ACTIVE Summer School

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The Intelligent Cargo Concept
in the European Project EURIDICE

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Content

- Why EURIDICE
- The EURIDICE vision and message
- What is Intelligent Cargo
- Architectural approach

The Project

(WHY)

EURIDICE: European Inter-Disciplinary Research on Intelligent Cargo for Efficient, Safe and Environment-friendly Logistics

FP7 ICT, Integrated Project, budget > 14 M€, duration 3 years since Feb. 2008

- Objective: to make cargo "intelligent", i.e.: self-aware, context-aware and connected to support a wide range of information services.
  This will allow to:
  - Monitor, trace and safely handle moving goods at the required level of detail, from full shipments to individual packages or items.
  - Increase efficiency of transportation networks, by improving synchronization between logistic users, operators and control authorities.
  - Improve sustainability of logistic systems, by reducing their impact on local communities in terms of traffic congestion and pollution.
- Results (so far):
  - High level architecture specifications.
  - Services library, Context Model and cargo-related information sources identification.
  - Pilot user requirements from different stakeholders (industry, logistics, authorities and infrastructures).
- Events
  - Intelligent Cargo Forum launched, open to logistic users, technology providers and researchers.
  - Annual "ICT in Transport Logistics" conference (this year in Venice, 29-30 Oct. 2009).
  - More info at www.euridice-project.eu

# The logistics industry

- **Extreme fragmentation**
  - Majority of SMEs, average turnover in EU: 430 k€ (src. EC DG TREN)
  - The world leader DHL controls 5% of total traffic
  - Large players subcontracting most low-value activities (e.g., DHL subcontracts over 70% transport).
- **Labour intensive, low margins**
  - 2.6 million workers in road freight transport (src. EC DG ENT)
  - Value-added per employee in EU: 33 k€ (src. EC DG TREN)
- **Commodity vs. value-added service**
  - Advanced services (3PL, intermodal) have yet to take off
  - SCM process and information mostly in the customer hands, i.e., the "cargo owner" (industry, distribution).
- **Sustainability challenges**
  - Trucks absorbing 35% of total road-fuel production with an expected increase to over 40% by 2030 (source "World Energy Outlook 2006").
  - Transport-related CO_2 emissions at 23% and rising.
- **Regulatory pressures**
  - The community pays for infrastructures (trucks account for 50% of motorway traffic)
  - Citizens suffer pressures on fuel prices, congestion in cities and road safety problems.

ICT innovation for the logistics industry: EC ICT for Mobility Strategic Research Agenda
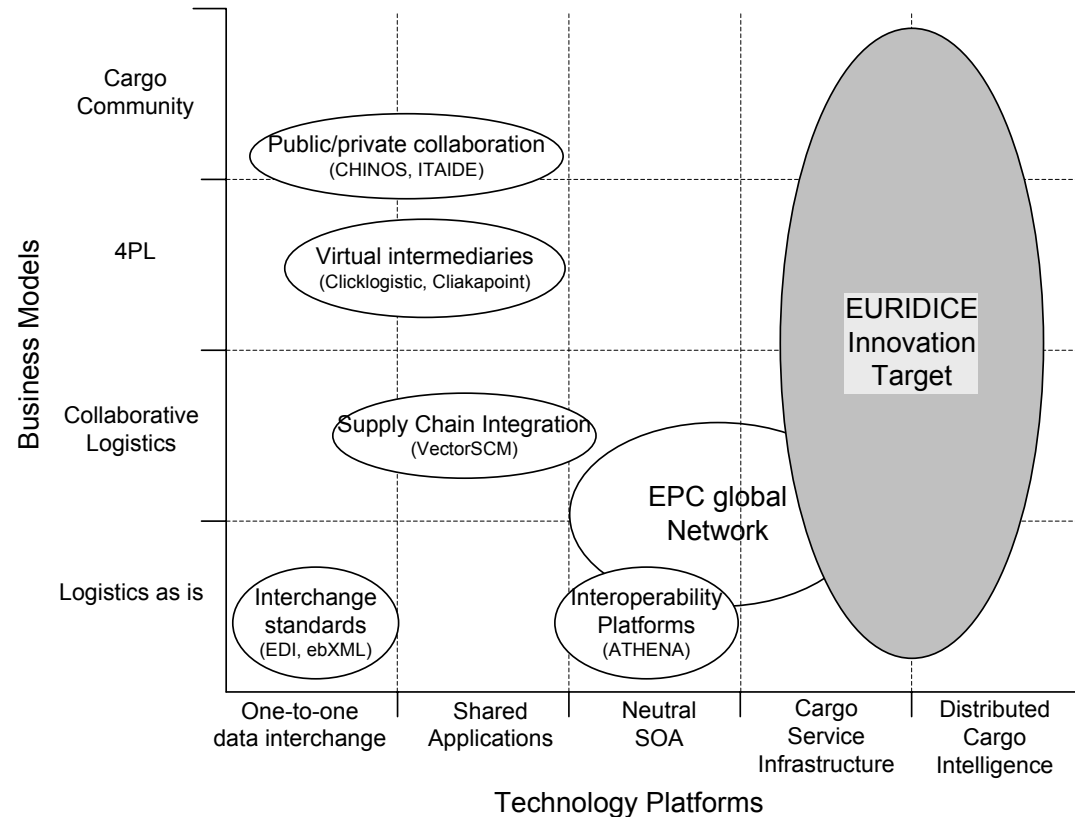
Mobility Services for Goods

- Creating a seamless efficient (goods) mobility service system using ICT as an enabler.

- Exploiting RFID and ICT platforms as critical component and architecture.

- Urban logistics supported by network management.

- High level of liable security and of adequate tracking and tracing.

All of this is technologically possible. Why isn't it happening already?
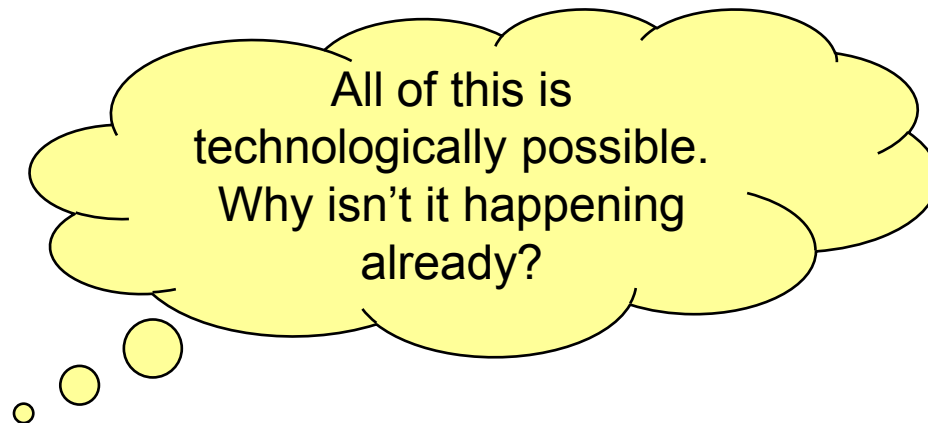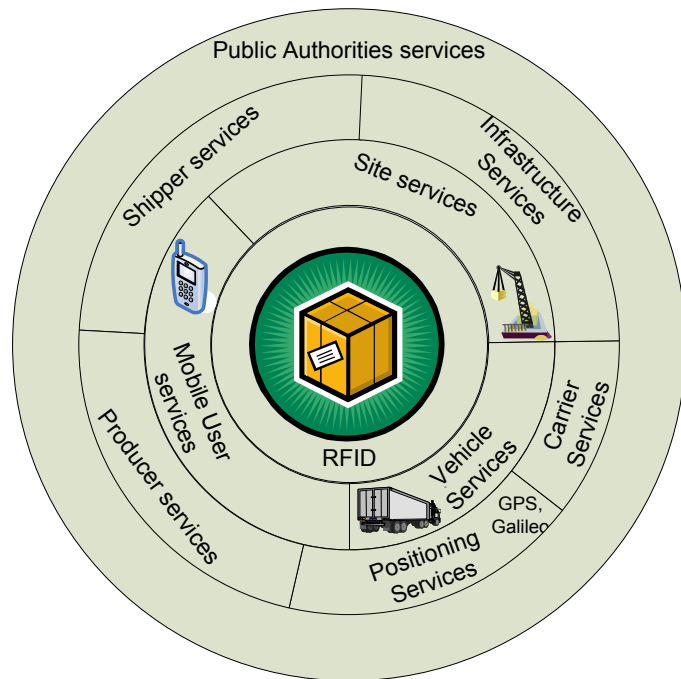
EURIDICE approach vs. state-of-the-art

EURIDICE intends to fill the **existing gap** between technical feasibility and adoption of ICT services platforms for goods mobility, by coordinating S/T research in two directions:

- Structured approach to technology innovation, harmonizing and filling gaps between existing technologies and aiming at the **intelligent cargo** as unifying concept.

