Software and system solutions for GNSS network service providers and precise GNSS applications

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Alberding GmbH

- 1994 – Founded by Jürgen Alberding in Leipzig
  - *Distribution of Trimble GPS in Eastern Germany*
  - *DGPS transmissions via AM radio transmitters*
- 2003 – Start of own GNSS software developments
  - *Move from Leipzig to Schönefeld (near Berlin)*
  - *Outsourcing of the Trimble GPS sales*
- 2009 – Sale of the Trimble GPS distribution company
  - *Independent from GNSS receiver manufacturers*
  - *Start of own sensor developments*

- 2025 – Based in Wildau (near Berlin)
  - *17 employees (15 engineers)*
  - *Development of software and sensor solutions for GNSS Service providers and precise GNSS applications*

Alberding server/client system approach

Development of own sensor solutions for automated server/client applications

Digital capture of
external sensor data

Cloud-based software solutions

Precise sensors for positioning, digital data capture and data transfer

Application software

The Alberding data management software running on the sensors is the basis to automize applications and to capture digital data in the field.

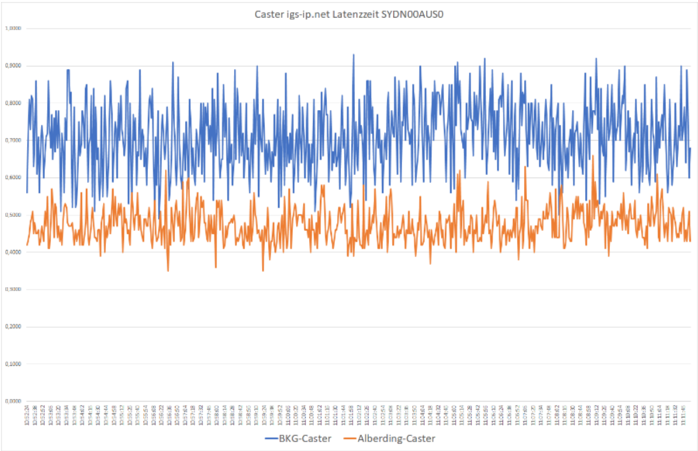
Alberding software products for GNSS network service provider

Software solutions for real-time GNSS data management

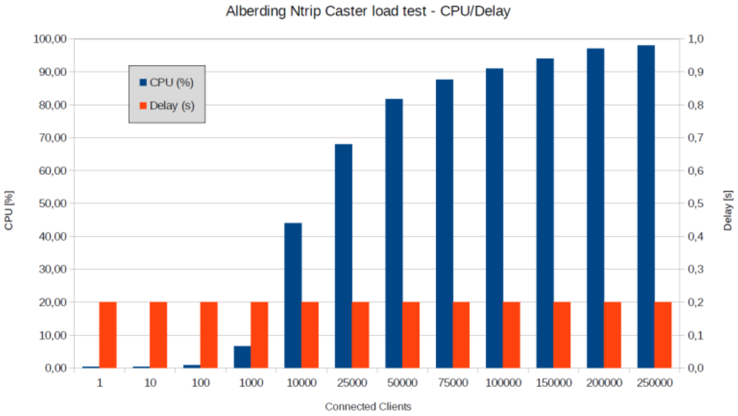
- **EuroRef** – GNSS reference station software at the site
  - Embedded PC / LINUX version
- **EuroNet** – Central data acquisition of GNSS raw data and correction data (> 1000 stations)
  - Central server / LINUX Version
- **EuroConv** – Conversion of GNSS raw data in RTCM MSM
  - Central server / local PC
- **manyRINEX** – Conversion of real-time data streams into RINEX data formats (3.x, 4.x)
- **EuroNet** – GNSS networking software
  - L1 C/A-Code networking software
  - VRS generation

