

Harmonised Frequencies for EME – Past, Present and Future

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EME can claim to be one of the most prominent forms of truly global communication on the amateur VHF and microwave bands, compared to amateur satellite or terrestrial DX. It also can demonstrate leading technology and self-training... but sadly, EME can also be considered by other amateurs to be a niche activity. These features make globally harmonised frequencies – and public outreach to get them – two topics of considerable importance for the future of EME.

Part of that ‘public outreach’ is to provide accurate, up-to-date information to the rest of the world. The national and international Band Plans do not always reflect current EME activity because that information is not readily accessible; and this weakens the foundations for planning and protecting the future of EME.

This paper summarises the current state of play on the frequency management scene, and also offers some thought-provoking suggestions for the Frequency Management forum at the EME2012 Conference. Hopefully the EME community itself will take these suggestions forward.

Message 1: Please help us to help you!

My apologies if there is some ITU/IARU Region 1¹ bias in the source material. World conferences like EM2012 are an ideal opportunity to remedy this, and to complete the wider picture.

Background

Frequency allocations for the Amateur Service and the Amateur Satellite Service are subject to an unprecedented level of pressure from competing services, from HF through to millimetre-wave. A companion paper on the 2.3 GHz situation in Sweden shows that when this is accompanied by a poor understanding within the regulatory and competing entities, a poor result is almost inevitable. Sweden is not unique, for we are generally seeing widespread degradation of the noise floor in the lower bands, and in some cases, complete loss of allocations.

At UHF and above where most EME is located, many of the allocations we have are secondary, and not all are harmonised, so preserving or enhancing amateur access is a significant challenge. EME in many ways demonstrates leading edge weak-signal techniques and personal development; but this can often be overlooked and its position undermined by the lack of outside knowledge and understanding, even within the immediate wider amateur community. This makes it hard to enlist support to raise the public profile of EME. Conferences such as EME2012 provide a rare platform to address this.

It would be nice to see results appearing in other areas and being credited to EME – as, for example, the HF community has already achieved for propagation research; and the Cubesat developers have done for science, education and at ITU level. EME also

1. Region 1 is Europe, Africa, the Middle East and Northern Asia. Region 2 is North and South America. Region 3 is Oceania and Southern Asia.

does not feature obviously in many DX Cluster feeds (and ideally we need one for EME alone).

Message 2: Broader outreach gives recognition of achievements – and that the EME frequencies are in use.

Band Plans – Where has EME Changed in the Past?

EME ideally needs globally harmonised segments to avoid split frequency operations (2.3 GHz being the worst example of fragmentation). EME is often, though not always, aligned with terrestrial narrowband activity. It is, though, worth noting that EME operating frequencies and Band Plans have not remained static or kept perfectly aligned. In some cases EME has helped to lead changes, while in others updates from operating trends have not been incorporated. Recent changes have been:-

- **50MHz:** The designated EME segment in Region 1 moved to 50.310–50.320 MHz since Sun City, effective Jan 2012. Regions 2/3 are looking at Region 1 developments in the 50.00–50.50 MHz DX section.
- **144 MHz:** In Region 1, EME is no longer exclusive at 144–144.035 MHz since Cavtat-2008, as activity had already moved further up the band.
- **3.4 GHz** G3LTF successfully encouraged the EME move from 3456 to 3400 MHz (2006/7). First adopted by Region 1, this was recently updated in the revised 2012 ARRL plan, which now terms 3456 MHz narrowband as a 'legacy' frequency.
- **24 GHz:** In 2004-6 there was a move from 24192 MHz to 24048 MHz which is in the Primary segment (though the US has yet to harmonise the rest of terrestrial narrowband activity).

Of the above, the re-plan of the 6m band by Region 1 of is the most recent. A key enabler for EME in this band, were the advantages offered by MGM² and by lower-noise antennas. Another feature that was part of the broader 6 m planning was the concept of regionally synchronized beacons (which in a different form are already arriving for EME on 1296 MHz). If these see wider adoption then the community will need to liaise closely with the band planners to better account for allocations and future changes.

Message 3: Band Plans evolve over time. Please keep abreast of changes, and feed your own changes back to national society band planners so that both sides keep up-to-date.

Band Plans and Activity – Where is EME Today?

EME activity is coordinated via Internet email reflectors, such as [Moon] and [Moon-Net] and by the monthly *432 & Above EME Newsletter*. These, and indeed the strong attendance at EME2012, show that there is dedicated EME community.

