HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE
FOR GEOSCIENCES

User Manual (tinyBlack)

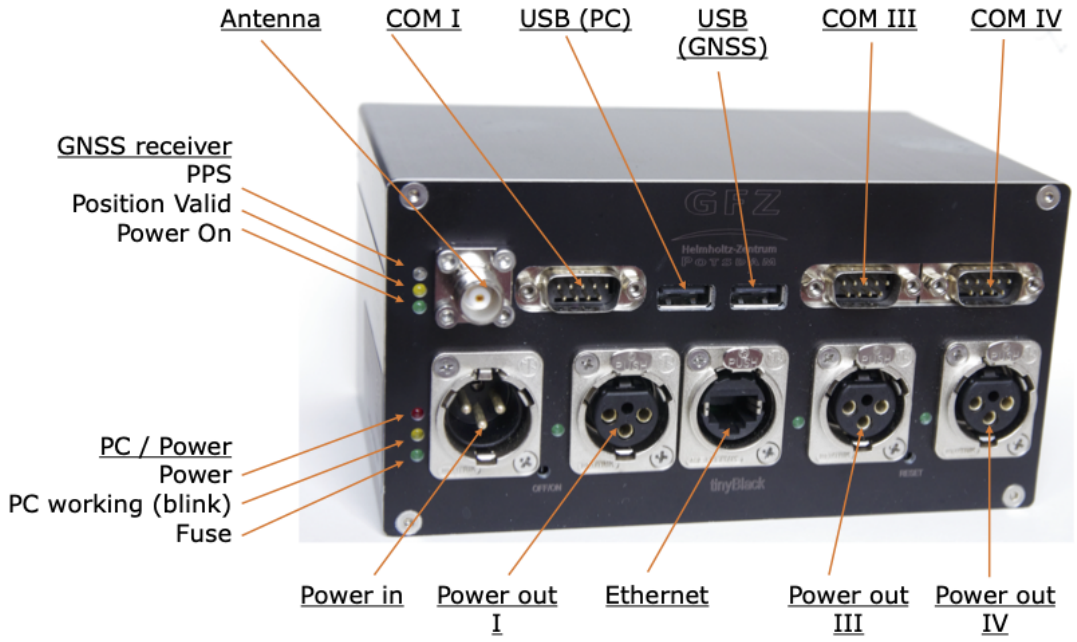
DokuWiki

Wed May 4 13:48:17 UTC 2022

Contents

Chapter 1

tinyBlack



1.0.1 Hardware layout

tinyBlack is based on BeagleBone Black industrial single board computer. It has an internal harddisc of 4 GByte for the system and an additional SD card slot for the data. The size of the SD card can be adjusted to the needs. A Debian linux distribution is used. It can be powered by a DC Voltage in the range of 9 .. 30 VDC, typ. power consumption is 5 Watt (including GNSS receiver).

tinyBlack includes a GNSS receiver too. This can be:

- u-Blox ZED F9P
- Swiftnav Piksi
- Septentrio Asterx M3

tinyBlack includes a four channel switching device with feedback function. It can be used to switch on/off devices to save power, the main usage however is the (automatical) power cycle of devices that are unstable / out of order. All channels are protected by a fuse (replaceable). The feedback line can be used to detect blown fuses.

Port assignemnt:

Power-port	internal number	attached device
I	0	communication device (optional)
II	1	GNSS-receiver, internal
III	2	METEO-station
IV	3	spare

Ports I, III and IV are availble from the front panel, through male XLR sockets. Voltage is equal to the input voltage. Status of the ports is indicated by a green LED close to the socket.

Pin asignment XLR socket	
Pin number	**remark**
1	+9VDC (8..30VDC)
3	Ground

To communicate with the switching device use the programme switch_it_bbb.pl. This script makes sure, that the power port I will be switch on again after a short pause.

The tinyBlack has 2 USB ports. One is attached to the BeagleBone PC, the other to the built in GNSS receiver. In some cases it might be necessary to connect them trough a USB cable, e.g. to provide RTCM data packages or to use LAN over USB (septentrio) Note: do not apply external hardiscs to these ports, as they may use to much of the current!

tinyBlack provides 3 serial ports for external usage, plus 2 for internal usage

Note: Port I (/dev/ttyS0) is used for remote access to the CPU module.
The settings are: 115200,8,n,1.

— Suggested port asignment:

Port	Device	Usage
I	/dev/ttyS0	remote access
II	/dev/ttyS1	GNSS-receiver (internal)
III	/dev/ttyS2	meteo-station
IV	/dev/ttyS4	spare
V	/dev/ttyS5	internal

tinyBlack provides 1 ethernet port with a maximum speed of 100 Mbit/s.

tinyBlack is equipped with a TNC socket to attach the external antenna. The internal GNSS receiver provides a 5VDC power supply to power an active antenna.

1.0.2 Operating System

in /boot/uEnv.txt enable the serial ports:

```
uboot_overlay_addr0=/lib/firmware/BB-UART1-00A0.dtbo
uboot_overlay_addr1=/lib/firmware/BB-UART2-00A0.dtbo
uboot_overlay_addr2=/lib/firmware/BB-UART4-00A0.dtbo
uboot_overlay_addr3=/lib/firmware/BB-UART5-00A0.dtbo
```

1.0.2.1 /etc/network/interfaces

Below is a sample of the configuration file:

```
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
# allow-hotplug eth0
auto eth0
#iface eth0 inet static
#   address 192.168.0.100
#   netmask 255.255.255.0
#   gateway 192.168.0.1
#   dns-nameservers 192.168.0.1 139.17.128.10

iface eth0 inet dhcp

# GFZ internal settings
#iface eth0 inet static
#   address 139.17.64.49
#   netmask 255.255.255.0
#   gateway 139.17.64.254
#   dns-nameservers 139.17.1.2 139.17.128.10
```

1.0.2.2 SD Card

The SD Card should contain this uEnv.txt in the root folder:

```
mmcdev=1
bootpart=1:2
mmcroot=/dev/mmcblk1p2 ro
optargs=quiet
```

to prevent that the BeagleBone tries to boot from SD Card.
That's why the SD card should contain two partitions with the first partition only containing the uEnv.txt.
If a second partion exist, it will be mounted through /root/wdt-start.csh as /home/gghrnet/transfer

1.0.2.3 Main script

The main script is /root/wdt-bbb.pl, which is started during boot through /etc/rc.local. This script sets all io ports (using /root/setio.csh) and executes /root/wdt_start.csh for startup tasks. Then it activates and feeds the built in watchdog, toggles the yellow activity LED and executes the script csh /root/wdt_jobs.csh periodically. This is the script that starts the monitor for the user and for root.

Chapter 2

Software

2.1 File System

2.1.1 Software

```
$PATH_SRC: ${PATH_HOME}/src
```

2.1.2 Option/Configuration Files

```
${PATH_HOME}/opt
```

2.1.3 Work Directories of Data Logging Programs

```
$PATH_WORK: ${PATH_HOME}/wrk
                       |--gps
                       `--meteo

$PATH_CMP_MV: ${PATH_HOME}/cmp_mv
```

2.1.4 Log Files

```
$PATH_PROT: ${PATH_HOME}/prt
```

2.1.5 Data Tranfer / Archive

```
$PATH_TRANSFER: ${PATH_HOME}/transfer
                |--WORK
                |--SAVE  ($PATH_SAVE)
                `--LATE
```

