



## – what's new on DVB-T2?

Webinar by Ed Wilson – EBU TECHNICAL  
& DigiTAG

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**EBU TECHNICAL**  
MEDIA TECHNOLOGY & INNOVATION

# Programme

- **Why change a winning system like DVB-T?**
- **Is DVB-T2 technology living up to its promises?**
- **Progress on the first practical implementations**
- **Further plans for introducing DVB-T2 into service**
- **What future for terrestrial?**

- **Why change a winning system like DVB-T?**
  - **A look at DVB-T in 2011**
  - **Research in transmission technology**
  - **The 'commercial' requirements for DVB-T2**

# DVB-T<sup>®</sup>

**was standardised in 1996 and  
launched in the UK in November 1998**



**Set-top box cost around  
£350 or €550!**



# DVB-T<sup>®</sup>

Was expected to spread like the ripples in a pond from the three launch countries of the UK, Sweden and Spain

Unfortunately, the payTV services ONdigital in the UK and ONDAdigital in Spain failed in early 2002

# Digital terrestrial TV since then.....



**Boxer was quietly succeeding in Sweden 2002 - the UK relaunched with Freeview and now has over 10 Million primary homes and >60 Million DTT products**

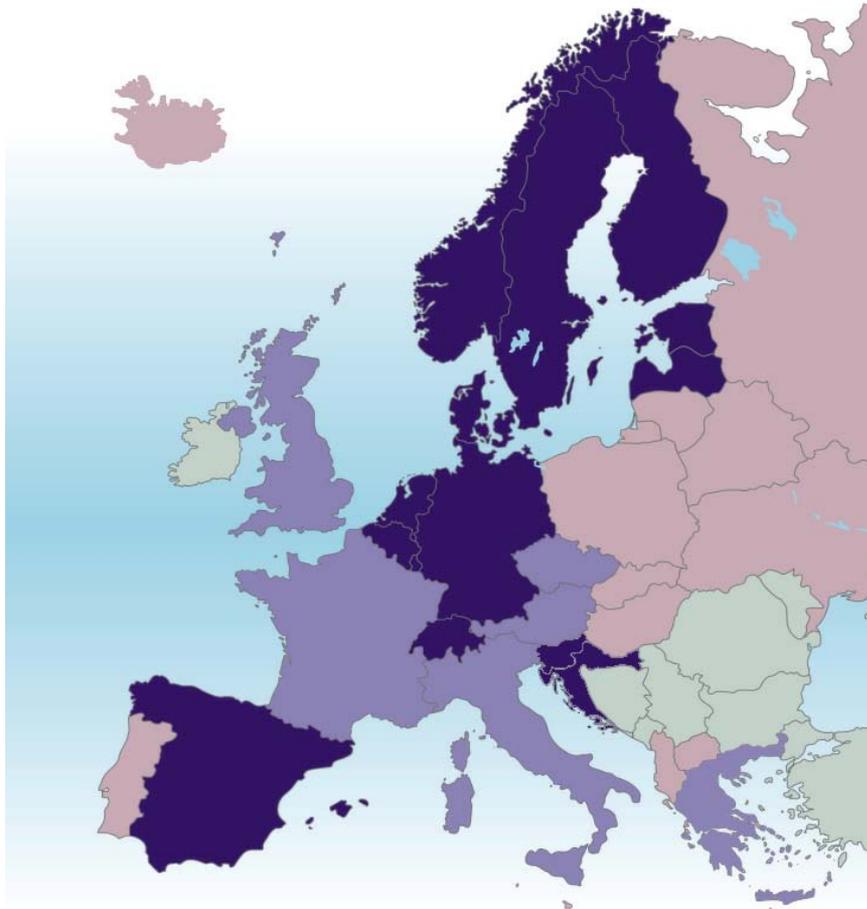
**Germany – launched in Berlin in 2002 and began switching off analogue TV six months later**

**Italy – launched in 2004**

**Spain relaunched in 2005 with success**

**France launched in 2005 with HDTV potential and launched HD in 2008**

# Digital terrestrial TV in Europe in 2011



-  Countries not yet formally launched
-  Countries with some DTT services launched
-  Countries with analogue switch off (ASO) process underway
-  Countries with ASO completed

European Union has target for analogue TV switch off by 2012.....

DigiTAG

# DVB-T Consumer products of all types:

**IDTVs, Set-top boxes, SCART receivers, USB Sticks and DVB-T mobile phones**



DVB-T product development continues.....



