DVB-H Receiver Quality and its effect on Network Cost

Gerard POUSSET
Technology Marketing Director
Outline

- DiBcom, the Heart of Mobile TV
  - DVB-H in the world
  - DVB-H receiver Quality and its effect on Network Cost
  - Conclusion
Six years of leading innovation in Mobile TV Markets

Our Mission

The Leading Provider of High-performance, Low-cost, Low-power IC solutions to the Fast-Growing Mobile TV Industry

Automobile (mobility)

Laptops/PCs (mobility/portability)

Portable LCD TV (portability)

Cell Phones (mobility)

2000

2006

DiBcom
The Heart of Mobile TV

20 October 2006
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- DiBcom, the Heart of Mobile TV
- **DVB-H in the world**
- DVB-H receiver Quality and its effect on Network Cost
- Conclusion
DVB-T & DVB-H: 250m people today, 500m by 2008

**DVB-T Commercial Service On-Air in 2005**
- Covers more than 240 million people
- 20-40 channels available
- Europe: UK, Germany, France, Italy, Spain, Sweden, Netherland, Finland, Norway
- Asia: Taiwan, 18 cities in China, Australia
- DiBcom sold more than 3M units in DVB-T in ‘06

**DVB-H technology launched in 2006 in Europe, the US and Asia**
- USA city coverage starts as of 2006 with Modeo and HiWire
- 500 K customers in Italy
- DVB-H is a new opportunity to allocate specific spectrum for mobile TV
- Simple transition from DVB-T to DVB-H
- DiBcom sold more than 1.4M units in DVB-H in ‘06
The end of narrowband ... DVB-H dominating, +DVB-SH tomorrow

DVB-H / DVB-SH
DVB-H/MediaFlo
DVB-H launch in 2007 in Europe

Source: Alcatel

2006 Availability

2007 Availability
Mobile TV in the United States 2006-2007

- Modeo has acquired a license to broadcast DVB-H nationwide at 1.672 GHz. DVB-H can use different frequencies such as UHF, L-Band and higher.
- First mobile phone at 1.672 GHz developed by HTC for Modeo
- Hiwire (Aloha Partners subsidiary) owns licenses for 2 UHF channels per market providing 12 MHZ of spectrum for DVB-H. Plans to launch commercial services in 2007
DVB-H Cell Phones with DiBcom inside

HTC, Modeo, U.S.A.

SAGEM
My Mobile TV,
Trials Paris, France

SAMSUNG
H3G, TIM in Italy

LG U900
H3G in Italy

NEW: SAGEM Communication
Trials in Paris, France
TIM, Italy; South-Africa
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Benefits of DiBcom “Proven Performance”
DVB-H receivers

Use the “Proven performance “ DVB-H DiBcom receiver DiB707x-H or DiB908x-H with:

- **Enhanced C/N**: 3 dB better than those of the “Typical Receiver”
- **Enhanced Doppler compensation**: offering 50% more speed than the typical receiver
Proven Performance Advantage: Quality of reception

High Doppler compensation due to:
- channel estimation Doppler bandwidth
- FFT leakage compensation algorithm
- Advanced estimation algorithm to reduce the noise effect on the estimation

Dynamic FFT window positioning:
- Fast track of channel profile variation
- Optimum positioning (no Post / Pre echoes phenomena)

Co-Channel Interference compensation
- Blind algorithm
- Better than MBRAI specification

Impulse noise compensation
- Very robust even in mobile environment
DVB-H Proven Performance Receiver (DiBcom)

Extracted from Validation task Force Report
« Proven Performance » DVB-H Receivers
C/N Benefits

Enhanced C/N
(3 dB better than Typical receivers)

Coverage improvement
+ 50 % end-users
DVB-H « Typical Performance » in UHF
(80% indoor coverage / Broadcast approach)

EIRP=100 kW

*indoor reception*: -11 dB

$\sigma_{comp} = 8$ dB

Rec. Antenna Gain: -7 dB

Freq. Carrier: 600 MHz

8k 16QAM CR:1/2 GI:1/4 FEC 3/4

Rec. Noise Figure: 4 dB

Receiver antenna height: 1.5 m

Propag. Model. : Okomura-Hata (Urban)

600 000 people watching TV

Berlin

230 m / 600 MHz

7 km

« Typical » reference receiver C/N=16 dB

600 000 people watching TV
DVB-H « Typical Performance » in UHF
(80% indoor coverage / Broadcast approach)

- EIRP=100 kW
- indoor reception: -11 dB
- $\sigma_{\text{comp}} = 8$ dB
- + 340k end-users (+ 56 %)
- « Typical » reference receiver C/N=16 dB
- 600 000 people watching TV
- Berlin
- 230 m / 600 MHz
- 9 km
- 940 000 people watching TV

« Proven performance » receivers
C/N=13dB

20 October 2006
« Proven Performance » DVB-H Receivers
C/N Benefits (continued)

Enhanced C/N
(3 dB better than Typical receivers)

or

Coverage improvement
+ 50 % end-users

Network Capex
- 50 %
**Cell Number Gain versus C/N Gain**

**DVB-H Network Capex Optimisation**

**Delta_Cells_Number vs Delta_C/N**

\[
\frac{N_{cell2}}{N_{cell1}} = 10^{\frac{2\Delta[C/N]}{20\log(N_{cell})}}
\]

