Digital Supply Chain

Use-Cases for RFID Sensors

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The Bosch Group at a Glance

- 70.6 billion euros in sales
- 374,778 associates

- Mobility Solutions
- Industrial Technology
- Energy and Building Technology
- Consumer Goods
Fields of cooperation between Bosch and GS1

• Cooperation between Bosch and GS1 since research project RAN (RFID-based Automotive Network)
• Close collaboration in defining EPCIS standard for business events (e.g. integration of geo-position)
• Research project SaSCh aims at including quality information into EPCIS standard
• Enhancement of EPCIS standard for “Automotive Business Steps / Events“ → Bosch leads project group EPCIS within the VDA (German Car Makers Association)
• Definition of Application Identifier (AIs) that have not been standardized yet.
• Bosch is founding member of the Technical Industry branch of GS1
Supply Chain Challenges & Requirements in Technical Industries

Internet based channels

Logistics for hardware, software, services

Real time transparency

Risk prediction

Robotics/ automation

Supply Chain Event (examples)

- Arrived!
- Rerouted!
- Delayed!
- Ordered online!
- Ready for pick-up!
- Affected by shock!
Digitized Supply Chain as Driver of Innovation
Use-Case: TraQ – Tracking and Quality

Acceleration
Air Pressure
Illumination
Inclination
Humidity
Temperature
Digitized Supply Chain as Driver of Innovation
Use-Case: Sensor module connected to standard KLT

Features

► Temperature, humidity, air pressure: detection of quality relevant events
► Light sensor: theft protection
► High-precision shock and inclination detection: identification of accidents and damages
► Duration of (rechargeable) battery: 100 - 200 days, depending on configuration
► USB interface for complete memory upload in RB IoT Cloud

► Wireless interfaces
  - Bluetooth LE: data transfer
  - RFID: Identification and status transmission at gates
► With Gateways (e.g. AMRA):
  - Geo localization and
  - Data transmission in real-time
► Without Gateway:
  - Data logger and
  - Status transmission at dedicated gates

The Bosch Tracking Solution
Offering a variety of Integration-Solutions.
Use-Case

Identify sensor entries by Application Identifier

Sensors

Temperature
Humidity
Shock

Data to RFID IC
Use-Case

- RFID tag with built in sensor for
  - Temperature, shock, acceleration,…
  - BAP = Battery-Assisted Passive RFID
  - Example: Confidex BAP Temperature Sensor Label

- Sensor values stored in UM, Procedure approach:
  1. Define threshold
  2. Alarm triggered (threshold / limit exceeded)
     - UMI set to “1”
  3. Write sensor value and timestamp into UM
     - If sensor value is present → Overwrite old sensor value
     - If single value is present → Overwrite with single + additional value (e.g. single = shock ; additional = temperature)
Criteria for Memory Organization

- **Overview**
  - Memory bank 01: **GIAI** as Unique Identifier (UII or EPC)  DEFINED
  - Filter for air interface to distinguish sensors → Filter 0 – 7  NOT DEFINED (ND)
  - User Memory Indicator (UMI) bit x15 shall be set  DEFINED
  - Application Identifier for sensor values  ND; NECESSARY
  - User Memory (UM) structure: Data Storage Format Identifier (DSFID)  DEFINED
  - Access method for UM: *Packed-Objects* or *No-Directory*  DEFINED
Background on GS1 Application Identifiers (AIs)

- Data elements for use in GS1 AIDC data carriers are defined by “Application Identifiers” (AIs)
  - An AI specifies the name of a data element, its data format, and its meaning
  - Each AI has a short numeric string used to delimit the data value in a bar code
  - Each AI also has an entry in the Packed Objects “ID Table” which governs the encoding of the data element into the user memory of an RFID tag

- New AIs are introduced by amending the GS1 General Specifications
  - A “work request” specifies the desired new data elements, their data format, and their meanings
  - The AI number and ID Table entry are assigned by GS1 in the late stages of the standards process
## Proposed new AIs for sensor data

- The AI numbers shown are placeholders for the sake of discussion; the actual numbers will be assigned by GS1 during the standards process.
- All sensor data elements (except date/time) have the same data format (n6); this is exploited to make the RFID encoding easier for sensor RFID tags.

<table>
<thead>
<tr>
<th>AI Number</th>
<th>Name</th>
<th>Data Format</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>3401</td>
<td>SENSOR DATE/TIME</td>
<td>N15</td>
<td>Date/time at which a sensor reading takes place, as YYMMDDhhmmssSSS, interpreted as UTC. (SSS = milliseconds)</td>
<td>160315151112345 = March 15, 2016, 3:11:12.345pm, UTC</td>
</tr>
<tr>
<td>3402</td>
<td>SENSOR TEMP</td>
<td>N6</td>
<td>Temperature in milli Kelvin</td>
<td>293150 = 293.15 K (= 20 C)</td>
</tr>
<tr>
<td>3403</td>
<td>SENSOR HUMIDITY</td>
<td>N6</td>
<td>Relative humidity in 1/1000 %</td>
<td>050000 = 50% relative humidity</td>
</tr>
<tr>
<td>3404</td>
<td>SENSOR ACCEL X</td>
<td>N6</td>
<td>Acceleration along X axis (or along the only axis if only a single dimension is available), in 1/1000 g.</td>
<td>002450 = 2.45 g</td>
</tr>
<tr>
<td>3405</td>
<td>SENSOR ACCEL Y</td>
<td>N6</td>
<td>Acceleration along Y axis, in 1/1000 g.</td>
<td>002450 = 2.45 g</td>
</tr>
<tr>
<td>3406</td>
<td>SENSOR ACCEL Z</td>
<td>N6</td>
<td>Acceleration along Z axis, in 1/1000 g.</td>
<td>002450 = 2.45 g</td>
</tr>
<tr>
<td>3407</td>
<td>SENSOR BATTERY</td>
<td>N6</td>
<td>Battery level, in millivolts</td>
<td>003400 = 3.4 V</td>
</tr>
<tr>
<td>3408</td>
<td>SENSOR FORCE</td>
<td>N6</td>
<td>Force, in centi-Newton (equivalent to grams at standard gravity)</td>
<td>000100 = 1 N</td>
</tr>
<tr>
<td>3409</td>
<td>SENSOR STRAIN</td>
<td>N6</td>
<td>Strain, in microns per meter (micro-strain units)</td>
<td>001234 = 1234 microns per meter</td>
</tr>
<tr>
<td>3410</td>
<td>SENSOR LIGHT</td>
<td>N6</td>
<td>Light in 1/10 Lux</td>
<td>003020 = 302,0 Lux</td>
</tr>
<tr>
<td>3411</td>
<td>SENSOR DEFLECT</td>
<td>N6</td>
<td>Deflection in degree (angle) 0 to 180 in 1/100 degrees</td>
<td>014755 = 147,55°</td>
</tr>
<tr>
<td>3411</td>
<td>SENSOR PRESSURE</td>
<td>N6</td>
<td>Air Pressure in 1/100 hPa</td>
<td>101325 = 1013,25 hPa</td>
</tr>
</tbody>
</table>