

DKE German Commission for Electrical, Electronic  
and Information Technologies of DIN and VDE

**Overview on the operation and usage principles  
of  
PWMS in Europe**

DKE WG 731.0.8  
"Professional Microphone Systems"  
of DIN and VDE (Germany)

## EU manufacturer group



**Pete Myring** – Consultant ,EU manufacturer group`



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## Abbreviations

### PMSE

Program Making Special Events

(includes PWMS + wireless video / cameras + talk backs + ...)

### PWMS

Professional Wireless Microphone Systems

(SAB / SAP: wireless microphones & music instruments, In Ear Monitoring...)

# Professional Wireless Microphone Systems

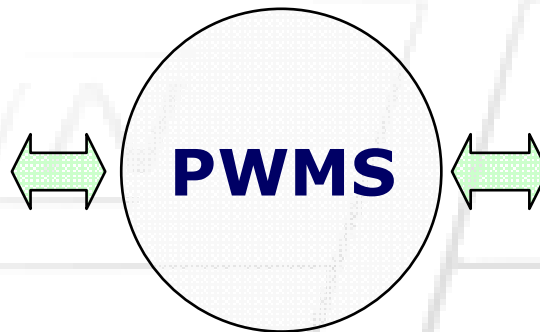


Services Ancillary to Programme making



Services Ancillary to Broadcasting

- Broadcast applications**
- TV production
  - Radio production
  - Sport production (i.e. Olympia)
  - News gathering
  - National events (i.e. elections)
  - And more



- Non broadcast applications**
- Actors 'on tour'
  - Audio distribution systems (e.g. in sport stations)
  - Business installations
  - Church installations
  - Conference installations
  - Industry trade shows
  - Movie production
  - Music groups 'on tour'
  - Studio production
  - Theatre installations
  - Theatres 'on tour'
  - And much more

## Facts on PWMS (1)

- Wireless microphones have been in production since 1957 (50 years).
- Sharing operation respectively secondary usage with broadcast service on VHF and UHF is possible by Stockholm and Chester agreements (1961 to 1997).
- The market entry of UHF PWMS by 1982 gave the break-through in audio quality (25 years ago).
- Live Events, Musicals and sport events are based on wireless technology.

## Facts on PWMS (2)

- From 2005 to 2006 there was an increase of approximately 20% in PWMS units in the European market.
- It is estimated that about 4-5 million PWMS are in operation in Europe (Source: PAMA 2006).
- PWMS operate in broadcast and non-broadcast applications (SAB/SAP).
- Non-broadcast applications have actually a larger number of units in operation.
- Re-mastered audio productions earn revenue for decades.

## License schemes

### License

- certificate shows specific frequencies to be used
- license fee
- granted for specific time
- granted for specific place
- or both, time and place

### Light License

- Small or no license fee
- User is able to choose from many frequencies published given by administration
- Specified frequencies for User Groups might differ between different applications

## License schemes - Examples

**Austria:** Light License 470 – 862 MHz

**France:** Light License 470 – 830 MHz

**Germany:** License 470 – 790 MHz,  
Light License 790 – 814 MHz + 838 – 862 MHz

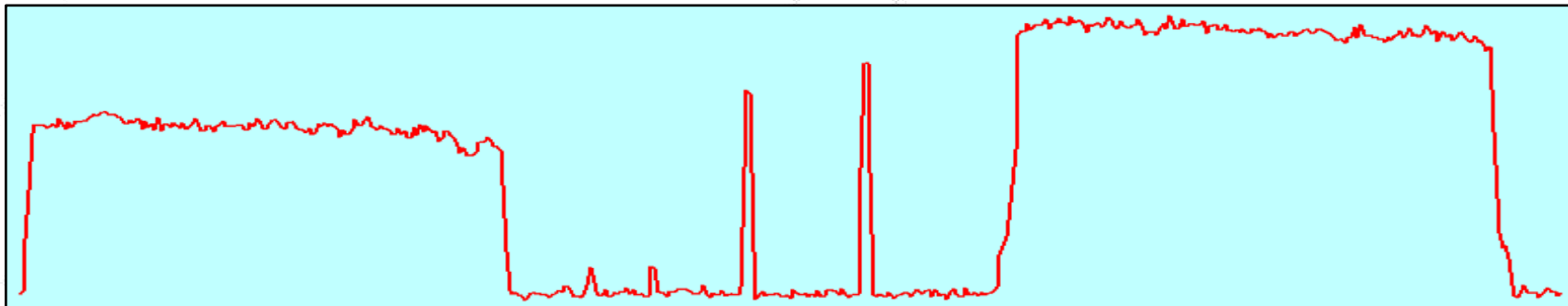
**Italy:** License 470 – 854 MHz

**Sweden, Norway, Finland, Denmark:**  
License 470 – 862 MHz  
Light License (does differ a little bit in each country) 790 – 820 MHz

