AtoN Remote Monitoring System

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Finnish Maritime Administration

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AtoN Remote Monitoring System

The Project

- 2005: Pre-study

- 2006: Planning of the pilot system and comparisions between the suppliers of the system

- 2007: Field tests (positioning) and Pilot system build-up

Finnish Maritime Administration

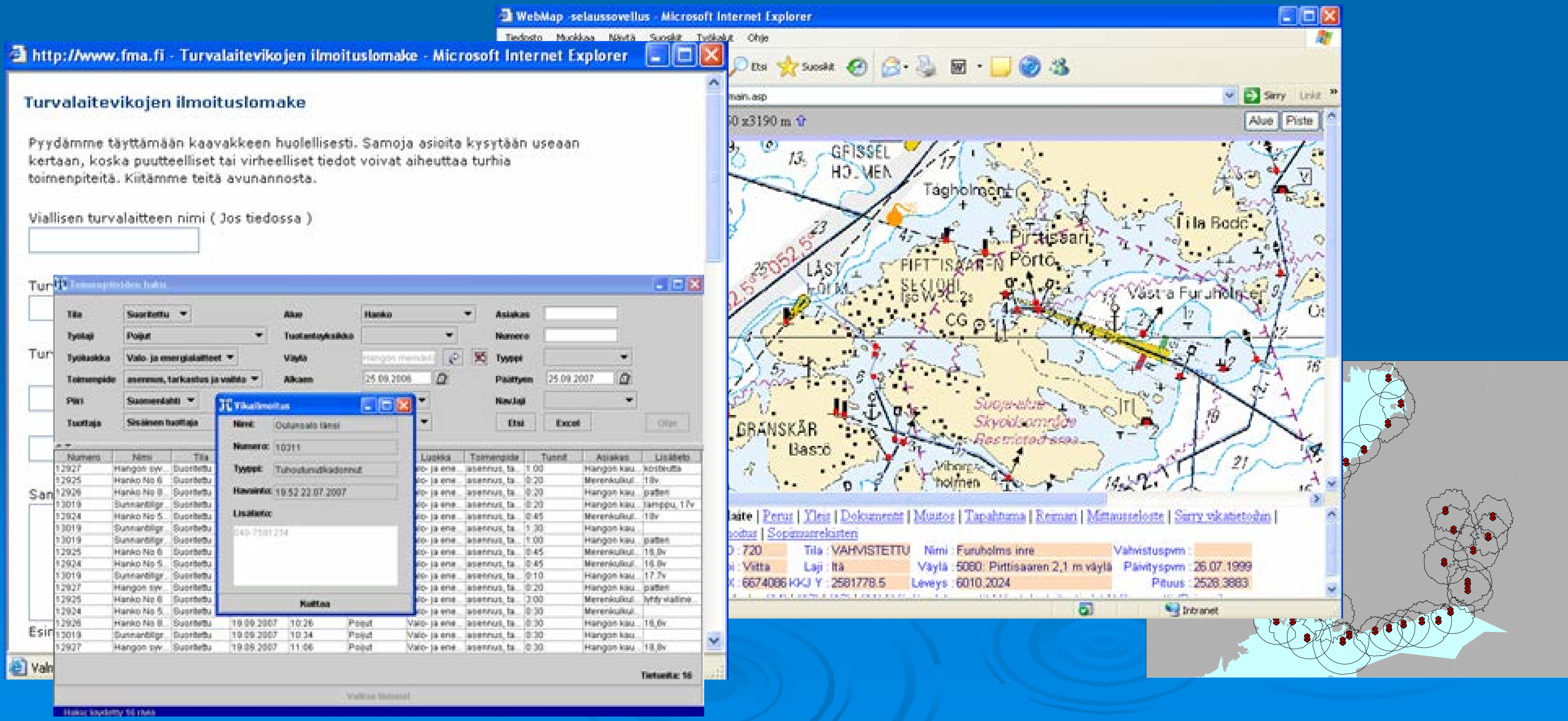
27.09.2007

Facts & Objectives

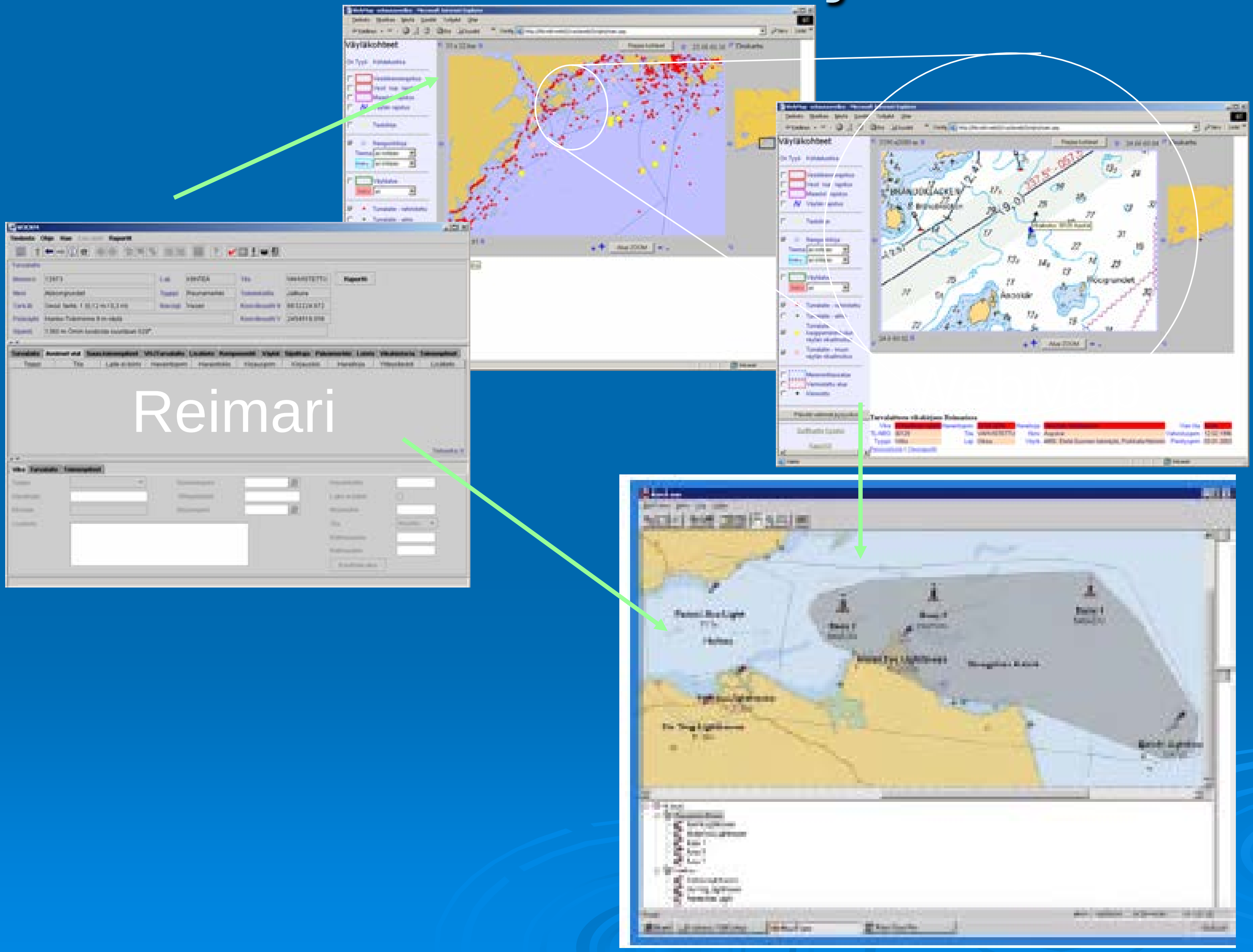
- Finnish Maritime Administration (FMA) has roughly 25 000 navigation aids along coastal and inland waterways
- In addition, there are about 6 500 privately owned navigation aids
- With the remote monitoring system there is possibility to save maintenance costs especially with the floating aids where position inspections take a significant part of the total fairway maintenance costs
- In order that the economical and technical advantages will be achieved: The system must be, at least 2,5 times more reliable than the AtoN itself (puoy) is today

Facts & Objectives

- Monitoring system will be used to transfer status and location information from navigation aids to a centralized data storage that makes it available for maintenance application (Reimari), VTS –system, WebMap and sea warning and AIS -system.



Facts & Objectives



Phase 1of 3
Survey (pre-study) of Remote Monitoring System
2006

27.09.2007

Finnish Maritime Administration

Survey tasks

Task I

- to collect information about existing navigation aids and waterway types
- to gather information about trials carried out by Finnish Maritime Administration

Task II

- to carry out literature surveys of technical requirements for the monitoring system (i.e. communication, availability and security)

Taska III

- to interview device and system experts

Task IV

- to compile the material collected from literature search and interviews
- to assess different system solutions based on technical and economical criterias today and after 5 years

