Creating and testing APRS – technology for GPS tracking and messaging…

Øyvind Hanssen "LA7ECA"

University of Tromsø
and the Norwegian Radio Relay League

Agenda

➡️ Radio amateurs and the voluntary rescue service
- Collaborate with many organisations, including the police, red cross, air rescue, marine rescue, etc. . .

- APRS – Automatic Position Reporting System
  - Infrastructure
  - Trackers, repeaters, internet-gateways, user-application.

- Projects
  - Polaric Tracker
  - Polaric Server (web-application)

- Tracking service in practical use
  - Rescue service, sports events, etc.

Agenda

- Radio amateurs and the voluntary rescue service
  - Collaborate with many organisations, including the police, red cross, air rescue, marine rescue, etc. . .
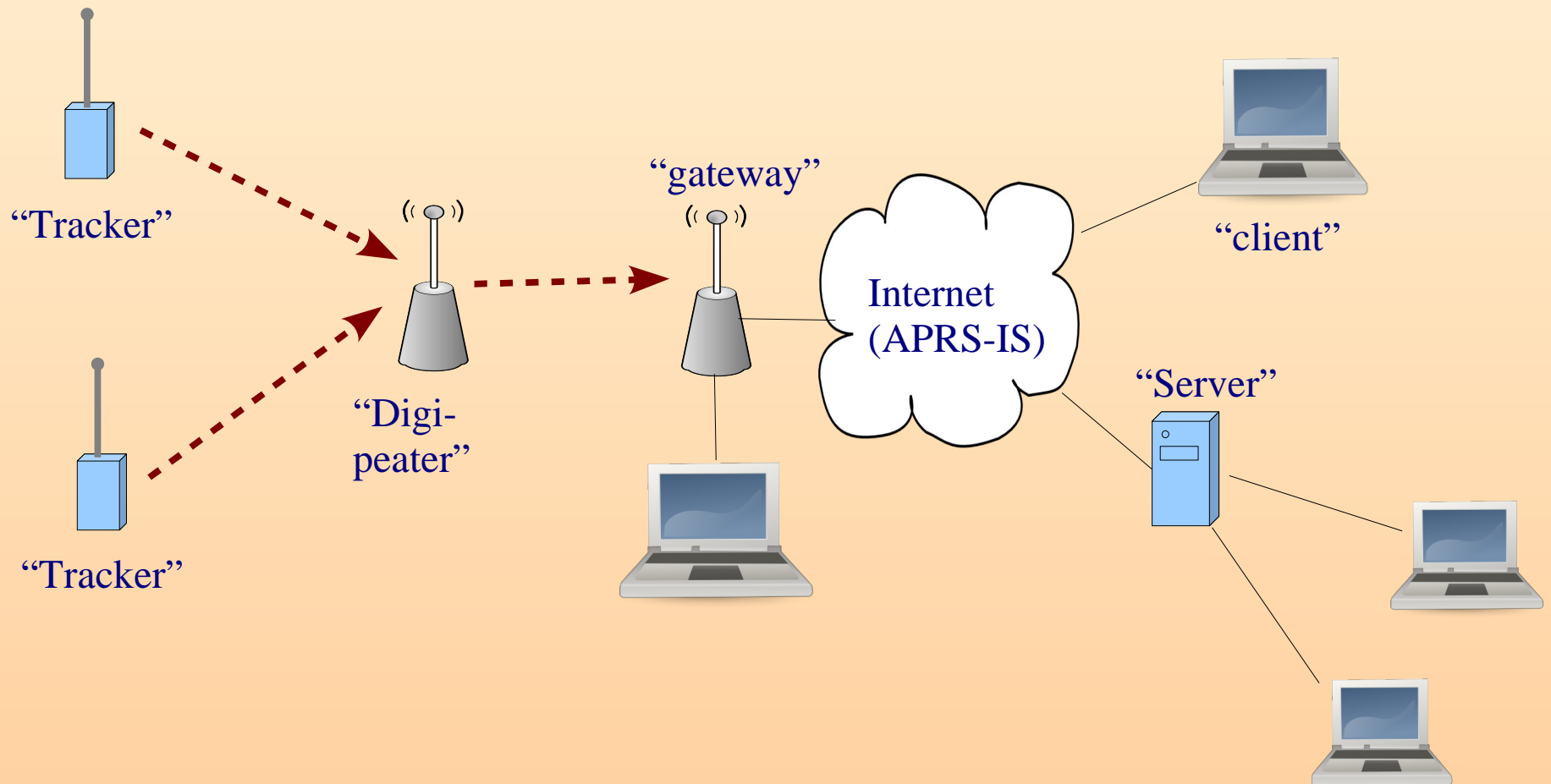
- APRS – Automatic Position Reporting System
  - Infrastructure
  - Trackers, repeaters, internet-gateways, user-application.

- Projects
  - Polaric Tracker
  - Polaric Server (web-application)

