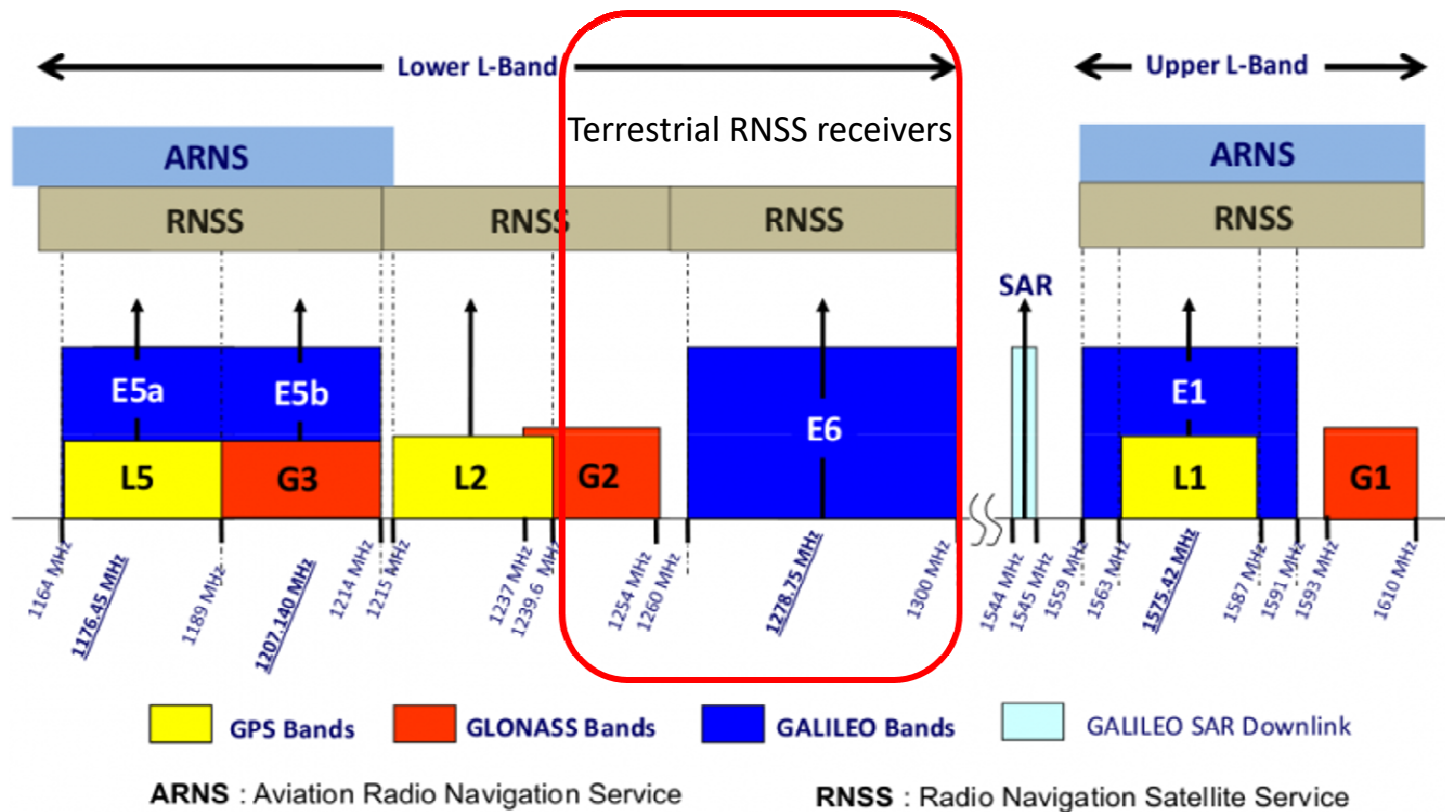




Amateur / RNSS Coexistence in the 23cm band

- Barry Lewis G4SJH
- IARU Lead on WRC23 AI9.1b
- IARU Interim Conference – June 2022

