A single and easy traceability solution

From product data to ERP

Joint presentation between Murata, Rfit Technologies, Schneider Electric and Sophia-Conseil
Presentation roadmap

• Companies presentations
• The current situation in Schneider
• Evaluation of RFID technology for tracking PCBA
• Transforming a PCB into a UHF RFID Tag
• Design of a PLC based solution: "TRACEIT ALL"
• Pilot in Schneider facility: Approach and challenges
• Perspectives
Trace It All project

- Project partially funded by french DGCIS (IPER program)
- Project Labelised by french competitiveness cluster SCS and CNRFID
- Total budget : 1 M€
- Duration : 2 years
- 3 french partners : Schneider / Sophia Conseil / Rfit Technologies
- 1 Rfid tag manufacturer
- Objective : Track and Trace PCB during manufacturing using RFID EPC C1G2 UHF technology
SCHNEIDER ELECTRIC : A GLOBAL SPECIALIST IN ENERGY MANAGEMENT

Key figures

- 15.8 B€ Sales in 2009
- 120,000 employees
- Represented in 106 countries
- 200 industrial facilities
- 7,000 engineers around 25 countries
- 5% of sales devoted to R&D

Sales by End markets – 2008

- Energy & Infrastructure: 16%
- Industry: 26%
- Data centres & Networks: 17%
- Buildings: 31%
- Residential: 10%

North America

- € 27%
- 31,500 employees

Europe

- € 35%
- 49,000 employees

Other

- € 11%
- 8,000 employees

Asia

- € 21%
- 31,500 employees

Listed at the Paris Stock Market– CAC40
### Murata - Profile

<table>
<thead>
<tr>
<th>Date of Establishment</th>
<th>October 1944</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Incorporation</td>
<td>December 23, 1950</td>
</tr>
<tr>
<td>Sales Amount</td>
<td>523,946 million Yen</td>
</tr>
<tr>
<td>Number of Subsidiaries</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>25 in Japan</td>
</tr>
<tr>
<td></td>
<td>50 overseas</td>
</tr>
<tr>
<td>Number of Employees</td>
<td>33,431</td>
</tr>
<tr>
<td></td>
<td>22,019 in Japan</td>
</tr>
<tr>
<td></td>
<td>11,412 overseas</td>
</tr>
</tbody>
</table>

- Sales amount, Operating Income…as of March 31, 2009
- Number of subsidiaries, Employees…as of March 31, 2009
Sophia Conseil – Company overview

Key figures

- Created in 2005, located in Sophia Antipolis (France)
- 6M€ Sales in 2009
- 120 employees
- 2 activities:
  - Consulting
  - Innovation
- 4 divisions:
  - Electronics
  - Mechanics
  - Computer
  - Optics
RFit Technologies – company overview

- French **RFID company**, created in 2008

- Partner of european company **RF-iT Solutions GmbH**

- Provide **RFID expertise, services, and traceability solutions** based on **powerful modules and middleware**.

- **Located in Valence** (south of France) in a favorable ecosystem for traceability
  - Pôle National de traçabilité / CNRFID / Academic partners
  - Traceability business consultants
Focus on the Schneider Automation business

€400 Millions business
1200 employees.
4 subsidiaries around the world
4 R&D locations
1 specialized factory

Seligenstadt (Germany)
Schneider Automation GmbH

Shanghai (China)
Schneider Electric Investment Ltd

North Andover (North America)
Schneider Automation INC

Carros, Sophia (France)
Schneider Automation S.A.S
The Carros Factory

• Expertise center for complex electronic products
  – Printed Circuit Boards Assembly
  – Final assembly and test (FAT)
• Targeted to Low Volume / High mix
  – 5000 references
  – 800K PCBA per year
• Lean manufacturing
• Integrated quality control
  – Product and process parameter tracking
Current product tracking solutions

- Laser marking 2D code on each PCB
  - Collect assembly process parameters
  - Process interlock
- 2D matrix code sticker after coating
  - Used as anti error system in FAT lines
- HF RFID tag
  - Removed and recycled
Common beliefs in question

• Barcode is cheap
  – Laser Process time and investment creates bottleneck
  – 5x5mm 22 character Alphanumeric Matrix code requires high definition cameras to be read
  – As an alternative, high temperature stickers are expensive / must be manually mounting
• Barcode is reliable
  – Solder resist light reflection strongly depends on PCB vendor
• Barcode covers all our needs
  – Need to be visually accessible
  – Code size and density limits data size
  – Need to be always located at the same area to be read in line
Our approach to RFID

• **ROI / Compensate tag over cost by process gain**
  – Evaluate the real cost of the current id solution
  – Evaluate the expected savings of RFID based on current requirements
  – RFID opens new doors but these will hardly justify the tag cost

