

**An Analysis of the Threat to  
Amateur Radio Spectrum  
(222 to 3500 MHz)  
Presented by  
The National Broadband Plan (NBP)  
Together With  
Proposed Strategies and Arguments  
to Protect  
Amateur Radio Spectrum**

**A Preliminary Report  
to the  
ARRL Board of Directors**

**July 1, 2011**

**By the ARRL NBP Committee:**

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# Chapter 1

## Introduction

In early 2009, Congress directed the FCC to develop a National Broadband Plan (NBP) to ensure every American has “access to broadband capability.”<sup>1</sup> In less than a year, pursuant to that directive from Congress, FCC developed and released the NBP to Congress. It is now slightly more than a year old.

The NBP, among other things, calls for the reallocation of 500 MHz of spectrum for broadband use, principally mobile broadband. The first 300 MHz, which will include spectrum in approximately the 222-3700 MHz band, would be made available within 5 years of the date of the NBP, and the remaining 200 MHz within 10 years of the date of the Plan.

Amateur Radio has allocations in seven bands comprising 389 MHz in the aggregate within the initially targeted segment of 222 MHz to 3700 MHz.

This Committee was created pursuant to Minute 40 of the January 2011 Meeting of the ARRL Board of Directors.

The Board resolution directed the Committee to:

1. Assess the current threat levels to Amateur Radio spectrum at 222-225 MHz, 420-450 MHz, 902-928 MHz, 1240-1300 MHz, 2300-2310 MHz, 2390-2450 MHz, and 3300-3500 MHz;
2. Develop arguments and recommend to the Board strategies to protect these bands; and
3. Submit a preliminary report to the ARRL Board by July 1, 2011.

This Initial (preliminary) Report provides the Committee’s assessment of the general threat to Amateur Radio spectrum from the National Broadband Plan, as well as an analysis of specific threat to each Amateur Radio band within the initially affected spectrum. The Committee will propose arguments and recommend strategies to protect these bands in our next report to the Board, which is anticipated to be prepared by the end of 2011.

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<sup>1</sup> See, Section 6001(k) of the American Recovery and Reinvestment Act of 2009, Pub. L. 111-5 (2009).

## Chapter 2

# Executive Summary

### 2.1 Background

The Federal Communications Commission, in response to an explicit mandate from Congress, developed a National Broadband Plan (NBP). In March of 2010, less than one year after receiving the mandate, FCC delivered the Plan to Congress. The NBP, among other things, calls for the reallocation of 500 MHz of spectrum currently assigned to private and governmental use to broadband, principally, but not exclusively, mobile broadband within ten years of the date of the NBP. The initially affected spectrum segments are between 225 MHz and 3700 MHz. The first 300 MHz are to be made available within 5 years and the remaining 200 MHz within the ensuing 5 years. More than a year of the ten year time frame has already elapsed.

The NBP, which proposes “to unleash spectrum and the opportunity of broadband” has already received the enthusiastic support of the Executive Branch and Congress. Congress was ready to pass legislation to inventory and evaluate spectrum use, (preparatory to broadband reallocation of large blocks of spectrum now assigned to various radio services) more than a year ago (H.R. 3125). The only reason Congress deferred action was because FCC promised to undertake the spectrum assessment directed in the bill without a further congressional mandate. The inventory provision is included in the NBP.

ARRL has been advised that Amateur spectrum has been carefully included in FCC’s inventory, conducted as part of the NBP. Six Amateur bands totaling 389 MHz fall within the initially targeted spectrum. Each of these bands is more or less at risk of reallocation, though the degree of risk varies greatly for technical and other reasons, some of which are still in flux.

The White House’s National Economic Council has called this expansion of wireless broadband connectivity a “national imperative” over the next 10 years. Wireless advocates currently have “center stage” and hold the microphone in this discussion. CTIA, “The Wireless Association”™, a principal spokesman for the wireless and mobile broadband industry, has estimated that the need will be closer to 800 MHz in order to keep pace with the demand for smartphones, tablet computers and new wireless devices. These devices are spectrum intensive and use from 20 to 120 times the bandwidth utilized by cell phones. As the capabilities of these devices expand we can fairly assume their demand for RF spectrum will expand accordingly. While there are alternatives to increases in spectrum allocations for mobile broadband, such as substantially increased physical infrastructure, infrastructure buildouts are not viewed as a feasible alternative to the allocation of an additional 500 MHz of spectrum in the near term.

President Bush had, as a principal goal of his administration, the provision of universal broadband by 2009. That goal was obviously not realized and certainly not realistic.

However, the present Administration has taken the matter several steps further. President Obama, in June of 2010, stated that:

America's future competitiveness and global technology leadership depend, in part, upon the availability of additional spectrum. The world is going wireless, and we must not fall behind....This new era in global technology leadership will only happen if there is adequate spectrum available to support the forthcoming myriad of wireless devices, networks, and applications that can drive the new economy. To do so, we can use our American ingenuity to wring abundance from scarcity, by finding ways to use spectrum more efficiently. We can also unlock the value of otherwise underutilized spectrum and open avenues for spectrum users to derive value through the development of advanced, situation-aware spectrum-sharing technologies.

Congress is viewing additional broadband allocations as a method of achieving economic prosperity in the United States, and as well a source of auction revenues for deficit reduction. The Executive Branch is in complete support of allocation of spectrum for wireless broadband, and the FCC is following those cues. This can be viewed as a "perfect storm" of an environment for reallocation of spectrum. The unprecedented NBP plan, already adopted as policy by the Executive and Legislative branches of government, presents a previously unseen challenge not just to Amateur Radio spectrum allocations, but to allocations of some of our long time allies and spectrum allocation partners as well.

Military and other government usage has been untouchable (or nearly so) in the past. Amateur allocations in the initially targeted spectrum range are most often secondary to military and other government allocations. This arrangement has worked well, as our spectrum usage, though different, is generally compatible with military and governmental use. NTIA has confirmed that compatibility.<sup>2</sup> That safe haven no longer exists. NTIA, the government equivalent of FCC, has initially identified large segments of currently assigned military and other government spectrum as candidate spectrum for the NBP. That spectrum includes bands assigned for military, NOAA, satellite and Homeland Security purposes.

Broadband equipment manufacturers, service providers and their supporters assert that the auction of 500 MHz of spectrum is necessary to satisfy a demonstrated and quantifiable need for additional mobile broadband spectrum. They claim that mobile broadband service will efficiently utilize spectrum (to a far greater extent than is now the case in deployed spectrum), and the process will generate much needed government revenue. As a non-commercial service, the value of Amateur Radio has been in

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<sup>2</sup> In the *Spectrum Allocation Final Report* of NTIA (February 1995) released in response to Title VI of the Omnibus Budget Reconciliation Act of 1993, NTIA stated at Appendix B of that Report that: "The amateur radio service has successfully coexisted with Federal fixed, mobile and radiolocation services (i.e. radar) for nearly fifty years. As indicated in many of the public comments on the Preliminary Report and the FCC NOI, this sharing has been successful for both Federal and amateur spectrum users. This success is primarily due to the fact that much of the Federal spectrum usage is located away from populated areas, minimizing potential interference as well as the amateurs' ability to utilize the guard bands placed between different types of Federal services. ...Recently, amateurs have indicated that there are practical problems sharing spectrum with commercial services that have a relatively high transmitter power, a high number of stations in heavily populated areas, and/or high duty cycle[s]..."

experimentation, development of technical skills and provision of voluntary communications to governmental entities and charities in times of need, such as during the aftermath of disasters and emergencies. These are occasional applications, however, and not indicative of high levels of loading of the allocations. Our stock in trade has been the knowledge, skills and services provided. As such, the Amateur Service has not had a reason to maintain “time and billing” records of spectrum utilization, or of the value of Amateur spectrum uses to the public.

So long as the discussion of “unlocking the value of underutilized spectrum” or “wringing abundance from scarcity” is framed in purely economic terms, the very nature of the Amateur Service will continue to inhibit our ability to address FCC’s and industry’s assertions head-on. The substantial allocations (389 MHz to the Amateur Service) in the target spectrum when compared with the current allocations to Mobile Broadband could be viewed as disproportionate in the absence of compelling arguments as to the continuing value of Amateur usage, and the importance of maintaining those Amateur allocations in the overall broadband allocation scheme.

The supporters of the National Broadband Plan, and non-U.S. spectrum managers and administrations have also undertaken efforts to seek similar plans in International Spectrum allocations. The support of several administrations for a WRC-15 agenda item (including sufficient support in the Americas for a regional proposal) has been secured as the result of these efforts. Any assessment of the threat of Broadband to domestic allocations must also consider the threat internationally. It must include appropriate efforts to develop strategies and support for the defense and maintenance of amateur allocations in those venues as well as domestically.

## **2.2 A Summary of Specific Band Threats**

### **2.2.1 The 125 cm Band (222-225 MHz)**

The NBP threat for this allocation seems VERY LOW due to the antenna sizes required for efficient transmission in this band. As well, the small bandwidth available in this segment is not conducive to mobile broadband. The segment is not easily coupled with other nearby spectrum.

### **2.2.2 The 70 cm Band (420-450 MHz)**

The NBP threat for this allocation is MODERATE. While the contiguous 30 MHz bandwidth is attractive for broadband applications, the antenna sizes required for efficient transmission are problematic. The band is occupied by critical military radiolocation. The capacity of this band for signal penetration of structures, particularly in urban areas at these frequencies, are factors that make this band a candidate for mobile broadband reallocation.

### 2.2.3 The 33 cm Band (902-928 MHz)

The NBP threat to this allocation is LOW. The noise levels are very high throughout the entire band, due to extensive part 18 and 15 device deployments making repurposing of this band difficult.

