

> Itron white paper

Wireless Transmissions: *An Examination of OpenWay Smart Meter Transmissions in a 24-Hour Duty Cycle*

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Overview

This document is a supplement to the paper titled “Analysis of Radio Frequency Exposure Associated with Itron OpenWay® Wireless Communication Equipment.” A key consideration for evaluating RF exposure from Itron smart meters is the duration of exposure—or how often the radios are transmitting. This report summarizes data collected from a representative large-scale OpenWay deployment over a typical 24-hour operational period, providing empirical data that quantifies the percentage of time a meter’s radios are active (also known as the meter’s “duty cycle”).

Introduction

Itron OpenWay CENTRON® meters utilize wireless communications to transmit and receive data between meters and a collection device (such as a Cell Relay). To better characterize the level of RF emissions emitted during this data collection process, a study was conducted by Itron to determine the amount of time, within a 24-hour window, a meter’s radio is actively transmitting.

The data collected by Itron represented approximately 7,000 meters in the sample network (see *Note #1*), over a 24-hour period, in order to determine the percentage of time that the meter was transmitting (again, the duty cycle). A read of the meter’s transmit counters (bytes transmitted) was captured at noon on Wednesday, December 1, and again at noon on Thursday, December 2. To determine the total amount of data transmitted in that 24-hour period, the numbers from December 1 were subtracted from the numbers on December 2.

For example, if Meter X’s transmit counter was at 10234342 when the reading was taken on December 1, but by December 2 the counter was up to 10432514, we can deduce that in 24 hours Meter X transmitted 198,172 bytes. While that figure is useful, it does not tell us what portion of the day that the meter was actually transmitting. To determine that figure, we must first convert the number of bytes to bits by multiplying by eight ($198,172 \times 8 = 1,585,376$).

Next, because we know that these meters transmit data at a rate of 19,200 bits per second (see *Note #2*), we divide our total by 19,200 ($1,585,376 / 19,200 = 82.57$ seconds) to determine that the number of seconds the meter was actually transmitting was 82.57 seconds in 24 hours. Finally, to calculate the duty cycle, we must divide the number of active seconds by the number of seconds in a day ($82.57/86,400 = 0.09557\%$). Therefore the daily duty cycle of meter X is ~0.1%.



Results

The following graphs and table summarize the results of the data gathered.

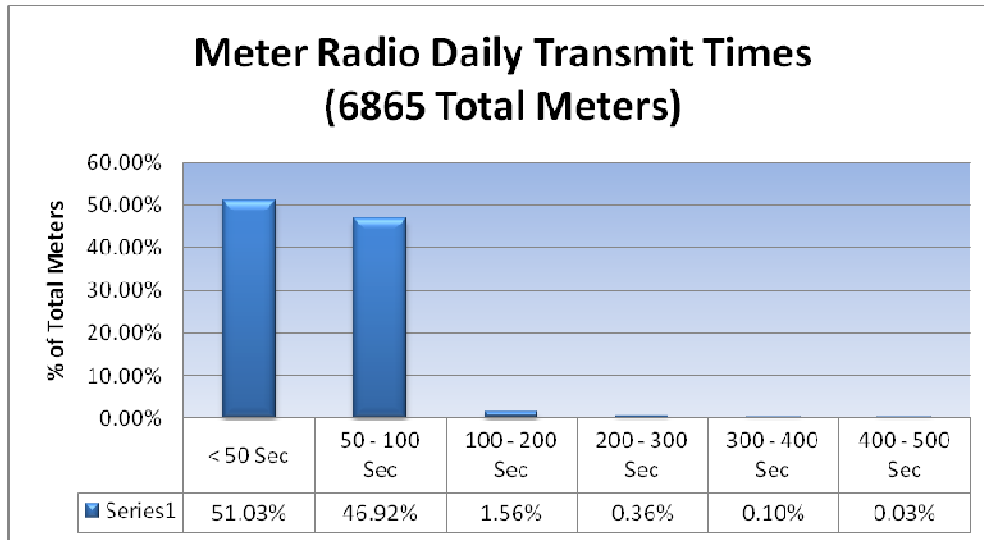


Fig. 1 Daily Transmit Times

Figure 1 shows that out of the 6,865 meters sampled, 97.95% of the meters transmitted for less than 100 seconds in the 24 hour period (duty cycle of less than 0.12% per day).