- Tracking service in practical use
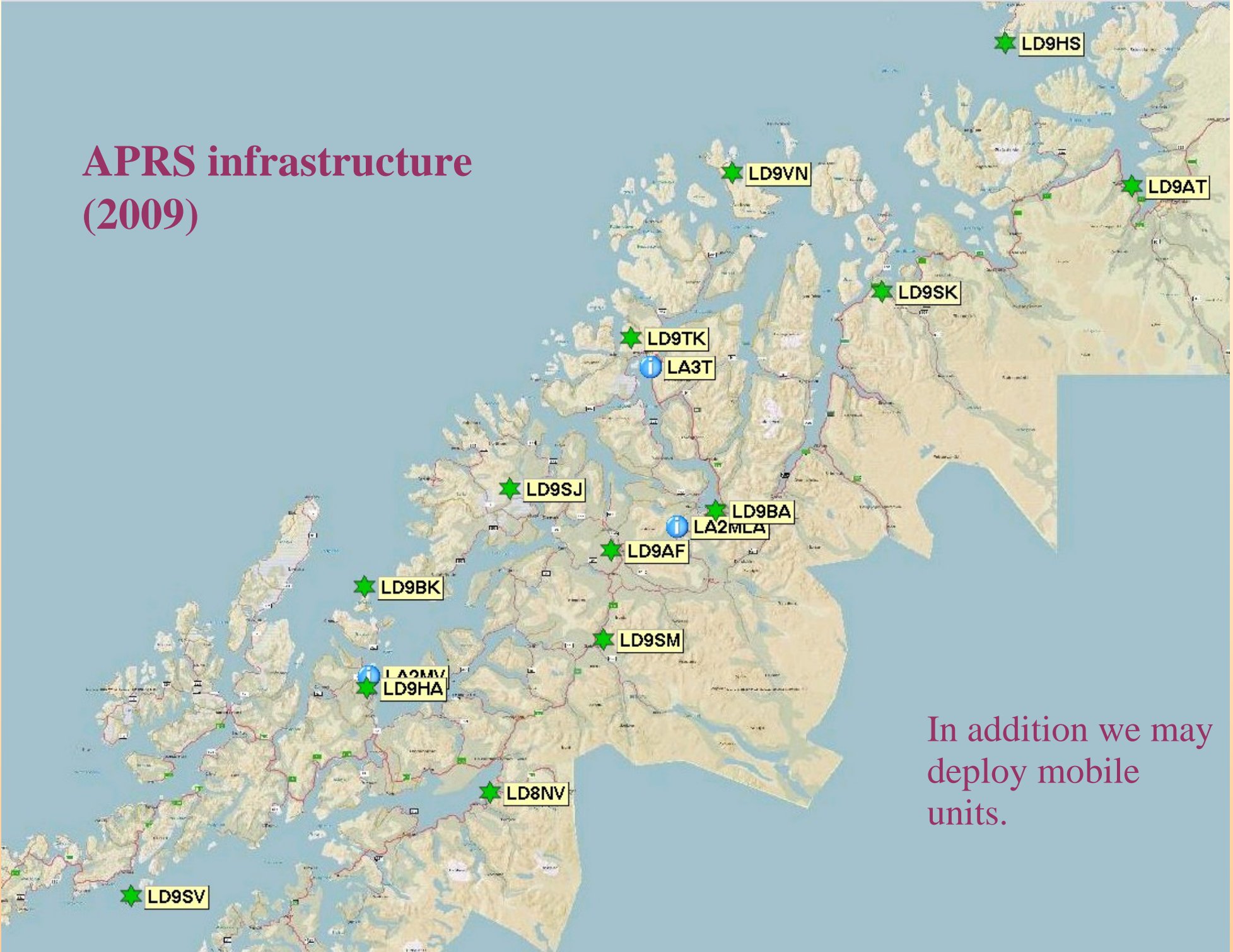 - Rescue service, sports events, etc.

APRS

- Based on GPS and AX.25 – packet radio
    - Uses a kind of HDLC UI frames to send position reports.
    - 144 MHz, 1200bd AFSK
    - Several variants: compressed packets, timestamping...
    - Also text messages, telemetry, weather reports, etc.

- "Digipeater"
    - Automatic re-transmission (broadcast) on radio
    - Use HDLC adress field to control repeating of packets

- Internet (APRS-IS)
    - "Streams" of APRS reports in a network (hierarchy) of servers
    - Can "connect to" APRS-IS in order to deliver data (from radio) or in order to receive data.
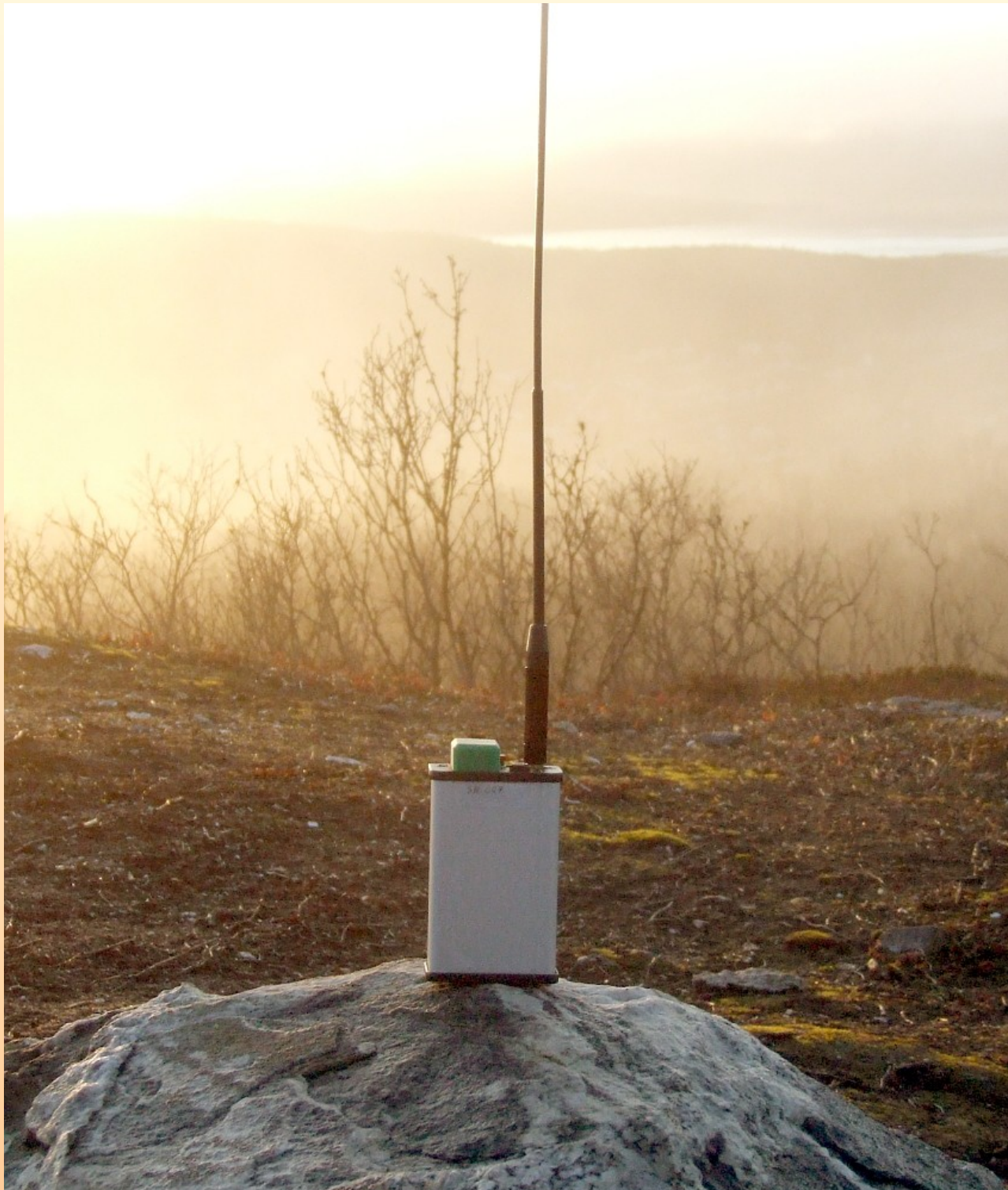   - May specify filters, for instance based on location.

