Enabling technologies for logistics

An NGIL/VISITEC result presented by Olle Hydbom, RFIDConstructors AB
Key aspects of Next Generation Logistics

- **Visibility**
  - Technology strategy, Return of Investment,

- **Risk management**
  - Handle Volatilities, Thefts, Terrorism, Counterfeit

- **Flexibility**
  - Quick response, Adaptivness

Questions related to these kinds of topics may be answered by NGIL projects in due course, or earlier if properly funded!
The VISITEC project

Purpose:
- to provide a technology base for NGIL and its partners.
- to identify technology gaps that could be profitably filled by Swedish industry.

- Phase 1: State-of-the-Art overview and seminar
- Phase 2: Publication
- Phase 3: Facilitate new NGIL projects
The VISITEC project objectives

Investigate technologies for:
- Positioning
- Identification
- Status and authenticity

We do NOT look into:
- Communication
- Application (Operations) layer software and systems
The technology available today

<table>
<thead>
<tr>
<th>Barcode</th>
<th>RFID</th>
<th>SatNav/MobTel</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
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</tbody>
</table>

@ factory in China
@ road or rail
@ sea or air
@ terminal
@ road or rail
@ loading dock
in warehouse in Sweden

In transit
Basic positioning system topologies

- Pull technology – Centralized, the positioning infrastructure system interrogates the labelled object

- Push technology – Decentralized, the labelled object decides when it should announce its position to the infrastructure positioning system
Indirect vs. Direct Positioning

Object ID

Reader Position

ID + Position

Decision Support System

Object ID & Position

ID + Position
Positioning basics

In range

In cell

Triangulation

• / ● = Reference beacon (Base station, Access Point etc.)
Positioning technologies

- Any text on label: 5m – 0.1m
- Bar Code label: 2m – 0.1m
- Passive RFID tag: 5m – 0.1m
- Active RFID Tag: 50m – 0.1m
- Light based systems (laser): 1m – 0.01m
- SRLS (e.g. WLAN based): 300m – 1m
- Mobile Telephony (GSM/3G/…): 10000m – 40m
- Satellite Navigation (GPS/Galileo/…): 40m – 0.015m
Positioning device/system properties

Functionality | Error rate | Labour cost | Pos. device cost | Incremental cost/read

- Any text on label
- Bar Code label
- Passive RFID tag
- Active RFID tag
- Light based systems
- SRLS
- Mobile Telephony
- Satellite Navigation
ID technologies

- Handwritten text on labels
- Printed text on labels
- Bar Code labels
- Light based (LNP, hologram, ...)
- Chipless (RF)ID (SAW, ...)
- Passive RFID tag
- Active RFID Tag
- Short Range Location Systems (RTLS(WiFi) etc.)
- Mobile Telephony (GSM/3G/...)
- Satellite Telephony
ID device/system properties

- Functionality
- Error rate
- Labour cost
- ID device cost
- Incremental cost/read

- Handwritten labels
- Printed labels
- Bar Code labels
- Light based
- Passive RFID tag
- Active RFID Tag
- Short Range Location System
- Mobile Telephony
- Satellite Telephony
Where are you today?

And where do you want to go next?
Package level vs. ID/positioning technology

<table>
<thead>
<tr>
<th></th>
<th>Component</th>
<th>Item</th>
<th>Case</th>
<th>Pallet</th>
<th>Container</th>
<th>Water/Rail/Road/Air vehicle</th>
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</thead>
<tbody>
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<td>Labels</td>
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<tr>
<td>Land Mobile Tele.</td>
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<tr>
<td>Satellite Navigation</td>
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<tr>
<td>Satellite Telephony</td>
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</table>
RFID and TREC (Secure Trade Lane) can complement each other by connecting an RFID reader or a handheld to the TREC as a sensor.

