LIDO - SN1 Data Unit

Scientific data management software

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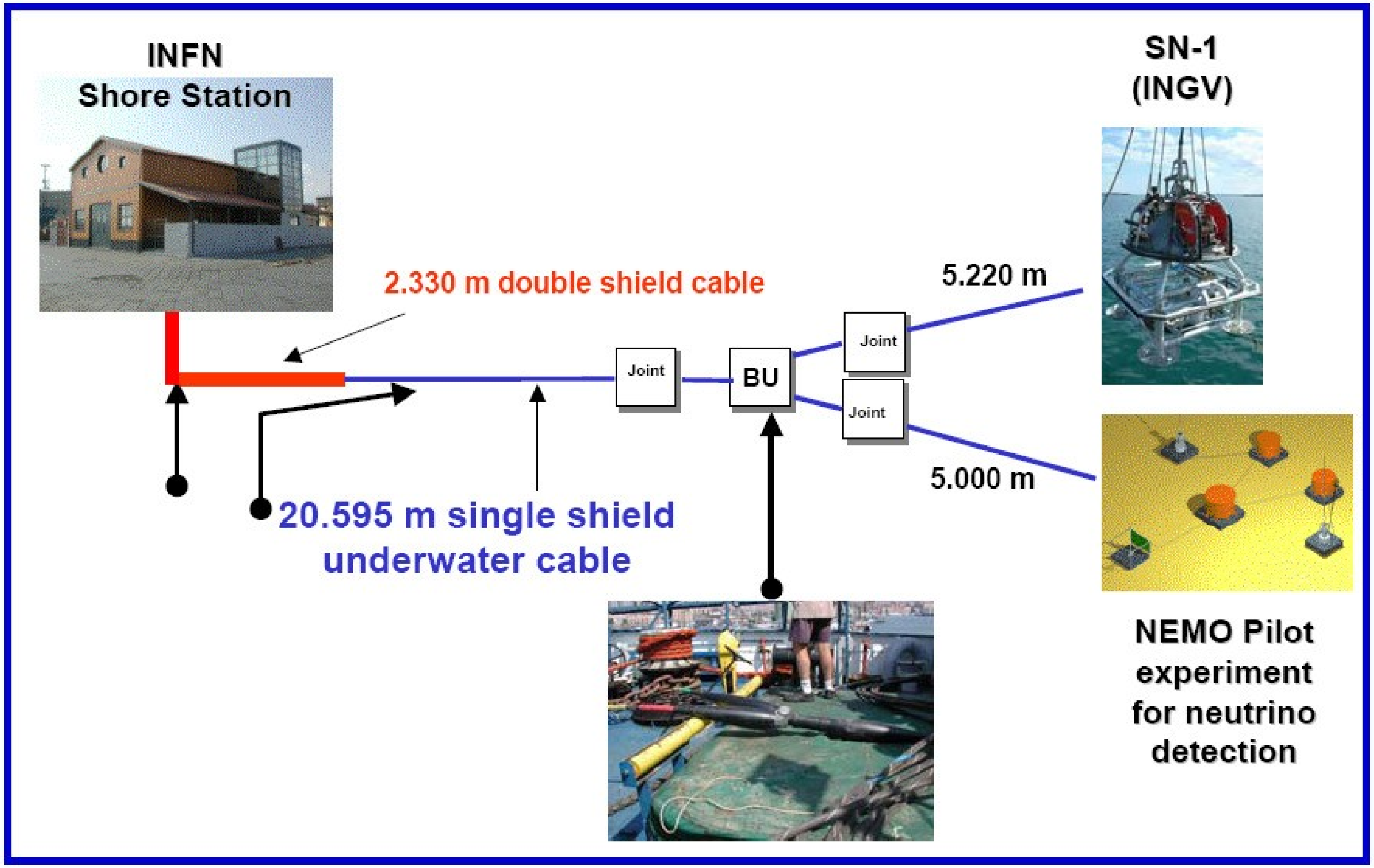
SN1 Data Unit machine is connected via serial-link to various sensors located in SN1 underwater station.

SN1DU software collects, parses and saves scientific real-time data from sensors.

It controls data acquisition process automatically, but allowes [remote] users to change settings and to communicate with instruments at run-time.

