Title: **Used Frequencies**
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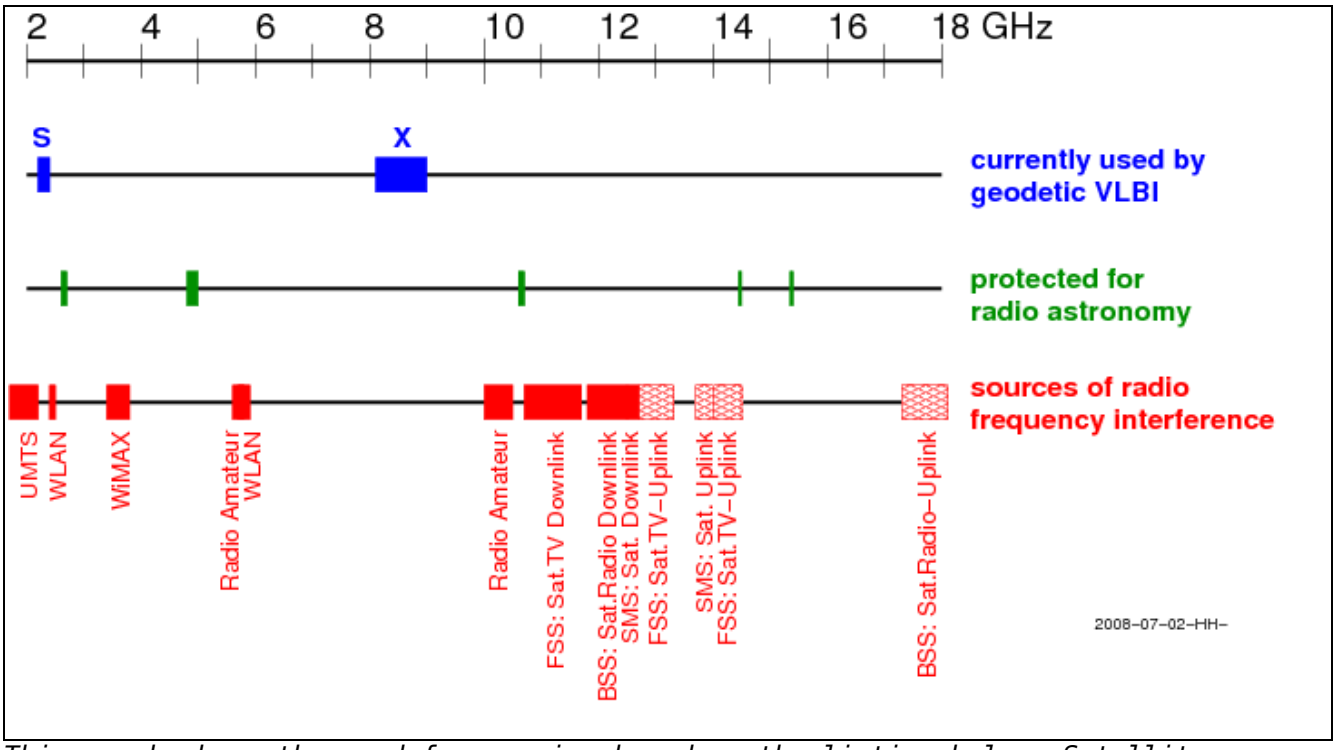
**Introduction:**
The following listing gives an overview about used frequencies in the electromagnetic spectrum which endanger the future geodetic VLBI operation according to the IVS-vision VLBI2010 concerning primarily the spectrum of 2.0-18.0 GHz. It was compiled for the definition of future RF-spectra and to define the VLBI2010 feed.

This list must be permanently updated according to further and new informations on used frequencies.




*This graph shows the used frequencies based on the listing below. Satellite downlinks effect radiotelescope stations globally, while satellite uplinks may have an impact on VLBI operations only when located in the vicinity of a ground station. It is clear from this picture, that only the unused gaps are suitable for future VLBI-operations.*

## 1. Fixed Satellite Services (FSS)

"Fixed" relates to non-movable satellite ground stations used for telecommunications with satellites in Ku-band. Originally destinated for telephone and telefax it is used since end of the 1980-ties for television; example ASTRA.

FSS-Downlink:
10.70-10.95 GHz
10.95-11.70 GHz

FSS-Uplink
14.00-14.50 GHz
12.75-13.25 GHz
Polarisation: horizontal, vertical

**2. Broadcasting Satellite Services (BSS)**

The WARC77 conference assigned frequencies of Ku-band for the DBS radio satellites in 1977. The satellites should reach the user directly with 260 W transmission power.

