocates only a single wireless technology to avoid radio interference. The process of license granting differs in each country; and the license is granted to different roles in the value chain according to the type of business model. In figure 22, we may find the required spectrums for each Mobile TV standards.

The spectrum availability for Mobile TV varies with countries since spectrum are used differently in each nation. Therefore, this may also be one of the decisive factors of choosing Mobile TV standards. In Taiwan, both the spectrum availability and standard problem is solved. However, spectrum availability is a major problem for some of the countries in Europe while DVB-H was endorsed by EC (European Commission) as the primary standard for Mobile TV. UHF spectrums are still used by analog TV in some of the countries, which will not be available until 2012, the EU deadline of switching off analog terrestrial broadcasting. Proposals are made to open up the use of L-band (1452-1492 MHz) which is an alternative solution for DVB-H in several markets where there is no UHF spectrums available. Spacing up the required spectrums in a short period is a challenging subject for governments.

The diversity of standards and spectrum allocation is also an obstacle of roaming, though the necessity of Mobile TV roaming is sometimes doubted since there are language and culture dissimilarities between countries. The EC and EU member states are addressing the regulation and spectrum issues through the Radio Spectrum Policy Group currently. Member states are also discussing how to exploit the digital dividend spaced from the shut-off of analogue TV broadcasting. In Q4 2007, a Commission communication on the Digital Dividend will be held to discuss the strategy for the use of the spectrum, and will address in particular the UHF Band.

There are still no specified regulations in the Mobile TV field though trials of broadcasting Mobile TV are progressing and Mobile TV service via 3G is already available in Taiwan. The related regulations might be shifted from the telecom law and cable radio and TV law. However, before the formation of the definite regulation for Mobile TV, companies are unwilling to invest in this field. NCC is expected to complete the amendment of communication law systems by September, 2007 targeting to facilitate the convergence of technologies. By the time we will see how the amendment boosts the development of Mobile TV.

In some of the Europe countries, the general regulation for Mobile TV is subject to broadcasting. In some others, definite regulatory frameworks for these new services are still being discussed. This condition creates a high degree of regulatory uncertainty and in some cases a legal vacuum which affects negatively to the Mobile TV service providers.

The authorization regime for Mobile TV in Europe is also unconfirmed. The EC proposed a pan- European authorization valid throughout all of the EU member states. This provides the highest legal certainty and promotes the service on a pan-European basis. However there are still plenty of barriers to overcome to attain this goal. Other options include a common authorization framework or independent development by nation. The latter guarantees no legal certainty and may discourage the investment willingness, and suspend the development of Mobile TV in some of the EU nations. Forming a common framework and leaving flexibility in details seems to be a compromised solution for all the member states.

Licensing regime must make sense in terms of the internal market, and the goal should be to creating a level playing field allowing various players in the value chain to compete on similar conditions. Some degree of uniformity in regulatory approaches across the EU is required in order to clarify feasible regulations and create a regulatory environment positive to investment and innovation.

5.4 THE OPPORTUNITIES OF MOBILE TV

Though most of the contents in this thesis focus on the use of broadcasting technologies such as DVB-H, there are several other alternative approaches to Mobile TV based on broadband streaming. The premise applying them is that sufficient bandwidth must be available, which was one of the major difficulties today, especially on mobile phones.

5.4.1 WIMAX

WiMAX was defined as ‘Worldwide Interoperability for Microwave Access' by the WiMAX forum. WiMAX is a term created to describe standard, interoperable implementations of IEEE 802.16 wireless networks, in a similar way to Wi-Fi being interoperable implementations of the IEEE 802.11 Wireless LAN standard. However, WiMAX works very differently from Wi-Fi.

WiMAX is a long range (up to 48 kilometers) system that uses licensed or unlicensed frequency to deliver a point-to-point connection to the Internet from an ISP to an end user. The data rate of WiMAX reaches 70Mbps. Wi-Fi is a shorter range (for the latest 802.11N standard, coverage reaches 300m) system that uses unlicensed frequency (2.4GHz or 5GHz) to provide access to a network, typically covering only a limited indoor area, like small offices or homes. The maximum data rate reaches 600Mbps. WiFi is similar to a cordless phone used only indoors, while the service of WiMAX is similar to cell phones, the mobility is much higher.

