Spectrum Reallocation Report

RESPONSE TO TITLE III OF THE BALANCED BUDGET ACT OF 1997

U.S. DEPARTMENT OF COMMERCE

National Telecommunications and Information Administration

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SPECTRUM REALLOCATION REPORT

Response to Title III of The Balanced Budget Act Of 1997

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EXECUTIVE SUMMARY

On behalf of the Secretary of Commerce, the National Telecommunications and Information Administration (NTIA) has prepared this report as required by Title III – Communication and Spectrum Allocation Provisions – of the Balanced Budget Act of 1997 (Title III of the BBA 97). This report identifies radio spectrum currently used by the Federal Government for reallocation to the private sector.

Title III of the BBA 97 requires the Secretary of Commerce to provide from the spectrum currently allocated for Federal use, an aggregate of at least 20 megahertz (MHz) below 3 gigahertz (GHz) for allocation and assignment by the Federal Communications Commission (FCC) to non-Federal users through the process of competitive bidding.

The paragraphs below provide an overview of the bands identified for reallocation, indicating the Federal usage; transition timetable; any needed sharing requirements for each band identified for reallocation; an overview of reported Federal implementation costs; and the potential operational and mission impacts.

OVERVIEW OF REALLOCATED BANDS

The Federal Government uses frequencies below 3 GHz to support missions that are of direct benefit to the public. These missions include Federal law enforcement activities, air traffic control, national defense, weather services, scientific studies, and environmental monitoring. The estimated Federal investment exceeds $280 billion. Approximately half of this spectrum is shared with non-Federal users. Federal and non-Federal use of the spectrum is concentrated below 3 GHz because atmospheric and foliage penetration losses are relatively low, components are inexpensive, and small, efficient antennas can be used for hand-held operations between 100 MHz and 3 GHz. These features have made use of the spectrum below 3 GHz so desirable that many bands have become congested and entrepreneurs can no longer find spectrum for new technologies.

Spectrum congestion for Federal operations below 3 GHz has been exacerbated by Congressionally mandated reallocation under the Omnibus Budget Reconciliation Act of 1993 (OBRA 93). OBRA 93 required that the Secretary of Commerce identify at least 200 MHz of spectrum used by the Federal Government for reallocation to new spectrum-based technologies. Of the 235 MHz identified, 135 MHz was below 3 GHz. Title III of the BBA 97 requires the Secretary of Commerce to identify an additional 20 MHz below 3 GHz for reallocation to non-Federal users. This could increase congestion in the remaining bands used by the Federal Government, and possibly affect critical agency missions even though the NTIA will try to balance spectrum requirements of the Federal agencies with benefits to the public.

Identifying spectrum for reallocation involves consideration of two overriding and sometimes conflicting factors: (1) the impact on the Federal agencies, in terms of mission, costs, and potential

reduction of services to the public and (2) the benefits expected to be realized by the public. In complying with the requirements and band selection criteria of Title III, this spectrum reallocation plan establishes a reasonable balance between the spectrum needs of the Federal Government and those of potential non-Federal users. The effective implementation of this spectrum reallocation plan depends upon the availability of funds to continue the displaced Federal activities either through the agency appropriations process or reimbursement from the non-Federal entities moving into the bands.

Spectrum Reallocation Plan

Bands Identified for Reallocation	Reallocation Status[4]	Reallocation Schedule[5]
139-140.5 and 141.5-143 MHz	Mixed	January 2008
216-220 MHz[1]	Mixed	January 2002
1385-1390 MHz[2]	Exclusive	January 1999
1432-1435 MHz	Mixed	January 1999
2385-2390 MHz[3]	Exclusive	January 2005

1) The SPASUR radar system (transmit frequency of 216.98 MHz and receive frequencies of 216.965-216.995 MHz), located in the Southern part of the United States will continue to be protected indefinitely.

2) Federal airborne operations at the sites listed in Table 3-3 in the report will be continued for 9 years after the scheduled reallocation date.

3) Federal and commercial airborne operations at the sites listed in Table 3-6 in the report will be continued for 2 years after the scheduled reallocation date.

4) Spectrum reallocated on a mixed-use basis can be used by the Federal Government, but this use must be limited by geographic area, time, or by other means, and must be substantially less than the potential non-Federal use.

5) The spectrum will be auctioned prior to 2002, in accordance with the Balanced Budget Act of 1997.

Several bands identified for reallocation are adjacent to bands that will continue to be used for high-powered or sensitive Federal operations. In order to reduce the potential for mutual interference, industry established transmitter and receiver standards are essential.

139-140.5 and 141.5-143 MHz

These band segments are part of the 138-144 MHz band that is used primarily by the military services to establish communications for both tactical and non-tactical use. This includes: tactical air-to-air and air-to-ground communications; non-tactical intra-base ground-to-ground communications; land mobile radio (LMR) nets; and trunking systems. The proposed reallocation strategy will minimize the impact to the Federal Government and will provide a transmit and receive separation, maximizing its usefulness for commercial applications. This band could be used for a wide variety of new non-Federal fixed and mobile communications services. Reallocating this band in 2008 will allow sufficient time to re-engineer radio systems operating in the band. This date also coincides with the established schedule for Federal conversion to narrowband technology in this band. Federal operations will be continued indefinitely at the sites listed in Table 3-1 in the report. The DoD has raised concerns about the need to include additional military sites in this band. The NTIA and the DoD will assess the need to include additional sites and work with the FCC during the reallocation process to insure that disruption to critical military operations is minimized.

216-220 MHz

This band is used for a space surveillance radar system, and various low power applications which include: telemetry for monitoring seismic activity and wildlife, hands free communication between firefighters wearing hazardous environment suits, and audio collection devices used by law enforcement agents. The band could be used for new non-Federal fixed and mobile communications services. This band could also be used for expansion of existing non-Federal services. The band is to be reallocated on a mixed-use basis with a scheduled availability date of January 1, 2002. The space surveillance radar located at three transmitter sites and six receiver sites listed in Table 3-2 in the report will be protected indefinitely.

1385-1390 MHz

The 1215-1400 MHz band is used by long-range air defense radars, air traffic control facilities, military test range telemetry links, and tactical radio relays. Reallocating the 1385-1390 MHz portion of the band is a reasonable balance between providing additional spectrum resources to non-Federal users and minimizing the operational and cost impact to the Federal Government. The 1385-1390 MHz band segment could be used for new fixed and mobile commercial and consumer communications applications. This band is adjacent to the 1390-1400 MHz band that has been identified for reallocation under OBRA 93 creating a contiguous block of spectrum 15 MHz wide. This band could also be combined with spectrum in the 1427-1435 MHz band that has also been identified for reallocation. Since high-powered Federal Aviation Administration and Department of Defense radars must continue to operate in the lower adjacent band, new commercial applications must adopt receiver standards to assure satisfactory performance. In order to protect the Department of Defense Nuclear Detonation System from interference out-of-band emission standards for the commercial transmitters must also be established. Reallocation of this band is scheduled for January 1, 1999, to coincide with the availability date of the 1390-1400 MHz and 1427-1435 MHz bands that have been identified for reallocation. To reduce the impact on important

Federal and university radio astronomy operations, airborne or space-to-Earth transmissions should not be permitted. In order to preserve the investment made by the Federal Government, essential operations will be continued at the sites listed in Table 3-3 in the report for 9 years after the scheduled reallocation date. The DoD has raised the issue of radar operations during wartime. The NTIA and the DoD will work with the FCC during the reallocation process in the 1385-1390 MHz band to insure that wartime emergency considerations will be addressed to maintain national security.

1432-1435 MHz

This band is used by the military for tactical radio relay communications, military test range aeronautical telemetry and telecommand, and various types of guided weapon systems. The 1432-1435 MHz band will be reallocated for non-Federal use on a mixed-use basis. This will preserve the investment made by the Federal Government and permit essential military operations to continue, while making additional spectrum available for the development of commercial and consumer applications. To realize its full public benefit, the reallocation date of the 1432-1435 MHz band will be January 1, 1999. This date coincides with that of the 1427-1432 MHz band that was previously identified for reallocation under OBRA 93. Essential Federal Government operations and their associated airspace will be protected indefinitely at the sites listed in Table 3-4 in the report. The DoD has raised concerns about the need to include additional military sites in this band. The NTIA and the DoD will assess the need to include additional sites and work with the FCC during the reallocation process to insure that disruption to critical military operations is minimized.

2385-2390 MHz

This band is used by the Federal Government for aeronautical flight test telemetry and for scientific observations. This band is also used by the commercial aviation industry for flight test telemetry and is designated for telemetry used in conjunction with commercial launch vehicles. This band could be used for new non-Federal fixed and mobile consumer and commercial services. It can also be used as an expansion of existing non-Federal services. Since airborne systems will continue to operate in the adjacent band, commercial receiver and transmitter standards must be established to reduce the potential for mutual interference. This band is to be reallocated on an exclusive basis with a scheduled availability date of January 1, 2005. Reallocation of this band in 2005 will provide a sufficient amount of time to implement new systems employing spectrum efficient modulation techniques. To minimize the operational impact on flight test programs that are ongoing or planned to begin in the near future, continued Federal and commercial use of the 2385-2390 MHz band at the sites listed in Table 3-6 in the report will continue for 2 years after the scheduled reallocation date. To provide protection to the Arecibo planetary radar, airborne and space-to-earth transmissions will be prohibited in Puerto Rico. The DoD has raised concerns about the need to include additional military sites in this band. The NTIA and the DoD will assess the need to include additional sites and work with the FCC during the reallocation process to insure that disruption to critical military operations is minimized.

OVERVIEW OF FEDERAL IMPLEMENTATION COSTS

Every effort has been made to insure that the bands identified in this report meet the Title III band selection criteria. However, the displaced Federal functions resulting from the reallocation must, in most cases, be preserved at a considerable cost to the Federal Government. The Federal agencies maintain that, in order to meet the time constraints of Title III, it is only possible to provide preliminary reallocation cost estimates and operational impact assessments since accurate data will require extensive cost and engineering analysis. The following list summarizes the Federal reallocation costs for each of the affected agencies.

The cost estimates provided by the DoD assume that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.

Individual Federal agencies provided the estimated reallocation cost information shown in the table below to NTIA. The NTIA did not independently verify the cost estimates as part of this study. Furthermore, the Office of Management and Budget has not formally reviewed the estimated costs. Federal agency requests for reallocation will be reviewed as part of the annual budget formulation process. Specific inquiries regarding the reallocation cost estimates should be referred to the originating agency.

Summary of Preliminary Federal Reallocation Costs

Federal Agency	Estimated Reallocation Cost
Department of the Army	$260 million
Department of the Navy	$251 million
Department of the Air Force	$520 million
Federal Aviation Administration	$10 million
Department of Energy	$2.1 million
Department of Interior	$1.76 million
Department of Justice	$7 million
Department of the Treasury	$3.5 million
National Aeronautics and Space Administration	$520,000
United States Information Agency	$100,000
Total	**$1.056 billion**

MISSION AND OPERATIONAL IMPACT

The spectrum below 3 GHz is extensively used to support missions mandated to the Federal agencies by the President and Congress. As a result of this extensive usage, it is not possible to identify Federal spectrum below 3 GHz for reallocation that will not affect these missions. In enacting Title III of the BBA 97, Congress acknowledged that reallocating spectrum used by the Federal agencies will not come without mission impacts. However, the Title III band selection criteria specify that the spectrum identified during the reallocation process should balance the operational impact on Federal Government missions with the potential public benefits. In complying with this criteria, the spectrum reallocation plan identifies spectrum that minimizes the impact on the missions performed by the Federal agencies. The following paragraphs discuss in general terms the extent that missions of the Federal agencies are affected. A more detailed discussion of the operational and mission impact to the Federal agencies is provided in the report.

The 10 MHz identified for reallocation on a mixed-use basis will limit Federal operations to specific geographic areas of the country. The Federal missions performed in these bands include: test and training for combat readiness to support national security, law enforcement, and environmental and wildlife management. If the Federal agencies cannot perform their missions given these restrictions, they will have to relocate to other bands. The mixed-use reallocation status may also restrict the Federal agencies from expanding their operations to satisfy future mission requirements.

The Federal Government will lose complete access to the 10 MHz identified for reallocation on an exclusive non-Federal basis. This may have an impact on Federal operations supporting current and future mission requirements. Further loss of spectrum for long-range radars could adversely affect the national defense, air traffic control, and drug interdiction missions performed by the Federal Government. The loss of this spectrum may restrict the use of these bands to support defense training exercises. This degradation in training activities could ultimately affect operational readiness, negatively affecting national security. The loss of this spectrum may also affect several test ranges that conduct flight tests of systems crucial to the nation's defense and commercial aviation.

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LIST OF ACRONYMS AND ABBREVIATIONS

AFFTC	Air Force Flight Test Center
AFOSI	Air Force Office of Special Investigations
AFTRCC	Aerospace and Flight Test Radio Coordinating Council
AGA	Air-Ground-Air
AMTS	Automated Maritime Telecommunications System
ARSR	Air Route Surveillance Radar
ATC	Air Traffic Control
ATM	Aeronautical Telemetry
ATS	Air Traffic Services
AVM	Automatic Vehicle Monitoring
BBA 97	Balanced Budget Act of 1997
CAS	Close Air Support
C-E	Communications-Electronics
CINCLANT	Commander in Chief Atlantic
CINCPAC	Commander in Chief Pacific
CNO	Chief of Naval Operations
DARS	Digital Audio Radio Service
DEA	Drug Enforcement Administration
DMSP	Defense Meteorological Satellite Program
DoD	Department of Defense
DOE	Department of Energy
DOI	Department of Interior
DOJ	Department of Justice
DTV	Digital Television
ELV	Expendable Launch Vehicle
EM	Electromagnetic
EMD	Engineering Manufacturing and Development
EPIRBS	Emergency Position-Indicating Radio Beacon Station
ERP	Effective Radiated Power
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FDD	Frequency Division Duplex
FEMA	Federal Emergency Management Agency
FLTSATCOM	Fleet Satellite Communications
FY	Fiscal Year
GOES	Geosynchronous Operational Environmental Satellite
GHz	Gigahertz
GMDSS	Global Maritime Distress and Safety System
GMF	Government Master File
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRDCUS	Gulf Range Drone Control Upgrade System

LIST OF ACRONYMS AND ABBREVIATIONS

HAMOTS	High Accuracy Multiple Object Tracking System
HAZMAT	Hazardous Materials
HETE	High Energy Transient Experiment
ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite
IRAC	Interdepartment Radio Advisory Committee
ISM	Industrial, Scientific, and Medical
ITS	Intelligent Transportation System
ITU-R	International Telecommunication Union-Radiocommunication Sector
IVDS	Interactive Video and Data Service
JSOW	Joint Standoff Weapon
JSS	Joint Surveillance System
LDRCL	Low Density Radio Communications Link
LMR	Land Mobile Radio
LMS	Location and Monitoring Service
LPRS	Low Power Radio Service
MARS	Military Affiliate Radio System
MAS	Multiple Address Service
MCEB	Military Communications-Electronics Board
Met Aids	Meteorological Aids
MHz	Megahertz
MSA	Metropolitan Statistical Area
MSE	Mobile Subscriber System
MSS	Mobile Satellite Service
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NDS	Nuclear Detonation System
NGTCS	Next Generation Target Control System
NIB	Non-Interference Basis
NMD	National Missile Defense
nmi	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NSBF	National Scientific Balloon Facility
NSF	National Science Foundation
NSSMS	NATO SEASPARROW Surface Missile System
NTIA	National Telecommunications and Information Administration
NWS	National Weather Service
OBRA 93	Omnibus Budget Reconciliation Act of 1993
OCST	Office of Commercial Space Transportation
POES	Polar Orbiting Earth Satellite

LIST OF ACRONYMS AND ABBREVIATIONS

PSWAC	Public Safety Wireless Advisory Committee
RAJPO DLS	Range Applications Joint Program Office Data Link System
RDTE	Research Development Test and Evaluation
RF	Radio Frequency
R&O	Report and Order
R&D	Research and Development
RSA	Rural Statistical Area
SARSAT	Search and Rescue Satellite-Aided Tracking
SCADA	Supervisory Control and Data Acquisition
SGLS	Space Ground Link Subsystem
SINCGARS	Single Channel Ground and Airborne Radio System
SPAC	Spectrum Planning and Policy Advisory Committee
SPASUR	Space Surveillance
SOLAS	Safety of Life at Sea
TAS	Target Acquisition System
TARS	Tethered Aerostat Radar System
TBMD	Theater Ballistic Missile Defense
TDD	Time Division Duplex
TDRSS	Tracking Data Relay Satellite System
THAAD	Theater High Altitude Air Defense
TT&C	Tracking, Telemetry, and Command
T&E	Test and Evaluation
T/R	Transmit and Receive
UAV	Unmanned Air Vehicle
UGV	Unmanned Ground Vehicle
UHF	Ultra High Frequency
USCG	United States Coast Guard
USIA	United States Information Agency
VHF	Very High Frequency
WARC-92	1992 World Administrative Radio Conference
WCS	Wireless Communication Service
WLL	Wireless Local Loop
WRC 97	1997 World Radio Conference

SECTION 1
INTRODUCTION

BACKGROUND

The National Telecommunications and Information Administration (NTIA) is the Executive Branch agency principally responsible for developing and articulating domestic and international telecommunications policy. NTIA acts as the principal advisor to the President on telecommunications policies pertaining to the Nation's economic and technological advancement and to the regulation of the telecommunications industry. Accordingly, NTIA conducts studies and makes recommendations regarding telecommunications policies and presents Executive Branch views on telecommunications matters to the Congress, the Federal Communications Commission (FCC), and the public.

NTIA is also responsible for managing the Federal Government's use of the radio spectrum. The FCC is responsible for managing spectrum used by the private sector, including state and local governments. With the proliferation of radio-based technologies, the management and use of the radio spectrum has become increasingly important. Congress found that telecommunications and information are vital to the public welfare, national security, and competitiveness of the United States, and that technological advances in the telecommunications and information fields make it imperative that the United States maintain effective national and international policies and programs capable of taking advantage of these continued advancements.[1]

The fiscal year 1998 (FY 1998) budget submitted by President Clinton to Congress in February 1997 contained proposals for the auction of spectrum by the FCC. The President's proposal estimated netting $ 36.1 billion over a 5 year period in spectrum auction proposals. The House and Senate concurrent budget resolution adopted in May 1997 directed the House and Senate Commerce Committees to raise $24.7 billion in estimated spectrum revenues.[a]

The concurrent budget resolution directed the Congressional Committees to reduce direct spending by more than $2.2 trillion over the five-year period between FY 1998 and FY 2002. Savings could be achieved only by making changes to existing law. The Committees, however, were given discretion as to precisely what amendments should be made to existing law, provided the changes resulted in $2.2 trillion in total savings over the five-year period.

The Administration and the Congress addressed these issues in Title III of the Balanced Budget Act of 1997 (Title III of the BBA 97), signed into law on August 8, 1997.[2] Title III expands the FCC's current authority to auction non-broadcast spectrum and extended FCC auction authority beyond 1998, when the authority was due to expire. Congress first granted the FCC authority to use competitive bidding as a licensing mechanism in 1993, with the enactment of the Omnibus Budget Reconciliation Act (OBRA 93).[3]

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[a] Revenue estimates are based on Office of Management and Budget scoring of spectrum.

INTRODUCTION

Title III requires that the FCC and the NTIA identify at least 120 MHz of spectrum (20 MHz of Federal Government spectrum and 100 MHz of non-Federal spectrum) below 3 GHz for auction. Title III also includes language that would allow Federal users of spectrum that are reallocated to be voluntarily compensated for the cost of moving by the new spectrum users. The following subsection discusses the activities that must be undertaken by the Secretary of Commerce and NTIA in order to comply with Title III. A copy of the NTIA Organization Act as amended by the BBA 97 is given in Appendix A.

COMMERCE DEPARTMENT RESPONSIBILITIES TO COMPLY WITH TITLE III

Spectrum Reallocation Report

Within 6 months after the enactment of the BBA 97, the Secretary of Commerce must prepare a report, to be submitted to the President, the Congress, and the FCC identifying and recommending 20 MHz of spectrum for reallocation. The spectrum identified for reallocation is to be assigned by the FCC prior to 2002 through the process of competitive bidding. The spectrum must be below 3 GHz and allocated to the Federal Government on a primary basis. One half of the spectrum (10 MHz) identified for reallocation can be for mixed-use.[b] Title III specifies five band-selection criteria that must be met by bands identified for reallocation, as well as the specific factors that the Secretary of Commerce must consider in determining whether a frequency band meets these criteria. Table 1-1 provides a synopsis of these criteria and factors.

Reallocation of 15 MHz in the 1990-2110 MHz Band

Title III requires that the FCC in coordination with the Secretary of Commerce reallocate 15 MHz of spectrum from the 1990-2110 MHz band for assignment through competitive bidding. The Congress recognized the importance of continued Federal use of this band for space research and exploration activities. Title III permits the President to identify other frequencies for reallocation if it is determined that spectrum in the 1990-2110 MHz band cannot be reallocated due to the need to protect incumbent Federal systems from interference. If the President makes such a determination, then the President within 2 years after the enactment of the BBA 97 must identify other frequencies that are expected to result in comparable receipts through competitive bidding. The President must report to the Congress on the identification of such alternative frequencies.

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[b] In the bands identified for mixed-use Federal Government use must be limited by geographic area, time, or by other means, and must be substantially less than the potential non-Federal use. See Section 113 (b)(2) of the NTIA Organization Act, 47 U.S.C. § 923 (b)(2).

TABLE 1-1
Summary of Title III Band Selection Criteria

1. Frequencies are allocated on a primary basis for Federal Government use
2. Frequencies are not required for present or identifiable future needs of the Federal Government
   - ❑ Consider whether the band of frequencies is used to provide a communications service that is or could be available from a commercial provider or other vendor
   - ❑ Seek to promote maximum practical reliance on commercially available substitutes
   - ❑ Seek to promote the sharing of frequencies
   - ❑ Seek to promote the development and use of new communications technologies
   - ❑ Seek to promote the use of non-radiating communication systems where practical
   - ❑ Seek to avoid serious degradation of Federal Government services and operations
   - ❑ Seek to avoid excessive costs to the Federal Government and users of Federal Government services
   - ❑ Seek to avoid excessive disruption of existing use of Federal Government frequencies by amateur radio licensees
3. Frequencies can feasibly be made available, as of the date of submission of the report or at any time during the next 15 years
   - ❑ Assume that the frequency will be assigned by the Commission within 15 years
   - ❑ Assume reasonable rate of scientific progress and growth of demand for telecommunications services
   - ❑ Seek to include frequencies which can be used to stimulate the development of new technologies
   - ❑ Consider the immediate and recurring costs to reestablish services displaced by the reallocation of spectrum
4. The transfer of selected frequencies will not result in costs to the Federal Government, or losses of services or benefits to the public, that are excessive in relation to the benefits to the public that may be provided by non-Federal licensees
5. Frequencies are most likely to have the greatest potential for productive uses and public benefits if allocated for non-Federal use
   - ❑ Consider the extent to which equipment will be available that is capable of utilizing the band
   - ❑ Consider the proximity of frequencies that are already assigned for commercial or other non-Federal use
   - ❑ Consider the extent to which commercial users could share the frequency with amateur radio licensees
   - ❑ Consider the activities of foreign governments in making frequencies available for experimentation or commercial assignments in order to support their domestic manufacturers

Accommodation of Displaced Incumbent Non-Federal Licensees

Title III requires that the FCC attempt to accommodate incumbent non-Federal licensees that are displaced as a result of reallocating spectrum for auction. The FCC is to first consider spectrum allocated for non-Federal use to accommodate the displaced licensees. If the FCC is unable to identify non-Federal spectrum suitable for relocation, they are permitted to notify the Secretary of Commerce identifying bands allocated for Federal Government use that are suitable for relocation of the licensees. Upon receipt of such notice, the Secretary must prepare a report to be submitted to the President, the Congress, and the FCC recommending for reallocation for use other than by the Federal Government frequencies that are suitable for the displaced licensees.

Petition for Relocation of Federal Government Stations

Title III permits an entity to submit to NTIA a petition to relocate a Federal Government station that has been assigned a frequency allocated for mixed Federal and non-Federal use, or has been scheduled for reallocation to non-Federal use. Within 6 months of receiving such a petition, the NTIA is to limit or terminate the Federal Government station's operating license if the petitioner meets all the requirements specified in section 113 of the National Telecommunications and Information Administration Organization Act (47 U.S.C. 923) as amended by section 3002(d)(1) of the BBA 97. (See Appendix A)

OBJECTIVE

The objective of this report is to develop a plan for the reallocation of at least 20 MHz of spectrum below 3 GHz from the Federal Government to the private sector in accordance with the requirements of Title III of the BBA 97.

APPROACH

The Federal Government uses frequencies below 3 GHz to support missions that are of direct benefit to the public. These missions include Federal law enforcement activities, air traffic control, national defense, weather services, scientific studies, and environmental monitoring. The estimated Federal investment exceeds $280 billion.[4] Approximately half of this spectrum is shared with non-Federal users. Federal and non-Federal use of the spectrum is concentrated below 3 GHz because atmospheric and foliage penetration losses are relatively low, components are inexpensive, and small, efficient antennas can be used for hand-held operations between 100 MHz and 3 GHz. These features have made use of the spectrum below 3 GHz so desirable that many bands have become congested and entrepreneurs can no longer find spectrum for new technologies.

Spectrum congestion for Federal operations below 3 GHz has been exacerbated by Congressionally mandated reallocation under OBRA 93. OBRA 93 required that the Secretary of Commerce identify at least 200 MHz of spectrum used by the Federal Government for reallocation

to new spectrum-based technologies. Of the 235 MHz identified, 135 MHz was below 3 GHz.[c] Title III of the BBA 97 requires the Secretary of Commerce to identify an additional 20 MHz below 3 GHz for reallocation to non-Federal users. This will increase congestion in the remaining bands used by the Federal Government, possibly affecting critical agency missions even though NTIA will try to balance spectrum requirements of the Federal agencies with benefits to the public.

In order to complete this spectrum reallocation report, NTIA used four principal data sources:

1. Advice on spectrum usage, estimated investment, estimated reallocation cost, and mission impact from the Federal agency representatives on the Interdepartment Radio Advisory Committee (IRAC);[d]

2. Testimony and legislative history associated with Title III of the BBA 97;

3. Data sources available within NTIA, including frequency-authorization records, spectrum certification data, and previously completed spectrum assessments of frequency bands below 3 GHz; and

4. Relevant publicly available documents including articles, reports, studies, etc., that describe Federal and non-Federal use of the radio spectrum.

The process used in identifying Federal Government spectrum for reallocation pursuant to Title III consisted of the following steps:

1. Identification of the total bands below 3 GHz allocated to the Federal Government on a primary basis;

2. Elimination of bands that should not be reallocated because they: 1) would result in excessive impact (cost and mission) to the Federal Government, 2) could not be made available during the next 15 years, or 3) already provide significant and unique benefits to the public;

3. For the remaining bands obtain estimated investment cost, estimation of the reallocation costs, and mission impact from the Federal agencies;

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[c] The estimated reallocation cost to comply with OBRA 93 exceeds $500 million in 1993 dollars.

[d] The IRAC, consisting of representatives of 20 Federal agencies, serves in an advisory capacity to the Assistant Secretary of Commerce for Communications and Information. The IRAC, in existence since 1922, assists the Assistant Secretary in the discharge of his responsibilities pertaining to use of the electromagnetic spectrum.

4. Development of a methodology to apply the band selection criteria of the BBA 97;

5. Assessment of the Federal Government use of the remaining bands and identification of mission and cost implications;

6. Identification of the factors that would effect the benefits to be accrued by the public for the various reallocation options;

7. Analysis of the various reallocation options on a band-by-band basis.

ENDNOTES

Requests for copies of references from Federal departments and agencies should be referred to the originating organization. Parts of the reference material may be exempt from public release.

1. The Omnibus Budget Reconciliation Act of 1993 required the transfer of Federally-controlled spectrum to the FCC, and provides other spectrum management guidance to both the FCC and NTIA. Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, 107 Stat. 31 (1993) [hereinafter OBRA 93]. The functions of NTIA were codified as a result of the National Telecommunications and Information Administration Organization Act. National Telecommunications and Information Administration Organization Act, Pub. L. No. 102-538, 106 Stat. 3533 (codified at 47 U.S.C. 901-904).

2. Balanced Budget Act of 1997, Pub. L. No. 105-33, 111 Stat. 251 (1997).

3. OBRA 93, *supra* note 1.

4. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Special Publication 94-27, *Preliminary Spectrum Reallocation Report* (Feb. 1994).

SECTION 2
SELECTION OF BANDS TO BE CONSIDERED FOR REALLOCATION

INTRODUCTION

As specified in Title III of BBA 97 only bands allocated to the Federal Government on a primary basis were considered for reallocation. While Title III sets an upper limit of 3 GHz for the spectrum to be considered for reallocation, no lower frequency limit was formally established. A recent NTIA report on High Frequency (3-30 MHz) spectrum planning[1], stated that reallocation of spectrum in this frequency range is a "zero sum" process, in that any gain in spectrum for one radio service is at the expense of another. The report concludes that reallocation of spectrum below 30 MHz is not viable and thus, the lower frequency limit for this reallocation study was set at 30 MHz.

An additional limitation applied in this study involves narrow segments of spectrum that are allocated to specific services. The National Table of Frequency Allocations contains some very narrow segments of allocated spectrum, as small as a few kilohertz.[2] In the spectrum reallocation study performed under OBRA 93, NTIA was advised by industry representatives to the Department of Commerce's Spectrum Planning and Policy Advisory Committee (SPAC)[a] that two megahertz was a reasonable lower limit for the reallocated spectrum size. On this basis, spectrum segments of less than two megahertz were not considered for reallocation, except in cases where two band segments could be paired to create a two megahertz wide segment.

Title III of BBA 97 addresses the concern of avoiding excessive cost and minimizing the operational impact on Federal Government missions during the reallocation process. As shown in Table 1-1, Title III provides five criteria for selecting frequency bands for reallocation from Federal Government to non-Federal use. Of the five criteria specified in Title III, three include a Federal Government cost or operational impact factor that must be considered. The following subsections provide a detailed discussion of how the bands between 30 MHz and 3 GHz, to be considered for reallocation, were selected. The list of bands to be considered for reallocation was the result of an elimination process structured around seven categories representing Federal Government bands that: 1) if reallocated would result in excessive impact (cost and mission) to the Federal Government, 2) could not be made available during the next 15 years, or 3) already provide significant and unique benefits to the public. The seven categories are:

- Civil and commercially provided safety-of-life bands;
- National security bands;

[a] The SPAC, composed of four Federal Government and 15 non-Federal representatives, is chartered to advise the Secretary of Commerce on radio-frequency spectrum allocation and assignment planning and the means by which the effectiveness of Federal Government spectrum management may be enhanced.

- Federal law enforcement and public safety communications bands;
- Satellite communications bands;
- Radio astronomy and passive remote sensing bands;
- Consumer-oriented and commercial services sharing with Federal systems;
- Bands that have already been identified for reallocation.

CIVIL AND COMMERCIALLY PROVIDED SAFETY-OF-LIFE BANDS

Spectrum Usage

Safe travel, in the air and at sea, is vitally dependent upon interference-free use of the radio frequency spectrum for the provision of radio navigation services. The frequency bands allocated to the aeronautical radionavigation, radionavigation satellite, aeronautical mobile (route), and maritime radionavigation services support a variety of civil, and commercially provided safety-of-life functions, as shown in Table 2-1. All of the frequency bands shown in this table are co-equally shared between Federal and non-Federal users. The Federal Government provides radionavigation services for the safe transportation of people and goods, and to encourage the flow of commerce. The Federal Aviation Administration (FAA), the United States Coast Guard (USCG), and the Department of Defense (DoD) each play a major role in providing these radionavigation services to the public.

TABLE 2-1
CIVIL AND COMMERCIALLY, PROVIDED SAFETY-OF-LIFE BANDS
(30 to 3000 MHz)

Frequency Band (MHz)	Principal Use
108-118	Instrument Landing Enroute Navigation
118-137	Air Traffic Services
328.6-335.4	Instrument Landing
960-1215	Air Traffic Control Enroute Navigation Collision Avoidance
1215-1240	Satellite-Based Navigation
1240-1370	Enroute Radars
1559-1610	Satellite-Based Navigation
2700-2900	Airport Surveillance Radars
2900-3100	Shipborne Navigation Radars

The FAA has the statutory responsibility for managing the National Airspace System (NAS) and for providing aeronautical services to the flying public. The FAA has an estimated investment of $30 billion

in facilities providing aeronautical radionavigation services in the frequency bands below 3 GHz.[3] The frequency bands used for providing aeronautical radionavigation services are allocated for primary use on a worldwide basis under an international treaty developed by the International Telecommunication Union-Radiocommunications Sector (ITU-R). One hundred seventy four nations have agreed to standardized ground facilities and airborne systems using these designated frequency bands worldwide through the International Civil Aviation Organization (ICAO). The United States must maintain this spectrum to ensure interoperability between international aircraft and the U.S. air traffic control system in accordance with these treaty obligations.

The USCG has a statutory responsibility to provide for safe and efficient maritime navigation in coastal and inland waterways under control of the United States. The maritime radionavigation service is subject to international treaty obligations with the International Maritime Organization (IMO) under the Safety of Life at Sea (SOLAS) treaty, which has established standards for worldwide interoperability among maritime stations.

