Workshop on mobile broadcasting –
Technological developments, market opportunities regulations and policy

Broadcast goes Mobile
From DVB-T to DVB-H

Gérard POUSSET / V.P Marketing

DiBcom
The Heart of Mobile TV

Bruxelles Feb 23th, 2006

- In your **car**:
  - → **DVB-T**
    - Up to 200 km/h in Europe and Asia

- On your **Laptop**…on your **Portable LCD**
  - → **DVB-T**
    - Accesories today
    - OEM: Q1/2006

- On your **Cell Phone** or **PDA**:
  - → **DVB-H**
    - 2006 (US, Italy, Germany,…)

- 1- DVB-T and DVB-H in European Projects
- 2- Mobile DVB-T solutions for cars
- 3- Portable DVB-T solutions for Laptops, Portable LCD
- 4- From DVB-T to DVB-H
- 5- Conclusion

1- Mobile DVB-T / DVB-H in European Projects

Project name	*Tested application*	*Conclusion*
VALIDATE (98)	DVB-T	*DVB-T is usable in fixed application*
MOTIVATE	Mobile DVB-T	*DVB-T mobile is possible in QPSK*
MCP (2000)	Mobile DVB-T in cars	*DVB-T mobile is possible for all modulations with Diversity*
confluent **2002**	Integrated Mobile DVB-T receivers	*DVB-T mobile Diversity receivers tested with success in cars, up to 150 km/h*
instinct **2004**	DVB-H / DVB-T integrated receivers	*DVB-H tested with success in indoor and outdoor with early prototypes*
2005	DVB-H tests (continuation of the DVB-H Validation Task force)	*Results in 2006*

- **1**- DVB-T and DVB-H in European Projects
- **2**- Mobile DVB-T solutions for cars
- **3**- Portable DVB-T solutions for Laptops, Portable LCD
- **4**- From DVB-T to DVB-H
- **5**- Conclusion

- In Mobile application the DVB-T demodulator chip has to challenge with:
  - **Speed**:
    - **Fast variation** of the receiving signal => *Fast channel estimation*
    - **Doppler** =>*Dynamic correction up to 200 km/h (instead of 50km/h for « static » application)*
  - **Fast fadings** => **Antenna Diversity**
  - **Spurious** (mainly due to omni-directionnal antenna) :
    - Adjacent Channels
    - Co-channel
    - Industrial Noise

Additionnal Signal Processing ⇨ **Chip Silicon Area <u>doubles</u> compared with « static » application**

Enhanced DVB-T demodulator IC for mobile environments

DiB3000 MC

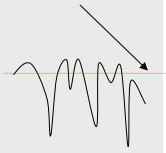
- **Fast Locking and Auto-Search Algorithm**
- **Diversity** combining
- **Mobile** features :
  - **Dynamic** Guard interval positioning
  - **Accurate channel estimation** (slow and fast fadings)
  - **Doppler Effect compensation** (up to ***90 Hz*** in single mode)

New DiB7000 M

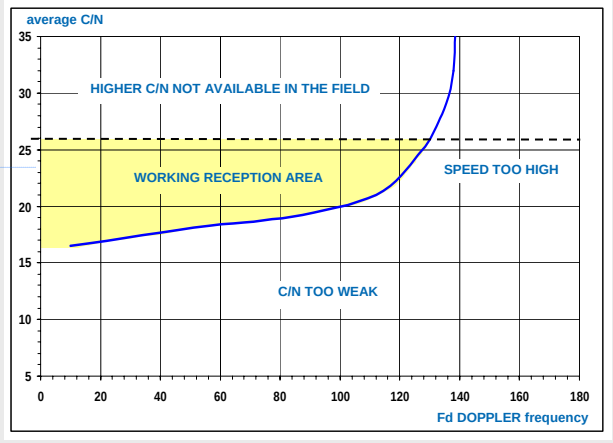
- **Same features** as **DiB3000MC**
- **Low power consumption (200mW) and smaller (BGA)**
- **Low cost**

For MOBILE reception,
the ROBUSTNESS is not only a matter of C/N, but also of SPEED

Average value of C/N



TU6 Mode
(Typical Urban with
6 paths)