- Holistic perspective on the **business models**, that considers both traditional and innovative logistic models, while looking explicitly at the cargo communities operating at the local and global levels.
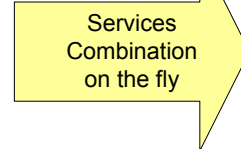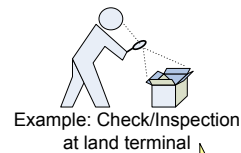
Business Models

- Cargo Community
  - Public/private collaboration (CHINOS, ITAIDE)
- 4PL
  - Virtual intermediaries (Clicklogistic, Cliakapoint)
- Collaborative Logistics
  - Supply Chain Integration (VectorSCM)
  - EPC global Network
- Logistics as is
  - Interchange standards (EDI, ebXML)
  - Interoperability Platforms (ATHENA)

EURIDICE Innovation Target

One-to-one data interchange | Shared Applications | Neutral SOA | Cargo Service Infrastructure | Distributed Cargo Intelligence
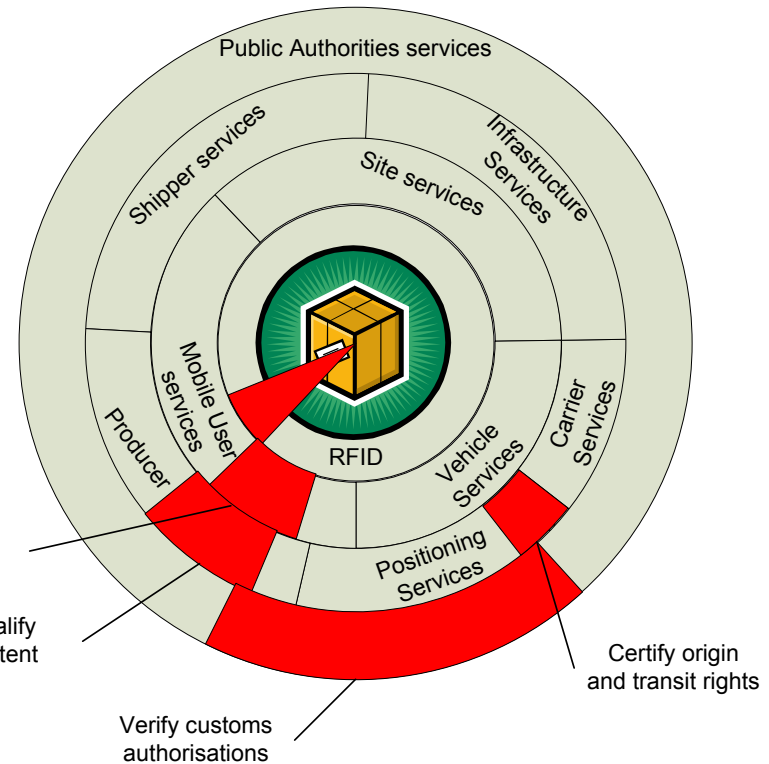
Technology Platforms

EURIDICE Intelligent Cargo vision

"In five years time, most of the goods flowing through European freight corridors will be 'intelligent', i.e.: self-aware, context-aware and connected through a global telecommunication network to support a wide range of information services for logistic operators, industrial users and public authorities."

Example: Check/Inspection at land terminal

Services Combination on the fly

Identify shipment

Qualify content

Certify origin and transit rights

Verify customs authorisations

Cargo-centric Information Services Infrastructure
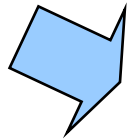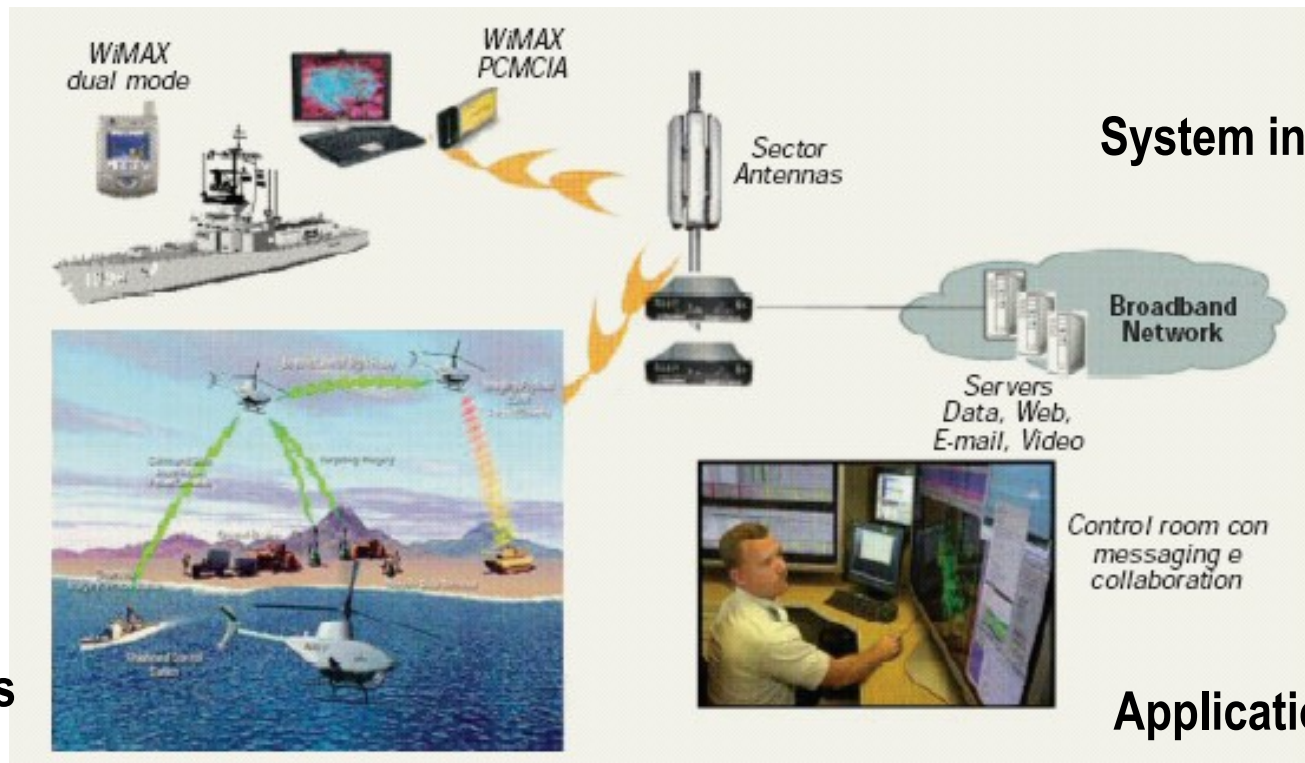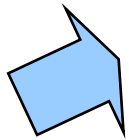
User and context specific interaction

The Vision and Message

ICT for goods mobility today:
Cutting-edge technologies for top demanding customers

Technology vendors

System integrators

IT departments
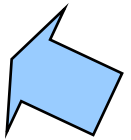
Application vendors

Target : high value goods, with special requirements
(precious, dangerous, perishable, needed just-in-time, …)
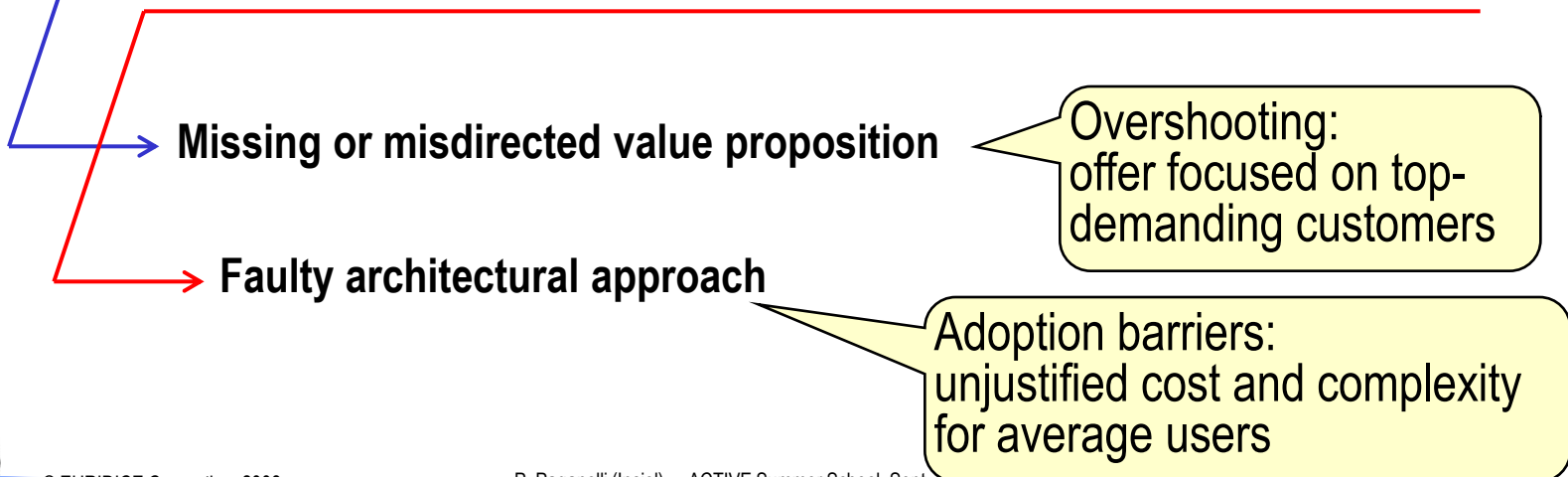
What about goods that are neither precious nor special?
What services are needed by the majority of logistic users and operators?

What services are needed by the majority of logistic users and operators?

- A qualified answer: "nothing, thank you!"
- "Governments should stop wasting money in goods traceability projects: no one cares about that"

  President of Assologistica (Italian Association of Logistic companies)
  23/4/08, speech at Politecnico of Milano convention on Logistics in Port

- Why:
  - "Because operators already have all the data they really need."
  - "Traceability across operators would force us to link our information system into a 'system of systems'.. costly and hardly achievable."

