IARU Region 3 HF Band Plan Committee
Amateur Service - HF Amateur Band Planning
40m Band Harmonisation Challenges

Executive Summary

The IARU Region 3 HF Band Plan committee and the IARU Region 3 board have long noted the problems on 40m of mis-alignment of activity types between national and even inter-regional band plans on the 40m band. This paper is the start of a process investigating whether improvements can be made to the 40m band plan that improve:

- Global harmonisation of activity
- Recognise the increase in demand for data mode band space
- Consider how to improve the availability and usability of band segments set aside to support Emergency Communications
- Consider ways of reducing conflict between contest activities and all other band users

The paper sets forth the case for improved harmonisation and attempts to define empirical based methods for assessing required band segment capacity for each of the main operating mode groups, and then proposes several solutions that demonstrate different ways of solving the problem.

Amateur operators, IARU Member societies and regional clubs are all invited to contribute their feedback and are, in particular, asked to consider the questions posed at the end of this paper.

Background

Amateur radio activity on the HF spectrum has always been carried out on a non-assigned / frequency agile basis, where individual operators have the autonomy to choose what frequencies they wish to operate on. However, given the diversity of activity types within the amateur service, it is inevitable that conflicts will arise between different user groups that are focused on diverse and incompatible activities.

To address these conflicts, the amateur service, through the efforts of the IARU, has published band plans that define preferred band segments for each major activity type. The aim is to organise amateur activity such that incompatible modes each have their own area to operate in. This reduces the probability that one stations activities will cause interference (potentially unwittingly) to another.

Global Harmonisation

Today, the amateur radio band plans published by the IARU, guide amateur radio operators on which band segment each activity should use. For example:

- CW or Morse Code – sending text-based information using aural based codes
- Data-modes – focused on primarily machine to machine communication
- Voice – sending speech-based information (in both analogue and digital formats)

Band segment alignment of these three fundamental activities globally has been a key objective of IARU for many years now.

40m Band Challenges

The Amateur Service 7000-7200 kHz band is considered an example of one of the more dis-organised bands on a global basis. The main problems affecting basic band plan alignment can be summarised as:

1) inconsistent IARU member society band plans.
2) specific national regulatory conditions (e.g. the FCC in the USA)
3) legacy band plan allocations that haven't been revised following the band expansion granted at WRC2003 (prior to which the 40m band was only 100 kHz wide)

In addition to these basic issues, the other more recent challenge has been the shift in general amateur radio activity towards wider use of data modes of communication. In particular, the explosion of data modes has also occurred on an ad hoc basis without following the global band plans. The most glaring example of this is the 7074 kHz WSJT data activity in what is spectrum currently set aside for voice communications in the IARU band plans.

It is through attempting to reduce the inconsistencies and making a concerted effort to deliver a harmonised global 40m band plan that many of the problems should be solved. At the same time, it is worth reconsidering the amount of spectrum allocated per activity to ensure that each mode has a fair share of the available spectrum based on current activity.

