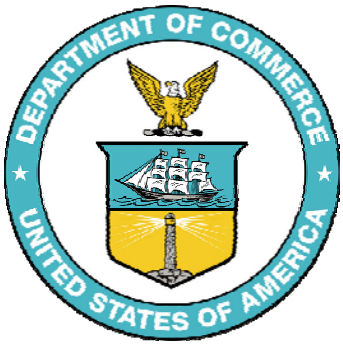

Strategic Spectrum Plan
2007 Version

U.S. Department of Commerce
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Table of Contents

Note: The organization of this document reflects conformance with requirements established by the National Telecommunications and Information Administration to standardize strategic spectrum plans across all federal government agencies. It is not optimized for presentation of the specific strategic spectrum plan of the Department of Commerce.

Executive Summary

The Department of Commerce (DOC) developed this Strategic Spectrum Plan in response to the Presidential Spectrum Reform Initiative and a November 29, 2004, Presidential Memorandum. Strategic Spectrum Plan objectives, specified by Secretary Gutierrez, are to provide:

- spectrum requirements, including bandwidth and frequency location for future technologies or services;
- planned uses of new technologies or expanded services requiring spectrum over a period of time agreed to by the selected agencies; and
- suggested spectrum-efficient approaches to meet identified spectrum requirements.

This plan accomplishes these objectives through identification of DOC's diverse spectrum requirements. These requirements range in frequency from 20 kHz to over 316 GHz. Applications range from law enforcement operations to scientific applications. They include spectrum for active operation and the protection of passive bands that are critical to monitoring the Earth's environment and to predicting weather. The Department of Commerce's use of the valuable spectrum resource directly supports and helps protect our Nation's $1,621.8 billion/year in foreign trade exports (for 2007), $31.6 billion/year commercial fishing industry, $141.5 billion/year of agriculture, and other sectors of our Nation's economy. Critical DOC programs reduce loss of life and prevent billions of dollars in property damage each year through its hurricane and severe weather prediction and warning services. These services could not be provided without access to and protection of vital radio frequency spectrum

Summary of Key Spectrum Requirements

Table A1 in Annex A provides a summary, in tabular form, of all DOC spectrum requirements. This table was developed based on the detailed inputs from the DOC offices and bureaus. Table A1 indicates the DOC spectrum requirements will increase for only a limited number of applications. A summary of DOC requirements, broken down by radio service, follows:

Fixed Service - DOC fixed service spectrum use includes emergency communications, standard time transmission, and providing feeds to weather radio transmitters, collecting climatological data from remote locations, and operating control links between offices and remote equipment such a radars. Requirements include access to spectrum ranging from 3 MHz to nearly 2 GHz. The only identified change in fixed service spectrum requirements over the next 10 years is the modernization of the existing 1,221 United States Historical

Climatology Network (USHCN) Studies are currently underway to determine the communication technologies to support HCN-M (Modernization). One of the technologies being investigated would consist of an infrastructure integrating optimized solutions within a hybrid network consisting of VHF/UHF, Satellite, TCP/IP, and Meteor Burst. All technologies would be based on digital electronics in order to provide the most efficient spectrum requirement.

Mobile Service - DOC requires radio spectrum for the mobile service for typical LMR applications as well as a number of specialized applications. Some of these applications include research, development, test and evaluation (RDTE), law enforcement, telemetry for tracking of marine mammals and fish, telemetry for remote control of research equipment, and broadcast of weather and hazards warnings to the public via weather radio. No significant changes in mobile spectrum requirements are anticipated with the possible exception of some small segments of spectrum needed for the Government to conduct specialized telemetry operations.

Earth Exploration Satellite Service (EESS) - DOC is a large user of EESS spectrum, including allocations to the meteorological satellite (MetSat) service. Access to EESS and MetSat spectrum is critical to maintain control of their satellites, transmit data, and operate active and passive sensors for atmospheric and Earth surface sensing. It is the passive sensor operations that are so sensitive to operational frequency. If passive sensing systems were required to vacate bands providing unique measurement characteristics, the operational capability will be lost.

Meteorological Aids Service (MetAids) - DOC operates a large number of radiosonde and dropsonde systems under the MetAids radio service. These systems support meteorological operations and atmospheric research within DOC. The data from these systems are critical to COOP and Homeland Security operations, in particular in plume modeling. No significant changes are anticipated in MetAids spectrum requirements. NOAA has upgraded 52% of its of radiosonde technology for the operational network so as to reduce the spectrum requirement by approximately 50%. The new reduced requirement is reflected in this plan.

Radiodetermination Service (including Radiolocation and Radionavigation) - DOC requirements for radiodetermination spectrum come from NOAA and NTIA radar operations. In the U.S. Table of Allocations, meteorological radars are categorized under the MetAids service. In the International Table of Frequency Allocations they operate under the radiodetermination service. Systems operated by DOC include ground-based and airborne meteorological radars and wind profiler radars. The change in spectrum requirements relating to meteorological radars is the possible use of the Collaborative Adaptive Sensing of the Atmosphere (CASA) concept for deploying of gap filler radars operating in the

9.41 GHz +/- 30 MHz range NOAA is transitioning the NOAA Profiler Network (NPN) from 404.37 MHz to 449 MHz.

Fixed Satellite Service (FSS) - DOC relies on commercial fixed satellite service allocations for satellite connectivity between NOAA facilities. Procurement of commercial satellite services is the most cost effective manner for meeting the Government's needs. DOC requirements for commercial satellite service are expected to increase in the future. Federal acquisition policies and the Federal Government spectrum regulatory rules require Federal agencies to use commercial services, where available and applicable. Current United States spectrum regulatory rules increase cost significantly and discourage government use of commercial satellite service providers. For Government operations employing the use of commercial satellite services to be protected, in addition to the satellite system, the satellite ground station must be commercially licensed and operated as well. This frequently requires the government to enter into costly third party contracts with commercial providers to license and operate the ground stations. Changing United States spectrum regulatory policy to allow government operation of the ground station on a protected basis, as are other commercial satellite service customers, will reduce costs and encourage further use of commercial service providers.

Mobile Satellite Service (MSS) - DOC relies on mobile satellite spectrum for satellite telephone applications in support of maritime operations, law enforcement, and COOP. Mobile satellite provides connectivity in areas where terrestrial networks are not available. DOC requirements for mobile satellite phone services are not expected to increase significantly in the next 10 years. In addition, the Search and Rescue Satellite (SARSAT) portion of the COPSAS-SARSAT system, a system operating in the MSS, is under the operational control of DOC (NOAA).

Summary of Trends – For DOC, the trend that most impacts spectrum use is increasing data resolution (spatial and temporal) in Earth observing systems, allowing a better understanding of climate change and improvement in weather forecast and severe weather warning capabilities. Higher data resolution requires greater bandwidth for data transmission. In addition, improved protection of the RF-based observing sensors is required. Higher resolution data will be of little use of the data is corrupted by interference.

Summary of Key Strategies – To ensure the DOC spectrum requirements continue to be met, DOC ORFM has established the following four strategic goals:

- Engage in domestic and international venues to ensure changes in spectrum regulations support economic growth while protecting DOC operations.

- Promote cooperation among DOC offices conducting operations, Government laboratories, and academia to ensure the necessary spectrum resources are available to develop, test, and deploy new technologies.
- Participate in international coordination meetings (SFCG and WMO SG-RFC) [1] to promote the availability of spectrum for global earth observation systems.
- Increase spectrum efficiency using new technologies, promoting spectrum sharing, and utilizing commercial services where available.

I. Introduction

Department of Commerce Mission

The mission of the Department of Commerce is to "*create conditions for economic growth and opportunity by promoting innovation, entrepreneurship, competitiveness and stewardship*." Within this mission the Department of Commerce has established three strategic goals[2].

- Goal 1: *Provide the information and tools to maximize U.S. competitiveness and enable economic growth for American industries, workers and consumers.*
- Goal 2: *Foster science and technological leadership by protecting intellectual property, enhancing technical standards, and advancing measurement science.*
- Goal 3: *Observe, protect, and manage the Earth's resources to promote environmental stewardship.*

DOC has diverse spectrum requirements ranging in frequency from 20 kHz to over 316 GHz. Access to radio spectrum for the DOC offices and bureaus supports meeting all three DOC mission goals. Applications range from law enforcement operations to scientific applications. They include spectrum for active operations and the use of passive bands that are critical to monitoring the Earth's environment and to predicting weather. The Department of Commerce's use of the valuable spectrum resource directly supports and helps protect our Nation's $1,621.8 billion/year in foreign trade exports, $31.6 billion/year fishing industry, $141.5 billion/year of agriculture, and other sectors of our Nation's economy. Critical DOC programs reduce loss of life and prevent billions of dollars in property damage each year through its hurricane and severe weather prediction and warning services. These services could not be provided without access to and protection of vital radio frequency spectrum.

DOC spectrum requirements were identified through a review of the Government Master File (GMF), which contains information on over 9,000

[1] The SFCG is the Space Frequency Coordination Group and the WMO SG-RFC is the World Meteorological Organization Steering Group on Radio Frequency Coordination.

[2] The Department of Commerce Strategic Plan can be obtained at http://www.osec.DOC.gov/bmi/budget/Strategic04-1002.htm

DOC frequency assignments, and through spectrum requirement information requests made to DOC offices and bureaus.

Strategic Vision for DOC Spectrum Management

Radio frequency spectrum is a limited resource, access to which is critical to meeting Department's strategic goals, our national economy, and public safety. DOC manages its use of this resource to ensure availability of the spectrum required to meet its operational requirements while making efficient use of radio frequency spectrum. Meeting its Departmental spectrum requirements with increasing commercial, public, and government demand for spectrum access, will require continued efforts to increasing spectrum efficiency using new technologies, promoting spectrum sharing, and utilizing commercial services where available.

Value of DOC Spectrum Use

The DOC operates a wide variety of spectrum-reliant systems. The table in Annex 1 summarizes the DOC spectrum requirements. The spectrum requirements support our Nation's economy in many diverse ways. Spectrum is required for safety and security, atmospheric and marine research, weather forecasting and severe weather warnings, and telecommunications research. All these uses of spectrum ensure safety and support economic prosperity of the U.S. Below are a few representative examples.

- The IEOS Strategic Plan[3] indicates "national institutions that contribute weather, climate, public health, and water services to their citizens contribute an estimated $20-$40 billion dollars each year to their national economies." Furthermore, "weather- and climate-sensitive industries, both directly and indirectly, account for as much as 1/3 of our Nation's GDP- $4 trillion in 2005 dollars."

- The NOAA Strategic Plan also states "Ocean resources account for a significant portion of the U.S. economy, and recent estimates indicate that coastal areas provide 28 million jobs, millions of dollars in goods and services, and tourist destinations for 180 million Americans per year." The NOAA Strategic Plan also indicates "The value of the ocean economy to the Unites States is over $115 billion" and the "United States manages the largest marine territory of any nation in the world."

- The USTPO Strategic Plan states, "There are an estimated seven million pending applications in the examination pipeline." Many of these applications are critical to the intellectual property rights of U.S. industry and the economic prosperity of our Nation.

[3] Strategic Plan for the U.S. Integrated Earth Observation System.

- The dollar value of the U.S. landscaping industry for 2002 was greater than $52 billion. Landscaping accounts for 2.9 percent of all fresh water usage in the U.S., consuming nearly 10 billion gallons per day. Benefits are realized from improved wind speed, humidity, and precipitation forecasts that result in reduced excess irrigation and fewer wasted fertilizer/pesticide applications.

For private sector spectrum use, income gained through spectrum use versus capital expended to license and use spectrum is easily quantifiable. In the case of DOC spectrum use it is more difficult to determine the dollar value of protecting our National security, economic prosperity, public safety, and the value of providing reliable weather forecasts to the public and industry. While it is difficult to quantify the value of radio spectrum to the DOC mission, access to radio spectrum is critical to carrying out the DOC mission. It is not sufficient to just ensure adequate bandwidth is available for all operations; some systems must be operated in specific ranges of the radio spectrum. Meteorological radar performance can be enhanced, or limited, depending on whether an appropriate frequency range is used. Satellite passive sensors require specific frequencies to detect conditions in the atmosphere and on the Earth's surface.