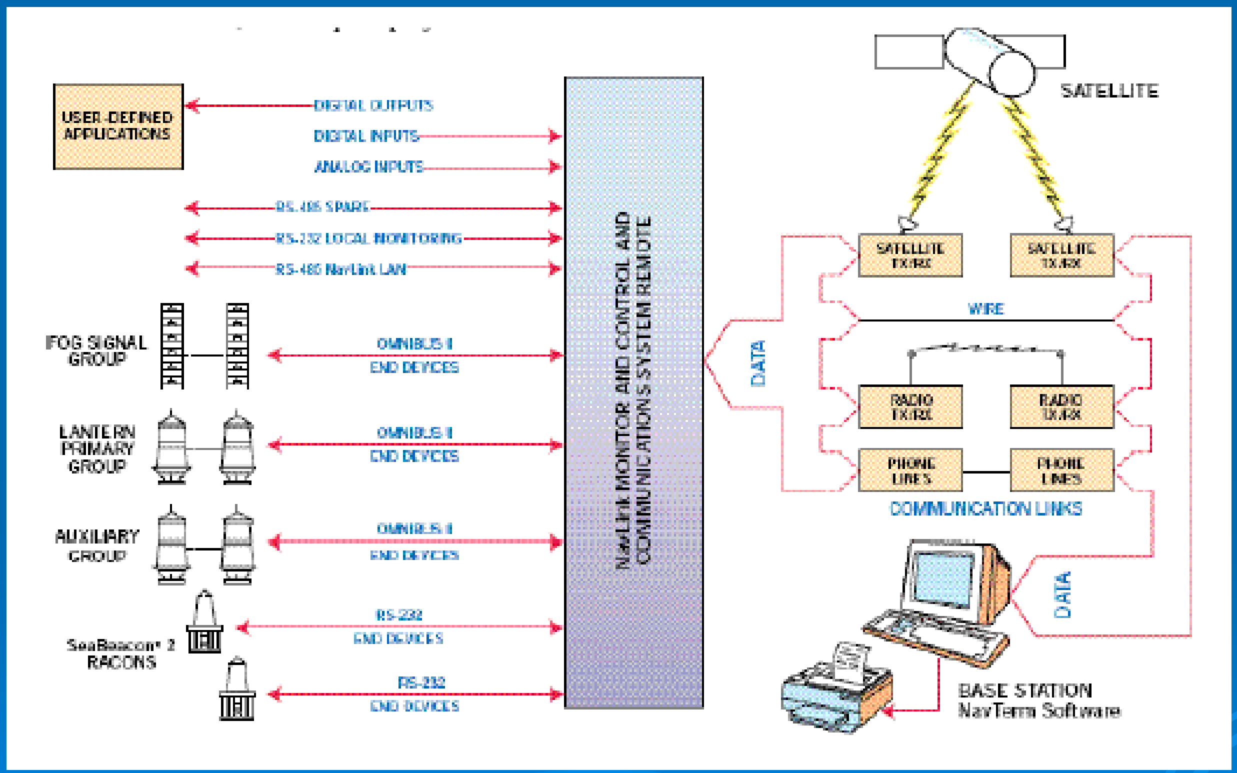
System requirements

- The most challenging task is to ensure energy supply to floating navigation aids and to develop antennas that can stand sea conditions (accelerations, vibrations and impacts)

battery duration	> 1 year
positioning accuracy	1 m
min. temperature	-35º C
max. acceleration	24 G
max. strain	100-120 kN
max terminal power consumption	0,1 W
max. power consumption for communication	0,1 W
continuous energy consumption	10-15 mA