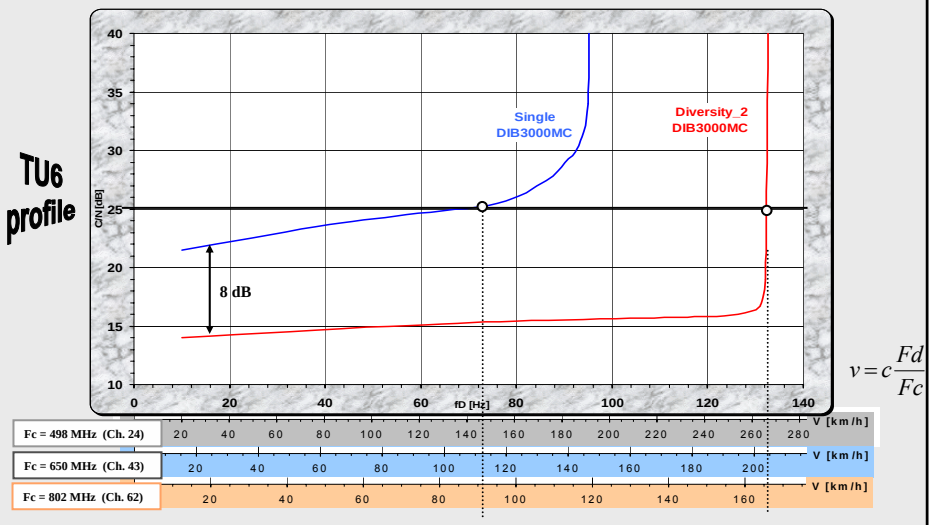
Defined in **MCP**
MOTIVATE

Used in **CONFLUENT**
INSTINCT
WING TV

(European projects)

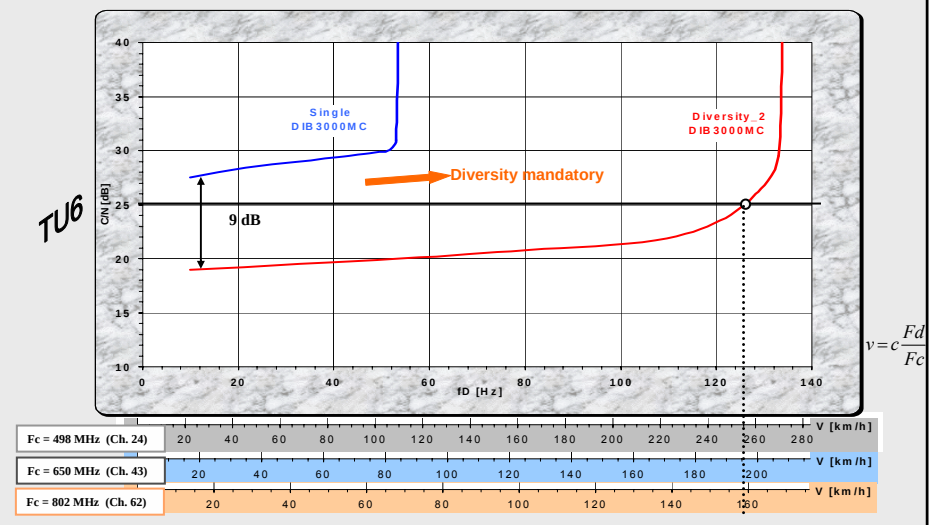
DIB3000MC performance in DVB-T

8k 16QAM CR2/3 GI1/8 (German mode)

