

Digital Video Broadcasting – Handheld

Valerio Zingarelli
Telecommunications Studies and Consulting

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SUMMARY

- **The Market**
- **The Technology**
- **Radio Network Overview**
- **Conclusion**

1. The Market

“Lesson learned” dopo 11 anni di GSM e 3 anni di UMTS:

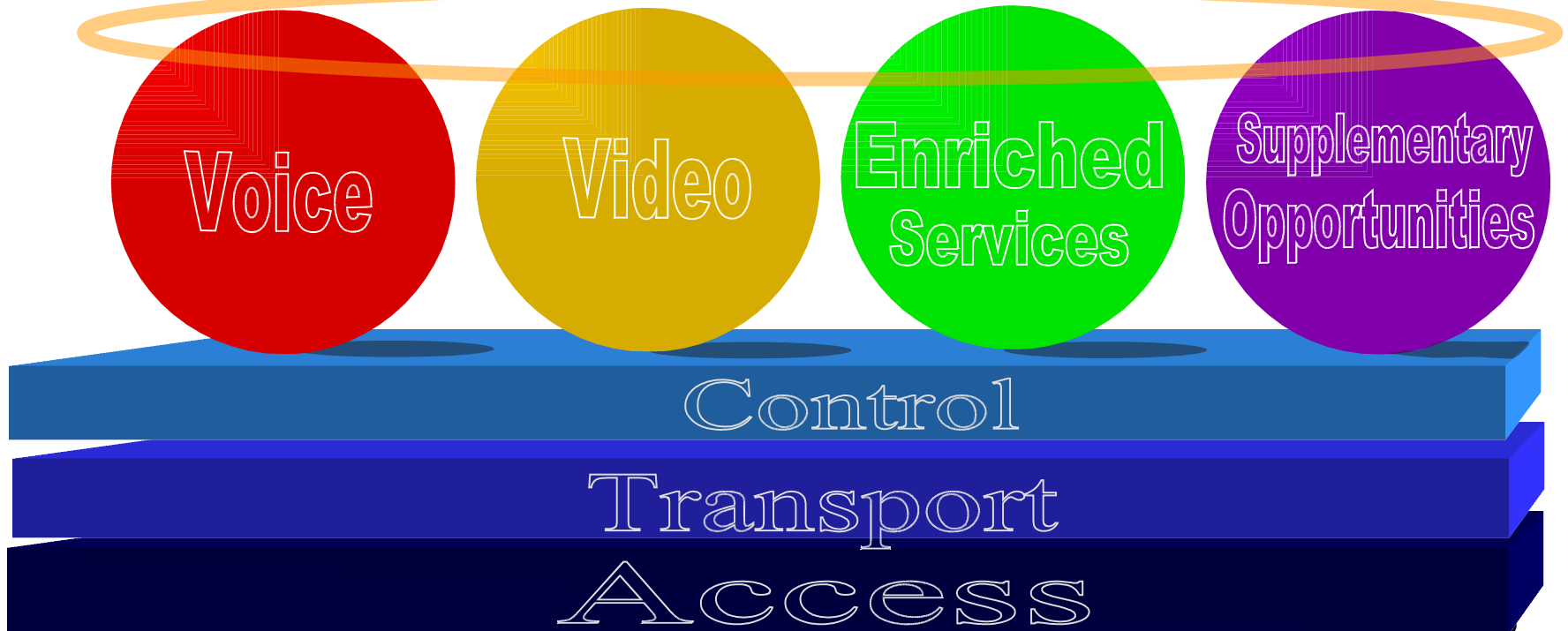
- Il 75% delle chiamate di terminali mobili sono effettuate in condizioni indoor
- L'80% dei ricavi TLC mobili sono da servizi voce; il 15% da SMS; il 5% da VAS

Evolution Drivers

While voice continues to be the most utilized application, a number of recognizable trends will influence the mobile scene over the next few years:

- Internet access
- Mobile TV
- Emergence of Peer-to-peer voice and video over IP applications
- Service bundles for video, data and voice from DSL providers entering the mobile market

Convergence



Video

TV over IP delivers digital television service to subscribers via the Internet Protocol over a **broadband connection**

- Offered in conjunction with Video on Demand (VoD) as well as Internet data services (the “Triple Play over broadband”)
- Broadcasters make use of non telco specific technology → competition from adjacent industries (e.g. content providers)
- VoD requires high bandwidth dedicated to a single end user

TV over IP on wireless

- DVB-H
- UMTS/MBMS
- Wi-Max/ Wi-Bro

TV over IP on wireline

- Broadband technology over DSL (Digital Subscriber Line)
- Optical fibers over the local loop

Technology Enablement

Access

DVB-H

Broadband

3G (MBMS)