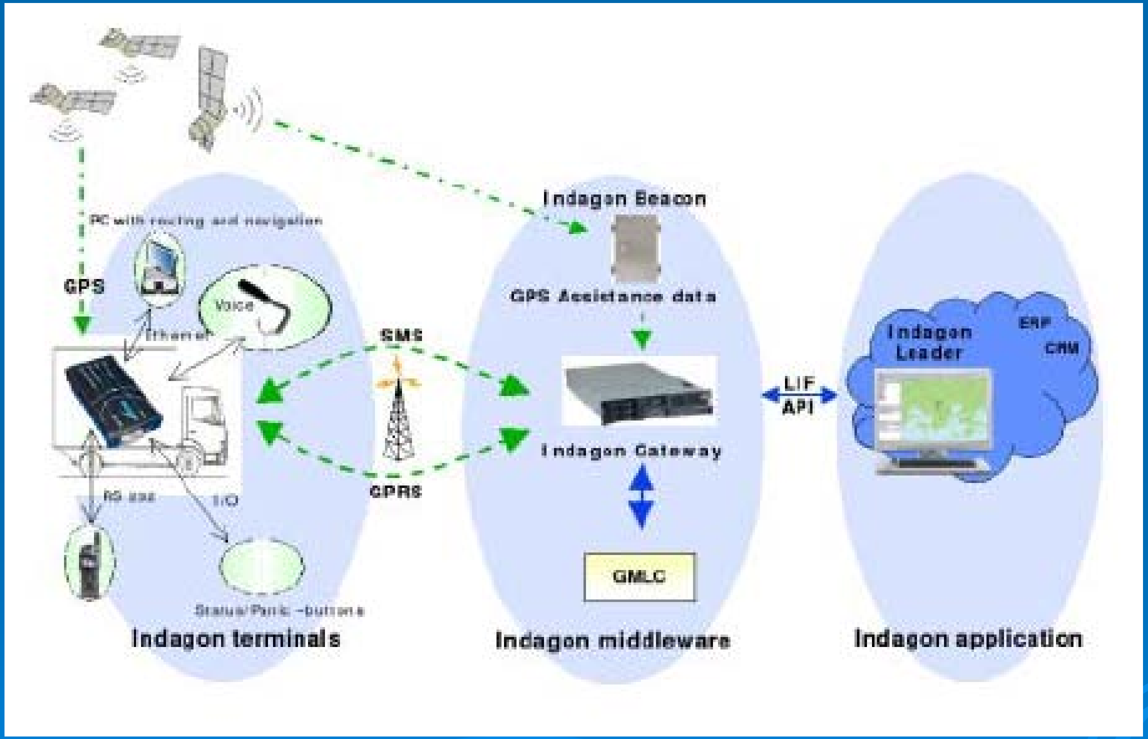
Companies interviewed

Tideland Ltd



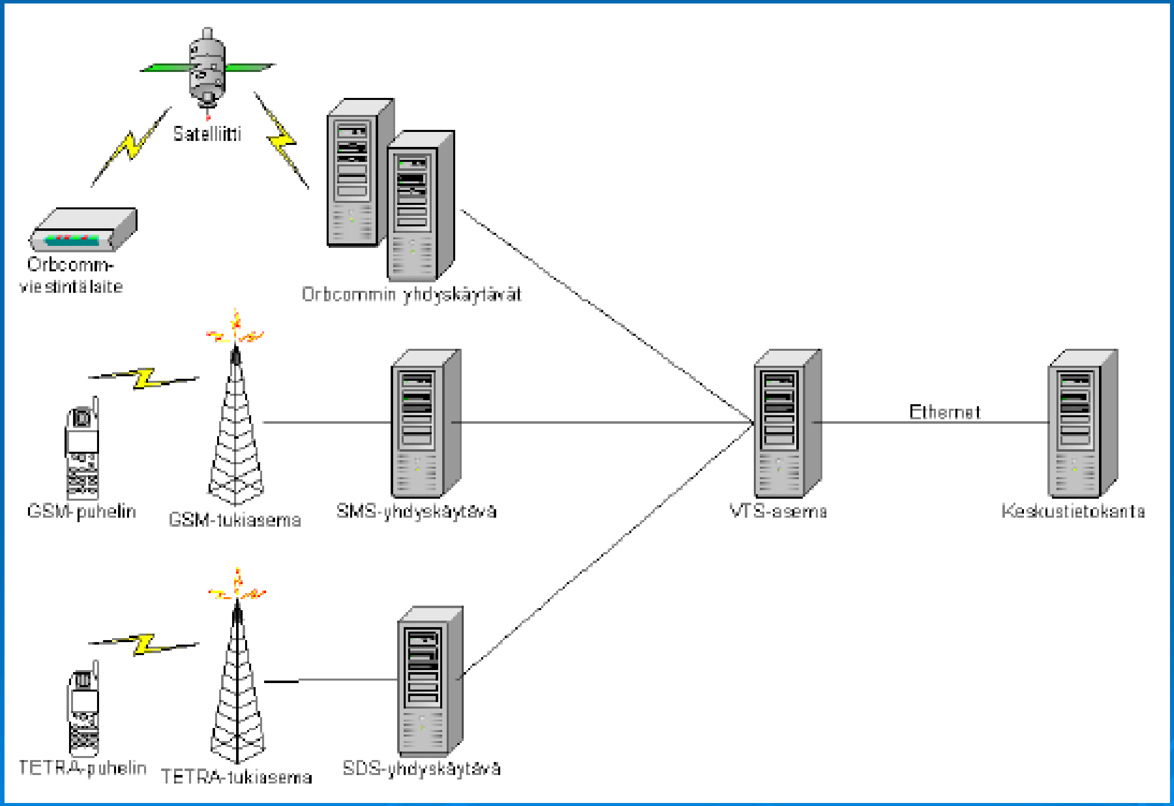
Companies interviewed

Indagon Oy



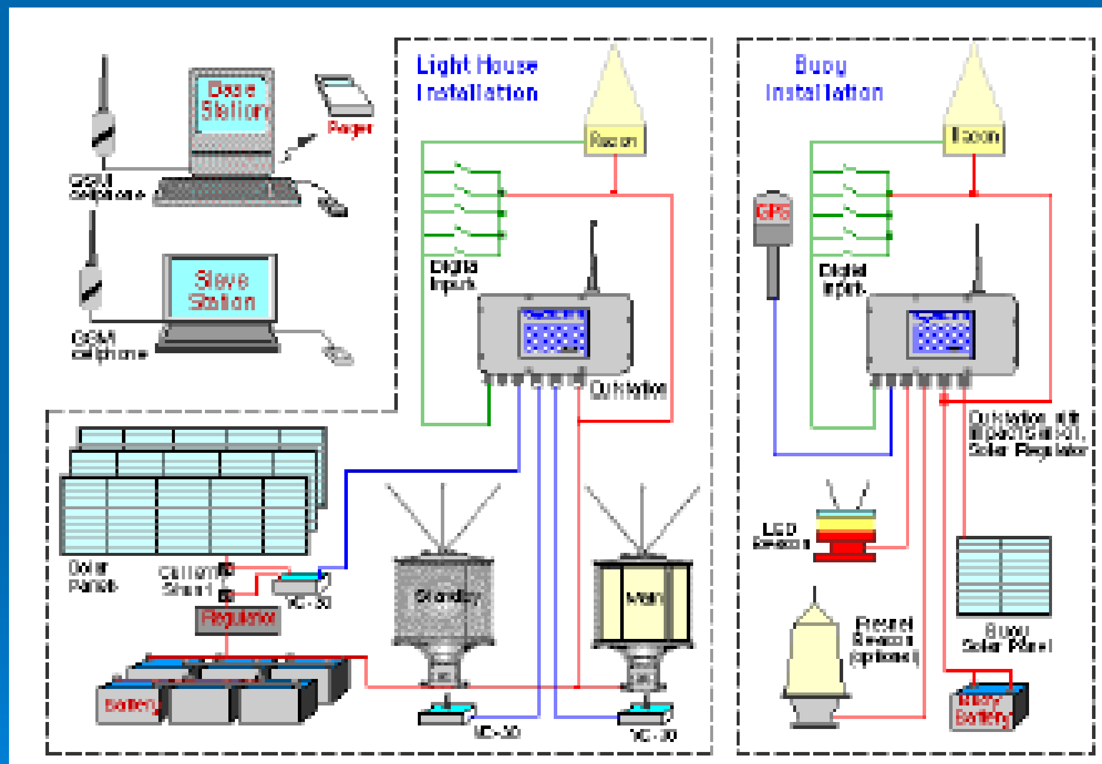
Companies interviewed

NaviElektro Oy



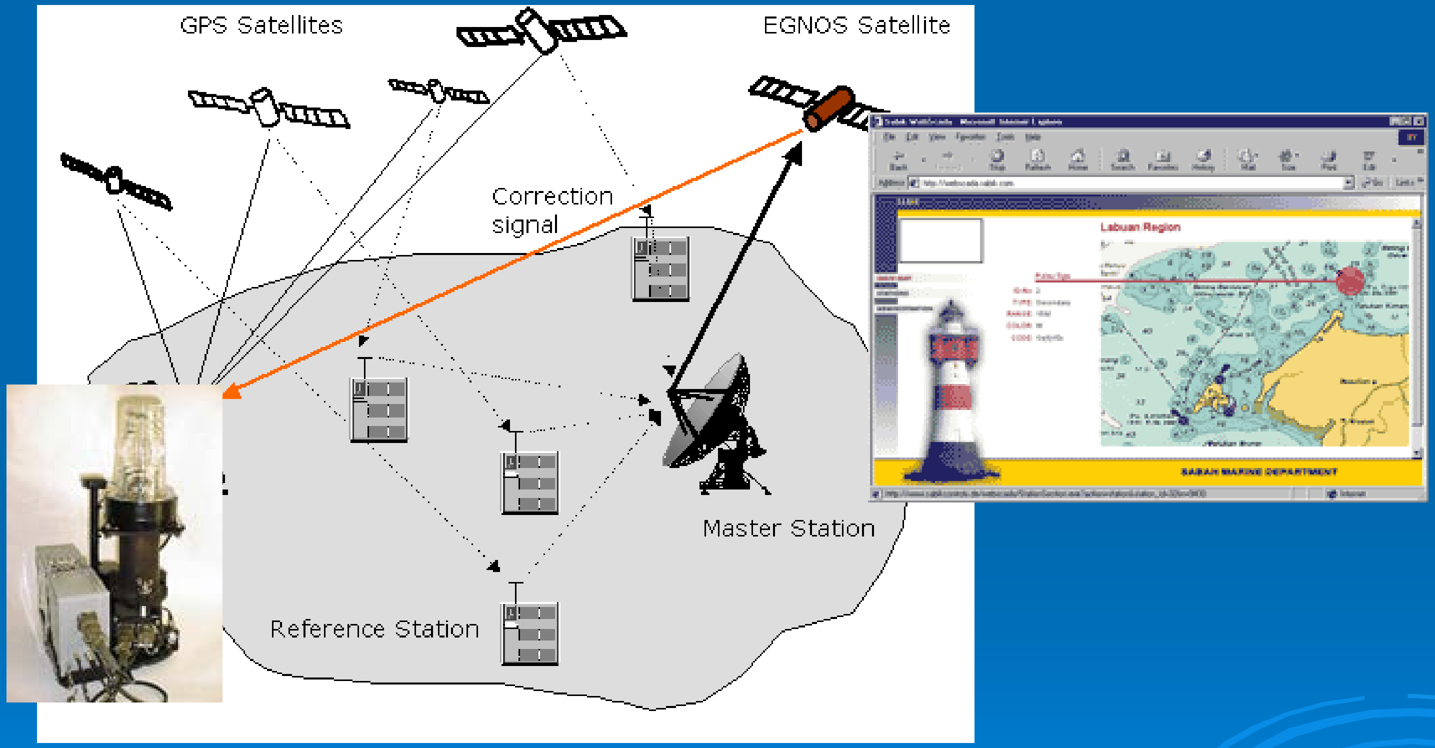
Companies interviewed

Vega Oy



