

# Digital TV Overview



數位電視系統原理及軟體技術  
銘傳大學資工系:陳游利、徐武孝

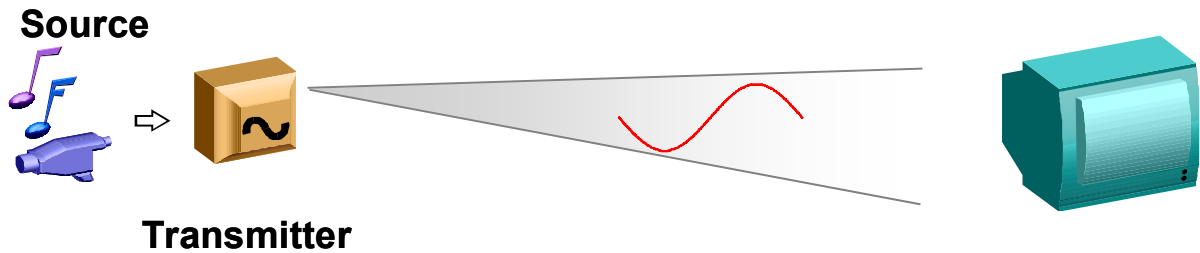
## Agenda



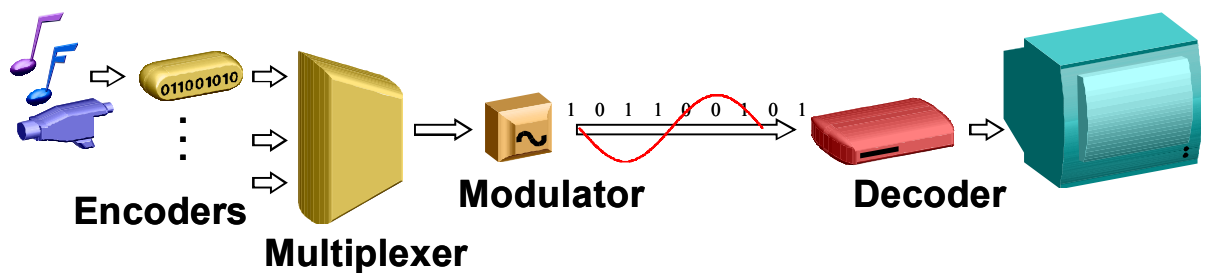
### ***What is digital TV ?***

- Digital TV applications
- An overview of the broadcasting chain
- Standards and present status
- Digital TV basics

# What is digital TV ?



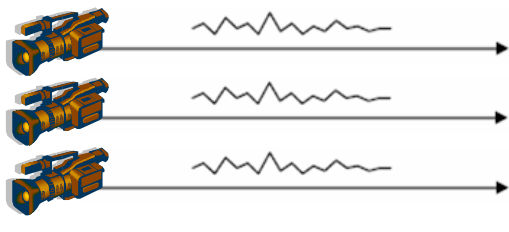
## Digital vs. Analogue TV



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# Analog TV vs. Digital TV

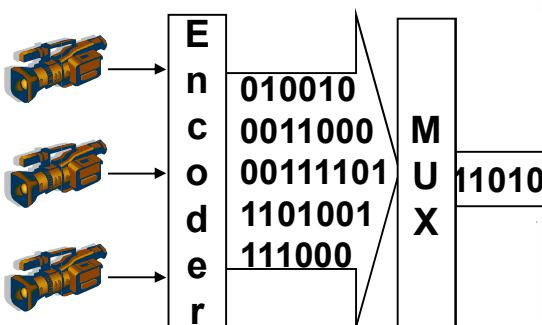
## Frequency-Domain Multiplexing



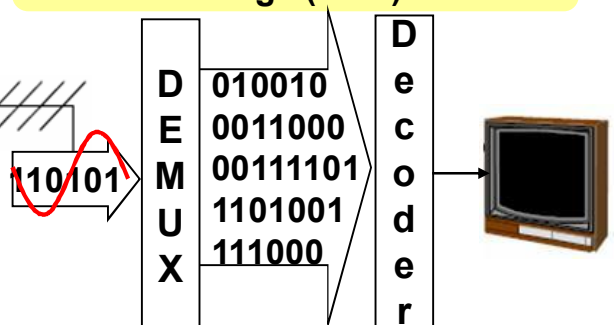
No Analog Storage



## Time-Domain Multiplexing



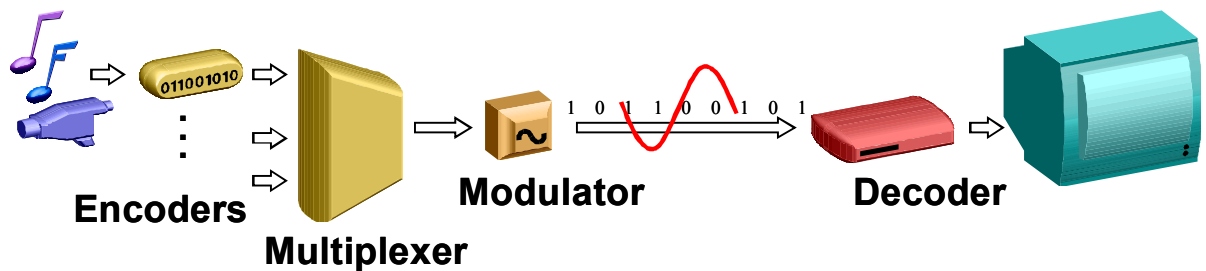
Flexible Digital Signal Processing & Local Storage (HDD)



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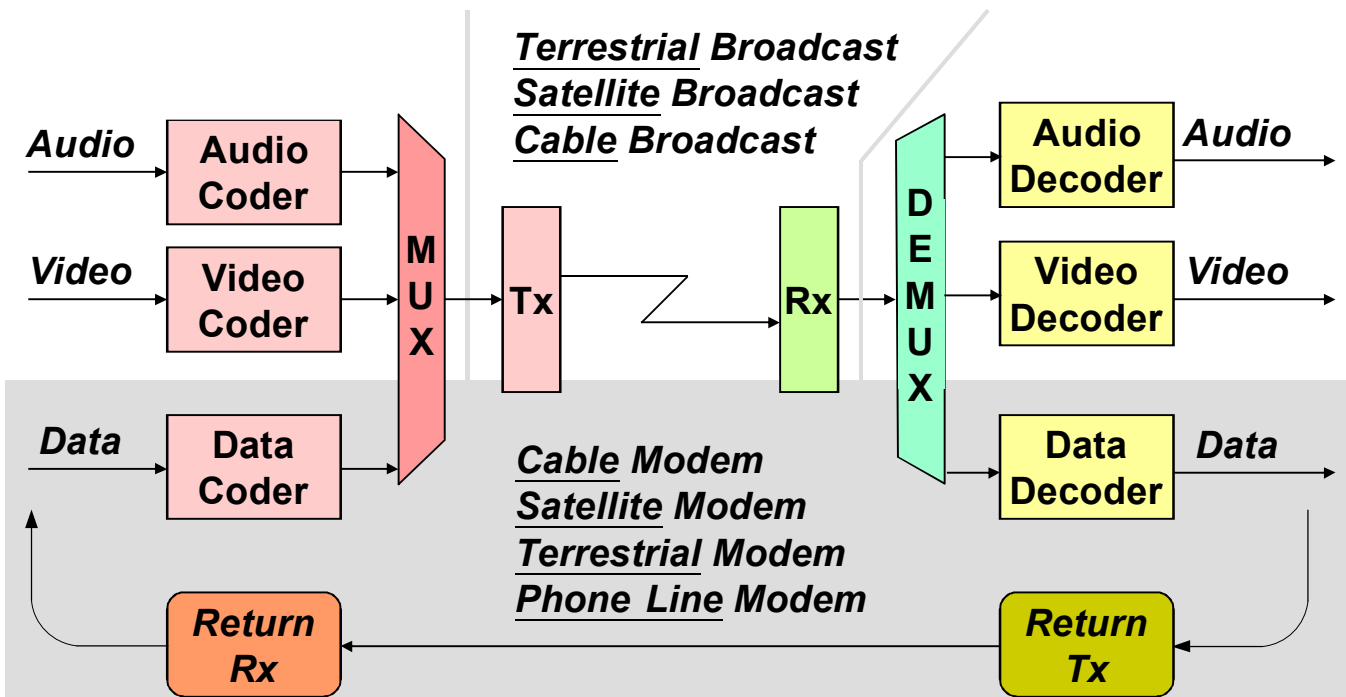
# The Digital TV system

- Video and audio source compressed
- Data information prepared
- Video, Audio and Data streams multiplexed
- Conditional access and Service Information added
- Transmission by cable/satellite/MMDS/terrestrial
- Demodulation by digital TV receiver
- Demultiplexing
- Decoding
- View on TV



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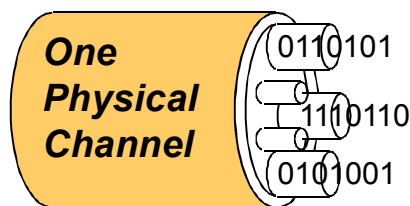
# A DTV System



