Developments in EPC & RFID in the Forest Products Industry

Erik Sundermann
Wood Supply Chain Optimisation 2010
20th May – Melbourne
25th May – Rotorua

Agenda

1. The Basics of RFID
2. The GS1 Organization & EPC
3. Product Traceability & the EPC Network
4. RFID / EPC in Forestry
Identification Technologies

Bar Code
Optical Character Recognition
Machine Vision
Magnetic Stripe
Smart Cards
Touch Memory
Voice Data Entry
Radio Frequency Data Communications (RFDC)

Radio Frequency Identification (RFID)

Basics of RFID

Tags
Readers
IT Systems
Passive Tag Forms and Styles

Inlays  Labels  Tickets  encapsulated  rugged  Speciality

Readers

Handheld, Fixed, Antennas
**Frequency**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Uses:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Frequency</td>
<td>~125 KHz LF</td>
</tr>
<tr>
<td></td>
<td>- Security (EAS)</td>
</tr>
<tr>
<td></td>
<td>- Access control</td>
</tr>
<tr>
<td></td>
<td>- Proximity to short range</td>
</tr>
<tr>
<td>High Frequency</td>
<td>~13.56 MHz HF</td>
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<tr>
<td></td>
<td>- Item Management</td>
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<tr>
<td></td>
<td>- Asset Management</td>
</tr>
<tr>
<td></td>
<td>- WIP, QA, Production control</td>
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<tr>
<td></td>
<td>- Ticketing vending</td>
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<tr>
<td></td>
<td>- Smartcard</td>
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<tr>
<td></td>
<td>- Proximity to short range</td>
</tr>
<tr>
<td></td>
<td>- ISO15693, ISO14443, ISO18000-3</td>
</tr>
<tr>
<td>Ultra High Frequency</td>
<td>~850-960 MHz UHF</td>
</tr>
<tr>
<td></td>
<td>- Supply chain management</td>
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<tr>
<td></td>
<td>- Item management</td>
</tr>
<tr>
<td></td>
<td>- Transport Logistics</td>
</tr>
<tr>
<td></td>
<td>- Medium to long range</td>
</tr>
<tr>
<td>Microwave</td>
<td>Frequency ~2.4 GHz UHF</td>
</tr>
<tr>
<td></td>
<td>- Real time location services</td>
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<tr>
<td></td>
<td>- Asset management</td>
</tr>
<tr>
<td></td>
<td>- Toll Collection</td>
</tr>
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<td></td>
<td>- Medium to long range</td>
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1. The Basics of RFID
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Improving the efficiency and visibility of supply and demand chains, globally and across sectors.
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GS1 Australia

- Formerly EAN Australia
- Role is to administer & maintain the GS1 System of standards in Australia
- 117 Staff members
- Subscription based organisation
- Current membership 16,500 companies
- Representing in excess of 20 industry sectors

GS1 New Zealand

Annual turnover approx. NZ$4m
Approx. 4500 members companies

23 staff members
Offices in Wellington, Auckland & Christchurch

Not-for-profit organization
Providing ‘standards’ advice, valued added services, consultancy & education

Key focus areas: Retail Supply Chain, Hardware, Health, Primary
Portfolio of GS1 Standards

- Global standards for automatic identification
  Rapid and accurate item, asset or location identification
- Global standards for electronic business messaging
  Rapid, efficient & accurate business data exchange
- The environment for global data synchronisation
  Standardised, reliable data for effective business transactions
- Global standards for RFID-based identification
  More accurate, immediate and cost effective visibility of information

EPCglobal Vision

The Electronic Product Code (EPC)
- Gives a unique identity to individual physical objects:
  items, cases, pallets, locations, loads, assets, etc

Radio Frequency Identification (RFID)
- Cheap sensing of object EPC codes

The Yin and the Yang
- EPC enables new, value-creating business processes
- RFID makes those processes practical
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## What is the EPCglobal Network?

[Diagram of EPCglobal Network]
What is the EPCglobal Network?

Real-time supply chain visibility

This enables high value services, such as
- Track & Trace
- Product Recall
- Anti-counterfeiting
- Health & safety
- Promotions management

Analogy with the Internet’s Architecture

<table>
<thead>
<tr>
<th>World Wide Web</th>
<th>EPCglobal Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNS</td>
<td>ONS</td>
</tr>
<tr>
<td>Authoritative system that routes requests for Web sites and email</td>
<td>Authoritative record of manufacturers that routes requests for product information</td>
</tr>
<tr>
<td>Web Sites</td>
<td>EPC Information Services</td>
</tr>
<tr>
<td>Resource that contains information on a particular topic</td>
<td>Resource for specific information about a product, e.g. date of expiration</td>
</tr>
<tr>
<td>Search Engines</td>
<td>EPC Discovery Services</td>
</tr>
<tr>
<td>A tool for finding Web sites on the network</td>
<td>A tool for finding EPC Information Services on the network</td>
</tr>
<tr>
<td>Security Services</td>
<td>EPC Trust Services</td>
</tr>
<tr>
<td>Provide trusted access control and information sharing</td>
<td>Provide security and access control for EPC product data</td>
</tr>
</tbody>
</table>
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Application: Logistics

Balance Bourbeau (Canada):

RFID system to facilitate the loading, weighing and unloading of logging trucks.

