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

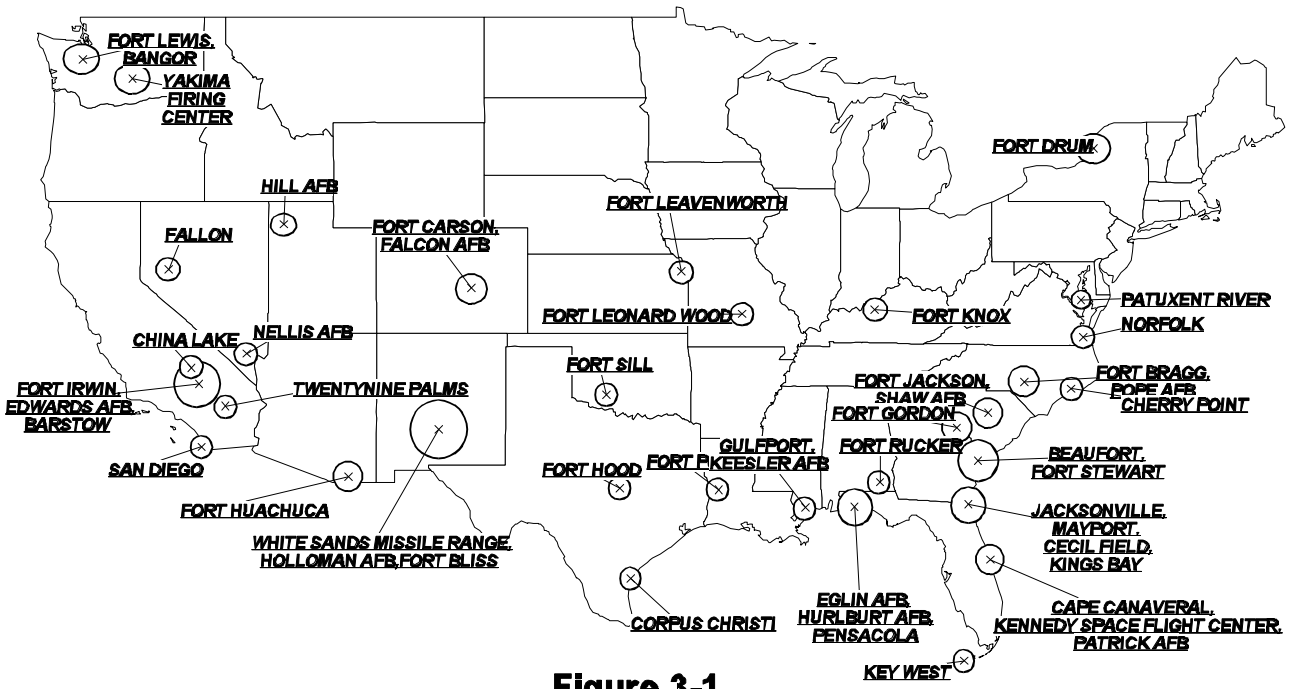

Figure 3-1.

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 ($\pm$ 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.

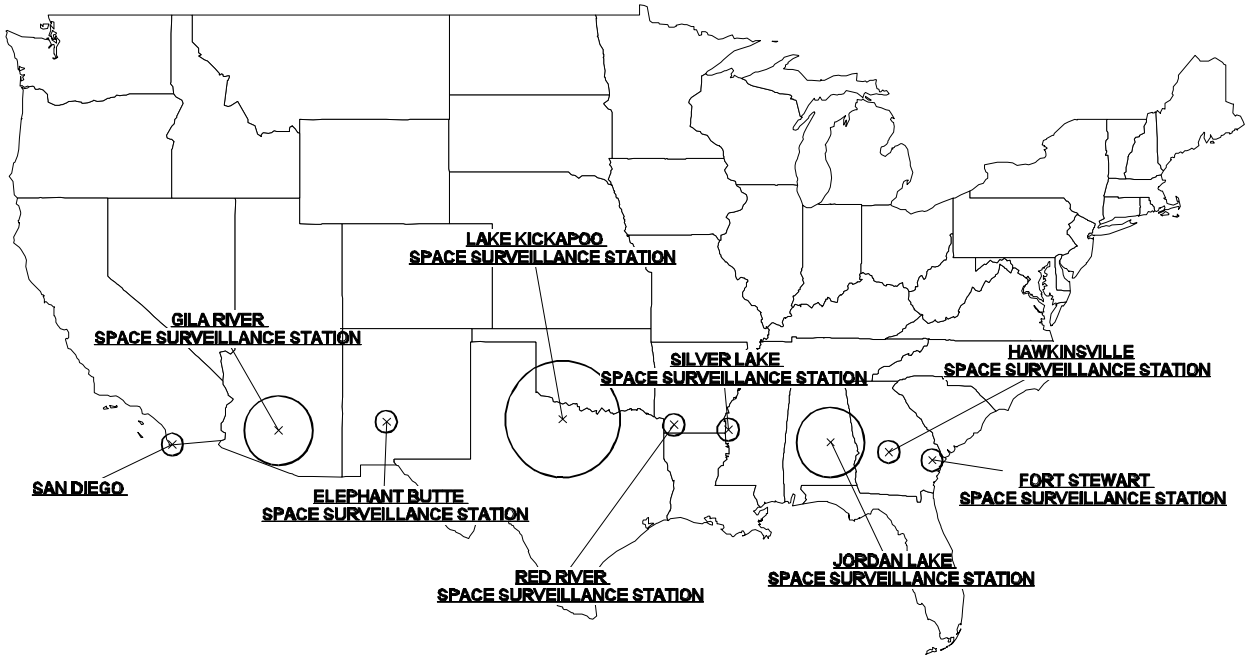

Figure 3-2.
SPASUR Radar Locations to Be Protected Indefinitely

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.