

EBU TECHNICAL



## HDTV services *Trends and Implementations...*

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European Broadcasting Union



# AGENDA ....

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- **Background on HDTV uptake ...**
- **HDTV service... Roll out considerations**
- **European Trends Implementations...**
- **Conclusions**



# NEXT...

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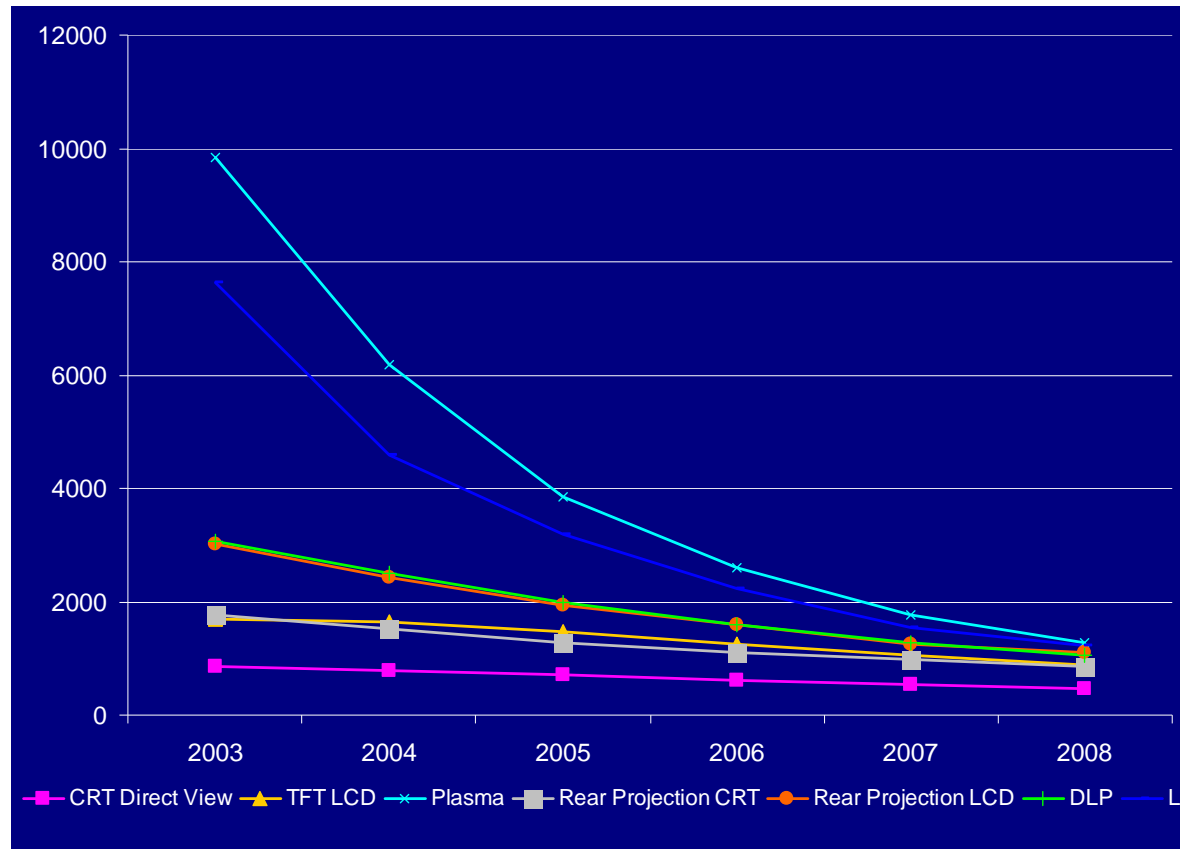
- **Background on HDTV uptake ...**
- **HDTV service... Roll out considerations**
- **European Trends...**
- **Conclusions**



