1240-1300 MHz

1. Band Introduction

The band 1240-1300 MHz is used by Federal agencies for operating various types of long-range radar systems that perform missions critical to safe and reliable air traffic control (ATC) in the national airspace, border surveillance, early warning missile detection, and drug interdiction. These radar systems ensure the safe transportation of people and goods, encourage the flow of commerce, and provide for national defense. Long-range radar systems are operated in this portion of the radio frequency spectrum because the effects of rain and fog on radar target detection are very low, the external background noise levels are low, and high-power transmitter tubes operate very efficiently. These factors are important to achieve the long-range detection of different size aircraft as well as other targets.

2. Allocations

2a. Allocation Table

The frequency allocation table shown below is extracted from the Manual of Regulations and 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)
1240-1300 EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION G56 SPACE RESEARCH (active) AERONAUTICAL RADIONAVIGATION 5.332 5.335	1240-1300 AERONAUTICAL RADIONAVIGATION Amateur Earth exploration-satellite (active) Space research (active) 5.282	Amateur (97)

2b. Additional Allocation Table Information

G56 Federal radiolocation in the bands 1215-1300, 2900-3100, 5350-5650 and 9300-9500 MHz is primarily for the military services; however, limited secondary use is permitted by other Federal agencies in support of experimentation and research programs. In addition, limited secondary use is permitted for survey operations in the band 2900-3100 MHz.

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 5650-5670 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.

5.332 In the band 1 215-1 260 MHz, active spaceborne sensors in the Earth exploration-satellite and space research services shall not cause harmful interference to, claim protection from, or otherwise impose constraints on operation or development of the radiolocation service, the radionavigation- satellite service and other services allocated on a primary basis. (WRC-2000)

5.335 In Canada and the United States in the band 1 240-1 300 MHz, active spaceborne sensors in the earth exploration-satellite and space research services shall not cause interference to, claim protection from, or otherwise impose constraints on operation or development of the aeronautical radionavigation service.

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 in the Government Master File (GMF) by agency.

Federal Frequency Assignment Table

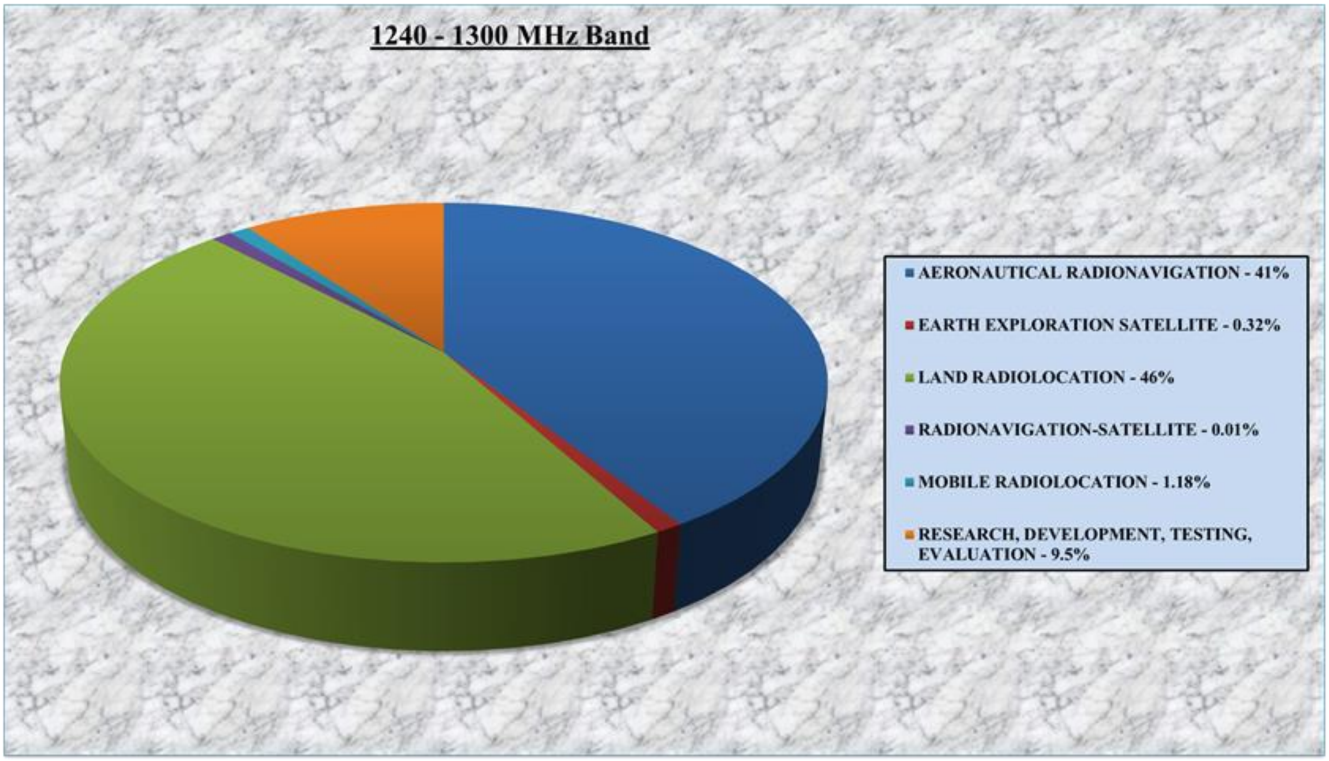
1240-1300 MHz Band							
SHARED BAND							
	AERONAUTICAL RADIONAVIGATION AMATEUR EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) SPACE RESEARCH (active)						
	TYPE OF APPLICATION						
AGENCY	AERONAUTICAL RADIONAVIGATION	EARTH EXPLORATION SATELLITE	RADIONAVIGATION-SATELLITE	LAND RADIOLOCATION	MOBILE RADIOLOCATION	RESEARCH DEVELOPMENT TESTING EVALUATION	TOTAL
AF	3			26		33	62
AR				138	5	2	145
DHS				1	4		5
DOC			1				1
DOE	8					3	11
FAA	216						216
MC	1			85		2	88
N	4			14	1	11	30
NASA		1		1	1	3	6
TOTAL	232	1	1	265	11	54	564

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

1240 – 1300 MHz

The following chart displays the percentage of frequency assignments in the GMF for the systems operating in the frequency band 1240-1300 MHz.



4. Frequency Band Analysis By Application

4a. Aeronautical Radionavigation

The Federal Aviation Administration (FAA) and Department of Defense (DoD) operate long-range aeronautical radionavigation radar systems in the band 1240-1300 MHz. These radars are capable of operating throughout the 1215-1400 MHz frequency range. These radar systems are used to monitor aircraft and other targets within the national airspace, along the border areas, and around military bases and airfields. The Air Route Surveillance Radar (ARSR) systems that operate throughout this band measure range, bearing, and velocity of aircraft and other targets.[1] They are used in directing aircraft en-route across the United States within the National Airspace System.

The aeronautical radionavigation radar systems operating in the band 1215-1240 MHz use a continually rotating antenna mounted on a tower. The antennas are mounted on a tower to provide an unobstructed view of the airspace they are monitoring. The antennas are directed slightly upwards to remove the effects of local obstructions (e.g., ground clutter), that would degrade the performance of the radar system. Each system installation is unique but the typical antenna height is approximately 45 feet for fixed radar systems, and approximately 20 feet for transportable radar systems. The typical antenna rotation rate for radar systems operating in this band is 5 to 6 revolutions per minute.

4b. Radiolocation

The military operates tactical radar systems in the band 1240-1300 MHz.
Tactical radars are designed to be more easily tuned than air traffic control radars, since they may have to operate in a battlefield environment with many other systems and require the flexibility to change frequencies to reduce their exposure to hostile forces.

The Tethered Aerostat Radar (TAR) system also operates in this band. The TAR consists of balloon mounted radars that are used for monitoring the southern boarders and Caribbean airspace for drug interdiction. The balloon is tethered to a ground station and the radar monitors the airspace, sending data down to the ground control station and the information is relayed to appropriate authorities.

[1] The radar systems operating in this band transmit pulsed radio frequency signals that are reflected from the surface of aircraft or target. The time required for a reflected signal that is transmitted to return from an aircraft and the direction of the reflected signal are measured. From this information, the radar can determine the distance of the aircraft from the antenna, the direction of the aircraft relative to the antenna, and in some cases the altitude.