However, it is more difficult for anyone outside the EME community to find up-to-date introductory material, real-time information on operating activity and precise frequencies. This information would not only help frequency managers within amateur radio, but also beginners and casual readers... who may also include our frequency regulators.

A simple question on 'EME Frequencies' as a search on Google or Wikipedia can be disappointing so please consider how we can improve our web presence. For example,

2. 'Machine Generated Modulation': IARU terminology for digital modes like WSJT etc.

members of the UK Microwave Group conducted a successful campaign a few years ago by consistently embedding 3400 MHz links to catch Google. It is important that 'Google is our friend', and not our downfall.

A key step is to review what is currently listed and whether this actually reflects the current activities within the EME community, which have evolved greatly since the advent of WSJT, modern SSPAs, improved LNAs etc.

Table 1 (at the end of this paper) shows the result of one attempt to collate EME frequency information from existing Band Plans. Information such as this needs to be quickly brought up-to-date, and needs to be in one popular place that is easy to maintain and gets ranked highly by search engines. Good information can only be helpful; but the opposite can be damaging.

Better visibility, accuracy in Band Plans etc are things we should be able to improve fairly quickly, and can assist readers at all levels – from beginners and casual readers all the way up to national and international spectrum planning and defence.

Message 4: It's more than just 'Use or Lose' our EME frequencies. We need to show more visibly what resources are being used. Please assist with web content etc.

External Pressures

Political and commercial pressures (notably for mobile broadband) and related governmental policies on spectrum release/pricing now combine to put enormous pressure on secondary amateur spectrum in the UHF/Microwave bands. Some notable examples are:

- **EU:** the Radio Spectrum Policy Programme (RSPP) to identify 1200 MHz of spectrum by 2015 (including regular audits of usage from 400 MHz to 6 GHz)
- **USA:** the National Broadband Plan (300 MHz by 2015, 500 MHz by 2020 for broadband)
- **UK:** Enabling UK Growth – Releasing Public Sector Spectrum (releasing 500 MHz from below 5 GHz by 2020)
- **ITU WRC-15:** More spectrum for mobile? 10 GHz satellites?

Message 5: Watch the Politics as well as the Engineering. We need to demonstrate our own 'economic and societal value' in these arenas too.

Current Situation in the Low Microwave Bands

1296 MHz is the most popular and best harmonised of the secondary bands, which we share with aeronautical and navigation services. These other applications may keep mobile broadband at bay but that still leaves us facing protected and growing numbers of L-band air traffic radars, along with newer satellite navigation systems (GNSS) such as Compass and Galileo. Consequently Region 1 has agreed 1240 MHz as a reserve frequency for narrowband/EME and is monitoring some early signs of new restrictions or exclusions. So far Regions 2 and 3, while sharing such concerns, have not yet made an equivalent reservation in case an alternative should be needed.

2300 MHz is globally designated to IMT (mobile communications) and this is likely to lead to further losses and fragmentation. In CEPT, IARU-R1 was successful in embedding Amateur station characteristics in the key CEPT ECC Report-172 that will form the basis for the final release decision. As other incumbents are present we are likely to

see a pioneering form of Licensed Shared Access (LSA) in the CEPT countries rather than a 100% clearance or sell-off.

Despite the IARU R1 assistance, premature results like the potential total loss in Sweden are particularly disappointing, all the more so given that the full band clearances are not going to be mandated. The most likely application in the band is LTE-TDD (perhaps in 5 MHz blocks) and the main hope is that a small guard band will be left at adjacent to the 2300 MHz band edge. Ironically LTE is also likely to be a good source of EME power amps!

Another application in prospect is a new class of Medical networks (MBANS) which merely adds to the complexity of the challenge! There is no doubt that vigilance in 2.3 GHz is required as prospects are not good.

3400 MHz also resides close to the ‘sweet spot’ frequencies for the mobile industry, but here the situation does look more hopeful. On both sides of the Atlantic 3400–3410 MHz is utilised by airborne radar and therefore is often excluded from commercial release. This sub-band is also recognised (though not entirely excluded) by CEPT ECC Decision (11)06. European amateur 3400–3410 MHz allocations, which are often based on the EU17 amateur allocation footnote, have been gradually growing and any further promotion of activity in this band is to be welcomed as a potential refuge from the 2300 MHz situation. Please see the references for further European 3400 MHz information.

Message 6: Please keep abreast of any new restrictions/allocations and inform all your contacts; and please keep 3400 MHz active!