### 2.2.4 The 23 cm Band (1240-1300 MHz)

The NBP threat to this allocation seems LOW TO MODERATE due to current allocations to Radionavigation Satellite Systems and other terrestrial services. Increased use by these primary users could, however, impact future amateur use of this band. These systems are already deployed and cannot be easily moved. Nevertheless, the amount of spectrum in this band, and its proximity to target bands already identified by NTIA for Fast Track broadband redeployment (i.e. 1675-1710 MHz and 1755-1780 MHz) creates a risk of reallocation. Amateur use of this band, other than the narrow segment near 1296 MHz, is believed to be very low.

### 2.2.5 The 13 cm Band (2300-2310 & 2390-2400 MHz)

These two bands must be viewed in terms of their various subband segments due to radically different risk factors.

2300-2305 MHz - The small size of this amateur allocation, coupled with the adjacent NASA Deep Space Network below 2300 MHz, suggest a RELATIVELY LOW threat. However, the FCC's decision to permit mobile as well as fixed Wireless Communication Service (WCS) operation in the 2305-2320 MHz band creates the clear risk of out-of-band emissions in this segment.

2305-2310 MHz - Since the allocation to the WCS, this segment has not been available to the Amateur Service to any substantial degree. It has been made available for broadband applications, and there does not exist much opportunity to recapture much utility in this band, though it is still nominally allocated to the Amateur Service. The marginal threat level is NOMINAL.

2390-2400 MHz - The threat to this band is VERY HIGH due to the level of amateur occupancy and the size of the allocation. It is below the 2400-2483.5 MHz ISM and Part 15 band and therefore is a low noise environment.

2400-2450 MHz - Current extensive embedded use by Part 15 and Part 18 devices in this segment would indicate that the threat of an NBP allocation is VERY LOW.

### 2.2.6 The 9 cm Band (3300-3500 MHz)

While there is a high level of military and government activity in this allocation, we can no longer rely on a primary military/government allocation for protection. The fact that NTIA is studying repurposing the entire 2700-3650 MHz federal allocation to non-federal use, and because this band is specifically listed on NTIA's Initial Candidate Band List for

broadband reallocation (and immediately adjacent to the 3500-3650 MHz “Fast Track” reallocation segment identified by NTIA) makes this an exceptionally high risk band for NBP reallocation. The threat to this band is assessed as EXTREMELY HIGH.

### **2.3 Initial Band Candidates that NTIA and the NBP Identified**

The following table is a slightly modified version of Table 2-1 in NTIA’s “Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband,” October, 2010, which lists a total of 2263.9 MHz of Spectrum which could be made available for mobile broadband and supporting fixed wireless broadband facilities. (The NTIA Plan and Timetable is included in the Reference Documents. See Appendix A, Document #2, page 7).<sup>3</sup>

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<sup>3</sup> The NTIA Plan and Timetable is a critical document; The Initial Candidate Band List contained therein is apparently the template currently used by FCC for assessing target spectrum for reallocation. More than that, however, the Plan and Timetable establishes an aggressive timetable for making the required 500 MHz of spectrum available for mobile broadband, and discusses “alternatives for legacy assignments of spectrum.” Therefore, the Plan and Timetable allows at least some assessment of the likelihood that NBP-displaced users (potentially including Federal users) may be re-accommodated in the future, possibly in Amateur allocations (though no such re-accommodation has been specifically proposed to date).



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(NBP highlighted in yellow; NTIA Fast Track Evaluation highlighted in green)

Usage	Frequency Band (MHz)	Bandwidth (MHz)	Current Allocation	Amateur Service
Broadcast TV	54-72 76-88 174-216 470-608 614-698	120	Non-Federal	
	406.1-420	13.9	Federal	
D-Block	758-763 788-793	10	Non-Federal	
	1300-1390	90	Federal	
MSS	1525-1559 1626.5-1660.5	40	Non-Federal	
MSS	1610-1626.5 2483.5-2500	10	Non-Federal	
	1675-1710	35	Fed/non-Fed Shared	
	1755-1780	25	Federal	
	1780-1850	70	Federal	
AWS 2/3	1915-1920 1995-2000	10	Non-Federal	
MSS	2000-2020 2180-2200	40	Non-Federal	
AWS 2/3	2020-2025	5	Non-Federal	
AWS 2/3	2155-2180	25	Non-Federal	
	2200-2290	90	Federal	
WCS	2305-2320 2345-2360	30	Non-Federal	2300-2310
	2700-2900	200	Federal	
	2900-3100	200	Fed/non-Fed Shared	
	3100-3500	400	Fed/non-Fed Shared	3300-3500
	3500-3650	150	Federal	
	3700-4200	500	Non-Federal	
	4200-4400	200	Fed/non-Fed Shared	
	4200-4220 4380-4400	40	Fed/non-Fed Shared	

## Chapter 3

# The General Threat from the NBP to the Amateur Service

### 3.1 The Political Climate

It is easy to perceive that the Federal Government is eager to allocate as much spectrum as possible for mobile broadband devices. On March 16, 2011, FCC Chairman Genachowski quoted President Obama as saying that high speed internet is essential to economic growth and global competitiveness. The administration's goal is to connect 98 percent of Americans to 4G. Genachowski said that of the three NBP goals that are on FCC's agenda, in order to align FCC policies with strategic goals, the FCC intends to "unleash spectrum and the opportunity of broadband." Spectrum, he said, is the "invisible infrastructure, and the oxygen that sustains mobile communications." In this type of political climate, which pits the public interest value of Amateur Radio (and its need for spectrum in the frequency ranges at issue) and other "traditional" users of wireless now occupying bands within and near the targeted segment of the radio spectrum against the perceived social and economic value of spectrum allocations for mobile broadband, Amateur Radio inevitably compares poorly. Skype, Facebook, Twitter and other social media that are used ubiquitously on mobile devices are becoming nearly universal. Amateur Radio is most certainly not universal. Its growth rate is pitifully small by comparison to the growth in demand for and use of mobile broadband. The political climate is also affected by the economic circumstances of the United States. Spectrum auctions have always been popular with administrations and in Congress. The "sale" and resale of the radio spectrum is a potentially huge deficit reducer. Auction of reclaimed spectrum will provide millions of dollars for constructing public safety broadband systems and for deficit reduction. Against this backdrop, maintaining the status quo of Amateur Radio allocations, because it provides no auction revenues for construction of broadband infrastructure or deficit reduction, compares poorly with reallocation of spectrum and auctions. See Section 3.3 below.

### **3.2 Spectrum Needs for Mobile Broadband are Quantifiable; Spectrum Needs of Amateur Radio Are Not; Nor is the Value of Amateur Radio Allocations Accurately Reflected in Terms of Band Loading.**

Smartphones, according to FCC, use twenty-four times the amount of data of traditional cell phones. Other wireless devices, like tablets, can use more than 122 times the data. The number of smartphones and tablets being sold now exceeds the number of PCs. The FCC and NTIA have data that establish that rising demand for mobile broadband devices and for higher speeds for those devices is rapidly outstripping the supply of spectrum available for them. There is data available that establish the increasing number of mobile and fixed broadband devices that require spectrum, and the extent of growth in short periods of time. Demand for spectrum to support that growth is easily calculated. While it is arguable that the raw numbers of mobile wireless devices does

not translate to a need for additional spectrum for such devices (because an alternative to such additional allocations is an increase in channel re-use resulting from additional infrastructure), the FCC's, Congress' and the administration's view is that additional spectrum is the only practical solution.

Because Amateur Radio is frequency agile; not channelized; and because band occupancy is variable and not easily monitored quantitatively, we have very little ability to document the intensity of use of the bands in the inventory range, as opposed to frequency-specific (i.e. channel or frequency assignment) services, which can more easily document the number of licenses issued and the number of transmitters per license authorized. So as a practical matter, we don't have much frequency loading data relative to what is available to Amateurs in any bands, and especially those above 148 MHz. This is, of course, a two-edged sword; if quantification of Amateur Radio spectrum needs were possible, the result of such a study may well work disadvantageously to the Amateur Service. See Section 3.3 below. One of the main recommendations of the NBP, however, is to create "methods for ongoing measurement of spectrum utilization." Because the value of Amateur Radio is not quantified in the same sense as is demand for new wireless spectrum, and because FCC is using a metric for comparing relative needs for spectrum largely in terms of intensity of loading, this works to Amateur Radio's detriment.

### **3.3 Amateur Radio Spectrum is Arguably Used Inefficiently and Produces no Government Auction Revenue**

Arguably, Amateur spectrum above 148 MHz is used inefficiently. That has been in the past something that we could "get away with," but no longer. There are large swaths of spectrum which lie fallow most of the time, and much of it is used for narrowband analog emissions, while mobile broadband spectrum is obviously used far more efficiently.<sup>4</sup> Amateur bands between 225 MHz and 3.7 GHz permit extensive frequency re-use, but the level of use of the bands (or at least portions of the bands) is not high above 148 MHz. All commercial spectrum assignments are now required under the Communications Act of 1934 to be subject to competitive bidding (auctions). That does not apply to the Amateur Service. Therefore, Amateur spectrum provides no auction revenues to offset the present budget deficit. Allocation of additional spectrum from Amateur Radio to Broadband provides potentially billions of dollars for the Federal treasury.

### **3.4 There is a Disproportionate Amount of Spectrum Allocated to the Amateur Service Relative to that Allocated Now for Mobile Broadband, in terms of persons served**

There is, according to the NBP, approximately 528 Megahertz of spectrum now available for Mobile Broadband. The NBP proposes to double this in ten years, and there are statistics in the NBP that indicate that this is a bare minimum in terms of the exponential

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<sup>4</sup> This is obviously true when one considers that there is now approximately 528 MHz of spectrum available for mobile and fixed wireless broadband, serving many millions of mobile broadband users. By contrast, some of the 700,000 Amateur Radio operators licensed by the FCC make some use at some times of some days of the 389 MHz of spectrum allocated to them in the 222-3700 MHz segment.

growth in mobile wireless spectrum demand. In the bands in which 300 of this additional 500 megahertz are to be reallocated in the next five years, the Amateur Service has available to it 396 Megahertz of spectrum. Not all of this Amateur spectrum is usable, but it is a large amount when one considers the number of persons served in the United States by broadband and the number of persons in the United States using the Amateur spectrum in this range. Most heavy Amateur operation takes place outside this frequency range, which relates to the inefficient use of the bands at issue.