SN1 experiment overview

- SN1 is a multidisciplinary observatory, placed about 25 km off Catania harbour, provided with various sensors, from seismic to environmental and bioacoustic. It operates since 2005, and in spring 2010 will be re-deployed with major enhancements, including new data management system.
- Underwater acquisition system is cabled to shore station with copper and optical fiber, providing real-time data link and power supply.
- On-shore and underwater facilities are shared with INFN Nemo-phase 1 experiment for neutrino observation.
- Shore station will host SN1 Data Unit, linked to INFN net.
- SN1 DU serial link to UW instruments is provided by Tecnomare system in a ”transparent” way.
- SN1DU communicates with SN1 Control Unit.



SN1 scientific payload

- **SN1 DU acquires real-time data from various instruments with different data rates.**

Sensor	**Acquisition rate**	**Interest area**
Hydrophone (SMID)	2 kHz	Earth science - bioacoustic
Absolute Pressure Sensor	1/15 s	Earth science
Accelerometer+Gyros (IMU)	200 Hz	Earth science
Gravity meter	1 Hz	Earth science
CTD + Turbid meter(*)	1 sample / hour	Oceanografic
ADCP	1 profile / hour	Oceanografic
Vectorial magnetometer	1 Hz	Earth science
Scalar magnetometer	1 Hz	Earth science
Current meter	5 Hz	Oceanografic
Triaxial broad band seismometer (**)	100 Hz	Earth science
Differential Pressure Gauge (**)	100 Hz	Earth science
Hydrophone (OAS) (**)	100 Hz	Earth science
High frequency INFN hydrophones (***)	192 kHz	Bioacoustic

(*) managed by SN1CU that communicates measures to SN1DU server
(**) managed by Guralp Scream software running on SN1DU machine
(***) managed by dedicated INFN Acoustic Server

SN1 DU - requirements

1. Real time operation, long term running.
2. Automatic start up and run (start acquisition from instruments after power-on without human intervention).
3. Saving sensors data in ”standard” format, with coherent time-stamping.
4. Allowing remote users to exchange any commands/answers with underwater instruments, at any time, without affecting the ongoing data acquisition for the rest of experiment.

SN1 DU software architecture

- **SN1DU Server:**
  - Includes **SN1 Device Modules**, which provide serial communication with each instrument.
  - Reads and parses configuration file.
  - Parses and saves data locally.
  - TCP/IP communication (SSH tunneling can be used) with SN1DU Client
  - Point-to-point communication between Client and instruments.
- **SN1DU Client:**
  - Multi-platform GUI
  - Connection and control commands with SN1DU Server
  - A console for each instrument: user can manage underwater instrument as it was connected direclty to PC.

SN1DU server:
Real time, long term

- SN1 DU machine is an industrial PC (redundancy on power supply, RAID disks) running Linux OS.
- Standard tasks (such as NTP syncronization, users privileges management, SSH tunneling, data mirroring etc.) are performed by OS or existing applications.
- SN1 DU Server application is launched as a daemon soon after boot.