Transport

IP

ATM

Core/SE

Service Delivery
Platform

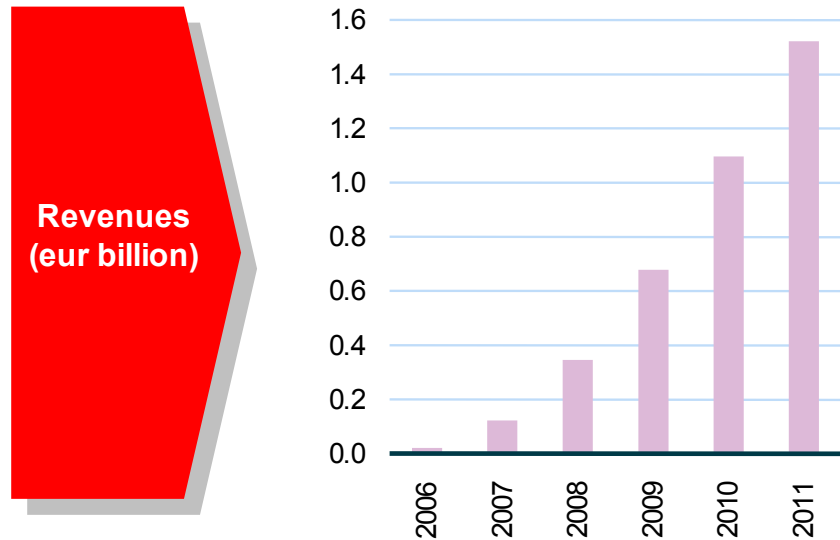
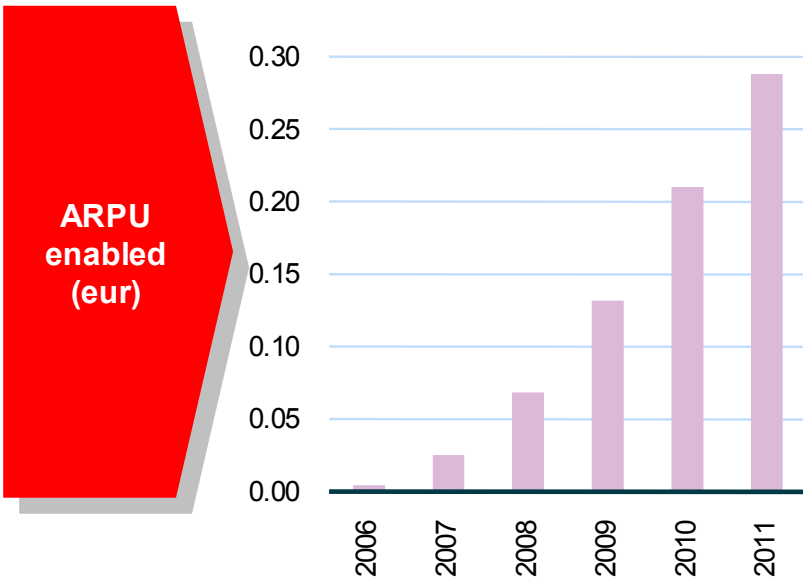
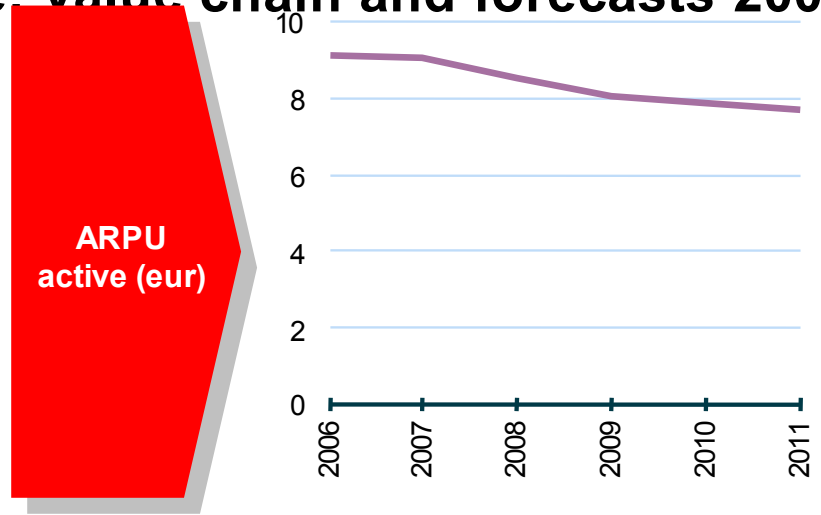
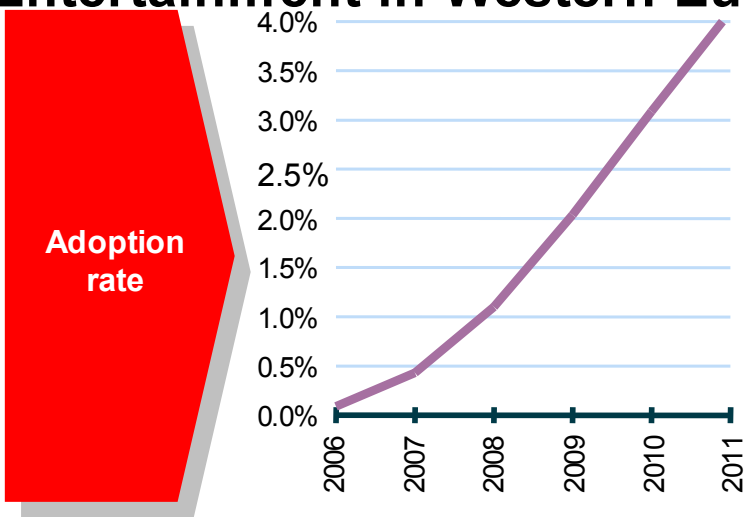
**La convergenza verso tecnologie “IP Based”
supporta bene il principio secondo cui i servizi
TV/video devono poter essere fruiti con diversi
terminali di accesso: oggi il DVB-H, domani il WiFi,
il WiMAX, il 4G**