The advantage of WiMax over 3G is that the speed of WiMax is even faster. Figure 21 shows the comparison of WiMax and its comepetitors:

Figure 23: Comparison of WiMax and competing technologies

	3G HSPDA	3G EV-DO	WiMax 802.16d	WiMax 802.16e	WiFi
Bandwidth, MHz	5	1.25	<20	<20	20
Data rates, Mbit/s	14.4	2.4	75	75	11, 54
bit/Hz	2.9	1.92	3.75	3.75	2.7
Multiple access	TDMA, CDMA	CDMA	OFDMA	OFDMA	CSMA/CA
Duplexing	FDD	FDD	TDD/FDD/ HD-FDD	TDD	—
Mobility	Full	Full	Portable	Nomadic/Full	Portable
Coverage	Large	Large	Mid	Mid	Small

Source: MIC, (2007) WiMAX 技術發展趨勢下之潛在商機探討

The WiMAX Forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL." Due to the advantage of WiMAX- long distance, high speed data transferring, numerous emerging countries are planning to construct their national WiMAX network rather than the cable infrastructure. The technology enables populace living in rural or distant, mountainous areas easy and cheap connection to internet. It decreases the digital gap between metropolitans and countryside. Developed countries may also save costs and increase mobility with the deployment of WiMAX.

Based on the business model of IPTV, WiMAX can be another carrier for Mobile TV. Though the blueprint of WiMAX looks quite good, the development of WiMAX is facing several uncertainties; most of them are similar to Mobile TV, for example, the spectrum availability, licensing fees, business models, and costs of infrastructure. As the other major Mobile TV standards penetrating globally at the same time, WiMax may not be in time to be adopted as an alternative Mobile TV solution; however it undoubtedly provides more bandwidth for further applications on mobile phones.

5.4.2 IPTV

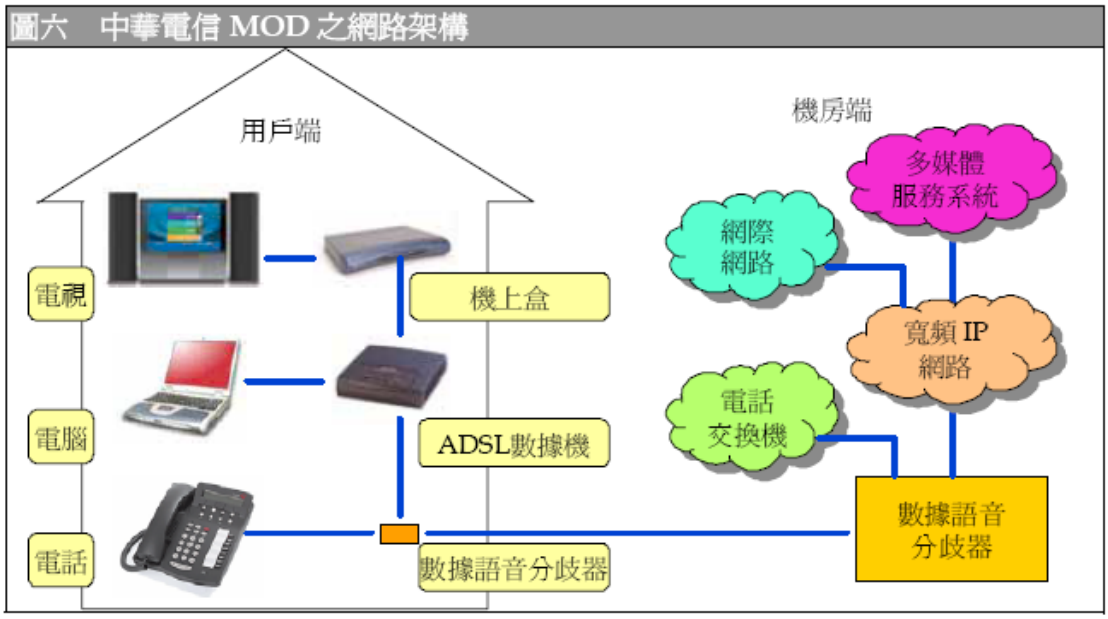
Traditionally, TV service was transferred through either wireless analog broadcasting or cable network. IPTV (Internet Protocol Television) is a digital television service based on Internet Protocol over the internet infrastructure. In the past, IPTV was not realized easily since broadband penetration rate was low. However, various broadband technologies were launched these years; heavy investments by MNOs expanded the internet bandwidth rapidly, the connection fees went down, stimulating more internet users and more online applications. Nowadays, a single broadband connection is capable of providing high speed internet, TV service (IPTV), VoIP (Voice over IP), forming a new marketing term for the combing of the three services, named"Triple play".