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# DTV Containers

**Normal Quality**



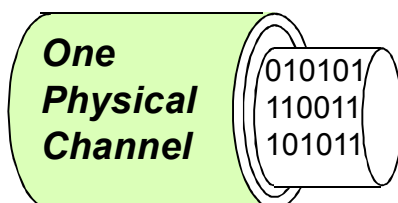
**SDTV1**



**SDTVn**



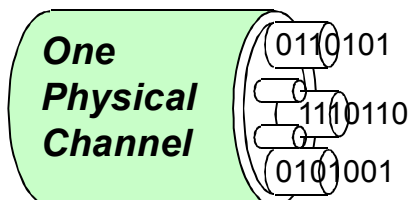
**Higher Quality**



**HDTV**



**Multi-Programmes or Variety Services**



**SDTV1**

**PPV3**

**SDTV2**

**Internet**

**Guide**

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# Digital TV - bit rate versus Quality

- 200 Mbit/s Studio original
- 8 Mbit/s perfect domestic
- 5 Mbit/s High quality pictures, OK for sports
- 2 Mbit/s Medium quality pictures, OK for news
- 1.2 Mbit/s VHS quality? (312 lines only)



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# Video Program Capacity

For a payload of around 19 Mb/s

- 1 HDTV service - sport & high action
- 2 HDTV services - both film material
- 1 HDTV + 1 or 2 SDTV non action/sport
- 3 SDTV for high action & sport video
- 6 SDTV for film, news & soap operas
- **More services means less quality**

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# Why Digital TV ?

- ⊗ Noise free pictures
- ⊗ Higher resolution images  
Widescreen / HDTV
- ⊗ No ghosting
- ⊗ Multi-channel sound
- ⊗ Combined entertainment with information.
- ⊗ Security and parent control
- ⊗ Other value added services.



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# Why Digital TV ?

- ◆ The TV industry is changing - Digital TV is here !
- ◆ Digital TV brings
  - More programs - 100s of TV channels
  - Better choice - viewer control
  - Interactivity - viewer becomes director
  - New services - video-on-demand, home shopping,
- ◆ More than TV: **new audiovisual services**



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# Why Digital TV ?

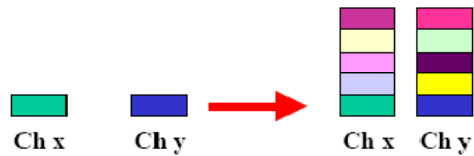
- ✿ Increase spectrum and power efficiency
- ✿ Resistance to channel distortion
- ✿ Flexibility in quality of program control
- ✿ Additional data information
- ✿ Provide more services
- ✿ Enable technology convergence

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# Why Digital TV ?

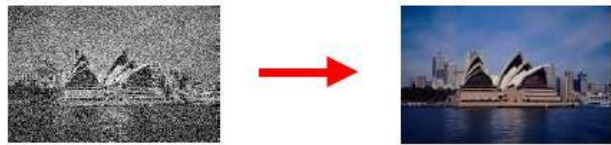
## Bandwidth efficiency

- More programs per channel



## Quality, reliability

- Noise free



## Compatibility

- MPEG-2 data



## Lower power

## Scalability



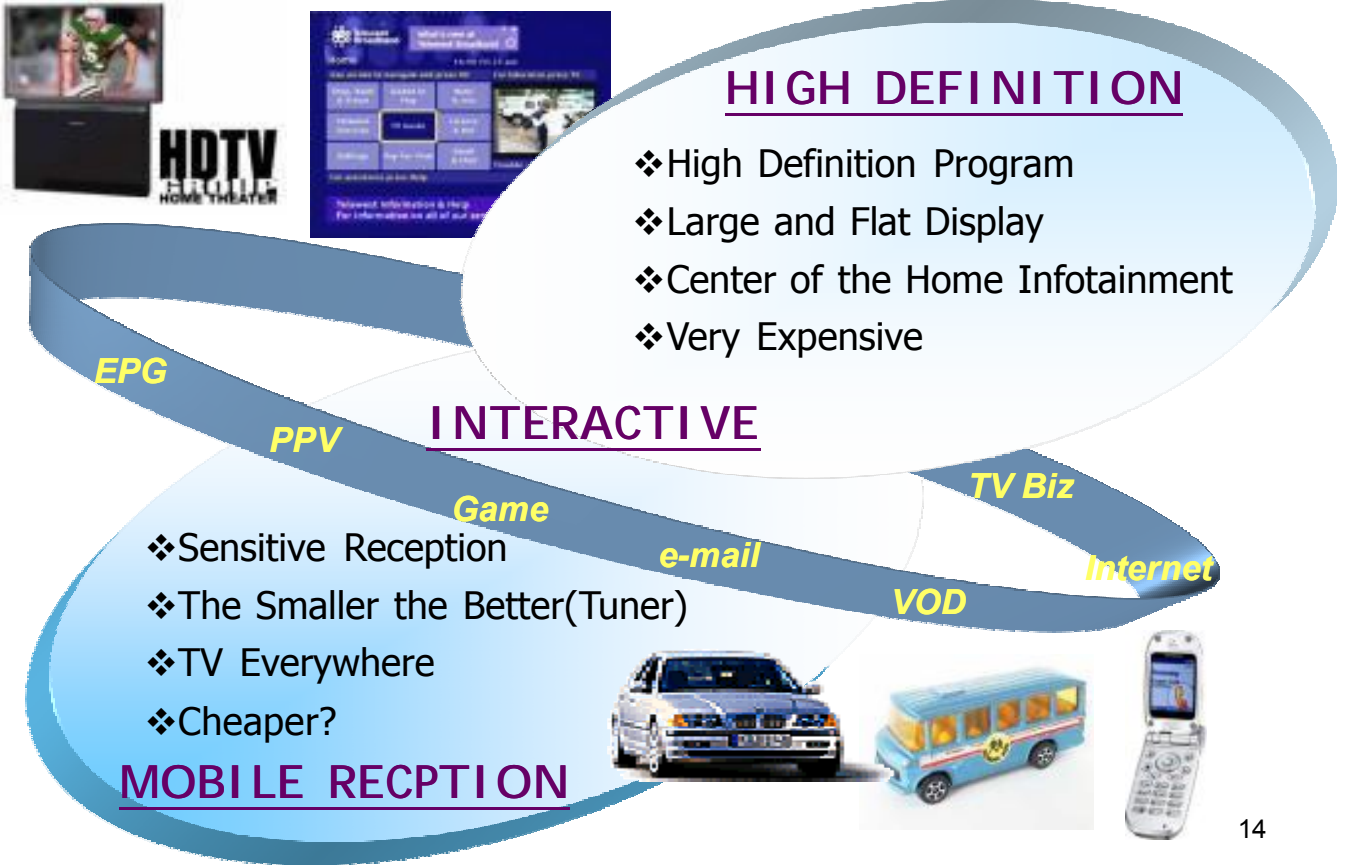
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# 視訊廣播數位化的優點

- 有效壓縮訊號傳輸所需要的頻寬(或在相同頻寬下提供較好的畫質或音質)
- 較能保證影音訊號的傳輸品質
- 提升系統的互動性與保密性
- 提供更完整的節目資訊與廣播服務資訊
  - 數位電視的用戶因此可以更方便的享受更高品質、更多樣性的視聽服務。

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# 數位化帶來新興電視服務-高畫質、互動、移動



## Agenda



- What is digital TV ?



### **Digital TV applications**

- An overview of the broadcasting chain
- Standards and present status
- Digital TV basics



# 台灣數位電視現況介紹

電台	頻道	頻號
中視	中視主頻道	533000
中視新聞台		
中視生活台 (My Life)		
公視	公視主頻道	545000
Dimo		
民視	民視主頻道	557000
愛琦電視台		
民視新聞台		
台視	台視主頻道	581000
TTV		
客家電視台		
華視	華視主頻道	593000
教育台		
U News 優新聞		



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## Features of The Next Entertainment STB

- ▶ Video Media Support (Cable, Satellite, Terrestrial)
- ▶ Electronic Program Guide
- ▶ Home Cinema Support ( 16:9, Dolby Digital)



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## Features of The Next Entertainment STB

