902-928 MHz

1. Band Introduction

The Navy operates air search and surveillance radar systems onboard ships and aircraft carriers in this band. Radiowave propagation characteristics make the band ideal for the detection of fast-moving targets over water. The military agencies use this band for tracking radar systems for aeronautical flight-testing and to monitor the position of missiles, drones, and manned aircraft. Security systems used for perimeter protection and intrusion detection are operated by the military agencies. Military and civilian agencies operate wind profiler radars that monitor and provide warnings of severe weather conditions through the measurement of wind speed and direction at various altitudes. The Federal agencies also operate radio frequency identification (RFID) systems in this band used for container tracking and port security.

Industrial, Scientific, and Medical (ISM) (Federal Communications Commission (FCC) Part 18) and unlicensed (FCC Part 15) devices are authorized to operate in this band. Although the major use of ISM and unlicensed devices in this band is by consumers, Federal agencies also use these devices for various non-mission critical applications.

2. Allocations

2a. Allocation Table

The frequency allocation table shown below is extracted from the Manual of Regulations & Procedures for Federal Radio Frequency Management, Chapter 4 – Allocations, Allotments and Plans.

Table of Frequency Allocations

United States Table

Federal Table	Non-Federal Table	FCC Rule Part(s)
902-928 RADIOLOCATION G59 5.150 US218 US267 US275 G11	902-928 5.150 US218 US267 US275	 ISM Equipment (18) Private Land Mobile (90) Amateur (97)

2b. Additional Allocation Table Information

5.150 The following bands:

13553-13567 kHz	(centre frequency 13560 kHz),
26957-27283 kHz	(centre frequency 27120 kHz),
40.66-40.70 MHz	(centre frequency 40.68 MHz),
902-928 MHz	(in Région 2 (centre frequency 915 MHz),
2400-2500 MHz	(centre frequency 2450 MHz),
5725-5875 MHz	(centre frequency 5800 MHz), and
24-24.25 GHz	(centre frequency 24.125 GHz)

are also designated for industrial, scientific and medical (ISM) applications. Radiocommunication services operating within these bands must accept harmful interference which may be caused by these applications. ISM equipment operating in these bands is subject to the provisions of No**. 15.13.**

US218 The band 902-928 MHz is available for Location and Monitoring Service (LMS) systems subject to not causing harmful interference to the operation of all Federal stations authorized in this band. These systems must tolerate interference from the operation of industrial, scientific, and medical (ISM) equipment and the operation of Federal stations authorized in this band.

US267 In the band 902-928 MHz, amateur stations shall transmit only in the sub-bands 902-902.4, 902.6-904.3, 904.7-925.3, 925.7-927.3, and 927.7-928 MHz within the States of Colorado and Wyoming, bounded by the area of latitudes 39° N and 42° N and longitudes 103° W and 108° W.

US275 The band 902-928 MHz is allocated on a secondary basis to the amateur service subject to not causing harmful interference to the operations of Federal stations authorized in this band or to Location and Monitoring Service (LMS) systems. Stations in the amateur service must tolerate any interference from the operations of industrial, scientific, and medical (ISM) devices, LMS systems, and the operations of Federal stations authorized in this band. Further, the amateur service is prohibited in those portions of Texas and New Mexico bounded on the south by latitude 31° 41' North, on the east by longitude 104° 11' West, and on the north by latitude 34° 30' North, and on the west by longitude 107° 30' West; in addition, outside this area but within 150 miles of these boundaries of White Sands Missile Range the service is restricted to a maximum transmitter peak envelope power output of 50 watts.

G11 Federal fixed and mobile radio services, including low power radio control operations, are permitted in the band 902-928 MHz on a secondary basis.

G59 In the bands 902-928 MHz, 3100-3300 MHz, 3500-3650 MHz, 5250-5350 MHz, 8500-9000 MHz, 9200-9300 MHz, 13.4-14.0 GHz, 15.7-17.7 GHz and 24.05-24.25 GHz,

all Federal non-military radiolocation shall be secondary to military radiolocation, except in the sub-band 15.7-16.2 GHz airport surface detection equipment (ASDE) is permitted on a co-equal basis subject to coordination with the military departments.

3. Federal Agency Use:

3a. Federal Agency Frequency Assignments Table:

The following table identifies the frequency band, type(s) of allocation(s), types of applications, and the number of frequency assignments by agency.