The DoD also develops and uses its own radionavigation services for national defense purposes. DoD radionavigation systems are often shared with the public. For example, the DoD developed and now operates the satellite-based Global Positioning System (GPS) that is revolutionizing navigation and location determination in the U.S. and worldwide. It is envisioned that GPS will be the primary navigation system well into the next century and will become an integral component of the Global Navigation Satellite System (GNSS).

A detailed description of the systems that operate in the bands used to support civil and commercially provided safety-of-life functions are provided in two NTIA reports: U.S. National Spectrum Requirements: Projections and Trends[4] and the Preliminary Spectrum Reallocation Report.[5] A discussion of the estimated investment cost in each of the frequency bands listed in Table 2-1 is contained in the Preliminary Report.[6]

Spectrum Requirements

Each of the bands listed in Table 2-1 is used to support safety-of-life functions provided within the NAS. International treaty obligations require that support be maintained worldwide within the frequency bands identified to ensure interoperability of cross-border aeronautical and maritime traffic. Since the public already has full access to each of these bands, no clear benefit to the public will be realized by removing Federal Government access to the bands. Therefore, reallocation of spectrum within these frequency bands is not considered viable.

NATIONAL SECURITY BANDS

Spectrum Usage

Frequencies in the electromagnetic spectrum below 3 GHz are vitally important to the DoD mission of providing for the national defense. For more than 50 years, the DoD has sponsored the

research and development of communications-electronics (C-E) systems for use in battlefield scenarios. The modern warfighter has become highly dependent on these C-E systems which have become essential in high technology warfare. The electromagnetic (EM) spectrum below 3 GHz is important due to the operating characteristics intrinsic to frequencies in this region of the spectrum. Low propagation losses at these frequencies enable medium-to-long-range voice and data communications between ground troops under varying terrain and foliage conditions. Similarly, communications from airborne and shipborne platforms benefit from the low propagation loss characteristics of frequencies below 3 GHz. In addition, the ability to use small antennas to capture signals at these frequencies enhances the required portability of military C-E systems. This enables compact systems to be designed for use in hand-held, manpack, airborne, and space-based applications. The same low-loss propagation characteristics are imperative to the functional requirements of long-range military radar systems used to detect and track potentially hostile aircraft and projectiles at distances that will provide sufficient time for response. As a result of these factors, billions of dollars have been invested in systems utilizing frequencies below 3 GHz for use by the active military services, the military reserves, the National Guard, and the USCG.

TABLE 2-2
BANDS THAT SUPPORT NATIONAL SECURITY
(30-3000 MHz)

Frequency Band (MHz)	Functions
225-328.6	Communication/Satellite
335.4-399.9	Communication/Satellite
420-450	Radar
902-928	Radar
1215-1350	Radar
1378.55-1383.55	Satellite
1559-1610	Satellite
1755-1850	Communication/Satellite
2200-2290	Communication/Satellite
2900-3100	Radar

Although military C-E systems can be found throughout the spectrum, the frequency bands identified in Table 2-2 represent those bands below 3 GHz that are used extensively by the U.S. military in providing for the national defense. Many of these bands are standardized with U.S. allies in Europe and elsewhere so that interoperability can be achieved during combined actions.

Communication functions performed by the DoD in support of its national security mission are conducted under the fixed and mobile service allocations in the 225-328.6 MHz, 335.4-399.9 MHz, 1755-1850 MHz, and 2200-2290 MHz bands. These functions include, but are not limited to, tactical voice, data, and video communications (secure and non-secure), air traffic control, air combat training, flight testing telemetry, control of remotely piloted vehicles, and weapons and target scoring systems. Most of the systems operating in these frequency bands support

wartime functions; however, extensive peacetime training and alert exercises are conducted to maintain combat readiness and for the development of fighter aircraft. The DoD operates more than 75,000 radio equipments in these bands[7] and the estimated investment costs in communication systems utilizing these frequency bands exceeds $12.3 billion.[8]

Radar systems are operated by the military services under the radiolocation service allocations in the 420-450 MHz, 902-928 MHz, 1215-1350 MHz, and 2900-3100 MHz bands from land-based (fixed and mobile), shipborne, and airborne platforms. Radars performing early warning and missile detection are typically fixed land-based systems that require a long detection range, a large antenna, and a low operating noise environment. These operational requirements constrain long-range search radar operations to the lower portions of the spectrum. Airborne radar serves as the eyes and ears of the crew, providing air and surface surveillance, air interception, target tracking, weapons control, navigation and ground mapping, target illumination, and intelligence gathering functions. Shipborne radars are used principally for surface and air search, height finding, weapons fire control, target illumination, and aircraft control. Battlefield radars are used to provide many of the same functions previously described with the added requirement of tactical mobility. In order to provide adequate immunity to hostile jamming, most military radars have a wide tuning capability that extends over most or all of their allocated frequency band. The loss of even a portion of the band could have a detrimental impact to their operational requirements. The DoD has an estimated investment in radars utilizing these frequency bands of greater than $26.6 billion.[9]

Satellite operations are conducted in the 235-322 MHz, 335.4-399.9 MHz, 1215-1300 MHz, 1559-1610 MHz, 1761-1842 MHz, and 2200-2290 MHz bands under the mobile satellite service, space operation, space research, and radionavigation-satellite service allocations. Functions performed include tactical and strategic military communications, radionaviagation, proliferation detection technology including nuclear burst data, and spacecraft tracking, telemetry, and command (TT&C) operations. Military satellite communications are essential to linking the activities of ground, air, surface, and subsurface mobile platforms. Radionavigation functions are provided to the military worldwide via the GPS system, developed by the DoD to be its primary navigation system well into the next century. The GPS satellites will also transmit an alerting signal at 1381.05 MHz $\pm$ 2.5 MHz in the event that a nuclear burst is detected. Spacecraft TT&C operations consist of space tracking to determine the orbit, velocity, or instantaneous position of the spacecraft, space telemetry for the transmission of data relating to the function of the spacecraft, and space telecommand to initiate, modify, or terminate spacecraft functions. The estimated DoD investment in satellite systems that utilize these bands exceeds $113.7 billion.[10]

A detailed description of the systems that operate in the bands used to support national security are provided in the Spectrum Requirements Report[11] and the Preliminary Report.[12] A discussion of the estimated investment cost in each of the frequency bands listed in Table 2-2 is contained in the Preliminary Report.[13]

Spectrum Requirements

The communications functions provided in the bands discussed above are crucial to DoD operations. For example, the DoD has stated that "... the 225-400 MHz band is the single most critical spectrum resource of the military tactical forces, both nationally and within the North Atlantic Treaty Organization (NATO)".[14] In addition, restructuring of the 225-400 MHz military communications band cannot possibly be accomplished within the rigid time and spectrum-sharing constraints imposed by the Title III legislation.

Most of the radar functions provided in these bands, such as the early warning capabilities of the long-range radar systems, cannot be accomplished in higher frequency bands. Therefore, these systems must be protected to avoid a detrimental impact to national security.

The transmit and receive subsystems on space-borne platforms such as the satellite systems that utilize these bands cannot be easily replaced or re-tuned to conform to a reallocation. Therefore, any changes resulting from a reallocation of these bands would have to be implemented in the next generation satellites, which would likely extend beyond the 15 year criteria imposed by Title III.

Finally, from an economic standpoint, reallocation of any of these bands, assuming there were relocation alternatives for the systems currently in operation, would be cost prohibitive based solely on investment expenditures. Actual relocation costs for each system would be anticipated to run several times the initial investment cost.

For these reasons, reallocation of the bands identified in Table 2-2 as being necessary for national security and required for the ability of our forces to support allies, is not considered to be a practical option.

SATELLITE COMMUNICATION BANDS

Spectrum Usage

The frequency bands below 3 GHz that are used to support satellite communications are vital to performing the missions assigned to the Federal agencies by the President and Congress. These missions include: meteorological observations, space research and exploration, distress and safety-of-life communications, and communications supporting military and non-military operations on a world wide basis. To support these functions, satellite systems owned and operated by the Federal Government, and commercial systems, are employed. The bands below 3 GHz that support Federal satellite communications (operated by the Federal Government) and global satellite communications (operated by commercial entities) are shown in Table 2-3.

There are several Federal mobile-satellite systems in the bands below 3 GHz that are used to support U.S. military operations on a worldwide basis. Tactical and strategic military satellite

communications, are essential to linking the activities of ground-based, airborne, and shipborne platforms. The satellites that operate in the bands below 3 GHz include both geostationary and non-geostationary systems. One of the primary DoD mobile satellite systems is the Navy's Fleet Satellite Communication (FLTSATCOM) Ultra High Frequency (UHF) satellites. This system provides the Navy with worldwide communications between ships, shore stations, and area commanders. The DoD's use of mobile-satellite systems, particularly in the 235-322 and 335.4-399.9 MHz bands is expected to increase in the next few years. The Federal Government has an estimated investment cost exceeding $10 billion in mobile satellite systems operating below 3 GHz.[15] In addition to tactical communication, nuclear detonations around the world are detected by sensors on GPS satellites, and a message is relayed to numerous fixed, transportable, and mobile locations in the spectrum below 3 GHz.

TABLE 2-3
SATELLITE COMMUNICATIONS BANDS
(30-3000 MHz)

Federal Satellite Communications

Frequency Band (MHz)	Functions
137-138	Meteorological Data
235-322	Communications - MSS (military only)
335.4-399.9	Communications - MSS (military only)
400.15-403	Meteorological Data - TT&C
1378.55-1383.55	GPS - Nuclear Burst Detection
1675-1710	Meteorological Data
1755-1850	TT&C
2025-2110	TT&C
2110-2120	TT&C
2200-2300	TT&C

Global Satellite Communications[a]

Frequency Band (MHz)	Functions
148-150.05	Commercial MSS Operations
399.9-401	Commercial Worldwide Navigation
1525-1559	Commercial MSS Operations
1610-1660.5	Commercial MSS Operations
2483.5-2500	Commercial MSS Operations

a) The Federal Government will not operate any satellites in these bands but is expected to be a substantial user of the services.

There are three main meteorological satellite systems that operate in the bands below 3 GHz that are being used by the Federal Government: the Geosynchronous Operational Environmental Satellite (GOES) system; the Polar Orbiting Environmental Satellite (POES) system; and the Defense Meteorological Satellite Program (DMSP) system. The POES and GOES satellite systems are used worldwide for gathering meteorological data for weather prediction, severe weather warning, and research. This data is essential for severe storm notification and public safety, and is used daily on television and radio broadcast weather reporting to the public. Both the POES and GOES carry a Search and Rescue Satellite-Aided Tracking (SARSAT) subsystem. The DMSP will provide weather data (meteorological, oceanographic, and ionospheric)

to meet the specialized requirements for a wide variety of DoD tactical users. The estimated Federal investment in these meteorological satellite systems exceeds $5.4 billion.[16]

The global ground network and Tracking and Data Relay Satellite System (TDRSS) operated by the National Aeronautics and Space Administration (NASA) in the bands below 3 GHz is essential to earth exploration, space operations, and space research activities. Over 50 U.S. space missions, and additional foreign missions, consistent with international agreements will be supported by NASA in the next 5 years using the 2025-2110 MHz band. This will include varying degrees of support from launch and orbital transfer to full-time data relay. These telecommunications links are also made available to commercial expendable launch vehicle operations. One hundred and twenty three satellites from nine countries are either planning or already have begun operations in the 2025-2110 MHz band. Deep Space Network command links for current and future missions such as Voyagers 1 and 2, GALILEO, and ULYSSES are also supported in the spectrum below 3 GHz.

The frequency bands below 3 GHz are extensively used for TT&C of DoD and NASA satellite systems. The spectrum below 3 GHz is important for performing TT&C because an all weather capability is required when communications must be established with a satellite regardless of its orientation. The Space Ground Link Subsystem (SGLS) is used to perform the TT&C to support 96 DoD satellites valued at $115 billion that are critical to national security.[17] Many of these satellites have life expectancies in excess of 15 years, and changing frequencies on satellites that have already been launched is not possible. The SGLS is the planned TT&C system for the next several generations of DoD satellites.

In the global satellite communications bands below 3 GHz the International Maritime Satellite Organization (INMARSAT) provides distress, and safety communications, as a part of the Global Maritime Distress Safety System (GMDSS). All Federal vessel operators use of INMARSAT/GMDSS system. The bands below 3 GHz are used by the SARSAT search and rescue subsystem to relay satellite distress and safety transmissions. The SARSAT is part of the international COSPAS/SARSAT system and is used to communicate safety and distress information from ships and aircraft to search and rescue units. The SARSAT system is used on both the POES and GOES satellite systems. Plans also exist for satellite Emergency Position-Indicating Radio Beacon Stations (EPIRBS) that will relay distress and safety signals between satellites in the bands below 3 GHz.

A detailed description of the systems that operate in the bands used to support satellite communication functions are provided in the Spectrum Requirements Report[18] and the Preliminary Report.[19] A discussion of the estimated investment cost in each of the frequency bands listed in Table 2-3 is contained in the Preliminary Report.[20]

Spectrum Requirements

The public already receives immeasurable benefits from the Federal Government satellite bands that support meteorological observations, space research and exploration, and public-safety communications. Therefore reallocation of the bands that support these functions is not seen as a viable option.

As discussed in Section 1, Title III of BBA 97 requires that 15 MHz of spectrum from the 1990-2110 MHz band be transferred for allocation and assignment through competitive bidding. Based on this, the 2025-2110 MHz portion of the band that is used by the Federal Government for earth exploration, space operations, and space research will not be considered for reallocation in this study.

The Federal Government bands that support military satellite communications and TT&C for DoD satellites are critical to satisfying national defense mission requirements. The life cycle of these satellites in many cases will exceed 15 years. The band selection criteria of Title III, specifically states that the bands identified for reallocation should not cause excessive mission and cost impact to the Federal Government. Because of the criticality to national defense, the extremely high investment in these bands, and the unavailability of the bands in the next 15 years, reallocation for non-Federal use is not considered a viable option.

The global satellite systems are a combination of Federally operated systems and commercially operated systems. However, all Federal use of these bands is strictly as a customer of the commercial services; the Federal Government does not own or operate any satellite networks in these bands. Consequently, reallocation of this spectrum under the requirements of Title III is not applicable.

RADIO ASTRONOMY AND PASSIVE REMOTE SENSING BANDS

Spectrum Usage

Scientific studies of the Universe have intensified in recent years, both within the United States and abroad. Radio astronomy and passive remote sensing are critical to these studies. Research is carried out at numerous Federal and university facilities from Hawaii to Puerto Rico. While it is difficult to estimate Federal investment in radio telescopes on a band-by-band basis, the overall total is approximately $410 million.[21]

Radio astronomers are interested in two distinct types of cosmic signals: wide band continuum emissions and narrowband spectral line emissions. Continuum emissions, both thermal and non-thermal, extend continuously over most of the radio frequency spectrum. Thermal emissions generally increase in intensity with increasing frequency, while the intensity of non-thermal emissions generally decreases with increasing frequency.

Spectral line emissions result from changes in the energy states of individual cosmic atoms and molecules. Spectrum planning for observation of these emissions is difficult because the Doppler effect causes a shift of the apparent frequency of the emissions as a function of the relative velocity of the source.

A number of bands are used exclusively for radio astronomy and passive remote sensing in the 30-3000 MHz frequency range. In this range, the four shaded bands, shown in Table 2-4 along with other bands are important for radio astronomy, support critical spectral line and continuum measurements, and are allocated on a worldwide basis for radio astronomy observations. The possibility of sharing these bands with other radio services is limited by the extreme sensitivity of the receivers used in radio astronomy and other passive service observations. However, in an effort to develop sharing relationships when possible and accommodate private sector spectrum requirements, the radio astronomers have developed an agreement with the FCC that will allow low power medical telemetry devices to operate in the 608-614 MHz band. In order to protect radio astronomy observations from interference the FCC will implement a coordination procedure.[22]

TABLE 2-4
RADIO ASTRONOMY AND PASSIVE REMOTE SENSING BANDS
(30-3000 MHz)

FREQUENCY BAND (MHz)	STATUS
406.1-410	Shared Primary
608-614	Exclusive Primary
1350-1400	Unprotected
1400-1427	Exclusive Primary
1610.6-1613.8	Shared Primary
1660-1660.5	Shared Primary
1660.5-1668.4	Exclusive Primary
1668.4-1670	Shared Primary
1718.8-1722.2	Unprotected
2690-2700	Exclusive Primary

A detailed description of radio astronomy and passive sensing operations is provided in the Spectrum Requirements Report[23] and the Preliminary Report.[24] A discussion of the estimated investment cost is contained in the Preliminary Report.[25]

Spectrum Requirements

The radio astronomy and passive remote sensing have little control over the signals they use. Their spectrum requirements are therefore based on physical phenomena rather than expected growth, as is the case for most other radio services. Simply replacing these frequencies with another set of frequencies is currently not a viable option. The four shaded bands in Table 2-4 are the only bands in the 30-3000 MHz frequency range where a national agreement has been reached to exclude all radio transmissions on a nationwide basis. Because of the importance of the bands allocated on an exclusive primary basis for radio astronomy and passive remote sensing, continued access by the Federal Government to satisfy current and future national and international radio astronomy

programs is essential. These specific frequencies were selected based on the physics of radio astronomy signals, and hence cannot be made available in the foreseeable future. For these reasons, the bands allocated for exclusive radio astronomy and passive remote sensing have not been considered for reallocation.

FEDERAL LAW ENFORCEMENT AND PUBLIC SAFETY COMMUNICATION BANDS

Spectrum Usage

The importance of radio communications to the public safety community cannot be overstated. In a large-scale disaster such as an earthquake, forest fire, or flood, hundreds of agencies from Federal, state, and local governments and thousands of individuals come together to provide emergency medical assistance, fire suppression, rescue operations, infrastructure repair, crowd control and security, food and shelter, and to begin the process of rebuilding. At a time when other means of communication are likely to be inoperable, public safety radio systems must provide interference-free communications between the responders and their agencies. The predominant bands used to support Federal law enforcement and public safety operations in the U.S. are shown in Table 2-5.

TABLE 2-5
FEDERAL LAW ENFORCEMENT AND PUBLIC-SAFETY COMMUNICATIONS BANDS
(30-3000 MHz)

Frequency Band (MHz)	Functions
162-174	Land mobile and associated fixed links
406.1-420	Land mobile and associated fixed links

Federal public safety responsibilities encompass law enforcement, transportation, natural resources, emergency and disaster, and medical and administrative duties. While many of these responsibilities are similar to those incumbent on non-Federal public safety agencies, there are some additional responsibilities that are unique to the Federal operations. Among these unique responsibilities are: protection of the President, and other high-level officials, both U.S. and foreign; promoting public safety and efficiency in traveling via air, water, and land; interdicting entry of illegal personnel and substances into the United States; establishing communications between disaster areas and relief forces; ensuring the swift search and rescue of human life; protecting the national forests, parks, and farmlands; bringing to justice perpetrators of Federal crimes; and ensuring the security of energy generation and distribution networks. In addition, Federal emergency response and public safety organizations conduct large scale exercises to prepare for and respond to a wide variety of emergencies and disasters, such as hurricanes, earthquakes, and chemical and nuclear power plant accidents.

Federal public safety operations have evolved over the years to be critically dependent on the use of the radio frequency spectrum as the only reliable and effective means of communications. Since these types of operations are often highly mobile, spectrum allocated to the land mobile radio service is necessary to support the communication needs. Although most operations are conducted within the land mobile service, public safety agencies also use fixed point-to-point and point-to-multipoint systems under the fixed service allocation. An additional requirement of Federal public safety providers is that operations be supported nationwide and in some cases worldwide.

The Public Safety Wireless Advisory Committee (PSWAC) was established by the FCC and NTIA in June of 1995 to provide advice on the specific wireless communications requirements of public safety agencies through the year 2010 and make recommendations for meeting those needs. In its final report, the PSWAC recognized the 162-174 MHz and 406.1-420 MHz bands as the primary frequency bands used by the Federal Government to support public safety requirements, including Federal law enforcement.[26] The land mobile service is the predominant service used by the Federal agencies in these bands. The 162-174 MHz frequency band supports more frequency assignments, and correspondingly, more equipment usage than any other 12 MHz of the radio spectrum allocated to the Federal Government. Approximately 25 percent of all Federal Government assignments fall into this band.[27] Federal trunked radio communications systems are accommodated primarily in the 406.1-420 MHz band.

A detailed description of the systems that operate in the bands used to support Federal law enforcement and public safety communications are provided in the Spectrum Requirements Report[28] and the Preliminary Report.[29] A discussion of the estimated investment cost in the 162-174 and 406.1-420 MHz bands is contained in the Preliminary Report.[30]

Spectrum Requirements

Although these two bands are already highly congested, assignments have been growing at a rate of 8-12 percent annually for the last several years. Currently, significant effort is being focused on increasing the spectral efficiency and capacity of Federal land mobile services in order to satisfy increasing user demands in these two bands. A channel plan has been adopted by the NTIA for the 162-174 MHz band that halves the previously permissible channel widths of 25 kHz to 12.5 kHz channel widths. This plan is applicable to all new systems introduced after January 1, 1995, and to all systems in the band by January 1, 2005.

In the 406.1-420 MHz band, Federal trunked systems are being accommodated in an effort to promote spectrum efficiency. Trunking improves the spectrum efficiency by providing more user access for a given number of channels. The NTIA and Federal agencies have adopted a migration plan to rechannelize the 406.1-420 MHz band from 25 kHz to 12 kHz channels. The 12.5 kHz channel plan commenced in 1995 for new eqipment and the changeover date for existing equipment is 2008. This new channel plan will increase the number of available channels in this band.

Because of the critical public safety and law enforcement functions performed in these bands, and the benefit that is already provided to the public, reallocation of these bands for non-Federal use is not considered to be a viable option.

CONSUMER-ORIENTED AND COMMERCIAL SERVICES SHARING WITH FEDERAL SYSTEMS

Spectrum Usage

Reallocation of Federal Government spectrum in a manner that disrupts the operations of well established consumer-oriented and commercial services in that spectrum will not serve the public interest if the service disruption out weighs the benefits gained by the public. Commercial and consumer-oriented products and services sometimes share bands allocated to the Federal Government. Title III of BBA 97 requires that the effect on these services be taken into consideration when identifying Federal Government spectrum for reallocation.[31] Federal Government bands that are used extensively for consumer-oriented and commercial services are shown in Table 2-6.

TABLE 2-6
CONSUMER-ORIENTED AND COMMERCIAL SERVICES SHARING WITH FEDERAL SYSTEMS
(30-3000 MHz)

Frequency Band (MHz)	Functions
902-928	Part 15 Devices and Location and Monitoring Service
1435-1525	Aeronautical Telemetry

As discussed in the NTIA Preliminary Report there are currently five separate user groups sharing the 902-928 MHz band, and the relative hierarchy among these users is well established. The 902-928 MHz band is allocated for primary use by the Federal Government for radiolocation, fixed, and mobile services and by users of Industrial, Scientific, and Medical (ISM) devices. Use of the spectrum by Federal Government fixed and mobile and Automatic Vehicle Monitoring (AVM) systems is secondary to both of these uses. The remaining users of the 902-928 MHz band, licensed amateur radio operators and unlicensed devices operating under FCC Part 15 rules, operate on a secondary basis to all other uses, including AVM. In the Location and Monitoring Service Report and Order (LMS R&O), the FCC modified and eliminated outdated regulations that have not kept pace with the technological evolution of AVM and established a new service, the LMS, that both encompasses the old AVM service and future advanced transportation-related services.[32] Despite this complex spectrum allocation structure, this band effectively supports a number of critical Federal requirements and a wide array of consumer and commercial applications.

The Navy operates the AN/SPS-49(V) as a shipborne radar on board approximately 115 ships and shore installations. Operation in the 902-928 MHz band is critical because it offers unique propagation characteristics that permit detection of small, fast moving targets over water, referred to as sea skimmers. A sea skimming missile or aircraft poses a particular problem, since at normal target tracking frequencies in smooth sea conditions there is a tendency for the radar return to be reflected back off the sea surface, causing confusion to the radar resulting in gross errors in assessment of speed and range. This problem has been largely overcome by using frequencies in the 902-928 MHz band.[33] The Navy maintains that continued access to the 902-928 MHz band is essential to meet national defense requirements. Relocating the AN/SPS-49(V) radar to another band may not be possible. Moving it to a lower frequency range could severely degrade the accuracy of the radar and compromise its mission. Moving it to a higher frequency range could significantly degrade the radar's capability to detect very small targets. Based on this unique frequency requirement, reallocation of the entire 902-928 MHz band is not considered a feasible option.[34] Reallocation of a portion of the band for non-Federal use would reduce available spectrum resources to conduct Naval exercises in coastal areas. The resulting increase in radar-to-radar interference would limit the size of combined task force formations to as few as two or three ships, a situation incompatible with Navy mission requirements. Redesign, procurement and installation of a replacement radar to operate in a different band would cost on the order of $1.66 billion.[35]

A large majority of the unlicensed products on the market today operate in the 902-928 MHz band due to the operating range and cost of radio frequency components. Part 15 of the FCC rules permits operation of radio frequency devices without a license from the Commission or the need for frequency coordination. The technical standards for Part 15 transmission systems are designed to ensure that there is a low probability that these devices will cause harmful interference to other users of the spectrum. Part 15 also authorizes the unlicensed operation of spread spectrum transmitters within the 902-928 MHz band at higher power levels than would be normally permitted for other unlicensed devices. Part 15 devices that operate throughout the 902-928 MHz band include: communication systems, cordless telephones, wireless barcode readers, meter reading systems, and commercial and residential wireless alarm systems. There are approximately 4 million Part 15 devices operating in the 902-928 MHz band.[36]

Under Footnote US218, LMS operations are licensed by the FCC. In the LMS R&O the FCC adopted a spectrum plan for the 902-928 MHz band.[37] This plan allocates spectrum in eight sub-bands within the 902-928 MHz band for both multilateration and non-multilateration LMS operations. LMS operations with bandwidths of 2 MHz, 6 MHz, and 8MHz are authorized to operate in the 902-928 MHz band. The FCC expects that in the coming years, LMS systems will play an integral role in the development and implementation of the variety of radio advanced transportation-related services known as the Intelligent Transportation System (ITS).[38]

The military and commercial aerospace industry use various aeronautical telemetry (ATM) systems to support a variety of test flight and equipment development functions. Aeronautical flight

testing is an expensive, technically sophisticated and demanding, and at times dangerous operation. A number of complex and organizationally independent functions must be successfully coordinated to complete a mission. Examples of some of these functions are: range safety (e.g., flight termination capability, clearing the range of non-participants, etc.); "chase" aircraft; weather; measurement support (radar, recorders, etc.); target drone aircraft; nominal test system operation (no test vehicle and system malfunctions); and aeronautical telemetry support. Because the successful scheduling of a mission relies on so many disparate factors, it is important that sufficient interference-free spectrum is available. The aeronautical flight test community extensively uses the 1435-1525 MHz band for ATM operations.

The 1435-1525 MHz band ATM allocation is vital and is used extensively for both Federal Government and commercial aviation flight testing of aeronautical vehicles and sub-systems. The importance of this band as a critical resource for Program Test and Evaluation (T&E) is reflected in letters on file with NTIA from several members of the Aerospace and Flight Test Radio Coordinating Council (AFTRCC)[b] which include: Boeing Defense and Space Group, Bell Helicopter Textron Inc., Raytheon Aircraft Company, and Teledyne Ryan Aeronautical.[39] In each case the correspondent expresses his Company's concerns regarding the 1435-1525 MHz band; the importance of the allocation to maintain international competitiveness; and the Company's commitment to preservation of the flight test allocation.

The unique characteristics of the ATM link make frequency sharing with other radio services in the same geographic area very difficult. The aircraft under test may be at extreme ranges from its monitoring ground station, and its effective antenna pattern experiences severe "fades" due to the various aircraft attitudes encountered during test maneuvers. The ground received signal is therefore often little above the noise level of the ATM monitoring receiver. In addition, because of the altitude of the aircraft, the area affected can be rather large in terms of potential interference from the ATM operation or other possible users of the band. Finally, due to the extremely dense use of the band in several of the most heavily populated areas of the U.S., attempts at "stand-by" use by another service would not be productive, especially during daylight hours.[40]

A detailed description of the systems that operate in the bands used to support consumer-oriented and commercial services sharing with Federal systems are provided in the Spectrum Requirements Report and the Preliminary Report.[41] A discussion of the estimated investment cost in these bands is contained in the Preliminary Report.[42]

[b] The AFTRCC as been recognized by the FCC as the frequency coordinating advisory committee for flight test frequencies.

Spectrum Requirements

The DoD considers that continued access to the full 902-928 MHz band on a primary basis is essential to meet national defense requirements. Based on this stated requirement, reallocation to exclusive non-Federal use is not considered feasible. Part 15 devices currently operating in the 902-928 MHz band allow businesses to operate more effectively and efficiently, without the regulatory complexities of many licensed services. It is envisioned that LMS will play an integral role in the development and implementation of the ITS, improving the efficiency and safety of our nation's highways. In essence a mixed-use allocation exists in this band that can be viewed as being highly successful. The Federal Government radars and other systems are operated while causing little or no impediment to the successful operation and growth of non-Federal users and vice versa. For these reasons, this band will not be considered for reallocation.

The 1435-1525 MHz band is coequally shared between Federal and non-Federal users and represents an important ingredient in the productivity and safety of the flight test process for the military and aerospace industry. The spectrum allocated for extensive airframe testing using telemetering equipment has contributed to the U.S. leadership in the aerospace industry, and will be required for the identifiable future needs of the Federal Government. In recent years, the spectrum available to support the flight test telemetry operations has been reduced by over 30 percent. The current uses of the bands allocated for ATM already provide considerable public benefits. The cost and operational impact to both the Federal and commercial aviation industry of an additional reallocation would far outweigh any positive public benefits. For these reasons the 1435-1525 MHz band is not considered for reallocation.

BANDS THAT HAVE ALREADY BEEN IDENTIFIED FOR REALLOCATION

Spectrum Reallocation Study Required by OBRA 93

In compliance with Title VI of OBRA 93, NTIA performed a spectrum reallocation study that identified 235 MHz of spectrum to be transferred to the FCC for licensing to the private sector.[43] The reallocation study established a schedule by which the President may withdraw or limit Federal frequency assignments in the bands identified for reallocation. The bands below 3 GHz that are scheduled for reallocation are shown in Table 2-7. Since these bands have already been identified for transfer to the FCC they cannot be considered in this study.

Accelerated Availability of the 1710-1755 MHz Band

Title III requires that the planned date for competitive bidding of the 1710-1755 MHz band be accelerated. However, it is clearly stated in the conference report for the BBA 97, that the conferees intend that the Federal stations in the 1710-1755 MHz band are to be withdrawn in accordance with the plan established in the NTIA Final Report.[44] Moreover, the conferees confirm that the sites identified in Appendix F of the NTIA Final Report will be retained indefinitely.

TABLE 2-7.
The Bands Below 3 GHz Scheduled for Reallocation Under OBRA 93

Bands Identified for Reallocation	Reallocation Status	Reallocation Schedule
1390-1400 MHz	Exclusive	January 1999
1427-1432 MHz	Exclusive	January 1999
1670-1675 MHz	Mixed	January 1999
1710-1755 MHz	Mixed	January 1999/2004[a]
a) Earlier availability date applies only to the 25 largest U.S. cities and is further subject to timely reimbursement of Federal costs, including reimbursement directly from the private sector.		

BANDS TO BE CONSIDERED FOR REALLOCATION

After eliminating the Federal bands that fall into one or more of the established categories the bands shown in Table 2-8 were considered for reallocation for non-Federal use.

TABLE 2-8.
Federal Government Bands To Be Considered For Reallocation

Frequency Band	Bandwidth
32-33, 34-35, 36-37, 38-39 MHz	4 MHz
40-42 MHz	2 MHz
138-144 MHz	6 MHz
216-220 MHz	4 MHz
403-406 MHz	3 MHz
932-935/941-944 MHz	6 MHz
1370-1378.55, 1383.55-1390 MHz	15 MHz
1432-1435 MHz	3 MHz
2360-2390 MHz	30 MHz

ENDNOTES

Requests for copies of references from Federal departments and agencies should be referred to the originating organization. Parts of the reference material may be exempt from public release.

1. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Special Publication 96-332, *High Frequency (3-30 MHz) Spectrum Planning Options* (Nov. 1996), at 3-2.

2. National Telecommunications and Information Administration, U.S. Department of Commerce, *Manual of Regulations and Procedures for Federal Radio Frequency Management* (September 1995) (Revised September 1996, Jan. and May 1997).

3. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Special Publication 94-27, *Preliminary Spectrum Reallocation Report* (Feb. 1994) [hereinafter NTIA Preliminary Report], at 2-7.

4. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Special Publication 94-31, *U.S. National Spectrum Requirements: Projections and Trends*, (Mar. 1995) [hereinafter NTIA Spectrum Requirements Report], at 105.

5. NTIA Preliminary Report, *supra* note 3, at 2-2.

6. *Id.* at 2-7.

7. *Id.* at D-8.

8. *Id.* at 2-33.

9. *Id.* at 2-16; NTIA Spectrum Requirements Report, *supra* note 4, at 130.