II. Current Spectrum Use: Update of November 2005 Department of Commerce Strategic Spectrum Plan

Missions and Programs Supported

For purposes of this spectrum plan, the details of DOC systems and spectrum requirements are not arranged by radio services, but by applications. Some applications span more than one radio service. DOC spectrum requirements can be divided in the following application categories: Observing Systems, Data Transmission Systems, Dissemination Systems, Communications Systems, and Research, Test and Development.

Observing Systems-

Due to the nature of many NOAA operations, Observing Systems constitute the largest use of spectrum within DOC. Observing systems operated by NOAA are critical to the accomplishment of the NOAA mission. The diversity of NOAA observing systems allows NOAA to support commerce and transportation, and serve the public's need for weather, water, climate, and ecosystem observation. A spectrum-reliant observing system is a system where spectrum is used directly for measurement of atmospheric or environmental conditions. Spectrum for observing systems account for 65% of the frequency assignments held by DOC.

Radars - NOAA operates a variety of ground-based and airborne meteorological radars. The NEXRAD program is the largest DOC user of radar spectrum, but other NOAA radar applications include airborne

weather radars operated on cyclone reconnaissance aircraft, wind profiler radars, and transportable radars for atmospheric research. Meteorological radars contribute to the NOAA *Weather and Water* mission goal by providing real-time accurate weather information.

The WSR-88D radar, operated under the NEXRAD program, has been instrumental in significantly improving the lead-time for severe weather, tornado, and flash flood warnings in the United States. The WSR-88D, operated in the band 2700-3000 MHz, is continuously undergoing upgrades to integrate new technology for enhanced performance and sustainable operations for at least 20 years. The requirements for spectrum to support the NEXRAD program are not anticipated to change in the next 10 years.

NOAA has ongoing work or interest in other meteorological radar bands. The bands near 5625 MHz and 9.4 GHz are used for NOAA atmospheric research applications. Clear air turbulence monitoring is also being studied using radars operated in the 1 to 2 GHz range. Studies partially funded by NOAA are underway to evaluate the use of small radars operating near 9.4 GHz to fill gaps in areas where the tilt angle of the NEXRAD and Earth curvature result in unmonitored areas low in the atmosphere. Additional NOAA requirements for meteorological spectrum around 9.4 GHz are possible in the next 10 to 15 years.

In 1992 NOAA deployed an experimental wind profiler demonstration network, now called the NOAA Profiler Network (NPN) in the central U.S. The demonstration network was assigned an experimental frequency of 404.37 MHz, sharing the band with radiosonde and data collection platforms. Emissions from the wind profilers operating on the experimental frequency became a source of interference to the COSPAS-SARSAT receivers on the NOAA polar-orbiting satellites. The NPN is currently being transitioned to an operational observing network. As part of the transition, NOAA will upgrade all the 404.37 MHz profilers, changing the frequency to 449 MHz. Wind profiler use of 404.37 MHz is anticipated to end by 2008. In addition to the 30 NPN, NOAA currently operates 5 profilers at 449 MHz. The long-term wind profiler deployment may include 100 wind profilers operating at 449 MHz.

NOAA may also have future requirements for spectrum to support wind profiler radar operations in the 902-928 MHz range. This frequency range will provide capabilities not possible at 449 MHz.

For 30 years NOAA has been working with oceanographic radars used for monitoring the surface conditions of the sea near coastal areas. These radars operate in the 3 to 30 MHz range, and near 42 MHz. Lower frequencies provide longer-range detection of the sea surface, but at a

lower data resolution than can be achieved at higher frequencies. These radars are operating on an experimental basis since no spectrum allocations exist for their operation. DOC initiated the creation of a WRC-11 agenda item to obtain allocations for operation of these radars (WRC Agenda Item 1.15). Data from these radars is important for detection sea surface conditions, and determining currents. Products support maritime search and rescue as well as oceanographic, meteorological, climatological and disaster response operations. The Coast Guard is interested in use of data from the same radars for maritime domain awareness.

Satellite Passive Sensing - NOAA operates the two civilian operational environmental satellite systems (Polar-orbiting Operational Environmental Satellite – POES and Geostationary Operational Environmental Satellite – GOES) that provide vital data in support of their mission. These satellites carry an array of imaging and passive sensor (POES only) systems. While the spectrum for data transmission and satellite control (discussed later) is critical to NOAA operations, protection of bands used for passive sensors is of extreme importance. Passive sensors are very low noise, ultra sensitive receivers used to sense emissions from the Earth's surface and atmosphere. The sensors are designed to sense changes in radio frequency (RF) levels on the order of tenths to hundredths of a decibel (dB), and interference easily corrupts the sensor data. Changing frequency bands to accommodate requirements of new spectrum users typically is not possible since bands for passive sensing are selected based on physical properties of the Earth and its atmosphere. The data from passive sensors improve NOAA's weather forecast capabilities.

In response to the first NOAA goal "*To understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social and environmental needs*.", NOAA scientists are using satellite data to monitor the long-term effects of heat stress on coral reefs in several areas of the world. NESDIS now produces a weekly chart known as Degree Heating Week. These satellite-derived charts allow scientists and reef managers to monitor the cumulative thermal stress on several coral reefs, including Australia's Great Barrier Reef and those in the Bahamas and the Galapagos. An example of the impact of NOAA' polar-orbiting satellite in meeting the second NOAA goal of climate variability is the long-term monitoring of the Antarctic ozone hole. The record is more than 10 years in length and provides a building climatology of the seasonal and annual variations of one of the many climate change parameters. The constant monitoring of tropical storms from their inception to their demise, and sometime U.S. landfall, fulfills the third goal for the Nation's need for weather and water information. The search and rescue function on both polar-orbiting and geostationary satellites supports the Nation's commerce with information for the safe and efficient transportation part of providing the critical

support for NOAA's overall mission. Data from NOAA satellites are also used to determine the safety of airline routes and flight plans, to reduce the risk of damage to ships and cargo, and to issue weather forecasts and warnings.

Table 1 summarizes the NOAA spectrum requirements for satellite passive sensors for current and future meteorological satellite operations.

Table 1: Passive Sensing Bands (receiving sensors on polar-orbiting spacecraft) Current and Future Requirements	
Frequency Band (GHz)	**Instrument**
6.425 – 7.025 [1]	Conical Microwave Imaging Sounder (CMIS)
10.6 - 10.7	CMIS
10.6 - 10.8	CMIS
23.6 - 24	Advanced Microwave Sounding Unit-A (AMSU-A) Sensor, Advanced Technology Microwave Sounder (ATMS), CMIS
31.3 - 31.5	AMSU-A and ATMS
36 - 37	CMIS
50.2-50.4	AMSU-A, CMIS and ATMS
51.4 - 59.3	AMSU-A, CMIS and ATMS
59.3 – 60.55 [1]	CMIS
86 - 92	AMSU-A, Advanced Microwave Sounding Unit-B (AMSU-B), ATMS and CMIS
148.5 –155.5	Microwave Humidity Sounder
164 - 167	ATMS and CMIS
174.8 - 191.8	AMSU-B, CMIS and Microwave Humidity Sounder
316 -334	CMIS

[1]- Band not allocated to EESS (passive).

Satellite Active Sensing - NOAA has limited requirements, shown in Table 2, for bands to perform satellite active sensing. Radar altimeters are used to measure sea surface topography to an accuracy of approximately 4.2 cm. These operations support the NOAA *Weather and Water*, *Climate Variability*, and *Commerce and Transportation* mission goals. Radar altimeters allow scientists to observe and study both short-lived events such as hurricanes and long-term climate phenomena such as the Pacific Decadal Oscillation. They also provide the capability to monitor global mean sea level, an indicator of global temperature change.

Table 2: Active Sensing Bands (sensors on polar-orbiting spacecraft) Future Requirements	
Frequency Band (GHz)	**Instrument**
5.250 – 5.570	NPOESS Altimeter
13.25 - 13.75	NPOESS Altimeter

Global Navigation Satellite System (GNSS) - The Global Positioning System (GPS) and the Russian Federation GLONASS system are typically used for navigation and position determination. In addition to the typical uses, NOAA uses GNSS for observation systems. The RRS will rely on GPS receivers integral to the radiosondes for measurement of winds. Use of GPS will provide improved wind measurement accuracy relative to the legacy system that relied on radio direction finding for tracking radiosonde movement. NOAA is also researching the use of GNSS for measuring atmospheric parameters such as refractivity, correction factors for remote sensing and radar, and integrated precipitable water vapor. These applications using GNSS support all four NOAA mission goals.

Data Transmission Systems - Radio-based data transmission systems, used for transmission of data and non-voice communications between locations, are necessary for NOAA operations. Many observing systems are operated in remote areas where land-line is not available. The systems can be terrestrial-only or may include a space component. This section does not include personal communications systems.

Hydrologic Radio Systems - Automated Local Evaluation in Real Time (ALERT) systems are locally owned and operated cooperator stream gage water height collection networks transmitting on Federal hydrologic radio frequencies. NTIA and the FCC have made special provisions in their rules to allow local communities to use Federal spectrum to collect hydrologic data for flash flood warning purposes, and share their information with NOAA. Several thousand transmitters operate in the 162-174 MHz band, and a few hundred more operate in the 406-412 MHz band on specific frequencies dedicated for hydrologic use. ALERT systems support the NOAA *Weather and Water* mission goal by providing data Federal, state and local agencies data critical to flood and flash flood warnings. Some systems, with an increasing number in the future, are capable of measuring wind speed and direction, critical to Homeland Security operations.

Future spectrum planning should consider the operational impacts on local governments and non-profit organizations if spectrum changes require alteration or replacement of existing systems. The cost to the local government may be substantial, and vary widely depending on the size, scope, and complexity of each system. The initiative to transition the operation of ALERT systems to FCC licenses held by the operator instead of NOAA was complete in 2007.

NOAA is modernizing its Cooperator Observer Network by deploying new sensor platforms and converting data reporting from a manual process to an automated radio-based process.

Meteorological Satellite Data Transmission **-** The NOAA geostationary and polar-orbiting meteorological satellites rely on radio spectrum for transmission and reception of raw and processed sensor data, and for control. Depending on the application, these links are operated under EESS, MetSat or MSS frequency allocations. Table 3 provides the bands required for NOAA MetSat data transmission.
For the relationship of these bands to the NOAA mission, refer to the Passive Sensor section under Observing Systems.

There are no known technologies that can replace data transmission from satellites orbiting the Earth carrying sensors that monitor its environment. With both next generation polar-orbiting (NPOESS) and geostationary (GOES-R) networks likely being launched before 2015, there will be a significant increase in spectrum use due principally to sensors having much greater complexity (greater sensitivity, higher resolution, both spectrally and spatially) in the number of channels and resulting data rates. However, the use of additional spectrum will result in a much better understanding of the Earth and its environment. The increase in spectrum use will be kept to a minimum through application of the latest technologies resulting in more efficient modulation schemes, encoding, compression, and filtering. The design of NPOESS is almost complete, thereby limiting the extent to which further improvements in spectrum efficiency can be accomplished. For GOES-R there is a significant radio frequency communications design effort in place that is expected to continue for several years. This effort has concentrated on examining the latest technologies available regarding efficient modulation, encoding and compression algorithms in order to achieve the maximum spectrum efficiencies which will result in the greatest data throughput in the least amount of radio frequency spectrum.

Table 3: NOAA MetSat Data Transmission Bands Current and Future Requirements		
Frequency Range (MHz)	**Function**	**Polar-Orbiting or Geostationary Operations**
121.45 - 121.55	Emergency Position Beacons	Polar
137-138	Data Transmission to Earth	Polar
242.95 - 243.05	Emergency Position Beacons	Polar
401 - 403	Data Collection Platform Uplink	Polar Geostationary
406.0 - 406.1	Emergency Position-Indicating Radio Beacons	Polar Geostationary
460 - 470	Data Collection Platform Interrogation	Geostationary Future Polar
1535 - 1559	Transmission of Emergency Position Data to User Terminals	Polar Geostationary
1670 - 1710	Data Transmission to Earth	Polar Geostationary
2025 - 2110	Spacecraft Command Uplink	Polar Geostationary
2200 - 2290	Backup Data Transmission to Earth	Polar Geostationary
7190 - 7235	Data Transmission to Spacecraft	Future Geostationary
7750 - 7850	Data Transmission to Earth	Future Polar
8175 - 8215	Data Transmission to Spacecraft	Future Geostationary
8025 - 8400	Data Transmission to Earth	Future Geostationary Future Polar
18,100 - 18,300	Data Transmission to Earth	Future Geostationary
25,500 – 27,000	Stored Mission Data Transmission to Earth	Future Polar

Water Level Monitoring - NOAA operates water level monitoring equipment in shipping channels and ports to support maritime operations. Transmission of the data from these systems is via data collection systems operated on board geostationary and polar-orbiting meteorological satellites, and terrestrial radio networks. Discussion of meteorological satellite data transmission spectrum requirements is provided the previous section.