23cm Band and Radio Navigation Satellite Services



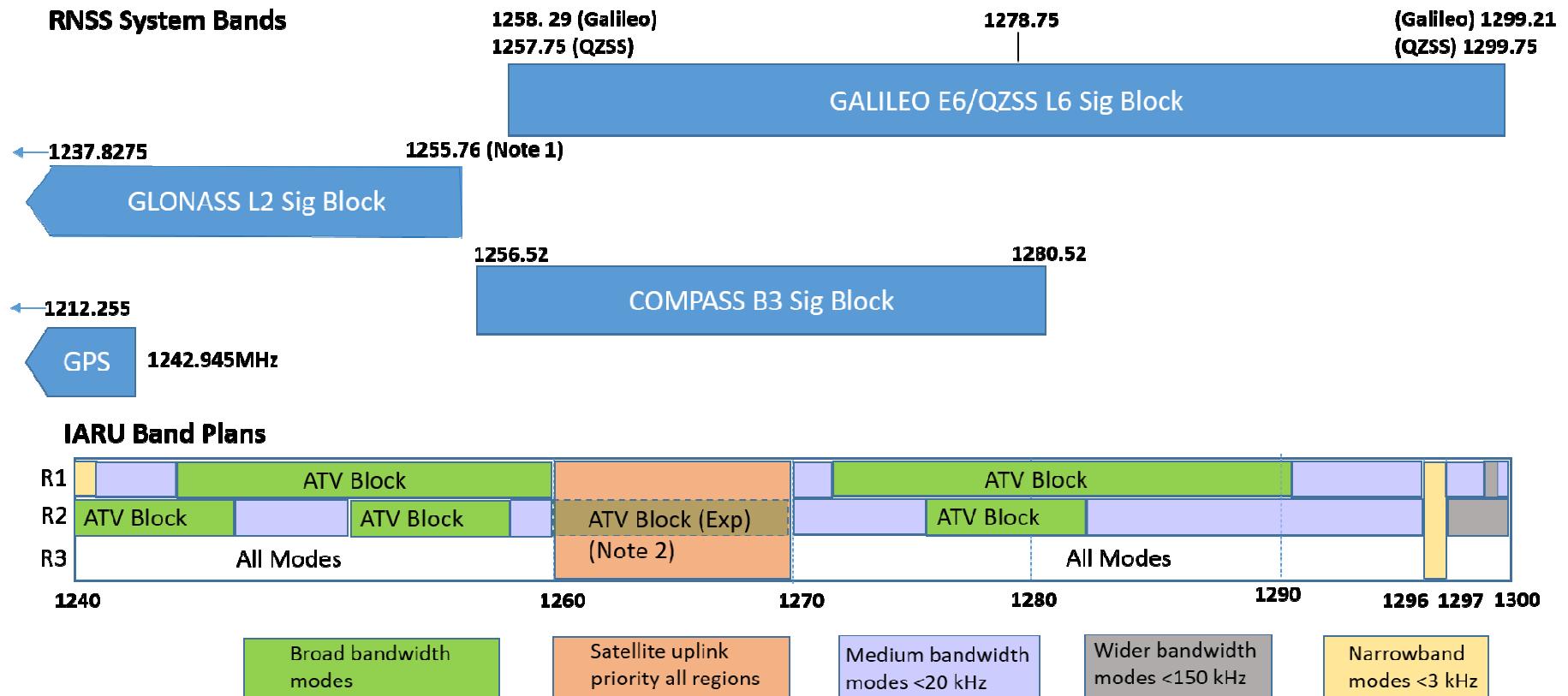
- CEPT Study Program is considering Galileo (EU).
- ITU-R Study Program as above plus GLONASS (R.Fed), COMPASS (China) and QZSS (Japan).
- Considering Technical and Operational measures to protect RNSS services.
- <https://www.iaru-r1.org/spectrum/iaru-and-itu/wrc-23-page/wrc-23-agenda-item-9-1b/>



Regulatory Status for the Amateur Services allocation in the ITU-R Radio Regulations

- 1240 – 1300MHz is allocated to the RNSS on a primary basis across all 3 regions.
- 1240 – 1300MHz is allocated to the amateur service (AS) on a secondary basis with 1260-1270 MHz also allocated by footnote to the amateur satellite service (ASS) also effectively on a secondary basis both across all 3 regions.
- Stations of a secondary service:
 - **5.29 a)** shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date;
 - **5.30 b)** cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date;
 - **5.31 c)** can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date.