10. NTIA Preliminary Report, *supra* note 3, at B-4 and B-6.

11. NTIA Spectrum Requirements Report, *supra* note 4, at 125, 128, and 129.

12. NTIA Preliminary Report, *supra* note 3, at 2-10, 2-17, 2-19, 2-23, and 2-33.

13. *Id.* at 2-10, 2-16, 2-20, 2-23, 2-33, and 2-35.

14. Letter from AF Frequency Management Agency, U.S. Department of the Air Force, to NTIA Interdepartment Radio Advisory Committee, *AF Title VI Mission and Financial Impact Statements* (Nov. 9, 1993) (FOR OFFICIAL USE ONLY).

15. NTIA Preliminary Report, *supra* note 3, at 2-20.

16. *Id.* at 2-33, and 2-35.

17. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Special Publication 94-27, *Spectrum Reallocation Final Report* (Feb. 1995), [hereinafter - NTIA Final Report] at 4-11, and 4-13.

18. NTIA Spectrum Requirements Report, *supra* note 4, at 53, and 146.

19. NTIA Preliminary Report, *supra* note 3, at 2-19 and 2-33.

20. *Id.* at 2-20, 2-23, and 2-35.

21. NTIA Preliminary Report, *supra* note 3, at 2-10.

22. Letter from Tomas Gergely, NSF IRAC Representative, to E. Drocella, NTIA (Dec. 2, 1997), at 2.

23. NTIA Spectrum Requirements Report, *supra* note 4, at 157.

24. NTIA Preliminary Report, *supra* note 3, at 2-8.

25. *Id.* at 2-10.

26. National Telecommunications and Information Administration, U.S. Department of Commerce, Public Safety Wireless Advisory Committee, Final Report, Vol.1 (Sept. 1996) at 18.

27. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA TM 94-160, *National Land Mobile Spectrum Requirements* (Jan. 1994), at 25.

28. NTIA Spectrum Requirements Report, *supra* note 4, at 13.

29. NTIA Preliminary Report, *supra* note 3, at D-2.

30. *Id.* at 2-33.

31. Balanced Budget Act of 1997, Pub. L. No. 111, Stat.251 (1997), § 9233 (a) (4).

32. *Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Report and Order, PR Docket No. 93-61 (Feb. 6, 1995) [hereinafter LMS R&O].

33. NTIA Preliminary Report, *supra* note 3, at 2-14.

34. *Id.*

35. Memorandum for the Assistant Secretary of Defense (C3I), from R.M. Nutwell, Rear Admiral, U.S. Navy, Deputy Director, Space, Information Warfare, Command and Control. Subject: Reallocation of Spectrum in Accordance with the Balanced Budget Act of 1997 (Dec. 9, 1997) at 4.

36. LMS R&O, *supra* note 32, at 12.

37. *Id* at 6.

38. *Id* at 3.

39. Letter from William K. Keane, Arter & Hadden Attorneys at Law, Counsel for the Aerospace & Flight Test Radio Coordinating Council, to Richard D. Parlow, Associate Director Office of Spectrum Management National Telecommunication and Information Administration (July 2, 1997) (on file with NTIA).

40. Department of Defense Comments in Response to the Notice of Inquiry and Request for Comments, *Current and Future Requirements for the Use of Radio Frequencies in the United States*, Docket No. 920532-2132, 57 Fed. Reg. 25,010 (Nov. 5,1992), at 12.

41. NTIA Preliminary Report, *supra* note 3, at 2-28 and 3-10.

42. *Id.* at 2-16 and 2-33.

43. NTIA Final Report, *supra* note 17, at 5-1.

44. Conference Report on H.R. 2015, Balanced Budget Act of 1997, 143 Cong. Rec. H6174 (July 29, 1997).

SECTION 3
ASSESSMENT OF REALLOCATION OPTIONS

INTRODUCTION

In the previous section, the bands to be considered for reallocation for non-Federal use were identified. All of the bands being considered for reallocation are used by the Federal Government agencies, in varying degrees, to support Presidential and Congressionally mandated missions. Thus, all reallocation options will entail to some degree cost and/or operational impact to the Federal agencies. Simply identifying the bands that have a minimum impact on the Federal Government agencies would not meet the intent of Title III with regard to the public benefit. The spectrum reallocation plan must strike a reasonable balance with respect to impact to the Federal Government users and potential benefits to the public.

This section provides a detailed assessment of the reallocation options for the bands under consideration. Factors such as, the Federal and non-Federal use of the band, estimated mission impact and cost to the Federal agencies, and potential benefits to the public will be addressed. A band-by-band assessment of these factors is presented and recommendations are made as to which bands will be included in the spectrum reallocation plan.

32-33, 34-35, 36-37, 38-39, AND 40-42 MHz BANDS

Band Usage

The DoD uses the frequency bands between 32-42 MHz for tactical communication using the Single Channel Ground and Airborne Radio System (SINCGARS) and other land mobile radio (LMR) assets (e.g., Scope Shield II) as well as some non-tactical intra base radio functions. The Scope Shield II system provides the Air Force Security Police with a tactical communications capability to support their mobility mission worldwide. The Scope Shield II equipment is also used by the Air Force Surgeon General, Air Force Civil Engineer, Air Force Special Operations Command (for other than security police missions), and the Army, Navy, and Marines. In addition, the Air Force has an airborne SINCGARS radio (1050 units at $13,000 per unit) designed to assist in Close Air Support (CAS) to ground forces. The SINCGARS airborne complement is scheduled to be installed in Air Force aircraft such as the A-10, AC-130H/U, EC-130E/H, and F-16C/D.[1]

The Air Force also uses frequencies in these bands to support contingency operations, including search and rescue; ground airbase defense training; special projects; and miscellaneous activities to include Research and Development Test and Evaluation (RDTE), aeronautical, air-ground advisory, in-flight communications for A-10 training, test range operations, and explosive ordnance disposal.

The Department of Energy (DOE) uses the bands between 32-42 MHz at their Albuquerque, Nevada, and Richland Operations Offices for wireless microphone, LMR, and meteor burst communications. These bands support the DOE statewide Public Safety Net which includes fourteen mountain top repeater sites and the perimeter security device used at the Nevada Test Site. A single frequency is also licensed nationwide for DOE emergency services.[2]

The Department of Interior (DOI) also uses these bands to provide communications in regions that encompass large geographic areas, such as national forests, national parks, wildlife refuges, and Indian reservations. The DOI estimates that they have an estimated investment cost of $12 million in equipment that operates in the bands between 32-42 MHz.[3]

Reallocation Considerations and Impact

The bands between 32-42 MHz are part of what is referred to as the lower Very High Frequency (VHF) spectrum. These bands are used by the Federal Government primarily for providing tactical and non-tactical communication. Because of the unique propagation characteristics in this region of the spectrum, wide area coverage is possible with a minimum number of transmitters. One type of communication that can only be supported in the lower VHF spectrum is meteor burst communications.[a] It has been determined that the 40-42 MHz band is the optimum band for meteor burst systems because there is a somewhat larger meteor scatter signal return and greater channel throughput.[4]

The Air Force states that the total investment cost in these bands and the cost of reallocation are unknown and would depend on whether the band would be reallocated for exclusive civil use or shared with the Federal Government. The Air Force believes that at a minimum, reallocation of these bands would constrain their ability to perform large scale training exercises as effectively and will limit the number of channels SINCGARS equipment can utilize.[5]

The DOE states that the LMR and wireless microphone services at the Albuquerque Operations Office could be accommodated in the existing Federal Government LMR bands. However, the existing Federal LMR bands are already overused. Moving additional services into these LMR bands may have significant negative impact on existing users, especially since all Federal agencies and the military would be moving to this portion of the spectrum. The DOE Meteor Burst System does need to operate in this band due to RF propagation characteristics, although it can be replaced by a satellite communications system. The DOE estimates that the cost to replace the Meteor Burst System is $300,000.[6]

[a] Radio waves with frequencies in the lower VHF can be reflected for distances up to 2000 km form the ionized trails that are produced from meteors that enter the Earth's atmosphere.

The DOE states that since the use of the frequencies in the bands between 32-42 MHz at the Nevada Operations Office are in rural areas, it is highly unlikely that there would be enough commercial interest to jeopardize DOE systems if reallocated on a mixed-use basis.[7] If these bands are reallocated on an exclusive basis to the private sector, DOE believes that the individual nets could be incorporated into a trunking system. However, DOE adds that the conversion of the Safety Net repeater pairs to another frequency band would be troublesome. The difference in RF coverage between 32-42 MHz bands and the other available VHF/UHF LMR bands is significantly different. Changing and/or adding mountaintop repeater sites to accommodate less RF coverage provided by VHF/UHF would be very expensive. The DOE believes that the Safety Net could be accommodated on an existing State of Nevada Department of Transportation 800 MHz trunking system. The DOE states that initial coordination has already taken place, and this application has potential. However, a major roadblock to DOE's proposal is that the FCC is not in favor of licensing Federal Government entities as private users, resulting in Federal users operating as secondary subscribers. DOE estimates that it would cost $100,00 for additional sites to cover the Nevada Test Site.[8]

The DOE also states that a replacement for a simplex radio system at the Richland Operations Office will be necessary, with an estimated reallocation cost of $40,000.[9]

The DOI states that the reallocation cost for their operations in the bands between 32-42 MHz could be orders of magnitude higher than the actual investment cost, depending on the frequency band they move to and the lack of coverage which will result in moving a low band system to a higher band.[10] Taking into consideration that the reallocation would occur at a higher frequency band, present day cost of equipment, and the increased number of repeaters required to cover the same geographic area, the DOI estimates that the reallocation cost for their systems in the bands between 32-42 MHz is $48 million.[11]

The lower VHF band was studied by the PSWAC as a possible candidate to satisfy future public safety spectrum requirements.[12] It was determined by the PSWAC that the spectrum from 30 to 50 MHz is good for wide area coverage from mobiles to dispatch centers in open terrain. However, it was determined that portable radios operate poorly due to antenna limitations. Frequencies in this part of the radio spectrum were also found to be subject to "skip" interference between widely separated systems. The bands between 30-50 MHz are in a region of the radio spectrum where the ambient noise levels are high, particularly on highways and near industrial areas. The increased noise levels can limit the performance of a communications system by restricting the operating range, generating errors in messages and data, and in extreme cases preventing the successful operation of a receiver. Moreover, the availability of equipment in the lower VHF band is questionable. Both Ericsson and Motorola have indicated that they will no longer manufacture equipment capable of operating in the 30-50 MHz frequency range.[13] The PSWAC concluded that these technical constraints impair future use of the band to satisfy public safety spectrum requirements.[14]

Public Benefit

Operating frequencies for new commercial services must be chosen in a region of the radio frequency spectrum where: it is possible to use efficient compact antennas; equipment can readily be made available; and where interference can be minimized. In the 32-42 MHz bands the technical constraints and questionable availability of equipment will be limiting factors in the development of a new commercial service. In identifying bands for possible reallocation, Title III of the BBA 97 specifically requires the Secretary of Commerce to consider the extent to which equipment will be available that is capable of utilizing the band.[15] This would include any technical constraints that would contribute to the unavailability of equipment. Reallocation of spectrum in these bands may not be consistent with Title III.

Reallocation Options

Reallocation of the Federal Government bands in the 32-42 MHz frequency range for private sector use would result in little or no benefit to the public. For this reason, reallocation of these bands was not considered to be a viable option.

138-144 MHz BAND

Band Usage

The military services use the 138-144 MHz band to support air-to-ground, air-to-air, and air-ground-air (AGA) tactical communications; air traffic control operations; LMR nets for sustaining base and installation infrastructure support; and for tactical training and test range support. The frequencies 143.75 and 143.90 MHz are used by the Civil Air Patrol for air rescue operations and to support Drug Enforcement Administration and the U.S. Customs Service operations along border areas. The Air Force Auxiliary, Coast Guard Auxiliary, and Military Affiliate Radio System (MARS) also use frequencies in this band in search and rescue and other emergency operations. An allocation plan was formulated by the Military Communications-Electronics Board (MCEB) in 1971[16] which created 240 25-kHz channels within the 138-144 MHz band allotted to the Air Force, Army, and Navy. In the 138-144 MHz band there are 80 channels allotted to the Air Force, 70 to the Army, and 90 to the Navy. There is also some use of the interstitial channels by narrowband systems.

In 1992, Congress passed the Telecommunications Authorization Act of 1992.[17] Title I of this Act required NTIA to develop and implement a plan to make Federal LMR systems use more spectrum efficient technologies. A report summarizing the plan and its implementation schedule was prepared and submitted to Congress as required by the legislation.[18] As part of this plan, NTIA selected a 12.5 kHz channel width for rechanneling the Federal LMR bands.[19] The 12.5 kHz plan for the 138-150.8 MHz band commences in 1998 for new equipment and the change over date for existing equipment is 2008.[20] This plan will double the number of channels in the 138-144 MHz portion of the band from 240 (25 kHz) channels to 480 (12.5 kHz) channels.

The Air Force has 3,371 frequency assignments in the 138-144 MHz band, used primarily for tactical air-to-air, air-to-ground, and non-tactical intra-base ground-to-ground communications. In general, all Air Force aircraft have the capability to communicate using the 138-144 MHz band with an estimated investment cost in airborne radios of $100 million. In addition, the Air Force estimates that they have approximately $123 million in LMR assets that operate in the 138-144 MHz band. These investment costs do not include costs such as research and development, equipment peripherals (antenna systems, combiners, etc.), vendor price increases, or man-hours associated with having to move or retune equipment to other frequency bands. [21]

In order to demonstrate the diverse LMR usage in the 138-144 MHz band by the Air Force two specific examples are provided. The First example is the Air Force Office of Special Investigations (AFOSI) which uses frequencies in the 138-144 MHz band for conducting investigative services for the DoD agencies. These services include but are not limited to: criminal investigations, counter intelligence activities, anti-terrorism operations, protective services, and fraud investigations. In order to satisfy these mission operations, AFOSI utilizes an integrated system that combines LMR, surveillance equipment, and alarms systems on the same frequencies providing the functional capability to conduct mission operations in a covert fashion. This integration design also provides cost savings benefits by consolidating equipment into condensed mobile packages. The AFOSI has an estimated investment of $7 million in equipment capable of operating in the 138-141 MHz frequency band. The second example, is the various LMR networks at Robins AFB. Several individual LMR networks are used to satisfy typical base communication requirements: Security Police and Law Enforcement LMR network; Depot Maintenance LMR network; and the Defense Logistics Agency Supply LMR network. The base fire alarm systems also employs frequencies in the 138-141 MHz band. There is an estimated current investment of $2.5 million in LMR and fire alarm equipment at Robins AFB that is capable of operating in the 138-141 MHz frequency band. It is also anticipated that an additional $93,765 will be spent on modifications to the existing configurations.[22]

The Army has 4,946 frequency assignments in the 138-144 MHz band, which are used to support air traffic control (ATC) operations, tactical air-ground and AGA communications, land mobile radio nets and trunking systems, fire alarms, robotic control systems for explosive ordinance units, and ground threat early warning systems. In general, all Army rotary and fixed wing aircraft have the capability to communicate using the 138-144 MHz band. The Army has an estimated investment cost in airborne radios capable of operating in the 138-144 MHz band of $200 million. In addition, the Army has approximately $350 million in LMR assets that operate in the 138-144 MHz band. This value does not include costs such as research and development, equipment peripherals (antenna systems, combiners, etc.), vendor price increases, or man-hours associated with having to move or retune equipment to other frequency bands.[23]

The Navy has 3,221 frequency assignments in the 138-144 MHz band, used for air traffic control, tactical air-to-air and air-to-ground communications, land mobile radio nets and trunking systems, and sonobuoys used along the Atlantic and Pacific coastal areas. The Navy estimates that it has in excess of $2.5 billion invested in the research, development, test, evaluation, procurement, fielding, and support for the tactical, training, and LMR assets currently operating in this band.[24]

The Navy's AN/URY-1/2/3 also operate in the 138-144 MHz frequency band. The AN/URY-1/2/3 are key elements in tracking systems developed for Navy use at test and evaluation and training ranges across the United States. The AN/URY-1/2/3 provides the data communication required to downlink tracking and instrumentation data from an aircraft or a ship. This tracking equipment is used in systems on the East and West Coasts of the United States, in Hawaii, and the Bahamas. The AN/URY-1/2/3 systems are fixed to 141 MHz with a 4 MHz spread spectrum output waveform. The AN/URY-1/2 cannot be retuned to another frequency and therefore would require replacement if access to 141 MHz is lost. The Navy states that there are 850 AN/URY-1/2/3 units in service at an estimated cost of $50,000 each.[25]

The Federal Emergency Management Agency (FEMA) has 146 frequency assignments within the 138-144 MHz band. FEMA LMR operations are currently being conducted exclusively in this band and all of the LMR equipment that FEMA uses for daily operations as well as disaster response operations utilize frequencies in the 138-144 MHz band. FEMA has millions of dollars worth of LMR equipment operating in the band, distributed across the nation at over ten Regional Offices and a few operating locations. During Presidentially declared major disasters of recent years, particularly when normal communications are disrupted or saturated during the critical initial stage, FEMA's ability to perform most important disaster response and coordination functions are dependent on these LMR systems. FEMA is in this band because many of their functions originated in the U.S. Army prior to the creation of this agency. FEMA still interfaces with DoD and other agencies operating in the band during disasters.[26]

NASA's National Scientific Balloon Facility (NSBF) currently uses 138.00 MHz, 138.54 MHz, and 138.75 MHz as the primary balloon command frequency. NASA also uses this band for LMR operations at their research facilities.

The DOE uses this band for portable fixed stations to transmit range timing signals and LMR to communicate with the military.

Reallocation Considerations and Impact

The importance of the 138-144 MHz band to the military, as indicated by the heavy usage and high estimated investment cost in equipment, precludes reallocating the entire band for non-Federal use. However, reallocation of up to one-half (3 MHz) of the band on a mixed-use basis is seen as a viable option. The recommended reallocation strategy is to transfer the 139.0-140.5 MHz

and 141.5-143.0 MHz band segments to the civil sector on a mixed-use basis. The remaining 138.0-139.0 MHz, 140.5-141.5 MHz, and 143.0-144.0 MHz band segments would be retained for exclusive Federal Government use. This reallocation strategy will lessen the impact to full duplex communications, in particular, military AGA operations, by leaving intact Federal Government spectrum that will enable the required transmit/receive (T/R) separation to be realized. Frequency pairing within the remaining 138.0-139.0 MHz, 140.5-141.5 MHz, 143.0-144.0 MHz, 148.0-149.9 MHz and 150.05-150.80 MHz Government band segments can be used to provide adequate T/R separation for military AGA operations to continue in the VHF spectrum. This strategy will also enable private sector users to realize channel pairing in the two reallocated segments of the band.

Reallocation on a mixed-use basis will permit the military services to have continued access to the reallocated portion of the band at a limited number of military installations. The DoD has proposed that 80-100 channels in the reallocated segment of the spectrum be retained for military airborne operations nationwide, under the mixed-use allocation.[27] The NTIA maintains that retention of eighty 12.5 kHz channels (1 MHz) for use by the DoD in national operations, would result in only 2 MHz being reallocated from this band. The NTIA believes that this request could only be accepted if another 1 MHz of spectrum is identified for the eighty channels proposed to be retained by the DoD. The DoD did not identify 1 MHz of spectrum for substitution. Therefore, this request is not supported by the DoD.

To reduce the impact that will result from the loss of spectrum in the 138-144 MHz band, NTIA, is considering a modification to G5 of the National Table of Frequency Allocations. Footnote G5 states that "in the bands 162.0125-173.2, 173.4-174, 406.1-410 and 410-420 MHz, the fixed and mobile services are allocated on a primary basis to the Government non-military agencies."[28] Removing this limitation from the 406.1-420 MHz band for military non-tactical LMR operations will provide some relief to the DoD in the remaining VHF band segments for tactical and aeronautical mobile operations by enabling displaced non-tactical LMR assets to move into the 406.1-420 MHz band.

Several of the non-military Federal agencies oppose the removal of Footnote G5 in the 406.1-420 MHz band. DOI states that NTIA has never before accommodated forced reallocation of Federal Government frequency bands and chose not to accommodate any of the other bands proposed for mandatory reallocation in this study. DOI maintains that even though the 406.1-420 MHz band is primary for Federal Government non-military use, the DoD also heavily uses the band. DOI believes that this is indicative of the Federal agencies' willingness to share the band.[29] The United States Postal Service states that the removal of Footnote G5 from the allocation table would prevent the civilian Federal agencies from having a voice in their own band.[30] The Department of Justice (DOJ) and the Department of Treasury (Treasury) state that they are opposed to the transfer of any spectrum in the 138-144 MHz band. DOJ further states that

the G5 restriction should remain in place until the scheduled transfer date of the spectrum for non-Federal use.[31] Treasury is also opposed to the removal of Footnote G5 in the 406.1-420 MHz band.[32]

Most of the VHF radios using this band have multi-channel, and in many cases, multi-band, tuning capability. These radios are typically synthesizer tunable in 12.5 or 25-kHz steps from 138-174 MHz. This enables operation in the 138-144 MHz, 148.0-149.9 MHz, 150.05-150.80 MHz, and 162-174 MHz Federal land mobile bands. Similarly, the airborne radio sets in this band typically have tuning capability in VHF spectrum (30-88 MHz and 118-174 MHz) and UHF spectrum (225-400 MHz). Reallocation of segments of the 138-144 MHz band on a mixed-use basis will not render these radios unusable. Only the reallocated portion of the tuning range will be affected, and under a mixed-use allocation, limited operations will still be permitted in the reallocated band segment. Equipment peripherals such as antennas and combiners will not be affected. Although frequency hopping systems that tune through this band may have to undergo modifications to their hop-sets to accommodate the reallocation, adequate hopsets can be designed for operation in the remaining Federal VHF band segments.

Many of the existing wide band (25-kHz) land mobile radios in the military inventory are being replaced with narrow band systems (12.5 kHz) as a means of improving spectrum utilization in the LMR bands. The proposed date for reallocation of this band is 2008. This reallocation date was chosen to coincide with the implementation date for the narrowband channel plan currently under development by NTIA in response to the Congressional mandate defined in Title I of the Telecommunications Act of 1992.[33]

The Air Force states that reallocation of the AFOSI LMR system could result in serious mission impact. The Air Force contends that two way communication is utilized as a primary means of maintaining contact between agent personnel and DoD support agencies during mission operations. The Air Force maintains that funding support for replacing the current AFOSI inventory will be necessary.[34]

The Air Force states that the loss of the 138-141 MHz band would severely impact LMR operations at Robins AFB. The Air Force states that it would cost $15,000 to modify the equipment used in the Security Police and Law Enforcement LMR network, assuming frequencies can be found in the tuning range of the equipment and it will cost $420,000 to replace the existing equipment if frequencies are not available. The Air Force estimates that it will cost $442,000 to reprogram or change crystals in the existing equipment for the Depot Maintenance LMR network and it will cost $950,000 to replace the equipment if frequencies are not available. The Air Force estimates that it will cost $90,000 to modify the existing equipment in the Defense Logistic Agency LMR network and it will cost an estimated $200,000 to replace the equipment if frequencies are not available. The Air Force estimates that it will cost $822,000 to modify the alarm system if frequencies are available, otherwise it will cost $3.21 million to replace the entire system.[35]

The Air Force states that for many of the newer LMR systems and tactical radios (both airborne and ground systems), the cost of re-tuning radios to operate within their designed tuning range is small compared to the total investment. However, there may be substantial investments in personnel costs required to make these changes. If sufficient spectrum is available to re-tune existing equipment, and minimal replacement of equipment is required by this reallocation, the total estimated relocation cost is $20 million.[36] This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[37]

The Army states that for many of the newer LMR systems and tactical radios (both airborne and ground systems), the cost of re-tuning radios to operate within their designed tuning range is small compared to the total investment. However, there may be substantial investments in personnel costs required to make these changes. If sufficient spectrum is available to re-tune existing equipment, and minimal replacement of equipment is required by this reallocation, the total estimated relocation is $40 million. This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[38]

The Army states that it supports the proposed segmenting of the band since it will allow the Federal Government to make the maximum use of the remaining 3 MHz available for exclusive government use by having some separation between frequencies. The Army maintains that the remaining band segments available for Government exclusive use; 138-139 MHz, 140.5-141.5 MHz, and 143-144 MHz, will still not be enough spectrum to meet all of DoD's VHF requirements by themselves, especially at bases that support test and training operations. In order to satisfy the DoD channel requirements the Army recommends that 100 of the 240 channels (12.5 kHz) that are to be reallocated, be retained for continued Federal use.[39]

The Navy states that the loss of full access to all the frequencies in this band by reallocation on a shared or mixed-use basis will adversely impact the Navy's ability to "train-as-you-fight". The Navy believes that the spectrum loss will also adversely affect the day-to-day operations, maintenance, and training at practically all military installations in the United States.[40] The Navy maintains that the identification of a segment of the 138-144 MHz band appears to violate the band selection criteria where frequencies are to be selected for reallocation that "are not to be required for present or identifiable future needs of the Federal Government."[41] The Navy further states that mixed-use spectrum will be, in fact, primary status for non-Federal operations and secondary, if at all possible, for the Federal Government. The Navy is also concerned that the mixed-use reallocation status will also restrict the Federal agencies from expanding their operations to satisfy future mission

requirements.[42] The Navy states that an additional allotment of 40 channels in the 406.1-420 MHz band will be required to migrate successfully selected systems from the 139-140.5 and 141.5-143 MHz band segments.[43]

The Navy states that the AN/URY-1/2/3 systems are key elements in tracking systems and are high priority for Commander in Chief Atlantic (CINCLANT) and Commander in Chief Pacific (CINCPAC) for supporting their daily operations as well as their major fleet exercises. The Navy further states that 100 AN/URY-2 units are used on expendable drones and targets. The Navy states that the AN/URY-3 units can be retuned by the manufacturers at a cost of $15,000 each. The Navy estimates that $7 to $10 million will be required to convert the AN/URY-3 systems (majority of the URY operations) to a new frequency. The Navy maintains that the AN/URY-1 and AN/URY-2 systems cannot be retuned to another frequency and therefore must be replaced at approximately $25,000 per system for 125 systems resulting in a total cost of $3 million.[44]

The Navy estimates that the total reallocation cost for LMR and tactical equipment will be $20 million.[45] This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[46]

The DOE states they would suffer little direct mission impact if this band was reallocated; however, they are concerned that the displaced military users may choose to move to the 162-174 MHz band. DOE believes that this could cause an increased load on a band that is already severely congested in many parts of the country, having a major impact on DOE LMR operations in the future. The DOE estimates that the cost to relocate their systems from the 138-144 MHz band is $70, 000.[47]

FEMA stated that they are in the process of planning the transition of their LMR assets into the 406.1-420 MHz band. But this has been delayed for years due to the delayed coordination of the new channel plan and lack of equipment capable of narrowband operation. FEMA states that this transition will require a number of years to fund and implement once the new channel plan is approved and the new equipment is available. FEMA adds that they need some reasonable time frame to fund and to make a transition from their use of the 138-144 MHz band to support daily operations. In the meantime FEMA requests that a provision be made that will allow FEMA and any other Federal agencies responding to disasters to operate in the 138-144 MHz band during the critical initial stage of a major disaster. FEMA states that this provision must include all major urban centers as well as less populated areas of the country.[48]

NASA states that the NSBF is currently in the process of transitioning from 138.54 MHz to 429.5 MHz as the primary balloon command frequency. This transition is funded and planned for

completion by the end of FY 1998. The 138.00 MHz and 138.75 MHz channels are utilized for voice communications. Transition from these channels will require authorization onto alternate frequencies and replacement equipment at an estimated cost of $50,000. In addition NASA stated that the cost of relocating systems from the 138-141 MHz band at the Kennedy Space Center is estimated to be $20,000 and relocation of systems in use at the Ames Research Center is estimated to be $450,000.[49]

NASA's comments were provided in response to an earlier reallocation strategy. Under the current proposal, the 138.00 MHz and 138.75 MHz voice communications channels will not be affected. The impact of this proposal to operations at the Kennedy Space Center and Ames Research Center is unclear but reallocation under a mixed-use status may not impair these operations to the degree previously stated.

The loss of spectrum in the 138-144 MHz band could also affect agencies that are attempting to develop sharing arrangements with public safety organizations to include DOJ and Treasury. There is a potential for this band to be used in the development of state-wide and regional shared public-safety telecommunication systems for joint Federal, state, and local public-safety agencies. The DOJ and Treasury maintain that the reallocation of this band for commercial services is contrary to their position of supporting public safety interoperability and the implementation of a seamless communications system for use by Federal, state, and local public safety officials.[50]

Public Benefit

The 139.0-140.5 MHz and 141.5-143.0 MHz band segments are within the VHF frequency range and can be used for various fixed, mobile, and portable applications. By reallocating two 1.5 MHz band segments, channel pairing can be realized from within the reallocated band segments. The relatively stable propagation conditions found at these frequencies facilitate the development of cost-effective wide-area communications systems. The design of compact radio sets with low power consumption and efficient antennas for portable use is easily achieved in this band. Equipment that operates in this frequency range is commercially available at reasonable costs, so that new services can be marketed at an early stage. These technical factors will permit flexible use of this band for a variety of wireless applications.

Reallocation Options

This band is heavily used by the three primary military services for tactical AGA and LMR and non-tactical (intra-base and law enforcement) communications operations and in some areas of the U.S. it is extremely congested. Reallocation of the entire band for private sector use is not practical. However, in balancing the public benefits and the Federal impact, a feasible option is to reallocate one-half of the band. The specific reallocation plan calls for reallocation of the 139.0-140.5 MHz and 141.5-143.0 MHz band segments on a mixed-use basis. The 138.0-139.0 MHz, 140.5-141.5 MHz, and 142.0-144.0 MHz band segments will be retained for continued Federal use on an exclusive primary basis. The reallocation of this band is scheduled for January 1, 2008, in order to permit the orderly phase-out of equipment, the procurement of replacement equipment, and the

completion of engineering analyses. This date also coincides with the established schedule for Federal conversion to narrowband technology in this band.

This reallocation strategy will provide the least impact to the existing users of the band while at the same time provide the private sector with valuable VHF spectrum that could be used for a variety of wireless applications. NTIA will modify Footnote G5 to the National Table of Frequency Allocations to facilitate military non-tactical LMR systems to relocate to the 406.1-420 MHz band thereby increasing the number of channels available to the DoD. The modification of Footnote G5 will be placed into effect by January 1, 2005. The removal of non-tactical systems from the remaining Federal Government VHF spectrum, in conjunction with current efforts to implement narrow-band technologies in the remaining Federal Government VHF bands, and the reallocation of the affected band segments on a mixed-use basis should reduce the impact to the Federal agencies from this reallocation proposal. In addition, most of the VHF radios and peripheral equipments currently operating in the band will not require extensive modifications to accommodate this reallocation. There will be some relocation costs associated with moving the non-tactical systems currently operating in the VHF bands to the 406.1-420 MHz band and in the re-tuning of fixed-tuned systems where necessary.

The remaining Federal Government VHF band segments must be retained for military tactical use. In the reallocated band segments essential LMR operations will be protected indefinitely at the sites identified in Table 3-1. The geographical representation of the site locations is shown in Figure 3-1.

TABLE 3-1[b]

Sites at Which Federal LMR Systems in the 139.0 -140.5 and 141.5-143.0 MHz Bands Will Be Protected Indefinitely

Location	Coordinates	Protection Radius
China Lake, CA	35°41'N 117°37'W	50 km
Twentynine Palms, CA	34°14'N 116°03'W	50 km
Key West, FL	24°34'N 081°48'W	50 km
Apra Harbor, GUM[c]	13°26'N 144°39'E	50 km
Nellis AFB, NV	36°14'N 115°03'E	50 km
Cape Canaveral/Kennedy SFC/Patrick AFB, FL	28°24'N 080°35'E	65 km
Pearl Harbor, HI[c]	21°19'N 158°05'W	50 km
Roosevelt Roads, PR[c]	18°13'N 065°39'W	50 km

[b] The DoD has raised concerns about the need to include additional military sites in this band. NTIA and DoD will assess the need to include additional sites and work with the FCC during the reallocation process to insure that disruption to critical military operations is minimized.

[c] This site is located outside of the Continental United States.