(from Okumura - Hata)

\[
N_{cell} = \frac{55.69}{\log(hb) - 6.55}
\]

\[
\Delta hb = 30m
\]

\[
\Delta hb = 60m
\]

\[
\Delta hb = 100m
\]

**« Proven Performance » gain versus « Typical » Receiver**
DVB-H « Proven Performance » benefit in UHF (Cellular approach with small cells)

- **DiBcom reference design**
  - C/N = 13 dB

- **Typical Reference Design**
  - C/N = 16 dB

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EIRP (W)</td>
<td>300</td>
</tr>
<tr>
<td>hb (m)</td>
<td>30</td>
</tr>
<tr>
<td>F (MHz)</td>
<td>600</td>
</tr>
<tr>
<td>Lindoor (dB)</td>
<td>11</td>
</tr>
<tr>
<td>$\sigma_{in}$ (dB)</td>
<td>6</td>
</tr>
<tr>
<td>$\sigma_{out}$ (dB)</td>
<td>5.5</td>
</tr>
<tr>
<td>$\sigma_{comp}$ (dB)</td>
<td>8</td>
</tr>
</tbody>
</table>

**Paris city outdoor (95%)**: 18 cells

**Paris city Indoor (80%)**: 56 cells

**ADDED COST**: ~50 % !!!

DiBcom Receiver

Typical Receiver
DVB-H « Proven Performance » benefit in UHF (Cellular approach with medium cells)

- « Proven Performance »
  DiBcom reference design  C/N = 13 dB

- « Typical » Reference Design
  C/N = 16 dB

<table>
<thead>
<tr>
<th>Parameter</th>
<th>« Proven Performance »</th>
<th>« Typical »</th>
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<td>hb (m)</td>
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<td>F (MHz)</td>
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<tr>
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<tr>
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<td>5.5</td>
<td></td>
</tr>
</tbody>
</table>

- Paris city outdoor (95%): 4 cells
- Paris city Indoor (80%): 12 cells
- 6 cells
- 17 cells

ADDDED COST: ~50%!
DVB-H Network Capex for Paris city (105 sq km)
hb=30m for 300W and hb = 60m for 5 kW
Commercial Example: Italian H3G coverage

Source Wall Street Journal, June 1, 2006

"3 Italia is building its own network, estimating costs at €220 million for the network."
Enhanced C/N
(3 dB better than Typical receivers)

or

Coverage improvement
+ 50 % end-users

or

Network Capex
- 50 %

or

Bit Rate increase
+ 10 services

16QAM 1/2 1/4 → 9.95 Mbit/s
instead of
QPSK 2/3 1/4 → 6.65 Mbit/s
« Proven Performance » DVB-H Receivers
Speed Benefit

Enhanced Doppler compensation
130 Hz for « Proven Performance » Receiver
[80 Hz for « Typical Performance » Receiver]

Commuting (Bus, trains,..)
Europe
185 km/h @ 750 MHz, 8MHz, 8k
[114 km/h only for « Typical Receivers »]

USA
130 mph @ 1.67 GHz, 5MHz, 2k
[80 mph only for « Typical Receivers »]

High Speed Trains
Europe
370 km/h @ 750 MHz, 8MHz, 4k
[228 km/h only for Typical Receivers »]
DVB-H trial in Paris
Mobile receiver measurement

Good Reception measured up to 110 km/h
thanks to DiBcom DVB-H Receiver
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CONCLUSION

- DVB-H is the world’s most efficient standard for Mobile TV applications
- DVB-H receiver compliance is not sufficient
- Small differences in DVB-H receiver quality (Sensitivity, Doppler compensation,..) can have enormous consequences when it comes to:
  - Network Quality (especially coverage)
  - and cost!
- The “Proven Performance” receiver also known as the “Possible Reference Receiver” (DVB-H Implementation Guidelines) is becoming a “de facto” standard thanks to the world’s first DVB-H commercial launch in Italy.
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BACK-UP SLIDES
DVB-H Network Capex for Paris Intramuros (105 sq km)
hb=30m for 300W and hb = 60m for 5 kW

<table>
<thead>
<tr>
<th>C/N</th>
<th>N_Cells</th>
<th>Capex (k$)</th>
<th>N_Cells</th>
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<td>2600</td>
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<td>800</td>
<td>130</td>
<td>6500</td>
<td>15</td>
<td>3000</td>
</tr>
</tbody>
</table>

Outdoor 95%

- 300W (50k$)
- 5 kW (200k$)

Indoor 80%

- 300W (50k$)
- 5 kW (200k$)

Indoor 95%

- 300W (50k$)
- 5 kW (200k$)
DVB-T / DVB-H DIB3000MC performance in TU6
DVB-T: 8k 16QAM CR2/3 GI1/8
DVB-H: MPE-FEC: 3/4

MPE-FEC Table Error Rate: $10^{-3}$

Portability improvement

Mobility improvement