5 650 - 5 925 MHz

1. Band Introduction

DoD uses this band for a wide variety of radar applications including anti-air warfare radars, which are part of an advanced ground-based air defense missile system. DoD and NASA also uses this band for a variety of land-based and shipborne radars including such functions as surface search, navigation, land-mapping and imaging, and weapons fire control.

The Department of Defense (DoD) and National Aeronautics and Space Administration (NASA) uses this band for test and launch range instrumentation radars to track rockets, missiles, satellites, launched vehicles, and other targets including testing of unmanned aircraft systems (UAS)[1] downlinks to ground control stations. This band supports daily DoD and Department of Homeland Security (DHS) UAS missions to provide command and control of unmanned aerial vehicle (UAV)[2] and control of cameras as the mission dictates.

DoD has several earth stations deployed in the 5 850 - 5 925 MHz band for utilization of commercial satellite services. These earth stations provide broadband support of military operations and data excluding command and control operations.

NASA utilizes mobile service hand-held security video surveillance instruments at Johnson space flight center.

[1] UAS refers to the unmanned aircraft system including payload and communications.

[2] UAV refers only to the unmanned platform.

2. Allocations

2a. Allocation Table

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

Table of Frequency Allocations

5 650 – 5 925 MHz

United States Table

5 650 - 5 925 RADIOLOCATION G2	5 650 - 5 830 Amateur 5.150 5.282	RF Devices (15) ISM Equipment (18) Amateur (97)
	5 830 - 5 850 Amateur Amateur-satellite (space-to-Earth) 5.150	
5.150 US245	5 850 - 5 925 FIXED-SATELLITE (Earth-to-space) US245 MOBILE NG160 Amateur 5.150	ISM Equipment (18) Private Land Mobile (90) Personal Radio (95) Amateur (97)

2b. Additional Allocation Table Information

5.150 The following bands:
13 553 - 13 567 kHz (centre frequency 13 560 kHz),
26 957 - 27 283 kHz (centre frequency 27 120 kHz),
40.66 - 40.70 MHz (centre frequency 40.68 MHz),
902 - 928 MHz in Region 2 (centre frequency 915 MHz),
2 400 - 2 500 MHz (centre frequency 2 450 MHz),
5 725 - 5 875 MHz (centre frequency 5 800 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.

5.282 In the bands 435 - 438 MHz, 1 260 - 1 270 MHz, 2 400 - 2 450 MHz, 3 400 - 3 410 MHz (in Regions 2 and 3 only) and 5 650 - 5 670 MHz, the amateur-satellite service may operate subject to not causing harmful interference to other services operating in accordance with the Table (see No. 5.43). Administrations authorizing such use shall ensure that any harmful interference caused by emissions from a station in the amateur-satellite service is immediately eliminated in accordance with the provisions of No. 25.11. The use of the bands 1 260 - 1 270 MHz and 5 650 - 5 670 MHz by the amateur-satellite service is limited to the Earth-to-space direction.

G2 In the bands 216 - 217 MHz, 220 - 225 MHz, 420 - 450 MHz (except as provided by US217 and G129), 890 - 902 MHz, 928 - 942 MHz, 1 300 - 1 390 MHz, 2 310 - 2 390 MHz, 2 417 - 2 450 MHz, 2 700 - 2 900 MHz, 3 300 - 3 500 MHz (except as provided by footnote US108), 5 650 - 5 925 MHz, and 9 000 - 9 200 MHz, the Federal radiolocation service is limited to the military services.

NG160 In the band 5 850 - 5 925 MHz, the use of the non-Federal mobile service is limited to Dedicated Short Range Communications operating in the Intelligent Transportation System radio service.

US245 In the bands 3 600 - 3 650 MHz (space-to-Earth), 4 500 - 4 800 MHz (space-to-Earth), and 5 850 - 5 925 MHz (Earth-to-space), the use of the non-Federal fixed-satellite service is limited to international inter-continental systems and is subject to case-by-case electromagnetic compatibility analysis. The FCC's policy for these bands is codified at 47 CFR 2.108

3. Federal Agency Use:

3a. Federal Agency Frequency Assignments Table:

