

# What is RF and how we utilize it!

Kit Carson Electric  
Kit Carson Internet  
Revision IV

# Definition of RF (Radio Frequency) and exposure limits

- ▶ Radio frequency (RF) refers to the rate of oscillation of electromagnetic radio waves in the range of 3 kHz to 300 GHz, as well as the alternating currents carrying the radio signals. This is the frequency band that is used for communications transmission and broadcasting. Although RF really stands for the rate of oscillation of the waves, it is synonymous to the term "radio," or simply wireless communication. [www.techopedia.com](http://www.techopedia.com)
- ▶ The IEEE standard has exposure limits for electric fields and magnetic fields that are whole-body and time averaged. Limits are expressed in terms of Maximum Permissible Exposure (MPE). MPE limits for the magnetic field are relaxed below 100 MHz since the exposure limits at lower frequencies are based on electrostimulation rather than body heating, and both induced and contact currents are related to the strength of the electric field. There are also limits for induced currents and contact currents. [www.IEEE.org](http://www.IEEE.org)

**MPE Limits for Controlled Environments**

Frequency (MHz)	Power Density (W/m <sup>2</sup> )
0.1–1.0	9,000
1.0–30	9,000/f <sup>2</sup>
30–300	10
300–3,000	f/30
3,000–300,000	100

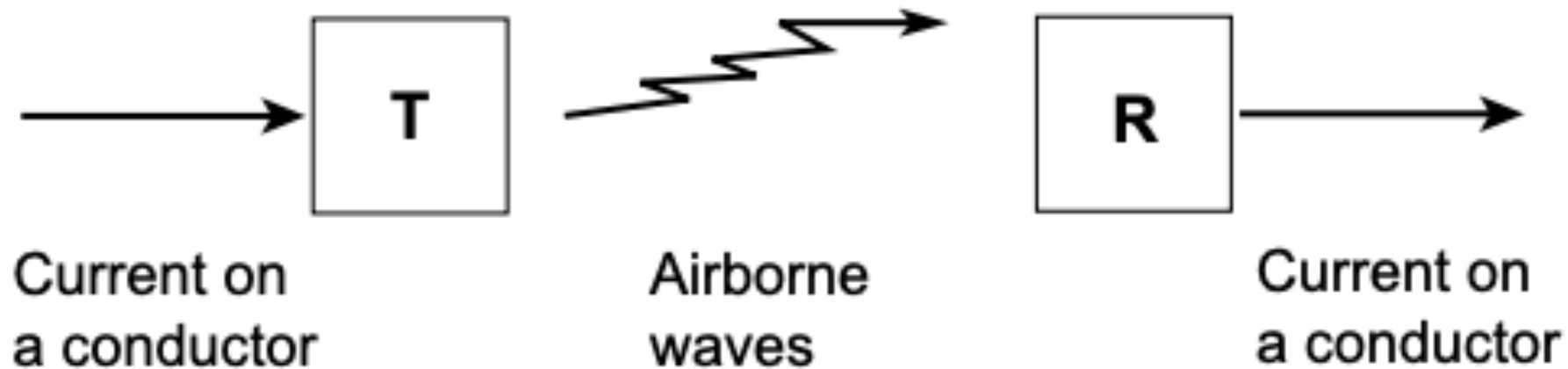
**MPE Limits for Uncontrolled Environments**

Frequency (MHz)	Power Density (W/m <sup>2</sup> )
0.1–1.34	1,000
1.34–30	1,800/f <sup>2</sup>
30–400	2.0
400–2,000	f/200
2,000–100,000	10
100,000–300,000	Increases from 10 to 100

# What a standard home would contain with RF.

- ▶ Wireless Router (2.4 Ghz-5Ghz)(50,000 microwatts)
- ▶ Radio (FM is 87.9 to 107.9 Mhz)(AM 540-1600 Khz)
- ▶ 1-2 Wireless Phone (900Mhz)
- ▶ Cellular Phone's (3G 2100 Mhz, 4G 1800Mhz)
- ▶ Wireless Computers, and Wireless Accessories (2.4Ghz - 5Ghz)
- ▶ I-Pad/Kindle/Android Tablet
- ▶ Smart Televisions
- ▶ Wireless Headphones (Bluetooth)
- ▶ Wireless Camera's
- ▶ Smart Thermostat
- ▶ Wireless Speakers (Bluetooth)
- ▶ Remote Controls
- ▶ Smart appliances
- ▶ Roku/Fire Sticks/Streaming Device (\*wireless only)
- ▶ Smart Meter (900 Mhz)
- ▶ Baby Monitors (100,000 microwatts)
- ▶ Microwave (2.45 Ghz)