# Background to HDTV uptake...

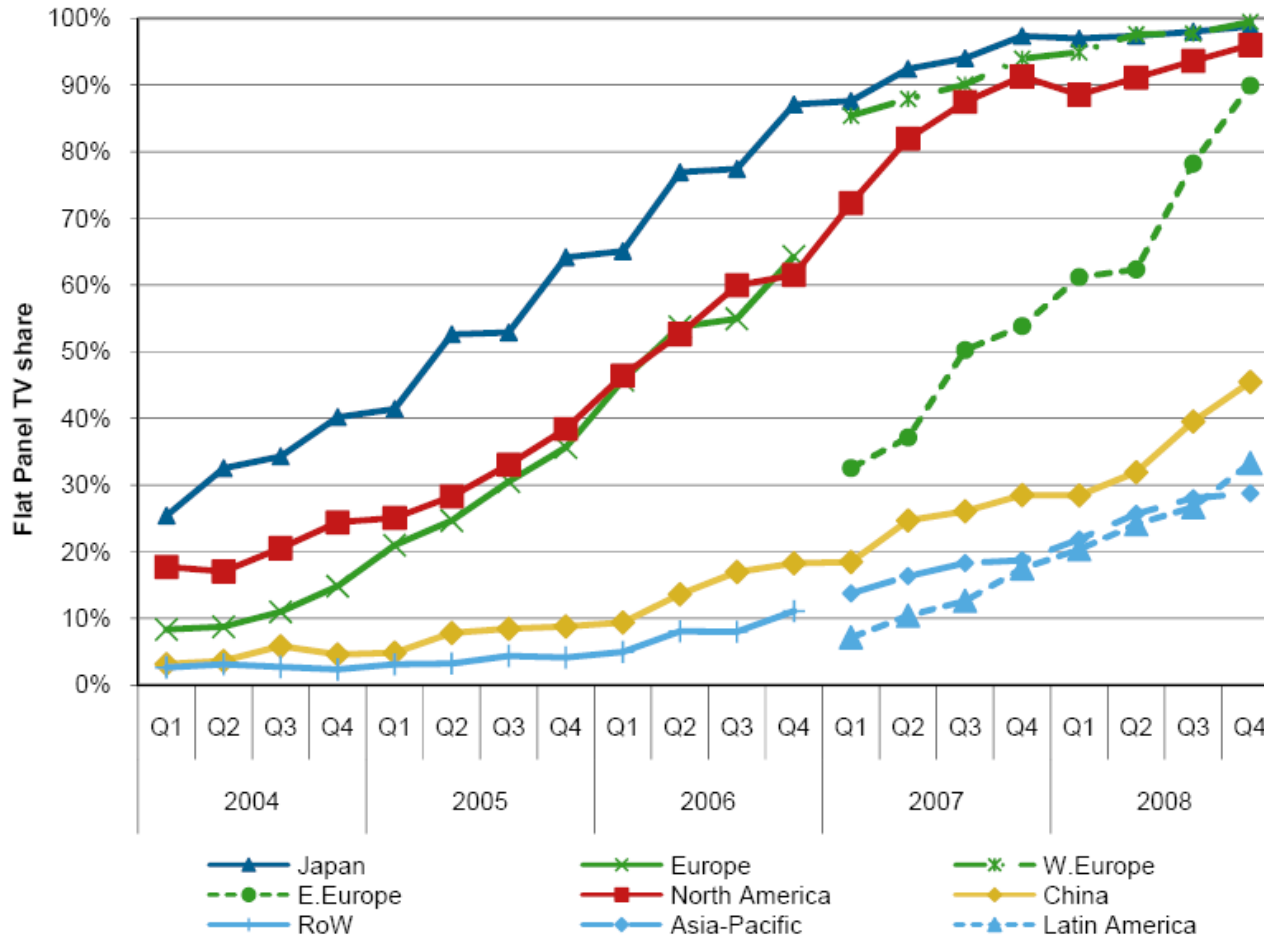
## ▪ Strong penetration of HDTV ready flat panel displays (FPDs) in EU households

- **Lower prices every year**, more features, larger, thinner, design etc...
- Several technologies in competition ( Plasmas, LCDs, Oled...)



