Chapter 1: Introduction to DTV

1.1 DTV Overview
1.2 Characteristics of DTV Industry
1.3 DTV Market Survey
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1.1 DTV Overview
DTV Overview

• **What does DTV mean?**
  
  – **Higher Picture Resolution**
    • It uses the same channel bandwidth as the current analog system to transmit four times more information. This capability translates to better quality in sound and picture (known as “high definition” TV).
  
  – **Multicasting**
    • It allows the transmission of several "standard definition" TV programs at once – called “multicasting”, with pictures and sound quality equal to or better than is generally available today.
  
  – **Better Picture Quality**
    • Digital pictures will be free from "ghosts" and "snow" that can affect analog transmissions
  
  – **New Type of Broadcasting Service**
    • Broadcasters can simultaneously transmit a variety of interactive video and data services that are not possible with “analog” technology. It is a new type of broadcasting service that will change your television viewing experience.
DTV Overview

• **What is a digital receiver?**
  – STB v.s. iDTV
  – STB (Set-top box)
    • A standalone box for digital signal receiving/processing
    • Two remote controllers
    • Need to learn new behavior
    • Easy to replace
    • A transition product for new/variable system
  – iDTV (Integrated DTV)
    • Digital signal receiving/processing are integrated with TV
    • Same behavior as normal TV operation
    • Hard to replace
    • A final product for mature system
DTV Overview

- **Viewing Experience with DTV**
  - **Basic Functions**
    - Channel Scanning
    - Channel Organization
    - Channel Change Banner
    - Now/Next Information
    - Parental Guidance
    - PIP/POP
    - Teletext, ClosedCaption
  - **Advanced Functions**
    - EPG (Electronic Program Guide)
    - PVR (Personal Video Recording)
    - SSU (System Software Update)
    - PayTV (CA/CI)
    - Interactive TV (MHP)
    - Mobile TV
DTV Overview

- **DTV Basic Functions**
  - **Channel Scanning**
    - Different settings for Satellite/Cable/Terrestrial DTV receivers
    - Automatically/manually scan

- **Channel Organization**
  - Channel list
  - Channel edit
    - Favorite list
    - Sort, delete, hide, …
    - Lock/unlock channels
DTV Overview

- **DTV Basic Functions**
  - Channel change banner
    - Program name, description
    - Date/time, duration
    - HD/SD, Dolby, Aspect ratio,
    - Parental rating, subtitling
  - Now/Next information
DTV Overview

- **DTV Basic Functions**
  - **Parental Guidance**
    - by program rating
    - by channel
    - by time
  
- **PIP & POP**
  - One tuner v.s. twin tuners
DTV Overview

• DTV Basic Functions
  – Teletext (TT)
  – Closed Caption (CC)
DTV Overview

- **DTV Advanced Functions**
  - **EPG (Electronic Program Guide)**
    - Program info: name, start time/duration, description.
    - Present/Following (now/next) vs. Scheduled (weekly) EPG
    - Display one dimensionally or two dimensionally
DTV Overview

- **DTV Advanced Functions**
  - **PVR** (Personal Video Recording)
    - Recording
      - Time-based, EPG-based
      - One time, periodically
  - Playback
    - Normal, FF, FR, Repeat
  - Time shifting
  - Stream Editing
  - **DVB-SSU** (System S/w Update)
    - Over-the-air sw update

### Software Update

- **During development**
  - ICE
  - RS232, Ethernet, USB
- **Mass production**
  - Flash programming equipment
- **In the field**
  - **On-site:**
    - RS232, USB
  - **Remote:**
    - Ethernet, OTA
DTV Overview

- **DTV Advanced Functions**
  - **PayTV**
    - The access to services inside TS is allowed only when subscription
  - **CA (Conditional Access)**
    - Smart card verification system
    - Middleware porting is needed
    - Different STB for different CA providers: Nagravision, Viaccess, Irdeto, etc.
    - Cheap but not compatible
  - **CI (Common Interface)**
    - Common PCMCIA interface for different CA modules
    - Same STB for different CA smart cards
    - Expensive but compatible
DTV Overview