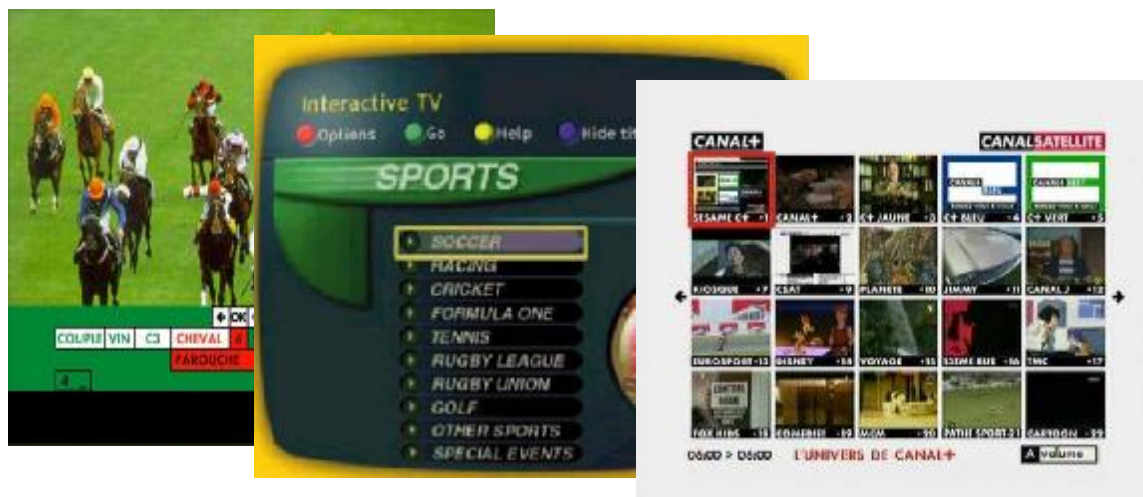
- ▶ Services - Weather Forecast, Airport Information
- ▶ Services - E-Mail, Web Browsing



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## Features of The Next Entertainment STB

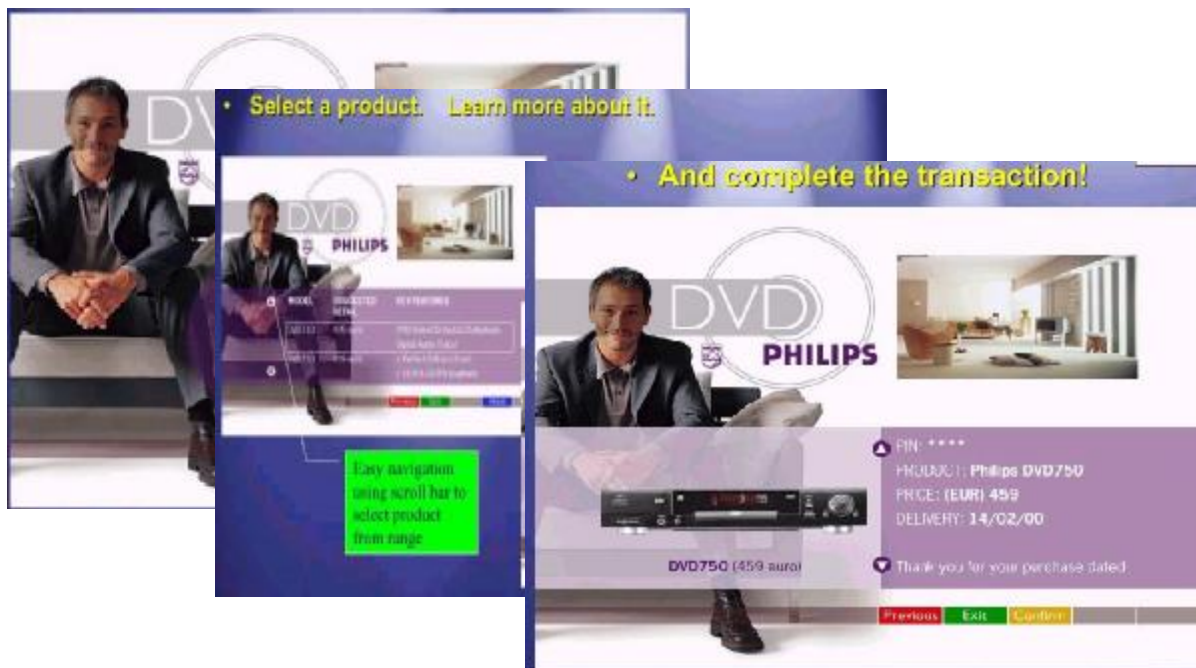
- ▶ Services - Lottery & Horse Race Results
- ▶ Services - Sports Stocks, Home Banking...
- ▶ Application - Mosaic



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# Features of The Next Entertainment STB

## ▶ E/T-Commerce



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# Features of The Next Entertainment STB

## ▶ PVR (Personal Video Recorder)

- Live Pause
- Trick Mode (Fast Forward , Fast Backward , Pause...)
- 30GB Hard driver can storage 23 Hours of 3Mbps content ( $30,000 \times 8 / 60 / 60 = 22.22 \text{Hours}$ )



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# Features of The Next Entertainment STB

- ▶ Voice telephony and Video Conference
- ▶ On-Line Game



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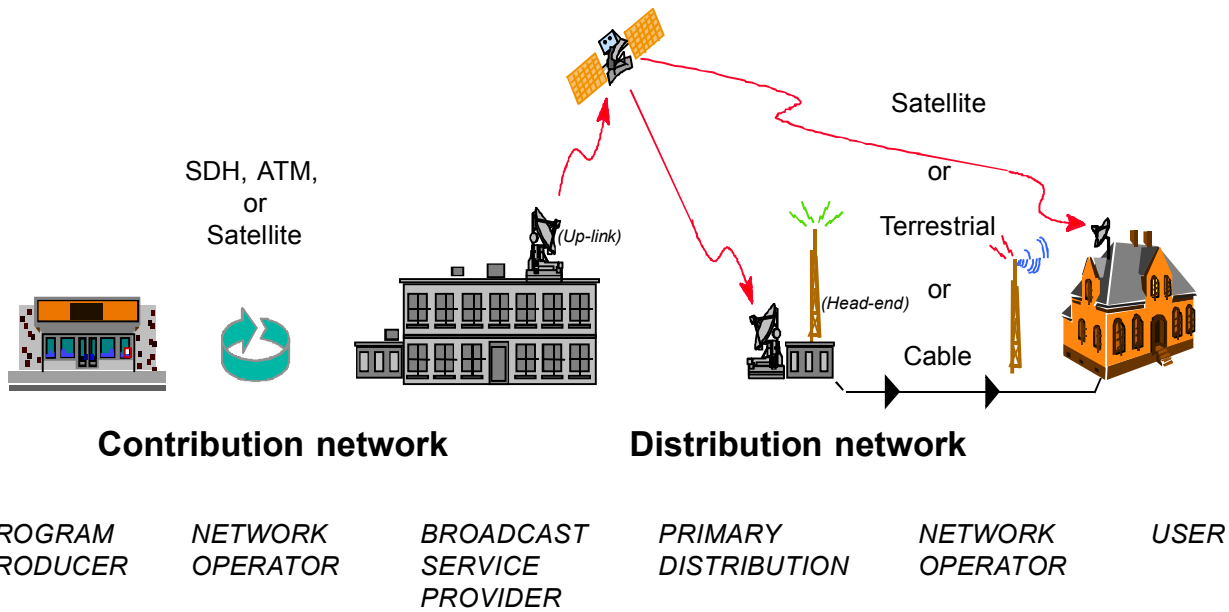
## Agenda



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- Digital TV applications
-  **An overview of the broadcasting chain**
- Standards and present status
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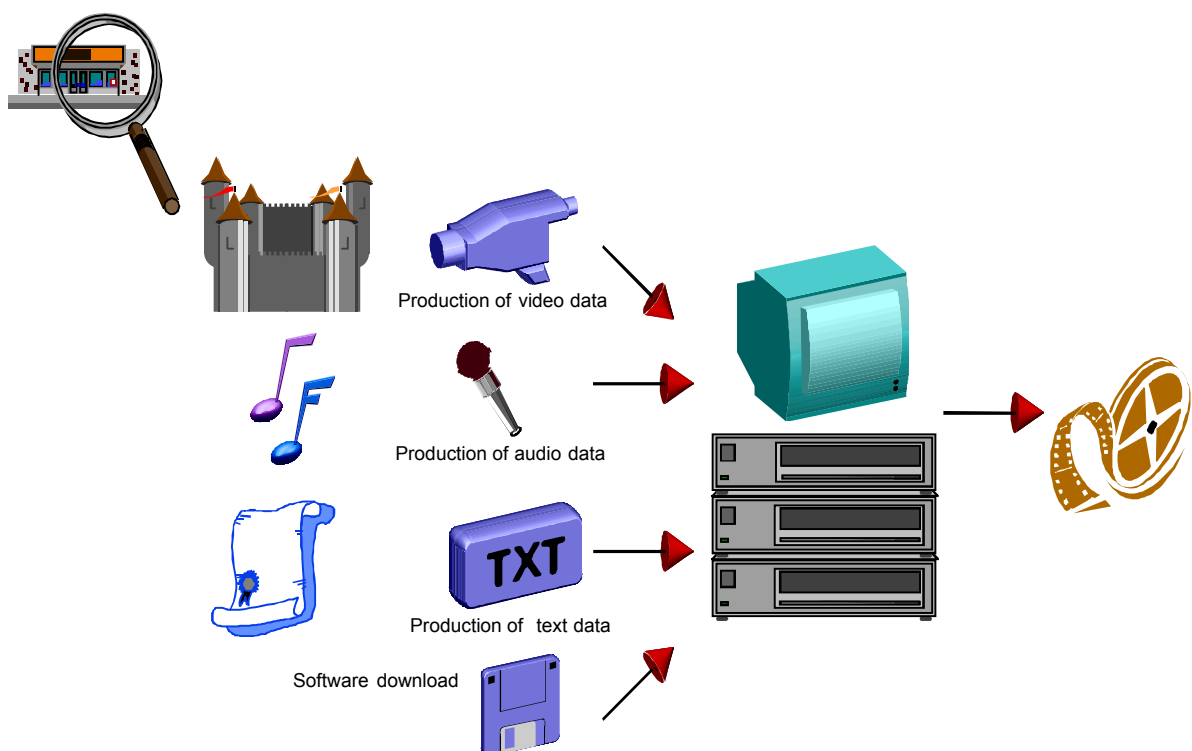
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# Broadcasting Chain Overview



