The PermaSense Mountain Lab

Technology and infrastructure for an open permafrost data repository

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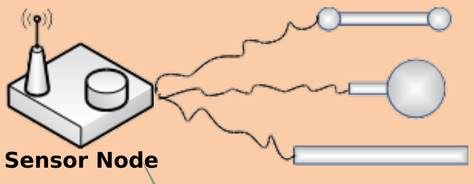
PermaSense

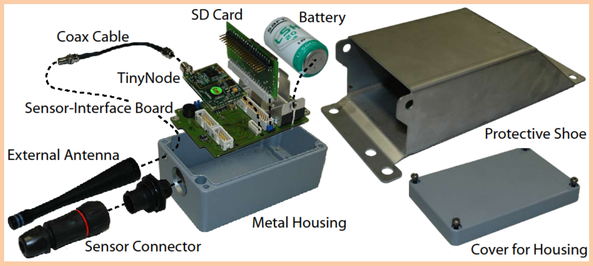
PermaSense System

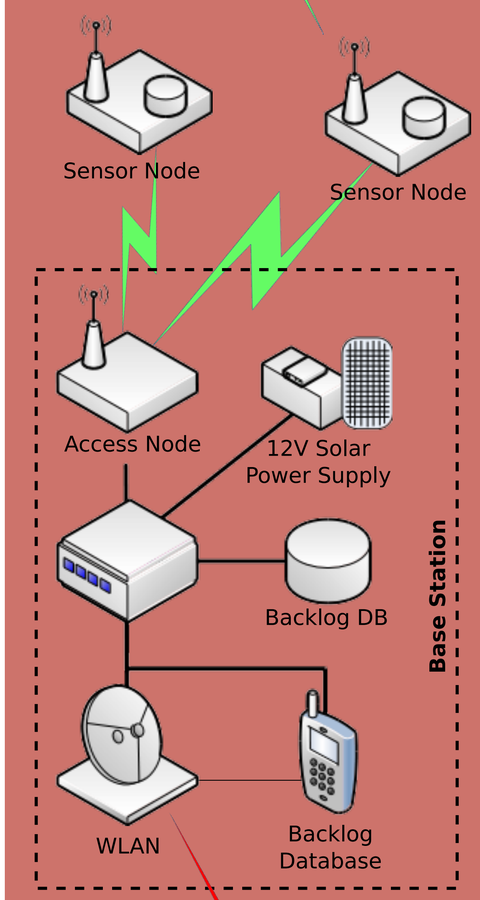
- Wireless systems, low-latency data transmission
- Customized sensors and ruggedized equipment
- Cloud based data management, open access
- Temperature, crackmeter, surface displacement (GPS), radiation, high resolution photos, acoustic and micro-seismic



Sensor Nodes and Sensor Integration

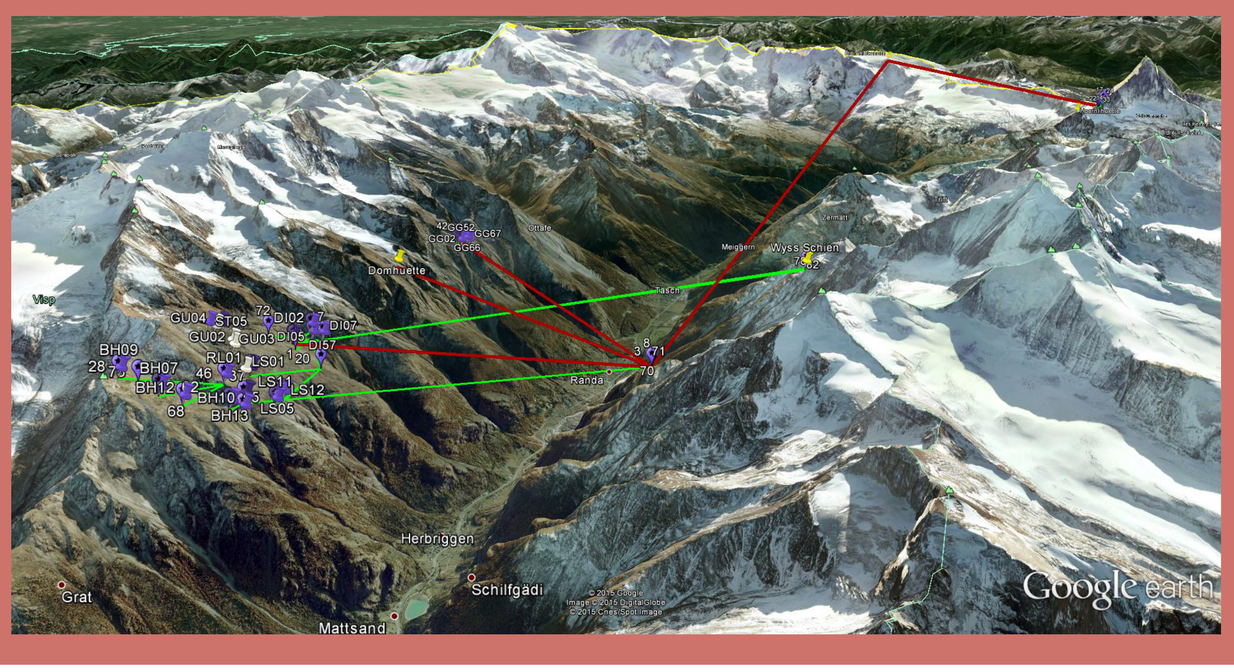
- Optimized for ultra-low duty cycles
- Static, low-rate sensing (120 sec)
- Disconnected operation: 1 GB storage
- 4 years of independent operation (~150 µA avg. power)
- Ruggedized for alpine extremes
- < 0.1 MB/node/day
- Generic interface for analog and digital sensors