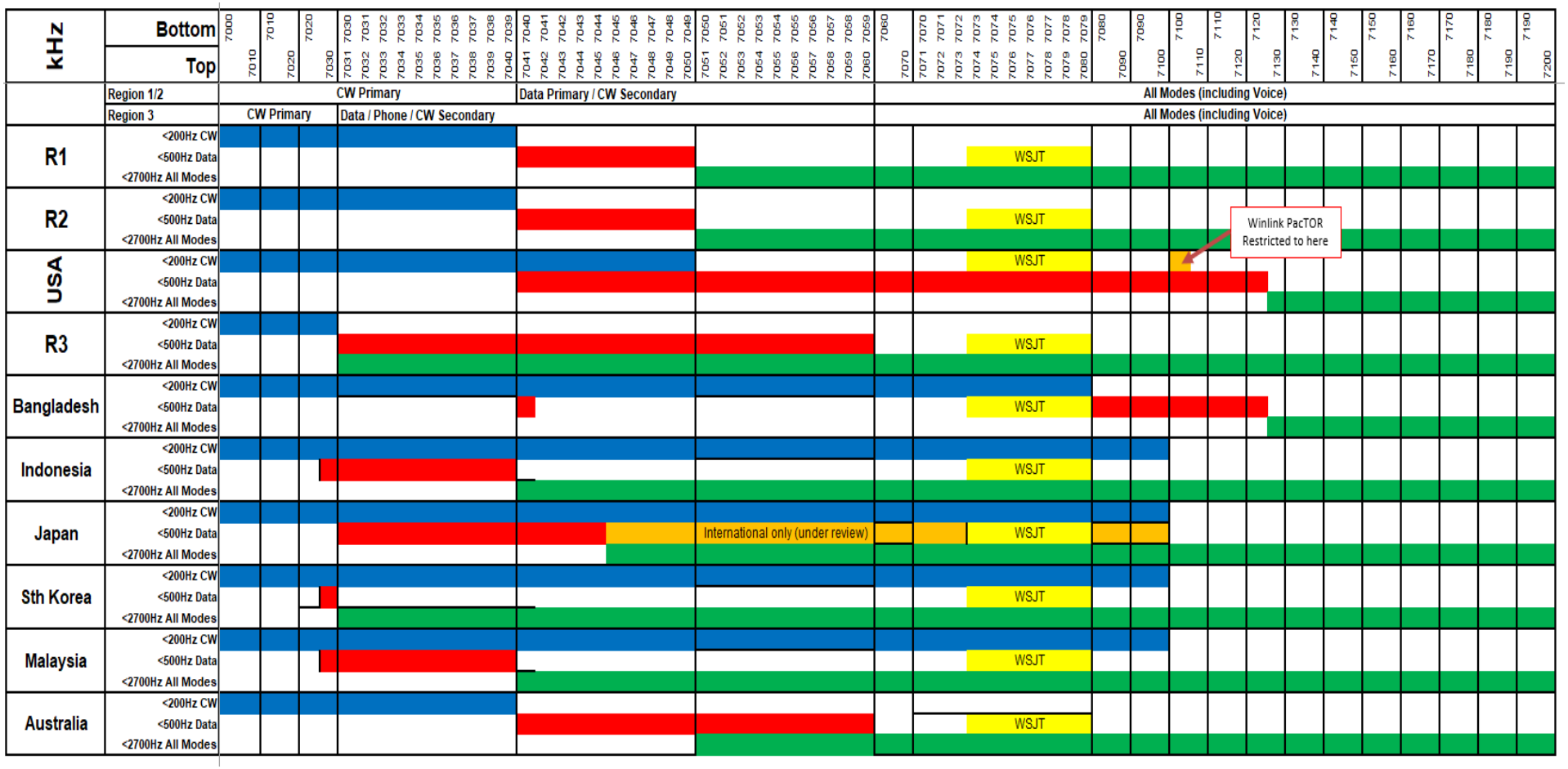
Spectrum segment definition – band position per mode

From the diagram below, you can see the obvious lack of alignment between nations within Region 3, and indeed between the three main regions. This is most pronounced when considering the data mode segments.

For example, the legacy 10 kHz data segment at 7030 kHz persists in several parts of Region 3. The corresponding misalignment in the voice segments results in substantial cross mode interference between data-modes and voice operators throughout the 7040-7080 kHz band segment (particularly in Region 3).

It is therefore clear that action needs to be taken to reduce the position conflicts that currently exist.

40m Band Plan Comparisons – IARU Global vs Region 3 Member Domestic Plans



Spectrum segment definition – bandwidth per mode

The disparity in bandwidth allocated to the different mode families is also views as a significant contributor to the problem across region 3 and the world. This is compounded by certain data mode activity occurring outside the IARU data mode sub-bands (particularly the WSJT calling frequency on 7074 kHz).

