

July 8, 2004

## **Networked Transport of RTCM via Internet Protocol**

# **Ntrip, Version 1.0**

## **Example Implementation**

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[http://igs.ifag.de/index\\_ntrip.htm](http://igs.ifag.de/index_ntrip.htm)

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## General Note

Networked Transport of RTCM via Internet Protocol (Ntrip) stands for an application-level protocol streaming Global Navigation Satellite System (GNSS) data over the Internet. Ntrip is a generic, stateless protocol based on the Hypertext Transfer Protocol HTTP/1.1. The HTTP objects are enhanced to GNSS data streams.

Ntrip is designed for disseminating differential correction data (e.g in the RTCM-104 format) or other kinds of GNSS streaming data to stationary or mobile users over the Internet, allowing simultaneous PC, Laptop, PDA, or receiver connections to a broadcasting host. Ntrip supports wireless Internet access through Mobile IP Networks like GSM, GPRS, EDGE, or UMTS.

Ntrip is implemented in three system software components: NtripClients, NtripServers and NtripCasters. The NtripCaster is the actual HTTP server program whereas NtripClient and NtripServer are acting as HTTP clients.

Ntrip is meant to be an open none-proprietary protocol. Major characteristics of Ntrip's dissemination technique are:

- Based on the popular HTTP streaming standard; comparatively easy to implement when having limited client and server platform resources available.
- Application not limited to one particular plain or coded stream content; ability to distribute any kind of GNSS data.
- Potential to support mass usage; disseminating hundreds of streams simultaneously for up to thousand users possible when applying modified Internet Radio broadcasting software.
- Considering security needs; stream providers and users don't necessarily get into contact, streams often not blocked by firewalls or proxyservers protecting Local Area Networks.
- Enables streaming over any mobile IP network because of using TCP/IP.

The original Ntrip documentation covered a description of the Version 1.0 transport protocol (Part I) as well as an example implementation (Part II). The work done for Part I sections "Client Messages" and "Source-Table" has been frozen on March 3<sup>rd</sup>, 2003 in order to allow the development of Ntrip-based implementations and applications on a firm and fully anchored basis.

On 23 June 2004 the original documentation containing Part I & II was split in two files. The document presented here covers only the content of Part II.

As of July 2004, Ntrip Version 1.0 is still in a standardization process within RTCM. Once this standard is approved, further Ntrip versions may be issued within RTCM when necessary. Contributions from anyone to the ongoing work on Ntrip are highly appreciated.

## Document History

- 15 Jan 2003 Draft
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- 28 Jan 2003 Wording, format, stylistics
- 30 Jan 2003 Source-table edited, parameter <vrs> renamed to <nmea>
- 31 Jan 2003 NMEA Request Messages included
- 03 Feb 2003 Modification of server and client messages, screenshots updated, Downloads section included
- 04 Feb 2003 NtripCaster hardware configuration example and proxyserver option included
- 05 Feb 2003 Additional explanations in Example Implementation section
- 10 Feb 2003 Appendix B extended, meaning of parameter <protection> in source-table changed
- 20 Feb 2003 Source-table parameters <solution>, <carrier>, <authentication>, and <fee> added, parameter <protection> deleted, Appendix B split into two sections
- 25 Feb 2003 Wording corrected
- 26 Feb 2003 Appendix A, new example source-table included
- 27 Feb 2003 Source-table: parameter <operator> included in CAS-records, sequence of parameters in STR-records changed, meaning of parameter <carrier> changed
- 03 Mar 2003 Status of work on technical content of Part I frozen as "Ntrip Version 1.0"
- 25 Mar 2003 Appendix C, Linux Client Example added
- 04 Apr 2003 GNSS Internet Radio screenshots updated
- 19 May 2003 GNSS Internet Radio screenshots updated
- 18 Jun 2003 Co-Processor included in Broadcaster hardware recommendation section
- 20 Jun 2003 Source-Agent included in Server Message section, Downloads section extended
- 23 Jun 2004 Documentation split in two parts. First document covers the actual Ntrip protocol following RTCM's standardization as of 20 May 2004. Second document (this one) covers EUREF's Ntrip Example Implementation.
- 02 Jul 2004 Screenshots updated, formatting  
Standard Broadcaster section included
- 07 Jul 2004 Monitoring section included
- 08 Jul 2004 GNSSInternetRadio CE section included, formatting

## Table of Contents

Ntrip Example Implementation .....	6
1. NtripServer .....	7
1.1. NtripServer .....	7
1.2. NtripServerCMD .....	9
2. NtripClient .....	11
2.1. GNSS Internet Radio (Windows Desktop) .....	11
2.2. GNSS Internet Radio (Windows CE) .....	15
3. NtripCaster .....	17
3.1. Standard NtripCaster .....	17
3.2. Professional NtripCaster .....	19
3.2.1. Status Information .....	21
3.2.2. Administration .....	25
3.3. Standard versus Professional NtripCaster .....	31
3.4. Internet Connection .....	32
3.5. Hardware .....	32
4. Monitoring .....	33
4.1. Remote Networked Monitoring .....	33
4.2. Local Monitoring .....	34
4.2.1. Stream Outages .....	34
4.2.2. Notice Advisory to Broadcaster Users (NABU) .....	36
4.2.3. NtripCaster Usage .....	37
4.3. Stream Distribution Maps .....	38
5. Downloads .....	40

## Figures

Fig. 1: NtripServer Window .....	7
Fig. 2: NtripServer Setting Windows .....	7
Fig. 3: NtripServer Reconnection Window .....	8
Fig. 4: About NtripServer & Copyright .....	8
Fig. 5: NtripServerCMD .....	9
Fig. 6: GNSSInternetRadio Window .....	11
Fig. 7: GNSSInternetRadio Broadcaster Settings Window .....	12
Fig. 8: GNSSInternetRadio Settings Window .....	12
Fig. 9: GNSSInternetRadio COM-Port Settings Window .....	13
Fig. 10: GNSSInternetRadio TCP/IP Settings Window .....	13
Fig. 11: GNSSInternetRadio File Settings Window .....	14
Fig. 12: GNSSInternetRadio Source-Table Window .....	14
Fig. 13: About GNSSInternetRadio & Copyright .....	15
Fig. 14: GNSSInternetRadio CE on Pocket PC .....	15
Fig. 15: GNSSInternetRadio CE Screenshots .....	16
Fig. 16: NtripCaster Source-Table .....	17
Fig. 17: Standard NtripCaster Configuration File .....	18
Fig. 18: Professional NtripCaster Configuration File .....	21
Fig. 19: NtripCaster Web Status Interface .....	21
Fig. 20: NtripCaster Web Status: Admins .....	22
Fig. 21: NtripCaster Web Status: Settings .....	22
Fig. 22: NtripCaster Web Status: Statistics .....	23
Fig. 23: NtripCaster Web Status: Listener .....	23
Fig. 24: NtripCaster Web Status: Sources .....	24
Fig. 25: NtripCaster Web Status: Source-Table .....	24
Fig. 26: NtripCaster Administration Console .....	25
Fig. 27: NtripMonitor Usage .....	33
Fig. 28: Daily Stream Outage Plot .....	35
Fig. 29: Monthly Stream Outage Statistic .....	36
Fig. 30: NABU - Stream Unavailable .....	36
Fig. 31: NABU - Stream Available .....	37
Fig. 32: Monthly NtripCaster Usage Statistic .....	37
Fig. 33: NtripCaster Daily Accounting File .....	38
Fig. 34: Stream Distribution Map .....	38

## Ntrip Example Implementation

The system components described in the Ntrip Version 1.0 protocol documentation are implemented as an example under several operating systems and designed with Microsoft Visual Studio C++ 6.0 including Microsoft Visual Studio 6.0 Service Pack 5 for Win32 and the gcc compiler for Linux (UNIX). This “Ntrip Example Implementation”, as developed within the EUREF-IP Pilot Project, includes the following programs:

- NtripServer (Windows 98/00/XP)
- NtripServerCMD, command line version of NtripServer (Windows 98/00/XP)
- NtripClient, “GNSS Internet Radio”, Windows 98/00/XP)
- NtripClient, “GNSS Internet Radio” (WindowsCE / PocketPC 2002/2003)
- NtripCaster, Standard version, derived from the **Icecast** Internet Radio Version 1.3.11 under GNU General Public License (Linux)
- NtripCaster Professional version, derived from the **Icecast** Internet Radio Version 1.3.11 under GNU General Public License (Linux)
- NtripMonitor, shell scripts for NtripCaster monitoring (Linux).

Please note that EUREF-IP has no responsibility for other software made available from third parties within the framework of the project.

Note further that parts of the example implementation are not capable of handling Ntrip’s NMEA Request Messages as necessary for supporting the VRS concept. It is limited to disseminate data streams with <nmea> parameter set to “0” (see Source-table section in Ntrip Version 1.0 documentation).

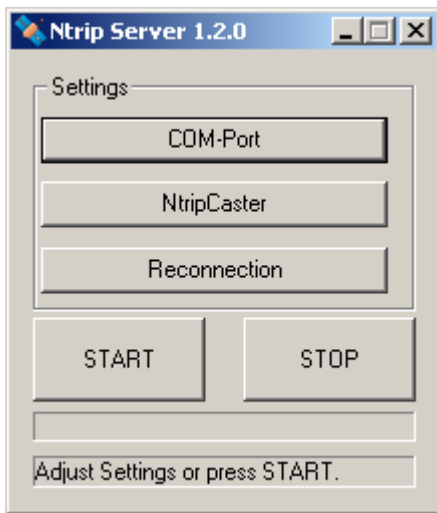
# 1. NtripServer

The NtripServer transfers a real-time data stream from an NtripSource to an NtripCaster. It is acting as an HTTP client program.

## 1.1. NtripServer

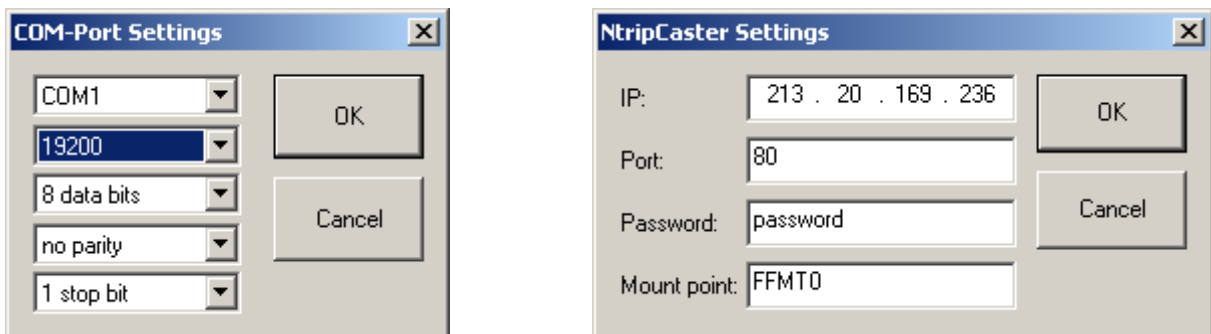
The NtripServer (Windows 98/00/XP) is designed to be a server for a single NtripSource. Basically the NtripServer grabs a serial GNSS byte stream (COM-port) from a GNSS receiver at a reference station and sends it off over an Internet TCP connection to the NtripCaster. The start window is shown in Fig. 1.

Mind that the NtripServer cannot handle a proxyserver. When using it in a proxy-protected Local Area Network (LAN), a TCP-relay has to be established connecting the proxyserver and the NtripCaster. Establishing the Internet connection for an NtripServer by using an Internet Service Provider (ISP) is an alternative.



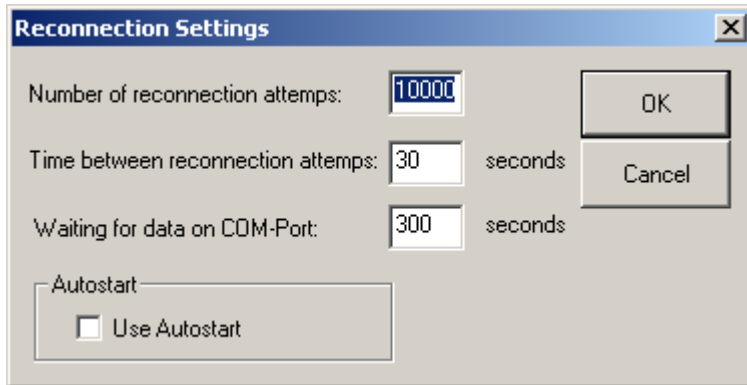
**Fig. 1: NtripServer Window**

A NtripServer operator needs to set all relevant parameters before the transmission will be started. The program includes setting windows to configure the serial byte stream (COM-port) from a GNSS receiver and the NtripCaster settings for the data output towards the NtripCaster (see Fig. 2). Note that it is recommended to use a high baud rate (e.g. 19200) if supported by hardware and software. Server password and mountpoint are provided by the administrator of the NtripCaster.



**Fig. 2: NtripServer Setting Windows**

The program will automatically recognize NtripCaster failures (e.g. NtripCaster is down) and can be configured, as shown in Fig. 3, to automatically reconnect to the lost NtripCaster. The “Reconnection Settings” windows offers a “Use Autostart” option. If this option is activated and a link to the NtripServer exists in the “Autostart” directory of the Windows Operating System, the program will automatically start running after a system reboot.



**Fig. 3: NtripServer Reconnection Window**

This example server implementation is currently an experimental software. The BKG disclaims any liability nor responsibility to any person or entity with respect to any loss or damage caused, or alleged to be caused, directly or indirectly by the use and application of the Ntrip technology (see Fig. 4).