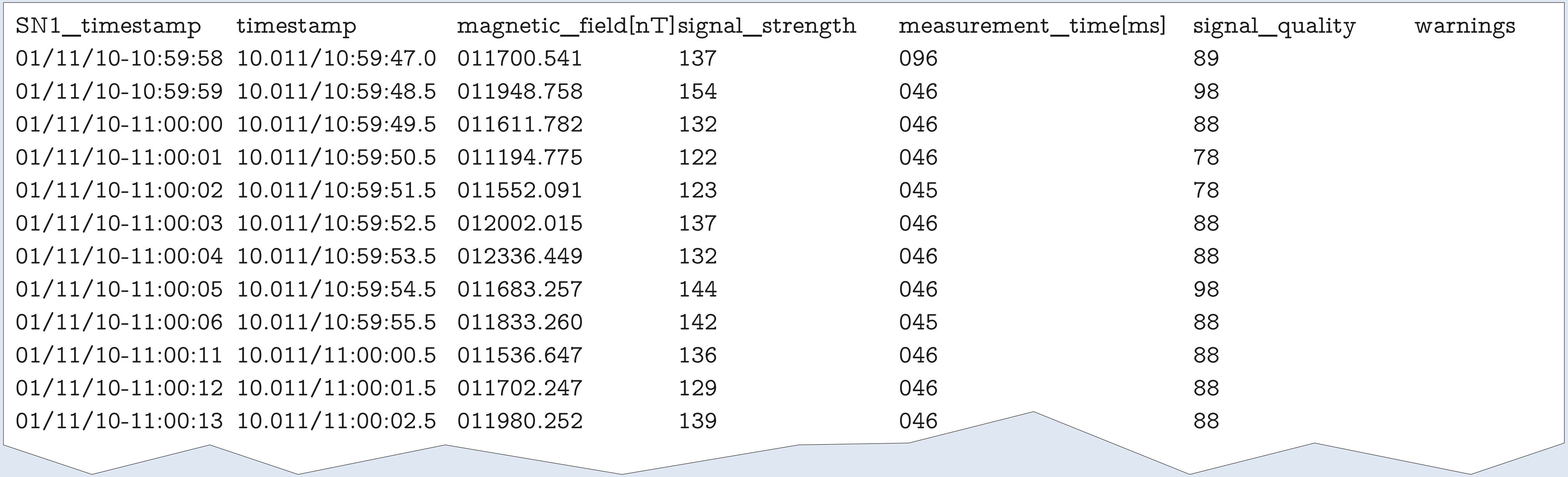
SN1DU server: Automatic start-up and run

- When the daemon is started, each instrument is configured to perform continuous acquisition, and parsed data are saved locally.
- Detailed configuration info for the whole system and for each instrument are described in an XML configuration file. Privileged users may modify this file in order to change settings, without software recompilation.
  Examples of configuration info are:
  - Instrument specific settings and initialization sequences
  - Frequency of file closing
  - System topology
  - ...

SN1DU server:
Parsing and saving data

- Data received from each instrument are parsed and converted according to the format used in previous experiments, in order to ease their insertion in INGV database.