The technical characteristics of systems operating in this band can be found in ITU-R M 1463-2 titled "*Characteristics of and protection criteria for radars operating in the radiodetermination service in the frequency band 1 215-1 400 MHz*". The systems in the band 1240-1300 MHz operated by the federal government and DoD are similar to the ones described in the following tables.

TABLE 1

1 215-1 400 MHz radiodetermination system characteristics

Parameter	Units	System 1	System 2	System 3	System 4	System 5	System 6	System 7	System 8
Peak power into antenna	dBm	97	80	76.5	80	73.9	96	93	78.8
Frequency range	MHz					1 215-1 400	1 280-1 350	1 215-1 350	1 240-1 350
Pulse duration	μs	2	88.8; 58.8 (Note 1)	0.4; 102.4; 409.6 (Note 2)	39 single frequency 26 and 13 dual frequency (Note 3)	2 each of 51.2 2 each of 409.6	2	6	115.5; 17.5 (Note 4)
Pulse repetition rate	pps	310-380 staggered	291.5 or 312.5 average	200-272 long-range 400-554 short-range	774 average	240-748	279.88 to 370.2	279.88 to 370.2	319 average
Chirp bandwidth for frequency modulated (chirped) pulses		Not applicable	770 kHz for both pulse widths	2.5 MHz for 102.4 μs 625 kHz for 409.6 μs	Not applicable	1.25 MHz	Not applicable	Not applicable	1.2 MHz
Phase-coded sub-pulse width	μs	Not applicable	Not applicable	Not applicable	1	Not applicable	Not applicable	Not applicable	Not applicable
Compression ratio		Not applicable	68.3:1 and 45.2:1	256:1 for both pulses		64:1 and 256:1	Not applicable	Not applicable	150:1 and 23:1
RF emission bandwidth (3 dB)	MHz	0.5	1.09	2.2; 2.3; 0.58	1	0.625 or 1.25	1.2	1.3	1.2
Output device		Klystron	Transistor	Transistor	Cross-field amplifier	Transistor	Magnetron/ Amplitron	Klystron	Transistor
Antenna type		Horn-fed reflector	Stack beam reflector	Rotating phased array	Parabolic cylinder	Planar array with elevation beam steering	47′ × 23′ (14.3 × 7 m) cosecant squared	45′ × 19′ (13.7 × 5.8 m) cosecant squared	Horn-fed reflector
Antenna polarization		Horizontal, vertical, LHCP, RHCP	Vertical, circular	Horizontal	Vertical	Horizontal	CP/LP	Linear orthogonal and CP	Vertical; RHCP

TABLE 1 (*continued*)

Parameter	Units	System 1	System 2	System 3	System 4	System 5	System 6	System 7	System 8
Antenna maximum gain	dBi	34.5, transmit 33.5, receive	32.4-34.2, transmit 31.7-38.9, receive	38.9, transmit 38.2, receive	32.5	38.5	34	35	34.5
Antenna elevation beamwidth	degrees	3.6 shaped to 44	3.63-5.61, transmit 2.02-8.79, receive	1.3	4.5 shaped to 40	2	3.75 (cosecant squared)	3.75 (cosecant squared)	3.7 shaped to 44 (cosecant squared)
Antenna azimuthal beamwidth	degrees	1.2	1.4	3.2	3.0	2.2	1.2	1.3	1.2
Antenna horizontal scan characteristics	rpm	360° mechanical at 5 rpm	360° mechanical at 5 rpm	360° mechanical at 6 rpm for long range and 12 rpm for short range	360° mechanical at 6, 12 or 15 rpm	5	6	5	360° mechanical at 5 rpm
Antenna vertical scan characteristics	degrees	Not applicable	–7 to +30 in 12.8 or 13.7 ms	–1 to +19 in 73.5 ms	Not applicable	−6 to +20	−4 to +20	−4 to +20	Not applicable
Receiver IF bandwidth	kHz	780	690	4 400 to 6 400	1 200	1 250 625	720 to 880 (log) 1 080 to 1 320 (MTI)	270 to 330 (20 series log) 360 to 480 (20 series MTI) 540 to 660 (60 series log) 720 to 880 (60 series MTI)	1 200
Receiver noise figure	dB	2	2	4.7	3.5	2.6	4.25	9	3.2

1240–1300 MHz

TABLE 1 (*end*)

Parameter	Units	System 1	System 2	System 3	System 4	System 5	System 6	System 7	System 8
Platform type		Fixed	Fixed	Transportable	Transportable	Fixed terrestrial	Fixed terrestrial	Fixed terrestrial	Fixed
Time system operates	%	100	100	100	100	100	100	100	100

LHCP: left-hand circularly polarized

RHCP: right-hand circularly polarized

NOTE 1 – The radar has 44 RF channel pairs with one of 44 RF channel pairs selected in normal mode. The transmitted waveform consists of a 88.8 µs pulse at frequency f_1 followed by a 58.8 µs pulse at frequency f_2. Separation of f_1 and f_2 is 82.854 MHz.

NOTE 2 – The radar has 20 RF channels in 8.96 MHz increments. The transmitted waveform group consists of one 0.4 µs P0 pulse (optional) which is followed by one 102.4 µs linear frequency modulated pulse (if 0.4 µs P0 is not transmitted) of 2.5 MHz chirp which may be followed by one to four long-range 409.6 µs linear frequency modulated pulses each chirped 625 kHz and transmitted on different carriers separated by 3.75 MHz. Normal mode of operation employs frequency agility whereby the individual frequencies of each waveform group are selected in a pseudo-random manner from one of the possible 20 RF channels within the frequency band 1 215-1 400 MHz.

NOTE 3 – The radar has the capability of operating single frequency or dual frequency. Dual RF channels are separated by 60 MHz. The single channel mode uses the 39 µs pulse width. In the dual channel mode, the 26 µs pulse is transmitted at frequency f, followed by the 13 µs pulse transmitted at f+ 60 MHz.

NOTE 4 – This radar utilizes two fundamental carriers, F1 and F2, with two sub-pulses each, one for medium range detection and one for long range detection. The carriers are tunable in 0.1 MHz increments with a minimum separation of 26 MHz between F1 (below 1 300 MHz) and F2 (above 1 300 MHz). The carrier sub-pulses are separated by a fixed value of 5.18 MHz. The pulse sequence is as follows: 115.5 µs pulse at F1 + 2.59 MHz, then a 115.5 µs pulse at F2 + 2.59 MHz, then a 17.5 µs pulse at F2 – 2.59 MHz, then a 17.5 µs pulse at F1 – 2.59 MHz. All four pulses are transmitted within a single pulse repetition interval.

4c. Space Research (Active) Service

There are no Federal systems operating in the space research (active) service.

4e. Earth Exploration-Satellite (Active) Service

There is an assignment for the NASA Aquarius non-geostationary satellite that operates in the EESS (active) service at 1260 MHz. It is a remote sensing instrument that is used to measure the salinity of the ocean as a joint venture with Argentina. The transmitter has a power of 200 Watts and 4.6 MHz bandwidth.

4c. Research Testing and Development

In addition to the operational radars in the band 1240 -1300 MHz, there are frequency assignments for research and development purposes to examine hardware and software improvements for existing systems. The research and development includes examining new waveforms and testing new signal processing techniques. The operation of radar systems used for research and development are carefully coordinated to ensure that they do not cause harmful interference to operational aeronautical radionavigation radar systems.

4d. Frequency Coordination and Sharing

In the band 1240-1300 MHz hundreds of high-power long-range radar systems operate across the country. In some cases near large population centers with airports, multiple radars must operate in the same geographic area. Compatible operation between different types of radar systems is accomplished through careful design of the radar receivers, frequency selection, and NTIA spectrum standards. The radar receivers use various types of circuitry and signal processing to reduce or eliminate the effects of pulsed interference from other radars.[2] The careful assignment of frequencies for radars operating in this band is crucial to prevent interference to and from other radar systems. The FAA and DoD carefully choose and coordinate the frequencies of each of their systems that operate in this band. Radar systems that operate in the band 1240-1300 MHz with power levels above 1 kilowatt are expected to comply with the NTIA Radar Spectrum Engineering

[2] These techniques are not effective in mitigating the effects of interference from continuous signals such as those generated by communication systems as discussed in NTIA Report TR-06-444, *Effects of RF Interference on Radar Receivers* (September 2006) available at www.its.bldrdoc.gov/publications.