Mobile TV market forecast

- “By 2010 **65 million customers worldwide** will use broadcasting or streaming TV services”(Juniper Research's report, Mobile TV)
- “**10% of content services expected revenues** in 2011 will come from broadcasting TV services in Western Europe” (Analysys Research, Western Europe, 2006)
- “Nearly **50% of Potential Users can imagine to change their mobile service provider**, if mobile TV was not offered by their current network operator ” (VF User Survey / Goldmedia GmbH, July 2004)
- “Italian mobile-TV market is expected to **exceed 800M Euro by 2010**” (Merril Lynch, 2006)

Broadcast TV services uptake (source: Analysis - Mobile

Entertainment in Western Europe: value chain and forecasts 2006–11)



Key Success Factors



- **Devices**

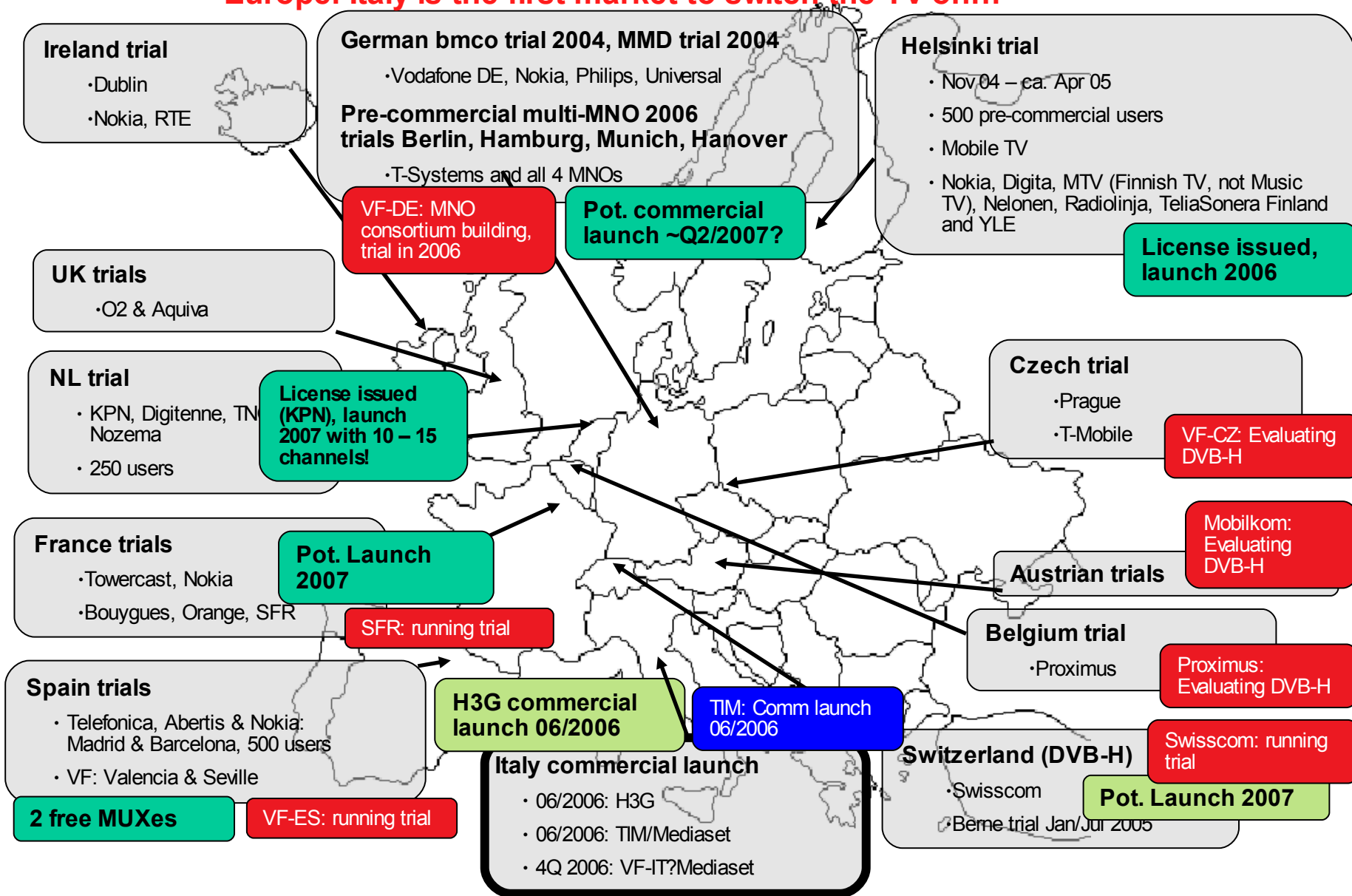
1. Content

- Best contents
- Flexible business model
- Ad hoc content packaging and broadcasting

1. Interactivity and interoperability



DVB-H is likely to become the *de facto* mobile broadcasting standard in Western Europe. Italy is the first market to switch the TV on!!!