Radiosonde Systems (including dropsondes) - Radiosondes are sensor packages lifted through the atmosphere by a balloon or in the case of dropsondes, dropped from aircraft. Sensor data is transmitted to a ground station near the release point where the data is processed (based on the

aircraft in the case of dropsondes), and meteorological data products are produced. Radiosonde data are used by NOAA and world-wide meteorological community as a necessary input to the numeric weather models and by NOAA researchers for atmospheric and climatologic research. NOAA operates a synoptic network of 102 radiosonde stations, each releasing a flight at 00 and 12 UTC. In addition, NOAA researchers operate transportable radiosonde and dropsonde stations for atmospheric research. Radiosondes are the only devices capable of providing in-situ atmospheric measurements to an altitude of 30 kilometers. Dropsondes are capable of data collection from flight level to within a few meters of the earth's surface, even over areas where radiosondes cannot be released.

Radiosonde data support the NOAA *Weather and Water*, *Climate Variability*, and *Commerce and Transportation* mission goals. Synoptic data improve the weather forecasters' ability to increase weather and water warning lead times and forecast accuracy, and improve the predictability, onset, and impact of hazardous weather events. Data users include Federal, and foreign metrological activities; atmospheric research; state and local governments. In addition, the NOAA radiosonde system data are critical to DHS and COOP missions by providing medium range information on weather related events (rainfall, wind speed and direction, severe weather events, etc.) and making the information readily available to all Federal agencies.

Radiosondes and dropsondes are operated by NOAA in the allocated bands 400.15-406 MHz and 1668.4-1700 MHz. With the deployment of the RRS most synoptic operations are conducted within 1675-1683 MHz, avoiding MetSat downlinks above 1683 MHz and commercial operations below 1675 MHz. Several synoptic stations and most NOAA research systems are operated in 400.15-406 MHz, which is shared extensively with DOD and non-government research institutions. NOAA requirements for radiosonde spectrum are anticipated to remain constant over the next 5 to 10 years.

Wildlife and Fish Tracking Systems - Radio telemetry and direction finding is used to track the movement and foraging behavior of wildlife and fish. These tracking systems support the NOAA *Ecosystems* mission goal. The technology and frequency range required varies with application. NOAA currently operates several tracking systems and has requirements for spectrum for additional systems.

Table 4: Wildlife and Fish Tracking Spectrum Requirements				
System	**Application**	**Current Spectrum Requirement**	**Future Requirement**	**Comments**
Marine Mammal Radio Tags	Marine mammal tracking	40 transmitters operating in 164-165 MHz	Expansion to 60 transmitters in next 3 years	None
Satellite Linked Position and Data Recording	Marine mammal tracking	57 Units operating at 401.650 MHz	Expansion to 125 units in the next 3 years	Operates on the ARGOS system.
Fish Tags- System #1	Fish tracking system	100 units operating in 30.05 - 30.25 MHz	Same as current requirement	None
Fish Tags- System #2	Transmit fish electromyogram data	Planned system	Very low power transmitters operating at 151.4 MHz	None
VEMCO Fish Tracking	Triangulation to track salmon movement in Puget Sound	20 Listening stations operating at 458.54 MHz	Same as current requirement	100 additional listening stations operated by other entities support NOAA operations
Passive Integrated Transponder/Transceiver	Salmon studies	20 systems operating at 134.2 kHz	Second frequency for non-salmonid studies in 125 – 400 kHz range	Approximately 500 systems total used in research community

Video Transmission - NOAA uses remote-controlled video cameras for continuous monitoring of wildlife from remote locations. Use of these systems supports the NOAA *Ecosystems* mission goal. The systems are operated at 1840 MHz where the transmitted video signal is relayed through mountain-top repeaters. The spectrum requirements for this system are not anticipated to change.

Commercial Satellite Services **-** Federal acquisition policies and the Federal Government spectrum regulatory rules require Federal agencies to use commercial services, where available and applicable, as opposed to development and deployment of Government-owned and -operated systems. NOAA uses commercial satellite services for support of its operations. Transport of water and weather data and products between NOAA facilities and to external customers is critical to the NOAA mission. Use of commercial satellite services is the only economically viable solution for global transport of data, supporting the NOAA *Weather and Water*, and *Mission Support* goals. NOAA systems reliant on commercial satellite services include the Alaska Tsunami Warning Network, future NOAA Weather Radio Links (NWRL), the Automated Weather Information Processing System (AWIPS), NOAA Weather Wire

Service (NWWS), and the International Satellite Communications System (ISCS). In addition, NOAA relies on services provided via commercial satellite communications like the NEXRAD Information Dissemination System (NIDS) and MetLab. Table 5 provides a list of commercial satellite applications used by NOAA. Requirements for commercial satellite service are expected to increase.

Table 5: Commercial Satellite Service Current and Future Requirements

Application	Current Use Earth Stations	Future Expansion	Band/ Bandwidth Requirement	Service Provider	Purpose
Tsunami Warning Network	12	None Anticipated	12/14 GHz 200 kHz	Intelsat	Transmit seismic data from remote sites
AWIPS	125	None Anticipated	4/6 GHz 8.6 MHz	GE Americom	Transmission of data an products between NOAA facilities
NWWS	20 transmit/ receive and 55 receive	None Anticipated	4/6 GHz	GE Americom	Transmission of data to national, state and local offices
ISCS	93	Non Anticipated	4/6 GHz 780 kHz	Intelsat	Worldwide transfer of meteorological data and products.
NWR Links	Future Requirement	> 800 Earth Stations	Not determined at this time	Not determined at this time	Transmission of NOAA Weather Radio programming to broadcast transmitter sites
NIDS	1 (TPC)	None Anticipated	Unknown	Unknown	
MetLab	1 (TPC)	None Anticipated	Unknown	Unknown	
GOES DCS ISP Ground Control	1	Mission termination in 2 years.	12/14 GHz	SES-Americom	
DOMSAT- GOES DCS	1	None	12/14 GHz	SES-Americom	Mission requirement through GOES R program
DOMSAT- GOES DCS Backup	1	None	12/14 Ghz	SES-Americom	Mission requirement through GOES R program

Meteorburst Communications - NOAA operates approximately 50 stations in the Alaska Meteor Burst Communication System (AMBCS). AMBCS, operated by the Bureau of Land Management, was installed to serve as a statewide, automated data collection system. AMBCS provides a simple, cost-effective manner to collect data from remote data stations, supporting the NOAA *Weather and Water* mission goal.

NOAA stations use two, 16 kHz wide channels in the range of 40 to 42 MHz to provide periodic connectivity at a throughput rate of 2 kBPS. NOAA plans to expand the number of remote sites at a rate of approximately 6 per year and data throughput may be upgraded to 4kBPS. Despite these changes, spectrum requirements to support NOAA operations on AMBCS should not change significantly in the next 10 years.

Hurricane Reconnaissance Aircraft Communications - Data communications links operated between the U.S. Air Force Reserve hurricane reconnaissance aircraft and the Tropical Prediction Center (TPC) permit the real-time exchange of meteorological data as the aircraft collects data near and in hurricanes. Real-time information flow between reconnaissance aircraft and the TPC supports the NOAA *Weather and Water* mission goal by increasing lead times and predictability of severe weather and water events caused by tropical cyclones. The immediate transmission of data, as it is collected, allows the TPC to issue more accurate storm strength and track predictions reducing the uncertainty associated with coastal evacuations and emergency planning.

The radio link for data transfer between reconnaissance aircraft and the TPC is operated by the DOD in the 225-400 MHz band. NOAA is the beneficiary of the data collected via the radio link operated by DOD. These operations are conducted in support of NOAA by DOD using military hardware, spectrum requirements for these operations are established by DOD.

Autonomous Underwater Vehicle Operations - NOAA currently operates one autonomous underwater vehicle and may acquire several additional vehicles in the future. Deployment of the underwater vehicles supports the NOAA *Ecosystems* mission goal. The vehicles are used for collecting oceanographic data and for matching oceanographic data to foraging areas of tracked marine mammals. The current NOAA system operates in the 902-928 MHz ISM band. Future systems are anticipated to require access to spectrum other than in 902-928 MHz, preferably in the 400-500 MHz range.

Unmanned Aircraft Systems (UAS)- NOAA has conducted joint operations with NASA on a number of research projects using unmanned aircraft systems. WRC-11 is tasked with consideration of spectrum issues for UAS under agenda item 1.3. The DOC spectrum requirements for NOAA UAS operations are still in the early development stages. ISM bands have typically been used, and approvals from the FAA have been necessary for operations.

Dissemination Systems - "*Serving Society's Need for Weather and Water Information*" and "*Supporting the Nation's Commerce with Information for Safe, Efficient, and Environmentally Sound Transportation*" makes the operation of diverse number of information dissemination systems critical to NOAA operations. These dissemination systems are designed to provide customized products to the end user.

Terrestrial Broadcast - NOAA operates two terrestrial broadcast systems for dissemination of weather information and warnings to the public and emergency mangers. The broadcast systems operated by NOAA are essential to supporting the *Weather and Water* mission goal.

NOAA Weather Radio (NWR) is a nationwide system for providing weather forecasts, current conditions and all-hazards emergency warnings to the public, state and local governments, businesses and industry. Over 97% of the United States population is covered by NWR transmissions. Approximately 50 new transmitters will be added to the system in the next two years, increasing national coverage. The NWR All Hazards system is an integral part of the DHS emergency warning network, providing automatic transmission of emergency warning messages for all types of hazardous situations. There are no other suitable technologies that could replace NWR, and continue to provide all its capabilities. The NWR system is comprised of two parts; the broadcast segment, and the dissemination feed segment.

Broadcast Segment - A total of 992 broadcast transmitters operated on seven 25 kHz-wide dedicated channels occupying a range from 162.4 to 162.55 MHz make up the broadcast segment. Transmitter power ranges from 5 to 1000 watts. Since a change in transmit signal characteristics would obsolete the receivers used by the public, NWR broadcast transmitters are exempt from NTIA narrowband requirements. NWR broadcast spectrum requirements are not expected to change in the next 5 to 10 years.

Dissemination Feed Segment - NWR transmitters typically are not collocated with the source for broadcast content. Broadcast content is provided to transmitter locations by landline and ultra-high frequency (UHF) radio links. The signals currently occupy eighteen (18) 25 kHz channels in the 406.1 to 420 MHz. The NWR links will be narrow banded to 12.5 kHz bandwidths by January 1, 2008.

The Weather Radio Improvement Program (WRIP) will replace existing telephone links connecting WRO's and transmitters with an integrated high-availability communication network architecture. WRIP will merge both NWR and the NWWS dissemination systems into one unified data

collection and data dissemination system utilizing NOAANet for the collection of NWR and NWWS messages from individual WFO's and a hybrid terrestrial/satellite communications network for the dissemination of NWR broadcasts and NWWS text products. NOAA anticipates that 80% of all NWR transmitters will be linked directly using the NOAANet infrastructure. The remaining 20% of NWR transmitters not directly linked with NOAANet will be linked using a combination of upgraded UHF links, C-Band/Ku-Band satellite links, or other dedicated communication links and circuits. The number of UHF links is likely to increase from the 100 now used to a maximum of 200 when the satellite dissemination system is implemented. Messages that are to be delivered to the NWWS will be sent to a C-Band Maser Ground Station (MGS) for broadcast to the NWWS users. WRIP will also provide an interface for DHS, FEMA, and other government agencies to disseminate localized and national emergency voice alerts through NWR transmitter stations. Implementation of the integrated WRIP communication infrastructure is expected to occur beginning FY 2009 through FY 2012.