### **3.5 The Federal Government, With Which Amateur Radio Shares Most Spectrum above 225 MHz, Is Having a Difficult Time Protecting Its Own Spectrum from NBP Reallocation**

The Federal government typically views Amateur Radio as a good sharing partner in most bands (see footnote 2 earlier). However, as is shown by the October, 2010 *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband* (Appendix A, Document #2), the Federal Government is having a difficult time keeping what is allocated to them. Our contacts within the Department of Defense tell us that they are concerned that important Federal bands are going to be reallocated for mobile broadband. One might assume that if the Federal Government is forced to give up large chunks of UHF or low microwave spectrum, the Amateur Service has no sacred cows. NTIA has already identified 115 megahertz of spectrum held by the government for reallocation: 100 megahertz is currently used by DoD for radar systems and naval vessels, and 15 megahertz is used by NOAA for weather balloons and satellites. If spectrum used for those purposes is subject to reallocation, Amateur uses of spectrum will not be given much weight when deciding whether or not to reallocate it.

### **3.6 It is Not Only Direct Reallocation of Amateur Spectrum that Threatens Amateur Allocations**

Amateur allocations are potentially subject to the threat of direct reallocation of the bands between 225 MHz and 3.7 GHz and below and above that segment. Were that the only concern, The Amateur Service allocations between 222 and 3500 MHz do not appear in substantial jeopardy *in the near term*, inasmuch as only two are listed in the NTIA Initial Candidate Bands List. However, that is not at all the scope of the threat. There are also threats of adding broadband to Amateur allocations, which could have the effect of making those bands unusable or less usable. More likely, Broadband allocations in adjacent bands would add to the ambient noise levels within the Amateur allocations. *This has already occurred at 2300-2305 MHz*, the FCC changed the Wireless Communications Service (WCS) rules to permit mobile as well as fixed operations at 2305-2320 MHz and 2345-2360 MHz, and in so doing announced that the Amateur Service would simply have to accept whatever interference results from the out-of-band emissions (OOBE) suffered at 2300-2305 MHz. FCC has taken the position (i.e. simply assumed) that Amateurs can live with this noise increase by, for example, rotating antennas away from the source of the noise (placing the interference resolution burden on the incumbent rather than the newcomer). The Commission may also assume that RF sensing technology will work in Amateur allocations; of course it does not, at least with respect to the weak-signal operations in the Amateur bands.

The NBP suggests that there should be relocation of incumbents as part of this process. It may be that the Amateur Radio Service could be relocated involuntarily and potentially to another band that is less desirable for whatever reason than the incumbent band.

Finally, there is a recommendation in the NBP that users of spectrum should have to pay a “spectrum fee” to the Government, or for spectrum that is being used by others, in lease fees for such use. While the Amateur Service has never had to pay for access to spectrum in the past, and because such a noncommercial service has no way to pay for such access, desperate times call for desperate measures.

### **3.7 The NBP has Resulted in an International Effort to Duplicate it or to Create Similar Plans Internationally, Thus Creating International Spectrum Threats due to Worldwide Markets for Mobile Broadband Products**

If international spectrum decisions are made that compromise or usurp Amateur Radio spectrum allocations in the United States, the current domestic allocation status of Amateur allocations becomes even more difficult or impossible to maintain. It is well-known now that in Europe and in other parts of the world, there is interest in making additional spectrum available for worldwide deployment of mobile broadband devices. Just as an international allocation for Amateur Radio is far more beneficial than is a United States allocation standing alone, International decisions that could lead to worldwide markets for mobile broadband devices are far more of a threat than is the NBP standing alone, because the market for mobile wireless devices is by necessity a worldwide market.

### **3.8 Generalized Reasons for Optimism About Amateur Spectrum Allocations in the Face of the NBP**

#### **3.8.1 Amateur Radio Allocations, with but one notable exception and one minor exception, have been left off NTIA’s October, 2010 *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband and None is included in NTIA’s “Fast Track” List of Allocations for Immediate Reallocation***

NTIA’s Plan and Timetable Study identified 2,263.9 Megahertz of Federal and Non-Federal spectrum that the NTIA and FCC consider prospects for “repurposing” for broadband use. This includes all of the broadcast television VHF and UHF channels at the lower frequency range and 4400 MHz at the top of the range. In this list, there are bands adjacent to Amateur Radio allocations, but there is only one band allocated to Amateur Radio (the 3100-3500 MHz band is listed as a candidate band by NTIA, within which the 3300-3500 MHz Amateur allocation is located) that is included in its entirety. A portion of one other (the 2305-2320 MHz WCS band) is listed as well. This is the upper half of the Amateur 2300-2310 MHz band. (The reason that 2305-2310 MHz is viewed as a minor issue is that the utility of that segment for Amateur Radio ebbed when the segment was made available on a primary basis for WCS before the first auction of the 2305-2320 MHz band years ago).

NTIA identified several bands, totaling 300 MHz, for “fast track” reallocation (1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, 4200-4220 MHz, and 4380-4400 MHz). Of these bands, none threatens directly an Amateur allocation. However, the 3500-3650 MHz band is directly adjacent to the Amateur 3300-3500 MHz allocation, which is on the NTIA Candidate band list.

Because the FCC seems to utilize the NTIA Candidate Band List as a template for broadband reallocation spectrum, non-inclusion on that list is, at least for the short term, a positive for the Amateur Service. It is suggested that this list could be changed or updated by NTIA, or simply not adhered to by FCC in the future which makes a definitive threat analysis somewhat tentative and valid for only a single point in time.

### **3.8.2 Most Amateur Allocations in the Frequency Range initially under Study are Shared with Federal Services, Making Them Unsuitable for Mobile Broadband.**

As noted above, the most frequent sharing partner in Amateur allocations above 225 MHz is the Federal Government. Some bands, such as 420-450 MHz, which contains Pave Paws and other military radars, seem to be less susceptible to reallocation from mobile broadband due to the important national security components of that Federal use than are others.

### **3.8.3 Some Amateur Allocations are not large enough to be well-suited for broadband applications; Some serve as *de facto* “Guard Bands” for other services, and some larger Amateur allocations are Part 15/Part 18 bands, making them unreliable for Mobile Broadband Applications.**

There is a strong preference in the NBP for large segments of contiguous spectrum. FCC is currently planning to repack the broadcast television band so as to achieve at least 120 Megahertz of contiguous spectrum. Adding mobile broadband to the MSS bands between 1990 and 2025 MHz is another high-priority plan. Segments much narrower than 10 megahertz are less attractive for broadband reallocation. Recommendation 5.11 of the NBP is that within the next ten years, the Commission should free up a nationwide, contiguous band for unlicensed use as part of the mobile broadband infrastructure and for development of new systems.

Several of the Amateur bands that are otherwise potential candidates for reallocation may not be large enough to be commercially auctionable, or otherwise too narrow to provide throughput speeds necessary for 4G and other mobile broadband service, though a thorough evaluation of the threat should include evaluation of the status of the bands adjacent both up and down in frequency to the Amateur allocation, to see what might be aggregated for broadband reallocation purposes.

## Chapter 4

# Band Specific Threat Assessments

The criteria used by the Committee for evaluating threats to individual Amateur bands may not have been exhaustive and this portion of the Committee's interim report may be subject to supplementation as the Committee's work progresses. However, relevant criteria used to date in preparing these band-by-band threat analyses included the following:

1. Inclusion or omission of the Amateur band and adjacent bands in the NTIA's Initial Band Candidate List and/or the NTIA Fast Track list.
2. Status and priority of sharing partners in existing Amateur bands.
3. Size of band available for reallocation.
4. Suitability in terms of propagation and equipment configuration for mobile broadband deployment.

We did not utilize Amateur Radio occupancy of the subject bands as a criterion for the threat analysis. Frankly, the extent of Amateur occupancy of a given band is not viewed as relevant to whether or not the band is subject to reallocation for mobile or fixed broadband use. Amateur occupancy of a given band may be more relevant to identification of strategies to retain the band than to an assessment of the threat level.

## 4.1 The 125 cm Band, 222 – 225 MHz

The 125 cm amateur band is technically outside (but adjacent to) the 225 – 3,700 MHz spectrum identified in the FCC’s NBP as the range of study for reallocation of 300 MHz within the next five years. It is therefore prudent to include this band in the study due to this proximity. The 125 cm amateur band was initially allocated to the Amateur Service at 235-240 MHz on Mar. 1, 1946. This was stated to be an “interim” band, as ultimately the FCC planned to move the hams to 220-225 MHz. The 220-225 MHz band was authorized by the FCC on Apr. 28, 1948 with 235-240 MHz to be vacated by June 8, 1948. Little use of this band was made for Amateur Radio purposes, and the allocation status of the band was changed from Amateur exclusive to Fixed, Mobile and Amateur. On August 27, 1991, after contentious rulemaking culminating in a Court appeal of the decision by ARRL, the FCC removed the 220-222 MHz portion of the band from the Amateur Service and allocated it to the Fixed and Land Mobile Services, leaving the Amateur Service with three of the five Megahertz on a primary basis.

The land mobile two Megahertz segment was intended to be used for narrowband ACSSB land mobile operation, but that plan was never effectuated to any significant degree. There are now several licensees in the 220-222 MHz band. Amateurs have made slightly more use of the 222-225 MHz band than before, but it is still not heavily occupied.