# Background to HDTV uptake... *FPDs penetration*

Penetration of flat panel TV into regional markets



Source: EBU based on DisplaySearch

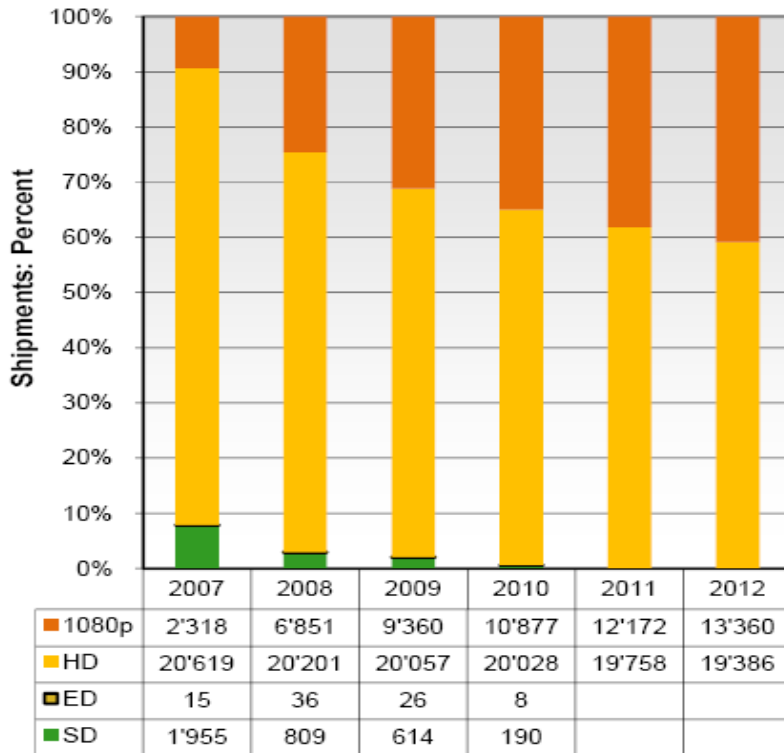


# Background to HDTV uptake... *Higher resolution FPDs*

## ▪ Inadequacy of Large FPDs in displaying SDTV

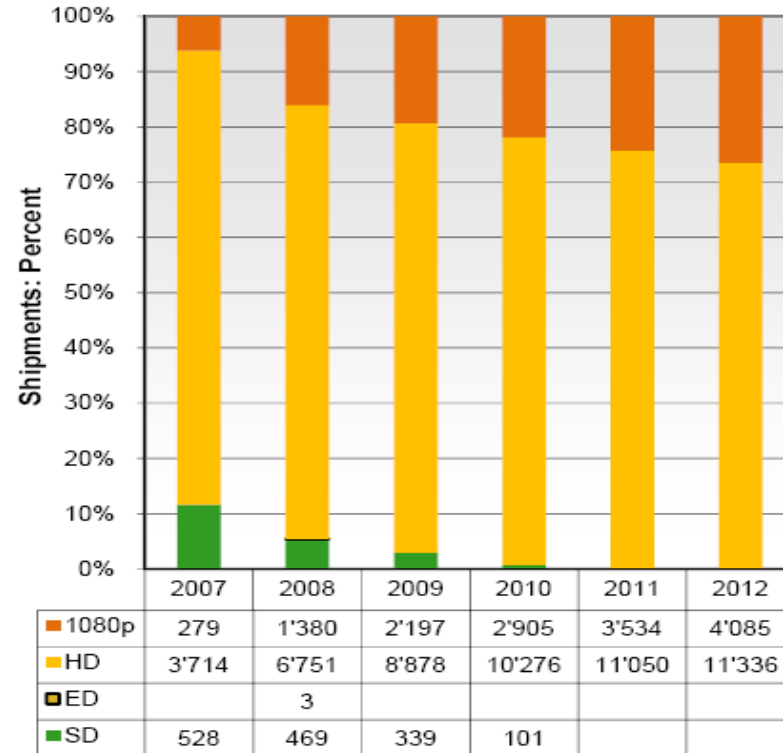
- Magnifying impairments of SD signal.

