# *Enabling technologies for logistics*

An NGIL/VISITEC result

presented by

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NGiL Next Generation Innovative Logistics

# Key aspects of Next Generation Logistics

- Visibility
  - Technology strategy, Return of Investment,
- Risk management
  - Handle Volatilities, Thefts, Terrorism, Counterfeit
- Flexibility
  - Quick response, Adaptivness

Questions related to these kinds of topics may be answered by NGIL projects in due course, or earlier if properly funded!

# The VISITEC project

Purpose:

- to provide a technology base for NGIL and its partners.
- to identify technology gaps that could be profitably filled by Swedish industry.

- Phase 1: State-of-the-Art overview and seminar
- Phase 2: Publication
- Phase 3: Facilitate new NGIL projects

# The VISITEC project objectives

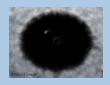
Investigate technologies for:

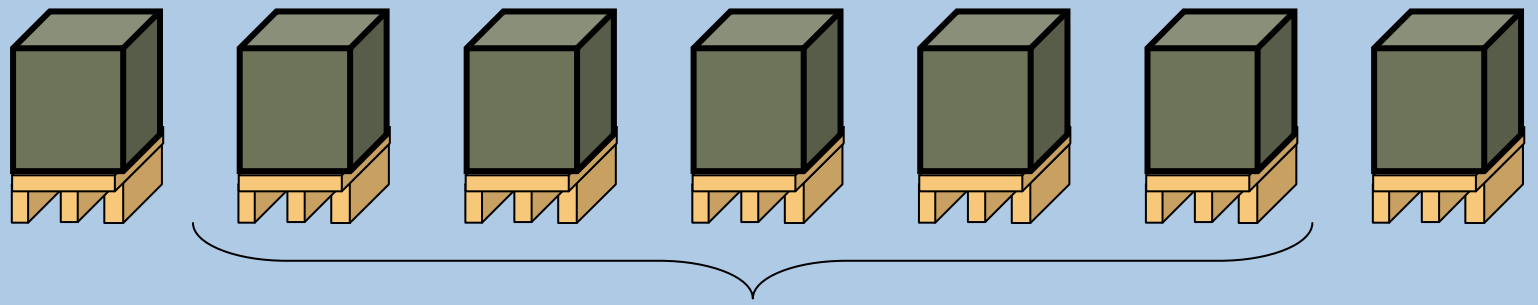
- Positioning
- Identification
- Status and authenticity

We do NOT look into:

- Communication
- Application (Operations) layer software and systems

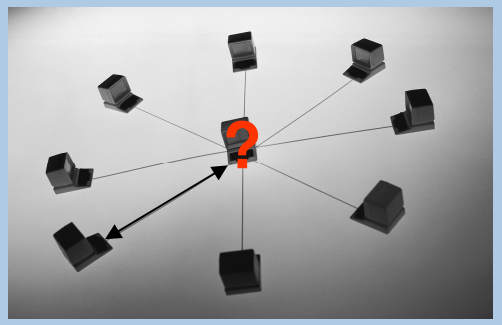
# The technology available today

| | @ factory in China | @ road or rail | @ sea or air | @ terminal | @ road or rail | @ loading dock | in warehouse in Sweden |
|---|---|---|---|---|---|---|---|
| Barcode | X | | | X | | X | X |
| RFID | X | | | X | | X | X |
| SatNav/MobTel | | X | | | X | | |
|  | | | X | | | | |

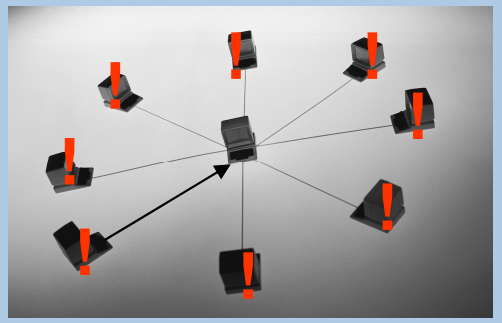


# Basic positioning system topologies

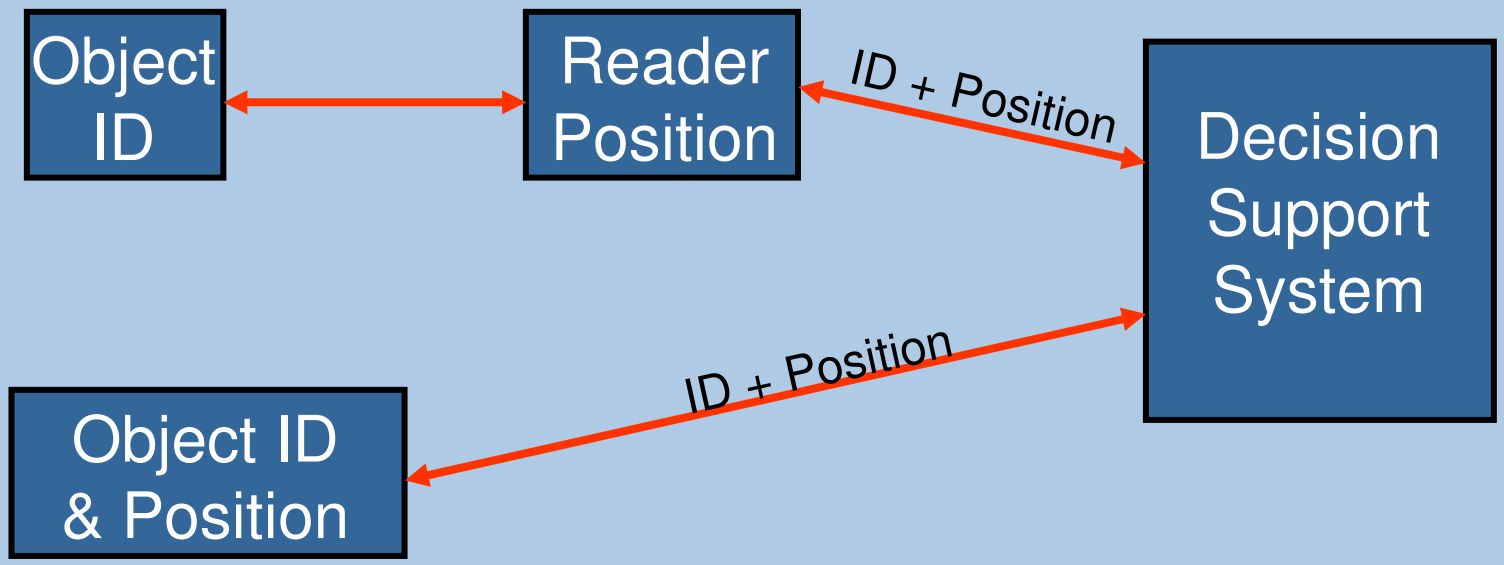
- Pull technology – Centralized, the positioning infrastructure system interrogates the labelled object