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Broadcast technologies comparison

	T-DMB (DAB)	DVB-H	mediaFLO	DVB-H+
Standard	ETSI Standard	ETSI Standard	Proprietary	Standardization on going
Capacity	3-7 channels @ 300kbps in 1,7 MHz (D-QPSK)* Theoretical values	9 - 18 channels @ 300kbps in 8 MHz with MPE-FEC (QPSK-16QAM respectively)	13-27 channels @ 300kbps in 8 MHz (QPSK-16QAM respectively. These values need to be verified in Trial)	20– 35 channels @300Kbps in 15 MHz (These values need to be verified in Trial)
Frequency	Band III (174 – 240 MHz) and in L-Band (1452 – 1477 MHz)	Bands UHF IV and V (470-862 MHz)	Bands IV, V and frequency up to 3 GHz	S-band (2170-2200 MHz)
Coverage (Urban km²)	52.8 (VHF), 13.8 (L Band)	9.8 (QPSK), 4.3 (16 QAM)	13.2 (QPSK), 6.1 (16 QAM)	9.8 (QPSK)
Switching Time	≅ 4 sec	≅ 1-2 sec	≅ 1-2 sec	tbv
Power Saving	Medium	High	High	High
Cost	Higher average costs per channel than DVB-H and mediaFLO	Lower average costs per channel than T-DMB	Lower average costs per channel than T-DMB	tbv
Trial	<ul style="list-style-type: none"> ✓ In France with Samsung, Bouygues Telecom, TF1 and VDL 	<ul style="list-style-type: none"> ✓ In Sweden from October to December 2006 with Nokia and others partners ✓ In Singapore with Innnoxius Technologies 	<ul style="list-style-type: none"> ✓ Qualcomm and British Sky Broadcasting announced intend to conduct mediaFLO technology trial in UK later this year. 	<ul style="list-style-type: none"> ✓ In Toulouse by Alcatel ✓ Orange late 2006 (tbc)
Launch	<ul style="list-style-type: none"> ✓ In Germany, MFD launched Watcha TV 	<ul style="list-style-type: none"> ✓ In Germany by MNOs consortium (2Q07) ✓ Italy by La3 (June06), TIM (4Q06), VF-IT (4Q06) ✓ Digita in Finland by the end of 2006 		

