

PermaSense: New Sensor Field in Matterhorn

Igor Talzi, Sandro Schönborn, Christian Tschudin / University of Basel, Computer Science Dept
 Andreas Hasler, Stephan Gruber / University of Zürich, Dept of Geography
 Jan Beutel, Mustafa Yücel, Roman Lim / Computer Engineering and Networks Lab, ETH Zurich

Introduction

Currently, there is a lack of stand-alone geo-monitoring systems for harsh environments that are

- easy to configure, deploy and manage,
- while at the same time adhering to science grade quality requirements.

In a joint computer and geo-science project we have built and deployed a wireless sensor network for measuring permafrost related parameters.

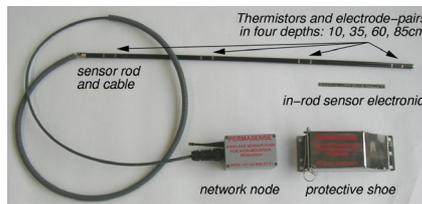


1-st Generation, year '06

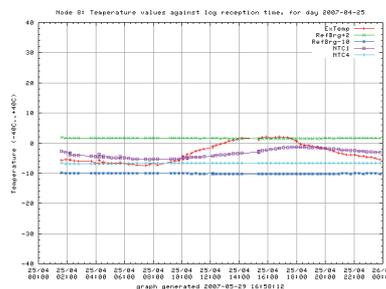
One sensor field (10 sensor nodes) was installed in the Swiss Alps on Jungfrauoch at 3'500 m above sea level, in August 2006. Each node measures in near real-time:

- 4 temperatures
- 4 conductivities

These values are indicative for rock moisture content and its phase state in the near surface layer.



Measurements, as well as special events (clock skew, sensor replacement, etc) are numbered, recorded in the flash memory and queued for transmission towards the GPRS node where they are cached.



The data-sink software (Java and CGI-scripts)

- receives and stores data packets,
- assigns calibrated time stamps to the measurements,
- visualizes data in a various ways,
- allows to manage the collected data and the network.

2-nd Generation, year '07-'08

A new sensor field with 16 nodes has been deployed in Matterhorn at 3'300 m above sea level, in October 2007, and upgraded in December. This set can also measure by attaching standard industrial sensors:

- crack dilatation
- moisture/ice content
- water pressure

The second generation implies:

- a fully customized extension board and a TinyNode wireless module.
- all form-factors remain the same.
- integration with Deployment Support Network (DSN) infrastructure.

Several upgrades are coming in spring 2008.

EMSR Initiative

In March, 2007 we have started an additional joint project including:

- Comp Science Dept, UniBas
- Dept of Geography, UniZür
- TIK group @ ETHZ

Major goals of the EMSR project are:

- specifying, production and testing the Sensor Interface Board (SIB) platform which includes many new features over standard extension board.

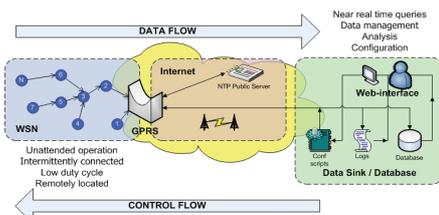


- providing testing support for PermaSense infrastructure.
- support and documentation for other projects.

PermaSense at a Glance

Adapting sensor data collection to an Intermittently Connected Network (ICN):

- long sleep cycles: power-aware hardware and protocol design.
- extended network partitions (e.g. due to snow cover).
- reliable data delivery.



- Own Time-Division-style Medium Access (TDMA) with integrated node re-synchronization.
- Multi-hop routing based on a simple spanning tree.
- Robust data collection, in-network data replication.