**In 2010 Garmin  
launched a SatNav  
GPS device with  
full diversity DVB-T  
reception**

# Research in transmission technology

- In 2006, eight years after the commercial launch of DVB-T the DVB Technical Module launched a technical ‘Study Mission’ to consider all the improvements that could be made in a second generation terrestrial system:
  - Enhanced capacity/spectrum efficiency
  - Enhanced robustness
  - Enhanced mobility
  - Variation of robustness with service
  - More flexibility for IP services
  - More flexibility in bandwidth and frequency
  - Lower peak-to-average power ratio
  - Increased provision for SFNs
- They reported in June 2006 with a whole set of options

# Technical options

- **Modulation scheme**
  - Removal of guard intervals together with some form of pulse shaping
  - Different (or no) pilot structures for channel equalisation
- **Channel Coding**
  - Better error correcting scheme
  - Time interleaving
  - MIMO (Multiple Input Multiple Output)
- **Signal pre-conditioning**
  - Flexible multiplexing schemes (as used with DVB-S2)
  - Variable coding & modulation depending on service
  - PAPR (Peak to Average Power Reduction) for transmitters

# DVB Process

- **The DVB was concerned that any new specification must be commercially justified and must not destabilise other DVB standards**
- **So the Commercial Module was asked to start capturing commercial requirements.**
- **The CM sub-group presented the CRs at the DVB Steering Board in spring 2007.**

# Commercial Requirements

- **Primarily for fixed reception using traditional rooftop antennas using existing transmitter sites and masts broadcasting to existing DVB-T domestic antenna and cable installations.**
- **Transmissions must meet the spectrum mask requirements defined in the ITU-R GE-06 frequency spectrum agreement, and must not cause more interference than DVB-T would.**
- **The DVB-T2 specification should target at least 30% increase in net payload capacity over DVB-T with similar or better robustness than DVB-T under the same conditions.**

# Other requirements

- **Should provide for improved Single Frequency Network performance (nationwide SFNs)**
- **Should have mechanism for providing service-specific robustness**
- **Should provide for bandwidth and frequency flexibility for use in other broadcast bands**
- **Should provide means to reduce peak-to-average power ratio to make more efficient use of transmitter high power amplifiers**

- **Has DVB-T2 lived up to its promises?**
  - **The chosen features of DVB-T2**
  - **Objectives achieved?**

# DVB-T2 chosen features

- **Error protection as used in DVB-S2**
  - Low Density Parity Check codes (Rates: 1/2, 3/5, 2/3, 3/4, 4/5, 5/6)
- **Compatible system layer (Baseband Frames) as in DVB-S2**
- **'Classical' Guard Interval – OFDM –like DVB-T but with more options:**
  - FFT sizes: **1K, 2K, 4K, 8K, 16K, 32K**
  - Guard Interval sizes: **1/128, 1/32, 1/16, 19/256, 1/8, 19/128, 1/4**
  - Bandwidths **1.7, 5, 6, 7, 8, 10** MHz
- **Up to 256QAM and hybrid (256/64QAM)**
- **8 Scattered Pilot patterns to offer choice of bit rate overhead**
- **Continual pilots for common phase error rejection and fine frequency control**

# DVB-T2 chosen features - continued

- **Time interleaving at physical layer to improve impulse noise robustness**
- **Time slicing at physical layer**
  - Different PLPs (Physical Layer Pipes) can have different levels of robustness
  - Enables power saving in the receiver tuner
- **Sub-slicing within frame**
  - Increases time diversity/interleaving depth without increasing de-interleaver memory

# DVB-T2 chosen features - continued

- **P1 Pilot carrier symbol for frame sync. and for rapid detection as a DVB-T2 signal**
- **P2 Pilot carrier symbol carrying baseband frame construction data and PSI/SI information**
- **Three main levels of interleaving**
  - **Bit interleaving, Time interleaving and Frequency interleaving**
- **Rotated constellations**

# DVB-T2 chosen features - continued

- **MISO (Multiple Input Single Output) capability (Alamouti-based transmit diversity)**
- **Peak-to-average-power reduction via tone reservation and constellation distortion**
- **Future Expansion Frames**
- **Signalling and compatibility with future implementations of Time Frequency Slicing**
- **Low-level transmitter identification signalling to manage and maintain SFNs**