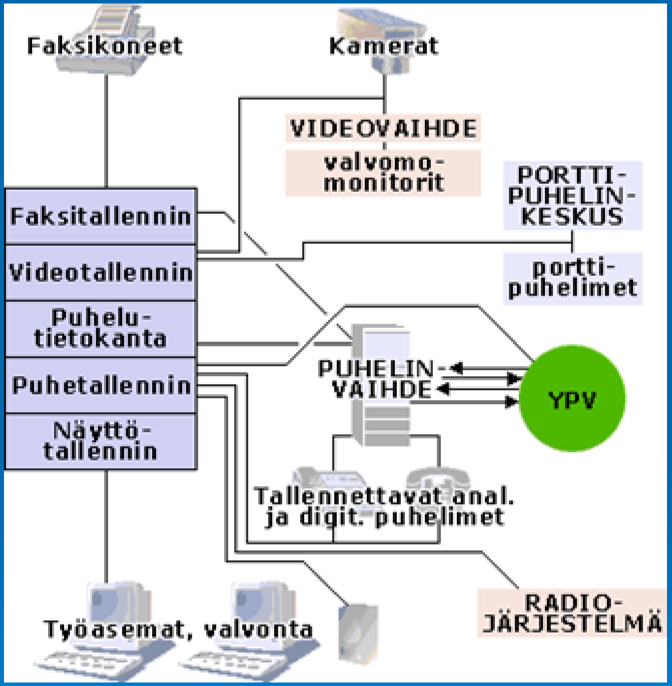
Companies interviewed

Sabik Oy



Companies interviewed

Scando Oy



Companies interviewed

Digita Oy	WiMAX
Elektrobit Group Oyj	TETRA terminals
Suomen Erillisverkot Oy	TETRA (VIRVE)
Fastrax Oy	Satellite systems
Finnet Oy	WiMAX
Geostar Oy	GPS
Geotrim Oy	GPS
Indagon Oy	Remote monitoring systems
Oy Insalko Ab	TETRA terminals
Finnish Maritime Administration	DGPS, AIS, remote monitoring
Navielektro Ky	Maritime monitoring systems
Rokmel Modem Oy	TETRA terminals
Oy Sabik Ab	Maritime monitoring systems
TeliaSonera Finland Oyj	GSM, GPRS, EDGE, UMTS
Topgeo Oy	Satellite systems