• **Benchmark tag vendors**
  – Cost / Designs constraints / Support

• **Evaluate product implementation constraints**
  – Check compatibility with PCBA density
  – Convince the designer that it has no impact on his product

• **Discover RFID technology limits**
  – Care about its limitation (antenna size, shielding...)
  – Make our own tests

• **Elaborate a realistic scenario for process implementation**
  – No Big Bang : RFID solution and barcode have to coexist
  – Think middleware : from the product data up to the information system
  – Define a backup solution
Our approach to RFID

• Compensate tag over cost by productivity gain
  – Replace multiple labeling by one SMD component UHF tag
  – Tag cost is the key figure
  – Assembly cost can be neglected
  – Use the same tag along PCBA assembly process and FAT process

• Evaluate implementation constraints
Discover technology limits

What RFID can do for us?

- Access PCB panel data in line before/after reflow
- Hold more data
- Access tagged PCBA data after conformal coating
- Access multiple PCBA data into a shielded product (with precautions)
What it cannot do in our conditions

Access thru distances >30cm

Access close

stacked PCB

Access tag in a plain metal box

Access stacked products

Be plug and play?
Scenario for process implementation

- 100% Tagged boards
- Laser matrix
- Max tagged
- Time

Graph showing the scenario with Laser EOL, Stickers, and tagged boards over time.
Transforming a PCB into a UHF RFID Tag

aschmoldt@murata.de
How can you solve your problems?

1. My product is copied by pirates
2. I need traceability
3. Problems with barcode labels
4. I want to reduce wrong deliveries
5. I want to reduce my stock
6. There are too many manual operations in my process
7. I want to fulfil recycling regulations
8. ...
By Adding Some Magic to Your PCB

Supply Chain Management

Conventional PCB without RFID tag function

1. xxx
2. xxxxxxxx
3. xxx
4. xxxx
5. xxxxx
6. xx
7. xx

Advanced PCB with RFID tag function

Add MAGICSTRAP® and your PCB will become a full RFID Tag!

Traceability

Anti-Counterfeit
Your Product will become Fully RFID

Example!

MAGICSTRAP® inside!

Traceability

Supply Chain Management

Anti-Counterfeiting

Your product will become a full RFID Tag over the whole value chain!
How does MAGICSTRAP® work on a PCB?

1. Conventional Dipole Antenna

2. Dipole Antenna with wide area

3. PCB antenna with MAGICSTRAP®

MAGICSTRAP® recognizes the PCB ground as an antenna

→ efficiently and reliably transform your PCB into a tag

*Magicstrap* and *MAGICSTRAP* are registered trademarks of Murata Manufacturing Co., Ltd.
What is inside of MAGICSTRAP®?

- Resin
- LTCC
- RFID IC
- Low Temperature Cofired Ceramics
- 3D multi-layer matching circuit

* Patents pending

- RFID IC
- Matching circuit in LTCC
  - Wideband antenna filter
  - ESD protection

Environmental Friendly: 100% GREEN materials

* Patents pending
**How does MAGICSTRAP® work on a PCB?**

**Maximum efficiency: antenna matching included**

The antenna only has to receive the incoming RF.
All other functions provided by MAGICSTRAP®

* Patents pending

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Murata MAGICSTRAP®</th>
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</thead>
<tbody>
<tr>
<td>Reception / refraction of RF wave</td>
<td>Antenna function</td>
<td>Antenna function</td>
</tr>
<tr>
<td>Impedance matching</td>
<td>Antenna function</td>
<td>Done by MAGICSTRAP®</td>
</tr>
<tr>
<td>Fix center frequency and bandwidth</td>
<td>Antenna function</td>
<td>Done by MAGICSTRAP®</td>
</tr>
</tbody>
</table>
4 Types of reference antenna on PCB

<table>
<thead>
<tr>
<th>Type</th>
<th>Dimensions</th>
<th>Read Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type1</td>
<td>0.5x0.5cm (0.25cm²)</td>
<td>0.7m</td>
</tr>
<tr>
<td>Type2</td>
<td>0.5x1.0cm (0.5cm²)</td>
<td>1.6m</td>
</tr>
<tr>
<td>Type3</td>
<td>1.2x1.0cm (1.2cm²)</td>
<td>3.6m</td>
</tr>
<tr>
<td>Type4</td>
<td>3.2x1.3cm (4.2cm²)</td>
<td>5m</td>
</tr>
</tbody>
</table>

(at 4W EIRP, 915MHz, with 6dBi directivity antenna and circularly polarized wave)
Read Range at High Power (4w EIRP)

- **Type 1**
  - 0.5x0.5cm (0.25cm²)
- **Type 2**
  - 0.5x1.0cm (0.5cm²)
- **Type 3**
  - 1.2x1.0cm (1.2cm²)
- **Type 4**
  - 1.2x1.3cm (1.42cm²)