Criteria (RSEC) Category C.[3] The RSEC regulates how much bandwidth radars are permitted to use, based on the parameters of the transmitted pulses and the amount of unwanted or spurious emissions they emit.

The radars in the band 1240-1300 MHz may experience interference from the RNSS systems of other administrations as they launch satellites and become operational. This will place additional limitations on the spectrum available for the radar systems operating in this band.

[3] The RSEC standards are available in Chapter 5 National Telecommunications and Information Administration, Manual of Regulations and Procedures for Federal Radio Frequency Management.

4e. Spectrum Contours

The spectrum contours for the radars operating in the aeronautical radionavigation, and radiolocation, services have been computed for a generic ground-based communication receiver. The spectrum contours represent the locations where the power of the radar signal causes the thermal noise power of the generic receiver to increase by 1 dB.[4] These contours do not represent the coverage area of the radar; rather they represent the locations where the signal level of the radar system causes a generic receiver to exceed the interference threshold. Any receiver inside the contour would experience interference from the radar.

The spectrum contour plots for the radar systems operating in 5-MHz segments of the band 1240-1300 MHz are shown in Figure 1 through Figure 27.

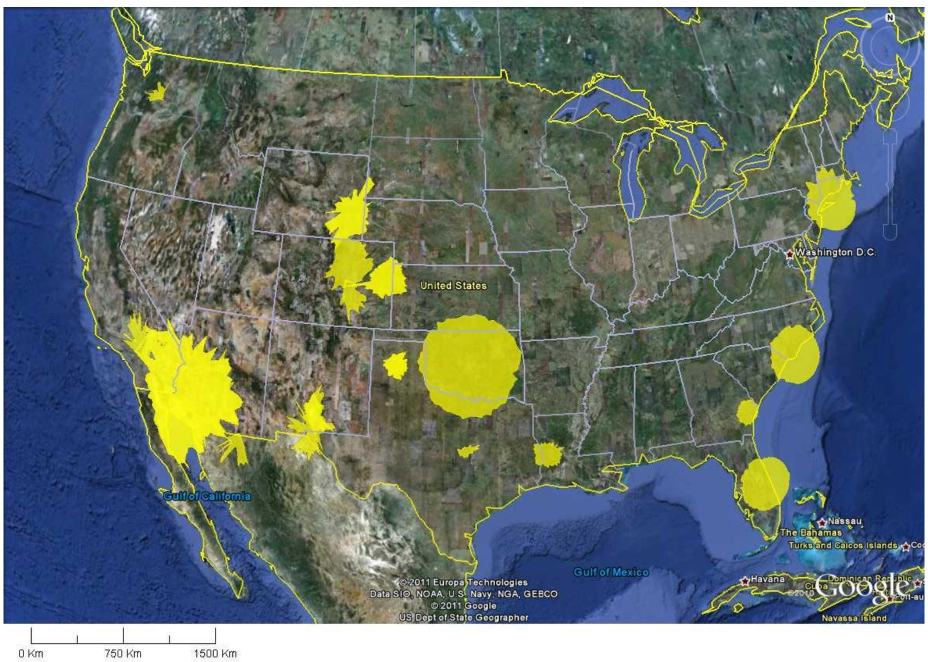


Figure 1. 1240 – 1245 MHz Band Segment

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[4] A 1 dB increase in receiver noise is equivalent to an interference-to-noise (I/N) ratio of -6 dB, which is a commonly used value for a first level interference threshold used in electromagnetic compatibility analyses.