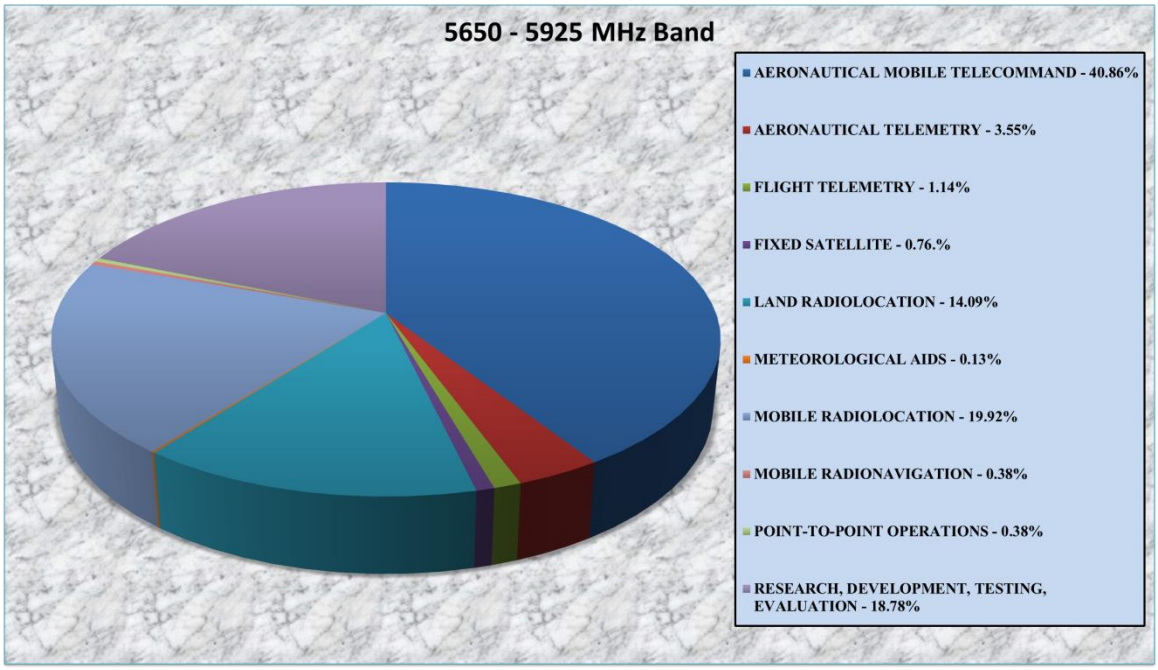
The following table identifies the frequency band, types of allocations, types of applications, and the number of frequency assignments by agency.

Federal Agency Assignment Table

5650 - 5925 MHz Band											
SHARED BAND											
	AMATEUR AMATEUR-SATELLITE (space-to-Earth) FIXED-SATELLITE (Earth-to-space) MOBILE RADIOLOCATION										
	TYPE OF APPLICATION										
AGENCY	AERONAUTICAL MOBILE TELECOMMAND	AERONAUTICAL TELEMETRY	FLIGHT TELEMETRY	FIXED SATELLITE	LAND RADIOLOCATION	METEOROLOGICAL AIDS	MOBILE RADIOLOCATION	MOBILE RADIONAVIGATION	POINT TO POINT OPERATIONS	RESEARCH DEVELOPMENT TESTING EVALUATION	TOTAL
AF	232				31		69		1	20	353
AR	8	6			13		15	3			45
DHS	30	14			3					12	59
DOC	1		9	1							11
DOE					1	1	16			7	25
MC		4			4						8
N	12	4		5	9		55		2	36	123
NASA	39				50		2			6	97
TRANS										67	67
TOTAL	322	28	9	6	111	1	157	3	3	148	788

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



4. Frequency Band Analysis by Application

4a. Aeronautical Mobile Telemetry and Telecommand

The DoD operates aeronautical telemetering mobile stations in this band for transmitting data directly related to the airborne testing of vehicles or major components. This band supports the testing of UAS downlinks to ground control stations. This testing ensures proper functioning of the command and control link to control the UAV. Also testing ensures that the transmit payload imagery and system data path are processing correctly and relayed to intelligence collection center. The DoD operates UAS telemetry and video uplink systems in this band supporting research, development, testing and evaluation and flight operations.

This band supports daily DoD and DHS UAS missions to provide command and control of aircraft and camera as the mission and aircraft dictate. UAS also support disaster relief efforts (i.e. firefighting operations in California). This expanded role results in a requirement to deploy UAS in proximity to U.S. cities and along the national borders.

4b. Instrumentation Radars

Test range instrumentation radars provide highly accurate position data on space launch vehicles and aeronautical vehicles undergoing developmental and operational testing. High transmitter powers and large aperture parabolic reflector antennas with narrow

beamwidths typify these radars. The radars have auto-tracking antennas, which either skin-track or beacon-track the object of interest.[3] Periods of operation can last from minutes up to several hours, depending upon the test program. Operations are conducted at scheduled times throughout the week.

The technical characteristics for instrumentation radar systems operating in the 5 570 - 5 650 MHz frequency range derived from Recommendation ITU-R M.1638-1[4] are given in Table 1 below. The example system data provided in this recommendation is typical for radar systems deployed in the United States.

Table 1. Instrumentation Radar Characteristics

Characteristics	Radar 2	Radar 3	Radar 4	Radar 5
Tuning range (MHz)	5 350 - 5 850	5 350 - 5 850	5 400 - 5 900	5 400 - 5 900
Transmit power into antenna (Megawatts)	2.8	1.2	1	0.165
Pulse width (microsecond)	0.25, 1.0, 5.0	0.25, 0.5, 1.0	0.25 - 1 (plain)[5] 3.1 - 50 (chirp)	100
Pulse rise/fall time (microsecond)	0.02 - 0.5	0.02-0.05	0.02 - 0.1	0.5
Pulse repetition rate (pulses per second)	160, 640	160, 640	20 - 1 280	320
Chirp bandwidth (MHz)	N/A	N/A	4.0	8.33
Emission bandwidth (MHz) –3 dB –20 dB	0.5-5	0.9-3.6 6.4-18	0.9-3.6 6.4-18	8.33 9.9
Antenna main beam gain (dBi)	54	47	45.9	42

4c. Tactical Radars

The DoD operates a transportable surface-to-air missile defense multi-function radar system in this band that is used to detect and track targets as part of a tactical air defense system. These systems are currently deployed at or near military bases.