- **DTV Advanced Functions**
  - **MHP (Multimedia Home Platform)**
    - A middleware
    - More applications than audio/video
    - Java-like applications

![Images of various DTV applications](image1.png)

- Football Guide
- TV Mail
- Virtual Keyboard
- Game
- Child Education
- English learning
- Weather
DTV Overview

• DTV Broadcasting System

Source coding

Digital Video Compression

System Layer

Service Multiplexing & Transport

Transmission System

Channel Coding

Digital Modulation

STB

Terminal System

Video

Audio

Service Information

Control Data
1.2 Characteristics of DTV Industry
Characteristics of DTV Industry

- Characteristics of DTV Industry
  - A lot of industries are involved.

- Major components of the DTV system
  - Content/Service Provider
    - TV program, Movie industry, Music industry, Game industry, information industry, etc.
    - Digital studio, storage, broadcasting equipments.
  - Transmission Channel
    - Satellite, Cable, terrestrial, fixed/mobile network
    - Communication equipments
  - Terminal devices
    - TV, Set-Top Box, PC/NB, cellular, PDA, vehicle device, etc.
    - IC(tuner/decoder/display), Panel, Storage, software, OS, etc.
Characteristics of DTV Industry
Characteristics of DTV Industry

- Huge difference among different DTV markets
  1. Different DTV standards
  2. Different ecological dispersion
  3. Different market demands

1. DTV Standards
   - ATSC: USA, Canada, Mexico, South Korea
   - DVB: Europe, Australia, New Zealand, Taiwan, etc.
   - ISDB: Japan
   - DMB-TH: China (2006/8)

Different DTV standards will affect the transmission equipment and the IC design of receiver front-end (tuner & demod).
2. **Ecological dispersion** (Satellite, Cable, Terrestrial)

- USA has the largest cable TV market in the world. There are over 85% of households watching cable TV.
- In Taiwan, cable TV viewers are also over 85%.
- In India, Indonesia, middle of Asia: Satellite TV is more popular.
- In Europe, Japan, China, Terrestrial TV is popular in urban; while Satellite TV is more popular in suburban.

Ecological dispersion affects the transmission equipment and the IC design of receiver front-end (tuner & demod).
Characteristics of DTV Industry

- DTV standards in the world wide

DSS – Hughes proprietary digital satellite system
ISDB-T Japan standard for Terrestrial TV
OpenCable – Digital cable standard developed by US CableLab.
3. Market Demands

- **Picture Quality**
  - HDTV markets: high-income countries, like North America, Europe, Japan, Australia.
  - SDTV markets: low-income countries, like China, India, South America.
- **TV Size**
  - Large size of TV: north America.
  - TV of 30 inches or even smaller, Asia urban, or room TV.
- **Functionality**
  - PayTV (various CA, CI), interactive DTV (MHP, OpenCable, …), PVR
  - Various customization
- **Integration**
  - Integrated with other consumer products, like HDD, DVD.
  - Popular in Japan, Korea.
1.3 DTV Market Survey
DTV Market Survey

• 數位衛星電視 (digital satellite stb, ds-stb)
  - 產品方展方向近年內無太大變化。美國最大衛星廣播公司direct tv將ds-stb產品增加連網能力，但除此之外，極少廠商提供有連網能力的ds-stb，因此在市場方面，仍以純ds-stb為主流。
  - 市場趨於飽和，未來成長幅度不高。
  - 預估2006年~2011年stb的年複合肥成長率達5.8%。
DTV Market Survey

• 數位有線電視 (digital cable stb, dc-stb)
  - 與cable modem整合的dc-stb產品，增加了連網能力，使消費者只需要一台機器一條纜線即可提供上網與stb需求。但在硬體成本差異考量下，低價的純dc-stb仍是市場主流。
  - 在北美與日本逐漸達飽和點，以東歐、中國以及南美洲較具成長空間。
  - 預估2006年~2011年的年複合成長率達9.7%。
DTV Market Survey