APRS Infrastructure

"Tracker"

"Tracker"

"Digi-
peater"

"gateway"

Internet
(APRS-IS)

"client"

"Server"

APRS infrastructure (2009)

LD9HS

LD9VN

LD9AT

LD9SK

LD9TK

LA3T

LD9SJ

LD9BA

LA2MLA

LD9AF

LD9BK

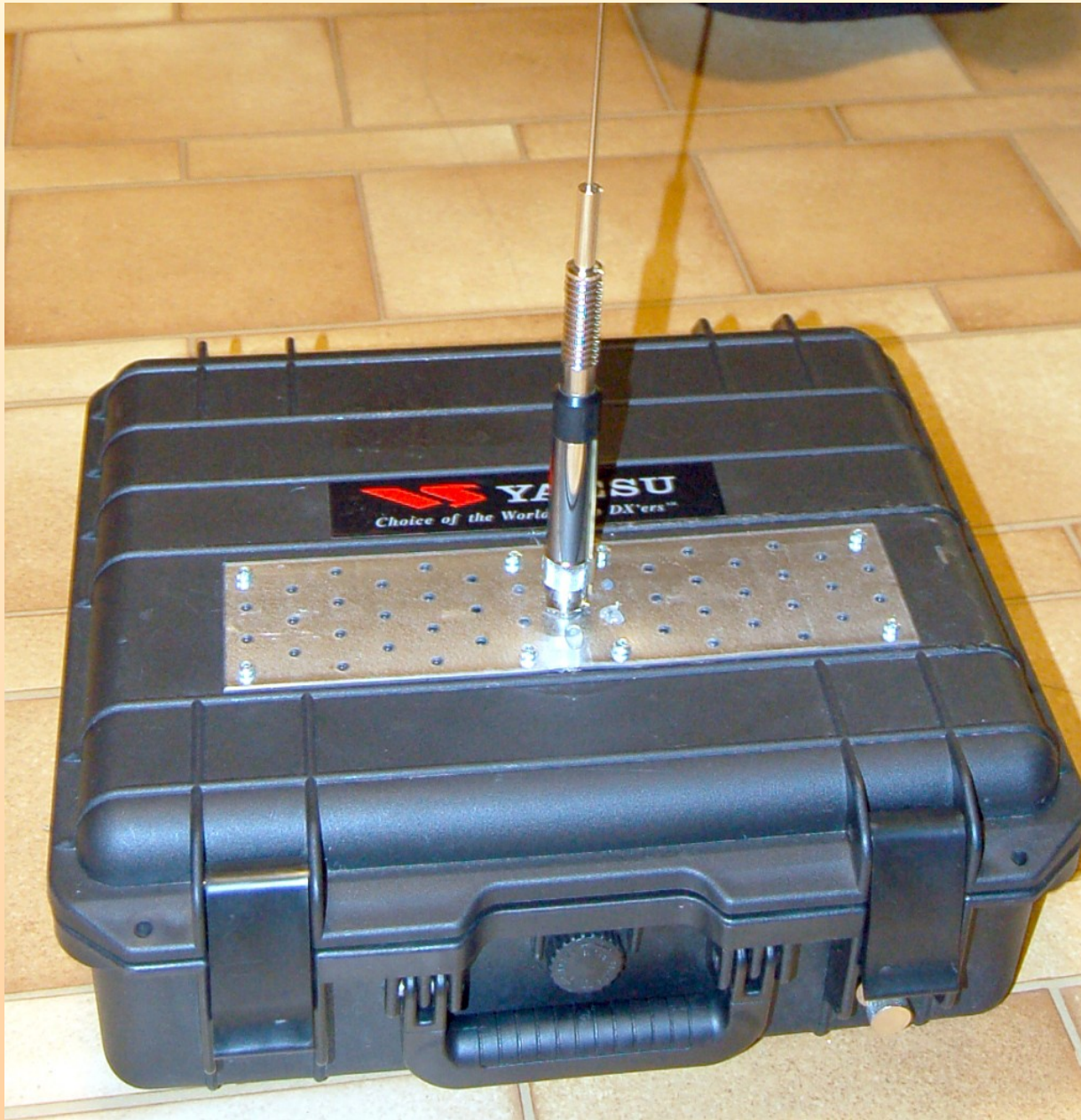LD9SM

LA2MV
LD9HA

LD8NV

LD9SV

In addition we may deploy mobile units.

"Mobile" repeater on Rødryggen, (776 m)

LA8JRA, Odd Halvard.
Foto: Odd-Christian Lilleeng

Digipeater in a case
(VHF antenna on top)

Server in a case (wireless LAN, tracker, radio, Linux PC, 12V ext. power)

Agenda

- Radio amateurs and the voluntary rescue service
    - Collaborate with many organisations, including the police, red cross, air rescue, marine rescue, etc. . .

- APRS – Automatic Position Reporting System
    - Infrastructure
    - Trackers, repeaters, internet-gateways, user-application.

Projects
    - Polaric Tracker
    - Polaric Server (web-application)

- Tracking service in practical use
   - Rescue service, sports events, etc.

"Polaric Tracker" project

- <u>Goal</u>: Construct a compact and affordable tracker
    - <u>Complete</u>: Transmitter/receiver, "modem", controller, GPS, battery...
    - Easy to use.
    - Programming/configuration via USB.
    - Moderate power consumption, at least 24 hours battery life.
    - Open source software development

- Prototyping
    - <u>June 2008</u>. Lab model (proof of concept), testing
    - <u>November 2008</u>. Pilot series, 10++ units.