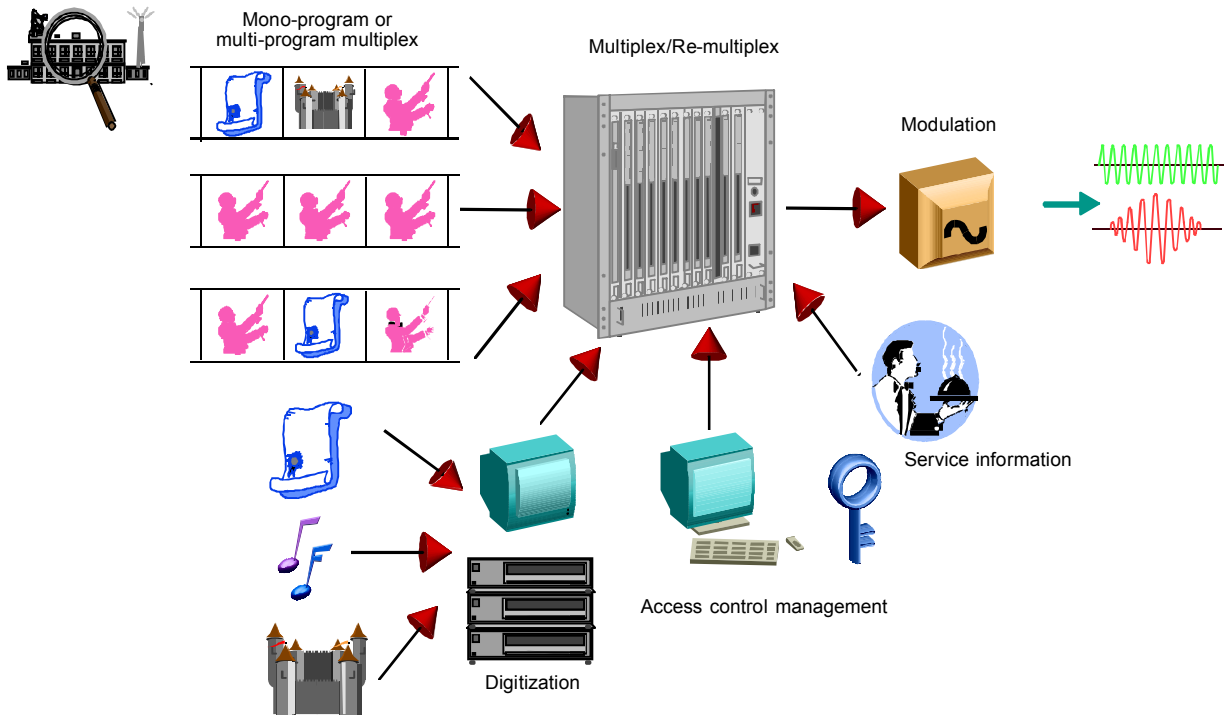
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# Broadcasting Chain: Program Producer



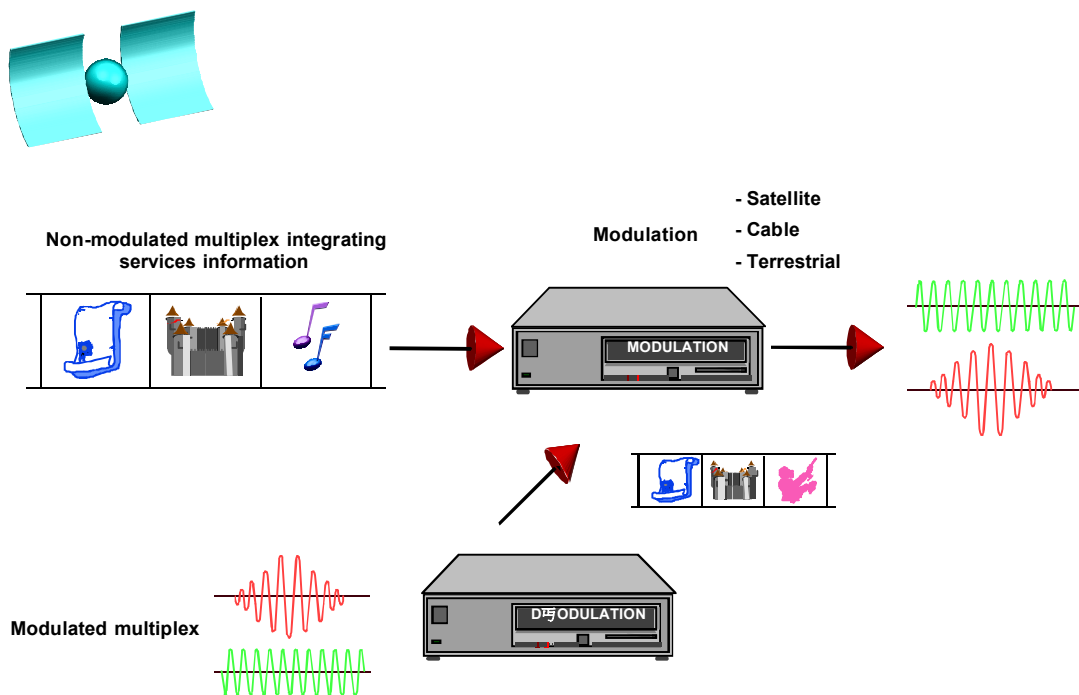
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# Broadcasting Chain: Service Provider



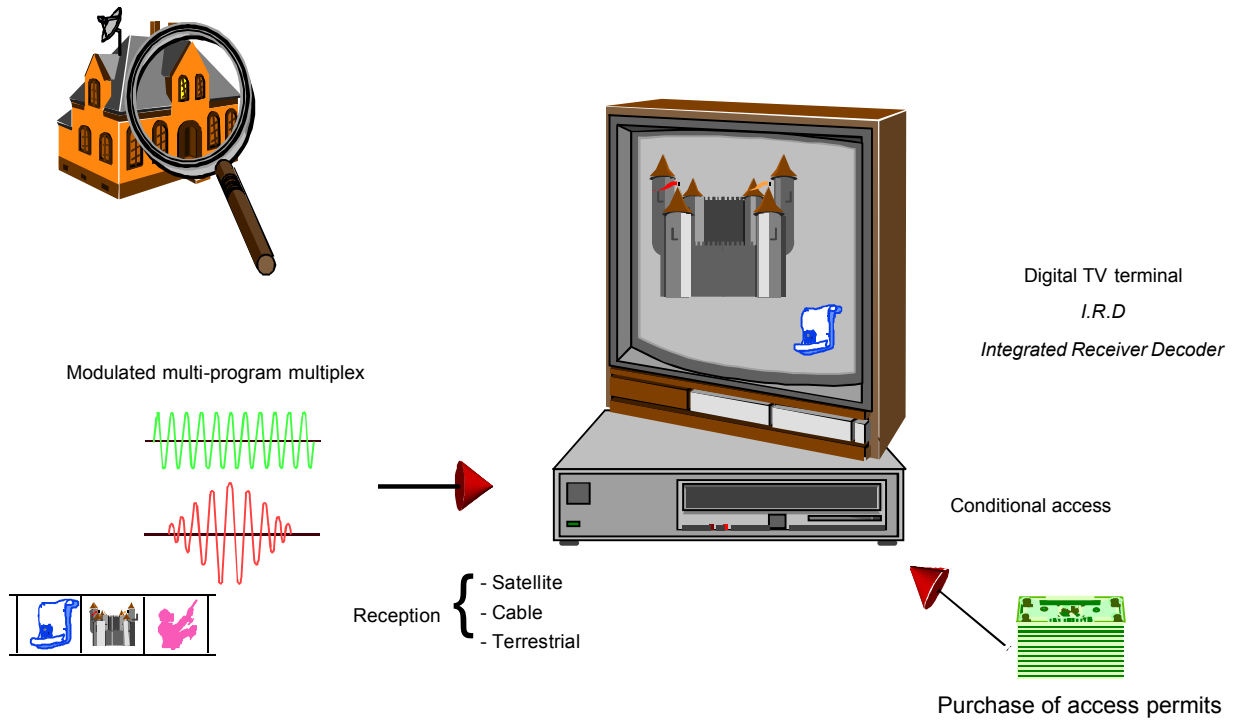
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# Broadcasting Chain: Network Operator