Today we find the following quantities of spectrum defined in the various band plans:

Country / Region	CW	Data Modes	Voice
Region 1	40 kHz	10 kHz *1	150 kHz
Region 2	40 kHz	10 kHz	150 kHz
Region 3	30 kHz	10 kHz	170 kHz *3
Japan	30 kHz	15 kHz	155 kHz
Australia	40 kHz	20 kHz	150 kHz *4
Bangladesh	40kHz + 39 kHz	1 kHz + 45 kHz	75 kHz
Indonesia	25 kHz	15 kHz	160 kHz
South Korea	25 kHz	5 kHz	170 kHz
Malaysia	25 kHz	15 kHz	160 kHz
United States	50 kHz	75 kHz	75 kHz *2

NOTES:
*1 is actually wider but not on a data modes exclusive only basis
*2 It is worth noting that the USA has access to the band as high as 7300 kHz – so the real voice capacity for USA amateurs is 175 kHz
*3 Region 3 has an overlapping Voice and data modes allocation between 7030-7050 kHz
*4 Australia has 10 kHz of the data modes and voice modes allocation overlapping

What is particularly noteworthy is how little spectrum is set aside in the band plans for data modes. Again, this almost appears to be a legacy of the band plan pre-expansion at WRC2003.

The challenge today, however, is to decide on a method of determining an equitable redistribution of spectrum per activity. The aim, therefore, is to try and find a suitable activity indicator or spectrum demand indicator that all user groups will accept as valid.

Band Segment Capacity Demand Modelling

Given that the amateur service is a non-assigned service, (i.e. stations have autonomy to pick their operating frequency within the band segment), you can't use any form of quantity of licensed stations-based allocation per kHz model to determine how much spectrum is in use for a given operating mode. The number of licenced stations has no bearing on band activity or interest in a particular mode.

To overcome this fundamental problem, a channel-based activity model is discussed for data modes and an activity-based model derived from proportionate logging data from a public global database is used for CW and SSB. Combining to two should see a way forward to equitable band distribution.

Stage 1 - Data Capacity Assessment

Considering the amount of general published information about where to find data mode activity on the bands (e.g. Winlink node listings plus WSJT operating channels for Fox and normal mode traffic),

it is considered at least feasible to estimate the amount of spectrum that might be required for data modes on a channel-by-channel basis.

For example, when examining typical data traffic:

- FT8 – traffic is usually on a main 3kHz channel but can regularly have up to 2 DX-pedition stations active at the same time. This means that up to 9 kHz needs to be made available for FT8 data alone.
- FT4 usually only requires one 3kHz channel
- WinLink and similar Store and Forward/Mailbox based activity – when operated in wideband VARA mode, occupies up to 2.7kHz / channel. Based on the number of reported active gateways[1] on disparate frequencies today, it could be argued that a minimum of 10 kHz should be set aside for Winlink activity. Allocating dedicated space to this mode is also in alignment with improving Emergency Communications (EmComm) support by the amateur service as there is substantial evidence in at least some areas of the world that HF data systems are very valuable means of communications in emergency relief type operations.
- Ad Hoc data – PSK/RTTY/Olivia/JS8Call etc is harder to assess, however it is not uncommon to see at least 1-2 QSOs in each of these modes active during certain times of the day. On that basis, if we allowed 2kHz for PSK, 2 kHz for general RTTY, 2kHz for Olivia and 2kHz for JS8Call we should then set aside ~8 kHz for general data traffic on the band.

All up, this paints a picture of data demand of ~30 kHz of general demand for data spectrum per band. (note this is not considering the temporary high demand situations created during contests).

That is a far cry from what is currently available on 40m, especially given that on a harmonised basis, only 16 kHz is notionally available across all three regions. (and that is considering the global FT8 channel notionally harmonised by default, despite not being included in the IARU band plans at this time).

Stage 2 - CW and SSB Capacity Assessment

Assessing the capacity requirements of each of these modes is somewhat more difficult. The traffic is completely ad-hoc and isn't generated by a "channelised" access mechanism (unlike data modes such as WinLink and WSJT).