2.1.6 Process Control

```
$PATH_STOP: ${PATH_HOME}/STOP
$PATH_PID:  ${PATH_WORK}/PID
```

2.2 Software Configuration

There is one central configuration file **/home/gghrnet/opt/cshrc_gps_site.csh** storing the configuration parameters for all running processes.
All program settings are given via **environment variables** provided by the central configuration file, which is sourced via command shell loading. One can easily see the settings for each program/task running on the computer.

```
#!/bin/csh

# ###################################################################### #
# GNSS Site option file                                                  #
#                                                                        #
#       last edit 2011/06/15 by emer                                     #
#                                                                        #
# ###################################################################### #

setenv SITE           xxxx                    # 4 char Station ID
setenv PROJECT        GLOBAL_GPS              # GLOABL_GPS,GASP,GITEWS

################## GLOBAL ###############################################################
#---------------------------------------------------------------------------------------

setenv PATH_HOME         "/home/gghrnet"              # my home
setenv PATH_SRC          "${PATH_HOME}/src"           # path to perl sources
setenv PATH_RAW_DATA     "${PATH_HOME}/wrk"           # working directory
setenv PATH_SYSLOG       "${PATH_HOME}/wrk/syslog"    # working directoy for syslogs
setenv PATH_CMP_MV       "${PATH_HOME}/wrk/cmp_mv"    # working directory compress move
setenv PATH_PID          "${PATH_HOME}/wrk/PID"       # store process ID here
setenv PATH_EXT_DATA     "${PATH_HOME}/ext_data"      # incoming for ext. data
setenv PATH_TRANSFER     "${PATH_HOME}/transfer"      # export directory
setenv PATH_PROT         "${PATH_HOME}/prt"           # protocols
setenv PATH_STOP         "${PATH_HOME}/STOP"          # Stopfiles
setenv PATH_START_PROT   "${PATH_HOME}/START_PROT"    # starting protocols
setenv PATH_BIN          "${PATH_HOME}/bin"           # path to binaries

setenv MAX_DISK_SPACE    "80"            # percentage of disk used prior message
setenv DO_MAIL           1                            # send info-files
################## PROGRAMMS2START ######################################################
#---------------------------------------------------------------------------------------

setenv STD_PROGS  "CHECK_OPT CHECK_DISC CLEANUP UPDATE" # CHECK_OPT CHECK_DISC
                                                       # CHECK_TRAFFIC CLEANUP NTP
                                                       # RSYNC SENSOR ACPI SYNCH UPDATE
setenv AUTO_PROGS "GPS COPYMOVE SCP UDP2TCP"   # GPS METEO SCP COPYMOVE UPDATE UDP2TCP
setenv ROOT_PROGS "VPN UPDATE"                 # VPN IP CRON NIF UPDATE

################## PROGRAMMS ############################################

setenv PRG_MAIL       "${PATH_SRC}/mail2"
setenv PRG_CC         "${PATH_SRC}/command_control"
setenv PRG_GPS        "${PATH_SRC}/GPS_read"
setenv PRG_HTLOG      "${PATH_SRC}/meteo_read"
setenv PRG_METEO      "${PATH_SRC}/meteo_read"
setenv PRG_SCP        "${PATH_SRC}/scp_data"
setenv PRG_SENSOR     "${PATH_SRC}/sensor_read"
setenv PRG_SET_IP     "${PATH_SRC}/set_ip"
setenv PRG_TCP2UDP    "${PATH_SRC}/tcp2udp"
setenv PRG_UDP2TCP    "${PATH_SRC}/udp2tcp"
setenv PRG_COPY_MOVE  "${PATH_SRC}/compress_move"
setenv PRG_CLOCK      "${PATH_SRC}/clock_read"
```

```
################## File transfer ##########################################################
#-------------------------------------------------------------------------------

setenv EXTENSIONS     "sbf m z"                      # 'last character' to transfer
setenv DEST_HOSTS     "139.17.3.110 139.17.3.111 "   # receiving server
setenv DEST_PATHES    "ext_data     ext_data     "   # incoming on receiving server
setenv DEST_USER       gpssite                       # user on receiving server
setenv CONNECT_TIMEOUT 60                           # seconds prior timeout

################## compress_move ##########################################################
#-------------------------------------------------------------------------------

setenv USE_TCOMP      1                          # 1/0 - yes/no
setenv USE_ZIP        1                          # 1/0 - yes/no
setenv USE_SAVE       1                          # 1/0 - yes/no
setenv USE_LATE       1                          # 1/0 - yes/no

setenv MAX_SCP_FILES  3                    # max. number of FILES per scp-command call
setenv MAX_SCP_ELAPSE 5                    # maximum elapse time per file (minutes)

################## clean up ###############################################################
#-------------------------------------------------------------------------------

######### defaults
## setenv AGE_SAVE      14                    # max days in $PATH_TRANSFER/SAVE
## setenv AGE_KEEP      3                     # min days to keep in $PATH_TRANSFER
## setenv AGE_SYSLOG    60                    # max days in PATH_SYSLOG
## setenv AGE_TRANSFER  1000                  # if emergency, start_age in transfer

################## VPN settings ###########################################################
#-------------------------------------------------------------------------------

setenv TCP_TARGET            139.17.3.111                  # stream target server
setenv VPN_SERVER_HOSTNAME   139.17.3.111                  # tunnel remote server
setenv VPN_SERVER            192.168.100.1                 # VPN remote address
setenv VPN_CLIENT            192.168.100.xxx               # VPN local address
setenv VPN_SERVER_USERNAME   gpssite                       # remote user

################## GPS reading ############################################################
#-------------------------------------------------------------------------------

setenv GPS_TTY    /dev/ttySx                                  # port for GPS
setenv GPS_TYPE   javad                                       # supported types:
                                    # trogue,septentrio,ashtech,getr,topcon,javad,
                                    # garmin,smart,oem4a,oem4b
######### defaults ########################################################
## setenv GPS_PATH_OUT    $PATH_CMP_MV        # ouput path    default PATH_CMP_MV
## setenv GPS_PATH_WORK   $PATH_WORK/gps      # work path     default PATH_WORK/gps
   setenv GPS_SYNCH_PC    1                   # 0/1 nosynch/synch default 0
   setenv GPS_UTC_OFFSET  15                  # difference of leap seconds to UTC default 15
   setenv GPS_DOUDP       1                   # 0/1 udp/noudp                     default 0
   setenv GPS_SUBTYPE     "congo,bit_grapper" # receiver specific commands        default 0
## setenv GPS_PORT        0                   # GPS response port (e.g.Ashtech A) default 0
   setenv GPS_UDPPORT     4056                # udp port                          default 0
   setenv GPS_UDPADDRESS  localhost           # udp target                        default localhost

## setenv # 0/1 NO clock / ext. clock         default 0
   setenv # external frequency (MHz)          default 0
## setenv CLOCK_STATUS "$PATH_PROT/clock_status" # read clock status default PATH_PROT/clock_status

## setenv GPS_STOP     "${PATH_STOP}/gps_stop"   # stop file         default PATH_STOP/gps_stop
```

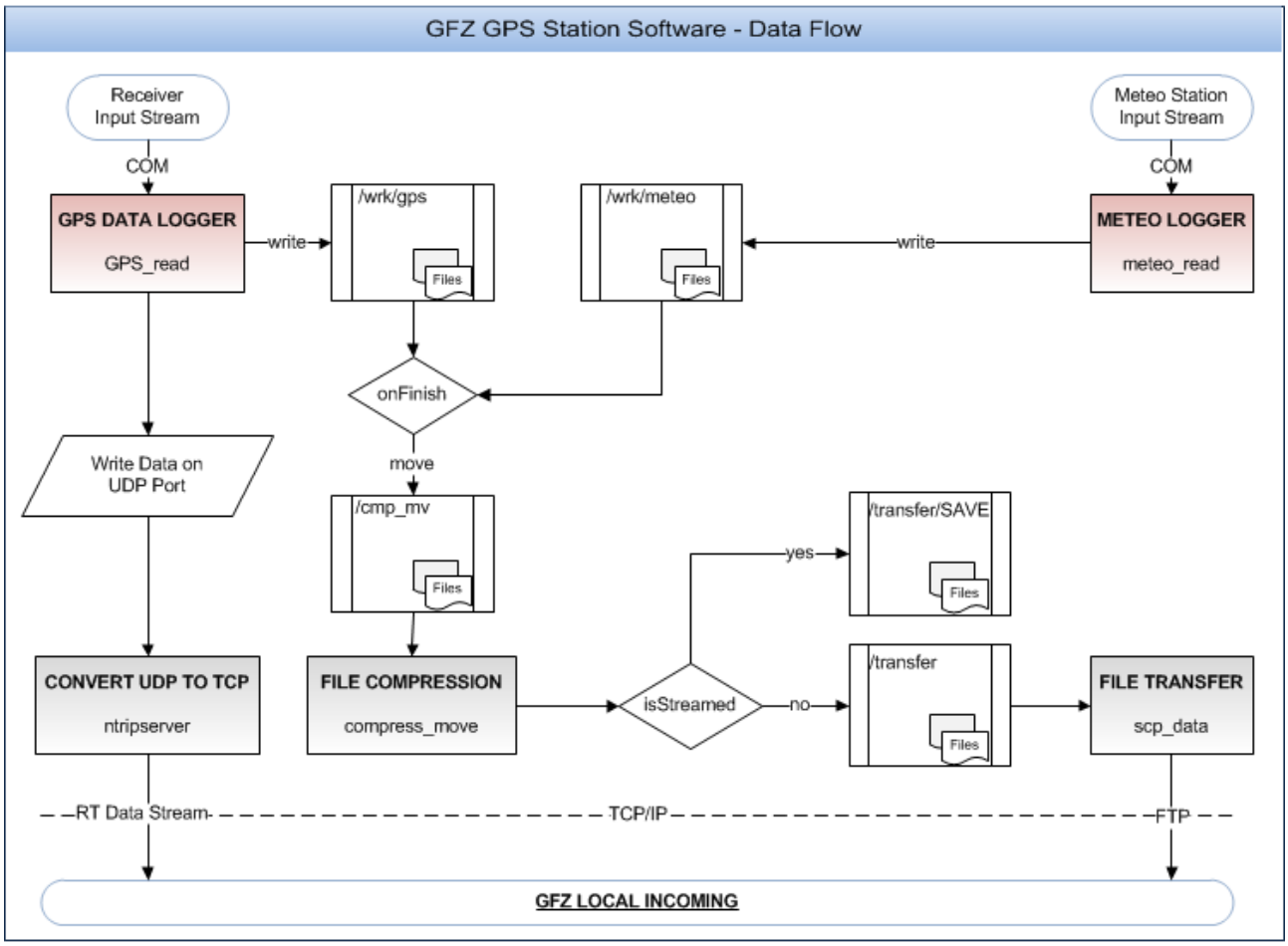
```
## setenv GPS_SAMPLE      1                       # sample rate (seconds)        default 1
## setenv GPS_PERIOD      15                      # file lenght (minutes)        default 15
## setenv GPS_ELEV_MASK       0                   # elevation mask               default 0
## setenv GPS_MIN_STREAM_BYTE 0                   # min. Paketsize while stream  default 0
## setenv GPS_SAVE_UNCHANGED  0                   # save data in seperat file    default 0
#-------------------------------------------------------------------------------------------
## setenv GPS_TCP_ADDRESS     none              # TCP/IP ADDRESS of GPS receiver  default none
## setenv GPS_TCP_USERNAME    none              # TCP/IP USER on GPS receiver     default none
## setenv GPS_TCP_PASSWORD    none              # TCP/IP PASSWORD for USER        default none

setenv CHECK_CMD "ssh gpssite@139.17.3.111 csh src_stream/scmv.csh" # check if streamed data is ok


################## METEO reading ############################################################
#-------------------------------------------------------------------------------------------

setenv METEO_TTY      /dev/ttySx             # port for meteo
setenv METEO_TYPE     ptu300                 # supported types: tm200, ptu200, ptu300, hmt330

######### defaults ##########################################################
## setenv METEO_SAMPLE   5             # sample rate            default 5
## setenv METEO_PERIOD   15            # file lenght (minutes)  default 15
## setenv METEO_PATH_OUT $PATH_CMP_MV         # write data to   default PATH_CMP_MV
## setenv METEO_PATH_WORK ${PATH_WORK}/meteo  # work path       default PATH_WORK/meteo
## setenv METEO_STOP      ${PATH_STOP}/meteo_stop  # stop file  default PATH_STOP/meteo_stop

################## CLOCK reading ############################################################
#-------------------------------------------------------------------------------------------
setenv CLOCK_TTY          none                         # port for clock
setenv CLOCK_TYPE         none                         # supported types: temex, spectra

######### defaults ##########################################################
## setenv CLOCK_CHECK   120                      # check rate (sec) default 120
## setenv CLOCK_STATUS  $PATH_PROT/clock_status  # status file      default PATH_PROT/clock_status

## setenv CLOCK_STOP    ${PATH_STOP}/clock_stop  # stop file        default PATH_STOP/clock_stop

## setenv CLOCK_DEBUG   clock_debug              # debug file       default clock debug

################## POWER SWITCH############
# supported types: maram_lpt, batman, pv1608,
                                                # how to connect
setenv POWER_PORT_NUM_MET     2                 # Meteo      channel
setenv POWER_PORT_NUM_GPS     1                 # GPS        channel
setenv POWER_PORT_NUM_CMP     none              # Computer   channel
setenv POWER_PORT_NUM_CLOCK   none              # ext. Clock channel
setenv POWER_PORT_USE_EXT     none              #
setenv POWER_PORT_NUM_ROUTER  none


################## WATCHDOGS ################################################################
#-------------------------------------------------------------------------------------------

setenv WATCHDOG_TYPE        none                # none, nbn, dev

# ... end
```

2.3 Software Components

2.3.1 Overview

- GNSS data recording
- Meteorological data recording
- Data Transfer
- Site Maintenance
  - Software System Monitoring
  - Computer Time Synchronisation
  - Hard Disk Cleanup
  - Power Cycle
  - Software Update
  - Watchdog

The image below describes the main data flow, explained in detail in the following subsections.



