Itron

RF Safety Compliance of OpenWay Smart Meters

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WHITE PAPER

EXECUTIVE SUMMARY

As a world-leading technology and services company that manufactures products that utilize wireless communications, Itron is committed to delivering safe products that meet or exceed all applicable safety standards. With that, we are also committed to providing accurate and complete product safety information to our utility customers and the customers they serve.

To this end, and to supplement the FCC and Health Canada certifications for the meters, Itron recently completed a detailed study of radio frequency (RF) transmissions and duty cycles for OpenWay® CENTRON® smart meters operating under the OpenWay CG-Mesh Internet Protocol Version 6 network. For this study, Itron utilized data from an OpenWay system operated by BC Hydro in British Columbia, Canada.

Results from the study show the RF wireless communication from the OpenWay meters meet all applicable safety standards established by government agencies, such as Health Canada and the Federal Communications Commission (FCC) in the U.S. In fact, the RF exposure to people from OpenWay meters amounts to a fraction of the maximum permissible exposure levels and safety standards set by these agencies. The study shows that the duty cycle – the total time meters are transmitting in a given 24-hour period – on average was about three minutes per day. That translates into a duty cycle of 0.21 percent. This means the OpenWay meters, on average, are not transmitting radio signals for 99.79 percent of a typical day. In addition, these meters utilize very low-power transmissions and typically operate at a significant distance away from people, especially compared to other common wireless devices such as cell phones. In conclusion, the exposure from OpenWay smart meters is negligible in comparison to other common wireless devices encountered every day.

WHY SMART METERS?

Utilities across the U.S. and Canada have been replacing old-style electromechanical meters with digital communicating smart meters for the past decade. Industry research groups estimate that today approximately 50 percent of the 180 million electricity meters in the U.S. and Canada are now smart, with the vast majority of those smart meters – approximately 95 percent or more – using RF wireless communication to send data back to the utility. Installation of digital smart meters continues to accelerate and it is estimated that by 2020, virtually all electricity meters in the U.S. and Canada will be smart.

Utilities, with the approval of regulatory bodies, are replacing their old meters with new smart meters for several reasons as smart meters deliver a variety of benefits both to utilities and consumers. Key among those benefits is the automation of meter data collection, which helps utilities control operating costs while improving operational efficiencies and customer service. Smart meters can also signal when there is a power outage so utilities can detect outages and restore power to customers in a timely manner. Smart meters also enable utilities to deliver a variety of new services and programs, such as providing real-time energy usage information to customers to help them reduce energy usage and control their monthly bill. In a time when adoption of new technologies, such as customer-owned solar, electric vehicles and energy storage, is accelerating, smart meters provide vital measurement, sensing and communications capabilities to help ensure the reliability and stability of the power grid.

WHAT IS OPENWAY AND HOW DOES IT WORK?

OpenWay is a smart metering network from Itron that utilizes IPv6 standards and architecture developed jointly by Itron and Cisco, the world's leading network technology provider. The network comprises Itron OpenWay CENTRON smart meters installed at homes and business, Cisco network routers that are typically installed on utility power poles to route the data received from nearby meters back to the utility, and software to collect and process the data from the meters so it can be made available to generate customer bills and support other utility operations.

The OpenWay smart meters and OpenWay CG-Mesh IPv6 network use RF wireless communications and operate in the Industrial, Scientific and Medical (ISM) bands at frequencies from 902 MHz to 928 MHz. This is the same portion of the RF spectrum utilized by other devices such as garage door openers and baby monitors. Regulatory agencies, such as the FCC and Health Canada, have established specific limits and standards for the wireless transmissions of all these devices to ensure they do not pose a danger to public health and do not interfere with one another. The OpenWay meters and network have been tested and certified by independent third-party labs, validating that they comply with all applicable safety standards from these and other standards organizations.

The OpenWay CG-Mesh IPv6 network is a mesh network, which is a type of network topology in which devices or nodes (in this case meters) transmit their own data and can also serve as a communication relay for other nodes in the network. Routers are used to provide the best and most efficient data path for effective and reliable communication back to the utility. In the event of a hardware failure in the network, many routes are available to continue the network communication process. This enables the network to be self-forming and self-healing to continue operating when a node breaks down or when a connection becomes unreliable due to changing environmental conditions. As a result, the network has higher reliability because there is often more than one path between a source and a destination in the network. In addition to transmitting electricity consumption and event data (e.g. outage detection, voltage alarms, meter tamper alerts), the network also transmits data to ensure efficient, reliable and secure operation of the network, including connectivity status, device management and network security.