Missing or misdirected value proposition

Faulty architectural approach

Overshooting:
offer focused on top-demanding customers

Adoption barriers:
unjustified cost and complexity for average users

Finding our own "elevator speech"

- "Pleased to meet you …"

  - ▓ "In five years time, most of the goods flowing through European freight corridors will be 'intelligent', i.e.: self-aware, context-aware and connected through a global telecommunication network to support a wide range of information services for logistic operators, industrial users and public authorities."

  - 👽 "(we are building) a cargo centric information chain that offers automated end-to-end information about the logistic supply chain based on existing technologies and standards combined with intermediating trusted third parties."

    …

  - ☺ "We provide this ❶product for these ❷customers to achieve these ❸benefits."

1. The product

- We provide:
    - Information infrastructure / platform? (too vague)
    - Hardware / software tools / systems? (too limited)
    - (yet another) process / data integration platform? (not true)

"We provide cargo information services .."

The customers: Who cares about the cargo being intelligent? → Who is target of our value proposition?

Strongly interested
Interested
Mildly interested
Neutral
Hostile

Cargo Owner (Manufacturer, Distributor) | 3PL (Logistic Outsourcer) | Authority | Carrier | Terminal Operator | Shipping Agent
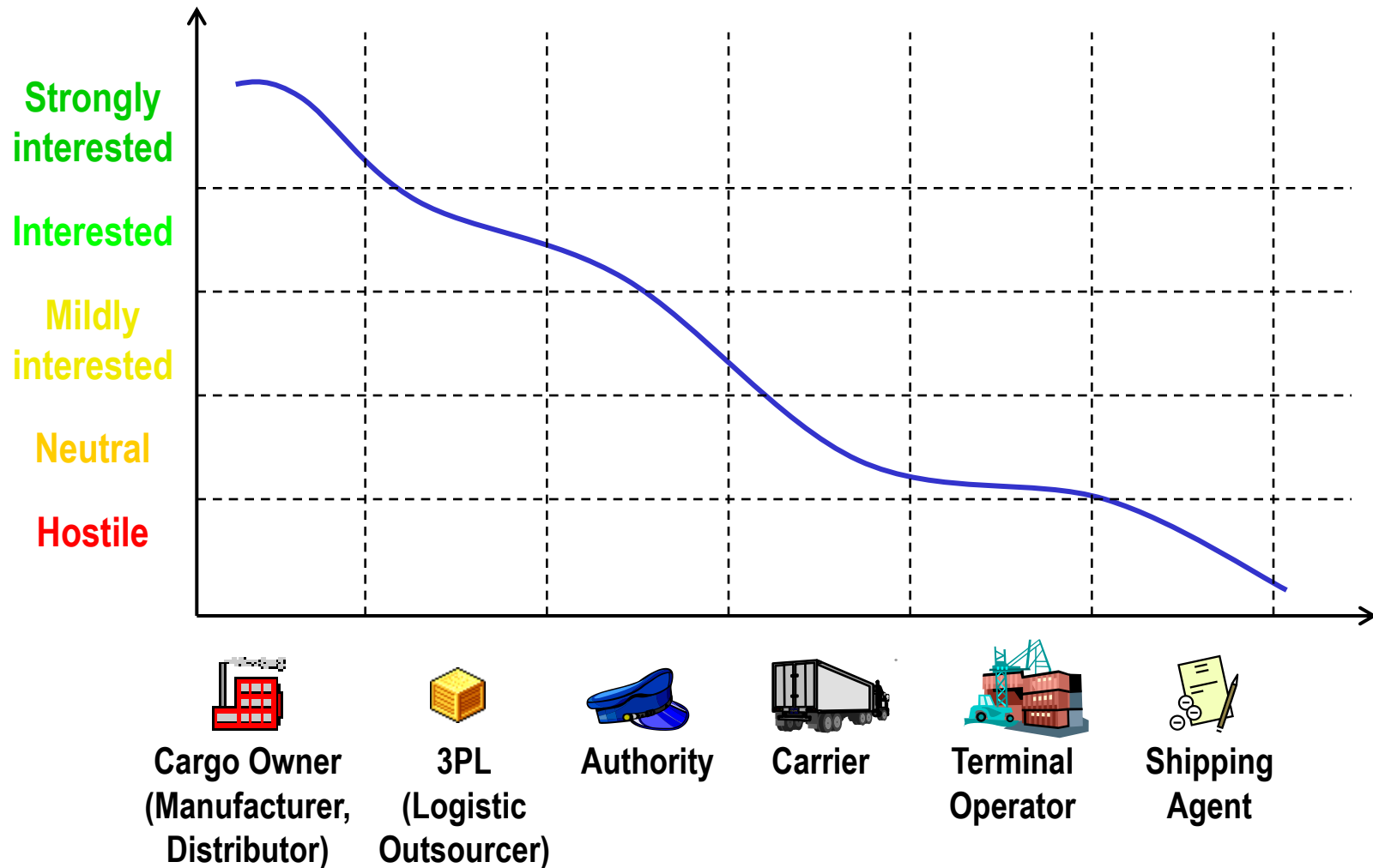
Approach to the market

- Bring about a paradigm shift by promoting the Intelligent Cargo approach across the widest audience of users.

- There is not an "intelligent cargo" product.

- Different intelligent cargo capabilities require different implementation models:

  - Basic capabilities should be available as public domain services for all the intelligent cargo users.

  - Specialized capabilities should be developed for specific purposes by individual users or groups of users to fulfill specific application requirements.

- There is not a single "intelligent cargo" user:

  - Need to carefully analyze value produced across the transport chain ("Who cares"?).

  - Need a convincing value proposition for all the involved actors.

Value proposition pitfalls

- Some apparently good targets are hostile or neutral at best
  - Shipping agencies, terminal operators, carriers.
  - Misdirected value propositions can be found behind some past failures.
- Aiming at individual targets is not enough
  - The intelligent cargo concept, like other similar approaches, builds on cooperation between different actors.
  - Among the necessary actors some will find no value in the interchange, at least at the beginning (e.g., small carriers).
  - Other motivations/levers can be attempted to convince them, but a good business architecture should work by itself (frictionless).
- Importance of finding the right architectural approach
  - Maximize the value for those who care.
  - Minimize the burden for those who don't care.

2. The customers

- Our customers:
    - Logistic companies
    - Cargo owners / shippers
    - Authorities / infrastructures ? (not customers, more providers / users)

"We provide cargo information services for logistic and industrial companies .. "

3. The benefits

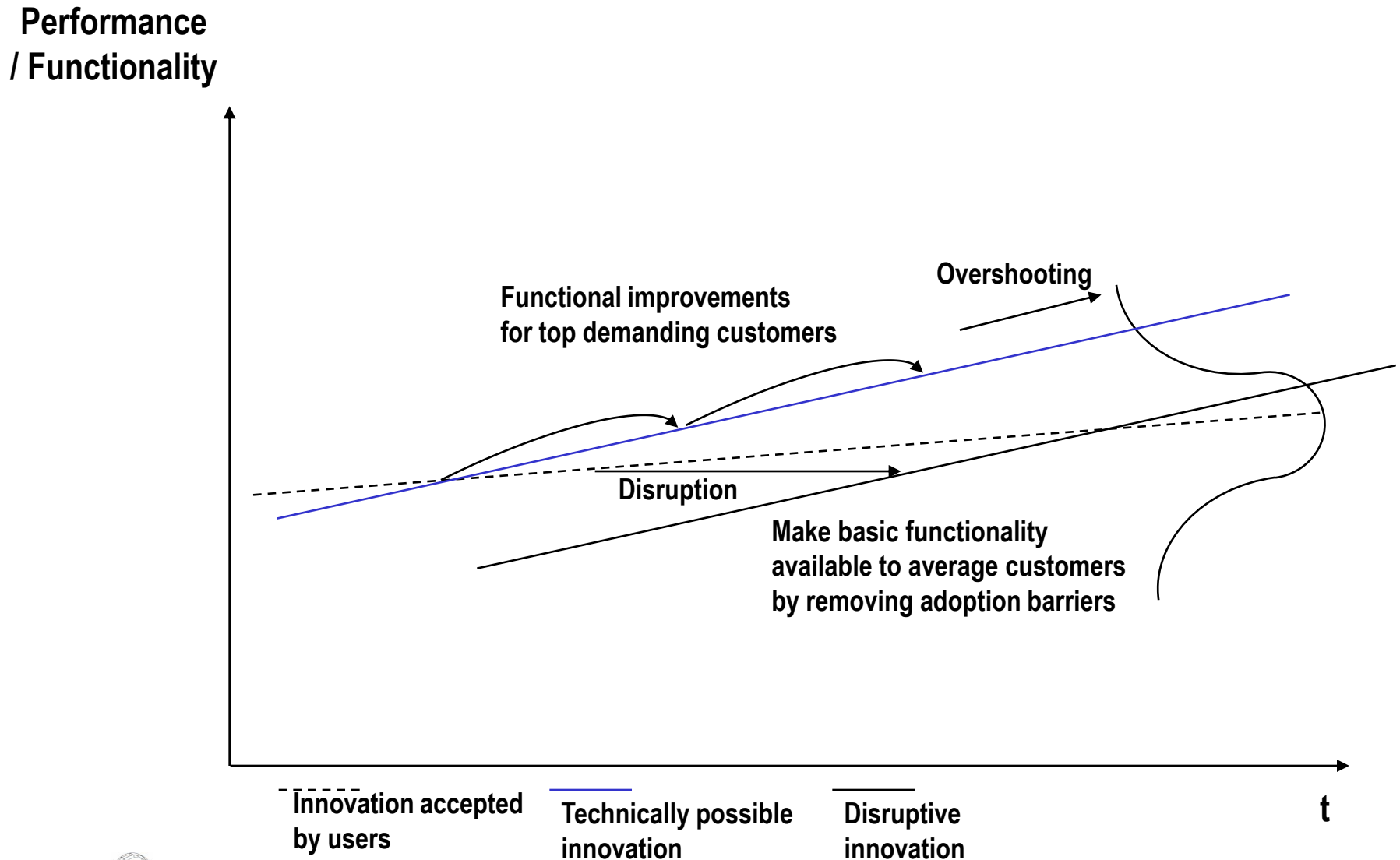- What is our value proposition?
    - Cargo-centric
    - Open (not proprietary), based on existing technologies and standards combined with intermediating trusted third parties
    - End-to-end information train
    - Option to use the EURIDICE architecture gradually, depending on the needs and available resources
    - …
- Need to translate this into user value

→ Blue Ocean "Value Innovation" approach

Application ideas

- Ubiquitous track & trace functionality, based on events communicated bottom-up by moving freight items.