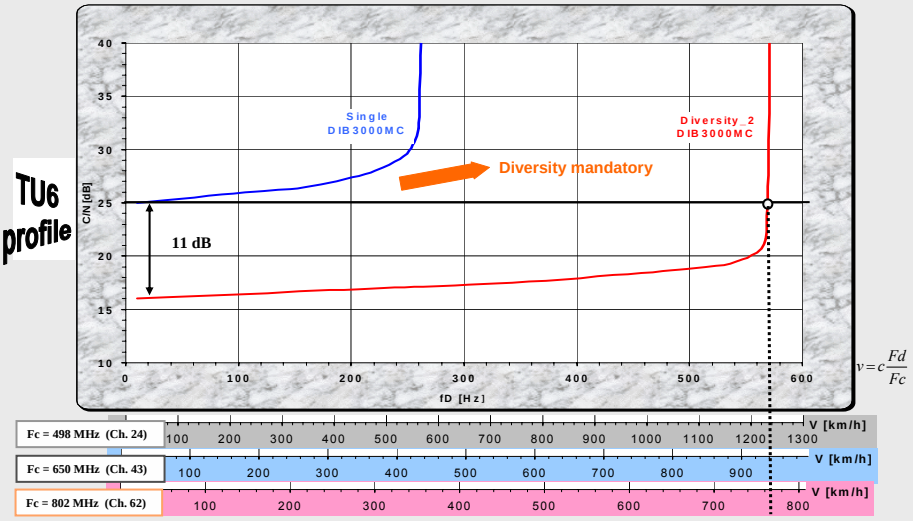


DiB3000MC performance in DVB-T

8k 64QAM CR2/3 GI1/8 (French mode)



DIB3000MC performance
in 2k 16QAM 3/4 1/32 (UK mode)



Mobile DVB-T tests in the field


Mobile DVB-T performance in Paris area
Perfect Video /Audio
Some frozen pictures+ audio interuptions
No audio, nor video
8k 64QAM 2/3 1/8
Fc=562 MHz
Single receiver
22km
Eiffel Tower
Paris
Diversity receiver
24 February, 2006
15


Mobile DVB-T performance in London City (Bus 390 Route)
Perfect Video Audio
Some frozen pictures+ audio interuptions
No audio, nor video
Single receiver
Londres
Diversity receiver
8k 16QAM 3/4 1/32
Fc=506 MHz (BBC)
6 km
5 km
Londres
24 February, 2006
16


Mobile DVB-T performance in Great London
Perfect Video /Audio
Some frozen pictures+ audio interuptions
No audio, nor video
8k 16QAM 3/4 1/32
Fc=506 MHz (BBC)
Single receiver
Diversity receiver
20 km
22 km
24 February, 2006


Mobile DVB-T performance in Berlin
Perfect Video /Audio
Some frozen pictures
+ audio interuptions
No audio, nor video
8k 16QAM 2/3 1/8
Fc=522 MHz (Das Erste)
Single receiver
Diversity receiver
Messe Berlin
A100
7 km
8 km
24 February, 2006

Mobile DVB-T performance

City	DVB-T mode	Receiver mode	C/N min	F_Doppler @C/N=25 dB	Speed @498 MHz	Speed @826 MHz
Berlin	8k 16QAM 2/3 1/8	SINGLE	21 dB	75 Hz	150 km/h	100 km/h
		DIVERSITY 2	14 dB	130 Hz	280 km/h	170 km/h
Paris	8k 64QAM 2/3 1/32	DIVERSITY 2	19 dB	120 Hz	240 km/h	150 km/h
London	2k 16QAM 3/4 1/32	DIVERSITY 2	16 dB	570 Hz	1235 km/h	745 km/h

Mach 1 !

Enhanced DVB-T demodulator ICs for portable environments

DiB3000 P

- **Low consumption** allows a USB self-powered module
- Embed all DiB3000MC features **except Doppler Cancellation**
- **High sensitivity** & **High robustness indoor**
- **Low cost**

New DiB7000 P

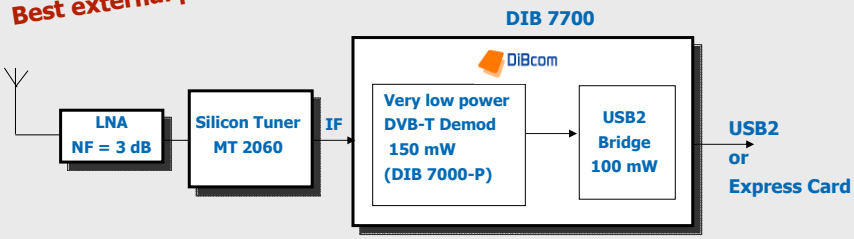
- **Same features** as **DiB3000 P**
- **Lower power consumption** (**150mW**) and **smaller IC (BGA)**
- **Lower cost**

New DiB7700

- a **DiB7000P** with an **embedded USB controller**
- **the ultimate low power consumption solution** (**250mW with USB cont**)
- **much Lower cost**

Ultra Low Power Stick Design
(under development)

Best external peripheral solution !



