



## WHITEPAPER

# Radio Frequency Emissions

Analysis of Radio Frequency  
Exposure Associated with  
Silver Spring Networks'  
Advanced Metering Devices

## Executive Summary

This document provides information regarding radio frequency (RF) emissions and the spectrum of frequencies one is exposed to almost daily. Specifically, we address RF emissions from Silver Spring Networks' Advanced Metering Devices for smart meter communications.

With an eye toward resolving concerns about RF emissions, this document presents a framework for RF emissions and the critical role it plays in our daily communication systems, such as police and fire radio systems, pagers, radio and television broadcasts, and cellular telephones. In our homes, we have grown accustomed to cordless phones, wireless networks, garage door openers, baby monitors, microwave ovens, and our PC's – all of which utilize and emit RF energy.

The data indicates that all Silver Spring-enabled devices present an extremely low-level of RF exposure when compared to the regulatory limits established by the Federal Communications Commission (FCC) for safe operations.

Smart meters transmit for only a fraction of the day for short durations and actual RF emissions are actually less than commonly used devices such as cell phones or baby monitors.

**"Wireless smart meters, when installed and properly maintained, result in much smaller levels of radio frequency (RF) exposure than many existing common household electronic devices, particularly cell phones and microwave ovens."**

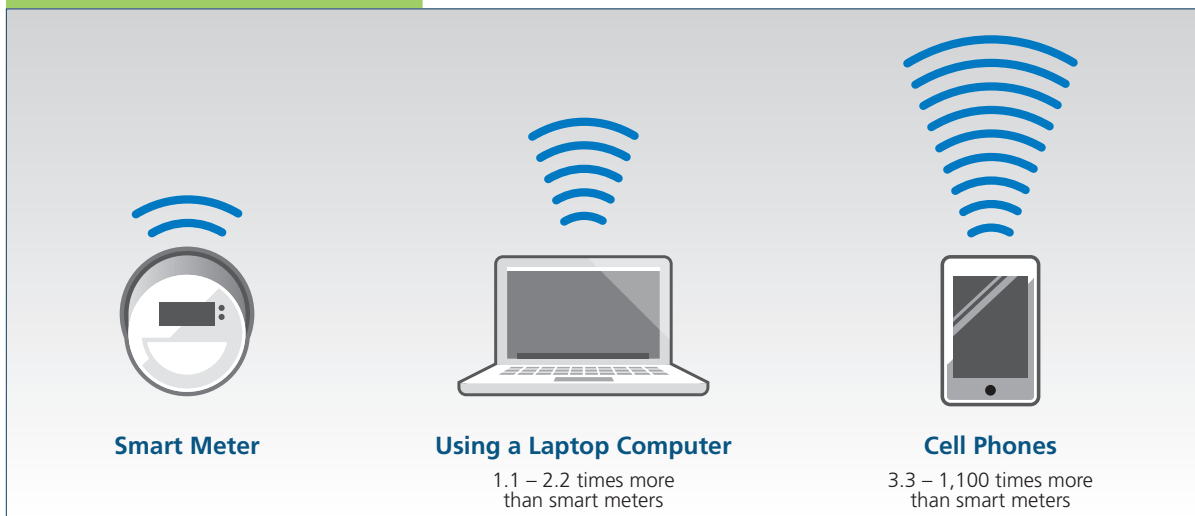
**"Health Impacts of Radio Frequency from Smart Meters". Published April 2011 by California Council on Science and Technology**

### Examples of RF fields commonly found in the everyday environment in relation to Silver Spring-enabled Smart Grid Devices

Source	RF Output Compared to standing two feet from a Smart Meter
Standing in front of an active microwave oven, two inches from door	550 times more
Holding a walkie-talkie to your head	55 – 4,600 more times
Holding an active cell phone to your head	3.3 – 1,100 times more
Using a laptop computer	1.1 – 2.2 times more
Sitting in a Wi-Fi cyber café	1.1 – 2.2 times more

A comparison of the expected RF densities near Silver Spring-enabled smart grid devices versus a sampling of other common devices.

