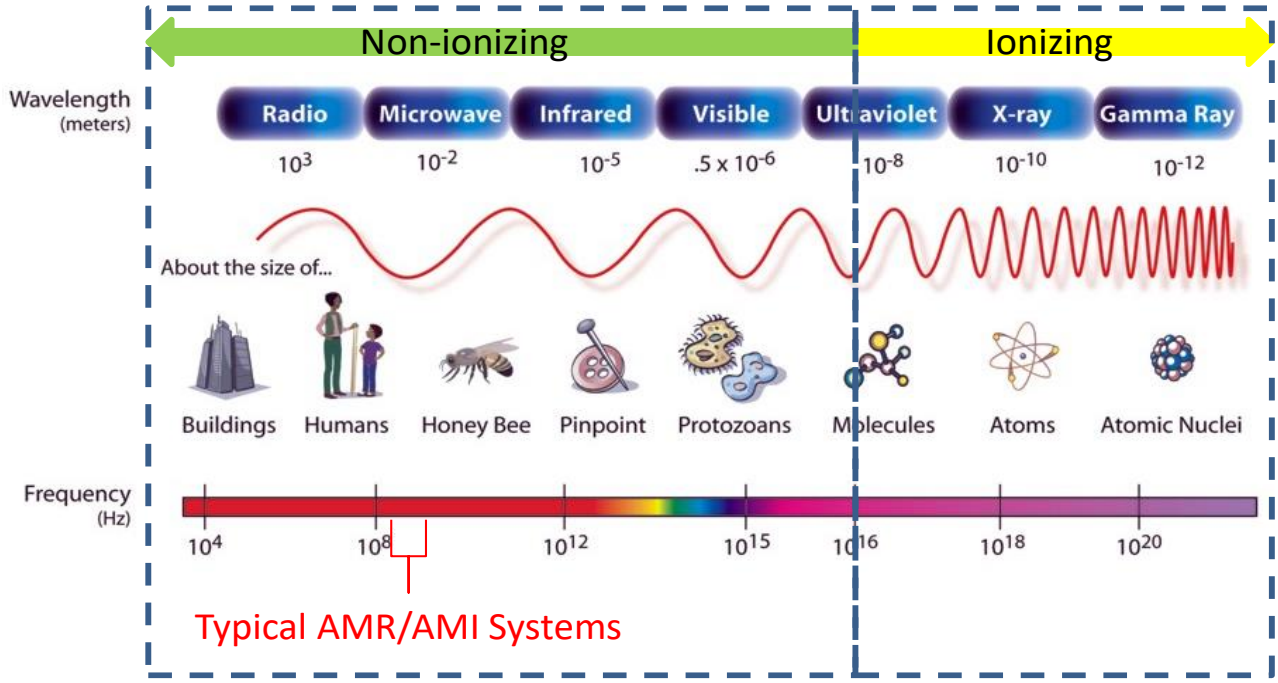
R900® Radio Frequency (RF) Explained

It should be noted that over120 million radio frequency devices have been installed in the past 5 years in North America to gather usage data from water, gas and electricity meters. Utilities of all sizes and types have realized the operational and customer service benefits of automating their data collection processes.

Within the passage below we have identified various items that many households today have that are either within or above the identified bandwidth.

Radio frequencies are part of a broad range of energy phenomena called the “electromagnetic spectrum.” Everything in the electromagnetic spectrum consists of waves of energy that are measured in terms of their frequency and magnitude. The electromagnetic spectrum includes not only radio waves but also visible light.

The diagram below illustrates the different types of waves that make up the electromagnetic spectrum1. As the diagram shows, the electromagnetic spectrum is often subdivided into two categories: ionizing radiation and non-ionizing radiation.



The EPA provides the following definitions:

> Radiation that has enough energy to move atoms in a molecule around or cause them to vibrate, but not enough to remove electrons, is referred to as "non-ionizing radiation." Examples of this kind of radiation are sound waves, visible light, and microwaves.
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> Radiation that falls within the “ionizing radiation” range has enough energy to remove tightly bound electrons from atoms, thus creating ions. This is the type of radiation that people usually think of as “radiation.” We take advantage of its properties to generate electric power, to kill cancer cells, and in many manufacturing processes.

