TimeTools TA-Series NTP Network Time Server

Configuration and User Guide

Models Covered:	TA110, TA210, TA310, TA610
Firmware Versions:	1.02
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The latest version of this user guide can be obtained from: https://timetoolsltd.com/manuals/

TimeTools

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CAUTION:
Before installing and configuring any TimeTools NTP server appliance, please read the manuals and retain for future reference. Please follow all instructions and heed all warnings.

Full product documentation can be found at :
https://timetoolsltd.com/manuals/

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Table of Contents

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1. Document Amendments

T1310-01	**25 Feb 2025**	Original document.

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2. Introduction

Network Time Protocol (NTP) can be used to synchronize the time on network clients, across an IP network, to the correct time of an NTP time server.

TimeTools TA-Series NTP Servers provide a stratum 1 NTP Time Server for ensuring synchronization of time is correct across an entire network.

The Network Time Server acquires time from global positioning satellite constellations and distributes time across a network using the TCP/IP Network Time Protocol (NTP).

3. Key Features

Manufactured In The UK, By TimeTools Limited.

Stratum-1, NTP v4 Network Time Server with full support for NTP and SNTP.

Gigabit Ethernet (GbE).

Includes GNSS antenna for reception of GPS (TA110, TA210, TA310), or concurrent reception of GPS and Galileo constellations (TA610).

Integrated high-stability TCXO oscillator provides continued operation (holdover) during loss of signal lock.

Powerful, yet easy to use, Web interface.

Command line interface, for advanced users, with full control of functionality.

Comprehensive networking support, including full HTTPS encryption with TLS certificate management, HTTP, SSH, SCP, SFTP, FTP, SNMP v1/2c/3, DHCP, DHCPv6.

Timing receiver synchronises to less than 30 nanoseconds (RMS, GNSS Locked).

NTP accurate to less than 3 microsecond ($3x10^{-6}$ seconds) UTC (GNSS Locked).

IPv4 and IPv6 Internet Protocol.

Integrated universal AC mains input PSU for world-wide operation (TA210, TA310, TA610).

Universal AC/DC mains power adapter for world-wide operation (TA110).

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4. Network Time Protocol (NTP)

4.1. Introduction

NTP is a computer network protocol which is used to synchronise time on computers across a network. NTP stands for Network Time Protocol. Dr David Mills of the University of Delaware invented it over 25 years ago. He saw a growing need to synchronise time on computers and networks. Now, many distributed computer processes and applications rely on precise system time. Transaction processing, event logging, CCTV and DVR applications all rely on accurate time stamping.

NTP has a hierarchical structure. At the highest level, or stratum, are precise hardware clocks, which can synchronise to highly accurate external time references, such as GPS or national radio time and frequency broadcasts. These hardware clock devices are known as stratum 0 devices. A stratum 1 time server obtains time directly from a hardware clock and is the most accurate reference in the NTP hierarchy. All lower stratum devices obtain time from the stratum above over a network. As the network introduces timing discrepancies, lower stratum devices are a factor less accurate.

A hierarchical structure allows the overhead of providing time to many clients to be shared among many time servers. Not all clients need to obtain time directly from a stratum 1 reference, but can utilise stratum 2 or 3 references. This has obvious advantages in large networks, such as the Internet, to spread load. However, in practice, on smaller networks, all clients can obtain time from a single stratum 1 time server.

NTP generally operates on a client-server basis. A network time client periodically requests time from a time server. The time server responds with a packet of information containing a time stamp. The time stamp is then used by the client to synchronise its system time. Complex algorithms are used to calculate the time a packet takes to get to the server and back-again, so as to eliminate or reduce any timing inaccuracies introduced by the network itself.

4.2. Time Zones and Daylight Saving Time

NTP uses UTC (Universal Time Coordinated) time, which is very similar to GMT time. It knows nothing of local time zones or daylight-saving time. It is a function of the time client to apply an offset to the supplied time to adjust for local time. In this manner, a time server located anywhere in the world can provide synchronisation to a client located anywhere else in the world. It allows clients to utilise different time zone and daylight-saving properties.

4.3. Fault Tolerance

NTP is fault tolerant, its internal algorithms can automatically select the best of a selection of external time sources to synchronise to. Also, multiple references can be peered to minimize any accumulated timing discrepancies. Depending on network traffic and the accuracy of the server, most clients can be synchronised to within a couple of milliseconds of the correct time.

4.4. NTP Support in Operating Systems

Most modern operating systems support either the Network Time Protocol (NTP) or Simple Network Time Protocol (SNTP) in some form or other. Originally developed for Linux, it has since been ported, in various forms, to UNIX, Netware and Microsoft Windows. SNTP is a simplified form of the protocol; it does not have some of the complex algorithms to maintain high precision time. However, the two protocols are entirely interchangeable – a SNTP client can synchronise to a NTP server.

4.5. Hardware Time References

A number of external time references are available that can be used as hardware reference clocks for NTP. The most common being GPS. The GPS system is a constellation of 24 orbiting satellites, primarily used for positioning and navigation. However, the GPS system also provides very precise timing information. GPS signals can be received anywhere, provided that an antenna can be located with a good view of the sky.

Galileo is the global navigation satellite system (GNSS) that is provided by the European Union (EU). Galileo signals can be received anywhere, provided that an antenna can be located with a good view of the sky.

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5. GPS\GNSS Operation

5.1. Start-Up

The first time the receiver module is powered-up, it searches for satellites from a cold start (no almanac, time, or ephemeris data).

While the receiver will begin to compute position solutions in less than one minute, the receiver must continuously track satellites for approximately 15 minutes to download a complete almanac. A complete and current almanac is essential for correct UTC output.

During this period, the TA-Series's GNSS status will be shown as “No Lock”.

INFORMATION:
After power up, it can take as long as 15 minutes for the receiver to obtain a satellite lock, longer if the antenna has an obscured view of the sky.

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6. NTP Synchronisation

On power-up NTP generally starts in an unsynchronised state. Network time clients will be unable to obtain time from the device until it has synchronised its internal clock to a time reference. To synchronise its internal clock, the device needs to be provided with an accurate source of time. Generally, accurate time is provided by a GNSS external time reference, however, you can also configure the NTP server to synchronise to other external NTP servers or use its internal real-time clock as a time reference.

6.1. Stratum 1 Operation

Stratum 1 operation of a NTP server is only guaranteed by synchronising the device with external hardware time references such as GNSS. An external hardware time reference can be considered to be stratum 0 – the highest stratum in the NTP hierarchy.

In order to maintain stratum 1 synchronisation, a NTP server must be supplied regular precise time-stamps by the external hardware reference clock.

6.2. Loss of Hardware Clock Synchronisation

In the event that GNSS time references fail, the TCXO oscillator will maintain stratum 1 operation for a holdover period of up to 72 hours (default: 24 hours). When the holdover period expires, they will fall back to using any alternative external NTP time references that may be configured, changing stratum accordingly. If no alternative external NTP time references are configured, or if they fail, stratum 1 operation will cease and the device will enter an unsynchronised state. TCXO holdover is only enabled after 24 hours of continuous uninterrupted GPS\GNSS reception.

6.3. NTP Peering

NTP can be configured to agree a common time between a number of NTP servers on a network. Peering allows a number of NTP servers to communicate together to provide a network with the same agreed time. Peering can be used to provide a high degree of redundancy.

Only servers with known good clocks should be peered together. The IP address or fully qualified domain name of peered NTP servers can be entered into the External Time Server field of the NTP Configuration Menu. See ‘Web Interface’ section.

6.4. External Backup NTP Servers

Most Internet based NTP servers will not allow peering. Therefore, to configure an external NTP server that does not allow peering as a backup time reference, to be used in the event of failure of the primary reference, you will need to use the NTP ‘server’ command in the NTP configuration file. You can append commands to the NTP configuration file using the ‘Edit NTP Configuration’ option in the ‘NTP Configuration Menu’. The ‘server’ command has a single operand, the IP address or fully qualified domain name of the server to be used:

```
server time-b.nist.gov          # Domain name of external NTP time server
server 129.6.15.28              # IP address of external NTP time server
```

In the event of failure of the primary synchronisation reference, the backup server will be used for synchronisation. In this event the stratum of the NTP server will be one less than the stratum of the synchronisation server. i.e. If the synchronisation server is stratum 2, the appliance will become stratum 3. The NTP server will only revert to stratum 1 operation when the primary synchronisation reference (GPS\GNSS) comes back online.

6.5. Typical Synchronisation Hierarchy

Stratum 0	GPS, Galileo hardware clock references.
Stratum 1	NTP Server appliance synchronised to a hardware reference clock, such as GPS.
Lower Stratum (2 to 15)	NTP servers synchronised to other NTP servers.

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7. LCD Display and Alarm LED Status

The TA310 and TA610 has a two line by 40 character ultra-bright backlit LCD display for displaying current status and configuration information. All TA-Series models have a Green Power LED and a Red Alarm LED indicator.

7.1. Initial Power-Up

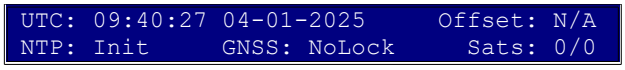
On power-up the LCD display will remain blank for approximately 10 seconds, while the unit boots and performs a self-test. On completion of self tests, the display will show the model and firmware version.

Alarm (Red) LED Status: OFF.

7.2. LCD Display – Initial Operation

After the initial boot sequence, the device will then show its normal status display. The current UTC (Coordinated Universal Time) time and date, which is held internally by the devices real-time clock, will be shown. The current time offset compared to any available external time references will be shown.

Synchronisation ‘Sync-Init’ indicates that the device is waiting for external time references to come online. GNSS status ‘GNSS:NoLock’ indicates that no GNSS satellite lock has yet been achieved.



Alarm (Red) LED Status: ON.