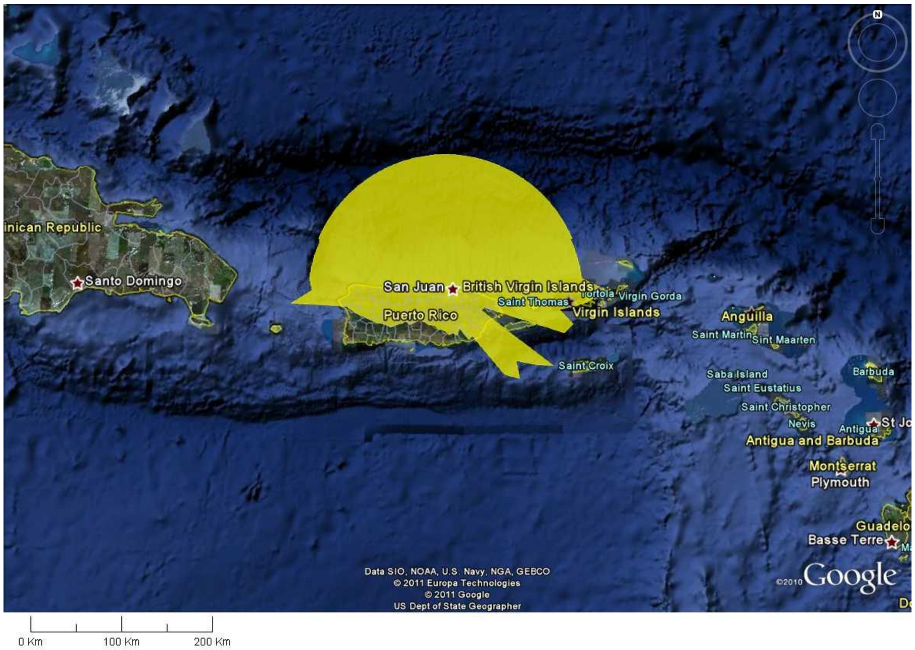

Figure 2. 1240-1245 MHz Band Segment

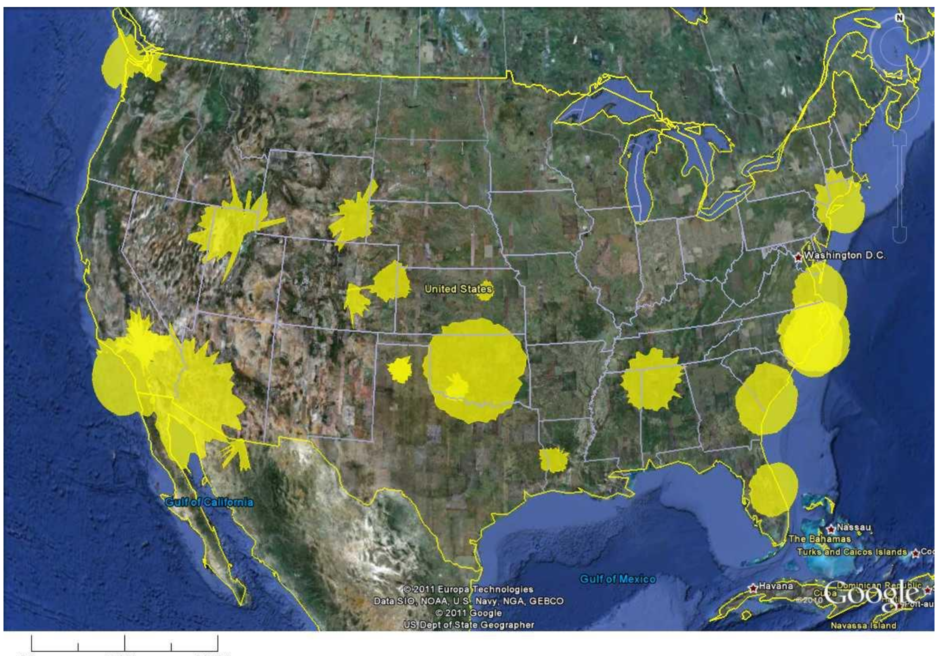

Figure 3. 1245-1250 MHz Band Segment

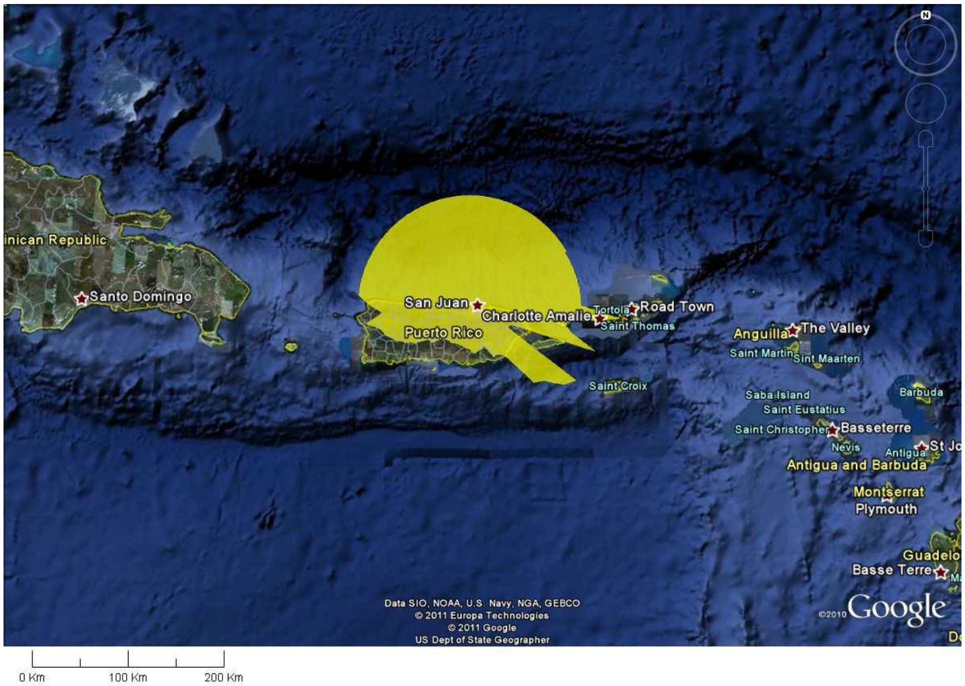

Figure 4. 1245-1250 MHz Band Segment

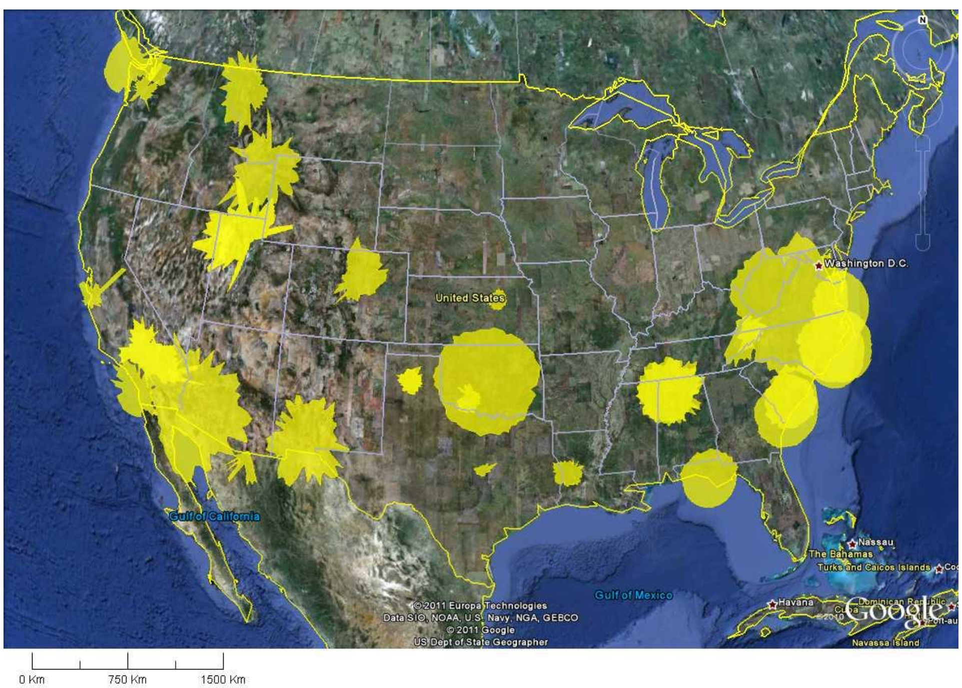

Figure 5. 1250-1255 MHz Band Segment

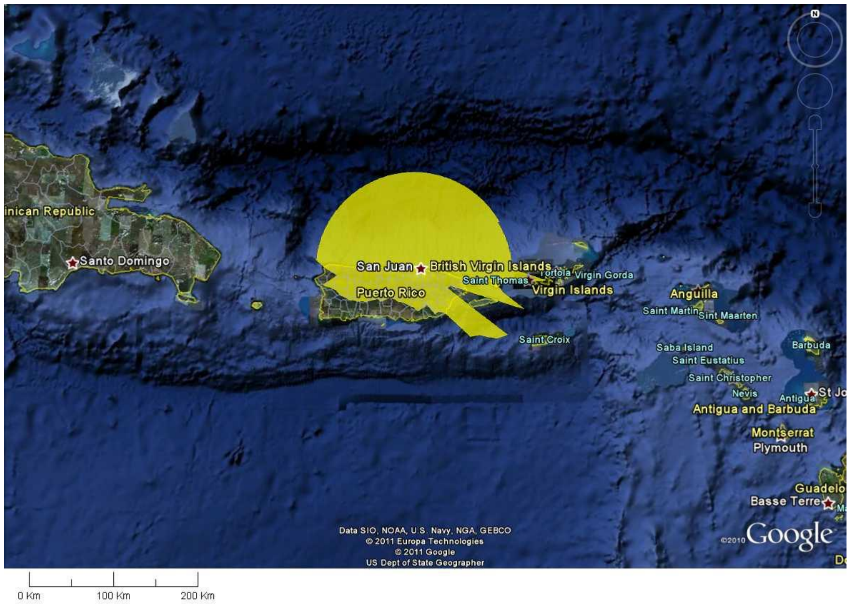

Figure 6. 1250-1255 MHz Band Segment

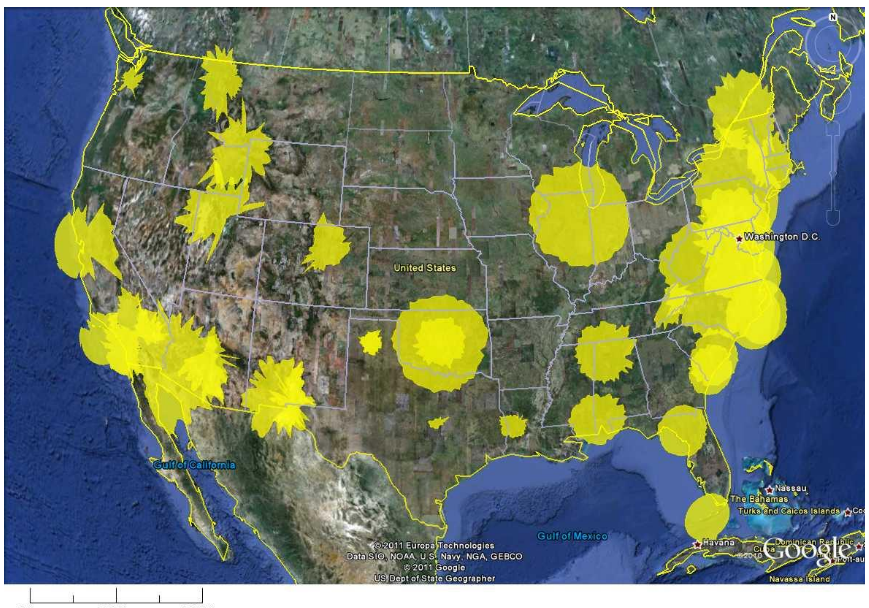

Figure 7. 1255-1260 MHz Band Segment