TABLE 3-1 (Continued)

Sites at Which Federal LMR Systems in the 139.0 -140.5 and 141.5-143.0 MHz Bands Will Be Protected Indefinitely

Location	Coordinates	Protection Radius
Gulfport/Keesler AFB, MS	30°23'N 089011'W	50 km
Fallon, NV	39°25'N 118°41'W	50 km
Cherry Point, NC	34°54'N 076°52'W	50 km
Beaufort, SC/Fort Stewart, GA	32°10'N 081°10'W	90 km
Corpus Christi, TX	27°41'N 097°16'W	50 km
Norfolk, VA	36°51'N 076°18'W	50 km
Jacksonville/Mayport/Cecil Field/Kings Bay, FL	30°30'N 081°37'W	80 km
Fort Bragg/Pope AFB, NC	35°09'N 079°01'W	65 km
Fort Carson/Falcon AFB, CO	38°43'N 104°39'W	65 km
Fort Huachuca, AZ	31°33'N 110°21'W	65 km
Fort Lewis/Bangor, WA	47°24'N 122°39'W	65 km
Fort Irwin/Edwards AFB/Barstow, CA	35°04'N 117°16'W	100 km
Fort Jackson/Shaw AFB, SC	33°59'N 080°42'W	65 km
Fort Knox, KY	37°54'N 085°57'W	50 km
Fort Leavenworth, KS	39°21'N 094°55'W	50 km
Fort Leonard Wood, MO	37°44'N 092°07'W	50 km
Fort Polk, LA	31°03'N 093°11'W	50 km
Fort Rucker, AL	31°20'N 085°43'W	50 km
Fort Sill, OK	34°40'N 098°24'W	50 km
White Sands Missile Range/Holloman AFB, NM/Fort Bliss, TX	33°21'N 106°18'W	125 km
Eglin AFB/Hurlburt AFB/Pensacola, FL	30°25'N 086°54'W	80 km
Hill AFB, UT	41°08'N 111°58'E	50 km
San Diego, CA	32°41'N 117°09'W	50 km
Patuxent River, MD	38°16'N 076°24'W	40 km
Fort Gordon, GA	33°25'N 082°09'W	65 km
Fort Hood, TX	31°07'N 097°46'W	50 km
Yakima Firing Center, WA	46°40'N 120°21'W	65 km
Fort Drum, NY	44°01'N 075°48'W	65 km

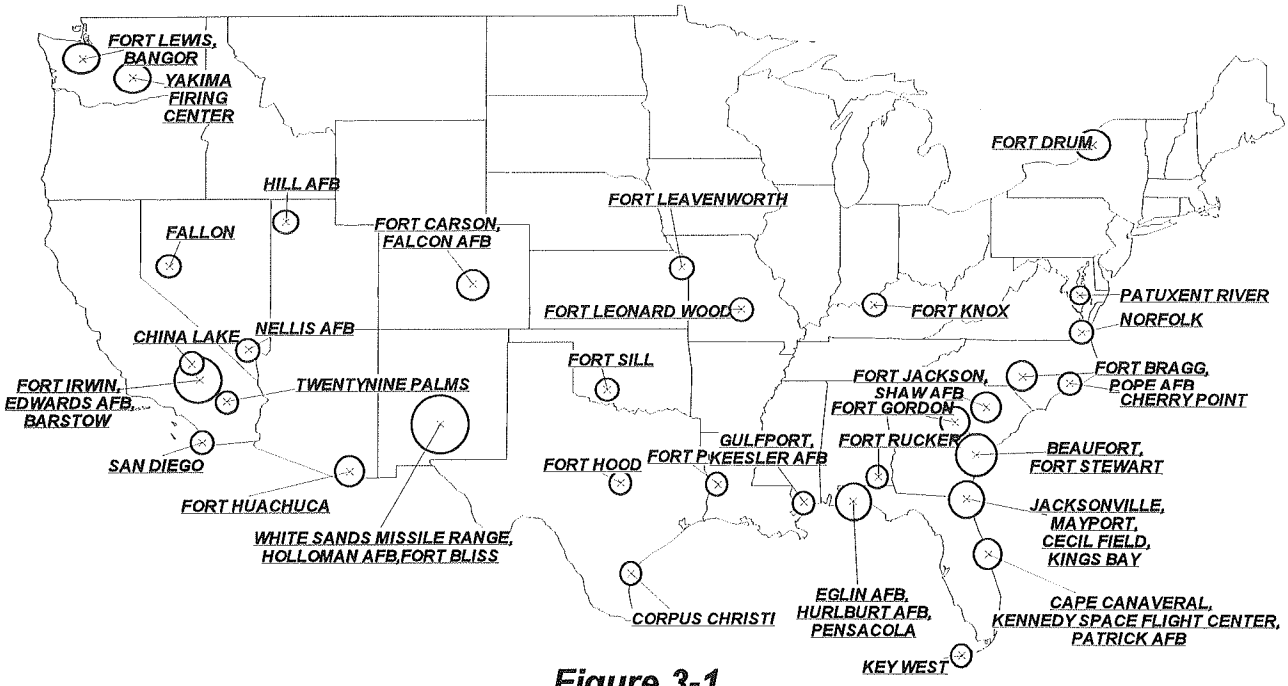

Figure 3-1.

Sites at Which Federal LMR Systems in the 139.0-140.5 and 141.5-143.0 MHz Bands Will Be Protected Indefinitely

216-220 MHz BAND

Band Usage

The 216-220 MHz band is allocated to the Federal Government and non-Federal maritime mobile service on a primary co-equal basis. The band is also allocated to Federal and non-Federal aeronautical mobile, fixed, and land mobile services as well as the Federal radiolocation service on a secondary basis. The use of the band by the fixed, aeronautical mobile, and land mobile services is limited to telemetering and telecommand operations. There are 563 assignments to Federal agencies in the band as reported in the GMF.

Assignments made to the fixed and mobile services are on a non-interference basis to the Navy Space Surveillance (SPASUR) bi-static radar system operating on the frequency 216.98 MHz (± 1 kHz). The SPASUR system consists of three transmit sites and six receiver sites located on a great circle line across the southern part of the U.S. and inclined 33.57 degrees to the equator. The SPASUR is used to maintain constant surveillance of space (un-alerted detection of earth orbiting satellites) and to provide satellite data as directed by the Chief of Naval Operations (CNO) and higher authority to fulfill Navy and National requirements.[51] The system is the only Federal radiolocation system operating in the band. New radiolocation systems have not been permitted in the band since January 1990.

The DOE has 295 assignments within this band used primarily for land mobile applications for hazard and environmental compliance, mobile telemetry for wildlife tracking for basic ecological research and predicting environmental impacts, and fixed telemetry for seismic monitoring data that is fed into the worldwide seismic network. The systems used by DOE in this band are low power and are generally located away from heavily populated areas.

The DOI has hundreds of low power transmitters in use for wildlife telemetry. The seismic monitoring stations used in this band are low powered and are generally located away from heavily populated areas. However, in areas where earthquakes are more prevalent they can be located near populated areas. The DOI estimates that they have an investment of $440,000 in systems that are capable of operating in the 216-220 MHz band.[52]

The U.S. Geological Survey (USGS) uses spectrum in the 216-220 MHz band in remote areas of California, Hawaii, and Alaska to operate telemetered seismic networks. USGS operations in this band may be able to continue to operate on a NIB basis since their locations are very remote and their powers are very low. However, if they are unable to operate on a NIB, they will have to relocate to higher frequency bands such as 900 MHz at additional cost.

The Air Force currently has 52 frequency assignments in this band used to measure the radar cross section of missiles, and to provide low-power, hands-free communication between Hazardous Material (HAZMAT) disposal teams. There are two locations that use this band for research, development and testing purposes. There is one location at White Sands Missile Range that uses this band to measure the radar cross section of missiles. Air Force HAZMAT teams use this band at 4 locations (Keesler AFB, MS; Goodfellow AFB, TX; Randolph AFB, TX; and Sheppard AFB, TX).[53]

Navy states that their primary use of this frequency band is for operation of the SPASUR system. Additional systems are operated as receive only and/or operated on a non-interference basis (NIB). Navy has an estimated investment cost of $193 million in the systems using this frequency band.[54]

The Army has 13 frequency assignments within this band used for wireless microphones, research purposes, and to provide low-power communication. The Army has approximately $150 million invested in systems that utilize this frequency band.[55]

The DOJ and the Department of the Treasury use this band for the operation of low-power audio collection devices.

Non-Federal services using the band include the Low Power Radio Service (LPRS) in the 216-217 MHz band segment for applications such as auditory assistance devices, health care assistance devices, and law enforcement tracking. The Automated Maritime Telecommunications System (AMTS) is allocated on a secondary basis for operation at coastal stations in the 217-218 MHz and 219-220 MHz segments of the band. In 1992, the FCC established an interactive video and data service (IVDS) and allocated spectrum in the 218-219 MHz segment of the band for

its use.[56] In 1994, the FCC made plans for awarding the first of approximately 1400 IVDS licenses through competitive bidding.[57] In July 28 and 29, 1994, the FCC held an auction for IVDS licenses that authorize service in 297 Metropolitan Statistical Areas (MSAs). Two licenses per market were offered for auction (a total of 594 licenses). Following the auction, a number of issues arose that resulted in bidders defaulting on approximately 125 of the 594 MSA licenses awarded through auction. These MSA licenses are to be offered for auction again, along with two licenses for IVDS operation in each of 428 Rural Service Areas (RSAs)[d]. As of this time, no known IVDS licensee is providing services to the public, three and one-half years after the auction. The FCC also allocated the 219-220 MHz band segment for amateur service use on a secondary basis in 1994.[58] Amateur use of this band is limited to stations participating in point-to-point fixed digital message forwarding systems using packet data networks.[59]

The operation of broadcast channel 13 in the adjacent band (210-216 MHz) has limited the use of this band primarily to low power devices. The transition to digital television (DTV), as mandated by Congress in the Telecommunications Act of 1996, may facilitate the development of a wider variety of commercial applications in this band.

Reallocation Considerations and Impact

The Federal usage in this band is primarily low-power devices and a fixed radar system. This makes the 216-220 MHz band an ideal candidate for reallocation on a mixed-use basis. This will preserve the Federal investment currently in the band, while at the same time making spectrum available for non-Federal use.

Under a mixed-use reallocation, SPASUR operations would be protected indefinitely. The low-power telemetry systems in the band could, in many cases, be able to continue operations on a non-interference basis, since typical operations are conducted intermittently and in remote locations; however, no protection would be afforded these systems. Those telemetry systems that require relocation may find spectrum support in the 40-42 MHz, 162-174 MHz or 23 GHz bands. Consideration should also be given to utilizing commercial satellite as a means to relay data collected at the monitoring stations.

The DOE estimates that the reallocation cost for their telemetry systems, assuming the operations can be re-accommodated in other frequency bands is $1.5 million.[60] DOE low-power seismic operations could be accommodated in the 162-174 MHz or 406.1-420 MHz band. The use of commercial satellite to relay seismic data should also be given consideration.

The DOI states that the final cost of relocating their systems may be orders of magnitude higher depending on the frequency band to which they are moved and the lack of coverage which

[d] A Public Notice from the FCC (DA 96-1958, December 4, 1996) announced that this auction would be held on February 18, 1997; however, this auction date was canceled and a new date has not been announced. (See Public Notice DA 97-209, Jan. 29, 1998).

will result from moving a low band system to a higher band.[61] DOI further states that hundreds of transmitters used to track wildlife are attached to the wildlife and cannot be recalled. Therefore, if this band is auctioned to the private sector, several geographic areas may experience interference until the transmitters have surpassed their useful life. The estimated relocation cost for DOI's wildlife transmitters is $1.76 million.[62] Many of these wildlife telemetry functions can be satisfied in the bands between 32-42 MHz, the 40.60-40.70 MHz band or on the interstitial channels in the 162-174 MHz band if relocation becomes necessary.[63]

The DOJ estimates that it will cost approximately $7 million to relocate their low-power audio equipment; however, they maintain that the effect on their operations has a much greater impact. The Department of the Treasury estimates that the replacement costs for new hardware in another band will be on the order of $3.5 million should another suitable band even be identifiable.[64]

The Air Force states that minimal impact is expected if the 216-220 MHz band is reallocated. The Air Force estimates that the total cost to replace all of the existing systems is $125,000. The Air Force states that the greatest impact will occur at Goodfellow AFB, TX, where the DoD Fire Academy uses the system less than 100 days per year to train students learning HAZMAT emergency response procedures. The Air Force estimates that the replacement of existing assets at Goodfellow is expected to be approximately $70,000. The Air Force adds that the manufacturer has sold over 35 systems to the Air Force, and if these systems need to be replaced the overall expense to the Air Force could exceed $1 million.[65] The Air Force has also requested that a 160 km protection radius around Nellis AFB and 80 km protection radius around other sites be established to protect HAZMAT team operations.[66]

It is anticipated that the Army will be able to continue to use this band on an NIB after reallocation due to the low power and typical use at locations away from populated areas. Under this assumption, the Army states that the reallocation of this band will have a minimal impact. However, if it is determined that the Army cannot share this band with private sector operators, and equipment must be moved to an alternate band, then relocation or re-tuning costs will be incurred.[67] The Army estimates that the reallocation cost for the 216-220 MHz band will be $250,000.[68]

The Navy states that contingent upon the continued protection of the SPASUR system, the reallocation impact of this band is expected to be minimal.[69]

Public Benefit

The 216-220 MHz band is in a region of the radio frequency spectrum which offers very desirable radiowave propagation characteristics and mature equipment technology that could lead to rapid development of commercial services. Being situated between the 138-174 MHz VHF and 406-512 MHz UHF land mobile spectrum, and adjacent to the 220-222 MHz land mobile band currently being auctioned, reallocation of this band, to the private sector could offer substantial benefits to the public. The removal of the primary allocation to the Federal Government could also

increase the non-Federal use of the band in the future. It is also anticipated that the functional benefits of this band will be enhanced by the transition from conventional analog television to DTV.[e]

Reallocation Options

Factors such as favorable radiowave propagation characteristics, availability of equipment, and its close proximity to existing non-Federal spectrum make the 216-220 MHz band a viable candidate for new commercial and consumer services. However, at this point in time the band has seen limited commercial use. Reallocation of the band on a mixed-use basis with limited Federal Government access should enhance commercial interest, and facilitate the development of emerging technologies to meet growing public requirements for wireless applications. In the specified band segment, the SPASUR radar sites listed in Table 3-2 will be protected. The geographical representation of the site locations is shown in Figure 3-2.

TABLE 3-2
SPASUR Radar Locations to be Protected Indefinitely

Transmit Frequency of 216.98 MHz		
Transmitter Location	**Coordinates**	**Protection Radius**
Lake Kickapoo Space Surveillance Station, TX	33°32'N 098°45'W	250 km
Jordan Lake Space Surveillance Station, AL	32°39'N 086°15'W	150 km
Gila River Space Surveillance Station, AZ	33°06'N 112°01'W	150 km
Receive Frequencies of 216.965-216.995 MHz		
Receiver Location	**Coordinates**	**Protection Radius**
San Diego Space Surveillance Station, CA	32°34'N 116°58'W	50 km
Elephant Butte Space Surveillance Station, NM	33°26'N 106°59'W	50 km
Red River Space Surveillance Station, AR	33°19'N 093°33'W	50 km
Silver Lake Space Surveillance Station, MO	33°08'N 091°01'W	50 km
Hawkinsville Space Surveillance Station, GA	32°17'N 083°32'W	50 km
Fort Stewart Space Surveillance Station, GA	31°58'N 081°30'W	50 km

[e] Present analog television requires a signal to noise ratio (S/N) of 30 dB for acceptable picture quality. For digital television an S/N on the order of 10 dB will be required to achieve a low bit error rate. This in conjunction with the error correction coding that is to be used in digital television should make it less susceptible to interference.

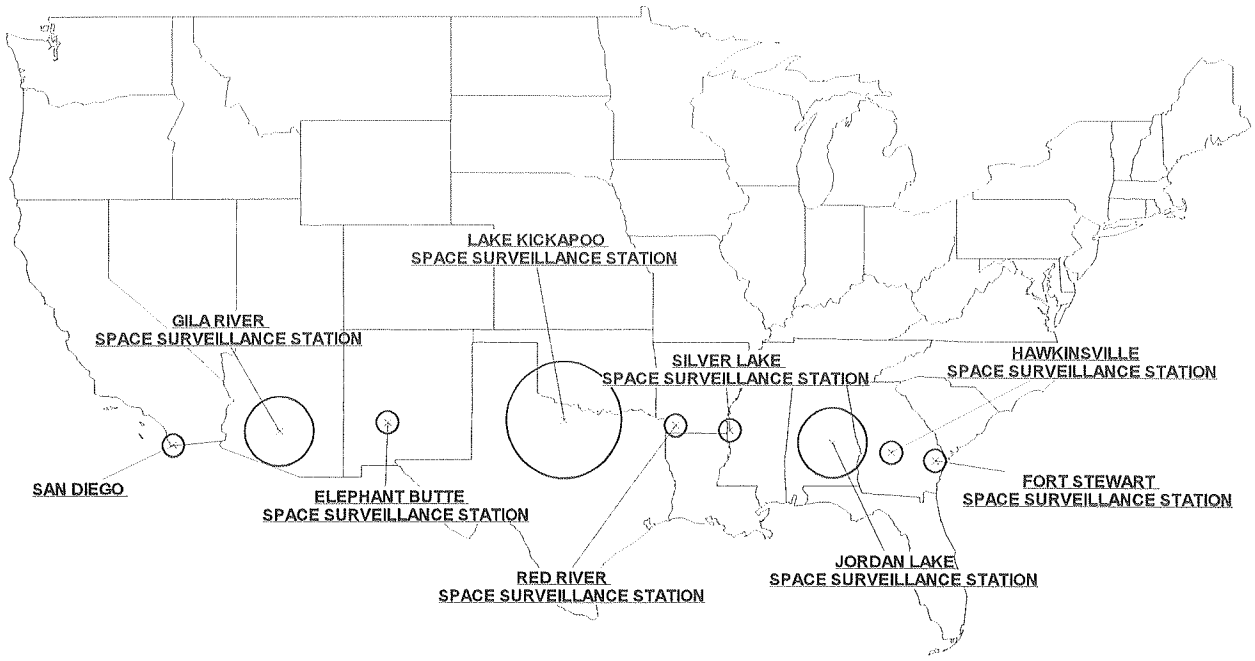

Figure 3-2.
SPASUR Radar Locations to Be Protected Indefinitely

403-406 MHz BAND

Band Usage

The 403-406 MHz band is allocated nationally and internationally to the meteorological aids (Met Aids) service on a primary basis. The U.S. position at the 1997 World Radio Conference (WRC 97) contained a recommendation to reallocate the 405-406 MHz band to accommodate mobile satellite service (MSS) downlinks. This proposal was predicated on implementing the MSS allocation after 2002 when new spectrally efficient radiosondes could be used, thus reducing the required bandwidth to the 3 MHz that would remain for radiosondes between 401-405 MHz.

The predominate use of the 403-406 MHz band is in support of radiosonde, rocketsonde, and dropsonde flights. These systems are used to collect atmospheric data such as barometric pressure, temperature, and relative humidity. An on-board transmitter, tunable on the ground in either the 401-406 MHz or 1675-1690 MHz Met Aids bands, relays the collected data to a fixed ground station receiver subsystem. Wind speed and direction are also determined through the use of an on-board radio navigation subsystem.

Frequencies in this band are used in two distinct ways to support radiosonde operations. First, many of the radiosondes transmit their collected atmospheric data to the ground station on a nominal frequency of 403 MHz. Since each radiosonde package is, for the most part, expendable,

most radiosondes do not incorporate state-of-the art transmitter design and are not typically temperature compensated. As a result, the transmitters often exhibit poor RF characteristics, in particular a characteristic frequency drift from the nominal tuning frequency. For radiosondes utilizing this frequency band, this drift can be as much as ± 2 MHz. Another use of frequencies in the 403-406 MHz band is to support the ranging adjunct used with radiosondes operating in the 1675-1690 MHz band during periods when high wind conditions exist. A transponder on board the radiosonde is interrogated with a 403 MHz signal transmitted from the ground station. The response time is used to more accurately determine wind speed.

The data collected from radiosonde flights, known as soundings, provide the primary input to many weather forecast models. On the national level, this data is shared among various Federal agencies, state and local governments, academic research programs, and private weather-forecasting firms. The data collected by radiosondes is also distributed worldwide for use in long-term forecasts via the Global Telecommunications System.

The National Weather Service (NWS) of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) is the largest user of radiosondes in the United States. There is currently a major emphasis on research in the area of climate and atmospheric changes which is anticipated to continue. The atmospheric data used in these studies will by gathered by radiosondes. The Federal investment in radiosonde systems is estimated to be $188 million[f] with an additional annual expenditure of more than $5 million for replacement radiosondes.[70]

Older radiosondes typically utilized radio navigation systems such as LORAN and OMEGA to determine relative position from which wind speed and direction are derived.[g] The latest generation of radiosondes utilizes the GPS radio navigation system to determine relative position. Currently, developmental radiosondes utilizing GPS as the radio navigation system are only available for use in the 401- 406 MHz band. As a result, there has been a migration to this band by virtually all radiosonde users.

Reallocation Considerations and Impact

The next generation of GPS based radiosondes are being designed to operate in the 403-406 MHz band. With the potential loss of the 405-406 MHz band segment for MSS downlinks, this would leave only 2 MHz for the radiosondes to operate. The additional loss of spectrum in this band could limit the ability of the radiosondes to deliver meteorological services to the public. Based on this reallocation of the entire band for non-Federal use is not possible.

[f] Investment costs are based on data presented in the NTIA Preliminary Spectrum Reallocation Report adjusted for inflation.

[g] LORAN and OMEGA are radionavigation systems that operate throughout the United States.

In general radiosonde receivers are very susceptible to co-channel interference, which makes sharing extremely difficult. Reallocation of any portion of this band on a mixed-use basis would have a detrimental effect on the ability of these Met Aids to perform their vital functions. Based on these factors reallocation of this band on a mixed-used basis is not seen as a viable option.

Public Benefit

The use of radiosondes in the 403-406 MHz band plays a critical role in delivery of accurate and timely weather information by the Federal Government to the public. The effect that accurate weather prediction has on the national economy, protection of lives and property, and general welfare of the public is very large but difficult to quantify. These frequencies are critical to providing these services with immeasurable benefits to the public.

Reallocation Options

In view of the importance of this band for weather prediction and the services already provided to the public by systems operating in the band, no public benefit would accrue by removing Federal Government access to this band. Reallocation for non-Federal use is therefore not considered to be a viable option.

932-935 AND 941-944 MHz BANDS

Band Usage

The 932-935 and 941-944 MHz bands are allocated to the Federal Government and non-Federal users for the fixed services on a co-equal shared basis. In addition, Government off-shore radiolocation operation is permitted on a non-interference basis limited to the military services. The 932-935 and 941-944 MHz bands are two of the few bands supporting fixed low-capacity communication links. The Federal agencies that use these bands include: FAA, Agriculture, DOE, DOI, Treasury, Navy, and USCG. Spectrum use for each agency is similar in both the 932-935 and 941-944 MHz bands. Usually, a transmit frequency in one band has a corresponding receive frequency in the other band or a paired channel.

The FAA uses these bands for low density communications links (voice and/or data). The majority of their assignments are authorized for the Low Density Radio Communication Link (LDRCL) system, which is deployed across the United States, in support of the NAS. Agriculture's assignments are concentrated on the West Coast and in the North-central States. These assignments are in support of their point-to-point, microwave backbone communications systems. The DOE operates fixed point-to-point microwave systems primarily in remote areas of the United States where their operations are not accessible by telephone. The DOI operates fixed point-to-point microwave systems that directly support law enforcement activities and dispatch systems for resource management and fire suppression.

The predominant non-Federal use of the 932-935 and 941-944 MHz bands is to support paging systems. Multiple Address Service (MAS) operations are also permitted to operate in these

bands. Typical MAS users include numerous system control and data acquisition (SCADA) uses, point-of-sale applications (check and credit card verifications), security alarms, airport runway lighting control, and many miscellaneous applications.

Reallocation Considerations and Impact

The initial intent of creating the paired 932-935 and 941-944 MHz bands was to provide a point-to-point band for Federal Government point-to-point operations, especially those in the 406.1-420 MHz band. Later modifications to the policy included sharing the band between Federal Government, private, and public services, as well as allowing spectrum in each band to be used for MAS.

The 932-935 and 941-944 MHz bands are an important resource to satisfy low-capacity Federal Government fixed communications systems. The major Federal Government user of these bands is the FAA for interconnection of air traffic control facilities. As described in Section 2 of the NTIA Preliminary Report, the total Federal investment in these bands is approximately $200 million.[71] Most of the Federal Government applications that use these bands are located in areas where commercial communication service is either unavailable or is more expensive. Satisfying these low-capacity communication requirements in higher frequency bands will generally result in less efficient use of spectrum because of the unavailability of suitable low-capacity radio equipment.

The DOE uses this band in the western part of the United States for the SCADA system, and to control and protect the power transmission systems for the Bonneville Power Administration and the Western Area Power Administration. The DOE stated that this band has just recently been made available for low density, point-to-point applications by NTIA and the FCC. Any reallocation affecting DOE's use of the band would be met with strong opposition, because it demonstrates a lack of national spectrum planning by the licensing authorities. The DOE has an estimated investment in these bands that exceeds $5.6 million.[72]

Moreover, in compliance with OBRA 93, the 1710-1755 MHz portion of the 1710-1850 MHz band is scheduled for reallocation on January 1, 2004.[h] The NTIA Final Reallocation Report recommends the 932-935 and 941-944 MHz bands as a possible option to accommodate some of the displaced Federal fixed microwave stations in the 1710-1755 MHz band.[73] Several agencies have initiated the procurement process for microwave equipment in the 932-935 and 941-944 MHz bands for their low capacity stations. If these bands were to be reallocated, Federal Government users would be forced to relocate their microwave stations for a second time.

[h] An earlier availability date of January 1999 applies to the 25 largest U.S. cities and is further subject to timely reimbursement of Federal costs, including reimbursement directly from the private sector.

Public Benefit

The 932-935 and 941-944 MHz bands are coequally allocated for Federal Government and non-Federal use by the fixed service, serving important functions for both. Through the established frequency coordination procedure, no non-Federal request for a frequency assignment in these bands has ever been denied because of competing Federal Government use. It is anticipated that Federal Government needs for this spectrum can continue to be satisfied in this band with little or no impediment to continued non-Federal use. Therefore, little or no public benefit would appear to result from the withdrawal of Federal assignments under the requirements of Title III of the BBA 97.

Reallocation Options

Reallocation of the 932-935 and 941-944 MHz bands under the requirements of Title III would result in a significant cost and operational impact to the Federal Government while offering little or no benefit to the public. For this reason, reallocation of these bands is not considered to be a viable option.

1370-1378.55 AND 1383.55-1390 MHz BANDS

Band Usage

The 1370-1378.55 and 1383.55-1390 MHz band segments are part of the overall 1215-1400 MHz band. This region of the spectrum is excellent for radars used for long-range search, surveillance, and tracking, and it is used extensively by the Federal Government for these purposes. Long-range radars are operated in this part of the spectrum because the effects of rain and fog on radar target detection are very low and high-power transmitter tubes operate very efficiently. Both factors are important to achieve the long-range detection of targets necessary for air traffic control, national defense, and drug interdiction requirements. There is no other part of the allocated spectrum that offers such intrinsic advantages and is also available for such important functions. The large number of high-powered radars that require access to this band makes it very congested in some areas of the United States.

The newest long-range search radar in the Joint Surveillance System (JSS) that has recently been fielded is the Air Route Surveillance Radar Model 4 (ARSR-4) which provides air defense and air traffic control for the continental United States, Guam, and Hawaii. The ARSR-4 was fielded through a $1 billion Congressionally mandated joint FAA and Air Force program. The radar has an operational frequency range of 1215-1400 MHz and uses dual-channel frequency hopping technology for long-range and anti-jam search and tracking, and is capable of detecting small objects by minimizing clutter, weather, and multipath effects. Each channel pair requires 83 MHz of frequency separation to maintain its highest possible reliability. This radar system supports defense of the national airspace and provides initial coastal civil air traffic control.

The Air Force also operates an extensive network of radars that have the capability to tune in the 1215-1400 MHz frequency range. The AN/FPS-117 and AN/FPS-124 form an array of radars

stretching across North America from Alaska via Canada to Greenland, and are designed to provide long-range detection and coverage for drug interdiction support and tactical command and control. Due to extreme northern locations of these radars, the physics of radiowave propagation in the 1215-1400 MHz frequency range is even more critical for target detection requirements.

The Navy operates long-range shipborne radars for missile detection and the Mark 23 (MK 23) Target Acquisition System (TAS) in the 1215-1400 MHz band. The MK 23 provides target information to the NATO SEASPARROW Surface Missile System (NSSMS).

In addition to the long-range radar systems the military also operates the GPS Range Applications Joint Program Office (RAJPO) Data Link System (DLS) in the 1350-1400 MHz band. The RAJPO DLS rebroadcasts real time position information of high velocity manned and unmanned airborne platforms during test and training system operations. This system is critical to ensuring the safety of personnel during training or test operations on military ranges. A total procurement of 719 units has been authorized at 25 sites throughout the United States. Each airborne participant rebroadcasts satellite derived time and location information via a pair of frequencies in the 1350-1400 and 1427-1435 MHz bands.[i] This dual frequency operation is required to ensure data availability in rugged terrain and to overcome the problems encountered with multipath fading during training exercises.

The Next Generation Target Control System (NGTCS) is being developed in part of the 1380-1390 MHz frequency band. The NGTCS is a development program whose immediate goal is to provide a common control system for unmanned target vehicles at three DoD test ranges, and whose ultimate goal is to extend that system to all DoD test ranges. To date the program has spent about $40 million of an anticipated development cost of over $100 million for the initial three ranges. Of the $40 million, approximately $20 million has been spent on the RF data link. It is anticipated that another $20 million will be spent to complete the link in the near future.[74]

The Army uses the bands in the 1350-1850 MHz frequency range for tactical transportable radio relay systems linking various headquarters and functional nodes into an area-wide integrated network for systems such as the Mobile Subscriber Equipment (MSE) and the Tri-Service Tactical Communications. To maintain interoperability with U.S. military allies, this frequency range is standardized within the NATO alliance. However, only a portion of these bands is available for peacetime training exercises. The Army also uses this band for the video links associated with unmanned air vehicle (UAV) and unmanned ground vehicles (UGV).

The FAA also operates several versions of Air Route Surveillance Radars (ARSRs) for air traffic control in the adjacent 1215-1350 MHz band. These radars include the ARSR-1, ARSR-2, and ARSR-3.

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[i] The 1390-1400 and 1427-1432 MHz band segments have already been identified for reallocation under OBRA 93.

The 1350-1400 MHz band is important for radio astronomy observation of red-shifted hydrogen spectral lines. Most of the galaxies detected using the hydrogen spectral lines and the associated red-shift frequency occur in the 1350-1400 MHz region of the spectrum. Although radio astronomy observations using the 1350-1400 MHz band are on an unprotected basis, the band is nevertheless extremely important to the success of many domestic and international scientific studies.[75]

The total estimated investment cost of Federal systems that are capable of operating in the 1370-1378.55 and 1383.55-1390 MHz band segments exceeds $2 billion.[76] A detailed description of the other systems that are capable of operating in the 1215-1400 MHz band is provided in the Spectrum Requirements Report,[77] the Preliminary Report,[78] and the Final Report.[79]

Reallocation Considerations and Impact

The functions discussed in the previous section that are performed in the 1370-1378.55 and 1383.55-1390 MHz band segments are important for meeting Federal agency mission requirements. Alternatives such as using commercial vendors, non-radiating systems, or different frequencies are not practical. While estimating the cost and mission impact to the Federal Government is difficult, it is clear that reallocation of both band segments is not possible without causing excessive impact to the Federal Government. Reallocation of one of the band segments is possible, however it must be done in such a way as to minimize the impact on Federal operations.

As discussed in Section 2, there is a satellite downlink that operates in the 1378.55-1383.55 MHz frequency range. This downlink is on each of the satellites in the GPS constellation and it is used to transmit an alerting signal that is part of the Nuclear Detonation System (NDS). In the event of a nuclear explosion the NDS will broadcast nuclear detection data to a variety of fixed and mobile stations allowing the National Command Authority and battlefield commanders to meet operational requirements for managing U.S. nuclear forces. The Air Force states that the 1380-1385 MHz band cannot be reallocated under any circumstances since it is used to receive satellite-based nuclear detonation signals and must be protected.[80]

Under OBRA 93 the 1390-1400 MHz band segment is to be reallocated for non-Federal use in January 1999. As a result of this scheduled reallocation many of the systems that have the capability to operate in the 1350-1400 MHz band will have to be modified to some extent. In some cases it will be necessary to install filters to prevent interference to non-Federal users, while in other cases it will be necessary to make modifications to the software that controls the frequency hopping algorithms to lock out those frequencies that are in the reallocated portion of the spectrum. Since the 1390-1400 MHz band segment is scheduled for reallocation in 1999 the modifications to the affected systems have not been implemented. From the standpoint of system modification, it would be desirable to reallocate spectrum that is adjacent to the spectrum already identified for reallocation. This would simplify any filter designs or software modifications that would be required. Reallocating spectrum in the 1370-1378.55 MHz band segment would require bandpass and notch filters in addition to the filters required for the 1390-1400 MHz portion. Each time a filter is added there is

an associated insertion loss. The ARSR-4 for example, has a distributed array transmit/receive module. Therefore, filtering on this radar requires individual filters on each module. The insertion loss that results from adding additional filters will decrease the probability of detection and degrade the overall performance of the radar. Based on cost and operational performance it is better to reallocate the 1385-1390 MHz band segment than the 1370-1378.55 MHz band segment.