When a GNSS antenna is installed and a signal lock is achieved, time-stamps will be passed to NTP from the reference clock. NTP will then enter a calibration mode for a period of 10 to 15 minutes, while its internal clock is being skewed towards the correct time. During this period, the unit will still be in an unsynchronised state and will display ‘No-Sync’, as indicated below.

Alarm (Red) LED Status: ON.

7.3. LCD Display – Normal Operation

When the device is synchronised, the LCD display will typically appear as follows.

Alarm (Red) LED Status: OFF.

UTC	The current system time maintained by the device. This is displayed as UTC time (Coordinated Universal Time).
Offset	The current offset, or estimated error, between the devices system time and the external reference clock. This may vary according to the external reference clock that is currently being used.
NTP	OK - Denotes that the device is synchronised and can serve network time clients with the correct time. No-Sync – The NTP local clock is not currently synchronized.
GNSS	No-Lock – The GPS\GNSS receiver has not yet gained a satellite lock. Lock - Signifies that a GPS signal lock has been achieved. Error – A GPS\GNSS receiver error has been detected. View the system log to determine error type.

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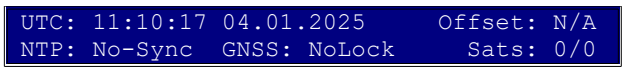
Sats	The number of satellites currently in use, and the number tracked, by the GPS\GNSS receiver.

7.4. LCD Display – Device Unsynchronised

If no external reference clock synchronisation has been possible for a period of time, eventually the display will show ‘NTP: No-Sync’ indicating that the device has entered an unsynchronised mode and will no longer provide synchronisation to network time clients.



Alarm (Red) LED Status: ON.

7.5. LCD Display – Internal Manual Time Adjustment Required

If the device has been powered off for an extended period, the system time stored in the real-time clock may have drifted too far away from the correct time in order for the device to synchronise correctly. The GNSS status will show ‘Error’ indicating too great a difference between the received reference clock time-stamp and the devices system time.

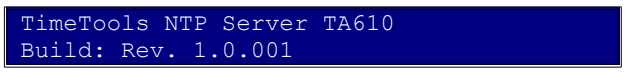
Alarm (Red) LED Status: ON.

In this event the real-time clock will need to be adjusted manually to within 10 minutes of the correct time from a SSH session, see section ‘Correcting the System Time’.

Other GNSS receiver errors are possible. Check the NTP log for further information about the error.

7.6. Front Panel 'Select' Button

The 'Select' button on the front panel of TA310 and TA610 models can be used to show additional information on the LCD display. The button can be used to rotate between the status display and a number of displays:



Select push-button ▼

Select push-button ▼

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8. Initial Configuration

Before configuring the NTP server, you will need to acquire the following basic configuration information:

IP address,
Network mask,
Gateway,
Domain name servers

or confirm availability of a network DHCP server for dynamic networking configuration.

TimeTools network time servers are configured with default primary DHCP and secondary IP address of 192.168.3.222.

IMPORTANT:
When first installing the TA-Series on your network, ensure that no other device conflicts with the default secondary IP address of the appliance.

Default IP Address (Eth0): DHCP
Default Secondary IP Address (Eth0): 192.168.3.222

The TA-Series can be initially configured in any of two ways:

- Over a network using a web browser or SSH on a PC connected to the same network segment.
- Using a web browser or SSH on a PC using a peer-to-peer (direct cable) network connection.

8.1. Default Configuration

Security

SSH, SCP, SFTP, FTP user name	admin
SSH, SCP, SFTP, FTP default password	admin
HTTPS \ HTTP Web Password	admin

Network Configuration

Host Name	NTP001
Domain Name	-
Name Server 1	-
Name Server 2	-
Network Services	HTTPS: Enabled, HTTP: Enabled, FTP: Enabled SSH\SCP\SFTP: Enabled

Ethernet Port 0

DHCP	Enabled
IPv4 Secondary Address \ Mask	192.168.3.222/24
IPv4 Default Gateway	-
IPv6 Address/Mask A:	-
IPv6 Address/Mask B:	-
IPv6 Address/Mask C:	-
IPv6 Gateway:	-
DHCPv6:	Enabled

NTP Configuration

External NTP Server Address 1	-
Key	-
External NTP Server Address 2	-
Key	-
External NTP Server Address 3	-

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Key	-
NTP Broadcast Address	-
Key	-
Trusted Keys	-
NTP Keys	-

SNMP Configuration

SNMP Traps	Disabled
Community String	-
Trap Address 1:	-
Trap Address 2:	-
Trap Address 3:	-
Trap Address 4:	-

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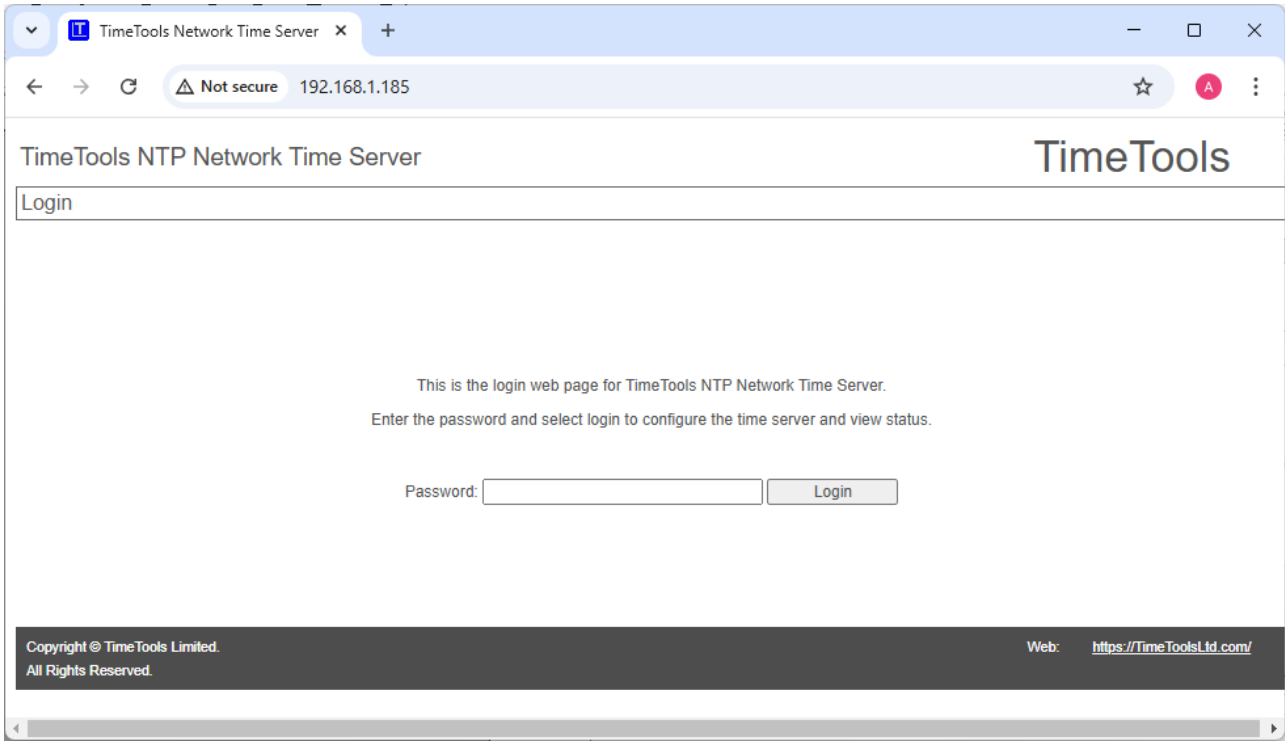
9. Web Interface

The web interface can be initiated by entering the IP address of the time server into a web browser, such as Internet Explorer, e.g. http://192.168.3.222. The user will then be greeted by the login screen. A HTTPS web connection can also be used.

9.1. Login



Enter the configuration password in order to login to the device. Default: 'admin'.

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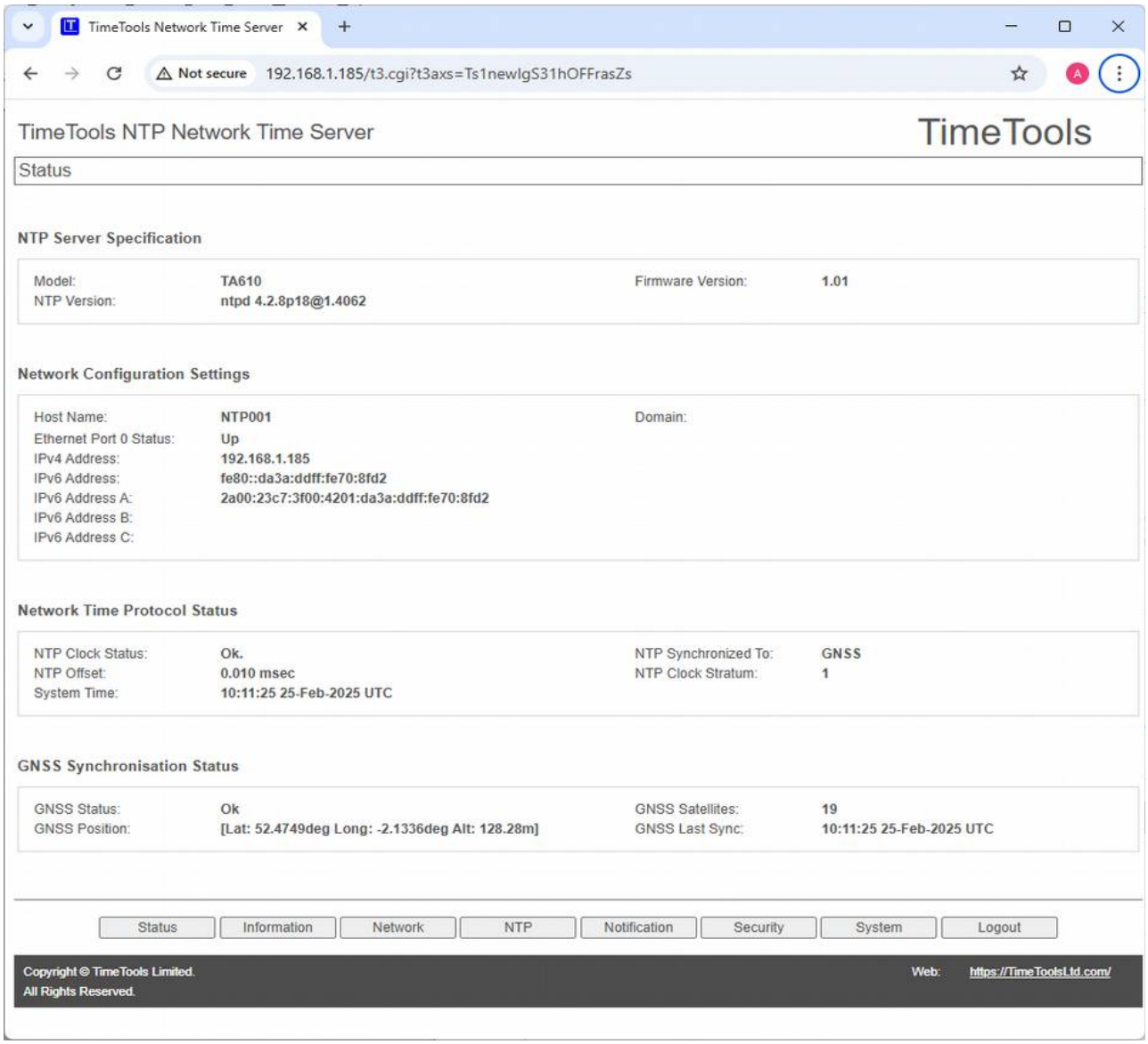
Status Menu