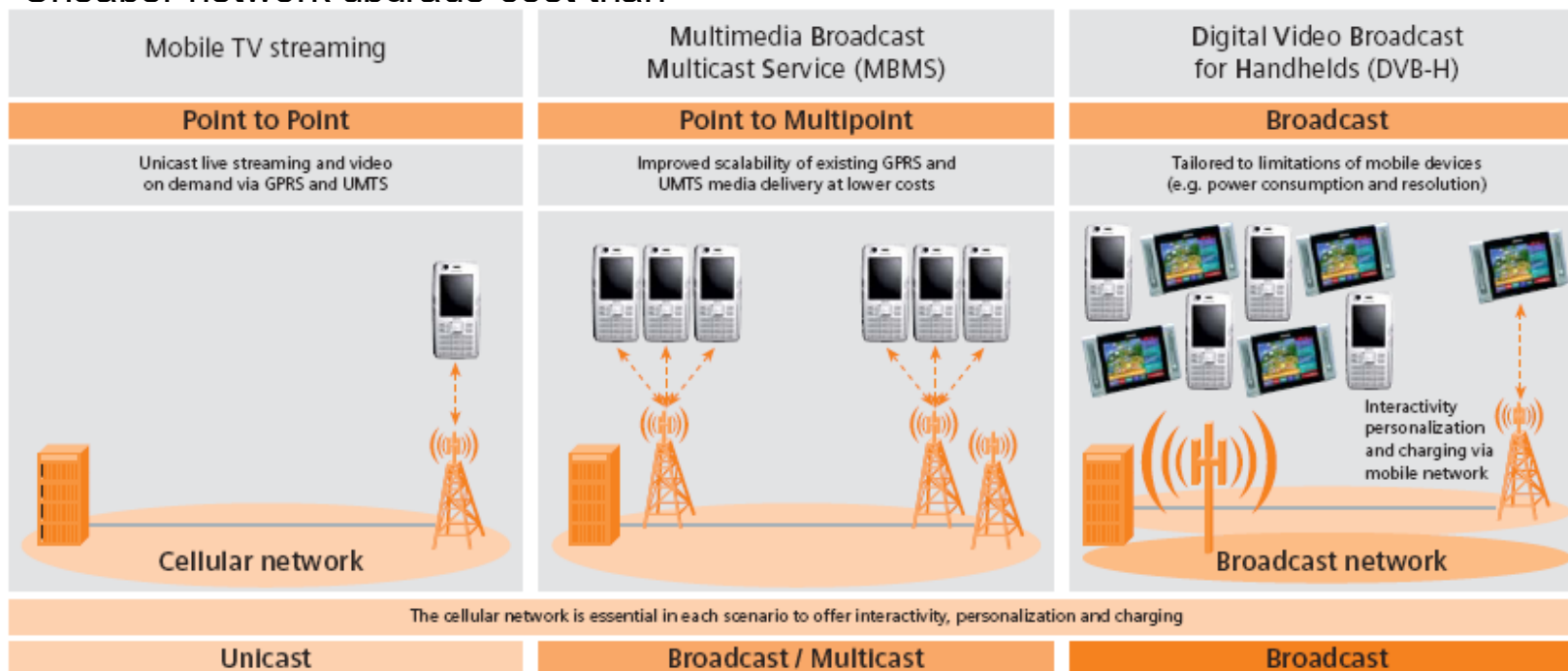
Communication and Multimedia – Mobile

MBMS

- Joins the advantages of broadcast and unicast: 3G / 2.5G equipment available from 2H 2008
- Data rates: 64 or 128 kbps (up to 256 kbps)
- Cheaper network upgrade cost than

DVB-H

- Designed for MPEG-2 video broadcasting
- Enhanced version of DVB-T to support mobility
- Maximum bitrate: 5Mbps vs 30Mbps of the Terrestrial version
- Needs a new network to be built



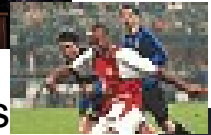
Why DVB-H ?

- **UHF frequencies** (470 – 700 MHz) **allow good outdoor coverage**
- **Large bandwidth** (8 MHz available in many countries)
- **High bit rate** (up to 18 channels in one MUX with 16QAM)
- **High quality reception** (based on OFDM technique improved by MPE-FEC)
- **Battery life improved by Time Slicing** (up to 2 hours continuous streaming)
- **Cellular return channel enables payment and many interactive services** (e.g. betting, voting, etc..)
- **Industry trend** (several forum recognise DVB-H as the only mature technology to be implemented today for one-to-many services)
- **Terminals availability** (Samsung, LG, Nokia, etc..)

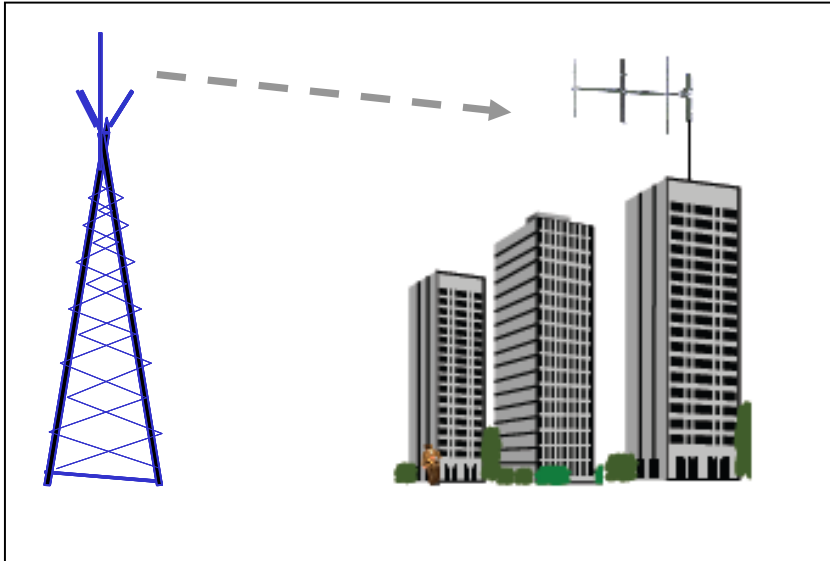
Digital Video Broadcasting - Handheld



- Based on OFDM technique which is very robust especially in difficult reception condition (e.g. mobility, urban environment)
- DVB-H is based on DVB-T (terrestrial), operating on 470-862 MHz spectrum (UHF band). Due to GSM interference the real usage is up to 700 MHz (UHF channel 49)
- Broadband system with high transmission speeds.
 - Channel bandwidth of 5,6,7,8 MHz are possible (Italy uses 8 MHz)
 - Maximum data rate up to 30 Mb/s can be reached with higher modulation schemes
 - The main additional features of DVB-H:
 - ***Time slicing*** technique to achieve better battery saving percentage
 - ***MPE-FEC*** error correction mechanism for additional robustness and mobility
 - ***4K-mode*** for mobility and radio network design flexibility
- From a core network point of view the data transmission (AV and signalling) from the source to the IPE/MUX is done via IP multicast (IPDC network).