**Fig. 4: About NtripServer & Copyright**

## 1.2. NtripServerCMD

Like the NtripServer, the command line program NtripServerCMD (Windows 98/00/XP) is designed to be a server for a single NtripSource. Basically the NtripServerCMD grabs a GNSS byte stream via TCP/IP from an IP network address and port number and sends it off over an Internet TCP connection to the NtripCaster.

Note that the NtripServerCMD cannot handle a proxyserver. When using it in a proxy-protected Local Area Network (LAN), a TCP-relay has to be established connecting the proxyserver and the NtripCaster. Establishing the Internet connection for the NtripServerCMD program by using an ISP is an alternative.

The user has to call the program with the following arguments:

```
NtripServerCMD -q <source IP>:<source port>
                -c <caster IP>:<caster port>:<mountpoint>:<password>
                -r <attempts>:<time>
                -p <protocol file>
```

Explanations:

-q -c -r	Obligatory arguments
-p	Optional argument
<source IP>	IP number of NtripSource
<source port>	Port number of NtripSource (optional)
<caster IP>	IP number of NtripCaster
<caster port>	Port number of NtripCaster (optional)
<mountpoint>	Mountpoint of NtripSource on NtripCaster
<password>	encoder password for NtripSource on NtripCaster (optional)
<attempts>	Number of attempts for connection, "0" for infinite number of attempts
<time>	Interval between connection attempts in seconds
<protocol file>	Name for protocol file, no protocol file generation without this argument

Use 'Ctrl + c' to quit the program during execution. The argument '-h' or '/?' will display "help information" on the screen. A screenshot of an NtripServerCMD DOS windows is shown in Fig. 5.

```

C:\Programme\Ntrip\NtripServerCMD.exe
NtripServerCMD, Version 1.3
source :
  IP :    194.29.150.254
  Port :    2101
caster :
  IP :    213.20.169.236
  Port :    80
mountpoint : JOZ20
password :   yes
attempts to connect : 0 in 51 second(s) interval(s)
protocol :   yes :   C:\Programme\Ntrip\Log\Warsaw.txt

running since : Fri Jul 02 10:13:32 2004

←   packet size : 224      average data rate : 768.063 bytes/s
                                average packet size : 212.503 bytes
                                average transmission interval : 0.276674 s
  
```

Fig. 5: NtripServerCMD

Example command line:

```
c:\NtripServerCMD -q 194.29.150.254:2101 -c 213.20.169.236:80:JOZ20:itsme -r 0:60 -p prot.txt
```

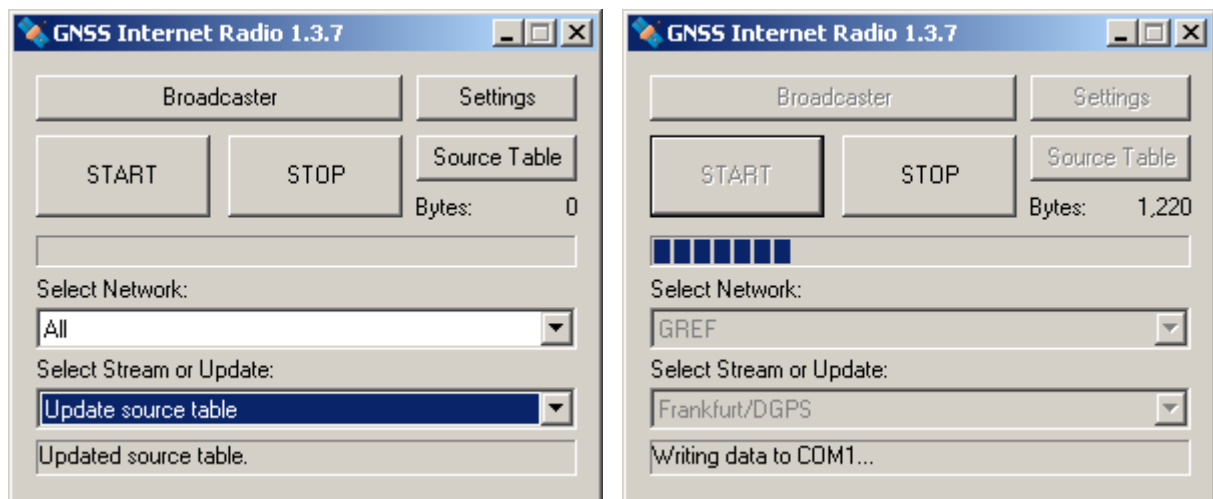
## 2. NtripClient

NtripClients access data streams of desired NtripSources on the NtripCaster. They are acting as HTTP client programs.

### 2.1. GNSS Internet Radio (Windows Desktop)

The “GNSS Internet Radio” is designed to run on a PC/Laptop (Windows 98/00/XP). It may feed a GNSS receiver which is connected via serial port (COM-port) to the PC/Laptop. The data stream is received from an NtripCaster. The program will handle the HTTP communication and transfer the received GNSS data e.g. to the serial port. After setting up the session parameters and pressing the start button, the software connects to the desired NtripCaster and writes the received GNSS data stream e.g. to the serial port until the session is stopped.

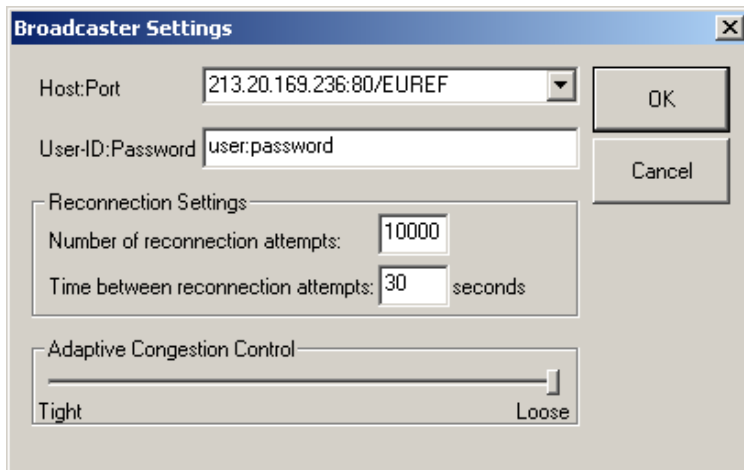
The basic start window is shown in Fig. 6. The program keeps a local file of the last session parameters (IP/port, username:password, COM-port settings, source-table etc.). As at first time use no recorded session parameters are available, they have to be set by the user (left). The source-table will be automatically received from the NtripCaster when sending the first request message.



**Fig. 6: GNSSInternetRadio Window**

Broadcaster IP and Port, user-ID and password as well as reconnection settings are entered through the “Broadcaster Settings” windows (see Fig. 7). The administrator of the NtripCaster provides the necessary user-ID and the password. They are generally associated to the usage of one specific data stream, but access to networks of data streams or even all data streams available from an NtripCaster can also be allowed through one single password.

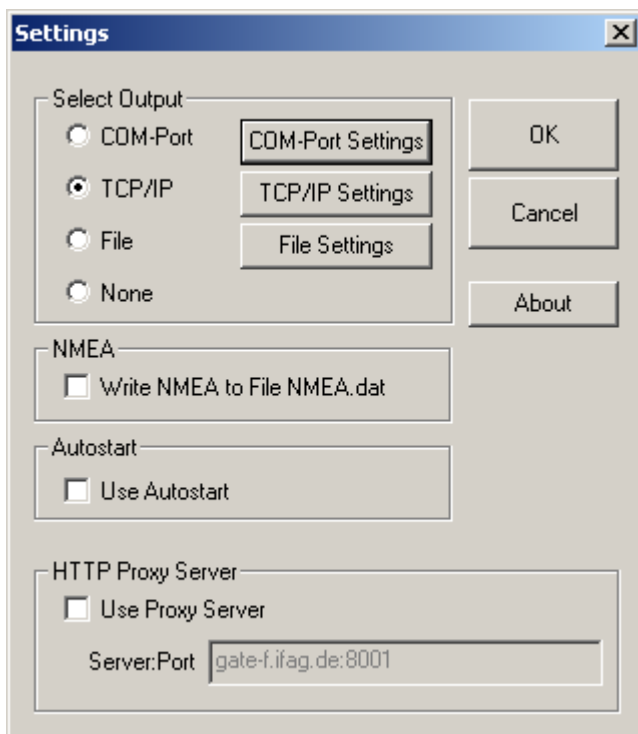
An adjustable “Adaptive Congestion Control” button allows controlling network congestions. In a congestion situation, the time span to identify and then reconnect a broken link will vary between 20 seconds (for “Loose”) and 5 seconds (for “Tight”).



**Fig. 7: GNSSInternetRadio Broadcaster Settings Window**

The "Settings" window enables the user to select an output option. The options available are COM-Port, TCP/IP, File, or None (see Fig. 8). When using a proxyserver, its IP and port number can be introduced as well in this window.

Although the "GNSSInternetRadio" can be used within a proxy-protected Local Area Network (LAN), users may still experience a blocked communication. This can especially happen if a combination of firewall, proxyserver, virus scanner etc. is in front. A work-around can be either to establish a TCP-relay (proxyserver - NtripCaster, to be arranged by a LAN administrator) or to access the Internet via an ISP.



**Fig. 8: GNSSInternetRadio Settings Window**

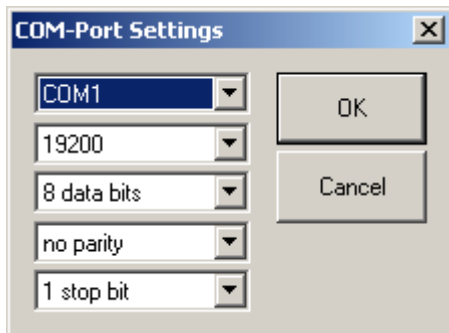
The "GNSS Internet Radio" supports the Virtual Reference Station (VRS) concept. This means that a specific data stream is generated based on an approximate position send by the "GNSS Internet Radio" in NMEA format to the NtripCaster. Preconditions for working in the VRS mode are:

- a) The GPS receiver is connected with the computer via COM port and sends your approximate position information in NMEA-GGA format to the “GNSS Internet Radio”.
- b) The Broadcaster used is capable of reading and handling NMEA from then “GNSS Internet Radio” for subsequent provision of a VRS data stream for the approximate position.

Independent from whether or not using a data stream and NtripCaster supporting the VRS mode, most GNSS receivers can be configured to make obtained position information available in NMEA format. As long as the same serial (COM port) connection between the “GNSS Internet Radio” and the GNSS receiver is used for both communicating RTCM corrections and NMEA messages, these messages can be saved in a file named “NMEA.dat“. Activate the “Write NMEA to File NMEA.dat” option in case you want to do this.

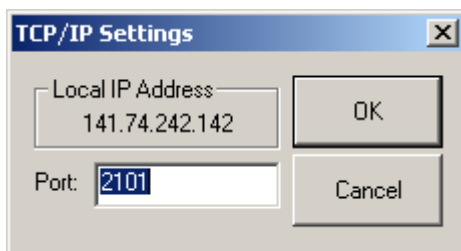
The “Settings” windows offers a “Use Autostart” option. If this option is activated and a link to the “GNSS Internet Radio” exists in the “Autostart” directory of the Windows Operating System, the program will automatically start running after a system reboot.

Details defining the COM-port communication are to be entered through the “COM-port Settings” window (see Fig. 9). The usage of a high baud-rate is recommended (e.g. 19200) if supported by hardware and software.



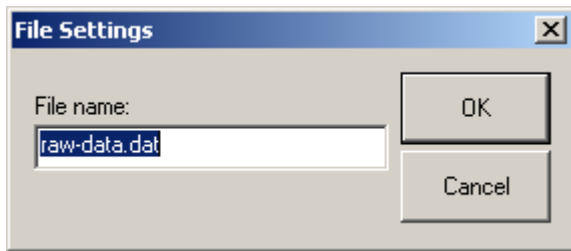
**Fig. 9: GNSSInternetRadio COM-Port Settings Window**

A port number can be defined through the “TCP/IP Settings” window when choosing the TCP/IP output option (see Fig. 10). Note that other programs running on the same host as the “GNSS Internet Radio” can access the data stream via the Local IP Address 127.0.0.1.



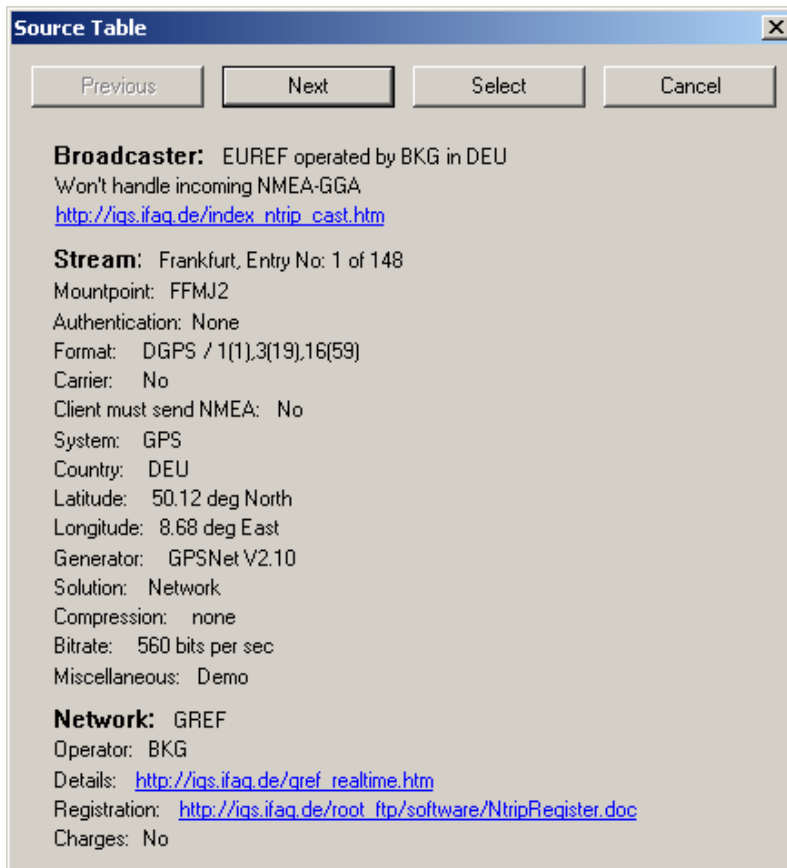
**Fig. 10: GNSSInternetRadio TCP/IP Settings Window**

Received data may be written into a file. The “File Settings” window enables the user to define a file name (see Fig. 11).