USB Modules for DVB-T reception on PC

DVB-T PC USB-Stick

Portable DVD Player
+ DVB-T Tuner

Single
Front-End

or

Diversity
Front-End

Portable LCD TV (DVB-T)

DTI 0601

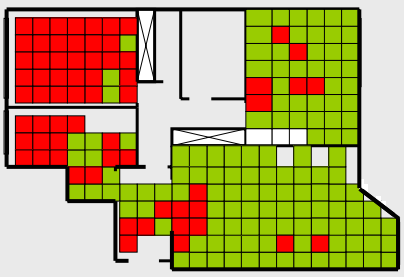
Thomson

24 February, 2006

Portability tests show the dramatic reception enhancements provided by DiBcom's products

(Squares 50cm x 50 cm)

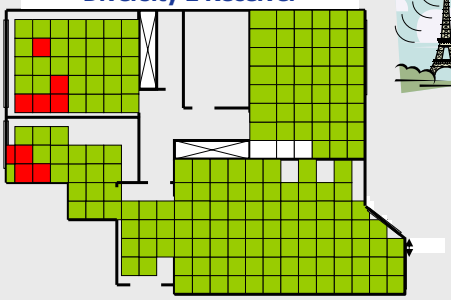
Single Receiver



BER < 10^{-4} : **67 %**

PER ≠ 0 : **33 %**

Diversity 2 Receiver



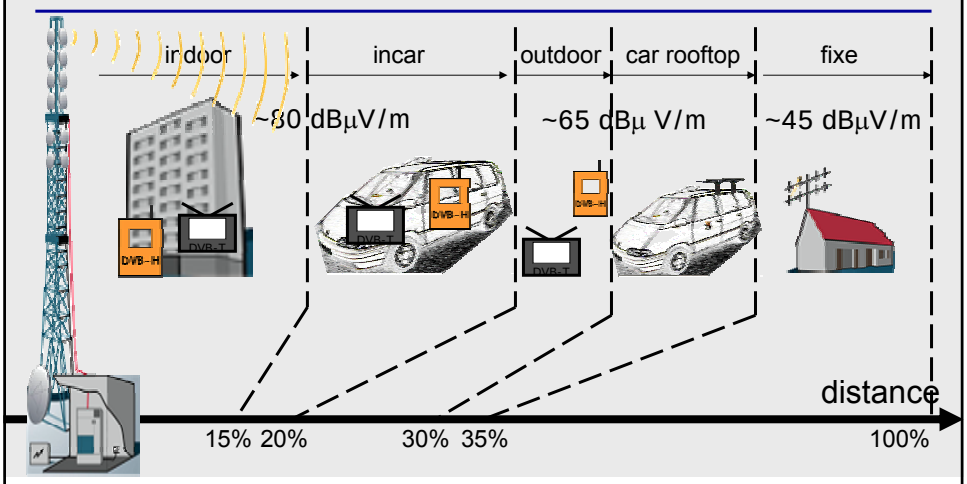
BER < 10^{-4} : **95 %**

PER ≠ 0 : **5%**

Eiffel Tower

- **Short echoes destroy up to 50% of the OFDM spectrum, due to small phase variations. These short echoes need to be compensated by reception with at least 2 antennas, that is,** the use of diversity.
- DiBcom **has implemented diversity for mobile reception, it serves dramatically in portable situation**