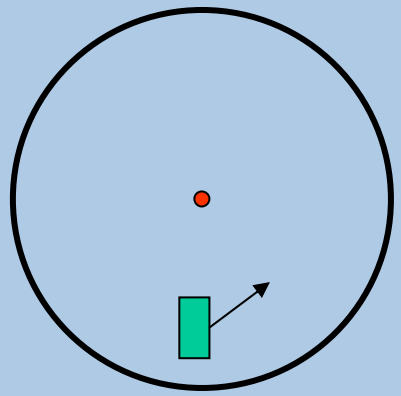

- Push technology – Decentralized, the labelled object decides when it should announce its position to the infrastructure positioning system



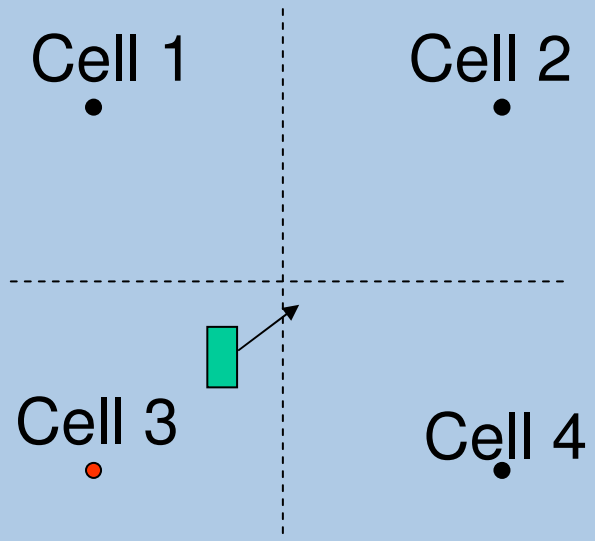
# Indirect vs. Direct Positioning



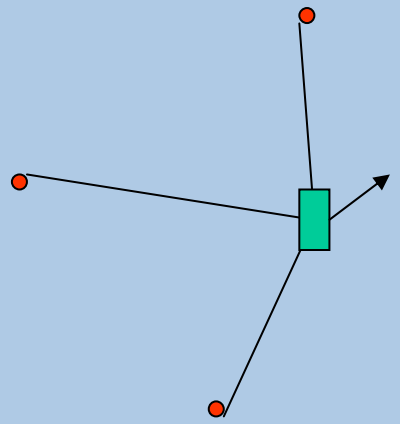
# Positioning basics



In range




In cell



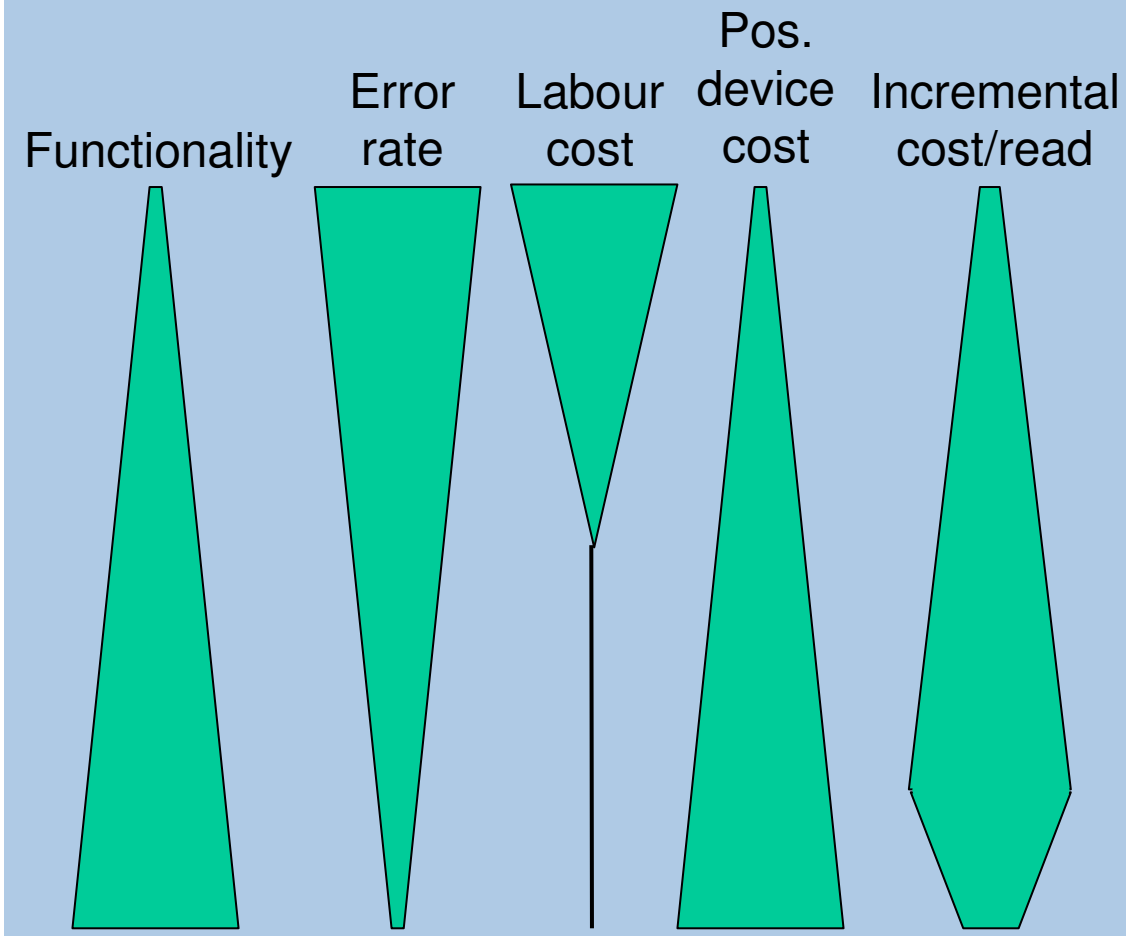
Triangulation

• / ◦ = Reference beacon (Base station, Access Point etc.)

# Positioning technologies

| | Accuracy |
|---|---|
| Any text on label | 5m – 0.1m |
| Bar Code label | 2m – 0.1m |
| Passive RFID tag | 5m – 0.1m |
| Active RFID Tag | 50m – 0.1m |
| Light based systems (laser) | 1m – 0.01m |