Model	NTP Server model.
Firmware Build	Describes the firmware build revision number.
NTP Version	Network Time Protocol version currently installed.
Hostname	Hostname of appliance.
Domain	Network domain name
Ethernet Port Status	The current state of the Ethernet port. Up – connected, Down – disconnected.
IPv4 Address	IPv4 Network address of appliance.
IPv6 Address	IPv6 Network address of appliance. Based on MAC address of Ethernet port.
IPv6 Address A	Assigned IPv6 Network address of appliance.

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IPv6 Address B	Assigned IPv6 Network address of appliance.
IPv6 Address C	Assigned IPv6 Network address of appliance.
NTP Clock Status	The current NTP clock status – OK / Not Synchronised.
NTP Offset	The offset between the appliances system time and the currently utilised reference clock.
NTP Synchronized To:	The reference clock that the appliance is synchronized to. Typically GNSS, but may also be an external NTP server.
NTP Clock Stratum:	The current stratum level of the appliance. Typically stratum 1 when synchronized to GNSS.
System Time	The appliances current system time as UTC (not local time).
GNSS Status	OK: GNSS satellite lock has been achieved and receiver operation is good. No Lock: GNSS satellite lock not achieved or lost. This may be due to poor antenna location. Error: Indicates GNSS receiver error. Check the system log to find exact cause.
GNSS Position	GNSS positioning information, location and height
GNSS Satellites	Satellites currently used in timing calculation.
GNSS Last Sync	The last valid time-stamp provided to NTP from the GNSS reference clock.

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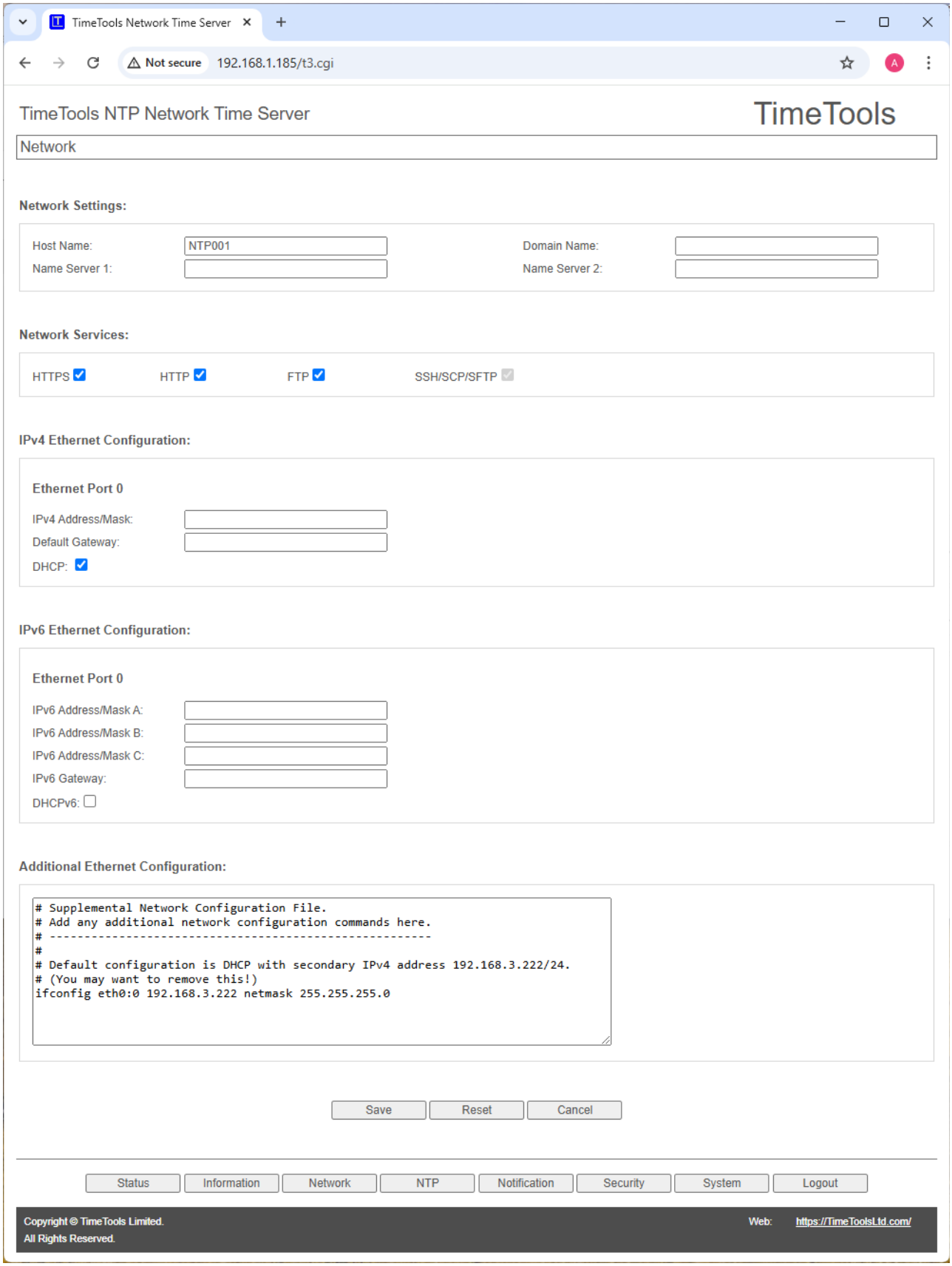
9.2. Network Configuration Menu



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Hostname	Hostname of time server.
Domain	Network domain name
Name Server 1	IP address of DNS name server 1.
Name Server 2	IP address of DNS name server 2.
Network Services	Shows which network services are currently enabled. HTTPS, HTTP, FTP, SSH/SCP/SFTP
IPv4 Address/Mask	IPv4 Network IP Address and subnet mask of the appliance.
Default Gateway	IPv4 Network default gateway
DHCP	Enable Dynamic Host Configuration Protocol
IPv6 Address/Mask	Additional IPv6 Network IP Addresses and subnet mask of the appliance.
IPv6 Gateway	IPv6 Network default gateway
DHCPv6	Enable DHCPv6 auto-configuration.
Additional Ethernet Configuration	Additional commands can be specified here that will be added to the boot sequence. Typically commands to add additional routes can be specified.

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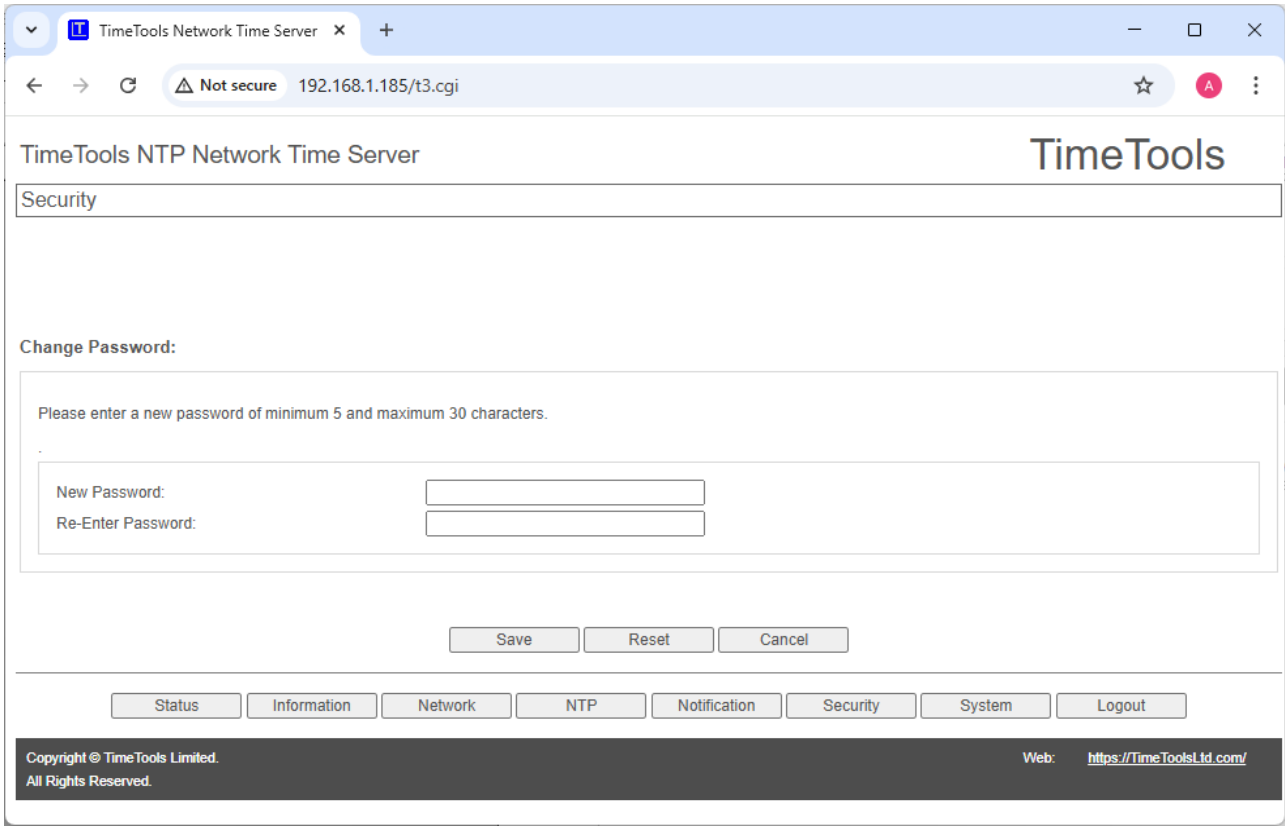
9.3. Security Configuration