The RNSS systems within the scope of studies





Additional challenges for the amateur service

- Amateur operations are co-frequency almost everywhere in the band.
- Amateur station operators do not know where or when an RNSS user is active.
- An RNSS user will most likely be unaware that interference is occurring.
- New “High Accuracy” services under development with commercial ambitions.
- Widespread deployment of RNSS receivers.

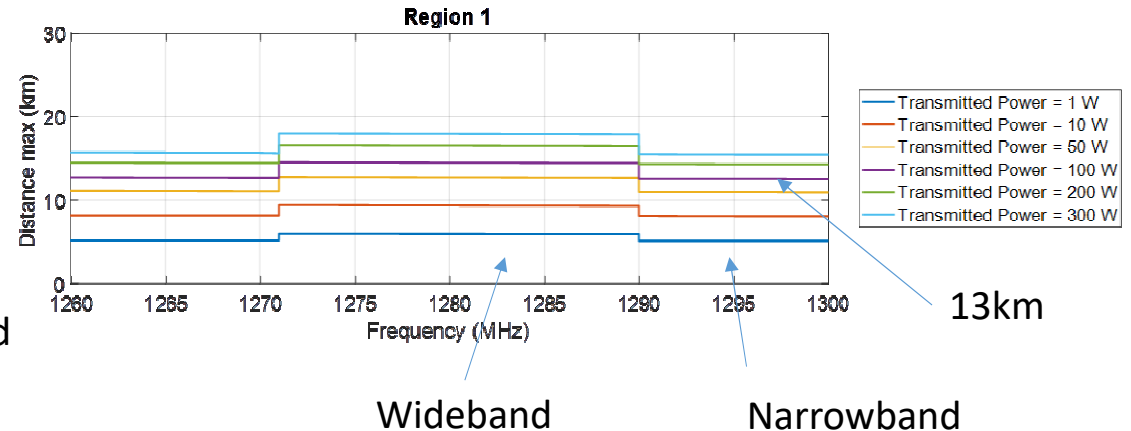
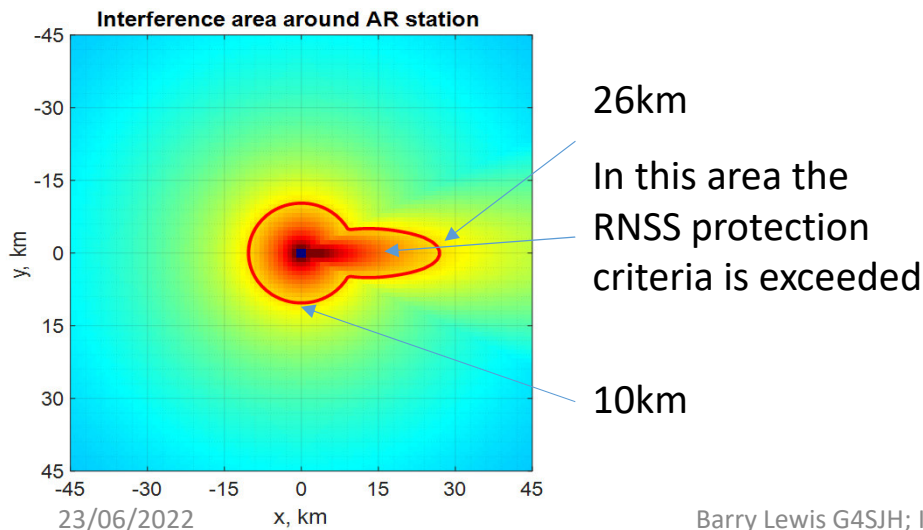
Technical Studies

- Propagation Model predictions to estimate the distance over which harmful interference could be caused to an RNSS receiver.
 - Harmful interference is that which exceeds the RNSS protection criteria in the relevant ITU-R Recommendation.
 - GALILEO Protection criteria (M.1902) = -134dBW for narrowband emissions (<128kHz) and -140.5dBW/MHz for wideband emissions (>1 MHz) at the receiver input.
- Conducted measurement programmes assessing the impact of various amateur radio application emissions on the RNSS receivers.
- Interference case study.