**Fig. 11: GNSSInternetRadio File Settings Window**

Details of data streams are available from the “Source Table” windows (see Fig. 12). Information is displayed about the NtripCaster, the data format provided and the network operating and providing the stream. A Web address or an e-mail address is given for background information or registration purposes.



**Fig. 12: GNSSInternetRadio Source-Table Window**

Note that this example NtripClient implementation is currently an experimental software. The BKG disclaims any liability nor responsibility to any person or entity with respect to any loss or damage caused, or alleged to be caused, directly or indirectly by the use and application of the Ntrip technology (see Fig. 13).



**Fig. 13: About GNSSInternetRadio & Copyright**

## 2.2. GNSS Internet Radio (Windows CE)

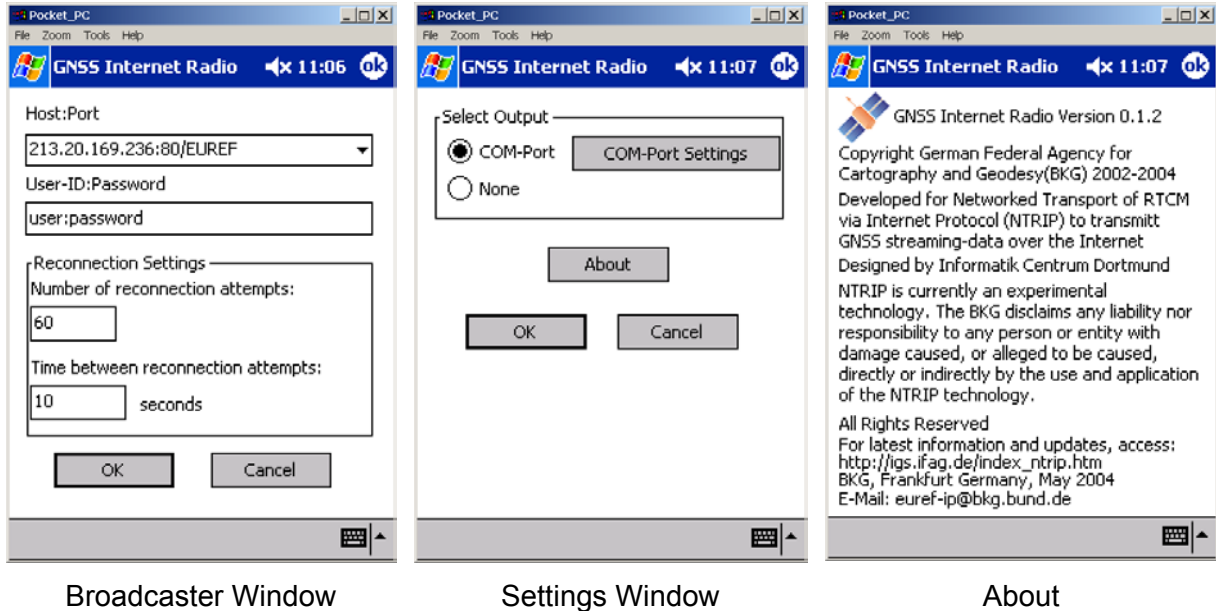
The “GNSSInternetRadio CE” is an NtripClient designed to run on a PDA under Microsoft Windows CE operating systems. It receives data streams from the NtripCaster. The program handles the HTTP communication and transfers received GNSS data e.g. to the serial port.



**Fig. 14: GNSSInternetRadio CE on Pocket PC**

The basic start window is shown in Fig. 14. The program keeps a local file “GNSS.ini” of the last session parameters (username:password, com-port settings, etc). As at first time use no recorded session parameters are available, they have to be set by the user. A file “sourcetable.dat” is maintained as received from the NtripCaster. It contains general caster, network and data stream information.

Broadcaster IP and Port, user-ID and password as well as reconnection settings are entered through the “Broadcaster” windows. The administrator of the NtripCaster provides the client user ID and password. The “Settings” window enables the user to choose an output option. The options available today are COM-Port and None. Details defining the COM-Port communication are to be entered through the “COM-Port Settings” window. The usage of a high baud-rate is recommended (e.g. 19200) if supported by hardware and software.



**Fig. 15: GNSSInternetRadio CE Screenshots**

The “GNSSInternetRadio CE” has been compiled for and tested on the Operating System Windows CE 3.0 (PocketPC 2000) on Compaq iPAQ models 3760 and 3970 with Intel PXA processor. Compatibility with other PDA’s mainly depends on the Operating System as well as on the processor in use. There is a good chance to get the “GNSS Internet Radio” running on other PDA’s with PocketPC 2002 or PocketPC 2003 Operating Systems as long as it is equipped with an Intel PXA processor.

So far the “GNSSInternetRadio CE” is not able to handle NMEA messages.

### 3. NtripCaster

The NtripCaster (LINUX) as the central software component receives data streams from NtripServers as generated by NtripSources. The NtripCaster administrator is responsible for handling mountpoints for NtripSources, passwords, NtripClient access-rights, billing, statistics, etc.

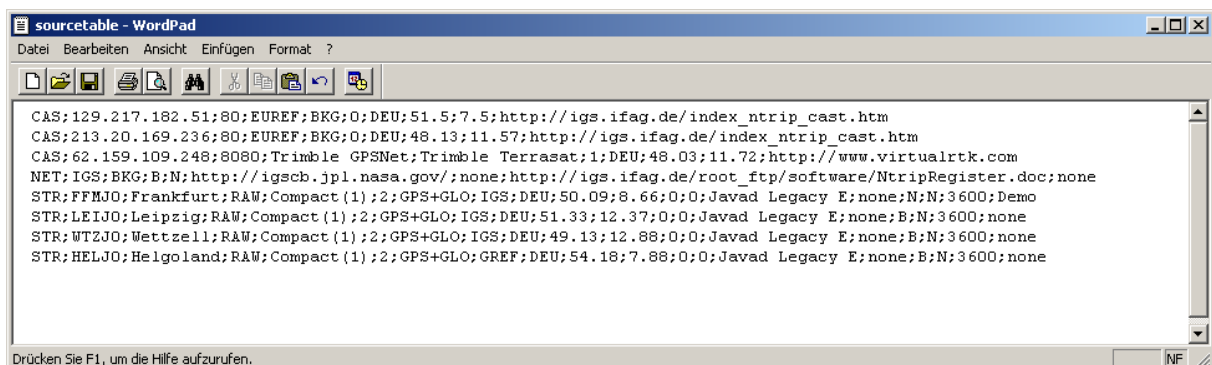
The NtripCaster is based on the **Icecast** software and developed under GNU General Public License. The purpose of Icecast is to duplicate source data for up to thousand or more simultaneously connected clients accessing up to a few hundred different sources. Network connections between source, Icecast, and clients are based on HTTP/TCP/IP. The Icecast server was originally designed to stream MP3-coded data with bit rates of 32 kbit/s up to 128kbit/s. The NtripCaster is a re-designed Icecast which supports the dissemination of GNSS data streams (GPS, GLONASS, EGNOS, WAAS etc.) with about 0.5 to 5 Kbit/s transmission rate carrying e.g.

- RTCM corrections, DGNSS,
- RTCM corrections, RTK,
- RTCA corrections, EGNOS & WAAS,
- RAW receiver data,
- SP3 ultra-rapid orbits,
- RINEX observations.

The NtripCaster does not alter the data. Two different implementation are developed, a so-called “Standard” and a “Professional” version. Both implementations follow the same concept. The Standard version has been tested with a limited number of sources and simultaneously connected clients - which may often satisfy today’s users/providers needs. The Professional version is meant for mass-usage and handles a few hundred sources for a few thousand simultaneously connected clients.

#### 3.1. Standard NtripCaster

The Standard NtripCaster (which is acting as an HTTP-server) is configured through its configuration file “ntripcaster.conf”. Information about data streams has to be made available through a source-table in file “sourcetable.dat”. An example for this file is given in Fig. 16 (see NtripDocumentation for further source-table details).



```

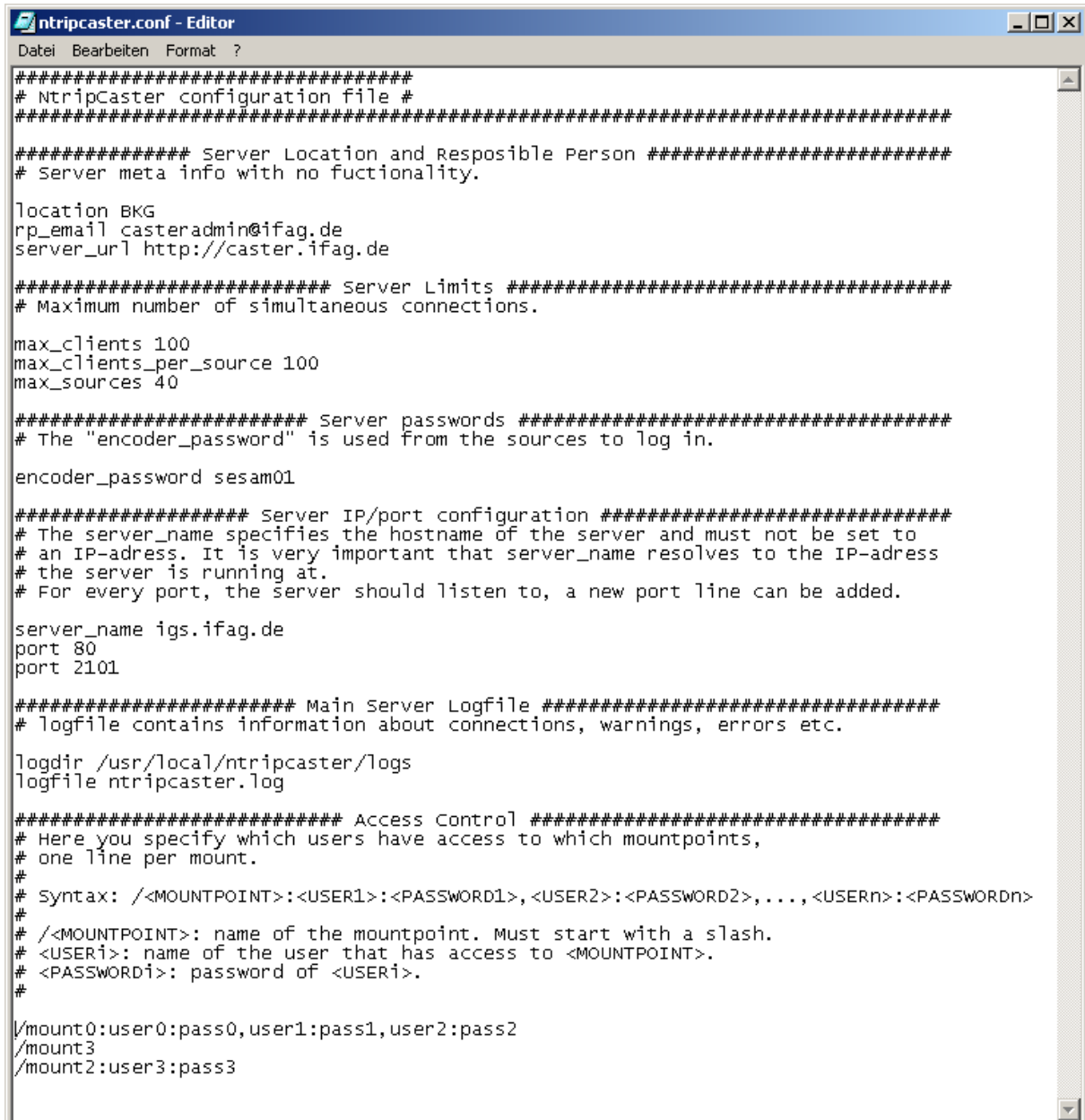
CAS;129.217.182.51;80;EUREF;BKG;0;DEU;51.5;7.5;http://igs.ifag.de/index_ntrip_cast.htm
CAS;213.20.169.236;80;EUREF;BKG;0;DEU;48.13;11.57;http://igs.ifag.de/index_ntrip_cast.htm
CAS;62.159.109.248;8080;Trimble GPSNet;Trimble Terrasat;1;DEU;48.03;11.72;http://www.virtualrtk.com
NET;IGS;BKG;B;N;http://igsch.jpl.nasa.gov//none;http://igs.ifag.de/root_ftp/software/NtripRegister.doc;none
STR;FFMJ0;Frankfurt;RAW;Compact (1);2;GPS+GLO;IGS;DEU;50.09;8.66;0;0;Javad Legacy E;none;N;N;3600;Demo
STR;LEIJO;Leipzig;RAW;Compact (1);2;GPS+GLO;IGS;DEU;51.33;12.37;0;0;Javad Legacy E;none;B;N;3600;none
STR;WTZJO;Wetzell;RAW;Compact (1);2;GPS+GLO;IGS;DEU;49.13;12.88;0;0;Javad Legacy E;none;B;N;3600;none
STR;HELJO;Helgoland;RAW;Compact (1);2;GPS+GLO;GREF;DEU;54.18;7.88;0;0;Javad Legacy E;none;B;N;3600;none

```

**Fig. 16: NtripCaster Source-Table**

The Standard NtripCaster uses a static source-table. This means that an NtripClient always receives the full content of “sourcetable.dat”, regardless of temporary outages of streams.

