intelligent cargo

The next revolution in logistics

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Past logistical revolutions

› ERP / DRP

› EDI

› On board computers

› Supply Management systems

› GPS / Mobile communication
Past logistical revolutions

- **ERP / DRP**
  For shippers rather than for carriers
- **EDI**
  Engineered individually
- **On board computers**
  Often isolated application
- **Supply Management systems**
  Only when control is centralised
- **GPS / Mobile communication**
  Non structured data
Present technological developments
› RFID, Internet of Things
› Webservices (integration technology)
› Model Driven Development (of information systems)
› Mobile computing
› Product centric information systems

Information systems can communicate on a technical level
Semantical protocols are still hand-crafted
Challenges

› Open infrastructure for Tracking and Tracing (technical and semantical)
› Protocol for semantical handshaking
› Translating business requirements into semantic level communication systems
Open Tracking and Tracing
Open Tracking and Tracing

› Each individual unit (product, pallet, container, truck) has a **record** in some **database**
› The ID number of the unit identifies both the **database** and the **record**
› *Any* checkpoint can scan *any* unit and upload information to the record of this unit
› Any authorised person or system may query information on any unit
From location-centric to product-centric systems

Location-centric:
Recording of transactions on quantities of Stock Keeping Units

Product-centric:
Recording of events that happen to individual products or units of transport
Product flow-centric vs. Enterprise-centric systems

- Current ERP systems have great difficulties to store and use information on individual product or transport unit level
- Difficulties increase when products and units of transport are somehow related to each other
- Relations between units may be very dynamic, especially in logistics (packing/unpacking pallets, loading/unloading trucks etc.)
- A product flow-centric approach offers an easy and extensible solution for tracking and tracing of units of transport
Events include:

- Manufacturing
- Assembling and Disassembling
- Picking and Packing
- Loading and Unloading
- Departing and Arriving
- Buying and Selling
- Scrapping and Disposing

Queries include:

- Where is item 123?
- Who is the owner?
- What are the contents of container 456?
- When will item 123 be available?
- What are its components?
- How was item 123 recycled?
Upload

Add type of event, time, location, temperature, etc.

Propagation of data from the database with information on the box to the database with information on the product

T&T Server Node

Internet

Box Info

Product Info

T&T Server Node

Product P inside Box B

RFID, barcode or manual observation

T&T Client

Add type of event, time, location, temperature, etc.
Querying

Where is box 456?

Where is product 123?

Product 123 is in Box 456

Box Info

T&T Server Node

Internet

T&T Server Node

Product Info

T&T Query Client

Product 123 is in Box 456
Challenge: Manage Semantics

- At design time it cannot be foreseen:
  - What information must be held for what product or unit of transport (location, time, temperature, colour, ...)
  - How products and units of transport may be related (assembly, packaging, ownership, location, ...)
- A semantical handshake protocol is needed between clients and servers
Unit 123 has a Temperature of 5 °C

What is a ‘Temperature’? A kind of Measurement?

Yes, a Temperature is a Measurement with a unit of °C

OK, Temperature is added as attribute for this type of unit
Unit types may have properties

› A property is a relation to another unit type or to a data type (e.g. Text, Date, Number, Measurement)

› Relations to other unit types may be:

› Relations to data types may be Length, Colour, Temperature, Production Date, Product Code, Shipping Location, etc.

› A unit type is defined by its set of properties
Definition of new unit types by constraining properties

- A new unit type is defined by a set of constraints on the properties of an existing type.

- A further specialised type inherits the constraints of its "parent" and adds new constraints.
Unit types have properties

› **Transport Equipment:**
  • Has a relation to one or more other type of units
  • Has a Length
  • Has a Description Document

› **Container__ Transport Equipment:**
  • Contains Products or Transport Units

› **40ft__ Sea__ Container__ Transport Equipment:**
  • Length = 40 ft
  • Description Document = ISO 90
Definition by constraints

> Allows all systems to communicate
  • Legacy systems simply fill existing properties with the defined values
  • New systems define the new unit types as new concepts
> Allows enhancement of the stored information on-the-fly
  • Handshake protocol works at run time and peer-to-peer
> Avoids tedious and time consuming standardisation or negotiation of data elements
Model driven application development

- Semantical handshaking enables users to incrementally enhance systems on the fly
- ’Traditional’ Model Driven Architectures automate the generation of systems by using advanced design tools
- MDA saves programming effort, but not design effort
- Open T&T implements user requirements at run time
- Whenever new types of information are needed or are available, the user may define it. The system then propagates the new information throughout the network

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The need for open T&T

› The world economy is more dynamic than ever
› A open sustainable economy needs an open tracking and tracing system; products need to be tracked and controlled from cradle to cradle
› All businesses, big and small, will need to co-operate in order to manage product (and service) lifecycles
› Open T&T with flexible semantics are the only solution

Open T&T will grow from a “nice to have” to a “must” for every business

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