The security configuration web page allows the default HTTP, HTTPS, FTP, SSH/SCP/SFTP password to be modified. (Default ‘admin’). A password of at least 5 characters must be entered, with a maximum of 30 characters.

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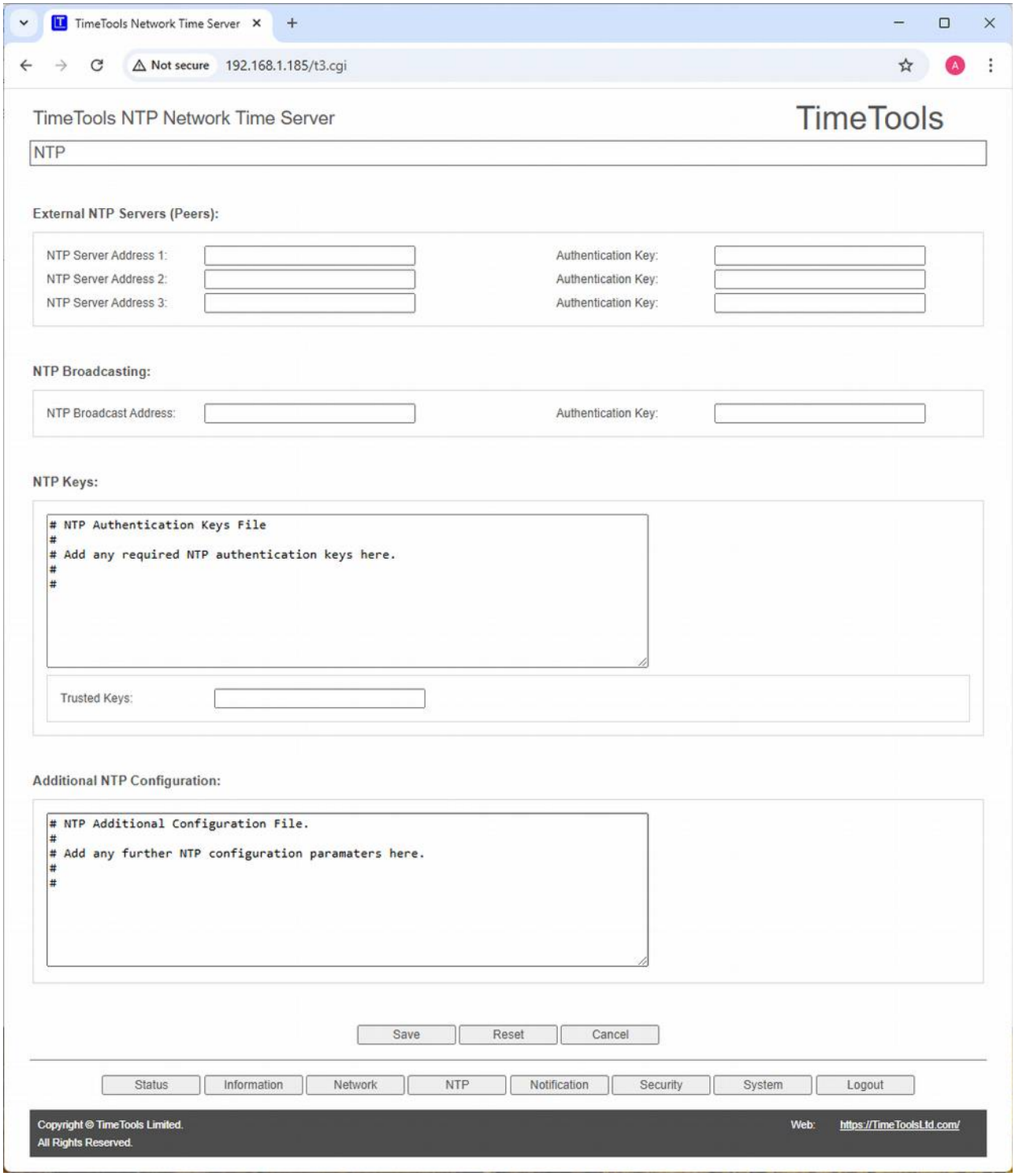
9.4. NTP Configuration Menu



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External NTP Servers	Up to three external NTP servers can be peered with the time server to provide backup in the event of primary time source loss or failure. In this mode the local clock can be synchronized to the remote peer or the remote peer can be synchronized to the local clock. This is useful in a network of servers where, depending on various failure scenarios, either the local or remote peer may be the better source of time.
NTP Broadcasting	In broadcast mode the local server sends periodic broadcast messages to a client population at the *address* specified, which is usually the broadcast address on (one of) the local network(s) or a multicast address assigned to NTP. The IANA has assigned the multicast group address IPv4 224.0.1.1 and IPv6 ff05::101 (site local) exclusively to NTP, but other non-conflicting addresses can be used to contain the messages within administrative boundaries. Ordinarily, this specification applies only to the local server operating as a sender; for operation as a broadcast client
Trusted Keys	Specifies the key identifiers, which are trusted for the purposes of authenticating peers with symmetric key cryptography. The authentication procedures require that both the local and remote servers share the same key and key identifier for this purpose, although different keys can be used with different servers. The *key* arguments are 32-bit unsigned integers with values from 1 to 65534 separated by a single space character.
NTP Keys	Contains key identifiers and keys controlling authentication of Network Time Protocol (NTP) transactions.

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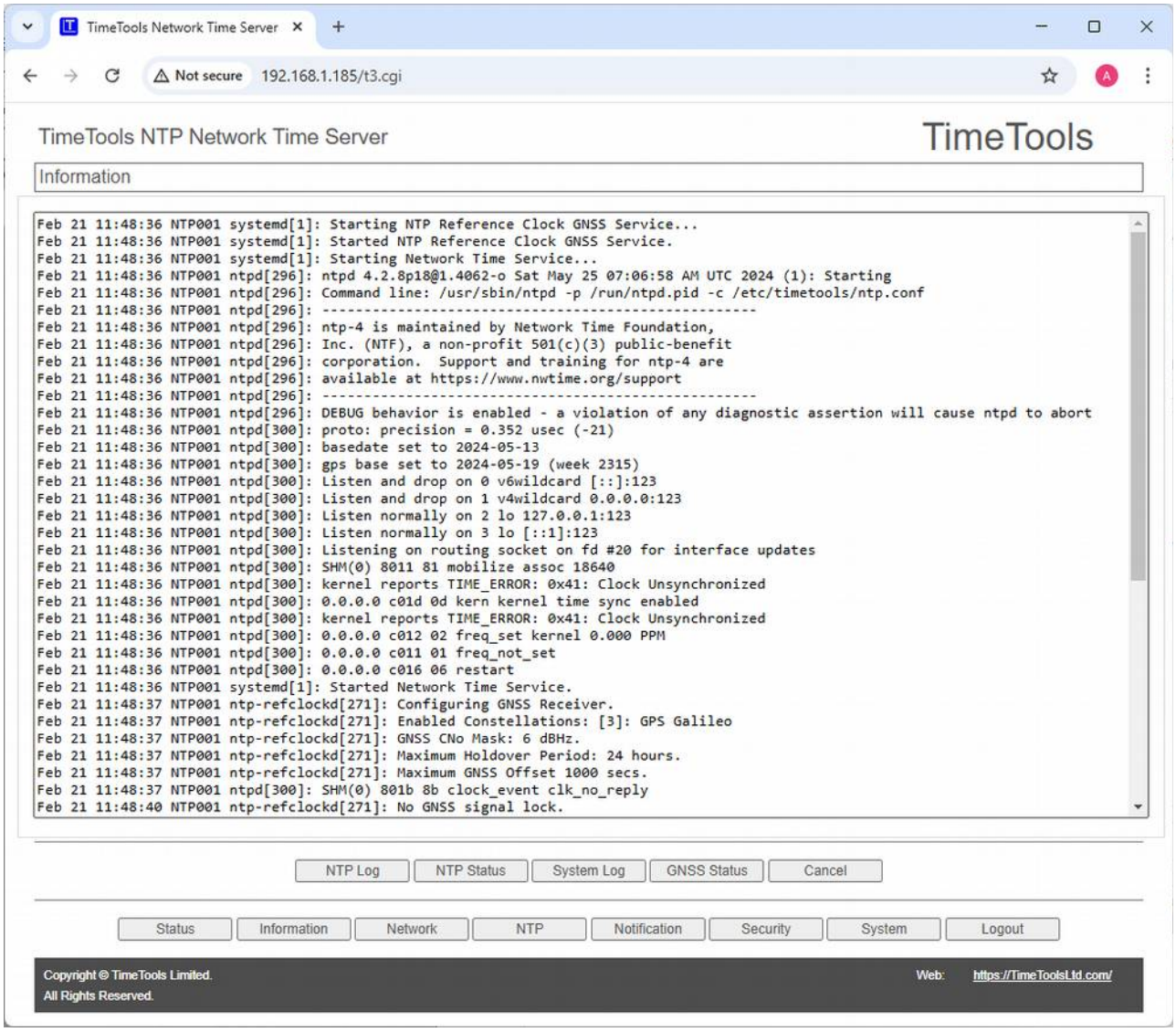
9.5. System Information

System information and logs are split into four categories: NTP Log, NTP Status, System Log and GNSS Status.

