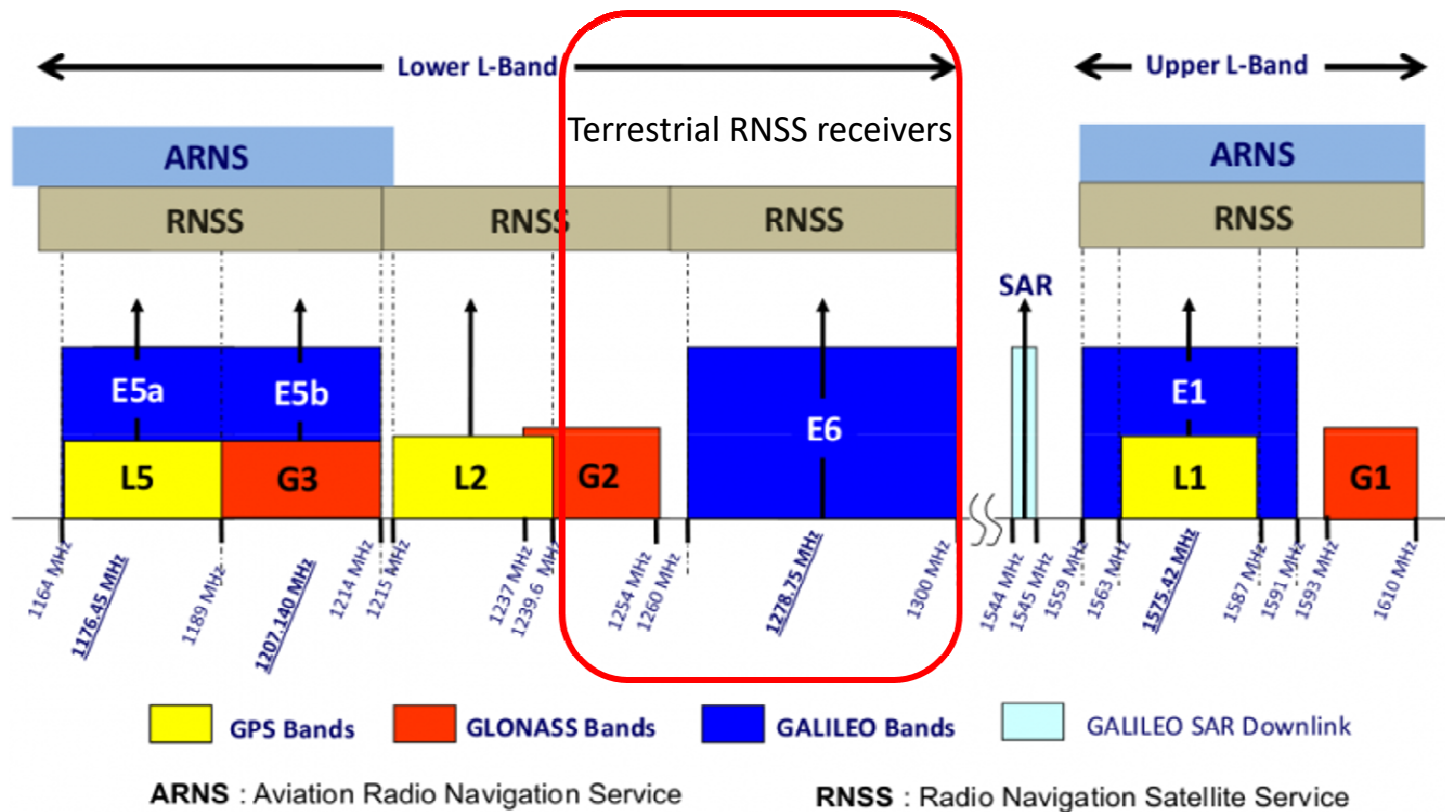




Amateur / RNSS Coexistence in the 23cm band

- Barry Lewis G4SJH
- IARU Lead on WRC23 AI9.1b
- October 2022
- BATC CAT22

23cm Band and Radio Navigation Satellite Services



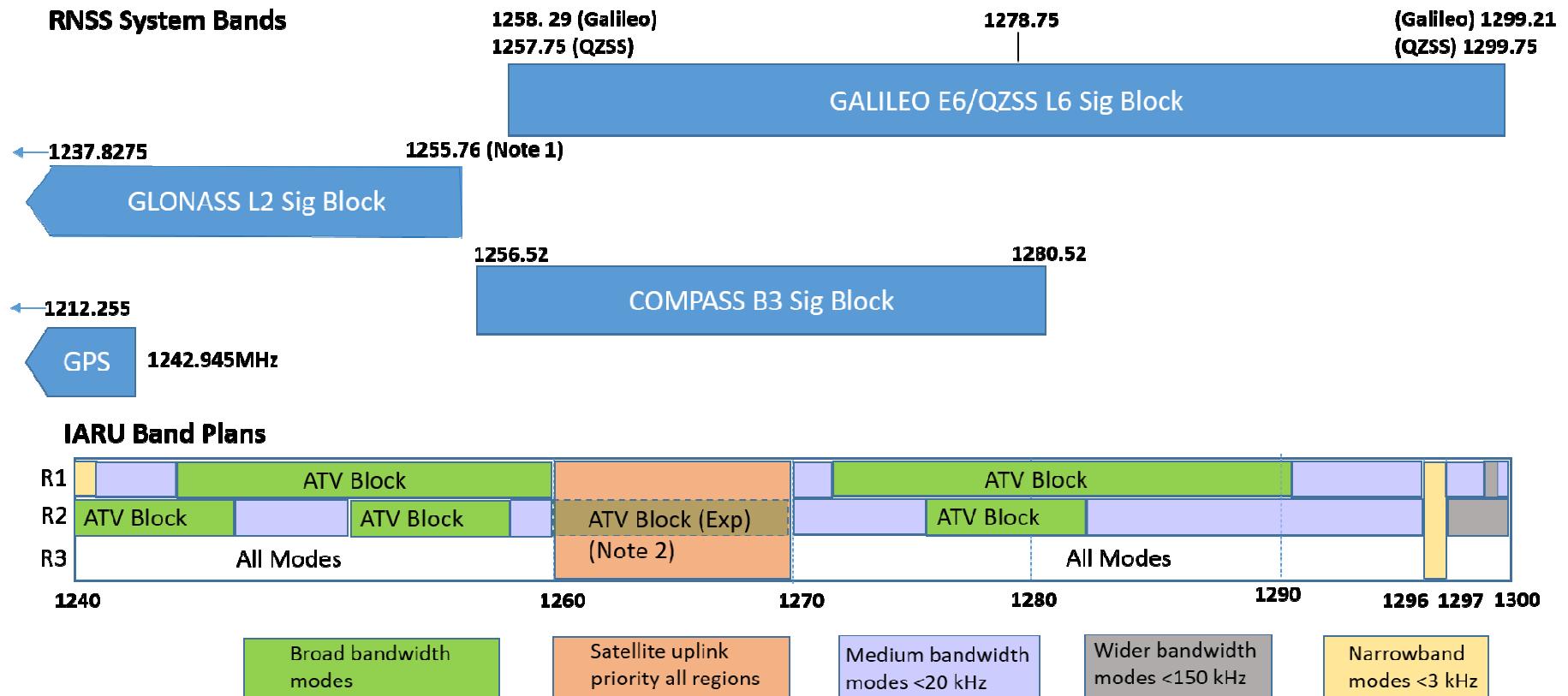
- CEPT Study Program is considering Galileo (EU).
- ITU-R Study Program as above plus GLONASS (R.Fed), COMPASS (China) and QZSS (Japan).
- Considering Technical and Operational measures to protect RNSS services.
- <https://www.iau-r1.org/spectrum/iau-and-itu/wrc-23-page/wrc-23-agenda-item-9-1b/>



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.
- In the Radio Regulations articles, 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 with RNSS 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.