DVB-T coverage



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MPEG-2 over DVB-T

15 Mbps

3-4 TV programs for large screen

IP over DVB-H

11 Mbps

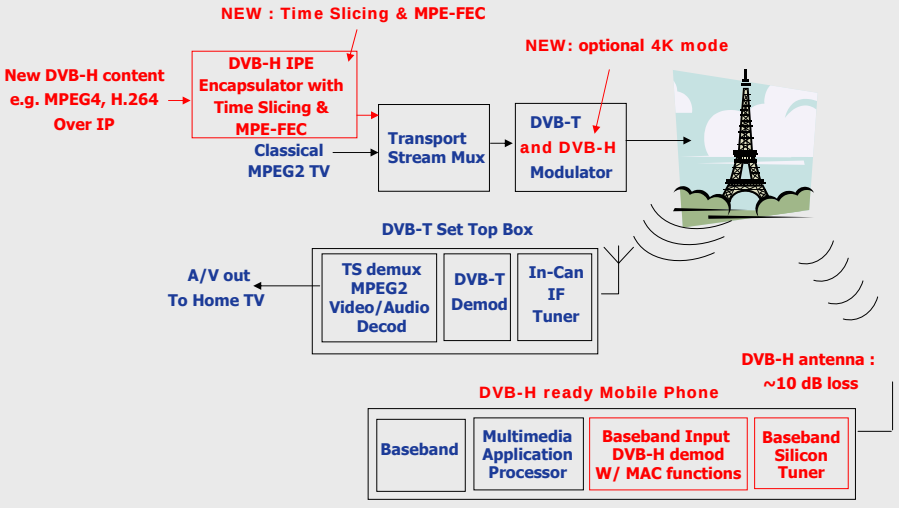
150-400 kbps

30-50 video streams for small screen

- DVB-H : New DVB-T based standard since Q4/2002
  to develop broadcast services (including TV) on mobile phones
- DVB-H = Mobile DVB-T + Time Slicing + MPE-FEC

DVB-T: the constraints to mobility		DVB-H targets
Various modes… (16/64 QAM…). Most of them reach high mobility with diversity (2 receivers)	⇒	Must be as close as possible to DVB-T Need to work with single receiver for handheld devices – MPE FEC
Important power consumption due to the high bit rate received in continuous mode	⇒	TIME SLICING (allows a trade-off between power consumption and the bit rate needed by the application)
Limited awareness of compatibility with mobile application/image	⇒	Marketing/strong awareness /contribution by large players

Modulation	DVB-T	DVB-H (3/4)
QPSK CR=2/3 GI=1/8	7.37 Mbits/s	*5.71* Mbits/s
16QAM CR=1/2 GI=1/8	11.06 Mbits/s	8.57 Mbits/s
16QAM CR=2/3 GI=1/8	14.75 Mbits/s	11.4 Mbits/s



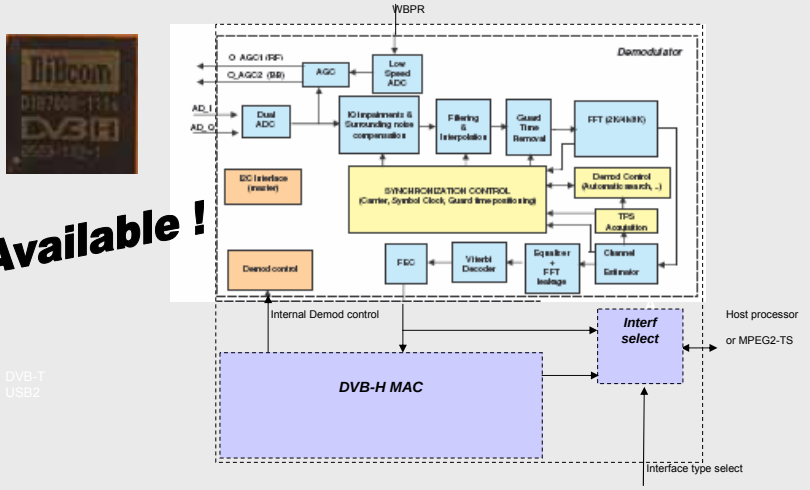
DIB7000:
Enhanced DVB-H demodulator IC for Handheld environments

- DiB 7000 H : IC for DVB-H :
  embed all algorithms of DVB-T IC DiB3000MC

- **Additional** features for DVB-H:
  - **enhanced FEC : MPE-FEC**
  - Allows a Maximum Doppler compensation (130 Hz) in single almost as good in a Diversity2 DVB-T without MPE-FEC
  - Allows a C/N improvement by around 3 dB at low speed
  - **reduced power consumption : TIME SLICING**
  - Allows to divide the power consumption of the front-end by 10