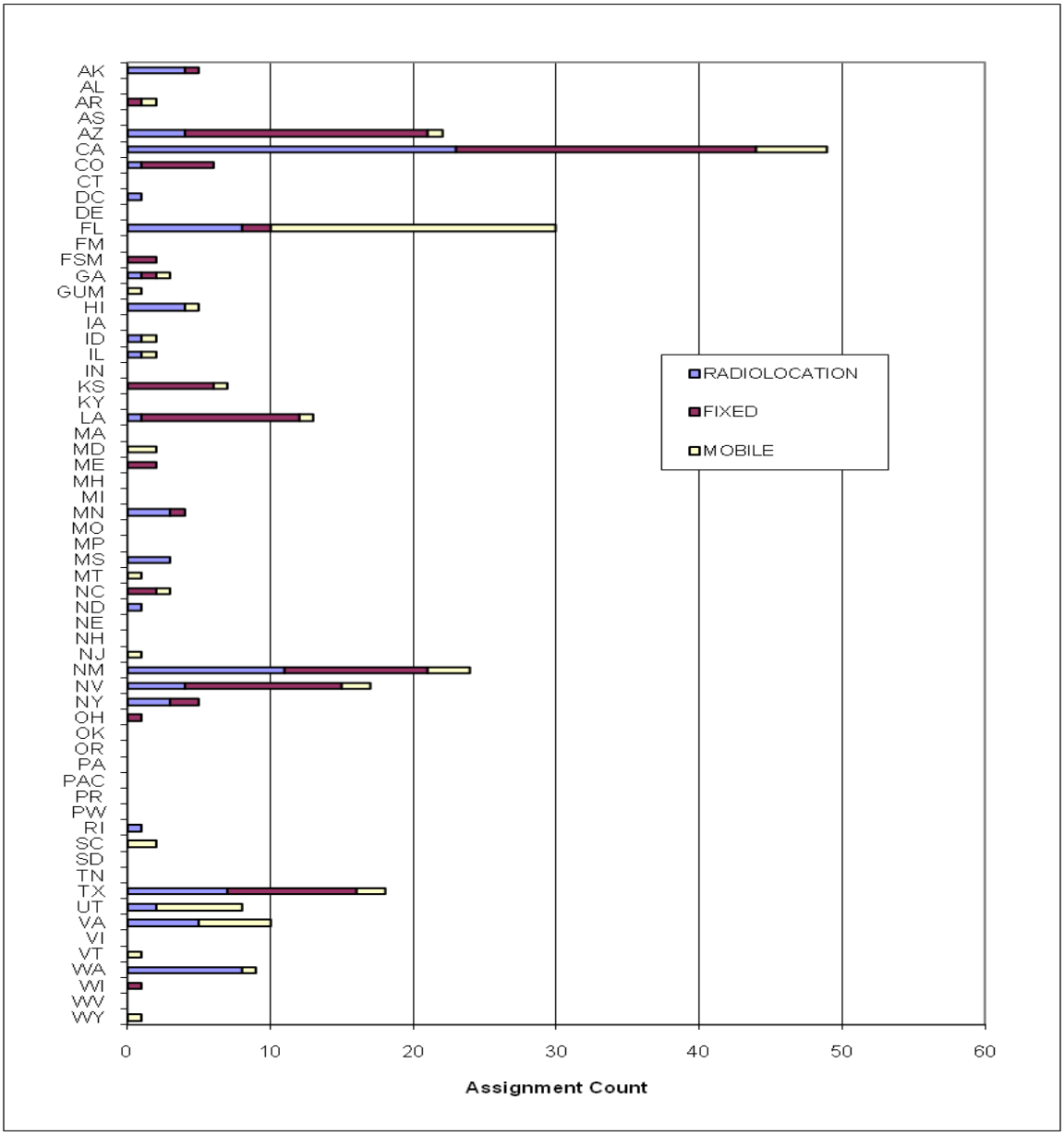
Federal Frequency Assignment Table

902-928 MHz Band													
FEDERAL EXCLUSIVE BAND													
	RADIOLOCATION												
	TYPE OF APPLICATION												
AGENCY	AIR-GROUND-AIR OPERATIONS	AERONAUTICAL TELECOMMAND	HYDROLOGIC OPERATIONS	LAND MOBILE OPERATIONS	LAND RADIO LOCATION	MARITIME MOBILE	MOBILE RADIOLOCATION	METEORLOGICAL AIDS	POINT TO POINT DATA LINK	SHIP SHORE SHIP OPERATIONS	RESEARCH DEVELOPMENT TESTING EVALUATION	TOTAL
A		2										2
AF	2	11		21	15		1		14		21	85
AR	1			2	10		2		22		1	38
BBG				17								17
CG											2	2
DHS				2	17							19
DOC		4				2					4	10
DOE					7			4	3			14
DOI			47		1				1			49
DOJ							1					1
EPA							1					1
FAA					1						1	2
N				1	14		19		6	8	20	68
NSF					3							3
USCP					1							1
VA				1								1
TOTAL	3	15	47	43	69	2	24	4	46	8	49	313