2.3.2 Main script GFZ_GNSS_SITE.csh

The main script GFZ_GNSS_SITE.csh includes startup scripts as well as working scripts. // Startup scripts are used to convert environmant variables into command-line options. They may also be used to carry out accessories, lke power on the devices and email notifications. All startup scripts are named in capital letters. They are executed if in stored in the environment variables STD_PROGS, AUTO_PROGS or ROOT_PROGS. The major startup scripts are:

- MONITOR
- GPS

- METEO
- COPY_MOVE
- SCP
- UPDATE
- VPN
- CHECK_DISC
- CLEANUP

Working scripts are named in lower letters.

2.3.3 GNSS data recording

2.3.3.1 Start script GFZ_GNSS_SITE.csh GPS

The script is used to power on the GNSS receiver, (optionally) checks the status of an external frequency generator (if present) and creates the command line for the GPS data logging program using the given environment variables. If the data logger stopps, it performs a power-cycle (depending on the return code) and sends an info-file (if DO_MAIL = 1)

Table follows on next page ...

variable	description	remark
GPS_TTY	port to GNSS-receiver	/dev/ttyS1
GPS_TYPE	type of GNSS-receiver	supported types: trogue,septentrio,ashtech,getr,topcon,javad,garmin,smart,oem4a,oem4b
GPS_PATH_OUT	output dir	default $PATH_CMP_MV
GPS_PATH_WORK	working dir	default $PATH_WORK/gps
GPS_SYNCH_PC	sync PC 0/1 nosynch/synch	default 0
GPS_UTC_OFFSET	leap seconds to UTC	default 16
GPS_DOUDP	0/1 udp/noudp	default 0
GPS_SUBTYPE	receiver specific commands	default 0
GPS_PORT	GPS response port	default 0
GPS_UDPPORT	udp port output port	default 0
GPS_UDPADDRESS	udp target	default localhost
GPS_EXT_CLOCK	0/1 NO clock / ext. clock	default 0
GPS_EXT_CLOCK_FREQ	external frequency (MHz)	default 0
CLOCK_STATUS	read clock status	default PATH_PROT/clock_status
GPS_STOP	stop file	default PATH_STOP/gps_stop
GPS_SAMPLE	sample rate (seconds)	default 1
GPS_PERIOD	file lenght (minutes)	default 15
GPS_ELEV_MASK	elevation mask	default 0
GPS_MIN_STREAM_BYTE	min. Paketsize while stream	default 0
GPS_SAVE_UNCHANGED	save data in seperat file	default 0

2.3.3.2 GPS data logging program GPS_read

The program/script **GPS_read** logs the GPS data to files and/or generates realtime data streams. The program supports various gnss receiver types:

Receiver	Sub-type	remark
trogue		AOA TurboRogue Benchmark ACT
septentrio	polarx2	PoLaRx2 type protocol
	polarx3	PoLaRx3 type protocol
	high_speed	COM-Setting: 115200 (default 57600)
	low_speed	COM-setting 19200
	no_nav	disable navigation messages
	use_sbas	enable SBAS satellites
	bit_grapper	enable 50Hz nav-messages stream
	smooth	enable smoothing
ashtech	z12	Z12 type receiver
	z18	Z18 type receiver
	ac12	single frequency
getr		Septentrio GeNeRx Galileo receiver
topcon		Net-G3, GB1000, GRIL protocoll, reads rM messages
	no_glo	disable GLONASS
	no_nav	disable navigation messages
	bit_grapper	enable 50Hz nav-messages stream
javad		Javad receiver with GREIS protocoll (triumph chip)
	aerograv	reads external ini-file 'PATH_HOME'/opt/aerograv.ini
	smooth	enables smoothing (smi, 50)
	no_glo	disable GLONASS
	no_nav	disable navigation messages
	no_sbas	disable SBAS satellites
	bit_grapper	enable 50Hz nav-messages stream
	congo	disbale rM messages and read dedicated messages
garmin		garmin GPS17 single frequency receiver
smart		Novatel smart receiver /marconi chip
oem4a		Novatel OEMIV family, ascii output
oem4b		Novatel OEMIV family, binary output

Below is the list of command lines. These are in use, if the programm is executed outside GFZ_GNSS_site.csh.

```
***** USAGE: ./GPS_read

            -ID            4 character station ID                  REQUIRED
            -path_wrk      <directory> working                     REQUIRED
            -path_prt      <directory> protocol                    REQUIRED
            -path_out      <directory> trans                       REQUIRED
```

```
              ------Optinal Settings-----------------------------------------------
              -device         COM port used for the turborogue          default '/dev/ttyS0'
              -path_arch      <directory> raw archive,                  default ""
              -rec_type       trogue,ashtech,septentrio,getr            default trogue
              -interval       sample interval [second],                 default 1
              -file_int       file interval   [minute],                 default 15
              -elev_mask      elevation masking angle [degree],         default 0
              -synch_pc       0/1 don't synch  / synch,                 default 0
              -gps2utc_offset Offset seconds GPS to UTC,                default 13
              -stop_file      filename to end programme,                default ""
              -ext_clock      0: internal >0 external [MHz]             default 0

              ------ Trogue related settings----------------------------------------
              -ferase         yes/no Erase Flashcard,                   default no

              ------Ashtech related settings---------------------------------------
              -ashtype        command set z12 or z18,                   default z12
              -ashport        Port on Ashtech (A,B,C,D),                default A

              ------Data streaming related settings--------------------------------
              -doudp          stream data using udp (0,1)               default 0
              -udpaddress     target address of udp stream              default localhost
              -udpport        target port of udp stream                 default ""
              -read_stream    read from data stream if 1                default 0
              -pipe_in        named pipe for input                      default ""
              -pipe_out       named pipe for output                     default ""

              ------globals-------------------------------------------------------
              -v              print version number and exit
              -file           read opt from file (overwrite cmdl_opts)


EXITCODES:
  0: normal end
  1: abnormal exit
  2: non optional parameter missing
 11: stopfile found while startup
 70: no data reading since 10 minutes, receiver soft reset performed
 71: too many errors while reading data stream
 72: odd file length (3600 modulo file length != 0)
 77: hard reset (power cycle) receiver required
```

2.3.4 Meteorological data recording

2.3.4.1 Start script GFZ_GNSS_SITE.csh METEO

The script **GFZ_GNSS_SITE.csh METEO** is used to create the command line for the METEO data logging program using the given environment variables.

variable	description	remark
METEO_TTY	COM-port to meteo device	e.g., /dev/ttyS2
METEO_TYPE	type of meteo device	supported types: tm200, ptu200, ptu300, hmt330, wxt520
METEO_SAMPLE	Output interval (minutes)	default 5
METEO_PERIOD	Output file length (minutes)	default 15
METEO_PATH_OUT	output dir	default $PATH_CMP_MV
METEO_PATH_WORK	working dir	default $PATH_WORK/meteo

PLEASE TURN OVER

variable	description	remark
METEO_STOP	stop file	default PATH_STOP/meteo_stop

2.3.4.2 METEO data logging program meteo_read

The programm **meteo_read** logs the meteo data to files, of the format RINEX version 2.11. The programm also generates plot-files, if -plot_name. The command line switches are shown below:

```
***** USAGE: ./meteo_read

             -ID          4 character station ID
             -device      COM port used for the meteo
             -interval    sample interval [minute], default 5
             -file_int    file inteerval (15, 60, 1440)
             -path_wrk    <directory> working
             -path_out    <directory> trans
             -path_arch   OPT. if set then a copy is placed there
             -rinex_head  <dir/file> rinex header template
             -rnx_ext     OPT., default 'm'
             -plot_name   OPT. if exist then save data in daily file
             -meteo_type  tm200, ptu200, ptu300, ht_log
             -path_prt    <directory> protocol
             -prot_name   OPT., default prt_meteo
             -stop_file   OPT. use this stopfile (incl. path)
```

2.3.5 Data Compression / Move to Transfer Directory

2.3.5.1 Start script GFZ_GNSS_SITE.csh COMPRESS_MOVE

The script **GFZ_GNSS_SITE.csh COMPRESS_MOVE** is used to call the compress/move script checking/using the needed environment variables.

Table follows on next page ...

variable	description	remark
PATH_CMP_MV	$PATH_CMP_MV	input dir
PATH_TRANSFER	$PATH_TRANSFER	output dir
USE_TCOMP	use ~/bin/tcomp	special compression tool for AOA turbobinary files if USE_TCOMP = 1
USE_ZIP	7z / gz compression	use 7z if installed, gz instead if USE_ZIP = 1

2.3.5.2 Compress/Move program compress_move

The program **compress_move** is a daemon like script which is waiting for files in the **PATH_CMP_MV**, does different compressions and moves the compressed files to the **PATH_TRANSFER**. It has no command line option, everything is passed into the programm via environmental variables.