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# Broadcasting Chain: End User



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# Digital Broadcast Satellite - 1



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# Digital Broadcast Satellite - 2

## 規格

- DVB-S
- DSS (美國DirectTV)
- ISDB-S (日規)

## 優勢

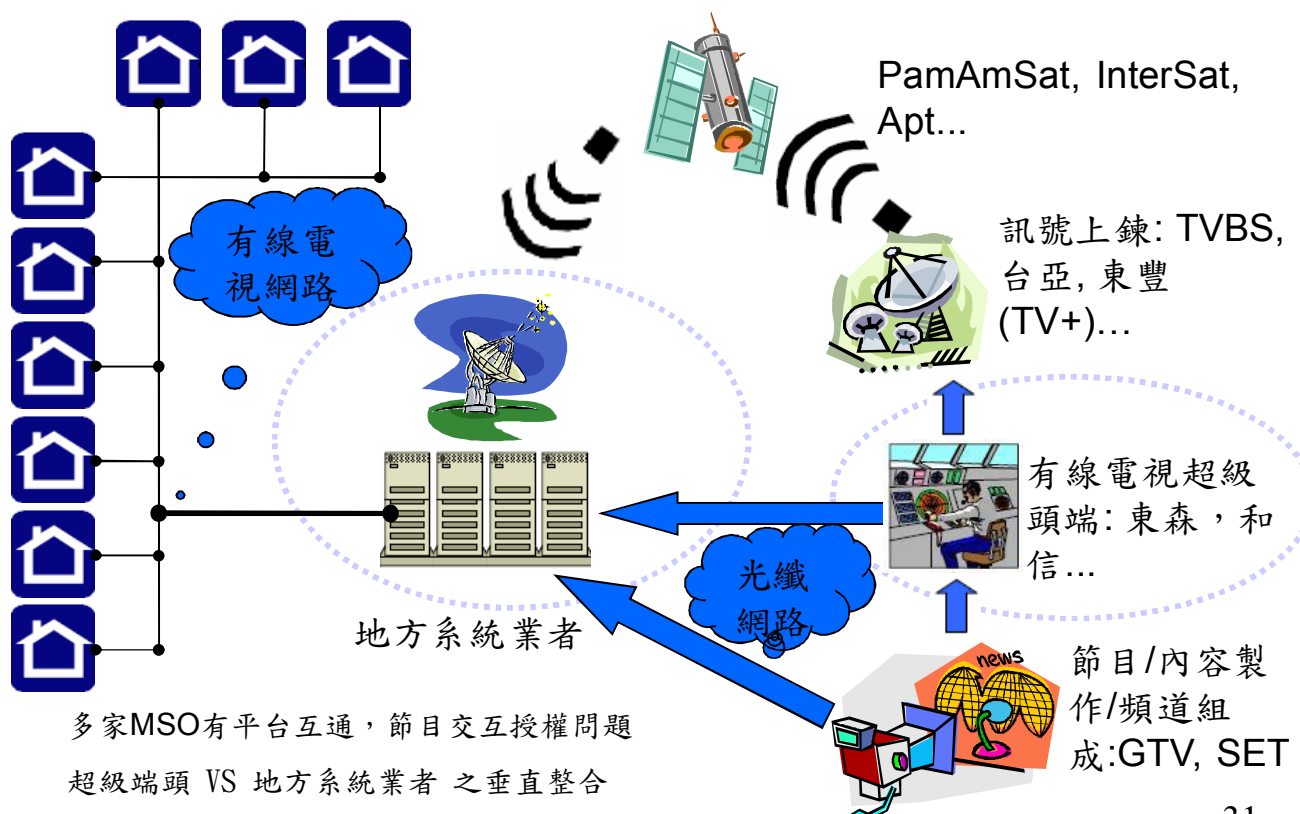
- 訊號廣佈，偏遠地區收視不受影響
- 平均營運成本隨用戶增加，大幅下降

## 劣勢

- 業者之先期投資成本較大(自有衛星)，或營運成本較高(租用衛星)
- 國內(台灣)市場規模有限，用戶平均收視成本較高
- 單向廣播式網路(no native return channel)，回傳需增加回傳網路(PSTN, GSM ...)

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# Digital Cable Systems - 1



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# Digital Cable Systems - 2

## 標準

- ☑ DVB-C
- ☑ OpenCable (美規, CableLabs)
- ☑ ISDB-C (日規)

## 優勢

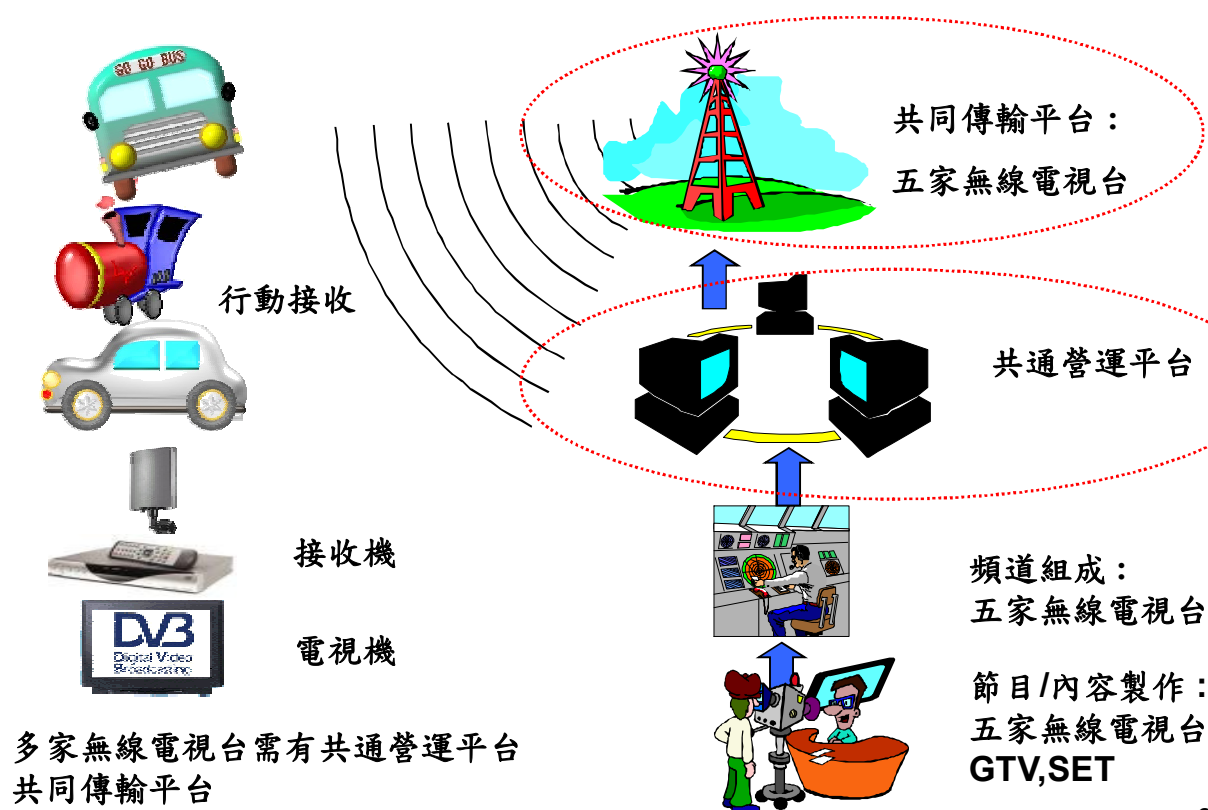
- ☑ 同一纜線可提供雙向傳輸
- ☑ 自建網路，自成系統整合較易，不須與其他業者分享頻寬

## 劣勢

- ☑ 無法提供移動接收
- ☑ 訊號涵蓋無法遍及人口稀少郊區(不符建置成本)
- ☑ 纜線維護成本高
- ☑ 多為地區性廣播系統

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# Digital Terrestrial TV - 1



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# Digital Terrestrial TV - 2

## 📻 標準

- ☑ DVB-T
- ☑ ATSC (美規)
- ☑ ISDB-T (日規)

## 📻 優勢

- ☑ 可作室內移動或行動接收(DVB-T 之優點)
- ☑ 僅需作傳輸塔台之建設與維護，用戶接收安裝較易
- ☑ 可較有線網路之訊號覆蓋面廣(全台灣可為單一系統)

## 📻 劣勢

- ☑ 頻寬需執照且為國家資源，頻寬較為有限(現有10ch x 6MHz)
- ☑ 單向廣播式網路，回傳資料需另增回傳網路

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## Agenda



- What is digital TV ?
- Digital TV applications
- An overview of the broadcasting chain
-  **Standards and present status**

- Digital TV basics

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# Current Analogue TV Standards