- Cargo-initiated, completely automated transit verification and authorization procedures.

- Supply chain event management based on thing-to-thing interaction and embedded intelligence, where cargo itself has the primary responsibility to detect and handle unexpected events and to escalate to a human operator if needed.

- …

- … and many more applications that Euridice S/T research will make possible.

Performance / Functionality

Overshooting

Functional improvements for top demanding customers

Disruption

Make basic functionality available to average customers by removing adoption barriers

Innovation accepted by users

Technically possible innovation

Disruptive innovation

t

The EURIDICE message

"We provide cargo information services for logistic and industrial companies that can be activated at low cost and work with any logistic partner along any transport route. "

Our mission:

"Providing cargo information services for all"

Our market
(go for the biggest catchment!)

All users

Basic cargo services
- Identification
- Positioning
- Monitoring
- ….

Tagged goods **+** Mobile / Fixed Terminals

Integration services **+** Application services

Services authoring & delivery

Large enterprise users

Service Providers

P. Paganelli (Insiel) – ACTIVE Summer School, Sept. 6, 2009
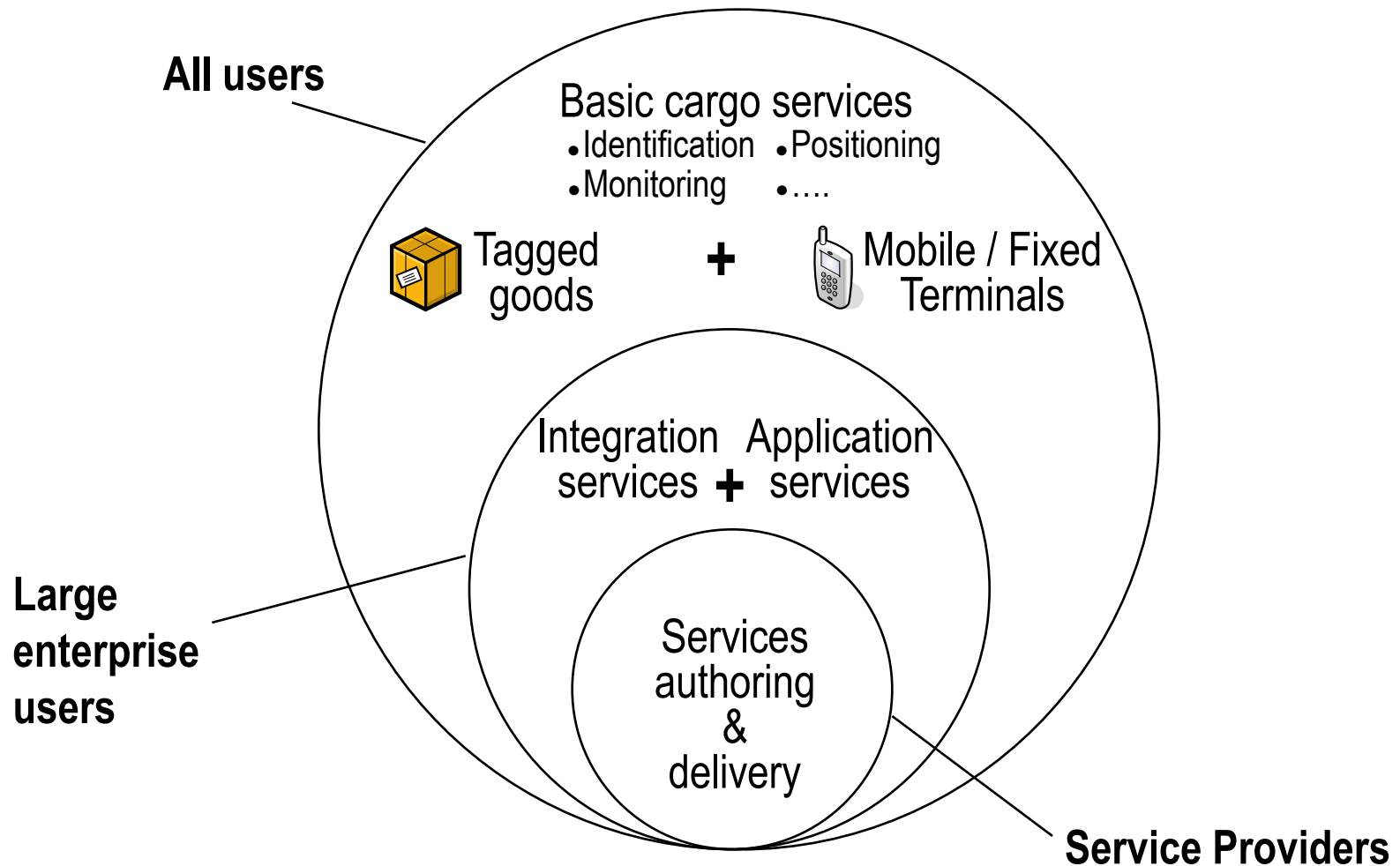
ICT for goods mobility tomorrow

Users

Ad-hoc services combination

Goods

Basic services
- Identification
- Positioning
- Std. processes (bill of lading, proof of deliv.,..)

Object Recognition and Positioning Hosted European Service
ORPHEUS

Advanced services
- Integration
- Authoring
- Orchestration

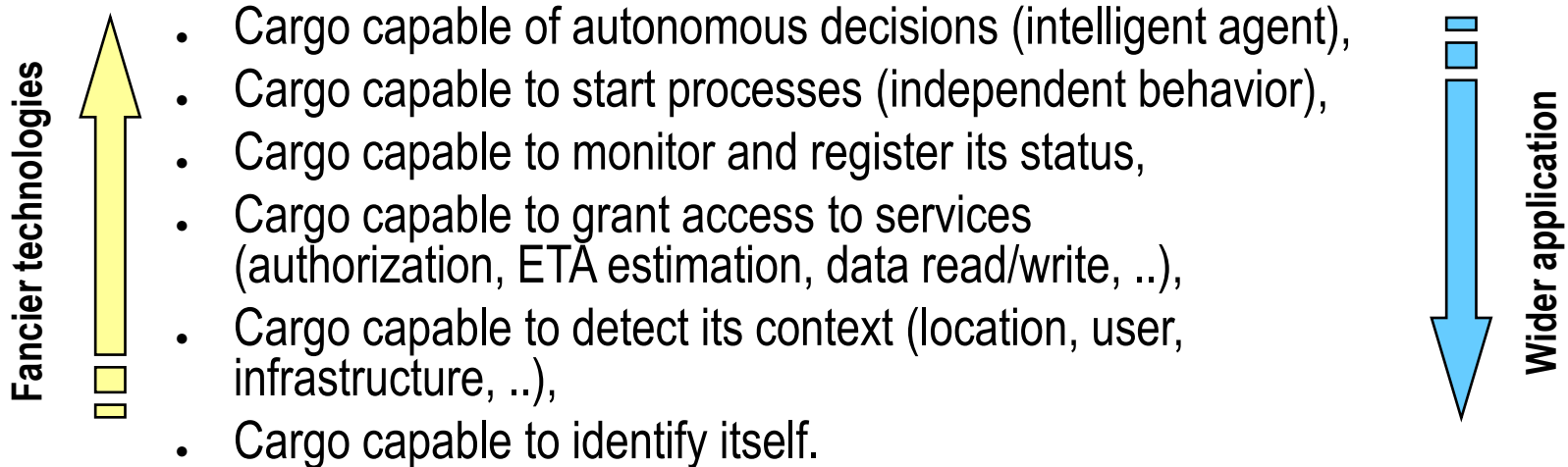**Enterprise Services / Third Party Services**
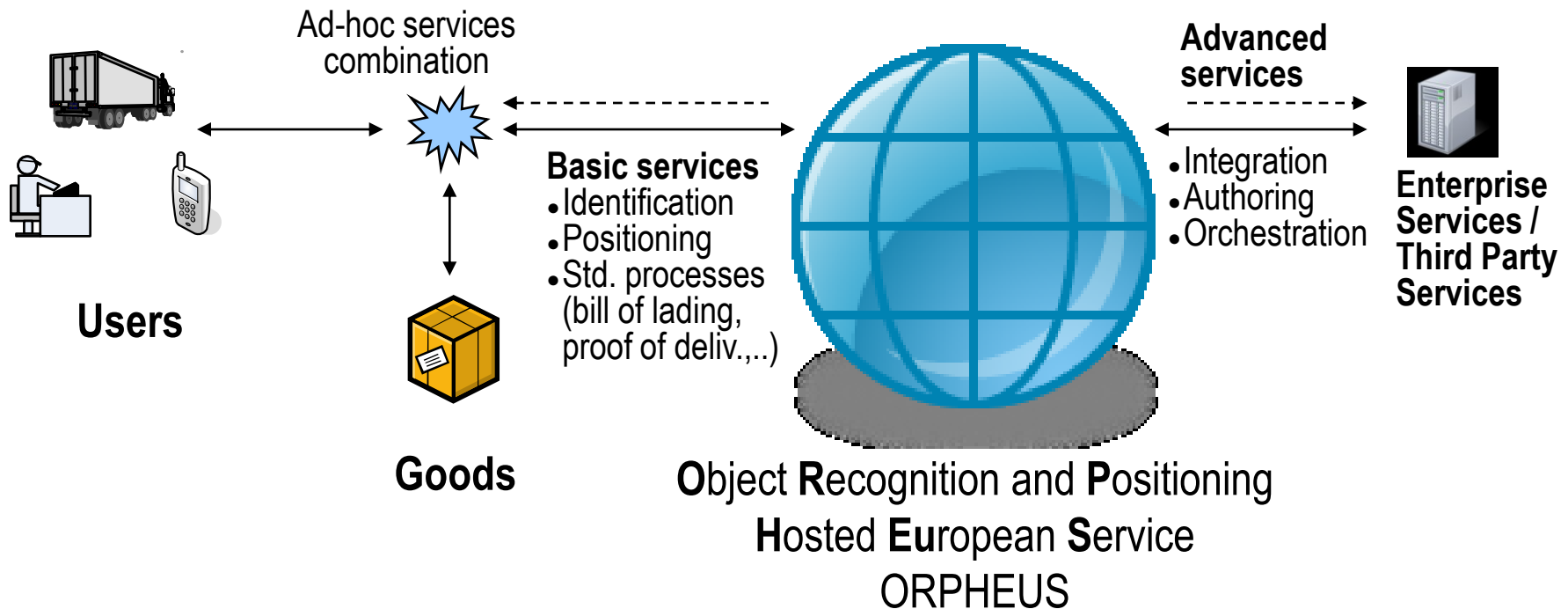
Intelligent cargo = self-identifying, easy to interact and communicate with