2.3.6 Data File Transfer

2.3.6.1 Start script GFZ_GNSS_SITE.csh SCP

The script **GFZ_GNSS_SITE.csh SCP** is used to call the file transfer script using the given environment variables.
Table follows on next page ...

variable	description	remark
PATH_TRANSFER	input dir	read files from
EXTENSIONS	file types to transfer	not realy the extension, but lst character, e.g. 'm' finds all files ending on m
DEST_HOSTS	target machine to transfer	note: must be enabled for passwor-free ssh access
DEST_PATHES	dir-structure on target machine	as sub-dir of path home of the user DEST_USER
DEST_USER	user on target machine	note: must be enabled for passwor-free ssh access
CONNECT_TIMEOUT	time-out via scp	use higher values on slow connections
USE_SAVE	$PATH_TRANSFER/SAVE	store in local archive if USE_SAVE = 1
USE_LATE	$PATH_TRANSFER/LATE	files in LATE are transferred first in, first out, in transfer last in, first out, see MAX_SCP_FILES
MAX_SCP_FILES	specify how many files to transfer in one scp call	if more than MAX_SCP_FILES in PATH_TRANSFER, move the older ones to PATH_TRANSFER/LATE
MAX_SCP_ELAPSE	limit to disale transfer	stop scp if scp is too slow

2.3.6.2 File transfer program scp_data

The script **scp_data** is a daemon like script which is waiting for files in the **PATH_TRANSFER** to send the files to GFZ via scp.
After successfull transfer the files are stored in the **SAVE** sub directory.
The usual mode is to transfer latest files first and only the last hour files are stored in the PATH_TRANSFER. If the data communication is down for longer time the files are put to the **LATE** sub directory and are transferred only if the PATH_TRANSFER directory with the newest files is empty. It has no command line option, everything is passed into the programm via environmental variables.

2.3.7 Data Streaming

Data streaming may be carried out via GFZ proprietary program 'udp2tcp', or via the BKG software tool 'ntripserver'. 'udp2tcp' requires the a remote 'tcp2udp' program receiving the data stream. The data transmission is low level tcp stream without any error detection. Error handling is only performed via the intern GNSS data format. Data transmission is performed on a dedicated tcp port, one unique port for each GNSS site. 'ntripserver' requires a remote NTRIP caster, and a dedicated mountpoint.

2.3.7.1 UDP2TCP

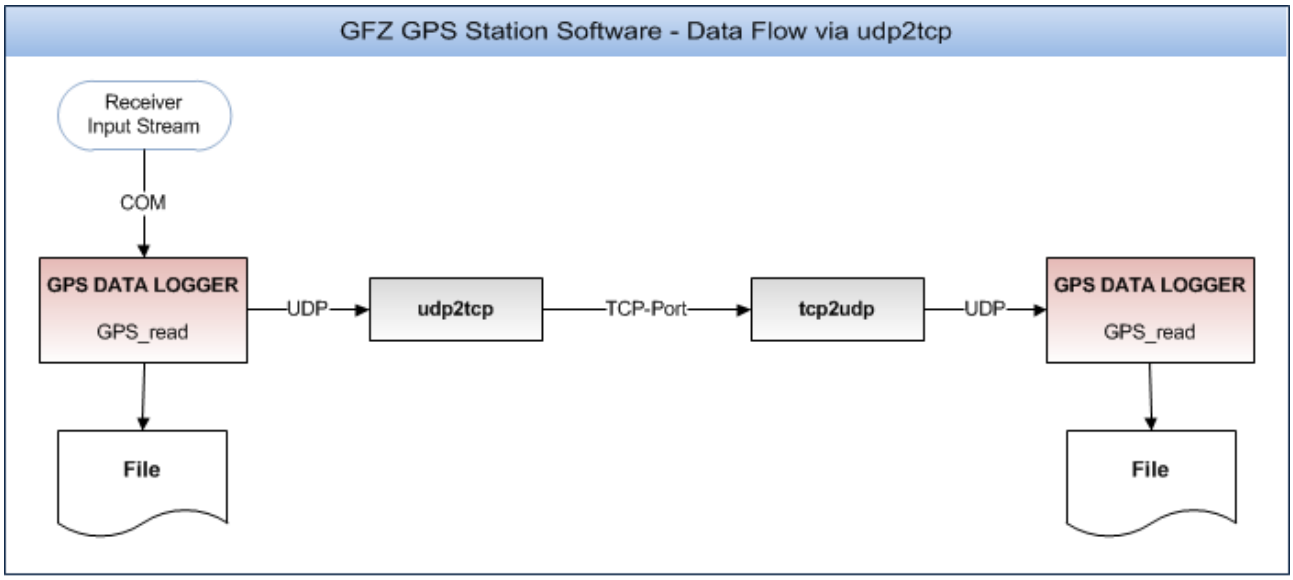
Start script GFZ_GNSS_SITE.csh UDP2TCP The script **GFZ_GNSS_SITE.csh UDP2TCP** is used to call the data streaming program udp2tcp using the given environment variables. udp and tcp are using the same port number.

variable	description	remark
GPS_UDPPORT	udp port user by the GPS_read	
TCP_TARGET	receiving server	

2.3.7.2 Data Streaming program udp2tcp

This program is used to transfer the real time GNSS data stream to GFZ server.

```
***** USAGE: ./udp2tcp

             -udp_port     input  udp port
             -udp_address  input  host name/address (localhost)
             -tcp_port     output tcp port
             -tcp_address  output host name/address (192.168.100.1)
             -stop_file    OPT. use this stopfile (incl. path)
             -path_prot    OPT. use this stopfile (incl. path)
```

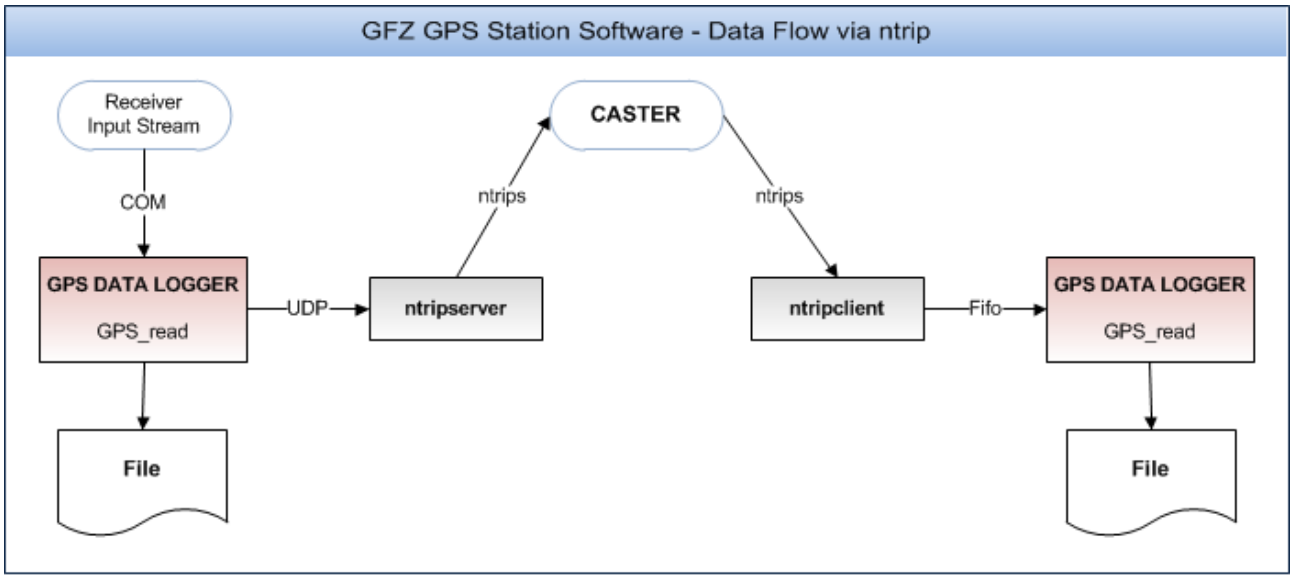


2.3.7.3 NTRIPS

Start script GFZ_GNSS_SITE.csh NTRIPS
The script **GFZ_GNSS_SITE.csh NTRIPS** is used to call the data streaming program ntripserver using the given environment variables.

variable	description	remark
PRG_NTRIPS	executable	default: PATH_SRC/ntripserver
NTRIP_CASTER	receiving caster	default: 139.17.3.112
NTRIP_PORT	port on receiving caster	default: 4080
NTRIP_USER	user on receiving caster	default: rawdata
NTRIP_PASS	password for the user	default: raw
GPS_UDPPORT	udp port user by the GPS_read	

The Mountpoint is generated from the SITE name and can not be altered!



2.3.8 Site Maintenance

The following programs/scripts are used to handle smaller maintenance tasks to ensure the automatic site operation. To seperate them from the data handling scripts, they are defined in the variable $STD_PROGS.
The scripts are started via the MONITOR likewise the $AUTO_PROGS

2.3.8.1 Software System Monitoring GFZ_GNSS_SITE.csh MONITOR

The **GFZ_GNSS_SITE.csh MONITOR** script is started via **cron** every 5 min. On tinyPC based hardware it is started via the watchdog (/root/wdt.csh), defined in /root/wdt_jobs.csh. The script checks internally whether it was started by user gghrnet or by root.

```
# MAIN Monitor ###################################################################
# --------------------------------------------------------------------------------
*/5         * * * *  csh ~/src/GFZ_GNSS_SITE.csh MONITOR                    > ~/prt/cron_gghr  +
                                                                               net_MONITOR 2>&1
```

The programs to be monitored are taken from environment variable:

```
setenv STD_PROGS
setenv AUTO_PROGS
setenv ROOT_PROGS
```

In $STD_PROGS those scripts are defined, which the user can do to maintain the site. Possible values for $STD_PROGS are: CHECK_OPT CHECK_DISC CLEANUP NTP RSYNC UPDATE
In $AUTO_PROGS we define the scripts to operate the data handling. Possible values are:GPS METEO SCP COPYMOVE SENSOR UDP2TCP NTRIP
The $ROOT_PROGS define scripts which have to be started as priviliged user (root). Possible Values are: VPN IP CRON NIF UPDATE

2.3.8.2 CHECK_OPT

CHECK_OPT checks the option file ~/opt/cshrc_gps_site.csh for changes. If any changes are detected, it will make a copy of the last change to ~/opt/.cshrc_gps_site.csh.YY_MM_DD_HH_NN_SS, with

- YY: Year (last two digits)
- MM: Month
- DD: Day
- HH: Hour
- NN: Minute
- SS: Second

The purpose is to monitor changes of the setup.