| SRLS (e.g. WLAN based) | 300m – 1m |
| Mobile Telephony (GSM/3G/…) | 10000m – 40m |
| Satellite Navigation (GPS/Galileo/…) | 40m – 0.015m |

# Positioning device/system properties

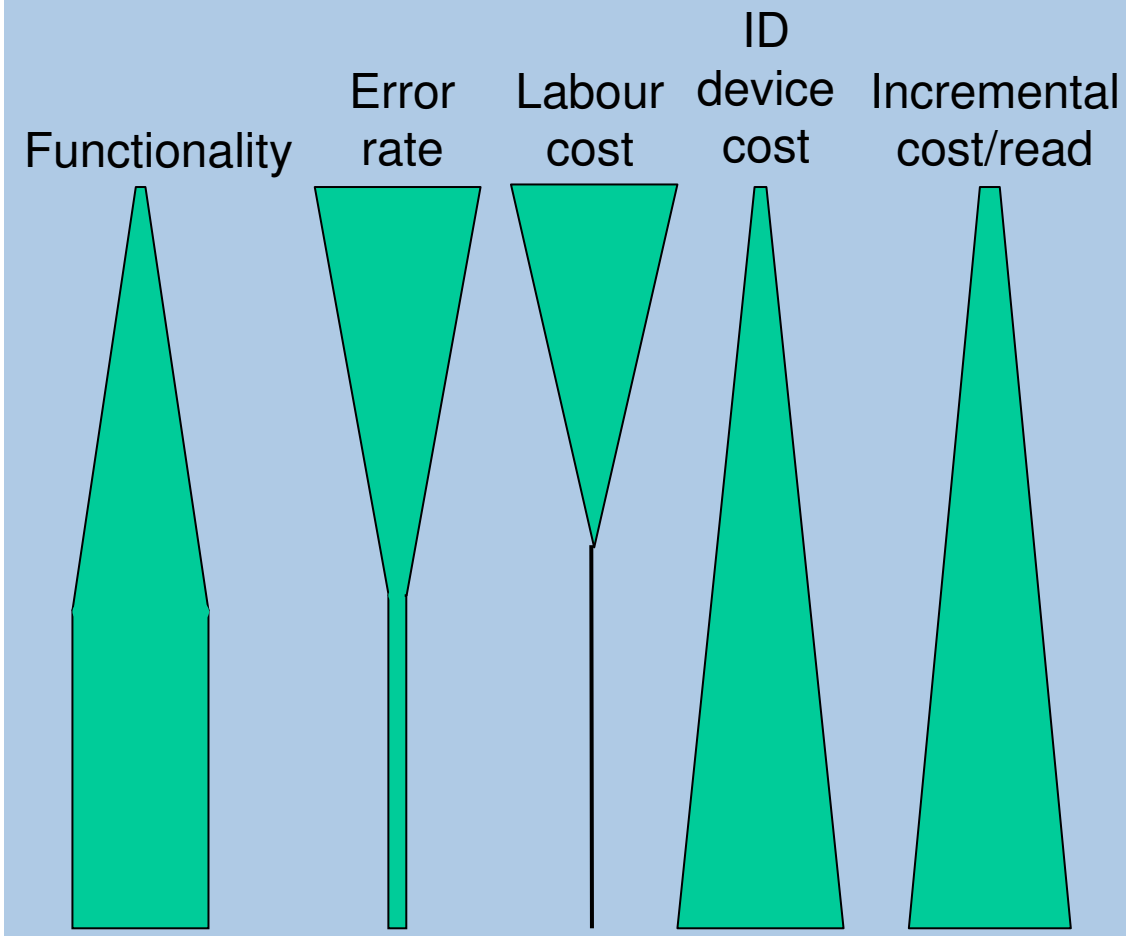



- **Any text on label**
- **Bar Code label**
- **Passive RFID tag**
- **Active RFID tag**
- **Light based systems**
- **SRLS**
- **Mobile Telephony**
- **Satellite Navigation**

# ID technologies

- Handwritten text on labels
- Printed text on labels
- Bar Code labels
- Light based (LNP, hologram, ...)
- Chipless (RF)ID (SAW, ...)
- Passive RFID tag
- Active RFID Tag
- Short Range Location Systems (RTLS(WiFi) etc.)
- Mobile Telephony (GSM/3G/…)
- Satellite Telephony