With the configuration file, the administrator is able to set up the maximum number of clients and sources, the password for authentication and authorization of incoming sources (encoder password) and other system parameters. Note that the maximum number of clients and sources shall not exceed the limits pre-defined in the source-code file "ntripcaster.h". The individual protection of data streams on a per user basis is possible (one line per stream/mountpoint, see section "access control" in Fig. 17).



```

#####
# NtripCaster configuration file #
#####

##### Server Location and Resposible Person #####
# Server meta info with no fuctionality.

Location BKG
rp_email casteradmin@ifag.de
server_url http://caster.ifag.de

##### Server Limits #####
# Maximum number of simultaneous connections.

max_clients 100
max_clients_per_source 100
max_sources 40

##### Server passwords #####
# The "encoder_password" is used from the sources to log in.

encoder_password sesam01

##### Server IP/port configuration #####
# The server_name specifies the hostname of the server and must not be set to
# an IP-adress. It is very important that server_name resolves to the IP-adress
# the server is running at.
# For every port, the server should listen to, a new port line can be added.

server_name igs.ifag.de
port 80
port 2101

##### Main Server Logfile #####
# logfile contains information about connections, warnings, errors etc.

logdir /usr/local/ntripcaster/logs
logfile ntripcaster.log

##### Access Control #####
# Here you specify which users have access to which mountpoints,
# one line per mount.
#
# Syntax: /<MOUNTPOINT>:<USER1>:<PASSWORD1>,<USER2>:<PASSWORD2>,...,<USERn>:<PASSWORDn>
#
# /<MOUNTPOINT>: name of the mountpoint. Must start with a slash.
# <USERi>: name of the user that has access to <MOUNTPOINT>.
# <PASSWORDi>: password of <USERi>.
#

/mount0:user0:pass0,user1:pass1,user2:pass2
/mount3
/mount2:user3:pass3

```

**Fig. 17: Standard NtripCaster Configuration File**

Accounting information is saved in a log file. The Standard version of the NtripCaster needs to be re-started whenever a change of "ntripcaster.conf" or "sourcetable.dat" shall become active.

## 3.2. Professional NtripCaster

The Professional NtripCaster can be accessed by a remote administrator using the same port (listening port) as NtripServers and NtripClients. This feature is important for running it in a professional manner, especially in an international context like EUREF where several wide-spread administrators may operate the software simultaneously under remote control. The Professional NtripCaster provides an administration console restricted to exclusive persons [admin password]. This can be accessed by Telnet. In addition, status inquiries are possible by using the NtripCaster's Web Interface through an Internet browser. This enables a remote control of the Professional NtripCaster independent from its physical location. An NtripCaster hosted within the premises of an Internet Service Provider (ISP) might be administrated by a person located at a completely different place. The administration functionality allows to organize the available GNSS data streams, set aliases, allow or deny clients (e.g. only accept clients from a specific country), kicking out connections to sources, clients or admins, view real-time statistics (all clients, sources) etc.

To limit network costs, which usually depend on the transferred data volume, the administrator can restrict the number  $N$  of simultaneous client connections (e.g.  $N_{\max}=1000$ ). Note that the maximum number of clients as well as the maximum number of sources shall not exceed the limits pre-defined in the source-code file "ntripcaster.h". The Professional NtripCaster comes with a built-in bandwidth-measuring tool. If a certain bandwidth limit (e.g. 1 MB/s) is reached, no further clients will be accepted until the required bandwidth falls below the specified limit. The Professional NtripCaster is able to connect to GNSS data streams on a different NtripCaster and present itself as an NtripServer. This allows e.g. the installation of a European network of NtripCasters. Therefore, Italian GNSS data streams could be made accessible via a German server, or German GNSS data streams can be made accessible via an Italian server.

The Professional NtripCaster is configured through its configuration file "ntripcaster.conf" (Fig. 18) and needs a source-table file "sourcetable.dat" (see NtripDocumentation for source-table details). The configuration file defines its behavior as an HTTP-server. The administrator may set up the maximum number of clients and sources, the overall throughput, an encoder password for sources, passwords for admins, access, major system parameters and more. The ntripcaster.conf and sourcetable.dat files can be edited on a local administrator PC (Windows or Unix) and uploaded to the Professional NtripCaster via an FTP connection.

```
#####
# NtripCaster configuration file #
#####
# If not stated otherwise, you can change these settings while the server is
# running through the admin console or by editing this file and using the
# <rehash> command.

##### Server Location and Responsible Person #####
# Server meta info with no functionality.

location Federal Agency for Cartography and Geodesy
rp_email euref-ip@bkg.bund.de
server_url http://igs.ifag.de

##### Server Limits #####
# Maximum number of simultaneous connections and maximum bandwidth in KB/s
# (throttle) (!!! no exact measurement !!!).

max_clients 2000
max_clients_per_source 1000
max_sources 200
max_admins 10
throttle 2000.0

##### Server passwords #####
```

```

encoder password itsme1
admin password itsme2
oper password itsme3

##### Server IP/port configuration #####
# These settings cannot be changed after once having started the server.
# If a hostname is specified, NtripCaster will listen on only this IP,
# otherwise on all available interfaces, i.e. INADDR ANY.
# The server name specifies the hostname of the server and must not be set to
# an IP-address. It is very important that server_name resolves to the IP-address
# the server is running at.
# For every port, the server should listen to, a new port line can be added.

#hostname IP
port 80
port 2101
server_name igs.ifag.de

##### Aliases (including virtual host support) #####
# With aliases relay streams from other servers can be mounted automatically
# on startup and connected on demand.
# usage: alias (/local mountpoint) http://(IP):(port)/(mountpoint)
#         [(username:password)]

alias /PASS0 http://129.217.182.51:2101/PASS0 user123:r2d2

##### Relays #####
# To connect to other NtripCaster's source streams at startup time. No on demand
# functionality. Argument 'pull' must be omitted.

# relay -i user456:passwd -m /TITZ0 129.217.182.51:2101/TITZ0
# relay -i user456:passwd -m /FFMJ1 129.217.182.51:2101/FFMJ1

##### Main Server Logfiles #####
# These settings can be changed by using the <rehash> command.
# logfile contains information about connections, warnings, errors etc.
# accessfile contains information about all connects and disconnects.
# usagefile contains information about bandwidth and usage.
# logfiledebuglevel is the debugging level for all output to the main logfile.

logfile ntripcaster.log
accessfile access.log
usagefile usage.log
logfiledebuglevel 0

##### Templates #####
# The place, where the HTML-template-files reside the server uses for output.
# An absolute path should be used.

templatedir /usr/local/ntripcaster/templates

##### Statistics #####
# The place and the frequency the server logs the statistics.
# For stats time the value x
# = 0 means: no statistics will be logged
# > 0 means: write statistics every x seconds to the file specified by stats_log

logdir /usr/local/ntripcaster/logs
stats log stats.log
statshtml log stats.html
stats_time 60

##### Console mode #####
# 0: stdin is to become a local admin console with log tailing (default)
# 1: stdin is to become a local admin console
# 2: console is to become a log window
# 3: the server is to be launched in the background (not available for Win32)

console_mode 3

##### Reverse Lookups #####
# 0: no reverse lookups
# 1: use reverse lookups

reverse lookups 0

##### Access Control Lists #####
# When using the internal acl rules of the server, a policy is to be specified
# to determine how to treat connections not affected by any allow or deny rule.
# The value

```

```
# 0 means: connections, that are not allowed by any allow rule will be denied
# 1 means: connections, that are not denied by any deny rule will be allowed

acl policy 1

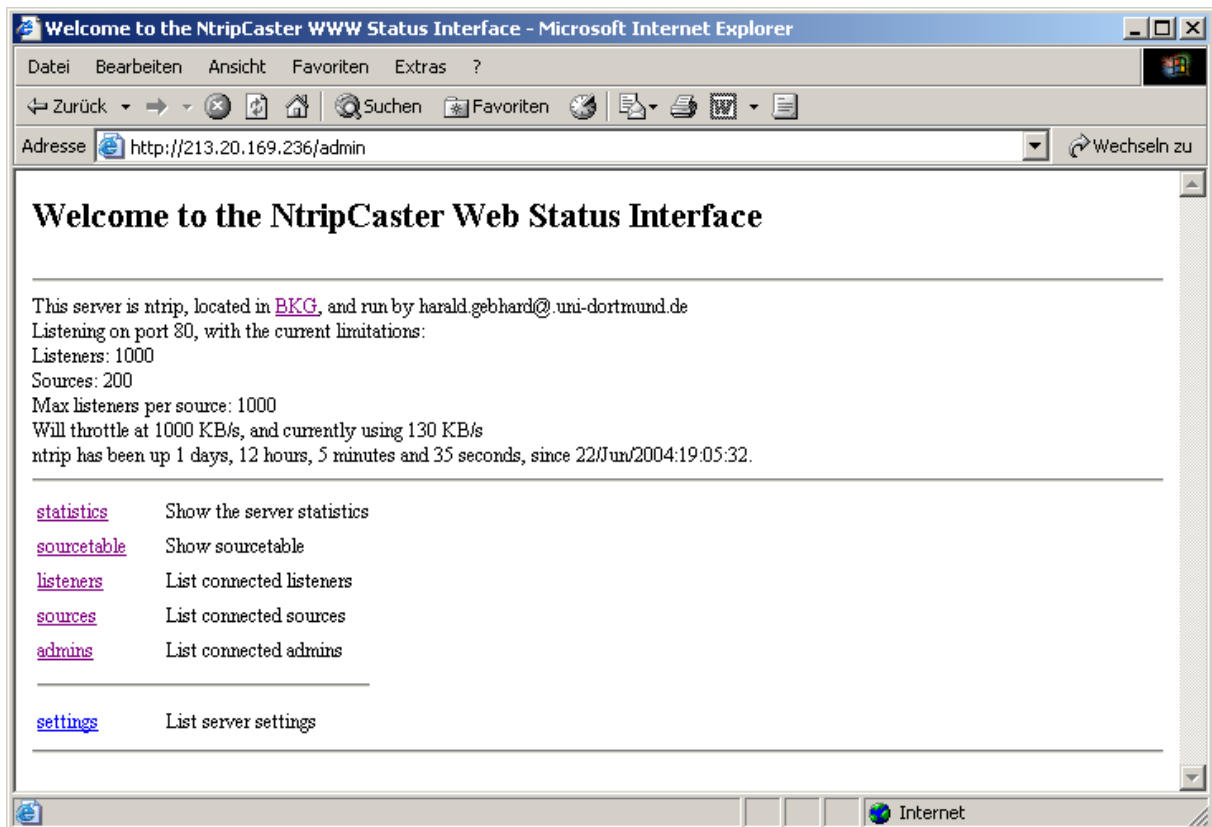
##### Other Settings #####

kick relays 10
```

**Fig. 18: Professional NtripCaster Configuration File**

### 3.2.1. Status Information

The Professional NtripCaster comes with a Web Interface. Authorized administrators (ID and password) can receive status information via a protected HTTP session (e.g. Internet Explorer). The NtripCaster Web Status Interface is shown in Fig. 19.



**Fig. 19: NtripCaster Web Status Interface**

More than one system administrator may work at the same time on the NtripCaster. Information on the administrators simultaneously logged into the system is available as shown in Fig. 20.

As shown in Fig. 21, the administrator can check and change current setting like encoder\_password, client\_password, admin\_password, max\_clients, max\_sources, max\_admins, max\_clients\_per\_source, throttle (how much bandwidth the server is allowed to use before client and source access is denied), etc.