The reallocation of the 1390-1400 MHz band segment under OBRA 93 will reduce the 39 frequency pairs (channels) available to the ARSR-4 by four. The reallocation of the 1385-1390 MHz band segment will further reduce the number of available ARSR-4 channels by four. This leaves 31 channels for current and future ARSR-4 operations. In addition to the channels lost through reallocation there are also ARSR-4 channels that can not be used because of operational restrictions (e.g., same frequencies as the NDS). A review of the GMF indicates that all of the frequency assignments for the ARSR-4 radars are located below 1370 MHz for normal operations. Therefore, the reallocation of the 1385-1390 MHz band segment will not impact the currently fielded ARSR-4 radars. However, in order to protect future commercial users from receiving interference, additional filters will be required at an estimated cost of $10 million.[81] Even with the channels lost through reallocation, the restricted channels, and the channels used by the currently fielded ARSR-4 radars, five channels will remain for future ARSR-4 radars. The FAA and Air Force are also concerned that continuing to reallocate spectrum used by the ARSR-4 will further impact the dual-frequency hopping capability that is key to its design. The Air Force states that the need to have frequency-hopping, anti-jam capabilities and the use of Air Traffic Control and other radars will make retuning and/or restricted use difficult in some areas. The Air Force maintains that the reallocation of the 1385-1390 MHz band segment will degrade the radar's frequency hopping capability that is key to its design for antijamming defense.[82] The FAA and Air Force state that reallocation at a minimum could require software modifications estimated to cost $35 million. Spectrum congestion already exists in this band and if the remaining available frequencies cannot support future dual-frequency requirements, hardware modifications estimated at $588 million and taking 5 years to complete will be required.[83]

In an attempt to avoid unnecessary and costly disruption of Federal operations in remote locations, the Final Report allowed Federal radars located in Alaska to continue operating on a secondary basis in the 1390-1400 MHz band segment that was identified for reallocation.[84] The same approach can be used for the reallocation of the 1385-1390 MHz band segment. The AN/FPS-117 and AN/FPS-124 radars located in Alaska will continue to operate in the 1385-1390 MHz band segment on a secondary basis. In response to the reallocation of the 1390-1400 MHz band segment, the Air Force stated that operation on a secondary basis was an acceptable option only if interference does not occur. In the event that interference does occur the Air Force stated that modifications or replacement of the radar would be necessary.[85] The Air Force also stated that the loss of spectrum in the 1350-1400 MHz band may make interference resolution with similar radars in Canada and Iceland more difficult.[86] These same comments would also apply to the reallocation of the 1385-1390 MHz band segment.

The Air Force and the FAA also operate a limited number of AN/FPS-117 radars within the continental United States. The AN/FPS-117 radar is capable of randomly hopping among 18 channels in the 1215-1400 MHz band.[87] The Air Force states that the reallocation of the 1390-1400 MHz band segment under OBRA 93 and the loss of the 1385-1390 MHz band segment under BBA 97 will result in a loss of an aggregate of 25 percent of its available channels. Similar losses will occur for the AN/FPS-124 and the ARSR-4. The Air Force maintains that the loss of additional spectrum will severely impair the radar's survivability in a hostile environment, reducing its capability to detect threats to national security, and may result in the need to redesign some of the radars.[88]

The Air Force further states that the radars operating is this band have already lost access to the 1390-1400 MHz band segment under OBRA 93 and would need to be further modified in order to prevent interference to commercial users. The Air Force and FAA estimate that the minimum cost for the modifications would be $100 million for the AN/FPS-117; $49 million for the ARSR-4; and $20 million for the AN/FPS-124. The modification costs include the need to install additional filtering and modify software. If hardware redesign/replacement is necessary the Air Force and FAA estimate it will cost $350 million to replace the AN/FPS-117, $588 million to replace the ARSR-4, and $150 million to replace the AN/FPS-124.[89]

The DoD has raised the issue of radar operations during wartime and has requested that for the 1385-1390 MHz band, the following footnote should be included in the National Table of Frequency Allocations:

> ***"During a national defense situation, as determined by CINCNORAD, these radars are authorized to use their full wartime hopset that includes this spectrum."***

While NTIA understands the defense concerns, adopting a footnote such as this can be a very complex issue. Although this proposal may be well defined in military terms, it is still vague from a national spectrum management standpoint. The impact that this proposed footnote would have on the "exclusive" reallocation status of this band to the private sector is unknown at this time. NTIA and the DoD will work with the FCC during the reallocation process in the 1385-1390 MHz band to insure that wartime emergency considerations will be addressed to maintain national security.

Because of the required dual frequency operation, the Federal investment in the RAJPO DLS may be jeopardized if continued access to the 1350-1400 MHz band is not available. After reallocation the 1390-1400 MHz band segment under OBRA 93 and the proposed reallocation of the 1385-1390 MHz band segment, 35 MHz will remain for RAJPO DLS operations. Each RAJPO DLS requires 8 MHz of bandwidth for operations, including guard bands. The loss of the proposed bandwidth will all but eliminate the ability to conduct simultaneous independent operations at some test ranges. The continued loss of spectrum in the 1350-1390 MHz band may serve to increase the spectrum congestion that already exists for test ranges that are using the RAJPO DLS. In response to the reallocation of the 1390-1400 MHz band segment, the Air Force stated that the Southwestern United States presents the most critical RAJPO DLS operation area.[90] There are six test and training

facilities in close proximity to each other, which requires six unique frequency pairs for interference free simultaneous operations. If the ranges are unable to perform simultaneous operations it could limit their ability to effectively schedule test events. The Air Force estimated that the costs due to delays in aircraft testing can exceed $1 million per occurrence.[91] To reduce the impact on the Federal Government, the Final Report permitted RAJPO DLS operations at specified test ranges to continue for 10 years. The same approach could be used for the reallocation of the 1385-1390 MHz band segment. The Air Force states that the loss of 1380-1390 MHz band will likely cause the RAJPO DLS to be completely redesigned at a cost of $50 to 70 million to replace its functionality. Moreover, the Air Force states that loss of several more RAJPO DLS channels will cause costly delays in the flight test programs of major multibillion dollar aircraft.[92]

The Air Force states that the data link for the NGTCS has been designed to operate on two frequencies within the 1350-1390 MHz band. The Air Force states that this is a multi-user band, and frequencies used for transmission are chosen to reduce interference both between the two NGTCS frequencies and between those frequencies used by the RAJPO DLS and the ARSR-4 radars. The Air Force maintains that with the loss of one fourth of the band, there would be no clear frequencies available for the NGTCS, at some test ranges, without shutting down other systems. The Air Force states that a new frequency band for the NGTCS will be required for operation without interference. The Air Force adds that the since the NGTCS data link was optimized for operation in the current band, a new band would require extensive redesign, potentially wasting all of the $20 to 40 million investment costs, and incurring additional costs in program delays.[93]

The Air Force states that the increased use of this frequency band, coupled with the fact that the 1390-1400 MHz band has already been scheduled for reallocation to the private sector, could make any further reallocation costly and further constrain DoD operations. The Air Force contends that no part of this frequency band should be reallocated under any circumstances as it will severely constrain their operations and may be very costly. The Air Force believes that there are no other frequency bands appropriate for some of these missions and the remaining spectrum may not be adequate to meet all their requirements.[94] The Air Force estimates that the cost to reallocate the 1385-1390 MHz band segment could exceed $200 million.[95] This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[96]

The loss of the 1390-1400 MHz band segment under OBRA 93 and the proposed reallocation of the 1385-1390 MHz band segment will result in an 8 percent reduction of the frequencies available for the Navy's shipborne radars and the MK 23 TAS. As stated in the Final Report, the reallocation approach that could be taken is to retune the radars and the MK 23 TAS within the remaining 1215-1385 MHz frequency range.[97] In response to the loss of the 1390-1400 MHz band

segment, the Navy stated that reducing the available bandwidth will reduce the anti-jamming and interference margins of the radars making them more susceptible to interference from new and existing systems operating in the remaining portion of the band.[98] Reallocation of the 1385-1390 MHz band segment will further reduce the number of available unique channels for the MK 23 TAS. The Navy stated that the impact of losing more spectrum in the 1350-1400 MHz band is particularly severe if two or more ships are operating within 200 nautical miles (nmi) of each other. The Navy also stated that EM energy from one MK 23 TAS can couple into the receiver of another MK 23 TAS causing interference that can be so severe as to render the MK 23 TAS incapable of detecting targets and performing its mission.[99] The reallocation of the 1385-1400 MHz portion of the band will require software modifications for the frequency hopping algorithms and hardware modifications to design and install filters. Engineering studies will also be necessary to analyze the specific impact and provide guidance on measures to avoid electromagnetic interference.

The Navy states that the Marine Corps also operates the AN/TPS-59 long-range air surveillance radar and point-to-point digital wide band communication systems in the 1215-1400 MHz band. The Navy estimates that the total reallocation cost for the 1385-1390 MHz band segment could exceed $3.8 million.[100] This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[101]

The tactical radio relay systems used by the Army are tunable over the entire 1350-1850 MHz frequency range. Although the reallocation of the 1390-1400 MHz under OBRA 93 and the 1385-1390 MHz currently proposed represents only a small portion of the operational bandwidth of these systems, the availability of authorized frequencies has continued to dwindle. The Army states that within the tuning range of the MSE and the AN/GRC-103 Band IV tactical radios, 60 MHz of spectrum was reallocated to the private sector under OBRA 93. The Army further states that the loss of the 1385-1390 MHz band segment will result in reaccommodation of communication nets associated with the MSE and the AN/GRC-103 and the video links associated with UAV and UGV systems. The Army maintains that some of these video links may have to be redesigned to operate in alternate spectrum. The Army estimates that the reallocation of the 1385-1390 MHz band segment could exceed $200 million.[102] This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[103]

The loss of the 1385-1400 MHz band segment will increase the spectrum congestion in the entire 1215-1400 MHz band. This congestion is, in part, a result of the power output tubes used in the radar design and the post-tube filtering. The spurious emissions of all of the existing FAA radar systems in the adjacent 1215-1350 MHz band are high and will require that these radars be

retrofitted with filters to protect non-Federal applications in the 1385-1400 MHz band segment. The FAA estimates that the cost to install filters on all of their radars could be as much as $10 million, depending on the non-Federal applications in the adjacent band.[104]

Radio astronomy observations using the 1350-1400 MHz band are on an unprotected basis. The band is nevertheless extremely important to the success of many domestic and international scientific studies. In order to reduce the impact on important Federal and university radio astronomy operations the National Science Foundation states that reallocation the 1385-1390 MHz band segment for non-Federal use must include restrictions on space-to-Earth and airborne transmissions.

Public Benefit

From a public benefit standpoint, spectrum in the 1385-1390 MHz band segment offers both positive and negative attributes. This band is in a region of the radio frequency spectrum with propagation characteristics that can support a wide variety of commercial fixed and mobile applications. The conversion of existing technologies for use in this band will make it possible to market rapidly new equipment for commercial use. This band is adjacent to the 1390-1400 MHz band already identified for reallocation under OBRA 93. Combining the two band segments will create a 15 MHz block of spectrum allowing greater flexibility in the development of commercial products and services. The 15 MHz can be used as one contiguous block and employ Time Division Duplex (TDD) technology, or it could be divided into two 5 MHz segments that can be paired with a 5 MHz transmit and receive separation to support mobile applications that typically will employ Frequency Division Duplex (FDD) technology. The 1385-1400 MHz band can also be paired with spectrum in the 1427-1435 MHz band (also scheduled for reallocation) which will substantially enhance its utility for emerging wireless technologies. In order to realize the full public benefit of this band the reallocation availability date should be consistent with that of the 1390-1400 MHz and 1427-1435 MHz bands.

This band segment has flexible frequency allocations in Europe and Africa for fixed and mobile services. This will support flexibility in the services that could be implemented and could foster U.S. export opportunities.

A concern in reallocating this band segment for non-Federal use is that it is adjacent to high-powered, megawatt, radar systems. Numerous case histories exist of interference from adjacent band high-power radar systems due to inadequate receiver selectivity. The FCC generally declines to establish receiver standards allowing industry to reach a consensus on receiver design. Even though the Federal Government has established one of the most restrictive radar transmitter standards in the world, poorly designed commercial receivers in the adjacent band will likely receive serious interference in many geographic areas.

Reallocation Options

The 1370-1378.55 and 1383.55-1390 MHz band segments are part of the 1215-1400 MHz band that is used by the Federal Government for long range search, surveillance, and tracking radars, aeronautical telemetry and telecommand systems, and tactical radio relay for the military. The 1390-1400 MHz band segment is scheduled for reallocation under OBRA 93 creating congestion in the remaining portions of the band. There is a high estimated investment by the Federal Government in systems capable of operating in the 1215-1400 MHz band making reallocation of both band segments for non-Federal use very costly. The loss of both band segments would also result in excessive impact to the missions performed by the Federal agencies which include: air traffic control, national defense, and drug interdiction.

In weighing the cost and operational impact to the Federal Government with the potential benefits to the public, reallocation for exclusive non-Federal use of the 1385-1390 MHz band segment is feasible. Reallocating the lower 1370-1378.55 MHz band segment will result in greater cost and mission impact to the Federal Government. Limiting the reallocation to the 1385-1390 MHz band segment is a reasonable balance between providing additional spectrum resources for non-Federal use and reducing the cost and operational impact to the allocated Federal services.

High-powered FAA and DoD radars will continue to operate in the lower adjacent band. Reallocating the 1385-1390 MHz band segment for non-Federal use will require modifications to the Federal radar systems, which will include modifications to the frequency hopping software and installing filters on the radar transmitters to reduce interference. In addition, adopting adequate industry receiver standards in this band is essential to reduce the potential for interference. Reallocation of the 1385-1390 MHz band must also be accompanied by mandatory transmitter standards to reduce the potential for interference to the Nuclear Detonation System. To avoid unnecessary disruption of Federal operations in isolated remote locations, the Federal radars operating in Alaska will continue on a secondary basis. To provide for the continued operation of certain high-valued DoD systems, continued Federal Government use of the 1385-1390 MHz band at the selected sites in Table 3-3 will continue for 9 years after the scheduled reallocation date.[105] The geographical representation of the site locations is shown in Figure 3-3. To minimize the impact on the radio astronomy service, reallocation for space-to-Earth links or airborne applications must not be permitted.

Table 3-3.[j]

Sites at Which Federal Systems in the 1385-1390 MHz Band
Will Continue to Operate for 9 Years After the Scheduled Reallocation Date

Location	Coordinates	Protection Radius
China Lake/Edwards AFB, CA	35°29'N 117°16'W	100 km
White Sands Missile Range/Holloman AFB, NM	32°11'N 106°20'W	160 km
Utah Test and Training Range/Dugway Proving Ground, Hill AFB, UT	40°57'N 113°05'W	160 km
Point Mugu, CA	34°07'N 119°09'W	80 km
Patuxent River, MD	38°17'N 076°24'W	70 km
Nellis AFB, NV	37°29'N 114°14'W	130 km
Fort Huachuca, AZ	31°33'N 110°18'W	80 km
Eglin AFB, FL/Gulfport ANG Range, MS/ Fort Rucker, AL	30°28'N 086°31'W	100 km
Wright-Patterson AFB, OH	39°50'N 084°03'W	80 km
Aberdeen Proving Ground, MD	39°29'N 076°08'W	80 km
Yuma Proving Ground, AZ	32°29'N 114°20'W	80 km
Fort Greely, AK	63°47'N 145°52'W	80 km
Redstone Arsenal, AL	34°35'N 086°35'W	80 km
Alpene Range, MI	44°23'N 083°20'W	80 km
Camp Shelby, MS	31°20'N 089°18'W	80 km
AUTEC[k]	24°30'N 078°00'W	80 km

[j] The DoD has raised the issue of radar operations during wartime. NTIA and DoD will work with the FCC during the reallocation process in the 1385-1390 MHz band to insure that wartime emergency considerations will be addressed to maintain national security.

[k] This site is located outside of the Continental United States.

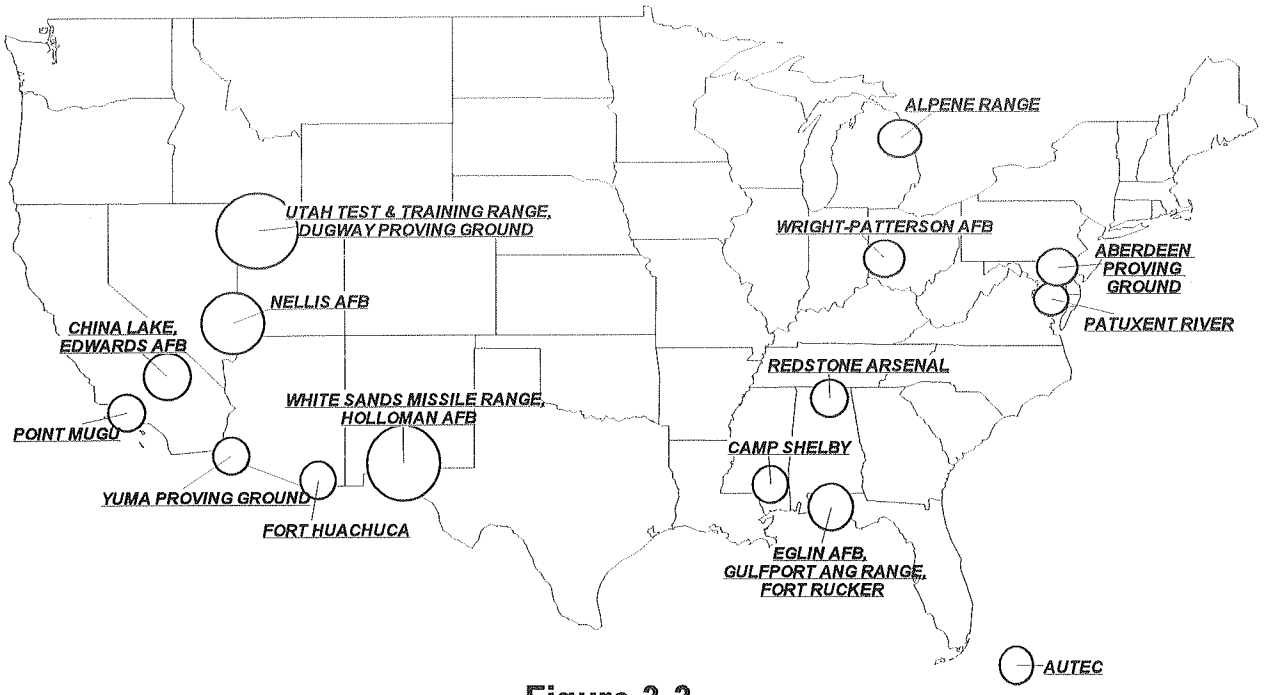

Figure 3-3.
Sites at Which Federal Systems in the 1385-1390 MHz Band Will Continue to Operate for 9 Years After the Scheduled Reallocation Date

1432-1435 MHz BAND

Band Usage

This band is allocated for Federal Government fixed and mobile services, and limited primarily to the military. The fixed service is used in support of proficiency training using tactical radio relay systems at specific Army bases. These tactical radio relay systems have broad tuning ranges, which include the 200-400, 600-1000, and 1350-1850 MHz ranges.

Mobile use is primarily air-to-ground telemetry and ground-to-air telecommand links to support various operational and testing programs mainly at military electronic test ranges. One major system that operates in this band is the RAJPO DLS. The RAJPO DLS, with a Federal investment cost of $70 million, is being operated in the vicinity of 22 DoD test and training ranges, and in the broad areas covered by their associated airspace to relay precise aircraft location to ground control locations. The RAJPO DLS is crucial to the flight testing of many high value aircraft. To achieve the required communications reliability this system operates in both the 1350-1400 and 1427-1435 MHz bands.

The Air Force also uses this band for drone control, remote control of ordnance handling robots and the data link for the Tethered Aerostat Radar System (TARS)) at Cudjoe Key, FL (about 20 miles west of Key West and over 120 miles from populated areas in mainland Florida).

The 1427-1435 MHz band is used for proficiency training using various guided weapon systems by the Navy. The weapon systems and supporting data links that operate in this band include: the AWW-13 Advanced Data Link, Walleye, and SLAM. The Navy inventory currently includes approximately 200 AWW-13's, 800 SLAM, and 7800 planned JSOW Unitary weapons.[106]

Compounding the problem are weapons in development that are planning to use the AWW-13, including the Joint Standoff Weapon Unitary variant (JSOW Unitary), and Expanded Response. The AWW-13 requires spectrum for both command and video functions.[107] The Navy estimates that they have an investment cost of $567 million in equipment capable of operating in the 1432-1435 MHz band.[108]

The Army uses this band for radio relay systems and for unmanned airborne vehicle video and telemetry downlinks. The Army estimates their investment in this band to be approximately $70 million.[109]

The DOE also uses this band for warehouse materials management and range airborne telemetry at the Nevada Test Site.

Reallocation Considerations and Impact

The RAJPO DLS was designed so that frequencies may be chosen within the authorized bands of 1350-1400 and 1427-1435 MHz, under software control. As a result of OBRA 93, after the year 2008, the 1390-1400 and 1427-1432 MHz band segments are no longer available for Federal use. To achieve the designed communications reliability under low-level flight conditions, simultaneous dual frequency operation is required, with adequate frequency separation to assure reliable communications. Since adequate frequency separation is not available solely within the 1350-1390 MHz band the RAJPO DLS requires at a minimum 3 MHz in the 1427-1435 MHz band. Therefore, continued access to the remaining 1432-1435 MHz band is crucial to maintain low altitude communications reliability requirements. Loss of access to the 1432-1435 MHz band segment would require a major redesign of the RAJPO DLS to operate with the required reliability in alternative frequency bands.[110] However, the continued loss of spectrum below 3 GHz makes finding alternative bands that are allocated to the Federal Government at an acceptably low frequency difficult.

The Navy states that the complete loss of the 1432-1435 MHz band segment would also affect the operations of missile command and guidance telemetry systems. The lower portion of the band will be completely lost for military use within the United States and territories in 2008,

ultimately affecting weapon system testing and training.[111] The Navy maintains that the only other channels available for test and training use are in the 1432-1435 MHz portion of the band, which has not been used for training to date to minimize the probability of compromising the full capabilities of the weapon systems.[112] The Navy states that the missiles in their inventory have factory-fixed frequencies of operation within the 1432-1435 MHz band segment and their expected service life runs well into the next century.[113]

For the weapon and data link systems the Navy identified three options for dealing with the loss of the 1432-1435 MHz band: 1) change the frequency band of operation for the AWW-13 and associated weapons; 2) develop a new digital video link with frequency agility or spread spectrum techniques and apply advanced compression techniques; 3) modify an existing radio or data link system to meet weapon data link requirements.[114] The Navy indicates that all of these options would require significant financial and technical investments for development and retrofit of both weapon and pod subsystems. The Navy estimates that development time could conceivably take 2 to 5 years depending on the alternatives considered with retrofit taking several additional years. The Navy believes that these options would also result in a negative impact on weapons acquisition and maintenance budgets and weapon inventory readiness.[115] The Navy estimates that if it is necessary to relocate or retune all of their systems in the 1432-1435 MHz band it would cost $2.3 billion.[116]

The Navy states that the complete reallocation of this band will make the required dual frequency operation of the RAJPO DLS impossible. The Navy also indicates that the loss of this band for missile command operations will render their systems more susceptible to jamming effects and will impair their terminal guidance. The Navy estimates that the costs associated with the reallocation of this spectrum to accommodate missile control systems and precision strike operations will be $67 million. This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[117]

The Air Force states that if using the RAJPO DLS under the mixed-use reallocation status is found to be feasible, no reallocation cost is anticipated. However, the Air Force states that the close proximity of test ranges in the Southwest of the United States requires using all the available spectrum to prevent interference. If at some point, sharing is determined to be unfeasible, the Air Force estimates that it would cost the DoD between $50 million to $70 million to replace the lost functionality. The Air Force adds that since the RAJPO DLS aircraft are used at altitudes as high as 30,000 feet, devices used by the public beyond the bounds of test ranges could experience interference.[118]

The mixed-use reallocation of this band would permit the Air Force drone control and remote control ordnance handling robot systems operating at Eglin Air Force Base to continue. If

operations are not allowed to continue the Air Force estimates that replacing the robot control link should be on the order of $150,000. The Air Force did not have a cost estimate to replace the drone control link.[119] The Air Force estimates that it will cost an estimated $100,000 to replace the data link to control the TARS. However, due to the low power (0.2 Watts), directional antenna, and remote location, the Air Force believes that there is a minimal possibility to cause interference or to constrain any future commercial services if the band is reallocated on a mixed-use basis.[120]

The Army states that if the mixed-use reallocation status proves feasible, no costs are expected. However, if at some point, sharing is determined to be unfeasible, then a major development of new equipment to operate in other bands may have to be undertaken. The Army estimates that the reallocation cost could exceed $150,000 if continued use of the band is not possible.[121]

DOE estimates that the cost to re-accommodate the warehouse materials management and range telemetry systems would be $300,000.[122] The DOE is requesting that the operations within warehouse buildings at their Savannah River Plant be permitted to continue under the mixed-use reallocation status. The low-powered equipment operates within a large metal building complex within the controlled access area of the Savannah River site and is the heart of a warehouse management system. A radius of 3 km would be required to protect the DOE operations at this location.[123]

Public Benefit

While the 1432-1435 MHz band segment is somewhat narrow (3 MHz), it nevertheless must be viewed as having a high public benefit if reallocated for commercial use. The lower portion 1427-1432 MHz (5 MHz) is already scheduled to be transferred for commercial use as a result of OBRA 93. Reallocation of the 1432-1435 MHz would result in a block of spectrum that is 8 MHz wide. It is located in a region of the spectrum that has very desirable radio wave propagation characteristics, able to effectively support a variety of commercial applications. Its worldwide frequency allocation for both fixed and mobile services further support the flexibility in services that could be implemented and could possibly foster U.S. export opportunities. Being located in the region of the spectrum that has radio propagation characteristics suitable for fixed and mobile applications, it is expected that existing technology could be adapted rapidly to this new band and marketed at an early stage. The ability to pair this band with spectrum that is also being reallocated in the 1390-1400 MHz band for duplex voice and/or data link applications could also substantially enhance its utility for emerging wireless technologies.[1]

[1] As a result of OBRA 93, the 1390-1400 MHz band segment is being reallocated for exclusive non-Federal use on January 1, 1999.

Reallocation Options

The 1427-1435 MHz band is used by the Federal Government for military tactical radio relay communications and military test range aeronautical telecommand and telemetering applications. The lower band segment (1427-1432 MHz) is already scheduled for reallocation for exclusive non-Federal use. There is a high estimated investment by the military in equipment capable of operating in this band making reallocation of the entire band for non-Federal use very costly.

Reallocation of the 1432-1435 MHz band segment for exclusive non-Federal use would result in a complete loss of the Federal investment in the RAJPO DLS and the missile command and guidance systems. There is an estimated high investment by the military in equipment capable of operating in this band making reallocation of the remaining 1432-1435 MHz band segment for exclusive non-Federal use very costly. However, reallocation of the 1432-1435 MHz band segment on a mixed-use basis with continued operations at a limited number of Federal Government electronic and missile test ranges would preserve the investment that the DoD has made in this band, while making additional spectrum available for new commercial applications.

In balancing the public benefit and impact (mission and cost) to the Federal Government, a feasible option is to reallocate the remaining 1432-1435 MHz band segment for non-Federal use on a mixed-use basis. This would preserve the investment made by the Federal Government and permit essential military operations to continue, while making additional spectrum available for the development of commercial wireless applications. In addition, essential military airborne operations at the sites listed in Table 3-4 and their associated airspace will be protected indefinitely.[124] The geographical representation of the site locations is shown in Figure 3-4.

2360-2390 MHz BAND

Band Usage

The 2360-2390 MHz band is the remaining part of the 2310-2390 MHz band that is used in conjunction with the 1435-1525 MHz band for ATM functions. The 1992 World Administrative Radio Conference (WARC-92) allocated spectrum to satellite audio broadcasting. The United States obtained 2310-2360 MHz for domestic satellite audio broadcasting. The FCC has since allocated the spectrum 2320-2345 MHz on a primary basis to the Digital Audio Radio Satellite Service (satellite DARS)[125] and the 2305-2320 and 2345-2360 MHz to the Wireless Communication Service (WCS).[126] This reallocation of spectrum reduced the available spectrum for ATM from 80 MHz to 30 MHz.

The remaining 2360-2390 MHz band is allocated on a primary basis to the Federal Government for the mobile and radiolocation services. The military uses this band to support telemetry in the flight testing of aircraft, spacecraft, and missiles at nine major military test ranges and numerous test facilities. The use of flight test telemetry is the only way to insure that the DoD accepts a fully tested quality product. This band is used to support such programs as the F-22, the Joint Strike Fighter, B-1, B-2, F-18 E/F, and the Ballistic Missile Defense Program.

Table 3-4.[m]
Sites at Which Federal Systems in the 1432-1435 MHz Band
Will Be Protected Indefinitely

Location	Coordinates	Protection Radius
China Lake/Edwards AFB, CA	35°29'N 117°16'W	100 km
White Sands Missile Range/Holloman AFB, NM	32°11'N 106°20'W	160 km
Utah Test and Training Range/Dugway Proving Ground/Hill AFB, UT	40°57'N 113°05'W	160 km
Patuxent River, MD	38°17'N 076°24'W	70 km
Nellis AFB, NV	37°29'N 114°14'W	130 km
Fort Huachuca, AZ	31°33'N 110°18'W	80 km
Eglin AFB, Tyndall AFB, FL/Gulfport ANG Range, MS/Fort Rucker, AL	30°28'N 086°31'W	140 km
Yuma Proving Ground, AZ	32°29'N 114°20'W	160 km
Fort Greely, AK	63°47'N 145°52'W	80 km
Redstone Arsenal, AL	34°35'N 086°35'W	80 km
Alpene Range, MI	44°23'N 083°20'W	80 km
Camp Shelby, MS	31°20'N 089°18'W	80 km
AUTEC[n]	24°30'N 078°00'W	80 km
MCAS Beaufort, SC	32°26'N 080°40'W	160 km
MCAS Cherry Point, NC	34°54'N 076°53'W	100 km
NAS Cecil Field, FL	30°13'N 081°53'W	160 km
NAS Fallon, NV	39°30'N 118°46'W	100 km
NAS Oceana, VA	36°49'N 076°01'W	100 km
NAS Whidbey Island, WA	48°21'N 122°39'W	70 km
NCTAMS, GUM[n]	13°35'N 144°51'E	80 km
Lemoore, CA	36°20'N 119°57'W	120 km
Naval Space Operations Center, ME	44°24'N 068°01'W	80 km
Savannah River, SC	33°15'N 081°39'W	3 km

[m] The DoD has raised concerns about the need to include additional military sites in this band. NTIA and DoD will assess the need to include additional sites and work with the FCC during the reallocation process to insure the disruption to critical military operations is minimized.

[n] This site is located outside of the Continental United States.

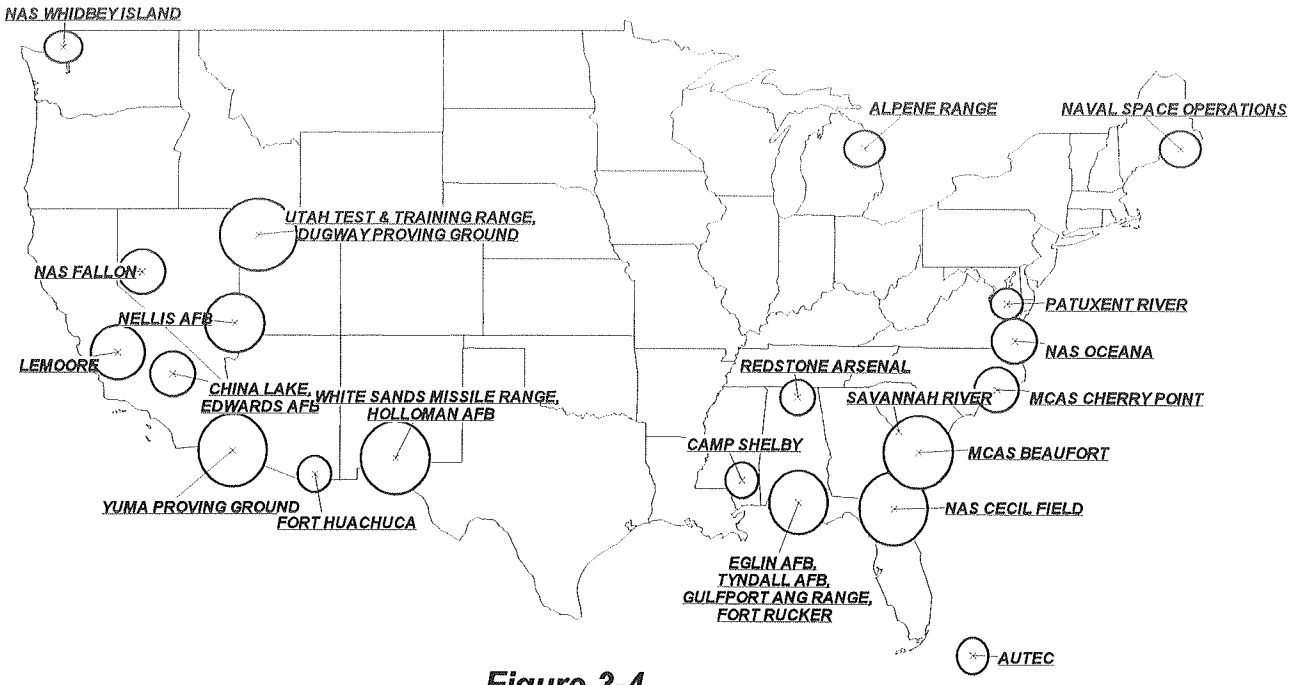

Figure 3-4.
Sites at Which Federal Systems in the 1432-1435 MHz Band Will Be Protected Indefinitely

NASA has two test centers that use the 2360-2390 MHz band in conjunction with the Scientific Balloon Program and the Aeronautical Telemetry Program for UAVs. The Scientific Balloon Program currently conducts 12 to 16 flights per year. NASA's use of the band for aeronautical telemetry averages 2 to 4 hours per day, however, it is anticipated that the total usage will increase.