Why DVB-H (instead of DVB-T) ?



- Target to have outdoor reception
- No power consumption constrains on receiver side
- Scalability capacity up to 4-5 Mobile TV channels/frequency

- Target to have portable, indoor and mobile reception
- Reduced power consumption on receiver side
- Improved error tolerance and robustness
- Improved Doppler performance
- Scalability capacity up to 10-30

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Coverage

(1/2)

- **DVB-H is more critical respect to DVB-T in terms of coverage. The scenarios considered, need a strong signal due to the presence of more attenuation in the signal transmission path (building loss). Differently from the DVB-T case where we have big rooftop receiving antennas, in DVB-H, the receiving antenna is a small and integrated inside the mobile device.**
- **A DVB-H network using only TV Towers is impractical because the TV masts do not guarantee a good indoor reception especially in an Urban area. So, we need to add gap fillers to increase coverage and quality.**



Coverage

(2/2)

- The service coverage offered from a single site is a trade-off between cell radius and useful throughput.
- The table below matches the different performances for different type of modulations.

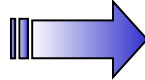
<i>Modulation Type</i>	<i>Useful throughput (Mb/s)</i>	<i>Ch. Numbers</i>	<i>Coverage quality</i>	<i>Network Cost</i>
<i>64 QAM</i>	<i>20</i>	<i>30-50</i>	<i>Very Poor</i>	<i>Very High</i>
<i>16 QAM</i>	<i>10</i>	<i>15-30</i>	<i>Poor</i>	<i>High</i>
<i>QPSK</i>	<i>5</i>	<i>10-15</i>	<i>Good</i>	<i>Acceptable</i>

- QPSK modulation seems to be the optimal choice for a DVB-H network implementation from a coverage and quality of service point of view but a high services demand (more than 10-15 channels) lead to implement 16QAM modulation

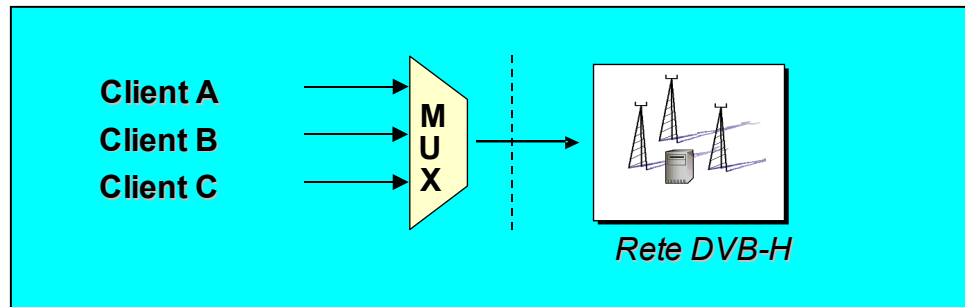
Radio network overview: system parameters

System Parameters:

Modulation: 16 QAM
Code Rate: $\frac{1}{2}$
Guard Interval: $\frac{1}{4}$
MPE-FEC: $\frac{3}{4}$



Total Bit Rate = 9,95 Mbps
Net Bit Rate = 7,45 Mbps



- VF-IT will be allowed to use 25% of the total throughput

Total VF-IT Bit Rate=2,5 Mbps, Net VF-IT Bit Rate=1,4 Mbps (considering IP, MPE-FEC packetization and other data services as ESG and EMM)

- How many channels will be possible to transmit ?

Assuming an average of A/V bit rate of 280 Kbps (240 video + 32 audio) and 500 Kbps dedicated for ESG and EMM data it seems to be possible to allocate around 5 channels in 2.5 Mbps MUX portion (burst time period = 2799 ms)

Radio network overview : network architecture

The network architecture will be composed of a **Primary Network** and a **Secondary Network**.

✓ **Primary Network (TV towers)**

Composed of 400 sites (TV Towers) in MFN configuration (each TV mast frequency is different from the others).

The transmitters with an output power greater than 50W will have a spare part.