- |           |       |         |           |
|-----------|-------|---------|-----------|
| • USA     | 60Hz  | NTSC    | 525 lines |
| • Japan   | 60 Hz | NTSC    | 525 lines |
| • China   | 50Hz  | PAL-D   | 625 lines |
| • Germany | 50Hz  | PAL-B/G | 625 lines |
| • France  | 50Hz  | SECAM-L | 625 lines |
| • UK      | 50Hz  | PAL-I   | 625 lines |
| • Belgium | 50Hz  | PAL-B/H | 625 lines |



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## 數位電視廣播的標準

### ✚ 世界上數位電視廣播的三大系統




- 歐規的DVB (Digital Video Broadcasting)
- 美規的ATSC (Advanced Television Systems Committee)
- 日規的ISDB (Integrated Services Digital Broadcasting)

### ✚ 數位電視廣播標準，針對不同傳輸環境分別制定其技術規範：

- 地面廣播(terrestrial, -T) ← **本課程重點**
- 衛星廣播(satellite, -S)
- 有線電視廣播(cable, -C)
- 手持式裝置廣播(handheld, -H)

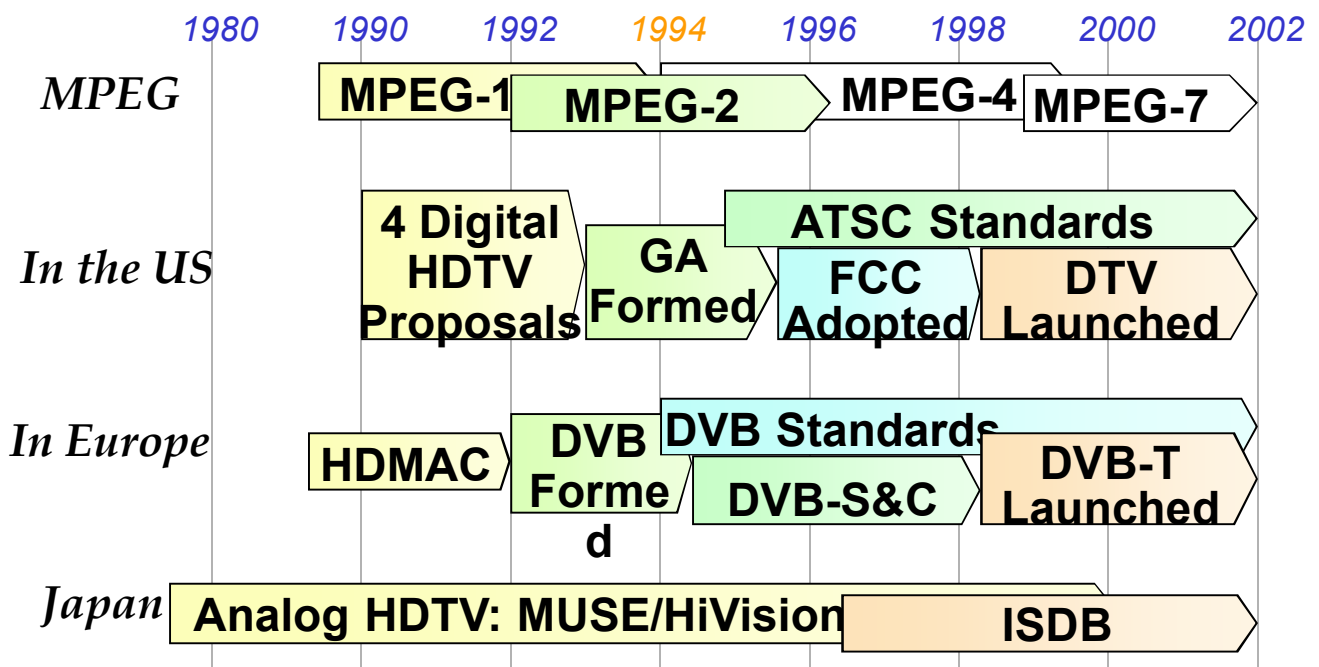
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# International Standards

	美國	歐洲	日本	台灣
 衛星	DDS, DVB-S	DVB-S	DVB-S	DVB-S
 有線電視	SCTE-031, OpenCable	DVB-C	DVB-C	DVB-C (可能)
 地面廣播	ATSC (8VSB) 加拿大, 阿根廷, 南韓	DVB-T (COFDM) 澳洲, 紐西蘭, 新加坡, 印度, 巴西	ISDB (COFDM)	DVB-T (COFDM)

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# Evolution of DTV Technologies



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# DVB Standards

- # The DVB Project began in September 1993
- # The Project now includes over 220 participants in more than 30 nations worldwide.
- # **DVB-SI (Service Information)** : EN 300 468 ; ETR 211; ETR 162
- # **DVB-S (Satellite)** : EN 300 421 ; TR 101 198



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# DVB Standards

- # **DVB-C (Cable)** : EN 300 429
- # **DVB-T (Terrestrial)** : EN 300 744 ; TR 101 191
- # **DVB-RC (Return Channel)** : ETS 300 800 ; TR 101 196
- # **DVB-MS/MC (MMDS)** : EN 300 748 ; EN300 749



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# MPEG-2 Specifications

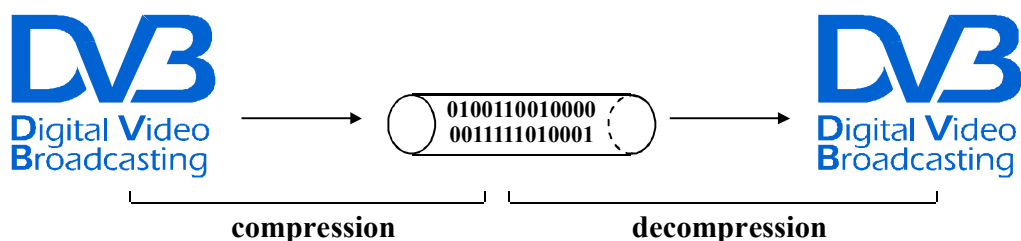
- ✚ ISO/IEC 13818-1 Systems
  - Defines Transport Stream & PSI
- ✚ ISO/IEC 13818-2 Video
- ✚ ISO/IEC 13818-3 Audio
- ✚ ISO/IEC 13818-4 Conformance
  - Defines Compliance Tests



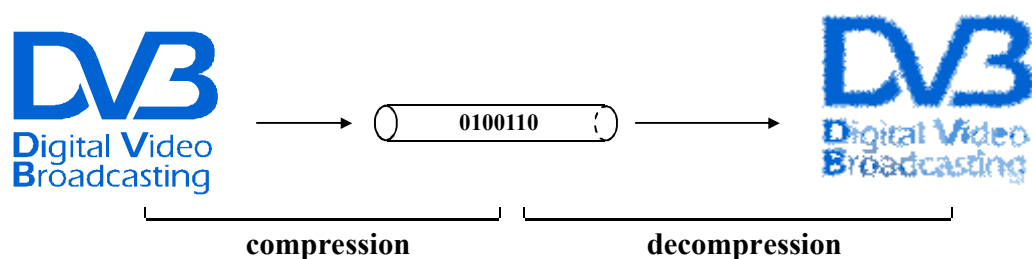
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## A word about compression

- ◆ lossless compression (eg .zip) : no rate control



- ◆ lossy compression (mpeg) : adjustable rate



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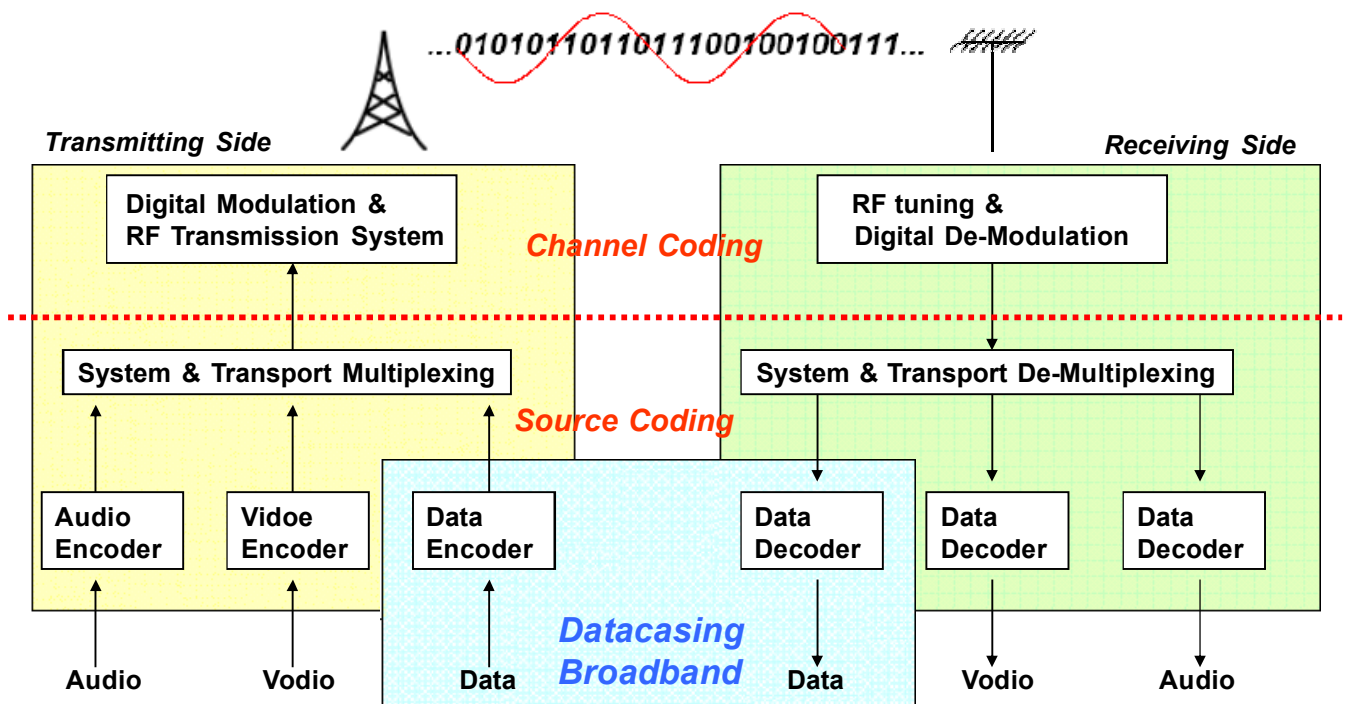