- Container level tracking can be expanded to pallet level, case level, and even item level tracking.
- As a result, the exact content of a container will be known.
The TREC acts as a central point of control that can authenticate the source of evidence and implement access control to the evidence.
Pictures of current device
Complementary ID/Pos. technologies

- Tags with integrated reader
- Traditional RFID tags with strong encryption
- Traditional RFID tags with User Interface
- Printed RFID tags with displays
- Mobile phones with RFID reader
- Mobile phones with built-in GPS
- Hand writing input to computers
- ...
What technologies should we expect to use for tracking objects in 5 years from now?
Disruptive technology shifts

performance/cost ~ benefit

Chipless ID

RFID

barcode

now

time
Barcode vs. RFID

**Barcode**
- Fixed data
- Line of sight
- Single read
- Standardized EAN
- Article #
- Volume prod. now
- Low price

**RFID**
- Changeable data
- Out of sight
- Multi read
- Standardized EPC
- Article + Serial #
- Volume prod. now
- Medium price
Chipless ID & authentication

- LCR-circuits (e.g. EAS, microwave strips,…)
- Magnetism
- SAW
- RFID Ink
- UV/IR pigment (e.g. Luminescent Nano Pigments)
- Synthetic DNA
- Printed structures beyond bar-codes on paper
- Microdots
## Sensor modules for the future?

<table>
<thead>
<tr>
<th>Property</th>
<th>Value for logistics sector</th>
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</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>food, pharma., dangerous goods,</td>
</tr>
<tr>
<td>Moisture</td>
<td>food, pharma., clothes, electronics,</td>
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<tr>
<td>Chemicals</td>
<td>dangerous goods, food,</td>
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<tr>
<td>Bacterial growth</td>
<td>fragile goods transports,</td>
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<tr>
<td>Shock, Accel, Vibration</td>
<td>fragile goods transports,</td>
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<tr>
<td>Tilt</td>
<td>loading</td>
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<tr>
<td>Load pressure</td>
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<td>Radioactivity</td>
<td>anti terrorism &amp; crime,</td>
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<td>Gas pressure</td>
<td>pharma, brand labels,</td>
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<tr>
<td>Intrusion</td>
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<tr>
<td>Authenticity</td>
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### Sensor modules for the future?

<table>
<thead>
<tr>
<th>Property</th>
<th>exists today</th>
<th>expected “tomorrow”</th>
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Technology Enablers

- Nanotechnology, sensing and processing
- Ubiquitous computing, low cost processing
- The Internet of things, IPv6 + operators
Drivers

- Network based defence, terrorism & int’l crime
- Global warming (CO$_2$-declarations)
- Regulation drives technology
- Globalization - demands global visibility
- Plug-and-play supply chains - need partner-independent visibility infrastructure
# What to use in 5 years?

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In transit:

- @ road or rail
- @ sea or air
- @ terminal
- @ road or rail
- @ loading dock
- in warehouse in Sweden
Application examples

- Tracing and Authenticity verification of pharmaceuticals
- Fresh food quality tracking
- Multimodal transport
- Demand driven supply chains
- Secure Trade Lanes
- Vendor managed inventory
- Supply chain collaboration
- 100% correct inventory status
- Track and correct for 100% JIT
- Total Asset Visibility
- MIT – Merge in Transit
- Network based defence
- Allocation in transit
- Sensor Driven Logistics
- Transit visibility
Chilled food supply chain example
Scandinavian Shuttle

- Delivery precision
- Time control
- Multi modal
Scandinavian Shuttle
100% Just in Time with road/rail kombi

- All load units and vehicles equipped with GPS + Mobile Phone
- Reports position status in real time to the Reliability Control Centre
- Back up system along the transport route stands by for contingency actions
- All deviation corrected immediately

Values for industry and society:
- Real-Time position and status of the goods
- Correction of deviations for 100% on time deliveries
- Added security decreases insurance cost of goods
- Fast recovery of lost or stolen assets
- Makes kombi transport with rail or short sea as reliable as road transport
- Less impact on global warming
- Less congestion and accidents on roads
Thank you!

from

Olle, Sten, Luca, Daniel, Niklas & all our interview victims.