The playback of IPTV requires either a personal computer or a "set-top box", IP-STB connected to a TV. Video content is typically compressed using either a MPEG-2 or a MPEG-4 codec and then sent in an MPEG transport stream delivered via IP Multicast in case of live TV. In cases of VOD (Video on Demand, a service enabling consumers to play the chosen the programs preferred on the catalogue), IP Unicast is applied. These compression standards are more efficient than the DVB-T, requiring lower bandwidth when transferring the same contents.

The business model of IPTV provides MNOs the ticket to the TV market. Although most of them are not the major players in content providing, possessing the network resource is the absolute advantage either to cooperate with the existing players or to be the content provider on their own. The largest telecom service provider in Taiwan, Chunghwa telecom, launched its IPTV service since March, 2004. The IPTV service

for PC terminals was named 'Big TV', while the service for TV terminals was named 'MOD'. Big TV provides 18 basic channels

Figure 24: Structure of the ChungHwa Telecom MOD



Source: 郭家蓉, (2005) 全球 IPTV 發展營運模式分析, MIC

The VOD contents of Big TV can be received by mobile phones via GPRS connection without any pay per view fees. However, the bills generated by data transferring may be high unless a flat rate was applied.

The status of IPTV in most of the world is still developing; in Taiwan, the contents of IPTV services are still far less than the conventional cable TV, except the VOD services. Therefore the service is at most a complementary solution of cable TV. New technologies will be applied onto mobile phones in the near future such as HSDPA, MBMS, or further version of 3G and WiMax. These technologies may become carriers for IPTV on mobile phones, since it provides larger bandwidth than

previous versions. Will IPTV success on mobile phones, or are there any other enhanced solutions? IMS will be one of the upcoming solutions.

5.4.3 IMS- IP MULTIMEDIA SUBSYSTEM

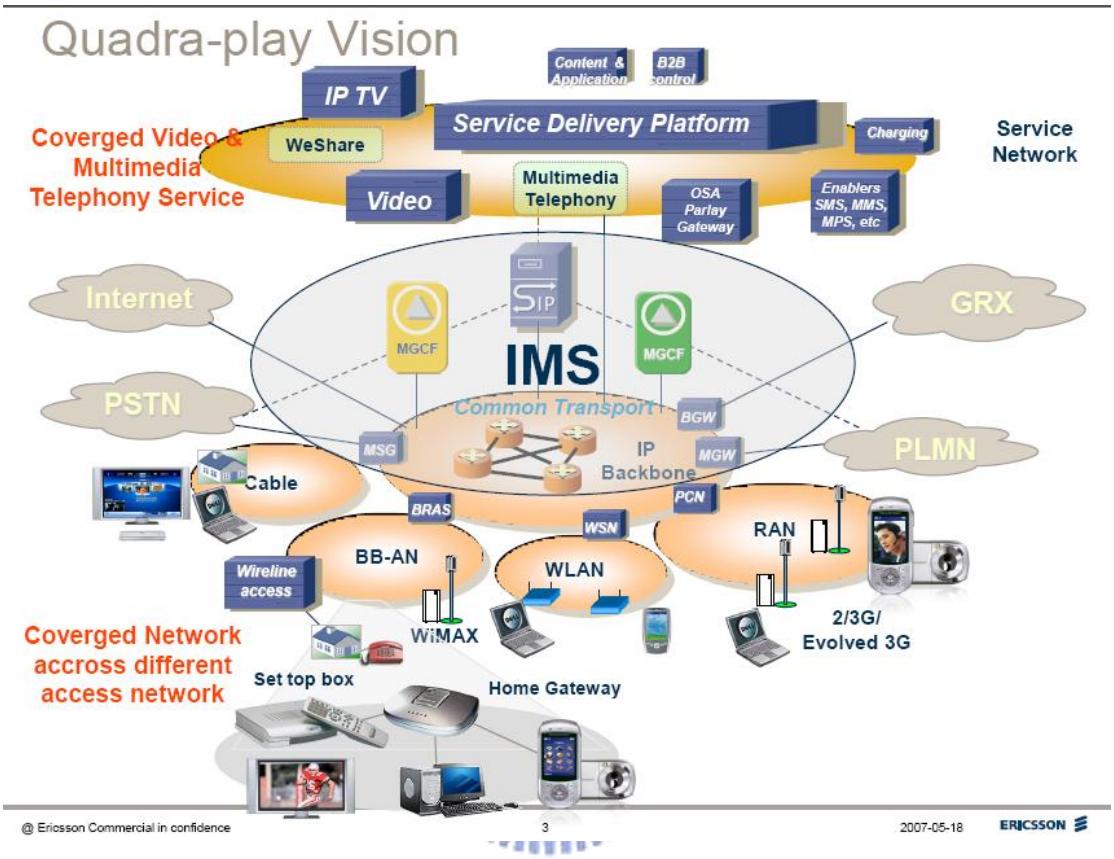
IP Multimedia system is a single architectural framework for delivering voice, data, and video services. It was first introduced in 3GPP release 5 in 2002 Q1, representing the approach of providing internet services over GPRS. It was then updated in 3GPP2, supporting other networks such as WiFi, CDMA 2000, and fixed networks. Figure 23 shows the applications of IMS.