Alberding Ntrip Caster Software – features

- Powerful Ntrip Caster Software for
  - Central GNSS data collection
  - Correction data provision to users
- Designed for **mass-market** applications
- Highly redundant and reliable system
- LINUX based system, cloud operation
- Minimal CPU requirements
- Low latencies – even with high CPU load
- Support of Ntrip 1.0 and 2.0 TCP, UDP, IPv4 and IPv6
- TLS encryption
- Support of multiple ports, domains and source tables



Ntrip Caster latency test, BKG 2024

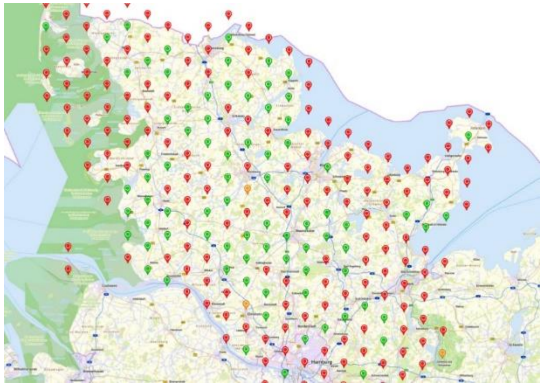


Ntrip Caster load test, Sapcorda 2020

Alberding Ntrip Caster Software – functionality

- Correction distribution from
  - GNSS base stations – nearest base
  - RTK networks (VRS) – re-broadcast
  - **Virtual grids** – from VRS or PPP/RTK
- **Geofence –** auto-switching between GNSS services
  - SAPOS states
  - EUPOS countries
- Monitoring of GNSS input data streams
- User management
  - User administration
  - Monitoring of the user access
  - Visualisation on digital maps
- API for 3rd party software
- Backup solution, load balancing

Automated switching between GNSS services based on the geofences (SAPOS services)



Automated switching between gridded correction data streams based on the “nearest base” function

Alberding Ntrip Caster for mass-market applications

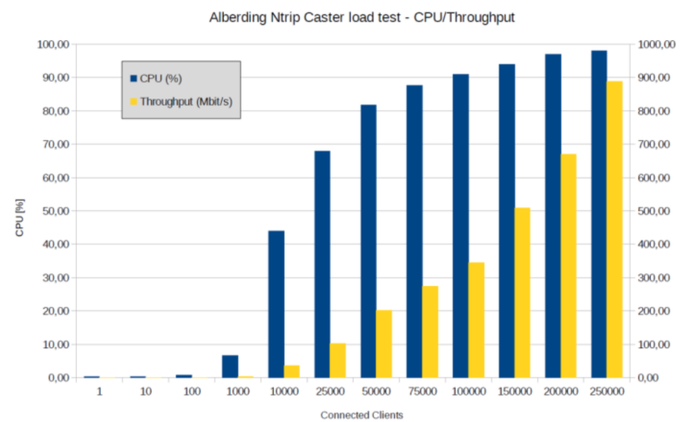
Alberding Ntrip Caster load test

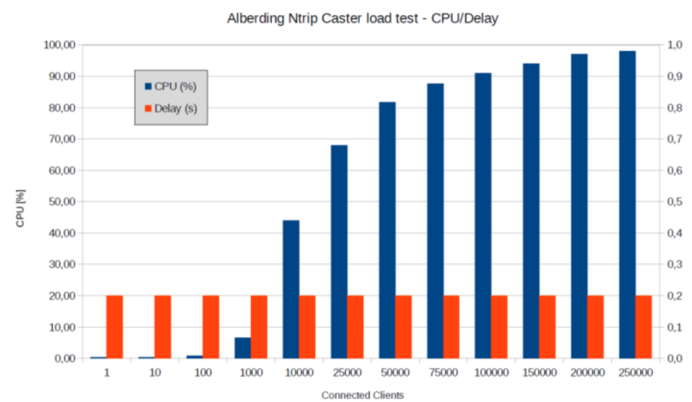
- Date of test: 13 March 2020
- Multiple simultaneous connections to a single RTCM 3.1 mountpoint