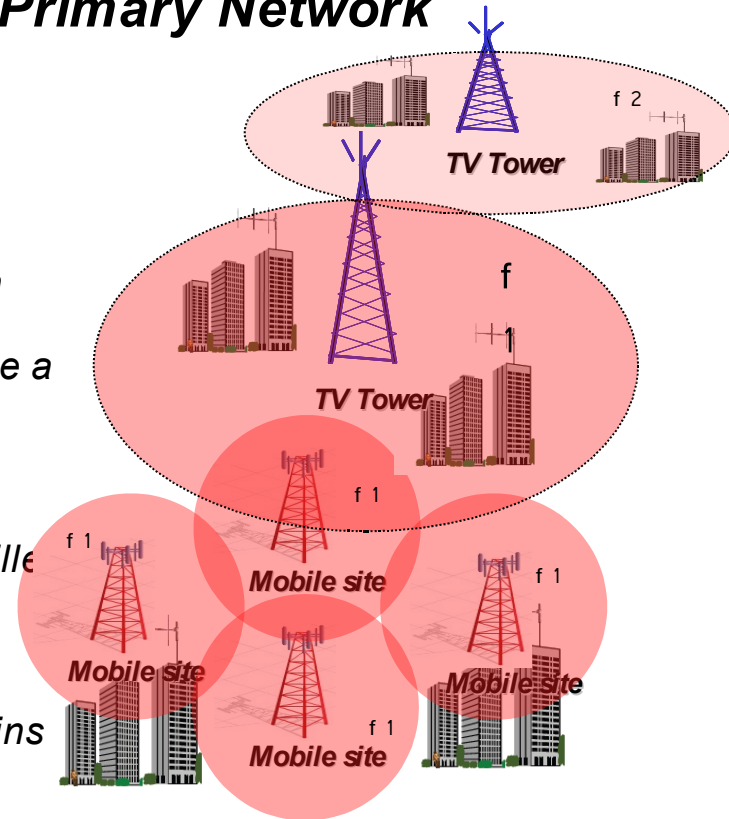
✓ **Secondary Network (gap fillers)**

Composed of 1,000 gap fillers in SFN configuration (each gap filler frequency is equal to the others in the same area and to the frequency of the dominant TV tower).

VF-IT will provide 250 sites to host DVB-H TX equipments.

The transmission power is limited to 20W for regulatory constraints except for particular cases.

The use of repeaters will be analyzed case by case (will be probably used for indoor usage)



RAI and Mediaset coverage capabilities

(1/2)

System parameters:

Modulation: QPSK

Code Rate: $\frac{1}{2}$

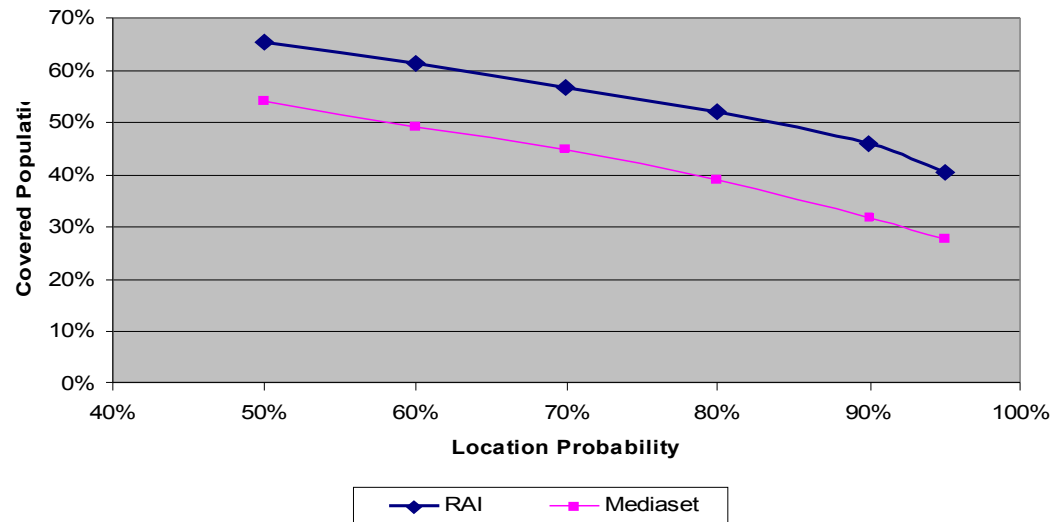
Guard interval: $\frac{1}{4}$

Frequency: 600 MHz

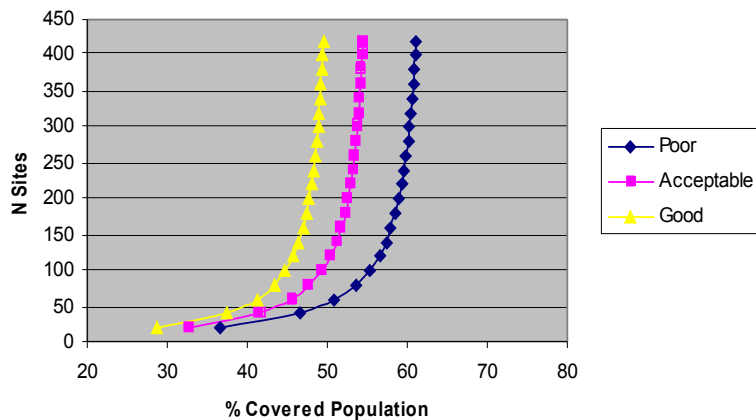
Network composed by the asset of the Broadcasters without using gap fillers.