## Digital TV basics

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## DTV System Model



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# DVB Enabling Technologies

## ◆ Cannel Coding

### ■ Coding Schemes

- Error Correction, Energy Dispersion
- RS/Convolutional Code, Interleaving

### ■ Transmission Modulation

- Satellite: QPSK, 8PSK
- Cable: 16/32/64/256-QAM, QPSK
- Terrestrial: 8VSB(ATSC), COFDM(DVB)

## ◆ Source Coding

### ■ Source Encoding & Compression

- Video Compression
  - ✓ MPEG-2 MP@ML(SDTV),MP@HL(HDTV)
- Audio Compression
  - ✓ MPEG-1, MPEG-2/AC-3 multi channel, MPEG-2 AAC

### ■ System Multiplex

- MPEG-2 Transport System protocol
- MPEG-PSI / DVB-SI

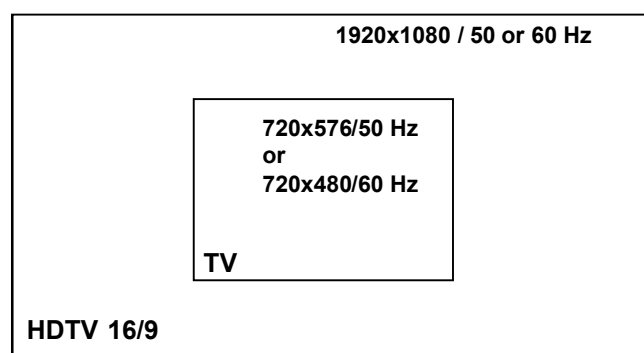
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# MPEG-2 Video Compression

◆ ISO/IEC IS 13818-2 standard (MPEG-2 Video)

◆ MPEG defines a family of standards

- ☞ from low resolution to high definition TV (levels)
- ☞ from low to high complexity algorithms (profiles)
- ☞ standard TV: MP@ML (Main profile/Main level)



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# MPEG-2 Video Compression

- ✿ Ratified as International Standard 1994
- ✿ Guarantees Interoperability through Defined Profiles and Levels
  - Variety of encoding techniques supported
  - Variety of resolutions supported
- ✿ No Definition of Quality



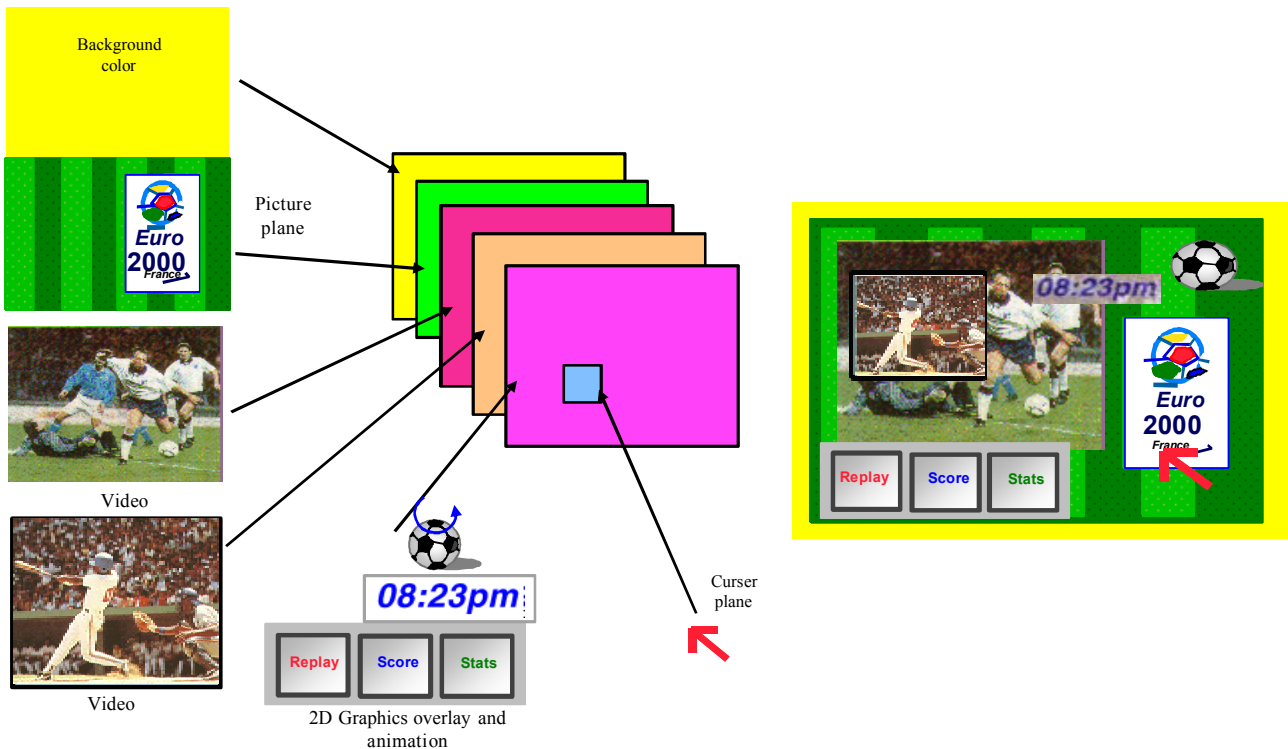
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# DVB Video Parameters

- ✚ MPEG-2 Main Profile @ Main Level
- ✚ 25/30 Hz Frame Rate
- ✚ 4:3, 16:9 or 2.2:1 Aspect Ratio
- ✚ IRDs Must Support:-
  - 4:3 and 16:9 (2.2:1 optional)
  - Pan Vectors for 4:3 Monitors
  - Upconversion to Full Screen Video

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# Video Display Plans



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# MPEG-2 Audio Compression

## ✚ DVB

- MPEG-1 audio for mono and stereo sounds
- MPEG-2 audio for surround sound (5 channels)
- Compatible with Dolby Surround (transmission of pseudo surround on a stereo pair)

## ✚ ATSC

- Dolby AC3 for stereo and surround (5 channels)



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# MPEG-2 Audio Compression

- Masking, PCM and Filtering
- 384 to 128Kbits/s at 32, 44.1 or 48kHz
- 5.1 Channels Defined:-
  - ☞ Left, Centre, Right, Left Surround and Right Surround
  - ☞ 0.1 For special Effects
- “near” CD quality