Future Spectrum

Apart from the Low bands, the other consideration for skyward-looking EME interests may be 10 GHz. The next World Radio Conference, WRC-15, has a pair of agenda items for new active services, Geostationary Satellites (AI-1.6 for Region-1) and active Earth Exploration Services (AI-1.12 for EEES), which IARU is keen to keep out of 10368/10450 MHz.

More generally, with spectrum under pressure it may be reassuring to know that the top level IARU Administrative Council (IARU-AC) recognises that specific new policies may be required in VHF/Microwave bands. In August 2011 it commissioned a study by a small tri-regional task group known as the Future Spectrum Committee. A summary of its wide no-holds-barred remit is:

“**To review** the current policies of the IARU in respect of the spectrum requirements of the amateur and amateur-satellite services in bands above 148 MHz as set out in the document *Spectrum Requirements for the Amateur and Amateur-Satellite Services*.”

This includes considering bands that may be sought instead of, or in addition to, current policies.

For some, this philosophy isn't new. For example in Region 1 we no longer endorse any new activity in the Secondary 24.05-24.25 GHz allocation, as there is a strong preference for 24048 MHz activity within the better protected 24.0–24.05 GHz Primary allocation. However, would you also be interested in new allocations with lower path losses at either side of 24 GHz, to fill the gaps above 10 GHz and below 47 GHz?

Even in the early stage of the Future Spectrum Committee's work it was clear that narrowband (including EME) and amateur satellite frequencies were the highest priority for global harmonisation – an approach that is sometimes termed ‘common narrowband segments’. Early work also included a band-by-band, Region-by-Region review. This

brings us back to the earlier comments regarding easily accessible and up-to-date information about frequency usage or restrictions. This activity is ongoing, but it has already started to form a useful backdrop.

Message 7: Let us know of any new threats or ideas – or new volunteers!

Becoming More Visible – ‘EMESpot’ ?

Returning to the visibility issue, some recent planning and regulatory submissions have used activity maps and other more visual information. Other areas of the hobby have been adopting more visual real-time aids which are of wider benefit and there may be scope for EME to follow.

Satellite tracking, virtual radar (for aircraft scatter), repeaters, Echolink, APRS, WSPR and beacon reporting all have some form real-time mapping (in 2, 3 or 4D).

For terrestrial beacons, BeaconSpot (<http://www.beaconspot.eu/>) was created by UK Microwave Group member Robin Lucas G8APZ and has proved very successful. It automatically filters beacon reception reports from the DX Cluster (or can accept direct entries) to populate an activity database and maps for beacon reception reports from 50 MHz upwards. Some virtual radar software is even more sophisticated and can plot 3D aircraft flight paths in Google Earth based on ADS-B signals and links to additional internet information.

So a suggestion for the EME community that would make for a useful (and more visible) tool might be ‘EMESpot’ - a Google Earth app that would overlay:

- Moon position and phase (Sun position and night zones already available)
- Station locations and callsigns
- Operating frequencies
- Dish/beam angles (ideally updated direct from rotators)
- Geometric overlays for angles, coverage circles etc
- Activity status/spots (inc as RSS or Twitter feeds or Phone/Tablet Apps)
- Integration with spot reports from database or WSPR-like extensions to WSJT

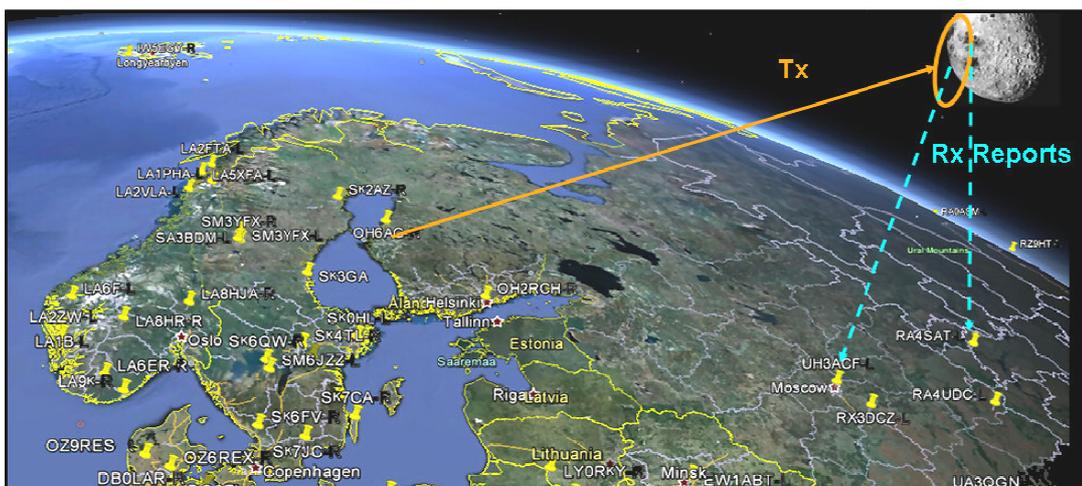


Figure 1: Visual concept for EMESpot

This could be a highly visual and powerful operating aid, and would help spectrum planners too.