The band is not targeted in any publications that the Committee has found for reallocation for mobile broadband. It is likely far too small to be of any interest in that respect.

Above 225 MHz, a large amount of spectrum is allocated to Government (i.e. military) fixed and mobile operation. This segment is not perceived to be vulnerable to reallocation, nor is the 220-222 MHz segment. For these reasons, the small band at 222-225 MHz is not likely to be reallocated for mobile broadband purposes.

### 4.1.1 The 125 cm Band Plan (adopted by ARRL BoD July 1991)

Frequency MHz	Bandwidth kHz	Amateur Use
222.000 – 222.150	150	Weak Signal Modes
222.000 – 222.025	25	EME (Earth-Moon-Earth)
222.050 – 222.060	10	Propagation Beacons
222.100		SSB & CW Calling Frequency
222.10 – 222.15	50	Weak Signal CW & SSB
222.15 – 222.25	100	Local Coordinator's option: weak signal, ACSB, repeater inputs and control
222.25 – 223.38	1,130	FM repeater inputs only
223.40 – 223.52	120	FM simplex
223.50		Simplex calling frequency
223.52 – 223.64	120	Digital, packet
223.64 – 223.70	60	Links, control
223.71 – 223.85	140	Local coordinator's option: FM simplex, packet, repeater outputs
223.85 – 224.98	130	Repeater outputs only



#### **4.1.2 NBP Threat Assessment – Specific to 125 cm Band**

The following reasons make the band undesirable for usage in the NBP:

- Large antenna size required for radiation efficiency
- Relatively small amount of spectrum (3 MHz)
- Close proximity to the heavily occupied Military UHF band (225-400 MHz)
- The band is not internationally allocated to the amateur service (Broadcasting in ITU Regions 1 & 3)

Desirable features of this band for NBP include:

- Low propagation loss; ease of building structure signal penetration
- Relatively low occupation by the amateur radio service (compared to 70 cm band)
- Band is not shared by any other service in the US (Amateur Radio is Primary)

The threat of losing this band to the NBP is assessed as VERY LOW.

## 4.2 The 70 cm Band, 420 – 450 MHz

The 70 cm amateur band existed pre-WWII as 420-450 MHz. On Jan. 16, 1946, the FCC authorized amateurs back in only the 420-430 MHz portion. It wasn't until June 11, 1947 that amateur radio was again authorized the full band, 420-450 MHz – where it remains today. This band enjoys a large amount of spectrum and a worldwide amateur allocation. It is therefore heavily populated by the amateur service with a wide variety of uses including FM and data repeaters, amateur satellite service, amateur television, and “weak signal” modes including EME. It is the most heavily used amateur band of the six under consideration.

The band is subject to a number of non-broadband threats, but it is not identified on the NTIA Candidate Bands List nor on the Fast Track reallocation list. It is perceived as being immune to reallocation threats despite its substantial size due to the use of the band for Pave Paws radars and for airborne radars used by Federal Government sources for drug interdiction.

That said, H.R. 607, without any apparent concern for current uses of 420-440 MHz, proposed the reallocation of that segment and auction for commercial purposes in exchange for allocation of the D-Block of 700 MHz spectrum to public safety. Given this, a mid-range threat level should be attributed to the 420-450 MHz band.

The very large adjacent band 406 to 420 MHz *is* on the NTIA Candidate Band list, though that band is subject to substantial international obligations as the result of Canadian and Mexican bilateral agreements, applicable especially near border areas. This fact might substantially constrain broadband deployment of the segment below 420 MHz. It is not anticipated that the 70 cm Amateur allocation will be subject to pairing with the 406-420 MHz segment, but such is not impossible. As to the segment immediately above, 450-470 MHz, this is very heavily used almost everywhere for business and industrial land mobile radio, public safety land mobile radio, for broadcast remote pickup operation, and for FRS and GMRS. That segment is not viewed as substantially vulnerable to broadband reallocation either, though, again, it was included in H.R. 607 with apparent impunity.

The band 420-450 MHz has recently been the subject of domestic regulatory action permitting Wind Profiler radars and ReconRobotics video transmitters for public safety use. It is proposed for use by wireless medical implant devices, which, ironically, could contribute to its immunity from consideration for broadband reallocation.

#### 4.2.1 The 70 cm Band Plan (general recommendation)

Frequency MHz	Bandwidth kHz	Amateur Use
420.00 – 426.00	6,000	ATV repeater or simplex with 421.25 MHz video carrier, control links and experimental
426.00 – 432.00	6,000	ATV simplex with 427.25 MHz video carrier frequency
432.00 – 432.07	70	EME (Earth-Moon-Earth)
432.07 – 432.10	30	Weak Signal CW
432.100		SSB & CW Calling Frequency
432.10 – 432.30	20	Mixed mode and weak signal work
432.30 – 432.40	10	Propagation Beacons
432.40 – 433.00	600	Mixed mode and weak signal work
433.00 – 435.00	2,000	Auxiliary/repeater links
435.00 – 438.00	3,000	Satellite only (internationally)
438.00 – 444.00	6,000	ATV repeater input with 439.250 MHz video carrier frequency and repeater links
442.00 – 445.00	3,000	Repeater inputs and outputs (local option)
445.00 – 447.00	2,000	Shared by auxiliary and control links, repeaters and simplex (local option)
446.00		National simplex frequency
447.00 – 450.00	3,000	Repeater inputs and outputs (local option)

#### 4.2.2 NBP Threat Assessment – Specific to 70 cm Band

The following reasons make the band undesirable for reallocation for mobile broadband usage:

- The relatively large antenna size required for radiation efficiency burden handheld devices.
- Shared with many important and expensive military RADARS in the US.
- Highest occupation by the amateur radio service of all the amateur bands in the 222-3500 MHz spectrum.
- The band is allocated to the Amateur Service worldwide on a shared basis with fixed and mobile, and radiolocation.
- 435-438 MHz World-wide allocation for Amateur-Satellite Service
- 430-440 MHz International allocation for Amateur service
- Intense land mobile use of the 450-470 MHz adjacent to the 70 cm band

Desirable features of this band for broadband reallocation include:

- Relatively large amount of spectrum (30 MHz).
- Low propagation loss; ease of building structure signal penetration. The adjacent 406.1-420 MHz band is on the NTIA initial candidate band list

The threat of reallocation of this band (or some portion of it) for broadband use is MODERATE.

## 4.3 The 33 cm Band, 902 – 928 MHz

The 33 cm allocation of 902-928 MHz to the US amateur service occurred on September 28, 1985. It is a large amount of spectrum – all shared by a myriad of FCC Part 15, Part 18 devices including microwave ovens and other ISM applications, and Part 90 Location Monitoring Service (LMS). LMS has not, however, been popular and is minimally deployed in this band. The band is lightly populated by the amateur service with a few amateurs conducting weak signal experiments. Some FM repeaters are located in populated areas, and a bit of Amateur television. The sharing of this band with the ubiquitous part 15 emitters has limited amateur usage of the band to date. It is in the truest sense of the word a “junk band”. The lack of an international allocation to the Amateur Service has stifled EME communications in the band, but that has also contributed to a relative absence of commercial products for use in the band as well, other than Part 15 devices.

The band is not listed in the NTIA Candidate Band list or the Fast Track list, and because of exceptionally high noise levels and pervasive embedded Part 15 RF devices, the band is not perceived to be of substantial interest for broadband reallocation. The “tragedy of the commons” is applicable to this band in terms of the ambient man-made noise levels there.

### 4.3.1 The 33 cm Band Plan (adopted by ARRL BoD July 1989)

Frequency MHz	Bandwidth MHz	Amateur Use
902.00 – 903.00	1	Weak signal
902.100		Calling Frequency
903.00 – 906.00	3	Digital
903.100		Alternate Calling Frequency
906.00 – 909.00	3	FM repeater inputs
909.00 – 915.00	6	Amateur TV
915.00 – 918.00	3	Digital
918.00 – 921.00	3	FM repeater outputs
921.00 – 927.00	6	Amateur TV
927.00 – 928.00	1	FM simplex and links

#### **4.3.2 NBP Threat Assessment – Specific to 33 cm Band**

The following reasons make the band undesirable for broadband reallocation:

- The band is not internationally allocated consistently (Fixed, Mobile, and Broadcasting in ITU Regions 1 & 3)
- Very high occupation by FCC part 15 and 18 devices in the US

Desirable features of this band for broadband reallocation include:

- The relatively small antenna size required for radiation efficiency is adequate for handheld devices.
- Relatively large amount of spectrum (26 MHz).
- Reasonable propagation loss and signal penetration of building structures (near the old analog cellular telephone spectrum).

The threat to this band (or some portion) for mobile broadband is assessed as LOW.

## 4.4 The 23 cm Band, 1240 – 1300 MHz

The 23 cm band, originally 1215-1295 MHz, was allocated to the amateur service effective Jan. 16, 1946. On Apr. 28, 1948 the FCC expanded the band to 1215-1300 MHz. As a result of WARC-79 reallocations, the FCC removed the lower 25 MHz from the Amateur Service. This was to provide spectral space to protect emerging NAVSTAR/GPS systems. Effective late in 1983, the FCC reduced the band to 1240-1300 MHz where it remains today.

This band has not been listed on the NTIA Candidate Band List, nor is it on the Fast Track list. However, the 1300-1390 MHz adjacent band is listed on the NTIA Candidate Band list.