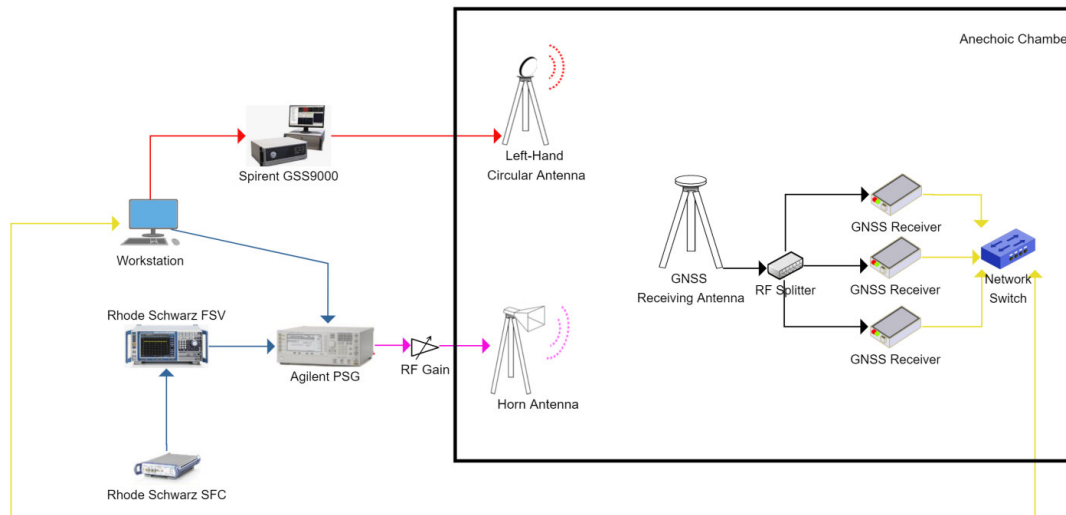
Propagation Model Estimates

- ITU-R model ITU-R P.1546 used based on sets of typical amateur station parameters and RNSS receiver deployment scenarios.
- Performed mainly by France (on GALILEO) and China (on COMPASS).

100W amateur narrowband transmitter
(50% Locations for 1% time)



Measurement campaign – EC JRC (3 receivers)



Narrow-band emissions

- Morse, Bandwidth < 1KHz,
- Narrow Band FM, 15 KHz bandwidth,
- Digital Transmission (dStar), 128 KHz bandwidth,

Wide-band emissions

- DVBT2 with 1.7 MHz bandwidth
- DVBT2 with 10 MHz bandwidth.

Frequencies according to IARU Band Plan:

- Morse: 1296.2 MHz
- Narrow Band FM: 1297.5 MHz
- Digital Transmission (dStar): 1299.2 MHz
- DVBT2: 1280 MHz

Frequencies relative to the E6 centre freq (1278.75MHz)

- $\Delta F = 0$ MHz
- $\Delta F = 5.115$ MHz
- $\Delta F = 20.46$ MHz
- $\Delta F = 23.0175$ MHz

EC JRC - Results

In accordance with band plan – JRC “Receiver C”

	Application	Centre Frequency	Bandwidth	Power at antenna input resulting in 1 dB C/N0 degradation
1	Telegraphy	1 296.2 MHz	< 1 kHz	-130.5 dBW
3	NBFM	1 297.5 MHz	11.1 kHz	-126 dBW
4	Digital Data 128 kBit/s	1 299.2 MHz	128 kHz	-124.5 dBW
5	DVB-T2	1280.0 MHz	1 MHz	-137.3 dBW/1 MHz
6	DVB-T2	1 280.0 MHz	10 MHz	-143.25 dBW/1 MHz