Message 8: Volunteer EME-Spot developers?

Conclusions

EME is one of the technical pinnacles of amateur radio. Frequency managers are keen to promote and protect activity – but they need your help. We should ensure that EME is as visible and accessible as possible; not only to gain wider understanding and recognition, but to try to make sure that the next generation of EMEers will have some spectrum left for them!

Message 9: Please discuss 1–8, and please assist!

Some useful target dates

Band Plan updates, spectrum defence etc are regular topics at major meetings, but in order to have any influence, submissions must be planned well in advance. Some useful target dates to know about are:

- ARRL 23 cm review – **now**
- IARU Future Spectrum Committee report/follow up – **now**
- European 2.3 GHz release/sell-off – **2012-2013**
- UK: RSGB Spectrum Forum meeting – **3 November 2012**
- IARU Region 1 Interim Meeting, Vienna, **19-21 April 2013**
- IARU Region 3 Conference, Ho Chi Minh City, Vietnam, **5-9 November 2012**
- IARU Region 2 Conference, Monterrey, Mexico **2013**
- ITU WRC-15 November 2015 (key preparatory inputs by **July 2014**)
- IARU Region 1 Conference, Varna, Bulgaria, **September 2014**

References

- [1] 'Allocations at 3400 MHz', Murray Niman G6JYB, RSGB Microwave Manager. Document B13, Interim Meeting of the IARU Region 1 VHF/UHF/Microwave Committee, Vienna, February 24-25 2007
- [2] '3400 MHz EME Developments', Peter Blair, G3LTF. Paper number CT08_C5_18. IARU Region 1 Conference, Cavtat, 2008.
- [3] EU17 and Region 1 3400 MHz allocations:
<http://www.microwavers.org/?3400mhz.htm>
- [4] IARU Spectrum Requirements:
http://www.iau.org/IARU_Spectrum_Requirements_2011.pdf

Table 1: EME Band Plans – Past, Present & Future

If allocations are squeezed due to future changes, a more precise knowledge and alignment of the Band Plans becomes more important for all users.

Band	Past	Present	Future	IARU Region 1 VHF Managers' Handbook v6**
50 MHz	Not defined	R1: 50.310–50.320 (Jan 2012) R2/3 - ??	R2 / R3 looking at new R1 plan	50.310–50.320 Major 6m Band Plan reform at IARU-R1 Sun City
70 MHz			?	Nothing so far
144 MHz	144.00 – 144.05	144.1+	May need a tidy up	CW: 144.000–144.110 MGM: 144.110–144.160
220 MHz		US: 222.0–222.025		No allocation – Digital Broadcasting
432 MHz		US 432–432.070?		CW: 432.000–432.025
902 MHz		ARRL: 902.8–903.0		No allocation
1296 MHz		IARU: 1296.0–1296.10 ARRL: 1296.00–1296.05	R1: 1240 +1296 ARRL re-plan in progress	1296.00–1296.025 (Reserve within 1240.0–1240.5)
2300 MHz	2304	2302, 2304, 2320, etc	Less than we have now....	2320.0 –2320.025 CW only Other Narrowband usage noted at 2304–6 and 2308–2310
3400 MHz	3456	IARU: 3400.1 ARRL: 3400.0–3400.3	Safe?	3400.100 activity centre Changed 2007/8 in R1, 2012 in USA
5760 MHz	5760	5760	RLANS, SRDs	No EME designation
10 GHz	10368	10368 / 10450(JA)		No EME designation WRC-15 threats
24 GHz	24192	24048.?	Primary only	No EME designation
47 GHz	47088	47088.?		No EME designation
76 GHz	–	UK: 75976 EU: 76032 US: 78192		WRC-15 AI-1.18 vs 77.5–78.0 (Primary)
134 GHz	134.001	R1: 134.928		134.928 (Aug 2011)

** IARU Region 1 has detailed top level HF and VHF/Microwave Band Plans that feed recommendations to its national Member Societies. The most up-to-date-version of the VHF/Microwave Band Plan can always be found in the IARU Region 1 VHF Managers' Handbook, at <http://iaru-r1.org>