With the use of IMS, not only triple play can be realized, but Quadruple play: Triple play plus mobility. Broadband connections to mobile phones and households are completely integrated under the system. As long as the standard Internet Protocol is used, users can connect to the IMS network, even during roaming in other networks. For service providers, their business model transform from “device oriented” to “subscriber oriented”, providing subscribers the same services regardless of the networks. Subscribers will be able to enjoy the same contents at home and on Mobile TV. Service providers are able to optimize the network traffic with IMS.

The IMS belongs to a standardized NGN (Next generation network) architecture and will be deployed in the next 5-10 years. Most of the IMS networks in major countries are still under construction by MNOs currently. In 2006, Far Eastone signed an IMS installation contract with Ericsson and it just announced (August, 2007) the launch of fixed-mobile convergence services via 3.5G and WiFi network, as the first MNO in Asia. Currently Far Eas Tone provides VoIP service over the IMS; in the future we

may see more appliances attained by IMS, hopefully Mobile TV.

Figure 25: Applications of IMS



Source: Ericsson (2007)

5.4.4 VIDEO SHARING WEBSITES

Video sharing websites such as Youtube are quite popular recently. Some of the mobile phones already supports video playback on these websites, like iPhone. Since the contents of these websites are compressed into low resolution form for smooth streaming, the screen size and resolution of mobile phones fits quite well for playing them. Most of the contents are less than ten minutes, which is also suitable for mobile entertaining. Equipping the function onto mobile phones will be a trend and also another approach to Mobile TV.

5.4.5 P2P TV

The concept of P2P (peer-to-peer) network connects terminals differently from the conventional client-server system. Each peer terminal is functioned simultaneously as server and client in the P2P network. Therefore, the resources are not concentrated in the server but separated to individual terminals. The bandwidth and the storage, computing power, contents are shared by each terminal. The more terminals sharing a particular file, the faster each node downloads the file. This is the greatest difference from the conventional client-server architecture; while more demand on a particular file will cause slower data transfer rate. The storage capacity and computing power of servers are also limited compared to the expandable P2P network composed by numerous terminals.

The concept of P2P network is now applied in several fields, for example, the well known VoIP internet telephony software "Skype". Several file sharing software such as Edonkey, Bittorrent enables people downloading all kinds of files through the P2P network. However, the legality of downloading copyrighted files and software was doubted, since most files are not protected in any form. The regulations and government attitudes toward P2P file sharing are also miscellaneous in different countries.

The concept of P2P network was also applied on TV program sharing, so called "P2P TV". The technology makes each end user a content receiver and a rebroadcaster, thus highly reduce the network traffic cost. There are more than ten kinds of P2P TV software available on the web currently, providing different contents according to regions and users. Most P2P TV technology is used to redistribute TV or movie

contents without a proper license up to the present; even some of the live games can be redistributed, which is illegal. The P2P TV market is still chaotic, and constructing feasible business models for P2P TV is a great opportunity for all players in the value chain. Once the computing power, internet bandwidth is improved and a proper business model is established, P2P TV can be realized on our mobiles in the near future.