**UK:** License 470 – 862 MHz, 854 – 862 MHz exclusively PWMS

## How do we share spectrum for 50 years?

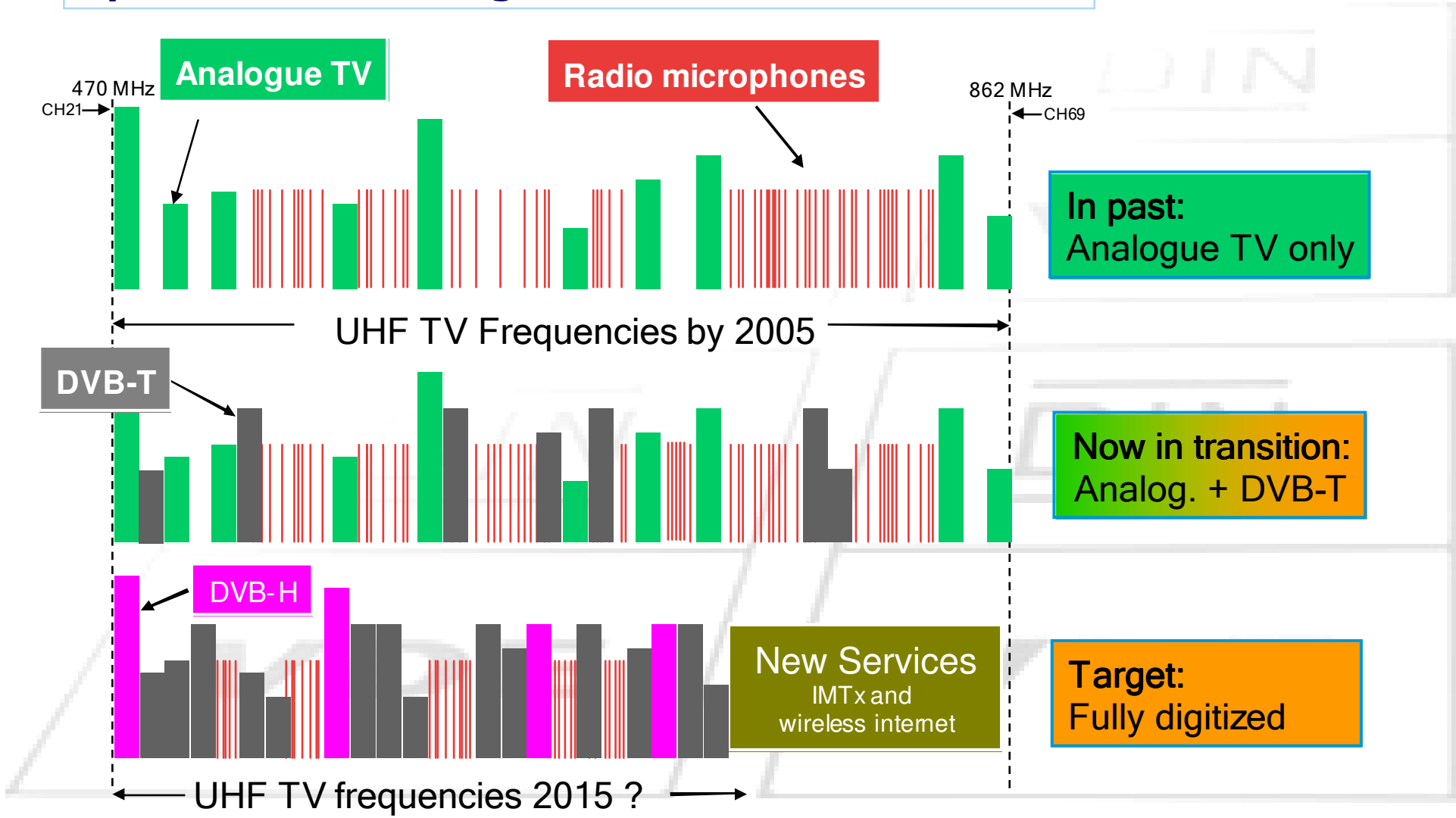
- PWMS and TV transmitter share the VHF and UHF spectrum
- Main operation takes place in the UHF band on secondary use
- No exclusive UHF frequency ranges for PWMS exist
- We use empty TV channels with geographical separation from adjacent TV transmitters
- PWMS use local TV reception gaps (shielded or indoor operation)
- Example: Two wireless microphones working between DVB-T channels