The number of actual systems, or number of equipments, may exceed and sometimes far exceed, the number of frequency assignments in a band. Also, a frequency assignment may represent, a local, state, regional or nationwide authorization. Therefore, care must be taken in evaluating bands strictly on the basis of assignment counts or percentages of assignments.

3b. Percentage of Frequency Assignments Chart

The following chart displays the percentage of frequency assignments in the GMF for the systems operating in the frequency band 902-928 MHz. The distribution of the frequency assignments in the 902-928 MHz band by state is shown in Figure 1. There are systems in this band that are authorized to operate under an area frequency assignment.[1]



[1]. The location of a system authorized to operate under an area frequency assignment is unknown. The operational area can be specified on a nationwide basis; within a state or multiple states; or within a geographic area.

4. Frequency Band Analysis By Application

4a. Radiolocation Service

The Navy operates a major long range two-dimensional air surveillance radar system in the 902-928 MHz band, which is installed on most medium to large naval ships. Operation in the 902-928 MHz band is critical because this frequency range offers unique propagation characteristics that permit the detection of "sea skimmers", fast moving targets over water. Radar systems operating in other frequency bands are less effective over water because the sea surface reflects energy back to the radar receiver, causing errors in determination of speed and distance of the target. This problem has been largely overcome by using radar systems operating in the 902-928 MHz band. This radar is used at various naval installations in Southern California, Hawaii, and Puerto Rico to conduct training exercises in coastal waters.[2] Generally, the emissions from the radar are directed seaward to reduce interference to shore locations. During training exercises in littoral waters (typically conducted outside of 46 kilometers from the coast), radar systems may be used closer to coastal areas (i.e. launching and/or recovering aircraft). Based on past operational experience, a distance separation of 56 kilometers inland from coastal areas has been found to be sufficient for sharing with other services.[3] The radar operates throughout the 902-928 MHz band in 3 MHz channels, with a peak output power of 300 kilowatts, pulse widths of 2 and 125 microseconds, pulse repetition frequencies of 285, 833, and 1000 pulses per second, and a mainbeam antenna gain of 28 dBi. [4]

At military facilities, radar systems operating in this band are used for tracking, control, and telemetry to support drone, aircraft, and missile flight testing.

The Gulf Range Drone Control System (GRDCS) is a radar system that utilizes multiple measurement sites to track and control drones on military test and training ranges..

Both non-Federal users and Federal agencies operate Wind Profile Radar (WPR) systems in this frequency band. The WPR system is a ground-based vertically directed Doppler radar that can measure the wind speed of crosswinds as a function of altitude in the clear atmosphere, where overlying wind streams have substantially different velocities. The

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[2]. Specific operational areas are identified in *FCC Wireless Telecommunications Bureau Announces Revised Pre-Auction Deadlines for the Auction of 528 Multilateration Location and Monitoring Service Licenses*, Public Notice, DA 98-239 released November 25, 1998.

[3]. *Id.*

[4]. All variants of this radar system have a tuning range of 850-942 MHz.

WPR system detects scattering from the turbulent media in the clear-air. Clear-air echoes are very weak, so a radar using high-transmitter power and a large-aperture antenna is required to detect low level return signals from the atmosphere.

The WPR systems can operate in one of three frequency ranges depending on the desired resolution of the measurements.[5] The WPR systems play an important role in experimental atmospheric research. Their ability to measure wind with a high temporal and spatial resolution makes them very well suited for the experimental verification of models, for boundary layer research and for investigation of processes that are important for understanding the atmosphere, including climate evolution. The WPR systems operating in this band are used for: short-term weather forecasting, air pollution monitoring, wind field analyses and forecasts of toxic plumes trajectories resulting from chemical or nuclear incidents, severe weather warnings for aviation, meteorological observations, airport operations, and public protection. The Air Force uses WPR systems to measure wind velocity and temperature at various altitudes in Utah, California, and Florida. The Department of the Interior (DOI) uses WPR systems for metrological and air quality studies at various locations in Louisiana. WPR systems are also used by the Department of Energy for atmospheric research in Alaska, Colorado, Illinois, New Mexico, Nevada, and Oklahoma. The National Science Foundation uses WPR systems to collect hazardous windshear data in Alaska. Figure 2 shows a typical configuration for a WPR system.