Western Europe LCD TV screen resolution forecast



Source: EBU based on DisplaySearch

Eastern Europe LCD TV screen resolution forecast



# Background to HDTV Uptake...*additional arguments*

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- **Strong Increase in HDTV retail content**
  - **INTERNATIONAL PROGRAMME EXCHANGE/SALES ONLY IN HD**
- **Higher image quality expectations from the viewers**
  - Games, Blu-ray ...
- **Non-EU HDTV channels available in EU through other delivery platforms**
  - Satellite , IPTV (with IP based geo-location), Download - VOD (see YouTube in HD)
- **Challenge: Maintain broadcast business model attractive with higher visual quality programs.**



# NEXT....

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- **HDTV service... Roll out considerations**
- European Trends Implementations...
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# HDTV Service ... Roll out considerations – *start when , how?*

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## When to start an HDTV service ?

- Usually coupled with major international events
  - World Cup (e.g. BBC HD in 2006)
  - EURO championships (Switzerland HD Suisse)

## But ....there is a clear separation between

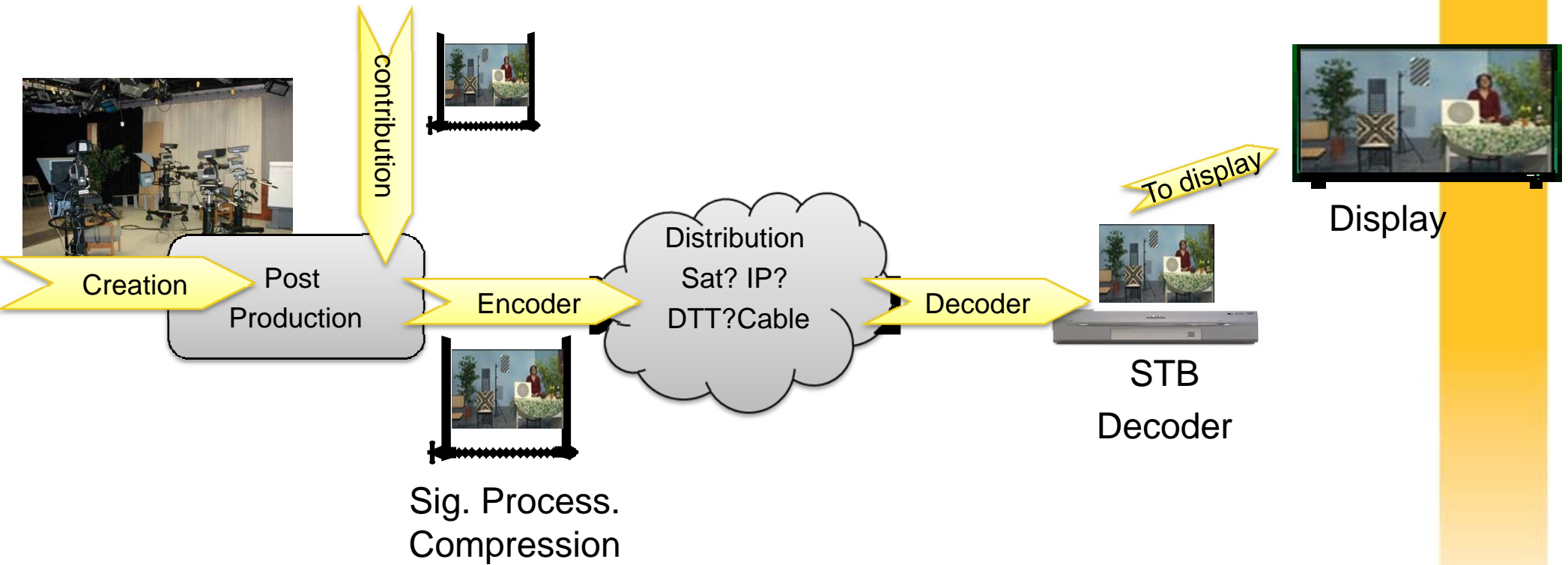
- When to **start broadcasting in HD** ?
- When to **start producing in HD** regular daily programs