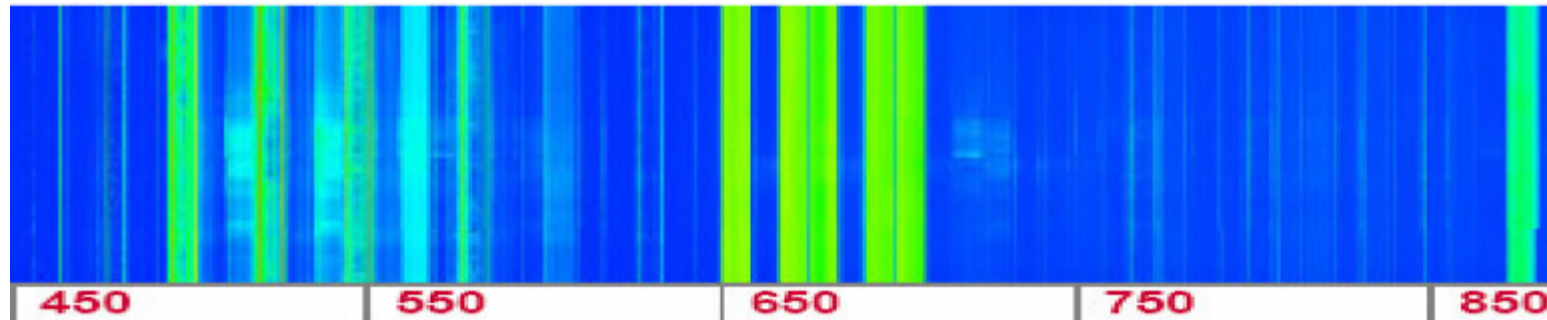
## Spectrum is reducing

- WRC2007  
New allocation for IMT 790 – 862 MHz (TV Channels 61 – 69)
- New services  
Different new wireless services are requesting UHF spectrum.
- DVB distribution might need more spectrum as currently planned  
DVB-H  
DVB-T2
- PWMS  
User are requesting more wireless systems and HD-Sound

