intelligent cargo

The next revolution in logistics

› Fred van Blommestein

› Hans Wortmann

fred@flowcanto.com

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

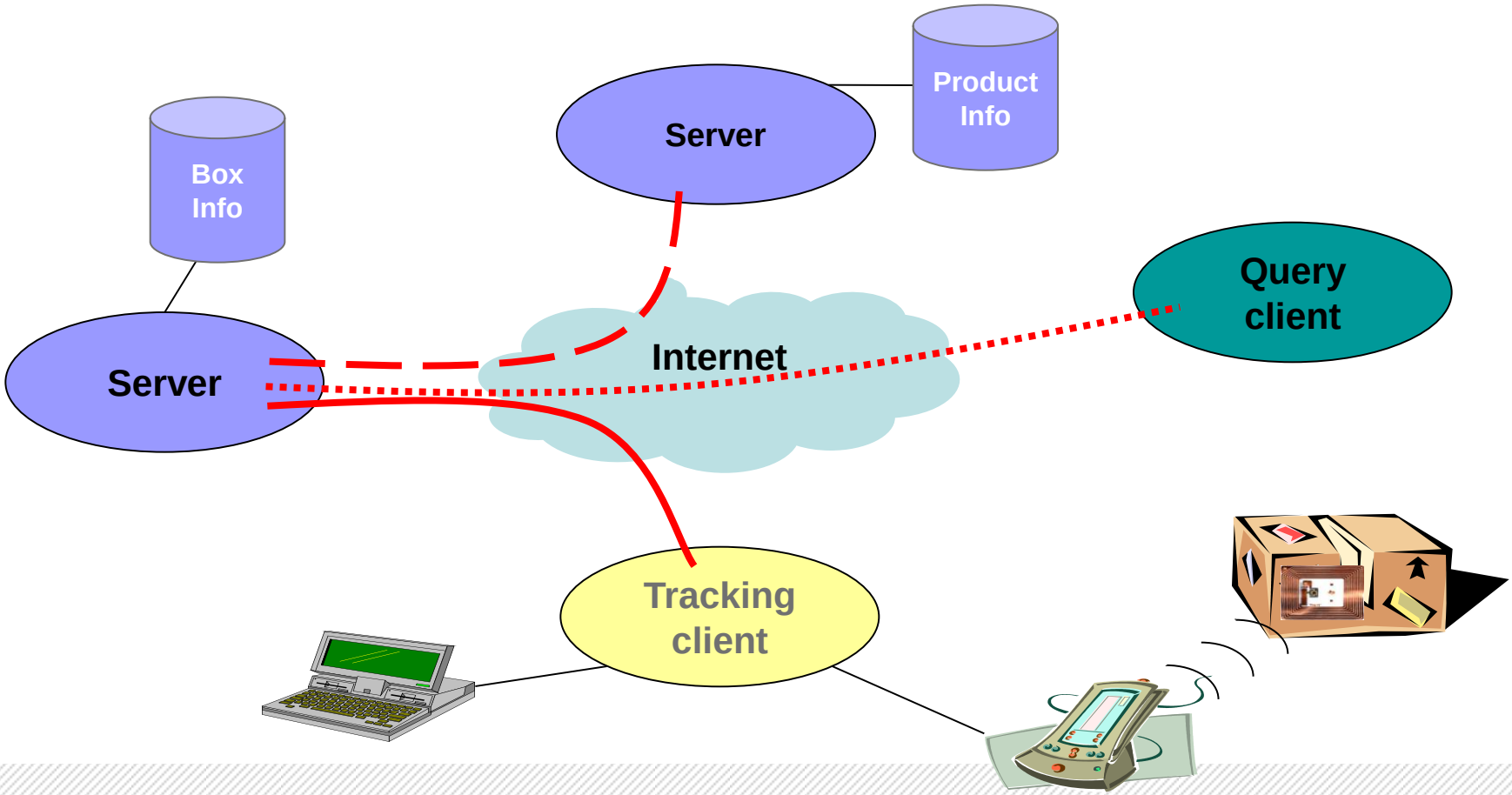
Information systems can communicate on a technical level