9.5.1. System Log and NTP Log

The system log is a log of all the messages generated by the Linux kernel and all applications since the device was last booted. The NTP log is a filtered version of the system log showing only NTP related log messages.



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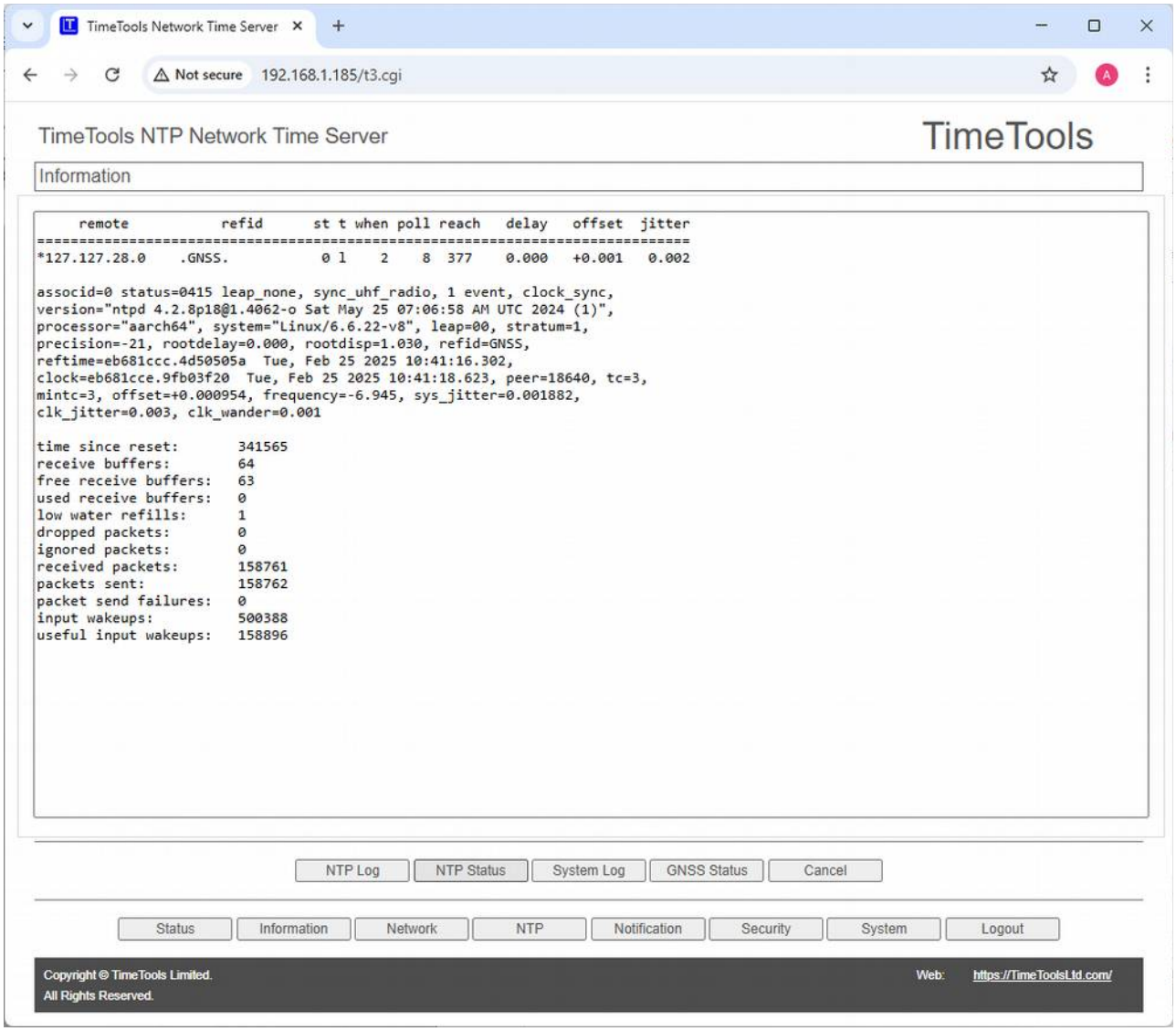
9.5.2. NTP Status



The NTP Status page provides current NTP synchronisation information. It provides a list of the peers known to the server as well as a summary of their state.

The symbol at the left margin displays the synchronisation status of each peer. The currently selected peer is marked '*', while additional peers designated acceptable for synchronisation, but not currently selected, are marked '+'. Peers marked * and + are included in the weighted average computation to set the local clock; the data produced by peers marked with other symbols are discarded.

remote – The peer or server being synchronised to. 127.127.28.0 is the local GNSS reference clock.
The host names or addresses shown in the remote column correspond to the server and peer entries listed in the configuration file; however, the DNS names might not agree if the names listed are not the canonical DNS names.

refid – The refid column shows the peers current source of synchronization. '.GNSS.' is specified for the local GNSS reference clock.

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st – The st column reveals the stratum of the peer (0 to 16). Stratum 0, specifies a hardware reference clock such as GPS or GNSS. Stratum 16 indicates an unsynchronised server

t – Type (u: unicast or manycast client, b: broadcast or multicast client, l: local reference clock, s: symmetric peer, A: manycast server, B: broadcast server, M: multicast server);

when – The when column shows the time since the peer was last heard in seconds (default), hours (denoted by the “h” symbol) or days (specified by the “d” symbol).

poll – The polling interval in seconds for the peer.

reach – Status of reachability register in octal (See RFC-1305).

delay – Round trip communication delay to the remote peer or server (milliseconds);

offset – The mean offset in the times reported between the local host and the remote peer in milliseconds.

jitter – The mean deviation in the time reported from the peer in milliseconds.

Refer to the NTP Documentation Archive's (doc.ntp.org) ntpq page for additional information.

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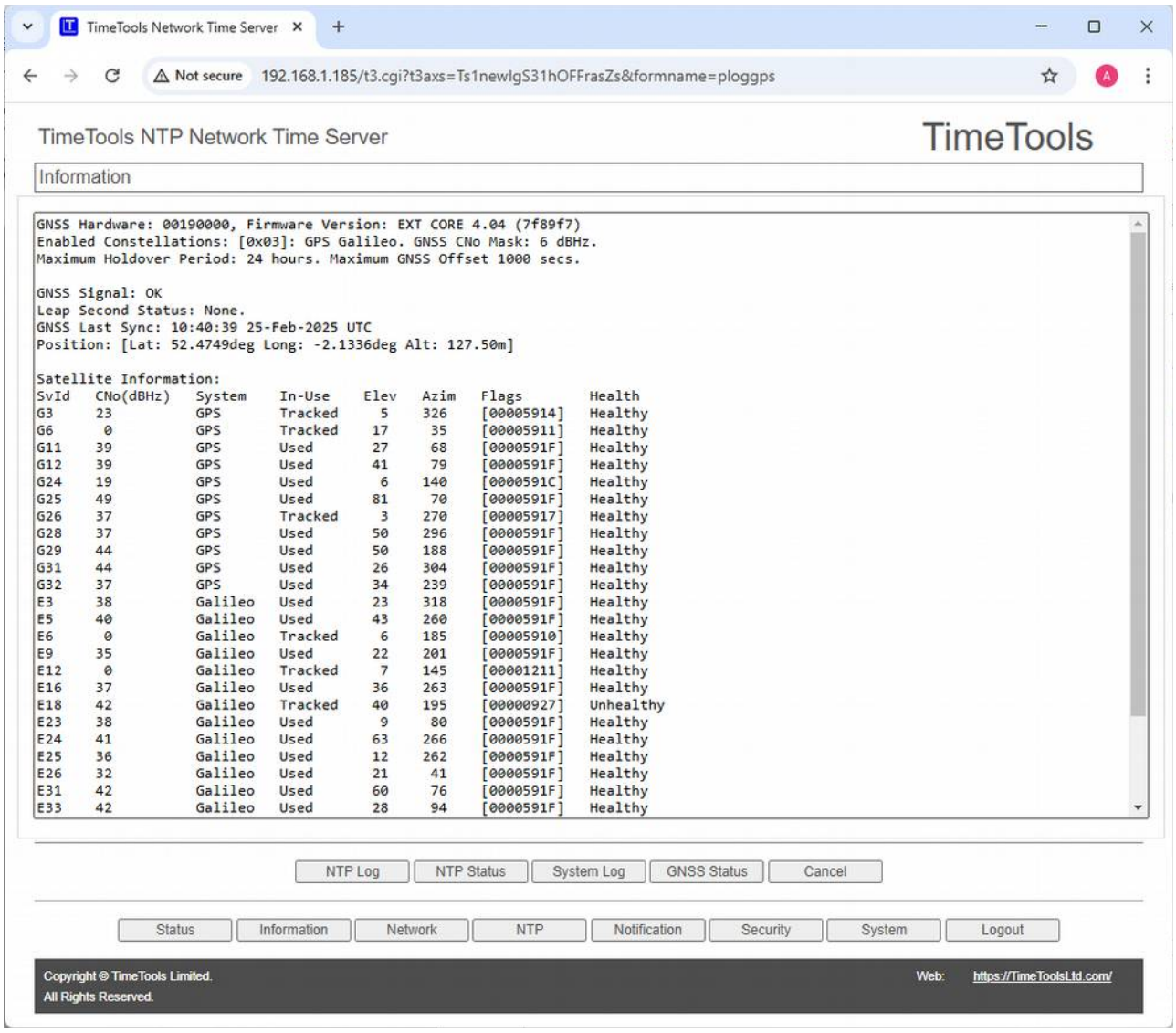
9.5.3. GNSS Status

The GPS Status page provides detailed information on the health and status of the TA-Series GPS\GNSS receiver and the satellites tracking information.