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# DVB Audio Parameters

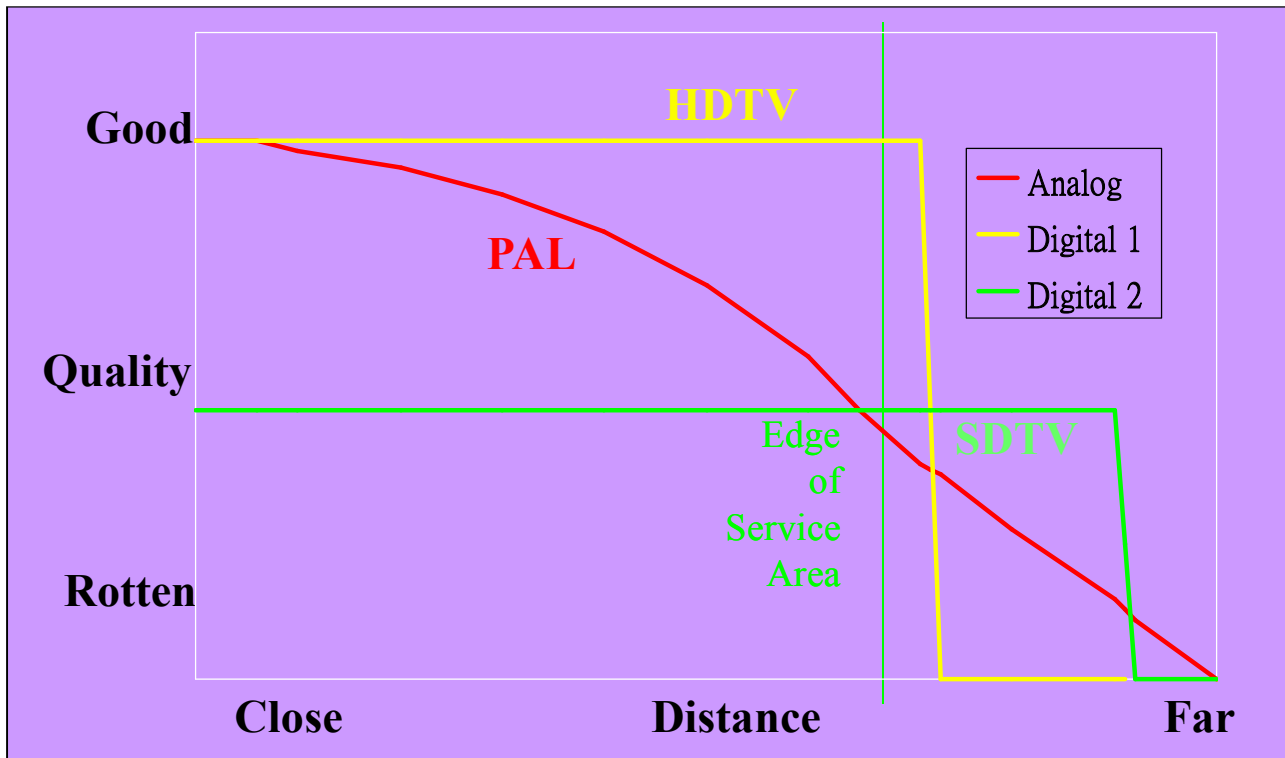
- ✚ MPEG-2 Layer II recommended for encoder
- ✚ IRDs support:
  - ☞ layer I and Layer II
  - ☞ Single, Dual and Stereo Channels
  - ☞ Sampling Rates of 32, 44.1 and 48 kHz



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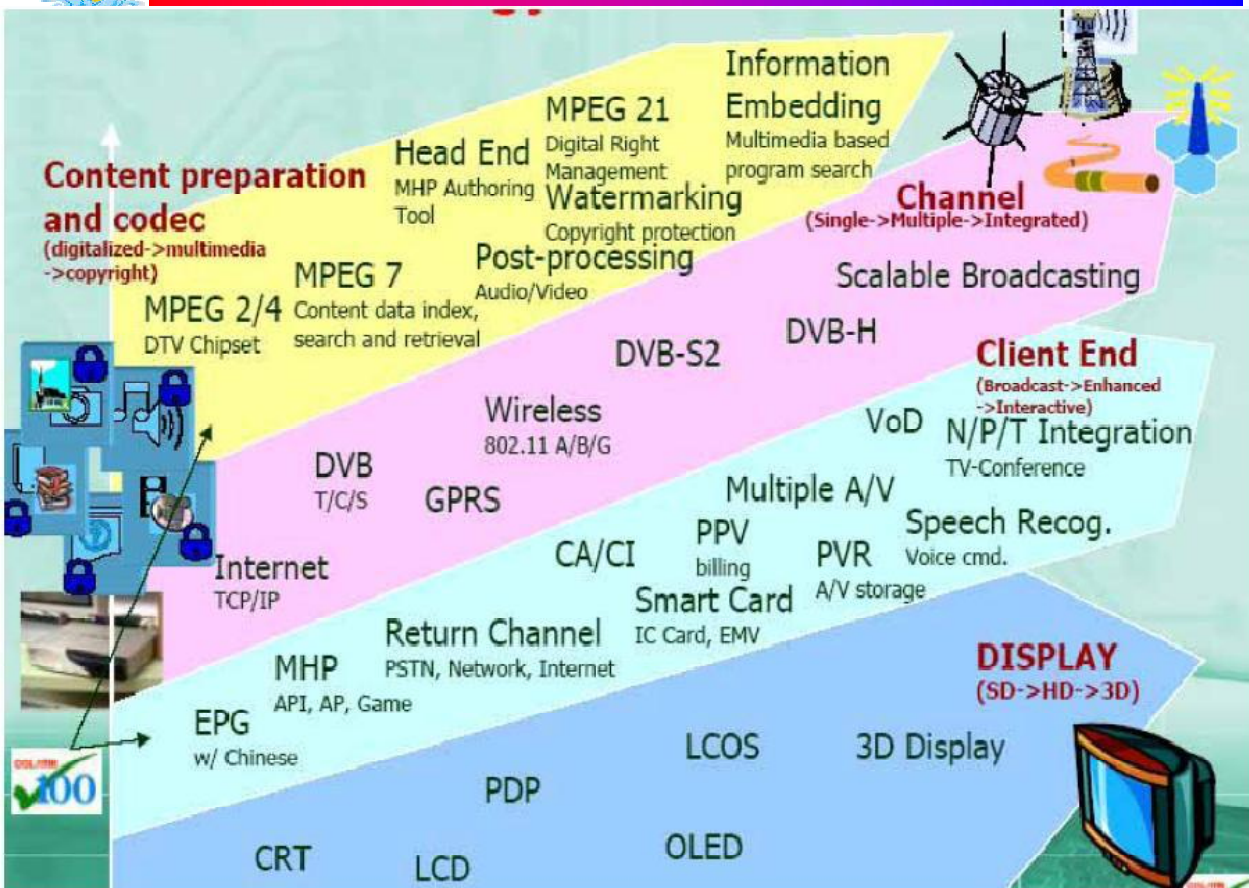
# TV Failure Characteristics



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# Technology Trend of DTV



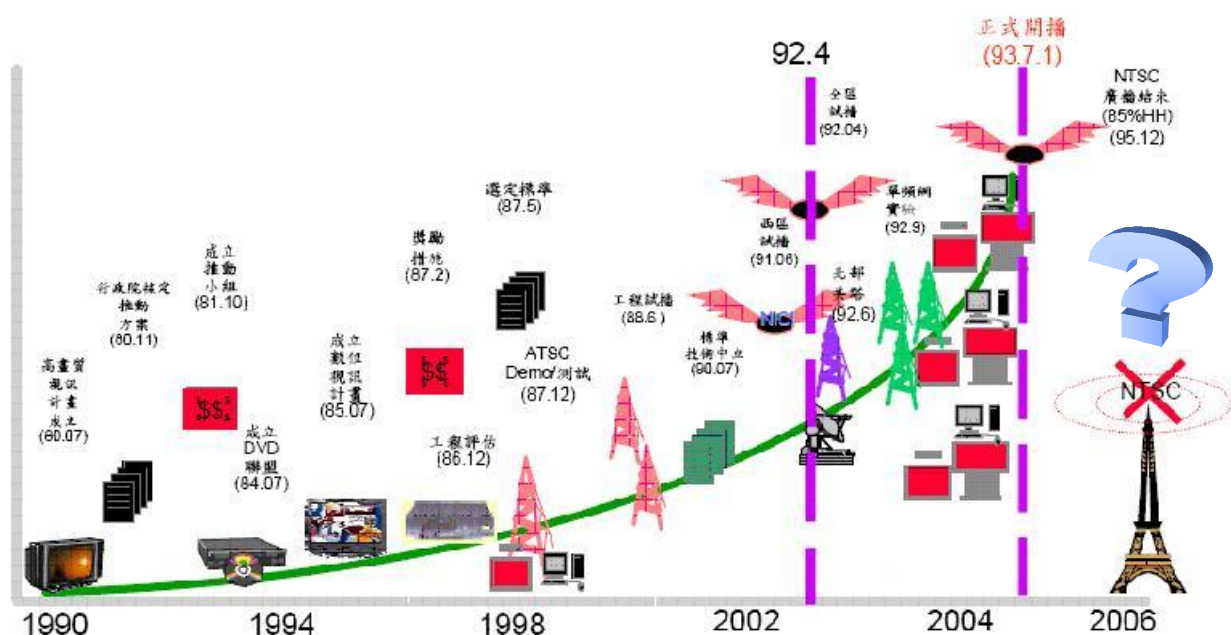
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# Vocabulary

- DVB: Digital Video Broadcasting, a European lead forum for digital TV specification
- MPEG: Moving Picture Expert Group, an ISO/IEC standardization group
- ATSC: Advanced Television System Committee
- SI: Service Information, a DVB spec for information on the contents of services
- EPG: Electronic Programm Guide, an application providing the consumer information on the services
- STB: Set-Top Box, the digital TV receiver
- DBS: Direct Broadcasting Satellite

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## Taiwan DTV Development Timelines



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# Any Questions?

敬請多指教!!