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

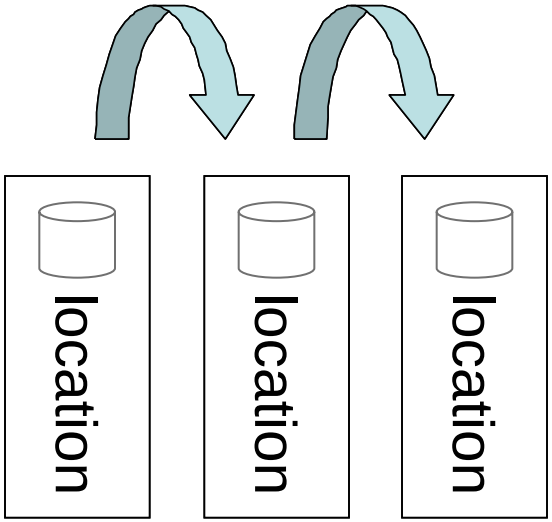


fred@flowcanto.com

Open Tracking and Tracing

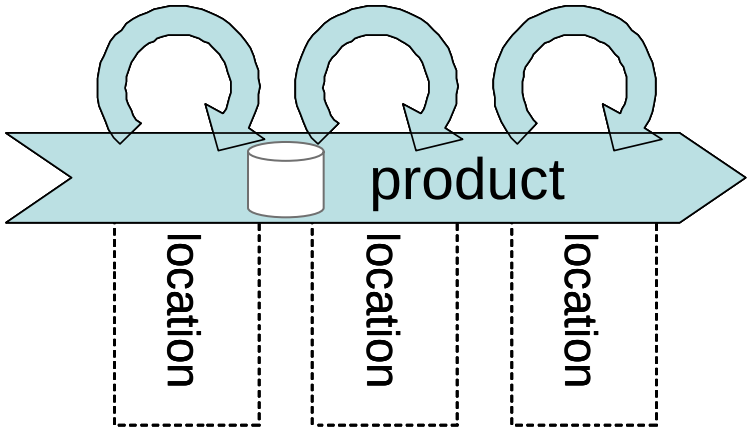
- Each individual unit (product, pallet, container, truck) has a **record** in some **database**
- The ID number of the unit identifies both the **database** and the **record**
- ***Any*** checkpoint can scan ***any*** unit and upload information to the record of this unit
- Any authorised person or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

From location-centric to product-centric systems



Location-centric:

Recording of **transactions**
on quantities
of **S**tock **K**eeping **U**nits



Product-centric:

Recording of **events**
that happen to
individual products
or units of transport

fred@flowcanto.com

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

fred@flowcanto.com

Events include:

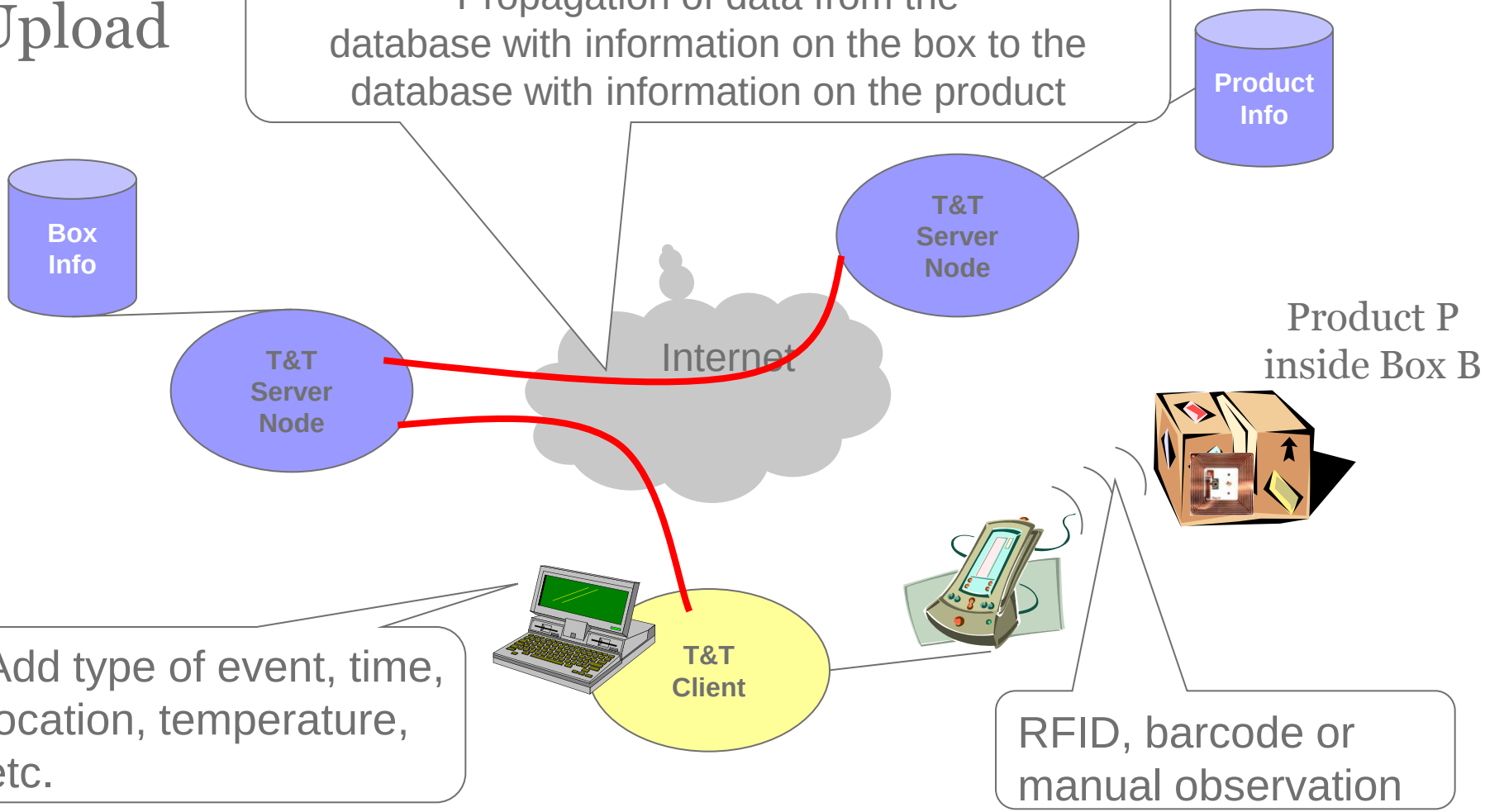
- Manufacturing
- Assembling and Disassembling
- Picking and Packing
- Loading and Unloading
- Departing and Arriving
- Buying and Selling
- Scrapping and Disposing