The information provided can be very useful for system debugging and installation, to find the optimum location for a GPS\GNSS antenna and to confirm signal reception levels for existing installations.

Useful Receiver Information	
GNSS Hardware	GNSS receiver hardware component version information.
Firmware Version	GNSS receiver firmware version information.
GNSS Signal	Indicates the status of the GNSS receiver: Lock, No Lock, Error
Position	The current global position of the appliance, latitude and longitude, in degrees and the height in meters.

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Satellite Information

SvId:	A unique number that identifies each particular satellite.
CNo (dBHz):	The quality of received GNSS satellite-signals is reported as C/No value (Carrier-to-Noise power ratio). Low C/No values can result from low-elevation satellites, partially obscured signals (due to dense foliage for example), or reflected RF signals (multipath). Multipath can degrade the position and timing solution. Multipath is most commonly found in urban environments with many tall buildings and a preponderance of mirrored glass. Reflected signals tend to be weak (low C/No value), since each reflection diminishes the signal.
System:	The system or constellation to which the satellite belongs. GPS, Galileo.
In Use:	Indicates if the satellite is currently used to obtain a computational fix.
Elevation, Azimuth:	Satellite elevation and azimuth, in degrees. This shows the actual position of the satellite in the sky.
Health:	Indicates whether the satellite is currently healthy.

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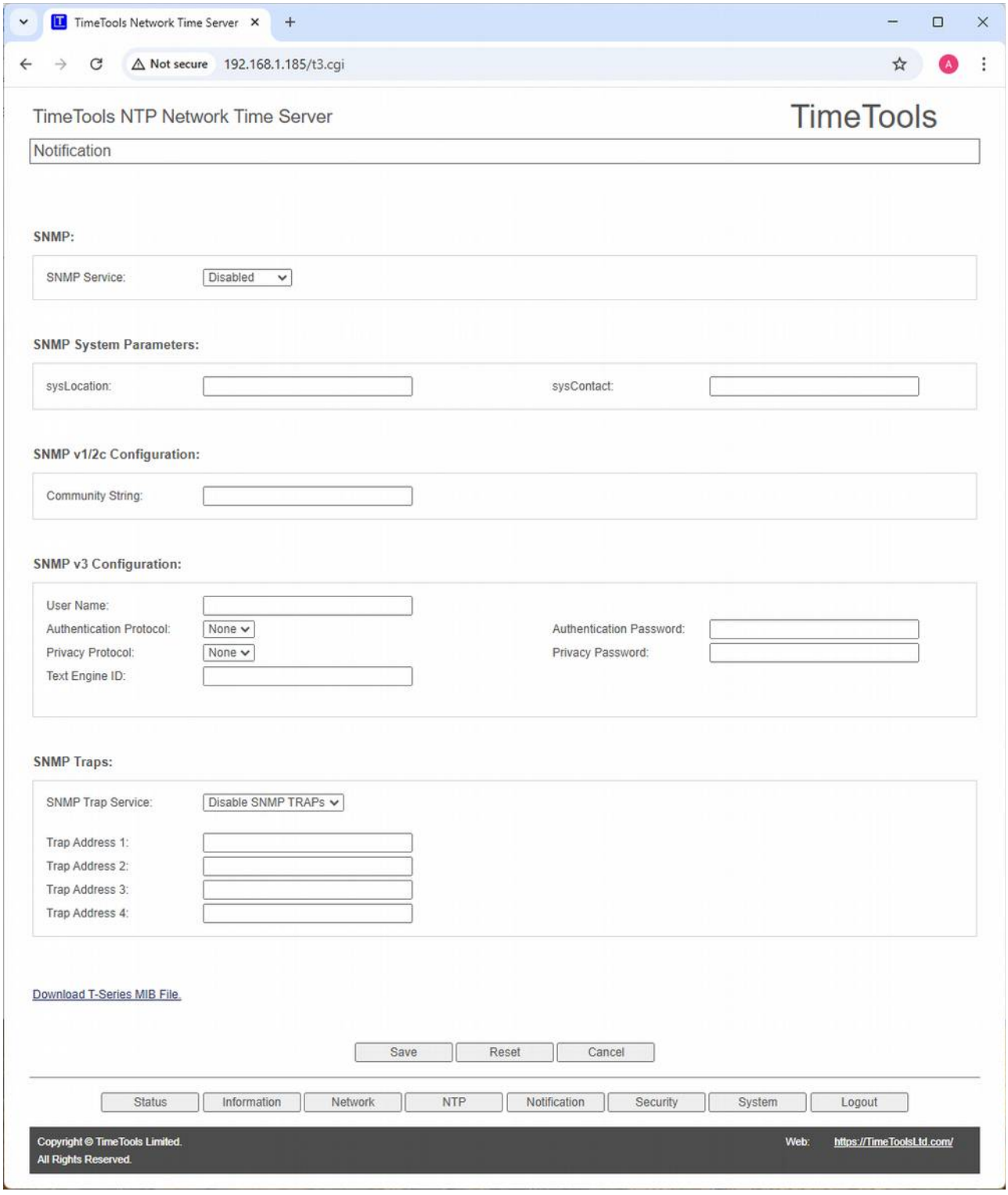
9.6. Notification Configuration Menu



The Notification Configuration menu is used to enable and configure the appliances Simple Network Management Protocol (SNMP) service. SNMP can be used to monitor the status of the appliance. Notifications can be generated by the NTP server to warn a network manager of error conditions that have occurred, such as loss of GPS signal or loss of synchronisation.

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The TA-Series supports SNMP v1, v2c and v3. When configured, the appliance can respond to requests for status information from a SNMP management system. It can also send SNMP traps or notifications to up to 4 separate SNMP management systems, each specified by their IP address. The Management Information Base (MIB) file is available for download from the Notification Configuration Menu page.

SNMP Service:	Disabled: Disable the SNMP service. v1 Enabled: Enable SNMP v1 service. v2c Enabled: Enable SNMP v2c service. v3 Enabled: Enable SNMP v3 service.
sysLocation:	A display string representing the physical location of the appliance.
sysContact:	A display string identifying the appliance administrators contact details.
SNMP v1/2c Configuration:	The following configuration items are relevant to SNMP v1/2c only.
Community String:	SNMP v1/2c community string or password to read SNMP entities. The same community string is also used to send SNMP v1/2c traps.
SNMP v3 Configuration:	The following configuration items are relevant to SNMP v3 only.
User Name:	Specify SNMP v3 user or security name.
Authentication Protocol:	Specify protocol to authenticate SNMP v3 messages. None: Disable authentication. MD5: Enable MD5 authentication. SHA: Enable SHA authentication (recommended).
Authentication Password:	An authentication password or secret key to append to SNMP v3 messages.
Privacy Protocol:	Specify the privacy algorithm to use for SNMP v3 encryption. None: Disable privacy. DES: Enable DES encryption. AES: Enable AES encryption (recommended).
Privacy Password:	A privacy password or secret key for SNMP v3 privacy.
Text Engine ID:	An Engine ID uniquely identifies an SNMP v3 entity in a management domain. It is used for identification, not addressing, purposes. The text engine ID specifies up to 27 characters to be used to build the engine ID using the text format scheme (RFC 3411).
SNMP Traps:	The following configuration items relate to SNMP traps and notifications.
SNMP Trap Service:	Control the generation of SNMP traps and notifications. Disable SNMP TRAPs. Enable TRAPs. Enable INFORMs.
Trap Address 1: **Trap Address 2:** **Trap Address 3:** **Trap Address 4:**	Address of SNMP management system to send trap or inform messages.
Download TA-Series MIB File.	Download the MIB file for managing SNMP entities.

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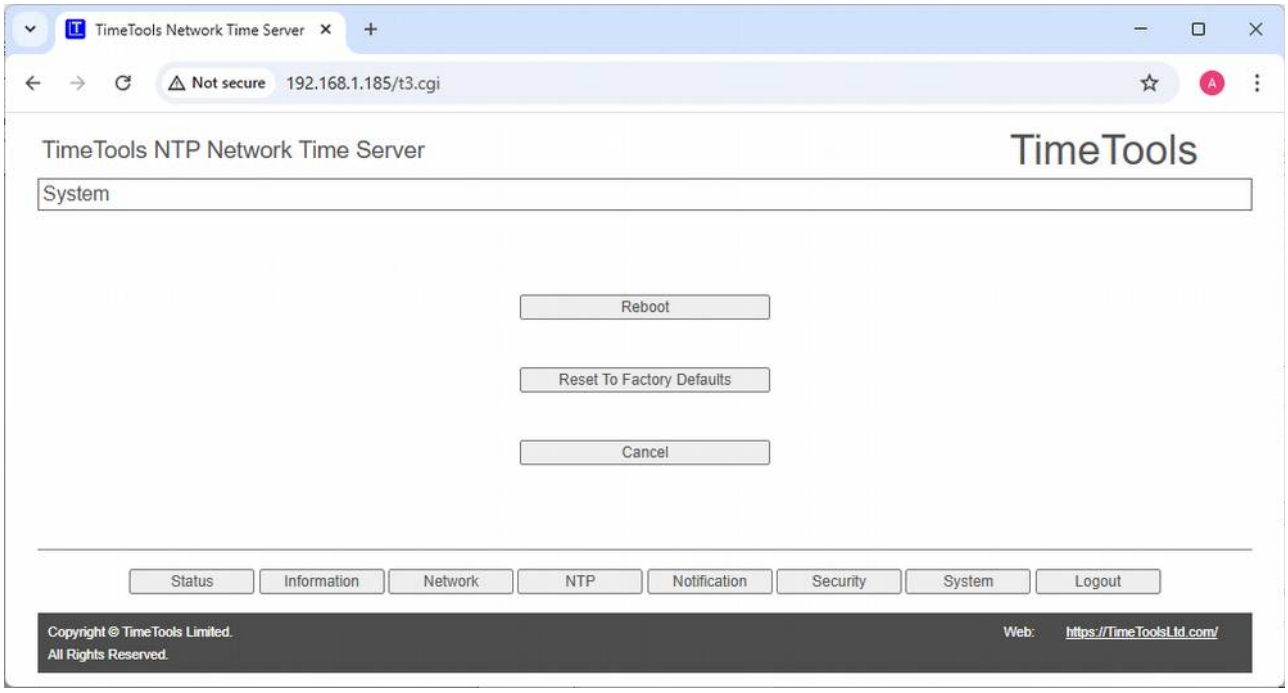
9.7. System Menu



Reboot	The reboot option restarts the time server. It is used to make any network configuration changes active.
Factory Defaults	The factory defaults menu option reverts all settings back to the factory defaults. All settings will revert to their factory defaults after the device has restarted. Please note, passwords will stay the same and will not revert back to default.