Content of survey

1. Navigation aids and waterway types
2. Remote monitoring trials
3. Existing solution for data transfer from navigation aids to center
4. Location techniques
5. System architectures
6. Data transfer techniques
7. Security aspects
8. Utilization of IP-technology
9. Antenna solutions
10. Commercial solutions and system providers
11. Proposal for the system

Location techniques

- Satellite positioning (~ 1 - 10 m)
  - GPS, DGPS, GALILEO
  - GLONASS
  - EGNOS
  - DORIS
- Cellular positioning(~ 50 m - 35 km)
  - Cell-ID
  - Time Of Arrival (TOA)
  - Enhanced Observed Time Difference, (E-OTD)
  - Assisted GPS, (A-GPS)
- Other positioning techniques (~ 50 m - 100 m)
  - based on pattern recognition
  - based on data correlation

Data transfer technologies

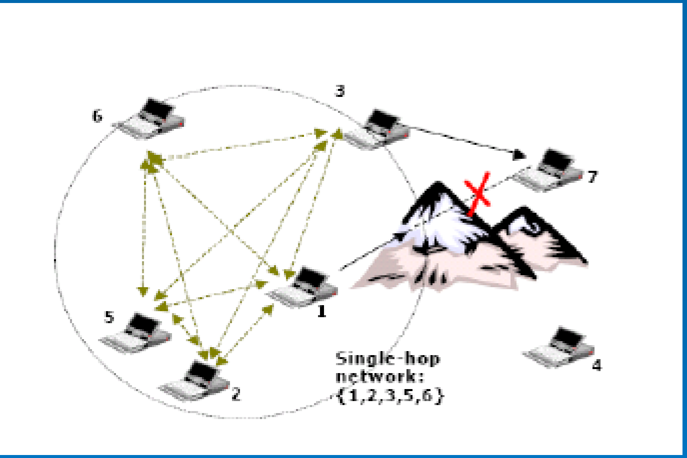
- OrbComm
- TETRA
- AIS
- GSM/GPRS/EDGE
- HAPS (High-Altitude platforms)
- UMTS (FDD/TDD)
- WLAN/WiMAX
- Flash-OFDM
- UHF radio link
- VHF radio link
- HF radio link

Figure. Coverage of VIRVE in Finland (source: Erillisverkot)

Attention: Remote monitored and in to FMA data base saved data is possible to copy in FMA AIS –data base. From there the required information is simple to print virtualy on AIS –layer.

Network architectures

- Types:
  - static (traditional cellular network)
  - dynamic (self-organising Ad hoc network)
  - hybrid (combination of traditional and Ad hoc network)



- Constraints to be considered:
  - power consumption
  - reliability
  - security
  - signalling
  - availability

Security aspects

- Examples of security threads:
  - jamming data transfer
  - jamming positioning
  - unnecessary power consumption
  - manipulating status and location information
  - intercepting and changing commands
  - hi-jacking radio resources
- Ways of preventing them:
  - encryption
  - authentication
  - system upgrades

- Security aspects should be handled on system level not on application level

Utilising IP-technology

- Benefits of IP-technology:
  - independent on data transfer technique
    - does not require protocol conversions
  - ready-made protocol stacks and implementions exist
    - Built-in encryption and authentication
  - the common trend is towards all-IP solutions
- Drawbacks of IP-technology:
  - relatively heavy
    - requires memory and processing power
    - high power consumption
  - for wireless data transfer not the most efficient solution
    - utilization of lower level protocols

Survey results

- The most suitable data transfer technologies:
  - TETRA
  - GSM/GPRS/EDGE

- Economically the best solution is GSM
- Technically the best solution, when security and confirmed data transfer are considered, is TETRA

In short:

- The chosen data transfer technology depends on the location of the navigation aid and its importance for maritime safety

GSM networks

- Strengths:
  - the costs of data transfer services and terminals are relatively low
  - wide terminal type selection
    - modems are available
  - network is available in whole Finland including coastal areas
  - supports different data transfer techniques (SMS, GPRS- and CS-data)
- Weaknesses:
  - the network is run based on economical interests (e.g. user density)
  - radio resources are optimized and therefore the network will halt more likely than TETRA network in emergency situations
  - security and confirmed data transfer must be provided on application level

TETRA networks

- Strengths:
  - security and confirmed data transfer is provided on system level
  - network is available in whole Finland including coastal areas
  - has its own frequency band, which is dedicated for authorities
  - the criterias for network robustness are very high and network should not halt even in a case of big catastrophes
  - supports different data transfer techniques (SDS, GPRS- and CS-data)

