DiSIM New SIM Card Server (nSCS)

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Overview

nSCS is a single-board device featuring an Ethernet up-link connection, a local processing module and up to 32 SIM Card Holders in three layout mixes:

- 16 Holders available at board edge (hot-pluggable SIM Cards)
- 16 Holders at board edge + 16 internal Holders
- 32 internal Holders

An USB Service Interface is also available for management, debugging and service.

The board powers from a single 5Vdc supply and spans over a single Eurocard Rack slot (6U height).

Regardless of the SIM Holders layout, the nSCS device can be used as a stand-alone SIM Card Server (SCS) or as part of an extended Virtual SIM Card Server (vSCS).

Stand-alone nSCS deployment

In stand-alone mode, the nSCS needs only an Ethernet connection (possibly shared with other nSCS devices through an Ethernet switch) and a gateway / router or direct connection to a public network accessible to clients.

Note: Direct connection of nSCS devices to a public network (Internet) is strongly discouraged because of potential security vulnerability. Internal nSCS processing module has a minimal TCP/IP stack with weak support for security and packet filtering options. Use of a filter / router and / or a firewall between the nSCS device(s) and public networks would minimize the risk of attacks and undesired access (flooding).

Stand-alone mode is fully compatible with existing SIM Card Servers, with only a maximum of 32 SIM Card Holders available per server instead of 48. All functional commands are processed by the internal unit without the need of any other external hardware or software.

Compatibility with the first version (v1) of SIM Card Server and some management and configuration commands has been removed, but the complete v2 functional compatibility is guaranteed.

Minimal SOAP support and HTTP Server are implemented and ready to be used by SCS v2 clients.

In this mode, the DiSIM nSCS device is a direct, 1:1 replacement for existing DiSIM SCS installations.

Note: Please be aware that traditional SCS v2 clients cannot handle the concept of hot pluggable SIM Cards. So when using the nSCS as a replacement for existing DiSIM SCS installations, handle the insertion / removal of SIM Cards with extreme care (close connections first, frequently refresh inserted SIM Cards list, etc).

To use nSCS in stand-alone mode, the only needed configuration settings are:

- a static IP Address and TCP listening port for the SCServer
- an additional TCP port for SOAP / UPnP Server (if used)

Note: Care must be taken when configuring multiple nSCServers on the same internal subnet to be used by v2 clients. Traditional SCS v2 clients (SCESupport.dll) can handle only a single server per IP address (regardless of assigned port number).

If a front-end router / gateway is able to identify hosts based on MAC Address and / or Hostname and route / NAT packets to designated nSCServer based on symbolic names, DHCP can be enabled for automatic IP Address assignment. But a single nSCS will be available to traditional SCS v2 clients on the external (public) IP address.

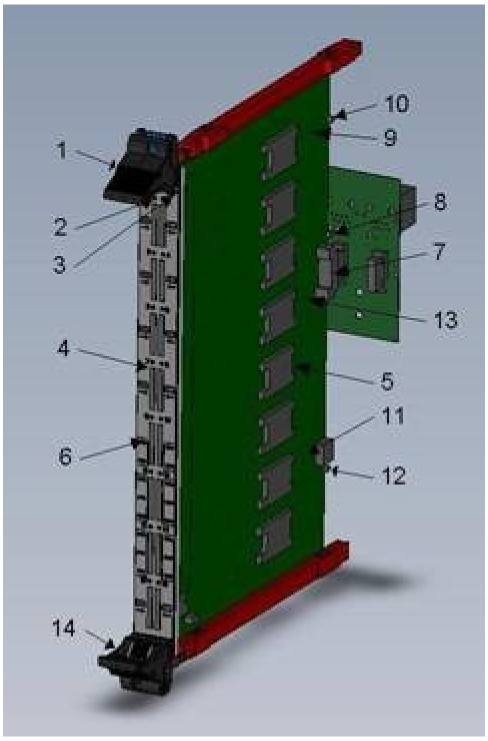
The DHCP Server may also be instructed to assign specific settings to nSCS DHCP Clients, based on reported MAC (Ethernet Address), Hostname and Vendor Class Identifier.