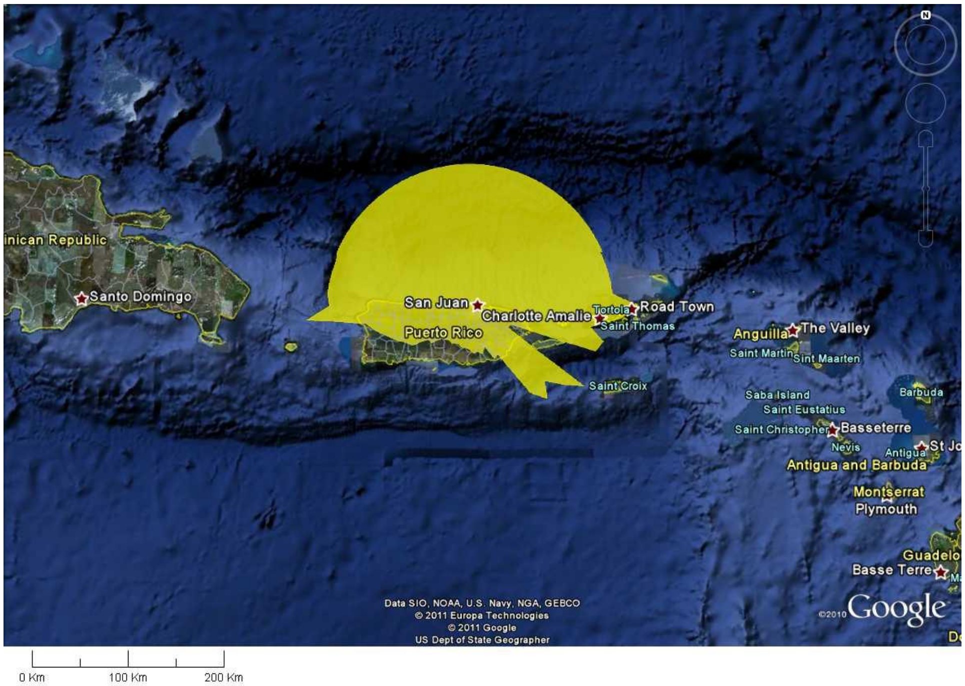

Figure 8. 1255-1260 MHz Band Segment

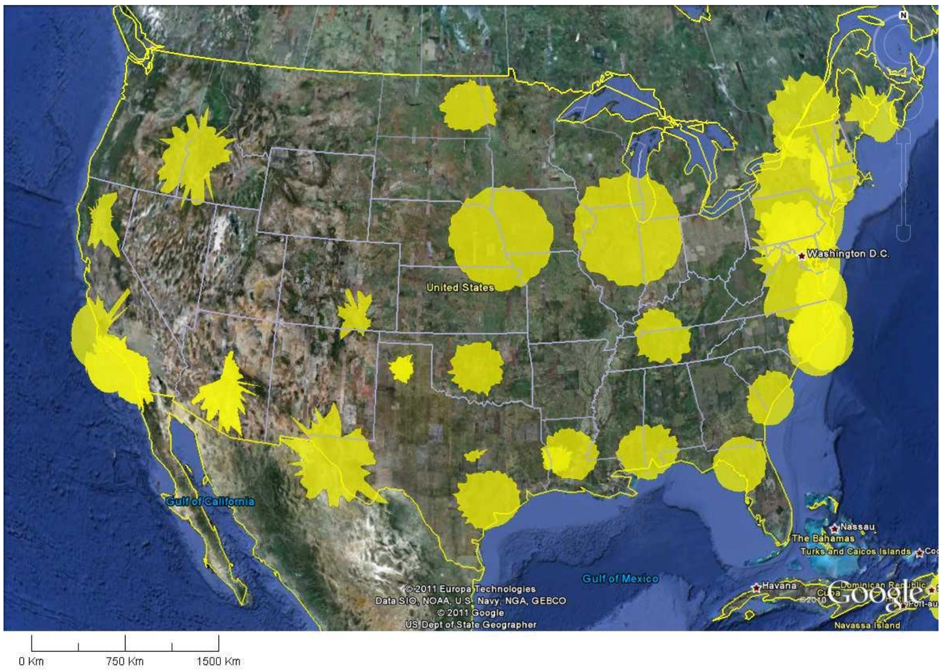

Figure 9. 1260-1265 MHz Band Segment

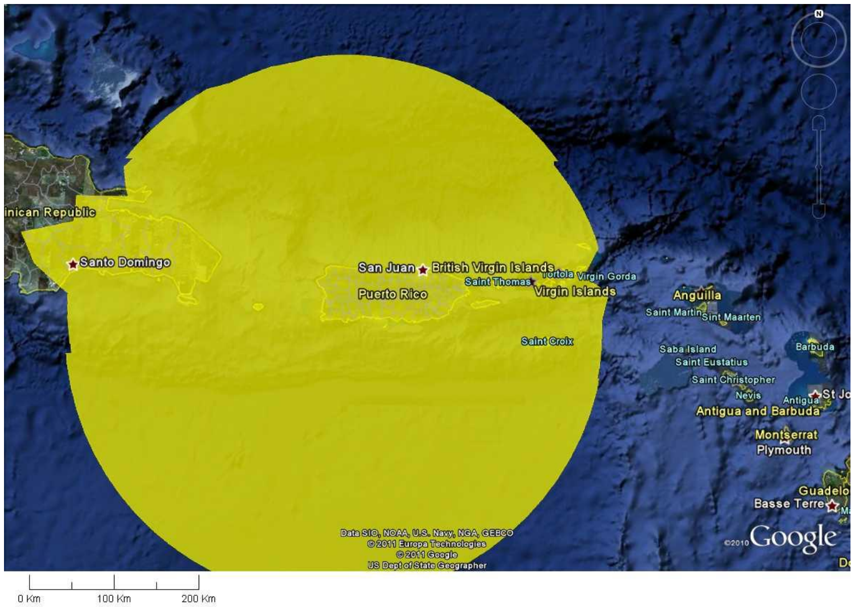

Figure 10. 1260-1265 MHz Band

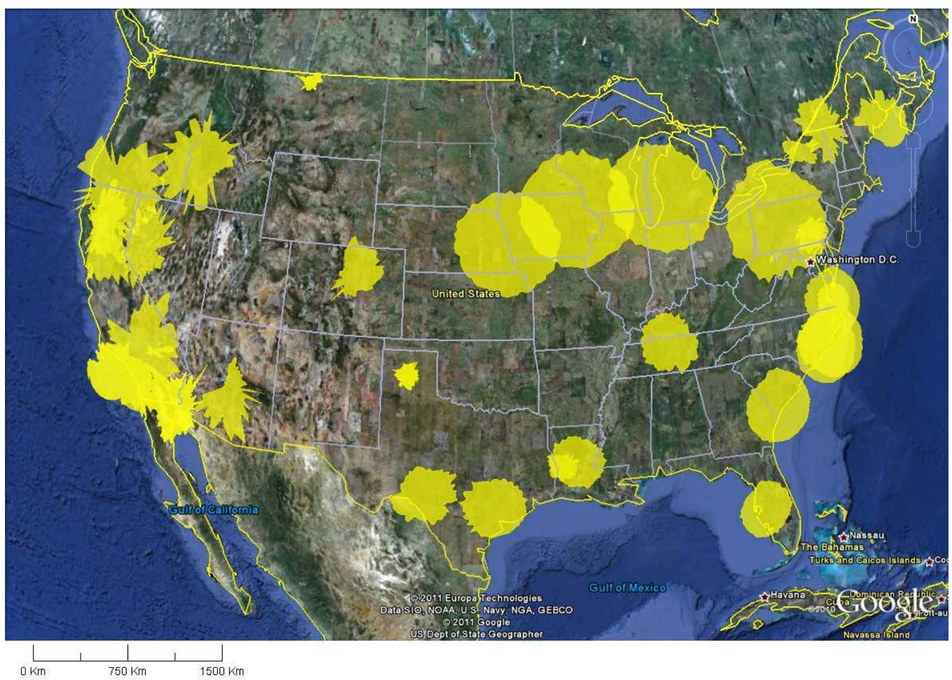

Figure 11. 1265-1270 MHz Band Segment

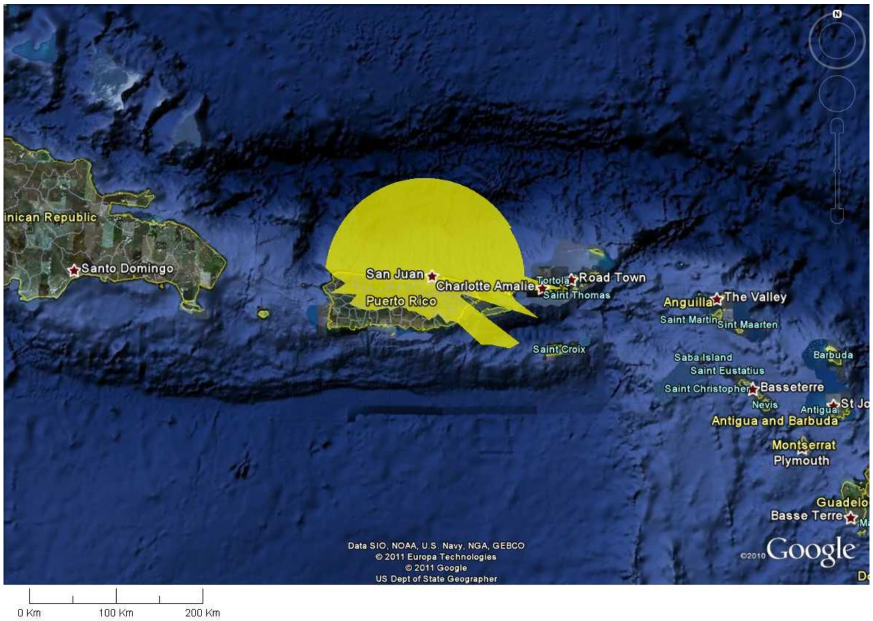

Figure 12. 1265-1270 MHz Band Segment

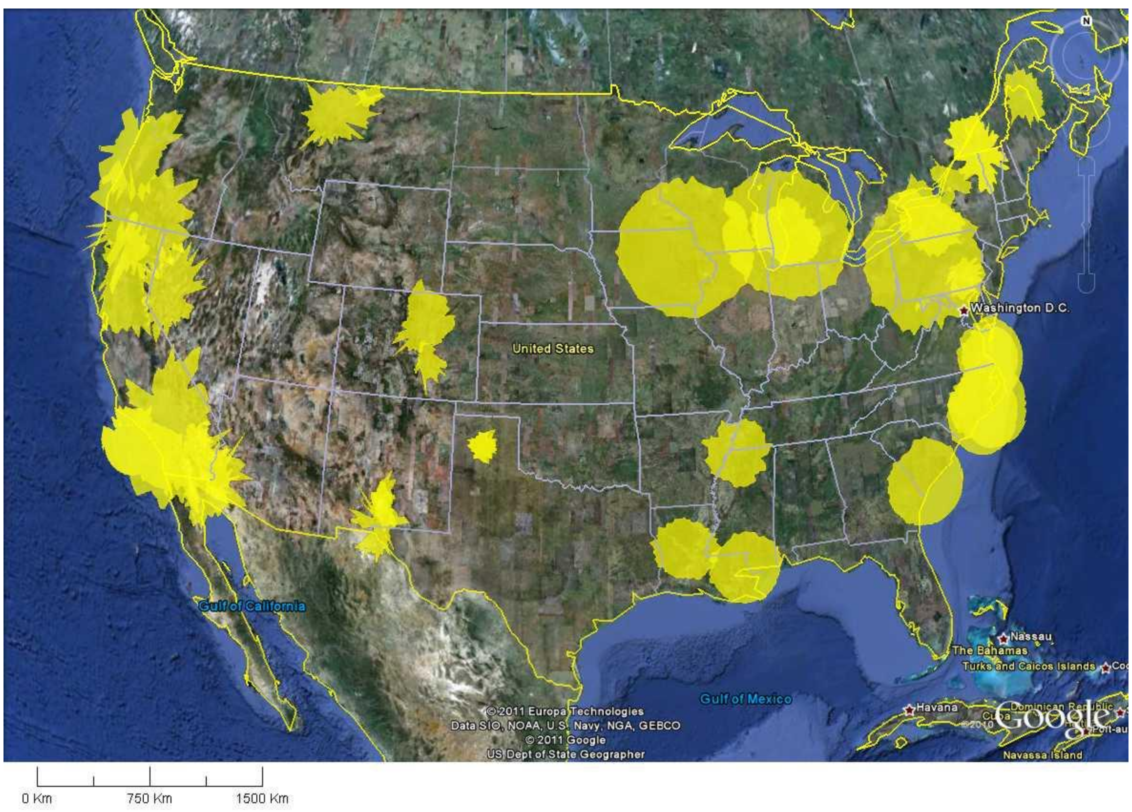

Figure 13. 1270-1275 MHz Band Segment

