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NCJ 212975

## Radio Spectrum

### Key Points

- Radio communications use radio waves at different frequencies, grouped within bands, that are part of the radio spectrum.
- The Federal Communications Commission (FCC) regulates use of the non-Federal spectrum, including that used by State and local public safety agencies.
- The spectrum is an increasingly scarce resource, and public safety competes with commercial interests for this resource.
- Recent spectrum allocations include parts of the 700 MHz band (not always available) and 4.9 GHz band to help meet increasing public safety spectrum demand.
- Narrowband channels increase the efficiency of the current frequency spectrum.

### RADIO COMMUNICATIONS

**Radio wave:** the basic building block of radio communications. Like waves on a pond, a radio wave is a series of repeating peaks and valleys. The entire pattern of a wave, before it repeats itself, is called a cycle. The number of cycles, or times that a wave repeats in a second, is called frequency. Frequency is measured in the unit hertz (Hz), referring to a number of cycles per second. One thousand hertz is referred to as a kilohertz (kHz), 1 million hertz as a megahertz (MHz), and 1 billion hertz as a gigahertz (GHz).

**Radio spectrum:** the complete range of frequencies from approximately 30 kHz up to more than 300 GHz that can be used for radio communications. Frequencies are often grouped in ranges called bands. Bands of interest to public safety include HF (high frequency), VHF (very high frequency), UHF (ultra high frequency), and most recently SHF (super high frequency). Radio systems operating in the 806–824 MHz and 851–869 MHz portion of the

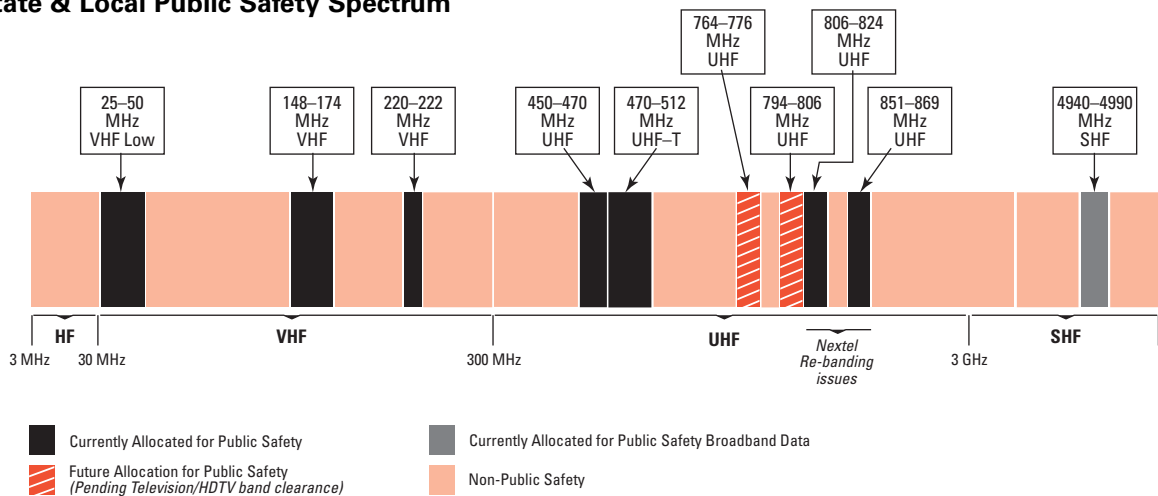
UHF band are often referred to as “800 MHz systems” and are distinguished from systems in the other parts of the UHF band. Frequencies above 1 GHz are often referred to as “microwave” bands. A radio wave is generated by a transmitter and then detected by a receiver. An antenna allows a radio transmitter to send energy into space and a receiver to pick up energy from space. Transmitters and receivers are typically designed to operate over a limited range of frequencies within a specific frequency band (or bands).

### SPECTRUM ALLOCATIONS/REGULATIONS

Spectrum allocations for State and local public safety are fragmented into many distinct slices of the radio spectrum. Regulation of specific frequencies for Federal agency use occurs within the National Telecommunications and Information Administration, while the FCC regulates the spectrum for non-Federal users. This spectrum is divided up as shown in the following chart.



## State & Local Public Safety Spectrum



**Changes/adjustments.** The aggregate amount of State and local public safety spectrum allocated within these bands is about 97 MHz and is subject to change pending resolution of re-banding issues in the 800 MHz band. Twenty-four MHz of the TV spectrum (channels 60–69) has been reallocated in the 700 MHz band. Users do not have access to this band, however, until local TV broadcasters relinquish these channels and their regional plans are approved by the FCC. An additional 50 MHz is also allocated for public safety broadband data applications in the 4.9 GHz band. Regional frequency planning is underway, standards are being developed,<sup>1</sup> and manufacturers are gearing up to produce equipment to operate in this new frequency band.

**Channels.** The FCC grants licenses for groupings of frequencies called channels. When the FCC licenses a channel, it authorizes a center frequency (or carrier frequency) and a maximum excursion from that frequency. Radio information is typically transmitted using frequencies contained within a single channel; older public safety radio systems typically use wideband 25 kHz channels.

### OUTLOOK

The FCC is reviewing a mandate directing that all public safety agencies must migrate to systems based on 12.5 kHz narrowband channels by some future date. The current target date is 2018, but the FCC's decision will affect new equipment and new systems at an earlier date. To avoid interference between systems using the same or adjacent frequencies, the FCC ensures that a channel is licensed

to only one user in a given area. As part of FCC licensing, an agency must first confirm availability of specific frequencies from an FCC-authorized public safety frequency coordinator,<sup>2</sup> a private entity that will confirm availability and provide assistance when evaluating frequency design issues.

### FOR MORE INFORMATION

- NIJ CommTech Web site:  
<http://www.ojp.usdoj.gov/nij/topics/commtech/>.
- Regional National Law Enforcement and Corrections Technology Centers:
  - Northeast (Rome, NY) 888-338-0584
  - Southeast (Charleston, SC) 800-292-4385
  - Rocky Mountain (Denver, CO) 800-416-8086
  - Western (El Segundo, CA) 888-548-1618
  - Northwest (Anchorage, AK) 866-569-2969
  - Rural Law Enforcement Technology Center  
866-787-2553

### NOTES

1. NPSTC, APCO, and other public safety organizations are working toward establishing both technical (TIA 8.8) and operational standards for the 4.9 GHz band. For more information, see <http://www.tiaonline.org/standards/sfg/scope.cfm#TR-8.8> and [www.npstc.org](http://www.npstc.org).
2. There are four authorized public safety frequency coordination organizations. A list of approved coordinators can be found at the FCC Wireless Telecommunications Bureau Web site: <http://wireless.fcc.gov/publicsafety/coord.html>.



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