2.3.8.3 CHECK_DISC

CHECK_DISC checks the used disk space of the disk containing $PATH_TRANSFER. As soon as the usage is higher than defined in MAX_DISK_SPACE (default 80 [%]) it will generate an info file to inform the user about the shortage of available disk space.

```
setenv MAX_DISK_SPACE         "80"
```

2.3.8.4 CLEANUP

CLEANUP starts csh ~/src/GFZ_GNSS_SITE.csh clean > $PATH_PROT/cron_cleanup, but waits 21600 seconds prior execution. clean checks those folders: $PATH_SAVE $PATH_PROT $PATH_WORK $PATH_SYSLOG $PATH_TRANSFER
It deletes all files older than $AGE_SAVE except for the $PATH_TRANSFER, where it will delete only the extensions '*.log*','*.ftp*','*.info*'
If the usage of the disk is higher than $MAX_DISK_SPACE + 10 (max. 95%) it will perform a so called emergency clean. In this case, it will delete all files in the folders keeping the days as specified below:

Folder	Days to keep (default)
$PATH_PROT	$AGE_KEEP (3)
$PATH_WORK	$AGE_KEEP (3)
$PATH_SYSLOG	$AGE_KEEP (3)
$PATH_SAVE	0
$PATH_TRANSFER	$AGE_TRANSFER (1000)

```
^ variable           ^ description                          ^ remark                          +
                  ^                                                                          ^
| AGE_KEEP           | age of files to keep                   | default 3                         +
                                                                                             |
| AGE_TRANSFER       | age of files to keep in $PATH_TRANSFER| default 1000                       +
                                                                                             |
```

If large harddisks are used for stations without internet connection, it might be recommended to increase AGE_TRANSFER. $PATH_TRANSFER is the last folder in the row, as these data are sensitive. They have never being transferred. They are only cleaned to make way for new data. If the cleaning of files older $AGE_TRANSFER does not succeed, $AGE_TRANSFER will be decreased in steps of 100 days (if > 100) or in steps of 1 day, until the disk usage is below ($MAX_DISK_SPACE + 10 / 95%)

2.3.8.5 RSYNC

RSYNC starts csh ~/src/GFZ_GNSS_SITE.csh rsync_opt > $PATH_PROT/cron_rsync_opt
This option is used to have a remote copy of the folders to make inspection more easy. It is also a remote backup. It synchs the folders $PATH_SRC $PATH_HOME/opt $PATH_HOME/bin $PATH_PROT, and, if existing the folders $PATH_HOME/perllib and $PATH_SYSLOG to the remote server/folder specified by $TARGET_RSYNC_OPT/$SITE

```
^ variable           ^ description                        ^ remark                              +
                  ^                                                                          ^
| TARGET_RSYNC_OPT   | specify the user and remote server | default "gpssite@139.17.3.110:GPS_  +
                                                                                      STATION"  |
```

2.3.8.6 UPDATE

Depending on the user, UPDATE starts ~/src/GFZ_GNSS_SITE.csh root_update > $PATH_PROT/prt_root_update_YYYY_DDD for the root and ~/src/GFZ_GNSS_SITE.csh auto_update > $PATH_PROT/prt_auto_update_YYYY_DDD for the user.
It scans $DEST_HOSTS:update for files named $SITE_root.csh (if root) or $SITE_update.csh (if user).
These files are downloaded to the home directory and renamed on the remote server by adding an extension. Then the files will be executed locally. The output of the script will be uploaded to the same server/folder, where the update script was found.
This mechanism can be used to maintain the station without having access via ssh.

2.3.8.7 Computer Time Synchronisation

The computer time synchronisation is needed especially for the meteo-data logging. The GPS-receiver clock can be used for synchronisation. In this case the environment variable GPS_SYNCH_PC has to be set to 1.

2.3.8.8 Power Cycle

Table follows on next page ...

variable	description	remark
POWER_SWITCH	name of the switching device	supported are: maram_lpt, batman, pv1608, barionet, batman_comm, tinyPC
POWER_PORT	how to connect	depends strongly on the hardware
	maram_lpt	parallel port on which the device is attached to (hex, e.g., 0x387)
	batman	COM-port, e.g., /dev/ttyS3
	pv1608	not in use
	barionet	IP of the device
	batman_comm	COM-port, e.g., /dev/ttyS3
	2watt	better use tinyPC
	tinyPC	not in use
POWER_PORT_NUM_MET	channel to meteo device	
POWER_PORT_NUM_GPS	channel to GPS receiver	
POWER_PORT_NUM_COMP	channel to Computer	not defined for batman, pv1608, batman_comm, tinyPC
POWER_PORT_NUM_ROUTER	channel to Router	not defined for maram_lpt,batman
POWER_PORT_EXT_CLOCK	channel to external Clock	not defined for maram_lpt
POWER_PORT_USE_EXT	channle to switch external Clock	not defined for maram_lpt
POWER_PORT_NUM_WLAN	channel to WLAN	

It is possible to power cycle the connected devices via ~/src/GFZ_GNSS_SITE.csh power_cycle <device> from a shell command prompt.
the following devices are supported if existant on certain site:

- GPS
- METEO
- COMPUTER
- CLOCK
- USECLOCK
- ROUTER
- WLAN

2.3.8.9 Watchdog

2.3.9 PLUGIN

If the directory $PATH_HOME/PLUGIN exist, the main script GFZ_GNSS_SITE.csh executes and monitors all files in this directory. It will generate protocolls in $PATH_HOME/START_PROT wich are named like prt_USER_NameOfExecutable

2.4 System Maintenance

All continuously working programs/scripts are monitored and (re)started via **AUTO_SITE_MONITOR** automatically. Usually no manual interaction is needed.

2.4.1 Show running processes

Below you can see an example of a process table part showing the continuously running site software parts.

```
ps uxf
...
...  0:00 csh AUTO_SITE_UPDATE.csh
...  0:00  \_ sleep 1800
...  0:00 csh AUTO_udp2tcp.csh
... 22:17  \_ perl /home/gghrnet/src/udp2tcp.pl -udp_port 4059 -udp_address localhost
                                               -tcp_port 4059 -tcp_address 192.168.100.1
                                               -stop_file /home/gghrnet/STOP/stop_udp2tcp
                                               -path_prot /home/gghrnet/prt
...  0:00 csh AUTO_METEO_read.csh
... 19:15  \_ perl /home/gghrnet/src/meteo_read.pl -ID zwe2 -device /dev/ttyS1
                                                   -interval 5 -file_int 15
                                                   -path_wrk /home/gghrnet/wrk/meteo
                                                   -path_prt /home/gghrnet/prt
                                                   -path_out /home/gghrnet/wrk/meteo
                                                   -rinex_head /home/gghrnet/src/rinex_head_tem  +
                                                                                    plate_ptu200
                                                   -meteo_type ptu200
                                                   -stop_file /home/gghrnet/STOP/stop_meteo_read

...  0:00 csh AUTO_GPS_read.csh
... 25:25  \_ perl /home/gghrnet/src/GPS_read.pl -ID zwe2 -device /dev/ttyS0
                                                 -path_out /home/gghrnet/cmp_mv
                                                 -gps2utc_offset 13 -synch_pc 1 -interval 1
                                                 -file_int 15 -elev_mask 0
                                                 -path_wrk /home/gghrnet/wrk/gps
                                                 -path_prt /home/gghrnet/prt
                                                 -stop_file /home/gghrnet/STOP/stop_GPS_read
                                                 -ext_clock 0 -rec_type septentrio
                                                 -ashtype bit_grapper
                                                 -ashport 0 -doudp 1 -udpport 4059
                                                 -udpaddress localhost
...  0:00 csh AUTO_COMPRESS_MOVE.csh
...714:57  \_ perl /home/gghrnet/src/compress_move.pl
...  0:00 csh AUTO_SCP_DATA.csh
..3502:47  \_ perl /home/gghrnet/src/scp_data.pl
...
```

2.4.2 Restart of running processes / STOP-files

All programs/scripts run in background without an user interface. **STOP-files** are used to shutdown the scripts/programs under control (see **-stop_file** command line parameter). Many programs create a STOP-file template in the STOP-directory **PATH_STOP**. The programs/scripts monitor for the STOP-file existance and shutdown themselfs if they find their own one. On program/script start a STOP-file template is created with an extension **.x**.

```
/home/gghrnet/STOP/stop_GPS_read.x
```

Removing the extension **.x** the STOP-file gets **active**.

```
/home/gghrnet/STOP/stop_GPS_read
```

If the STOP-file is detected by its program/script it will be deleted and the program/script stops itself. It will be restartet by the **AUTO_SITE_MONITOR**, which is checking for missing programs/scripts every 5 minutes.