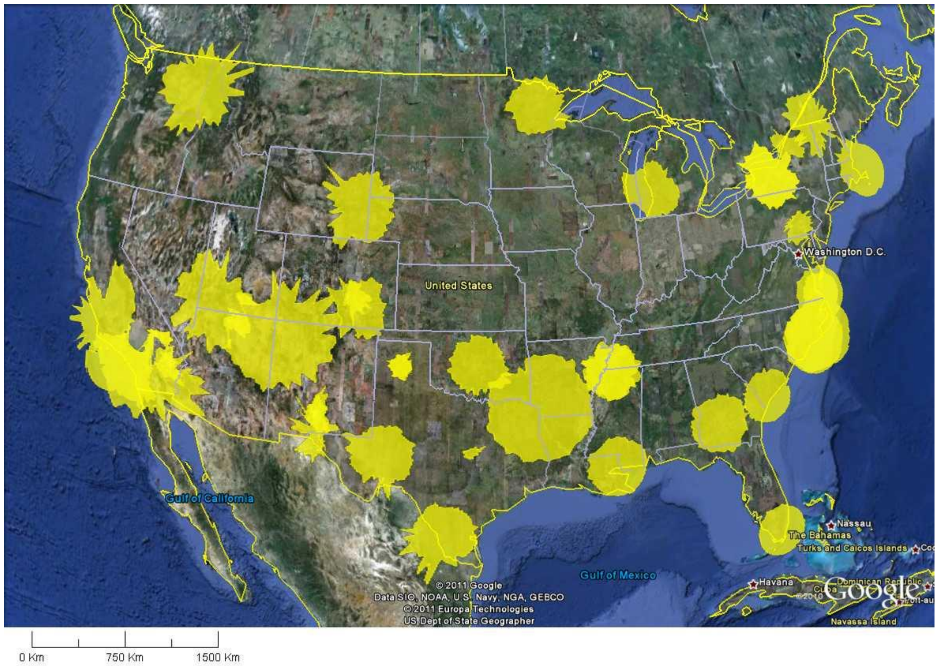

Figure 14. 1275-1280 MHz Band Segment

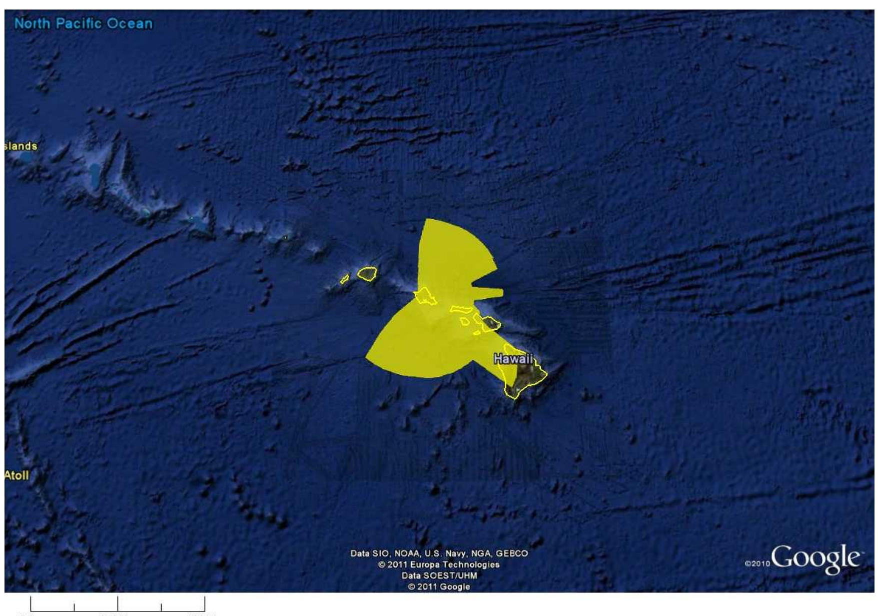

Figure 15. 1275-1280 MHz Band Segment

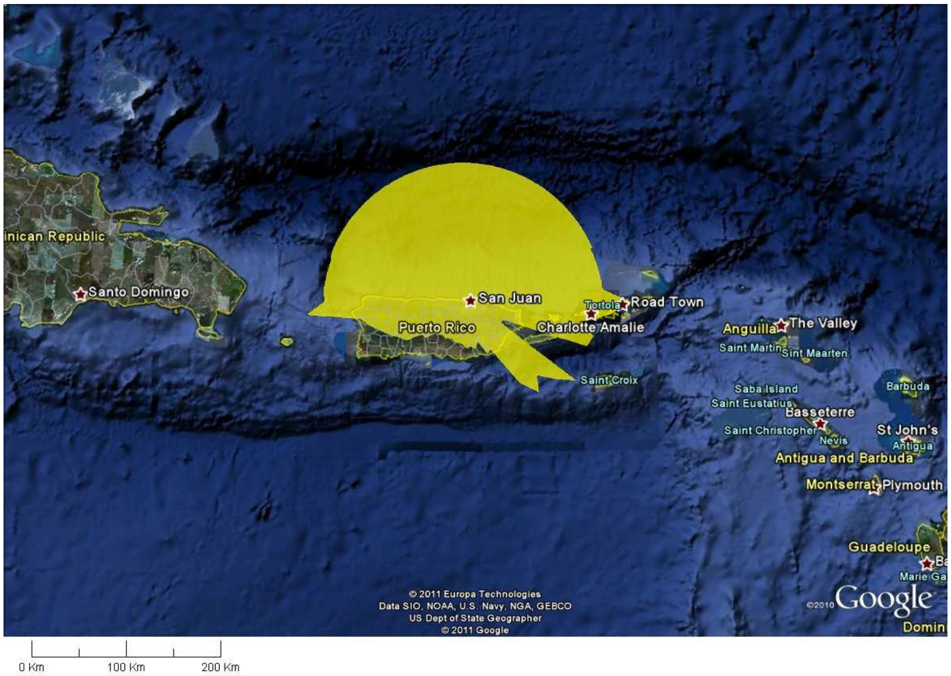

Figure 16. 1275-1280 MHz Band Segment

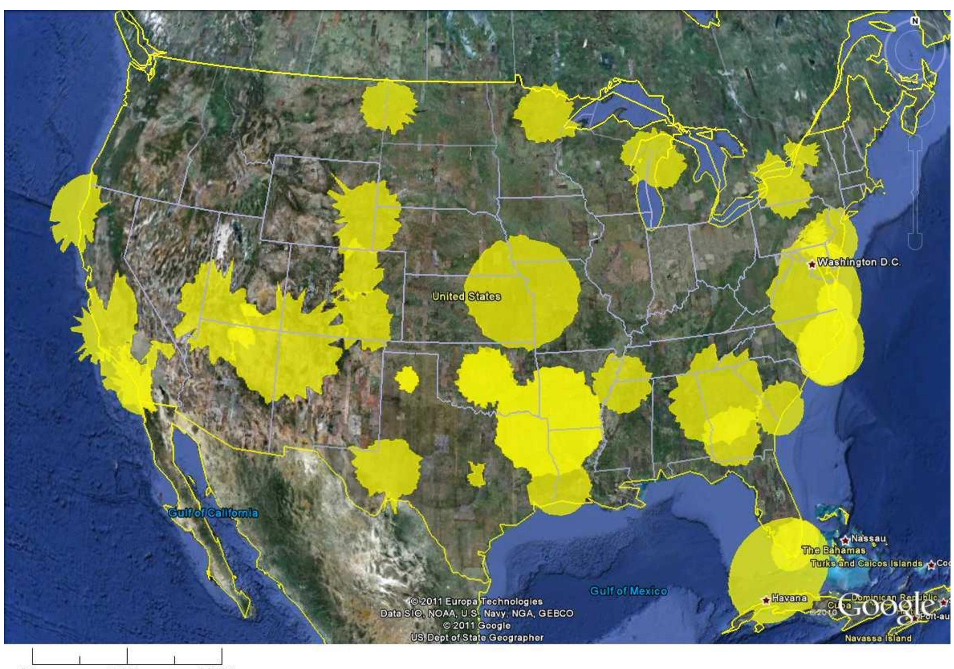

Figure 17. 1280-1285 MHz Band Segment

Figure 18. 1280-1285 MHz Band Segment

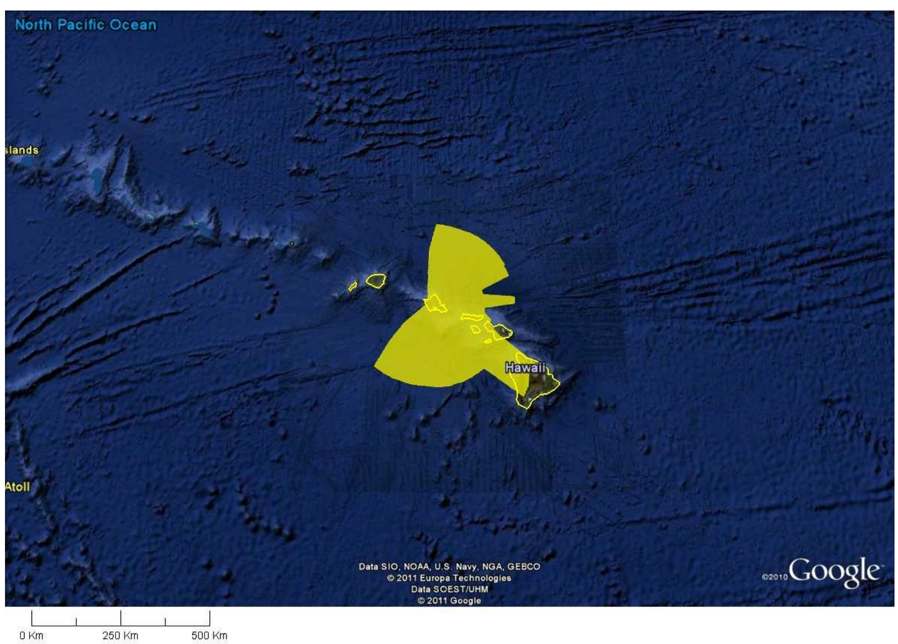

Figure 19. 1280-1285 MHz Band Segment

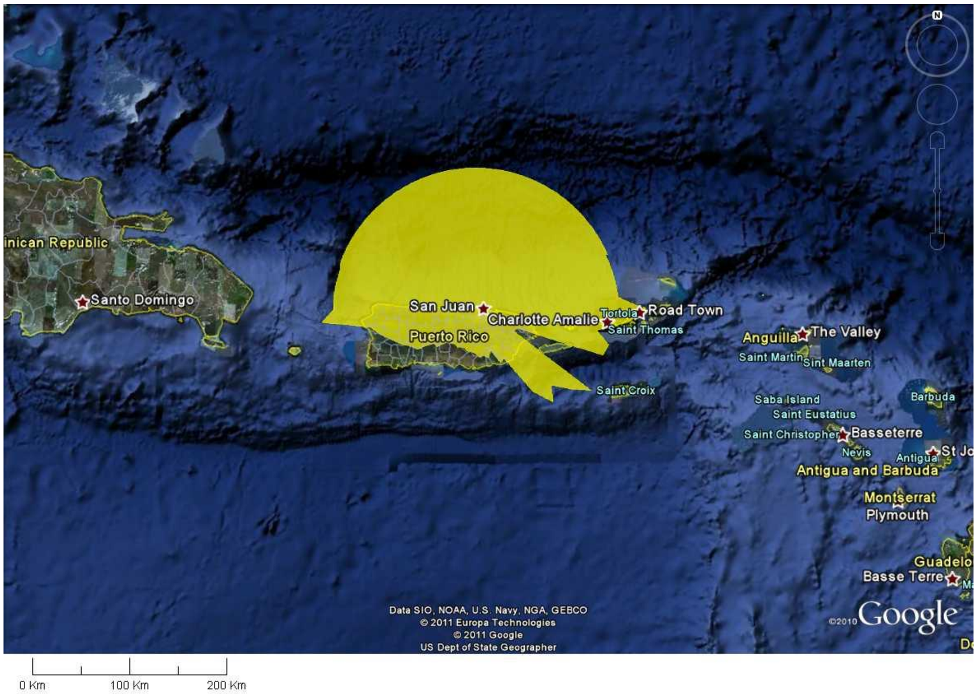