RF COMMUNICATION AND PUBLIC HEALTH

Radio frequency (RF) energy is all around us. RF plays a critical role in the communications systems that we depend on every day, such as police and fire radio systems and pagers, radio and television broadcasts and cellular telephones. Many of the conveniences we've grown accustomed to in our homes, such as cordless phones and wireless internet (Wi-Fi), utilize radio frequency communications.

Since 1996, the FCC in the U.S. has required all wireless communications devices sold in the United States meet minimum guidelines for safe human exposure to radio frequency emissions. Health Canada has established similar requirements and regulations for RF devices sold in Canada. In addition, federal health and safety agencies, including the EPA, FDA, National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA), consistently monitor and regulate RF safety. The research and recommendations from these public health organizations are factored into FCC regulations regarding RF exposure. Through the course of this research, the FCC has concluded that "currently no scientific evidence establishes a causal link between wireless device use and cancer or other illnesses."

Itron's products are stringently evaluated for RF safety and meet all FCC, Health Canada, and Institute of Electrical and Electronic Engineers (IEEE) standards. We consistently evaluate key factors for exposure risk, including the total duration of the transmission (duty cycle), the power output and the distance from the public. These key factors ensure that Itron OpenWay meter represent exposure levels which are not only well below the legal limits, but, minimal when compared to other devices people use every day.

- **Limited time on the air:** Itron electric smart meters and associated communication modules transmit for very short intervals (typically totaling about three minutes per day) and thus have a very low duty cycle. The resulting RF exposure levels amount to a fraction of the limits specified by regulatory agencies, including the FCC and Industry Canada.
- **Low power:** Itron electric smart meters and associated communication modules are low power; transmitting at one watt or less, well within the regulatory and safety limits.
- **Limited proximity to humans:** Itron electric smart meters and associated communication modules are typically installed outside the home. Since RF energy falls off very quickly with distance, smart meters typically represents much lower exposure than other RF devices located within the home. More specifically, the RF exposure decreases exponentially with distance – at twice the distance, the exposure level is reduced to a quarter of the original.

STUDY METHODOLOGY

This study took place in the summer of 2015 and used the Cisco network management system to pull operational data and statistics from a total of 12,969 OpenWay smart meters operating in the BC Hydro service territory. Each meter or node in the network delivers all transmission statistics to the Cisco system as part of its standard status reporting. The meter population selected for the study was randomized to ensure a representative cross section of deployed meters in differing service environments and operational scenarios within the network. This approach was taken because duty cycles for individual meters will vary to some degree depending on where they are situated in the topology of the mesh network. In addition to sending their own data (typically one to three times a day), meters will also relay data from other meters in the mesh network.

SUMMARY OF DUTY CYCLE DATA, SUMMER 2015 BC HYDRO

	Daily Transmission Time *(min)*	Duty Cycle Per Interval *(% Time Transmitting)*
Mean/Average	2.99	0.21
Median	2.43	0.19
Mimimum	0.03	0.003
Maximum	115.2	7.99

RESULTS

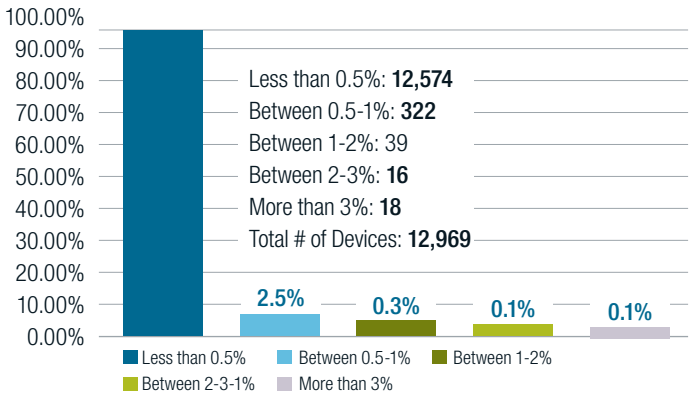
The analysis of this representative meter population operating in the field at BC hydro showed that the average duty cycle for the meters was 2.99 minutes. That figure translates into a duty cycle of 0.21 percent. This also means that, on average, OpenWay meters are not transmitting or emitting RF signals for 99.79 percent of a typical 24-hour period. That means that the vast majority of the meters are not transmitting for 23 hours and 56 minutes in a typical day.