5.5 How can Mobile TV take off in Taiwan

A SWOT analysis of the Taiwanese Mobile TV circumstances is made according to the current status, as shown in Figure 25. Currently trials of Mobile TV are progressing using DVB-H and MediaFLO compatible first of all the standard problem and spectrum availability is solved. Handsets availability will not be problems for that various commercial DVB-H and MediaFLO compatible models are already available in the market. Furthermore, Taiwan is one of the largest PDA & Smartphone manufacturing nations in the world, which is a positive factor for the Mobile TV industry. MNOs and BNOs can cooperate seamlessly with the local handset manufacturers by following the experiences in Japan and Korea. The availability of contents is also not a setback; the analog cable TV in Taiwan already provides more than 100 channels to consumers, which is one of the most in the world. These are the strengths of the Taiwanese environment.

Regardless of the strengths, the development of Mobile TV in Taiwan is still far behind the pioneering countries. The license of spectrum operation and Mobile TV broadcasting was not granted yet, and the converged communication law is still under legislation. Unlike the Japan and Korea government, the government was not leading

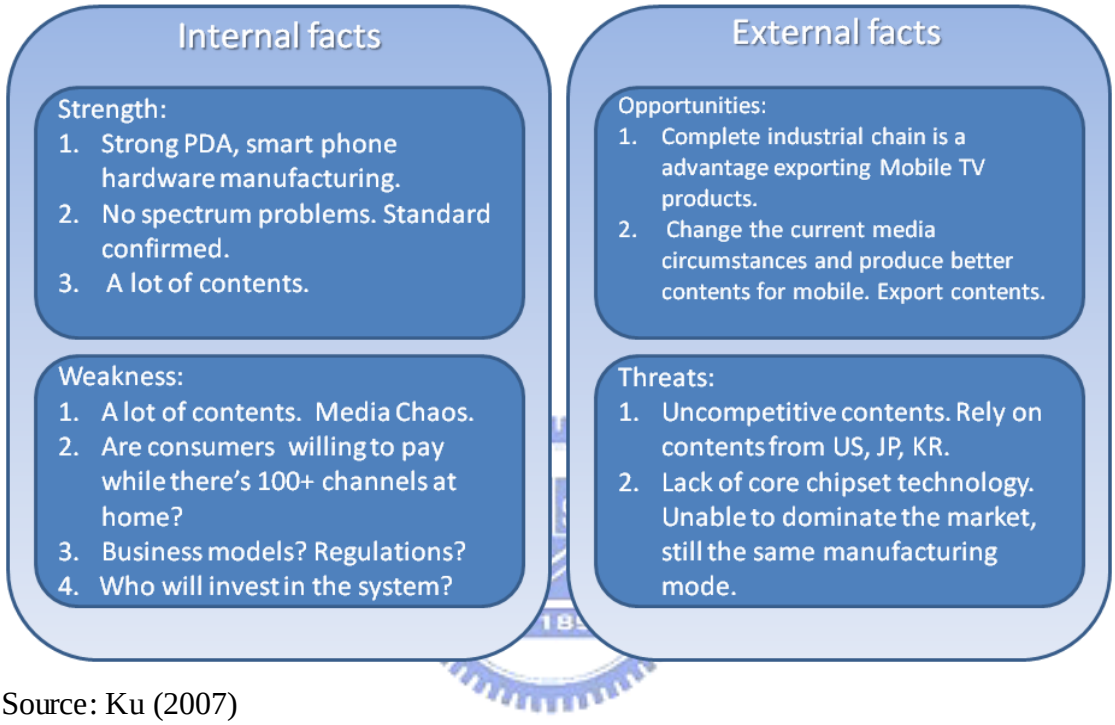
the industry aggressively, resulting in the uncertainty of the circumstances. Besides the uncertainties due to the government, the quantities of content providers surpassed the market demand, causing fierce competition in the market and disperse of the resources. There are more than 100 channels available on cable TV; however, some of the contents are duplicated or similar, and for instance there are more than 10 news channels. Most of the contents in these channels are the same, broadcasting the local news without any diversity. The result of vicious competition was dilution of revenue for all of the content providers and suffering losses for them in the end. When content providers neglect the functions of their own but focus on acquiring the audience rating, it meant media chaos to consumers.