- 数位地面广播电视（digital terrestrial stb, dt-stb）
  - dt-stb的市场发展在全球数位电视广播政策带领下，预计2008年到2010年期间将大幅成长，大部份来自於政府的大量採购。
  - 目前最大市场在澳洲，亚洲市场则偏好将dt-stb整合进数位电视。
  - 预估2006年~2011年stb的年複合成长率達17.4%。
DTV Market Survey

• 網路電視 – ip(internet protocol) stb
  - 全球ip-stb市場發展在2004年到2007年間成長幅度緩和，2008年之後將開始大幅成長，原因在於各國寬頻基礎建設的普及率與線上內容產業的成熟。
  - 預估2006年~2011年stb的年複合成長率達66.9%。
DTV Market Survey

• 以地區別來看
  - 2006年至2011年歐洲地區為最大stb市場
  - 而中國則以27.7%的年複合成長率領先其他地區，其中以dc-stb佔中國最大市場，預計2011年可達3500萬台。

資料來源：IBTS 編製
• 美國
  - 自2002年起，美國的無線商業和非商業電視台便已陸續開播數位電視，數位節目的比例也在逐漸增加中。
  - 根據 eMarketer 的資料顯示，2002年全美擁有數位電視機收視戶共 3,890 萬戶，普及率 35.8%，自2004年開始，數位電視普及率以每年增加5個百分點的速度緩步成長。
  - 「數位類比轉換器計畫」
    • 9.9億美元的經費，補貼購買轉換器的消費者。每一個美國家庭可申請兩張40美元的優惠券。
DTV Market Survey

- 美國
  - 目前市面上的電視機種，大多未內建數位調諧器，需要加裝數位視訊轉換盒(或稱STB)才能接收數位電視訊號，稱不上是數位電視。
  - FCC為鼓勵數位電視的發展實施導入政策
    - 36吋以上：07/2004以前須50%；07/2005以前須100%具數位接收能力。
    - 25吋到35吋：07/2005以前須50%；07/2006以前須100%具數位接收能力。
    - 13吋到24吋的電視：07/2007以前須100%具備數位接收能力。
    - 錄影機和數位影音光碟機：須在07/2007以前100%具備數位接收能力。
DTV Market Survey

- **Europe:**
  - Currently, Europe has more than 3,000 million digital TV users, estimated that 2010 European digital TV users total will reach 9,710 million, can reach 41% penetration rate.

<table>
<thead>
<tr>
<th>Country</th>
<th>Satellite</th>
<th>DSL</th>
<th>DMB</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>18%</td>
<td>21%</td>
<td>4%</td>
<td>50%</td>
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<tr>
<td>Germany</td>
<td>32%</td>
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<td>4%</td>
<td>33%</td>
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<td>Netherlands</td>
<td>55%</td>
<td>1%</td>
<td>3%</td>
<td>60%</td>
</tr>
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<td>Spain</td>
<td>9%</td>
<td>24%</td>
<td>4%</td>
<td>52%</td>
</tr>
<tr>
<td>Sweden</td>
<td>52%</td>
<td>20%</td>
<td>5%</td>
<td>81%</td>
</tr>
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<td>Switzerland</td>
<td>64%</td>
<td>1%</td>
<td>3%</td>
<td>70%</td>
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<tr>
<td>UK</td>
<td>17%</td>
<td>32%</td>
<td>2%</td>
<td>66%</td>
</tr>
<tr>
<td>Europe</td>
<td>19%</td>
<td>12%</td>
<td>3%</td>
<td>41%</td>
</tr>
</tbody>
</table>

Note: Percentage as a percentage of total TV users.