### 4.4.1 The 23 cm Band Plan (adopted by ARRL BoD Jan. 1985)

Frequency MHz	Bandwidth kHz	Amateur Use
1240 – 1246	6,000	ATV #1
1246 – 1248	2,000	Narrow-bandwidth FM point-to-point links and digital, duplex with 1258 – 1260
1248 – 1252	4,000	Digital communications
1252 – 1258	6,000	ATV #2
1258 – 1260	2,000	Narrow-bandwidth FM point-to-point links and digital, duplex with 1246 – 1248
1260 – 1270	10,000	Satellite uplinks, experimental simplex ATV
1270 – 1276	6,000	Repeater inputs, FM and linear, paired with 1282 – 1288 (239 pairs, every 25 kHz, e.g. 1270.025, 050, etc.)
1271/1283		Non-coordinated test pair
1276 – 1282	6,000	ATV #3
1282 – 1288	6,000	Repeater outputs paired with 1270 – 1276
1288 – 1294	6,000	Wide band experimental, simplex ATV
1294 – 1295	1,000	Narrow band FM simplex, 25 kHz channels
1294.50		National FM Simplex calling frequency
1295 – 1297	2,000	Narrow band weak signal (no FM)
1295.00 – 1295.80	800	STV, FAX, ACSSB experimental
1295.80 – 1296.00	200	Reserved for EME, CW expansion
1296.00 – 1296.05	50	EME exclusive
1296.07 – 1296.08	10	CW beacons
1296.100		CW/SSB calling frequency
1296.40 – 1296.60	200	Cross band linear translator input
1296.60 – 1296.80	200	Cross band linear translator output
1296.80 – 1297.00	200	Experimental Beacons (exclusive)
1297 – 1300	3,000	Digital Communications

#### **4.4.2 NBP Threat Assessment – Specific to 23 cm Band**

This band has been excluded from the United States proposal for a wireless broadband agenda item at WRC-15 because of the incumbent RNSS (Radio Navigation Satellite Service) allocation. The FCC is looking to harmonize allocations around the world, and this is a poor band because of RNSS use in systems such as Galileo, GLONASS, and Compass.

For the reasons stated above, the threat to this allocation by the NBP is LOW to MODERATE. Increased use by primary services is much more likely to impose constraints on amateur operation, but our Pave Paws experience indicates that damage can be contained to an acceptable level.

## 4.5 The 13 cm Band, 2300–2310 & 2390–2450 MHz

The 13 cm band from 2300-2450 MHz was originally allocated by the FCC to the amateur service on Nov. 15, 1945. As a result of WARC-79 reallocations, the FCC removed 80 MHz of the band from the amateur service for reallocation to aeronautical flight test telemetry in the 2310-2390 MHz band. Defense of this band segment was doomed when an ARRL plea in QST for amateurs using this portion of the band failed to produce a single response. In late 1983, the 13 cm amateur band became split into two segments: 2300-2310 & 2390-2450 MHz.

Subsequently, the 2305-2320 MHz and 2345-2360 MHz segments were reallocated for WCS purposes, and the 2320-2345 MHz band was made available for Satellite Digital Audio Radio Service (DARS), which is now exclusively Sirius-XM. Thus, the Amateur 2305-2310 MHz segment has very limited utility to Amateurs now.

There have been threats to the 2300-2305 MHz band recently, including suggestions by AFTRCC that Medical Body Area Networks (MBANS) that were proposed for 2360-2400 MHz should utilize 2300-2305 MHz instead, as well as 2390-2400 MHz. There were also suggestions that satellite location services could be located at 2300-2305 MHz. However, to date, that allocation remains exclusively available to Amateurs. The analysis below analyzes the broadband reallocation threat to this band in segments, as each segment in this band is, from a regulatory perspective, unique.

None of the segments analyzed below, ***save for the 2305-2320 MHz band*** is included in the NTIA Initial Candidate Band List, and none are included in the Fast Track reallocation list. We have no indication that any of the segments other than 2305-2320 MHz is the subject of any published threat of broadband reallocation.



**4.5.1 The 13 cm Band Plan (adopted by ARRL BoD Jan. 1991)**

<b>Frequency MHz</b>	<b>Bandwidth kHz</b>	<b>Amateur Use</b>
2300 – 2303	3,000	High-rate data
2303 – 2303.5	500	Packet radio
2303.5 – 2303.8	300	TTY, packet
2303.8 – 2303.9	100	Packet, TTY, CW, EME
2303.9 – 2304.1	200	CW, EME
2304.1 – 2304.2	100	CW, EME, SSB
2304.2 – 2304.3	100	SSB, SSTV, FAX, Packet, AM, AMTOR
2304.30 – 2304.32	20	Propagation beacon network
2304.32 – 2304.4	80	General propagation beacons
2304.4 – 2304.5	100	SSB, SSTV, ACSSB, FAX, Packet, AM, AMTOR experimental
2304.4		Calling frequency
2304.5 – 2304.7	200	Cross band linear translator input
2304.7 – 2304.9	200	Cross band linear translator output
2304.9 – 2305.0	100	Experimental beacons
2305.0 – 2305.2	200	FM simplex (25 kHz spacing
2305.2		FM simplex calling frequency
2305.2 – 2306.0	800	FM simplex (25 kHz spacing
2306 – 2309	3,000	FM repeaters (25 kHz ) input
2309 – 2310	1,000	Control and auxiliary links
<b>BREAK</b>		
2390 – 2396	6,000	Fast-scan TV
2396 – 2399	3,000	High-rate data
2399 – 2399.5	500	Packet
2399.5 – 2400.0	500	Control and auxiliary links
2400 – 2403	3,000	Satellite
2403 – 2408	5,000	Satellite high-rate data
2408 – 2410	2,000	Satellite
2410 – 2413	3,000	FM repeaters (25 kHz spacing) output
2413 – 2418	5,000	High-rate data
2418 – 2430	12,000	Fast-scan TV
2430 – 2433	3,000	Satellite
2433 – 2438	5,000	Satellite high-rate data
2438 - 2450	12,000	Wideband FM, FSTV, FMTV, SS experimental

## 4.5.2 NBP Threat Assessment – Specific to 23 cm Band

### 4.5.2.1 2300-2305 MHz Threat Assessment from NBP Implementation

Given the relatively small size of this band and its adjacency to the NASA Deep Space Network (DSN) below 2300 MHz, (which has been carefully protected by NTIA and FCC to date, partially because of the use of this band for the operation of interplanetary probes), it does not appear that there is a significant threat of reallocation of this band for broadband use. It does not appear in the NTIA's October, 2010 *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband*, Table of Initial Band Candidates (Table 2-1). It is therefore suggested that the threat of reallocation of this band for commercial broadband use and auction is RELATIVELY LOW. There is always the chance that the FCC will decide to include some or all of this band within the WCS band, however.

### 4.5.2.2 2305-2310 MHz Threat Assessment from NBP Implementation

The Commission has made much of the addition of mobile operation to the previously permitted fixed WCS operations, heralding the use of this band for broadband applications. Therefore, because the utility of this band for Amateur use was already very much compromised and because the FCC has already intensified the use of the band by facilitating mobile broadband use of it, it appears that there will not be any additional, marginal harm to the Amateur allocation, and it appears unlikely that this band will be re-auctioned in any case. Therefore, the marginal threat level to this band is now NOMINAL. This is true despite the fact that the entire WCS band is included as a candidate band in the NTIA's October, 2010 *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband*, Table of Initial Band Candidates (Table 2-1). The band is listed because the FCC was already considering adding mobile operations to the WCS band at the time the list was prepared, and it has now completed that action.

### 4.5.2.3 2390-2400 MHz Threat Assessment from NBP Implementation

The threat to this band from the NBP is VERY HIGH. The band has apparently quite low active use by radio Amateurs, so it is difficult to protect. There are effectively no other current users. Flight test telemetry is not used at 2390-2395 MHz now, and the band is of sufficient size as to cause it to be considered for broadband reallocation and auction. The band is not included as a candidate band in the NTIA's October, 2010 *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband*, Table of Initial Band Candidates (Table 2-1). There is now under active consideration a proposal to use the 2360-2400 MHz band for MBANS as discussed above. This proposal is likely to be effectuated, and if it is, it would be a likely (albeit ironic) defense to the reallocation of the 2390-2400 MHz band for broadband use. Since MBANS operation is not proposed as an alternative to Amateur Radio operation in the band, MBANS may be a strategic defense opportunity to offset an otherwise substantial risk to this segment.

#### **4.5.2.4 2400-2450 MHz Threat Assessment from NBP Implementation**

The threat level to this band is considered to be VERY LOW. The band, though exceptionally large, is nevertheless largely populated by unlicensed devices, Wi-Fi systems and Part 18 ISM equipment. The band is noisy. High-power (i.e. up to one watt for wide-bandwidth digital equipment) part 15 equipment is deployed extensively in this band, making the band unattractive for commercial broadband auction. This band is not included as a candidate band in the NTIA's October, 2010 *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband*, Table of Initial Band Candidates (Table 2-1).

## 4.6 The 9 cm Band, 3300 – 3500 MHz

The 9 cm band from 3300-3500 MHz was originally allocated to the amateur service effective September 30, 1946. In June 1958 the FCC changed the band from 3300-3500 MHz to 3500-3700 MHz. But then in early 1962, the FCC changed the band back to 3300-3500 MHz – where it remains to date. Amateur use of the band has been and is today primarily weak signal modes, some EME, and similar experimental work. It is the most lightly used band of the six under consideration.

It is also the most directly threatened of all of the Amateur allocations within the 222-3700 MHz band under consideration. The bands 2900-3100 MHz, 3100-3500 MHz and 3500-3650 MHz are specifically listed in the NTIA's October, 2010 *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband*, Table of Initial Band Candidates (Table 2-1) for reallocation. The band immediately adjacent to the 3300-3500 MHz segment is slated for Fast Track evaluation and reallocation.

### 4.6.1 The 9 cm Band Plan (adopted by ARRL BoD July 1988)

Frequency MHz	Bandwidth MHz	Amateur Use
3300 – 3456.3	156.3	No band plan
3456.3 – 3456.4	0.1	Propagation beacons
3456.4 – 3500	43.6	No band plan

### 4.6.2 NBP Threat Assessment – Specific to 9 cm Band

Except for continuation as a radar band, the 3400-3500 MHz is a fixed wireless access (FWA) candidate band.

