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International Amateur Radio Union

INFORMATION REGARDING WRC-23 AGENDA ITEM 9.1 TOPIC B)

Introduction

WRC-19 approved new WRC-23 agenda item 9.1, topic b), “review of the amateur service and the amateur-satellite service allocations in the frequency band 1 240-1 300 MHz to determine if additional measures are required to ensure protection of the radionavigation-satellite (space-to-Earth) service operating in the same band in accordance with Resolution **774 (WRC-19)**”.

The International Amateur Radio Union is the worldwide federation of national amateur radio organizations with member-societies in more than 140 Member States of the ITU. The IARU plays an active role in the work of the ITU Radiocommunication and Development Sectors on behalf of more than three million licensees in the amateur and amateur-satellite services.

Background

At the 23rd Working Party (WP) 5A meeting, initial discussions considered the amateur and amateur satellite service characteristics required to support the studies under Resolution **774 (WRC-19)** and concluded that additional and clarifying information will be required by WP 4C to supplement the information contained in Recommendation ITU-R M.1732-2.

With this in mind, the IARU consulted a number of national amateur radio societies and carried out a review of the current applications in use by the amateur services and collected the technical characteristics, deployment characteristics and operational profiles of the amateur service transmitters used to support these applications.

The review consulted published information that provides records and details of actual amateur service activities in order to accurately reflect the relevant and actual usage of the band 1 240-1 300 MHz.

The IARU has collected the results of this review to support the coexistence studies between the amateur service and the amateur-satellite service and the radio navigation satellite service.

Amateur Service applications in the 1 240-1 300 MHz frequency band

The data set provided in Attachment 1 are the applications and typical operational aspects of the amateur and amateur satellite services operating in the band 1 240-1 300 MHz. The IARU would like to emphasise the following important aspects with regard to the information provided:

- This information is specific to amateur operations in the band 1 240-1 300 MHz and builds upon the general information detailed in Recommendation ITU-R M.1732-2.
- As far as possible the IARU and national amateur radio societies have consulted to gather published and traceable data pertaining to operating periods and activity levels.
- The following information was provided to the IARU by a number of national amateur radio societies.

Attachment: 1

ATTACHMENT 1

Applications and typical operational aspects of the Amateur and Amateur Satellite Services operating in the band 1 240-1 300 MHz

Background

The 23rd Working Party (WP) 5A meeting considered the amateur and amateur satellite service applications and characteristics required to support the work of WP 4C under Resolution 774 (WRC-19). It was concluded that additional and clarifying information will be required by WP 4C to supplement the information contained in Recommendation ITU-R M.1732-2.

Amateur and amateur satellite applications and station types

The detailed list of amateur and the amateur-satellite service applications in the band 1 240-1 300 MHz are considered against the typical amateur station types considered under three categories as follows:

1) *Home station*

This refers to equipment installed at the station licence holder's home address.

2) *Temporary "portable" station*

A temporarily sited station is usually located in an advantageous position (usually high ground) away from a home station location and operational for a short period radio contest, an experimental long-distance communication or a time-limited special activity event.

3) *Permanent installation (sometimes referred to as "automatic" or "unmanned" stations)*

Permanent installations refer to stations installed away from a Home Station. They operate as voice, amateur television or data repeaters and propagation beacons. As permanently installed stations, these are licensed by the national authority in their own right for their designated location, operating frequency and output power. The licence and responsibility of the station operation are usually associated with an already licensed radio amateur operator known as the "keeper" of the installation.

Propagation beacons are usually intended to operate continuously and are required to transmit a short repeating message using on/off keying or a narrowband FSK signal with call sign ID and location information.

Voice repeaters usually re-transmit narrow band analogue and digital voice traffic when activated with a signal on the input frequency and are mostly associated with extending geographic coverage area. Data and TV repeater stations transmit wider bandwidth amateur signals and TV repeater stations may transmit test signals when not being accessed by a user station on the input channel. All repeater stations are required by national regulations to transmit identification information.

Satellite communications and mobile stations could be possible, but these are rare in this frequency band.