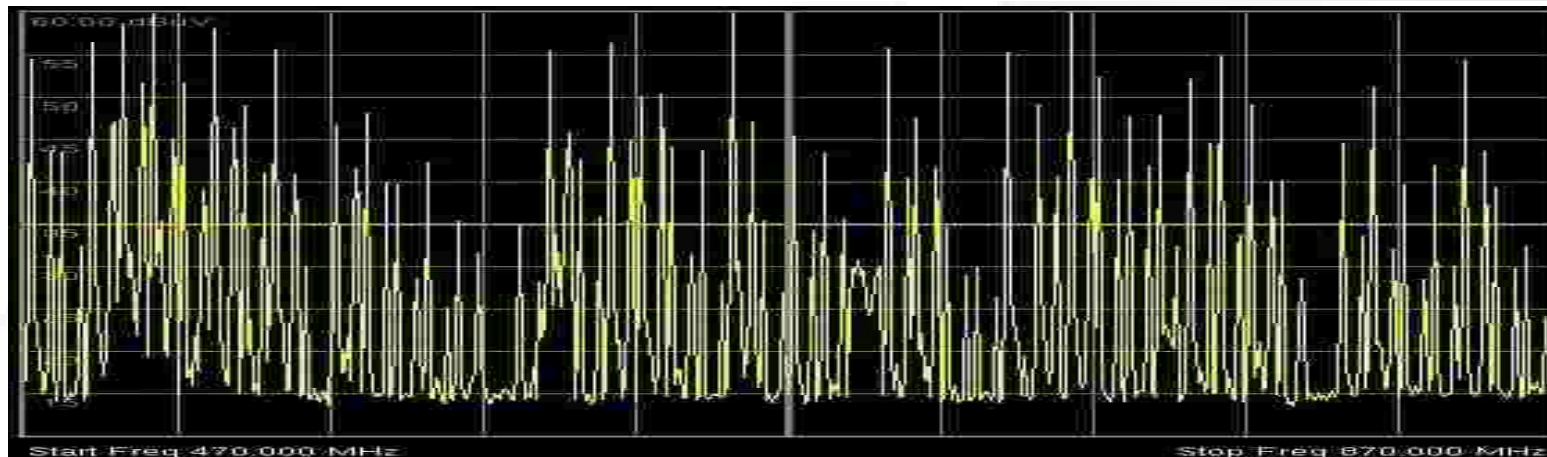
# Spectrum is reducing



## Is there spectrum to share with others? White spaces?



Some think that the urban spectrum is mostly empty all the time.



We often see the spectrum at events as completely overloaded.  
Indoor spectrum without microphones seen at preparation  
for European Song Contest, Athens 2006.