Emergency Managers Weather Information Network (EMWIN) performs a function similar to NWR, but the weather information is transmitted in digital form and is customized to meet the needs of emergency managers. The EMWIN signal is received from the GOES and retransmitted with a 100 watt VHF transmitter. The data can be received, demodulated, and displayed on a computer by emergency managers. The EMWIN receiving system may be fixed, transportable, or mobile. NOAA uses three VHF frequencies for the EMWIN 24 hour per day, 7 day per week rebroadcast. EMWIN complies with the NTIA narrowband mandate. The current spectrum requirements for EMWIN are anticipated to extend until at least 2010. Changes in the next series of GOES satellites, the GOES-N thru P constellation, have necessitated development of EMWIN-N. Sometime before 2011 the current GOES satellites will be removed from operation and will be replaced by the new series. To meet ITU regulations power and modulation changes, EMWIN users will need to migrate to newer technologies due to L band carrier frequency change from 1690.725 MHz to 1692.700 MHz, reduction in the power level from 51 dBmi to 43 dBmi, and modulation scheme change from Frequency Shift (FSK) to Binary Phase Shift Key (BPSK),

Broadcast Media - The broadcast media plays an important role in NOAA mission though NOAA does not hold licenses to radio or television broadcast spectrum, nor directly uses the broadcast spectrum. NWR is the system used by NOAA to immediately warn the public of hazardous conditions. Once a warning is issued via NWR, the broadcast media plays an important role in providing the public with additional details and guidance from emergency managers. Periodically the media will bring

remote links directly into NOAA facilities to conduct interviews and provide timely information to the sector of the public who have turned to television and radio for more information. The video feeds from the Tropical Prediction Center in Miami, Florida, often seen on national television before landfall of a hurricane, are an excellent example of the cooperative effort between NOAA and broadcast media. The dissemination of highly detailed weather information via the commercial broadcast services serves society's needs for water and weather information. A cooperative effort with the broadcast media enhances environmental literacy and improves understanding, value and use of weather and water information and services.

Communication Systems - Communications systems for supporting DOC daily operations are absolutely critical to operations efficiency and safety of its employees and assets. Outside NOAA, communications systems make up the largest use of spectrum by the remaining DOC line offices and bureaus. Communications systems, used for personal voice and data communications, support DOC daily operations and are absolutely critical to operations efficiency and safety of its employees and assets.

Land Mobile Radio - Land mobile radio (LMR) operated in the Government LMR bands for communications between field staff (technicians and scientists) and their offices, and for coordination of security and law enforcement activities is critical to DOC operations. LMR radio systems allow DOC to conduct its operations in a more efficient manner, ensuring safety of field staff and providing communication between security personnel. Interoperability with other Federal enforcement agencies and state and local governments is required for some operations. The LMR equipment used by DOC is typically commercially available hardware meeting the NTIA standards for federal spectrum use. Some operations require frequency assignments on a national basis. DOC LMR requirements are not expected to grow significantly in the next 5 to 10 years. New requirements as well as some existing requirements may be satisfied through the future use of cellular telephone, where cellular coverage is adequate. DOC has provided frequencies for trunked radio systems in several parts of the country in return for service on the trunked radio network.

In addition to traditional LMR operations, NOAA has requirements for a small number of paging systems to provide pager coverage in areas where commercial service is inadequate or does not exist. NOAA use of the 162-174 MHz band for paging systems is small and not expected to increase. New technologies, including commercial services, will be evaluated as they become available.

Maritime Communications - NOAA uses maritime HF and VHF radio communications for weather observations, quality control of maritime weather products, and NOAA ship operations. NOAA operates both shore-based and ship borne HF and VHF radios in support of the NOAA maritime operations, the Voluntary Observing Ship (VOS) program and for monitoring transmission of maritime weather products.

The VOS program enables collection of weather data, using HF and VHF radio, from ocean areas where installation of permanent sensor systems is not possible. The VOS communications contribute to meeting the NOAA *Weather and Water* and *Commerce and Transportation* mission goals. A single HF and a single VHF frequency are used for operations. The current technology characteristics are necessary for compatibility with the reporting ships. NOAA will adopt any suitable technology to improve performance or spectrum efficiency as required by the VOS program, but no improvements are foreseen in the near future. Expansion of the number of NOAA-operated radio systems for VOS is not anticipated.

NOAA operates a maritime fleet that is reliant on HF and VHF maritime communications for operations and safety. These systems are essential for maintaining communications with people at sea, supporting the NOAA *Ecosystems* and *Commerce and Transportation* mission goals. Other technologies, such as cell phones and satellite communications, have replaced some maritime communications requirements. NOAA will continue to require access to HF and VHF maritime spectrum into the future, though requirements are not anticipated to increase in the next 10 years.

NOAA monitors Marine Fax for quality control of transmitted NOAA products. Marine Fax is used to disseminate a wide variety of information, including weather forecasts and severe weather warnings to mariners. It is not a system under the control or operation of NOAA, however, this service is critical to supporting the *Commerce and Transportation* mission goals. Marine Fax is operated to monitor the transmission of maritime weather products. Marine Fax uses 4 HF frequencies in the 4 to 17.25 MHz range.

Commercial Satellite Phone - NOAA uses mobile satellite phone technology for a variety of operations. The Alaska Region (AR) of the NWS operates a single satellite telephone terminal to increase participation in the collection of marine observations under the VOS program. Fishing vessels and some other craft choose to not broadcast their coordinates over VHF or UHF radio for competitive reasons. Use of satellite phone allows private contact with the Valdez Weather Service Office (WSO), avoiding cost of calls entering the public telephone

switched network (PTSN). NOAA also uses 12 satellite phones for enforcement operations in remote areas and for ship-to-ship and ship-to-shore communications.

Use of satellite telephone technology allows NOAA to increase participation in the collection of marine weather data and ensures safety during NOAA law enforcement operations and while NOAA ships are at sea. This directly contributes to all the NOAA activities, with emphasis on monitoring and observing the sea, managing ocean resources to optimize safety. This activity supports both the NOAA *Weather and Water Goal* and the Commerce and Transportation Goal. Satellite phone communications are provided by commercial services such as Iridium and Globalstar.

Cell Phone - The cellular telephone has become so embedded in business practices Federal agencies even benefit from the commercial service. Many NOAA operational personnel and managers are issued cellular telephones (cell phone) as well as cell phones are used for ship-to-ship and ship-to-shore communications while NOAA ships are close to shore. Use of cell phone technology contributes to the NOAA Strategic Plan *Mission Support* goal. The cell phone provides an acceptable, more cost-effective communications solution in comparison to Government operated land mobile radio systems and commercial satellite phone technology. While third generation mobile telephone systems promise multimedia data services including video and wide band data, most requirements within the NOAA are satisfied with simple voice communications with occasional remote access to office email.

Wireless Ethernet - NOAA plans to integrate wireless local area networks into campus (i.e. large NOAA facilities) networks and single facilities where applicable and secure. NOAA uses wireless Ethernet for communication between a deployed hydroacoustic survey buoy and its associated ship. The current system used for this application operates in the 902-928 MHz industrial, scientific and medical (ISM) band. Spectrum requirements for this application are not expected to change.

Shipboard Wireless Data Collection - NOAA is investigating the use of wireless technology for data collection and entry on board research vessels while at sea. This system would provide wireless communication between a file server in a protected area and ruggedized laptop or tablet PCs on deck for data collection. The system is currently under development and a frequency range has not been selected. NOAA plans to use commercial technology for this application. Wireless Ethernet LAN hardware is a candidate for this application.

Amateur Radio - Amateur radio operators provide a critical service to NOAA by reporting severe weather observations, supporting the NOAA *Weather and Water* mission goal. The SkyWarn program establishes operating procedures and formal training programs for allowing volunteer amateur radio operators to serve as weather observers for Weather Forecast Offices (WFO) during severe weather. Typically the amateur radio community will provide a radio operator for the WFO during periods of severe weather. This operator, using amateur radio equipment in the WFO, will communicate with field spotters to gather observations and information on the formation of severe weather. Similar operations are also conducted between the Tropical Prediction Center and Caribbean Islands during hurricane landfall in the islands.

The Citizen Weather Observer Program (CWOP) is a public-private partnership involving amateur radio that results in NOAA receiving surface weather data from approximately 2700 citizen (amateur and non-amateur) weather stations around the world, and this number is steadily increasing. These data are quality controlled and sent to other federal agencies, including NOAA, and educational institutions. The citizen weather data are sent by amateur packet radio at 144.390 MHz and the Internet to an amateur radio server, where they are stored, made available to NOAA, and sent to NWS Forecast Offices around the country as part of the AWIPS data stream.

NOAA has no direct requirement for amateur radio spectrum. Federal spectrum regulators should recognize the valuable service amateur radio volunteers provide in many emergency situations, including severe weather spotter support to NOAA.

SARSAT - As an integral part of a worldwide search and rescue system, NOAA operates the Search and Rescue Satellite Aided Tracking (SARSAT). The SARSAT system uses NOAA the polar-orbiting and geostationary meteorological satellites to detect and locate aviators, mariners, and land-based users in distress. The satellites relay distress signals from emergency position-indicating radio beacons (EPIRBs) to a network of ground stations and ultimately to the U.S. Mission Control Center (USMCC) in Suitland, Maryland. The USMCC processes the distress signal and alerts the appropriate search and rescue authorities to who is in distress and, more importantly, where they are located. NOAA-SARSAT is a part of the international COSPAS-SARSAT Program, which 36 nations and two independent search and rescue organizations are members. The NOAA SARSAT system is operated with frequencies identified in Table D-4.

In addition to the NOAA contributions to the COSPAS-SARSAT program, NOAA researchers and observers going to sea and into remote

areas are issued personal locating beacons (PLBs) for use in emergency/distress situations.

FedSMR Program- The Federal Specialized Mobile Radio Program (FedSMR) is a trunked radio service that is used on a shared basis by some Federal agencies. It is a two-way dispatch service, with airtime billed at a flat rate per month. The cost of airtime is dependent on individual radio user needs. Many government agencies have used the service for the past 15 years. The FedSMR system provides 24/7 connectivity between radio sites. This connectivity supports radio roaming and wide area communication.

FedSMR is operated by the Federal Radio Service Corp (FRSC)/ Pegasus Radio Corp under contract from DOC/NTIA. The purpose of the FedSMR program is to provide spectrum-efficient trunked radio communications to a number of government users that can benefit from multiple talk groups and other features trunked radio technology provides, without the agencies independently bearing the costs associated to build, manage and maintain a complete system. FedSMR supports over 2100 individual radio subscribers. Some examples of current subscribing agencies in the Washington, DC area are:

•Smithsonian Institution	820 subscribers
•GSA	5 subscribers
•National Zoo	257 subscribers
•US Holocaust Memorial	214 subscribers
•National Archives	300 subscribers
•Dept of State	18 subscribers
•Dept of VA	97 subscribers
•Export/Import Bank	45 subscribers
•Kennedy Center	82 subscribers
•VA Med Center	60 subscribers

The system topology is based on low tower height, lower power transmitters and frequency reuse. The use of digital signaling enables each radio in the system to dynamically select a site for use for each communication. The operating frequencies for FedSMR are within the government band 406.1-420 MHz. The frequencies are assigned for operation in five urban areas on the east coast.

The systems will be transitioned to narrowband (12.5 kHz) channels by year-end 2007. These changes to narrowbanding are to facilitate more efficient use of available spectrum. The effort is considerable and requires engineering and financial commitments in order to develop a smooth, safe transition plan that is within budget cycles. FRSC began this process in 2001 in order to meet the requirements of the NTIA.

In conjunction with the transition to narrowband, FRSC also is addressing increased capacity requirements as well as additional interoperability needs, connectivity to a digital backbone, improved connectivity between multiple sites, and enhanced security (including voice-encryption) and reliability. The FedSMR contractor is utilizing its 1CommWireless network platform to support UHF, VHF, 700, 800, 900 MHz trunked radio communications and conventional communications in other frequency bands.

Each FedSMR radio is equipped with an individual ID and an Electronic Serial Number. These identifiers allow the radio access to the network. Only the network operator at Federal Radio Service Corp can grant access to the system. If a radio is lost it can be temporarily disabled. A radio, when transmitting, sends its own ID to all radios receiving the call. This provides positive identification to all units. This is also a management tool which enables tracking of radio abusers and in times of duress can save valuable time in determining the identity of the caller.