The DOE uses this band for an airborne ranging system that supports Sandia National Laboratory research and development at Edwards AFB, CA and in New Mexico.[127]

The commercial aviation industry is also using this band for aeronautical flight testing. The 1435-1525 MHz band is vital for aeronautical flight test telemetry and is used heavily by the commercial aviation industry. In order to relieve the congestion in the 1435-1525 MHz band and to satisfy the growing need for wideband ATM the 2360-2390 MHz band is being used. AFTRCC coordinates the use of this band by the private sector.

Cornell University operates the National Astronomy and Ionospheric Center (NAIC) under a cooperative agreement with NSF. NAIC in turn, operates a megawatt planetary research radar occupying 20 MHz of bandwidth centered at 2380 MHz as part of the $100 million Arecibo Observatory in Puerto Rico. It is the world's largest radio telescope and radar station. Radar echoes from objects such as comets, planets, and the Moon contain information about surface properties,

orbit and object size. This enables controllers, for example, to guide spacecraft accurately to specific positions on other planets. The Arecibo planetary radar is also used to keep track of space debris, and to detect minor objects in the solar system. It is one of the only two such facilities, the other being part of NASA's Deep Space Network, at Goldstone, CA. Some bistatic radar applications require simultaneous operations at both facilities.

In addition to the ATM functions, satellite launch facilities (Cape Canaveral, FL and Vandenberg, CA) have equipped their ranges with 2360-2390 MHz band systems to support expendable launch vehicles (ELV). This ELV allocation is primarily to support commercial ELVs at Federal Government launch facilities. The allocation was made to allow these ranges to meet the Presidential directive to provide Federal Government launch support to the commercial space program. The Department of Transportation's Office of Commercial Space Transportation (OCST) promotes and licenses commercial launch vehicles. To accommodate the telemetry requirements of commercial launch vehicles, the FCC and NTIA allocated six frequencies in the 2310-2390 MHz band. Since the FCC allocated the 2310-2360 MHz band for satellite DARS and WCS, the use of the three lower ELV telemetry channels may be difficult to utilize. To date no use has been made of this band for ELV operations.

Reallocation Considerations and Impact

Relocating the aeronautical telemetry operations from the 2360-2390 MHz band to an entirely new band is not seen as being a technically feasible alternative. The Air Force provided a first-level assessment of range impacts and has identified required infrastructure costs for telemetry equipment redesign and replacement of transmitters, filters, antennas, additional tracking stations and integration into the range data collection and display system. Based upon the cost in similar developmental efforts, the Air Force estimates that these costs could exceed $80 to $100 million per test range. For the six key test ranges, the Air Force states that reallocation of all aeronautical telemetry operations in the 2360-2390 MHz band could result in a total cost that could be as high as $600 million.[128]

A key determinant of the spectrum required for ATM is the number of separate RF signals being simultaneously transmitted. Each transmitter/transmitted signal is composed of multiplexed data streams from many sensors, normally several hundred. The number of sensors inputting data into each ATM transmitter is a minimum of 40 or 50, and data from approximately 8,000 are continuously sent in the case of the B-2. It is anticipated that the number of sensors required for flight testing will continue to grow. The other main determinant of ATM spectrum use is the bandwidth of the individual transmitted signal, this principally results from the number of sensors employed during the test. The increasing number of sensors required during flight testing results in higher data rates and higher resolution video requirements. Studies on data compression and spectral efficient modulation techniques are being performed to satisfy the bandwidth requirements of the current and future aeronautical telemetry systems.

Another factor in the amount of spectrum required for ATM is the heavy workload at the test ranges. At some ranges it is necessary to simultaneously run from 12 to 13 to as many as 18 to 20 separate signals. The actual number being transmitted in the range area depends on the type of tests that are scheduled for that particular day. Since mutual interference typically limits the number of simultaneous ATM signals in the available bandwidth to only 12 or 13, it is only possible to exceed this number if receiver antenna discrimination or natural terrain shielding is available.

Aeronautical testing is now conducted on a very tight time schedule. Flight programs that suffer longer than normal delays will incur cost overruns. Test flight delays as a result of insufficient spectrum for simultaneous operations could add several months to larger test programs. The loss of the entire band could limit the ability to effectively schedule simultaneous test events on some ranges. Flight test and range personnel, as well as specialized hardware, will be idle during delays in testing. The Air Force stated that the anticipated delays in program test schedules resulting from the loss of the entire band would create an estimated 15 percent increase in time required for range operations. Using an estimate of $1 million per day and 200 test days per range, a 15 percent increase in the test time translates to an additional $180 million per year, assuming that the redesigned antennas fit within existing enclosures. Over a 5 year period, this is an increase of approximately $900 million.[129]

The primary ATM band for Government and commercial flight testing is the 1435-1525 MHz. This band is currently used very heavily and is extremely congested. The 2360-2390 MHz band is being used to support some current and future flight test operations and will be used to relieve the growing congestion in the 1435-1525 MHz band. All indications are that the use of ATM in the future is expected to increase. Figure 3-5 shows the increase in data requirements for ATM as a function of time. The number of parameters monitored during a test and data rates required is also expected to increase. Thus, the bandwidth required for each test is growing as well as the number of tests that are needed. Based on these factors, the congestion resulting from the loss of the 2310-2360 MHz potion of the band, and the excessive reallocation cost, reallocation of the entire 2360-2390 MHz band is not considered an option. However, reallocating a portion of the band is possible without complete disruption of the ATM operations in the band.

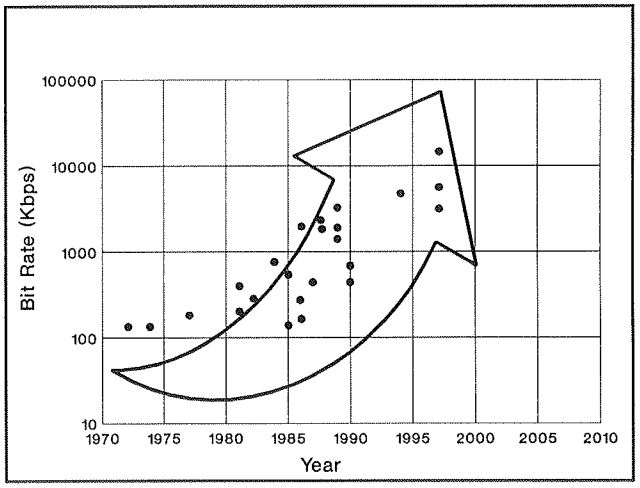

Figure 3-5. Data Requirements for ATM

Wideband ATM is becoming increasingly more important as a result of the high data rates and the corresponding high bandwidths anticipated for future flight test telemetry. Since there is only 30 MHz remaining in the 2360-2390 MHz band, reallocation of a large part of the band would all but eliminate the ability to perform wideband ATM functions.[o] However, reallocating a 5 MHz segment would still leave 25 MHz of spectrum that could satisfy many of the anticipated wideband ATM spectrum requirements. Reallocating spectrum in the 2360-2390 MHz near the edges of the band versus the middle of the band will also minimize the impact on ATM operations.

The Air Force states that the reallocation of a portion of the band will have an impact on flight test programs. In Table 3-5 the Air Force provided examples of the impact that the loss of the 2360-2365 MHz band segment will have on flight test missions at the Air Force Flight Test Center (AFFTC) at Edwards AFB, CA.[130] The Air Force states that the reallocation of the 2360-2365 MHz band segment to the private sector would reduce the amount of spectrum available to the DoD for aeronautical telemetry by 17 percent. The Air Force estimates that the loss of this spectrum will result in $1.5 billion in additional weapons system program costs over the next 10 years, caused by the cancellation of missions due to spectrum unavailability. The Air Force adds that multiple schedule slips with potential impacts with associated costs in delayed Milestone II and III decisions would also result, the cost of which is not included in the estimates provided in Table 3-5.[131]

The Air Force states that the loss of the 2360-2365 MHz band will also have an impact on the development of the nation's theater and national missile defense programs. The 2360-2390 MHz band or portions of the band are used for transfer of in-flight data during development and operational testing. Current Army systems, Theater High Altitude Air Defense (THAAD) and the National Missile Defense (NMD) programs require approximately 20 MHz of bandwidth in the 2360-2390 MHz band. The Navy Theater Ballistic Missile Defense (TBMD) program will require greater bandwidths extending to approximately 30 MHz. The Air Force states that while it may be possible to conduct some of the less complex test using some other frequencies, the loss of available bandwidth will make some data collection requirements impossible. The Air Force maintains that the current allocation is marginally sufficient to meet known and projected ballistic missile defense requirements. Any further reduction will require flight hardware redesign efforts, which are unfunded within these programs.[132]

The DoD has stated that reallocation of the upper 5 MHz (2385-2390 MHz) instead of the lower 5 MHz (2360-2365 MHz) would minimize the impact on military flight test operations. The DoD maintains that reallocating the 2385-2390 MHz band segment will reduce costly modifications to the F-22 and other aircraft test programs. The DoD states that in order to minimize the impact on flight test operations the implementation date of the reallocation should be 2007. Furthermore, the DoD states that 10 military sites and additional civilian sites to be identified by AFTRCC must be protected from 2007 to 2010.[133]

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[o] An issue identified in the Preliminary Agenda (Resolution GTPLEN1-4) for the World Radiocommunications Conference 2001 is to consider the spectrum requirements for wideband aeronautical telemetry in the bands between 3 and 30 GHz.

Table 3-5.
Examples of AFFTC Projects Impacted by the Loss of the 2360-2365 MHz Band Segment[134]

AFFTC PROJECT	IMPACT ON AFFTC PROJECT
F-22	The F-22 Engineering Manufacturing and Development (EMD) program is scheduled to fly through FY02. The program is estimated to support about 3,000 sorties in the EMD phase. The loss of the 2360-2365 MHz band segment would delay about 500 sorties past the estimated completion date. Based on a cost of $3 million per aircraft per month, it is estimated a $125 million program cost increase ((500/12)x$3 million). This does not address additional contract costs, or additional cost due to a 8 month slippage (17 percent of 48 months total flying program length) to Milestone III decision.
Joint Strike Fighter	The Joint Strike Fighter is currently in phase II (Dem/Val). The program estimate is for a $2.2 billion dollar effort with 24 flights per month over 6 months (144 sorties). A loss of the 2360-2365 MHz band segment would extend the program another month to accomplish 24 delayed flights. This would result in an estimated 1 month slip in the Milestone II decision. The additional month slip would cost the program an additional $42 million (2.2 billion/52 months program length). The EMD phase of the program is scheduled to fly 3,000 sorties in 36 months. A loss of the 2360-2365 MHz band segment would delay about 500 sorties past the estimated completion date. Based on a cost of $3 million per aircraft per month and an effective sortie rate per aircraft around 12 sorties per month. It is estimated a that there will be a $125 million program cost increase ((500/12)x$3 million) in flight costs. The EMD program is a $16 billion ($16 billion over 78 months results in $205million per month). Based on 10 functional aircraft flying 12 sorties each per month, a slip of 5 months is estimated to make up the 500 sorties. This would require a contract extension costing almost $1 billion. This does not address additional costs due to a 5 month slippage to the milestone III decision.
Airborne Laser Lab	The Dem/Val of the Airborne Laser Lab will be impacted by the loss of the 2360-2365 MHz band segment. This 73 month program is estimated to cost $210,000 per month. Based on 270 flight hours with 17 percent delayed due to spectrum non-availability (46 hours). The 17 percent delay would cause a 6 month slip (based on 36 flying months) with a $1.2 million additional program cost.
F-16	$75 million resulting from numerous 1 to 3 month program slips.
F-15	$50 million resulting from numerous 1 to 3 month program slips.
B-1	$15 million resulting from numerous 1 to 3 month program slips.
B-2	$15 million resulting from numerous 1 to 3 month program slips.
V-22	$30 million resulting from numerous 3 to 6 month program slips.

The DoD states that reallocation of 2385-2390 MHz rather than 2360-2365 MHz would mitigate the impact to all other programs in this band. The DoD states that the test and evaluation community continues to operate as a secondary user in the 2110-2360 MHz band, even though this portion of the spectrum was previously allocated. The DoD maintains that the retention of the 2360-2365 MHz band would allow test ranges to continue operating across a contiguous band of 2310-2385 MHz until new users below 2360 MHz became operational. The DoD further states that a contiguous band also permits more efficient use of the spectrum. The DoD adds that the strategy of using contiguous bandwidth would reduce the impact in program test schedules from approximately $350 million per year to roughly $205 million per year. This will result in a savings of $145 million per year until the lower adjacent band becomes unavailable for telemetry use.[135]

The Air Force states that the loss of any portion of this heavily used band will impact Government and commercial flight testing of manned aircraft. The Air Force states that reallocation of the 2385-2390 MHz band will cost an estimated $100 million for each of the three major test ranges.[136] This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[137]

The Navy states that the loss of the 2385-2390 MHz band will result in program slippages that will impact their ability to test and field aircraft weapon systems. The Navy maintains that losing this additional spectrum will delay the F-18 E/F test and evaluation program as well as other projects at major test ranges. The Navy estimates that the total reallocation cost could exceed $160 million.[138] This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[139]

The Army also uses this band for a variety of in-flight telemetry and other telemetry uses. The Army states that their use could be accommodated in the remaining telemetry spectrum, but programs would be more expensive due to more testing time required to gather data. The Army estimates that the reallocation cost for the 2385-2390 MHz band segment could exceed $20 million.[140] This estimate assumes that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modifications will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.[141]

The NSF states that reallocation of the 2385-2390 MHz band will affect the NAIC radar that operates at 2380 MHz with a 20 MHz bandwidth. The NSF states that this radar has just been refurbished with joint NSF and NASA funding. The estimated cost of relocating the radar is approximately $5 million. The NSF believes that relocating this 1 Megawatt radar will be extremely

difficult, and that the preferred option is to provide protection to it indefinitely, particularly from airborne and satellite downlink transmissions.[142] The area affected is Puerto Rico and the U.S. Virgin Islands.

NASA states that the loss of any portion of the 2360-2390 MHz band would impact the Scientific Balloon Program, which is a joint program with the Canadians.[p] NASA states that the new transmitters purchased for the Scientific Balloon Program are multi-band and tunable over the entire 2300-2399.5 MHz band. [143] However, NASA believes that the congestion that currently exists in the band will make it impossible to relocate this activity and that other spectrum would have to be found.[144] NASA states that unavailability of spectrum will mean the loss of three flights per year from resulting from inadequate ground support or not having options to avoid frequency conflicts. NASA states that the direct impact could be expected during the heaviest flight schedule periods of March thru October each year. NASA maintains that because of the time sensitive nature of many of these experiments, delays resulting from the loss of spectrum will probably have the impact of tarnishing the reliability of the Scientific Balloon support capabilities. believes that they may well lose their ability to meet some of the program flight support capabilities.[145]

NASA states that their Aeronautical Telemetry Program would also suffer as a result of losing more spectrum in the 2360-2390 MHz band. NASA maintains that losing more spectrum without identifying spectrum to replace it is only delaying the problem to a time when it will become more serious because projects are going to higher data rates and higher resolution video. NASA states that studies on data compression have shown only minimal gains in bandwidth resolution which will not come close to keeping up with the increases in bandwidth requirements for ATM. NASA states that the transmitters used in their Aeronautical Telemetry Program are tunable, and if they are able to retune within the same band the estimated reallocation cost will be minimal.

The DOE states that their airborne ranging system has an 11 MHz bandwidth, with the ground uplink operating at 2315.48 MHz and the airborne downlink operating at 2379.8 MHz. The DOE states that the reallocation of the 2385-2390 MHz band will not cause a substantial impact to the airborne downlink if: 1) the authorized bandwidth can be reduced slightly from 11 MHz to 10.4 MHz and 2) the new private sector service has equipment that is not susceptible to relatively low-level emissions from the adjacent band. The DOE believes that since small frequency adjustments can be made to their system there should be no substantial impact.[146]

Footnote US 276 identifies six frequencies in the 2310-2390 MHz band that can be used for commercial ELVs. The six frequencies are: 2312.5 MHz, 2332.5 MHz, 2352.5 MHz, 2364.5 MHz, 2370.5 MHz, and 2382.5 MHz. The allocation of the 2305-2360 MHz band for satellite DARS and

[p] This program was forced to move from its original assignments in the 1400 MHz band to the current assignments between 2365.5 to 2386.5 MHz to avoid interference with the introduction of Canadian Terrestrial-Digital Audio Radio.

WCS leaves only the upper three frequencies available on a primary basis for commercial launch telemetry. The lower three frequencies are still available on a secondary basis and are not protected from interference. These frequencies will support both the ground telemetry for testing and the telemetry for the launch. NASA and the Air Force launch government payloads, including military satellites, weather satellites, data relay satellites, and scientific payloads, among others. NASA and the Air Force have launch sites at several locations in the United States. The Federal Government uses the 2200-2300 MHz band for the launch telemetry. Currently all of the commercial launch telemetry spectrum requirements are being satisfied in the 2200-2300 MHz band. There have been no requests made for the commercial launch telemetry frequencies in the 2360-2390 MHz band.

Public Benefit

The 2385-2390 MHz band is in a region of the radio frequency spectrum where the current state-of-the-art technologies can lead to the early development and implementation of new commercial products and services. The worldwide allocation to fixed, mobile, and radiolocation services provides the flexibility to support a wide variety of new technologies both domestically and potentially for export. While this segment of spectrum is somewhat narrow, the proximity to frequencies already assigned for commercial use; the availability of equipment; and the flexible regulatory structure will enhance its utility for emerging technologies.

A concern in reallocating this band for non-Federal use is that it is immediately adjacent to airborne telemetry systems. Reallocation of the 2385-2390 MHz band must be accompanied by mandatory commercial receiver and transmitter standards to reduce the potential for mutual adjacent band interference.

Reallocation Options

The 2360-2390 MHz band is allocated to the Federal Government for aeronautical flight test telemetry, radars used for scientific observations, and telemetry for commercial launch vehicles. The primary aeronautical telemetry band is the 1435-1525 MHz band which is currently used very heavily by both the Federal Government and the commercial aviation industry. With the extreme congestion in the 1435-1525 MHz band both Federal and commercial users are beginning to move some of their ATM operations to the 2360-2390 MHz band. Previous reductions in the 2310-2390 MHz band have reduced the allocation to only 30 MHz. At the same time, demands for increased bandwidth driven by new information-intensive technologies are being incorporated in U.S. systems. Based on these factors as well as the excessive cost impact to the Federal Government, reallocation of the entire 2360-2390 MHz band is not possible.

In balancing the public benefits and the impact to the Federal Government, a feasible option is to reallocate the 2385-2390 MHz portion of this band for exclusive non-Federal use. The Federal Government will retain the rest of the band to satisfy current and future ATM flight test spectrum requirements. A large majority of the equipment that operates in the 2360-2390 MHz band is tunable

providing a great deal of flexibility within the band. Loss of this spectrum could however have an impact on simultaneous ATM flight test operations at some test ranges. Retaining the 25 MHz of contiguous spectrum will also permit some wide band ATM operations that are envisioned in the future to continue. Reallocation of the upper portion of the band eliminates the concerns expressed by the DoD with regards to the impact of flight test operations. The loss of the 2385-2390 MHz band segment does impact one of the frequencies planned for use by commercial launch telemetry. Currently there are no commercial launch facilities using the frequencies in the 2360-2390 MHz band. There are also other existing Federal Government communications facilities and frequency bands that are being used to support the commercial launches. Since airborne systems will continue to operate in the adjacent band commercial receiver and transmitter standards must be adopted to minimize potential adjacent band interference. To provide protection to the Arecibo Planetary Radar, airborne transmissions and space-to-Earth transmissions will be prohibited in Puerto Rico.

In order to provide adequate time for engineering studies on spectrum efficient modulation techniques, budgeting, and modification of equipment it will require a minimum of seven years (2005) to reallocate this band for non-Federal use. To minimize the operational impact on flight test programs that are ongoing or planned to begin in the near future continued Federal and commercial use of the 2385-2390 MHz band at the selected sites in Table 3-6 will continue for 2years after the scheduled reallocation date. The geographical representation of the site locations is shown in Figure 3-6.

Table 3-6.[q]

Sites at Which Federal and Commercial Systems in the 2385-2390 MHz Band Will Continue to Operate for 2 Years After the Scheduled Reallocation Date

Location	Coordinates	Protection Radius
Yuma Proving Ground, AZ	32°54'N 114°20'W	160 km
Nellis AFB, NV	37°48'N 116°28'W	160 km
White Sands Missile Range, NM	32°58'N 106°23'W	160 km
Utah Test Range, UT	40°12'N 112°54'W	160 km
China Lake, CA	35°40'N 117°41'W	160 km
Eglin AFB, FL	30°30'N 086°30'W	160 km
Cape Canaveral, FL	28°33'N 080°34'W	160 km
Seattle, WA	47°32'N 122°18'W	160 km
St. Louis, MO	38°45'N 090°22'W	160 km
Palm Beach County, FL	26°54'N 080°19'W	160 km
Barking Sands, HI[r]	22°07'N 159°40'W	160 km
Roosevelt Roads, PR[r]	18°14'N 065°38'W	160 km
Glasglow, MT	48°25'N 106°32'W	160 km
Edwards AFB, CA	34°54'N 117°53'W	100 km
Patuxent River, MD	38°17'N 076°25'W	100 km
Wichita, KS	37°40'N 097°26'W	160 km
Roswell, NM	33°18'N 104°32'W	160 km

[q] The DoD has raised concerns about the need to include additional military sites in this band. NTIA and DoD will assess the need to include additional sites and work with the FCC during the reallocation process to insure that disruption to critical military operations is minimized.

[r] This site is located outside of the Continental United States.

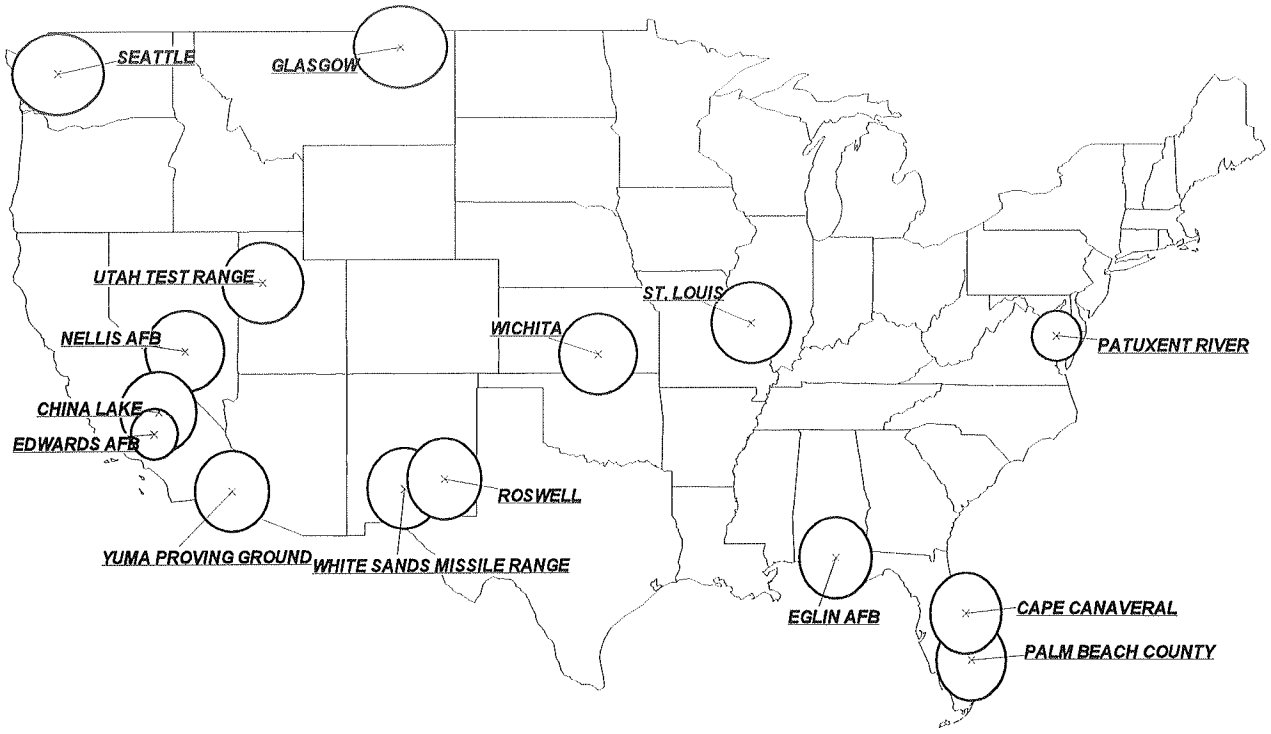

Figure 3-6.
Sites at Which Federal and Commercial Systems in the 2385-2390 MHz Band Will Continue to Operate for 2 Years After the Scheduled Reallocation Date

ENDNOTES

Requests for copies of references from Federal departments and agencies should be referred to the originating organization. Parts of the reference material may be exempt from public release.

1. Memorandum from the AFFMA/SCA, to Chairman, IRAC, Subject: Pre-decisional AF BBA 97 Reallocation Cost Information, (Nov. 1997) [hereinafter AFFMA/SCA Letter], at 2.

2. Letter from Lawrence A. Wasson, IRAC Representative, Department of Energy IRAC Representative, to Gerald Hurt, Office of Spectrum Management, U.S. Department of Commerce (Oct. 1997) [hereinafter DOE Letter], at 4.

3. Letter from Rick Murphy, Interior IRAC Representative, to Edwin E. Dinkle, Executive Secretary, IRAC, National Telecommunications and Information Administration (Oct.17, 1997) [hereinafter DOI Investment Cost Letter], at 1.

4. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Report 89-241, *Meteor Burst System Communications Compatibility* (Mar. 1989), at 4.

5. AFFMA/SCA Letter, *supra* note 1, at 2.

6. DOE Letter, *supra* note 2, at 4.

7. *Id.*

8. *Id.* at 5.

9. *Id.*

10. DOI Investment Cost Letter, *supra* note 3, at 1.

11. Letter from Julio "Rick" Murphy, Interior IRAC Representative, to Edwin E. Dinkle, Executive Secretary, IRAC, National Telecommunications and Information Administration (Oct. 28, 1997) [hereinafter DOI Reallocation Cost Letter], at 1.

12. National Telecommunications and Information Administration, U.S. Department of Commerce, Public Safety Wireless Advisory Committee, Final Report, Vol. 2, Appendicies (Sept.1996), at 637.

13. *Id.* at 638.

14. National Telecommunications and Information Administration, U.S. Department of Commerce, Public Safety Wireless Advisory Committee, Final Report, Vol. 1, (Sept.1996), at 58.

15. Balanced Budget Act of 1997, Pub. L. No. 105-33, 111 Stat. 251, § 113(c)(3)(a).

16. MCEB-M 149-71, U.S. Military Frequency Allocation Plan for 132.0-150.8 MHz band, (Confidential) Military Communications-Electronics Board, Washington, D.C., (April 1971).

17. Telecommunications Authorization Act of 1992, Pub. L. No. 102-538, 106 Stat. 3533 (1992).

18. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Report 93-300, *Land Mobile Spectrum Efficiency*, (Oct. 1993) [hereinafter NTIA Land Mobile Spectrum Efficiency Report], at 1.

19. *Id.* at 8.

20. *Id.* at 53.

21. Memorandum from William J. Donahue, Lt. General, USAF, Director, Communications and Information, for Assistant Secretary of Defense, ASD/C3I, Subject: Impacts of the Balanced Budget Act of 1997 to the Air Force (Dec. 8, 1997) [hereinafter Air Force Impact Letter], at 4.

22. Memorandum from Nelson Pollack, Air Force IRAC Member, AFFMA/SCA, for NTIA BBA 97 Team, Subject: AF Comments on Second Draft of NTIA Balanced Budget Act of 1997 (BBA 97) Report (Dec. 30, 1997) [hereinafter Air Force Comments on the Second Draft], at 5.

23. Memorandum from Frank Holderness, Army Spectrum Manager, Army IRAC Member, for National Telecommunications and Information Administration Balanced Budget Act of 1997 Team, Subject: Army Comments on Spectrum Reallocation Study as Required by the Balanced Budget Act of 1997, Second Draft, NTIA Special Publication 98-36, 18 Dec. 97 (Dec. 30, 1997) [hereinafter Army Comments on Second Draft], at 6.

24. Memorandum from B. L. Swearingen, Navy IRAC Member, for National Telecommunications and Information Administration SEAD BBA-97 Project Team, Subject: Navy Comments on Second Draft of the NTIA Spectrum Reallocation Study Required by Title III of the Balanced Budget Act of 1997 (Dec. 24, 1997) [hereinafter Navy Comments on Second Draft], at 4.

25. *Id.*

26. Letter from (James Turk for), Paul K. Reid, Jr., Federal Emergency Management Agency, to Gerald Hurt, Office of Spectrum Management, U.S. Department of Commerce (Dec. 15, 1997) [hereinafter FEMA Letter], at 1.

27. Air Force Impact Letter, *supra* note 21, at 5; Army Comments on Second Draft, *supra* note 23, at 7.

28. National Telecommunications and Information Administration, U.S. Department of Commerce, *Manual of Regulations and Procedures for Federal Radio Frequency Management*, (Sept. 1995) (Revised Sept. 1996, Jan., and May 1997) [hereinafter NTIA Manual], at 4-96.

29. Letter from Julio "Rick" Murphy, Interior IRAC Representative, to Gerald F. Hurt, Chief, Spectrum Engineering and Analysis Division, Subject: Requested Comments on the Proposed Spectrum Reallocation Plan dated December 16, 1997 (Dec. 18, 1997) [hereinafter DOI Comments on Spectrum Reallocation Plan], at 1.

30. Letter from Elwood Lewis, USPS IRAC Representative, to BBA 97 Project Team, Subject: Removal of Footnote G5 from 406.1-420 MHz Band (Dec. 19, 1997), at 1.

31. Memorandum from Richard Allen, Alternate IRAC Representative, DOJ, to BBA 97 Project Team, Subject: Spectrum Reallocation Plan Required by Title III of the BBA 97 (Dec. 23, 1997) [hereinafter DOJ Comments on Spectrum Reallocation Plan], at 1.

32. Letter from D. A. Koppie, Treasury IRAC Representative, to BBA 97 Project Team, Subject: Spectrum Reallocation Plan Required by Title III of the BBA 97 (Dec. 24, 1997) [hereinafter Treasury Letter], at 1.

33.NTIA Land Mobile Spectrum Efficiency Report, *supra* note 18, at 53.

34. Air Force Comments on the Second Draft, *supra* note 22, at 6.

35. *Id.* at 6 and 7.

36. Air Force Impact Letter, *supra* note 21, at 5.

37. Letter from Anthony M. Valletta, Acting Assistant Secretary of Defense, to Larry Irving, Assistant Secretary of Commerce for Communications and Information, Department of Commerce (Jan. 21, 1998) [hereinafter Valletta Letter], at 1.

38. *Id.*

39. Army Comments on Second Draft, *supra* note 23, at 7.

40. Memorandum from R. M. Nutwell, Rear Admiral, U.S. Navy, Deputy Director, Space, Information, Warfare, Command and Control, for the Assistant Secretary of Defense (C3I), Subject: Reallocation of Spectrum in Accordance with the Balanced Budget Act of 1997 (Dec. 9, 1997) [hereinafter Navy Impact Letter], at 3.

41. Memorandum from B. L. Swearingen, Navy IRAC Member, to NTIA SEAD BBA-97 Project Team, Subject: Navy Comments on the NTIA Spectrum Reallocation Study as required by the

Balanced Budget Act of 1997 (First Draft NTIA Special Publication 98-36) (Dec. 16, 1997) [hereinafter Navy Comments on First Draft], at 3.

42. *Id.* at 2.

43. Memorandum from B. Swearingen, Navy IRAC Member, to NTIA SEAD BBA-97 Project Team, Subject: Navy Operational Sites Requiring Protection (Dec. 16, 1997) [hereinafter Navy Site Protection Letter], at 2.

44. Navy Comments on Second Draft, *supra* note 24, at 5.

45. Memorandum from B. L. Swearingen, Navy IRAC Member, for the National Telecommunications and Information Administration SEAD BBA-97 Project Team, Subject: DON Cost Impact Matrix (Jan. 16, 1998) [hereinafter Navy Cost Matrix Memo] at 3.

46. Valletta Letter, *supra* note 36, at 1.

47. DOE Letter, *supra* note 2, at 1.

48. FEMA Letter, *supra* note 26, at 1.

49. Electronic-mail from Jim Hollansworth, NASA, to Ed Drocella, NTIA, Subject: NASA Reallocation Impact Data (Oct. 15, 1997), at 2.

50. Memorandum from Richard N. Allen, Alternate IRAC Representative, Department of Justice, to BBA 97 Project Team, Subject: Spectrum Reallocation Plan Required by Title III of the BBA 97 (Dec. 17, 1997), at 1; Treasury Letter, *supra* note 32, at 1.

51. Navy Impact Letter, *supra* note 40, at 3.

52. Letter from Julio "Rick" Murphy, Interior IRAC Representative, to Edwin E. Dinkle, Executive Secretary, IRAC, National Telecommunications and Information Administration (Dec. 4, 1997) [hereinafter DOI Comments on BBA97 Draft Report], at 1.