## Example (1): World bicycle championship\_1

- 240 wireless units including PWMS were licensed



**10 %**  
1 - 4 GHz  
wireless video usage

**13 %**  
140 - 170 MHz  
narrow band applications



**38 %**  
470 - 854 MHz  
PWMS

**4 %**  
170 - 230 MHz  
PWMS



**27 %**  
410 - 470 MHz  
narrow band talk back

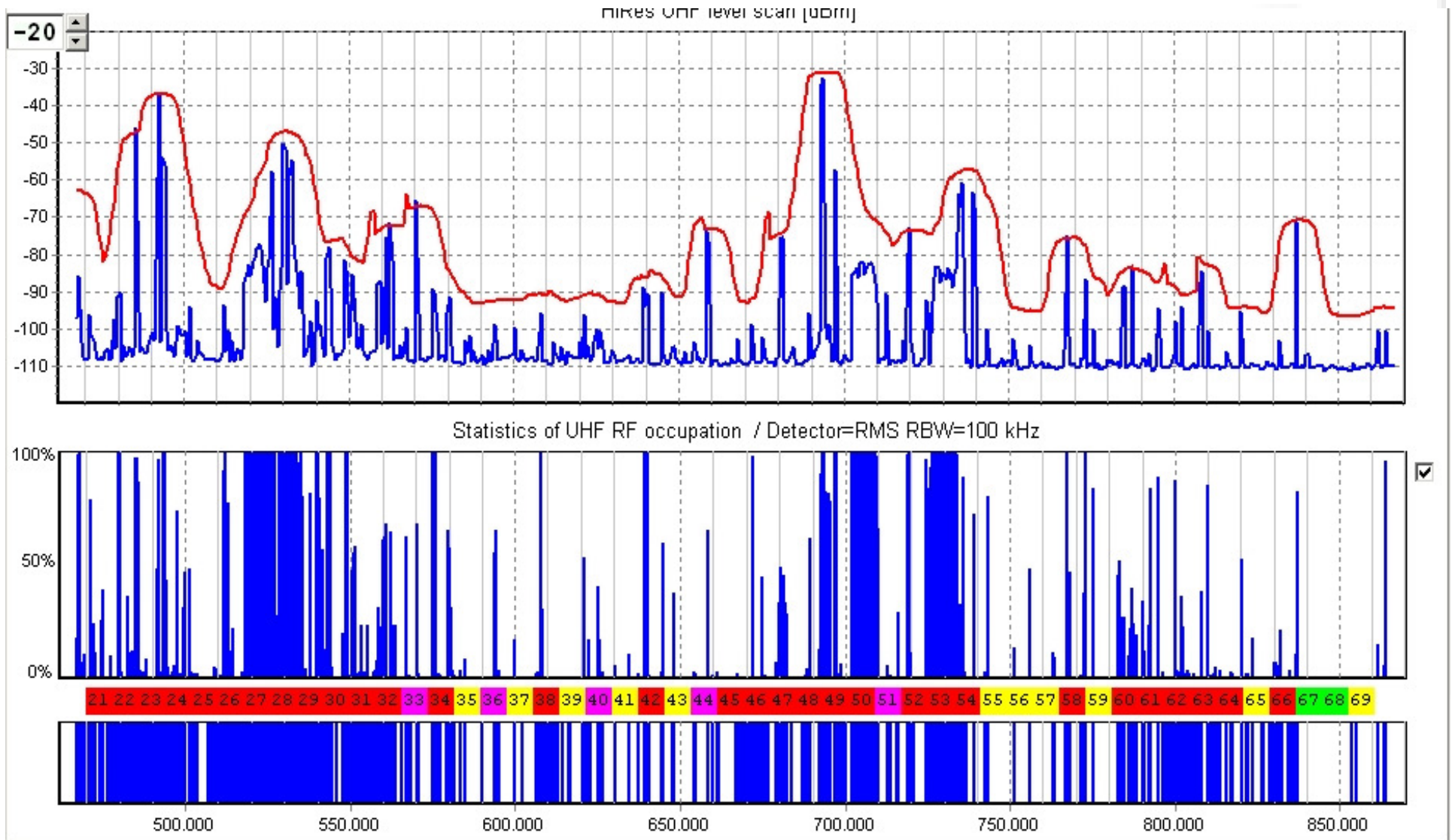


**8 %**  
410 - 510 MHz  
narrow band  
talk back



# Example (1): World bicycle championship\_2

- Spectrum occupancy recorded during world bicycle championship in Stuttgart 2007



## Examples (2): Musical – London West End

TV Bar					53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	
>>> S															8	8						
Avenue	Disney's <b>THE LION KING</b>	<b>MAMMA MIA!</b>	<i>The Phantom of the Opera</i>	<b>WE WILL ROCK YOU</b>														8	8	8	8	
Billy E	London	London	London	London												8		8	8	8		
Dirty T	Infos/Tickets	Infos/Tickets	Infos/Tickets	Infos/Tickets																	2	
Frost/															8			8	8	8		
Guys &															8			8		8	8	
Les Mi															8						15	
Lion K	<b>Wicked</b>	<b>42nd Street</b>	<b>Avenue Q</b>	<b>BAD GIRLS</b>											8			15	15	15		
Lord o	London	London	London	London														8	8	8	8	
Mamm	Infos/Tickets	Infos/Tickets	Infos/Tickets	Infos/Tickets														8	8	8	8	
Mary P															8			8	8	8	12	
Spome															8	8		8	8	8	8	
The S															8	8		8	8	8	2	
We W															8	8		8	8	8	4	
Wicke															8	8		8	8	8	8	
Daddy	<b>Billy Elliot</b>	<b>Blood Brothers</b>	<b>BUDDY</b>	<b>GREASE</b>											8	8		8	8	8	8	
Phant	London	London	London	London											8	8		8	8	8	8	
Danci	Infos/Tickets	Infos/Tickets	Infos/Tickets	Infos/Tickets											8	8		8	8	8	8	
Blood																		8	8	8	8	
Bent																		8	8	8	8	
Blue M																		8	8	8	8	
Cabar																		8	8	8	8	
Chicag																					16	
Evita	<b>HAIRSPRAY</b>	<b>Joseph and the Amazing Technicolor Dreamcoat</b>	<b>Les Misérables</b>	<b>Mary Poppins</b>																	2	
Porgy	London	London	London	London																		
The Pr	Infos/Tickets	Infos/Tickets	Infos/Tickets	Infos/Tickets																		
Rock n																						
Histor																						
>>> E																						
Childr																						
Maria																						
HRH B	<b>The Lord of the Rings</b>	<b>The Sound of Music</b>	<b>The Woman in Black</b>	<b>Opern im Coliseum</b>																		
Prince	London	London	London	London																		
Brits 2	Infos/Tickets	Infos/Tickets	Infos/Tickets	Infos/Tickets																		
VE ZA																						
Strictl																						
Dance																						
Live8																						
	<b>The Last Night of the Proms</b>	<b>DIRTY DANCING</b>																				
	London	London																				
	Infos/Tickets	Infos/Tickets																				

## Examples (3) – Disneyland Paris

- Disneyland Paris:
  - France, indoor & outdoor
  - Located in Marne la Vallée.
  - Wireless microphones are used all over the Theme Parks to produce music shows, outside animation, the daily parade...
  - 200 wireless microphones are used daily.