Voice encryption options are available on some radios only, at this time. Encryption choices range from simple analog inversion, to rolling code encryption, to AES voice encryption. The radio is not capable of being remotely monitored so therefore cannot operate as surveillance or "bug" device.

The federal government as well as state, local and regional public safety entities, are aware of the critical need for interoperable communications between legacy systems, new systems and public safety systems (state and local). Interoperability can be accomplished through various means and at various levels. Interoperability is a method to rapidly exchange information between different responding agencies and departments (generally on different frequencies). The National Telecommunications System (NTS), used in the FedSMR network, has many interfaces and external tools available to provide a variety of methods to satisfy specific interoperability requirements.

Federal Radio Service Corp along with a key radio manufacturer is currently developing a digital platform to increase efficiency by reducing channel bandwidth to 6.25 kHz. The adoption of a digital radio will provide a 100% digital trunked radio system. The digital radio use will improve the interface and transfer of data operations such as GPS and status message. FedSMR system loading is projected to continue its current annual rate of growth by approximately 20% per year for at least the next five years. This translates to a spectrum increased requirements of 3 channels per year. Spectrum requirements could be reduced as new efficient digital technologies are implemented. The nature of the technology is highly dependant upon the spectrum allocations. For example CDMA technology could be deployed today in the 406 to 420 MHz band provided sufficient contiguous bandwidth was available to make a commercial investment viable. The FedSMR

contractor continues to support the reduction of transmitter power and fixed end antenna heights in an effort to limit propagation range to the needed operational area. As discussed above, the contractor continually evaluates and introduces technical changes to improve system functionality, enhance security and increase spectrum efficiency.

As an alternative to FedSMR, the individual federal agencies could finance, build and operate their own conventional or trunked radio systems. Many agencies do have such systems, particularly in areas where FedSMR does not provide service, or for sensitive requirements for which a shared system would not provide sufficient security. Another alternative would be for individual agencies to procure and use commercial wireless services. This approach is likely to be more costly and would not provide the security available through a closed government system.

The FedSMR system in Washington DC currently supports COOP mission requirements for the Department of Veterans Affairs, US Holocaust Memorial Museum, and US Patent and Trademark Office. The locations of the 1CommWireless sites support the radio communications requirements for the agencies' contingency locations.

The USPTO has requirements for mobile radio operations. USPTO, through DOC frequency assignments, uses the DOC contracted FedSMR trunked radio system (See Annex E). The use 53 potable radios, in three talk groups on the FedSMR system, supports the daily internal operations of the USPTO in the Washington, DC area. While USPTO is continuously seeking ways to expedite the patent and trademark review process, USPTO has not identified new spectrum-reliant technologies that will be implemented in the future.

BIS Land Mobile Radio Network- The spectrum requirements of BIS are limited to land mobile radio systems for coordinating real-time tactical activities and ensuring officer safety for the Office of Export Enforcement. The Office of Export Enforcement (OEE) operates approximately 100 mobile radios in support of law enforcement activities at its 14 field offices and headquarters. The mission of BIS/OEE is to protect U.S. national security and foreign policy interests by enforcing the export control and antiboycott provisions of the Export Administration Regulations. BIS/OEE accomplishes this by identifying and apprehending violators and by pursuing criminal and administrative sanctions against them. Without proper radio communications, operations would be hampered and officer safety would be compromised. The operations of BIS, supported by radio communications are critical to COOP and Homeland Security operations.

HF Radio- In support of continuity of operations (COOP) of NTIA and DOC, and NTIA participation in the National Communications System (NCS)

SHAred RESources (SHARES) High Frequency (HF) Radio Program, NTIA operates an HF radio station at its alternate site.

HF frequency assignments are required by NTIA to participate in the NCS SHARES HF Radio Program and to support an emergency back-up HF communications network for the DOC and NTIA (the DOC HF Radio Emergency Communications Network). The HF frequencies are critical to NTIA performing their assigned Priority Mission Essential Functions (PMEFs) when other means of Federal interagency communications are unavailable. The DOC PMEF performed by NTIA that would be supported in part via HF radio operations is to: "Manage the Federal Government's use of the radio frequency spectrum. This PMEF supports the National Essential Function (NEF): "Provide rapid and effective response and recovery from the domestic consequences of an attack or other incident."

NCS, in its role of planning and preparing for national security and emergency preparedness (NS/EP), has undertaken a number of initiatives to provide communications to support all hazards situations. One of these initiatives, developed through the combined efforts of the 23 NCS member organizations (of which NTIA is one), is the SHAred RESources (SHARES) High Frequency (HF) Radio Program. The purpose of SHARES is to provide a single, interagency emergency message handling system by bringing together existing HF radio resources of Federal, State and industry organizations when normal communications are destroyed or unavailable for the transmission of NS/EP information. SHARES further implements Executive Order No. 12472, "Assignment of National Security and Emergency Preparedness Telecommunications Functions," dated April 3, 1984. The SHARES HF Radio Program brings together the assets of over 1,100 HF radio stations (of which one is the NTIA radio station) worldwide to voluntarily pass emergency messages when normal communications are destroyed or unavailable. The SHARES HF Radio Program uses common radio operating and message formatting procedures and more than 250 designated frequencies.

In addition to the current Department of Commerce (DOC) frequency assignments in the GMF, two additional frequencies are required near 6 and 9 MHz to avoid disruption caused by sunspots at various times.

NCS Directive 3-10, Required Minimum Continuity Communications Capabilities, to be published before the end of 2005 requires NTIA to possess its present HF radio capability as well as additional capabilities as a backup communications capability. Those additional capabilities include Automatic Link Establishment (ALE) and HF email.

Research Test and Development-

Land Mobile Radio, Project 25

The new generation of digital (narrowband) LMR systems, being standardized under Project 25/TIA TR-8, are critical elements within an overall U.S. public safety telecommunications interoperability strategy. Considerable laboratory effort is needed in two areas to bring Project 25 (P25) systems to a state where they can be used fully by the public safety community. First, testing is required to help finalize the remaining system interface standards for the P25 systems. The associated process and procedure (testing) standards are needed to verify the performance of individual radios and system interoperability among radios produced by different manufacturers. Second, testing is required for P25 products now on the market to assess how well they perform and whether they can interoperate. Specifically, testing is needed to evaluate the fully standardized "common air interface" using the P25 test standard that has also been approved and accepted widely. Therefore, all P25 interoperability testing must include the provision for operating FM "wideband" radios along with digital "narrowband" equipment. Another critical element of P25 testing is that it must be approached from the perspective of the entire public safety community, i.e., it considers Federal, state, local, and tribal public safety applications. Therefore, testing must encompass all frequency bands assigned to the respective echelons of government - VHF, UHF, 700/800 MHz - and must consider both conventional and trunked radio operation. While the current laboratory testing emphasis is on Project 25-related radio equipment, the NTIA/ITS program includes the assessment of all existing and emerging wireless, IT, and hybrid (wireless/IT) products and services that have the potential for playing a major role in interim interoperability solutions (that could be applied now in selected geographic areas) and the ultimate long-term, standardized, nationwide interoperability approach. In this vein, NTIA/ITS will require authorization to use 4.9 GHz systems (and systems in other bands that may show promise).

Shared Spectrum Testing

Pursuant to the Presidential Spectrum Policy Initiative, a number of federal departments and agencies have assignments and responsibilities. The essential goal of this initiative is to promote the development and implementation of U.S. spectrum management policy for the 21st century. Some of the assignments and responsibilities reside in DOC and in the NTIA. A number of projects within NTIA have been planned as a response to the Initiative. One of the projects (No. 11) is entitled "Spectrum Sharing Innovation Test-Bed" and it requires the allocation of 20 MHz of spectrum.

This project will be jointly performed by NTIA's Office of Spectrum Management (OSM) and The Institute for Telecommunication Sciences in cooperation with the Federal Communications Commission (FCC). In the first phase of the project, NTIA and FCC will each identify 10 MHz of spectrum. These two segments of spectrum will support the spectrum sharing innovation

test-bed by enabling both public and private sector tests and experiments that explore both the effectiveness of sharing as well as new, innovative approaches of allocating channels and managing the spectrum. The project description indicates that the central coordination point for this effort will be under the auspices of a special ad hoc committee of the NTIA Interdepartmental Radio Advisory Committee (IRAC), and possibly within the Technical Subcommittee (TSC) of the IRAC. The proposed time frame for the project spans Fiscal Years 2006 and 2007.

ITS is proposing the use of the Table Mountain Field Site for some or all of the testing of new and innovative radio and wireless technologies and spectrum-sharing strategies. Therefore, ITS will require the allocation of 10 MHz of spectrum. While it is unknown what technologies might be tested, a reasonable choice for this test-bed spectrum would be between 2 and 6 GHz where most new and future radio and wireless devices are expected to function. However, in order to explore even more diverse systems that may take advantage of differing signal propagation characteristics, it would be more desirable to have parts of the 10 MHz located in different frequency ranges. For example, some of the 10 MHz bandwidth could be located in the in the 2 to 6 GHz range and the remainder at around 800 MHz or lower. This notion could be extended even further by allocating a third portion of the 10 MHz bandwidth at 12 to 14 GHz. While it is unknown what radiated powers will be used, it is reasonable to assume that most of the work could be done at relatively low power thus the geographic region associated with this allocation might extend no further than 50 miles from Table Mountain Field Site.

Feasibility of Spectrum Sharing

DOC increases spectrum efficiency through sharing with other Government Agencies and with commercial services. DOC has participated in many studies on the sharing of spectrum between Government operations and commercial operations. Sharing is not always possible when DOC operations are not consistent with the requirements of other users, or the sensitivity of DOC systems would be impaired by shared use of radio spectrum. Successful sharing scenarios are occasionally identified through cooperative studies between the Government and the commercial sector. Radiosonde and meteorological satellite operations in 402-405 MHz[4] now share spectrum with short-range telemetry links to implanted medical devices. The operational and technical characteristics of the medical implants combined with interference mitigation techniques implemented in the implants made shared use of the spectrum possible. Many of the atmospheric observing systems operated by NOAA use high sensitivity receivers and are particularly sensitive to interference. In the case of passive sensors and radar systems, meeting mission requirements requires access to specific frequency ranges. Reallocation to enable spectrum sharing is not possible. However, NOAA has participated in study efforts where sharing has been found to be feasible.

[4] Metsat operations allocated in 402-403 MHz only.

Feasibility of Using Commercial Alternatives

DOC uses commercial telecommunication services in cases where the services offered fully support mission requirements and provide a cost effective telecommunications solution. Use of commercial services, when cost effective, is consistent with Federal Acquisition Regulations and with the NTIA spectrum regulatory rules. DOC investigates the use of commercial alternatives during the planning stages of any new program or system upgrade. Not all Government telecommunications can be conducted using commercial services. Due to the nature of DOC operations, particularly within NOAA, commercial alternatives often do not meet mission requirements. However, there are cases where commercial alternatives do provide an attractive, cost-effective. For example, commercial mobile phone service is used in areas where it can meet requirements, replacing the need for Government land mobile radio networks. DOC will continue to evaluate existing and new spectrum-reliant requirements to determine whether commercial services exist to address the requirement.

Feasibility of Using Non-spectrum Sources

In most applications, DOC will select the use of non-spectrum-reliant technology if it will meet mission requirements. Use of landline communications often results in higher reliability and lower cost. However, many DOC applications, particularly within NOAA require use of radio spectrum to operate. Wired connections to mobile platforms, satellites and radiosondes is not practical. Radars cannot operate over wired connections.

New Technologies and Improved Spectrum Efficiency

DOC strives to implement spectrum efficiency where it is cost effective and consistent with the DOC mission requirements. Some measures implemented by DOC include use of commercial services, sharing spectrum with commercial services and Government agencies, and use of more efficient modulation techniques and technologies.

COOP/COG implications

DOC requires use of radio frequency spectrum for COOP/COG communications and for operations which support COOP/COG operations. Departmental COOP/COG spectrum requirements are identified in Annex A, Table Summary of DOC Radio Applications.

III. Future Spectrum Requirements- Technologies and Expanded Services requiring spectrum (2007-2015)

Most current spectrum requirements identified in this plan will extend well into the future. With a few exceptions, the spectrum requirements are not expected to decrease for currently operational systems. One of the objectives of this plan is identification of new spectrum requirements for new and expanded systems. Table A1 indicates systems and radio services where spectrum requirements are

expected to increase or potential new requirements have been identified. These requirements include additional spectrum for meteorological satellite data transmission; satellite passive sensing; meteorological radars; telemetry links for control and programming of autonomous vehicles; and wildlife, marine life and fish tracking.