Connections	CPU (%)	Delay (s)	Throughput (Mbit/s)
1	0.33	0.2	0.04
10	0.33	0.2	0.07
100	0.80	0.2	0.35
1000	6.66	0.2	3.18
10000	44.00	0.2	35.78
25000	68.00	0.2	102.78
50000	81.76	0.2	201.19
75000	87.67	0.2	273.94
100000	91.00	0.2	344.71
150000	94.00	0.2	509.43
200000	97.00	0.2	670.79
250000	98.00	0.2[1]	888.16

Server: Quad-Core CPU (Intel i7-6700 3.4 GHz), 32 GB Memory, 500 GB SSD

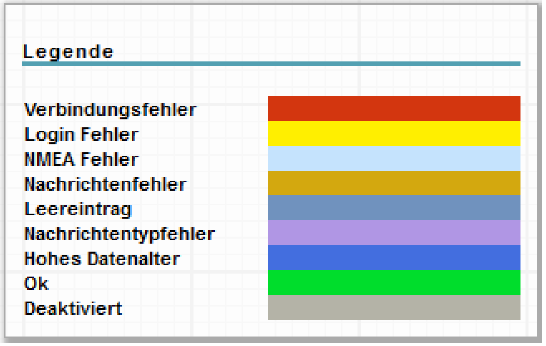
[1] Delay values have been growing up to 3.1 s randomly. Mostly stayed at 0.2 s.



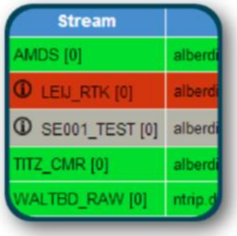


The Ntrip Caster load test (2020) has shown the potential of the Alberding Ntrip Caster for mass-usage applications – ideal for an open service architecture.

Alberding Quality Control – GNSS Network Service Monitoring



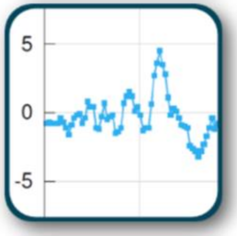
Alberding-QC modules



Checkstream

- Ntrip stream availability and data consistency

- Monitoring hundreds of Ntrip mountpoints
- Periodic data sampling
- Data content analysis – message types and update rates
- Automatic email/SMS warnings



RTK-Check

- Positioning accuracy and ambiguity fixing time

- Physical monitoring stations or software solution (RTKLIB)
- Periodic connection sessions
- Statistics generation
- Outlier rejection

InspectRTCM

- GNSS binary data decoding and visualisation

- RTCM (incl. MSM, SSR, etc.), CMR, RTCA and raw binary input
- NMEA GGA output for network RTK streams
- Data rate analysis of individual Message Types
- Real-time streams (TCP/UDP/Ntrip/serial) and file input

Alberding manyRINEX – Generation of RINEX data

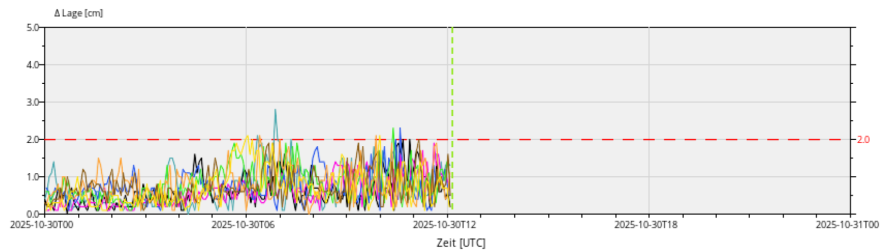
Automated RINEX generation for up to hundreds of GNSS reference stations / data streams