- Active UHF tags (915 MHz) on truck
- Identification of truck during loading / weighing / unloading
- Linked with GPS system (location)
- Benefits: lower operational cost, increased visibility, fuel efficiency
Application: Track & Trace

T.U. Munich (Germany):

RFID-enabled harvester staples tags into logs

- Passive HF tags (13.56 MHz), credit card size, stapled into logs
- Tags read by harvester / forwarder / transporter / processor
- Benefits: increased visibility, more accurate billing

Application: Track & Trace

Cambium Forstbetriebe (Germany):

RFID nails track timber from the time it’s logged until it reaches the sawmill.

- Passive LF tags (125 kHz), embedded in plastic nail, 35mm long, 4mm wide
- Specially designed hammer to pound tag into log
- Wristband reader > PDA > GSM
- Tags read during felling / dragging / transporting / processing
- Benefits: increased visibility, faster & more accurate billing, reduced shrinkage (70%), improved logistics
Application: Traceability

Malaysian Forestry Department:
RFID-based system to meet legal requirements.

- EPC Gen2 UHF tags (860-960 MHz), stapled or nailed to log
- Multiple control points (harvesting, transport, cut into logs, export inspection
- Handheld reader > USB + laptop > GPRS
- UHF allows for high-throughput points
- Benefits: automated documentation & reports, inventory management (both pre- & post-harvest)

Application: Traceability

Indisputable Key (European Union):
System for analyzing the forestry supply chain (incl. RFID)

- Traceability based on automatic individual identification of logs
- EPC Gen2 UHF tags (860-960 MHz), wedge-shaped, applied into the logs
- Readability: 2-3 metres from moist wood, almost 100%
- Prototype automatic applicator developed
- Prototype robust reader for use in harvester
- Read points: harvesting, log sorting, sawing
Indisputable Key

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Indisputable Key (cont’d)

LOG TRACING WITH RFID

- RFID technology development was lead by VTT, co-operation with Tieto, Confidex and Tampere University of Technology.
- Developed new technology for automatic tracing of logs
  - Passive UHF RFID technology (EPC compatible)
  - Transponder materials harness in pulp and papermaking
  - Manual and automatic transponder application onto logs
  - Robust RFID reader for the harvester
  - RFID reader systems customised for saw mill use
- Trials with commercial RFID tags
  - Label tags for board marking
  - Identification of impregnated poles
Indisputable Key (cont’d)

**TRANSPONDER DEVELOPMENT**

- Challenges for the Tags
  - Suitable for automatic identification of fresh logs
  - Hard in all-weather four-season environment
  - Durable and robust tag for good survival in the logs
  - Materials harmless in the pulping process
  - Inexpensive to manufacture
- New Tag Solution (patents pending):
  - passive EPC C1G2 UHF RFID made of artificial wood
  - Reading range 2-3 m from moist logs
  - Tested to be harmless in pulping processes
  - Low water absorption, material harder than most plastics
  - Common mass production methods can be used

Indisputable Key (cont’d)

**TRANSPONDER PERFORMANCE**

- Reading range was measured for moist logs (moisture content ~ 100%)
- 2.5 m at the European UHF RFID frequency
- ~2 m in the US frequency & in Japanese frequency band
- Required reading distance in the mill is approximately 1 m
Indisputable Key (cont’d)

**READER DEVELOPMENT**

- **Challenges**
  - Harsh all-weather four-season outdoor environment
  - Temperatures down to -40°C, rain, snow, mud etc.
  - Operation in the harvester head
  - Vibration and shocks
  - Impacts and spatter
  - Difficult environment for RFID tag reading
  - Large metallic bodies cause reflections

- **Developed robust RFID reader**
  - Water-proof IP67 impact resistant electronics casings
  - Robust mechanical design and shock isolation (50G, 2G@10-2000 Hz)
  - Adaptive RF front end (patent pending)
  - Electronic components specified for -40°C to +85°C
  - Impact protected compact antenna in the applicator arm

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**RFID READERS AT THE SAW MILLS**

- Reader installations over the conveyor or around the conveyor based on commercial readers
- High readability (several tests with 50-1500 logs in different saw mills)
  - >100% of functional tags
  - Including damaged tags ~90-100%
- Readers are integrated into the saw mill data systems
- Measurement data is linked with the logs
- Logs are automatically identified
Indisputable Key (cont’d)

**TRANSPONDER APPLICATORS**

- Manual attachment of the tags to the logs
  - Special tool developed
  - Tag is inserted into the log end
  - ~100 tags/h with 95% success rate
- Prototype of an automatic applicator was developed
  - Automatic insertion of the tag into the log end
  - Application takes about 3-4 s
  - 60 transponder magazine
  - Reading of the ID code for the log with the harvester RFID reader

Indisputable Key (cont’d)

**CONCLUSION**

- Novel EPC Class 1 Gen 2 compatible UHF transponder was developed for marking logs (patents pending)
  - Materials tested to be harmless in pulping processes
  - Reading range ~2.5 m for wet wood
- Prototype of a robust RFID reader for harvesters
  - Vibration and shock resistant
  - Water-proof impact resistant casing
- Manual and automatic applicator prototypes were developed
  - Manual applicator can be used to mark 100 logs/h with ~95% success rate
  - Transponder readability at saw mills is close to 100%
- Log identification rate is approximately 95%
  - Further improvement needed and feasible
- UHF RFID is a promising technology for marking wood and wooden items
Applications: “other”

- Asset & equipment management (e.g. scheduled maintenance)
- Rubber mats used during harvesting
- Monitoring of trees (health, disease, erosion)
- RFID-enabled arboretum / tourist guide
- Artificial fireplace logs - WalMart

Questions?

Erik Sundermann
GS1 - Senior Consultant
Erik.Sundermann@gs1nz.org
+64 9 820 3785