Configuration parameters (addresses, timeouts, access control, etc.) that apply to SCS v2 can be set using global configuration pages or DHCP Server.

The Logging section can be enabled and used, independently of the SCServer v2 compatibility mode.

nSCS Hardware Description

The nSCS board diagram is presented in figure:



1. Front-panel upper handle
2. Service Processor LED
3. Main Processor LED
4. Front-panel SIM Holders
5. Internal SIM Holders
6. Front-panel SIM Holder LEDs
7. Backplane connector (power supply, Ethernet)
8. Ethernet LEDs
9. Board power supply regulator
10. Power LED
11. Service Interface processor
12. USB Connection LED
13. Main Processor
14. Front panel lower handle (with switch)

To insert the nSCS board into the rack follow next steps:

- Place the board in vertical position with SP/MP LEDs upward;
- Select a position in rack and slide the board along the red guiding rails. Be sure to match the upper/lower rail position so that the board is vertical;
- The upper/lower front-panel handles must be in the “open” position (outward);
  Note: The small screw in the handle may sometimes prevent the handle (hook) to fully open. When this happens, please push the screw inside to let the hook open completely.
- Align the hook claws with the perforations in the upper/lower edges of the rack. The claws must properly engage in those perforations (slightly move the front-panel left/right to find the right position).
- Gently close the front panel hooks (inward position). The white button in the middle of the handle should click when fully closed. The nSCS board should now be properly engaged with the backplane connector.

When the lower front-panel handle is fully closed, the micro-switch inside the handle will signal the board that operating conditions are met and it can start running.

To remove the nSCS board from the rack, first push the white button in the lower front-panel handle. The micro-switch will signal a software reset to the board which will stop running in a few seconds.

Then push the white button in the upper front-panel handle and open the handles (outward). The board will disengage from backplane connector and upper/lower edges of the rack. Pull the board outside the rack along the guide rails.

Note: The little screw inside the front-panel handles can be used to permanently fix the board inside the rack. Be sure to unscrew them first, before attempting to remove the board from rack.

nSCS Functional Description

Once the nSCS board is inserted into the rack and 5Vdc supply is present, the device is ready to run.

First the Service Processor (SP) wakes-up and begins a series of hardware and firmware self-tests. During this time, the SP LED on the front-panel will light Red. This stage should take only a few milliseconds.

If everything is in order, the SP LED color turns Orange.

Note: The Service Processor can be powered by the board 5Vdc supply or through USB connection. Thus SP can run without powering the rest of the board. This mode is intended for factory / debugging service and should not be used during normal operation (disconnect USB cable before powering the board).

While operating conditions are not met (5Vdc supply absent or outside allowed range and/or front-panel lower handle switch is open), the Service Processor will hold the rest of the board in Reset, with board power turned Off. The SP LED on the front-panel will flash Orange.

When 5Vdc supply is present and stable, Power LED will turn Green. If the handle switch is also closed, SP will turn On the board power (Power LED lights Orange) and release board Reset. From this moment on, the Main Processor takes control of the board. SP LED will stop flashing and light stable Green.

SP will continue to monitor operating conditions and signal (software) to MP any alarms. MP is responsible to reset Holder Processors and himself, returning to initial operating state (driven by SP) when done.

When Main Processor starts running, it will also perform first some hardware and firmware self-testing. During this time the MP LED on the front panel will light Red and the step should complete in a fraction of a second.

If MP remains in this initial step with LED Red, the board is facing unrecoverable hardware or firmware errors and must be diagnosed through the Service Interface (USB).

Note: Some firmware errors can be recovered automatically. MP is able to reprogram the Base firmware from a backup copy saved internally. This may last for a few seconds and should not be considered a permanent error.

DO NOT TURN OFF the board power during this time.

A permanent error should be considered only if no activity is performed by MP during 10 or more seconds.

If internal tests complete with success, MP LED on the front-panel will turn Orange.

Next step is to activate the Ethernet connection. Without a proper network connection, MP will remain in this stage indefinitely.

Note: The entire purpose of the SIM Card Server is to offer network services to clients. Also the one and standard access point to the device is the network interface. Thus no activity can be performed without a proper network connection and the entire system sleeps in an idle state.

