

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
<p>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.</p> <p>2) Military airborne operations at the sites listed in Table 3-3 will be continued for 9 years after the scheduled reallocation date.</p> <p>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.</p> <p>4) The spectrum will be auctioned prior to 2002, in accordance with the Balanced Budget Act of 1997.</p>		

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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

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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

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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

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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:

- G** the extent to which equipment is or will be available that is capable of utilizing the band;
- G** the proximity of frequencies that are already assigned for commercial or other non-Federal use;
- G** the activities of foreign governments in making frequencies available for experimentation or commercial assignments in order to support domestic manufacturers of equipment; and
- G** the extent to which, in general, commercial users could share the frequency with amateur radio licensees.

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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	<ul style="list-style-type: none"> o Low atmospheric and foliage penetration losses; o Availability of inexpensive components; o Permits the use of smaller antennas for hand-held applications 	<ul style="list-style-type: none"> o This band could be used for various commercial land-mobile wireless applications.
216-220	<ul style="list-style-type: none"> o Effective radio wave propagation characteristics; o Permits the use of smaller antennas for hand-held applications; o Availability of inexpensive components; o Adjacent to the 220-222 MHz currently allocated for non-Government Private Mobile Radio Services for Part 90 devices. 	<ul style="list-style-type: none"> o This band could be used for Interactive Video and Data Services (IVDS), Wireless Local Loop (WLL), or Wideband Intercity Packet Data Service. o This band could be used as expansion channels for the 220-222 MHz band that is currently being auctioned by the FCC.
1385-1390	<ul style="list-style-type: none"> o 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; o 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; o This band is adjacent to the 10 MHz in the 1390-1400 MHz band to be transferred under OBRA 93. 	<ul style="list-style-type: none"> o 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). o 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)		

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

Frequency Band (MHz)	Technical Considerations	Potential Commercial Applications
1432-1435	<ul style="list-style-type: none"> o 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; o 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; o Existing technology could be adapted rapidly and marketed at an early stage; o This band is adjacent to the 5 MHz in the 1427-1432 MHz band to be transferred under OBRA93. 	<ul style="list-style-type: none"> o 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). o 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	<ul style="list-style-type: none"> o 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; o Worldwide frequency allocation for fixed and mobile services further supports flexibility in services that can be implemented and could foster U.S. export opportunities; o This band is in close proximity to spectrum already allocated for non-Federal use. 	<ul style="list-style-type: none"> o 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

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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.

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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).