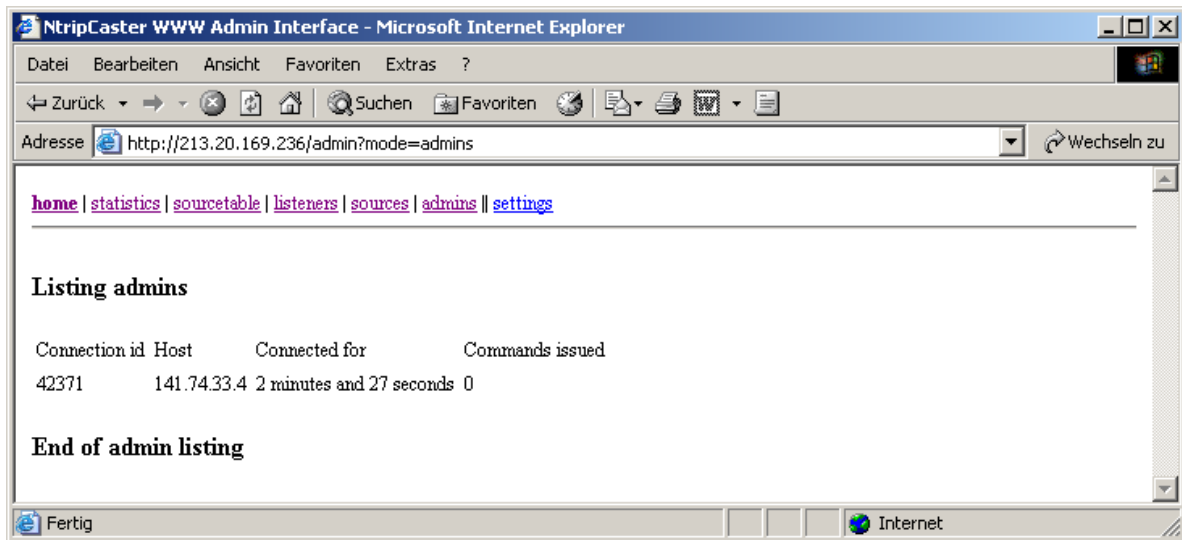


Fig. 20: NtripCaster Web Status: Admins

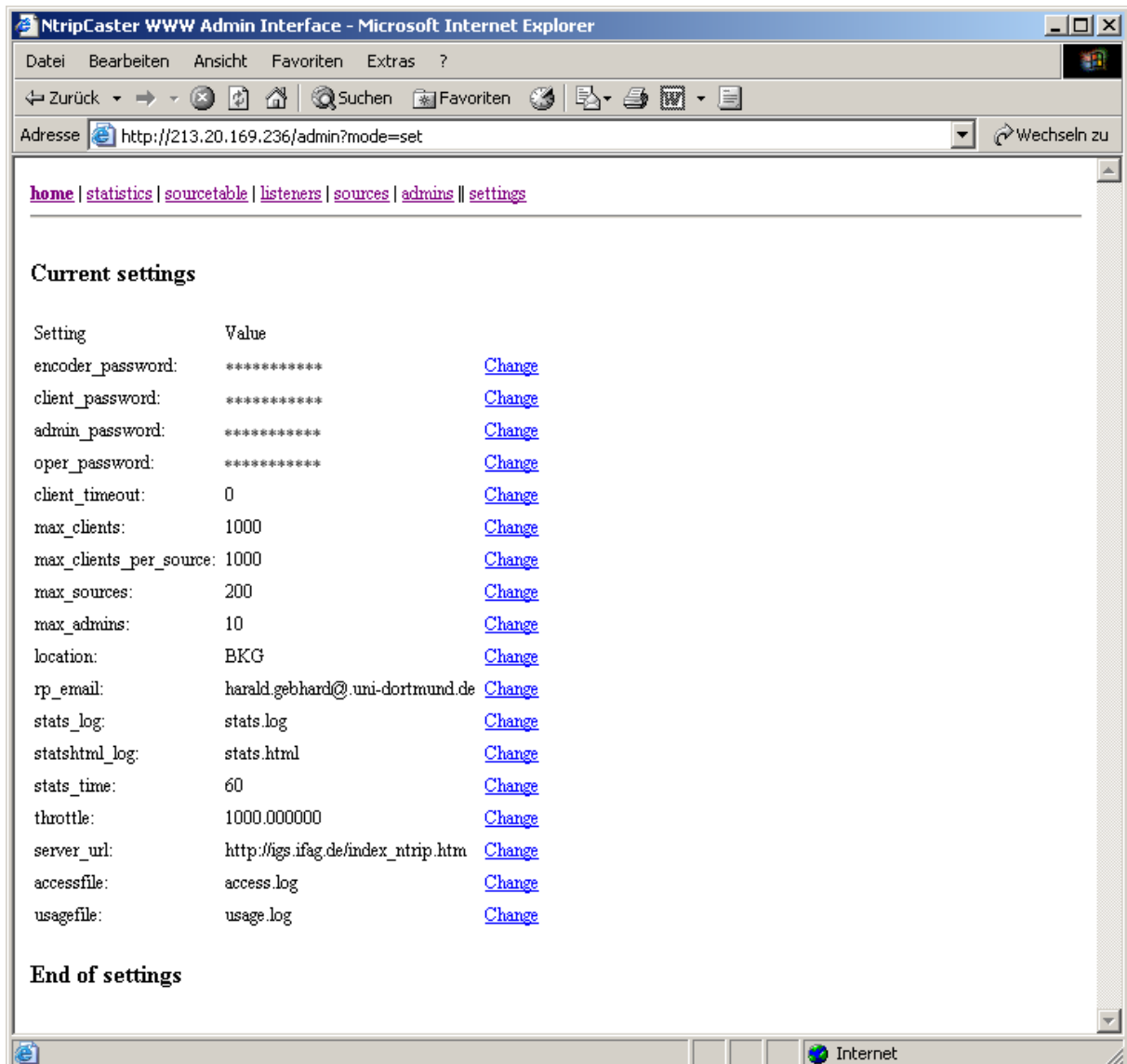
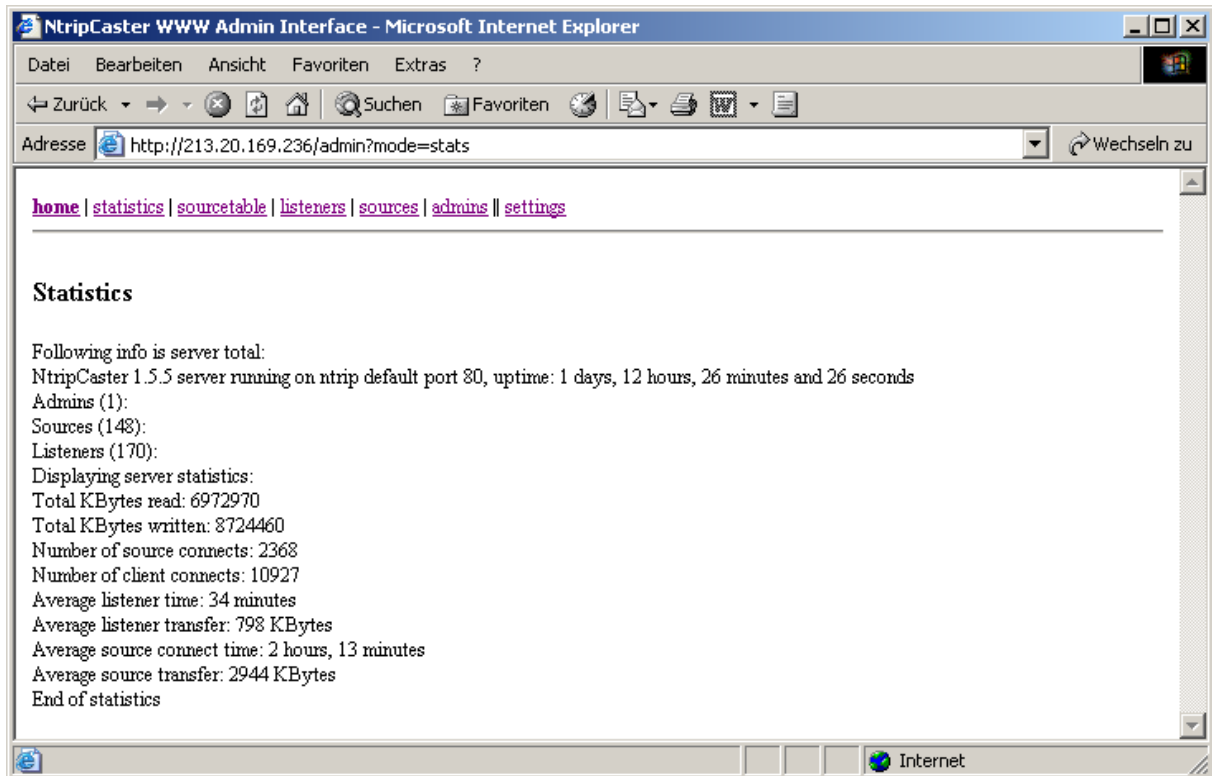


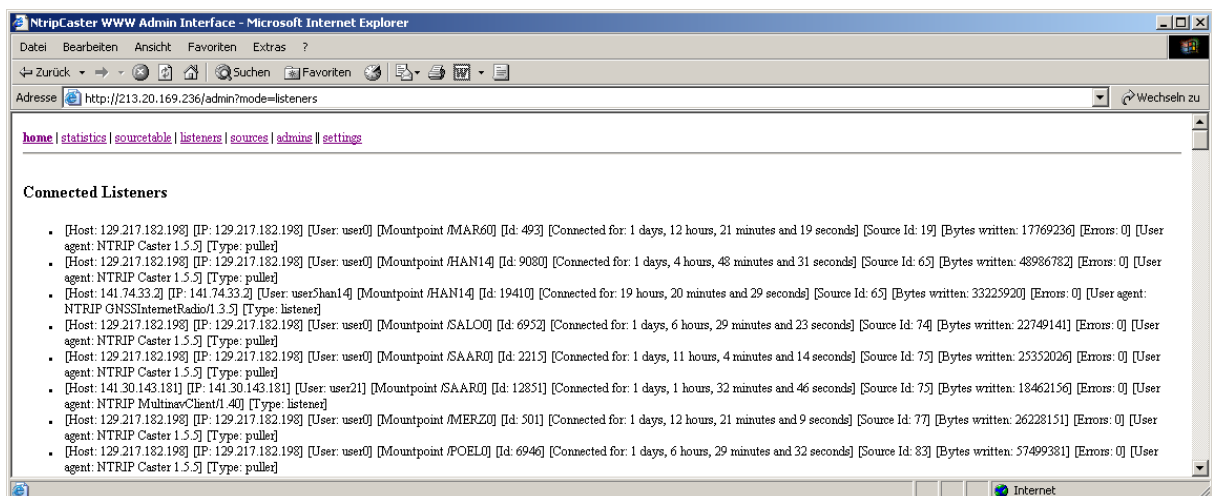
Fig. 21: NtripCaster Web Status: Settings

Statistic information can be of interest for the administrator when operating the NtripCaster. Mean values characterizing the number of users, the number of data streams, the bandwidth in use and other important parameters are available (see Fig. 22).



**Fig. 22: NtripCaster Web Status: Statistics**

The system administrator has real-time control over client parameters like listen IP, username, chosen source/mountpoint, connection time, bytes written, errors und used NtripClient (Fig. 23). This information is kept in log files for statistical or billing purposes. NtripClient usernames are only logged and displayed for password-protected mountpoints. For open mountpoints the username “null” is displayed/recorded. Unwanted users can be identified in real-time and kicked out by the administrator using the admin console command window.



**Fig. 23: NtripCaster Web Status: Listener**

The system administrator can also view all currently connected NtripSources (Fig. 24).

Mountpoint	Id	Host	Source Agent	Time of connect	IP	Clients	KBytes read	KBytes written	Client connections	Connected for
/MAR60	19	192.71.188.105	NTRIP GNSS-SurferCMD/1.0	22/01/2004 19:05:33	192.71.188.105	1	17416	17363	1	1 days, 12 hours, 29 minutes
/HAN14	65	195.82.84.106	NTRIP NtripServerCMD, Version 1.3	22/01/2004 19:05:38	195.82.84.106	2	60069	155753	14	1 days, 12 hours, 28 minutes and 55 seconds
/SALOO	74	212.88.146.98	NtripServerCMD, Version 1.0	22/01/2004 19:05:38	212.88.146.98	1	26428	26890	5	1 days, 12 hours, 28 minutes and 55 seconds
/SAAAR0	75	212.88.146.98	NtripServerCMD, Version 1.0	22/01/2004 19:05:38	212.88.146.98	2	25752	51136	5	1 days, 12 hours, 28 minutes and 55 seconds
/MERZ0	77	212.88.146.98	NtripServerCMD, Version 1.0	22/01/2004 19:05:38	212.88.146.98	1	25704	25627	1	1 days, 12 hours, 28 minutes and 55 seconds
/POELO	83	194.25.108.124	NTRIP NtripServerCMD, Version 1.2	22/01/2004 19:05:38	194.25.108.124	2	67009	78236	83	1 days, 12 hours, 28 minutes and 55 seconds
/BERG0	84	194.25.108.124	NTRIP NtripServerCMD, Version 1.2	22/01/2004 19:05:38	194.25.108.124	1	67211	78710	89	1 days, 12 hours, 28 minutes and 55 seconds
/HROSO	100	194.25.108.124	NTRIP NtripServerCMD, Version 1.2	22/01/2004 19:05:39	194.25.108.124	2	67159	78327	81	1 days, 12 hours, 28 minutes and 54 seconds
/FARM0	101	194.25.108.124	NTRIP NtripServerCMD, Version 1.2	22/01/2004 19:05:39	194.25.108.124	1	66932	77860	93	1 days, 12 hours, 28 minutes and 54 seconds
/SCHW0	102	194.25.108.124	NTRIP NtripServerCMD, Version 1.2	22/01/2004 19:05:39	194.25.108.124	1	66973	78014	82	1 days, 12 hours, 28 minutes and 54 seconds
/ATBD0	102	194.25.108.124	NTRIP NtripServerCMD, Version 1.2	22/01/2004 19:05:39	194.25.108.124	2	66056	78769	82	1 days, 12 hours, 28 minutes and 54 seconds

Fig. 24: NtripCaster Web Status: Sources

When displaying the source-table (see Fig. 25), red color indicates currently unavailable data streams.