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

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



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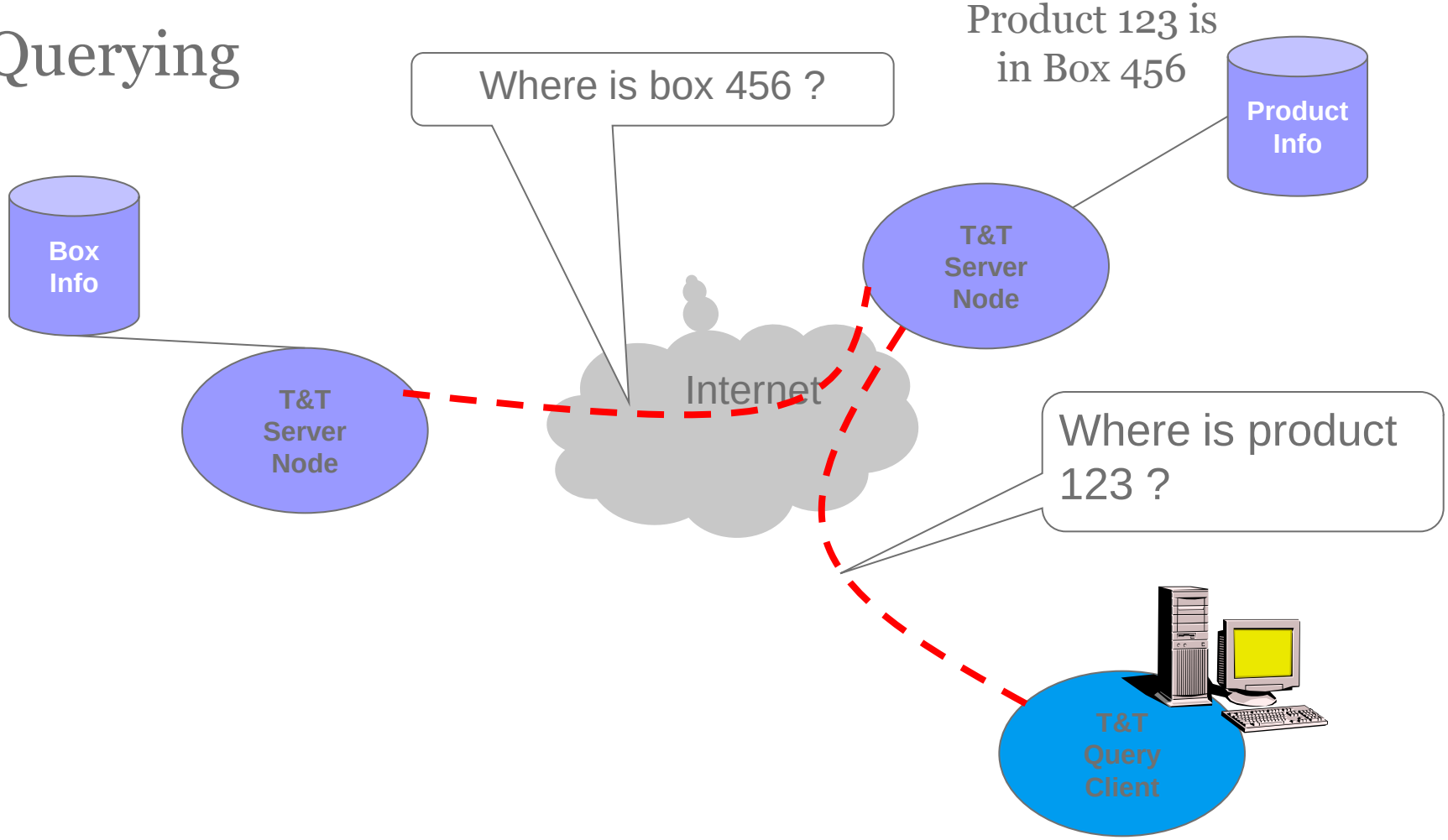
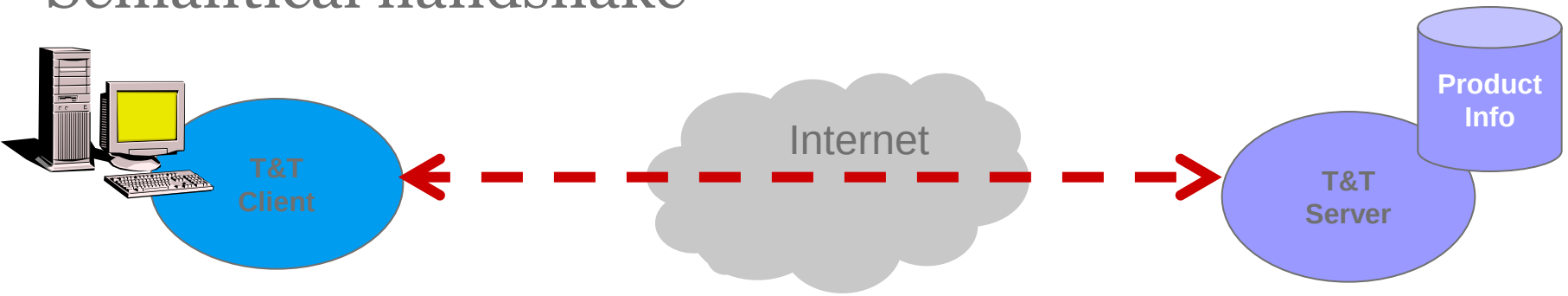
Querying