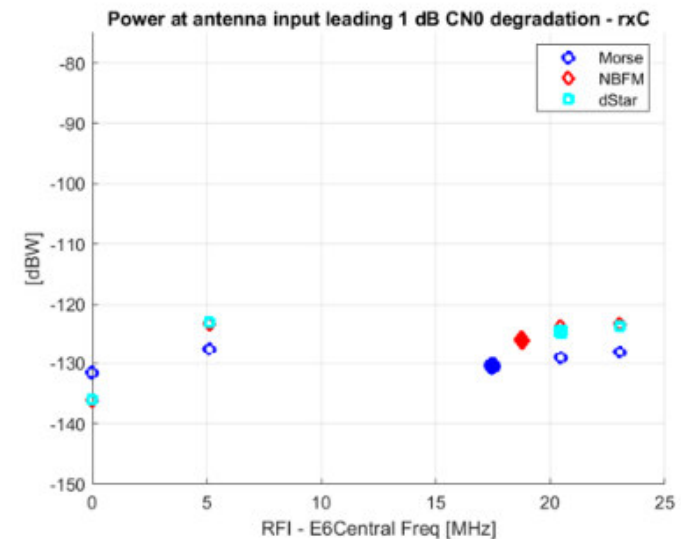
Benefit of moving away from the E6 centre depends on the specific receiver. E.g. (D-star test signal at 0 MHz and 20.46 MHz):

Rx A = 46dB; Rx B = 26dB and Rx C = 13dB improvement.

Rx A has a narrower BW (30MHz) but the difference between B and C (40MHz BW) is not explained.

E6 Offset Frequencies

Test results – Narrow-band AS emissions – Receiver C

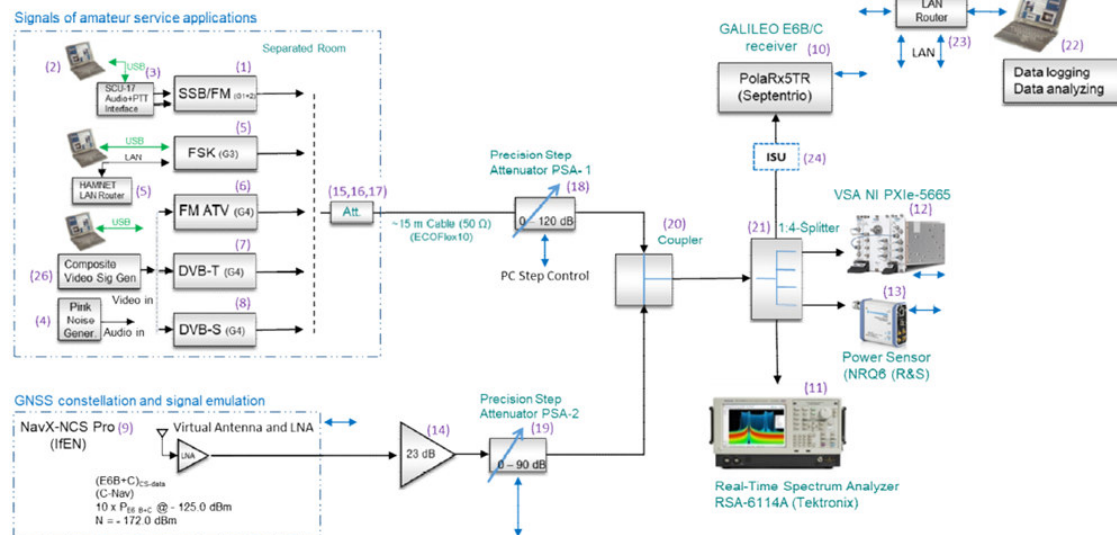


Generally the receivers exhibit:

A higher robustness to NB AS signals when they are transmitted at higher frequency offsets.