Chapter 3

Web Interface

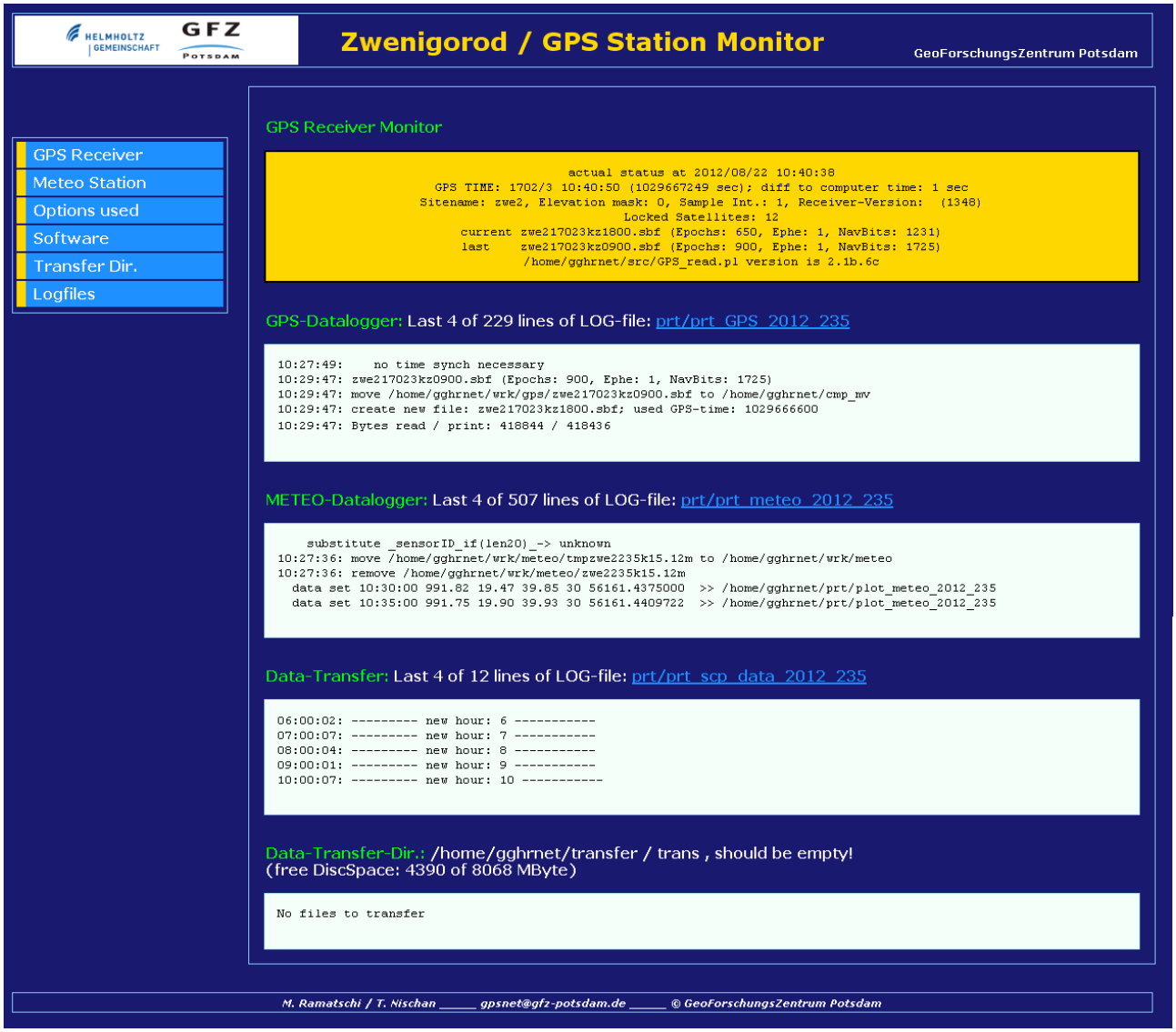
3.1 Main Window

To view the web interface of your GPS station, type in the following URL at the site computer's web browser:

```
http://localhost
```

The image below shows the start page of the GPS station monitor, which includes information about:

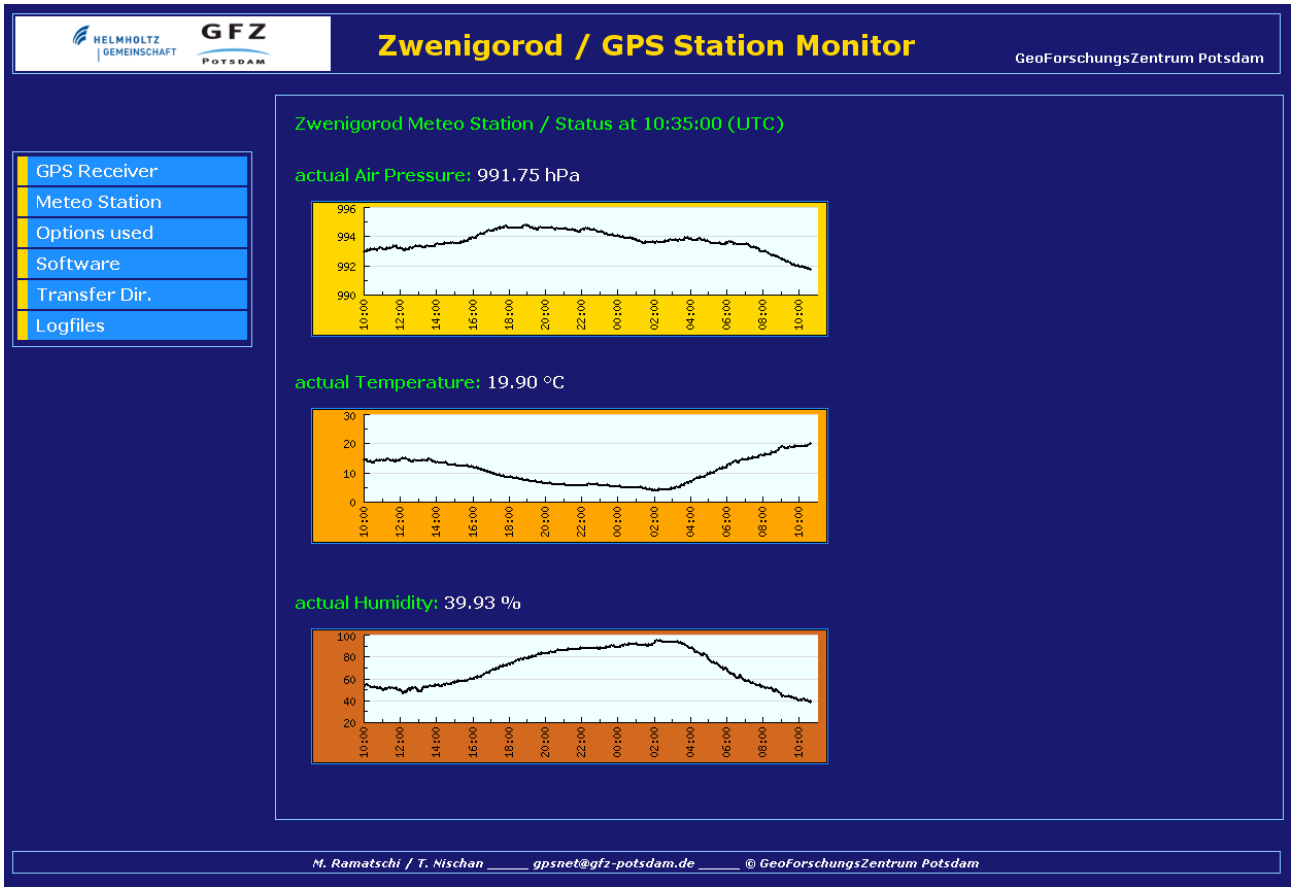
- the current data logging status of the GPS receiver (locked satellites, number of epochs of current and last received data),
- last protocol entries for GPS tracking, extracted from protocol **prt/prt_GPS_YYYY_DOY**,
- last protocol entries for METEO tracking, extracted from protocol **prt/prt_meteo_YYYY_DOY**,
- data transfer status.



3.2 Meteorological Information

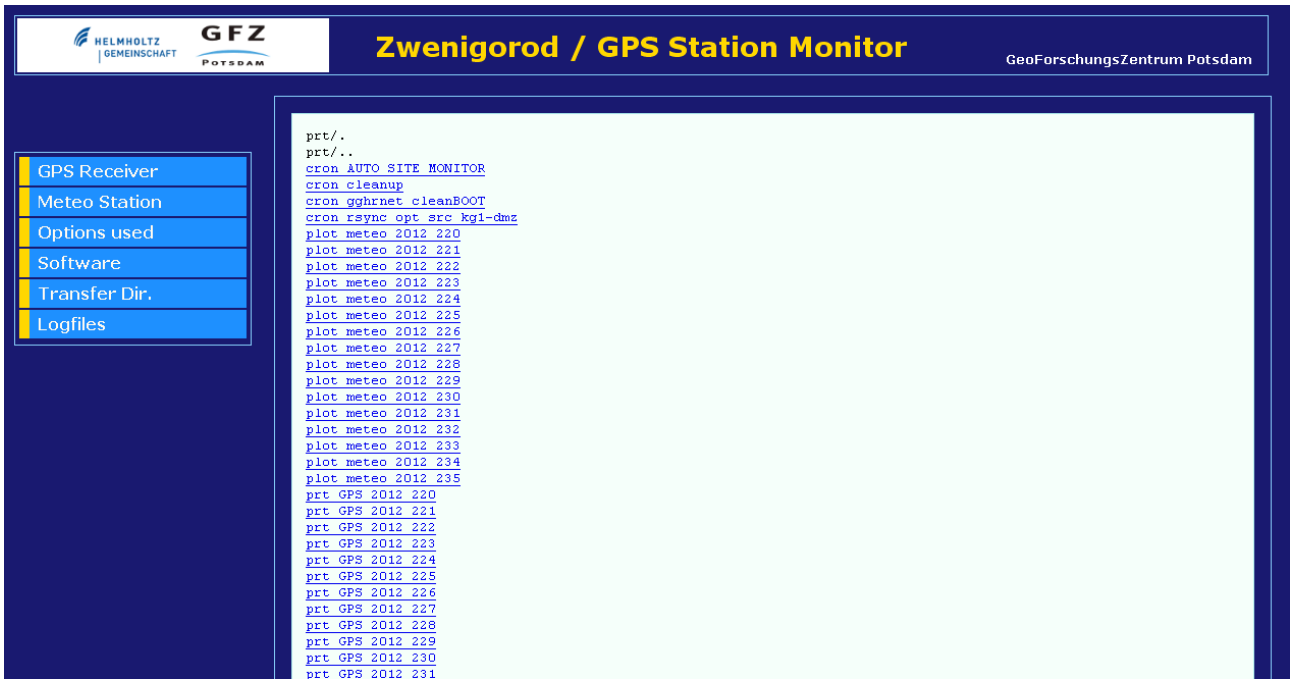
The image below shows the current meteorologial parameters measured by the installed PTU200 meteo station for the last 24 hrs.
The following meteorological parameters are measured:

- Pressure
- Temperature
- Humidity



3.3 Logfiles

The hyperlink **Logfiles** contains all logfiles generated by the GPS software, saved unter **prt**. Via select/click you can view them in the web browser window.