Product 123 is in Box 456
Where is box 456 ?
Product Info
Box Info
T&T Server Node
T&T Server Node
Internet
Where is product 123 ?
T&T Query Client

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

Semantical handshake



Unit 123 has a Temperature of 5 °C

What is a 'Temperature'? A kind of Measurement?

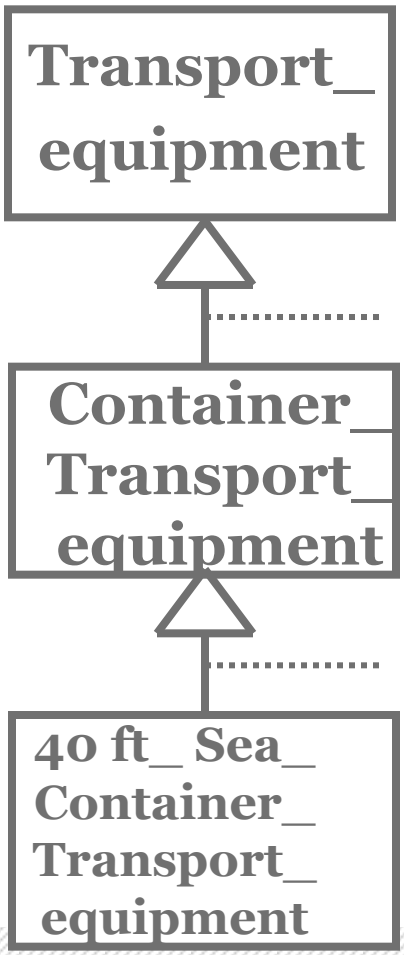
Yes, a Temperature is a Measurement with a unit of °C

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:
  Is Packed In – Is Part Of – Is Carried With – Is Stored In – Is Owned By – Is Located At – Is Made Of – etc.
- 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



Constraint:
Contains Products and/or transport units

Constraint:
Length=40 ft according ISO90

- 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

fred@flowcanto.com

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

fred@flowcanto.com

rijksuniversiteit groningen

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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