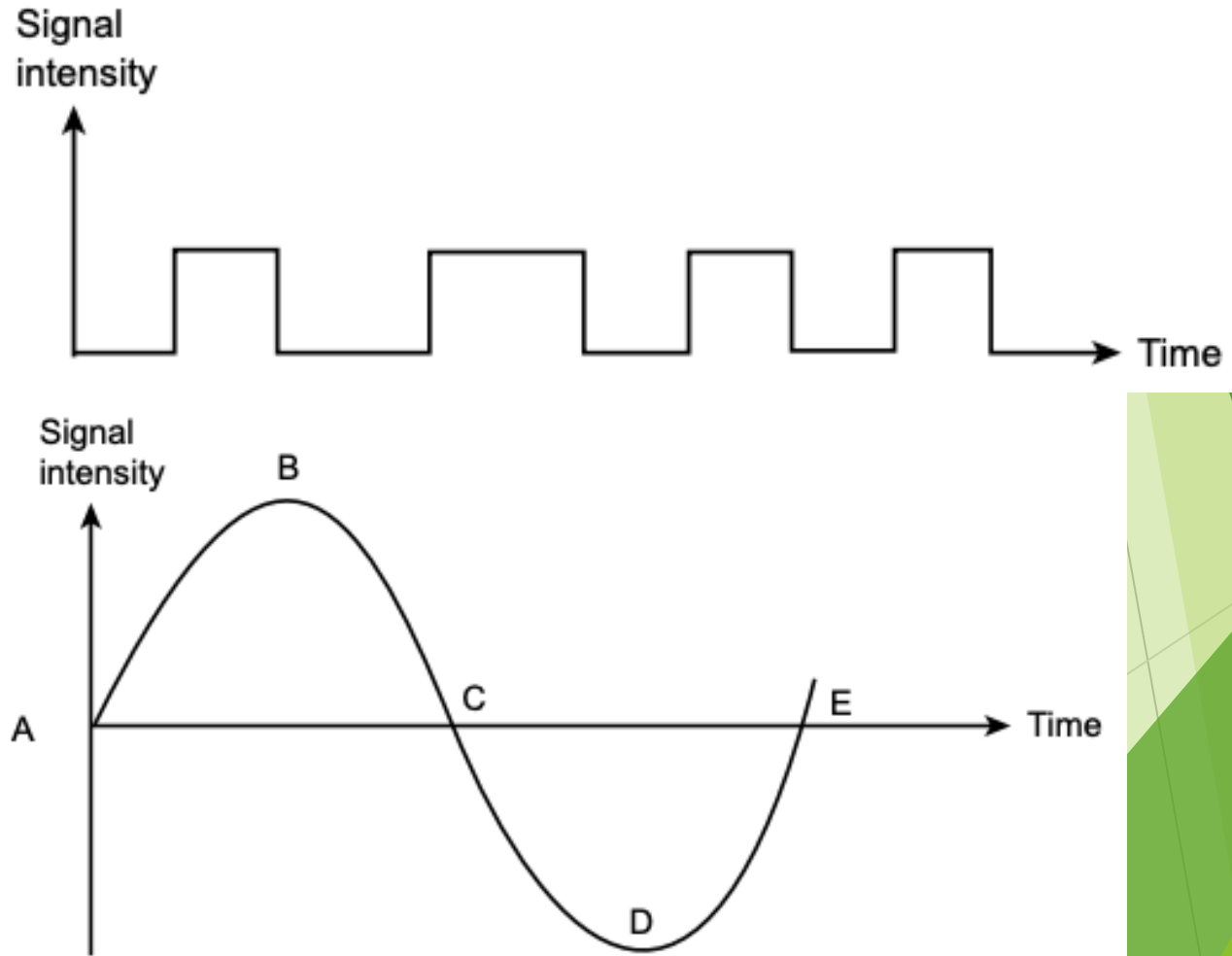
# Basic concept of a wireless connection