The Navy operates shipboard sea and air surveillance radars in this band for ship protection and operate continuously while the ship is underway as well as when entering and leaving port areas. These surveillance radars usually employ moderately high transmitter powers and antennas which scan electronically in elevation and mechanically a full 360 degrees in azimuth. Operations can dicate that multiple ships operate these radars simultaneously in a given geographical area.

The technical characteristics for tactical radar systems operating in the 5 650 –

[3] The characteristics for the radar beacons are not included in the table. These radar beacons are typically tunable over the frequency range of 5 400 - 5 900 MHz and have transmitter power levels in the range 50 to 200 Watts. They rebroadcast the received radar signal.

[4] *Characteristics of and protection criteria for sharing studies for radiolocation (except ground based meteorological radars)and aeronautical radionavigation radars operating in the frequency bands between 5 250 and 5 850 MHz*

[5] The pulse widths referenced here are for plain (CW) radar systems and chirped (FM modulated) radar systems.

5 925 MHz frequency range derived from Recommendation ITU-R M.1638-1[4] are given in Table 2 below. The example system data provided in this recommendation is typical for radar systems deployed in the United States.

Table 2. Tactical Radar Characteristics

Characteristics	Radar 7	Radar 9
Function	Surface and air search	Search
Tuning range (MHz)	5 450 - 5 825	5 250 - 5 725
Transmit power into antenna (Kilowatts)	285	0.1100 - 0.400
Pulse width (microsecond)	0.1/0.25/1.0	1.0
Pulse rise/fall time (microsecond)	0.03/0.05/0.1	0.05
Pulse repetition rate (pulses per second)	2 400/1 200/ 750	200-1 500
Chirp bandwidth (MHz)	N/A	N/A
Emission bandwidth (MHz) –3 dB –20 dB	 5.0/4.0/1.2 16.5/12.5/7.0	 4.0 10.0
Antenna main beam gain (dBi)	30.0	30 - 40

4d. Special Purpose Radars

DoD utilizes special-purpose radar systems in the 5 650 - 5 925 MHz band to include airborne synthetic aperture radars for land-mapping and imaging, environmental and land-use studies, and other related research activities. DOD operates these radars systems continuously at various altitudes and with varying look-down angles for periods of time up to hours in duration depending upon the specific measurement campaign being performed.

4e. Fixed-Satellite

DoD operates several fixed-satellite service (FSS) earth stations in the 5 850 - 5 925 MHz band to connect to commercial satellite systems used in support of operations and data transmissions. Use of these commercial satellite systems preclude command and control functions but otherwise support a full range of services for base and operations support.

The DoD is developing earth stations having the flexibility of operating in numerous bands. These bands include 6/4 GHz, 8/7 GHz, and 14/12 GHz. Some of these earth stations have the capability of operating in the band 5 850 - 5 925 MHz.

4f. Land Mobile

DoD and NASA utilize hand-held mobile systems in the 5 650 - 5 925 MHz band for a variety of functions including personal communications, video, and unit operations.

4g. Low Power Devices

Responding to industry requests for spectrum in which to operate unlicensed devices, e.g., primarily wireless local area networks and WiFi devices, in June 2006, the Federal Communications Commission (FCC) adopted rules in Part 2[6] and Part 15 subpart E[7] of the Commission's Rules (CFR 47) allowing commercial users to employ opportunistic sharing techniques to share 355 MHz of radio spectrum. Using Dynamic Frequency Selection (DFS) detect-and-avoid algorithms, commercial devices are now able to operate in the 5 250 - 5 350 MHz and 5 470 - 5 725 MHz bands. Commercial devices may use the 5 150 - 5 250 MHz and 5 725 - 5 825 MHz bands without DFS. Federal agencies operate unlicensed devices that comply with the FCC Part 15 Rules or Annex K of the NTIA Manual through adherence to NTIA Manual Part 7.8 ("PURCHASE AND USE OF NON-LICENSED DEVICES").

5. Planned Use:

The DoD and NASA will continue to operate radiodetermination systems, aeronautical mobile telemetry and telecommand in this band for the foreseeable future.

NASA use of mobile service video security systems in this band will continue for the foreseeable future.

The DoD use of FSS earth stations in this band will continue for the foreseeable future.

[6] http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=3012cbea9f5a67984ec438c5cd3e9fde&tpl=/ecfrbrowse/Title47/47cfr2_main_02.tpl

[7] http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=3012cbea9f5a67984ec438c5cd3e9fde&rgn=div6&view=text&node=47:1.0.1.1.14.5&idno=47