## Radio Frequency Comparison

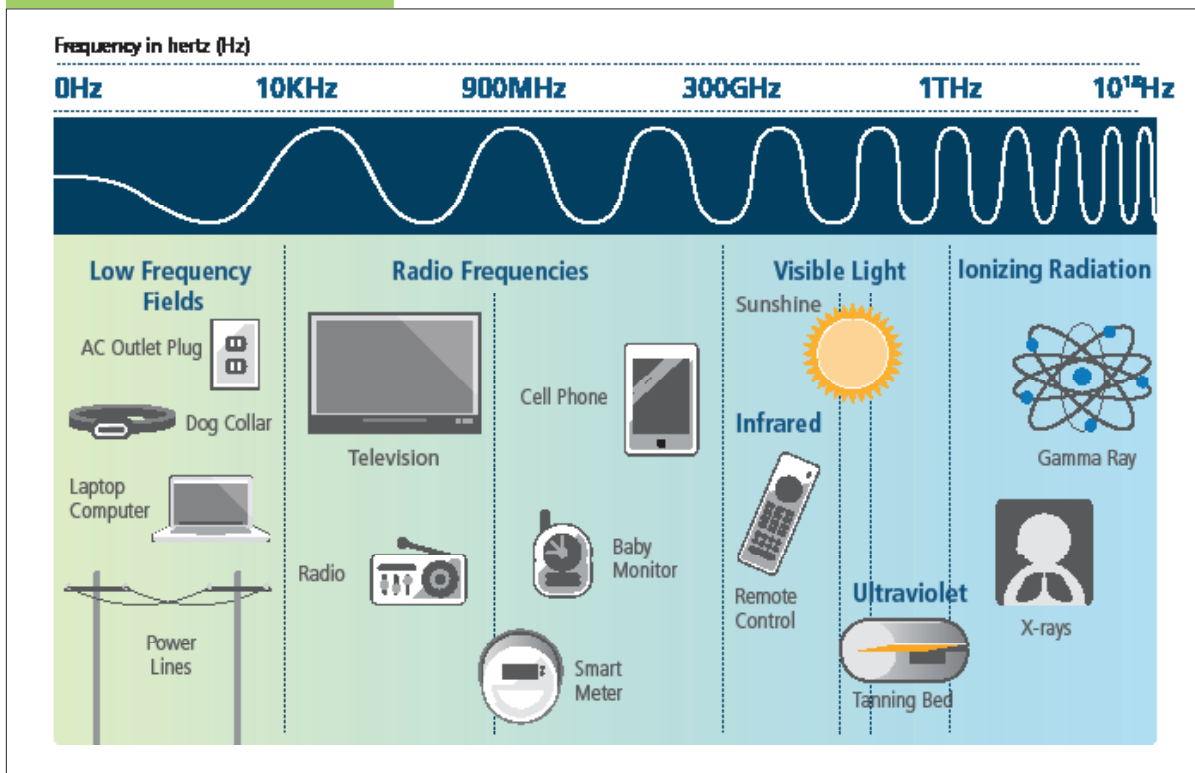


Silver Spring Networks continually monitors regulatory and scientific developments related to human exposure to RF emissions. Silver Spring Networks relies on expert scientific conclusions related to RF exposures and potential health effects. According to the Federal Communications Commission (FCC), the Electric Power Research Institute (EPRI) and the California Council on Science and Technology (CCST), no adverse short or long-term health effects have been shown to occur from the radio frequency signals produced by smart meters or other such wireless networks.

Our smart grid networking solution, utilizing radio frequency communications, fully complies with the United States Federal Communications Commission's Part 15 rules for safe use in publicly unlicensed spectrum. Pursuant to these rules, products are tested as if they are constantly transmitting. Many factors impact the total smart meter transmission schedule during a 24-hour period. The frequency of transmission varies widely depending on network usage, customer configured scheduled reads, and network maintenance activities. *Silver Spring-enabled smart grid devices, not only meet the FCC rules, but in actual usage, transmit significantly less frequently.*

Based on actual field tests of 88,000 and 50,000 meters, the median transmission time is 45 seconds per day (half fall above, half below). The average transmission time is 60 seconds per day. The total per day transmission time includes meter read data, network management and time synchronization.

## Electromagnetic Spectrum



## Regulations

In 1985, the FCC first established guidelines to limit human exposure and protect against thermal effects of absorbed RF emissions. The guidelines were based on those from the American National Standards Institute (ANSI) that were issued in 1982. In 1996, the FCC modified its guidelines, based on a rulemaking process that began in 1993 in response to a 1992 revision of the ANSI guidelines, and findings by the National Council on Radiation Protection and Measurements (NCRP). The 1996 guidelines are still in place today and have been updated as recently as 2001. In its rulemaking process to set SAR and MPE limits, the FCC relied on many federal health and safety agencies, including the U.S. Environmental Protection Agency and the Food and Drug Administration.

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The FCC document detailing how to measure and/or calculate the levels of RF radiation titled "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" can be found at [transition.fcc.gov](http://transition.fcc.gov)



## Types of Exposure and Exposure Limits

The FCC Rules and Guidelines define two types of exposures to RF energy:

- 1. Occupational / Controlled Exposure** – persons who are exposed as a consequence of their employment and are fully aware of the potential for exposure and have the ability to exercise control over their exposure.
- 2. General Population/Uncontrolled Exposures** – apply when one is exposed and may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

## FCC Limits for Maximum Permissible Exposure (MPE)

### Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electronic Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time in Minutes  E  <sup>2</sup> ,  H  <sup>2</sup> or S
0.3 – 3.0	614	1.63	(100)*	6
3.0 – 30	1842/f	4.89/f	(900/f <sup>2</sup> )	6
30 – 300	61.4	0.163	1.0	6
300 – 1,500	–	–	f/300	6
1,500 – 100,000	–	–	5	6

