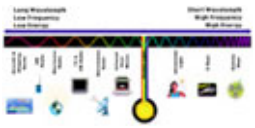

Courtesy of
NASA Imagine the Universe

Source
http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html

Although all electromagnetic waves are identical in nature, to observe every type of radiation in the EM spectrum a wide range of instruments is required, as shown in this diagram.

Radio/Microwave Spectrum

Radio astronomers rely on the lower energy end of the EM spectrum, where the wave range in lengths from kilometers to centimeters—and in some cases to slightly less than millimeters (called submilliter). These waves are often referred to as radio and microwaves. When they are used to probe distance objects by echo location techniques, they are also called radar, which is an acronym for "radio detection and ranging."

The radio/microwave spectrum is arbitrarily divided into various categories according to frequency range.

Frequency	Name	Application
3-300 Hz	Extremely Low Frequency (ELF)	telegraph, teletypewriter
300-3kHz	Voice Frequency (VF)	telephone circuitry
3kHz-30kHz	Very Low Frequency (VLF)	high fidelity
30kHz-300kHz	Low Frequency (LF)	maritime mobile, navigational radio broadcast
300kHz-3MHz	Medium Frequency (MF)	land and maritime radio broadcast / AM radio (550 kHz -1600 kHz)

3MHz-30MHz	High Frequency (HF)	amateur radio/ maritime and aeronautical mobile
30MHz-300MHz	Very High Frequency (VHF)	maritime and aeronautical mobile/ amateur radio, TV broadcast, Meteorological communication/ FM: (88MHz - 108 MHz)
300MHz-3GHz	Ultrahigh Frequency (UHF)	TV, military, long-range radar
3GHz-30GHz	Superhigh Frequency (SHF)	space, satellite and microwave communication
30GHz--300GHz	Extremely High Frequency (EHF)	radio astronomy, radar

Microwave oven uses about 12cm wavelength. Microwave communication is good to about 30 km line-of-sight.

Radio Broadcast bands: AM: 550 kHz - 1600 kHz
FM: 88MHz - 108 MHz

While AM signals reflect off the ionosphere, FM waves does not. As a result, AM stations can be detected farther away than FM stations. The tradeoff is that FM signals are stronger since they doesn't modulate in amplitude (power) like AM signals do. As its name implies, FM modulates frequency while keeping amplitude (power) at its maximum.

RADAR

Doppler radar can be divided into several different categories according to the wavelength of the radar. The different bands are L, S, C, X and K. Radar designations originate from the days of WWII.

Band Designation	Frequency Range	Typical Usage
VHF	50-330 MHz	Very long-range surveillance
UHF	300-1,000 MHz	Very long-range surveillance
L	1-2 GHz	Long-range surveillance, enroute traffic control
S	2-4 GHz	Moderate-range surveillance, terminal traffic control, long-range weather
C	4-8 GHz	Long-range tracking, airborne weather
X	8-12 GHz	Short-range tracking, missile guidance, mapping, marine radar, airborne intercept
Ku	12-18 GHz	High resolution mapping, satellite altimetry
K	18-27 GHz	Little used (H_20 absorption)
Ka	27-40 GHz	Very high resolution mapping, airport surveillance
m m	40-100+ GHz	Experimental

(Source: http://www.aewa.org/Library/rf_bands.html)
from AIAA (American Institute of Aeronautics and Astronautics)

L band radars operate on a wavelength of 15-30 cm and a frequency of 1-2 GHz. L band radars are mostly used for clear air turbulence studies.

S band radars operate on a wavelength of 8-15 cm and a frequency of 2-4 GHz. Because of the wavelength and frequency, S band radars are not easily attenuated. This makes them useful for near and far range weather observation. The National Weather Service (NWS) uses S band radars on a wavelength of just over 10 cm. The drawback to this band of radar is that it requires a large antenna dish and a large motor to power it. It is not uncommon for a S band dish to exceed 25 feet in size.

C band radars operate on a wavelength of 4-8 cm and a frequency of 4-8 GHz. Because of the wavelength and frequency, the dish size does not need to be very large. This makes C band radars affordable for TV stations. The signal is more easily attenuated, so this type of radar is best used for short range weather observation. Also, due to the small size of the radar, it can therefore be portable like the University of Oklahoma's Doppler on Wheels. (DOW) The frequency allows C band radars to create a smaller beam width using a smaller dish. C band radars also do not require as much power as an S band radar. The NWS transmits at 750,000 watts of power for their S band, where as a private TV station such as KCCI-TV in Des Moines only broadcasts at 270,000 watts of power with their C band radar.

X band radars operate on a wavelength of 2.5-4 cm and a frequency of 8-12 GHz. Because of the smaller wavelength, the X band radar is more sensitive and can detect smaller particles. These radars are used for studies on cloud development because they can detect the tiny water particles and also used to detect light precipitation such as snow.. X band radars also attenuate very easily, so they are used for only very short range weather observation. Most major airplanes are equipped with an X band radar to pick up turbulence and other weather phenomenon. This band is also shared with some police speed radars and some space radars.

K band radars operate on a wavelength of .75-1.2 cm or 1.7-2.5 cm and a corresponding frequency of 27-40 GHz and 12-18 GHz. This band is split down the middle due to a strong absorption line in water vapor. This band is similar to the X band but is just more sensitive. This band also shares space with police radars.

(Source: http://www.everythingweather.com/weather-radar/bands.shtml)

The **Experimental** microwave band is further designated by the following scheme:

Band Designation	Frequency (GHz)
Q	36 - 46
V	46 - 56
W	56 - 100

In addition, the frequency range 40 - 60 GHz is sometimes referred to as band U.

(Source: http://www.eec.com.tw/e-micro.htm)