**Potential Threats** (Source: Appendix A, Reference 4):

- NTIA Fast Track Evaluation: Make available 3500-3650 MHz for wireless broadband use on a shared basis, subject to certain exclusion zones.
- NTIA study for repurposing to exclusive or predominately non-Federal use: 2900-3650 MHz.

**Assessment:**

Given the degree of military and government activity within this spectrum, it has been unlikely for other threats (aside from more military and government users) to arise and potentially affect the 9-cm amateur band. Existing military and government users have effectively shielded the amateur spectrum from the proliferation of other threats, especially of the unlicensed variety. However given NTIA's Ten-Year Plan and Fast Track Evaluation, a real threat exists to the 9-cm band along with the aforementioned military and government use of the surrounding spectrum. The threat to this band is assessed as **EXTREMELY HIGH**.

## **Chapter 5**

# **International Broadband Plans – An Assessment**

### **Inter-American Proposals to a World Radiocommunication Conference**

Inter-American Proposals to a World Radiocommunication Conference are generated by the Second Permanent Consultative Committee (PCC.II) of the Inter-American Telecommunication Commission, (CITEL). At the May 16-20, 2011 PCC.II meeting in Santo Domingo, the United States' proposal for wireless broadband went over like a lead balloon, garnering the support of no other country.

A much simpler proposal (see below) achieved Inter-American status with the support of Argentina, Brazil, Canada, Costa Rica, Dominican Republic, Guatemala, Mexico, Uruguay, and Venezuela. There are both good and bad aspects to this proposal compared to what came out of the United States.

**XVII MEETING OF PERMANENT  
CONSULTATIVE COMMITTEE II:  
RADIOCOMMUNICATIONS  
INCLUDING BROADCASTING  
May 17 to 20, 2011  
Santo Domingo, Dominican Republic**

**OEA/Ser.L/XVII.4.2  
CCP.II-RADIO/doc. 2684/11  
19 May 2011  
Original: English**

**AGENDA ITEM 8.2: INTER-AMERICAN PROPOSALS FOR  
WRC-12**

**(Item on the Agenda: 3.1 (SGT4))**

**(Document submitted by the Coordinator)**

**SGT 4 - Future work programme and other issues**

**Coordinator:** Mr. Carmelo RIVERA, USA ([Carmelo.Rivera@noaa.gov](mailto:Carmelo.Rivera@noaa.gov))

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**Agenda Item 8.2:** *to recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, taking into account Resolution 806 (WRC 07)*

## **BACKGROUND**

Wireless broadband has helped provide more people in the world with higher data transmission speeds. It has also encouraged greater investment in telecommunication networks, serving as an economic trigger in most countries, especially the developing countries.

To facilitate the development of broadband wireless networks worldwide, ITU-R estimated 2015-2020 IMT spectrum requirements as 1280 MHz for developing countries and 1720 MHz for developed countries.

Moreover, standards now being developed for fourth generation IMT systems make provision for operation with 100 MHz channels in order to offer speeds of 1 Gbps.

The incorporation of direct inter-device communication is now reality in the mobile service and will enable far more data to be handled on these networks than is now estimated.

Therefore, it may be concluded that the spectrum now available will be insufficient to support the high data volumes estimated for 2015-2020. Accordingly, administrations signatories to this proposal consider it necessary for the next WRC to include as an agenda item for to undertake studies to determine the spectrum requirements to support IMT and other mobile broadband applications and technologies, and report the results of these studies to the next WRC for regulatory actions as required, including new allocations and identifications, taking into account sharing studies with existing radio services.

## **PROPOSAL**

**MOD** B/CAN/MEX/UR/GUAT/V/CR/DR/ARG/8.2/1

### **RESOLUTION 806 (Rev. WRC-12)**

#### **Agenda for the 2015 World Radiocommunication Conference**

The World Radiocommunication Conference (Geneva, 2012),

**Reasons:** To modify the agenda for WRC-15 to add a new item.

**ADD** B/CAN/MEX/UR/GUAT/V/CR/DR/ARG/8.2/2

2.3 to consider spectrum requirements and possible regulatory actions, including additional spectrum allocations to the mobile service on a primary basis to accommodate the development of IMT and other mobile broadband applications and technologies, taking into account the results of ITU-R studies, in accordance with Resolution [XXX] (WRC-12).

**Reasons:** This agenda item will provide an opportunity to determine the need for spectrum, and to identify suitable spectrum for the IMT and other mobile broadband systems, including through sharing studies of candidate frequency bands. The CITEL PCC-II proposes that the ITU-R undertake the studies called for in Resolution [XXX] below to determine the amount of spectrum needed to support the development of mobile broadband systems, including IMT, and report the results of these studies to the next WRC for its regulatory actions as required, including new allocations and identifications.

**ADD** B/CAN/MEX/UR/GUAT/V/CR/DR/ARG/8.2/3  
RESOLUTION XXX (WRC-12)

**Consideration of Spectrum Allocations and Regulatory Provisions for  
IMT and Other Broadband Applications and Technologies in the Mobile Service**

The World Radiocommunication Conference (Geneva, 2012),

*considering*

- a) that since WRC-07 there has been tremendous growth in the demand for mobile broadband applications with multimedia capabilities;
- b) that mobile broadband services constitute an essential contribution to worldwide economic and social development;
- c) that IMT and other mobile broadband systems could help reduce the digital divide between urban and rural areas, including underserved communities;
- d) that International Mobile Telecommunications (IMT) systems support broadband applications and a wide range of services and platforms;
- e) that IMT systems have been the main method of delivering wide area mobile broadband services;
- f) that Radio Local Area Networks (RLANs), support a wide range of mobile broadband applications in urban, suburban and rural areas;
- g) that through the use of mobile broadband services a range of applications can be supported, for example, Public Protection and Disaster Relief, smart grid and other utilities, machine to machine communications, education and health care, etc.;



- h) that additional spectrum is required to accommodate emerging demand and user requirements for terrestrial mobile broadband applications;
- i) that Resolution ITU-R 57 addresses the future development of IMT including the needs of developing countries in the development and implementation of mobile radiocommunication technology;
- j) that several of the bands identified for IMT are not consistent across the Regions or even in some cases within a Region, impacting adversely the harmonization and economies of scale for radio systems, especially consumer equipment;
- k) the need to implement regulatory provisions, due the lengthy intervals of time required between the regulatory provisions and the actual deployment of systems;
- m) that provision of mobile services, including broadband, by satellite is essential in remote areas,

*recognizing*

- a) that adequate and timely availability of spectrum and supporting regulatory provisions are essential to support future growth of IMT and other mobile broadband systems;
- b) that harmonized worldwide bands and frequency arrangements IMT and other mobile broadband systems are essential in order to achieve global roaming and the benefits of economies of scale,

*resolves*

- 1 to invite ITU-R to further study the technical and operational issues related to the future development of IMT and other mobile broadband applications and technologies in the mobile service, and develop recommendations as required;
- 2 to invite ITU-R to report, in time for WRC-15, on the results of studies on the spectrum requirements and potential frequency ranges suitable for future IMT identifications and the development of other mobile broadband applications and technologies in the mobile service, taking into account:
  - the evolving needs, including growth in demand for mobile broadband services and applications;
  - the evolution of spectrum efficient radiocommunication technologies, including IMT;
  - the particular needs of developing countries;
  - the time-frame in which spectrum would be needed;
  - sharing with other radiocommunication services in these frequency ranges,

*invites administrations*

1. to participate in the studies by submitting contributions to ITU-R;
2. to contribute proposals aiming at global harmonization of frequency bands to the maximum extent possible achieving global economies of scale for the deployment of

mobile broadband applications. In cases where global harmonization is not feasible, regional harmonization should be pursued.

**Reasons:** This agenda item will provide an opportunity to determine the need for spectrum, and to identify suitable spectrum for the IMT and other mobile broadband systems, including through sharing studies of candidate frequency bands. The CITEL PCC-II proposes that the ITU-R undertake the studies called for in Resolution [XXX] below to determine the amount of spectrum needed to support the development of mobile broadband systems, including IMT, and report the results of these studies to the next WRC for its regulatory actions as required, including new allocations and identifications.

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**Proposal:** CITEL PCC-II proposes that the ITU-R undertake studies to determine the spectrum requirements to support IMT and other mobile broadband applications and technologies, and report the results of these studies to the next WRC for regulatory actions as required, including new allocations and identifications, taking into account sharing studies with existing radio services.

**Background/reason:** Currently approximately 5 billion of the world's estimated 6.8 billion people are connected to global telecommunication networks via mobile terminals. Mobile telephony and mobile broadband demand and consumption have been growing at an unprecedented pace. Currently, 3G technologies are providing services to more than one billion subscribers worldwide and, by 2013, the number of 3G subscribers is projected to reach approximately 2.4 billion. Estimates of worldwide wireless data traffic indicate that it grew by 5,800 percent during the two year period from 2006 to 2008 with slightly decreased rate of 4,500 percent forecast over the next few years. Current projections indicate that by 2014 monthly worldwide mobile broadband data traffic will exceed the total broadband data traffic for all of 2008. One operator in the Region 2 reported in February 2010 that its mobile broadband traffic had grown more than 5,000 percent over the past three years. This strong demand creates an ever-expanding market for phones, smartphones, PDAs, tablets, e-readers, gaming devices, consumer electronics devices, and laptops.

In light of these developments, it is anticipated that the mobile data demand is likely to exceed capacity under current spectrum availability in the near-term, and that meeting this demand by making additional spectrum available is likely to create significant economic value. Preliminary analyses indicate that, in some countries in the Region 2, the mobile spectrum deficit is likely to approach 300 MHz by 2014.