Source-Table

- CAS:213.20.169.236:80/EUREF/BKG/DEU/48.13.11.57/http://igs.ifaag.de/index\_ntrip\_cast.htm
- CAS:80.38.104.84:80/Instituto Geografico Nacional/IGNE/ESP/40.4.3.7/http://www.ign.es
- CAS:193.224.183.67:2101/SGO/FOMI/HUN/47.79.19.27/http://www.sgo.fomi.hu
- CAS:paster.fg.fi:80/Nordic-Diff/FGI/FIN/60.10.24.50/http://www.fgi.fi
- CAS:141.74.33.11:80/EGNOS-WAAS/BKG/DEU/50.12.8.69/http://igs.ifaag.de/index\_ntrip\_cast.htm
- CAS:193.2.110.249:8080/Geodetski Institut Slovenije/Geodetska Uprava/SVN/46.06.14.51/http://www.geod-is.si
- CAS:pipeline.gps.caltech.edu:20/SCIGN/Southern California Integrated GPS Network/USA/34.13.241.88/http://www.scign.org
- CAS:129.217.132.51:80/ICD/BKG/DEU/50.12.8.68/http://igs.ifaag.de/index\_ntrip\_cast.htm
- CAS:62.154.166.171:8080/Trimble/GPSNet/Trimble/Texas/1.DEU/48.03.11.72/http://www.virtuairtk.com
- CAS:195.145.245.203:8040/SAPOS/THR/TLV/Verma/1.DEU/51.0.11.0/http://sapos.thuemgen.de
- CAS:sapos.hrv.hessen.de:8080/LVA/Hessen/LVA/Hessen/DEU/50.80.90/http://sapos.hrv.hessen.de
- CAS:62.134.61.201:8080/SAPOS/Bayern/BLVA/1.DEU/48.50.11.50/http://sapos.bayern.de
- CAS:193.5.216.58:8080/SWIPOS-GPSNet/swisstopo.1.CHE/46.90.7.50/http://www.swisstopo.ch/de/geoswipos.htm
- CAS:217.74.214.75:9000/GPSNet/Denmark/Trinble Center Denmark/1.DNK/55.73.12.37/http://www.GPSNet.dk
- NET:EUREF/EUREF.B.N/http://www.epncb.oma.be/eueref\_IP/http://www.epncb.oma.be/organisation/projects/eueref\_IP/NtripRegister.html:none
- NET:JGS/BKG.B.N/http://igsb.jpl.nasa.gov/none/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:GREF/BKG.B.N/http://igs.ifaag.de/gref\_realtime.htm/http://igs.ifaag.de/rootftp/misc/ntrip/streamlist.htm/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:asos/Rubergs.AG.B.N/http://www.asos.de/none/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:SAPOS-THR/LVA.Thuemgen.B.N/http://www.thuemgen.de/de/vermessung/SAPOS/none/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:SAPOS-BLN/Berliner Senatsverwaltung.B.N/http://www.stadtenwicklung.berlin.de/geoinformation/sapos/none/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:SAPOS-SAR/Landesamt fuer Kataster, Vermessungs- und Kartenwesen Saarland.B.N/http://www.lkv.saarland.de/9724\_11211.htm/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:SAPOS-MVP/Landesvermessungsamt Mecklenburg-Vorpommern.B.N/http://www.lvema-nv.de/SAPOS.htm/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:SCIGN/JGS.B.N/http://www.scign.org/none/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:SCIGN-OCRT/SOPAC/CSRC.B.N/http://www.scign.org/none/ybook@ucsd.edu/none
- NET:COORS/NGS.B.N/http://www.ngs.noaa.gov/COORS/http://igs.ifaag.de/rootftp/misc/ntrip/streamlist.htm/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:Misc/BKG.B.N/http://igs.ifaag.de/rootftp/misc/ntrip/streamlist.htm/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:EGNOS/BKG.B.N/http://igs.ifaag.de/rootftp/misc/ntrip/streamlist.htm/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- NET:OmniSTAR/BKG.B.N/http://www.omnistar.nl/graphs.asp/http://www.omnistar.nl/purchase.asp,Test and Evaluation only
- NET:Test/BKG.B.N/http://igs.ifaag.de/rootftp/misc/ntrip/streamlist.htm/http://igs.ifaag.de/rootftp/software/NtripRegister.doc:none
- STR:FFM12/Frankfurt.RTCM 2.1.1(1),3(19),16(59),0/GPS/GREF/DEU/50.12.8.68/0/GPSNet V2.10:none,N,N,3600/Demo
- STR:FFM11/Frankfurt.RTCM 2.2.3(19),16(59),18(1),19(1),2/GPS/GREF/DEU/50.09.8.66/0/GPSNet V1.9:none,N,N,2800/Demo
- STR:FFM10/Frankfurt.RTCM 2.0.1(3),2(90),3(90),16(90),0/GPS/Misc/DEU/50.09.8.66/0/Trimble 4000SSI:none,N,N,190,ALF Demo
- STR:CONZ0/Concepcion-TIGO/RAW/Compact(1),2/GPS+GLO/JGS/CHL/36.84.286.98/0/Javad Legacy E:none,B,N,3600:none
- STR:FFM10/Frankfurt.RAW/Compact(1),2/GPS+GLO/JGS/DEU/50.09.8.66/0/Javad Legacy E:none,N,N,3600/Demo
- STR:LEU01/Leipzig.RAW/Compact(1),2/GPS+GLO/JGS/DEU/51.33.12.37/0/Javad Legacy E:none,B,N,3600:none
- STR:WTZ01/Wetzell.RAW/Compact(1),2/GPS+GLO/JGS/DEU/49.13.12.88/0/Javad Legacy E:none,B,N,3600:none
- STR:HELJ0/Helgoland.RAW/Compact(1),2/GPS+GLO/GREF/DEU/54.18.7.88/0/Javad Legacy E:none,B,N,3600:none
- STR:TITZ0/Titz.RAW/Compact(1),2/GPS+GLO/JGS/DEU/51.00.6.42/0/Javad Legacy E:none,B,N,3600:none
- STR:GORL0/Gorleben.RAW/Compact(1),2/GPS+GLO/JGS/DEU/52.99.11.31/0/Javad Legacy E:none,B,N,3600:none
- STR:HOER0/Hoerum.RAW/Compact(1),2/GPS+GLO/JGS/DEU/54.76.8.29/0/Javad Legacy E:none,B,N,3600:none
- STR:HOLT0/Holltau.RAW/Compact(1),2/GPS+GLO/JGS/DEU/54.37.10.16/0/Javad Legacy E:none,B,N,3600:none

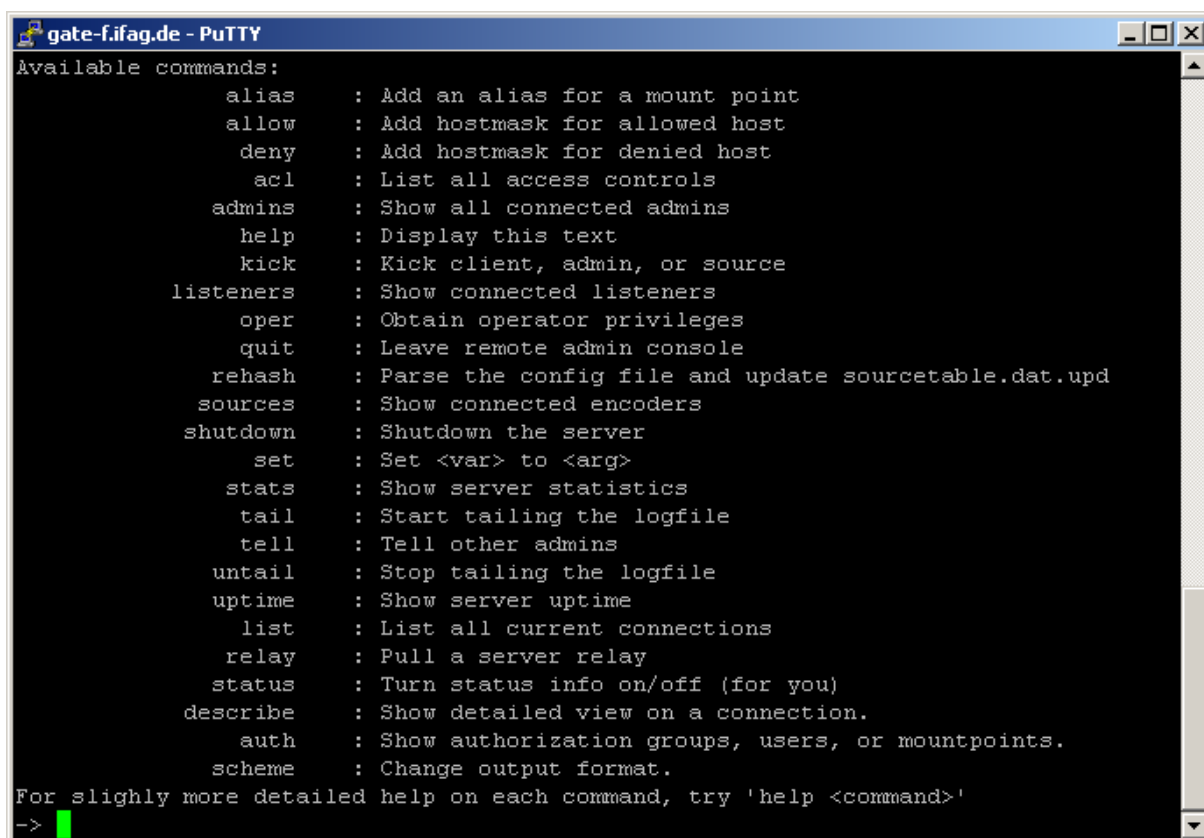
Fig. 25: NtripCaster Web Status: Source-Table

### 3.2.2. Administration

The Professional NtripCaster can be remote controlled via the admin console. To access the admin console, a password-protected telnet connection (e.g. through communications/ listening port 80 or ports 80 and 2101) can be used. After connecting, no prompt will be displayed. Then 'ADMIN [admin password]' followed by two new lines (press enter twice) has to be entered. Substitute [admin password] by the administrator password set in "ntripcast.conf" or enter it as an NtripCaster command line parameter (see following example).

```
telnet euref-ip.ifag.de 80
ADMIN adm1npa55
Return
Return
```

The admin console command window is shown in Fig. 26.



```
gate-f.ifag.de - PuTTY
Available commands:
    alias      : Add an alias for a mount point
    allow      : Add hostmask for allowed host
    deny       : Add hostmask for denied host
    acl        : List all access controls
    admins     : Show all connected admins
    help       : Display this text
    kick       : Kick client, admin, or source
    listeners  : Show connected listeners
    oper       : Obtain operator privileges
    quit       : Leave remote admin console
    rehash     : Parse the config file and update sourcetable.dat.upd
    sources    : Show connected encoders
    shutdown   : Shutdown the server
    set        : Set <var> to <arg>
    stats      : Show server statistics
    tail       : Start tailing the logfile
    tell       : Tell other admins
    untail     : Stop tailing the logfile
    uptime    : Show server uptime
    list       : List all current connections
    relay      : Pull a server relay
    status     : Turn status info on/off (for you)
    describe  : Show detailed view on a connection.
    auth       : Show authorization groups, users, or mountpoints.
    scheme     : Change output format.
For slightly more detailed help on each command, try 'help <command>'
->
```

Fig. 26: NtripCaster Administration Console

The admin console defines following basic commands [*Icecast 1.3.11, Manual*, <http://www.icecast.org>, 2002]:

**alias**

---

The alias command is used for two things. It can be used to add an alias for a local mountpoint so that a stream can be accessed from two mountpoints. Or it can be used to add an alias for a remote NtripCaster stream.

Syntax:

```
alias add <mountpoint> <newmountpoint>
alias del <mountpoint>
alias list
```

**allow and deny**

---

This adds a hostmask to an internal access lists (acl). It specifies that this hostmask should allow or deny access. A type for this acl can be specified, which can be either all, client, source or admin. It only has affect on the specified connection type.

Syntax:

```
allow|deny <client|source|admin|all> add <hostmask>
allow|deny <client|source|admin|all> del <hostmask>
allow|deny <client|source|admin|all> list
```

Examples:

```
allow client add *.se
allow all del *.netcom.com
deny admin add *.se
deny admin del ap.*.com
allow admin list
```

**admins**

---

The „admins“ command is used to list the admins connected to the server. It will display one admin connection per line, like:

```
Admin 341 <d66.ryd.student.liu.se> connected for 1 hours, 8 minutes and 14 seconds. 0
commands issued
```

A host-mask as an argument can be supplied, and only the admins who match the mask, will be shown.

Syntax:

```
admins [hostmask]
```

Example:

```
admins *.ifag.de
```

**dump**

---

This command can be used to dump a connected stream to a file on disk.

If the filename specified is „close“, then the file will be closed.

Syntax:

```
dump <source id> <filename|close>
```

Example:

dump 230 /tmp/stream.rpcm

## **help**

---

Without arguments, the command „help“ prints a list of all commands and what they are used for. With a command as an argument, a slightly longer description of what the command does, is printed.

Syntax:

```
help [command]
```

Examples:

```
help kick  
help
```

## **kick**

---

This command can be used to get rid of some listeners, admins, or sources. A single connection may be kicked out as well as all connections of a certain type matching a hostmask.

Syntax:

```
kick <id>  
kick <-acs> <hostmask>  
kick <hostmask>
```

Examples:

```
kick 314  
kick -a *.com  
kick *.badsouce.com
```

## **listeners**

---

This command displays a list of all connected listeners. The output can be restricted to those listeners matching a specific hostmask.

Syntax:

```
listeners [hostmask]
```

Example:

```
listeners *.ifag.de
```

## **oper**

---

Most commands on the admin console are restricted to NtripCaster operators. To obtain operator privileges, the „oper“ command with the NtripCaster operator password as argument can be used.

Syntax:

```
oper <operator password>
```

Example:

```
oper cooloperpass
```

## **pause**

---

The data flow to a client or from a source can be cut with this command.

Syntax:

pause <client or source id>

Example:

pause 314

## **quit**

---

The „quit“ command is used to leave the NtripCaster admin console. This can only be used, when the console is accessed through the remote interface (e.g. using telnet). An optional argument will be used as a signoff message, e.g. displayed to other connected admins.

Syntax:

quit [message]

Example:

quit Bye Bye

## **rehash**

---

This command can be used after changing parameters in the NtripCaster configuration file (ntripcast.conf or source-table.dat). When used with an argument, it will understand this argument as a filename and parse this as a configuration file.