An Examination of Itron OpenWay® Wireless Transmissions in a 24-hour Duty Cycle

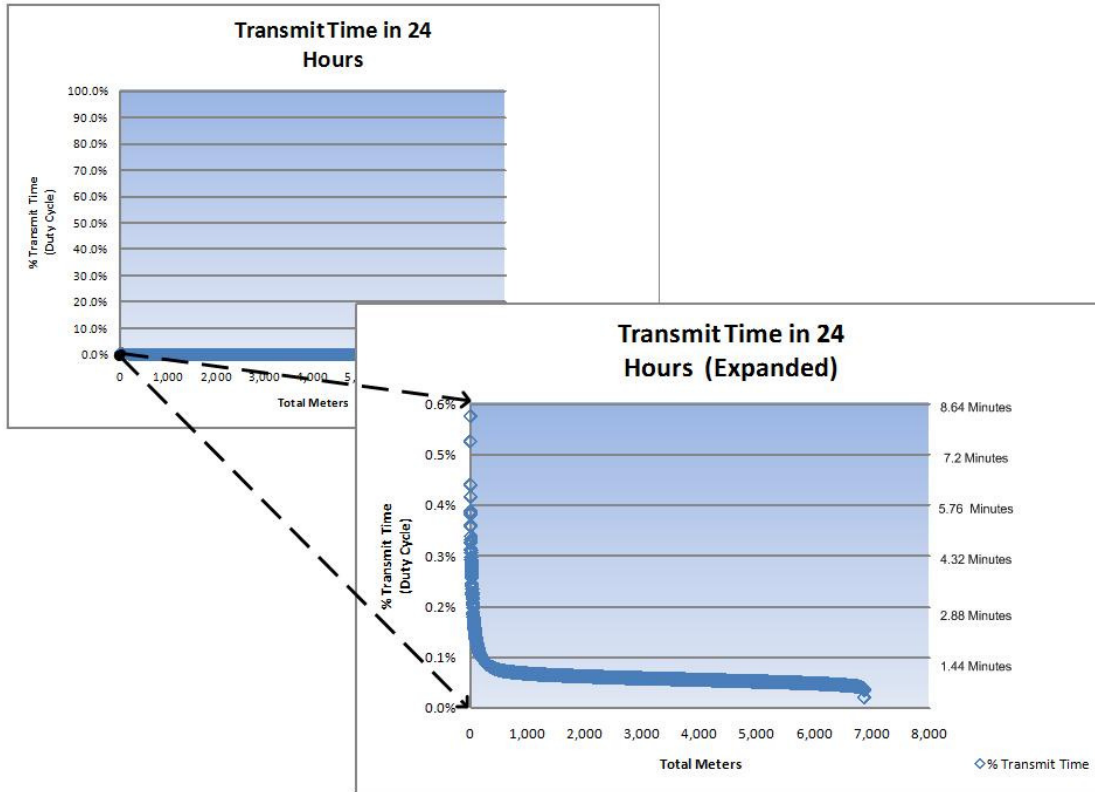


Fig. 2 Percentage of Transmit Time

Figure 2 represents a scatter plot of all meters’ transmit times. Because the meters transmit for such a small percentage of the time, the first view appears as a solid blue line resting on the x-axis (below 1%). In the expanded view it is possible to see the maximum daily duty cycle is less than 0.6% (transmit time less than 8.64 minutes/day). This view also shows that 98% of the meters have a daily duty cycle of less than 0.1% (transmit time less than 1.44 minutes/day).

	Duty Cycle	Time
Mean	0.06%	53.14 seconds per day
Maximum	0.58%	497.8 seconds per day
Minimum	0.02%	18.31 seconds per day
Median	0.06%	49.81 seconds per day

Fig. 3 Transmit Time Statistics



The table above (*Figure 3*) shows that meter emission times vary, but even the maximum transmission represents less than 1% of the 24-hour period. Median and Mean (or average) times are relatively close together, which indicates the absence of many meters on the extreme ends of the range.

