#LevelUpConference

LEVEL UP!
Hosted by AVIXA
Radio Frequencies: Best Practice in a Nutshell

BEST PRACTICES FOR WIRELESS AUDIO

Hosted by AVIXA

#LevelUpConference
What’s so difficult about Wireless?

#LevelUpConference
There are many things that can "break" a wireless system...

The top three:
  • Frequency Choice
  • Coaxial Cable
  • Interference

#LevelUpConference
Frequency Choice

- Frequency Choice – how many frequency bands?
- “Channel 38”!
- Please Note: 606.500MHz to 613.500MHz ONLY!
UK LICENSING

Wireless Telegraphy Act

- De-Regulated – i.e. No licence Required
  - some VHF... 173.8MHz to 175.0MHz
  - UHF ‘Channel 70’ (863 – 865MHz)
  - 2.4GHz “ISM”
  - 1.9GHz “DECT”

- Shared UK General licence
  - Channel 38 – 606.5MHz to 613.5MHz
  - 823MHz to 832MHz, a.k.a. “The Duplex Gap”
  - 1785 – 1805MHz “1.8GHz”

- Interleaved UHF – 470MHz to 694MHz
  - Coordinated Site Specific, Long Term Fixed Site (Annual)
UK LICENSING

Wireless Telegraphy Act

- **960MHz to 1164MHz**
- Primary Services: “Aeronautical Navigation”
- SSR – Secondary Surveillance Radar
  - 1030MHz & 1090MHz
  - Guard bands of ±15MHz
- Distance Measuring Equipment – DME
- So, in reality... several small PMSE sub-bands
  - 961 to 1015 MHz
  - 1045 to 1075 MHz
  - 1105 to 1154 MHz

http://licensing.ofcom.org.uk/radiocommunication-licences/pmse/

https://commons.wikimedia.org/w/index.php?curid=1215149
Sennheiser Frequency Ranges ITU Region 1 Europe v 4.2 April 2020

Disclaimer:
Always check the relevant national regulatory authority for the exact rules governing frequency usage and local laws. This applies in particular to the interference standards and test criteria that allow for the correct frequency allocations and only use the allocated frequencies. Apply for an individual license if necessary, and do not yet transmit into airspace before your technical license has arrived.

Analog
174 - 230 MHz

Digital
D: Digital Audio
S: Standard Devices
SRD: Short Range Devices
174 - 230 MHz

DD: Dual Digital Audio
D: Digital Audio
S: Standard Devices
SRD: Short Range Devices
174 - 230 MHz

J: Single Channel
D: Digital Audio
S: Standard Devices
SRD: Short Range Devices
174 - 230 MHz

DD: Dual Digital Audio
D: Digital Audio
S: Standard Devices
SRD: Short Range Devices
174 - 230 MHz
Frequency Choice

https://en-uk.sennheiser.com/sifa

Sennheiser International Frequency Advisor (SIFA)

Your peace of mind is our goal.

#LevelUpConference
Frequency Choice


Frequencies for wireless microphones

This is how it works in Australia, Austria, Belgium, Brazil, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Japan, Latvia, Luxembourg, Malta, The Netherlands, New Zealand, Norway, Portugal, Romania, Slovenia, Spain, South Korea, Sweden, Switzerland, USA, UAE, Ukraine and UK.

- Revision 30th April 2020 -

Note: Updates of section Germany

#LevelUpConference
Where does it all go wrong?

• There are many things that can “break” a wireless system...
• The top three:
  • Frequency Choice
  • Coaxial Cable
  • Interference
Where does it all go wrong?

- Cable loss - Attenuation
  - Minimise the length
  - Use the right type
    - 50 ohm impedance
    - But... which spec.?
Cable Loss – RF Signal Attenuation

- 50 dB / 100 m
- 25 dB / 100 m
- 9 dB / 100 m

Frequency vs. dB per 100 m for different types of cables:
- RG 58
- RG 213 / GZL 5000
- Ecoflex 15

#LevelUpConference
# Cable loss – Attenuation

The attenuation based on a cable length of:

- **100 m** (in Europe)
- **100 feet** (in USA)

<table>
<thead>
<tr>
<th>Type</th>
<th>100MHz</th>
<th>500 MHz</th>
<th>1000 MHz</th>
<th>Cable Ø</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RG 58</strong></td>
<td>16.3 dB</td>
<td>40.0 dB</td>
<td>55.6 dB</td>
<td>5.0 mm</td>
</tr>
<tr>
<td><strong>RG 213</strong></td>
<td>7.0 dB</td>
<td>19.0 dB</td>
<td>26.5 dB</td>
<td>10.3 mm</td>
</tr>
<tr>
<td>Aircell 5</td>
<td>9.9 dB</td>
<td>22.6 dB</td>
<td>32.8 dB</td>
<td>5.0 mm</td>
</tr>
<tr>
<td><strong>GZL 5000</strong></td>
<td>7.3 dB</td>
<td>19.8 dB</td>
<td>26.7 dB</td>
<td>5.0 mm</td>
</tr>
<tr>
<td>Aircell 7</td>
<td>6.3 dB</td>
<td>14.7 dB</td>
<td>21.6 dB</td>
<td>7.3 mm</td>
</tr>
<tr>
<td>Ecoflex 10</td>
<td>4.0 dB</td>
<td>9.6 dB</td>
<td>14.2 dB</td>
<td>10.2 mm</td>
</tr>
<tr>
<td>Aircom plus</td>
<td>3.8 dB</td>
<td>9.0 dB</td>
<td>13.4 dB</td>
<td>10.3 mm</td>
</tr>
<tr>
<td><strong>RG 174</strong></td>
<td>27.5 dB</td>
<td>62.6 dB</td>
<td>89.8 dB</td>
<td>2.8 mm</td>
</tr>
</tbody>
</table>
Where does it all go wrong?