# ID device/system properties

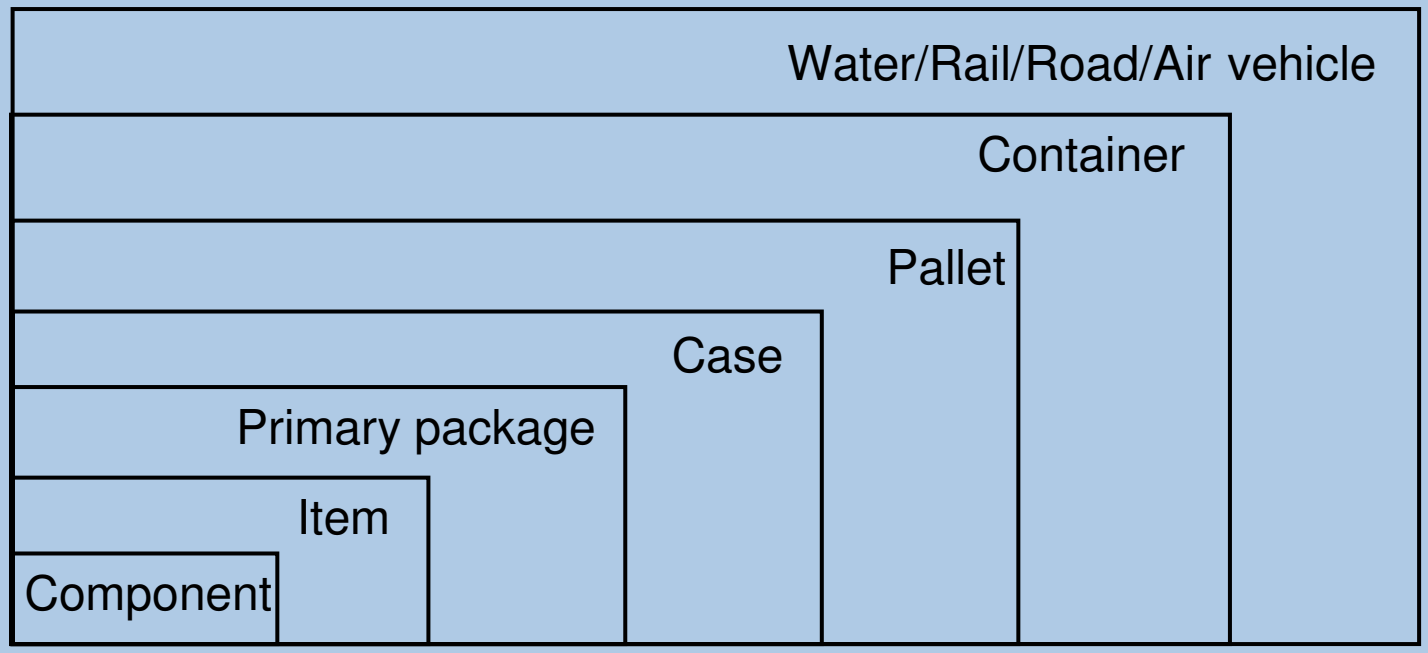



- **Handwritten labels**
- **Printed labels**
- **Bar Code labels**
- **Light based**
- **Passive RFID tag**
- **Active RFID Tag**
- **Short Range Location System**
- **Mobile Telephony**
- **Satellite Telephony**

# Where are you today?

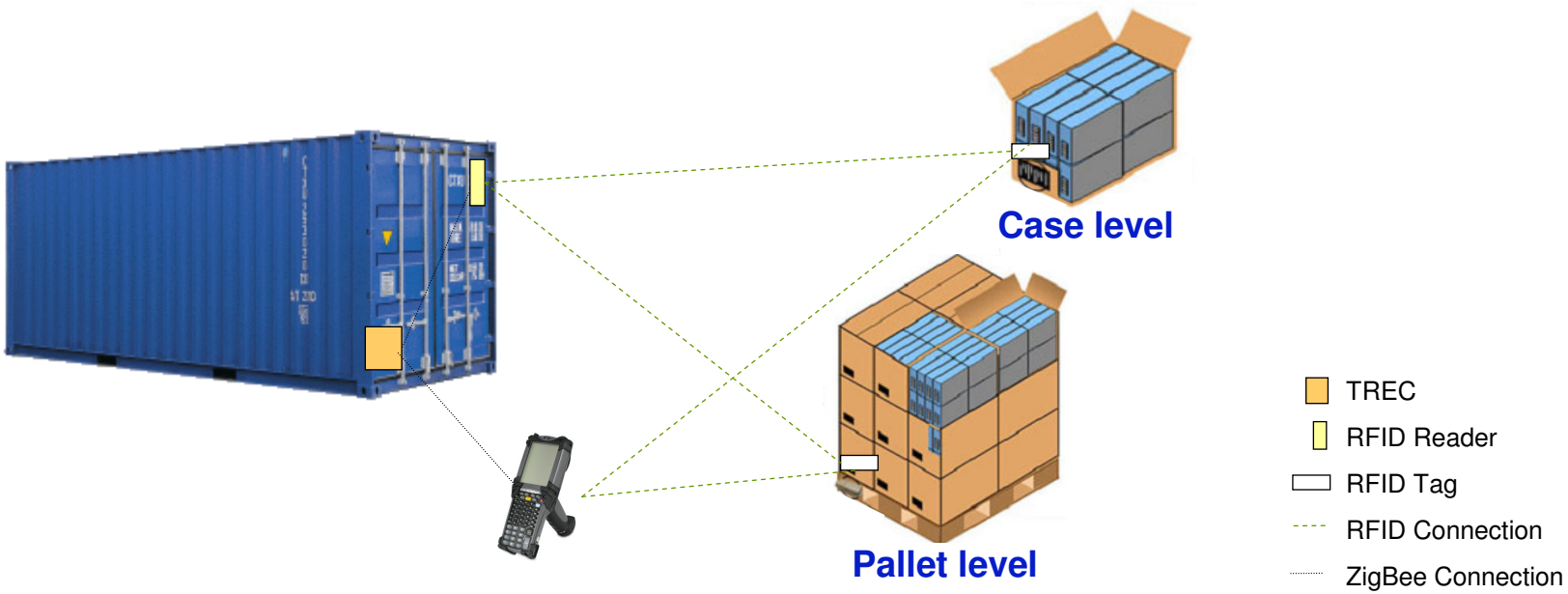
And where do you want to go next?

