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.)

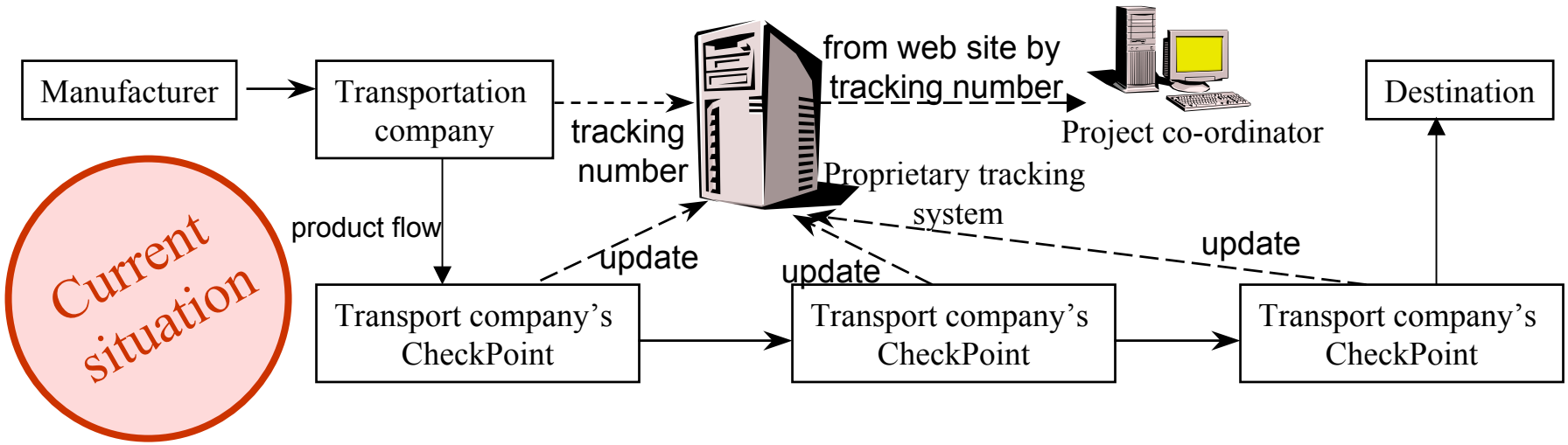
DIALOG approach

- **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

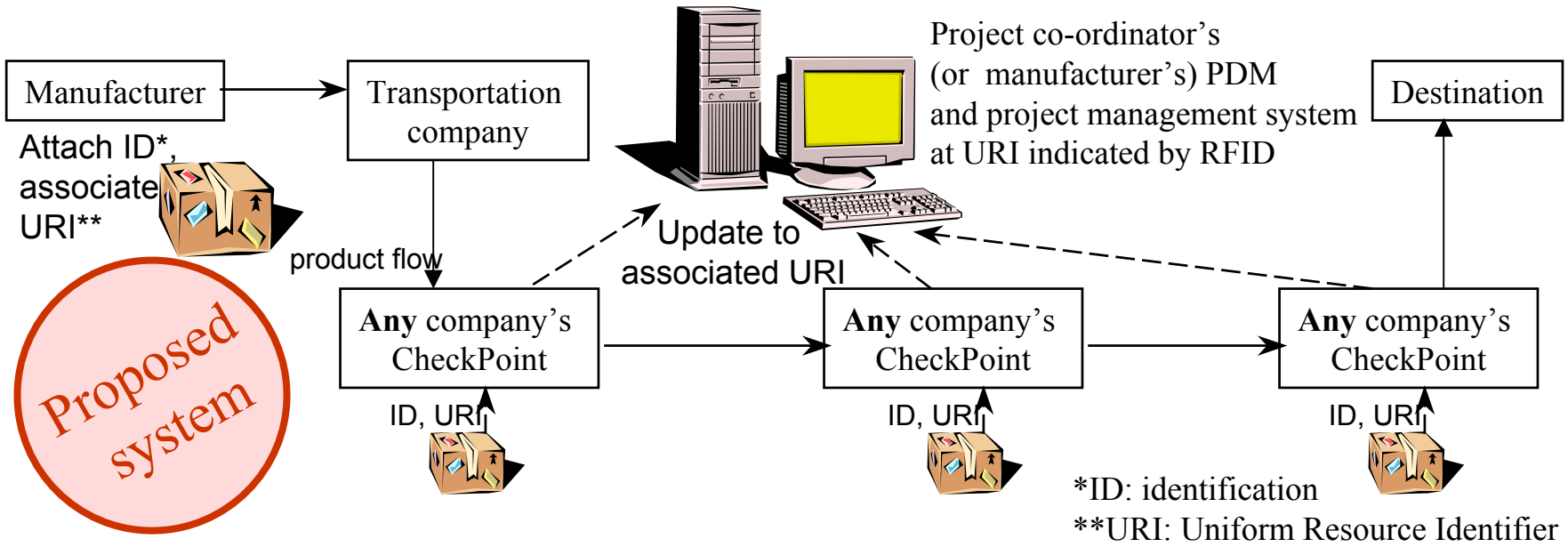
- Tracking and tracing of international project deliveries
- Developing models and tools for:
  - Global, company-independent tracking of sendings
  - Global, multi-company project management
  - Ubiquitous product data management (PDM) through the whole product life-cycle