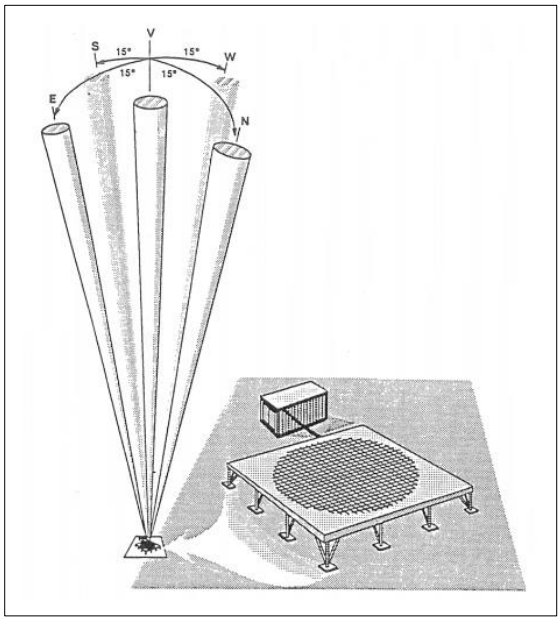

Figure 2. Typical Beam Configuration for a Wind Profiler Radar System

[5]. WPRs operate around 50 MHz, in the 200-500 MHz frequency range, and around 900 MHz. Each of these frequency ranges is used for better resolution depending upon altitude.

The Federal agencies are beginning to deploy radio-frequency identification (RFID) systems in this frequency band.[6] The Department of Homeland Security (DHS) operates RFID systems to support law enforcement operations. The two systems that make up the majority of the DHS frequency assignments for RFID systems are the: Secure Electronic Network for Travelers' Rapid Inspection (SENTRI) system operated by U.S. Citizenship and Immigration Service with devices installed inside certain passports; and Vehicle and Cargo Inspection System (VACIS), which uses gamma rays to produce an image of the contents of a container for review by the Customs and Border Protection inspector. These systems support the bilateral border partnership ("Smart Border") Agreement. This agreement calls for enhancing security by utilizing technology to strengthen infrastructure while facilitating the transit of legitimate people and goods across the border.[7] These DHS systems deploy at various locations (e.g., borders and ports of entry) in the United States. The RFID systems used to communicate the status of people entering the U.S. operate at 915 MHz with a bandwidth of approximately 1.2 MHz. RFID systems used for monitoring rail vehicles, automobiles, and trucks operate at 915 MHz with a bandwidth of approximately 50 kHz.

4b. Fixed Service

The operation of systems in the fixed service is permitted in the band on a secondary basis as specified in footnote G11.

DHS operates fixed video surveillance systems for law enforcement operations along some of the states bordering Mexico and Canada (e.g., CA, AZ, NM, ME). These surveillance systems are operated on a continuous basis to monitor activities along the border.

The DOI operates hydrologic systems in this band that are used for monitoring and data analysis at the Hoover Dam, including the measurement of: flow rate, salinity temperature, and river level data along the Colorado River. In general, hydrologic operations conducted by the Federal Government represent a valuable nationwide service provided to state and local communities. These operations support environmental monitoring and forecasting, flood watch and warning, and water analysis. In addition, the DOI operates fixed microwave systems that are used for supervisory control, telemetry, and operations and maintenance of power generation and water transmission facilities on a continuous basis at various locations in Colorado.

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[6]. In an RFID device tag is usually applied to or incorporated into a product, person, or animal for the purpose of identification and tracking using radio waves.

[7]. Additional information on the Border Partnership under the broader U.S. Mexico Partnership is available on the Department of State website http://www.state.gov/p/wha/rt/c6287.htm.

The Department of Energy operates low power video links in Nevada, New Mexico, and Arizona to support various functions that include range safety operations and bomb disposal associated with training exercises.

The military agencies operate fixed point-to-point microwave communication systems and telecommand networks at various military facilities. The microwave communication systems are operated continuously, while the telecommand networks are only used during training or testing of drones, unmanned aerial vehicles (UAVs), or ground targets. Training exercises are limited to military facilities and can occur at anytime.