Coverage target: indoor

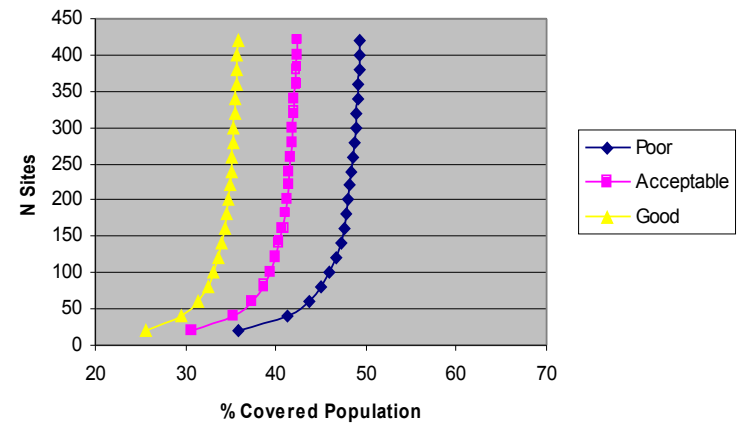
RAI and Mediaset coverage (ERP_A -10dB)



RAI POW -10dB



Mediaset Pow -10dB



Radio network overview : roll-out and performances

- **The network will be implemented according to the following roll-out plan:**
 - Activation of Primary network and 600 gap-fillers within 1 September 2006.
 - Activation of the others 400 gap-fillers within 31 December 2006. In these gap-fillers are comprise the 250 sites of VF-IT.
- **Following table summarizes the coverage simulation results according to the roll-out plan:**

Nr. Siti Broadcast	Nr. gap-filler (20W)	QoS	Stima Copertura (%)	
			pop. dei CdP/ CdR	Nazionale
~ 400	~600 (CdR/ CdP)	Outdoor	90%	64%
		Incar	79%	41%
		Indoor	53%	29%
~ 400	~1,000 (di cui ~600 in CdR/ CdP)	Outdoor	94%	75%
		Incar	80%	48%
		Indoor	54%	34%

250 gap filler out of CdR/CdP will be implemented in VF premises

Coverage simulation results provided by Mediaset
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RAI and Mediaset coverage capabilities

(2/2)

The results have been also filtered according to VF coverage criterion considering the main 290 Italian municipalities.

Coverage evaluation

RAI (DVB-H TV mast power is <u>10</u> dB less than analogue power)									
Service Quality (Location Probability)	National Coverage according to TV broadcaster definition	Coverage according to VF definition - SFN at province level (Quality criteria definition: city is COVERED when more than 75% of resident inhabitants are reached by the service). Only those municipalities greater than 30k inhabitants have been considered (total 290)							
		Provincial Capitals	Region Capitals (part of Province Capitals)	Cities > 100k inhabitants	Cities >70k<100k inhabitants	Cities >50k<70k inhabitants	Cities >20k<50k inhabitants	TOTAL cities	Coverage on Italy population
Poor (60%)	61,20%	52	14	0	3	6	45	106	21,25%
Acceptable (75%)	54,61%	38	13	0	2	4	33	77	17,51%
Good (85%)	49,59%	25	12	0	1	4	24	54	13,59%

MEDIASET (DVB-H TV mast power is <u>10</u> dB less than analogue power)									
Service Quality (Location Probability)	National Coverage according to TV broadcaster definition	Coverage according to VF definition- SFN at province level (Quality criteria definition: city is COVERED when more than 75% of resident inhabitants are reached by the service). Only those councils greater than 30k inhabitants have been considered (total 290)							
		Provincial Capitals	Regional capitals (part of Provincial capitals)	Cities > 100k inhabitants	Cities >70k<100k inhabitants	Cities >50k<70k inhabitants	Cities >20k<50k inhabitants	TOTAL cities	Coverage on Italy population
Poor (60%)	49,31%	25	7	0	2	8	28	63	16,15%
Acceptable (75%)	42,21%	12	4	0	2	6	23	43	10,75%
Good (85%)	35,53%	4	0	0	2	5	12	23	2,01%

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Conclusion

DVB-H network planning:

A network operator has to consider the following 4 main drivers to plan a DVB-H network:

- Coverage target: outdoor, indoor
- Service quality: location probability
- Capacity: number of TV channels
- Investment

A trade-off between the above drivers has to be established. To target an acceptable indoor coverage and quality of service a huge number of gap fillers need to be implemented.

The current DVB-H network implemented by Mediaset is based on high modulation (16QAM) in order to offer high capacity. H3G planned to switch in 16QAM before end of this year in order to increase the current number of channels (up to 20).

DVB-H issues:

• Access to the UHF Italy spectrum:

today UHF frequencies belong to broadcasters and used to Analogue and DTT transmissions. Third parties entry (e.g. MNO) is not possible from a regulatory point of view

• Interference:

It is under discussion a possible DVB-H showstopper due to adjacent channel interference. A DVB-T receiver could be blocked because it is interfered from a DVB-H adjacent channel.

• Capacity limitations:

The total capacity has to be shared between several components:

- Video and audio content
- MPE-FEC and IP packetization overhead
- ESG and EMM/ECM signalling
- PSI/SI tables

The non related content capacity has a weight of around 50% of the gross capacity

• Conditional access

CA solution used for service protection mechanism means an integration of proprietary components into mobile devices and SIM. This could limit the entrance of new terminals vendors (not agree to implement this solution, e.g. NOKIA) and managing high volume in case of huge demand.