

**BEFORE THE**  
**Federal Communications Commission**  
**WASHINGTON, D.C. 20554**

In the Matter of

Spectrum Policy

Spectrum Policy Task Force

Seeks Comments on Issues

Related to the Commission's

Spectrum Policies

)  
)  
) ET Docket No. 02-135  
) DA 02-1311  
)  
)  
)  
)

To: Chairman, Spectrum Policy Task Force

**Reply Comments**  
**of the**  
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

**General**

The National Aeronautics and Space Administration (NASA), pursuant to the Federal Communications Commission's (FCC) Public Notice released June 6, 2002<sup>1</sup>, hereby offers its comments concerning the FCC's request for input from public, academic and government interests on possible revisions to existing FCC spectrum policies. In light of the ever-changing spectrum environment in which we must operate, we commend the Commissioners for this initiative and hope that the comments presented herein will help the FCC in its efforts within the Spectrum Policy Task Force.

---

<sup>1</sup> See Public Notice, "Spectrum Policy Task Force Seeks Public Comment on Issues Related to Commission's Spectrum Policies", DA 02-1311, released June 6, 2002.

NASA has been directly involved in the development and advancement of new technologies directed at space communications since the Agency's inception. This role stems from the responsibilities assigned to the agency by the National Aeronautics and Space Act of 1958, under which NASA was established, and also by the Communications Satellite Act of 1962 which created the Communications Satellite Corporation. NASA has conducted several communications satellite development programs, which have been considered instrumental in launching and advancing the communications satellite industry in C-band, Ku-band and currently through projects such as the Advanced Communications Technology Satellite (ACTS) Program, in Ka-band. NASA has also played an important role in the advancement of technology necessary to further the development of an emerging Mobile-Satellite industry.

It is from this background of involvement in both Federal and non-Federal spectrum utilization and management that the comments contained in this submission have been developed. NASA encourages the Commission to consider the key elements of this submission as summarized below:

- *Market oriented approaches to spectrum management do not provide a suitable spectrum policy solution for radio services that are not market oriented or in bands shared with such non-commercial services.*
- *Spectrum policy approaches to different radio services must themselves be flexible in order to accommodate differing requirements and the Commission's spectrum allocation decisions must be based on a case-by-case basis.*
- *Spectrum auctions should not be used simply as a revenue-generating tool but rather as part of a sound spectrum management approach.*

- *The Commission should attempt to harmonize its activities and spectrum allocations approaches with the broader international ITU regulations and definitions to the extent possible.*
- *The Commission should consider the feasibility, methods and resources required to establish baseline RF noise floors in critical spectral regions as a tool to help in efficient allocation and assignment processes.*
- *The Commission should consider a greater role for its RF testing facilities in the establishment of sharing feasibility between services.*
- *The Commission should exercise caution in the issuance of "blanket waivers" to the FCC rules in cases where technologies have not demonstrated the ability to share frequencies with incumbent services without causing harmful interference.*
- *NASA reminds the Commission that the "burden of proof" of electromagnetic compatibility between new technologies and existing radio services should properly reside with the proponent of the new technology, rather than with the incumbent radio services with which sharing is being proposed.*
- *NASA believes that there is no one definition of spectral efficiency and that the Commission must view this concept on a service-by-service basis.*
- *The Commission should align the National Table of Allocations with that of the Final Acts of ITU World Radio Conferences in a more expeditious manner.*

## **Market Oriented Allocation and Assignment Process**

Market oriented allocation and assignment processes are best addressed by commercial entities on whose balance sheets such activities most heavily weigh. However, NASA would like to take this opportunity to discuss the suitability of such spectrum management tools with respect to other spectrum dependent entities where market forces are not the premier guiding element in spectrum decisions.

Over 40 years of spectrum management experience has shown NASA that no single approach to spectrum allocation and assignment has demonstrated its applicability to the wide range of radio services regulated by the FCC and the NTIA. Experience has shown that individual radio services have unique and individual requirements and serve differing aspects of the public in differing ways. As such, many services simply cannot be allocated or considered in allocation and assignment processes with commercial services based solely on market driven forces. Some such radio services and applications include National Defense, Public Safety, Radioastronomy, Satellite-borne passive sensors and other services where generation of revenues is not the primary use of the spectrum. It is not possible, for example, to compare the rewards gained from radioastronomy observations with the revenues accrued from PCS spectrum obtained at auction. The reliance of such services upon the radio spectrum is for entirely different purposes and thus the "value" of that spectrum has different, incomparable meanings to each.