Western Europe 2010 digital TV penetration rate estimate.
• 日本
  - 至2003年上半年為止，約有421萬戶以衛星或有線電視接收數位電視訊號。
  - 2003年12月數位地面廣播在東京、大阪、名古屋三大城試播，2006年全國廣播。

日本數位電視用戶發展現況

單位：萬戶
台灣

- 交通部電信總局於八十七年七月公告台灣將採用美國的ATSC 數位電視標準
  - ATSC採用的 6MHz 頻寬和台灣現有類比頻寬相同。
  - 傳輸效率高、抗脈衝雜訊強，接收構造簡單便宜，適合市場推廣。
- 九十年年六月改採歐規 DVB 標準
  - 主要是具行動接收、可建立單頻網路（SFN）改善收視涵蓋、室內接收能力佳、抗多路徑干擾強，較適合台灣地理環境與營運模式。
• 各電視台分工任務：
  - 中視：中部發射站
  - 台視：三義發射站 華視：南部發射站
  - 民視：主控頭端系統設立、宜蘭發射站
  - 公視：花蓮及台東發射站
  - 電視學會：相關行政與財務管理

• 各台頻譜分配現況：
  - 中視（CTV）：CH24、CH25
  - 公視（PTS）：CH26、CH27
  - 民視（FTV）：CH28、CH29
  - 台視（TTV）：CH31、CH32
  - 華視（CTS）：CH34、CH35
DTV Market Survey
DTV Market Survey

- The analog will be switched off as digital becomes more popular.
  - 已完成停類比訊號停播
    - Netherlands: by late 2006. (the first country to completely move to DTV)
  - 其他世界各國停播類比訊號時程

<table>
<thead>
<tr>
<th>国家</th>
<th>開播年</th>
<th>停播年</th>
</tr>
</thead>
<tbody>
<tr>
<td>美國</td>
<td>1998</td>
<td>2009</td>
</tr>
<tr>
<td>英國</td>
<td>1998</td>
<td>2012</td>
</tr>
<tr>
<td>德國</td>
<td>2000</td>
<td>2010</td>
</tr>
<tr>
<td>韓國</td>
<td>2001</td>
<td>2010</td>
</tr>
<tr>
<td>日本</td>
<td>2001</td>
<td>2010</td>
</tr>
<tr>
<td>法國</td>
<td>2001</td>
<td>2015</td>
</tr>
<tr>
<td>義大利</td>
<td>2001</td>
<td>2010</td>
</tr>
<tr>
<td>台灣</td>
<td>2001</td>
<td>2010</td>
</tr>
<tr>
<td>中國大陸</td>
<td>2002</td>
<td>2015</td>
</tr>
</tbody>
</table>

資料來源：IBTS編製
1.4 DTV Standard Overview
DTV Standard Overview

• ATSC History – USA
  – Developed by **Advanced Television Systems Committee**, and accepted by FCC in 1996 for digital TV broadcast in U.S.
  
  – 1988 FCC starts HDTV research
    • Advanced Television Test center
  
  – 1993 ATSC (Advanced Television System Committee) formed
    • Members include: TV broadcasters + more than 200 companies.
  
  – 1996 ATSC digital TV standard accepted by FCC
  
  – 1998 Start ATSC broadcast
  
  – 2004-2007 USA 36”, 25”, 13” DTV build-in
• DVB History - EU
  – DVB standard is maintained by DVB Project which is an industry-led consortium with over 260 members in over 35 countries.
  – 1987 EU starts DTV research
  – 1993 DVB (Digital Video Broadcasting) organization founded with more than 300 members.
  – 1994 Start DVB-C, DVB-S broadcast
    • SD video + stereo audio
  – 1996 Start DVB-T broadcast
  – 1997 DVB agrees to incorporate HDTV elements
  – 1998 Australia (HDTV + Dolby Digital)
  – 1999 DVB cooperation with China for terrestrial DTV
  – 2000 DVB approves MHP
  – 2001 Taiwan chooses DVB-T, reversing 1997 for ATSC
DTV Standard Overview

- **ISDB History - Japan**
  - ISDB (Integrated Services Digital Broadcasting) is developed by DiBEG as digital TV standards used in Japan.
  