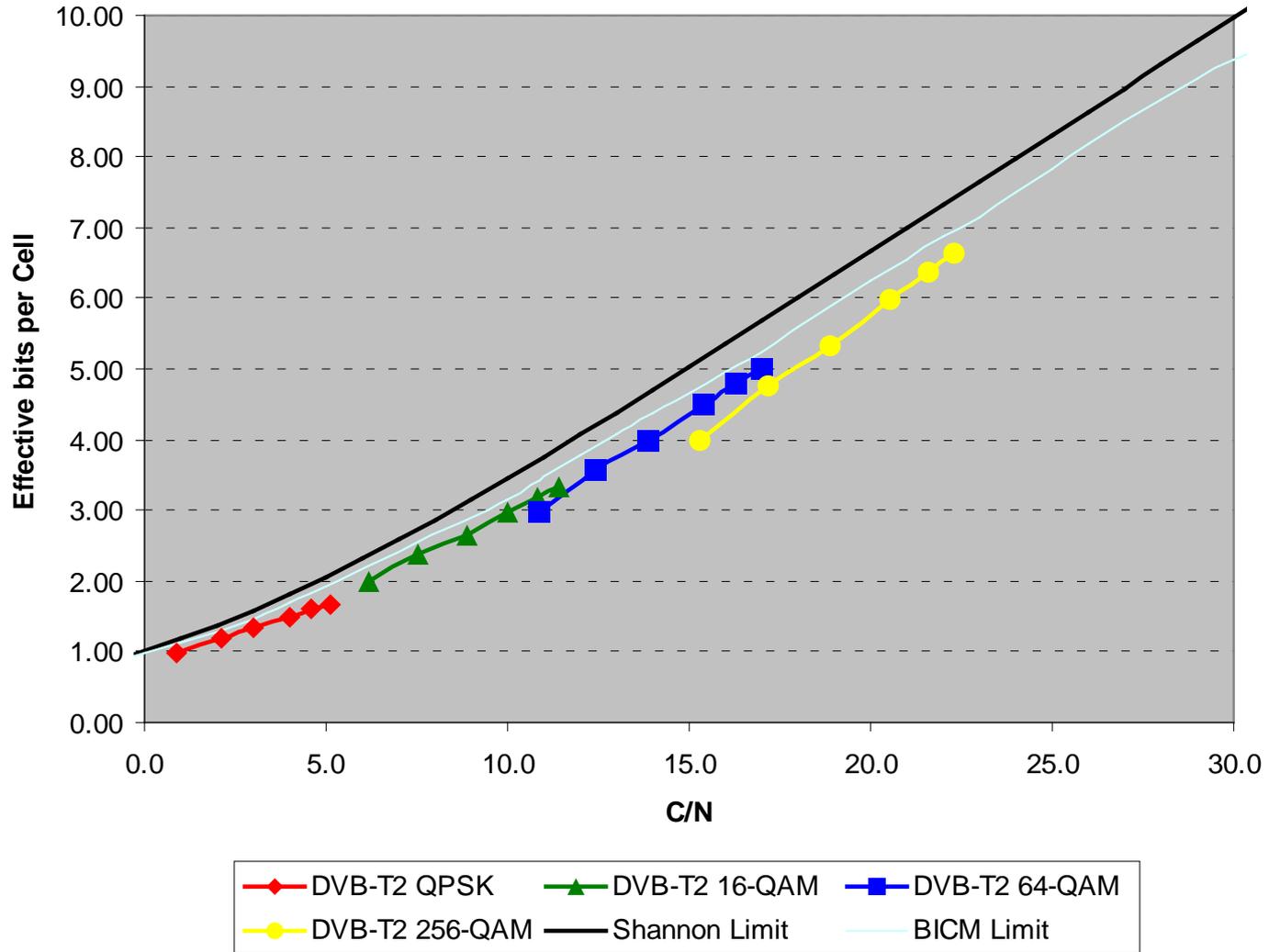
# 30% objectives achieved?

## - UK example

	UK DVB-T mode	UK DVB-T2 mode
Modulation	64QAM	256QAM
FFT size	2K	32K
Guard Interval	1/32	1/128
FEC	2/3 CC + RS	2/3LDPC + BCH
Scattered Pilots	8%	1%
Continual Pilots	2.6%	0.35%
P1/P2 overhead	0%	0.7%
Bandwidth	Standard	Extended
Capacity	24 Mbit/s	40.2Mbit/s

**Capacity = DVB-T + 67%**

# Capacity Performance



- **Progress on practical implementation and verification**
  - **Prototype equipment and first live demonstrations**
  - **First Field trials and pilots**
  - **Plugfest progress**

# The DVB Steering Board approved the DVB-T2 specification on 26 June 2008



**Source: BBC**

**On 27 June the BBC published a press release announcing the first live on air trials in conjunction with the broadcast network operator Arqiva from the Guildford transmitter mast**

