Design Considerations for Wireless Devices using Energy Harvesting

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The key to optimizing energy scavenging devices with low-power wireless systems is to take advantage of some very important but sometimes forgotten best practices. These practices are used by system architects designing wireless sensor systems to reduce the demand on the energy harvesting components in the system. They are:

1. Select the lowest frequency band available to improve range and reduce average current consumption for active mode radio transmissions.

2. Put the sensor, microprocessor and radio in standby or deep sleep mode as much as possible to reduce the amount of energy required from the scavenging or harvesting device. Component manufacturers provide state diagrams for different operational modes of their components such as typical values for power down, crystal start-up, full TX-RX time, and power down. By developing a power budget spread sheet, designers can create the typical current consumption for devices that need to transmit every second, every minute, or every day. Use cases obviously determine how often the operator needs to get data from the device. The point is to match how much energy is required for the application and then try to reduce the on time as much as possible.

3. Transmit data when it is absolutely essential; otherwise keep the radio in sleep mode. Most transceivers today have a buffer or storage section which allows the sensor data to be stored until the processor asks for the data. SPI communication systems use a lot of power. Use the lowest possible voltage setting. Most radios today have reduced current at low voltages. Using the on-chip regulator with low-quiescent current reduces the total energy usage.

4. Use the false package detection feature on the receiver. By minimizing the time used to process false or packets not intended for your system, the less overall energy you will need from your energy harvester. Checking the incoming carrier for a valid carrier sense, preamble, sync word, and packet byte length are typical methods to reduce energy.

5. Select a crystal that reduces clock drift between the devices. A few cents spent on crystal accuracy reduces the chance that a link will be lost and the transmitter has to resend the data again, saving precious electrons from the energy scavenger.

A large number of building automation devices today such as light switches, motion sensors, daylight sensors, and thermostats are very good candidates for wireless sensor networks. Wireless end devices can eliminate the renovation cost of

reinstalling existing wired sensors.

As more and more installers and users become familiar and comfortable with wireless sensors, the more they will see the benefit of using this technology. Imagine if just 10% percent of today's building lighting systems were only on when a person was present in the room or office. Think about the total reduction of energy needed to light those buildings during off peak times and the corresponding reduction in energy generation facilities that would be needed on an annual basis. These are just a few of the examples we can all employ to make the world just a little bit greener!

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