International co-ordination of DVB-T in Europe

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The challenge

How to introduce DVB-T in Europe?

1. Respecting equal rights of all countries
2. Achieving satisfactory digital coverage
3. Ensuring protection of analogue services
4. Making migration to all digital plan possible

For detailed information see: Reports on www.ero.dk
...equal rights of all countries (1)

International agreements

<table>
<thead>
<tr>
<th>To protect</th>
<th>Analogue tv</th>
<th>DVB-T Conversions</th>
<th>T-DAB</th>
<th>Other services</th>
</tr>
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<tbody>
<tr>
<td>Analogues tv</td>
<td>ST61</td>
<td>CH97</td>
<td>CH97</td>
<td>WI95</td>
</tr>
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* protection criteria in CH97

ST61: Stockholm agreement 1961
CH97: Chester agreement 1997
WI95: Wiesbaden arrangement 1995
...equal rights of all countries (2)

- Additional procedures to ST61
- Rules and calculation methods for co-ordination
- Right of conversion of an analogue assignment into digital
- Co-ordination on basis of unified criteria (i.a. C/N=20dB)
- Frequency assignments by means of bi or multilateral negotiations
...equal rights of all countries (3)

Co-ordination distances

7 affected countries
10 kW

2 affected countries
10 W

examples

Sent by NL: 188 requests
Received by NL: 1397 requests

Affected countries (3)
Bielorussia
Moldavia
Russia
...equal rights of all countries (4)

CH97 calculation process

• Calculation of increase of interference relative to reference situation

• Reference interference situation (July ´97) calculated at 36 test points for each station

• Increase of < 0.3 dB normally acceptable

• Higher increase subject to negotiations

• Calculations for current and fictive all digital situation (conversions!)

Results available at ERO ftp

example
In general no great difficulties with CH97
  – strict application leads to severe restrictions of DVB-T stations
  – administrations agree bilaterally on more relaxed criteria

Considerable burden is required in dealing with DVB-T co-ordinations
...satisfactory digital coverage (1)

- Analogue planning based on roof top antenna
- Most countries have indicated that now or in future portable and mobile reception is important
- CH97 co-ordination criteria take portable reception into account to a certain extent
  - no antenna discrimination
  - however Emin of 65 and 69 dBµV/m for Band IV and V respectively
Rooftop and indoor reception

<table>
<thead>
<tr>
<th>Item</th>
<th>Rooftop</th>
<th>Indoor</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>Ricean</td>
<td>Rayleigh</td>
<td>1.5 – 7 dB</td>
</tr>
<tr>
<td>Antenna gain minus feeder loss</td>
<td>5 – 7 dB</td>
<td>0 dB</td>
<td>5 – 7 dB</td>
</tr>
<tr>
<td>Building penetration</td>
<td>No</td>
<td>7 dB</td>
<td>7 dB</td>
</tr>
<tr>
<td>Receiving height</td>
<td>10 m</td>
<td>1.5 m</td>
<td>10 – 12 dB</td>
</tr>
<tr>
<td>Location margin - 95%</td>
<td>9 dB</td>
<td>14 dB</td>
<td>5 dB</td>
</tr>
</tbody>
</table>

- Total effect depends also on interference level:
- Indoor requires ~8 - 31 dB more than for rooftop antenna
- No criteria yet for mobile reception in CEPT and ITU
To achieve satisfactory digital coverage e.g.:
- use of adjacent channels
- use of SFNs

Nevertheless often ERP restrictions are needed to protect analogue

Compromises are needed in overage or capacity
...satisfactory digital coverage (4)

DVB-T introduction

- **Operational:**
  - 572 tx in G, FIN and S
- **Test:**
  - 87 tx in 8 countries
- **Within one year:**
  - 974 tx
- See also www.ero.dk

Information from CEPT
Current situation

• > 85,000 analogue tx
  – main stations
  – fill-in stations
  – some are disputed
  – information available from ERO

• 9 different analogue systems

• Also other services to be protected
  • Radio astronomy ch 38
  • Tactical relay ch >60
  • DAB in Band III
...protection of analogue services (2)

Frequency band allocation

- CEPT decision: Band III and IV/V (not band I) for DVB-T
- Need to re-use analogue television spectrum
- Co-exist with analogue television for many years

According to CEPT position

Study allocation and sharing of IMT2000 i.a. <862MHz

WRC 2000

Region 1 (Europe & Africa)

470MHz

Broadcasting

Mobile (IMT 2000)

862 MHz

Next WRC
...protection of analogue services (3)

Planning considerations

- DVB-T robust against analogue television interference
  - Attention! Do not overlook the right of conversion
- However: not so much vice versa (noise like)
  - DVB-T stations generally have less power than analogue
  - Nevertheless ERP restrictions may be needed as a result of the co-ordination process
Protection ratios