A low tolerance to wide-band interference especially when the emission is close to the E6 carrier frequency

Measurement Campaign - Germany



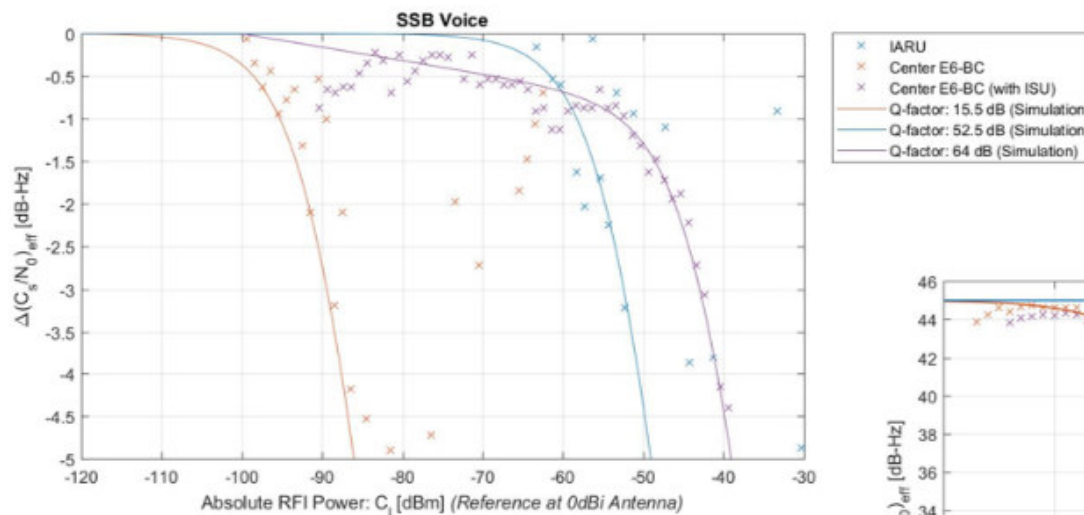
Four AS Signal type "Groups" used:

- G1: signal bandwidth < 1 kHz (Morse, SSB voice);
- G2: signal bandwidth up to 15 kHz (FM voice);
- G3: signal bandwidth up to 200 kHz (high speed data)
- G4: signal bandwidth 1 ... 16 MHz (Amateur TV)

Frequencies chosen according to the IARU band plan and the E6 centre freq.

Germany - Results

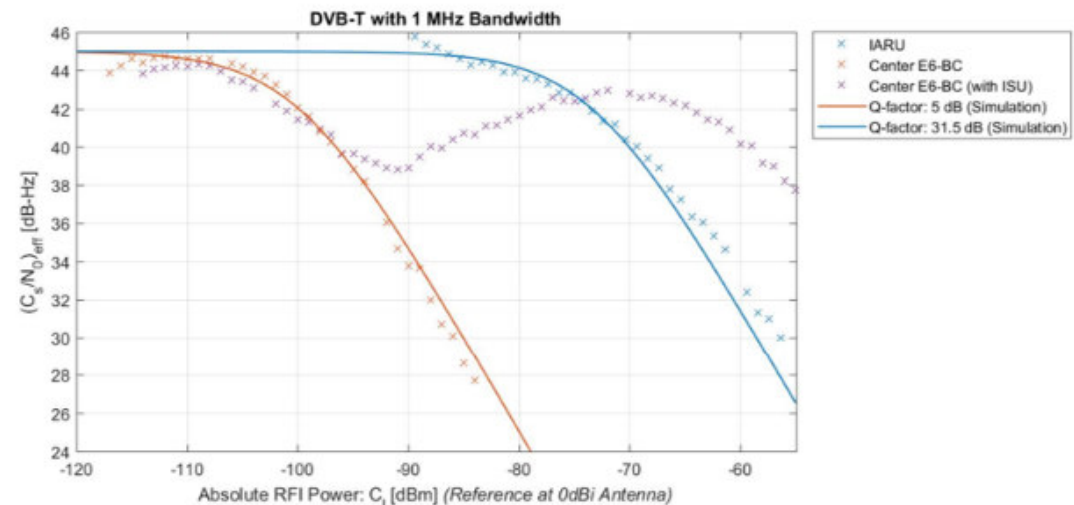
Result summary showing C/N0 changes relative to 45 dBHz for SSB voice signal



Note: ISU = Interference Suppression Unit

- The worst case occurs when an interfering signal is applied on the E6 centre frequency.
- Frequency separation yields significantly higher tolerable levels for the interfering signal.
- ISU can significantly reduce the impact of interfering signals, particularly for narrowband signals