200mW in DVB-T ⟶ 20 mW in DVB-H

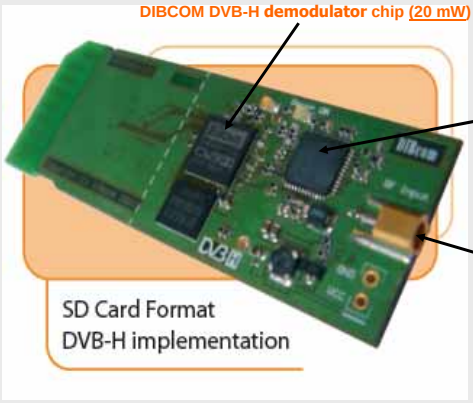
DIBCOM DVB-H demodulator chip



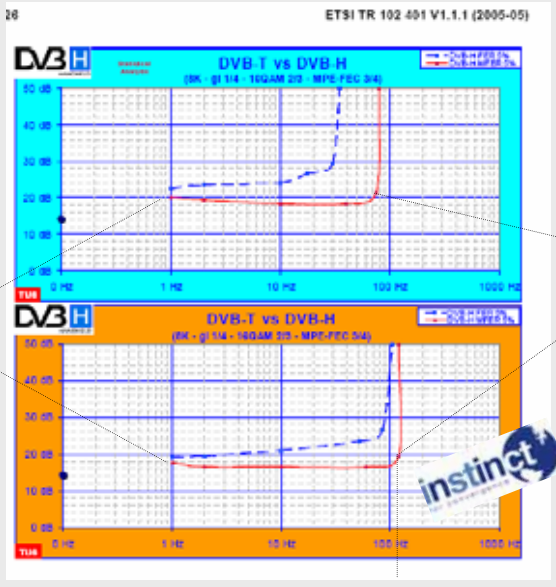
Available !

DVB-T
USB2

DIBCOM/ FREESCALE DVB-H Front-End



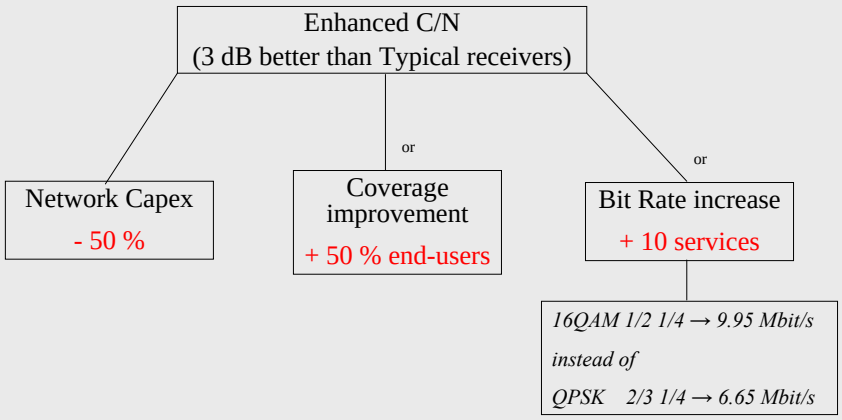
DVB-T
USB2



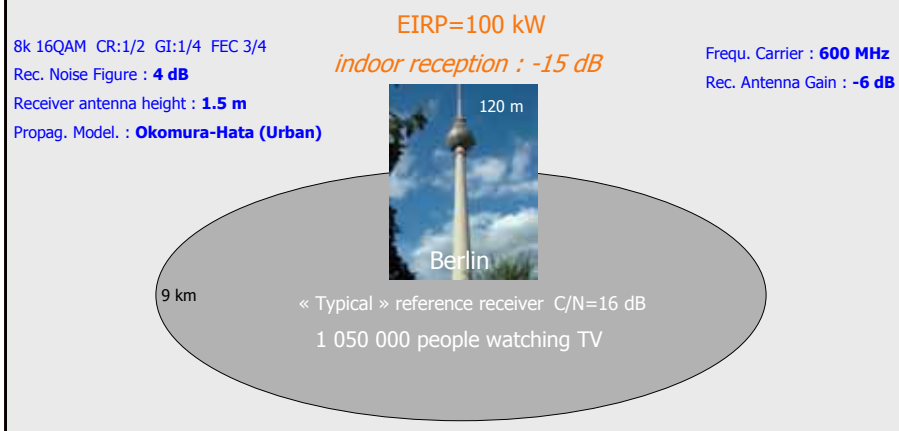
Typical receiver

Proven performance receiver

C/N Benefits



DVB-H « Typical Performance » in UHF (Broadcast approach)