There are many things that can “break” a wireless system...

The top three:

- Frequency Choice
- Coaxial Cable
- Interference
NO!
THIS IS NOT THE PROBLEM
### Interference

<table>
<thead>
<tr>
<th>Country</th>
<th>Band</th>
<th>Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ireland</td>
<td>3.4 - 3.8 GHz (350 MHz)</td>
<td>2017</td>
</tr>
<tr>
<td></td>
<td>26 GHz</td>
<td>2018</td>
</tr>
<tr>
<td>France</td>
<td>3.46 - 3.8 GHz</td>
<td>2018/2019</td>
</tr>
<tr>
<td></td>
<td>26 GHz</td>
<td>2019/2020</td>
</tr>
<tr>
<td>Spain</td>
<td>3.6-3.8 GHz</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td>26.5 - 27.5 GHz</td>
<td>2019/2020</td>
</tr>
<tr>
<td>Italy</td>
<td>3.6 - 3.8 GHz</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td>26.5 - 27.5 GHz</td>
<td>2018</td>
</tr>
<tr>
<td>England</td>
<td>3.4 - 3.6 GHz (150 MHz)</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td>3.6 - 3.8 GHz (116 MHz)</td>
<td>2019</td>
</tr>
<tr>
<td></td>
<td>26.5 - 27.5 GHz</td>
<td>2019/2020</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Band</th>
<th>Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>3.4 - 3.8 GHz</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td>26.5 - 27.5 GHz</td>
<td>2018*</td>
</tr>
<tr>
<td>Finland</td>
<td>3.4 - 3.8 GHz</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td>26.5 - 27.5 GHz</td>
<td>2019</td>
</tr>
<tr>
<td>Russia</td>
<td>3.4-3.8 GHz</td>
<td>2019/20*</td>
</tr>
<tr>
<td></td>
<td>26 GHz</td>
<td>2020+*</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.4 - 3.8 GHz</td>
<td>2019</td>
</tr>
<tr>
<td></td>
<td>26.5 - 27.5 GHz</td>
<td>2019</td>
</tr>
</tbody>
</table>
Where does it all go wrong?

• There are many things that can “break” a wireless system...

• The top three:
  • Frequency Choice
  • Coaxial Cable
  • Interference
New types of noise
Where does it all go wrong?

- There are many things that can “break” a wireless system...
- The top three:
  - Frequency Choice
  - Coaxial Cable
  - Interference
How to Make Sure It Works!

- Want to know more about...
- The top three:
  - Frequency Choice
  - Coaxial Cable
  - Interference
- And so much more...
  - Intermodulation
  - Digital v Analogue
  - Splitters & Combiners
  - Antennas
  - Boosters...

#LevelUpConference
Learn How to Make sure it Works!
sennheiser.com/soundacademy

Training Courses > Wireless Mics & Monitoring Essentials - Marlow course

Course Details
Edit Course
Course Dates
Email Templates
Admin

This course is for new and existing users of wireless microphones and in-ear monitor systems who wish to further their understanding of the area for the benefit of their career. We are now pleased to offer a 50% discount for members of the Association of Sound Designers, Institute of Professional Sound and a 20% discount for those aged under 24 years. A complimentary copy of the Sound Academy Handbook is provided with the course.

Target Group:
Sound engineers, Sound designers, Live events professionals, Students/apprentices, Sales people, AV Technicians

Learning Objectives:
A basic introduction to Wireless Mics and In Ear Monitors.

Content:
E-Learning (completed ahead of the face to face training day)

On the day:
Module 1: Basic Acoustics & Electrotechnology
Acoustics, Decibels, Electromagnetic waves, Distortions, E-Learning

Module 2: Wireless Mics & Monitoring
Choosing a microphone, Wireless microphone components, RF transmitters & receivers, Antennas & accessories, Choice of frequencies, Wireless Monitoring

Workshop 1: Antenna technology
Compare the characteristics of various antennas with respect to range and transmission security, as well as how to handle antenna cables, splitters and boosters correctly.

Workshop 2: Microphone technology
To select and position microphones correctly. To ensure the optimum audio gain structure of the radio links.

Workshop 3: Frequency Management
To set up multichannel systems with secure frequency management, and to become familiar with the interference that may occur when incorrect frequencies are selected.

Workshop 4: Wireless Monitoring
Operate a wireless monitoring system.
Select frequencies in conjunction with radio microphones. Experience the difference between Stereo, Mono & Focus mode.

#LevelUpConference