This agenda item will provide an opportunity to determine the need for spectrum, and to identify suitable spectrum for the IMT and other mobile broadband systems, including through sharing studies of candidate frequency bands. The CITEL PCC-II proposes that the ITU-R undertake the studies called for in Resolution [XXX] below to determine the amount of spectrum needed to support the development of mobile broadband systems, including IMT, and report the results of these studies to the next WRC for its regulatory actions as required, including new allocations and identifications.

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**Radiocommunication services concerned:** Mobile, Fixed, Broadcasting, Satellite, Radiolocation Aeronautical

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**Indication of possible difficulties:** The frequency bands to be considered as candidates are equally likely to be encumbered by other services (e.g., fixed, broadcast, radiolocation and satellites).

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***Previous/ongoing studies on the issue:*** Several studies have been performed in SG -4, -5 and -6 on sharing between IMT and mobile broadband technologies, and existing services in a number of bands.

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<b><i>Studies to be carried out by:</i></b> as decided by CPM-12
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<b><i>with the participation of:</i></b> Study Groups 4, 5, 6, and 7
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***ITU-R Study Groups concerned:*** 4, 5, 6 and 7

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***ITU resource implications, including financial implications (refer to CV126):*** Work can be completed within the existing resources of the ITU-R Study Groups, placing no additional burden on ITU-R

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***Common regional proposal:*** Yes      ***Multicountry proposal:*** No  
***Number of countries:***

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***Remarks***

## **Chapter 6**

# **Recommended Strategies to Protect the Amateur Bands in the 222 – 3,500 MHz Spectrum**

This chapter will be completed after the July 2011 ARRL Board Meeting

## Appendix A – Reference Documents

1. Connecting America: The National Broadband Plan. Available at:  
<http://www.broadband.gov>
2. *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband*, U.S. Department of Commerce, Gary Locke, Secretary; Lawrence E. Strickling, Assistant Secretary for Communications and Information; October 2010. Available at:  
[http://www.ntia.doc.gov/reports/2010/TenYearPlan\\_11152010.pdf](http://www.ntia.doc.gov/reports/2010/TenYearPlan_11152010.pdf)
3. *An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220 MHz, 4380-4400 MHz Bands* (November 15, 2010), National Telecommunications and Information Administration. Available at:  
[http://www.ntia.doc.gov/reports/2010/FastTrackEvaluation\\_11152010.pdf](http://www.ntia.doc.gov/reports/2010/FastTrackEvaluation_11152010.pdf)
4. *First Interim Progress Report on the Ten-Year Plan and Timetable*, U.S. Department of Commerce, Gary Locke, Secretary; Lawrence E. Strickling, Assistant Secretary for Communications and Information; April 2011. Available at:  
[http://www.ntia.doc.gov/reports/2011/First\\_Interim\\_Progress\\_Report\\_04012011.pdf](http://www.ntia.doc.gov/reports/2011/First_Interim_Progress_Report_04012011.pdf)
5. *Fast Track Evaluation of the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220 MHz and 4380-4400 MHz bands*, NTIA Report October, 2010. Available at:  
[http://www.ntia.doc.gov/reports/2010/FastTrackEvaluation\\_11152010.pdf](http://www.ntia.doc.gov/reports/2010/FastTrackEvaluation_11152010.pdf)
6. *NTIA Fact Sheet on Spectrum Plan and Timetable, Fast Track Evaluation, NTIA*. Available at:  
[http://www.ntia.doc.gov/reports/2010/SpectrumFactSheet\\_11152010.pdf](http://www.ntia.doc.gov/reports/2010/SpectrumFactSheet_11152010.pdf)

## **Appendix B – Amateur Band Spectrum Allocations and Uses**

Tables are included for each Amateur and Amateur-Satellite service allocation in the bands from 222 MHz through 3500 MHz. They give the ITU frequency allocations on a regional basis. United States federal government and non-government allocations and uses are shown. UPPER CASE denotes a primary allocation and lower case indicates a secondary allocation. Footnotes from Article 5 of the ITU Radio Regulations are shown by number; the full text is not given. This data is current per *MANUAL OF REGULATIONS AND PROCEDURES FOR FEDERAL RADIO FREQUENCY MANAGEMENT* September 2010 Revision of the 2008 Edition.

Internationally, the “amateur service” and the “amateur-satellite service” are separate services. In the United States, both services are combined in the “Amateur Radio Service” in Part 97 of the FCC rules.

Where they exist, ARRL band plans are included to show how they fit with other uses of the bands.

### 222 – 225 MHz Spectrum – Allocations and Uses

ITU Allocation to services Region 1	ITU Allocation to services Region 2	ITU Allocation to services Region 3	United States Federal Government	United States Non-Federal Government	ARRL Band Plan a/o July 1991
<b>174-223</b> BROADCASTING  5.235 5.237 5.243		<b>174-223</b> FIXED MOBILE BROADCASTING 5.233 5.238 5.240 5.245	<b>220-222</b> FIXED LAND MOBILE US241 US242		
	<b>222-225</b> AMATEUR MOBILE FIXED Radiolocation 5.241			<b>222-225</b>	<b>222-225</b> AMATEUR RADIO
<b>223-230</b> BROADCASTING Fixed, Mobile  5.243 5.246 5.247		<b>223-230</b> FIXED MOBILE BROADCASTING AERONAUTICAL RADIO NAVIGATION Radiolocation 5.250			



## 420 – 450 MHz Spectrum – Allocations and Uses

ITU Allocation to services Region 1	ITU Allocation to services Region 2	ITU Allocation to services Region 3	United States Federal Government	United States Non-Federal Government	ARRL Band Plan
<b>420-430</b> FIXED & MOBILE (except aeronautical mobile) Radiolocation  5.269 5.270 5.271			<b>420-450</b> RADIOLOCATION G2 G129           5.286 US87 US230 US269 US270 US397 G8	<b>420-450</b> Amateur US270	<b>420-426</b> ATV repeater or simplex, control links and experimental  <b>426-432</b> ATV Simplex  <b>432.00-432.07 EME</b>  <b>432.07-432.10</b> Weak signal CW  <b>432.10</b> Calling Frequency  <b>432.10-432.30</b> Mixed mode & weak signal  <b>432.30-432.40</b> Beacons  <b>432.40-433.00</b> Mixed mode & weak signal  <b>433-435</b> Auxiliary/repeater links  <b>435-438</b> Satellite only  <b>438-444</b> ATV repeater input and repeater links  <b>442-445</b> Repeater inputs and outputs  <b>445-447</b> Auxiliary & control links, repeaters & simplex  <b>446.00</b> National Simplex Frequency  <b>447-450</b> Repeater inputs and outputs
<b>430-432</b> AMATEUR RADIOLOCATION services are co-primary  5.271 5.272 5.273 5.274 5.275 5.276 5.277	<b>430-432</b> RADIOLOCATION Amateur   5.271 5.276 5.277 5.278 5.279				
<b>432-438</b> AMATEUR RADIOLOCATION Earth Exploration Satellite (active) 5.279A  5.138 5.271 5.272 5.276 5.277 5.280 5.281 5.282	<b>432-438</b> RADIOLOCATION Amateur Earth Exploration Satellite (active) 5.279A  5.271 5.276 5.277 5.278 5.279 5.281 5.282				
<b>438-440</b> AMATEUR RADIOLOCATION  5.271 5.273 5.274 5.275 5.276 5.277 5.283	<b>438-440</b> RADIOLOCATION Amateur  5.271 5.276 5.277 5.278 5.279				
<b>440-450</b> FIXED MOBILE except aeronautical mobile Radiolocation  5.269 5.270 5.271 5.284 5.285 5.286					

### 902-928 MHz Spectrum – Allocations and Uses

ITU Allocation to services Region 1	ITU Allocation to services Region 2	ITU Allocation to services Region 3	United States Federal Government	United States Non-Federal Government	ARRL Band Plan a/o July 1989
<p><b>890-942</b> FIXED MOBILE (except aeronautical mobile) 5.317A BROADCASTING 5.322 Radiolocation 5.323</p> <p>----- <b>Applications:</b></p> <p><u>GSM cellular</u> <b>880-915 Tx</b> <b>925-960 Rx</b></p> <p><u>IMT-2000</u> Some countries may use parts of the band <b>806-960</b></p>	<p>----- <b>902-928</b> FIXED Amateur Mobile except aeronautical mobile 5.325A Radiolocation</p>	<p><b>890-942</b> FIXED MOBILE 5.317A BROADCASTING Radiolocation 5.327</p> <p>----- <b>Applications:</b></p> <p><u>GSM cellular</u> <b>880-915 Tx</b> <b>925-960 Rx</b></p> <p><u>IMT-2000</u> Some countries may use parts of the band <b>806-960</b></p>	<p><b>902-928</b> RADIOLOCATION G59 5.150 US218 US267 US275 G11</p> <p>----- <b>Applications:</b></p> <p><b><u>Federal Usage:</u></b> <b>Radars.</b> Various Federal agencies operate mobile and fixed radars in this band. <b>Land Mobile Radio.</b> Numerous fixed and mobile systems are supported in this band. <b>Wind Profiler Radar.</b> Frequency 915 MHz is authorized for Federal use for the wind profiler radar whose implementation for weather and aviation safety purposes is expected to be rapid.</p> <p><b><u>Federal &amp; Private Sector Usage. ISM.</u></b> The band 902-928 MHz (center frequency 915 MHz) is designated for industrial, scientific and medical (ISM) applications.</p>	<p><b>902-928</b> ISM (18) Private land mobile (90) Amateur (97) 5.150 US218 US267 US275</p> <p>----- <b>Applications:</b></p> <p><b><u>Part 90 Automatic Vehicle Monitoring (AVM) Systems</u></b></p> <p><b><u>Band (MHz) System License</u></b> 902.00-904.00 Non-multilateration 904.00-909.75 Multilateration 909.75-919.75 Non-multilateration 919.75-921.75 Multilateration and Non-multilateration 921.75-927.25 Multilateration 927.25-928.00 Multilateration</p> <p><b><u>Federal &amp; Private Sector Usage. ISM.</u></b> The band 902-928 MHz (center frequency 915 MHz) is designated for industrial, scientific and medical (ISM) applications.</p> <p><b><u>Private Sector Usage:</u></b> This band is used by the Transportation Infrastructure Radio Service consisting of location &amp; monitoring service licensees; Unlicensed radio frequency devices; and Amateur Radio with secondary status.</p>	<p><b>902-903</b> Weak signal <b>902.1</b> Calling frequency</p> <p><b>903-906</b> Digital <b>903.1</b> Alternate calling frequency</p> <p><b>906-909</b> FM repeater inputs</p> <p><b>909-915</b> Amateur TV</p> <p><b>915-918</b> Digital</p> <p><b>918-921</b> FM repeater outputs</p> <p><b>921-927</b> Amateur TV</p> <p><b>927-928</b> FM simplex and links</p>
	5.150 5.325 5.326				