New Technologies and Improved Spectrum Efficiency- Use of more advanced technologies and modulation techniques can, in some cases, greatly increase spectrum efficiency. The potential use of advanced technologies and modulation techniques needs to be balanced with disadvantages introduced by those technologies and techniques. Evaluation of more efficient spectrum use must include consideration of operational impacts and cost effectiveness. DOC strives to implement spectrum efficiency where it is cost effective and consistent with the DOC mission requirements. Below are some examples of implementing systems with greater spectrum efficiency.

- NOAA is in the planning stage of the next generation of GOES meteorological satellites. Increased spectrum efficiency is needed to accommodate the higher resolution sensors within the available allocated bandwidth. Spectrum is not available to provide the necessary bandwidth if current technology is used. An extensive engineering effort is underway to study the advantages and disadvantages of more spectrum-efficient modulation schemes, allowing transmission of more data per given bandwidth. The bandwidth advantages provided by the advanced modulation techniques need to be balanced against the greater transmitter power typically needed to support reliable communications.

- DOC has responded to the NTIA mandate to narrowband radio systems operated in 162-174 MHz by January 1, 2005 and in the band 406.1-420 by January 1, 2008. The NTIA mandated narrowband initiative was to provide additional LMR channels for government operations.

- NOAA has also begun deployment of the Radiosonde Replacement System (RRS) for the U.S. synoptic radiosonde network. Legacy synoptic radiosonde operations required on the order of 15 to 20 MHz of bandwidth in the range 1670-1690 MHz. Radiosondes are expendable items, where approximately 80,000 are flown in the U.S. per year for synoptic operations. Legacy radiosondes used a low cost AM transmitter based on a free running oscillator design to maintain a minimum expendable cost. The emission bandwidth was excessive and the transmitter frequency would drift as much as 4 MHz while in flight. The new RRS radiosonde uses a more efficient digital transmitter where drift is minimized. Through deployment of RRS, the U.S. synoptic radiosonde spectrum requirements were cut by 50% or more, albeit at a per-radiosonde cost increase.

In summary, DOC has and will continue to evaluate new technologies, and spectrum sharing techniques to reduce spectrum requirements and make spectrum available to other users.

COOP/COG implications
DOC will continue to require use of radio frequency spectrum for COOP/COG communications and for operations which support COOP/COG operations. Departmental COOP/COG spectrum requirements and future requirements changes are identified in Annex A, Table Summary of DOC Radio Applications.

International Issues
The significant international issue at the time of the 2007 update is the need for global allocations for oceanographic radars operating in the 3 to 30 MHz range and near 42 MHz. WRC-07 created the WRC-11 Agenda Item 1.15 to address this issue. Based on past agenda items concentrating on the 3 to 30 MHz range, reaching a WRC-11 outcome where spectrum can be allocated for these radars will be difficult.

Impact of Unavailable Spectrum
Due to the broad range of systems operated in support of DOC operations, the impact of spectrum unavailability can vary. For some systems, if spectrum is available elsewhere that meets the propagation requirements operations can be moved to other bands without a significant impact, albeit at a cost for new hardware and installation. For some systems, such as radars and passive sensors, the physical properties of the measurements combined with the radio spectrum wavelength and propagation characteristics dictate the frequency range the system operate within. Operation of such a system at a different frequency can render it useless. This is the reason many scientists consider the passive sensor frequencies to be a scarce resource, which when polluted with interference, are irreplaceable.

IV. Current and Future Use of Non-Federal Spectrum Offered by Commercial Service Providers

Several spectrum-reliant DOC programs use or are considering use of commercial services that rely on non-Federal spectrum. In many cases mission requirements preclude the use of commercial services.

Broadcast Media - The broadcast media plays an important role in NOAA mission though NOAA does not hold licenses to radio or television broadcast spectrum, nor directly uses the broadcast spectrum. Please refer to the Broadcast Media section on Page 19.

Commercial Satellite Services - NOAA uses commercial satellite services for support of its operations. Transport of water and weather data and products between NOAA facilities and to external customers is critical to the NOAA mission. Use of commercial satellite services is the only economically viable

solution for global transport of data. Please refer to the Commercial Satellite Services section on Page15.

Commercial Satellite Phone - NOAA uses mobile satellite phone technology for a variety of operations. For the Voluntary Observing Ship program, use of satellite phone allows private contact with the Valdez Weather Service Office (WSO), avoiding cost of calls entering the public telephone switched network (PTSN). NOAA also uses 12 satellite phones for enforcement operations in remote areas and for ship-to-ship and ship-to-shore communications. A detailed discussion is provided under the Communications Systems section on Page 21.

Cell Phone - The cellular telephone has become so embedded in business practices Federal agencies even benefit from the commercial service. Many DOC operational personnel and managers are issued cellular telephones (cell phone) as well as cell phones are used for ship-to-ship and ship-to-shore communications while NOAA ships are close to shore. A detailed discussion is provided under the Communications section on Page 22.

V. Current and Future Use of Non-Licensed Devices

DOC makes extensive use of unlicensed radio systems. Facilities and campuses use 802.11a, 802.11b and/or 802.11g WIFI systems for wireless internet access. New versions of the 802.11 technology will be implemented in the future. Current requirements are defined in Section II, on Page 22. Use of unlicensed network technology as well as other most likely increase in the future.

VI. New Technologies

At the time of the 2007 update to the DOC Strategic Spectrum Plan, no new technologies were identified that were being evaluated that may potentially use spectrum in the future.

VII. Strategic Spectrum Planning

DOC Spectrum Management Organization

Access to spectrum is crucial to accomplishing DOC's mission. The Office of Radio Frequency Management (ORFM), organizationally located in NOAA's National Environmental Satellite and Data Information Service (NESDIS), is responsible (per Department Administrative Order 201-39) for managing spectrum requirements for all DOC offices and bureaus. Each office and bureau having radio frequency spectrum requirements identifies a frequency management liaison to assist ORFM in managing their organization's spectrum needs. With demands for radio spectrum growing in the Government and private sector, ORFM relies heavily on these liaisons and their technical staff for frequency management support, for development of spectrum-sharing studies, and for ensuring representation of their agency's interests in domestic and international spectrum meetings.

DOC Office of Secretary and Office of Security The Office of Security provides policies, programs, and oversight as it collaborates with facility managers to reduce the terrorism risks to DOC personnel and facilities; program managers to reduce the espionage risks to DOC personnel, information and facilities; and Department and bureau leadership to increase emergency preparedness for DOC operations. The Office of Security employs both commercial service providers and government operated systems in meeting Continuity of Operations Plan (COOP) and Continuity of Government (COG) requirements.

National Oceanic and Atmospheric Administration (NOAA) NOAA, the largest user of spectrum in DOC, supports the DOC Strategic Goal 3. The NOAA mission is "*To understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social and environmental needs*." NOAA cannot accomplish its mission without access to sufficient radio spectrum in the appropriate frequency ranges.

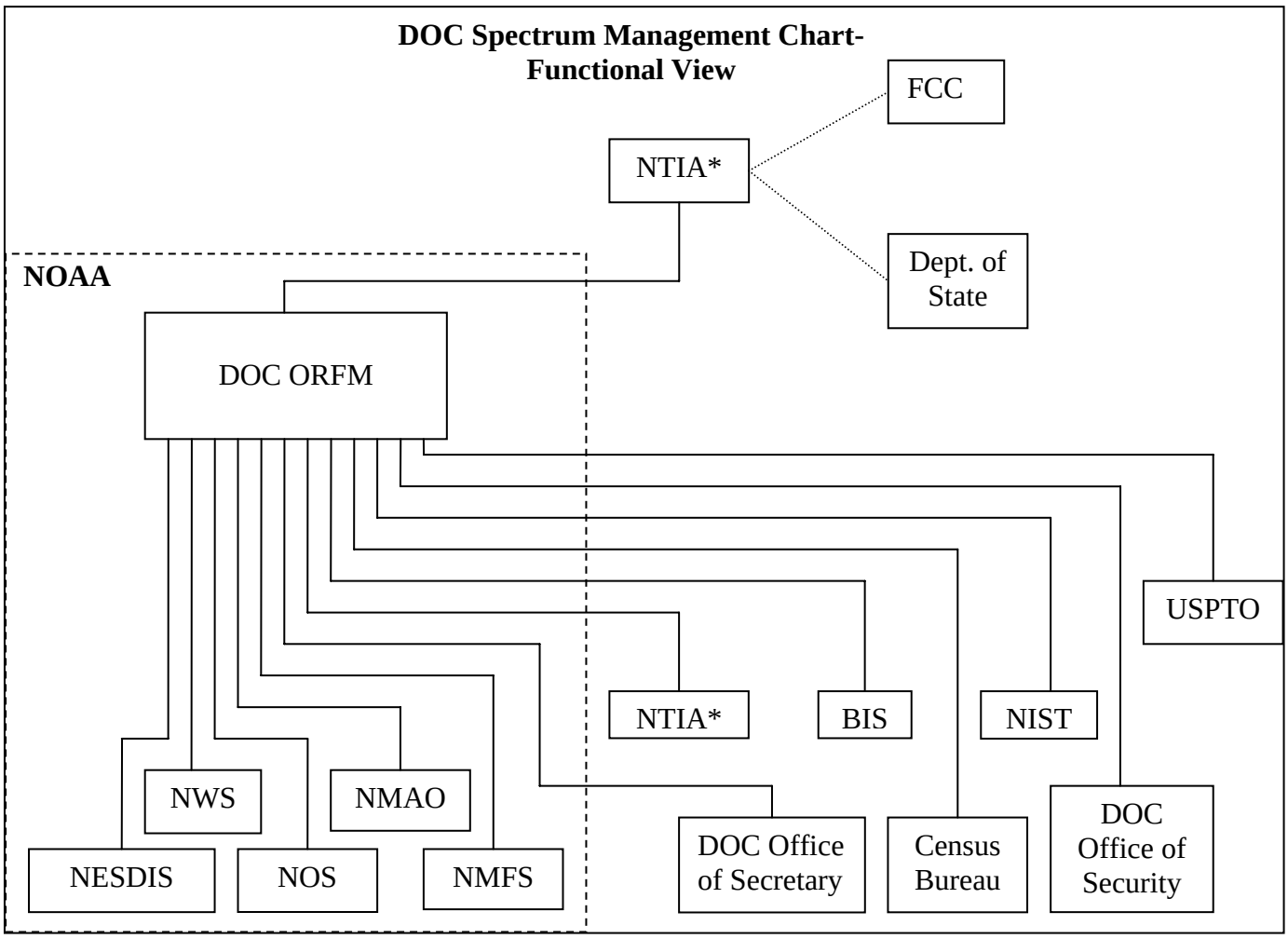
National Telecommunications and Information Administration (NTIA) NTIA supports the DOC Strategic Goal 2. NTIA's mission is to "*promote the efficient and effective use of telecommunications and information resources in a manner that creates job opportunities, enhances U.S. competitiveness, and raises the standard of living*." NTIA is the spectrum regulator for the Federal Government, working closely with the Federal Communications Commission (FCC) which is responsible for regulating non-federal spectrum use.

Bureau of Industry and Security (BIS) The mission of the Bureau of Industry and Security (BIS) is to advance U.S. national security, foreign policy, and economic interests. BIS supports Goals 1 and 2 of the DOC Strategic Plan. BIS relies on spectrum for law enforcement activities, safety of their employees and for operations critical to Homeland Defense.

National Institute of Standards and Technology (NIST) The mission of NIST is to develop and promote measurement, standards and technology to enhance productivity, facilitate trade, and improve the quality of life. NIST supports Goal 2 of the DOC Strategic Plan.