VARIATIONS IN DUTY CYCLE

As previously mentioned, the mesh network topology relies on meters in certain areas of the network to act as pathways for data from other meters during the journey back to the router and the utility. For this reason, duty cycles will vary to some degree among meters depending on their position in the network and how many other meters' data they may be transmitting back to the network router.

Typically, meters located closer to the network routers tend to have higher duty cycles than meters located further from the router. Despite these dynamics, duty cycles remain consistently lower for the vast majority of meters throughout the network. For this representative field study of 12,969 meters, 99.5% of the meters have duty cycles of less than 1% with 97% having duty cycles of less than 0.5%. The meters with duty cycles greater than 3% totaled only eighteen meters or roughly 0.1% of the population.

DUTY CYCLE RANGES (% DAILY TIME TRANSMITTING)



COMPARISON TO LIMITS

The FCC and Health Canada requirements account for the duty cycle of the devices when determining the level of exposure. The table below compares the OpenWay meter power density to the FCC and Health Canada Maximum Permissible Exposure limits with the Average (0.21%) and Majority (0.5%) field duty cycles from this study.

IVP6 OPENWAY METERS AND FEDERAL COMMUNICATIONS COMMISSION (FCC) EXPOSURE LIMITS

	RF MESH: Duty Cycle	RF MESH: Transmission time per day	RF MESH: Power Density*	FCC LIMIT	RF MESH: Percent of limit
Mean	0.21%	3 min.	0.0005 mW/cm^2	0.61 mW/cm^2	0.08%
Majority	0.5%	7.2 min.	0.00114 mW/cm^2	0.61 mW/cm^2	0.18%

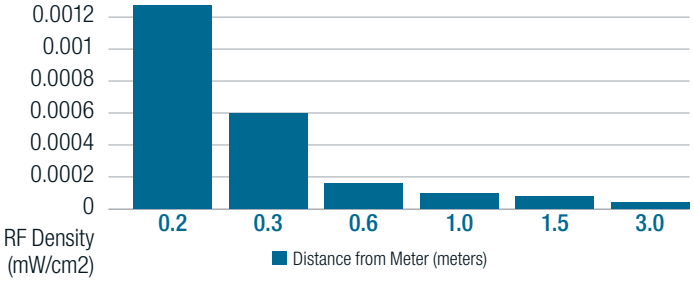
*At 0.2 meter distance

IVP6 OPENWAY METERS AND HEALTH CANADA (HC) EXPOSURE LIMITS

	RF MESH: Duty Cycle	RF MESH: Transmission time per day	RF MESH: Power Density*	HC LIMIT**	RF MESH: Percent of limit
Mean	0.21%	3 min.	0.0005 mW/cm^2	0.28 mW/cm^2	0.17%
Majority	0.5%	7.2 min.	0.00114 mW/cm^2	0.28 mW/cm^2	0.41%

*At 0.2 meter distance
**Health Canada Safety Code 6 (2015) Limit for 900MHz

POWER DENSITY OF TYPICAL METER (MAJORITY, <0.5% DUTY CYCLE) BY DISTANCE



OPENWAY RIVA DUTY CYCLES

Itron's new generation technology, OpenWay Riva, is based on the current routing protocols and introduces new communications capabilities such as integrated RF, Powerline Carrier and Wi-Fi communications on the same device, as well as multiple modulations for RF and PLC comms. Like all Itron radio products, the new OpenWay Riva devices are fully compliant with all applicable regulatory standards and safety requirements. Some of these advancements, such as higher data rates using faster modulations and the use of PLC communications are expected to reduce RF duty cycles, while additional coordination traffic on the network to manage these new communication capabilities is expected to add to the device transmit times. These changes are also expected to better balance the network traffic distribution between meters closer to the router and those further from the router.

Based on our lab testing of OpenWay Riva devices thus far, our expectation is that the RF duty cycles for OpenWay Riva technology will be comparable to OpenWay CG-Mesh technology, with no significant changes. The Wi-Fi interface replaces the current 2.4GHz ZigBee radios and will be used only occasionally for field access. 2018 will bring our first significant deployments of OpenWay Riva technology in the field, and will provide Itron the opportunity to analyze duty cycles at scale under realistic operating conditions.

CONCLUSION

The results of the latest duty cycle analysis show that the RF power densities for OpenWay smart meters operating under the OpenWay CG-Mesh IPv6 network amount to only a small fraction of the MPE limits set forth by both Health Canada and FCC. Itron will continue to monitor the regulatory standards and research related to RF exposure to ensure that its products are in compliance with all applicable safety standards and legal requirements.

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