IMPORTANT:
When reverting to factory defaults, ensure that no other device on your network conflicts with the default IP address of the appliance.

Default IP Address (Eth0): DHCP
Default Secondary IP Address (Eth0): 192.168.3.222

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10. SSH Command Line Interface Configuration

10.1. Secure Shell Session (SSH) via Remote Host

The time server can be configured remotely using a secure telnet session (SSH) and a Command Lime Interface (CLI). Windows and Linux has a built-in SSH client that you can use from a terminal session. From terminal session:

ssh admin@<ip-address>

Where <ip-address> is the IP address of the TA-Series NTP server.

E.g.
ssh admin@192.168.3.222

10.2. Logging On

The default username and password is ‘admin’.

NTP001 login: admin
Password: admin

10.3. Status and Configuration Commands

A convenient command (nts) is provided to view and change the current device settings

Command: nts
nts help

Display nts command help page.

10.4. System Status Commands

Command: nts status

Show the current status of the device, including firmware versions, network configuration summary, NTP status and GNSS status.

Command: nts status ntp

Show the current NTP synchronisation status. It provides a list of the peers known to the server as well as a summary of their state.

Command: nts status gnss

Show detailed information on the health and status of the GNSS receiver and satellite tracking information.

Command: nts status ntplog

Show a filtered version of the system log showing only NTP related log messages.

Command: nts status syslog

Show the complete system log of all messages generated by the Linux kernel and all applications since the device was last booted.

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10.5. NTP Configuration Commands

Please note, the NTP service must be restarted after any NTP configuration changes.

Command: nts ntp

Show the currently saved NTP configuration.

Command: nts ntp ext1 <address> [<key>]
nts ntp ext2 <address> [<key>]
nts ntp ext3 <address> [<key>]

Set external NTP address and optional authentication key. Up to three external NTP addresses can be specified: ext 1, ext2 and ext3.

Examples: nts ntp ext1 192.168.1.262 15 # External NTP server IP address with authentication key 15.
nts ntp ext2 0.uk.pool.ntp.org # External Internet NTP server.

Command: nts ntp broadcast <address> [<key>]

Set NTP broadcast address and optional authentication key. **Most NTP clients use unicast communication, generally broadcasting does not need to be configured.**

Example: nts ntp broadcast 192.168.1.255 # Broadcast NTP to specified subnet.

Command: nts ntp trust “<keys>”

Set NTP trusted authentication keys.

Example: nts trust "3 5 12". # Set trusted keys 3 5 12.

Command: nts ntp keys <keyfilename>

Save specified NTP key file to flash memory. The key file must be previously uploaded or created.

Example: nts ntp keys mykeyfile # Save NTP keys file mykeyfile to flash.

Command: nts ntp conf <conffilename>

Save specified NTP additional configuration file. The configuration file must be previously uploaded or created.

Example: nts ntp conf myconffile # Save NTP configuration file myconffile to flash.

Command: nts ntp panic <enable|disable>

Enable or disable NTP service and GNSS reference clock service time validation check at start up.
“nts ntp panic enable” turns on a 10 minute system time – reference clock time validation check at start up.
“nts ntp panic disable” turns off time validation at start up.

Command: nts ntp restart

Restart the NTP service. **The NTP service must be restarted for any configuration changes to take effect.**

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10.6. SNMP Configuration Commands

Command: nts snmp

Display currently saved SNMP configuration.

Command: nts snmp version v1|v2c|v3

Set SNMP version: v1, v2c or v3.
- v1: Enable SNMP v1 service.
- v2c: Enable SNMP v2c service.
- v3: Enable SNMP v3 service.

Command: nts snmp system <location> <contact>

Set SNMP location and contact details. Location is a display string representing the physical location of the appliance. Contact is a display string identifying the appliance administrators contact details.

Command: nts snmp community <comstring>

Set SNMP v1/2c community string or password to read SNMP entities. The same community string is also used to send SNMP v1/2c traps.

Command: nts snmp user <username>

Specify SNMP v3 user or security name.

Command: nts snmp auth <none|md5|sha> [password]

Specify protocol to authenticate SNMP v3 messages.
- none: Disable authentication.
- md5: Enable MD5 authentication.
- sha: Enable SHA authentication (recommended).

Authentication password or secret key to append to SNMP v3 messages.

Command: nts snmp priv <none|des|aes> [password]

Specify the privacy algorithm to use for SNMP v3 encryption.
- none: Disable privacy.
- des: Enable DES encryption.
- aes: Enable AES encryption (recommended).

Privacy password or secret key for SNMP v3 privacy.

Command: nts snmp engineid <engineid>

An Engine ID uniquely identifies an SNMP v3 entity in a management domain. It is used for identification, not addressing, purposes. The text engine ID specifies up to 27 characters to be used to build the engine ID using the text format scheme (RFC 3411).

Command: nts snmp trapservice disable|trap|inform

Control the generation of SNMP traps and notifications.
- disable: Disable SNMP TRAPs.
- trap: Enable TRAPs.
- inform: Enable INFORMs.

Command: nts snmp trapaddress <addr1> [<addr2>] [<addr3>] [<addr4>]

Addresses of SNMP management system to send trap or inform messages.

Command: nts snmp service disable|restart

Disable or restart SNMP service. The SNMP service must be restarted for any configuration changes to take effect.

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10.7. Network Configuration Commands

Please note, the NTP server must be rebooted after any network configuration changes.

Command: nts net

Show currently saved network configuration.

Command: nts net hostname <hostname>

Set host name. Please note, the NTP server must be rebooted after any network configuration changes.

Example: nts net hostname myhostname # Set hostname to myhostname

Command: nts net domainname <domainname>

Set domain name. Please note, the NTP server must be rebooted after any network configuration changes.

Example: nts net domainname mydomainname # Set domain name to mydomainname

Command: nts net nameserver <nameserver1> [<nameserver2>]

Set name servers – up to two name servers can be specified. Please note, the NTP server must be rebooted after any network configuration changes.

Example: nts net nameserver 8.8.8.8 8.8.4.4 # Set name servers

Command: nts net services [http] [https] [ftp] [ssh]

Set enabled network services. Please note, the NTP server must be rebooted after any network configuration changes.

Default: nts net service http https ftp ssh # Enable all network services

Example: nts net service https ssh # Enable HTTPS and SSH only. All other services disabled.
nts net service # Disable all network services.

Command: nts net eth0ip dhcp

Set Eth0 IPv4 DHCP. Please note, the NTP server must be rebooted after any network configuration changes.

Command: nts net eth0ip <ipaddr/mask> [gw <gateway>]

Set Eth0 IPv4 IP address /mask and gateway. Please note that the IP address and mask is specified using the CIDR notation. Please note, the NTP server must be rebooted after any network configuration changes.

Example: nts net eth0ip 192.168.0.1/24 gw 192.168.0.254

Command: nts net eth0ipv6 <ipv6addrA/mask> [<ipv6addrB/mask>] [<ipv6addrC/mask>] [gw <ipv6gateway>]

Set Eth0 IPv6 IP address/mask (up to three) and optional gateway. Please note, the NTP server must be rebooted after any network configuration changes.

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10.8. GNSS Configuration Commands

Command: nts gnss

Show current GNSS module configuration.

Command: nts gnss <constellation>

Configure the GNSS module to receive specific constellations (TA610 models only). Where <constellation> is one of: gps, gps-galileo, galileo.

GPS is the US GNSS system, available globally. Galileo is the European (EU) GNSS system, available globally.

Default: nts gnss gps-galileo # GPS, Galileo constellation (TA610)

Examples: nts gnss gps # Change constellation to GPS only.
nts gnss galileo # Change constellation to Galileo only. (TA610)

Command: nts gnss restart

Stop and restart the GNSS reference clock service.

10.9. Security Commands

Command: nts security savecert [default]

Save uploaded user certificate files 'certificate.crt' and 'certificate.key' to flash. Specifying default will restore original certificate files. The device must be rebooted for any network configuration changes to take effect. Same as ttsavecert command described below.

10.10. System Commands

Command: nts system restart

Restart the NTP server. The device must be rebooted for any network configuration changes to take effect. Same as ttrestart command described below.

Command: nts system default

Reset to factory defaults and restart. Same as ttdefault command described below.

Command: nts system shutdown

Safely shut down the device. The Linux operating system will safely shut down the device. Power can be removed one the alarm LED is extinguished.