Once the Ethernet link is available, DHCP configuration process starts (see **nSCS Configuration** for more details).

Next stage is to search for firmware update if *Automatic Updates* are enabled. MP will contact the designated *Update Server* and request updates for current firmware versions running on different processors on the nSCS board (Service, Main Base, Main System and Holders). If an update for any of those is available, it will be downloaded and applied. The board will then Reset/Restart and the process will repeat until all firmware parts are synchronized with the firmware images stored on the *Update Server*.

Note: When new firmware releases are found on the Update Server, it is possible for this boot stage to last for significant periods of time. During this time the board may seem to behave heretically, with

LEDs flashing Red and network connection going up and down repeatedly.

For example, reprogramming Holder Processors may last up to one minute on a 32 Holders board.

Don't panic and let the system do the job. It is normal and the update phase will eventually end. It is an error only if the system seems to hang-up in the same state for a long period of time (minutes). Logging is available and update errors can be detected by inspecting the log files.

After the update phase completes with network link up and no other updates to be downloaded, a final suite of tests is performed on the complete system and SIM Holders. Results of those tests are not preventing the device to function as a whole. Errors for specific services or holders will only disable functionality of the offending section without affecting the rest. Services will log the error (or fail to log the normal operating start) and HP LEDs on the front-panel may turn Red and remain like that.

The normal operating state of the nSCS device is indicated by the MP front-panel LED turning Green and flashing regularly each second. SP LED is Green from a previous stage and Ethernet LEDs are On, depending on link parameters.

HP LEDs on the front panel will light Orange for about 4 seconds (lamp test) then go into ready/idle state.

This normal operating state can be interrupted by a number of events.

First, SP can signal a power failure or front-panel switch opening. When this happens, MP will notify all child services and processors, close pending connections, deactivate the Ethernet adapter and go into initial state. On power failure events, MP will auto-Reset (software) and pass control over to the SP.

Tip: It is possible to use the lower handle on the front-panel (micro-switch) as software reset of the nSCS device. The entire device is placed in a stand-by position and SIM Cards can be safely inserted or removed if client software is not able to deal with hot-plugging.

Also the complete device initialization stages are repeated, possibly recovering from errors and hang-ups.

Reset/Restart commands can also be submitted over Telnet, Web or Service Interface. Again, the device shuts down and initialization is repeated (see respective sections for more details).

Finally, network connection failures will stop all services and holder processors and the device will enter a stand-by state until network link is back up.

Scanning for updates is repeated automatically at specific intervals in background. If new firmware versions are detected during normal system operation, they will only be logged without interrupting functionality. When network connection drops or the system is Reset/Restarted, pending updates are applied automatically (if enabled) before normal device operation resumes.

Summary of LED indication:

Power LED states:

Shut	Board power (5Vdc) not present
Green, steady	5Vdc power supplied to board
Orange, steady	3V3 board power (on-board regulator) On

Ethernet LEDs states:

Shut	No connection
Green	Connected 10BASE-T
Orange	Connected 100BASE-TX
Flashing (Green or Orange)	Link activity (Rx/Tx)

Second Ethernet LED (board back):

Shut	Half-duplex link
Flashing	Collision (half-duplex only)
Green, steady	Full-duplex link

USB LED states:

Shut	USB not connected
Green, steady	USB connected, no host application
Orange, steady	USB connected, Service/Test/Debug mode
Green or Orange, flashing	USB Suspend state

SP LED states:

Shut	Board/SP not powered
Red, steady	SP internal error
Orange, flashing	No board power, holder switch open
Orange, steady	Testing / starting MP
Green	Normal operation
Other	Intermediate upgrade stages or hang-up (bug, please report)

MP LED states:

Shut	Not powered
Red, steady	MP internal error
Orange, steady	No network
Green	MPBase running (testing, upgrading, etc)
Green, flashing	MPSystem running (normal operation)
Other	Intermediate upgrade stages or hang-up (bug, please report)

Important: If MP LED stops flashing during normal operation (either steady Green or shut) please turn off the board power or disconnect the network link. This may be a network hang-up and the nSCS device may flood the local network with garbage Ethernet packets.