## Depends on the broadcaster strategy and delivery platforms regulations...

- Premium channel over dedicated distributed platform
- Mixed SD up-converted and HD native content with a slow increase on HD native content



# HDTV Services...Roll out considerations – *chain overview*



# HDTV service ... Roll out considerations – *codecs*?

## Which compression system ?

- In **production** ?

AVC-I, MPEG2-long GOP, JPEG2000, ... (a Headache !)

Evaluation in **EBU BPN 076 – 079** (EBU Members only...sorry !)

- In **contribution** ?

MPEG-2 legacy for long...

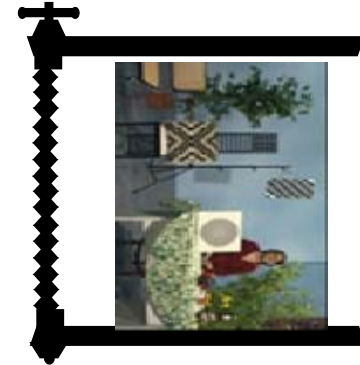
H.264/AVC High Profile 422 ? JPEG2000 ? Dirac ?

Investigations ongoing in EBU project group **N/HDCC** to provide guidance .

- In **distribution** ?

MPEG-2 or H.264/AVC (MPEG-4 part 10) or even SVC – scalable video coding?

Depends on receivers availability and price...



# HDTV Services... Roll out considerations – *formats?*

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## Image format selection ?

- 1920x1080*i*/25 (production & distribution) **1.48Gb/s**  
1440x1080*i*/25 (downsampled 1080/i25)
- 1280x720*p*/50 (production and distribution) **1.48Gb/s**
- 1920x1080*psf*/25 (mainly drama production) **1.48Gb/s**
- 1920x1080*p*/50 (3Gbps) Next generation HDTV but...
  - good production master format (consistent down-conversion to 720p/50)
  - potential future distribution format .



# HDTV Services...Roll out considerations – 720p50 vs 1080i25?



It's a lower number than 1080, so must be worse!

*Wrong: Interlacing reduces vertical resolution, has only half the frame rate than 720p/50, any motion is better represented with 720p/50*



The world is using 1080i/25, so why should we change?

*Early adopters could only chose 1080i due to equipment availability, today 720p/50 is available in the full chain, and requires less bandwidth in emission, it is future proof, and allows easy migration to 1080p/50. Even UHD TV and any other developments in DC etc. don't use Interlace*



My display has "1080 lines" so 1080i is much better

*Wrong: Interlaced artefact are much more apparent than upscaling of 720p; 1080-Displays up to 50" work very good with 720p/50 when images move*

# HDTV service ... Roll out considerations – *delivery platform* ?

## Which distribution platform i.e. what coverage/capacity do we have?

- **Terrestrial** - Digital switch over done yet ?

GE06 – Geneva 2006 plan defines spectrum availability and sharing ...