# Package level vs. ID/positioning technology



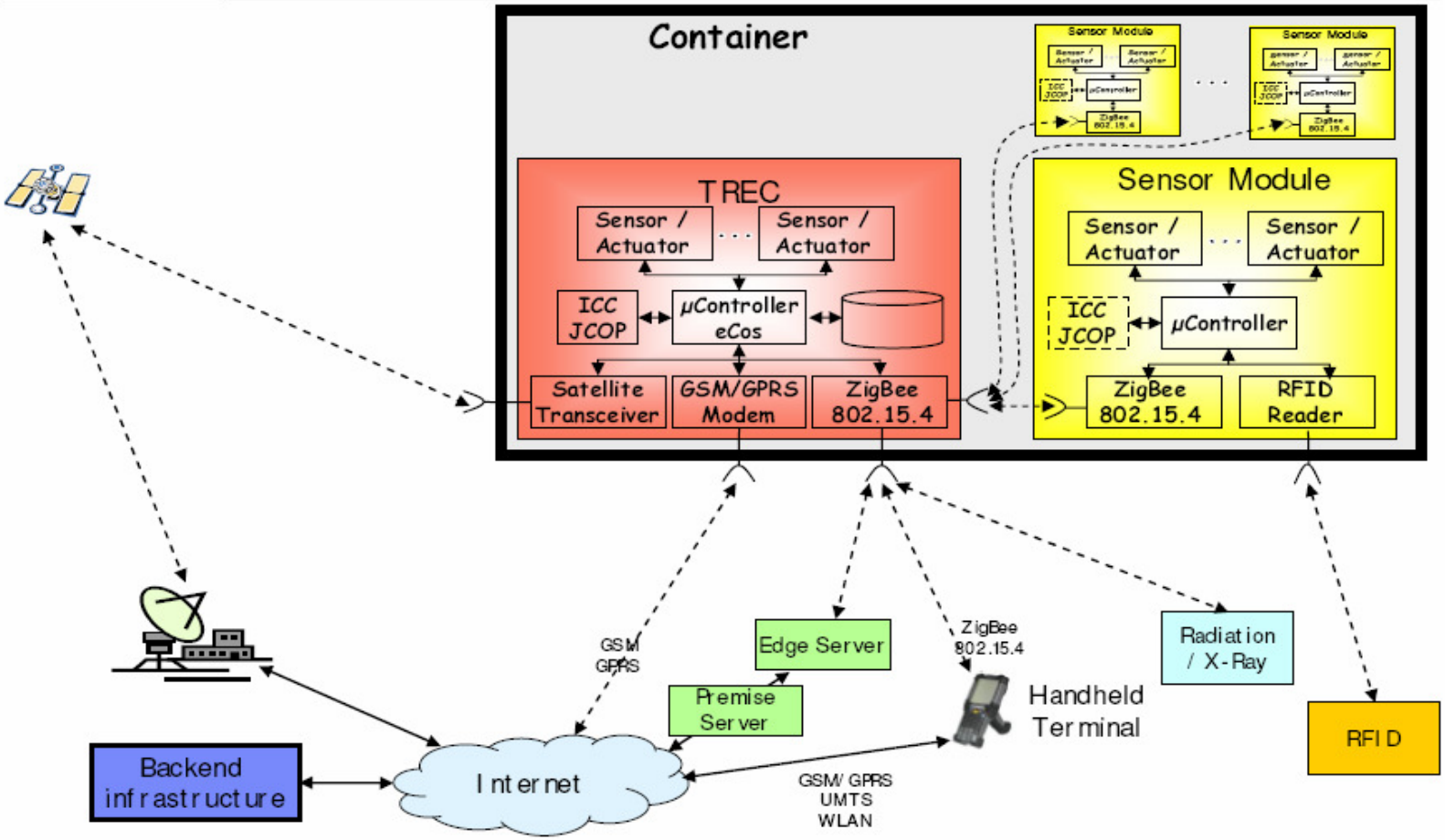

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Labels | X | X | X | X | X | X | X |
| Chipless ID | X | X | X | | | | |
| Passive RFID | | (X) | X | X | X | X | |
| Active RFID | | | | | (X) | X | |
| Short Range LocSys | | | | | X | X | |
| Land Mobile Tele. | | | | | (X) | X | X |
| Satellite Navigation | | | | | (X) | X | X |
| Satellite Telephony | | | | | | X | X |

# RFID and TREC (Secure Trade Lane) can complement each other by connecting an RFID reader or a handheld to the TREC as a sensor

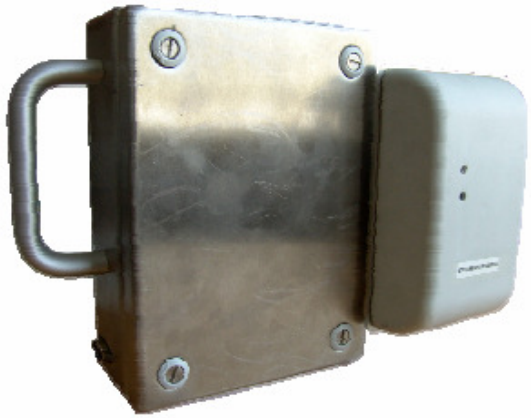



- Container level tracking can be expanded to pallet level, case level, and even item level tracking
- As a result, the exact content of a container will be known

## The TREC acts as a central point of control that can authenticate the source of evidence and implement access control to the evidence