Result summary for DVB-T ATV, 1 MHz bandwidth

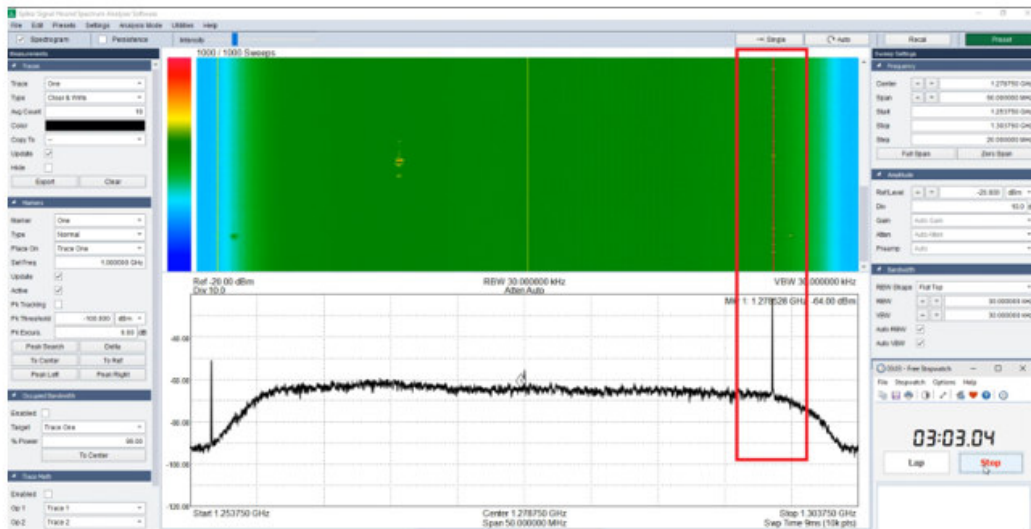


Wider BW DATV and FM-TV result in lower tolerable levels

Interference Cases

- Two documented national cases of interference
 - One historic case in Germany from ATV to a GALILEO control centre
 - A second in Italy (Varese) from an FM repeater into receivers in the EC JRC in Ispra.

Spectrum Analyser displaying interfering narrow-band signal at 1297.3 MHz



Area Affected by the emission (as a minimum)



Implications for the 23cm band



- Removing the allocation is **outside the scope** of the WRC related work.
- But there **will be constraints** on large parts of the band for amateur and amateur satellite operation.
- An ITU-R Recommendation is under development (working doc.) in ITU-R WP5A.
 - To provide guidance for administrations on constraints required on amateur service operation to protect the RNSS primary allocation.
- CEPT will mirror this as guidance in a Decision (to harmonise the band for RNSS).
- EU may mandate the guidance in an EC Decision for EU countries.
- At WRC, some countries may try to mandate the guidance in the Radio Regs by incorporation by reference or through an updated WRC Resolution.



Proposals under consideration

- Two elements are considered:
 - Frequency separation.
 - Power level restrictions.
- None of these proposals are agreed at this time but remain under serious consideration:

- Allow higher power operations (100W) in the range 1298-1300MHz plus....
-allow higher power (100W) spectrum for ATV (Digital only) at 1250-1254 MHz plus.....
- ...Amateur satellite higher power operation (20W) in 1260-1262 MHz.....
- 5mW power limit across the remaining parts of the 23cm band.

Admin
#1

- Or....only remove ATV operation across the centre of the GALILEO band
- ...identify a small low power segment for FM voice channels around 1293 MHz.

Admin
#2

- Or.....limit all amateur eirp to less than 1W across the entire band.

Admin
#3



IARU will continue to....

- Minimise the constraints on the amateur services as far as possible.
- Retain the ability for as many of today's applications to be able to continue as possible.
 - Narrowband telegraphy and telephony and digital modes
 - Wideband ATV (Digital)
- Work towards minimum disruption to narrow band activities.
 - Maintain cross-region harmonisation of the narrowband section.
- Engagement will continue up to and including the WRC23 itself.