The sample period that was selected represents a day of higher-than-normal activity for the sample network. During this time, in addition to the two normally scheduled daily meter data reads, there were two crucial updates being transmitted to every endpoint on the network—one for an adjustment for Daylight Savings Time and the other was a crucial firmware update. In a typical day with no updates taking place, the numbers would more than likely be even lower.

Conclusion

OpenWay smart meters are advanced, highly-efficient devices. They are able to communicate a large amount of metering and event data in short bursts throughout a 24-hour period (each transmit burst is less than 150mSec). The worst case meter in the sample population was essentially silent (not transmitting) for over 99.40% of the day while the average meter was silent 99.94% of the day. In terms of FCC regulations for Maximum Permissible Exposure (MPE) limits, the worst case meter was less than 0.09% of the limit mandated by the FCC (0.00051 mW/cm^2 vs 0.61 mW/cm^2) with the average meter less than 0.009% of the FCC limit (0.000053 mW/cm^2 vs 0.61 mW/cm^2). [With the duty cycle is accounted for, See *Note #3*]

This empirical field data further refines our estimations for maximum duty cycle of Itron OpenWay meters. When accounting for the variations in cell size and data requests, our expectations for maximum duty cycle are 1% (14.4 min/day). The previous estimate prior to this field data was 5% duty cycle.

Itron takes all concerns about RF exposure very seriously and continuously strives to ensure its products meet or exceed FCC guidelines and regulations. In the case of OpenWay smart meters, Itron dramatically exceeds these mandates with a product that generates only a very small fraction of the FCC limits for RF exposure.

Note #1:

The sample meter data was taken from one of Itron's large-scale, operational network customers. It is representative of the OpenWay smart grid solution. There were 6,865 meters in the population sample, spread across 10 cells (average cell size of ~687 meters). The data for the Cell Masters is included in this analysis.

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Note #2:

The 19,200 Kbps transmit rate represents the 1G RFLAN currently deployed at this site. Itron has released the 2G RFLAN (with SR3.0) which increases the transmit rate to 153 Kbps and added sub-timeslot efficiencies. For networks deployed with or moving to 2G RFLAN, the transmit efficiency will be greatly increased, so that with the same amount of data passing through the network, the amount of radio transmit time will significantly less.

Note #3:

The FCC has defined the Maximum Permissible Exposure (MPE) as the strength of electromagnetic fields or the equivalent power density associated with this field to which a person may be exposed without harmful effect. For the general population (individuals who might potentially be exposed to RF energy without their knowledge), the limits are set using the following equation:

$$\text{General Population MPE: Exposure [mW/cm}^2\text{]} = \text{Frequency [MHz]} / 1,500$$

The MPE limits for continuous exposure by an Itron OpenWay smart meter is 0.61 mW/cm². These limits are based on the thermal effect of continuous RF radiation. To calculate the power density the following equation is used:

$$\text{Power_Density [mW/cm}^2\text{]} = \frac{\text{Transmitter_Power [mW]} \times \text{Antenna_Gain [times]} \times \text{Duty Cycle}}{(4 \times \pi \times \text{Distance [cm]} \times \text{Distance [cm]})}$$

In the population sample discussed, the worst case meter had a duty cycle of 0.58% (0.0058). With power density of 0.088 mW/cm² during transmission, the resulting power density with duty cycle is 0.00051 mW/cm². When compared to the MPE limit set by the FCC (0.61mW/cm²) this meter was at 0.084% of the allowable amount. The average meter had a duty cycle of 0.06% (0.0006). With power density of 0.088 mW/cm² during transmission, the resulting power density with duty cycle is 0.000053 mW/cm². When compared to the MPE limit set by the FCC (0.61mW/cm²) this meter was at 0.009% of the allowable amount.



About Itron

At Itron, we're dedicated to delivering end-to-end smart grid and smart distribution solutions to electric, gas and water utilities around the globe. Our company is the world's leading provider of smart metering, data collection and utility software systems, with nearly 8,000 utilities worldwide relying on our technology to optimize the delivery and use of energy and water. Our offerings include electricity, gas, water and heat meters; network communication technology; collection systems and related software applications; and professional services.

To realize your smarter energy and water future, start here: www.itron.com.

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