[1] https://www.winlink.org/RMSChannels?qt-live_winlink_information=1#qt-live_winlink_information

To overcome the problem, the method chosen for this estimation was to look at the proportion of activity being logged on each mode in Clublog[2]. From the statistics available, the following can be derived:

Mode	Clublog activity proportion	Bandwidth required for 1 transmission
CW	15%	400 Hz
SSB	13%	3000 Hz
FT8	60%	50 Hz [3]
FT4	7%	83.3 Hz [3]
Data (other)	5%	400 Hz

Using these percentages and bandwidths, a proportional allocation of spectrum can be calculated based on activity for each mode.

Overall Spectrum Demand by Mode – 40m

Taking the traffic estimations for all modes above, including the typical required occupied bandwidths, a derivation of what is a fair proportion of the spectrum for each mode can then be devised:

Mode	Clublog Measured Activity Factor	Channel Bandwidth Required	Bandwidth adjusted Activity Factor %	Calculated 40m Band Spectrum Allocation by Mode	40m Band Proposed Allocation by Mode
CW	15%	400 Hz	12%	24.2 kHz	25 kHz
SSB	13%	3 kHz	73%	146.8 kHz	145 kHz
FT8	60%	50 Hz	6%	12.1 kHz	30kHz (all Data)
FT4	7%	83.3 Hz	1%	2.8 kHz	
Data (other)	5%	400 Hz	2%	4 kHz	
Winlink [4]	NA	500-2700 Hz		10 KHz	

The interesting outcome is that the figure of 30 kHz of proportional capacity being made available for data modes in fact matches the earlier channel-based estimation. This adds weight to an argument that data modes are currently being starved of clean spectrum, which plays out as ongoing conflict and interference arising between data mode operators and other spectrum users.

Ultimately, this provides evidence that the proportion of spectrum assigned today per mode category no longer reflect the proportion of activity types actually occurring on the band. It certainly presents a case for considering a rebalancing of how much spectrum is required for each mode.

[2] https://clublog.org/

[3] It is noted that these modes with their error correction can operate with overlapped transmissions, however for the purposes of this estimation, noting the channel demand described earlier, this model has used the bandwidth figure as an uncontested bandwidth use figure in a broader % occupancy figure to simplify the assessments.

[4] Winlink's spectrum estimation was described above based on registered stations not logged traffic, as Winlink does not have its traffic typically logged in Clublog.

Activity Position within the 40m band

Having reached the conclusion that rebalancing is required, then the issue to be tackled is how to align the spectrum for each activity. Specifically, what is the best way to arrange the spectrum usage in terms of minimising conflict between disparate modes particularly at usage borders.

Sime existing rules worth considering and continuing would be:

1) CW operation should always start from the bottom of the band. (This is a long-standing position that doesn't need to change)
2) SSB operation should always start from the top of the band – (again this is also a long-standing arrangement)
3) Data modes form the boundary between CW/SSB. The high spectrum utilisation, particularly of the primary FT8 calling channel, in fact acts today as a useful marker in many bands for the border between CW and other operating modes.

In addition, there are several problems that have always plagued band planning, specifically around how to manage transient high traffic periods caused by on air events (such as contests or DX-peditions to rare locations). These can be expressed as:

1) how to establish band segments that have room to dynamically flex their usage based on demand while minimising interference to other activities. For example, multiple times in a year, contest activity causes a significant peak in traffic on the band in the given mode being used by a particular contest, which invariably causes the mode to take up more spectrum that normal.