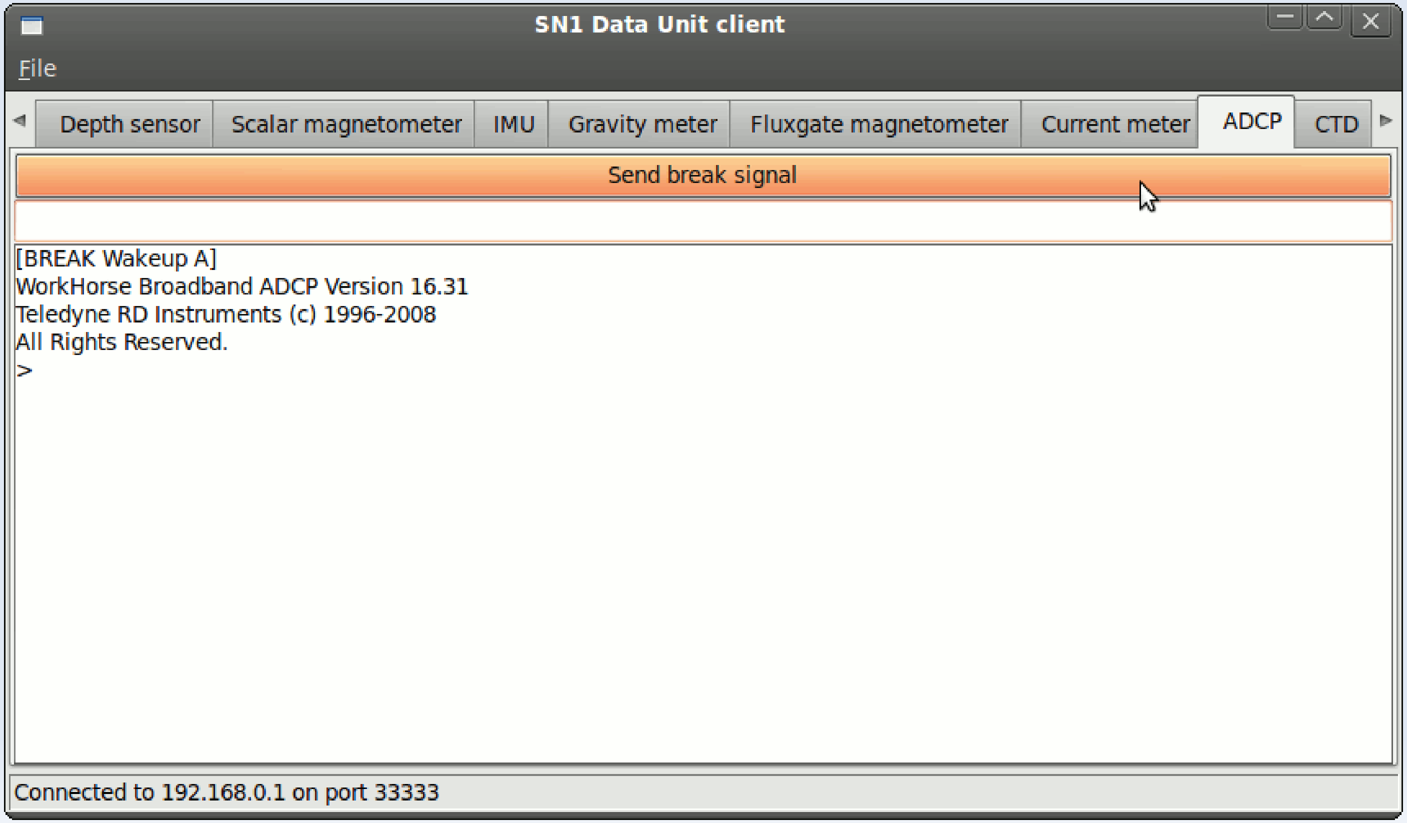
Data file example (Scalar Magnetometer):



```
SN1_timestamp      timestamp          magnetic_field[nT]signal_strength     measurement_time[ms]  signal_quality      warnings
01/11/10-10:59:58  10.011/10:59:47.0  011700.541        137                 096                   89
01/11/10-10:59:59  10.011/10:59:48.5  011948.758        154                 046                   98
01/11/10-11:00:00  10.011/10:59:49.5  011611.782        132                 046                   88
01/11/10-11:00:01  10.011/10:59:50.5  011194.775        122                 046                   78
01/11/10-11:00:02  10.011/10:59:51.5  011552.091        123                 045                   78
01/11/10-11:00:03  10.011/10:59:52.5  012002.015        137                 046                   88
01/11/10-11:00:04  10.011/10:59:53.5  012336.449        132                 046                   88
01/11/10-11:00:05  10.011/10:59:54.5  011683.257        144                 046                   98
01/11/10-11:00:06  10.011/10:59:55.5  011833.260        142                 045                   88
01/11/10-11:00:11  10.011/11:00:00.5  011536.647        136                 046                   88
01/11/10-11:00:12  10.011/11:00:01.5  011702.247        129                 046                   88
01/11/10-11:00:13  10.011/11:00:02.5  011980.252        139                 046                   88
```

SN1DU client: Remote users control

- SN1 DU server accepts TCP/IP connection(s), executing commands, and providing point-to-point communication with each instruments.
- SN1 DU Client is a multi-platform GUI that allows users to send commands to SN1 application and to communicate with each instrument. This communication will not affect (if not intentionally) data acquisition process.



```
[BREAK Wakeup A]
WorkHorse Broadband ADCP Version 16.31
Teledyne RD Instruments (c) 1996-2008
All Rights Reserved.
>
```

Connected to 192.168.0.1 on port 33333

SN1 Data Unit Client GUI appearance (on Ubuntu 9.10)

SN1 software – technical description

- SN1DU Server application:
  multi-threaded application written in C++
  (Eclipse IDE, POSIX threads, sockets, tiny XML)
- SN1DU Client application:
  GUI written in Python using wxPython graphical library
- Configuration file:
  XML

SN1DU software: development status (12/1/2009)

- **SN1 Device modules:**
  - Ready for available instruments.
- **SN1DU Server:**
  - Under test at Rome INGV labs.
  - Further tests overseen at Tecnomare with all instruments connected, and at INFN shore station at Catania harbour before deployment.
- **SN1DU Client:**
  - Under debug.

Minor debug and tuning is possible even after deployment.