Chapter 4

Data Description

4.1 GNSS data

The following data types are produced:

1. Receiver dependent raw data (binary) files. Each receiver vendor provides its own format.
2. Receiver dependent raw data real-time streams (same content as file).

The table below shows the receiver types used by GFZ:

Receiver Type	File Extension
Septentrio	sbf
Javad	jps
Topcon	tps
Ashtech	as
Trogue	tb

The files are stored with the data duration of 15 minutes. The **file name** consists of the following parts:

Charcters	Description	Example	Comment
1-4	4-char station id.	zwe2	
5-8	GPS-week	1702	
9	week day (0-6).	5	0-sunday
10	hour (a-x)	a	0-23
11	z	z	fix
12-15	second of data begin	0900	nominal
16	dot	.	
17-	extension	sbf	javad

The file additionally gets a compression extension (Z, gz, 7z, ...).

Here the files of one day (1702-5 friday) for station **zwe2**:

```
zwe2-dmz transfer/SAVE> ls zwe217025*
zwe217025az0000.sbf.7z  zwe217025gz0000.sbf.7z  zwe217025mz0000.sbf.7z  zwe217025sz0000.sbf.7z
zwe217025az0900.sbf.7z  zwe217025gz0900.sbf.7z  zwe217025mz0900.sbf.7z  zwe217025sz0900.sbf.7z
zwe217025az1800.sbf.7z  zwe217025gz1800.sbf.7z  zwe217025mz1800.sbf.7z  zwe217025sz1800.sbf.7z
zwe217025az2700.sbf.7z  zwe217025gz2700.sbf.7z  zwe217025mz2700.sbf.7z  zwe217025sz2700.sbf.7z
zwe217025bz0000.sbf.7z  zwe217025hz0000.sbf.7z  zwe217025nz0000.sbf.7z  zwe217025tz0000.sbf.7z
zwe217025bz0900.sbf.7z  zwe217025hz0900.sbf.7z  zwe217025nz0900.sbf.7z  zwe217025tz0900.sbf.7z
zwe217025bz1800.sbf.7z  zwe217025hz1800.sbf.7z  zwe217025nz1800.sbf.7z  zwe217025tz1800.sbf.7z
zwe217025bz2700.sbf.7z  zwe217025hz2700.sbf.7z  zwe217025nz2700.sbf.7z  zwe217025tz2700.sbf.7z
...
zwe217025fz0000.sbf.7z  zwe2170251z0000.sbf.7z  zwe217025rz0000.sbf.7z  zwe217025xz0000.sbf.7z
zwe217025fz0900.sbf.7z  zwe2170251z0900.sbf.7z  zwe217025rz0900.sbf.7z  zwe217025xz0900.sbf.7z
zwe217025fz1800.sbf.7z  zwe2170251z1800.sbf.7z  zwe217025rz1800.sbf.7z  zwe217025xz1800.sbf.7z
zwe217025fz2700.sbf.7z  zwe2170251z2700.sbf.7z  zwe217025rz2700.sbf.7z  zwe217025xz2700.sbf.7z
zwe2-dmz transfer/SAVE>
```

4.1.1 Decode GNSS Receiver Raw Data

To decode the receiver/vendor dependent GNSS raw data to the receiver independent exchange format **RINEX** one can use the free program **teqc** provided by UNAVCO. See `http://facility.unavco.org/software/teqc/teqc.html` for details. Here some simple **teqc** command line examples for different receiver raw data formats:

4.1.1.1 Septentrio (sbf)

```
teqc -sep sbf file.sbf > file.rnx
```

4.1.1.2 Ashtech (as)

```
teqc -ash s -week <GPSWEEK> file.as > file.rnx
```

4.1.1.3 Topcon (tps)

```
teqc -top tps -week <GPSWEEK> file.tps > file.rnx
```

4.1.1.4 Javad (jps)

```
teqc -javad jps file.jps > file.rnx
```

4.1.1.5 Rogue (t, tb)

```
teqc -aoa tbY file.t  > file.rnx
teqc -aoa tbY file.tb > file.rnx
```

The above examples can be used for a first view. One needs more command line parameters to fill the right header meta data information. See the **teqc** description for details. Usually the archived files need to be uncompressed before decoding them. Here an example for a zwe2 data file.

```
zwe2-dmz transfer/SAVE> 7z e zwe217042nz1800.sbf.7z

7-Zip 4.43 beta  Copyright (c) 1999-2006 Igor Pavlov  2006-09-15
p7zip Version 4.43 (locale=en_US.UTF-8,Utf16=on,HugeFiles=on,1 CPU)

Processing archive: zwe217042nz1800.sbf.7z

Extracting  zwe217042nz1800.sbf
Everything is Ok
```

```
zwe2-dmz transfer/SAVE> teqc -sep sbf zwe217042nz1800.sbf > zwe217042nz1800.rnx
```

```
zwe2-dmz transfer/SAVE> more zwe217042nz1800.rnx
     2.11           OBSERVATION DATA    M (MIXED)           RINEX VERSION / TYPE
teqc  2012Jun6                          20120905 14:31:18UTCPGM / RUN BY / DATE
Linux 2.4.20-8|Pentium IV|gcc -static|Linux|486/DX+         COMMENT
BIT 2 OF LLI FLAGS DATA COLLECTED UNDER A/S CONDITION       COMMENT
-Unknown-                                                   MARKER NAME
-Unknown-           -Unknown-                               OBSERVER / AGENCY
-Unknown-           -Unknown-           -Unknown-           REC # / TYPE / VERS
-Unknown-           -Unknown-                               ANT # / TYPE
        0.0000        0.0000        0.0000                  APPROX POSITION XYZ
```

```
        0.0000        0.0000        0.0000                  ANTENNA: DELTA H/E/N
     1     1                                                 WAVELENGTH FACT L1/2
     7    L1    L2    C1    P1    P2    S1    S2            # / TYPES OF OBSERV
SNR is mapped to RINEX snr flag value [0-9]                 COMMENT
 L1 & L2: min(max(int(snr_dBHz/6), 0), 9)                   COMMENT
 2012     9     4    13    30    0.0000000     GPS         TIME OF FIRST OBS
   16                                                       LEAP SECONDS
                                                            END OF HEADER
12  9  4 13 30  0.0000000  0 13G29G18G31G26G06G16G25G21G05G30S20S26
                             S24
-44230181.12748 -34267757.59346  21391890.692    21391889.891    21391891.366
       49.000          40.000
 -2942064.01746   -451481.20841  24572939.456    24572938.264    24572941.390
       36.000          10.000
-23833187.52546 -15640507.42942  25302587.254    25302586.297    25302591.914
       37.000          12.000
  -113523.32845                  25443845.670
       33.000
 -5262900.11546  -3665289.09142  24628763.391    24628762.932    24628767.943
       39.000          14.000
-15503237.88447 -11395779.50844  22988804.136    22988803.697    22988805.885
       43.000          28.000
-36581857.79046 -28428440.93442  24429595.729    24429594.528    24429601.033
       39.000          16.000
-30492725.04348 -23354039.96746  21492387.415    21492386.155    21492387.200
       49.000          40.000
-27869229.85547 -21562892.47645  23058898.631    23058897.439    23058899.159
       45.000          30.000
-29706821.01948 -22591731.07646  21466027.521    21466026.583    21466029.065
       50.000          38.000
```

4.1.2 RINEX/OBS remarks

4.1.2.1 Types of Observations

The RINEX-2 observation data format consists of a header part containing meta information and a data part with the observations epoch by epoch. The main header information for the later given data records is:

```
     7    L1    L2    C1    P1    P2    S1    S2            # / TYPES OF OBSERV
```

C1/P1/P2 are code observations, which are a distance (m) to the satellite for the given epoch; L1/L2 are phase observations (frequency cycles); S1/S2 are signal to noise ratios. The numbers 1/2 indicate the used frequencies of the satellite system.

4.1.2.2 GNSS Data

The RINEX-2 data part consists of an epoch line containing the list of satellites for which the observations with the "TYPES OF OBSERV" order are given. Below you can see the obs. block of one epoch (2012.09.04 13:30) for 13 observed satellites (10 GPS, 3 SBAS). For the GPS satellites are dual frequency observations and for the SBAS satellites are only single frequency observations available.

```
12  9  4 13 30  0.0000000  0 13G29G18G31G26G06G16G25G21G05G30S20S26
                             S24
-44230181.12748 -34267757.59346  21391890.692    21391889.891    21391891.366
       49.000          40.000
 -2942064.01746   -451481.20841  24572939.456    24572938.264    24572941.390
       36.000          10.000
-23833187.52546 -15640507.42942  25302587.254    25302586.297    25302591.914
       37.000          12.000
  -113523.32845                  25443845.670
```

```
        33.000
  -5262900.11546  -3665289.09142  24628763.391    24628762.932    24628767.943
        39.000          14.000
 -15503237.88447 -11395779.50844  22988804.136    22988803.697    22988805.885
        43.000          28.000
 -36581857.79046 -28428440.93442  24429595.729    24429594.528    24429601.033
        39.000          16.000
 -30492725.04348 -23354039.96746  21492387.415    21492386.155    21492387.200
        49.000          40.000
 -27869229.85547 -21562892.47645  23058898.631    23058897.439    23058899.159
        45.000          30.000
 -29706821.01948 -22591731.07646  21466027.521    21466026.583    21466029.065
        50.000          38.000
 -12996159.919 5                  20890318.141
        35.000
1349294917.798 6                  19781786.539
        39.000
 -72576701.247 6                  20845853.606
        39.000
 12  9  4 13 30  1.0000000  0 13G29G18G31G26G06G16G25G21G05G30S20S26
                               S24
...
```

See the RINEX documentations for the full details.