TABLE 1

Narrow band amateur and amateur satellite applications against the station types

Application	Station type				Max. bandwidth	Comments
	Home	Temporary	Installation			
			Repeater	Beacon		
Voice (Analogue SSB)	Yes	Yes			2 700 Hz	Long distance tropospheric weak signal ops. Contest operation (incl. EME).
Voice (Analogue NBFM)	Yes	Yes	Yes		25 000 to 12 500 Hz	Local neighbourhood communications satellite communications.
Voice (Digital)	Yes		Yes		12 500 Hz	Local neighbourhood communications
Telegraphy (Morse code On/Off keying)	Yes	Yes		Yes	500 Hz	Long distance tropospheric weak signal ops. Contest operation (incl. EME).
MGM (e.g. RTTY, SSTV, PSK31, WSJT ¹)	Yes	Yes		Yes	6 to 2 700 Hz	Long distance tropospheric weak signal ops. (incl. EME).
Data (e.g. AFSK 1k2, FSK 9k6), D-Star, Digital Data 128 kbit/s	Yes	Yes (Mobile)	Yes		12.5 to 150 kHz	Local neighbourhood communication links.

TABLE 2

Wide band amateur applications against the station types

Application	Station type				Max. bandwidth	Comments
	Home	Temporary	Installation			
			Repeater	Beacon		
Analogue Television (FM-TV)	Yes	Yes	Yes		16-18 MHz	Legacy technology, deployments decreasing.
Digital Television (DVB Standards)	Yes	Yes	Yes		1-8 MHz	State of the art technology, deployments increasing

¹ These WSJT applications consist of a number of highly structured data modes which send a limited amount of data with strong Forward Error Correction which allows the data to be recovered at very low signal-to-noise ratios. WSJT modes –Weak Signal Joe Taylor– are named after their inventor Dr. Joe Taylor.

Modern amateur television installations employ spectrally efficient digital TV transmitters based on DVB-S/MPEG-2 signals. Symbol rates of 2 Msym/sec or 4 Msym/sec operate in lower bandwidth channels and further experimentation continues to increase the spectrum efficiency of amateur TV signals. It has been shown possible to transmit HD MPEG-4 signals with symbol rates less than 333 kSym/sec in a bandwidth as low as 500 kHz.

Typical amateur station antenna characteristics in 1 240-1 300 MHz

There is no standard amateur station and in most cases the antenna installation at any individual amateur station is constrained or influenced by the physical location and town planning restrictions. The following antenna types are typical and based on deployments detailed in published information relating to activity periods and operating contests. In general home and temporary stations use highly directional, narrow beam width antennas in this frequency range.

1) *Home station and temporary “portable” station antennas*

Home Stations generally use a single directional beam antenna, however in a few cases multiple beam antennas are combined to increase the array gain. This is more usual for EME² operators for whom high antenna gain is essential for overcoming the high path and reflection loss. A higher performance EME station might use instead a medium size dish antenna.

TABLE 3
Typical home station and temporary “portable” station antennas

Antenna type	typical gain	3 dB beam width
Single Yagi beam (23 to 55 element)	18 to 21 dB	18° to 10°
Multiple Yagi (for EME)	21 dB	10°
Dish antenna (for EME)	(4 m) 32 dB	4°

2) *Permanent installation antennas*

Most permanent installations antennas are less directional and (in the case of repeaters) are generally intended to provide coverage over a local area.

TABLE 4
Typical permanent installation antennas

Typical antenna types	Typical gain	3 dB beam width
Various (e.g. linear slot, coli-near array, horn, flat panel etc.)	Up to around 13 dB	Omnidirectional to 60° in the azimuth plane.

² Earth-Moon-Earth communications use the Moon as a passive reflector and achieves global coverage at certain times. The reflected signals are very weak, though modern Digital Signal Processing techniques and structured data modes reduce the need for high power transmitters.

Typical amateur station power level spread in 1 240-1 300 MHz

Typical power level distribution can be derived from published information about the stations that submit information resulting from national activity periods and operating contests.