- <u>Financing</u>: Gjensidigestiftelsen + NRRL

Technical info

- Microcontroller:
  - Atmel AT90USB1287: 8K RAM, 4K EEPROM, 128K Flash, USB

- Transmitter/receiver:
  - Analog Devices ADF7021 transceiver (80-950MHz)
  - We can cover 140-150MHz (typically 144,800MHz)
  - Supports FSK, but we need 1200 bd AFSK...
  - PA unit from Mitsubishi. Up to 5 watts

- Li/ion battery, Charging and programming through USB, plus separate socket for quick charging (7-14V, 2A, ½ hour)

- Compact and cheap GPS-receiver

- User interface: button, 3 LEDs, speaker + USB

Prototype
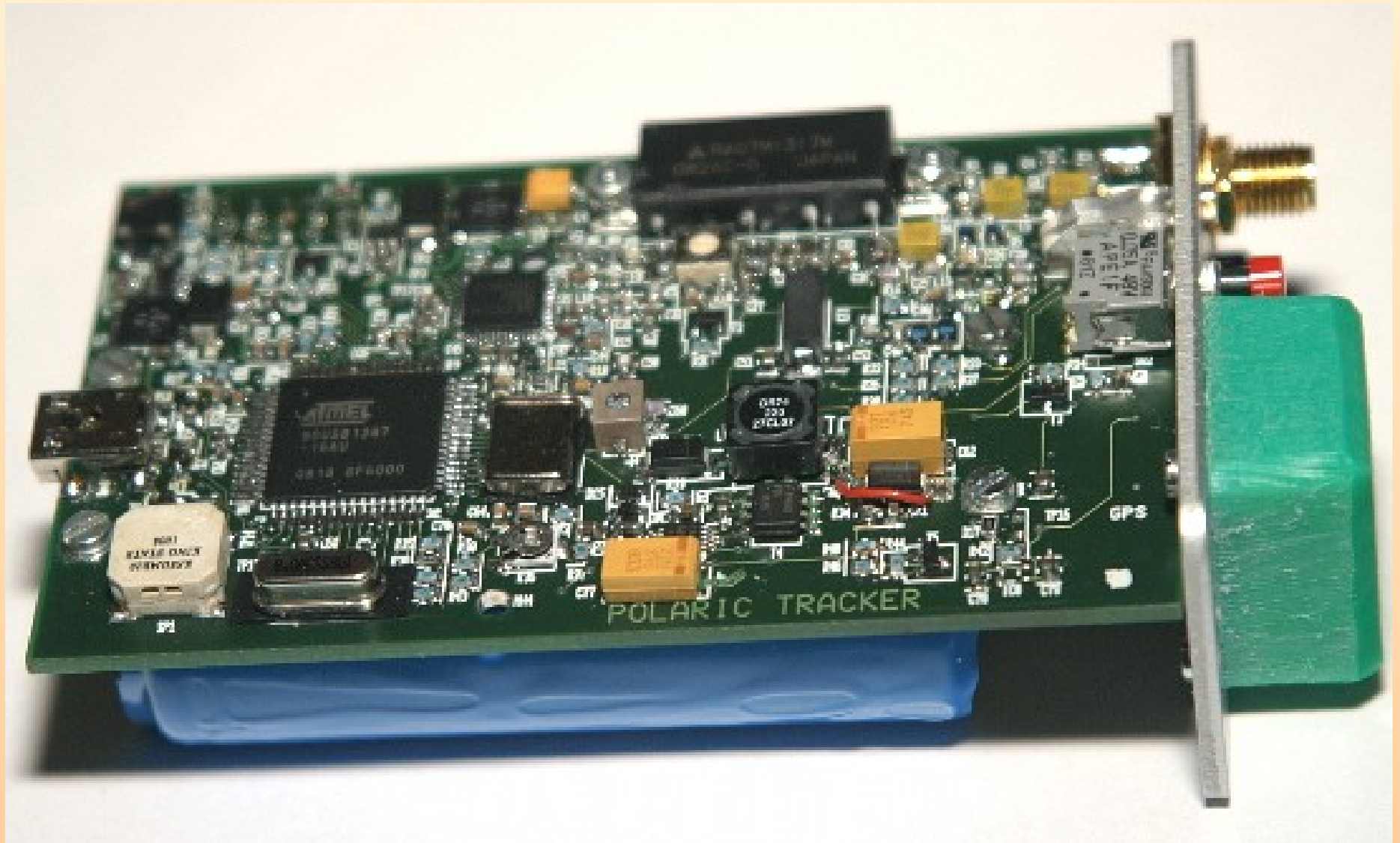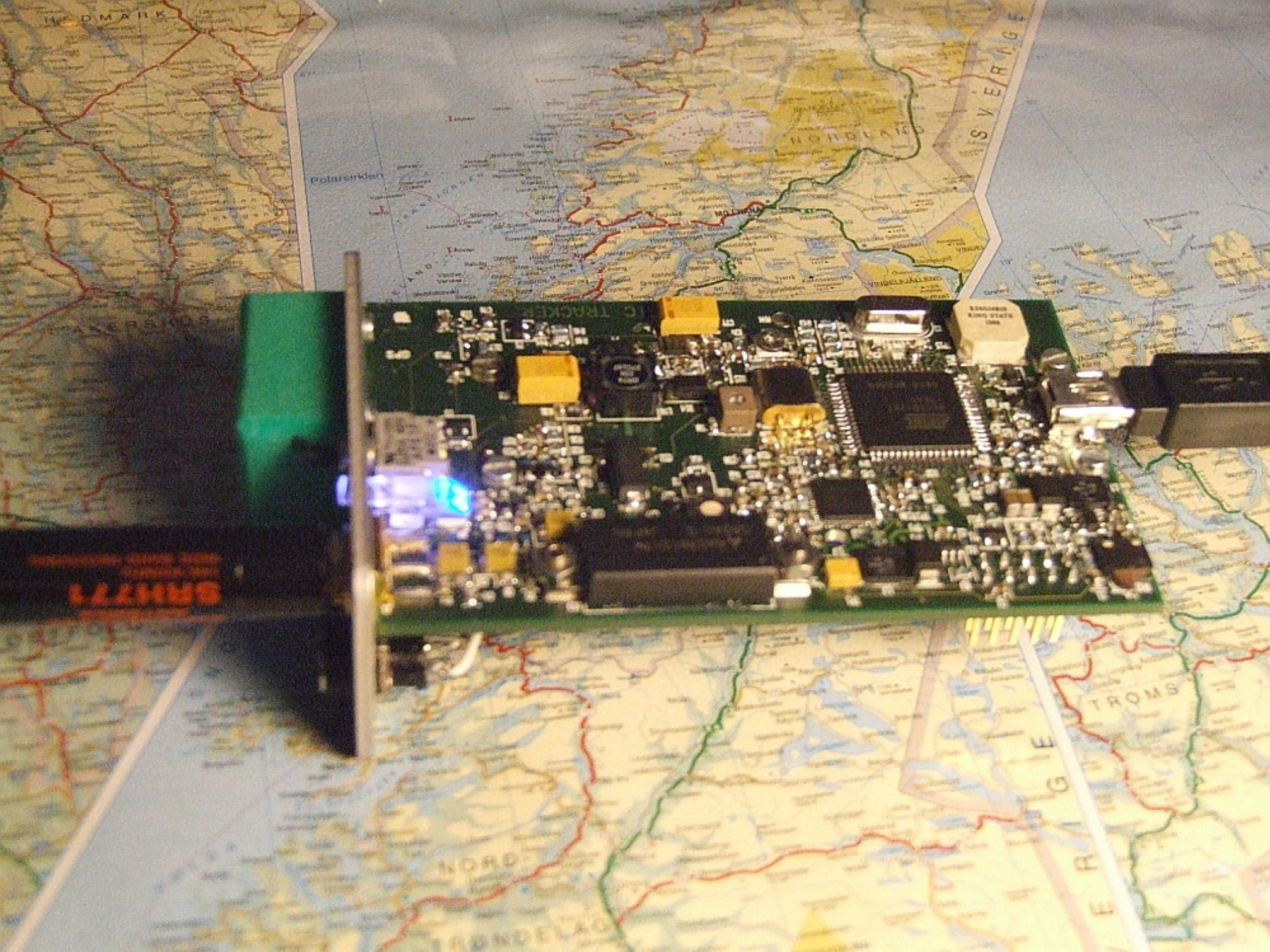
LA9SDA (Dag Kjetil), LA2NI (Kjell), my self and LA4DEA(Torfinn)
Working with 16 circuit boards