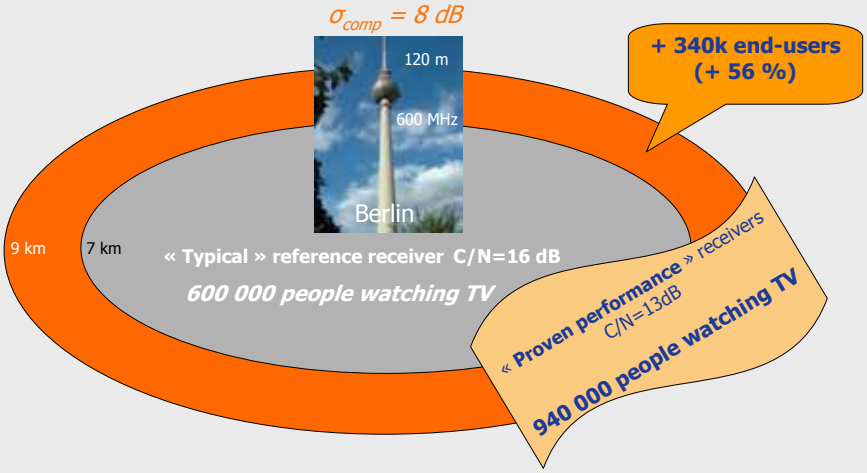
DVB-H « Proven Performance » in UHF

80% indoor coverage in Broadcast approach

EIRP=100 kW

indoor reception : -11 dB

σ_{comp} = *8 dB*



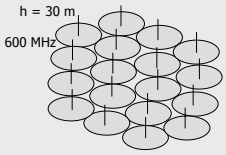
(Cellular approach with **small** cells)

- « Typical » Reference Design

  C/N = 16 dB

  EIRP=300W

  Indoor : -15 dB

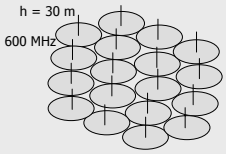


Paris intramuros outdoor: 7 cells

Paris intramuros Indoor : 49 cells

(Cellular approach with **small** cells)

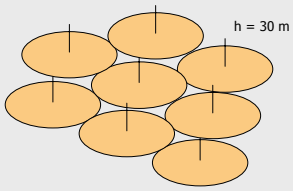
- « Typical » Reference Design
  C/N = 16 dB
  EIRP=300W
  Indoor : -15 dB



Paris intramuros outdoor: 7 cells

Paris intramuros Indoor : 49 cells

- **« Proven Performance »** DiBcom reference design
  C/N = 13 dB
  EIRP=300W
  Indoor : -15 dB



5 cells

33 cells

Benefit : 48 % !

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 »]

EU-China Cooperation on Digital Olympics

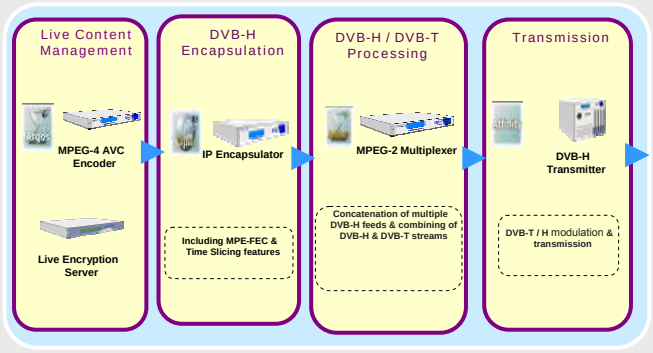
3rd EU-China Workshop on Digital Olympics

Beijing International Convention Center (www.bicc.com.cn)

Beijing - June 22, 2005

DVB-H Receivers

DVB-H Broadcast



INSTINCT DVB-H receiver equipped with DiBcom demodulator chip and Freescale silicon tuner chip

instinct

DVB-H on PDA

PALM / Palm OS/ MPEG4

Shown at CeBit05 (Munich)

