Creating and testing APRS - technology for GPS tracking and messaging...

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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.
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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"
- "Digi-peater"
- "Tracker"
- "Client"
- "Server"
- "gateway"
- Internet (APRS-IS)
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)
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“Polaric Tracker” project

- **Goal**: Construct a compact and affordable tracker
  - Complete: 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**
  - June 2008. Lab model (proof of concept), testing

- **Financing**: 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 connection 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

client

browser

OLayers
js/html

maps

External map sources (WMS)

web server

ka-map
PHP
Mapserver
Map data

APRS
server/igate

Radio

APRS-IS

XML
(objects)
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**Tracking service in practical use**
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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

- **January**: Red Cross – winter exercise (Tromsdalen)
- **February**: Search for missing person (Tromsø)
- **February**: Search for missing person (Vannøya)
- **March**: Search for missing fishing boat (Andøya)
- **March**: Snow avalanche alarm (Lakselvdalen)
- **March**: Search for missing ski tourists (Tromsdalen)
- **May**: Red Cross – course/exercises
- **June**: Search for missing persons (Hansnes and Kaldjord)
- **June**: Midnight Sun Marathon
- **August**: Air SAR exercise
- **September**: Night Orienteering (NM Red Cross)
- **September**: Search for missing persons close to swedish/finnish border.
- **November**: Search for missing person
- **November**: Red Cross SAR excercise
Midnight Sun Marathon
Night orienteering event
Air SAR exercise
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, mobile units, 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?