### 1240-1300 MHz Spectrum – Allocations and Uses

ITU Allocation to services Region 1	ITU Allocation to services Region 2	ITU Allocation to services Region 3	United States Federal Government	United States Non-Federal Government	ARRL Band Plan a/o Jan. 1985
<p><b>1240-1300</b>                      EARTH EXPLORATION-SATELLITE (active)                      RADIOLOCATION                      RADIONAVIGATION-SATELLITE (space- to-Earth) (space-to-space) 5.328B 5.329 5.329A                      SPACE RESEARCH (active)                      Amateur</p> <p>5.282 5.330 5.331 5.332 5.335 5.335A</p> <hr/> <p><b>Applications:</b>                      Amateur EN301 783                      GNSS                      Radar                      Navigation systems                      Active sensors</p>			<p><b>1240-1300</b>                      EARTH EXPLORATION- SATELLITE (active)                      RADIOLOCATION G56                      SPACE RESEARCH (active)                      AERONAUTICAL RADIONAVIGATION</p> <p>5.332 5.335</p> <hr/> <p><b>Applications:</b>                      Surveillance Radars. Used jointly by FAA and DOD for long-range air surveillance and safety-of-flight enroute air traffic control. Military services use for high-power long-range surveillance radars on land and ships. ARSR-4 recently deployed for air-defense, drug interdiction and air-traffic control.</p> <p>NASA space research and earth exploration-satellite service for geological studies and ocean wave structures using active microwave sensors.</p> <p>Ref: Federal Long-Range Spectrum Plan</p>	<p><b>1240-1300</b>                      AERONAUTICAL                      RADIONAVIGATION                      Amateur                      Earth exploration-satellite (active)                      Space research (active)</p> <p>5.282</p>	<p><b>1240-1246</b> ATV #1  <b>1246-1248</b> Narrow-band FM digital duplex with 1258-1260  <b>1248-1252</b> Digital comms  <b>1252-1258</b> ATV #2  <b>1258-1260</b> Narrow-band FM digital duplex with 1246-1252  <b>1260-1270</b> Satellite uplinks, experimental, simplex ATV  <b>1270-1276</b> Repeater inputs  <b>1276-1282</b> ATV #3  <b>1282-1288</b> Repeater outputs  <b>1288-1294</b> Wideband experimental, simplex ATV  <b>1294-1295</b> FM simplex                          <b>1294.5</b> National FM calling Simplex  <b>1295-1295.8</b> SSTV FAX                          ACSSB experimental  <b>1295.8-1296</b> EME CW expansion  <b>1296-1296.05</b> EME  <b>1296.05-1296.08</b> CW beacons                          <b>1296.1</b> CW/SSB calling  <b>1296.4-1296.8</b> Cross-band linear translator input  <b>1296.6-1296.8</b> Cross-band linear translator output  <b>1296.8-1297</b> Experimental beacons  <b>1297-1300</b> Digital comms</p>

### 2300-2310 & 2390-2450 MHz Spectrum – Allocations and Uses

ITU Allocation to services Region 1	ITU Allocation to services Region 2	ITU Allocation to services Region 3	United States Federal Government	United States Non-Federal Government	United States Applications	ARRL Band Plan a/o Jan. 1991
2300-2450 FIXED MOBILE 5.348A Amateur Radiolocation  5.150 5.282 5.395	2300-2450 FIXED MOBILE 5.348A Amateur Radiolocation  5.150 5.282 5.393 5.394 5.396	2300-2305 G122	2300-2305	2300-2305 Amateur	Amateur (97)	2300-2303 High-rate data 2303-2303.5 Packet radio 2303.5-2303.8 TTY, packet 2303.8-2303.9 Packet, TTY, CW, EME 2303.9-2304.1 CW, EME 2304.1-2304.2 CW, EME, SSB 2304.2-2304.3 SSB, SSTV, FAX, Packet, AM, AMTOR 2304.3-2403.32 Beacon network 2304.32-2404.4 General beacons 2304.4-2304.5 SSB, SSTV, ACSSB, FAX, packet, AM, AMTOR, experimental 2304.4 Calling frequency 2304.5-2304.7 Linear transponder input 2304.7-2304.9 Linear transponder output 2304.9-2305 Experimental beacons 2305-2305.2 FM simplex 25 kHz spacing 2305.2 FM simplex calling frequency 2305.2-2306 FM simplex 25 kHz spacing 2306-2309 FM repeaters 25 kHz input 2309-2310 Control and auxiliary links
		2305-2310  US338 G122	2305-2310 FIXED MOBILE except aeronautical mobile RADIOLOCATION Amateur US338	Wireless Communications (27) Amateur (97)		
		2390-2395 MOBILE US276	2390-2395 AMATEUR MOBILE US 276	Aviation (87) Amateur (97)		
		2395-2400 G122	2395-2400 AMATEUR	RF Devices (15) Amateur (97)		
		2400-2417 5.150 G122	2400-2417 AMATEUR	ISM Equipment (18) Amateur (97)	2399-2399.5 Packet 2399.5-2400 Control and auxiliary links 2400-2403 Satellite 2403-2408 Satellite high-rate data 2408-2410 Satellite 2410-2413 FM repeaters 25 kHz output 2413-2418 High-rate data 2418-2430 Fast-scan TV 2430-2433 Satellite	

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		<p><b>2417-2450</b> Radiolocation G2 5.150</p>	<p><b>2417-2450</b> Amateur 5.150 5.282</p> <p>-----</p> <p><b>Applications:</b> <u>802.11b Channel</u>  <b>2401-2423</b> Ch 1  <b>2406-2417</b> Ch 2  <b>2411-2422</b> Ch 3  <b>2416-2427</b> Ch 4  <b>2421-2443</b> Ch 5  <b>2426-2448</b> Ch 6  <b>2431-2453</b> Ch 7  <b>2436-2458</b> Ch 8  <b>2441-2463</b> Ch 9  <b>2446-2468</b> Ch 10</p>	<p>ISM Equipment (18) Amateur (97)</p>	<p><b>2433-2438</b> Satellite high-rate data  <b>2438-2450</b> Wideband FM, FSTV, FMTV, SS, experimental</p>
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### 3300-3500 MHz Spectrum – Allocations and Uses

ITU Allocation to services Region 1	ITU Allocation to services Region 2	ITU Allocation to services Region 3	United States Federal Government	United States Non-Federal Government	U.S Amateur Applications a/o July 1988
<p><b>3300-3400</b> RADIOLOCATION 5.149 5.429 5.430 ----- Applications: Radars (upper limit for airborne radars is 3410)</p> <p><b>3400-3500</b> FIXED FIXED- SATELLITE (Space-to- Earth) Mobile Radiolocation 5.431 5.434 ----- Applications: <b>3400-3410</b> Amateur EU17 EN 301 783 Fixed links ERC REC 14-03, EN 301 751 including point- to-multipoint Fixed wireless access systems ERC REC 13-04, EN 301 751 ERC REC 14-03, EN 301 753 Radars (upper limit for airborne radars is 3410) Mobile (SAP/SAB) EU17A <b>3410-3500</b> Amateur EN 301 783 Fixed links ERC REC 14-03, EN 301 751 including point-to-multipoint Fixed wireless access systems ERC REC 13-04, EN 301 751 ERC REC 14-03, EN 301 753 Radars Mobile (SAP/SAB) EU17A</p>	<p><b>3300-3400</b> RADIOLOCATION Amateur Fixed Mobile 5.149</p>	<p><b>3300-3400</b> RADIOLOCATION Amateur 5.149 5.429</p> <p><b>3400-3500</b> FIXED FIXED-SATELLITE (Space-to-Earth) Amateur Mobile 5.432B Radiolocation 5.433 5.282 5.432 5.432A</p>	<p><b>3300-3500</b> RADIOLOCATION US108 G2 US342 ----- <b>Applications:</b> <b>3300-3400</b> Military radars. Band is extensively used by the military radiolocation systems throughout the U.S. <b>3400-3500</b> Military radars. Critical radar band used extensively by all military services <b>3400-3500</b> FIXED FIXED-SATELLITE (Space-to-Earth) Amateur Mobile 5.431A Radiolocation 5.433 5.282</p>	<p><b>3300-3500</b> Amateur Radiolocation US108 5.282 US342 ----- <b>Applications:</b> <u>\$15.251, \$15.251</u> <b>3267-3332</b> AVIS <b>3332-3339</b> restricted <b>3339-3345.8</b> AVIS <b>3345.8-3358</b> restricted <b>3358-3600</b> AVIS <b>3400-3410</b></p>	<p><b>3400-3410</b> Amateur-satellite <b>3456.1</b> Calling Frequency <b>3456.3-3456.4</b> Propagation beacons</p>