## Pictures of current device

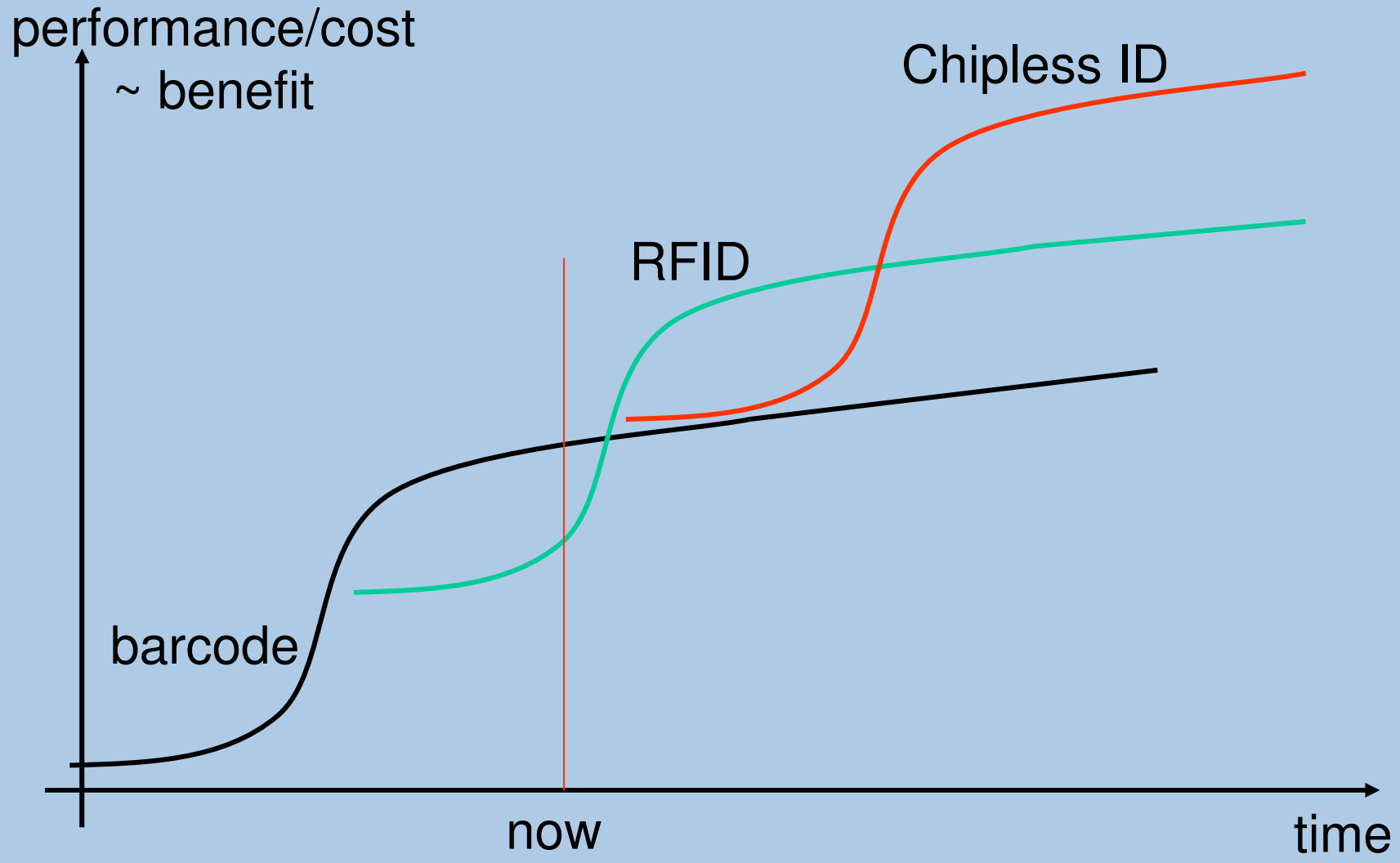


# Complementary ID/Pos. technologies

- Tags with integrated reader
- Traditional RFID tags with strong encryption
- Traditional RFID tags with User Interface
- Printed RFID tags with displays
- Mobile phones with RFID reader
- Mobile phones with built-in GPS
- Hand writing input to computers
- …

# What technologies should we expect to use for tracking objects in 5 years from now?

# Disruptive technology shifts



# Barcode vs. RFID

| Barcode | RFID |
| --- | --- |
| Fixed data | Changeable data |
| Line of sight | Out of sight |
| Single read | Multi read |
| Standardized EAN | Standardized EPC |
| Article # | Article + Serial # |
| Volume prod. now | Volume prod. now |
| Low price | Medium price |

# Chipless ID & authentication

- LCR-circuits (e.g. EAS, microwave strips,… )
- Magnetism
- SAW
- RFID Ink
- UV/IR pigment (e.g. Luminescent Nano Pigments)
- Synthetic DNA
- Printed structures beyond bar-codes on paper
- Microdots

# Sensor modules for the future?

| Property | Value for logistics sector |
|---|---|
| Temperature | food, pharma., dangerous goods, |
| Moisture | food, pharma., clothes, electronics, |
| Chemicals | dangerous goods, |
| Bacterial growth | food, |
| Shock, Accel, Vibration | fragile goods transports, |
| Tilt | fragile goods transports, |
| Load pressure | loading |
| Radioactivity | dangerous goods, |
| Gas pressure | transport safety (tyres), |
| Intrusion | anti terrorism & crime, |
| Authenticity | pharma, brand labels, |

# Sensor modules for the future?

| Property | exists today | | | | expected "tomorrow" | | | |
|---|---|---|---|---|---|---|---|---|
| | Label | Chipless | RFID | Active RFID | Label | Chipless | RFID | Active RFID |
| Temperature | X | | | X | X | | | X |
| Moisture | X | X | | | X | X | | |
| Chemicals | X | | X | | X | X | X | |
| Bacterial growth | X | | | | X | X | | |
| Acceleration | X | | | X | X | | X | X |
| Tilt | | | | X | | | | X |
| Stress | | | | | | | | X |
| Radioactivity | | | | X | | | | X |
| Gas pressure | | | X | X | | | X | X |
| Intrusion | | | | | | | X | |
| Authenticity | | X | X | | | X | X | |

