IMT Stations Interference to GNSS Navigation Equipment

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### Basic GNSS frequency bands

<table>
<thead>
<tr>
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<th>GNSS</th>
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<th>GNSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>F, MHz</td>
<td>1164</td>
<td>1215</td>
<td>1300</td>
<td>1559</td>
</tr>
</tbody>
</table>

**Global navigation satellite systems operate in the radionavigation satellite service**

**No.1.43 Radio Regulations:** «radionavigation-satellite service is a radiodetermination-satellite service used for the purpose of radionavigation»

**No.4.10 Radio Regulations:** «Member States recognize that the safety aspects of radionavigation and other safety services require special measures to ensure their freedom from harmful interference; it is necessary therefore to take this factor into account in the assignment and use of frequencies»
The frequency bands identified for IMT

WRC-2012 and WRC-2015 resolved to identify the following frequency bands for the IMT systems:

470-694 MHz, 694-790 MHz, 790-862 MHz and 1427-1518 MHz. The frequency band identification for IMT was a global one for some of the mentioned bands.
Potential impact from IMT frequency bands to GNSS frequency bands

Spurious emission (2-nd harmonic)
IMT unwanted emissions limits

Out-of-band and spurious domains

Unwanted emissions

Spurious domain

Out-of-band domain

Unwanted emissions

Necessary bandwidth

Out-of-band domain

Spurious domain

Frequency of the emission

Limits of the necessary bandwidth

Boundary of the spurious domain

-30dBm/MHz (-60dBW/MHz) base/mobile stations

-30dBm/MHz (-60dBW/MHz) base/mobile stations

Recommendation ITU-R M.2070 «Generic unwanted emission characteristics of base stations using the terrestrial radio interfaces of IMT-Advanced»

Recommendation ITU-R M.2071 «Generic unwanted emission characteristics of mobile stations using the terrestrial radio interfaces of IMT-Advanced»
Protection criteria for GNSS receivers in L-band

- Recommendation ITU-R M.1902 «Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) operating in the band 1 215-1 300 MHz»;
- Recommendation ITU-R M.1903 «Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) and receivers in the aeronautical radionavigation service operating in the band 1 559-1 610 MHz»;
- Recommendation ITU-R M.1905 «Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) operating in the band 1 164-1 215 MHz». 
# Interference evaluation from IMT into GNSS

<table>
<thead>
<tr>
<th></th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spurious emissions level (dB(W/MHz))</td>
<td></td>
<td></td>
<td>-60</td>
</tr>
<tr>
<td>Maximum receiver antenna gain (dBi)</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acquisition mode threshold power</td>
<td>-142</td>
<td>-148</td>
<td>-127</td>
</tr>
<tr>
<td>density level of aggregate wideband</td>
<td></td>
<td></td>
<td>-156</td>
</tr>
<tr>
<td>interference at the passive antenna</td>
<td></td>
<td></td>
<td>-146</td>
</tr>
<tr>
<td>output (dB(W/MHz))</td>
<td></td>
<td></td>
<td>-156</td>
</tr>
<tr>
<td>Power density level at the antenna</td>
<td>-54</td>
<td>-54</td>
<td>-54</td>
</tr>
<tr>
<td>output (dB(W/MHz))</td>
<td></td>
<td></td>
<td>-53</td>
</tr>
<tr>
<td>Required attenuation (dB)</td>
<td>88</td>
<td>94</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>102</td>
<td>93</td>
<td>99</td>
</tr>
</tbody>
</table>

The required mitigation of unwanted emissions from IMT base and mobile stations would be of 73–102 dB in different frequency bands.
Full-scale experiment

The full-scale experiment instrumentation:
- ANRITSU MS2720T spectrum analyzer;
- R&S HL040 antenna;
- calibrated HF-cables;
- HUAWEI: LTE USB 822FT modem.
Interference evaluation from IMT into GNSS
(full-scale experiment)

\[ P_{\text{out}} = P_{\text{meas}} + G_{\text{ant}} - N_{\text{cab}} - P_{fs} \]

where:
\[ P_{fs} = 20 \log D + 20 \log F + 32.45 \]

The level of IMT user terminals spurious emissions at the second harmonic frequency would be of minus 61.31 dBW/MHz
The experiment results showed that unwanted emissions from IMT base and mobile stations could cause harmful interference to operation of the GNSS receiving stations in the frequency bands 1 164 -1 300 MHz and 1 559-1 610 MHz.
Thank you for your attention!