# IBC 2008 on the DVB stand

DVB-T2 live  
transmission in  
Amsterdam

Prototype

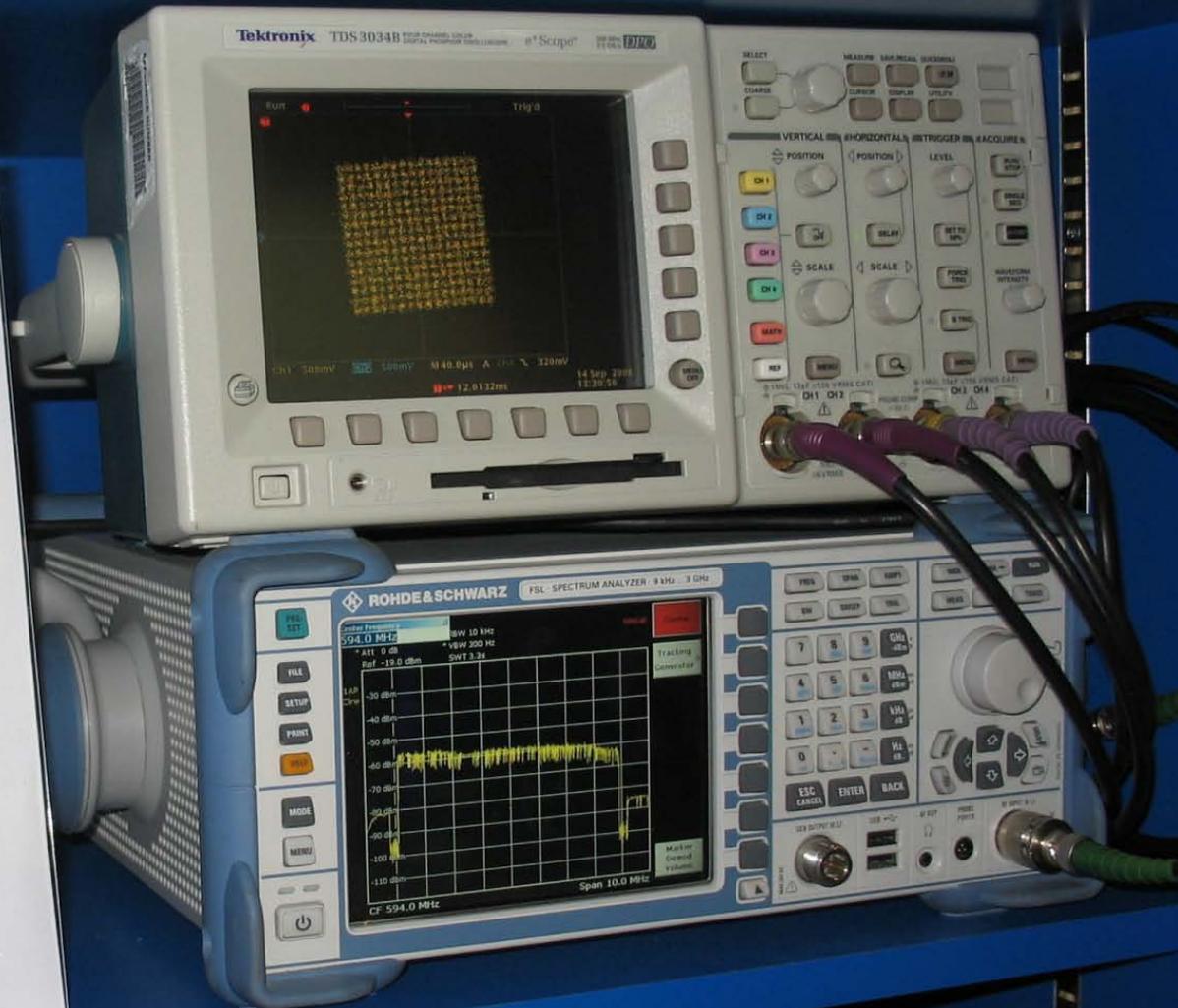
Modulators

and

Demodulators

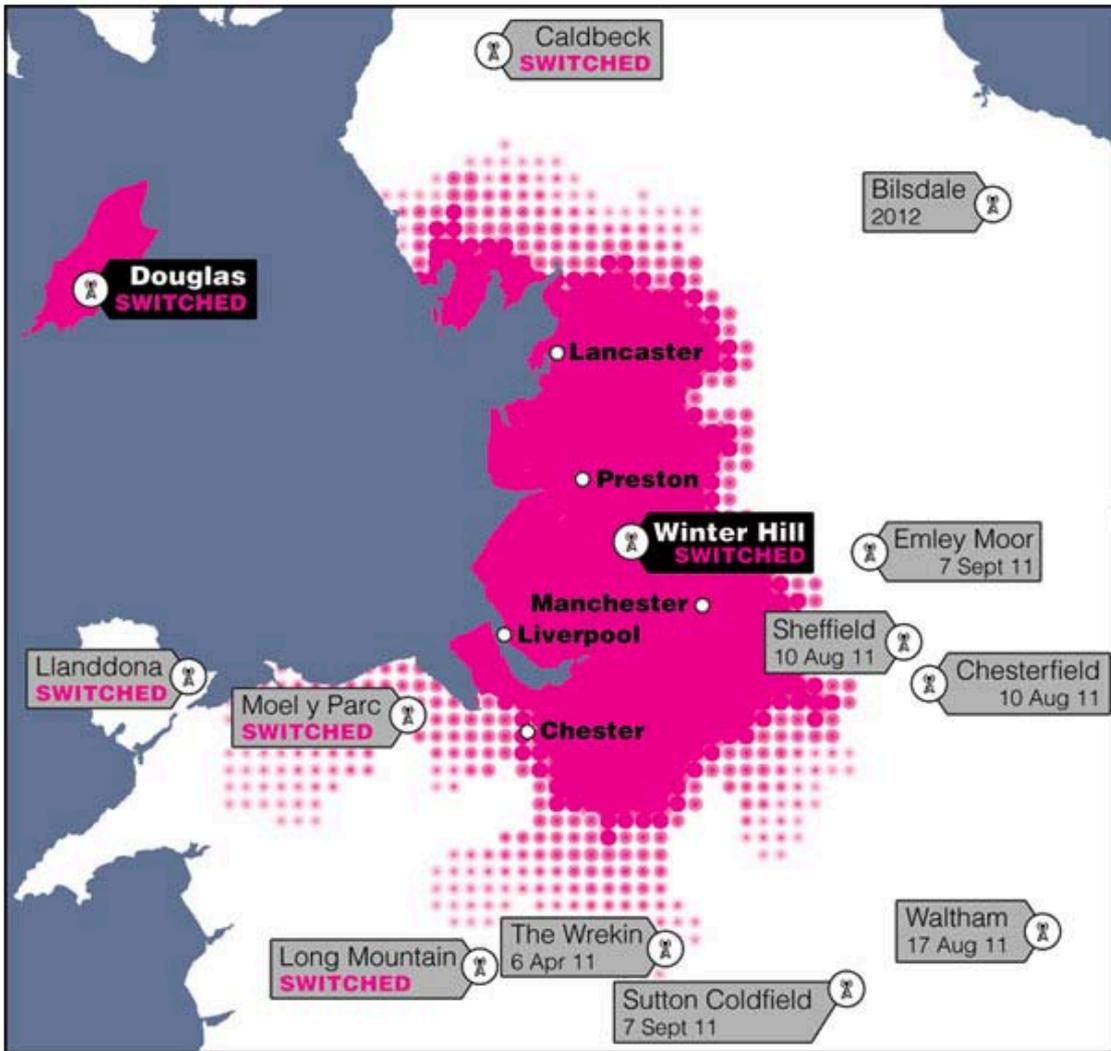


# DVB-T2 Rotated Constellation and Frequency Spectrum



- **Plans for introducing DVB-T2 into service**
  - **UK soft launch in 2009**
  - **UK Freeview HD launch in March 2010**
  - **Sweden is next**
  - **Realistic expectations**

# UK launched with real commitment



- UK Ofcom announced plans to use DVB-T2 from the end of 2009 in the Granada Region (North-West England) in replacing Multiplex B with 3 HDTV programmes and possibly 4 or 5 later.

Source: Digital UK

# UK launched with real commitment

- **Test transmissions began at Crystal Palace in London to provide industry with on-air test signals**
- **Further DVB-T2 transmissions were to be squeezed in, well before Analogue Switch-Off , to give population coverage of 50% by the time of the South Africa FIFA World Football Cup in 2010**
- **By December 2010, 1.2 Million DVB-T2 products were in use in the UK and DVB-T2 coverage reached 60% of the population**

■ Regions Switched      ■ Regions to Switch

### Regions currently switching:

▶ STV Central



For more information on your region click on the map or choose from the list below:

### TV Regions in the UK

- ▶ Anglia
- ▶ Border
- ▶ Central
- ▶ Channel Islands
- ▶ Granada (including Isle of Man)
- ▶ London
- ▶ Meridian
- ▶ STV Central
- ▶ STV North
- ▶ Tyne Tees
- ▶ UTV
- ▶ Wales
- ▶ West
- ▶ West Country
- ▶ Yorkshire