The Commission under the Omnibus Budget Reconciliation Act of 1993 and the Balanced Budget Act of 1997 began the process of allocating radio spectrum based upon

the winners in a series of competitive biddings. While the revenues initially generated for the US Treasury were impressive, the results of such auctions in the more recent past have been less than fulfilling as more spectrum has been made available and the business models of many in the telecommunications industry have become more cloudy. Also, over time, auctions have become increasingly used as revenue producing activities rather than spectrum management tools and, as a result, we have at times lost sight of sound spectrum management policies.

NASA believes that a market oriented allocation and assignment process can only be effective in areas of the spectrum that are shared between similar services and where no other encumbrances, such as associated relocation costs or complex sharing scenarios, are involved. Such an approach would allow for healthy economic competition and result in a higher value being placed on the spectrum being offered.

NASA encourages the Commission to take into consideration the needs of non-commercial radio services in its deliberations of market-oriented approaches to spectrum management and in which bands to apply them. Particular care should be exercised in bands shared between Federal and non-Federal services.

## **Interference Protection**

All the best allocation and assignment processes which maximize the use of the RF spectrum are to no avail if the RF environment becomes corrupted and interference becomes "harmful" to radio services depending on that spectrum for fulfillment of mission goals. Certainly the RF spectrum has become much more congested over the last ten years or so as more technologically advanced radio systems have become available in the market place. We have had tremendous growth in personal communications devices and equally tremendous improvements in communications serving the public through Federal, State and local government implementation of these advances. This unprecedented growth has placed a severe burden on our ability to manage the radio spectrum wisely (and thus effectively and safely).

The International Telecommunications Union (ITU) over the years has developed hypothetical reference circuits and interference criteria for a large number of radio services. The US has played a major role in fostering these regulations and recommendations and as such has a significant political, economic and technical investment in the acceptance of these criteria worldwide. NASA is of the opinion that the FCC should adopt as a baseline, most, if not all, of these standards in its policy on what constitutes radio frequency interference. These standards have worldwide recognition and, since the US played such a large role in their acceptance, it would seem wise politically and technically to adopt them, to the extent possible, as US standards as well.

The definitions of what constitutes "interference" and "harmful interference" both have undergone many, many years of ITU scrutiny. In fact, many of the systems the US has operating in the world today are predicated on designs based upon these receiver sensitivities and operational standards. NASA has no proposed new definition of radio frequency interference to offer the Commission. In fact, we feel that considering new definitions could be detrimental to commercial as well as Federal agencies that rely on such technical criteria for design and development of new radio systems.

Over the years, NASA spectrum management personnel have considered the desirability of establishing a baseline of the radio frequency environment in several areas of the spectrum. The usefulness of such a model is clear. The RF spectrum has become so crowded that placement of new services is very difficult, and at times impossible based on analytical modeling alone. However, the complexity of developing a useful RF noise floor model is also clear. There appear to be several approaches possible varying from analytical to RF measurement equipment flown on aircraft or spacecraft platforms.

NASA encourages the Commission to consider the usefulness and the resources involved in developing useful noise floor measurements in bands critical to the US.

NASA recognizes the usefulness and also the potential limitations of using analytical modeling as the sole determinant in assessing compatibility between radio services. In many situations, mathematical modeling is quite sufficient to understand and mitigate any interference potentials. However, the agency has long been a strong proponent of hardware testing to fully understand the implications of some of its design choices ---

particularly where safety of life is concerned. At our facilities at Langley Research Center in Hampton, VA, NASA has established a state of the art RF measurement laboratory primarily for the measurement of potential RF interference to aircraft avionics. This lab and its measurements have proven invaluable in establishing safety standards for EMC of electronic devices used on board the nations aircraft. NASA believes that the FCC should consider a greater role for its RF testing resources in the assessment of new technologies and the establishment of standards by which these technologies can share the radio spectrum with existing services --- particularly where safety of life services are involved.

NASA is concerned with the issuance of "blanket waivers" to unlicensed technologies, which have yet to demonstrate that frequency sharing with other radio services is feasible. While NASA understands the intent behind such actions has been to further the commercial development of desired technologies with the least amount of governmental restrictions. However, such waivers must be considered in the bigger picture of potential interference to existing services----particularly safety-of-life services.

Traditionally within the spectrum management community it has been the responsibility of the newly introduced service to demonstrate its electromagnetic compatibility with existing radio services in the band. In some cases, however, this has not been the approach taken by the Commission when allocating spectrum to new radio technologies. NASA encourages the Commission to place the "burden of proof" clearly in the hands of the proponents of new technology rather than on the incumbent radio services.