Pocket PC / Windows CE / WM9

Shown at NAB05(Las Vegas)

Mobile Phone

SAMSUNG

Shown at CTIA05 (New Orleans)

DVB H HANDHELD

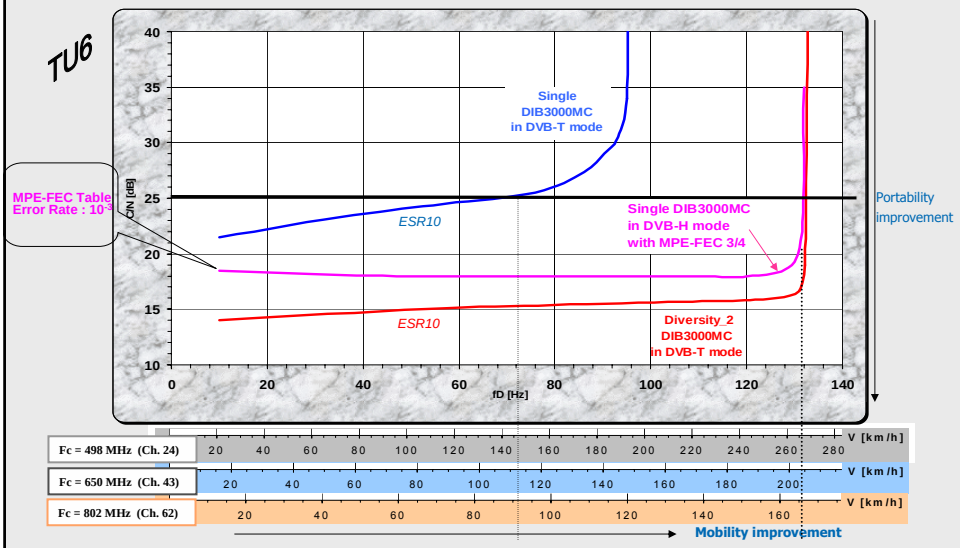
Mobile Phone

SIEMENS

Shown at CeBit05

DVB-T / DVB-H DIB3000MC performance in TU6

DVB-T : 8k 16QAM CR2/3 GI1/8 DVB-H : MPE-FEC : 3/4



Mobile receiver measurement

Broadcast Standards:
DVB-H appears as the only true global standard today

	Fixed Reception	Mobile Handheld	Companies supporting standard	Mobile Front-end power consumption	Network cost / user	# prog. per channel
EU + part of AP +India…	DVB-T	DVB-H	**Nokia, Motorola, Samsung, Siemens Crown Castle**	**50mW** (time slicing)	**$1-3**	**30**
US	ATSC	**DVB-H**				
		Media-Flo	**Qualcomm** *(proprietary)*	No time slicing	?	?
JAPAN	ISDB-T 13 Segments	ISDB-T 1 Segment	Japanese companies	**120mW** No time slicing	**>$15**	2
KOREA	ATSC	T-DMB	LG (Samsung)	**200mW** No time slicing	**$6-10**	5
CHINA	DMB-T or DVB-T ?	DVB-H or other?	*Universities*	?	?	?

Conclusion

DVB-T :

- ***Mobility*** **: up to 200 km/h even in 64QAM with Diversity receivers (CONFLUENT)**
- ***Portability*** **:**
  - ✓ **USB « Sticks » for PC available today**
  - ✓ **Diversity receivers under development for integration into Laptop PC and Portable Media Players (LCD screens)**

DVB-H :

- **World's first DVB-H demodulator chip (INSTINCT)**
- **« Proven Performance » :**
  - **✓Doppler compensation (130 Hz) as good on a DVB-H / MPE-FEC single receiver as on a DVB-T Diversity2 Receiver**
    - ⇨ **Good Mobile performance**
  - **✓3 dB C/N improvement at low speed thanks to MPE-FEC**
    - ⇨ **Good Receiver sensitivity**
  - **✓Low power consumption of the front-end (50 mW) thanks Time Slicing, Silicon Tuner with I&Q inputs (Freescale), and optimized demodulator IC**
    - ⇨ **Long life time duration of the batteries**

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The Heart of Mobile TV

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