Foto: LA7QM (Arvid Andreassen)

GIS/Map application
"Polaric Server"

- Display APRS information on electronic maps
    - Should be updated in real-time (close to) based on received APRS traffic
    - Zooming, panning, maps of good quality.
    - UTM projection!!

- Web-based
    - Standard web browser should be enough for most clients
    - Can set up on server how things are displayed. Add information. .

- Open online service: aprs.la3t.no
    - Norwegian Mapping Authority WMS service !!

- Also used on mobile/portable servers
    - Use in the "field"
    - Radio, LAN, slow or no connecton to internet

GIS/map application

- Open source software components
    - OpenLayers
    - Ka-Map, UMN Mapserver
    - KaXmlOverlay (plot objects on maps)
    - Apache Webserver, PHP, etc., Linux and Java platform
    - Consider PostGIS for future versions.

- "Home made" component
    - Server program for APRS datastream
        - Receives data from APRS-IS or radio
        - HTTP server: XML (for KaXmlOverlay), HTML.
        - Can also be used standalone as APRS-IS gateway
        - Remote control, APRS messaging
        - Java, Scala

Software architecture
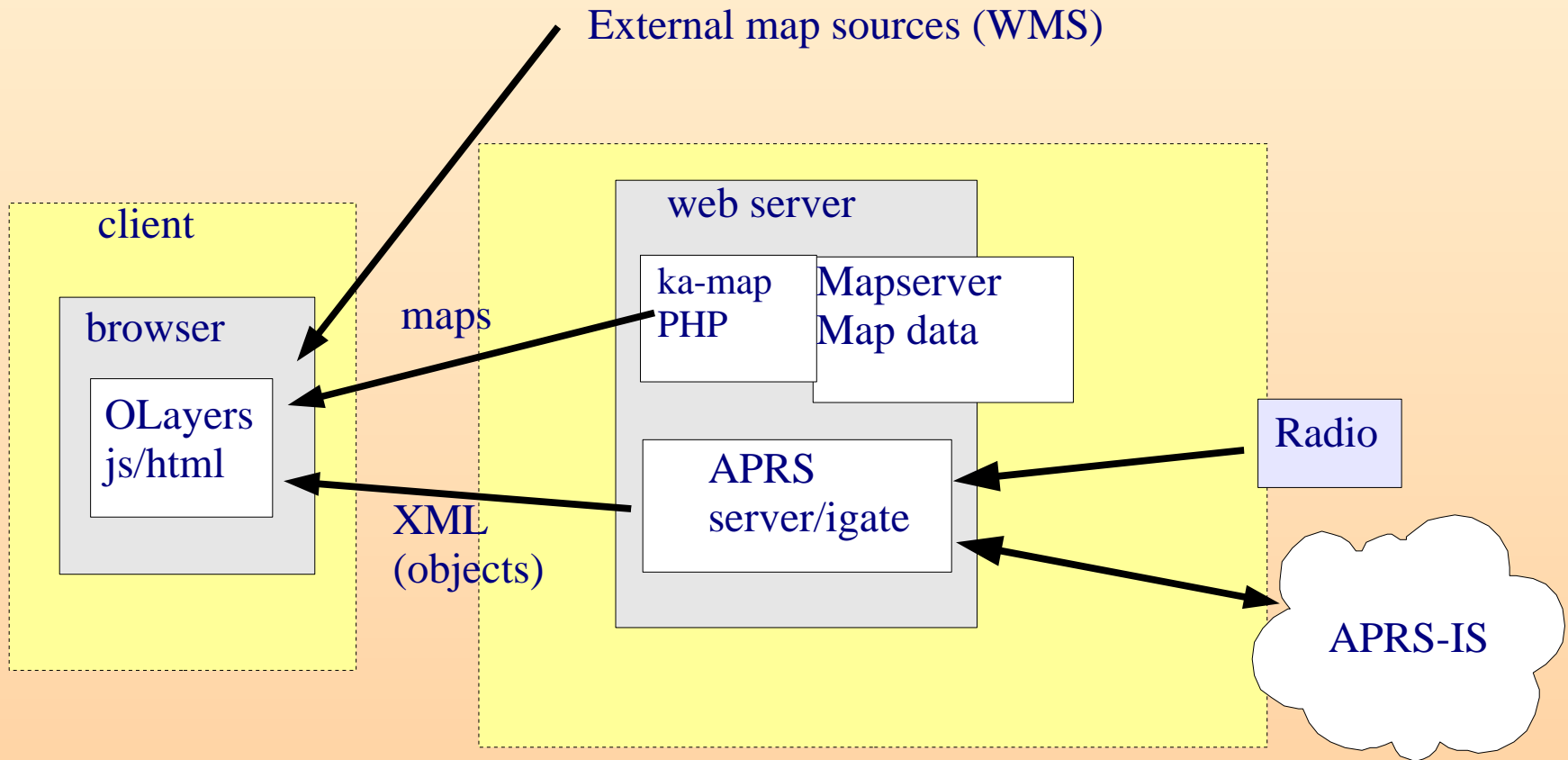
Agenda

- Radio amateurs and the voluntary rescue service
    - Collaborate with many organisations, including the police, red cross, air rescue, marine rescue, etc. . .