**4W EIRP at 915MHz**

- EIRP: Effective Isotropic Radiated Power
- 4W EIRP: 4 watts Equivalent Isotropic Radiated Power
- 915MHz: 915 megahertz frequency
- Directivity antenna: Antenna that is designed to focus the energy of its radiated electromagnetic field in a particular direction
- Circularly polarized wave: A wave that oscillates in a plane perpendicular to the direction of propagation and changes its plane of polarization in a circular manner as it propagates
Fully Standard Compliant

1. 100% compatible to EPC Global C1G2
   - Standard Product Number for World Wide use
   - Compatible to any EPC Global C1G2 compliant equipment

2. Additional Memory – 512 bit
   - Freely add your own information (production date, version ID, process data...)
   - Keep your own numbering system internally

3. ISO 18000- 6 compliant
Global Use – World Wide SCM

- Measurement condition: Free Air
- Antenna: 4 inch for SCM

Broad band coverage!

Cost Saving: One Tag for anywhere in the world!
Future Magic – Serial Interface

Serial interface to µC
- Firmware update
- Activation switch
- ...

VDD in (Battery etc.)
- increased read range!

Possible feature for next generation of Magicstrap® - please let us know your requirements
**Future Magic - Embedding**

*Embed MAGICSTRAP® into the PCB and make it invisible*

1. Perfectly invisible copy protection
2. Space saving

![Diagram of PCB and Magicstrap](image-url)
UHF RFID Magic

- up to 5m read range
- SMT device, fully reflow compliant
- miniature size 3.2 x 1.6mm x 0.55mm h
- 4 generic antenna designs available
- data retention >10 years

read through housing and carton box
Ensure the total process traceability

RFiD tag on PCB

Data collection

Data aggregation
Industrial production line simplified architecture

ERP

MES

SCADA

Transformation Process 1

Transformation process 2

Transformation process N

Raw material

Finished product
Flux link to the transformation process

Transformation parameters
- Date
- T / pressure / humidity
- Process duration
- etc.

To obtain traceability on the sub-product 2, we need:
- Sub product 1 traceability data
- Raw material traceability data
- Transformation parameters
Transformation process example

Step 1 : Solder paste
- Sub product input : PCB nude
- Raw material : solder paste
- Parameters : Time, date, Stencil reference, humidity…
- Sub product output : PCB + solder paste

Step 2 : Pick & Place
- Sub product 1 : PCB + solder paste (Step 1 output)
- Raw material : Components
- Parameters : Time, date,…
- Sub product output : PCB + component side 1
Black box for the industrial tracability

The data collect is done thanks to a black box which performs 3 functions:

- **Data acquisition**
  - on sub-product with RFID reader

- **Parameters acquisition**
  - Communication with production machine
  - External sensors (t, humidity…)

- **Data transfer**
  - to traceability server
  - to EMS/ERP
Black box architecture

Based on Schneider industrial automaton M340

- Dual core ARM9 architecture
- All standard interfaces
  - Ethernet
  - CAN
  - RS485 (modbus…)
  - RS232…
- Memory for internal data logging
- Linux software architecture
- Support large range of RFID reader and other peripherals
TIA - Architecture approach – Step 1

ERP

MES

SCADA

ID + Date

ID + Date

ID + Date

ID + Date

Labelled Raw Material

Final Product
TIA - Architecture approach – Step 3

ERP
MES
SCADA

Traceability service

Labelled Raw Material

Final Product

ID + Date
Process Param

ID + Date
Process Param

ID + Date
Process Param

ID

RFIT Technologies

RFID JOURNAL LIVE! EUROPE 2-4 Nov., 2010 | Darmstadtium Science & Congress Centre
**TIA – RFID challenges**

- **RFID equipped PCB**
  - Finding the right place for the RFID tag
  - The environment around the pcb is changing along the production line ex: radiators / housing / shielding
  
  **we still need to read the tag when packaged**

- **Readers and antennas**
  - Find the most adapted reader and associated antennas
  - Find the most suitable location for reading points along the production line
  - Evaluate reading range and performance of the tag in each situation (single read or multiple read)
TIA – Software challenges

Interconnecting heterogeneous devices and software layers

- Manufacturing machines (proprietary protocols)
  - CAN
  - PLC
  - ModBus

- Interconnection with Auto ID device (standard and proprietary)
  - UHF RFID reader as a first step
  - Hf readers
  - Barcodes / Datamatrix codes readers
  - Cameras
  - Etc.

- Upper layers (SCADA / MES / ERP) (standard and proprietary)
  - Files / Web services / etc.
Perspectives

Developed for the RFID...

...but also for a progressive approach
support: Barcodes, datamatrix...

Developed for the main electronic manufacturer...

...but also adapted to the small OEM
small traceability data base

A better management of the product life cycle:

From the early manufacturing stages to product recycling
THANK YOU