Command: nts system defaultsw [enable | disable]

The 'def' push-button switch located on the rear panel of the TA-Series device resets the device to default configuration, including the system password. The ' nts system defaultsw' command can be used to enable or disable the 'def' push-button.

Default: enabled.

Example: nts system defaultsw disable

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Command: nts password “<newpassword>”

Set admin password. TimeTools recommends using only alphanumeric (A-Z, a-z, 0-9) password characters.

Example: nts password “mynewpassword”

10.11. Additional Commands

Help information on all additional commands is available using the -help option. eg. 'ttdefault -help'.

Command	Description
ttdefault	Reverted to factory default settings. The system must be restarted for the changes to take effect.
ttsavecert	Save uploaded SSL certificate files to flash. usage: ttsavecert - save user certificate files 'certificate.crt' and 'certificate.key' to flash. ttsavecert default - revert to default user certificate. The system must be restarted for the changes to take effect.
ttdefaultpwd	Reset 'admin' password to default (admin).
ttrestart	Reboot the appliance immediately.
ttsetclock	Manually adjust the system time. See section: '14. Adjusting the System Time' usage: ttsetclock help - display help information. ttsetclock HHMM ddmmyyyy - update system time. Eg: ttsetclock 1258 28062016 - Set system time to 12:58, 28 June 2016.

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10.12. Typical Minimum Configuration Requirements

The TA-Series is supplied with Eth0 set to DHCP and a secondary IP address/network mask of 192.168.3.222/24.

The typical minimum configuration requirement is to set a new static IP address and network mask with an optional default gateway. The device must then be restarted for network configuration changes to take effect.

Example:. nts net eth0ip 192.168.0.1/24 gw 192.168.0.254
nts system restart

Please note that IP addresses and network masks are specified using the CIDR notation. The notation is constructed from an IP address, a slash ('/') character, and a decimal number. The decimal number is the count of leading 1 bits in the subnet mask.

Example: 192.168.0.1/24 specifies an IP address of 192.168.0.1 and a 24 bit network mask, i.e. 255.255.255.0

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11. System Log Messages

System log messages are generated by both the NTP service and the reference clock service to warn of a system status change. Log messages can be viewed the system log tab of the information web page.

The following messages are generated by the GPS/TCXO reference clock service:

Type	Log Message	Model	Description
Warning	No GNSS signal lock.	All Models	GNSS signal lock lost – possibly due to poor antenna location or antenna/cable fault.
Information	GNSS signal lock OK.	All Models	GNSS signal lock regained after loss of signal.
Information	Holdover oscillator calibration started.	All Models	Restarting TCXO holdover oscillator calibration after reacquired GPS\GNSS signal.
Information	Holdover oscillator calibrated.	All Models	TCXO oscillator calibrated and ready for operation in the event of GNSS signal loss.
Warning	No GNSS signal lock. Holdover enabled.	All Models	GNSS signal lock lost - holdover started.

The following are a selection of messages generated by the NTP service.

Type	Log Message	Description
Information	no_system_peer	No reference clock peer available.
Information	clock_sync	NTP local clock synchronised.
Information	SHM(0) reachable	NTP is receiving timestamps from GPS\GNSS receiver.
Information	SHM(0) sys_peer	NTP is using GPS\GNSS as reference clock peer.
Information	Clock step	Local clock step adjustment.

A full list of NTP service event messages is available at: https://www.eecis.udel.edu/~mills/ntp/html/decode.html

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12. NTP Authentication

12.1. Symmetric Key Cryptography

The original RFC-1305 specification allows any one of possibly 65,534 keys, each distinguished by a 32-bit key identifier, to authenticate an association. The servers and clients involved must agree on the key and key identifier to authenticate NTP packets.

Keys and related information are specified in a key file. Besides the keys used for ordinary NTP associations, additional keys can be used as passwords for the `ntpq` and `ntpdc` utility programs.

When `ntpd` is first started, it reads the key file and installs the keys in the key cache. However, individual keys must be activated with the `trusted keys` command before use. This allows, for instance, the installation of possibly several batches of keys and then activating or deactivating each batch remotely using `ntpdc`. This also provides a revocation capability that can be used if a key becomes compromised.

12.2. NTP Keys

NTP Keys are entered in the following format:

KeyNumber **T**ype Key

where,

KeyNumber	A positive integer (between 1 and 65534).
Type	The name of any digest or cipher supported by the installed OpenSSL package: SHA1 MD5
Key	Must be a printable ASCII string excluding the "#" character of up to 20 characters in length.

Example:

```
1  MD5   Password1
2  MD5   Password2
5  SHA1  Password3
25 SHA1  Password4
```

12.3. Trusted Keys

The trusted keys specifies the key identifiers which are trusted for the purposes of authenticating peers with symmetric key cryptography, as well as keys used by the ntpq and ntpdc programs. The authentication procedures require that both the local and remote servers share the same key and key identifier for this purpose, although different keys can be used with different servers. The *key* arguments are 32-bit unsigned integers with values from 1 to 65,534 separated by a single space character.

Example (from example keyfile above):

1 2 5 25

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13. Uploading User Generated SSL Certificates

All TimeTools NTP servers can accept a user generated SSL certificate for authentication. The user generated certificate must be uploaded into the devices ‘/tmp/admin’ directory using FTP, SCP or SFTP. The uploaded certificate then needs to be saved into flash using the ‘nts security savecert’ command available from a SSH session to the time server.

Command: nts security savecert
nts security savecert [default]

Save uploaded user certificate files 'certificate.crt' and 'certificate.key' to flash.

Specifying default will restore original certificate files.

The device must be rebooted for any network configuration changes to take effect.

13.1. SSL Certificate File Format

The SSL certificate should be in the PEM file format.

The 'nts security savecert' command requires two certificate files: certificate.crt and certificate.key. Both files should be located in the /tmp/admin directory.

The 'certificate.crt' file should contain the server certificate. The certificate should be contained between ---- BEGIN CERTIFICATE---- and ----END CERTIFICATE---- statements.

The seperate 'certificate.key' file should contain the private key. The private key should be contained between ---- BEGIN RSA PRIVATE KEY----- and -----END RSA PRIVATE KEY----- statements.

The default SSL certificate can be reinstated by using the 'nts security savecert default' commands

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14. Adjusting the System Time

In the unlikely event that the device has been powered off for an extended period of time, the units system time, stored in its battery-backed real-time clock may have drifted too far away from the correct time in order for synchronisation to occur. The LCD or web configuration fields GNSS status will show ‘Error’ when a GNSS signal lock is achieved.

In this event, the unit’s system time will need to be adjusted manually to within 10 minutes of the correct UTC time. This can be done by opening a SSH session and logging into the device and using the ‘ttsetclock’ command.

```
admin@NTP001:~$ ttsetclock 0930 25022025        # set the devices system time
                                                # (must be UTC time NOT local time !)
Tue Feb 25 09:30:00 UTC 2015
ttsetclock: System time updated.

/tmp/admin $ exit                               # exit the SSH session
Connection to host lost.
```

The ttsetclock command has the following syntax:

ttsetclock HHMM ddmmyyyy

where:

HH is the hour of the day	- 2 digits, range 0 - 23
MM is the minute of the hour	- 2 digits, range 0 – 60
dd is the day of the month	- 2 digits, range 1 - 31
mm is the month of the year	- 2 digits, range 1 - 12
yyyy is the current year	- 4 digits, range 1000 - 9999

IMPORTANT:
When adjusting an NTP servers system time, **UTC time MUST be used** NOT local time !

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15. NTP Statistics

The NTP service records loop filter statistics and peer statistics in files named loops.yyyymmdd and peers.yyyymmdd, where yyyymmdd is the date that the statistics refer to. The files are available in the devices \tmp\admin\ntpstats directory. Individual files are stored for 7 days before being discarded.

If required, the files can be downloaded from the device using FTP or SFTP.

File Location: /tmp/admin/ntpstats
File Format: loops.yyyymmdd
peers.yyyymmdd
Days Kept: 7 days

Description:

The loopstats file records NTP loop filter statistics. Each update of the local clock outputs a line of the following form to the file generation set named `loopstats`:

```
50935 75440.031 0.000006019 13.778190 0.000351733 0.0133806
```

The first two fields show the date (Modified Julian Day) and time (seconds and fraction past UTC midnight). The next five fields show time offset (seconds), frequency offset (parts per million - PPM), RMS jitter (seconds), Allan deviation (PPM) and clock discipline time constant.

The peerstats file records NTP peer (reference clock) information. Each update from a peer outputs a line of the following format to the file generation set named peerstats:

day, second, address, status, offset, delay, dispersion, skew (variance)

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16. Reset to Default Configuration

In the event of a network configuration error or lost or forgotten password, the device can be reset to default (factory) settings using the 'Def' push-button on the rear panel.

Press and hold the 'Def' push-button for 10 seconds in total to reset to default (factory) settings.

After an initial 3 seconds, the 'Alarm' LED indicator will flash rapidly.

Contuniue to hold the 'Def' push-button. After a further 7 seconds, the 'Alarm' LED indicator will remain steady.

Release the push-button and the device will automatically restore default settings and restart.

The 'Def' push-button can be released at any time during the 10 second hold period to cancel the operation.

16.1. Disabling the 'Def' Push-Button Default Configuration Operation

If required, the 'Def' push-button operation can be disabled using the SSH command 'nts system defaultsw', see section “System Commands” above.

IMPORTANT:
If the 'Def' push-button default configuration operation has been disabled, in the event of forgotten or lost password, the devices flash memory will need to be completely re-programmed.

16.2. Flash-Loader

If the 'Def' push-button is pressed as the device is powered-up, the flash loader will be run, allowing reprogramming of the flash memory.

Powering the device down and releasing the push-button will clear the flash-loader function. The flash loader functionality cannot be disabled.

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17. Copyright and Permission Notices

17.1. Network Time Protocol (NTP) 4.2

```
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********************************************************************************
```

17.2. GNU Public Licence

Version 3, 29 June 2007

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