Before iniating the Mobile TV market, the government should solve the problems in the past and prevent it from extending to the next platform. Deficits of content providers and broadcasters will result in unwillingness of investing in new infrastructures and producing more creative contents. Therefore a total quantity control over contents must be implemented to guarantee a positive environment for content providers and broadcasters.

The phrase "Content is the King" is often mentioned, emphasizing the importance of contents. From the experiences of pioneering countries, the success of Mobile TV relies on contents even more. The contents must be attractive enough for consumers to watch on mobile phones; moreover pay for it. Otherwise watching the same content on a conventional TV is undoubtedly more enjoyable. Currently numerous of contents in Taiwan were imported from America, Japan and Korea, whereas these countries are also leading in Mobile TV deployment. Live sports, news, music videos and dramas are the most produced and popular contents in these countries. The variety and quality

of local contents in Taiwan is still not comparable with these countries, which is a may not attract consumers to watch it on mobile phones. Therefore, producing high quality contents for Mobile TV will be the most urgent issue for content providers.

Figure 26: Taiwanese Mobile TV circumstances SWOT analysis

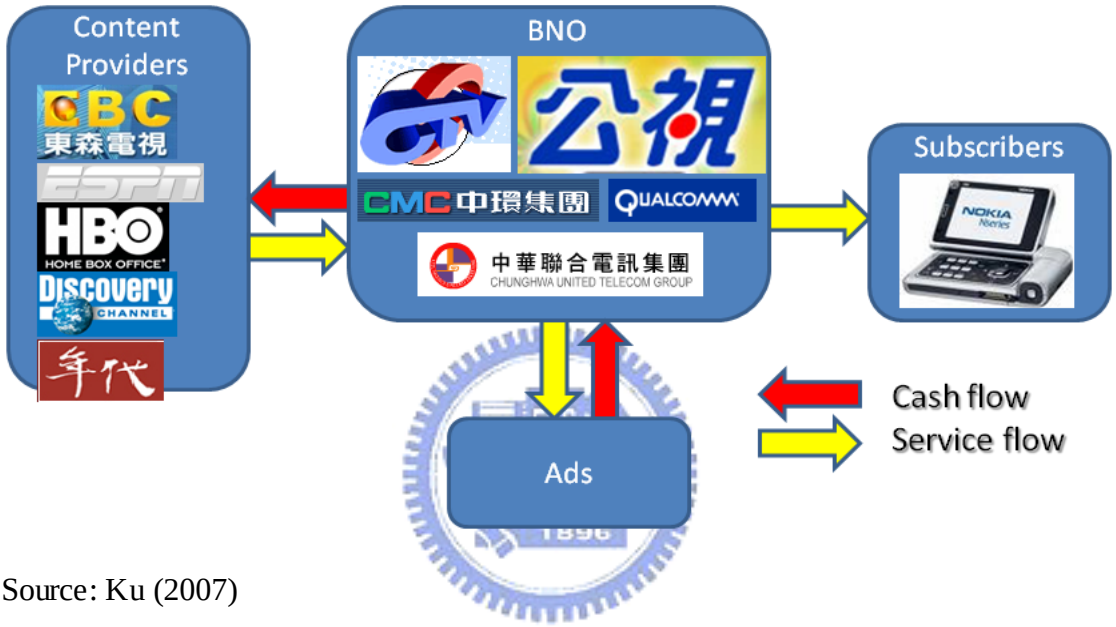


Source: Ku (2007)

Constructing an affirmative business model is also necessary for all of the players in the value chain. In my opinion, the contents should be broadcasted free-to-air in the early stage as a broadcaster led model as shown in Figure 26. For the case in Japan and Korea, free-to-air broadcasting attracted lots of Mobile TV users in a short period. This may be a great approach to promote the service and demonstrate consumers the experiences of Mobile TV. However, some of the content providers and broadcasters will not be interested in this model since it engages in extra expenditures. The increase in costs will not collect further revenue from consumers or advertisers. Moreover MNOs is bypassed in this business model unless it cooperates with

broadcasters by providing interactive services. This will cause MNOs neglecting the Mobile TV services similar to the Korean T-DMB case. Therefore this model will partially rely on the supplement of the government, similar to the development of DVB-T in Taiwan.