- APRS – Automatic Position Reporting System
    - Infrastructure
    - Trackers, repeaters, internet-gateways, user-application.

- Projects
    - Polaric Tracker
    - Polaric Server (web-application)

Tracking service in practical use
    - Rescue service, sports events, etc.

Experiences

- Tracking service proven to have significant impact
    - ICT tools make operations more efficient. Logistics.
    - Radio amateur APRS infrastructure – emerging as an important resource in volunteer rescue service.
    - Other organisations are interested. Including police, government, rescue central …

- Challenges
    - Radio coverage in some areas. Internet not always available. Need to put up mobile repeaters, servers, IS gateways, etc.
    - Privacy and security???

Missions/assignments

2009

- <u>January</u>: Red Cross – winter exercise (Tromsdalen)
- <u>February</u>: Search for missing person (Tromsø)
- <u>February</u>: Search for missing person (Vannøya)
- <u>March</u>: Search for missing fishing boat (Andøya)
- <u>March</u>: Snow avalanche alarm (Lakselvdalen)
- <u>March</u>: Search for missing ski tourists (Tromsdalen)..
- <u>May</u>: Red Cross – course/excercises
- <u>June</u>: Search for missing persons (Hansnes and Kaldjord)
- <u>June</u>: Mdnight Sun Marathon
- <u>August</u>: Air SAR exercise
- <u>September</u>: Night Orienteering (NM Red Cross)
- <u>September</u>: Search for missing persons close to swedish/finnish border.
- <u>November</u>: Search for missing person
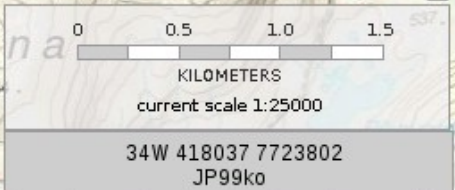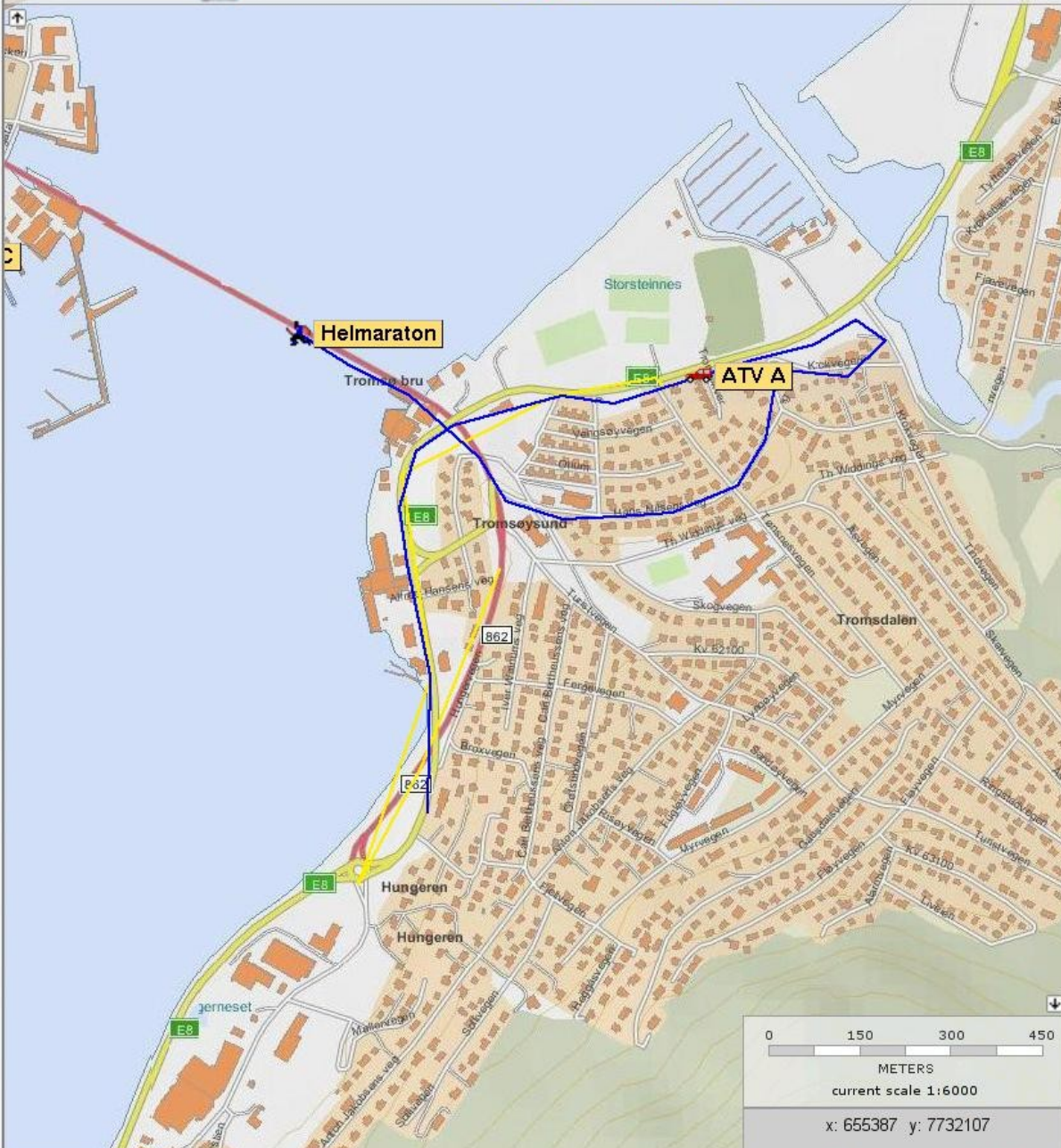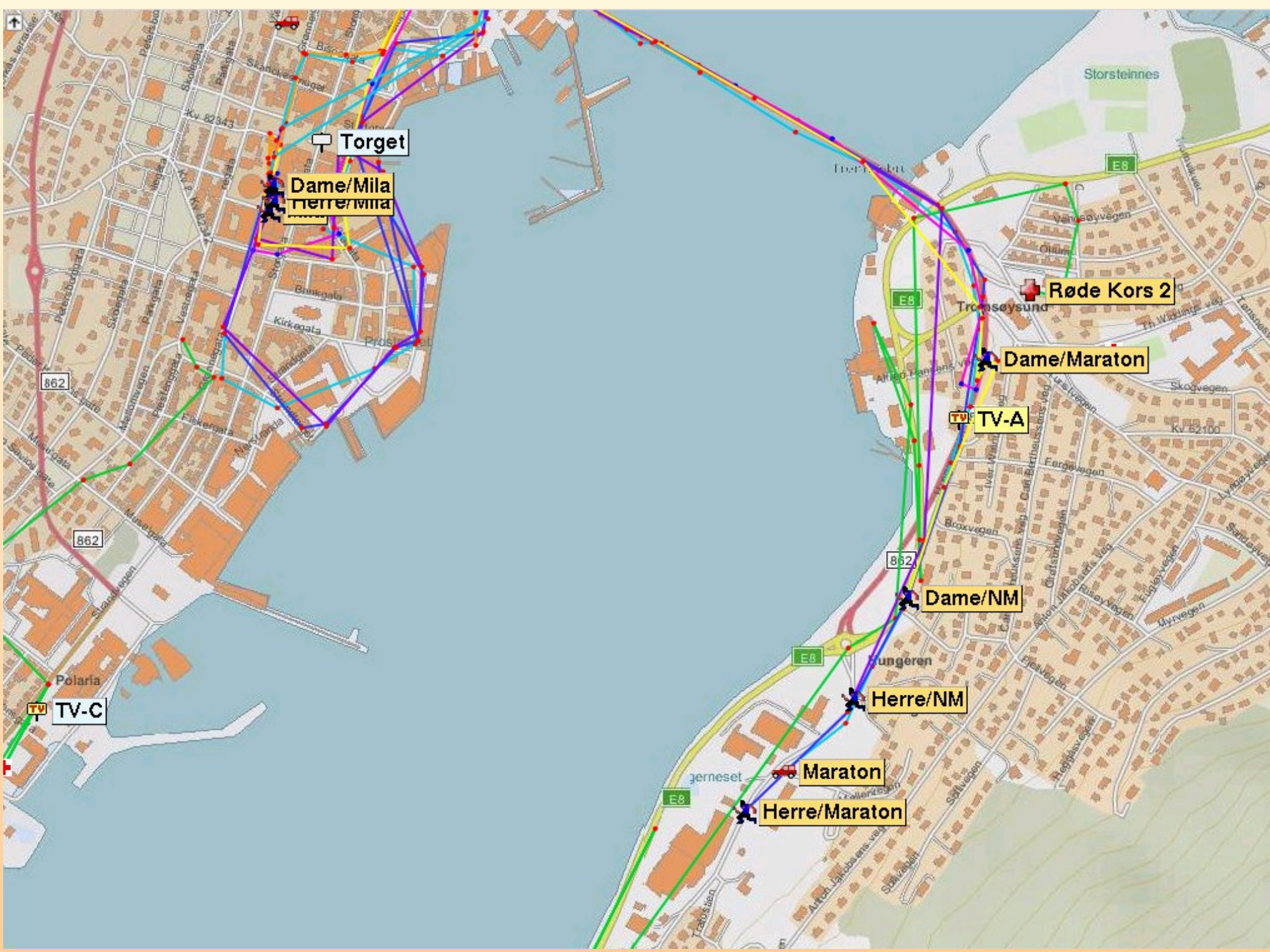- <u>November</u>: Red Cross SAR excercise