What is Intelligent Cargo

(HOW)

What does "Intelligent Cargo" mean?

- The technological innovation dimension <u>is not</u> sufficient to define Intelligent Cargo.

  Smart tags, sensor networks, distributed intelligent agents, …

- Defining Intelligent Cargo requires a second dimension of architectural innovation, to highlight changes from the users perspective.
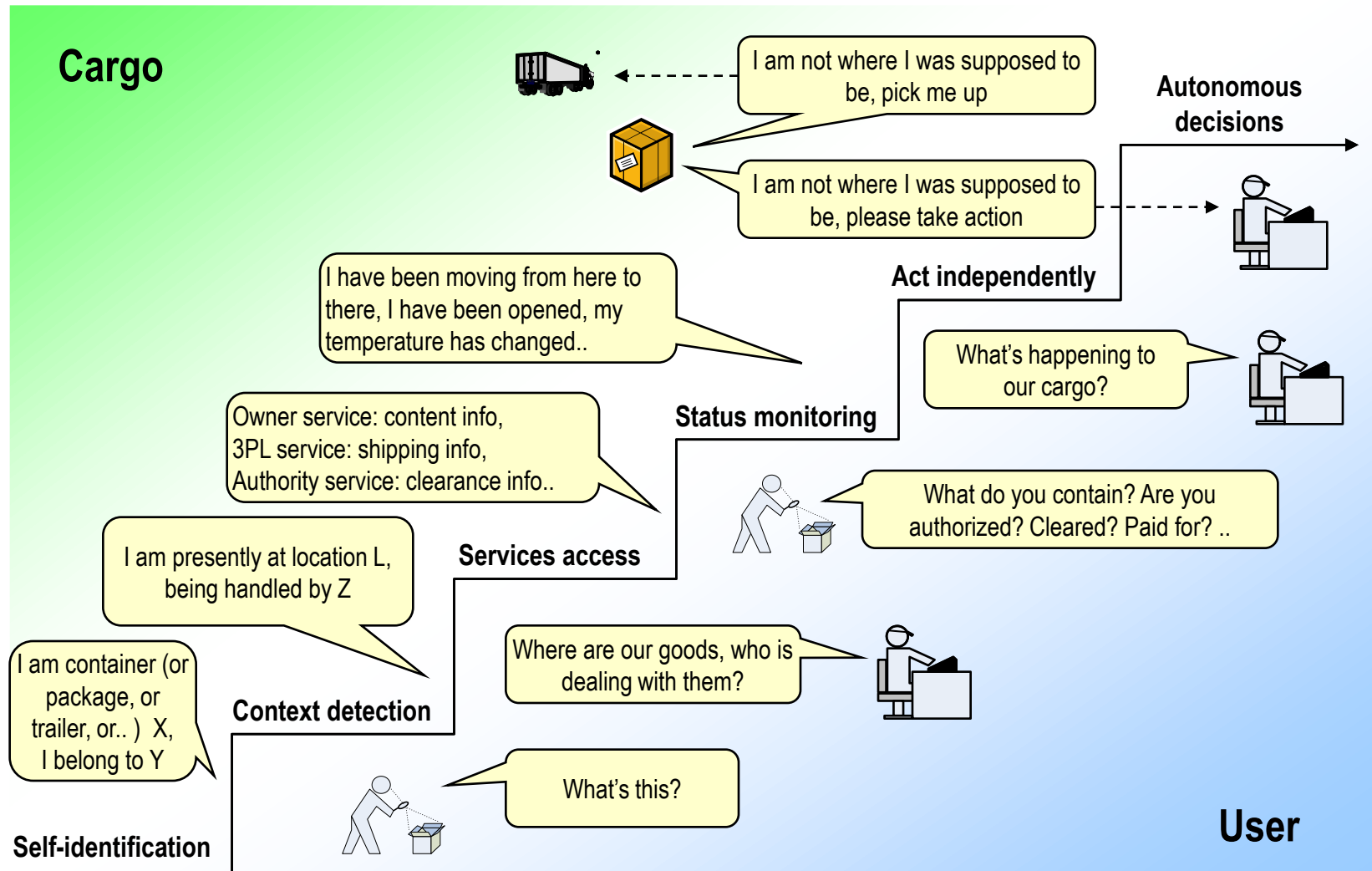
- EURIDICE list of **intelligent cargo capabilities**:

Fancier technologies

Wider application

- Cargo capable of autonomous decisions (intelligent agent),
- Cargo capable to start processes (independent behavior),
- Cargo capable to monitor and register its status,
- Cargo capable to grant access to services (authorization, ETA estimation, data read/write, ..),
- Cargo capable to detect its context (location, user, infrastructure, ..),
- Cargo capable to identify itself.

Intelligent vs. "dumb" cargo, basic capabilities

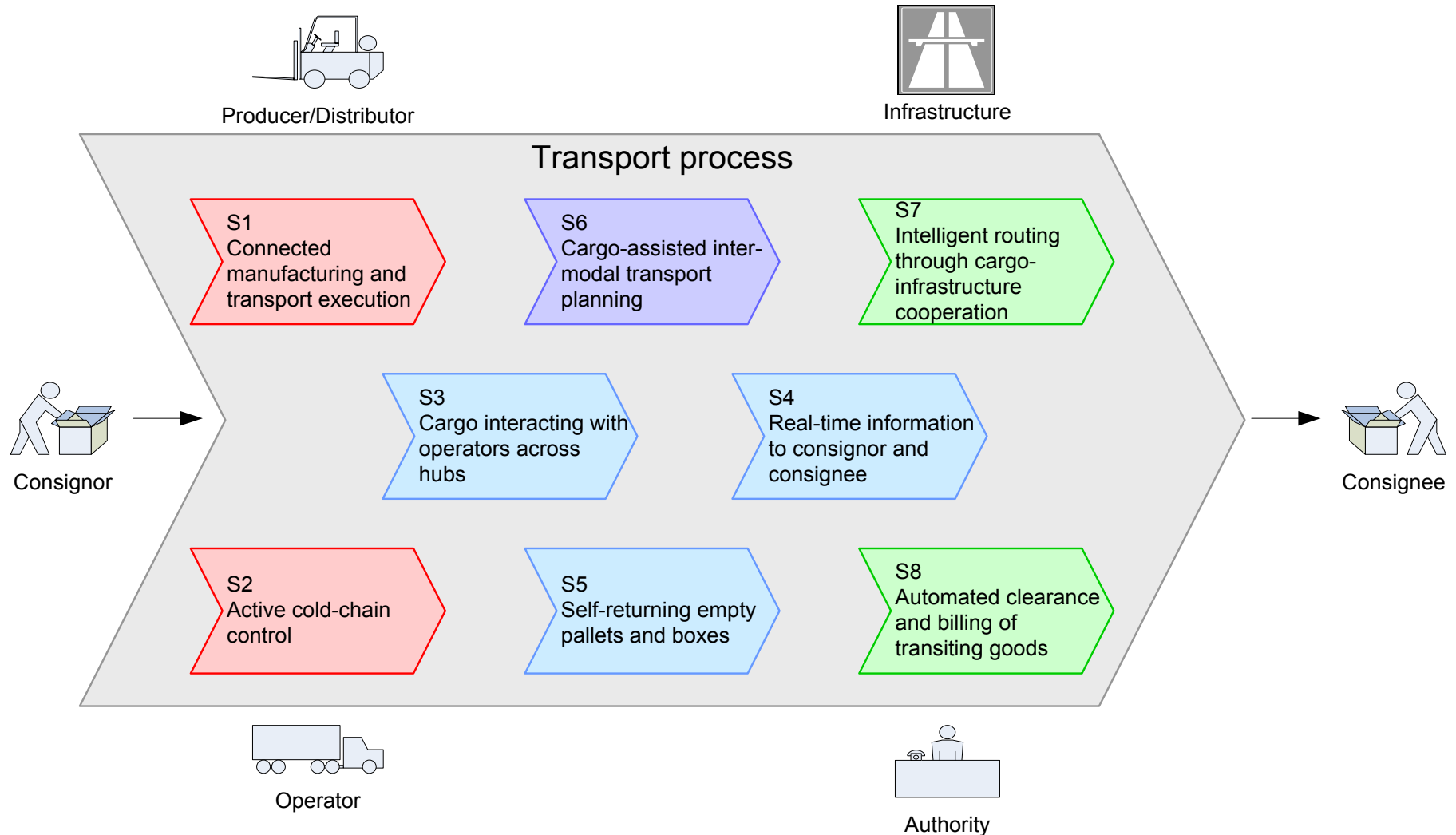| Capability	Dumb Cargo (state of the art)	Intelligent Cargo
Self-identification	• Local identification based on proprietary systems of each actor. • Shared IDs through ad-hoc connection between back-office systems. • Pre-fixed level of detail throughout the supply chain.	• Global identification provided by public domain services. • Cargo is able to self-identify through a common infrastructure, accessible to field users, vehicles and back-office. • Dynamically selected level of detail (package, pallet, container, ..).
Context detection	• No self-standing context detection capability. • Context is extrapolated by back-office systems accessing other information sources (e.g., local ID repository).	• Context determination provided by public domain services. • Common infrastructure, providing context data (identification details, location, time) to authorized users.
Access to services	• No direct access to services from the cargo itself. • Services managed by proprietary systems of each actor or by generic (not cargo related) platforms.	• Common infrastructure, providing access to services to authorized users or systems interacting with the cargo.