- Weaknesses:
  - VIRVE is more expensive to use than GSM
    - need for co-operation among authorities to share costs
  - power consumption is higher in TETRA terminals than i.e. in GSM terminals
    - battery saving features are still missing
  - availability of TETRA modems is still uncertain

Phase 2 of 3 2006

Objectives

to establish final plans for the pilot system and set in order comparisions between the suppliers of the system.

to Investicate how to collect consortium for the project and investicate what different participators of the consortium can technically offer to project/system.

to carry out additional study for the positioning (Egnos)

Invite tenders from the consortium

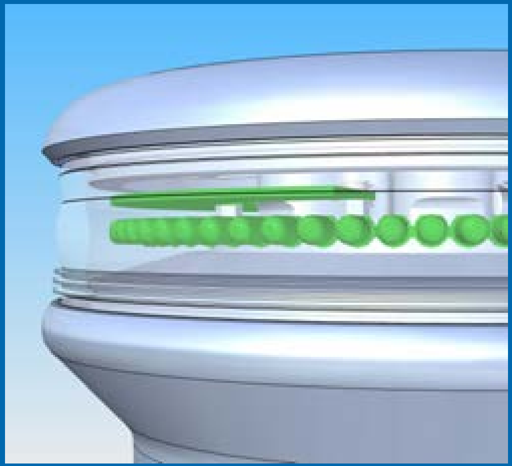
Phase 3 of 3 2007

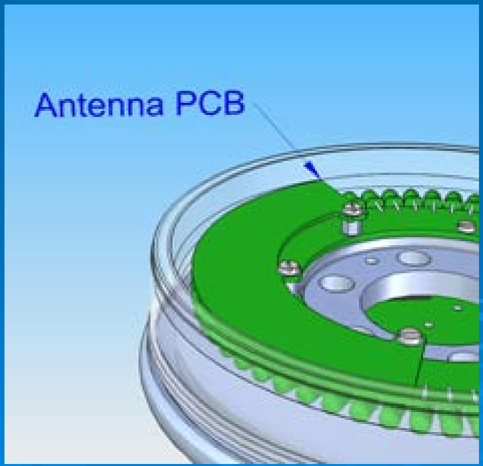
Received tenders:

-Erillisverkot-consortium (Tetra, short messsages, position calculation on network side)
-Indagon-consortium (GSM, SMS or GPRS –messages, position calculation in the AtoN)
-Sabik (GSM, SMS –messages, EGNOS –positioning)

1. Tender comparisons 01/2007
2. – most advantageous was Sabik in both: for whole project/system and for the pilot
   - Erillisverkot was most expensive in all levels