- Support of all RINEX versions from 2.10 to 4.x
- Support of many different GNSS binary raw data input formats:
  - Leica, Trimble, Javad, Septentrio, Topcon, NovAtel, Hemisphere GNSS, Ashtech, u-blox, NVS, Swift, Sirf, etc.
  - RTCM 2.x, RTCM 3.x, RTCM MSM
- Daily and hourly RINEX files, configurable sampling rates
- Data content filtering (remove constellations, observables)
- Processing of delayed raw data inputs
- Statistics output and completeness check with email warnings

Special developments for GNSS network RTK services

GNSS performance service information

- Implementation of real-time GNSS RTK monitoring stations in active web-sites for performance information

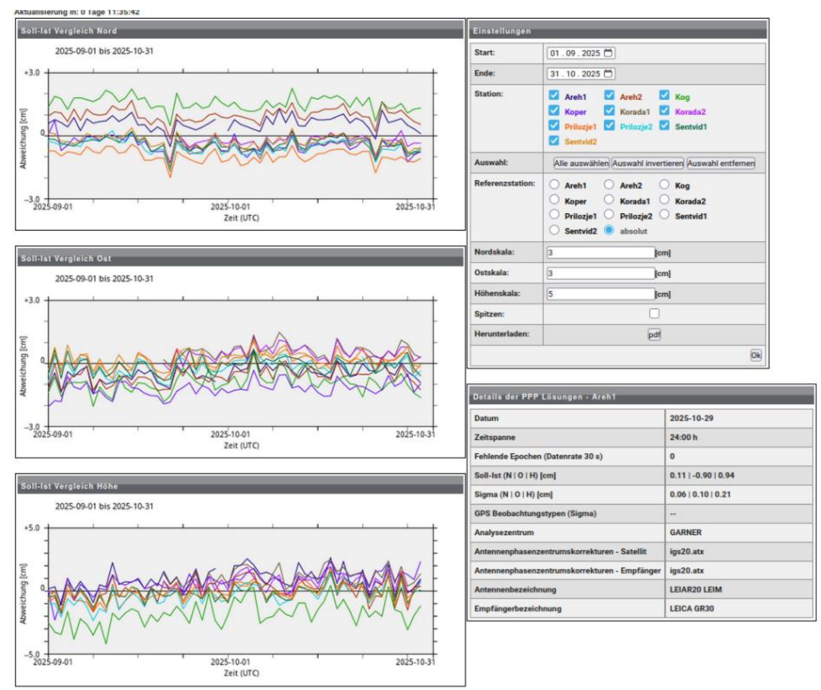


GPPS – GNSS postprocessing service

- Use of the Wanninger post-processing modules (network, VRS generation)
- Customer management, automatization

Monitoring of GNSS reference station coordinates

- GNSS networking approach
- PPP approach



Alberding GNSS Status Software

- Server-based modular GNSS quality monitoring software (Windows, Linux)
  - GNSS observation data (latency, completeness, No_SVs, MP, C/N_0, etc.)
  - Reference station coordinate stability (PPP/baseline post-processing)
  - Real-time correction service performance (RTK/PPP)
  - Troposphere status (real-time PPP based ZTD, IWV)
  - External sensor data (weather station, tilt sensor, geotechnical sensors
- Mobile solution for Embedded PCs
- Interfaces to multiple GNSS receivers
  - GNSS raw data
  - Spectrum analysis
- 2025 - Integration of military GNSS receivers
- Q4/2025 – Integration of CRPA GNSS antennas

Alberding GNSS Status Software

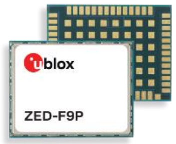
Web interface for:

Configuration, Visualisation, Alarming, Data archiving, Reporting

Alberding sensor products for user of GNSS services

Alberding A08-RTK sensor - hardware concept

- Support of Multifrequency GNSS RTK modules
  - u-blox ZED F9P (L1/L2), **ZED X20P**
  - Septentrio Mosaic X5 (L1/L2/L5), **G5 P3**
  - Trimble BD9250 (L1/L2 or L1/L5)
  - Others
- External GNSS antenna (Helix or Patch)
- Integrated 4G LTE Cat M1 Modem
- Integrated BT/WiFi module
- Integrated LiPo battery (3,2 Ah)
- Integrated CortexM4 processor
- Integrated IMU (6 axis)
- Integrated temperature and pressure sensors
- Integrated memory



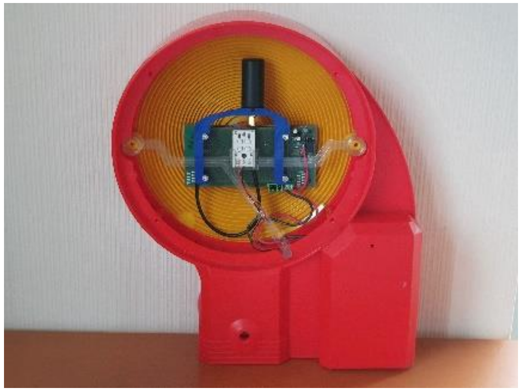
Alberding A08-RTK sensor – features and applications

Hardware modifications for different applications:

- Surveying/GIS: A08-RTK GEO-MICHEL
- Geo-monitoring: A08-MON, A08-MONiPOL
- Road works: A08-Bake
- Water level determination: A08-buoy
- Control Points: A08-Sensor

Main features:

- Configurable data flow due to Alberding data management software on the processor
- Remote configuration via Internet
- Can be used with or without external terminal
- Secure data transfer (TLS encryption)



A08-MONiPOL – automated GNSS monitoring solution

GNSS Antenna

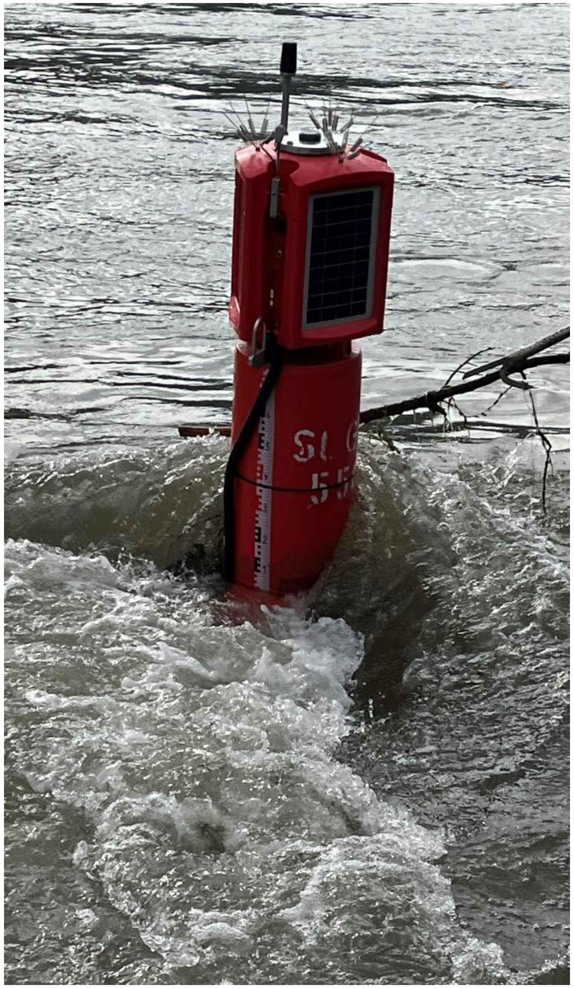
Solar Panel (6W)

A08 sensor box

- A08 board
- battery
- charger

- Simple installation
- Vandalism protection
- Automated operation
- Cost-effective solution

A08-RTK IoT sensor applications



Smart Buoy:

- GNSS RTK sensor
- Measurement cycle every 15 minutes
- Slope sensor
- Pressure sensor
- Automated processing