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

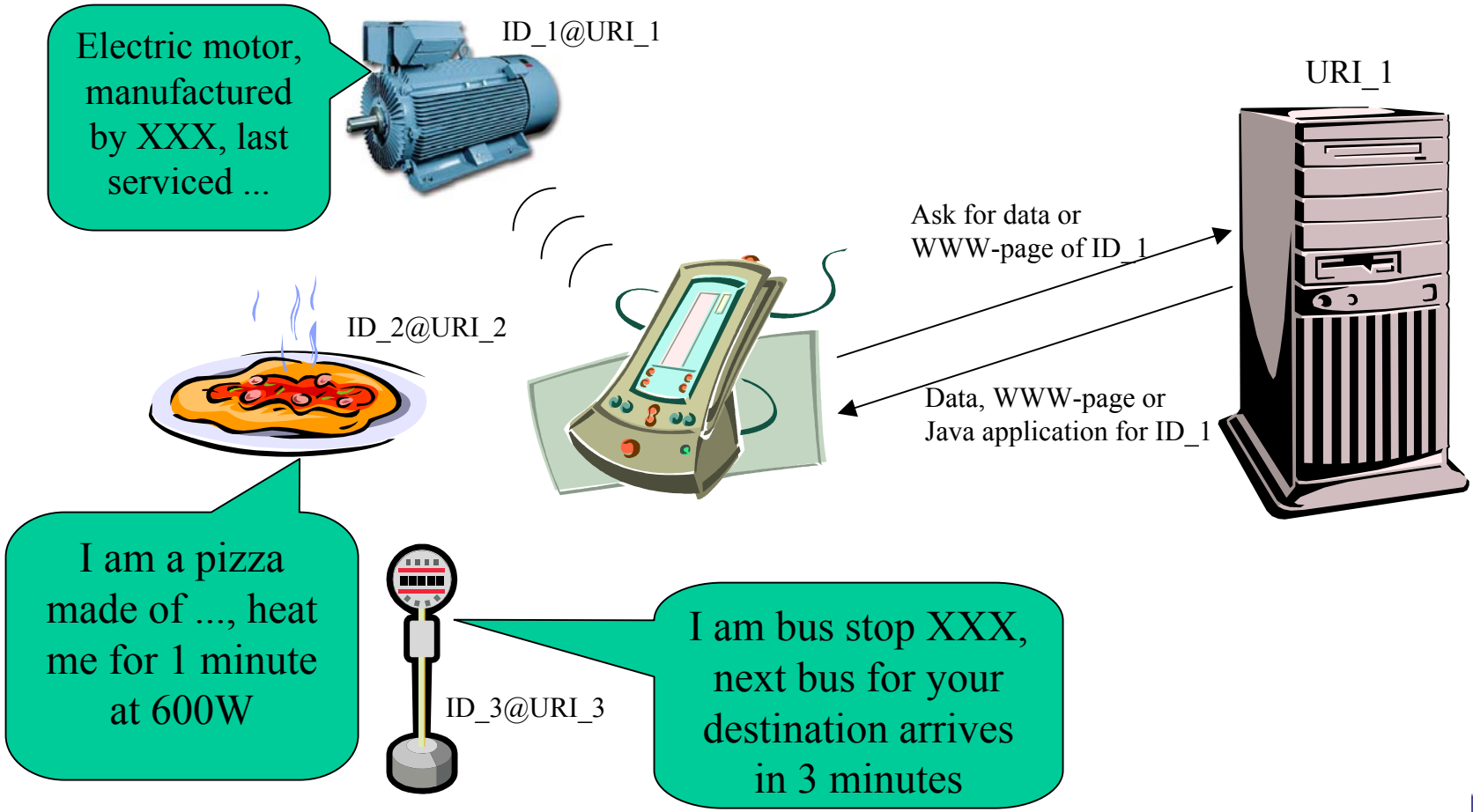


- Tracking active for all companies involved in the delivery
- Information about delays sent directly to project co-ordinator, where it can be automatically treated

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



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

	Forwarder Independent Tracking	Merge In Transit	Product Life-Cycle Support
	Passive products	Active products in delivery chain	Active products through life-cycle
Benefits	**COST:** • **Automation, no manual monitoring** **SERVICE:** • **Enhanced delivery performance measurement** • **Increased delivery accuracy** • **Enhanced customer service**	**COST:** • **Reduced need for warehousing** • **Potential in transportation cost** **SERVICE:** • **Complete deliveries** • **Wider product range**	**COST:** • **Single maintenance records** **SERVICE:** • **Enhanced product performance measurement** • **Customised aftersales services**
Who are doing?	**HIIPS,** **SAVI Technologies**	**Hansel,** **Dell, HP, Cisco**	**Metso Automation**

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