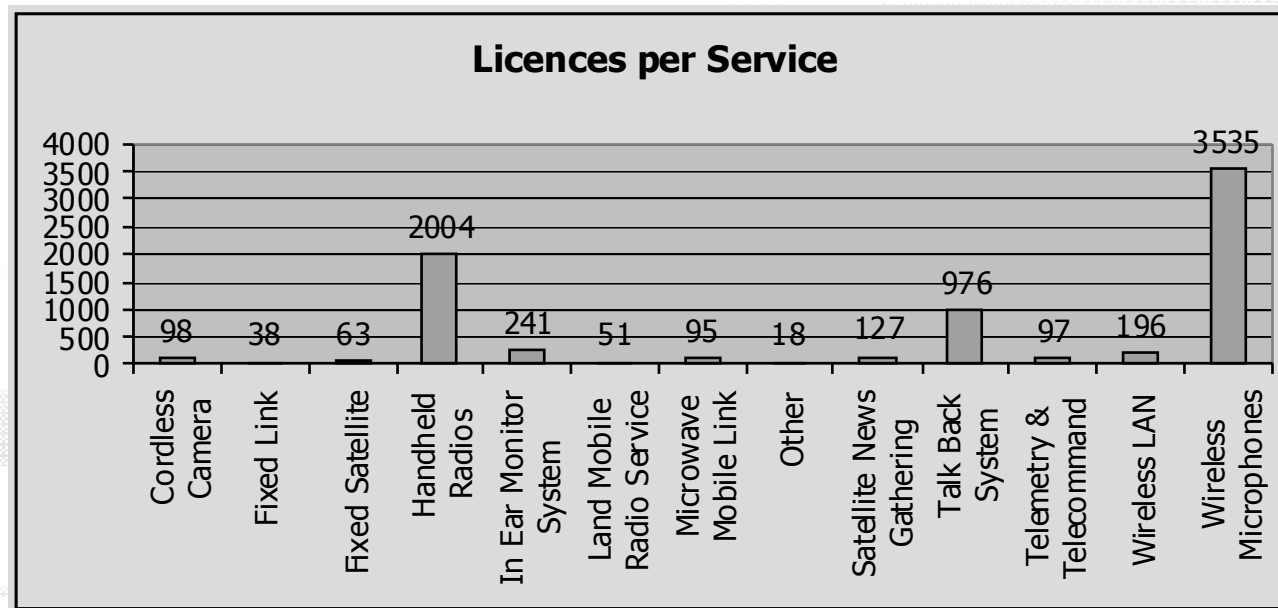
## Examples (4) – Universities, Schools,...

- Universities Fribourg, Bern, Basel Genf, St. Gallen, Luzern Yverdon, Lausanne (Switzerland)
  - 1500 wireless microphone systems



## Examples (5) – Olympics 2004

- **Athens, indoor / outdoor**
  - 3 535 wireless microphones on 527 frequencies.
  - 241 IEMs on 71 frequencies.
  - 976 talkback systems on 423 frequencies.



## Examples (6) – Musical

- “Domstufen” Erfurt (Germany, August 2006)
  - Outdoor, free open-air opera
  - 86 wireless microphones simultaneously
  
- “Best of Musical” tour throughout Germany
  - indoor
  - 25 wireless microphones
  - 10 IEM simultaneously



## Examples (7) – Eurovision Song Contest

### ■ Places of event:

- 2001: Copenhagen, Parken Stadion.
- 2002: Tallinn, Saku Suurhall.
- 2003: Riga, Skonto-Olympia Hall.
- 2004: Istanbul, Abdi Ipekci Spor Salonu.
- 2005: Kiew, Palats Sportu.
- 2006: Athens, Olympic Stadium.



- Typically 48 active wireless microphones on stage.
- Typically 16 active IEM on stage.
- Additional wireless microphones off-stage and outdoor operation.
- Careful frequency planning employed to reduce required UHF resource.
- High potential for high levels of man-made noise due to installed stage effect applications.
- Very high collision potential with "On tour applications".
- Up to 250 million spectators per event.