53. Air Force Impact Letter, *supra* note 21, at 6.

54. Navy Impact Letter, *supra* note 40, at 3; Letter from Bruce Swearingen, Navy IRAC Member, to Gerry Hurt, SEAD/NTIA, Subject: Relocation Costs Affected by BBA-97 (Secret) (Oct. 28, 1997) [hereinafter Navy Cost Letter], at 1.

55. Army Comments on Second Draft, *supra* note 23, at 8.

56. *Amendment of Parts 0, 1, 2, and 95 of the Commission's Rules to Provide Interactive Video and Data Services*, Report and Order, GEN Docket No. 91-2, 7 FCC Rcd 1630 (1992).

57. *Implementation of Section 309(j) of the Communications Act -- Competitive Bidding*, Fourth Report and Order, PP Docket No. 93-253, 9 FCC Rcd 2330 (1994) (adopting IVDS competitive bidding design).

58. *Allocation of the 219-220 MHz Band for Use by the Amateur Radio Service*, Report and Order, ET Docket No. 93-40, 10 FCC Rcd 4446 (1995).

59. *Id.*

60. DOE Letter, *supra* note 2, at 6.

61. DOI Investment Cost Letter, *supra* note 3, at 1.

62. DOI Comments on BBA97 Draft Report, *supra* note 52, at 1.

63. NTIA Manual, *supra* note 28, at §8.2.42.

64. Letter from Richard Allen, Alternate IRAC Representative for the Department of Justice, to Mr. Ed Drocella, National Telecommunications and Information Administration, Subject: DOJ Comments on Proposed NTIA Spectrum Reallocation Plan (Oct. 17, 1997), at 1; Memorandum from D. A. Koppie, Treasury IRAC Representative, for Ed Drocella, SEAD BBA 97 Project Team, National Telecommunications and Information Administration, Subject: Reallocation Costs (Oct. 30, 1997), at 1.

65. Air Force Impact Letter, *supra* note 21, at 6.

66. Air Force Comments on the Second Draft, *supra* note 22, at 2.

67. Army Comments on Second Draft, *supra* note 23, at 8.

68. *Id.* at 3.

69. Navy Impact Letter, *supra* note 40, at 4.

70. International Telecommunication Union Working Party 7C, Document United States Working Party (USWP)-7C/57 (Rev. 4).

71. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Special Publication 94-27, *Preliminary Spectrum Reallocation Report* (Feb. 1994) [hereinafter NTIA Preliminary Report], at 2-33.

72. DOE Letter, *supra* note 2, at 2.

73. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Special Publication 95-32, Spectrum Reallocation Final Report (Feb. 1995) [hereinafter NTIA Final Report], at A-8.

74. Memorandum from MILDEP IRAC Members, for NTIA BBA 97 Team, Subject: AF Comments on NTIA Draft balanced Budget Act of 1997 (BBA 97) Plan: 1385-1390 MHz and 2360-2365 MHz Frequency Bands (Dec. 19, 1997) [hereinafter Air Force Letter on the Impact to 1385-1390 MHz and 2360-2365 MHz Bands], at 8.

75. NTIA Preliminary Report, *supra* note 71, at 4-12.

76. *Id.* at 2-16 and 2-33.

77. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Special Publication 94-31, U.S. National Spectrum Requirements: Projections and Trends (Mar. 1995), at 128.

78. NTIA Preliminary Report, *supra* note 71, at 4-9.

79. NTIA Final Report, *supra* note 73, at 3-4.

80. Air Force Impact Letter, *supra* note 21, at 11.

81. Letter from Gerald Markey, Program Director for Spectrum Policy and Management, Federal Aviation Administration, to Edwin Dinkle, Executive Secretary, IRAC, National Telecommunications and Information Administration, Subject: Second Draft of the NTIA Spectrum Reallocation Study Required by Title III of the BBA 97 (Dec. 29, 1997) [hereinafter FAA Comments on Second Draft], at 2.

82. Air Force Comments on the Second Draft, *supra* note 22, at 3.

83. NTIA Final Report, *supra* note 73, at 3-8; FAA Comments on Second Draft, *supra* note 81, at 2.

84. NTIA Final Report, *supra* note 73, at 4-4.

85. *Id.* at 3-7.

86. *Id.*

87. Electromagnetic Compatibility Analysis Center, ECAC-CR-85-025, *An EMC Analysis for the Proposed Operation of the AN/FPS-117 Radar at Gibbsboro AFS, NJ* (June 1985), at 2-3.

88. Air Force Impact Letter, *supra* note 21, at 11.

89. *Id.*; FAA Comments on Second Draft, *supra* note 81, at 2.

90. NTIA Final Report, *supra* note 73, at 3-8.

91. *Id.*

92. Air Force Impact Letter, *supra* note 21, at 12.

93. Air Force Letter on the Impact to 1385-1390 MHz and 2360-2365 MHz Bands, *supra* note 74, at 8.

94. Air Force Impact Letter, *supra* note 21, at 12.

95. *Id.* at 3.

96. Valletta Letter, *supra* note 37, at 1.

97. NTIA Final Report, *supra* note 73, at 3-4.

98. *Id.*

99. *Id.*

100. Navy Cost Matrix Memo, *supra* note 45, at 5.

101. Valletta Letter, *supra* note 37, at 1.

102. Army Comments on Second Draft, *supra* note 23, at 5.

103. Valletta Letter, *supra* note 37, at 1.

104. FAA Comments on Second Draft, *supra* note 81, at 2; NTIA Final Report, *supra* note 73, at 3-9.

105. Memorandum from Nelson V. Pollack - GM-15, AF IRAC Member, U.S. Department of the Air Force, for Chairman of IRAC, Subject: RAJPO Data Link System Description (Aug. 13, 1996), at 1; Memorandum from Nelson V. Pollack, AF IRAC Member, U.S. Department of the Air Force, for NTIA OSM, Subject: AF Comments on NTIA Draft Balanced Budget Act of 1997 (BBA 97) Report, Table 3-5 (Dec. 8, 1996) [hereinafter Air Force RAJPO Memos], at 2.

106. Fax from Bruce Swearingen, Naval Electromagnetic Spectrum Center, to Gerald Hurt, NTIA Spectrum Engineering and Analysis Division, Subject: Spectrum Reallocation Impact on Navy Data Link Weapon Systems (Oct. 7, 1997) [hereinafter Weapon Systems Letter], at 6.

107. *Id.* at 4.

108. Navy Cost Letter, *supra* note 54, at 2.

109. Army Comments on Second Draft, *supra* note 23, at 11.

110. NTIA Preliminary Report, *supra* note 71, at 4-27.

111. Weapon Systems Letter, *supra* note 106, at 1 and 4.

112. *Id.* at 4.

113. Letter from M. J. Langston, Deputy Assistant Secretary of the Navy (Command, Control, Communications, Computers and Intelligence/Electronic Warfare/Space) to Richard Parlow, Associate Administrator, Office of Spectrum Management, U.S. Department of Commerce (Sept. 26, 1997), at 5.

114. Weapon Systems Letter, *supra* note 106, at 4.

115. *Id.* at 5.

116. Navy Cost Letter, *supra* note 54, at 5.

117. Valletta Letter, *supra* note 37, at 1.

118. Air Force Impact Letter, *supra* note 21, at 10.

119. *Id.*

120. *Id.*

121. Army Comments on Second Draft, *supra* note 23, at 5 and 11.

122. DOE Letter, *supra* note 2, at 2.

123. Letter from William L. Hollingsworth, IRAC Representative Department of Energy, to Gerald Hurt, Office of Spectrum Management, U.S. Department of Commerce (Dec. 8, 1997), at 2.

124. Air Force RAJPO Memos, *supra* note 105, at 1.

125. *Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band*, Report and Order, IB Docket No. 95-91 12 FCC Rcd 5754 (1997).

126. *Amendment of the Commission's Rules to Establish Part 27, the Wireless Communication Service*, Report and Order, GN Docket No. 96-228 (Feb. 1997).

127. E-Mail from William L. Hollingsworth, IRAC Representative Department of Energy, to Edward Drocella, NTIA, Subject: Comments to 2385-2390 MHz Band Reallocation (Jan. 12, 1998) [hereinafter DOE Comments on 2385-2390 MHz], at 1.

128. Air Force Letter on the Impact to 1385-1390 MHz and 2360-2365 MHz Bands, *supra* note 74, at 2.

129. *Id.*

130. *Id.* at 3.

131. *Id.*

132. *Id.* at 4.

133. Letter from (James E. Soos for) Anthony M. Valletta, Acting Assistant Secretary of Defense, to Larry Irving, Assistant Secretary of Commerce for Communications and Information (Dec. 30, 1997), at 1.

134. *Id.*

135. Memorandum for NTIA BBA Team from Nelson Pollack, Air Force IRAC Member, Subject: Relative S-Band Cost and Mission Impacts (Jan. 26, 1998), at 2.

136. Letter from Anthony M. Valletta [Unsigned], Acting Assistant Secretary of Defense, to Larry Irving, Assistant Secretary of Commerce for Communications and Information, U.S. Department of Commerce (Jan. 16, 1998) [hereinafter DoD Cost and Mission Impact Letter], at 7.

137. Valletta Letter, *supra* note 37, at 1.

138. Navy Cost Matrix Memo, *supra* note 45, at 7.

139. Valletta Letter, *supra* note 37, at 1.

140. Army Comments on Second Draft, *supra* note 23, at 5.

141. Valletta Letter, *supra* note 37, at 1.

142. Letter from Tomas Gergely, NSF IRAC Representative, to E. Drocella, NTIA, U.S. Department of Commerce (Jan. 15, 1998), at 2.

143. Letter from David Struba, Acting Director, Program Integration Division, Office of Space Flight, National Aeronautics and Space Administration, to Mr. William Hatch, Chairman, Interdepartment Radio Advisory Committee, NTIA/Department of Commerce (Dec. 23, 1997), at 2.

144. *Id.*

145. *Id.* at 3.

146. DOE Comments on 2385-2390 MHz, *supra* note 127, at 1.

SECTION 4
SPECTRUM REALLOCATION PLAN

OVERVIEW OF REALLOCATED BANDS

The radio spectrum allocated for Federal use, especially in the bands below 3 GHz, is intensely used for a variety of purposes including support of the private sector. Identifying spectrum for reallocation involved consideration of two overriding and sometimes competing factors: (1) the impact on the Federal agencies, in terms of mission impact, costs, and potential reduction of services to the public; and (2) the benefits expected to be realized by the public. Significant impediments to the ability of Federal agencies to perform their missions and a reduction in services provided to the public were widely regarded as unacceptable tradeoffs. In complying with the requirements and band selection criterion of Title III of the BBA 97, this spectrum reallocation plan establishes a reasonable balance between the spectrum needs of non-Federal users and those of the Federal Government. The effective implementation of this spectrum reallocation plan is contingent upon the availability of funds either through the agency appropriations process or reimbursement from the private sector.

TABLE 4-1
Spectrum Reallocation Plan

Bands Identified for Reallocation	Reallocation Status	Reallocation Schedule[4]
139-140.5 and 141.5-143 MHz	Mixed	January 2008
216-220 MHz[1]	Mixed	January 2002
1385-1390 MHz[2]	Exclusive	January 1999
1432-1435 MHz	Mixed	January 1999
2385-2390 MHz[3]	Exclusive	January 2005

1) The SPASUR radar system (transmit frequency of 216.98 MHz and receive frequencies of 216.965-216.995 MHz), located in the Southern part of the United States will continue to be protected indefinitely.

2) Military airborne operations at the sites listed in Table 3-3 will be continued for 9 years after the scheduled reallocation date.

3) Military and commercial airborne operations at the sites listed in Table 3-6 will be continued for 2 years after the scheduled reallocation date.

4) The spectrum will be auctioned prior to 2002, in accordance with the Balanced Budget Act of 1997.

Several bands identified for reallocation are adjacent to bands that will continue to be used for high-powered or sensitive Federal operations. In order to reduce the potential for mutual interference, industry established transmitter and receiver standards are essential.

139-140.5 and 141.5-143 MHz

These band segments are part of the 138-144 MHz band that is used primarily by the military services to establish communications for both tactical and non-tactical use. This includes: tactical air-to-air and air-to-ground communications; air traffic control; non-tactical intra-base ground-to-ground communications; LMR nets; and trunking systems. This reallocation strategy will minimize the impact to the Federal Government and will provide a transmit and receive separation, maximizing its usefulness for commercial applications. This band has a great deal of potential for a wide variety of new non-Federal fixed and mobile wireless communications services. Reallocating this band in 2008 will allow sufficient time to re-engineer radio systems operating in the band. This date also coincides with the established schedule for Federal conversion to narrowband technology in this band. Federal operations will be protected indefinitely at the sites listed in Table 3-1. DoD has raised concerns about the need to include additional military sites in this band. NTIA and DoD will assess the need to include additional sites and work with the FCC during the reallocation process to insure that disruption to critical military operations is minimized.

216-220 MHz

This band is used for a space surveillance bistatic radar system, and various low power applications which include: telemetry for monitoring seismic activity and wildlife, hands free communication between firefighters wearing hazardous environment suits, and audio collection devices. The band has potential for new non-Federal fixed and mobile communications services. This band could also be used as an expansion to the existing non-Federal services. The band is to be reallocated on a mixed-use basis with a scheduled availability date of January 1, 2002. The space surveillance radar located at three transmitter sites and six receiver sites listed in Table 3-2 will be protected indefinitely.

1385-1390 MHz

This band segment is part of the 1215-1400 MHz band that is used by the Federal Government for long-range radars, aeronautical telemetry systems, and tactical radio relay systems. In weighing the cost and operational impact to the Federal Government with the potential public benefit, reallocation of the 1385-1390 MHz segment for non-Federal use establishes a reasonable balance. This band is adjacent to the 1390-1400 MHz band previously identified for reallocation under OBRA 93, creating a contiguous block of spectrum 15 MHz wide. This band can also be combined with spectrum in the 1427-1435 MHz band (also scheduled for reallocation) to create a pair of bands with adequate transmit and receive separation. In order to realize the full public benefit of this band, the reallocation availability date will be scheduled to coincide with that of the

1390-1400 MHz and 1427-1435 MHz bands, which is January 1, 1999. To reduce the impact on important Federal and university radio astronomy operations, reallocation of this band for airborne or space-to-Earth links must be avoided. High-powered FAA and DoD radars will continue to operate in the lower adjacent band and will require that filters be installed on radar transmitters. In addition, adopting adequate regulatory or industry receiver standards for new non-Federal equipment in this band is essential to assure satisfactory performance of commercial services. Reallocation of the 1385-1390 MHz band must also be accompanied by mandatory transmitter standards to reduce interference to the Nuclear Detonation System. To preserve the investment made by the Federal Government, essential operations will be protected at the sites listed in Table 3-3 for 9 years after the scheduled reallocation date. DoD has raised the issue of radar operations during wartime. NTIA and DoD will work with the FCC during the reallocation process in the 1385-1390 MHz band to insure that wartime emergency considerations will be addressed to maintain national security.

1432-1435 MHz

This band is used by the military for tactical radio relay communications, military test range aeronautical telemetry and telecommand, and various types of guided weapon systems. The 1432-1435 MHz band will be reallocated for non-Federal use on a mixed-use basis. This will preserve the investment made by the Federal Government and permit essential military operations to continue, while making additional spectrum available for the development of commercial and consumer wireless applications. This band is adjacent to the 5 MHz in the 1427-1432 MHz band to be transferred under OBRA 93. This band can also be combined with spectrum in the 1390-1400 MHz band (also scheduled for reallocation) to create a pair of bands with adequate transmit and receive separation. To realize its full public benefit, the reallocation date of the 1432-1435 MHz band will be January 1, 1999. This date coincides with that of the 1427-1432 MHz and 1390-1400 MHz bands that were previously identified for reallocation under OBRA 93. Essential Federal Government operations and their associated airspace will be protected indefinitely at the sites listed in Table 3-4. DoD has raised concerns about the need to include additional military sites in this band. NTIA and DoD will assess the need to include additional sites and work with the FCC during the reallocation process to insure that disruption to critical military operations is minimized.

2385-2390 MHz

This band is used by the Federal Government for aeronautical flight test telemetry and for scientific observations. This band is also used by the commercial aviation industry for flight test telemetry and as designated for telemetry used in conjunction with commercial launch vehicles. Reallocating the 2385-2390 MHz portion of the band establishes a reasonable balance between providing additional spectrum resources for new commercial and consumer applications while reducing the cost and operational impact to the Federal Government. Since the adjacent band will continue to be used by airborne systems it is important that commercial receiver and transmitter standards be established to reduce the potential for mutual interference. Reallocation of this band is scheduled in 2005 to provide a sufficient amount of time for engineering studies and to implement

new systems employing more spectrum efficient modulation techniques. To minimize the operational impact on flight test programs that are ongoing or planned to begin in the near future, continued Federal and commercial use of the 2385-2390 MHz band at the sites listed in Table 3-6 will continue for 2 years after the scheduled reallocation date. To provide protection to the Arecibo planetary radar, airborne and space-to-earth transmissions will be prohibited in Puerto Rico. DoD has raised concerns about the need to include additional military sites in this band. NTIA and DoD will assess the need to include additional sites and work with the FCC during the reallocation process to insure that disruption to critical military operations is minimized.

OVERVIEW OF FEDERAL IMPLEMENTATION COSTS

Every effort has been made to insure that the bands identified in this report meet the Title III band selection criteria. However, the displaced Federal functions resulting from the reallocation must, in most cases, be preserved at a considerable cost to the Federal Government. The Federal agencies maintain that, in order to meet the time constraints of Title III of the BBA 97, it is only possible to provide preliminary reallocation cost estimates and operational impact assessments since accurate data will require extensive cost and engineering analysis. Furthermore, the task of estimating reallocation costs becomes more complex as available spectrum continues to diminish. Table 4-2 summarizes the Federal reallocation costs for each of the affected agencies. Several agencies provided low and high estimates for the reallocation costs associated with the 20 MHz in Table 4-1.

TABLE 4-2
Summary of Preliminary Federal Reallocation Cost

Federal Agency	Estimated Reallocation Cost
Department of the Army	$260 million
Department of the Navy	$251 million
Department of the Air Force	$520 million
Federal Aviation Administration	$10 million
Department of Energy	$2.1 million
Department of Interior	$1.76 million
Department of Justice	$7 million
Department of the Treasury	$3.5 million
National Aeronautics and Space Administration	$520,000
United States Information Agency	$100,000
Total	$1.056 billion

The cost estimates provided by DoD assume that suitable spectrum will be available for relocation such that current equipment can be retuned and that extensive system modification will not be required to operate on new frequencies or to avoid interfering with new commercial users. If replacement of major systems is required, relocation costs could be significantly higher.

Individual Federal agencies provided the estimated reallocation cost information shown in Table 4-2 to NTIA . NTIA did not independently verify the cost estimates as part of this study. Furthermore, the Office of Management and Budget has not formally reviewed the estimated costs. Federal agency requests for reallocation will be reviewed as part of the annual budget formulation process. Specific inquiries regarding the reallocation cost estimates should be referred to the originating agency.

MISSION AND OPERATIONAL IMPACT

The spectrum below 3 GHz is extensively used to support missions assigned to the Federal agencies by the President and Congress. As a result of the extensive usage, it is not possible to identify Federal spectrum below 3 GHz for reallocation that will not affect these missions to some extent. In enacting Title III of the BBA 97, Congress acknowledged that reallocating spectrum used by the Federal agencies will not come without mission impacts. However, the Title III band selection criteria specify that the spectrum identified during the reallocation process should balance the operational impact on Federal Government missions with the potential public benefits. In complying with this criteria, the spectrum reallocation plan identifies spectrum that minimizes the impact on the missions performed by the Federal agencies. The following paragraphs discuss in general terms the extent that missions of the Federal agencies are impacted. A more detailed discussion of the operational and mission impact to the Federal agencies is provided in the text.

The 10 MHz identified for reallocation on a mixed-use basis will limit Federal operations to specific geographic areas of the country. The Federal missions performed in these bands include: test and training for combat readiness to support national security, law enforcement, and environmental and wildlife management. If the Federal agencies cannot perform their missions given these restrictions, they will have to relocate to other bands. This may increase congestion in the remaining Federal bands. The mixed-use reallocation status could also eventually restrict the Federal agencies from expanding their operations, possibly impacting future mission requirements.

The Federal Government will lose complete access to the 10 MHz identified for reallocation on an exclusive non-Federal basis. This will have an impact on Federal operations supporting both current and future mission requirements. Further loss of spectrum for long-range radars could adversely affect the national defense, air traffic control, and drug interdiction missions performed by the Federal Government. The loss of this spectrum could restrict the use of these bands to support defense training exercises. This degradation in training activities could ultimately affect operational

readiness, negatively affecting national security. The loss of this spectrum could also affect several test ranges that conduct flight tests of systems crucial to the nation's defense.

As stated earlier, the spectrum identified for reallocation involved consideration of two overriding and sometimes competing factors: 1) impact to the Federal agencies, in terms of mission and cost impact; and 2) the benefits expected to be realized by the public. The Navy states that there is no overriding factor for national defense, therefore, it is impossible to establish a reasonable balance between the Federal Government needs and those of potential non-Federal users. The Navy maintains that reallocation actions must not adversely impact military capabilities and readiness. The Navy also believes that the mixed-use reallocation status will restrict Federal agencies from expanding their operations to satisfy future mission requirements.[1]

The Air Force states that spectrum reallocation as mandated by BBA 97 and OBRA 93 accelerate the loss of military access to the RF spectrum and may diminish their ability to carry out national defense responsibilities. For example, the process of identifying spectrum to satisfy BBA 97 forced the Air Force to choose at one point between further impacting the nation's air defense and air traffic control radar network or a multi-billion joint tactical communication system crucial to joint military combat operations and a key ingredient in achieving the Joint Vision 2010. Long range defense spectrum access, essential to successful accomplishment of national security goals, is put at risk if current pressures to accommodate near term private sector spectrum desires continue to escalate. Most of the advantage that our military enjoys relies heavily on spectrum dependent technology, and we must protect that advantage if we are to fully achieve the revolution in military affairs that has become the shared vision of the DoD leadership.[2]

PUBLIC BENEFIT OF REALLOCATED SPECTRUM

The following factors are specified in section 113 of Title III and will be used to address the public benefits of the Federal Government spectrum that is being reallocated:

☐ the extent to which equipment is or will be available that is capable of utilizing the band;

☐ the proximity of frequencies that are already assigned for commercial or other non-Federal use;

☐ the activities of foreign governments in making frequencies available for experimentation or commercial assignments in order to support domestic manufacturers of equipment; and

☐ the extent to which, in general, commercial users could share the frequency with amateur radio licensees.

Table 4-3 provides a band-by-band summary of the public benefits that may be realized from the transferred spectrum. The public benefits are addressed in terms of: equipment availability; radio wave propagation constraints; proximity of frequencies to existing non-Federal spectrum and previously transferred Federal spectrum; availability of existing technology; and technological and regulatory constraints.

TABLE 4-3
Public Benefits of Reallocated Spectrum

Frequency Band (MHz)	Technical Considerations	Potential Commercial Applications
139-140.5 and 141.5-143	⊙ Low atmospheric and foliage penetration losses; ⊙ Availability of inexpensive components; ⊙ Permits the use of smaller antennas for hand-held applications	⊙ This band could be used for various commercial land-mobile wireless applications.
216-220	⊙ Effective radio wave propagation characteristics; ⊙ Permits the use of smaller antennas for hand-held applications; ⊙ Availability of inexpensive components; ⊙ Adjacent to the 220-222 MHz currently allocated for non-Government Private Mobile Radio Services for Part 90 devices.	⊙ This band could be used for Interactive Video and Data Services (IVDS), Wireless Local Loop (WLL), or Wideband Intercity Packet Data Service. ⊙ This band could be used as expansion channels for the 220-222 MHz band that is currently being auctioned by the FCC.
1385-1390	⊙ This band is located in a region of the spectrum that has very desirable radio wave propagation characteristics able to effectively support a variety of fixed and mobile services; ⊙ Frequency allocation in Europe for fixed and mobile services further support flexibility in services that could be implemented and could foster U.S. export opportunities; ⊙ This band is adjacent to the 10 MHz in the 1390-1400 MHz band to be transferred under OBRA 93.	⊙ This band combined with the 10 MHz to be transferred would create a 15 MHz block of contiguous spectrum that could support a wide variety of commercial fixed and mobile wireless applications (e.g., Fixed Wireless Access). ⊙ The 1385-1400 MHz band could be paired with spectrum in the 1427-1435 MHz band that is to be transferred under OBRA93 and as proposed herein. This would create paired frequencies that are balanced and separated by a reasonable amount of spectrum (27 MHz).

(Continued)

TABLE 4-3 (Continued)
Public Benefits of Reallocated Spectrum

Frequency Band (MHz)	Technical Considerations	Potential Commercial Applications
1432-1435	⊙ This band is located in a region of the spectrum that has very desirable radio wave propagation characteristics able to effectively support a variety of fixed and mobile services; ⊙ Worldwide frequency allocation for both fixed and mobile services further support flexibility in services that could be implemented and could foster U.S. export opportunities; ⊙ Existing technology could be adapted rapidly and marketed at an early stage; ⊙ This band is adjacent to the 5 MHz in the 1427-1432 MHz band to be transferred under OBRA93.	⊙ This band combined with the 5 MHz to be transferred would create an 8 MHz block of contiguous spectrum that could support a wide variety of commercial fixed and mobile wireless applications (e.g., Fixed Wireless Access). ⊙ The 1427-1435 MHz band could be paired with spectrum in the 1385-1400 MHz band that is to be transferred under OBRA93 and as proposed herein. This would create paired frequencies that are balanced and separated by a reasonable amount of spectrum (27 MHz).
2385-2390	⊙ This band is located in a region of the spectrum where current state of the art technologies and the availability of equipment can lead to early development of commercial services; ⊙ Worldwide frequency allocation for fixed and mobile services further supports flexibility in services that can be implemented and could foster U.S. export opportunities; ⊙ This band is in close proximity to spectrum already allocated for non-Federal use.	⊙ This band could be used to support adjuncts to existing commercial services.

THE ACTIVITIES OF THE AMATEUR RADIO SERVICE

Title III of the BBA 97 specifies that in determining whether a band of frequencies meets criteria specified in subsection (a)(2), the Secretary shall ... seek to avoid ... excessive disruption of existing use of Federal Government frequencies by amateur radio licensees.[3] The Federal Government frequency bands between 30-3000 MHz allocated for use by the amateur service are shown in Table 4-4. Many of these frequency bands are allocated on a secondary basis, and amateurs have developed a reputation of being able to share effectively with Federal Government radio

services, particularly radiolocation.[4] This indicates that it may be possible for amateurs to share with other spectrum users. As indicated in Table 4-1, the 216-220 MHz band has been identified for reallocation for non-Federal use.

TABLE 4-4
Federal Government Frequency Bands Between 30-3000 MHz Allocated for Use by the Amateur Radio Service

Federal Government Frequency Band	Typical Amateur Usage
219-220 MHz	wideband intercity packet radio services
420-450 MHz	beacon; repeater; television; space and earth stations; space telecommand
902-928 MHz	weak signal; digital communications; repeaters; spread spectrum
1240-1300 MHz	beacon; repeater; television; space and earth station; space telecommand
2300-2310 MHz	television; space and earth stations; space telecommand
2390-2450 MHz	beacon; space and earth stations; space telecommand

The 219-220 MHz band has been reallocated to the amateur radio service on a secondary basis for wideband intercity packet radio services. Packet radio systems transmit data in the form of short messages referred to as "data packets". Data on these radio channels are transmitted in bursts, and packets lost due to interference are automatically retransmitted. In packet radio networks, the need to safeguard the traffic continuously from excessive co-channel interference is less demanding than in other types of communications systems.[5] This ability to retransmit automatically errored data packets makes it extremely robust and enables it to overcome effectively many types of interference, therefore facilitating sharing with other radio services.

NTIA recognizes the important contributions to the public that amateur operations have made. The amateur service is used by technically inclined private citizens world-wide to engage in self training, information exchange, and radio experimentation. It is at the forefront of communications technology and has been instrumental in the development of land mobile systems, hand-held radios, and satellite communications. In times of disaster when normal communications are disrupted, amateur systems often alert the world to the disaster and provide assistance in relief operations. By reallocating the 216-220 MHz band, NTIA believes that there will be acceptable impact to the amateur radio service and they will be able to continue to provide benefits to the public.

ENDNOTES

Requests for copies of references from Federal departments and agencies should be referred to the originating organization. Parts of the reference material may be exempt from public release.

1. Memorandum from B. L. Swearingen, Navy IRAC Member, to the NTIA SEAD BBA-97 Project Team, Subject: Navy Comments on the NTIA Spectrum Reallocation Study as Required by the Balanced Budget Act of 1997 (First Draft - NTIA Special Publication 98-36) (Dec. 16, 1997), at 2.

2. Memorandum from William Donahue, Lt General, USAF, Director, Communications and Information, for Assistant Secretary of Defense, ASD/C3I, Subject: Impacts of the Balanced Budget Act of 1997 to the Air Force (Dec. 8, 1997), at 1.

3. Balanced Budget Act of 1997, Pub. L. No. 105-33, 111 Stat. 251 §923(c)(1) (c)(iii).

4. National Telecommunications and Information Administration, U.S. Department of Commerce, NTIA Special Publication 94-27, *Preliminary Spectrum Reallocation Report* (Feb. 1994), at 3-5.

5. Jean-Paul Linnartz, Narrowband Land-Mobile Radio Networks, at 275 (Artech House 1993).

APPENDIX A

NTIA ORGANIZATION ACT
(AS AMENDED BY THE BALANCED BUDGET ACT OF 1997)

This appendix contains the NTIA Organization Act as amended by The Balanced Budget Act of 1997. All of the modifications in this text were made by NTIA personnel.

U.S.C. TITLE 47 - TELEGRAPHS, TELEPHONES, AND RADIOTELEGRAPHS
CHAPTER 8 - NATIONAL TELECOMMUNICATIONS AND INFORMATION
SUBCHAPTER I - ORGANIZATION AND FUNCTIONS

§ 901. DEFINITIONS; FINDINGS; POLICY

(a) Definitions

In this chapter, the following definitions apply:

(1) The term "NTIA" means the National Telecommunications and Information Administration.

(2) The term "Assistant Secretary" means the Assistant Secretary for Communications and Information.

(3) The term "Secretary" means the Secretary of Commerce.

(4) The term "Commission" means the Federal Communications Commission.

(5) The term "Corporation" means the Communications Satellite Corporation authorized in title III of the Communications Satellite Act of 1962 (47 U.S.C. 731 et seq.).

(b) Findings

The Congress finds the following:

(1) Telecommunications and information are vital to the public welfare, national security, and competitiveness of the United States.

(2) Rapid technological advances being made in the telecommunications and information fields make it imperative that the United States maintain effective national and international policies and programs capable of taking advantage of continued advancements.

(3) Telecommunications and information policies and recommendations advancing the strategic interests and the international competitiveness of the United States are essential aspects of the Nation's involvement in international commerce.

(4) There is a critical need for competent and effective telecommunications and information research and analysis and national and international policy development, advice, and advocacy by the executive branch of the Federal Government.

(5) As one of the largest users of the Nation's telecommunications facilities and resources, the Federal Government must manage its radio spectrum use and other internal communications operations in the most efficient and effective manner possible.

(6) It is in the national interest to codify the authority of the National Telecommunications and Information Administration, an agency in the Department of Commerce, as the executive branch agency principally responsible for advising the President on telecommunications and information policies, and for carrying out the related functions it currently performs, as reflected in Executive Order 12046.

(c) Policy

The NTIA shall seek to advance the following policies:

(1) Promoting the benefits of technological development in the United States for all users of telecommunications and information facilities.

(2) Fostering national safety and security, economic prosperity, and the delivery of critical social services through telecommunications.

(3) Facilitating and contributing to the full development of competition, efficiency, and the free flow of commerce in domestic and international telecommunications markets.

(4) Fostering full and efficient use of telecommunications resources, including effective use of the radio spectrum by the Federal Government, in a manner which encourages the most beneficial uses thereof in the public interest.

(5) Furthering scientific knowledge about telecommunications and information.

§ 902. ESTABLISHMENT; ASSIGNED FUNCTIONS

(a) Establishment

(1) Administration

There shall be within the Department of Commerce an administration to be known as the National Telecommunications and Information Administration.

(2) Head of administration

The head of the NTIA shall be an Assistant Secretary of Commerce for Communications and Information, who shall be appointed by the President, by and with the advice and consent of the Senate.

(b) Assigned functions

(1) In general

Subject to section 904(d) of this title, the Secretary shall assign to the Assistant Secretary and the NTIA responsibility for the performance of the Secretary's communications and information functions.

(2) Communications and information functions

Subject to section 904(d) of this title, the functions to be assigned by the Secretary

under paragraph (1) include (but are not limited to) the following functions transferred to the Secretary by Reorganization Plan Number 1 of 1977 and Executive Order 12046:

(A) The authority delegated by the President to the Secretary to assign frequencies to radio stations or classes of radio stations belonging to and operated by the United States, including the authority to amend, modify, or revoke such assignments, but not including the authority to make final disposition of appeals from frequency assignments.