Figure 27: The probable Mobile TV business model of Taiwan in the early stage

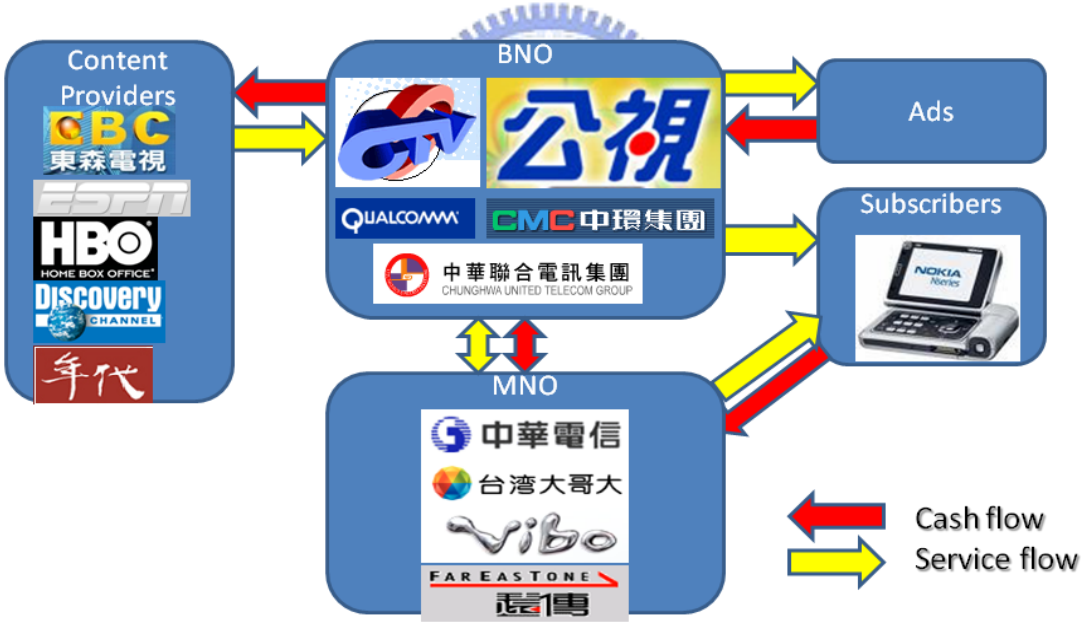


Source: Ku (2007)

As the market expands gradually and more consumers experience the service, a wholesale model embracing more pay contents can be launched. A German DVB-H consortium like model will be a preferable choice; the probable approach might be a consortium formed by the current trial members, who will possibly acquire the license as BNOs in the future and buy contents from the content providers then wholesaling the service to MNOs, as shown in Figure 27. However it requires a unified broadcasting network like the T-systems in Germany, which is still under discussion between the government and broadcasters currently. The current solution of the trial members is constructing the network independently by each BNO.

Providing free-to-air contents is still possible where pay contents will be managed by MNOs through CA. The DVB-H or MediaFLO system can be focused on broadcasting live contents such as sports, news and talking shows, whereas the contents streamed or downloaded via 3G/3.5G can be focused on more diversified or personalized contents, such as VOD or video sharing websites. A complemented correlation shall be established between MNOs and the consortium instead of competing with each other. This will help relieving the bandwidth load for MNOs and fill up the content insufficient (about 20-30 channels according to the total trial bandwidth) for the consortium.

Figure 28: The probable Mobile TV wholesale model of Taiwan



Source: Ku (2007)

The appropriate price of monthly fee is estimated to be 0.5%~0.75% (See Table 6) of the GDP per capita according to the research by Wang (2007). That is approximately 200~300 NTD. Various pricing packages can be provided according to the quantity of contents with the aim of attracting potential consumers; furthermore, the pricing

strategy of Italy can be applied by MNOs, bundling phone call, TV and SMS as a package, which maximizes the synergy of product mix.