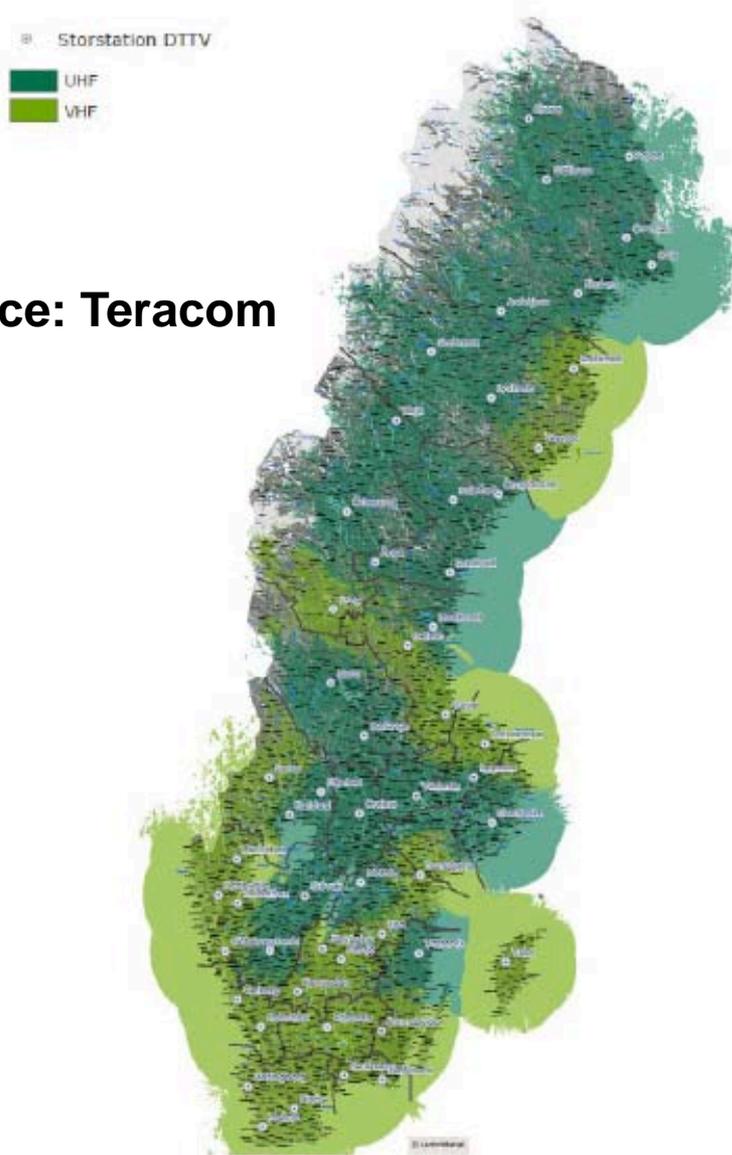
# UK Analogue Switch Off Progress in February 2011