  - Japan starts HDTV research in early 1960.
  - 1987 NHK demonstrated HDTV in NAB show and made great impression on US.
    - After this, US starts ATSC and Europe starts DVB development.
  
  - 1997 DiBEG (Digital Broadcasting Experts Group) formed with 32 members.
  - 2000 NHK started ISDB-S commercial broadcasting (BS digital)
  - 2003 NHK started ISDB-T commercial broadcasting.
  - 2006 Brazil announced ISDB-T as the chosen standard for Digital TV transmissions, to be fully implemented by 2016
DTV Standard Overview

- **ATSC standard**
  - Video: MPEG-II MP@HL (main profile, high level)
  - Audio: MPEG-I layer I,II, Dolby AC-3
  - System layer: MPEG-II TS + PSIP
  - Modulation: 8-VSB (terrestrial), 16-VSB(cable)
  - Interactive middleware: DASE(old) ACAP(new)
- **Main Features**
  - HDTV
    - ATSC system supports 18 formats with 6 HDTV, 9 EDTV, 3 SDTV.
  - Dolby AC-3
    - ATSC boasts “theater quality" audio because it uses the Dolby Digital AC3 format to provide 5.1-channel surround sound.
  - Low transmission power
    - VSB requires half transmission power compared with COFDM, so ATSC signal coverage is larger than DVB-T with same power.
    - Good for N. America where many places are rural with lower population density.
DTV Standard Overview

- **DVB standard**
  - Video: MPEG-II MP@ML (main profile, main level)
  - Audio: MPEG-I layer I, II
  - System layer: MPEG-II TS + SI
  - Modulation: COFDM (DVB-T/H), QAM(DVB-C), QPSK(DVB-S)
  - Channel Bandwidth: 6/7/8MHz (ATSC 6MHz with fixed 19.39bps)
  - Interactive middleware: MHP (Multimedia Home Platform)

- **Main Features (DVB-T)**
  - **SFN** (Single Frequency Network):
    - Since it is better at handling multipath, same channel freq can be used for adjacent areas. The spectrum allocation is efficient.
  - **Mobile Reception**
    - Due to Guard Band and the better multipath handling in COFDM, it is good for mobile reception.
  - **Two-way communication support**
    - DVB has standardized return channels RCS/C/T to provide bi-directional communication which is good for interactive DTV.
DTV Standard Overview

• **ISDB standard**
  - Include ISDB-T, ISDB-C, ISDB-S
  - Video: MPEG-II
  - Audio: MPEG-II AAC (allows 5.1 audio output)
  - System Layer: MPEG-II TS + ARIB STD B-10
  - Modulation: DPSK, QPSK, QAM, OFDM
  - Channel Bandwidth: 6MHz (3.7 ~ 23.2Mbps)

• **Main Features**
  - ISDB-S is 1.5 times more *efficient* than DVB-S. (ISDB-S could transmit at 51 Mbps with a single transponder, while DVB-S allows at about 34 Mbps)
  - ISDB-T has the most flexibility and efficiency for *mobile* and *portable* reception, compared with DVB-T and ATSC.
DTV Standard Overview

• **Mobile TV standards**
  - **DVB-H** (digital video broadcasting-handheld)
    • Derived from DVB-T with improvement on low power consumption, mobile reception, IP data casting.
  - **T-DMB** (digital multimedia broadcasting)
    • Derived from DAB. Used by South Korea.
  - **MediaFLO** (Media Forward Link Only)
    • Qualcomm’s technology to broadcast data to portable devices.
    • FLO means transmission path is one-way, from tower to device.
    • Verizon Wireless (second-largest wireless network in the U.S.) and Cingular (merged by AT&T Wireless and become the largest wireless carrier in the U.S.) announced to deploy MediaFLO in US.
  - **DVB-SH** (digital video broadcasting-Satellite handheld Feb. 2007)
    • to deliver IP based media content and data to handheld terminals like mobile phones and PDAs via satellite.