Intelligent vs. "dumb" cargo, specialized capabilities

Capability	Dumb Cargo (state of the art)	Intelligent Cargo
Status monitoring and registering	• Sensing and data storing at a specific cargo level (e.g. container). • To go beyond raw data, ad hoc back-office elaboration is needed.	• Status data are available in real time through the service infrastructure. • Status data are contextualized and integrated with the other cargo information services.
Independent behavior	• No such capability.	• Cargo is able to invoke services and start processes autonomously in response to predefined events.
Autonomous decisions (Intelligent agent)	• No such capability.	• Cargo has decisions making capabilities and is able to choose services to invoke according to circumstances.

Intelligent Cargo in practice

Cargo

I am not where I was supposed to be, pick me up

I am not where I was supposed to be, please take action

Autonomous decisions

Act independently

I have been moving from here to there, I have been opened, my temperature has changed..

What's happening to our cargo?

Status monitoring

Owner service: content info, 3PL service: shipping info, Authority service: clearance info..

What do you contain? Are you authorized? Cleared? Paid for? ..

Services access

I am presently at location L, being handled by Z

Where are our goods, who is dealing with them?

Context detection

I am container (or package, or trailer, or..) X, I belong to Y

What's this?

User

Self-identification

Pilot Scenarios

Producer/Distributor

Infrastructure

Transport process

S1 Connected manufacturing and transport execution

S6 Cargo-assisted inter-modal transport planning

S7 Intelligent routing through cargo-infrastructure cooperation

S3 Cargo interacting with operators across hubs

S4 Real-time information to consignor and consignee

S2 Active cold-chain control

S5 Self-returning empty pallets and boxes

S8 Automated clearance and billing of transiting goods

Consignor

Consignee

Operator

Authority

Example: Scenario S7
Intelligent routing through cargo-infrastructure cooperation

Objective:

To avoid congestion and accidents and optimize utilization of road and parking infrastructures, through:

- automated re-routing performed by the cargo itself based on its planned and actual status, traffic and weather conditions, availability of parking areas;

- cooperation between cargo and infrastructure operator to acquire authorization and reserve parking space;

- self-diagnosis of anomalous events on the cargo (e.g., non-authorized movements in parking area) and automated triggering of the infrastructure security systems.

Example: Scenario S8
Automated clearance and billing of transiting goods

Objective:

To speed up the transit of goods at international borders and to increase security levels, through:

- security information self-generated by the cargo interacting with vector, agent and customs authority;

- event-triggered clearance and authorization procedures, with the cargo activating the involved authorities based on its present location, status and applying regulations;

- automated billing system based on prepaid tokens, allowing the cargo to pay for itself customs and shipping duties.

EURIDICE architecture and components (WHAT)

EURIDICE vision translated into an architecture

"In five years time, most of the goods flowing through European freight corridors will be 'intelligent', i.e.: self-aware, context-aware and connected through a global telecommunication network to support a wide range of information services for logistic operators, industrial users and public authorities."

- What does this mean from an architectural perspective?

"Connect cargo objects with each other, to provide intelligent services for logistics stakeholders."

- We aim to realize the "internet of cargo"

Internet of Cargo vs. Internet of Things

The internet of cargo

Connect cargo objects
with each other,
to provide intelligent services
for logistics stakeholders

The internet of things

Connect objects with each other,
to provide intelligent services
for any individual user

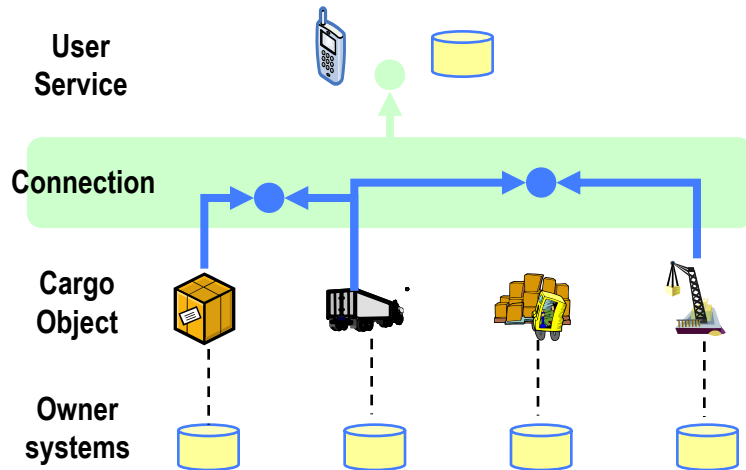# Expected paradigm shift

|	Current paradigm	Intelligent Cargo
Data origin	User or back-office generated.	Item/sensor generated.
Interaction paradigm	Organization-to-organization	Thing-to-thing.
Data processing	Centralized at organization level.	Distributed, may start at object level.
Communication support	Predefined communication channels.	Self-configuring combination of local and global communication resources.
Data interchange semantics	Mutually agreed with each partner or between trade community members.	Globally established, for any-to-any ad hoc exchanges.
Decisions support	Top-down decision making, based on periodic data revision.	Event-triggered, decentralized and (partially) automated exception resolution.

Cargo objects and logistics stakeholders

Cargo Objects

	Cargo owner	Carrier	Logistic service provider	Infrastructure manager
Infrastructure	--	Needs data / provides data	Needs data / provides data	Owns
Warehouse	Needs data	Needs data / provides data	Owns	--
Vehicle	Needs data	Owns	Manages	Needs data / provides data
Item	Owns	Needs data / provides data	Manages	Needs data / provides data

Stakeholders

Thing-to-thing vs. organization-to-organization

User Service

Connection

Cargo Object

Owner systems

User Service

Connection

Owner systems

Cargo Object

Thing-to-thing

- Connect via cargo objects interaction.

- Decentralized data processing.

