Using mobile duplex gaps and guard bands for audio PMSE

Preliminary remarks

Duplex gaps are frequency ranges between the uplink channels (user equipment (UE) to base station) and downlink channels (base station to user equipment) which are not used by mobile communications. The size of the gap is frequency-dependent (the higher the frequency, the wider the gap) or is based on the standard duplexer filter equipment used by mobile communications. With the introduction of new mobile technology, e.g. 5G, the duplex gap can be completely eliminated in some frequency ranges.

Guard bands are a frequency gap to prevent interference from the mobile service interfering with another service such as Broadcasting.

If PMSE services use the duplex gap or guard band in the vicinity of user equipment or mobile base stations, interference in both directions is created. To protect mobile communications, PMSE devices have to keep outside guard bands to provide protection to both base and UE allocations, but they themselves enjoy no protection at all—a significant disadvantage when comparing the relative RF powers of the mobile equipment to the PMSE low power (<50mW).

1) 800 MHz

800 MHz frequency band

<table>
<thead>
<tr>
<th>Guard band</th>
<th>Downlink</th>
<th>Duplex gap</th>
<th>Uplink</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MHz</td>
<td>80 MHz (U block of 5 MHz)</td>
<td>1 MHz</td>
<td>30 MHz (6 blocks of 5 MHz)</td>
</tr>
</tbody>
</table>

Due to its size of only 1MHz, the guard band does not allow independent PMSE use.

Typical national frequency 800 MHz allocation

<table>
<thead>
<tr>
<th>Guard band</th>
<th>Downlink</th>
<th>PMSE</th>
<th>Uplink</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 MHz</td>
<td>50 MHz (B block of 5 MHz)</td>
<td>2</td>
<td>9 MHz</td>
</tr>
</tbody>
</table>

Possible frequency use by PMSE in close proximity to mobile devices

<table>
<thead>
<tr>
<th>Guard band</th>
<th>Downlink</th>
<th>PMSE</th>
<th>Uplink</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MHz</td>
<td>80 MHz (U block of 5 MHz)</td>
<td>2</td>
<td>&lt;0.5 MHz</td>
</tr>
</tbody>
</table>

The out of band energy from the mobile service sometimes causes massive interference for PMSE

Note

Test reports of PMSE problems caused by mobile devices can be accessed via this link http://www.apwpt.org/technical-papers/apwpt/index.html
2) 1800 MHz

1800 MHz frequency band

Possible frequency use by PMSE in close proximity to mobile devices

The out of band energy from the mobile service sometimes causes massive interference for PMSE.

The interference scenario shown will commence as soon as the majority of UMTS users have moved over to LTE systems. Since the 1.8 GHz band is one of the most used LTE mobile communications frequencies, this scenario will soon become a reality.

3) 700 MHz (will be discussed at the next WRC\(^1\))

Currently the most probable allocation of the 700 MHz duplex gap

Depending on IMT use, up to 4 MHz of the left guard band spectrum could be used for PMSE.

Due to its size, the right guard band spectrum does not allow PMSE use.

This frequency plan would utilise the duplex gap in a way that would be spectrum efficient and ideal for PMSE use.

This frequency plan utilises the duplex gap in a way that would completely prevent PMSE use.

\(^1\) World Radiocommunication Conference of ITU-R
4) Estimate of the number of audio PMSE applications that can operate within the duplex gap

Basically, there are two usage scenarios

a. radio microphone use only
b. mixed use with talk-back links (In Ear Monitoring, IEM)

Relatively small duplex gaps normally prevent mixed use as described under point b.

The maximum number of PMSE links which could use parts of a duplex gap which provides sufficient quality with the type of PMSE technology used (analogue or digital technology, different performance criteria) can easily be calculated.

- Analogue PMSE devices which are used in a venue must always be operated in an intermodulation-free frequency setup:

- With a small number of links, digital PMSE devices can be operated in a linear grid over several 100 kHz. With a larger number of links, intermodulation products require larger protection distances.

Note: PMSE manufacturers provide powerful software management tools for planning on-site use.

5) Useful reference documents

- ETSI, 2006, System Reference Document TR 102 546
- CEPT, 2013, CEPT Report 50 „Technical conditions for the use of the bands 821-832 MHz and 1785-1805 MHz for wireless radio microphones in the EU”
- DKE-AK 731.0.8 (DIN/VDE), 2012, „LTE Interference potential to Microphones“
- DKE-AK 731.0.8 (DIN/VDE), 2013, „Study on audio PMSE spectrum usage“
- Technische Universität Braunschweig, 2013, „A study of future spectrum requirements for terrestrial TV and mobile services and other radio applications in the 470-790 MHz frequency band, including an evaluation of the options for sharing frequency use from a number of socioeconomic and frequency technology perspectives, particularly in the 694-790 MHz frequency sub-band.“
- Institut für Rundfunktechnik GmbH, 2013, „LTE interference on analogue and digital PMSE devices“

DKE AK 731.0.8 (DIN/VDE), 2014, Using mobile duplex gaps guard bands for audio PMSE applications