### DVB-T or DVB T2 ?

Reference planning configuration	RPC1	RPC2				RPC3	
		Portable outdoor		Mobile		Portable indoor	Portable indoor
Reception mode	Fixed	Portable outdoor		Mobile		Portable indoor	Portable indoor
Modulation	64-QAM	16-QAM	64-QAM	QPSK	16-QAM	16-QAM	16-QAM
Code rate	3/4	2/3	2/3	2/3	1/2	2/3	2/3
Location probability for planning	95%	95%	95%	99%	99%	70%	95%
Max. net bit rate* (Mbit/s)	27.14	16.09	24.13	8.04	12.06	16.09	16.09

\* Source: EBU BPN005 - *Terrestrial Digital Television: Planning and Implementation Considerations*, Third issue, Summer 2001

- **Satellite** - available bandwidth depends on satellite operators.

### DVB-S or DVB-S2 ?

- **Broadband** (IPTV) also depends on DSL / FTTH penetration in the country.

- **Cable** depends on the infrastructure already established in the country.

**DVB-C** as a transmission standard (DVB-T is also used by some operators)



# HDTV service ... Roll out considerations – *content?*

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## Content provisioning?

- Can we provide 100% HDTV content on our services ?
- Consumer recognise difference between **SD up-converted** and carefully checked native HDTV
- HDTV **native 24/7** is difficult
  - Simulcast versus dedicated HD channel ?
  - Start producing now in HD !!!!**

## Standard converters (60Hz/50Hz)?

- Frame rate and/or image ratio conversion can have serious quality impact.
- Preliminary conclusions / Recommendation:
  - Using a good motion-compensated standards converter**
  - More tests are conducted by EBU and Members in the **project group N/SC**
  - Go to **<http://tech.ebu.ch/groups> !**



# HDTV Services... Roll out considerations – *Facts...*

## A few Technical hints ...

DVB-T2 provide up to **45%** gain over DVB-T using the same bandwidth.

- But the overall bit rate depend on the select reception profile.

Possible transmission characteristics of DVB-T and DVB-T2

	DVB-T	DVB-T2
FEC	Convolutional Coding + Reed Solomon 1/2, 2/3, 3/4, 5/6, 7/8	LDPC + BCH 1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Modes	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM, 256QAM
Guard Interval	1/4, 1/8, 1/16, 1/32	1/4, 19/256, 1/8, 19/128, 1/16, 1/32, 1/128
FFT size	2k, 8k	1k, 2k, 4k, 8k, 16k, 32k
Scattered Pilots	8% of total	1%, 2%, 4%, 8% of total
Continual Pilots	2.6% of total	0.35% of total

Source: DVB Project

	Fixed reception		Portable reception	
	UHF Bands IV/V	VHF Band III	UHF Bands IV/V	VHF Band III
DVB-T	7-24	1-3	7-16	1-2
DVB-T2	21 <sup>9</sup> -40	4-5	14-24	2-3





# HDTV Service... Roll out considerations – few more facts...

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- DVB-S2 provides up to **35%** gain over DVB-S
- H.264/AVC (MPEG4) was proven to provide **~50%** coding gain over MPEG-2 for delivery rates.
- 720p/50 provides **20%** benefits in distribution than 1080i/25
  - ***EBU recommendation R124***
- Minimum (video) bit rate to provide HD quality (from EBU tests – ***EBU BPN085-087***) :
  - 1280x720p/50 – 10 Mbps**
  - 1440x1080i/25 – 12.1 Mbps**
  - 1920x1080i/25 – 12.8 Mbps**

**(Measured over several sequences and using 5 different encoders)**
- Using statistical multiplexing helps balance the rate on other channels (more HD services or higher quality at lower costs)



# HDTV Service... Roll out considerations

## Estimate of capacity needed per TV service on a DVB-T multiplex

Format	Source coding	Data rate (Mbit/s) fixed MUXing	Data rate (Mbit/s) statistical MUXing
SD	MPEG-2	4	3
SD	MPEG-4/AVC	3	2.5
HD-720p	MPEG-4/AVC	10-12	8-10
HD-1080i	MPEG-4/AVC	12-14	10-12
HD-1080p	MPEG-4/AVC	12-14	10-12