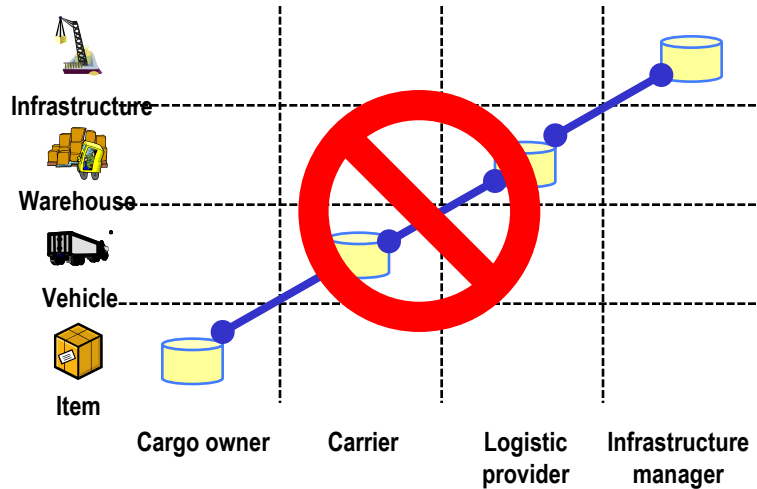- Owner systems may not be involved (only to access owner services).
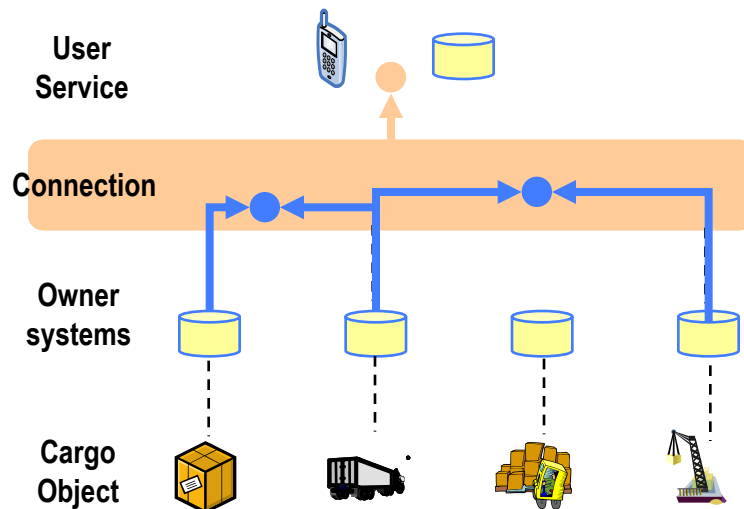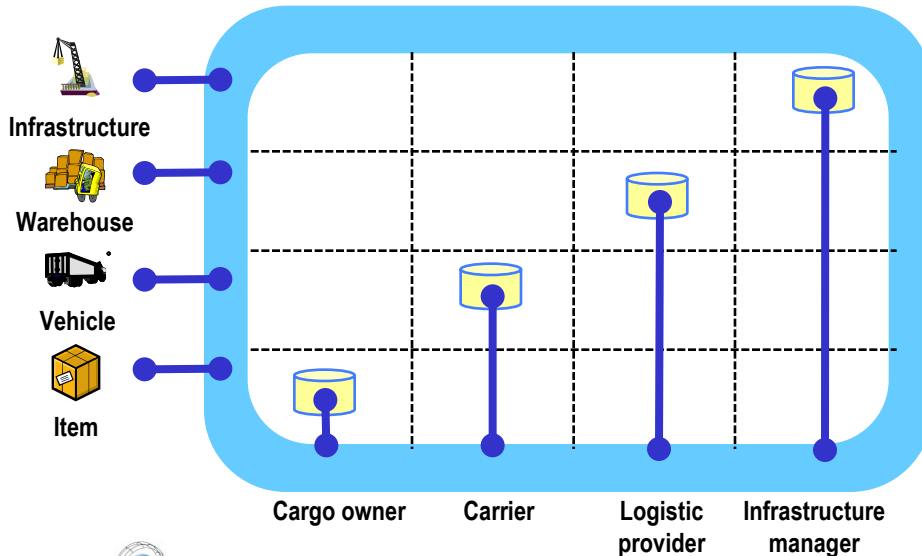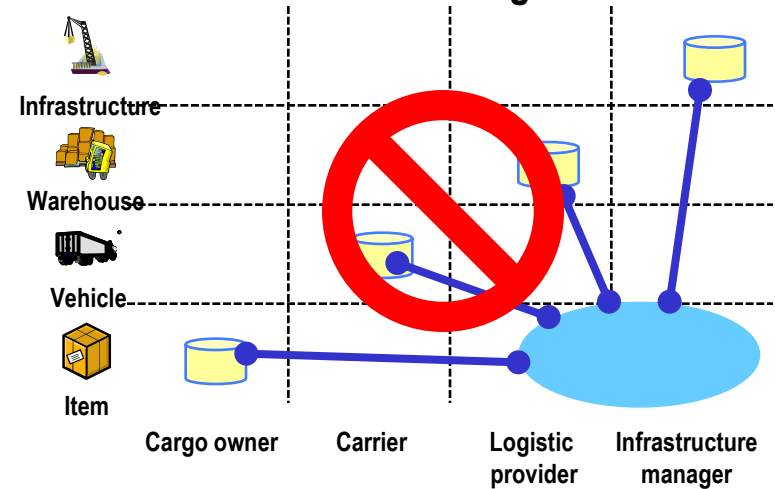
Organization-to-organization

- Connect via pre-existing links between organizations.

- Cargo objects may not be involved (disconnected physical / information flows).

Any-to-any communication and data interchange

One-to-one links

Data interchange hub

- DNS[1]-like system for cargo objects and related services.

- Globally shared semantics.

- On demand configuration of communication resources.

[1] = Domain Name System, used to make computers and sites accessible via the internet.
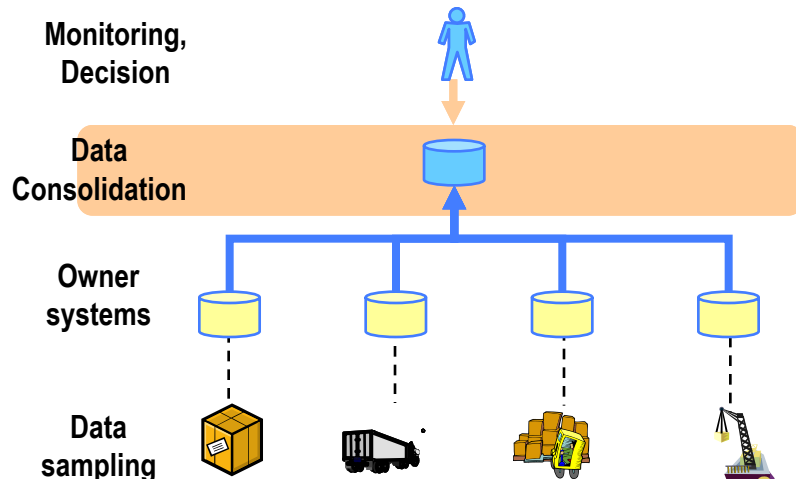
Event-triggered, decentralized decisions support

Decision Consolidation

Event Propagation

Context Determination
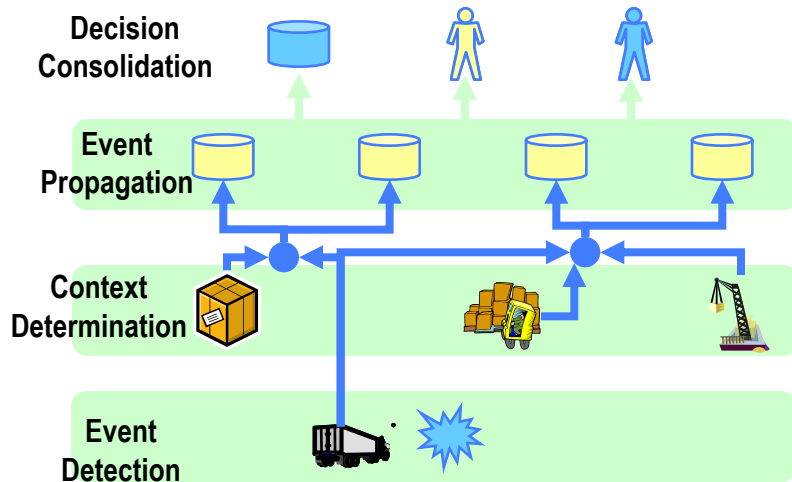
Event Detection

Intelligent cargo

- Automated event detection and context determination.
- Bottom-up exception resolution (escalation, consolidation of decisions).
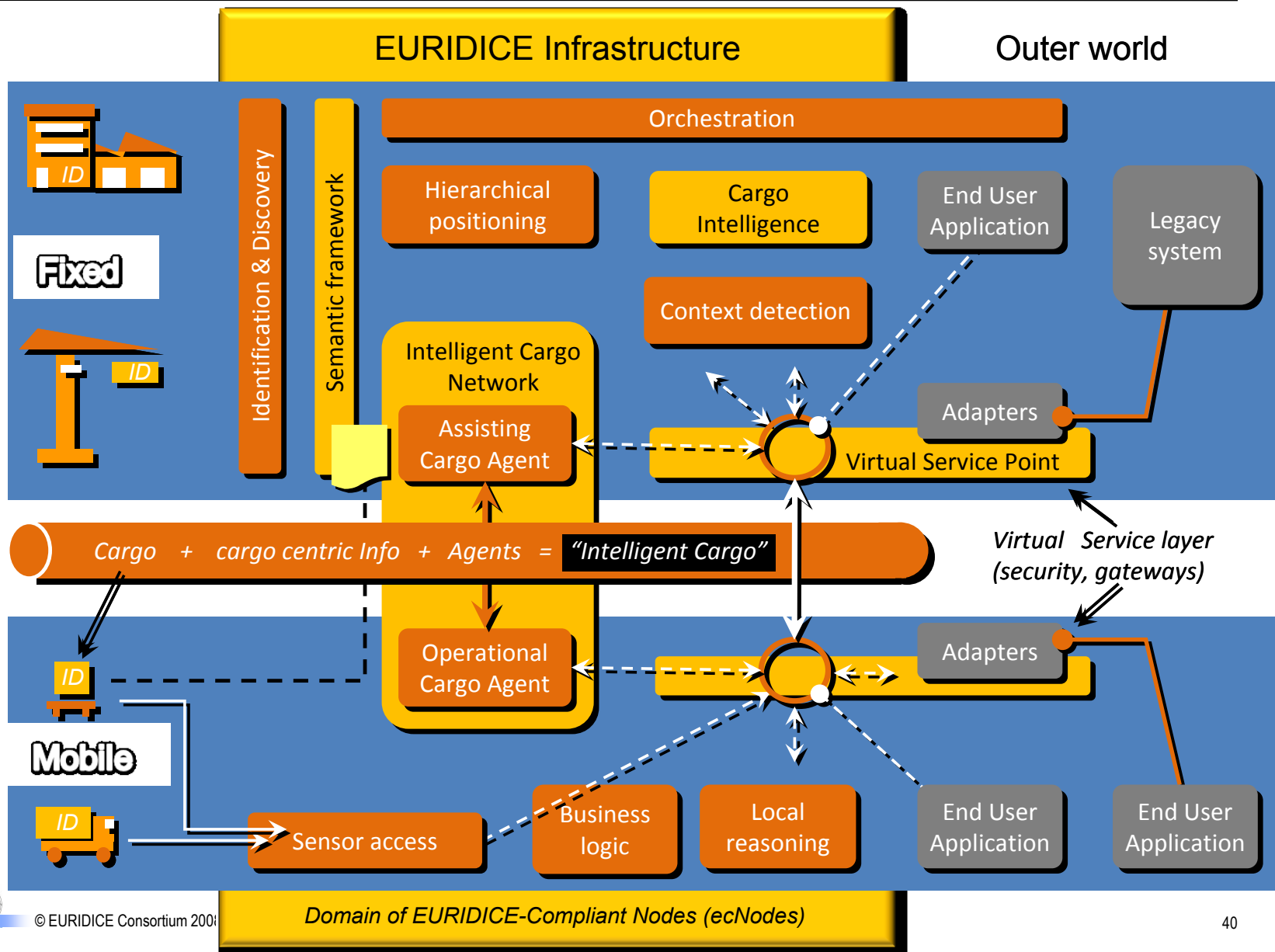
Monitoring, Decision