Table 6: Mobile TV monthly fees and its percentage of GDP per capita

國家	服務業者	服務月費	% of GDP per capita	依台灣 GDP per capita 調整之月費
韓國	TU Media	13,000 韓圜(約 13 美元)	0.75%	新台幣 292 元
德國	Debitel	9.95 歐元(約 12.6 美元)	0.53%	新台幣 208 元
義大利	3 Italia	月費 29 歐元(約 36.9 美元)	1.6%	新台幣 625 元
英國	Virgin Mobile	5 英鎊(約 9.4 美元)	0.36%	新台幣 140 元
芬蘭 (Trial)	Digita	4.9 歐元(約 6.2 美元) 可接受 10 歐元(約 12.6 美元)	0.5%	新台幣 95~194 元

Source: 王韻筑, (2007) 行動電視服務價值鏈分析, MIC

CHAPTER SIX
CONCLUSION & RECOMMENDATION

6.1 CONCLUSION

According to the results of case studies in this thesis, it shows that only a few countries succeed in deploying Mobile TV services currently, including Japan, Korea and Italy. The diverse of standard are expected to be converged after the announcement of unified Mobile TV standard by EC. DVB-H will become the most adopted standard even though some countries are using its own standards, such as T-DMB, S-DMB, MediaFLO, and ISDB-T. The Chinese government insists on developing its nationwide standard; however, furious wars over several own developed standards may result in delaying the launch of the service.

The main difficulties of nowaday Mobile TV are the availability of spectrum, regulation issues and business models. Although a unified standard is being pushed forward, in some countries the spectrum for specified standards is remain unavailable unless phasing out the existing analog service or military usage. The general regulation for Mobile TV is subject to broadcasting in some countries, whereas in some other countries there are no definite regulatory frameworks for Mobile TV. This condition creates a high degree of regulatory uncertainty and in some cases a legal vacuum which results in the unwillingness of investing in the industry.

The manner of governments is critical to developing Mobile TV. Governments have to construct a desirable environment by solving the problems of spectrum availability

and regulation uncertainty to encourage business investments. To foster this new industry, supplements from the government in the early stage are necessary.

Applying appropriate business models is also significant to all the members in the value chain. Business models are difficult to copy from one case to another since the environment is different in each country. Generally speaking, MNOs are new players in the TV field; instead of competing with each other, a complemented correlation shall be established between the MNOs, broadcasters and the content providers to educate consumers and create the demand in the market. The case of Italy is a successful example of collaboration among each players.

Equipping large (over 3 square inches) and high resolution displays (QVGA→ VGA) will be a trend for Mobile TV handsets, once the difficulty of power consumption is solved. A mobile projector may be also a display solution for Mobile TVs in the future. The launch of iPhone demonstrates technology breakthroughs in touch displays; moreover, the successful iTunes+ iPod business model which provides video clips and VOD downloading services through its web store may be shifted to the telecommunication market by cooperating with the MNOs and becomes another approach to Mobile TV.

There will be new technologies carrying out Mobile TV in the future, as the bandwidth of mobile network is increased. Most of them are already applied to PC, for example video sharing websites, IPTV, P2P TV, which can be transfered to the mobile platform and create new business models. The launch of IMS will provide even more fixed-mobile convergence services, including Mobile TV.

In Taiwan, trials of Mobile TV using DVB-H and MediaFLO are progressing currently and the licenses are expected to be granted in late 2007 or 2008. A free-to-air broadcasting model like the Japanese One-Seg model is suggested to be used in the early stage to promote this new service. As the market expands gradually and more consumers experienced the service, a wholesale model embracing more pay contents can be adopted. MNOs and broadcasters must cooperate seamlessly to provide a complete TV solution.

The media environment of Taiwan is in trouble of vicious competition. The government should solve the problems and prevent the Mobile TV platform from them. Creating a desirable environment is essential for content providers to produce more competitive contents. Producing attractive contents is significant to developing Mobile TV.

6.2 RECOMMENDATIONS FOR FURTHER STUDIES

Mobile TV is highly expected as one of the next killer applications in the upcoming years. However, it is still developing in most of the countries and faces to various difficulties; therefore still plenty of subjects worth to be studied, in aspects of spectrum, regulations, business model, devices, contents and pricing, especially contents, the soul of developing Mobile TV. Broadcasting Mobile TV standards aren't the only approaches to the service, the new technologies mentioned in Chapter 5 are some of the alternative solutions. In my opinion, more research can be done in this part. There will be plenty of new Mobile TV networks being installed in the upcoming years; new applications and new business models will emerge, and we need to update all these information daily to capture the movement of Mobile TV.

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