Source: EBU Press Release [14].

## Examples (8) – Tour de France 2005

- **Publics**
  - 15 million spectators
- **Media**
  - 2 300 accredited journalists
  - 1 200 journalists, photographers, cameramen & TV directors
  - 1 100 technicians or chauffeurs
  - 528 various media
- **TV broadcasting**
  - 78 channels in 170 countries, 2 billion viewers
  - 2 400 hours of TV coverage
- **Internet**
  - 350 million pages viewed
  - 7.7 million visitors
- **Radio frequency resources**
  - At least 1 000 wireless microphones used daily



## Examples (9) – Tours and Concerts

### ■ **Phil Collins European Tour** (Switzerland)

- Indoor
- 16 wireless microphones
- 10 IEM channels



### ■ **"Prince's Trust" Concert 2006** (UK)

- outdoor
- 44 wireless microphones



### ■ **Johnny Hallyday tour** (France)

- indoor
- Biggest concert in France.
- 100 concerts around the French territory.
- 80 wireless microphones and ear monitors



## DD Market research OFCOM UK



Digital Dividend Review  
Market Research 2007  
Executive Summary

Research Document

Publication date: 28 November 2007

### Methodology

The research conducted in 2007 consisted of both **quantitative** and **qualitative** research.

The research was designed to assess consumer and citizen responses to six potential services that could use the digital dividend:

- extra standard-definition channels on Freeview;
- local TV on Freeview;
- High-definition (HD) channels on Freeview;
- wireless home networks;
- improved mobile phone and mobile broadband services<sup>1</sup>; and
- mobile television

### ■ What material will fill up the services?

- TV productions?
- Live events? Sport, music, theatre, musical, conferences, elections, ...

**Whatever will be distributed – PWMS is the first part of the production chain**

## Conclusion

- Not just an application in isolation
- PWMS are at the start (front-end) of the production chain
- Any mistakes can effect the entire future media production
- No PWMS
  - No cost effective multimedia productions
  - No flexible multimedia services
  - No world wide ultra-flexible Electronic News Gathering
  - No big events any more (Olympiads, world sport games, song contests, elections,...)
- **The main question:**
  - Can multimedia productions be made without wireless microphone systems?

**... a few slides – frequently asked questions**



**DKE German Commission for Electrical, Electronic and Information Technologies of DIN and VDE  
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## Why UHF?

- We are performing compatibility studies within CEPT SE24 in L-Band (1.5 GHz).  
These proposed frequency band might be able to compensate DD loss, however this is only a DD substitution for indoor fixed installations.  
Current status: Existing primary services deny secondary use of PWMS.
- VHF cannot provide needed quality, too much man-made noise.
- UHF is the only frequency band which fulfils essential RF requirements for PWMS: working range, needed RF power, antenna length,...
- → We can not just move.

## Go digital – is this better?

Digital is always better?

- Digital modulation schemes do not change RF physics
  - IM products remains the same.
  - Spectrum efficiency is not better. Actually it is requested to transmit Audio in HD-Quality, i.e. technology requires wider RF bandwidth.
- Critical issue in audio world is real time audio. Current technology is not able to provide needed data compression to fit in 200 kHz in real time.
- Moreover current technology has a very high power consumption.

## PWMS – technical

- ETSI TR 102 546, SRDoc PWMS  
System Reference Document
  - CEPT SE24, Document M41\_08R0...doc  
Technical specifications above 1 GHz including protection ratio
  - ETSI TR 102 546 Annexes  
Technical specification below 1 GHz including protection ratio
- All documents are attached to this presentation.

## Last but not least – The protection criteria

### Specified application parameters for protection of PWMS:

- Minimum field strength
  - **51.5 dB $\mu$ V/m** (i.e. in the fading notches)
    - ➔ This level has to be protected by other applications
- Protection criteria for wireless microphones using analogue modulation
  - 12 to **20 dB** (depending on the receiver technique)
- Protection criteria for wireless microphones using digital modulation
  - 25 to **30 dB** (depending on the modulation scheme)

### Note:

Wireless microphones will also move to digital (EN 300 422 v1.3.1). Used digital techniques will use not constant envelope modulations. This has to be considered with LBT and DAA working concepts.