# Technology Enablers

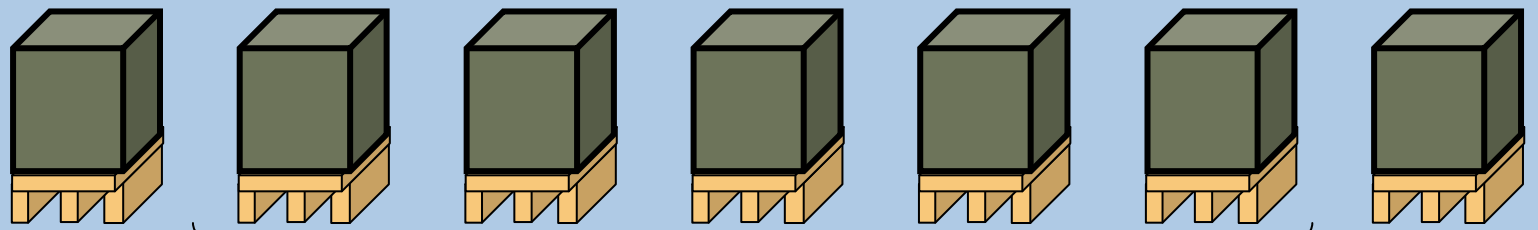
- Nanotechnology, sensing and processing
- Ubiquitous computing, low cost processing
- The Internet of things, IPv6 + operators

# Drivers

- Network based defence, terrorism & int'l crime
- Global warming  ($CO_2$-declarations)
- Regulation drives technology
- Globalization - demands global visibility
- Plug-and-play supply chains - need partner-independent visibility infrastructure

# What to use in 5 years ?

| | @ factory in China | @ road or rail | @ sea or air | @ terminal | @ road or rail | @ loading dock | in warehouse in Sweden |
|---|---|---|---|---|---|---|---|
| RFID | X | | | X | | X | X |
| Active RFID | | | | X | | | |
| Short Range LocSys | X | | | X | | X | X |
| Land Mobile Tel. | | X | | X | X | | |
| SatNav + L MobTel | | X | | X | X | X | |
| SatNav + SatTel | | X | X | | X | | |