1) *Home station and temporary “portable” station*

TABLE 5

Transmitter power ranges in use

Transmitter power range (Watts)	% home stations	% temporary stations
Up to 10	47%	61.5%
11 – 25	9%	7.5%
26 – 100	26%	7.5%
101 – 300	12%	15%
Over 300	6%	7.5%

2) *Permanent installation*

Propagation beacon and repeater station directories can be consulted to gather information on the permanent stations deployed within a territory. They are usually licensed to operate at a specific ERP.

TABLE 6

Transmitter radiated power ranges in use

ERP range (Watts)	% propagation beacons	% repeaters
Up to 10	69%	16%
11 – 25	8%	76%
26 – 100	20%	8%
101 – 300	1%	0%
Over 300	1%	0%

Antenna heights

The following antenna heights are representative of typical amateur station installations.

- Typical antenna height for a home station = 12 m above ground level.
- Typical antenna height for a temporary station = 3 m to 15 m above ground level.
- Typical height for a permanent installation station = 25 m above ground level.

Amateur station 1 240-1 300 MHz band usage patterns

For all Home and Temporary “Portable” Station applications, narrow band or wideband, the highest number of actively transmitting amateur stations can be found during the scheduled operating and radio contest periods. The following table summarises the total scheduled operating and contest periods scheduled in one region for a typical year. As these activities are usually formalised in the

amateur operator calendars, the published national results³ can be consulted to determine the number of transmitting stations that were active during any one activity or contest period.

TABLE 7

Scheduled operating periods and active operating station numbers

Usage type	Annual scheduled operating periods	Total active stations per scheduled operating period	Active temporary stations per scheduled operating period
Narrow Band Activity Period and Contests	Total, on average 108 hours over a year	From 9 to 140 maximum depending on the country reviewed.	15 to 20 maximum depending on the country reviewed.
EME activity	5 × 24-hour contest periods	Up to 10 maximum depending on the country reviewed. (Maximum < 70 across the European area)	None
Wide band Activity Period and Contests (ATV)	Total, on average 120 hours over a year	From 1 to 24 maximum depending on the country reviewed. (Maximum < 100 across the European area)	10 maximum depending on the country reviewed.

Permanent Installation stations present a different scenario when considering the operational time. Propagation beacon and repeater station directories from a representative region can be consulted to develop the summary presented in the following table.

TABLE 8

Permanent Installation station operating periods in a typical year

Usage type	Annual operation	Active installations
Narrow band propagation beacons	Transmitting continuously usually.	From 4 to 20 depending on the country reviewed. Region 1 = 88 in total.
Narrow band repeaters	Low and only when activated on the input frequency by a user station. May transmit more regularly if a beacon mode is present.	From 9 to 19 depending on the country reviewed.
ATV repeaters	Low and only when activated on the input frequency by a user station. May transmit more regularly if a beacon mode is present.	From 10 to 18 depending on the country reviewed.
ATV repeater user (usually a home station)	Random and sporadic	5 to 10 users within the local coverage area transmitting one at a time.

³ The analysed results were published by the national radio amateur societies in several European countries.

Activity Factors

Activity factor considers the amount of time that any particular station is transmitting during any operational period of activity. All applications involve two-way communication requiring periods of reception as well as transmission. It is usual practice for any home station or temporary portable station to spend more time listening for and receiving other transmitting stations than transmitting.

Maximum Activity Factor for Home Station and Temporary “Portable” Station = 50% and typically less.

Any permanent installation station operating in a beacon mode will exhibit a 100% activity factor.

User density of amateur transmitting stations

1) *Home station and temporary “portable” station*

- For narrow band activity periods the maximum density of transmitting stations = 0.0002 km^{-2} .
- For wide band activity periods the maximum density of transmitting stations = 0.0001 km^{-2} .
- For EME operations the maximum density of transmitting stations = 0.000013 km^{-2} .

Recognising that not all active stations may submit a record of their activities a 33% uplift has been added to the total active stations per scheduled operating period from Table 7.

2) *Permanent installation*

- For narrow band data and voice repeaters the average density of transmitting stations = 0.0003 km^{-2} .
- For wide band ATV repeaters, the average density of transmitting stations = 0.0001 km^{-2} .
- For propagation radio beacon stations, the average density of transmitting stations = 0.0001 km^{-2} .