Syntax:

rehash [filename]

Example:

rehash /tmp/newwrtcmast.conf

## **select**

---

„select“ is useful when a listeners should be transferred from one stream to another. It can either transfer all clients connected to source A, to source B, or all clients connected to source A matching a pattern, to source B, or just one single client with a specified id, to a new source.

Syntax:

select <-a> <source source id> <target source id>

select <client id> <target source id>

select <source source id> <hostmask> <target source id>

Examples:

select 514 23

select -a 43 23

select 23 \*.se 43

## **sources**

---

„sources“ is used just like „listeners“ to view all the connected sources. It can be used with an optional argument to limit the list to only the sources matching the specified hostmask. It also accepts a large number of options. By default the output is defined by the variable default\_sourceopts.

The options are as follows.

i - Connection id  
 s - Socket descriptor  
 t - Time of connect  
 p - Connection ip  
 h - Hostname  
 c - Connection state  
 y - Source type  
 c - Number of clients  
 d - Dumpfile  
 r - Mountpoint priority  
 M - Source mountpoint  
 R - Bytes read  
 W - Show bytes written  
 C - Total client connects  
 T - Time connected

Syntax:

```
sources [hostmask] [-options]
```

Example:

```
sources *.apan.com -aCW
```

## **shutdown**

This command is used to shutdown the server. An optional argument can be introduced which will be used as a shutdown message broadcasted to all connected admins.

Syntax:

```
shutdown [message]
```

Example:

```
shutdown caster_goes_down
```

## **set**

This command is used without arguments. „set“ will display a list of all NtripCaster variables and their current values. It can be used also to change any of those variables if the name is specified and the new value is entered as arguments. Typing „help settings“ will give a short description of all the settings, and a longer description for the settings is available here.

Syntax:

```
set  

set <variable name>  

set <variable name> <new value>
```

Examples:

```
set client_timeout  

set max_clients 580
```

## **stats**

The „stats“ command will print some information about the current number of connections, averages on client connections, bytes read and written, etc. It looks a lot like the output available from the statistics file. As an argument, „hourly“ or „daily“ can be put. Then the averages and totals for the last hour or day will be printed.

Syntax:

```
stats [hourly|daily]
```

Example:

```
stats hourly
```

### **tail**

---

The „tail“ command can be issued by an administrator to display messages written to the logfile. It's similar to the unix tail command.

Syntax:

```
tail
```

Example:

```
tail
```

### **tell**

---

An admin can send a message to all other connected admins using the „tell“ command. Any argument will be send to all admins.

Syntax:

```
tell <message>
```

Example:

```
tell new NtripSource
```

### **unpause**

---

The „unpause“ command unfreezes a client or stream previously paused with the „pause“ command.

Syntax:

```
unpause <client or source id>
```

Example:

```
unpause 314
```

### **uptime**

---

The „uptime“ command is similar to the Unix uptime command. It prints the number of days, hours, minutes and seconds the NtripCaster is up and running.

Syntax:

```
uptime
```

Example:

```
uptime
```

### **list**

---

This command is used to list all connections, sources, admins, or clients.

Syntax:

list [hostmask]

Example:

```
list *.toomanyarguments.com
```

## **relay**

---

To mount a remote stream on the NtripCaster, or to mount one of your local streams on a remote server, the „relay“ command should be used.

Syntax:

```
relay pull [-m <localmount>] <url>
```

Example:

```
relay pull ifag.de:2101/BUCU0
```

## **auth**

---

This command is used to display authorization users, mounts and groups.

Syntax:

```
auth <groups|users|mounts>
```

Example:

```
auth groups
auth users
```

### **3.3. Standard versus Professional NtripCaster**

As stated above, the general structure of both NtripCaster versions is identical. Their implementations follow the same concept. However, the following features are available only with the Professional version. They may become important in case of a professional/commercial usage of the software when hosting/housing an NtripCaster e.g. within the premises of an Internet Service Provider or computer center:

- Meant for mass-usage, handles a few hundred sources for a few thousand simultaneously connected clients
- Offers Telnet administration console and Web Interface for remote operation and control over the Internet
- Generates and maintains dynamic in addition to static source-table
- Creates log files with detailed information for accounting/billing
- Configuration “on the fly”, no shutdown and restart in case of configuration changes (interruption-free operation)
- Extended Authentication/Authorization/Accounting (AAA) mechanism, allows building of and authorization for “logical” networks of streams
- Control of simultaneous client access on a per-user-bases, user can be authorized for a single or any number of simultaneous client connections
- Relay function (puller feature), allows accessing streams from other NtripCaster installations for further dissemination (and thus setting up cascading network of NtripCasters)

- Temporary allow/deny NtripClient/NtripServer access to NtripCaster via IP address hostmask

### **3.4. Internet Connection**

Any operator of an NtripCaster has to guarantee sufficient Internet bandwidth in order to provide an uninterrupted service. The bandwidth needed depends on the number of simultaneously supported clients and the kind of data they retrieve. Two examples:

- 250 simultaneously connected RTK/RAW data users need about 1Mbit/s.
- 2500 simultaneously connected DGPS data users need also about 1Mbit/s.

The Professional NtripCaster controls the required bandwidth. It can be configured to not exceed a bandwidth limit. When reaching the limit, any further client access to the NtripCaster is denied till the number of simultaneous users drops down again.

Besides an adequate bandwidth, a continuous availability of the Internet connection is very important. In case the Internet connection is shared with other users, it is highly recommended to prioritise the real-time NtripCaster communication against none real-time applications in order to avoid temporal bottlenecks and high latencies following network congestions.

### **3.5. Hardware**

Various Linux distributions and hardware platforms may be used to run the NtripCaster example implementation. The following configuration has been tested in January 2003 and may thus be understood as one possible example.

- Server PowerEdge 1650
- Basic Server Installation Packet, Linux Redhat 7.3
- Intel® Pentium® III Processor 1,40 GHz
- Second Processor, PIII P1650
- 8x DVD-ROM
- Rack Kit for 19" Racks
- Redundant power supply (2x)
- PCI Slots - PE 1650 Riser: 2x 64 Bit/66 MHz
- 1 GB PC133 ECC SDRAM (2x 512 MB)
- 2x18 GB SCSI Hard Disc, 10.000 RPM Ultra3/160
- PERC3/DC PCI RAID Controller 128 MB
- RAID Level 1
- 2x Intel® Gigabit Ethernetadapter Onboard (10/100/1000)
- ERA - Embedded Remote Access onboard integrated

## 4. Monitoring

To establish and maintain a professional service, it is important to continuously control “single points of failure” like the NtripCaster. This means that a monitoring of NtripCaster implementations and (if possible) individual data stream is necessary.

### 4.1. Remote Networked Monitoring

To guarantee an outage detection of NtripCaster’s at a reliability level of 99 percent or even higher, a Networked Monitoring concept has been developed where the function of an Ntripcaster is controlled by at least three independent remote monitoring systems. A Linux shell script NtripMonitor has been written to do this. It simply checks whether an NtripCaster is up and running. If an outage is seen simultaneously by at least two NtripMonitor implementations, it is extremely likely that an NtripCaster problem or a problem of its Internet connection occurred. Information on detected outages is stored in a log-file that is uploaded once per day via FTP to the affected NtripCaster operator. The NtripMonitor control mechanism consists of:

- Download NtripCaster source-table once per minute
- If downloading source-table fails: NtripMonitor tries to ping the NtripCaster
- If ping to the NtripCaster fails: Pings to a series of other regional servers are tried.

Consequently, preconditions for running NtripMonitor are that:

- Ping to hosts outside the LAN housing NtripMonitor is allowed
- FTP upload is allowed
- Clock of the machine hosting NtripMonitor is synchronized
- Sendmail daemon is activated to e-mail warnings in case of critical situations.

Daily generated NtripMonitor log-files contain lines like

```
SOURCETABLE DOWNLOAD FAILED AT "MINUTE" yymmdd HH:MM
PING TO BROADCASTER FAILED AT "MINUTE" yymmdd HH:MM
```

where parameter "MINUTE" is given in minutes since begin of the year. All times refer to UTC.

Linux shell script NtripMonitor is available for NtripCaster operators on request, see Fig. 27 for its help function and usage examples.

```
[weber@gref-ip monitor]$ ./NtripMonitor -h
Version: 2.0
Usage: NtripMonitor <Local> <Remote>
Local: May be set to BKG ICD IGNE SGO FGI SCIGN
Remote: May be set to EUREF EGNOS ICD IGNE SGO FGI SCIGN
Examples: NtripMonitor BKG EUREF
          nohup ./NtripMonitor BKG EUREF 1>/dev/null 2>&1 &
[weber@gref-ip monitor]$
```

**Fig. 27: NtripMonitor Usage**

Note that NtripMonitor may simultaneously monitor more than one NtripCaster implementation e.g. through entering commands:

```
nohup ./NtripMonitor BKG EUREF 1>/dev/null 2>&1 &
nohup ./NtripMonitor BKG EGNOS 1>/dev/null 2>&1 &
```

Commands like this may also be included e.g. at the end of `/etc/rc.d/rc.local` to get script NtripMonitor running after re-booting the hosting machine.

Each `<Local>` and `<Remote>` parameter refers to a configuration section in NtripMonitor where a number of parameters are defined. For integrating additional `<Local>` or `<Remote>` definitions, the corresponding sections in NtripMonitor have to be extended.

## 4.2. Local Monitoring

In addition to the Networked Monitoring, the EUREF-IP NtripCaster operated by BKG is continuously controlled by a local monitoring system. This again consists of Linux shell scripts operated apart from the NtripCaster implementation. They are neither part of the Standard nor part of the Professional NtripCaster software but build a separate software tool meant for internal use only.

The local monitoring comprises

- availability checks carried out every minute as well as a
- daily and monthly analysis of NtripCaster log-files.

The results of the availability checks are used to:

- Control whether the NtripCaster software is up and running
- Detect individual streams outages
- Generate "Notice Advisories to Broadcaster Users" (NABU)
- Generate daily outage plots as well as daily & monthly outage tables
- Generate distribution maps of available streams/networks/casters.

The availability checks are based on source-table downloads. In case of Professional NtripCaster implementations, a comparison of static and dynamic source-tables is carried out. Note that monitoring the Standard NtripCaster does not provide individual stream outage information because this software version does not maintain a dynamic source-table.

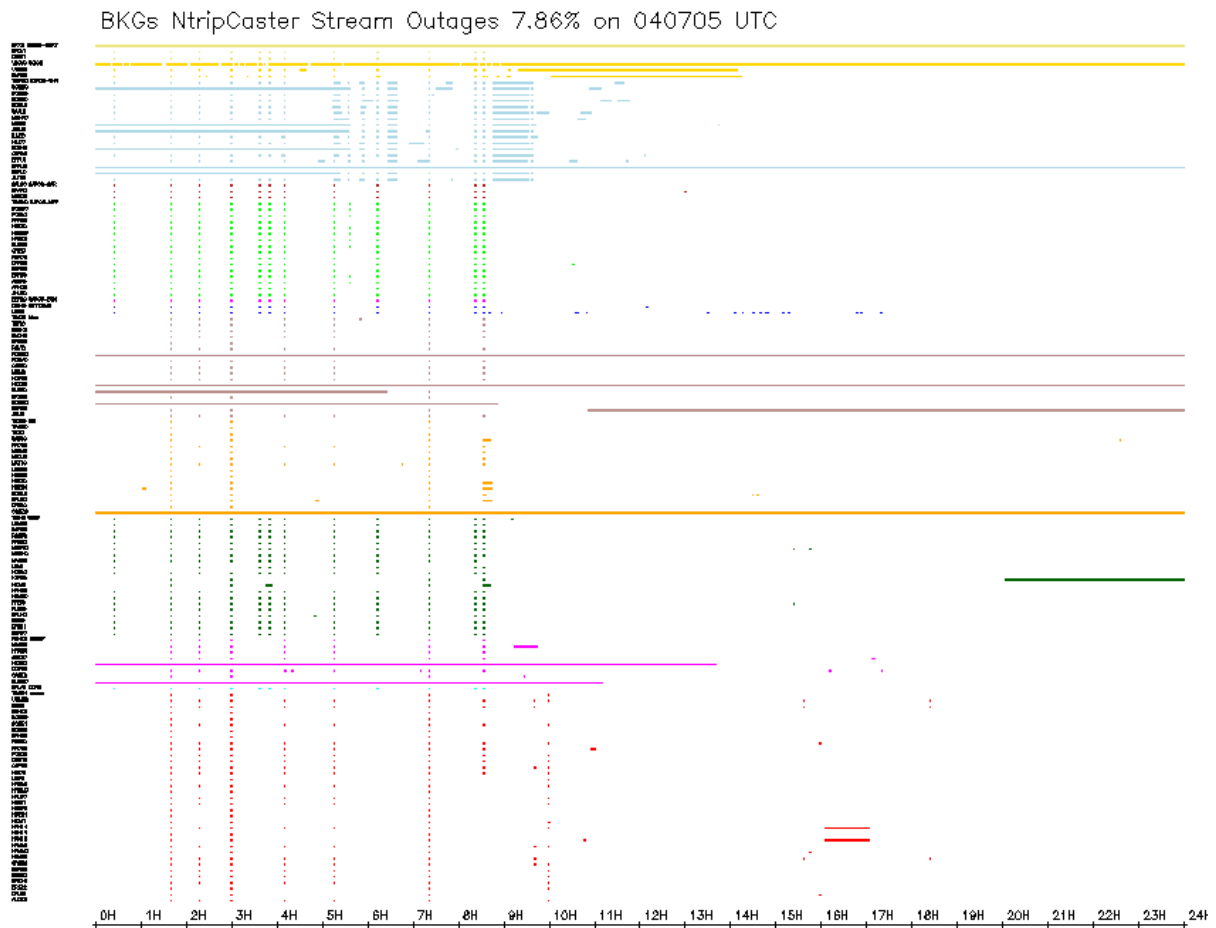
The results of the log-file analysis are used to:

- Generate statistics about the daily and monthly usage and user characteristics as seen by the NtripCaster
- Generate MS Excel files in CSV format with accounting information e.g. for billing purposes.