The U.S. Department of Veterans Affairs has frequency assignments in this band that are used for a hospital emergency room telemetry system used to obtain vital health information from patients in Amarillo, TX**.** This system can operate on either a limited or continuous basis.

4c. Mobile Service

The operation of systems in the mobile service is permitted in the band on a secondary basis as specified in footnote G11.

The systems operating in this band under the mobile service allocation include land and aeronautical mobile systems used for short-range communications such as: control of range instrumentations, law enforcement for base security operations, short-haul frequency hopping digital communication systems that link computers to facilitate rapid and safe collation and evaluation of data, tracking and control of airborne targets and data, and video telemetry at military test ranges.

The Air Force operates video surveillance systems in the band for explosive ordinance disposal (EOD). The EOD operation entails a video link from a remote controlled robot for bomb disposal to the control site to monitor the disposal operation. The geographic areas of EOD operation includes the following bases or facilities: Little Rock, AR; Luke, AZ; Edwards, CA; Travis, CA; Hurlburt, FL; Patrick, FL; Tyndall, FL; Moody, GA; Andersen, GUM; Mountain Home, ID; McConnell, KS; Barksdale, LA; Andrews, MD; Malmstrom, MT; Pope, NC; Holloman, NM; Kirtland, NM; Nellis, NV; Charleston, SC; Lackland, TX; Hill, UT; Langley, VA; South Royalton, VT; McChord, WA; and Fe Warren, WY. The radius of operation ranges between 5 to 10 kilometers.

The United States Department of Agriculture operates systems in this band that provide real time emergency fire imagery during major fires and air-to-ground data links to support fire operations.

The military agencies operate tracking, control, and telemetry systems used to provide real-time data from remotely piloted vehicles, drones, and missiles during training or testing operations performed at various military test ranges. The military agencies operate low-power devices such as those used for tactical and non-tactical intrusion detection at military facilities. In addition, the military agencies operate target and control systems that provide telemetering of data, command and control of unmanned ground targets. A typical system consists of a fixed ground station and mobile ground targets. For example, the Air Force uses the 902-928 MHz band to transmit signals from a fixed location to control and target moving tanks for training and exercises. These mobile operations are limited to military test ranges.

The Broadcasting Board of Governors also operates wireless microphones in this band throughout the United States to provide communications to and from a specific studio for live coverage events. This system operates with a transmit power between 0.1 and 0.5 watts.

5. Planned Use:

The Navy requirements for shipborne air search and surveillance radar systems operating in the 902-928 MHz band are expected to continue for at least the next ten years. The Federal Government does not plan to develop new radar systems in the 902-928 MHz band.[8]

In order to satisfy the increasingly complex and diverse requirements for video surveillance operations, the Department of Justice is starting to incorporate the use of a new type of video surveillance system that uses Internet Protocol (Video over IP) services in the 902-928 MHz band.[9]

The use of this band for ground-to-air communication links for command and control of drones or remotely piloted vehicles (RPVs) and UAVs and for air-to-ground communication links for telemetry of data and video in support of missile testing, drone, and RPV/UAV operations is expected to increase in the future.[10]

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[8]. Department of Defense *Strategic Spectrum Plan -November 2005*, available at http://www.ntia.doc.gov/osmhome/spectrumreform/2007_Agency_Plans.html.

[9]. Department of Justice *Strategic Spectrum Plan -2007*available at http://www.ntia.doc.gov/osmhome/spectrumreform/2007_Agency_Plans.html.

[10]. Department of Defense *Strategic Spectrum Plan February 2008*, available at http://www.ntia.doc.gov/osmhome/spectrumreform/2007_Agency_Plans.html.

The implementation of RFID systems is expected to increase in the 902-928 MHz band as the Federal agencies start to employ RFID tags to monitor, track, and identify their various assets or inventories (e.g., trucks, tanks, shipping containers, munitions, nuclear waste, supplies, etc).[11] .

The use of WPR systems in the 902-928 MHz band is expected to continue for at least the next ten years.

[11]. The U.S. Coast Guard has started working with International Standards Organization (ISO) Technical Committee 104 (Freight Containers) Sub-Committee 4 (Identification) and Communications), which is responsible for international standards for RFID use on containers for the purposes which includes port security. *See* Department of Homeland Security, United States Coast Guard, *Strategic Spectrum Plan-December 2007*, available at http://www.ntia.doc.gov/osmhome/spectrumreform/2007_Agency_Plans.html