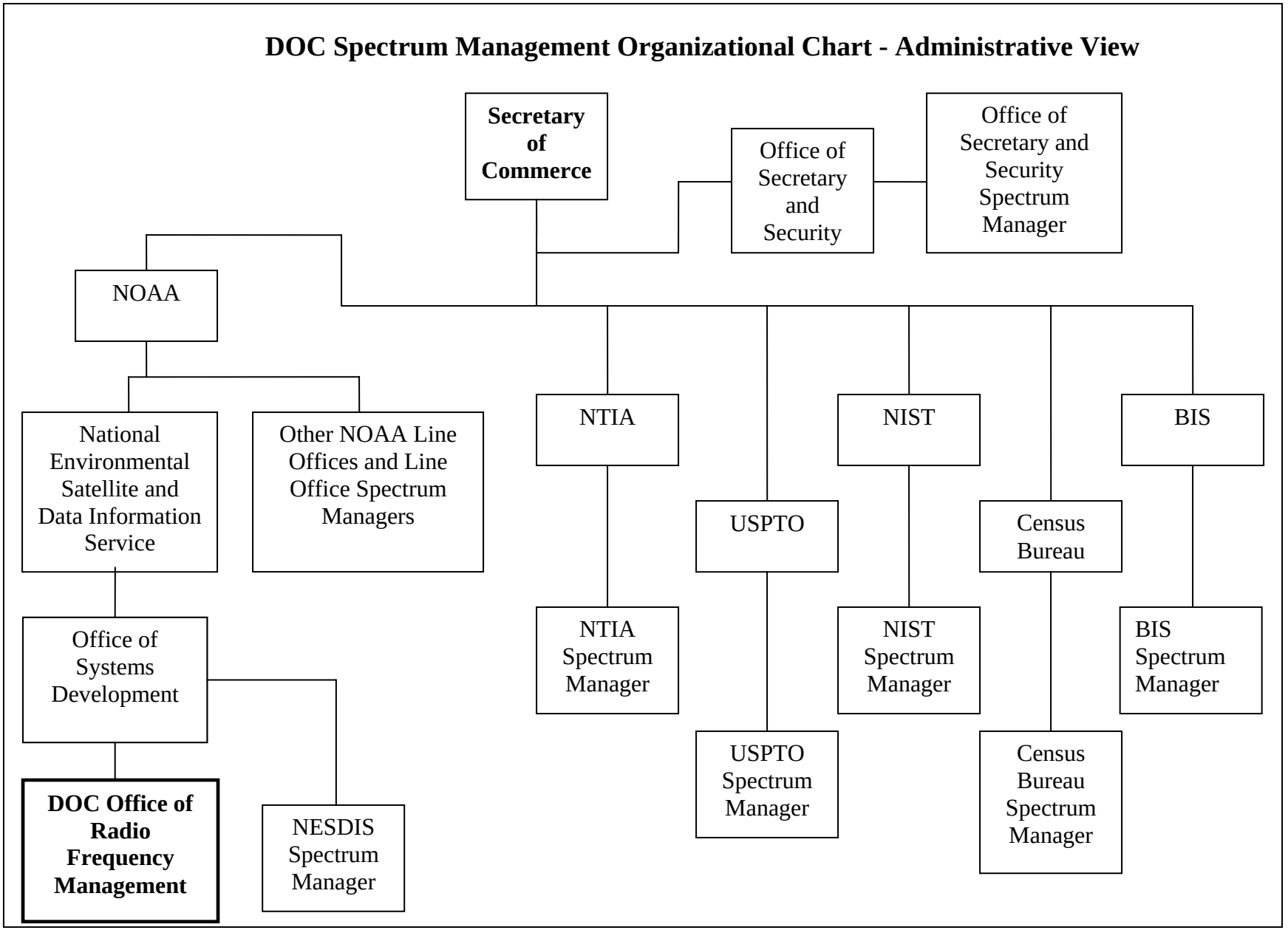
Census Bureau (within the Economics and Statistics Administration) The Census Bureau is the premier source of information on the American people and the economy, supporting DOC meeting Goal 1 of the DOC Strategic Plan. The spectrum requirements of the Census Bureau are small at this time, but could potentially increase as new wireless technologies are incorporated into operational practices.

U.S. Patent and Trademark Office (USPTO) The U.S. Patent and Trademark Office ensures that the intellectual property system contributes to a strong global economy, encourages investment in innovation, and fosters entrepreneurial spirit.



* - Within DOC, NTIA has the role of both a spectrum user, and regulator of Government spectrum use. For this reason, NTIA is shown in two places on this organizational chart. NTIA must work through DOC ORFM for to fill their spectrum requirements. Ultimately the NTIA requirements are submitted back to NTIA for processing.

DOC Spectrum Management Organizational Chart - Administrative View



DOC Strategic Spectrum Plan Approval Process

The DOC spectrum management process is unique among the Federal agencies due to the fact the DOC is tasked with management of all Government spectrum use, and must also represent its own interests, which may conflict with other Federal and non-Federal users. Within DOC, NTIA serves as both a spectrum user and as the regulator of all Government spectrum use. Since NOAA is the largest user of spectrum within DOC, NOAA is tasked with representing the DOC spectrum interests, allowing NTIA to maintain an unbiased position with respect to management of spectrum for all federal agencies. DOC ORFM develops the DOC Spectrum plan based on input from all DOC offices and bureaus, and submits the plan to NOAA management for approval. The NOAA Under Secretary approves the plan as the DOC input and it is submitted to DOC for use in development of the Federal Spectrum Plan.

Strategic Spectrum Planning- DOC Budget, Planning, Programming, and Operational Execution

Incorporating Spectrum Planning in the DOC budget, planning, programming and operational execution process has been difficult and largely unsuccessful. Historically there has been little recognition for the need to plan the use of spectrum resources as part of initial planning of a new program. Until recent years when spectrum has become a scarce resource, new programs have succeeded without any spectrum planning effort, establishing a culture within many parts of DOC that spectrum planning and spectrum management is unimportant to the success of the DOC mission. Due to the established culture, program offices are largely unaware of the DOC spectrum management process, NTIA requirements, and the existence of ORFM and the connection made only when ORFM learns of the program's existence or the program office encounters spectrum related problems and seeks help. Education of the budget, program and procurement offices is a slow process.

Strategic Spectrum Planning- System Certification and Frequency Assignment Requests

The need to change the DOC culture and the view of the DOC budget, program and procurement offices hold regarding the required spectrum management process is discussed in the previous section. As stated above, changing the DOC culture is a slow process. Many program offices are ensuring the have submitted spectrum certification and frequency assignment requests in a timely manner, however there are still instances where programs progress very far into the procurement and deployment process before program managers realize the spectrum certification and assignment process is a necessary step.

Strategic Spectrum Planning- Process Changes

DOC budget, program and procurement offices are widely spread both across DOC offices and bureaus, and geographically. ORFM is working to incorporate the necessary spectrum planning steps in the DOC processes, however it may be an extended time before significant changes are made to the extent that spectrum planning is included in the planning process of every program requiring access to radio spectrum.

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ANNEX A-
Table Summary of DOC Radio Applications

TABLE A1- Summary of DOC Spectrum Requirements						
Band	**System**	**Current Use**	**Bureau**	**Number of Assignments***	**Projected Change in Requirements In Next 10 Years**	**COOP, COG or Interoperability**
19.05-20.05 kHz	Frequency and Time Standard	Time and Frequency Transmission	NIST	1	None	COG
60 kHz	Time Standard	Standard Frequency and Time	NIST	2	None	
134.2 kHz	Animal Tracking	Salmon Fish Tags	NOAA		None	
1000 kHz	Time Standard	Time Transmission	NIST	1	None	
2-30 MHz	Maritime Communications	Maritime Operations and Maritime Weather Warnings	NOAA	865	None	COG
	HF Communications	COOP	NOAA		None	COOP/Interoperability
	Distress Safety and Calling		NOAA		None	
	Voice Communications	For Emergency Net	OSY	16	None	COOP
	HF Coordination	Research, Development, Test and Evaluation Support	NOAA	2	None	
	Time Standard	Time Transmission	NIST	17	None	COG
	Amateur Radio	Meteorological Operations (Severe Weather Observations)	NOAA	Not direct NOAA requirement. Service provided to NOAA by Amateur Radio Community		
	HF Communications	Emergency, SHARES	NTIA	4	2 additional channels	COOP, COG, Interoperability
30-40 MHz	Land Mobile Radio	Law Enforcement	NOAA	5	None	
		Geodetic Field Communications	NOAA	7	None	
	Animal Tracking	Fish Tags	NOAA		None	
40-42 MHz	AMBCS (Meteorburst Communications)	Meteorological/Hydrologic Operations	NOAA	15	6 additional sites per year	COG
	VHF Coordination	Research, Development, Test and Evaluation Support	NOAA	4	None	

TABLE A1 (continued)- Summary of DOC Spectrum Requirements						
Band	**System**	**Current Use**	**Bureau**	**Number of Assignments***	**Projected Change in Requirements In Next 10 Years**	**COOP, COG or Interoperability**
40-42 MHz (continued)	Radar	Wind and Temperature Profiling Radars	NOAA		minor	
42-50 MHz	Land Mobile Radio	Law Enforcement	NOAA	3	None	
	HF Communications	Emergency, SHARES	NTIA	1	None	COOP, COG, Interoperability
	R&D	Harbor Area Observation	NOAA	5	None	
50 MHz	Profiler	Research Profiler	NOAA	1	None	
108-117.975 MHz	Navigation	Aeronautical Radionavigation	NOAA	Receive only	None	
118-136.975 MHz	Communication	Aeronautical Mobile	NOAA		None	Interoperability
121.45-121.55 MHz	SARSAT	Emergency Position Beacons	NOAA	NOAA requirement is receive only	Expected to be phased out within the next 5 years	
122-123 MHz	Communications "ground to air"	Severe Storm Studies and related weather/climate studies	NOAA	2	None	
137-138 MHz	MetSat Data Transmission	Data Transmission to Earth	NOAA	10	None	
144.390 MHz	Citizen Weather Data	Citizen Weather Observer Program	NOAA	Not direct NOAA use. Service provided to NOAA by Amateur Radio Community		
151.4 MHz	Animal Tracking	Fish Tags	NOAA	0	Future system- extent of use unknown at this time.	
156-157.5	Maritime Mobile Radio	Inter-Ship Communications	NOAA	16	None	

TABLE A1 (continued)- Summary of DOC Spectrum Requirements						
Band	**System**	**Current Use**	**Bureau**	**Number of Assignments***	**Projected Change in Requirements In Next 10 Years**	**COOP, COG or Interoperability**
162-174 MHz	Land Mobile Radio	Operations Support, Maintenance, and Security	NOAA, NIST, Census, Office of Secretary, Office of Security	4366	None	
	Hydrologic Networks	Meteorological/Hydrologic Operations	NOAA		Potential deployment of 8 – 10,000 new sites for NERON Program	
	NOAA Weather Radio	Public All-Hazards Warnings	NOAA		None	COG
	EMWIN	Meteorological Operations in Support of Emergency Management Activities	NOAA		EMWIN phased out in 5 to 10 years	COOP
	Animal Tracking	Marine Mammal Radio Tags	NOAA		Expanded use over next 3 years	
	Research	RDTE Support	NOAA		None	
	Research	RDTE Support	NTIA	19	None	
	Transportation		CEN	3	None	
213 MHz	Wind Profiler Radar	Experimental Tropospheric Profiler	NOAA	1	None	
225-400 MHz	Hurricane Reconnaissance Aircraft Communications	Meteorological Operations	NOAA	2	None	COG
	SARSAT (242.95-243.05 MHz)	Emergency Position Beacons	NOAA	NOAA requirement is receive only	Expected to be phased out within the next 5 years	

TABLE A1 (continued)- Summary of DOC Spectrum Requirements						
Band	**System**	**Current Use**	**Bureau**	**Number of Assignments***	**Projected Change in Requirements In Next 10 Years**	**COOP, COG or Interoperability**
400.15-406 MHz	Radiosondes	Meteorological Operations and Atmospheric Research	NOAA	1048	None	COG
	Wind Profiler Radar	Wind Profiler Radar Experimental Network	NOAA		Discontinued use of 401-406 MHz.	
	MetSat Data Transmission	Data Collection Platform Transmission to Satellite	NOAA		None	
	Radiosondes	Test and Research	NTIA	1	None	
406-406.1	SARSAT	EPIRB Uplink	NOAA	2	None	
406.1-420 MHz	Automated Surface Observing System	Meteorological Operations(aviation support)	NOAA	1618	None	COG
	Hydrologic Networks	Meteorological/Hydrologic Operations	NOAA		None	COG
	NOAA Weather Radio Links	Public All-Hazards Warnings	NOAA		None	COG
	Satellite Animal Tracking	Transmit Fish Electromyogram Data	NOAA		Expanded use in next 3 years	
	Research	Miscellaneous Research	NIST		None	
	Land Mobile Radio	Law Enforcement	BIS		None	
	Research	Tsunami Warning Research	NOAA		None	
	Land Mobile Radio (LMR)	FedSMR Trunking System	NTIA		None	Interoperability
		Operations Support	CEN		None	
	Physical Oceanographic Real Time System (PORTS)	Ocean Current Measurement System	NOAA		None	
	Water Level Stations	Measure tide levels	NOAA		None	
	Research	RDTE Support	NTIA		None	