### 4.2.1. Stream Outages

Outages as detected by availability checks are used to generate stream outage plots. Streams that don't show up in an outage plot had no outage. Note that the outage information is based on a minute by minute check as seen by the monitoring system and not on recordings of the (Professional) NtripCaster. Stream interruptions shorter than 60 seconds as well as failures of the monitoring system or its Internet connection may leave some outages undetected. Each line in an outage plot contains unavailability information for a specific stream and is labeled by its mountpoint. Any single outage appears as a colored dot. The plots show a one minute resolution in time. Colors represent affiliations to networks of streams. All times are UTC. Fig. 28 shows an example for a daily outage plot.

In addition to individual stream outages, information on overall outages of the NtripCaster software as well as outages of its host or Internet connection is shown under the labels "SOURCETABLE" and "BROADCASTER". This information is based on results merged from remote Networked Monitoring and local monitoring.



**Fig. 28: Daily Stream Outage Plot**

Compiled outage information is used to provide daily and monthly outage statistics as shown in Fig. 29. These statistics include information on overall outages of the NtripCaster software as well as outages of the host or its Internet connection (merged from remote Networked Monitoring and local monitoring).

MONTHLY OUTAGE STATISTIC 0406 OF BKGs NTRIP EUREF-IP BROADCASTER STREAMS

BROADCASTER

-----

NTRIPCASTER HOST DOWN OR UNAVAILABLE 0.03%  
 NTRIPCASTER SOFTWARE DOWN OR UNAVAILABLE 0.17%

OUTAGE	M-POINT	STREAM-IDENTIFIER	NETWORK
0.33%	SZEK0	Szekesfehervar	Misc
0.35%	SALO0	Saarlouis	SAPOS-SAR
0.37%	MERZ0	Merzig	SAPOS-SAR
0.44%	LEIJ0	Leipzig	IGS
0.45%	HUEG1	Huegelheim	ascos
0.46%	BERL0	Berlin	SAPOS-BLN
0.50%	OMNI0	Test EA Sat	OmnISTAR
0.54%	HAMM0	Hamm	ascos
0.55%	PENC0	Penc-RT	EUREF
0.93%	PASS0	Passau	GRAF
0.94%	WTZJ0	Wettzell	IGS
1.09%	GOPE0	Praha-Ondrejov	EUREF
1.12%	MUWF0	Muenster-WF	GRAF
1.19%	STEI0	Steinbrink	ascos
1.20%	KOEL0	Koeln	GRAF
1.21%	DREJ1	Dresden	GRAF
2.84%	BRUS0	Brussels	Misc
2.88%	FFMT0	Frankfurt	Misc
2.89%	LEID0	Leidschendam	OmnISTAR

2.90%	GORL0	Gorleben	IGS
3.58%	ERLA0	Erlanger	CORS
7.65%	GVR50	Pasadena	SCIGN
7.93%	MAT10	Matera	IGS
8.53%	ERFU1	Erfurt	SAPOS-THR
9.10%	JOZ20	Jozefoslaw-Warsaw	EUREF
9.70%	ULM00	Ulm	GRAF
9.91%	BUTE0	Budapest	Misc
10.24%	KRAW0	Krakow	EUREF
10.44%	HUET0	Huethum	ascos
16.13%	PADO0	Padova	IGS
99.49%	HEER0	Heerbrugg	Misc
99.49%	STO51	LaJolla	SCIGN-OCRT

**Fig. 29: Monthly Stream Outage Statistic**

### 4.2.2. Notice Advisory to Broadcaster Users (NABU)

The monitoring system generates "Notice Advisories to Broadcaster Users" (NABU's) whenever necessary. If a data stream is unavailable for more than 15 minutes due to any reason, the monitor system creates a NABU message and sends it by e-mail to the affected stream provider, see NABU – Stream Unavailable example in Fig. 30. Each NABU carries an 8-digit NABU number. Digits 1 to 4 show the current year number whereas digits 5 to 8 contain a serial number. All NABU messages are stored in a NABU archive and could be downloaded from the Ntrip Web pages.

```
NOTICE ADVISORY TO BROADCASTER USERS (NABU) 20043551

SUBJ: GNSS REAL-TIME DATA STREAM(S) FROM EUREF-IP NTRIP BROADCASTER
      213.20.169.236 UNAVAILABLE - UNTIL FURTHER NOTICE

1. NABU TYPE: UNAVUFN
   NABU NUMBER: 20043551
   NABU DTG: 040706 10H46 UTC

2. STREAM(S) AFFECTED: 1
   ROMA0: ROMA
   START DTG: 040706 10H32 UTC
   STOP: UFN

3. CONDITION: GNSS REAL-TIME DATA STREAM(S) FROM EUREF-IP
   NTRIP BROADCASTER 213.20.169.236 UNAVAILABLE
   UNTIL FURTHER NOTICE

4. POC: BKG AT +49 69 6333-253, EUREF-IP@BKG.BUND.DE,
   http://igs.ifag.de/root_ftp/misc/ntrip
   http://igs.ifag.de/index_ntrip.htm
```

**Fig. 30: NABU - Stream Unavailable**

An additional message is sent to the affected stream providers 5 minutes after the stream becomes available again (see NABU – Stream Available example in Fig. 31).

```
NOTICE ADVISORY TO BROADCASTER USERS (NABU) 20043550

SUBJ: GNSS REAL-TIME DATA STREAM(S) FROM EUREF-IP NTRIP BROADCASTER
      213.20.169.236 AVAILABLE AFTER OUTAGE

1. NABU TYPE: AVAILAB
   NABU NUMBER: 20043550
   NABU DTG: 040706 10H07 UTC

2. STREAM(S) AFFECTED: 1
   BUCU0: BUCHAREST, REF NABU: 20043548, REF START DTG: 040706 09H01 UTC
```

3. CONDITION: GNSS REAL-TIME DATA STREAM(S) FROM EUREF-IP NTRIP BROADCASTER 213.20.169.236 AVAILABLE AFTER OUTAGE
4. POC: BKG AT +49 69 6333-253, EUREF-IP@BKG.BUND.DE,  
[http://igs.ifag.de/root\\_ftp/misc/ntrip](http://igs.ifag.de/root_ftp/misc/ntrip)  
[http://igs.ifag.de/index\\_ntrip.htm](http://igs.ifag.de/index_ntrip.htm)

**Fig. 31: NABU - Stream Available**

Further NABU types are defined to provide information on forecasted outages or general information. Templates describing them are available from the NABU archive.

### 4.2.3. NtripCaster Usage

The NtripCaster log-files provide details for generating daily and monthly usage statistics. These statistics cover information on active clients, sources, networks of sources, transfer rates, and transmitted data volumes etc., see example in Fig. 32.

```

MONTHLY USAGE STATISTIC 0406 OF BKGs NTRIP EUREF-IP BROADCASTER STREAMS
=====
NUMBER OF REGISTERED CLIENTS:           232
NUMBER OF ACTIVE CLIENTS:              91
NUMBER OF CLIENT CONNECTS:            213639

NUMBER OF REGISTERED NETWORKS:         15
NUMBER OF REGISTERED STREAMS:          159
NUMBER OF ACCESSED STREAMS:            153

TOTAL LISTENER TRANSFER (MBYTE):       153630
AVERAGE LISTENER TRANSFER (KBYTE):     719

TOTAL LISTENER TIME (H):                115015
AVERAGE LISTENER TIME (SEC):           1938

USED CLIENT SOFTWARE
-----
NTRIP Caster 1.5.5
NTRIP DLR NMTF/1.0
NTRIP DLR NMTF/1.1
NTRIP GNSMART
NTRIP GNSS-Surfer
NTRIP GNSSInternetRadio Pocket PC/0.1.2
NTRIP GNSSInternetRadio/1.3.7
NTRIP J2ME/1.3
NTRIP J2MEClient/0.1
NTRIP LinuxClient NtripLC 0.1
NTRIP MultinavClient/1.42
NTRIP NtripLinuxClient1.3
NTRIP SurveyController/10.70
NTRIP TerraSync
NTRIP WindowsClient1.0
NTRIP anonymous

```

**Fig. 32: Monthly NtripCaster Usage Statistic**

For billing purposes, daily accounting files are generated as shown in Fig. 33. These accounting files document the connection time of clients per mountpoint as well as retrieved data volumes. They refer to users ID's and thus protect personal identities for data privacy reasons.

	A	B	C	D	E	F	G	H
1	Date	Time	User	IP	Station	Client	Seconds	Bytes
2	05. Jul 04	06:05:39	user21	141.30.143.181	DREJO	NTRIP MultinavClient/1.42	57963	27358988
3	05. Jul 04	06:27:56	user183	193.8.40.126	ILMED	NTRIP WindowsClient1.0	1959	822079
4	05. Jul 04	06:33:58	user5	141.74.33.2	SYDNO	NTRIP GNSSInternetRadio/1.3.7	14	6325
5	05. Jul 04	06:34:30	user5	141.74.33.2	SYDNO	NTRIP GNSSInternetRadio/1.3.7	2	481
6	05. Jul 04	06:35:17	user5	141.74.33.2	SYDNO	NTRIP GNSSInternetRadio/1.3.7	41	19017
7	05. Jul 04	06:38:05	user14	141.15.20.1	BERLO	NTRIP GNSS-Surfer	54992	13214016
8	05. Jul 04	06:38:34	user5berl0	141.74.33.2	BERLO	NTRIP GNSS-Surfer	8900	2256056
9	05. Jul 04	06:38:34	user14	141.15.20.1	BERLO	NTRIP GNSS-Surfer	29	6651
10	05. Jul 04	06:39:12	user0	129.217.182.198	JENAD	NTRIP Caster 1.5.5	670	301
11	05. Jul 04	06:39:41	user0	129.217.182.198	SAALO	NTRIP Caster 1.5.5	2	501
12	05. Jul 04	06:39:49	user183	193.8.40.126	WORBO	NTRIP WindowsClient1.0	718	11041

Fig. 33: NtripCaster Daily Accounting File

### 4.3. Stream Distribution Maps

An NtripCaster source-table can be downloaded via Internet using an NtripClient or a Web Browser. Source-tables contain meta data describing the location of reference stations and data formats (STR-records), networks of streams (NET-records), and NtripCaster implementations (CAS-records, see NtripDocumentation). Downloading a source-table and decoding its content enables generating stream distribution maps as shown in Fig. 34.

Ntrip Real-Time GNSS Networks All-Europe, Status 040708

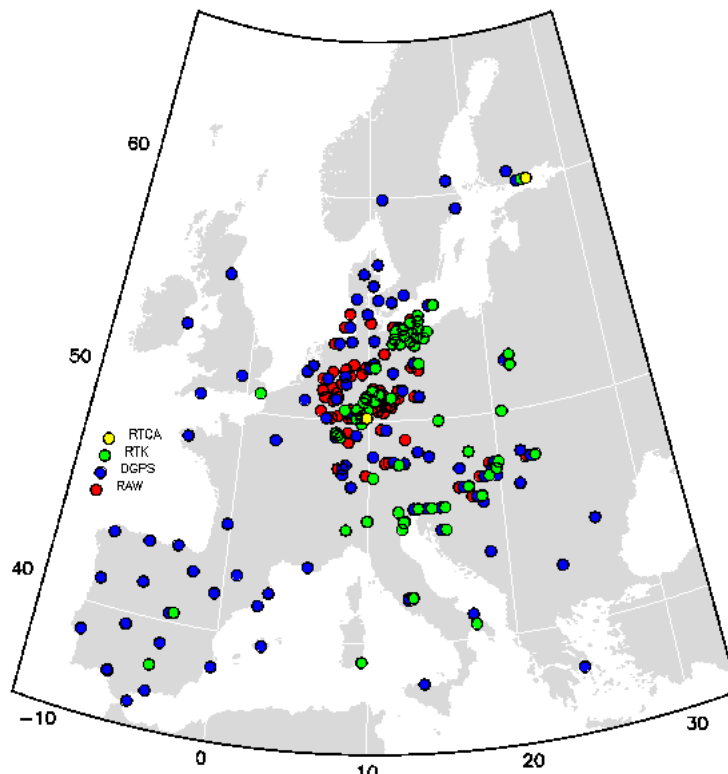


Fig. 34: Stream Distribution Map

Maps of this type are produced on a daily basis for all known NtripCaster implementations. Note that the EUREF-IP Pilot Project tries to keep track of all upcoming NtripCaster implementations and maintains a Web page with stream distribution maps in order to keep the user community informed and help spreading the Ntrip standard.

## 5. Downloads

The BKG maintains a Web site in order to keep the interested community up to date about Ntrip developments. This information is available through Ntrip's homepage at [http://igs.ifag.de/index\\_ntrip.htm](http://igs.ifag.de/index_ntrip.htm) .

The latest version of this document as well as the programs which are part of the example implementation are available through [http://igs.ifag.de/ntrip\\_down.htm](http://igs.ifag.de/ntrip_down.htm).

Operational information on available NtripCasters and their real-time data streams is available from [http://igs.ifag.de/index\\_ntrip\\_cast.htm](http://igs.ifag.de/index_ntrip_cast.htm).