2007





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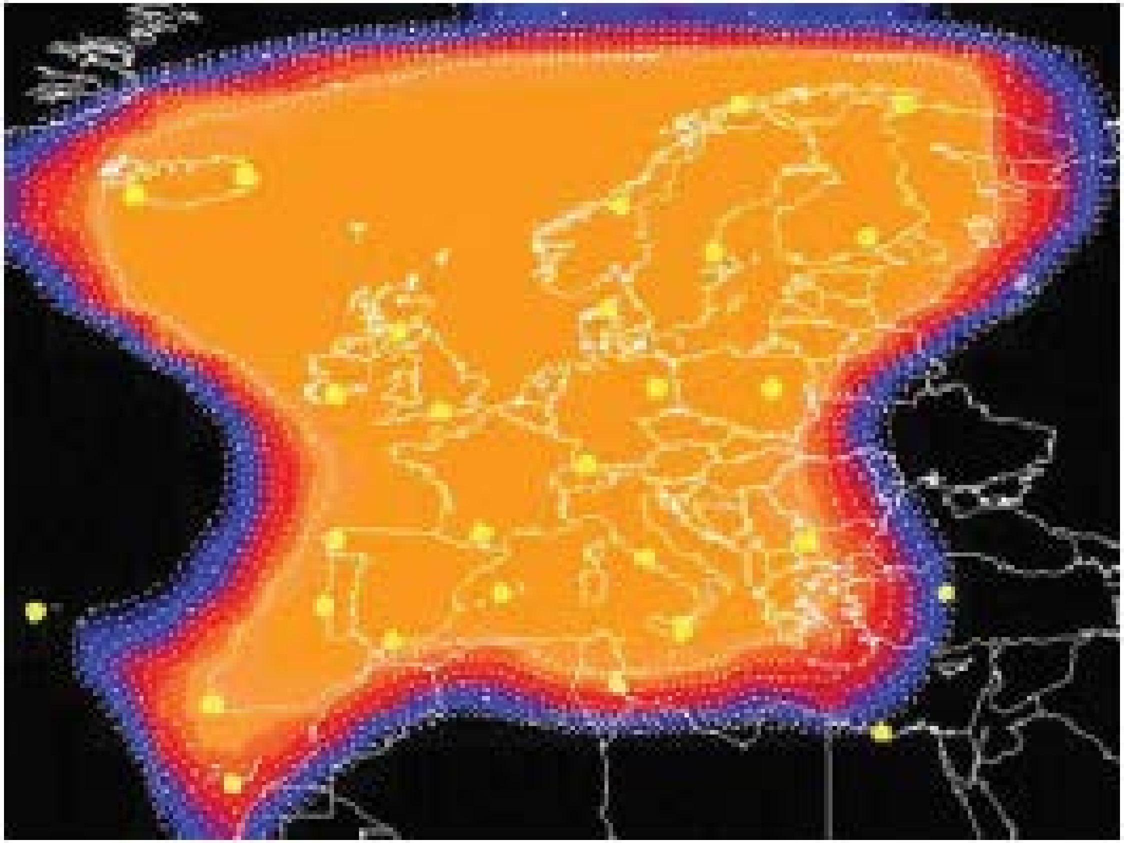
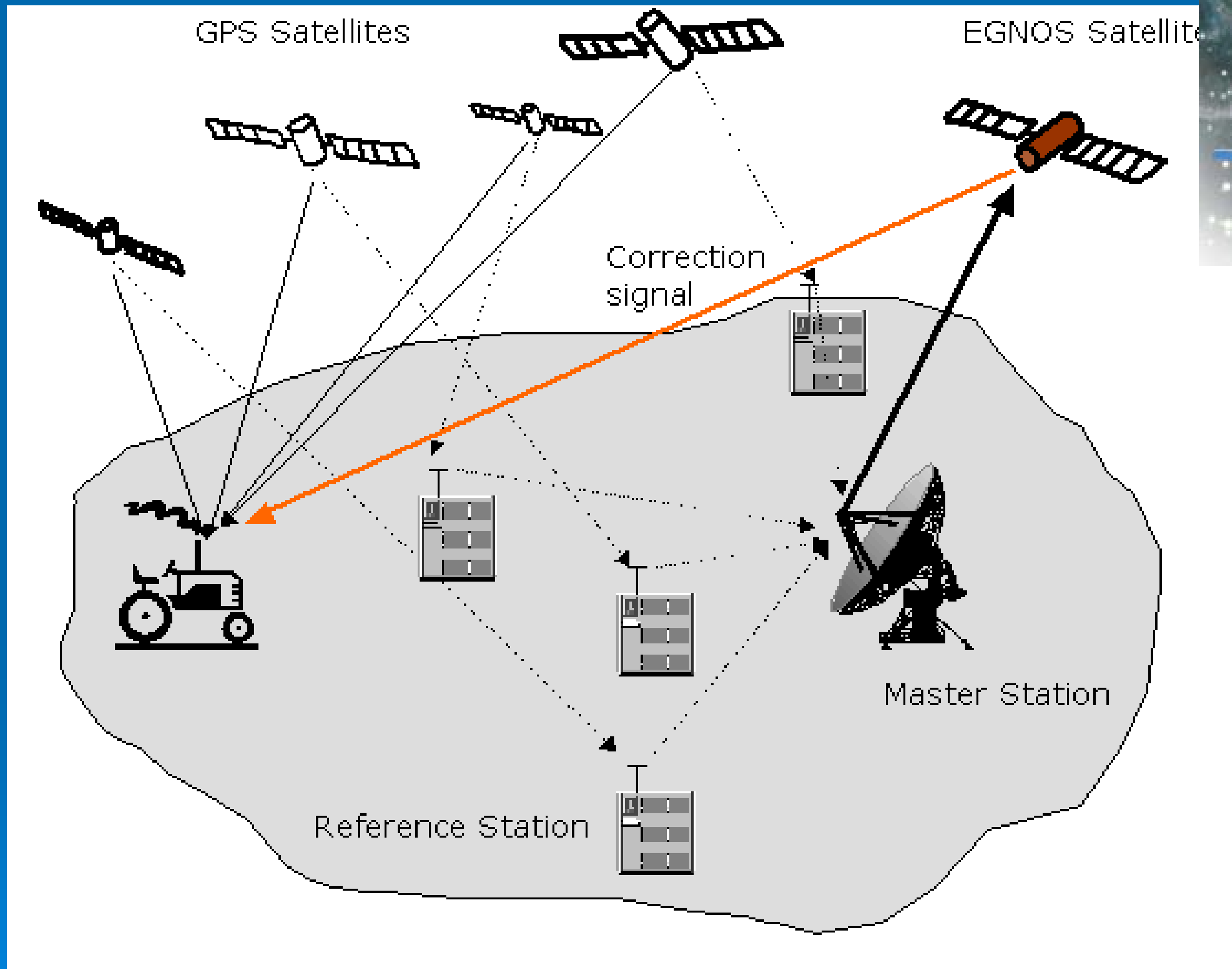
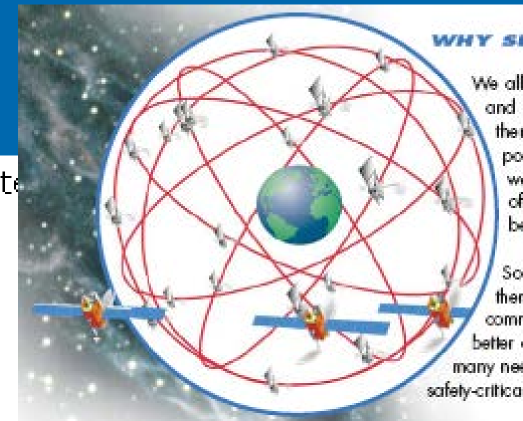


Expected EGNOS coverage for a high-accuracy service (1-3 m horizontal)

2007


GPS Satellites
EGNOS Satellite
Correction
signal
Master Station
Reference Station



2007

That´s all – Thanks!

Questions:

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