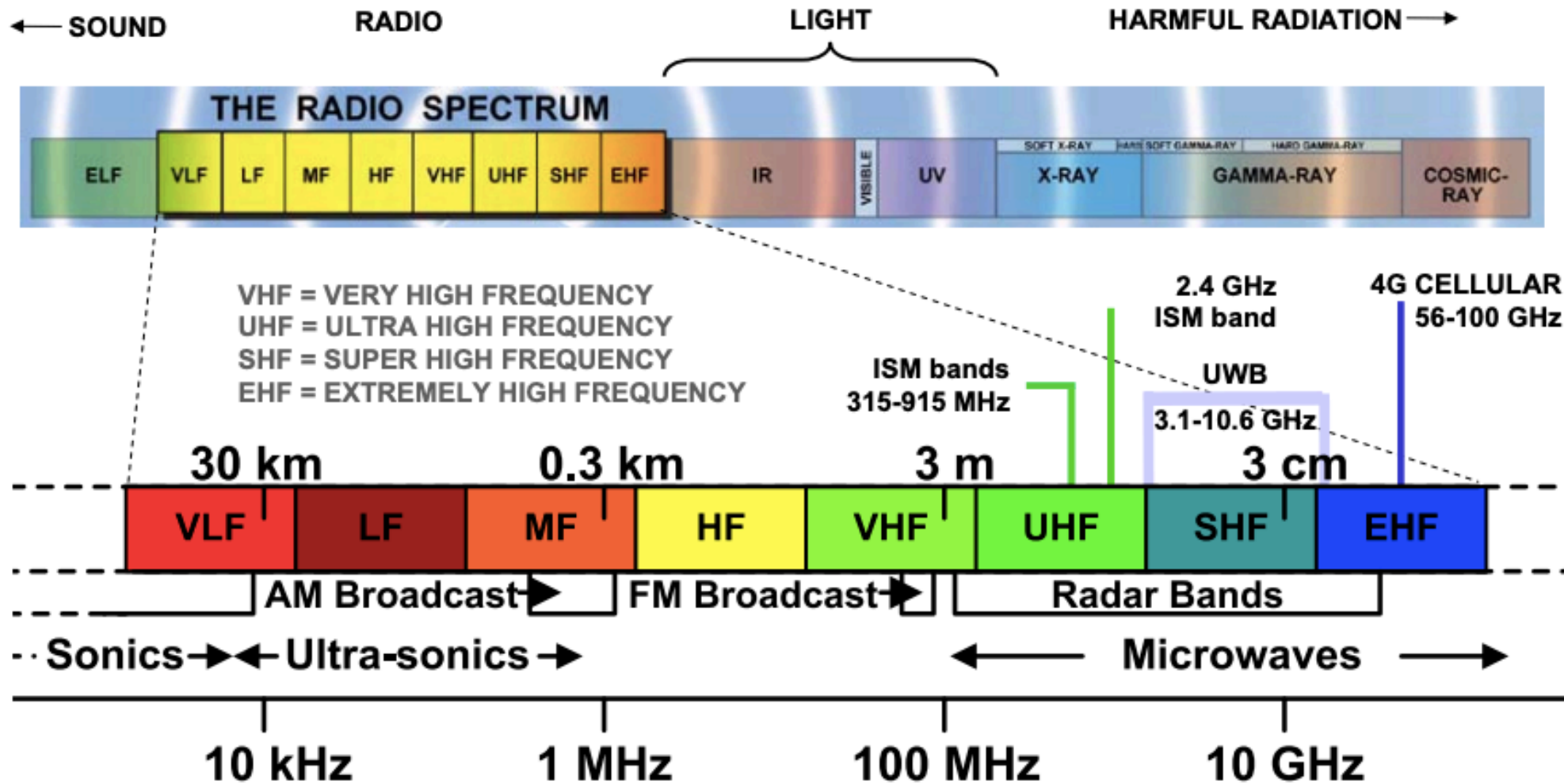
Electrical energy moves from place to place in one of two ways. It either flows as current along a conductor, or it travels in the air as invisible waves. In a typical wireless system, the electrical energy starts out as current flowing along a conductor, gets changed into waves traveling in the air, and then gets changed back into current flowing along a conductor again.

# Digital Signal and Analog Signal

The concept of frequency is key to understanding RF, because all RF is frequency-dependent. That is, it can distinguish between two different signals solely on the basis of their different frequencies. Frequency is what separates one RF signal from another and it is what distinguishes one wireless application from another. Digital signal is up and down and no signal in between. Analog signal is the motion flowing in a sine wave from A through E on the diagram and that represents a full cycle.