### Limits for General Population/Uncontrolled

Frequency Range (MHz)	Electronic Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time in Minutes  E  <sup>2</sup> ,  H  <sup>2</sup> or S
0.3 – 1.34	614	1.63	(100)*	30
1.34 – 30	842/f	2.19/f	(180/f <sup>2</sup> )	30
30 – 300	27.5	0.073	0.2	30
300 – 1,500	–	–	f/1500	30
1500 – 100,000	–	–	1.0	30

f = frequency in MHz \*Plane-wave equivalent power density

Source: FCC OET Bulletin 56 – Fourth Edition

## Silver Spring Networks Smart Meter Specifications per FCC certification

<b>FCC Rule:</b>	15.247
<b>Environment:</b>	General Population/Uncontrolled Exposure
<b>Exposure Conditions:</b>	Minimum 20 centimeters (8 inches)
<b>Frequency Bands:</b>	RFLAN 902-928 MHz ZigBee 2.4-2.48 GHz
<b>Transmit Power:</b>	RFLAN 30 dBm (1000 mW) at 902 MHz ZigBee 22dBm (160mW) at 2.4 GHz
<b>Antenna Gain:</b>	RFLAN 4 dBi (2.5 times) at 902 MHz ZigBee 1 dBi (1.25 times) at 2.4 GHz
<b>Duty Cycle (Estimate Max): (over 30 minute period)</b>	RFLAN 4% ZigBee 10%

### Calculation of RF emissions

#### Power Density calculated with Reflection Factor

$$\text{PowerDensity [mW/cm}^2\text{]} = \frac{\text{TransmitterPower [mW]} \times \text{Antenna Gain[times]} \times \text{Reflection Factor [times]}}{(4 \times \pi \times (\text{Distance[cm]})^2)}$$

### MPE limits for continuous exposure

	Occupational	MPE Level	General Population
RFLAN (902MHz)	3.0 mW/cm <sup>2</sup>		0.6 mW/cm <sup>2</sup>
ZigBee (2.4GHz)	8.0 mW/cm <sup>2</sup>		1.0 mW/cm <sup>2</sup>

### Using realistic (high end) duty cycle

Transmitter	MPE Limit	MPE @ 20cm	Margin
RFLAN (902MHz)	0.6 mW/cm <sup>2</sup>	0.02 mW/cm <sup>2</sup>	3.3% of the limit
ZigBee (2.4GHz)	1.0 mW/cm <sup>2</sup>	0.004 mW/cm <sup>2</sup>	0.4% of the limit

## Summary

Pursuant to the FCC rules, products are tested in extreme conditions as if they are constantly transmitting. In actual usage, Silver Spring enabled devices transmit significantly less frequently than this. And, our solution meets the FCC testing standards even under these stringent testing parameters.

Silver Spring Networks will continue to monitor the regulatory standards and research related to RF exposure to verify that our products are in compliance with all applicable legal and regulations.

## Additional Information

### Federal Communications Commission (FCC)

- [Radio Frequency Safety](#)
- [Radio Frequency Safety FAQs](#)
- [Q&A about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields Evaluating](#)
- [Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields](#)

### Federal Drug Administration (FDA)

- [Radiation Health](#)

### Occupational Health & Safety Administration (OHSA)

- [Radio Frequency and Microwave Radiation](#)

### The National Institute for Occupational Safety and Health (NIOSH)

- [EMF \(Electric and Magnetic Fields\)](#)

### World Health Organization (WHO)

- [Electromagnetic fields and public health](#)

### California Council on Science and Technology (CCST)

- <http://www.ccst.us/publications/2011/2011smart-final.pdf>

### About Silver Spring Networks

Silver Spring Networks provides a leading networking platform and solutions that enable utilities to transform the power grid infrastructure into the smart grid, helping utilities to achieve operational efficiencies, reduce carbon emissions and empower their customers with new ways to monitor and manage their energy consumption. Silver Spring provides the hardware, software and services that allow utilities to deploy and run multiple smart grid solutions, including Advanced Metering, Distribution Automation and Demand Side Management, over a single, unified network. Silver Spring's *Smart Energy Platform* is based on open, Internet Protocol (IPv6) standards, allowing continuous, two-way communication between the utility and devices on the grid. Silver Spring has numerous deployments with leading utilities around the world, including Baltimore Gas & Electric, CitiPower & Powercor, Florida Power & Light, Jemena Electricity Networks Limited, Pacific Gas & Electric, Pepco Holdings, Inc., and United Energy Distribution, among others. For additional information, please visit [www.silverspringnet.com](http://www.silverspringnet.com).

**Corporate Headquarters**  
555 Broadway Street  
Redwood City, CA 94063  
650.298.4200 [Phone](#)  
866.204.0200 [Toll Free](#)