<table>
<thead>
<tr>
<th>To protect</th>
<th>From Analogue</th>
<th>From DVB-T</th>
<th>Increase of interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analogue</td>
<td>22 – 45 dB depending on offset</td>
<td>35 dB</td>
<td>+13 to -10 dB (+6 to -17 dB)*</td>
</tr>
<tr>
<td>DVB-T</td>
<td>4 +13 dB for 64QAM2/3</td>
<td>20 +13 dB for 64QAM2/3</td>
<td>+16 dB (+ 9 dB)*</td>
</tr>
<tr>
<td>Increase of interference</td>
<td>-4 to -28 dB</td>
<td>-2 dB</td>
<td>*ERP of DVB-T station reduced by 7 dB</td>
</tr>
</tbody>
</table>
...migration to all digital plan (1)

- ITU planning Conference for B III, IV/V for European Broadcasting Area

1st session
- in 2003
- planning criteria
- planning method
- method of transition

2nd session
- in 2005
- to agree on a plan

Success of all-digital Plan depends on the method to migrate from pre-existing situation
Advantages
• Compatible with analogue services
• Administrations retain their rights
• Smooth transition by means of bilateral agreements

Disadvantages
• May not lead to equitable access
• May not be optimised for spectrum efficiency
• May not result in adequate coverage
...migration to all digital plan (3)

By means of complete new plan?

• New digital plan could be designed to solve disadvantages
• However difficult to implement:
  – Change of frequencies and associated technical characteristics
  – Need to synchronise between countries
• *Flexible approach needed with acceptance of different time scales*
Required spectrum

Depends on:
- network structure: SFN, MFN, combination
- reception mode: fixed, portable, mobile
- system variant
- size of coverage area

Initial conclusions:
- 4 to 9 channels for 1 multiplex for fixed reception in MFN
- portable reception requires more spectrum than fixed reception
- portable reception (70%, SFN and 16QAM2/3) number of channels in same range as for fixed

Studies in progress!
...migration to all digital plan (5)

Band III issues

now

T-DAB/TV

174 MHz

T-DAB

223 MHz

Ch 12

230 MHz

T-DAB

174 MHz

future?

T-DAB/DVB-T?

216 MHz

Ch 11 - 13

240 MHz

? T-DAB

T-DAB

DVB-T

➾ Priority in upper part (incl. 230 - 240 MHz)?
➾ T-DAB in whole of B III? 
➾ Incorporation of WI95 in new ITU plan?

➾ Full coverage in B III?
➾ Harmonisation of 7 or 8 MHz channel raster?
Requirements

Before the conference decisions needed on i.a.:

- kind of service?
  - fixed/portable/mobile
  - universal/partial

- number of multiplexes per country?

- extent of protection of existing analogue and digital services during transition?

- *This seminar may help to make up your mind*
...migration to all digital plan (7)

Organisation of the work

- ITU SG 6
- EBU project group B/MDT
- CEPT project team FM24

Above all: we depend on the people to do the work

Co-operation with:
- EBU
- DVB
- Digitag
- WorldDAB
- Eacem

Please: join the groups!

Participants in Chester conference
Finally

- New plan and in particular migration is a great challenge.
- Preparation of conference will require a lot of work and negotiations.
- Please do not underestimate the amount of work in the coming years.

Thank you for your attention.
DVB-T system variants

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Code rate</th>
<th>Guard interval</th>
<th>C/N dB</th>
<th>MBit/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable</td>
<td>5/8</td>
<td>1/4</td>
<td>3.6 dB</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>7/8</td>
<td>1/8</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1/16</td>
<td>21dB</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1/32</td>
<td>27.9 dB</td>
<td>31.7</td>
</tr>
</tbody>
</table>

Implementation margin of ~3 dB to be added

FX: Fixed
Port: Portable
<table>
<thead>
<tr>
<th>Item</th>
<th>Band III</th>
<th>Band IV/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq. band</td>
<td>174 - 230 MHz</td>
<td>470 - 862 MHz</td>
</tr>
<tr>
<td>System</td>
<td>B, B(I), B1, D, D1, I, L</td>
<td>G, K, I, L</td>
</tr>
<tr>
<td>Video bandwidth</td>
<td>5, 5.5, 6 MHz</td>
<td>5, 5.5, 6 MHz</td>
</tr>
<tr>
<td>Colour</td>
<td>Pal; Secam</td>
<td>Pal; Secam</td>
</tr>
<tr>
<td>2nd sound</td>
<td>dual FM, digital</td>
<td>dual FM, digital</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>7 or 8 MHz</td>
<td>7 or 8 MHz</td>
</tr>
<tr>
<td>Channel spacing</td>
<td>7 or 8 MHz</td>
<td>8 MHz</td>
</tr>
<tr>
<td>Raster</td>
<td>Overlapping</td>
<td>Uniform</td>
</tr>
</tbody>
</table>

9 different systems