(B) The authority to authorize a foreign government to construct and operate a radio station at the seat of Government of the United States, but only upon recommendation of the Secretary of State and after consultation with the Attorney General and the Chairman of the Commission.

(C) Functions relating to the communications satellite system, including authority vested in the President by section 201(a) of the Communications Satellite Act of 1962 (47 U.S.C. 721(a)) and delegated to the Secretary under Executive Order 12046, to -

(i) aid in the planning and development of the commercial communications satellite system and the execution of a national program for the operation of such a system;

(ii) conduct a continuous review of all phases of the development and operation of such system, including the activities of the Corporation;

(iii) coordinate, in consultation with the Secretary of State, the activities of governmental agencies with responsibilities in the field of telecommunications, so as to ensure that there is full and effective compliance at all times with the policies set forth in the Communications Satellite Act of 1962 (47 U.S.C. 701 et seq.);

(iv) make recommendations to the President and others as appropriate, with respect to steps necessary to ensure the availability and appropriate utilization of the communications satellite system for general governmental purposes in consonance with section 201(a)(6) of the Communications Satellite Act of 1962 (47 U.S.C. 721(a)(6));

(v) help attain coordinated and efficient use of the electromagnetic spectrum and the technical compatibility of the communications satellite system with existing communications facilities both in the United States and abroad;

(vi) assist in the preparation of Presidential action documents for consideration by the President as may be appropriate under section 201(a) of the Communications Satellite Act of 1962 (47 U.S.C. 721(a)), make necessary recommendations to the President in connection therewith, and keep the President informed with respect to the carrying out of the Communications Satellite Act of 1962 (47 U.S.C. 701 et

seq.); and

(vii) serve as the chief point of liaison between the President and the Corporation.

(D) The authority to serve as the President's principal adviser on telecommunications policies pertaining to the Nation's economic and technological advancement and to the regulation of the telecommunications industry.

(E) The authority to advise the Director of the Office of Management and Budget on the development of policies relating to the procurement and management of Federal telecommunications systems.

(F) The authority to conduct studies and evaluations concerning telecommunications research and development and concerning the initiation, improvement, expansion, testing, operation, and use of Federal telecommunications systems and advising agencies of the results of such studies and evaluations.

(G) Functions which involve -

(i) developing and setting forth, in coordination with the Secretary of State and other interested agencies, plans, policies, and programs which relate to international telecommunications issues, conferences, and negotiations;

(ii) coordinating economic, technical, operational, and related preparations for United States participation in international telecommunications conferences and negotiations; and

(iii) providing advice and assistance to the Secretary of State on international telecommunications policies to strengthen the position and serve the best interests of the United States in support of the Secretary of State's responsibility for the conduct of foreign affairs.

(H) The authority to provide for the coordination of the telecommunications activities of the executive branch and assist in the formulation of policies and standards for those activities, including (but not limited to) considerations of interoperability, privacy, security, spectrum use, and emergency readiness.

(I) The authority to develop and set forth telecommunications policies pertaining to the Nation's economic and technological advancement and to the regulation of the telecommunications industry.

(J) The responsibility to ensure that the views of the executive branch on telecommunications matters are effectively presented to the Commission and, in coordination with the Director of the Office of Management and Budget, to the Congress.

(K) The authority to establish policies concerning spectrum assignments and use by radio stations belonging to and operated by the United States.

(L) Functions which involve -

(i) developing, in cooperation with the Commission, a comprehensive long-range plan for improved management of all electromagnetic spectrum resources;
(ii) performing analysis, engineering, and administrative functions, including the maintenance of necessary files and data bases, as necessary for the performance of assigned functions for the management of electromagnetic spectrum resources;
(iii) conducting research and analysis of electromagnetic propagation, radio systems characteristics, and operating techniques affecting the utilization of the electromagnetic spectrum in coordination with specialized, related research and analysis performed by other Federal agencies in their areas of responsibility; and
(iv) conducting research and analysis in the general field of telecommunications sciences in support of assigned functions and in support of other Government agencies.

(M) The authority to conduct studies and make recommendations concerning the impact of the convergence of computer and communications technology.
(N) The authority to coordinate Federal telecommunications assistance to State and local governments.
(O) The authority to conduct and coordinate economic and technical analyses of telecommunications policies, activities, and opportunities in support of assigned functions.
(P) The authority to contract for studies and reports relating to any aspect of assigned functions.
(Q) The authority to participate, as appropriate, in evaluating the capability of telecommunications resources, in recommending remedial actions, and in developing policy options.
(R) The authority to participate with the National Security Council and the Director of the Office of Science and Technology Policy as they carry out their responsibilities under sections 4-1, 4-2, and 4-3 of Executive Order 12046, with respect to emergency functions, the national communication system, and telecommunications planning functions.
(S) The authority to establish coordinating committees pursuant to section 10 of Executive Order 11556.
(T) The authority to establish, as permitted by law, such interagency committees and working groups composed of representatives of interested agencies and consulting with such departments and agencies as may be necessary for the effective performance of assigned functions.

(3) Additional communications and information functions
In addition to the functions described in paragraph (2), the Secretary under paragraph

(1) -

(A) may assign to the NTIA the performance of functions under section 504(a) of the Communications Satellite Act of 1962 (47 U.S.C. 753(a)); and

(B) shall assign to the NTIA the administration of the Public Telecommunications Facilities Program under sections 390 through 393 of this title, and the National Endowment for Children's Educational Television under section 394 of this title.

§ 903. SPECTRUM MANAGEMENT ACTIVITIES

(a) Revision of regulations

Within 180 days after October 27, 1992, the Secretary of Commerce and the NTIA shall amend the Department of Commerce spectrum management document entitled "Manual of Regulations and Procedures for Federal Radio Frequency Management" to improve Federal spectrum management activities and shall publish in the Federal Register any changes in the regulations in such document.

(b) Requirements for revisions

The amendments required by subsection (a) of this section shall -

(1) provide for a period at the beginning of each meeting of the Interdepartmental Radio Advisory Committee to be open to the public to make presentations and receive advice, and provide the public with other meaningful opportunities to make presentations and receive advice;

(2) include provisions that will require (A) publication in the Federal Register of major policy proposals that are not classified and that involve spectrum management, and (B) adequate opportunity for public review and comment on those proposals;

(3) include provisions that will require publication in the Federal Register of major policy decisions that are not classified and that involve spectrum management;

(4) include provisions that will require that nonclassified spectrum management information be made available to the public, including access to electronic databases; and

(5) establish procedures that provide for the prompt and impartial consideration of requests for access to Government spectrum by the public, which procedures shall include provisions that will require the disclosure of the status and ultimate disposition of any such request

(c) Certification to Congress

Not later than 180 days after October 27, 1992, the Secretary of Commerce shall certify to Congress that the Secretary has complied with this section.

(d) Radio services

(1) Assignments for radio services
In assigning frequencies for mobile radio services and other radio services, the Secretary of Commerce shall promote efficient and cost-effective use of the spectrum to the maximum extent feasible.

(2) Authority to withhold assignments
The Secretary of Commerce shall have the authority to withhold or refuse to assign frequencies for mobile radio service or other radio service in order to further the goal of making efficient and cost-effective use of the spectrum.

(3) Spectrum plan
By October 1, 1993, the Secretary of Commerce shall adopt and commence implementation of a plan for Federal agencies with existing mobile radio systems to use more spectrum-efficient technologies that are at least as spectrum-efficient and cost-effective as readily available commercial mobile radio systems. The plan shall include a time schedule for implementation.

(4) Report to Congress
By October 1, 1993, the Secretary of Commerce shall submit to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Energy and Commerce of the House of Representatives a report summarizing the plan adopted under paragraph (3), including the implementation schedule for the plan.

(e) Proof of compliance with FCC licensing requirements

(1) Amendment to manual required
Within 90 days after August 10, 1993, the Secretary and the NTIA shall amend the spectrum management document described in subsection (a) of this section to require that -

(A) no person or entity (other than an agency or instrumentality of the United States) shall be permitted, after 1 year after August 10, 1993, to operate a radio station utilizing a frequency that is authorized for the use of government stations pursuant to section 902(b)(2)(A) of this title for any non-government application unless such person or entity has submitted to the NTIA proof, in a form prescribed by such manual, that such person or entity has obtained a license from the Commission; and

(B) no person or entity (other than an agency or instrumentality of the United States) shall be permitted, after 1 year after August 10, 1993, to utilize a radio station belonging to the United States for any non-government application unless such person or entity has submitted to the NTIA proof, in a form prescribed by

such manual, that such person or entity has obtained a license from the Commission.

(2) Retention of Forms
The NTIA shall maintain on file the proofs submitted under paragraph (1), or facsimiles thereof.

(3) Certification
Within 1 year after August 10, 1993, the Secretary and the NTIA shall certify to the Committee on Energy and Commerce of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate that -

(A) the amendments required by paragraph (1) have been accomplished; and

(B) the requirements of subparagraphs (A) and (B) of such paragraph are being enforced.

§ 904. GENERAL ADMINISTRATIVE PROVISIONS

(a) Interagency functions

(1) Agency consultation
Federal agencies shall consult with the Assistant Secretary and the NTIA to ensure that the conduct of telecommunications activities by such agencies is consistent with the policies developed under section 902(b)(2)(K) of this title.

(2) Report to President
The Secretary shall timely submit to the President each year the report (including evaluations and recommendations) provided for in section 744(a) (FOOTNOTE 1) of this title.
(FOOTNOTE 1) See References in Text note below.

(3) Coordination with Secretary of State
The Secretary shall coordinate with the Secretary of State the performance of the functions described in section 902(b)(2)(C) of this title. The Corporation and concerned executive agencies shall provide the Secretary with such assistance, documents, and other cooperation as will enable the Secretary to carry out those functions.

(b) Advisory committees and informal consultations with industry
To the extent the Assistant Secretary deems it necessary to continue the Interdepartmental Radio Advisory Committee, such Committee shall serve as an advisory committee to the Assistant Secretary and the NTIA. As permitted by law, the Assistant Secretary may

establish one or more telecommunications or information advisory committees (or both) composed of experts in the telecommunications and/or information areas outside the Government. The NTIA may also informally consult with industry as appropriate to carry out the most effective performance of its functions.

(c) General provisions

(1) Regulations
The Secretary and NTIA shall issue such regulations as may be necessary to carry out the functions assigned under this chapter.

(2) Support and assistance from other agencies
All executive agencies are authorized and directed to cooperate with the NTIA and to furnish it with such information, support, and assistance, not inconsistent with law, as it may require in the performance of its functions.

(3) Effect on vested functions
Nothing in this chapter reassigns any function that is, on October 27, 1992, vested by law or executive order in the Commission, or the Department of State, or any officer thereof.

(d) Reorganization

(1) Authority to reorganize
Subject to paragraph (2), the Secretary may reassign to another unit of the Department of Commerce a function (or portion thereof) required to be assigned to the NTIA by section 902(b) of this title.

(2) Limitation on authority
The Secretary may not make any reassignment of a function (or portion thereof) required to be assigned to the NTIA by section 902(b) of this title unless the Secretary submits to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Energy and Commerce of the House of Representatives a statement describing the proposed reassignment and containing an explanation of the reasons for the reassignment. No reassignment of any such function (or portion thereof) shall be effective until 90 legislative days after the Secretary submits that statement to such Committees. For purposes of this paragraph, the term "legislative days" includes only days on which both Houses of Congress are in session.

(e) Limitation on solicitations
Notwithstanding section 1522 of title 15, neither the Secretary, the Assistant Secretary, nor

any officer or employee of the NTIA shall solicit any gift or bequest of property, both real and personal, from any entity for the purpose of furthering the authorized functions of the NTIA if such solicitation would create a conflict of interest or an appearance of a conflict of interest.

§ 905. ANNUAL REPORT TO CONGRESS

The National Telecommunications and Information Administration shall submit an annual report to the Congress not later than January 31 of each calendar year, beginning with calendar year 1980. Each such report shall relate to the preceding calendar year and shall contain information on the activities of the Administration with respect to domestic communications, international communications, Federal Government communications, spectrum plans and policies, and any other matters.

SUBCHAPTER II - TRANSFER OF AUCTIONABLE FREQUENCIES

§ 921. Definitions

As used in this subchapter:

(1) The term "allocation" means an entry in the National Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more radiocommunication services.
(2) The term "assignment" means an authorization given to a station licensee to use specific frequencies or channels.
(3) The term "the 1934 Act" means the Communications Act of 1934 (47 U.S.C. 151 et seq.).

§ 922. NATIONAL SPECTRUM ALLOCATION PLANNING

The Assistant Secretary and the Chairman of the Commission shall meet, at least biannually, to conduct joint spectrum planning with respect to the following issues:
(1) the extent to which licenses for spectrum use can be issued pursuant to section 309(j) of this title to increase Federal revenues;
(2) the future spectrum requirements for public and private uses, including State and local government public safety agencies;
(3) the spectrum allocation actions necessary to accommodate those uses; and
(4) actions necessary to promote the efficient use of the spectrum, including spectrum management techniques to promote increased shared use of the spectrum that does not cause harmful interference as a means of increasing commercial access.

§ 923. Identification of reallocable frequencies

(a) Identification required

The Secretary shall, within 18 months after August 10, 1993 and within 6 months after the date of enactment of the Balanced Budget Act of 1997, prepare and submit to the President and the Congress a report identifying and recommending for reallocation bands of frequencies -

(1) that are allocated on a primary basis for Federal Government use;

(2) that are not required for the present or identifiable future needs of the Federal Government;

(3) that can feasibly be made available, as of the date of submission of the report or at any time during the next 15 years, for use under the 1934 Act (47 U.S.C. 151 et seq.) (other than for Federal Government stations under section 305 of the 1934 Act (47 U.S.C. 305));

(4) the transfer of which (from Federal Government use) will not result in costs to the Federal Government, or losses of services or benefits to the public, that are excessive in relation to the benefits to the public that may be provided by non-Federal licensees; and

(5) that are most likely to have the greatest potential for productive uses and public benefits under the 1934 Act (47 U.S.C. 151 et seq.) if allocated for non-Federal use.

(b) Minimum amount of spectrum recommended

(1) Initial Reallocation Report

In accordance with the provisions of this section, the Secretary shall recommend for reallocation in the initial report required by subsection (a), for use other than by Federal Government stations under section 305 of the 1934 Act (47 U.S.C. 305), bands of frequencies that in the aggregate span not less than 200 megahertz, that are located below 5 gigahertz, and that meet the criteria specified in paragraphs (1) through (5) of subsection (a) of this section. Such bands of frequencies shall include bands of frequencies, located below 3 gigahertz, that span in the aggregate not less than 100 megahertz.

(2) Mixed uses permitted to be counted

Bands of frequencies which a report of the Secretary under subsection (a) or (d)(1) of this section recommends be partially retained for use by Federal Government stations, but which are also recommended to be reallocated to be made available under the 1934 Act (47 U.S.C. 151 et seq.) for use by non-Federal stations, may be counted toward the minimum spectrum required by paragraph (1) or (3) of this subsection, except that -

(A) the bands of frequencies counted under this paragraph may not count toward more than one-half of the minimums required by paragraph (1) or (3) of this subsection;

(B) a band of frequencies may not be counted under this paragraph unless the assignments of the band to Federal Government stations under section 305 of the 1934 Act (47 U.S.C. 305) are limited by geographic area, by time, or by other means so as to guarantee that the potential use to be made by such Federal Government stations is substantially less (as measured by geographic area, time, or otherwise) than the potential use to be made by non-Federal stations; and

(C) the operational sharing permitted under this paragraph shall be subject to the interference regulations prescribed by the Commission pursuant to section 305(a) of the 1934 Act (47 U.S.C. 305(a)) and to coordination procedures that the Commission and the Secretary shall jointly establish and implement to ensure against harmful interference.

(3) SECOND REALLOCATION REPORT- In accordance with the provisions of this section, the Secretary shall recommend for reallocation in the second report required by subsection (a), for use other than by Federal Government stations under section 305 of the 1934 Act (47 U.S.C. 305), a band or bands of frequencies that--

(A) in the aggregate span not less than 20 megahertz;

(B) are located below 3 gigahertz; and

(C) meet the criteria specified in paragraphs (1) through (5) of subsection (a).'.

(c) Criteria for identification

(1) Needs of the Federal Government

In determining whether a band of frequencies meets the criteria specified in subsection (a)(2) of this section, the Secretary shall -

(A) consider whether the band of frequencies is used to provide a communications service that is or could be available from a commercial provider or other vendor;

(B) seek to promote -

(i) the maximum practicable reliance on commercially available substitutes;

(ii) the sharing of frequencies (as permitted under subsection (b)(2) of this section);

(iii) the development and use of new communications technologies; and

(iv) the use of nonradiating communications systems where practicable; and

(C) seek to avoid -

(i) serious degradation of Federal Government services and operations;

(ii) excessive costs to the Federal Government and users of Federal Government services; and

(iii) excessive disruption of existing use of Federal Government frequencies by amateur radio licensees.

(2) Feasibility of use

In determining whether a frequency band meets the criteria specified in subsection (a)(3) of this section, the Secretary shall -

(A) assume that the frequency will be assigned by the Commission under section 303 of the 1934 Act (47 U.S.C. 303) within 15 years;

(B) assume reasonable rates of scientific progress and growth of demand for telecommunications services;

(C) seek to include frequencies which can be used to stimulate the development of new technologies; and

(D) consider the immediate and recurring costs to reestablish services displaced by the reallocation of spectrum.

(3) Analysis of benefits

In determining whether a band of frequencies meets the criteria specified in subsection (a)(5) of this section, the Secretary shall consider -

(A) the extent to which equipment is or will be available that is capable of utilizing the band;

(B) the proximity of frequencies that are already assigned for commercial or other non-Federal use;

(C) the extent to which, in general, commercial users could share the frequency with amateur radio licensees; and

(D) the activities of foreign governments in making frequencies available for experimentation or commercial assignments in order to support their domestic manufacturers of equipment.

(4) Power agency frequencies

(A) Applicability of criteria

The criteria specified by subsection (a) of this section shall be deemed not to be met for any purpose under this subchapter with regard to any frequency assignment to, or any frequency assignment used by, a Federal power agency for the purpose of withdrawing that assignment.

(B) Mixed use eligibility

The frequencies assigned to any Federal power agency may only be eligible for mixed use under subsection (b)(2) of this section in geographically separate areas, but in those cases where a frequency is to be shared by an affected Federal power agency and a non-Federal user, such use by the non-Federal

user shall not cause harmful interference to the affected Federal power agency or adversely affect the reliability of its power system.

(C) "Federal power agency" defined
As used in this paragraph, the term "Federal power agency" means the Tennessee Valley Authority, the Bonneville Power Administration, the Western Area Power Administration, the Southwestern Power Administration, the Southeastern Power Administration, or the Alaska Power Administration.

(5) Limitation on reallocation
None of the frequencies recommended for reallocation in the reports required by this subsection shall have been recommended, prior to August 10, 1993, for reallocation to non-Federal use by international agreement.

(d) Procedure for identification of reallocable bands of frequencies

(1) Submission of preliminary identification to Congress
Within 6 months after August 10, 1993, the Secretary shall prepare, make publicly available, and submit to the President, the Congress, and the Commission a report which makes a preliminary identification of reallocable bands of frequencies which meet the criteria established by this section.

(2) Public comment
The Secretary shall provide interested persons with the opportunity to submit, within 90 days after the date of its publication, written comment on the preliminary report required by paragraph (1). The Secretary shall immediately transmit a copy of any such comment to the Commission.

(3) Comment and recommendations from Commission
The Commission shall, within 90 days after the conclusion of the period for comment provided pursuant to paragraph (2), submit to the Secretary the Commission's analysis of such comments and the Commission's recommendations for responses to such comments, together with such other comments and recommendations as the Commission deems appropriate.

(4) Direct discussions
The Secretary shall encourage and provide opportunity for direct discussions among commercial representatives and Federal Government users of the spectrum to aid the Secretary in determining which frequencies to recommend for reallocation. The Secretary shall provide notice to the public and the Commission of any such discussions, including the name or names of any businesses or other persons

represented in such discussions. A representative of the Commission (and of the Secretary at the election of the Secretary) shall be permitted to attend any such discussions. The Secretary shall provide the public and the Commission with an opportunity to comment on the results of any such discussions prior to the submission of the initial required by subsection (a) of this section.

(e) Timetable for reallocation and limitation

(1) Timetable required

The Secretary shall, as part of the reports required by subsections (a) and (d)(1) of this section, include a timetable that recommends effective dates by which the President shall withdraw or limit assignments of the frequencies specified in such reports.

(2) Expedited reallocation

(A) Required reallocation

The Secretary shall, as part of the report required by subsection (d)(1) of this section, specifically identify and recommend for immediate reallocation bands of frequencies that in the aggregate span not less than 50 megahertz, that meet the criteria described in subsection (a) of this section, and that can be made available for reallocation immediately upon issuance of the report required by subsection (d)(1) of this section. Such bands of frequencies shall include bands of frequencies, located below 3 gigahertz, that in the aggregate span not less than 25 megahertz.

(B) Permitted reallocation

The Secretary may, as part of such report, identify and recommend bands of frequencies for immediate reallocation for a mixed use pursuant to subsection (b)(2) of this section, but such bands of frequencies may not count toward the minimums required by subparagraph (A).

(3) Delayed effective dates

In setting the recommended delayed effective dates, the Secretary shall -

(A) consider the need to reallocate bands of frequencies as early as possible, taking into account the requirements of paragraphs (1) and (2) of section 925(b) of this title;

(B) be based on the useful remaining life of equipment that has been purchased or contracted for to operate on identified frequencies;

(C) consider the need to coordinate frequency use with other nations; and

(D) take into account the relationship between the costs to the Federal Government of changing to different frequencies and the benefits that may be

obtained from commercial and other non-Federal uses of the reassigned frequencies.

(f) ADDITIONAL REALLOCATION REPORT- If the Secretary receives a notice from the Commission pursuant to section 3002(c)(5) of the Balanced Budget Act of 1997, the Secretary shall prepare and submit to the President, the Commission, and the Congress a report recommending for reallocation for use other than by Federal Government stations under section 305 of the 1934 Act (47 U.S.C. 305), bands of frequencies that are suitable for the licensees identified in the Commission's notice. The Commission shall, not later than one year after receipt of such report, prepare, submit to the President and the Congress, and implement, a plan for the immediate allocation and assignment of such frequencies under the 1934 Act to incumbent licensees described in the Commission's notice.

(g) RELOCATION OF FEDERAL GOVERNMENT STATIONS-

(1) IN GENERAL- In order to expedite the commercial use of the electromagnetic spectrum and notwithstanding section 3302(b) of title 31, United States Code, any Federal entity which operates a Federal Government station may accept from any person payment of the expenses of relocating the Federal entity's operations from one or more frequencies to another frequency or frequencies, including the costs of any modification, replacement, or reissuance of equipment, facilities, operating manuals, or regulations incurred by that entity. Such payments may be in advance of relocation and may be in cash or in kind. Any such payment in cash shall be deposited in the account of such Federal entity in the Treasury of the United States or in a separate account authorized by law. Funds deposited according to this paragraph shall be available, without appropriation or fiscal year limitation, only for such expenses of the Federal entity for which such funds were deposited under this paragraph.

(2) PROCESS FOR RELOCATION- Any person seeking to relocate a Federal Government station that has been assigned a frequency within a band that has been allocated for mixed Federal and non-Federal use, or that has been scheduled for reallocation to non-Federal use, may submit a petition for such relocation to NTIA. The NTIA shall limit or terminate the Federal Government station's operating license within 6 months after receiving the petition if the following requirements are met:

(A) the person seeking relocation of the Federal Government station has guaranteed to pay all relocation costs incurred by the Federal entity, including all engineering, equipment, site acquisition and construction, and regulatory fee costs;

(B) all activities necessary for implementing the relocation have been completed, including construction of replacement facilities (if necessary and appropriate) and identifying and obtaining new frequencies for use by the

relocated Federal Government station (where such station is not relocating to spectrum reserved exclusively for Federal use);
(C) any necessary replacement facilities, equipment modifications, or other changes have been implemented and tested to ensure that the Federal Government station is able to successfully accomplish its purposes; and
(D) NTIA has determined that the proposed use of the spectrum frequency band to which the Federal entity will relocate its operations is--
(i) consistent with obligations undertaken by the United States in international agreements and with United States national security and public safety interests; and
(ii) suitable for the technical characteristics of the band and consistent with other uses of the band.
In exercising its authority under clause (i) of this subparagraph, NTIA shall consult with the Secretary of Defense, the Secretary of State, or other appropriate officers of the Federal Government.

(3) RIGHT TO RECLAIM- If within one year after the relocation the Federal entity demonstrates to the Commission that the new facilities or spectrum are not comparable to the facilities or spectrum from which the Federal Government station was relocated, the person who filed the petition under paragraph (2) for such relocation shall take reasonable steps to remedy any defects or pay the Federal entity for the expenses incurred in returning the Federal Government station to the spectrum from which such station was relocated.

(h) FEDERAL ACTION TO EXPEDITE SPECTRUM TRANSFER- Any Federal Government station which operates on electromagnetic spectrum that has been identified in any reallocation report under this section shall, to the maximum extent practicable through the use of the authority granted under subsection (g) and any other applicable provision of law, take action to relocate its spectrum use to other frequencies that are reserved for Federal use or to consolidate its spectrum use with other Federal Government stations in a manner that maximizes the spectrum available for non-Federal use.

(i) DEFINITION- For purposes of this section, the term `Federal entity' means any department, agency, or other instrumentality of the Federal Government that utilizes a Government station license obtained under section 305 of the 1934 Act (47 U.S.C. 305).'.

§ 924. WITHDRAWAL OR LIMITATION OF ASSIGNMENT TO FEDERAL GOVERNMENT STATIONS

(a) In general
The President shall -

(1) within 6 months after receipt of a report by the Secretary under subsection(a), (d)(1), or (f) of section 923 of this title, withdraw the assignment to a Federal Government station of any frequency which the report recommends for immediate reallocation;
(2) within any such 6-month period, limit the assignment to a Federal Government station of any frequency which the report recommends be made immediately available for mixed use under section 923(b)(2) of this title;
(3) by the delayed effective date recommended by the Secretary under section 923(e) of this title (except as provided in subsection (b)(4) of this section), withdraw or limit the assignment to a Federal Government station of any frequency which the report recommends be reallocated or made available for mixed use on such delayed effective date;
(4) assign or reassign other frequencies to Federal Government stations as necessary to adjust to such withdrawal or limitation of assignments; and
(5) transmit a notice and description to the Commission and each House of Congress of the actions taken under this subsection.

(b) Exceptions

(1) Authority to substitute
If the President determines that a circumstance described in paragraph (2) exists, the President -

(A) may substitute an alternative frequency or frequencies for the frequency that is subject to such determination and withdraw (or limit) the assignment of that alternative frequency in the manner required by subsection (a) of this section; and
(B) shall submit a statement of the reasons for taking the action described in subparagraph (A) to the Commission, Committee on Energy and Commerce of the House of Representatives, and the Committee on Commerce, Science, and Transportation of the Senate.

(2) Grounds for substitution
For purposes of paragraph (1), the following circumstances are described in this paragraph:

(A) the reassignment would seriously jeopardize the national defense interests of the United States;
(B) the frequency proposed for reassignment is uniquely suited to meeting important governmental needs;
(C) the reassignment would seriously jeopardize public health or safety;
(D) the reassignment will result in costs to the Federal Government that are excessive in relation to the benefits that may be obtained from commercial or other non-Federal uses of the reassigned frequency; or

(E) the reassignment will disrupt the existing use of a Federal Government band of frequencies by amateur radio licensees.

(3) Criteria for substituted frequencies

For purposes of paragraph (1), a frequency may not be substituted for a frequency identified and recommended by the report of the Secretary under section 923(a) of this title unless the substituted frequency also meets each of the criteria specified by section 923(a) of this title.

(4) Delays in implementation

If the President determines that any action cannot be completed by the delayed effective date recommended by the Secretary pursuant to section 923(e) of this title, or that such an action by such date would result in a frequency being unused as a consequence of the Commission's plan under section 925 of this title, the President may -

(A) withdraw or limit the assignment to Federal Government stations on a later date that is consistent with such plan, except that the President shall notify each committee specified in paragraph (1)(B) and the Commission of the reason that withdrawal or limitation at a later date is required; or

(B) substitute alternative frequencies pursuant to the provisions of this subsection.

§ 925. DISTRIBUTION OF FREQUENCIES BY COMMISSION

(a) Allocation and assignment of immediately available frequencies

With respect to the frequencies made available for immediate reallocation pursuant to section 923(e)(2) of this title, the Commission, not later than 18 months after August 10, 1993, shall issue regulations to allocate such frequencies and shall propose regulations to assign such frequencies.

(b) Allocation and assignment of remaining available frequencies

With respect to the frequencies made available for reallocation pursuant to section 923(e)(3) of this title, the Commission shall, not later than 1 year after receipt of the initial reallocation report required by section 923(a) of this title, prepare,
submit to the President and the Congress, and implement,
a plan for the allocation and assignment under the 1934 Act (47 U.S.C. 151 et seq.) of such frequencies. Such plan shall -

(1) not propose the immediate allocation and assignment of all such frequencies but, taking into account the timetable recommended by the Secretary pursuant to section 923(e) of this title, shall propose -

(A) gradually to allocate and assign the frequencies remaining, after making the

reservation required by subparagraph (B), over the course of 10 years beginning on the date of submission of such plan; and

(B) to reserve a significant portion of such frequencies for allocation and assignment beginning after the end of such 10-year period;

(2) contain appropriate provisions to ensure -

(A) the availability of frequencies for new technologies and services in accordance with the policies of section 7 of the 1934 Act (47 U.S.C. 157);

(B) the availability of frequencies to stimulate the development of such technologies; and

(C) the safety of life and property in accordance with the policies of section 1 of the 1934 Act (47 U.S.C. 151);

(3) address (A) the feasibility of reallocating portions of the spectrum from current commercial and other non-Federal uses to provide for more efficient use of the spectrum, and (B) innovation and marketplace developments that may affect the relative efficiencies of different spectrum allocations;

(4) not prevent the Commission from allocating frequencies, and assigning licenses to use frequencies, not included in the plan; and

(5) not preclude the Commission from making changes to the plan in future proceedings.

(c) ALLOCATION AND ASSIGNMENT OF FREQUENCIES IDENTIFIED IN THE SECOND REALLOCATION REPORT-

(1) PLAN AND IMPLEMENTATION- With respect to the frequencies made available for reallocation pursuant to section 113(b)(3), the Commission shall, not later than one year after receipt of the second reallocation report required by section 113(a), prepare, submit to the President and the Congress, and implement, a plan for the immediate allocation and assignment under the 1934 Act of all such frequencies in accordance with section 309(j) of such Act.

(2) CONTENTS- The plan prepared by the Commission under paragraph (1) shall consist of a schedule of allocation and assignment of those frequencies in accordance with section 309(j) of the 1934 Act in time for the assignment of those licenses or permits by September 30, 2002.'.

§ 926. AUTHORITY TO RECOVER REASSIGNED FREQUENCIES

(a) Authority of President

Subsequent to the withdrawal of assignment to Federal Government stations pursuant to section 924 of this title, the President may reclaim reassigned frequencies for reassignment to

Federal Government stations in accordance with this section.

(b) Procedure for reclaiming frequencies

(1) Unallocated frequencies
If the frequencies to be reclaimed have not been allocated or assigned by the Commission pursuant to the 1934 Act (47 U.S.C. 151 et seq.), the President shall follow the procedures for substitution of frequencies established by section 924(b) of this title.

(2) Allocated frequencies
If the frequencies to be reclaimed have been allocated or assigned by the Commission, the President shall follow the procedures for substitution of frequencies established by section 924(b) of this title, except that the statement required by section 924(b)(1)(B) of this title shall include -

(A) a timetable to accommodate an orderly transition for licensees to obtain new frequencies and equipment necessary for its utilization; and

(B) an estimate of the cost of displacing spectrum users licensed by the Commission.

(c) Costs of reclaiming frequencies
The Federal Government shall bear all costs of reclaiming frequencies pursuant to this section, including the cost of equipment which is rendered unusable, the cost of relocating operations to a different frequency, and any other costs that are directly attributable to the reclaiming of the frequency pursuant to this section, and there are authorized to be appropriated such sums as may be necessary to carry out the purposes of this section.

(d) Effective date of reclaimed frequencies
The Commission shall not withdraw licenses for any reclaimed frequencies until the end of the fiscal year following the fiscal year in which a statement under section 924(b)(1)(B) of this title pertaining to such frequencies is received by the Commission.

(e) Effect on other law
Nothing in this section shall be construed to limit or otherwise affect the authority of the President under section 706 of the 1934 Act (47 U.S.C. 606).

§ 927. EXISTING ALLOCATION AND TRANSFER AUTHORITY RETAINED

(a) Additional reallocation
Nothing in this subchapter prevents or limits additional reallocation of spectrum from the Federal Government to other users.

(b) Implementation of new technologies and services

Notwithstanding any other provision of this subchapter -

(1) the Secretary may, consistent with section 903(e) of this title, at any time allow frequencies allocated on a primary basis for Federal Government use to be used by non-Federal licensees on a mixed-use basis for the purpose of facilitating the prompt implementation of new technologies or services and for other purposes; and

(2) the Commission shall make any allocation and licensing decisions with respect to such frequencies in a timely manner and in no event later than the date required by section 157 of this title.

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