Making physical objects "intelligent" - the case of tracking and tracing

DIALOG project
Distributed Information Architectures for collaborative LOGistics
Outline

• How to connect physical objects to virtual counterparts (agents)
• Item identification
• Tracking and tracing application
• Tracking and tracing demonstration
• Ubiquitous access to product data
• Future focus areas and conclusions
Underlying ideas

• Every "physical object" should possess a "virtual counterpart" (agent) during its whole life-cycle
• "Physical objects" can be goods, shipments, machines, vehicles, homes, humans, ...
• Agent handles:
  – Information about its physical counterpart (location, user instructions, service records etc.)
  – Service lookup (transport, assembly, maintenance, …)
  – Other transactions (payment, access control, …)
How connect physical object to virtual counterpart?

- Physical object must be uniquely identified
- The identification has to give sufficient information about where the agent is located
- Location of agent is typically an Internet address, a Uniform Resource Identifier (URI)
- At least two approaches can be used:
  1. Looking up the URI from a “name server”
  2. Integrating the URI in the identifier itself
Auto-ID Center approach

• MIT Auto-ID center and Dialog have many similar goals
• Links objects to agents by a 96-bit Electronic Product Code (ePC), Object Naming Service (ONS) infrastructure
• Product Markup Language (PML) for product information
• Strengths of Auto-ID system:
  – Strong support and interest from industry
  – ONS can handle redirection of product information
• Potential weaknesses of Auto-ID system:
  – Requires acceptance of new standard (ePC)
  – Requires new ONS infrastructure
  – May present technological challenges (amount of data and network traffic, managing add/delete operations in ONS etc.)
DIALOG approach

- **ID@URI**: the ID part is unique at the given URI, URI unique by definition -> **globally unique identifier**
- Strengths of DIALOG system:
  - Uses existing standards -> operational **now**
  - Doesn’t need third-party infrastructure (new name servers, for instance)
- Weaknesses of DIALOG system:
  - Supposes that URI does not change owner (should be relatively rare)
Current implementation area

• Tracking and tracing of international project deliveries

• Developing models and tools for:
  – Global, company-independent tracking of sendings
  – Global, multi-company project management
  – Ubiquitous product data management (PDM) through the whole product life-cycle
Third-party based item tracking in global project management

- Tracking only when handled by one single transportation company
- Difficult access to tracking information
- Automated follow-up of delays only with proprietary systems
Open item tracking in global project management

- Tracking active for all companies involved in the delivery
- Information about delays sent directly to project co-ordinator, where it can be automatically treated
Ubiquitous access to product data

• Life-cycle covering PDM – from planning and fabrication to disposal and recycling
• Product identification (RFID, bar code, ...) and URI (Uniform Resource Identifier) are sufficient to access product information anywhere where a reader and Internet are available
• Product information can also be updated through appropriate interfaces, defined by user profiles (quality control, maintenance, ...)
Ubiquitous access to product data

Electric motor, manufactured by XXX, last serviced ...

I am a pizza made of ..., heat me for 1 minute at 600W

I am bus stop XXX, next bus for your destination arrives in 3 minutes
Technology

• Internet – location of object and agent can be different
• Lightweight software components using Java, distributed programming
• Currently used identification technologies:
  – Barcode
  – RFID
• Future technologies
  – Java-enabled RFID tags
  – BlueTooth
  – Mobile phones, others
Future focus areas

• Technology:
  – Embedded devices
  – Mobility and service lookup
  – Security

• Application areas:
  – Flexible delivery control
  – Intelligent machines in industry
  – Negotiating objects in intelligent homes, towns etc.
## Applications for Dialog

### Benefits

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<th>Active products through life-cycle</th>
<th>Active products in delivery chain</th>
<th>Passive products</th>
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<td><strong>COST:</strong></td>
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### Who are doing?

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<th>Metso Automation</th>
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**Forwarder Independent Tracking**

**COST:** Reduced need for warehousing

**SERVICE:** Complete deliveries

Wider product range

**COST:** Single maintenance records

**SERVICE:** Enhanced product performance measurement

Customised aftersales services

**Merge In Transit**

**COST:** Automation, no manual monitoring

**SERVICE:** Enhanced delivery performance measurement

Increased delivery accuracy

Enhanced customer service

**COST:** Reduced need for warehousing

**SERVICE:** Complete deliveries

Wider product range

**COST:** Single maintenance records

**SERVICE:** Enhanced product performance measurement

Customised aftersales services
Conclusions

• Globally unique identifier that connects physical objects and their virtual counterparts
• Software components exist for basic operations
• Lightweight solutions (low installation overhead, scalability)
• Proof-of-concept from first ongoing industrial pilot case
• Number of application areas almost infinite