## **Spectral Efficiency**

Spectral efficiency comes in many different forms and definitions. Generally speaking, efficiency is defined as the ratio of desired output to the required resource input. In the case of spectrum efficiency, with the resource input being a given amount of spectrum, higher efficiency levels would indicate higher levels of desired output. In some cases of very similar services, one may be able to compare different technologies to determine their spectral efficiencies, as in a comparison of modulation techniques in cell phones for instance. However, if one tries to compare disparate radio services by this means one would have to quantify the levels of desired outputs in order to do so. For example, radioastronomy observations have a certain "value" for a given amount of spectrum utilized. However, how can one compare this value with the dollar value, or the enjoyment received by cell phone users, if they were to occupy the same amount of spectrum? It is not possible. Within a given service however, it may be possible to quantify some form of energy throughput to bandwidth ratio such that comparisons can be made of different technologies within the same service.

In general however, NASA is of the belief that the best use of the term "spectrum efficiency" is in relation to a given radio service and the multiple users within that service. Cell phone operators perhaps know this better than most since both the competitiveness of their markets and the cost to purchase spectrum at auction have been so high that they must accommodate as many users of the same spectrum as is possible by today's technological means.

NASA has been forced by spacecraft design constraints to re-use radio frequencies as much as possible on the Tracking and Data Relay Satellite System (TDRSS). A single TDRS satellite is capable of accommodating up to 20 simultaneous user satellites with voice and data, all in 6 MHz of bandwidth using spread spectrum techniques and phased array antenna systems. However, it should be noted that other technologies that utilize spectrum spreading may not be comparable with traditional methods and therefore cannot be held to the same definition of spectral efficiency.

The Agency is continuously striving to improve its spectrum use and thus reduce weight penalties associated with multiple or redundant communications equipments. NASA practices efficient spectrum use through antenna designs, modulation techniques and intensive real-time coordination with the international space community to "time share" or "geographically share" spectrum allocated to space science services.

NASA believes that the Commission should require that a given portion of allocated spectrum be used in the most efficient manner consistent with the radio service being allocated to the band. However, since all efficiencies are not measured the same, the FCC should view each allocation in terms that best accommodate the most simultaneous users to the spectrum. It is NASA's belief that the spectral efficiency of a given service must be evaluated on a case-by-case basis. Rules need to be promulgated on a service-by-service basis with particular attention paid to other radio services using the same bands or adjacent bands.

## **International Issues**

The nature of spectrum use on board satellite platforms is inherently global. As such, NASA believes it is important that US domestic spectrum allocation and assignment policies reflect, to the maximum extent possible, the international framework established within the ITU. This is particularly true for Fixed Satellite, Mobile Satellite, Broadcast Satellite and the Space Science Services where international agreements influence the manner in which the spectrum is utilized. The use of the radio spectrum in space requires a great deal of coordination among nations to ensure interference free operations and maximum efficiencies in spectrum use.

NASA believes that the Commission should take into account worldwide spectrum usage when considering US domestic allocation and assignment to any service which is either global in nature or potentially impacts operations to our neighbors in Canada or Mexico. The problems encountered with the allocation of bands to the Mobile Satellite Service in bands designated for worldwide IMT-2000 usage could be averted in future spectrum policy decisions if more attention is paid to the longer term desirability of adopting international harmonization of spectrum usage.

Many of the regulations within the ITU concerning spectrum use by satellite borne services were developed with the US Delegation acting as the lead proponent. As a result, NASA believes that it is critically important that agreements made within the ITU framework be reflected in US domestic policy as well. In this context, it is noted that many of the changes to the international Table of Frequency Allocations have, as yet, not

been implemented within the US Table. In fact, to NASA's knowledge, some of these omissions go back as far as the Final Acts of WARC-92. NASA understands that the Commission is in the process of updating the US Table based on ITU deliberations but believes that it is important to make every effort to reflect the results of World Radio Conferences in a timelier manner.

NASA believes that it is critically important for US credibility in ITU negotiations that the Commission recognize applicable international regulations in all allocation and assignment policy decisions. In its recent Report and Order in the Ultra-wideband proceeding, the Commission failed to address issues raised by RRS5.340, which prohibits emissions in bands used by passive sensors. These types of policy decisions can lead to confusion on the part of other ITU member nations and thus to an erosion of US positions in negotiating processes, in addition to possibly violating US Treaty obligations.

The above comments have been submitted to the FCC in response Public Notice  
DA 02-1331 dated June 6, 2002.

NASA appreciates the opportunity the Commission has extended in their solicitation of  
government input in this important proceeding. We remind the Commission that NASA  
is able and willing to provide objective technical expertise, specialized insight and RF  
testing capabilities in the furtherance of US spectrum management objectives and look  
forward to working directly with the FCC on this and other spectrum policy issues in the  
future.

Respectfully Submitted,



By: \_\_\_\_\_

David Struba  
Office of Space Flight  
NATIONAL AERONAUTICS  
And SPACE ADMINISTRATION

July 23, 2002