Source: Digital UK



## DVB-T2 in service in February 2011

Source: Teracom

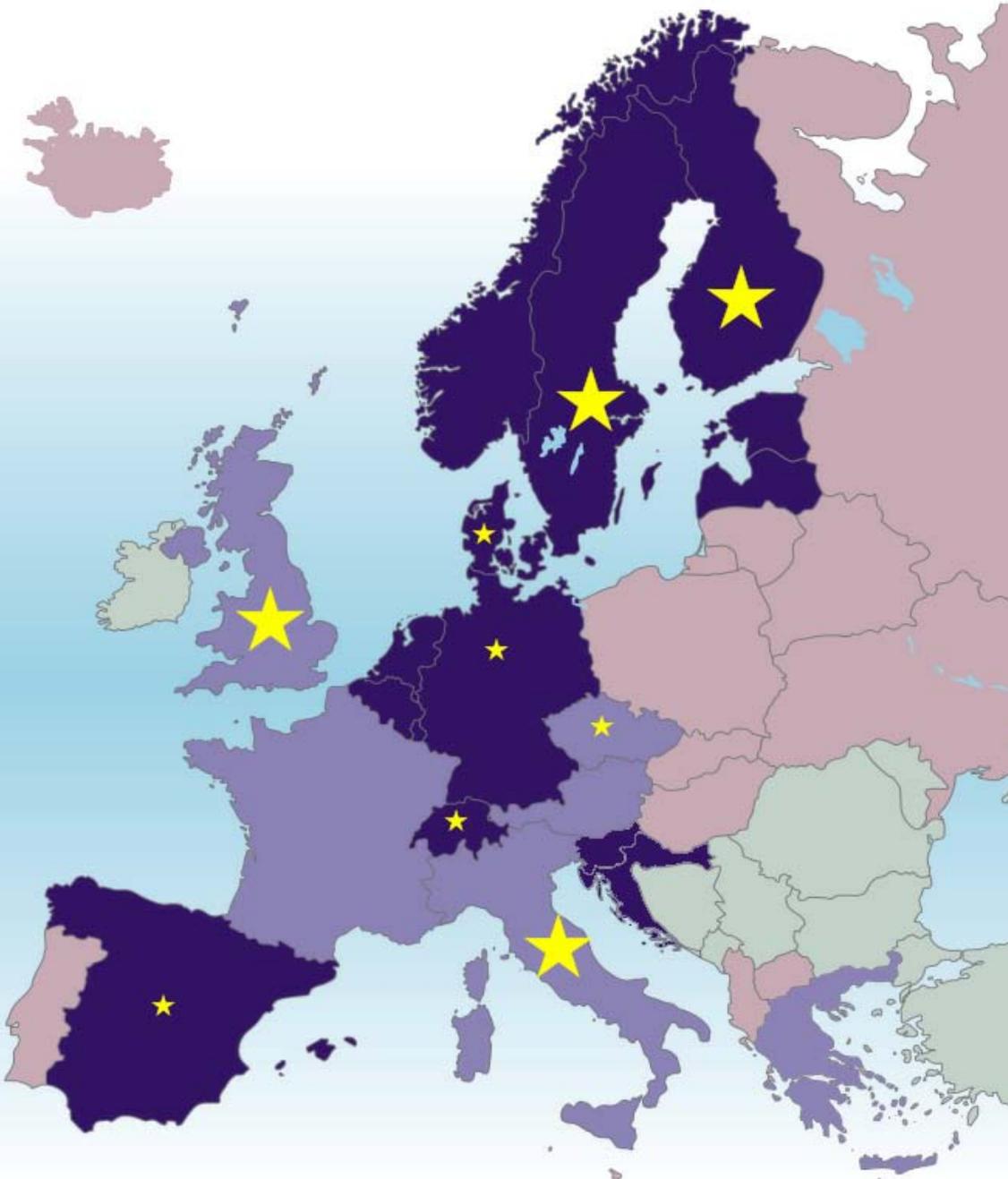


## Multiplex 7 in Sweden

# Sweden - Mux 7 Modes used

Mode	N7_VHF_Nor mal	N7_VHF_Long	N7_UHF
Frekvensband	VHF	VHF	UHF
Bandwidth (MHz)	7	7	8
Modulation & code rate	256-QAM 2/3	256-QAM 3/4	256-QAM 3/5
FFT size	32KN	32KN	32KE
Pilot pattern	PP4	PP2	PP4
Guard interval fraction	19/256	1/8	19/256
Guard interval ( $\mu$ s)	304	512	266
C/N Gauss NorDig (dB)	20,4	22,9	18,9
C/N Rice (dB)	20,8	23,4	19,2
C/N Rayleigh (dB)	24,4	27,8	22,5
Capacity (Mbit/s)	~ 30,81	~31,59	~32,49