   Consider how intermittent high intensity use by one mode can be at least partially accommodated while not causing severe disruption to emergency communications activities (which are seen as one of the key drivers for regulators facilitating amateur radio's existence in the first place in many countries).

   a. the emergency communications perspective of this and the perception of the amateur service's ability to deliver on that capability is a factor here. For example, when considering WinLink
      i. it is a technology that has been demonstrated to provide great value in handling emergency communications traffic,
      ii. it is at times difficult to deploy for such uses on the amateur bands because every weekend contest activity comes along and interferes with Winlink gateway stations
      iii. the amateur service is therefore at risk of being overlooked by some jurisdiction's authorities for providing EmComm capabilities because of the intra-service QRM

   b. positioning spectrum for WinLink and voice EmComm activity and incentivising contesters to leave that spectrum clear is an important element to consider when replanning the band

2) Given that SSB operation on the band typically has two distinct interest groups:
    a. local nets (utilising what is typically near vertical incidence (NVIS) or short haul type communications are a very popular uses of the band
    b. there is also a strong interest in DX use of the band

   one needs to be aware particularly on 40m that the stations operated by both groups are not of equal capabilities.

   The stations engaged in using near vertical incidence propagation to support local communications (<1000km) do not always have equipment designed to hear or contact weaker DX stations on the band. With activities such as contesting being DX focused, the inevitable complaints regularly arise that contest activity interferes with the who are interested in maintaining local communications.

3) The unfortunate position in the 40m band of the international FT8 calling channel (outside the defined IARU digital segments) has left a challenge for IARU. It would be highly desirable, moving forward, to have the FT8 traffic on the band contained within the data mode segments of the global band plans, not just that of one domestic country (i.e. USA). Having said that, it is also well understood that relocating the channel today will be nearly impossible.

Taking these considerations into account creates some complex competing challenges. The goal here, therefore, is to find a way to satisfy as many of these as possible.

40m Band Proposals

To start the discussion, three possible options have been developed for consideration. This doesn't mean these are the only options that could be considered, but in presenting these, the aim was to show how many of the objectives for capacity and placement could be met given different fundamental drivers.

Further, while are driven by different principles, it is worth noting that each of the options presented do maintain several common core goals:

1) Each mode category is entitled to having a segment of the band dedicated to that activity (CW, Voice and Data)
2) Consideration of where to place EmComm type traffic in an attempt to limit the risk of QRM from other amateur activity

Option A – Evolution with a fairer proportional allocation by activity

The main element of Option A is that it was modelled on the traditional approach to band planning, where the band is organised in on the existing CW, then data, then voice structure, but used the proportional spectrum quantities described above as the foundation for a new plan.

There are quite a few negatives however with this plan. In particular

a. the CW mode could be perceived to be disadvantaged (even though based on activity it could be argued that it has too much spectrum allocated to it today).
b. It doesn't resolve the problem of the FT8 centre of activity sitting outside of the data segment (and fails to recognise the difficulties likely encountered in trying to move this activity)

c. It doesn't preserve parts of the spectrum for "variable dynamic use" to accommodate (and with the cooperation of the contest organisers potential containment of) contest activity
d. It doesn't provide a particularly palatable solution for EmCom service operators who will find most transient high load activity will likely continue to interfere with them.
e. It presents one of the more challenging existing use migration pathways for all users except CW.

The one thing Option A did achieve was to be an evolutionary path from where the current band plans are today.

Option B – Revolution and accommodation of new requirements

Option B is very much revolutionary rather than evolutionary, and as such has taken a very different approach to band management> It has a different emphasis placed on different outcomes.

What does Option B do:

a. It places the data band anchored to the position of the current WSJT-X call channel on 7074 in the same way it is placed on 20m (i.e. data starts at x.070).
b. The challenge of how to manage overlapping interference and disruption to EmComm activity by contesting has been in part tackled by suggesting contest segments for CW extend up to 7070 when CW needs more room, Data modes extend down from 7090 to 7025 when data contests need more room, and SSB contests stay above 7110 kHz as much as possible.
    i. This only works, however, if the major contests are also prepared to cooperate and provide incentives for contest activity to not take place in the EmCom band segments (i.e. by providing zero points for QSOs made in those bands or even going as far as issuing disqualifications for operating on those frequencies).
c. The proposal accepts the fact that one of the high population areas (the USA) suffers from some restrictive regulations imposed by the FCC that otherwise make harmonised global band planning extremely problematic (i.e. at least partially align the IARU band plan in a way that accommodates the FCC restrictions).
d. The proposal seeks to address the complaints often heard from voice net and local chat focused band users that contesters overrun their favoured band segments disrupting their activities. They would be given priority access to the SSB spectrum at the lower end of the band, leaving the DX and contesting activity at the higher end of the band.

