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

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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

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

In past: Analogue TV only

Now in transition: Analog. + DVB-T

Target: Fully digitized

New Services IMT and wireless internet

UHF TV Frequencies by 2005

UHF TV frequencies 2015?

470 MHz

862 MHz

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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

- 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
- 8% 410 – 510 MHz narrow band talk back
- 27% 410 – 470 MHz narrow band talk back
- 14% 170 – 230 MHz PWMS
Example (1): World bicycle championship_2

- Spectrum occupancy recorded during world bicycle championship in Stuttgart 2007
Examples (2): Musical – London West End

- Disney's The Lion King
- Mamma Mia!
- The Phantom of the Opera
- We Will Rock You
- Wicked
- Avenue Q
- Bad Girls
- Billy Elliot
- Blood Brothers
- Buddy
- Grease
- Hairspray
- Joseph and the Amazing Technicolor Dreamcoat
- Les Miserables
- Mary Poppins
- The Lord of the Rings
- The Sound of Music
- The Woman in Black
- The Last Night of the Proms
- Dirty Dancing

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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.

![Licences per Service chart](chart.png)
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: Kopenhagen, Parken Stadion.
  - 2003: Riga, Skonto-Olympia Hall.
  - 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
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; 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
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.
Specified application parameters for protection of PWMS:

- Minimum field strength
  - 51.5 dBμV/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.