Source: EBU Technical

# HDTV service... Roll-out considerations – *DTT STBs availability?*

## Set Top Boxes and TV-Tuners compatibility and availability ?

Yes and prices will go down

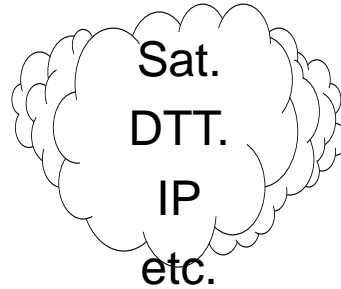
Digital switchover and compression format

Country	Launch date	Compression format	Completion of ASO
United Kingdom	1998	MPEG-2	2012
Sweden	1999	MPEG-2 / MPEG-4 AVC	Completed (2007)
Spain	2000/2005	MPEG-2	2010
Finland	2001	MPEG-2	Completed (2007)
Switzerland	2001	MPEG-2	Completed (2008)
Germany	2002	MPEG-2	Completed (2008)
Belgium (Flemish)	2002	MPEG-2	Completed (2008)
The Netherlands	2003	MPEG-2	Completed (2006)
Italy	2004	MPEG-2	2012
France	2005	MPEG-2 / MPEG-4 AVC	2011
Czech Republic	2005	MPEG-2	2011
Denmark	2006	MPEG-2 / MPEG-4 AVC	2009
Estonia	2006	MPEG-4 AVC	2010
Austria	2006	MPEG-2	2010
Slovenia	2006	MPEG-4 AVC	2011
Norway	2007	MPEG-4 AVC	2009
Lithuania	2008	MPEG-4 AVC	2012
Hungary	2008	MPEG-4 AVC likely	2011
Portugal	2009	MPEG-4 AVC	2012
Ireland	2009	MPEG-4 AVC	2012
Russia	TBC	MPEG-4 AVC	2015
Slovakia	2009	MPEG-4 AVC	2012
Poland	2009	MPEG-4 AVC likely	2014

Source: DigiTAG



# HDTV Services...Roll out considerations - (*suming up...*)

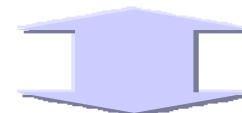
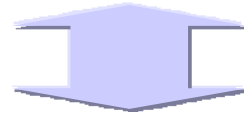
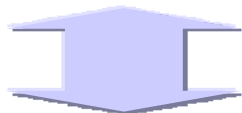
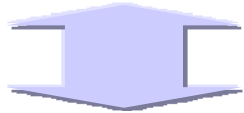


Sig. Process.  
Compression

STB

Display

Decoder



Studio-Interfaces

Signal Processing

Contribution

STB

Display

- Camera /Lens
- HD-SDI (1.485Gb)
- HD-SDI (3Gb)**
- 10 Gb (not yet)
- Switcher
- Router
- mixer

- P/I
- 1080i/25
- 1080p/25
- 1080p/24
- 720p/50**
- 1080p/50**
- Storage
- Archives

- still MPEG-2
- 422P@HL
- Emission format
- H.264/AVC**
- 720p/50**
- 1080i/25
- 1080psf/25
- Future: 1080p/50?
- Future: SVC?

- MPEG-2
- H.264/AVC**
- HDTV Ready**
- (720p/50
- 1080i/25)

- HD-Ready**
- 720p/50-60**
- 1080i/25-30**
- HD ready**
- 1080p**

4-6 compression formats



# NEXT....

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- **Conclusions**



# Trends in Europe... *Terrestrial dependent countries*

- Clear Roll-out Plan from Terrestrial dependent countries (>50% households dependent on DTT)
- Several HD services Launches and trials ongoing or planned  
Maintain relevance and competitiveness of terrestrial TV.
- Main configuration adopted (except UK):  
**DVB-T (64QAM-2/3-1/8) Bit Rate : 22.1Mbps (Fixed reception profile.)**  
**H.264/AVC**

## **Trials...**

- Finland (ongoing) – Helsinki area  
2 HD Muxes in VHF and 1 HD in UHF
- UK – End 2008 – DVB-T2 trials.  
Launch of 3-4 HDTV channels on 1 Mux – End 2009.  
DVB-T2, Stat. Mux, unknown image format.  
Estimated Rate : 34.5Mbps.