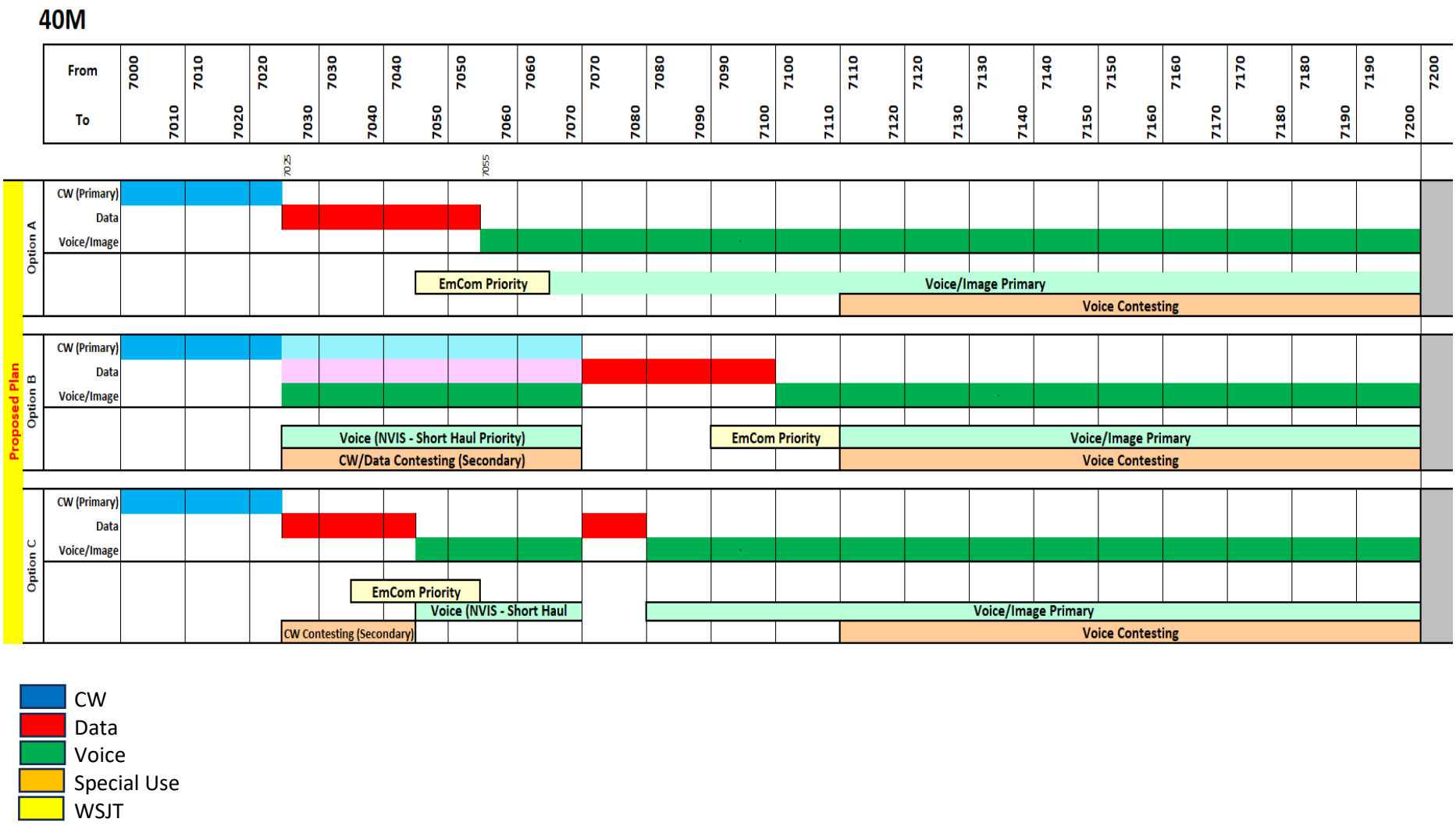
The obvious problem with Option B is going to be:

1) Education will be required for the SSB ops currently using 7080-7100

2) The WinLink folk operating above 7100 in the USA will need to be encouraged to move down into 7090-7100 (now that the data bandwidth limitations have been removed in that jurisdiction it is thought this is now possible)

IARU would also need to work with major contests to ideally see them enact penalties within the contest rules (e.g. disqualification or earning zero points for such contacts) for operating outside the contest band segments per mode. This is needed to help better protect EmCom activities within the amateur service, not only on 7MHz but in fact on many bands.

Options for the 40m Band Plan



CW
Data
Voice
Special Use
WSJT

Option C – Split Data Band Proposal

Option C is more about adopting the status quo into the band plan, while balancing the amount of allocated spectrum based on mode activity demand.

What does Option C do:

a. It accommodates the existing WSJT activity

What Option C does not do:

a. Provide any dynamic spectrum access options
b. Promote large enough coherent spectrum blocks for each activity. Wrapping the band plan around the existing activity does not solve the identified problems that the existing activity is generating.

Next Steps - Feedback Sought

To progress the discussion, feedback is invited on this consultation.

To assist with this process, please particularly consider the following questions:

Q1. Do agree that there is merit in seeking to globally harmonise the amateur service 40m band plan?

Q2. Do you agree with the way the different quantities of spectrum for different modes has been determined? If not, please suggest alternative models that can be considered for making the assessments.

Q3. Do you agree that more should be done to protect EmComm frequencies particularly from contest activity?

Q4. Do you agree that the proposals to separate out contesting and other traffic types are suitable and would be acceptable to contest organisers?

Q5. Do you see merit in separating DX SSB activity from local communications activity (including local nets) etc?

Q6. Do you consider it appropriate to consider the “SSB” segment as a “Voice” segment, and thus in the future when digital voice modes become more prevalent, that they should rightly belong in the SSB segment alongside SSB operators, or is there a need to consider a separation of the “Voice” segment into analogue and digital voice?

Q7. Do you think the band plan should be more or less prescriptive about individual sub-modes within an operating category? (i.e. should the band plan specifically separate/designate WSJT, PSK, RTTY, Winlink and other data communications types?) Or is sufficient to name it the data sub-band, perhaps with a couple of indicative centres of activity for core activities named?

Q8. Is there anything else you would like to comment on regarding this discussion paper or other concepts or ideas that haven’t been mentioned that you feel should be considered?

Next Steps

Making changes to a band plan is always a complex problem to solve. Multiple groups need to be provided the opportunity for input and many views need to be considered.

For this proposal to proceed, the following steps have been proposed:

1. The IARU Region 3 member societies are asked to also circulate this among their members and form individual society views which should be communicated back to the IARU Region 3 HF Band Plan committee for consideration by the consultation deadline
2. IARU Region 3 invites IARU Region 1 and 2 to form a joint multi-region committee to progress this matter as a global IARU initiative.
3. A final multi-region proposal should be submitted for consideration by the IARU-AC and the AC be asked to determine the most appropriate pathway for ratifying the changes on a global basis that where possible avoids the delay of a further 3 year regional conference cycle.

This preliminary consultation process for step 1 is now open.

10 weeks will be provided for comment, with the intention that the first formal proposal can then be formulated in time for presentation at the IARU Region 3 conference later in 2024.

If you wish to provide feedback on this consultation, please send your comments addressing the consultation questions to:

tac@wia.org.au no later than 6th September 2024.