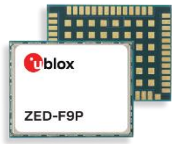
Digital control point

- GNSS sensor (PP)
- Switch on after sensor setup
- Collection of SAPOS data
- Automated processing

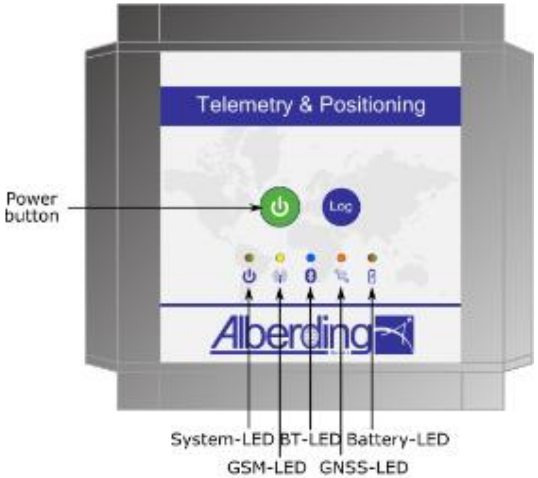
Alberding sensor products for the GEPOS PPP/RTK service

Alberding A10-DAB+ sensor

- Multifrequency GNSS modules
    - u-blox ZED F9P (L1/L2)
    - Septentrio Mosaic X5 (L1/L2/L5)
    - Trimble BD9250 (L1/L2 or L1/L5)
    - Others

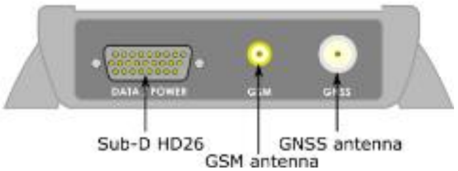


- External GNSS antenna (heading option)
- Integrated 4G LTE Cat M1 modem
- Integrated BT/WiFi module
- Integrated Cortex processor



<u>Optional:</u>

- Integrated Embedded PC (Linux) – SSR2OBS
- Integrated DAB+ receiver module

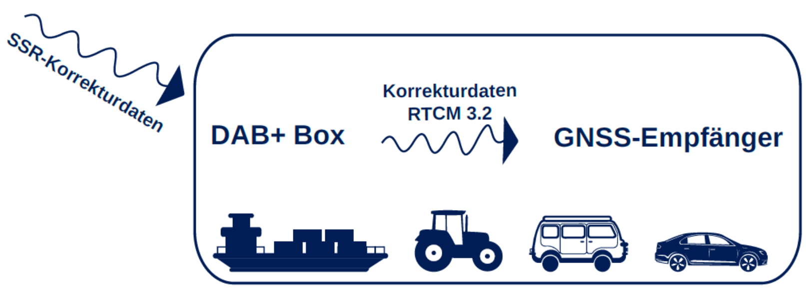


Alberding DAB+ Box

- Raspberry Pi with LINUX OS
- u-blox GNSS L1 or L1/L2 Board
- DAB+ receiver
- SSR2OBS software (Geo++ GmbH)
- EuroNet software (data management and DAB+ decoding)

DAB+ Box als „Repeater“ für Vermessungsaufgaben

DAB+ Box als Modem für mobile Anwendungen



A08-RTK GEO-MICHEL with WiFi communication

- GEPOS (PPP/RTK) corrections (SSRZ) via
  - Internal 4G modem (Ntrip)
  - Internal DAB+ receiver
- Bidirectional WiFi connection for data conversion (SSRZ -> RTCM MSM) between A08-RTK and Tablet PC
- SSR2OBS (Geo++ GmbH) running on the Tablet PC
- RTK positioning by converting from SSRZ to RTCM 3.2 MSM

International SSR standardisation (RTCMSSR) will make the usage of open PPP/RTK corrections much easier in the future !

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