In transit

# Application examples

Tracing and Authenticity verification of pharmaceuticals

Fresh food quality tracking

Multimodal transport

Demand driven supply chains

Secure Trade Lanes

Vendor managed inventory

Supply chain collaboration

100% correct inventory status

Track and correct for 100% JIT

Total Asset Visibility

MIT – Merge in Transit

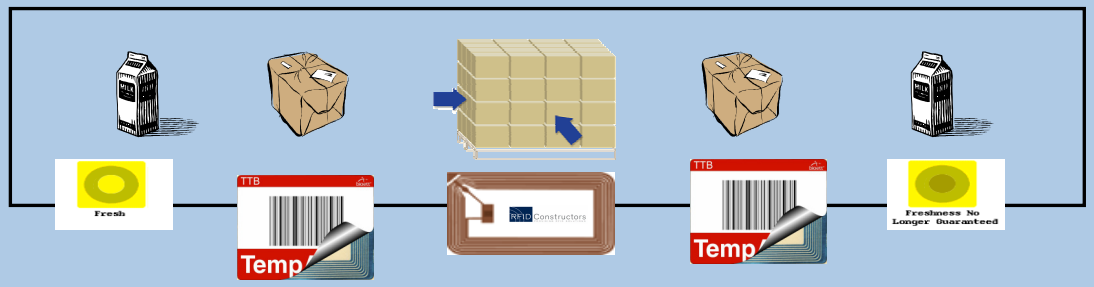
Network based defence

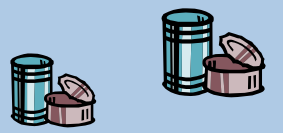
Allocation in transit

Transit visibility

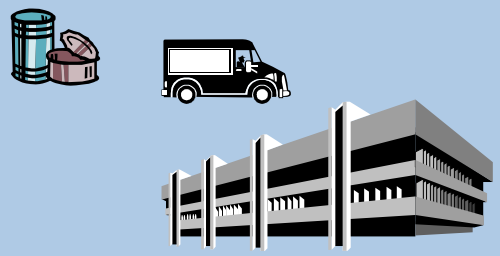
Sensor Driven Logistics

# Chilled food supply chain example

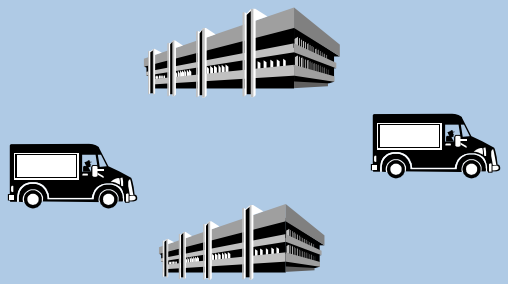


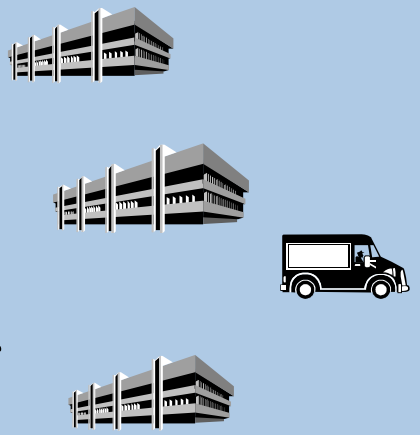



Raw materials



Production





Distribution centre/ Wholesaler


Retailer

# Scandinavian Shuttle

- Delivery precision
- Time control
- Multi modal

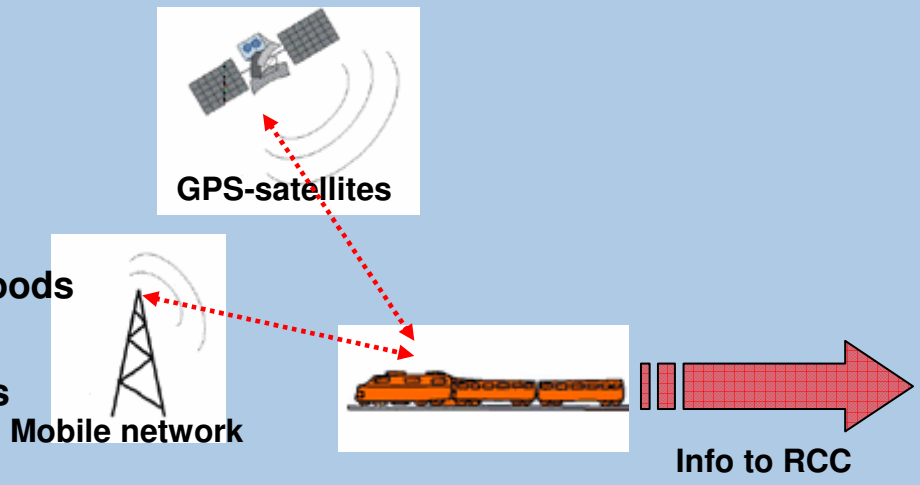
# Scandinavian Shuttle

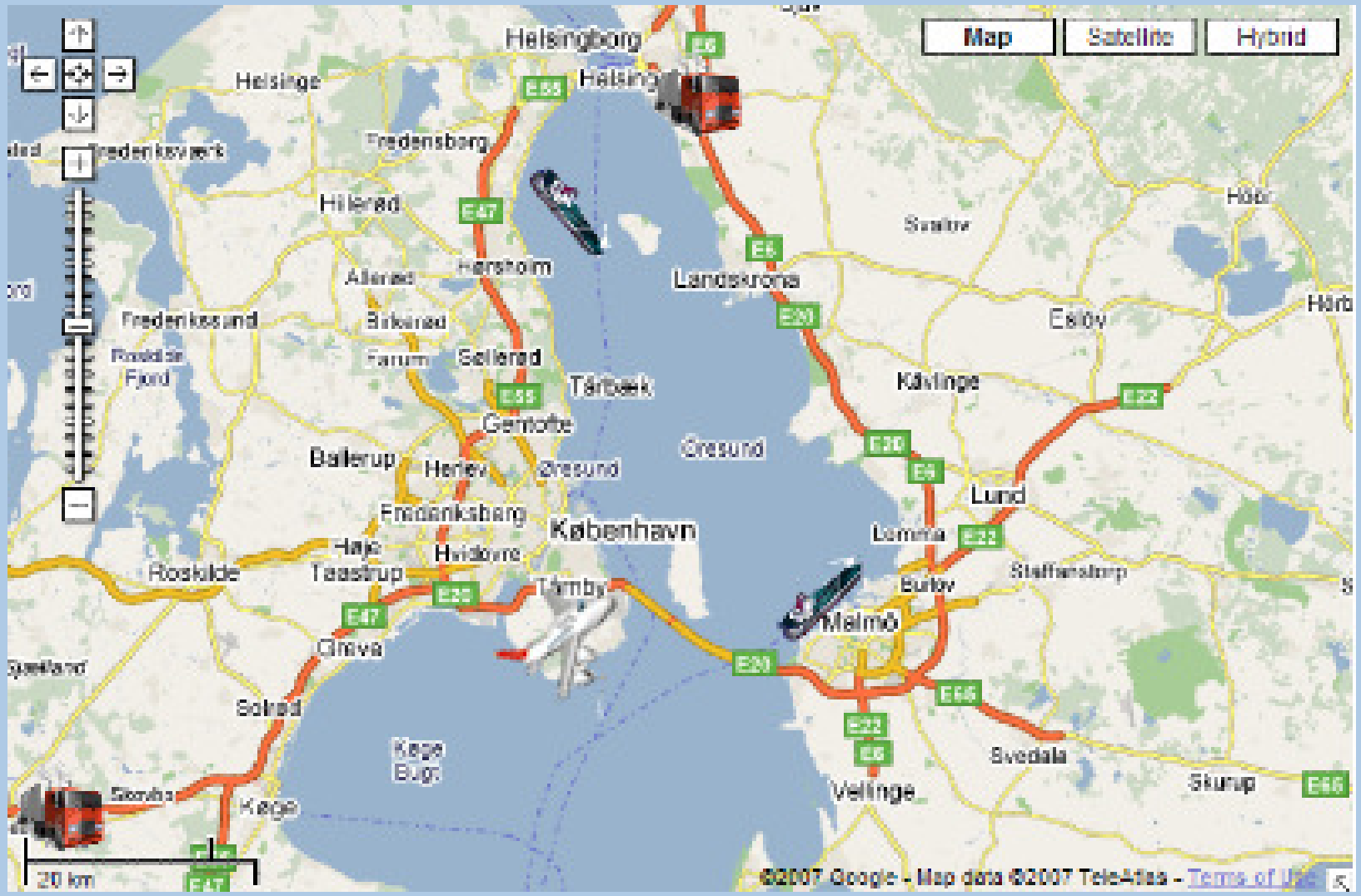
*100% Just in Time with road/rail kombi*

- **All load units and vehicles equipped with GPS + Mobile Phone**
- **Reports position status in real time to the Reliability Control Centre**
- **Back up system along the transport route stands by for contingency actions**
- **All deviation corrected immediately**

**Values for industry and society:**

- **Real-Time position and status of the goods**
- **Correction of deviations for 100% on time deliveries**
- **Added security decreases insurance cost of goods**
- **Fast recovery of lost or stolen assets**
- **Makes kombi transport with rail or short sea as reliable as road transport**
- **Less impact on global warming**
- **Less congestion and accidents on roads**





# Thank you!

from

Olle, Sten, Luca, Daniel, Niklas & all
our interview victims.