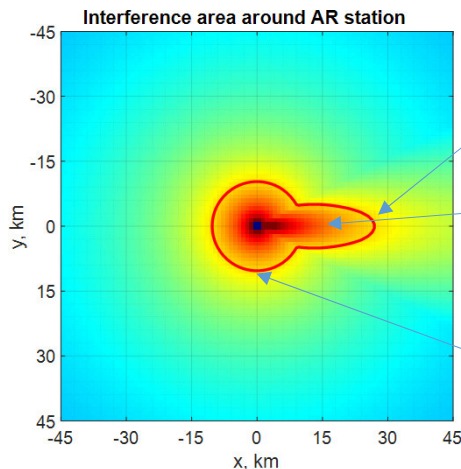
Technical Studies in ITU-R WP4C

- Propagation Model predictions are used 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 (ITU-R M.1902) = -134dBW for narrowband emissions (<128kHz) and -140.5dBW/MHz for wideband emissions (>1 MHz) at the receiver input.
- Conducted measurement programmes have been assessing the impact of various amateur radio application emissions on the RNSS receivers.
- Interference case study (2 cases documented)

Propagation Model Estimates

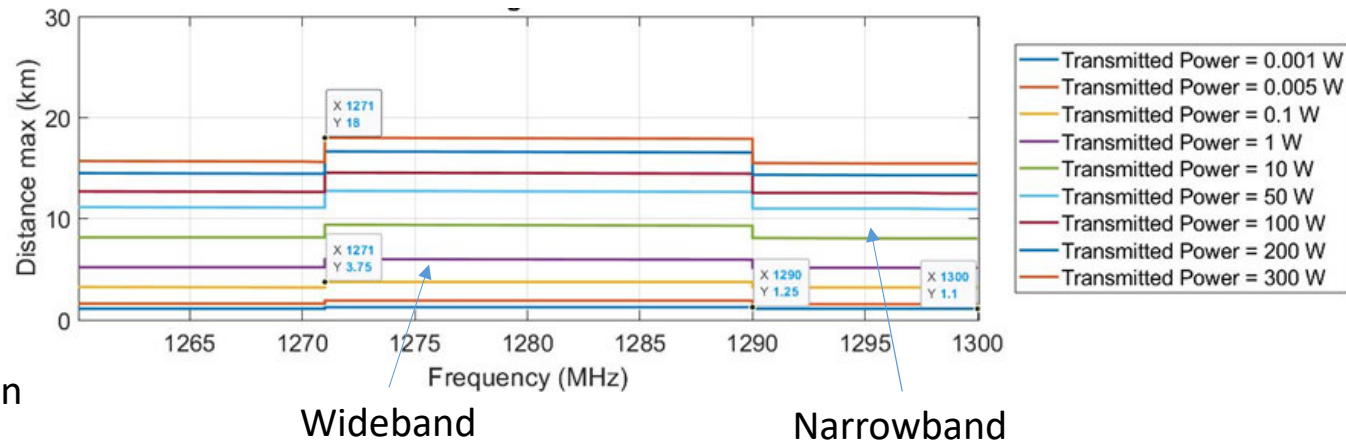
- ITU-R model ITU-R P.1546 used along with sets of typical amateur station parameters and RNSS receiver deployment scenarios.
- Performed mainly by France (on GALILEO) and China (on COMPASS).