4.2 METEO data

The following data types are produced:

1. RINEX-2 format Meteorological data files (recorded from meteo station).

The files are stored with the data duration of 15 minutes. The RINEX file naming scheme is used and the **file name** consists of the following parts:

Charcters	Discription	Example	Comment
1-4	4-char station id.	pots	
5-7	day of year	237	
8	hour (a-x)	a	0-23
9-10	minute of data begin	15	nominal
11	dot	.	
12-13	year (2-digit)	12	2012
14	m (meteo file id.)	m	fix

The file additionally gets a compression extension (Z, gz, 7z, ...).

Here the files of one day (2012-237) for station **pots**:

```
gps-pots transfer/SAVE> ls pots237*
pots237a00.12m.7z  pots237f00.12m.7z  pots237k00.12m.7z  pots237p00.12m.7z  pots237u00.12m.7z
pots237a15.12m.7z  pots237f15.12m.7z  pots237k15.12m.7z  pots237p15.12m.7z  pots237u15.12m.7z
pots237a30.12m.7z  pots237f30.12m.7z  pots237k30.12m.7z  pots237p30.12m.7z  pots237u30.12m.7z
pots237a45.12m.7z  pots237f45.12m.7z  pots237k45.12m.7z  pots237p45.12m.7z  pots237u45.12m.7z
...
pots237d00.12m.7z  pots237i00.12m.7z  pots237n00.12m.7z  pots237s00.12m.7z  pots237x00.12m.7z
pots237d15.12m.7z  pots237i15.12m.7z  pots237n15.12m.7z  pots237s15.12m.7z  pots237x15.12m.7z
pots237d30.12m.7z  pots237i30.12m.7z  pots237n30.12m.7z  pots237s30.12m.7z  pots237x30.12m.7z
pots237d45.12m.7z  pots237i45.12m.7z  pots237n45.12m.7z  pots237s45.12m.7z  pots237x45.12m.7z
...
```

The data rate of the meteo file is 5 minutes. Here an example of a meteo-file (pots228c15.12m) of station **pots**:

```
gps-pots transfer/SAVE> cat pots228c15.12m
     2.1            METEOROLOGICAL DATA                     RINEX VERSION / TYPE
meteo_read 1.0      GFZ Potsdam         15-Aug-2012 02:27   PGM / RUN BY / DATE
pots                                                        MARKER NAME
                         Sensor ID: Z2310004                COMMENT
     3    PR    TD    HR                                    # / TYPES OF OBSERV
Vaisala             HMP45A-P                      0.1    TD SENSOR MOD/TYPE/ACC
Vaisala             PTU200                        0.1    PR SENSOR MOD/TYPE/ACC
Vaisala             HMP45A-P                      1.5    HR SENSOR MOD/TYPE/ACC
                                                            END OF HEADER
 12 08 15 02 15 00 1006.6   13.0   84.9
 12 08 15 02 20 00 1006.5   12.9   85.7
 12 08 15 02 25 00 1006.5   12.9   86.6
gps-pots transfer/SAVE>
```

4.3 INFO files

INFO files are generated via stop or (re)start of data logging programs or by some monitoring tools (disk space monitoring, software updates, ...) to inform the operational data center at GFZ on events. Here an example of the information about the GNSS data logger stop.

```
transfer/SAVE> 7z e zwe220120831161049.info.7z

7-Zip 4.43 beta  Copyright (c) 1999-2006 Igor Pavlov  2006-09-15
p7zip Version 4.43 (locale=en_US.UTF-8,Utf16=on,HugeFiles=on,1 CPU)

Processing archive: zwe220120831161049.info.7z

Extracting  zwe220120831161049.info

Everything is Ok
```

Originally the information was sent out via mail. Later the mail content was put to a file to be independent from the local mailing system. The e-mails are now generated at the operational data center at GFZ and are sent to the persons responsible for the GFZ GNSS network.

```
transfer/SAVE> cat zwe220120831161049.info
+mail
 SITE    | zwe2
 SUBJECT | GPS_read END (exit 0: normal end)
 TIME    | 2012/08/31 16:10:49
+body
 mail send via perl /home/gghrnet/src/mail2.pl


 ******************************
 2012-06-17 06:45:02 Start of the script
 perl /home/gghrnet/src/GPS_read.pl
 -ID zwe2 -device /dev/ttyS0 -path_out /home/gghrnet/cmp_mv -gps2utc_offset 13 -synch_pc 1
 -interval 1-file_int 15 -elev_mask 0 -path_wrk /home/gghrnet/wrk/gps
 -path_prt /home/gghrnet/prt -stop_file /home/gghrnet/STOP/stop_GPS_read -ext_clock 0
 -rec_type septentrio -ashtype bit_grapper -ashport 0 -doudp 1 -udpport 4059
 -udpaddress localhost
 my version is: 2.1b.6c

 Start @ Computer local Time: 2012/06/17 06:45:03
 ************************************************
 Station ID:    zwe2
 Port:          /dev/ttyS0
 WORK PATH:     /home/gghrnet/wrk/gps
 OUT  PTAH:     /home/gghrnet/cmp_mv
 PROT PATH:     /home/gghrnet/prt
 rec_type:      septentrio
 samplerate:    1 sec
 file interval: 900 sec
 elevation:     0
 synch_pc:      1
 gps2utc_offset:13
 last bang time:1
 Stopfile      :/home/gghrnet/STOP/stop_GPS_read
 External Clock:0
 save_unchanged:0
 bangstatus:    1
 UDPport:       4059
 Use of uninitialized value in concatenation (.) or string at /home/gghrnet/src/GPS_read.pl lin  +
                                                                                          e 1202.
```

```
UDPaddress:
**************************************************

********************set up of com port: /dev/ttyS0 ***************************

...

port /dev/ttyS0 opened!
initialize Septentrio, sbf_request: 70

$PolaT&: SetDisplayOutput
#06:45:39  17 Jun 2012 - sec: 24339 week:1693 - uptime:205d16:28
#Ch PRN  Elev Health lock    -----C/N0------ UDRE  --Residuals--
#              Y/N   time    C/A   P1   P2    [m]   [m]    [Hz]
# 1   5  26 +   Y   0:47:42  42.7 27.9 28.1  2.00   ---    ----
# 2   7  72 +   Y   2:02:39  50.7 43.7 43.2  2.00   ---    ----
# 3  16  32 -   Y   2:40:58  43.8 27.9 28.0  2.00   ---    ----
# 4   6  10 +   Y   0:21:42  36.6 12.0 12.5  2.00   ---    ----
# 5   2  18 -   Y   2:29:29  41.0 21.1 21.0  2.00   ---    ----
# 6   4   7 -   Y   3:57:21  36.6  8.9  9.3  2.00   ---    ----
# 7
# 8
# 9  10  60 -   Y   2:50:08  50.0 40.2 40.1  2.83   ---    ----
#10  23  36 -   Y   5:02:47  47.8 32.0 32.2  2.00   ---    ----
#11  13  71 -   Y   3:48:57  50.9 42.4 42.3  2.00   ---    ----
#12   8  31 +   Y   0:58:25  43.7 27.6 27.5  2.00   ---    ----
#13  30  11 -   Y   3:30:43  36.8 13.8 13.6  8.00   ---    ----
#14   3   9 +   Y   0:20:06  38.0 11.7 10.2  2.83   ---    ----
#15
#16 120  12     <   0:38:00  33.6 MT04 INIT         ---    ----
#17 124  --         0:31:45  37.5 MT03 INIT         ---    ----
#18 126  26        >9:59:59  38.8 MT25 INIT         ---    ----
#--Position: WGS84 ----- ellipsoid ------ --xDOP: --------------
#X:              m  lat :    o  '       " PDOP:      TDOP:
#Y:              m  lon :    o  '       " HDOP:      VDOP:
#Z:              m  h   :               m HPL :      VPL :
#--Velocity: ------ --Fix time: --------- --Status: -unknown err
#East :        m/s  Bias :          ms    SV used :  0  of   12
#North:        m/s  Drift:          us/s  ElevMask:  0  CPU: 24%
#Up   :        m/s  sec:       week:      FreqRef : Int
 #EoL

write to comport: ssu SBAS off

read from comport: $PolaRx: SetSatelliteUsage GPS, on
$PolaRx: SetSatelliteUsage SBAS, off #EoL

write to comport: sca all auto

read from comport: $PolaRx: SetChannelAllocation all_DF , auto
$PolaR#: SetChannelAllocation       1,    5 # DualFreq
$PolaR#: SetChannelAllocation       2,    7 # DualFreq
$PolaR#: SetChannelAllocation       3,   16 # DualFreq
$PolaR#: SetChannelAllocation       4,    6 # DualFreq
$PolaR#: SetChannelAllocation       5,    2 # DualFreq
$PolaR#: SetChannelAllocation       6,    4 # DualFreq
$PolaR#: SetChannelAllocation       7, none # DualFreq
$PolaR#: SetChannelAllocation       8, none # DualFreq
$PolaR#: SetChannelAllocation       9,   10 # DualFreq
$PolaR#: SetChannelAllocation      10,   23 # DualFreq
$PolaR#: SetChannelAllocation      11,   13 # DualFreq
```

```
 $PolaR#: SetChannelAllocation      12,    8 # DualFreq
 $PolaR#: SetChannelAllocation      13,   30 # DualFreq
 $PolaR#: SetChannelAllocation      14,    3 # DualFreq
 $PolaR#: SetChannelAllocation      15, none # DualFreq
 $PolaRx: SetChannelAllocation all_SB , auto
 $PolaR#: SetChannelAllocation      16,  120 # SBAS
 $PolaR#: SetChannelAllocation      17,  124 # SBAS
 $PolaR#: SetChannelAllocation      18,  126 # SBAS #EoL

...

 check the directory /home/gghrnet/wrk/gps for lost files
 06:47:19: move /home/gghrnet/wrk/gps/zwe216930gz0900.sbf to /home/gghrnet/cmp_mv
    next file will end at 1023951600
    update /home/gghrnet/wrk/gps/.lastbang.info
 06:47:19: ****** Start the endless loop! ********

 ******************************
 2012-08-31 16:10:48 script returns 0: normal end
 mail send with perl /home/gghrnet/src/mail2.pl

-body
-mail
```

List of Figures