# Trends in Europe... *Terrestrial dependent countries*

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- Ireland – trials made but unclear launch date.
- Estonia – trials ongoing.
- Slovenia – (RTVSLO, Kanal A, PopTV ) trial during olympics08 on UHF channel 26 – 1080i/25
- Poland – TVP trials during olympics 08.
- Portugal not trials but HD service launch planned.

## Launched...

- Croatia – 1 HD Service since 2007.  
zagreb, Rijeka, osijek, Split (30% population coverage)
- France – Since Oct. 2008, 5 HD services on 3 different multiplexes  
TF1, FR2, M6 HD → Mux 1 ; CANAL+ HD → Mux 2, Arte HD → Mux 3  
DVB-T, 1080i/25  
Full transition to HD only services by 2012-2015  
Mandatory MPEG-4 tuners in all Receivers sold in France.
  - Law enforcement to regulate MPEG-2 to MPEG-4 migration in all DTT receivers.



# Trends in Europe... *Cable/Satellite dependent countries*

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## **HDTV roll out over satellite or cable.**

- Some public broadcasters, (Dominated by pay-TV operators.)

Switzerland (HD Suisse) 13Mbps, H.264/AVC, DVB-S, 720p/50

UK (BBC HD) ~14Mbps, H.264/AVC, DVB-S, **1440x1080i/25**

Germany (Arte , ARD/ZDF) 720p/50; FRANCE ARTE 1440x1080i/25

- No plans on HD services over Terrestrial.

Sweden (SVT HD) 720p/50

- Netherlands, Belgium

## **Use of terrestrial for mobile TV applications**

- Germany (DVB-T)
- Switzerland (DVB-H)





# Trends in Europe - *Mixed market countries...*

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## **Market evenly shared between IPTV, Sat., Cable and Terrestrial :**

- HD launches on terrestrial mainly by pay-**DTT** operators.  
Increase number of services offer for competitiveness.
- Norway  
Trial during olympics 08,  
Most DTT receivers already HD H.264/AVC capable.  
To launch HD service on DTT around 2010.
- Sweden  
SVT HD over satellite (720p/50)  
TV4 - Trials in stockholm (26% population coverage)  
DVB-T, H.264/AVC, 720p/50



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# Conclusions...

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## **HDTV roll-out is actively ongoing in Europe INCLUDING on Terrestrial**

- Compete with alternative, continuously growing platforms (satellite, IPTV, ...)

## **DVB-T is legacy as modulation standard in HD roll out except in UK**

- Move to new DVB-T2 attractive but too early/expensive for late Digital switchers

## **▪ In emission keep the bit rates high >10 for 720p/50 and >12Mbps for 1080i/25**

- To provide the HIGH definition experience expected

## **▪ Standards conversions only with high quality equipment (motion compensated)**

## **▪ For now and the near time and for efficient spectrum use**


- **Plan a fully progressive HDTV chain !**

## **All new HD services use H.264/AVC.**

- Migration path needed for Early Digital switchers from MPEG-2 to H.264/AVC.



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THANK  
YOU!

**Thank you**

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<http://tech.ebu.ch>

*Further Readings ...*

*HD on DTT (Digitag) - [http://www.digitag.org/HDTV\\_v01.pdf](http://www.digitag.org/HDTV_v01.pdf)*

*Accommodation of HDTV in the GE06 Plan – EBU tech 3334 – <http://tech.ebu.ch>*

*Articles on DVB-S2 , T2 etc... On <http://tech.ebu.ch>*