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



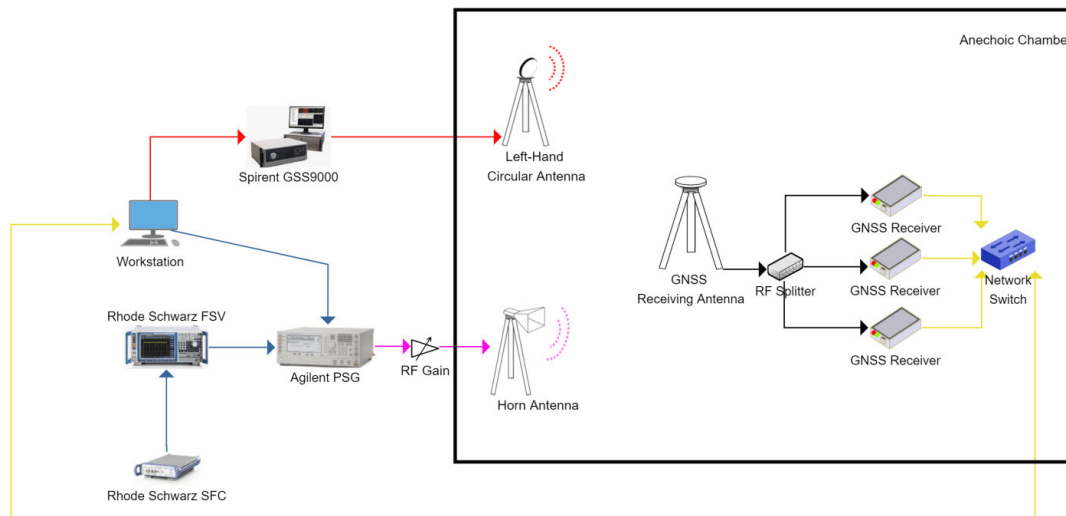
26km

In this area the RNSS protection criteria is exceeded
10km



Home station 1, maximum distance where the RNSS protection criteria is not satisfied, transmission power from 1mW to 300 W.

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

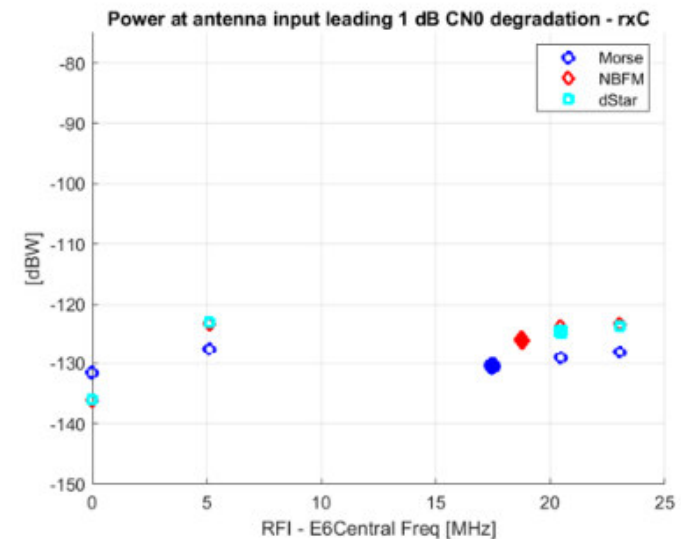
Benefit of moving away from the E6 centre depends on the specific receiver. E.g. (D-star test signal at 0 MHz and 20.46 MHz):

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

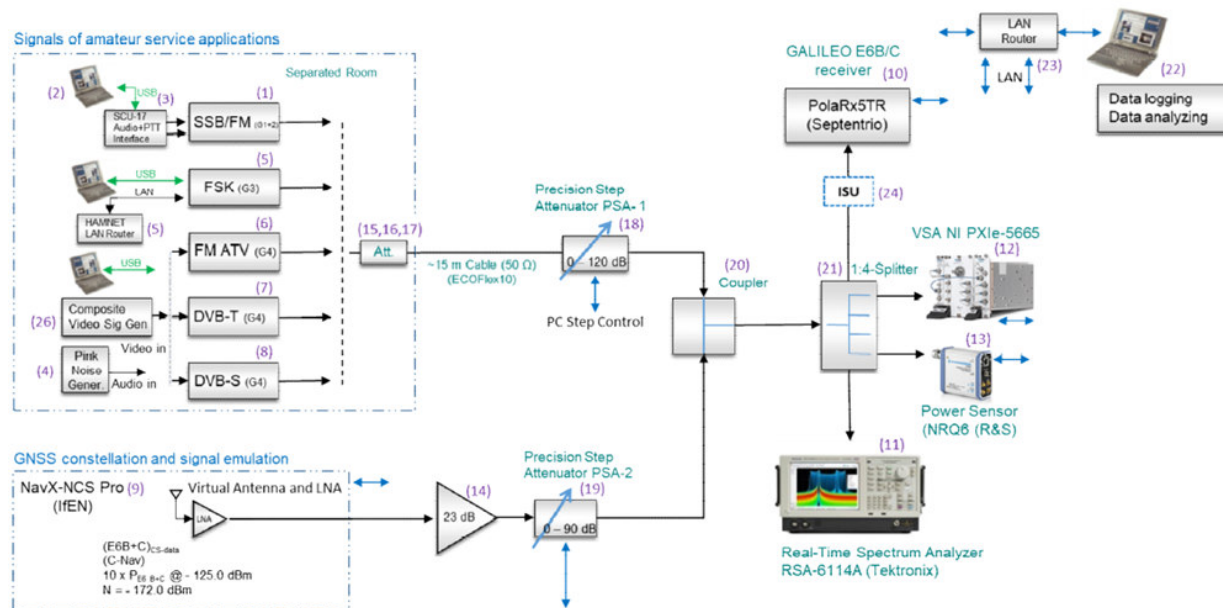


Generally the receivers exhibit:

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



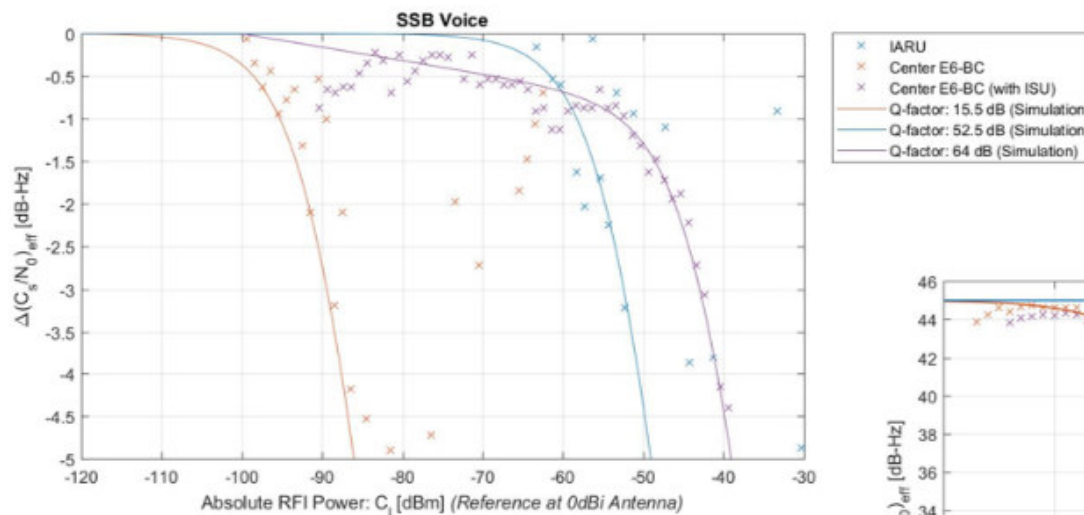
Four AS Signal type "Groups" used:

- 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

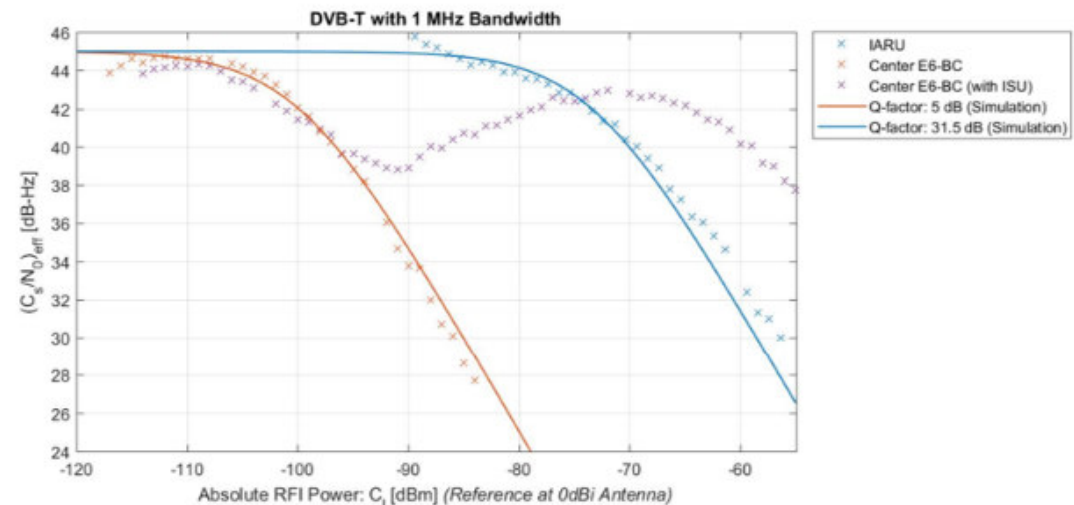
Result summary showing C/N0 changes relative to 45 dBHz for SSB voice signal