TABLE A1 (continued)- Summary of DOC Spectrum Requirements						
Band	**System**	**Current Use**	**Bureau**	**Number of Assignments***	**Projected Change in Requirements In Next 10 Years**	**COOP, COG or Interoperability**
449 MHz	Wind Profiler Radar	Meteorological Operations and Atmospheric Research	NOAA	5	Deployment of 37 systems - vacating 401-406 MHz band.	
458.54 MHz	Animal Tracking	VEMCO Fish Tracking System	NOAA	3	None	
460-470 MHz	MetSat Data Transmission	Data Collection Platform Interrogation from GOES	NOAA	15	Expand to include polar-orbiting satellites	
861-866 MHz	Research	RDTE Support	NTIA	6	None	
816-821 MHz	Voice Communication	Storm Intercept Vehicles	ERL	25	None	
902-928 MHz	Wind Profiler Radar	Atmospheric Research	NOAA	3	None	
1164-1188 MHz	Radionavigation Satellite Service	GPS L5	NOAA	NOAA requirement is receive only and is critical to many operations	To be transmitted in 2007 when first Block IIF satellite is launched	
1215-1240 MHz	Radionavigation Satellite Service	GPS L2	NOAA	NOAA requirement is receive only and is critical to many operations	New atmospheric observing systems	
1215-1400 MHz	Meteorological Radar	Research Air Turbulence and Meteorological Radars	NOAA		None	
1400-1450 MHz	Radio Astronomy	Environmental Research	NOAA		New oceans and surface data collections	
1544-1545 MHz	SARSAT	Search and Rescue Downlink	NOAA	33	None	
1559-1610 MHz	Radionavigation Satellite Service	GPS L1	NOAA	NOAA requirement is receive only and is critical to many operations	New atmospheric observing systems	

TABLE 1 (continued)- Summary of DOC Spectrum Requirements						
Band	**System**	**Current Use**	**Bureau**	**Number of Assignments***	**Projected Change in Requirements In Next 10 Years**	COOP, COG or Interoperability
1675-1683 MHz	Radiosondes	Meteorological Operations	NOAA	124	None (Deployment of modernized system underway- spectrum efficiency increased reducing requirements 50%)	
1670-1710 MHz	Satellite Data Downlinks	Command and Data Acquisition Data Collection Platform Report	NOAA	82	None	COG
1765-1840 MHz	Meteorological Data Exchange	NEXRAD link	NOAA	18	None	COG
	Video Transmission	Remote Wildlife Monitoring	NOAA		None	
2000-2400 MHz	Satellite Uplink	TT&C	NOAA	54	None	COG
2412 MHz	R&D	Experimental Testing of 802.11B system	ERL	1	None	
2700-3000 MHz	Meteorological Radar	Forecast and Warnings Operations	NOAA	145	None	COG
3/6 GHz	Commercial Fixed Satellite Services	Meteorological Operations (AWIPS, NWWS, ISCS, NIDS, MetLab)	NOAA	38	None	
		Weather and All-Hazards Warning	NOAA	0	Future requirement- up to 800 Earth stations	COG
4800-4990 MHz	Research	RDTE Support	NTIA	6	None	

TABLE A1 (continued)- Summary of DOC Spectrum Requirements						
Band	**System**	**Current Use**	**Bureau**	**Number of Assignments***	**Projected Change in Requirements In Next 10 Years**	**COOP, COG or Interoperability**
4950-5450 MHz	Meteorological Radar	Atmospheric Research	NOAA	5	Ongoing Research for future potential requirements	
5250-5570 MHz	Satellite Active Sensing	NPOESS Altimeter	NOAA	0	Future requirement, circa 2010	
5600-5650 MHz	Meteorological Radar	Atmospheric Research	NOAA	5	Ongoing research for future potential requirement	
6425 – 7025 [1]	Satellite Passive Sensing	Conical Microwave Imaging Sounder (CMIS)	NOAA	**	None	COG
7190-7235 MHz	MetSat Data Transmission	Data Transmission to Spacecraft	NOAA	2	None	
7750-7850 MHz	MetSat Data Transmission	Data Transmission to Earth	NOAA	0	Use by NPOESS, circa 2010	
8025-8400 MHz	MetSat Data Transmission	Data Transmission to Earth and Spacecraft	NOAA	6	Possible GOES Series R use	
9300-9500 MHz	Meteorological Radar	Atmospheric Research	NOAA	7	Possible deployment of gap filler radars. Number of systems not yet determined.	
	Experimental Radar	Research	NTIA	1	None	
10.6 - 10.8 GHz	Satellite Passive Sensing	CMIS	NOAA	**	None	COG
12/14 GHz	Commercial Fixed Satellite Services	Tsunami Warning Network	NOAA	5	None	COG
14-14.5 GHz	AVKSAT 1214-1 Commercial Service Provider	Data compression research of satellites	NTIA	1	None	
13.25 – 13.75 GHz	Satellite Active Sensing	NPOESS Altimeter	NOAA	0	Future requirement, circa 2010	

TABLE A1 (continued)- Summary of DOC Spectrum Requirements						
Band	**System**	**Current Use**	**Bureau**	**Number of Assignments***	**Projected Change in Requirements In Next 10 Years**	COOP, COG or Interoperability
15.731 GHz	Research	Experimental System to measure electromagnetic propagation during precipitation	NOAA	1	None	
18.1-18.3 GHz	MetSat Data Transmission	Data Transmission to Earth	NOAA		Future requirement	
23.6 – 24 GHz	Satellite Passive Sensing	Advanced Microwave Sounding Unit-A (AMSU-A) Sensor, Advanced Technology Microwave Sounder (ATMS), CMIS	NOAA	**	None	COG
25.5-27 GHz	MetSat Data Transmission	Stored mission data transmission to Earth	NOAA	0	Use for NPOESS, circa 2010	
31.3 - 31.5 GHz	Satellite Passive Sensing	AMSU-A and ATMS	NOAA	**	None	COG
34.5-35 GHz	Radar	Clouds and other related weather research	NOAA	3	Minor increases possible	
36 – 37 GHz	Satellite Passive Sensing	CMIS	NOAA	**	None	COG
50.2-50.4 GHz	Satellite Passive Sensing	AMSU-A, CMIS and ATMS	NOAA	**	None	COG
51.4 - 59.3 GHz	Satellite Passive Sensing	AMSU-A, CMIS and ATMS	NOAA	**	None	COG
59.3 – 60.55 GHz[1]	Satellite Passive Sensing	CMIS	NOAA	**	None	COG
86 – 92 GHz	Satellite Passive Sensing	AMSU-A, AMSU-B, ATMS and CMIS	NOAA	**	None	COG
148.5 –155.5 GHz	Satellite Passive Sensing	Microwave Humidity Sounder	NOAA	**	None	COG
164 – 167 GHz	Satellite Passive Sensing	ATMS and CMIS	NOAA	**	None	COG

TABLE A1 (continued)- Summary of DOC Spectrum Requirements						
Band	**System**	**Current Use**	**Bureau**	**Number of Assignments***	**Projected Change in Requirements In Next 10 Years**	COOP, COG or Interoperability
174.8 - 191.8 GHz	Satellite Passive Sensing	AMSU-B, CMIS and Microwave Humidity Sounder	NOAA	**	None	COG
316 -334 GHz	Satellite Passive Sensing	CMIS	NOAA	**	None	COG

* Number of Assignments reflects total number in the indicated band and may not reflect actual number of users in that band due to generic assignments (i.e. U.S. and Possessions (US&P) assignments).

** Passive only operations. Frequency assignments not required, but may be submitted.

1 - Band not allocated to EESS (passive).

ANNEX B
DOC Office and Bureau Spectrum Requirements Points of Contact

Office of Radio Frequency Management (ORFM): ORFM is responsible for spectrum management for DOC and its agencies.

- James Mentzer, james.mentzer@noaa.gov, (301) 713-1853 x176

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Technology Administration:

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United States Patent and Trademark Office:

- Ronald Hack, ronald.hack@USPTO.GOV, (571) 272-9095

ANNEX C
Acronyms and Abbreviations

ALE - Automatic Link Establishment

ALERT - Automated Local Evaluation in Real Time

AMBCS - Alaska Meteorburst Communications System

AMSU-A - Advanced Microwave Sounding Unit A

AMSU-B - Advanced Microwave Sounding Unit B

ARGOS – POES Data Collection System

ASOS - Automated Surface Observing System

AWIPS - Automated Weather Information Processing System

BIS - Bureau of Industry and Security

CDMA - Code Division Multiple Access

COSPAS-SARSAT - Cosmitscheskaja Sistema Poiska Awarinitsch Sudow - Search and Rescue Satellite-aided Tracking

CMIS - Conical Microwave Imaging Sounder

COOP - Continuity of Operations

COG - Continuity of Government

CWOP - Citizen weather Observer Program

DHS - Department of Homeland Security

DOC - Department of Commerce

DOD - Department of Defense

EESS - Earth Exploration Satellite Service

EMWIN - Emergency Manager's Weather Information Network

EPIRB - emergency position indicating radio beacon

FAA - Federal Aviation Administration

FCC - Federal Communications Commission

FedSMR - Federal Specialized Mobile Radio

FM - frequency modulation

FRSC - Federal Radio Service Corporation

FSS - fixed satellite service

GDP - gross domestic product

GHz - gigahertz

GMF - Government Master File

GEOSS - Global Earth Observation System of Systems

GLONASS - Global Navigation Satellite System

GOES - Geostationary Operational Environmental Satellite

GOES-R - Geostationary Operational Environmental Satellite, Series R

HF- high frequency

IEOS - Integrated Earth Observation System

ISCS - International Satellite Communications System

ITS - Institute of Telecommunications Sciences

kHz - kilohertz

LAN - local area network

LMR- land mobile radio

MetAids - meteorological aids

MetSat - meteorological satellite

MHz - Megahertz

MSS - mobile-satellite service

NEF - National Essential Function

NERON - Near Real Time Observing Network

NESDIS - National Environmental Satellite and Data

NIDS - NEXRAD Information Display System

NIST - National Institute of Standards and Technology

NOAA - National Oceanic and Atmospheric Administration

NOS - National Ocean Service

NMFS - National Marine Fisheries Service

NPOESS - National Polar-orbiting Operational Environmental

NS/EP - National Security/Emergency Preparedness

NTIA - National Telecommunications and Information Administration

NTS - National Telecommunications System

NWR - NOAA Weather Radio

NWRL - NOAA Weather Radio Links

NWS - National Weather Service

NWWS - NOAA Weather Wire Service

OAR - Oceanic and Atmospheric Research

OEE - Office of Export Enforcement

ORFM - Office of Radio Frequency Management

P25 - Project 25

PC - personal computer

PLB - personal locating beacon

PMEF - Priority Mission Essential Function

POES - Polar-orbiting Operational Environmental Satellite

PTSN - public telephone switched network

R&D - research and development

RDTE - research, development, test and evaluation

RF - radio frequency

RRS - Radiosonde Replacement System

SARSAT - Search and Rescue Satellite

SHARES - Shared Resources

TPC - Tropical Prediction Center

TT&C - telemetry, tracking and control

UHF - Ultra-high frequency

US&P - United States and possessions

USMCC - United States Mission Control Center

USPTO - United States Patent and Trademark Office

VA - Veteran's Administration

VLF - very low frequency

VOS - Voluntary Observing Ship

WFO - weather forecast office

WRC-2007 - 2007 World Radiocommunication Conference

WWV - call sign for NIST HF transmit station in Fort Collins, CO

WWVB - call sign for NIST VLF transmit station in Fort Collins, CO

WWVH - call sign for NIST VLF transmit station in Hawaii