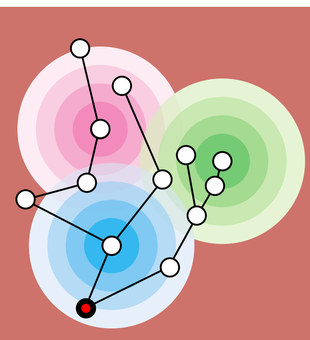




Wireless Sensor Network (WSN)

- WSN Technology allows to acquire mountain phenomena
- Self organizing multi-hop network
- Optimized for ultra-low duty cycles
- 8+ years experience, ~1'276'035'519 data points, 1.5 TB



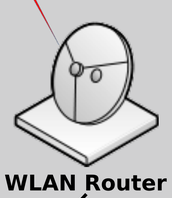


Advantages

- Enables spatially distributed field measurements
- Data all year-round at near real-time
- No long cables, less problems with lightning
- Low maintenance

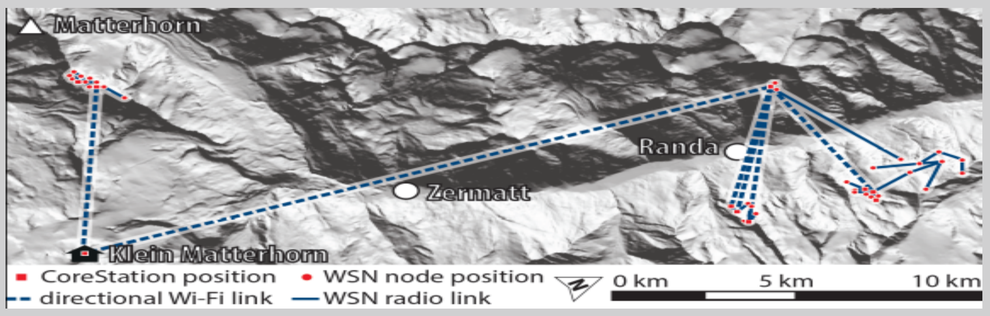
Challenges

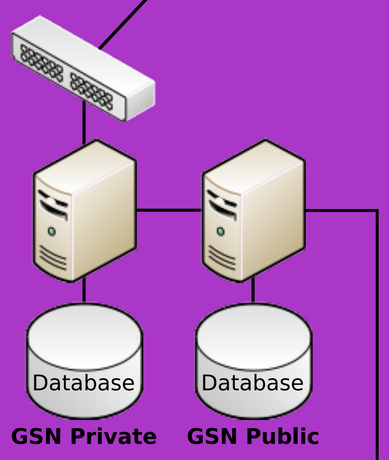
- Harsh environment
- Low power consumption
- Time synchronization



Internet Access

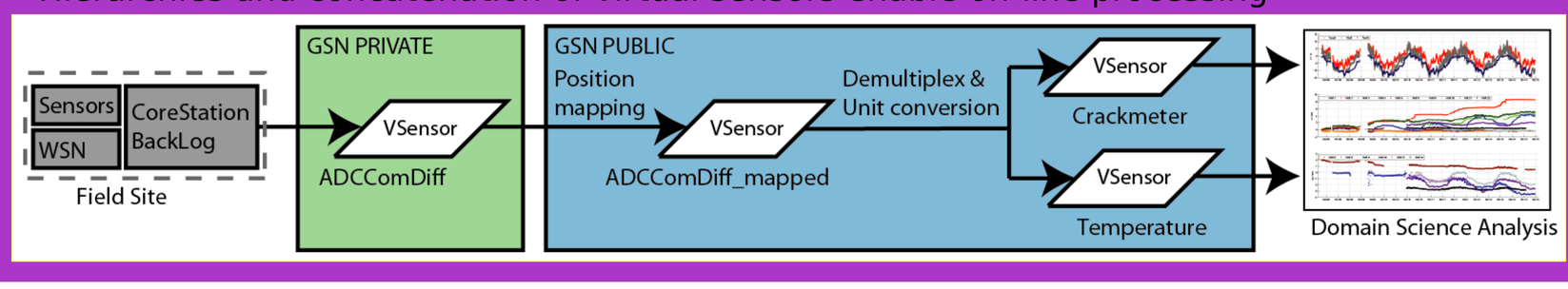
- WLAN (802.11a) long-haul communication using directional links
- Leased fiber/DSL from Zermatt Bergbahnen AG to mountaintop
- Commercial components (Mikrotik)
- Weatherproofed, protected





Server Backend: Global Sensor Network (GSN)

- Dual architecture translates data from machine representation to SI values, adds metadata
- Organized in "virtual sensors", i.e. data types/semantics
- Hierarchies and concatenation of virtual sensors enable on-line processing



Data Access Portal

- Public open data access in real time
- Tutorial available online