# Using Smart Phones for Remote Powering and Charging of Miniature Wireless Nodes

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*Wireless remote powering and charging is more and more used for daily life objects. It has been used at CSEM for wireless sensor network nodes when the nodes are hermetically sealed. Here, we present an application of the technology to power wireless sensors embedded in walls or structures.*

In a number of applications, it is needed to embed sensors in structures and have the capability to read them remotely. RFID-based sensors are typically used in such a case and it is tempting to use NFC-enabled smart phones or tablets as readers. However, the available power is not sufficient to embed sensors too deeply. We present here an alternative that still use smart phones as readers but allows a larger range.

In this example, we assume that the sensor has a Bluetooth low energy interface (BTLE). The sensor is battery-less and will be powered once in presence of a remote energy source. This energy will be provided in this experiment by a tablet suitably equipped with a Near-Field Communication (NFC) transponder. This transponder supplies the necessary power to the BTLE sensor, which then wakes up and starts a task such as the measurement of the surrounding environment and then transmits the measured values to the tablet or to another BTLE receiver over greater distances.

For the demonstration, a wireless sensor provided by Texas Instruments, referred as the SimpleLink™ Sensortag, was used (Figure 1). The sensor tag includes multiple sensors: IR temperature, accelerometer, gyroscope, magnetometer, barometric pressure, temperature and humidity.

*Figure 1: SimpleLink™ Sensortag from TI.*

The system architecture (Figure 2) is based on the following blocks:

- Magnetic Resonant Interface. This interface harvests the maximum available power from the tablet and is based on magnetic coupling resonant technology.
- Rectifier circuit. This block transforms the high voltage output of the magnetic resonant interface into a continuous voltage.
- Power management. This device translates, with a high efficiency, the large dc voltage from the rectifier output to a suitable voltage for the sensor tag. It also delivers the power only when sufficient energy has been harvested. This is to prevent the BTLE from trying constantly to turn on and not succeeding because too much energy is required during the initial and startup phase.

For the demo, a Nexus 4 tablet was used as the power source. This device includes a NFC reader with an available output power of 200 mW as well as a BTLE interface. The tablet acts as a power source as well as a receiver for the measurements sent by the sensor tag. Both devices (NFC and BTLE) could also be two distinct devices.

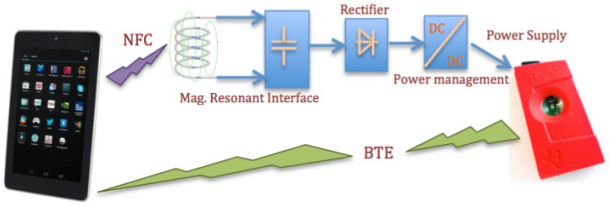


*Figure 2: Architecture schematic.*

Besides the embedded sensor case described earlier, there are many applications where the sensors are difficult to access, where it is complicated to change the batteries or where the sensors are completely encapsulated in a sealed enclosure making it impossible to change the batteries. The capability to remotely charge batteries that are close to depletion or depleted is a nice additional feature.

For such applications, the capability to do maintenance, such as updates or calibration, on the sensor remotely without soliciting the internal battery is key to long battery life. The principle described above can be used during all maintenance operations, thus avoiding to shorten the battery lifetime of the sensor.

The principle is also interesting when an increase of bandwidth is needed. NFC is much more limited in bandwidth than BTLE or equivalent technologies. Decoupling the remote powering technology from the communication technology gives the freedom to increase the bandwidth and possibly reduce interaction time.

The remote powering and charging of wireless sensors using NFC-enabled smart phone and tablets has a number of interesting applications. It has been tested with BTLE as the communication technology but it can be extended to other standards.