BSS-Downlink:
11.70-12.50 GHz

BSS-Uplink:
17.30-18.10 GHz

Polarisation: right hand circulated, left hand circulated

Note: The frequencies are due to less acceptance by the users nowadays also used by television broadcast in horizontal or vertical polarisation with about 100 W per channel, for example by ASTRA.

**3. Satellite Media/Messages Services (SMS)**

The frequecies were thought to be used by mobile broadcast radio team for communication with their central radio station.
Today these frequencies are also used by satellite TV, for example DFS-Kopernikus.

SMS-Downlink:
12.50-12.75 GHz

SMS-Uplink:
14.00-14.50 GHz
13.75-14.00 GHz (due to co-positioned satellites)

Polarisation: horizontal, vertical

**4. Other frequencies**

General overview on frequencies and services:

| Band | lower [MHz] | upper limit [MHz] | Bemerkung |
|---|---|---|---|
| SRD | 868.0 | 868.0 | SRD, radio controlled temperatur sensor |
| GSM850 | 824.0 | 894.0 | complementary GSM-network America |
| GSM900 | 880.0 | 960.0 | mobile phone D-networks |
| GPS | 1227.60 | 1227.60 | satellite navigation system |
| DAB | 1452.0 | 1492.0 | |
| GPS | 1575.42 | 1575.42 | satellite navigation system |
| Iridium | 1616.0 | 1625.0 | |

| | | | |
|---|---|---|---|
| GSM1800 | 1710.0 | 1880.0 | mobile phone E-network |
| GSM1900 | 1850.0 | 1990.0 | GSM-network America |
| UMTS | 1885.0 | 2025.0 | |
| UMTS | 2110.0 | 2200.0 | |
| ISM | 2400.0 | 2500.0 | Bluetooth, WLAN |
| WLL | 3400.0 | 3600.0 | WiMAX |
| ISM | 5725.0 | 5875.0 | WLAN, U-NII |
| DVB-S | 10700.0 | 12750.0 | satellite TV |

**5. Amateur Radio**

Internationale Regelungen

| | | | | | |
|---|---|---|---|---|---|
| A | 135.7-137.8 kHz | 2.2 km | 1, 2, 10 | S | 1 W ERP |
| A | 1810-1850 kHz | 160 m | 3 | P | 750 W PEP |
| E | 1810-1850 kHz | 160 m | 3 | P | 100 W PEP |
| A | 1850-1890 kHz | 160 m | 3, 10, 12 | S | 75 W PEP |
| E | 1850-1890 kHz | 160 m | 3, 10, 12 | S | 75 W PEP |
| A | 1890-2000 kHz | 160 m | 3, 10 | S | 10 W PEP |
| E | 1890-2000 kHz | 160 m | 3, 10 | S | 10 W PEP |
| A | 3.5-3.8 MHz | 80 m | 3 | P | 750 W PEP |
| E | 3.5-3.8 MHz | 80 m | 3 | P | 100 W PEP |
| A | 7.0-7.1 MHz | 40 m | 3, 13 | P+) | 750 W PEP |
| A | 7.1-7.2 MHz | 40 m | 3 | S | 250 W PEP |
| A | 10.10-10.15 MHz | 30 m | 1, 10, 12 | S | 150 W PEP |
| A | 14.00-14.35 MHz | 20 m | 3, 13 | P+) | 750 W PEP |
| A | 18.068-18,168 MHz | 17 m | 3, 13 | P | 750 W PEP |
| A | 21.00-21.45 MHz | 15 m | 3, 13 | P+) | 750 W PEP |
| E | 21.00-21.45 MHz | 15 m | 3, 13 | P+) | 100 W PEP |
| A | 24.89-24.99 MHz | 12 m | 3, 13 | P | 750 W PEP |
| A | 28.0-29.7 MHz | 10 m | 4, 13 | P | 750 W PEP |
| E | 28.0-29.7 MHz | 10 m | 4, 13 | P | 100 W PEP |
| A | 50.08-51.00 MHz | 6 m | 5 | S | 25 W ERP |
| A | 144.0-146.0 MHz | 2 m | 6, 13 | P+) | 750 W PEP |
| E | 144.0-146.0 MHz | 2 m | 6, 13 | P+) | 75 W PEP |
| A | 430.0-440.0 MHz | 70 cm | 7, 13 | P | 750 W PEP |
| E | 430.0-440.0 MHz | 70 cm | 7, 13 | P | 75 W PEP |
| A | 1240.0-1300.0 MHz | 23 cm | 8, 11, 13 | S | 750 W PEP |
| A | 2320.0-2450.0 MHz | 13 cm | 9, 13 | S | 75 W PEP |
| A | 3.400-3.475 GHz | 9 cm | 9 | S | 75 W PEP |
| A | 5.65-5.85 GHz | 6 cm | 9, 13 | S | 75 W PEP |
| A | 10.0-10.5 GHz | 3 cm | 9, 13 | S | 75 W PEP |
| E | 10.0-10.5 GHz | 3 cm | 9, 13 | S | 5 W PEP |
| A | 24.00-24.05 GHz | 1,2 cm | 13 | P+) | 75 W PEP |
| A | 24.05-24.25 GHz | 1,2 cm | 9 | S | 75 W PEP |
| A | 47.0-47.2 GHz | 6 mm | 13 | P+) | 75 W PEP |
| A | 75.5-76.0 GHz | 4 mm | 9, 13 | P+) | 75 W PEP |
| A | 76.0-77.5 GHz | 4 mm | 9, 13 | S | 75 W PEP |
| A | 77.5-78.0 GHz | 4 mm | 9, 13 | S | 75 W PEP |
| A | 78.0-81.5 GHz | 4 mm | 9, 13 | S | 75 W PEP |
| A | 122.25-123.00 GHz | 2,5 mm | 9 | S | 75 W PEP |
| A | 134.0-136.0 GHz | 2 mm | 9, 13 | P+) | 75 W PEP |
| A | 136.0-141.0 GHz | 2 mm | 9, 13 | S | 75 W PEP |
| A | 241.0-248.0 GHz | 1 mm | 13 | S | 75 W PEP |