Source: Teracom



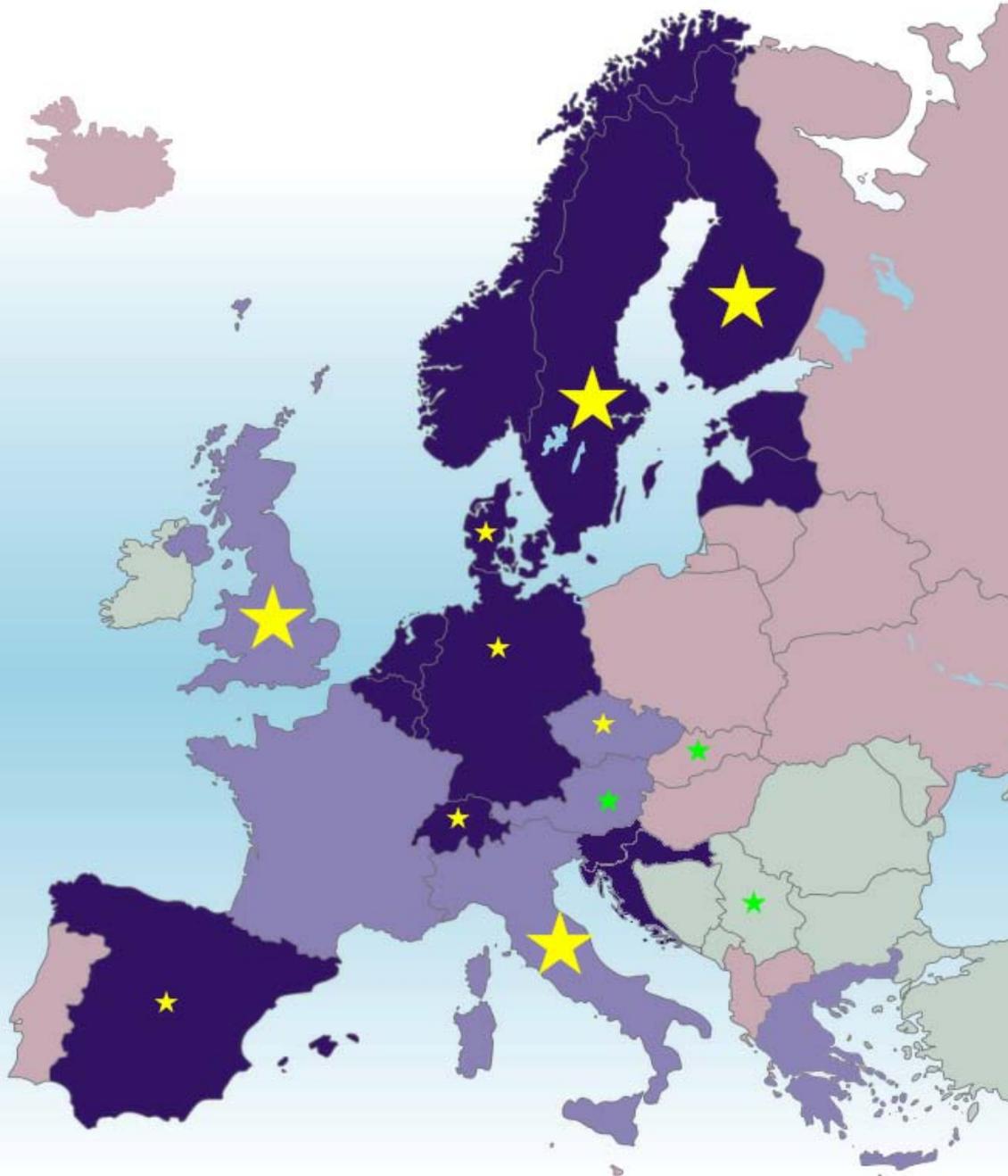
## DVB-T2 in service and under test in February 2011

# Plenty of other announcements

- **DigiTAG surveyed its members and the public service broadcasters of the EBU.**
- **DVB-T2 is seen by everyone (including most recently France) as an exciting opportunity.**
- **The UK launch was particularly successful and there are plenty of DVB-T2 products of all kinds in the market.**
- **Several ‘greenfield’ countries around the world could go directly for DVB-T2, and others could extend with DVB-T2 after ASO.**

**DVB-T2  
services have  
been  
announced  
for many  
more**

**countries:  
Austria, Serbia,  
Slovakia, India,  
South Africa, Sri  
Lanka, Ukraine,  
Thailand,  
Kazakhstan etc...**



# Realistic expectations

- The DVB ‘commercially led’ process seems to give all members of the value chain - broadcasters, network operators, chip makers, professional and consumer manufacturers, and regulators - the confidence to invest in the technology and services
- The falling prices of flat panel displays makes them ever more easily affordable. Broadcasters need to get HD programmes to them to compare well with Blu-ray discs and sophisticated Games consoles
- The UK market have effectively ‘paid’ for some of the development costs of DVB-T2 and later countries will benefit from Moore’s Law impact on costs

# Final thoughts - what future for terrestrial?

- **Threats to broadcasting:**
  - **The increasing political value of spectrum**
  - **Governments claiming back the Digital Dividend**
  - **Pragmatic or risky band sharing**
  - **Can Cognitive Radio really work in Europe?**
- **DVB-T2 may become an essential weapon in the broadcasters fight to retain access to spectrum!**

# Acknowledgements and more information:

- Many thanks go to the members of the Ad-hoc group DVB TM-T2 under the leadership of Nick Wells (BBC) for their amazing energy and inventiveness in the specification process and the impressive results achieved!
- Thank you to those whose material I have used and whose Websites I have plundered.
- If you'd like more information you could start with [www.dvb.org](http://www.dvb.org) and [www.digitag.org](http://www.digitag.org)
- Questions to [tech@ebu.ch](mailto:tech@ebu.ch)