Midnight Sun Marathon

http://aprs.msm.no/aprstest/

Google

LA3T APRS

MSM kart   link to this view   Powered by ka-Map

Storsteinnes

Helmaraton

Tromsø bru

E8   **ATV A**

Kroliveien

Vangsøyvegen

Ollum

Th. Widdings veg

Tromsøysund

E8

Tromsdalen

 Altor Hansens veg

Skogvegen

862

Fergevegen

Broxvegen

Kv.62100

P.82

Hungeren

E8

Hungeren

jerneset

E8

| 0 | 150 | 300 | 450 |

METERS

current scale 1:6000

x: 655387 y: 7732107

Torget

Dame/Mila
Herre/Mila

Røde Kors 2

Dame/Maraton

TV-A

Dame/NM

TV-C

Herre/NM

Maraton

Herre/Maraton

Polaria

Storsteinnes

Night orienteering event

Air SAR excercise

LN-DAY

LD9VN

LN-ALV

LN-TOS

LN-FAW

SKJERVØY

0		4		8

KILOMETERS
current scale 1:200000

Search for missing persons
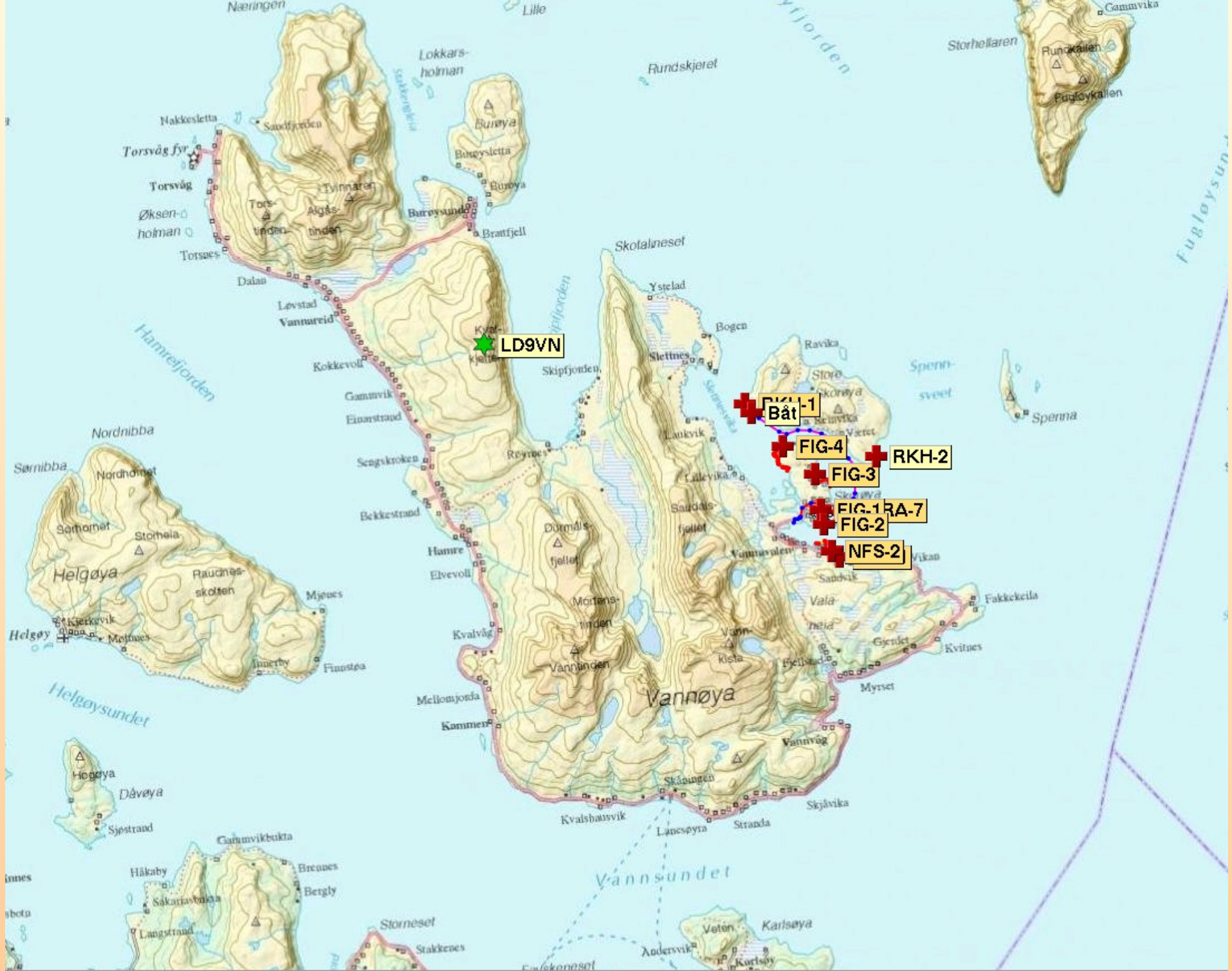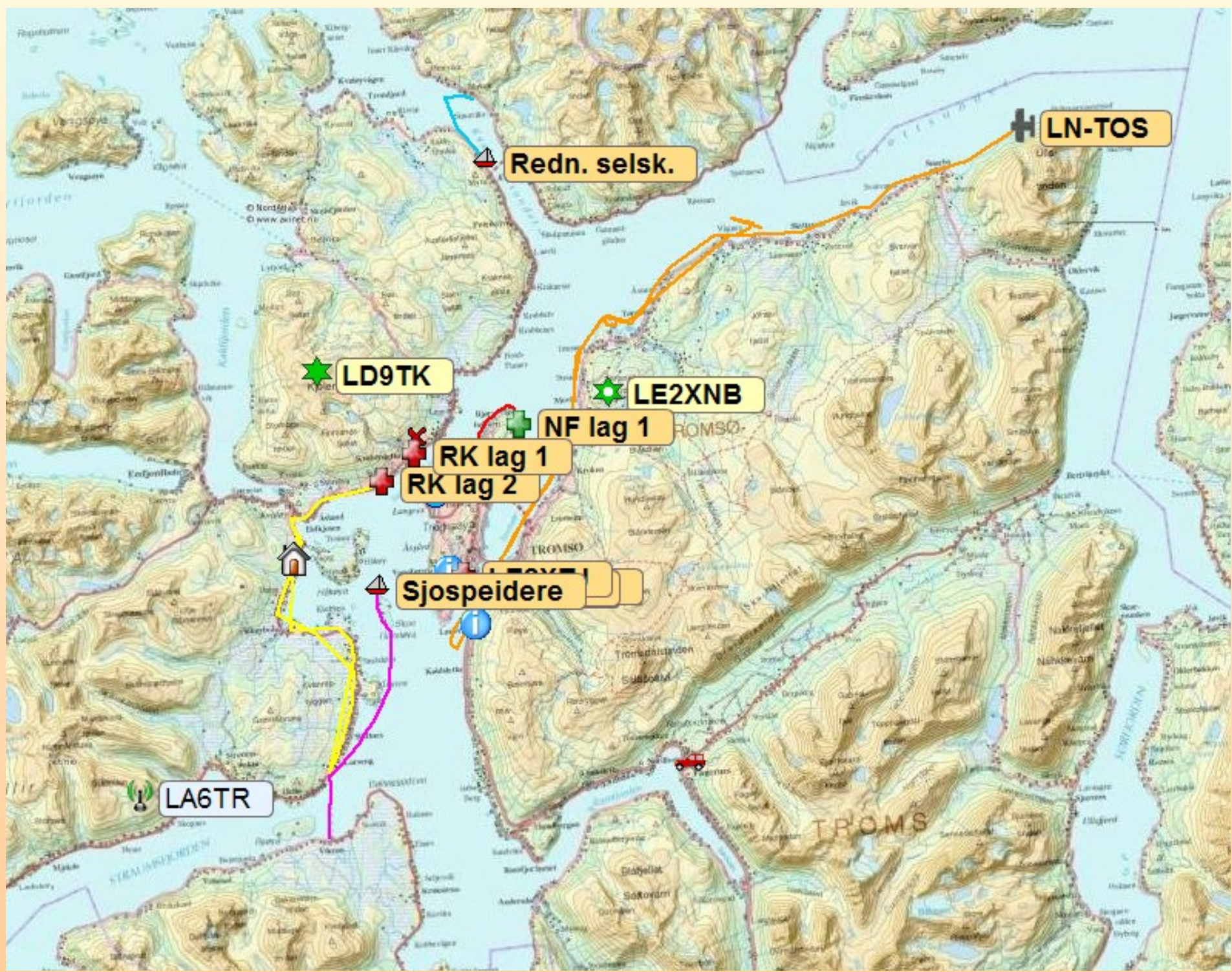
Further work

- Further development
    - Repeater functionality on tracker
    - Remote control over radio, messaging, ...
    - Better transmitting methods, FSK modulation
    - Even more portable units (igates, digipeaters)

- Challenges...
    - Minimalise loss of reports, efficient conveying of essential information
        - When/how often to transmit?
        - Redundancy??
    - Ad hoc routing using other trackers??
    - Automatic/dynamic configuration
    - Resource management (battery, bandwidth)
    - Privacy, security

Conclusions

- HAM radio tracking is making a difference in rescue service.

- APRS infrastructure, repeaters on mountaintops, <u>mobile units,</u> server/webapp, online service.

- Tracker prototyping as a club project. Norwegian hamradio association has started manufacturing 150 trackers.

- Free (open source) software. "Hacking" spirit.

- Involve other organisations..

- There are still interesting challenges.

Questions?