| | | | | | |
|---|---|---|---|---|---|
| A | 248.0-250.0 GHz | 1 mm | 13 | P+) | 75 W PEP |
| A/E | >250 GHz | - | 14 | - | - |

**6. Aviation navigation**

Different frequencies, mostly about 5 GHz and above 10 GHz.

**7. Radio Astronomy**

| lambda | frequency [GHz] | observation example | protected freq. | RFI source |
|---|---|---|---|---|
| 73cm | 0.395-0.440 | complete sky continuum | 0.406-0.410 | - |
| 50cm | 0.595-0.620 | continuum | 0.608-0.614 | TV channel 38 (UHF) |
| 30cm | 0.800-1.300 | continuum/spectroscopy: CH3OH, non-protected | | - |
| 18-21cm | 1.3-1.7 | continuum/spectroscopy: H, OH | 1.40-1.43/1.610-1.614/1.66-1.67 | satellites: GLONASS, Iridium |
| 13cm | 2.2-2.3 | pulsars, continuum/VLBI | non-protected | microwaveoven |
| 11cm | 2.60-2.68 | Cygnus loop, continuum | 2.6-2.7 | - |
| 9cm | 3.08-3.35 | spectroscopy: CH non-protected | | - |
| 6.5cm | 4.3-4.9 | spectroscopy: H2CO | 4.8-5.0 | - |
| 6cm | 4.6-5.1 | Andromeda-Galaxy, continuum | 4.8-5.0 | - |
| 5cm | 5.50-6.75 | continuum/spectroscopy: CH4O non-protected | | - |
| 3.6cm | 7.8-8.9 | continuum/spectroscopy: ionized Helium isotopes | non-protected | |
| 2.8cm | 10.3-10.6 | galactic centre, continuum | 10.6-10.7 | TV-satellite ASTRA-1D |
| 2.2cm | 12.9-13.6 | spectroscopy: SO non-protected | | - |
| 2cm | 13.6-15.6 | pulsars, continuum/VLBI | 14.47-14.50/15.35-15.40 | - |
| 1.9cm | 13.5-18.7 | spectroscopy: C3H2 | 14.47-14.50/15.35-15.40 | - |
| 1.3cm | 21.7-24.4 | continuum/VLBI | 22.01-22.50/22.81-22.86/23.6-24.0 | - |
| 1.3cm | 18.0-26.0 | spectroscopy: NH3, H2O | 22.21-22.50/23.6-24.0 | distance radar |
| 1cm | 27.0-36.7 | spectroscopy: CH3OH | 31.2-31.8/36.4-36.5 | - |
| 9mm | 31.0-33.0 | continuum | 31.2-31.8 | - |
| 7mm | 41.6-44.4 | pulsars continuum/VLBI | 42.5-43.5 | - |
| 6.5mm | 41.05-49.70 | spectroscopy: SiO | 42.5-43.5/48.90-49.04 | - |
| 3mm | 84.0-95.5 | pulsars continuum/spectroscopy: HCN | 81.0-100.0 | - |