[1] Adapted from My NASA Data, © NASA, https://mynasadata.larc.nasa.gov/images/EM_Spectrum3-new.jpg

Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) systems typically operate in the 450MHz to 2.4GHz frequency range. The Neptune R900 AMR system transmits for a total of approximately 14 seconds per day. This transmission lasts less than one second. It should be noted that homeowners and their neighbours use and operate many radio frequencies both within and around this range including; baby monitors, remote car keys, smart phones, cellular networks, cordless telephones, AM and FM radio broadcasts, garage door openers, radio-controlled toys, television broadcasts, satellite communications, police radios and the list goes on and on.

With the accelerated use of social media, smart phones, WiFi, mobile streaming, GPS systems, and a myriad of other applications, the use of RF has grown exponentially.

RF systems that are used for AMR and AMI systems fall into the category of non-ionizing radiation, as they do not have sufficient energy to change the structure of molecules with which they come in contact.

Within the non-ionizing group of frequencies, where do AMR- and AMI-equipped smart meters fall? The table below shows the relative power density in microwatts per square centimeter (µW/cm2) so that the various devices can be compared. Although water devices were not specifically measured in this independent study, they would tend to operate like gas smart meters which are also dependent on battery power and therefore can't transmit as often or at an output power as high as electric Smart Meters.

Comparison of RF Power Density in the Everyday Environment (microwatts per square centimeter or $\mu W/cm^2$)

Everyday Environment	**$\mu W/cm^2$**
Adjacent to a gas Smart Meter (1 foot)	0.00166
Adjacent to an electric Smart Meter (10 feet)	0.1
Adjacent to an electric Smart Meter (1 foot)	8.8
Microwave oven nearby (1 meter)	10
Wireless routers, laptop computers, cyber cafés, etc. maximum (~1 metre for laptops, 2-5 metres for access points)	10 to 20
Cell phone (at head)	30 to 10,000
Walkie-Talkie (at head)	500 to 42,000

As we can see, the level of exposure to RF emissions is much less for smart meters (gas and water being the lowest of these) than our typical exposure to laptops, WiFi networks, and cell phones.

The following summary from Health Canada from February 12th, 2012 highlights their position on RF transmission:

> As with any wireless device, some of the RF energy emitted by smart meters will be absorbed by anyone who is nearby. The amount of energy absorbed depends largely on how close your body is to a smart meter. Unlike cellular phones, where the transmitter is held close to the head and much of the RF energy that is absorbed is localized to one specific area, RF energy from smart meters is typically transmitted at a much greater distance from the human body. This results in very low RF exposure levels across the entire body, much like exposure to AM or FM radio broadcast signals.
>
> Survey results have shown that smart meters transmit data in short bursts, and when not transmitting data, the smart meter does not emit RF energy. Furthermore, indoor and outdoor survey measurements of RF energy from smart meters during transmission bursts were found to be far below the human exposure limits specified in Health Canada's Safety Code 6.

Based on this information, Health Canada has concluded that exposure to RF energy from smart meters does not pose a public health risk.

The Neptune R900 device is a one-way device that operates in the 902-928 MHz band. That range of frequencies is referred to as an "unlicensed" band, as opposed to "licensed" frequencies on which AM and

FM operate. The R900 uses frequency hopping spread spectrum to avoid harmful interference or collisions with radio waves emanating from other household equipment. The R900 is certified under Part 15.247 of the FCC regulations. That certification is required by law of any RF device. We are required by the FCC to place in the R900 manuals the following statement from the Part 15 rules.

FCC Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

RF Exposure Information

This equipment complies with the FCC RF radiation requirements for uncontrolled environments. To maintain compliance with these requirements, the antenna and any radiating elements should be installed to ensure that a minimum separation distance of 20cm is maintained from the general population.

The R900 is certified pursuant to Part 15 of the FCC regulations. In addition, the following factors ensure that the R900 does not cause any environmental or health issues:

- Low power device
  - Relative to cell phones, the R900 has approximately 1/3 less the output power.
- Distance of installation
  - Instead of being adjacent to your head as with a cell phone, the R900 typically is located remotely to the homeowner (i.e. with the meter in the basement, on the outside of a house, etc).
- Duration of transmission
  - The duration of the automatic meter reading message is every 7 mSec every 14 seconds, which is quite a low duty cycle versus continuous signal transmission of a cell phone

With millions of R900 radio frequency meter interface units installed throughout the North America there have been no reported issues of interference or health issues related to the transmission of the R900 RF device.