Data Consolidation

Owner systems

Data sampling

Traditional approach

- Data consolidation from back-office systems.
- Top-down centralized monitoring, revision and communication.

Architecture overview

EURIDICE Infrastructure — Outer world

- Orchestration
- Identification & Discovery
- Semantic framework
- Hierarchical positioning
- Cargo Intelligence
- End User Application
- Legacy system
- Context detection
- Intelligent Cargo Network
  - Assisting Cargo Agent
  - Operational Cargo Agent
- Virtual Service Point
- Adapters
- *Cargo + cargo centric Info + Agents = "Intelligent Cargo"*
- *Virtual Service layer (security, gateways)*
- Sensor access
- Business logic
- Local reasoning
- End User Application
- End User Application
- Fixed
- Mobile
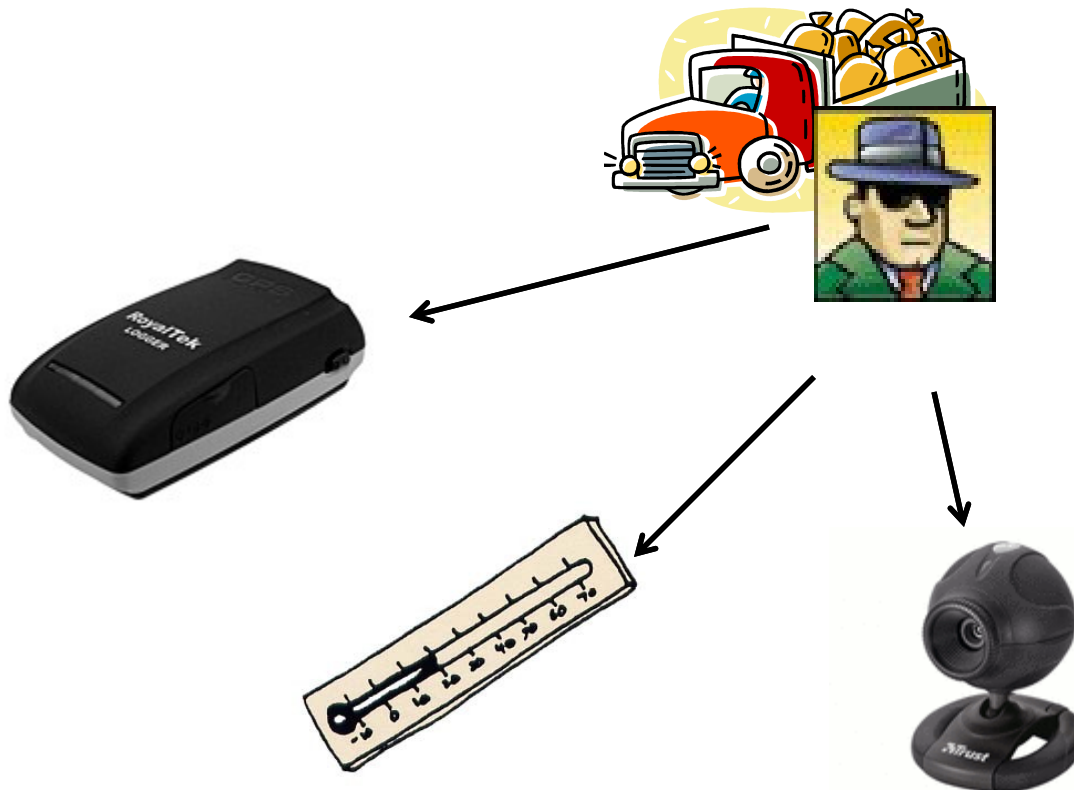- ID

Domain of EURIDICE-Compliant Nodes (ecNodes)

Intelligent Cargo & the Agent Paradigm → WP13

- **Agents … [by definition]**
  - ... sense their environment

Agents use **sensors**

They **interpret** their environment and react **appropriately**

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Cargo Intelligence solution

GUI applications for decision support, visualisations,…

GLOBAL INTELLIGENCE

Reasoning

Context generation

Trend detection

Prediction

Anomaly detection

Knowledge discovery

Background knowledge

Pattern tag

Data processing (fusion, cleaning)

Information extraction

LOCAL INTELLIGENCE

Local data analysis

Cargo control

Cargo sensors

Cargo

External information
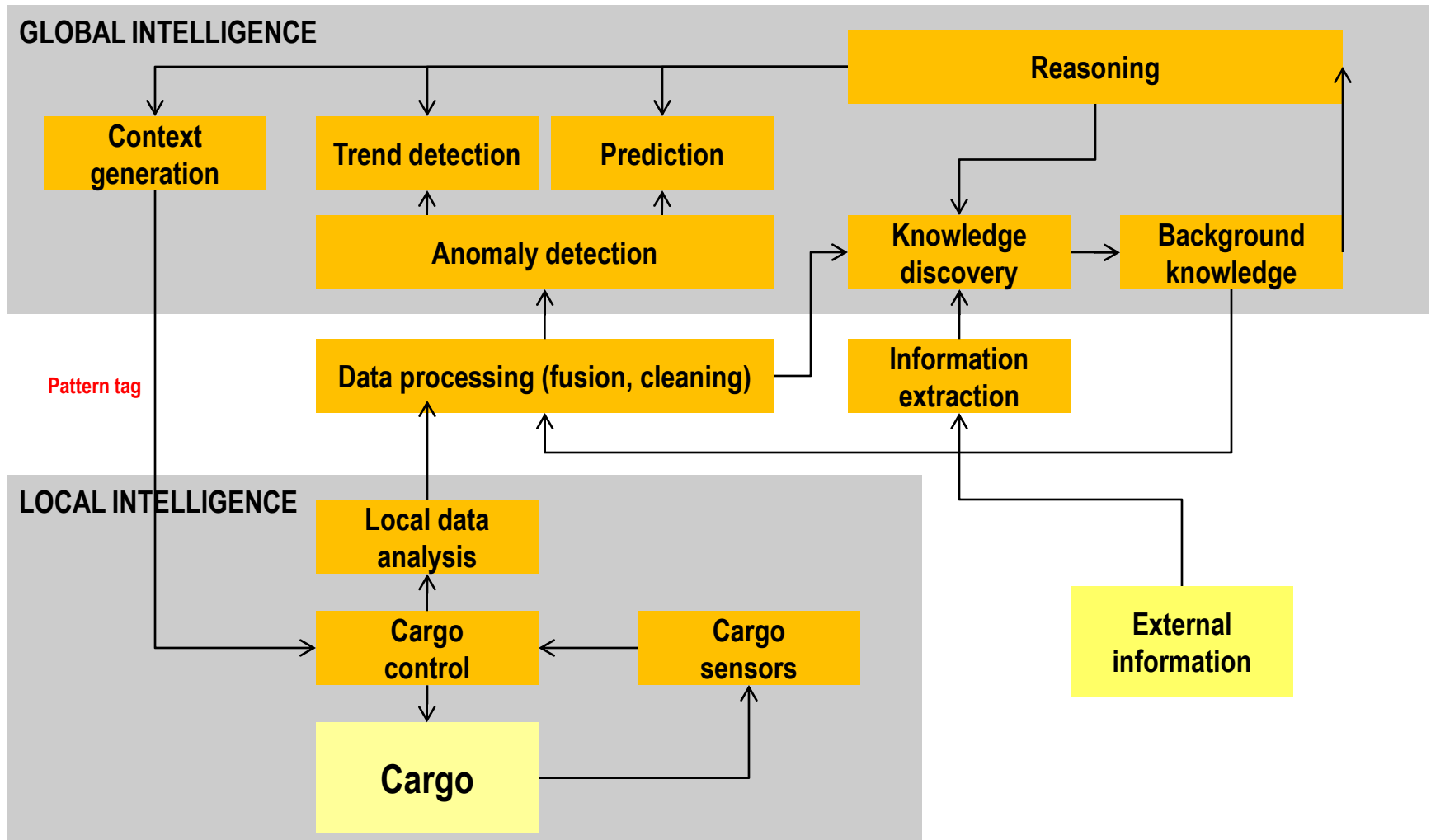
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