Application Note: A vision for Industrial Internet of Things

Introduction

Moving industry towards an era of full automation and smart manufacturing within the Industrial Internet of Things (IIoT or Industry 4.0) requires new ecosystems with people, products, machines and services connected through the cloud. This interconnection requires the deployment of small size sensor nodes which can be autonomously powered.

Machine-to-machine (M2M) connectivity is currently often done using cabled devices or conventional battery powered devices. Using these incumbent technologies has installation & maintenance costs associated with such factors as the cost of deploying cables and retro-fitting sensors in old buildings, plus changing batteries at regular intervals. Further, it is often impractical and sometimes impossible when sensors and devices need to be placed in:

- difficult-to-reach places (e.g. downhole mining, military, geophysics).
- hot environments (drilling, machinery, engines, pipeline inspection gauges).
- high vibration environments (drilling, machinery).

Currently deployed batteries include polymer or liquid electrolytes which limit the operating temperature window and may leak with high vibrations. Industrial cylindrical primary batteries are available which may operate to 160°C, but these are quite bulky (AA type). Some primary coin cells operate up to 125°C but are not rechargeable. Rechargeable coin cells often have a 70°C top operating temperature, too low for some industrial applications.

Application examples

Deployment of sensor nodes are required for:

- *Full automation:*
  "Smart Factories", for M2M connection with creation of data (Big Data) to analyse performance of high temperature machines & improve production results.
- *Testing:*
  For example, in the automotive industry, strain and temperature gauges to monitor engines and chassis.
- *Failure detection:*
  Sensors providing information (e.g. temperature or vibration) to create early warning systems when machines are showing signs of failure.
- *Asset monitoring.*
- *Supply chain traceability.*
- *Defence and security applications.*

Solution offered by Stereax® SSB

Ilika's Stereax® SSB do not have liquid or polymer electrolytes which may leak in high vibration environment. They use solid components with higher resistance to temperature than incumbent technologies. Stereax® batteries currently operate to 100°C, which is higher than coin cells and other solid state batteries, but requirements for higher temperature exist.

SSB have a small footprint, typically around 1 cm^2 and are ultra-thin (<1 mm), so they may be integrated in Systems on Chip.

Combining an SSB with an energy harvester, allows the fabrication of "perpetual" sources of energy. Hence, such a device can function for many years (typically > 10 years).

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