# Electromagnetic Spectrum



**ISM** = Industrial, Scientific and Medical  
**UWB** = Ultra Wide Band

Source: [JSC.MIL](http://JSC.MIL)

# Typical RF Exposure Values

Smart Meter  
900 MHz radio



Baby Monitor  
7 x greater



Wii Remote Controller  
30 x greater



Nintendo DS with WiFi  
180 x greater



WiFi Access Point  
400 x greater



Cordless Phone  
1,000 x greater



Cell Phone  
1,000 - 10,000 x greater



# Why is this technology becoming important to us all.



The average passenger vehicle emits about 404 grams of CO<sub>2</sub> per mile. The smart meter allows Utility companies to eliminate a portion of their fleet and reduce their carbon foot print.



Efficiency with real time reading and data. Smart meters and data transmitting allow the utilities to operate efficiently and allow minimal down time, proper load balancing in turn becomes less money wasted.



Communications for all America. This world is becoming the right know generation. Everything is in reach from your fingertips. Tele-health, Education, Economics, etc.



# What is 5G?

- ▶ The G in this 5G means it's a generation of wireless technology. While most generations have technically been defined by their data transmission speeds, each has also been marked by a break in encoding methods, or "air interfaces," that make it incompatible with the previous generation.
- ▶ 1G was analog cellular. 2G technologies, such as CDMA, GSM, and TDMA, were the first generation of digital cellular technologies. 3G technologies, such as EVDO, HSPA, and UMTS, brought speeds from 200kbps to a few megabits per second. 4G technologies, such as WiMAX and LTE, were the next incompatible leap forward, and they are now scaling up to hundreds of megabits and even gigabit-level speeds
- ▶ 5G brings three new aspects to the table: greater speed (to move more data), lower latency (to be more responsive), and the ability to connect a lot more devices at once (for sensors and smart devices).
- ▶ The actual 5G radio system, known as 5G-NR, isn't compatible with 4G. But all 5G devices in the US, to start, will need 4G because they'll lean on it to make initial connections before trading up to 5G where it's available. That's technically known as a "non standalone," or NSA, network. Later, our 5G networks will become "standalone," or SA, not requiring 4G coverage to work.

# More Information:



Federal Communication Commission [www.FCC.gov](http://www.FCC.gov)



Utilities Technology Commission [www.UTC.org](http://www.UTC.org)



National Rural Electric Cooperative Association  
[www.electric.coop](http://www.electric.coop)



Institute of Electrical & Electronics Engineers [www.IEEE.org](http://www.IEEE.org)



American National Standards Institute [www.ANSI.org](http://www.ANSI.org)



International Electrotechnical Commission [www.IEC.ch](http://www.IEC.ch)



European Telecommunications Standards Institute  
[www.ETSI.org](http://www.ETSI.org)

## Can smart meters effect you?

- ▶ Smart meters give off RF radiation. RF radiation is low-energy radiation. RF radiation doesn't have enough energy to remove charged particles such as electrons (ionize), and so is called non-ionizing radiation. Non-ionizing radiation has enough energy to move atoms in a molecule around or cause them to vibrate, which can lead to heat but it can't damage DNA directly.
- ▶ It would be nearly impossible to conduct a study to prove or disprove a link between living in a house with smart meters and cancer because people have so many sources of exposure to RF and the level of exposure from this source is so small. The amount of RF radiation you could be exposed to from a smart meter is much less than what you could be exposed to from a cell phone.
- ▶ American Cancer Society    [www.cancer.org](http://www.cancer.org)

## ▶ In conclusion...

- ▶ Smart meters do not produce any negative health impacts. They emit a low level of radio frequency energy that is both FCC-approved and lower than the level of RF energy emitted by many other devices that are used daily by millions of people. At most, smart meters transmit radio frequency energy for only a few minutes each day, and that energy is reduced further by surrounding materials. Smart meters are a very important step to improving the delivery of electricity for consumers. They will give you more insight into your energy usage and more control over your energy expenditures. Most importantly, smart meters will help create a more efficient, more reliable, and more sustainable electricity world for generations to come.
- ▶ <http://www.whatissmartgrid.org>
- ▶ They operate at levels much lower than the maximum permissible exposure limits for RF and communicate back to the utility via spread spectrum RF between 902-928 MHz. This does not require 5G technology to operate.
- ▶ Kit Carson Electric/Internet own and manage a large Fiber Optic network that has the ability to strategically place access points and allow two way communications to our current smart meters. We have done so to eliminate all unnecessary equipment.