Amateur radio interference on APOS-stations 2017

EUPOS Council and Technical Meeting 2019, Budapest

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BEV – Federal Office of Metrology and Surveying
Budapest, 30th October 2018
### 1240 - 1300 MHz Bandplan (Amateur Radio, Status 2016)

<table>
<thead>
<tr>
<th>Frequency MHz</th>
<th>Maximum Bandwidth</th>
<th>MODE</th>
<th>USAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1240.000</td>
<td>2700 Hz</td>
<td>ALL MODE</td>
<td>(reserved for future)</td>
</tr>
<tr>
<td>1240.500</td>
<td>500 Hz</td>
<td>Telegraphy MGM</td>
<td>Beacons (reserved for future)</td>
</tr>
<tr>
<td>1240.750</td>
<td>20 kHz</td>
<td>FM Digital voice</td>
<td>(reserved for future)</td>
</tr>
<tr>
<td>1241.000</td>
<td>20 kHz</td>
<td>ALL MODE</td>
<td>1240.000-1241.000 Digital communications</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Repeater output, ch. RS1 - RS10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Repeater output, ch. RS11 - RS28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Digital communications, ch. RS29 - RS50</td>
</tr>
<tr>
<td>1243.250</td>
<td>(d)</td>
<td>ATV Digital ATV</td>
<td>1258.150-1259.350 Repeater output, ch. R20 - R68</td>
</tr>
</tbody>
</table>

*INTERNATIONAL AMATEUR RADIO UNION REGION 1

VHF MANAGERS HANDBOOK

(Maybe switch to 430-440 MHz)
GPS & GLONASS Signals

ATV
Digital ATV

1258.150 - 1259.350
Relais Map of the Austrian test transmitter association (ATV)

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23 cm (orange)
**Chronology APOS <> ATV (Part I)**

2010

- Contact with the „Austrian Supreme Radiocommunications Authority“ (SRA) in terms of ATV-problems

- Primary/Secundary users: ATV and other radio amateurs are secundary users and will be forced to switch to another band mid-term. SRA admitts that GLONASS because of its disastrous situation several years ago was not really in their focus. The BEV is the first to appear, describes the current situation and „thus forces the SRA to take action“.
Chronology APOS <> ATV (Part II)

2010
- Agreement with ATV: Temporary leaving of the 23cm band during night time though problems for stations and users possibly can occur
- SRA shall find out further jammers in cooperation with the ATV and externals

2011 or later: with the help of ATV-Austria we solved a similar problem in Marburg ...

2017: Final APOS - tests and closing of ATV activities in the L2-Band
Impression 4th Nov. 2017
APOS Vienna (Wien_3), Leica GR30, no Glonass solving / GPS tracking reduced
<table>
<thead>
<tr>
<th>Device</th>
<th>Test</th>
<th>GNSS Receiver</th>
<th>Wien</th>
<th>GNSS Receiver</th>
<th>Wien_3</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS/Glonass L2</td>
<td>OK</td>
<td>Septentrio POLARX5</td>
<td>(Auto Notch filter activated)</td>
<td>Leica GR 30</td>
<td>(No filter)</td>
</tr>
</tbody>
</table>

Impression 30th Oct. 2017
Vienna-Testbed (Wien/Wien3): simultaneous GNSS-tracking with/without filtering.

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Septentrio POLARX5
Spectrum-view

(Testing on 10th Feb, 2017 at APOS Station Vienna simultaneously with interfered Leica GR30)

Main freq. 1.230 GHz

Main freq. 1.275 GHz
(detection of amateur radio before interference mitigation; interferes obviously the Glonass L2 - spectrum)
DOY 018 / 2017 (Wednesday)

DOY 021 / 2017 (Saturday)

# of Sat. during Amateur radio activity (APOS Station Vienna)
Impressions of Station **Krahberg/Tyrol (12/2013):**

Leica GRX 1200+GNSS without filtering / alternate radio amatuer activities

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Data Rate</th>
<th>Tracked Processes</th>
<th>Processed</th>
<th>Solved</th>
<th>GPS Tracked</th>
<th>GPS Processed</th>
<th>GLONASS Tracked</th>
<th>GLONASS Solved</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.11.2013</td>
<td>09:46</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.11.2013</td>
<td>17:20</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39.12.2013</td>
<td>00:53</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Network Processor [LVG-RTK]**
Impressions of Station **Krahberg/Tyrol** (12/2013):
Leica GRX 1200+GNSS without filtering / alternate radio amateur activities
Conclusion

✓ Problems with Radio Amateurs (ATV) in Austria are obviously solved (since 2017)
✓ Most of the CORS brands today have optional filter technologies

➢ Question(s): how can GNSS-users be protected against jamming/spoofing?
  - Upcoming „LowCost“ GNSS-Chips for mass market seem to be more vulnerable ...
  - e.g. GALILEO is in preparation for special services
    - HAS (encryption for access) for all
    - PRS (encryption, broadband signal spectrum, etc.) > restricted to government-authorised users, for sensitive applications that require a high level of service continuity etc.
  - ....

❖ How can we deal with such szenarios in the future, resp. partizipate?
Galileo and EGNOS differentiators enable innovative applications. Examples

- **Dual frequency, with E5 as second frequency**
  - E5 especially effective in urban areas, bringing new levels of accuracy (sub-meter level) and robustness. Now available in smartphones (see Xiaomi Mi8) and automotive

- **Authentication**
  - **Data level:** Open Service Navigation Message Authentication (OSNMA)
    - Integrated in the E1-B band for OS. Aimed at mass market users and offered for free. Already prototyped and under testing.
  - **Range level:** Signal Authentication
    - Based on the E6-C Spreading Code Encryption to protect against more sophisticated attacks.

- **High Accuracy Service (HAS)**
  - Provision of PPP corrections via E6B (and terrestrial link tbc), offering high accuracy (decimeter level) for mass market and profesional users
  - FREE provision of service
Thank You for Your Attention!

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