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

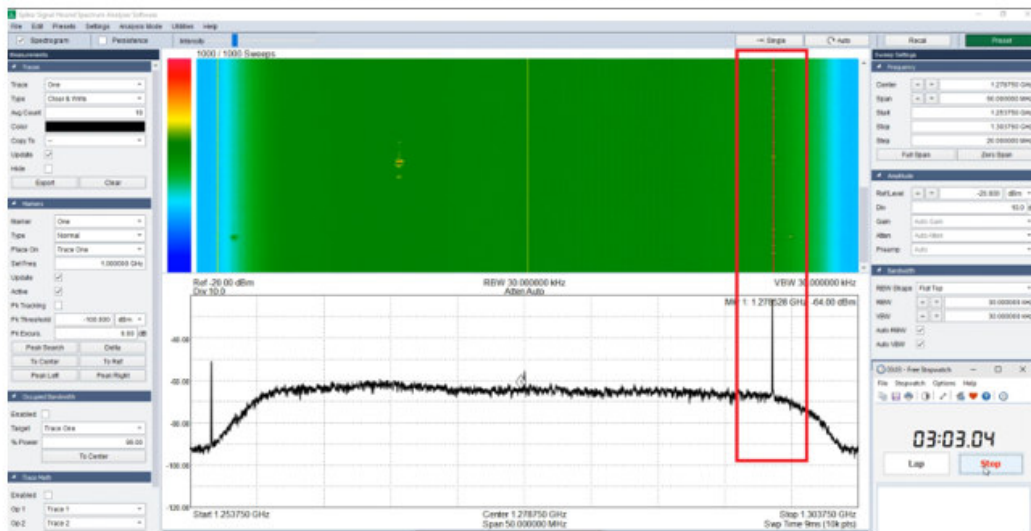


Wider BW DATV and FM-TV result in lower tolerable levels

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 in ITU-R WP5A.
 - To provide guidance for administrations on technical and operational measures applied to amateur service operation to protect the RNSS primary allocation.
- CEPT supports the Recommendation route and will probably mirror this as guidance in an ECC 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.



Guidance proposals under consideration

- These elements have been proposed by three administrations for the draft guidance Recommendation under development in WP5A :
 - Frequency separation.
 - Power level restrictions.
 - Excluding some applications in parts of the band.
- **None of these proposals are agreed at this time** but remain under serious consideration:
 - Allow higher power narrow band operations (100W) in the range 1298-1300MHz plus....
 -allow higher power (100W) spectrum for wideband (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.
 - 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.
 - Or.....limit all amateur eirp to less than 1W across the entire band.



IARU objectives

- IARU is a recognised “Sector Member” in the ITU-R
 - Has the same observer organisation status as the European Commission
 - IARU can contribute and participate and has a specific working group in WP5A (chaired by Dales Hughes VK1DSH).
- IARU seeks to ensure that appropriate amateur service characteristics are used in the studies (documented in WP5A).
- IARU seeks to ensure that appropriate usage information is considered for all applications in the band (documented in WP5A).
- IARU seeks to minimise any eventual constraints on the amateur services as far as possible (in the guidance recommendation).



IARU Position on AI9.1b

- *“...Therefore any additional regulatory, operational or technical measures incorporated into the Radio Regulations are unnecessary. Any recommendations resulting from studies under Resolution 774 can be applied on a national basis and should be based on realistic assumptions, proportionate in scope and carefully justified so as not to unnecessarily inhibit development of the amateur services.”*
- Retain the ability for as many of today’s applications to be able to continue as possible.
- Work towards minimum disruption to narrow band activities.
- Engagement will continue up to and including the WRC23 itself.



Latest Situation at October 2022

- ITU-R WP4C has completed the studies based on the amateur service characteristics defined in WP5A and the report was adopted in Study Group 4.
 - This means that the technical studies are considered complete.
- ITU-R WP5A meets during November 2022.
 - Work will continue on the draft Recommendation with contributions expected from IARU, China, Russian Federation, France, Japan.
- This is a vital meeting to inject the IARU contribution on the guidance.