Figure 20. 1280-1285 MHz Band Segment

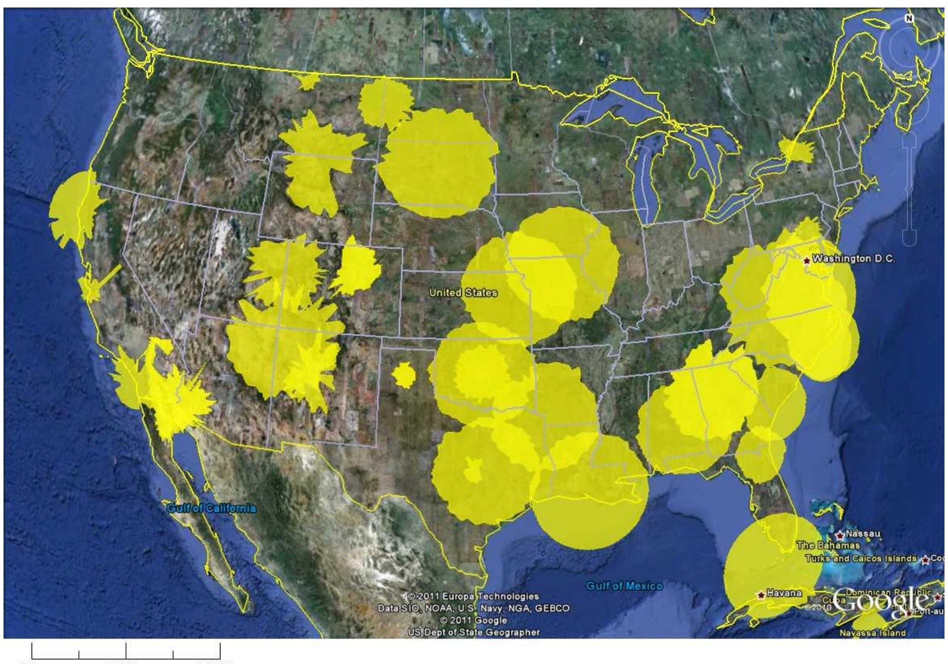

Figure 21. 1285-1290 MHz Band Segment

Figure 22. 1285-1290 MHz Band Segment

Figure 23. 1285-1290 MHz Band Segment

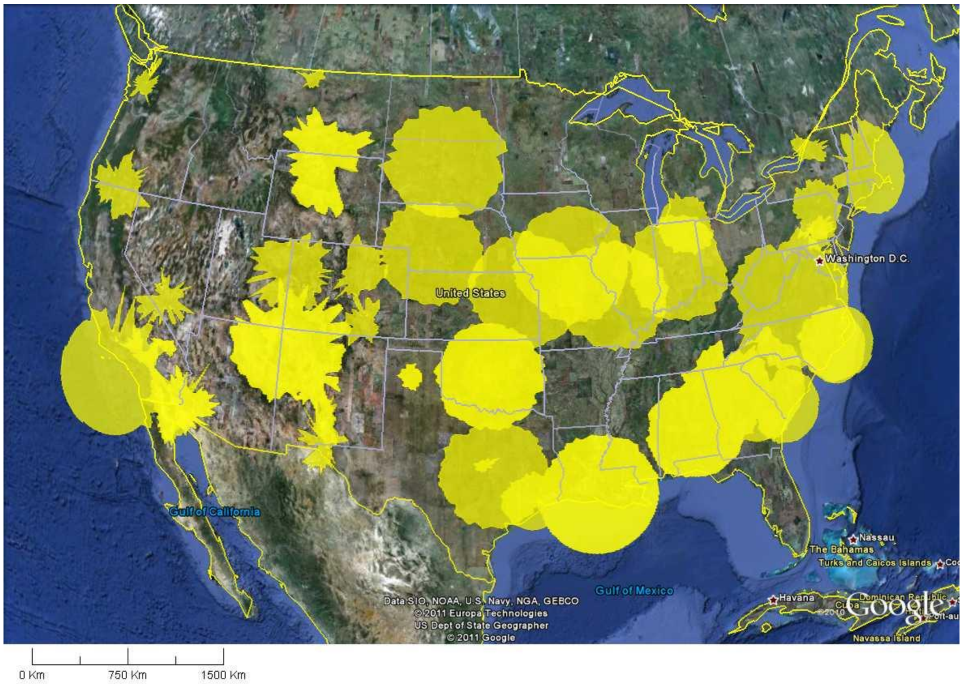

Figure 24. 1290-1295 MHz Band Segment

Figure 25. 1290-1295 MHz Band Segment

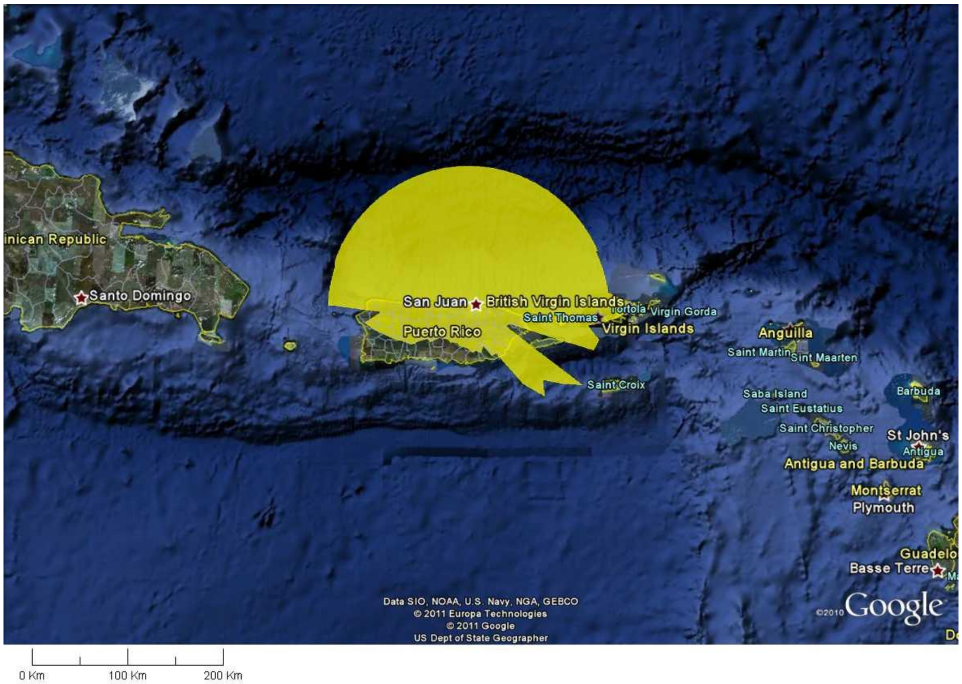

Figure 26. 1290-1295 MHz Band Segment

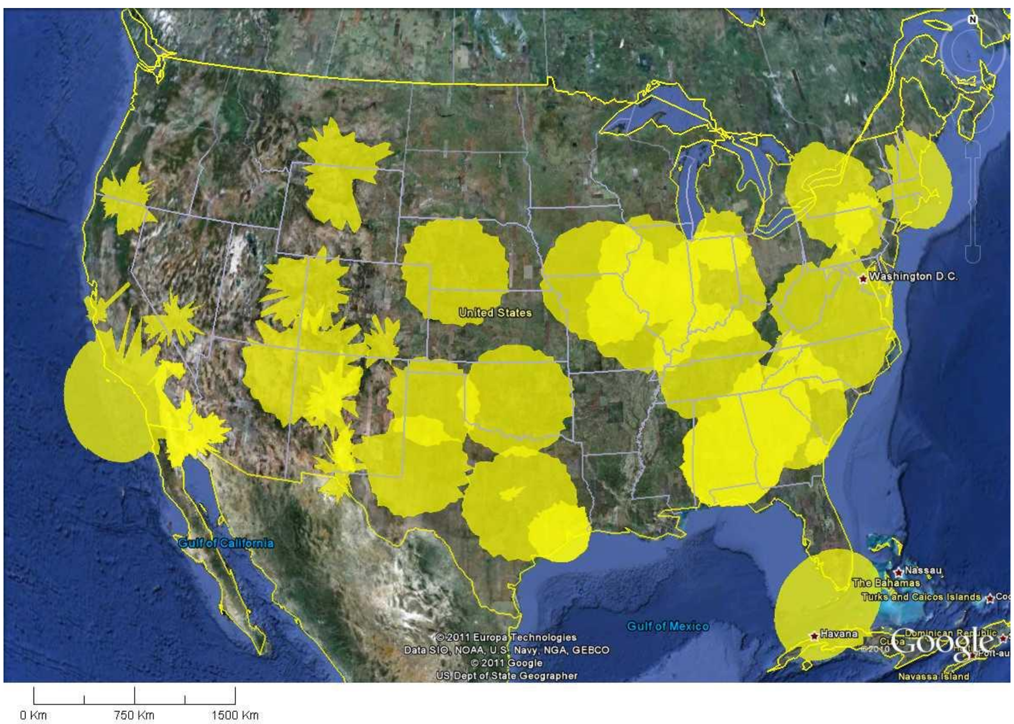

Figure 27. 1295-1300 MHz Band Segment

5. Planned Use

The Federal use of the band 1240-1300 MHz for the long-range radar systems will remain the same for the foreseeable future.

The federal agencies will continue to operate ATC and tactical long-range radar systems in the band 1240-1300 MHz for the foreseeable future.

At this time there are no new installations planned, however new radar sites could be added if the need arises to monitor additional airspace or other vital assets.