(Please see dedicated section for Holder Processors functional description).

nSCS Configuration

nSCS devices need a minimal configuration before being able to run.

There are four levels of internal configuration storage, explained bellow.

- Layer1 – non-volatile EEPROM for permanent storage of configuration settings. This area is empty on new devices meaning to use build defaults for all configurable parameters;
- Layer2 – RAM copy of entire EEPROM content. Because the slow access time of EEPROM, a second storage area is allocated in internal RAM. Copy from Layer1 to Layer2 is performed automatically after each boot;
- Layer3 – this is another RAM area initialized by DHCP service before network configuration. Layer2 configuration is copied here, then build defaults are set for all parameters not defined in permanent configuration. This step is performed each time the network connection goes up, even if DHCP client will not run or a *DHCP Server* is not configured or available;
- Layer4 – is the complete (operational) configuration resulted by applying settings received from *DHCP Server* (if any) to the default configuration build in Layer3;

After completing the last step (Layer4) internal services and processing modules are allowed to run. Layer3 and Layer4 configuration are discarded each time the network connection is down (services and processing modules are stopped) and rebuild when network connection is up again.

Changing configuration settings can be performed over various interfaces (Web, Telnet and Console) and operates on Layer2. In order for those changes to take effect, a *Network Reset* or *System Restart* (without *Reboot*) is needed. A good practice would be to change configuration parameters in Layer2 then test system operation. If everything works as expected, changes can be made permanent by storing Layer2 to Layer1 (EEPROM).

Minimal configuration that allows the device to operate must define the IP layer parameters. There are build defaults for mandatory parameters and an IP address can be automatically generated. Other internal services can be stopped/not functional by default or running with default parameters.

The IP address and Subnet Mask can be set from permanent (stored) configuration, using a DHCP Server or auto-generated in the “local link” address space (169.254.x.y).

If a *DHCP Server* is available in the local subnet, the complete configuration can be set or modified. Some configuration options conform to the DHCP standard, other are vendor extensions. The name for the vendor class is **DISIM.nSCS10** and the *DHCP Server* can be instructed to respond with vendor options to devices that advertise in this class (see an example in **Annex B**).

Configurable parameters are grouped in several sections. For each group it is possible to apply different methods of handling configuration:

- ***Use Configured*** – this method apply by default to all groups. When this method is allowed for a group, the configured values from Layer2 are used to build Layer3. If this method is not allowed, settings in Layer2 are ignored and Layer3 is either left not set or filled with build defaults for mandatory parameters.
- ***Use DHCP*** – this method apply by default to all groups. When this method is allowed for a group, the settings received in response from a *DHCP Server* will override existing settings (in Layer4). If no *DHCP Server* is available or no response is received or the received response does not contain the relevant parameter option, the value is left as initialized in Layer3. If this method is not allowed, the DHCP client will not request parameters in that group and received options for those parameters (if any) are ignored.

As a practical conclusion, when both methods are allowed (the default case), configured values are used where present, build defaults are filled where needed, then DHCP service overrides any of them based on the options received from a *DHCP Server*.

When Use Configured is not allowed, only build defaults and maybe DHCP options are used to build Layer3 and Layer4 of configuration.

If none is allowed, the processing module or service that depends on that parameter group is left unconfigurated and thus not running. The only exception is the IP layer which is configured with an auto-generated address (local link space) and default parameters to make the device available on the network with limited functionality for possible reconfiguration.

Use Configured method can be disabled to completely ignore a group of parameters already stored in configuration without the need to delete them individually. The function will relay on DHCP options (if *Use DHCP* is enabled and relevant options are received) or will not operate at all. Enabling the service later with pre-configured parameters will only take one click.

A preferred *DHCP Server* can be preset in configuration. If set, the first attempt to retrieve configuration parameters will be addressed to that server (unicast). If the server fails to respond (after multiple retries), the normal broadcasting method is applied to search for other available DHCP servers. Subsequent messages exchange with the *DHCP Server* will use the address of the first one to respond, either preset or discovered by broadcast.

The list of configurable parameters for the nSCS device is presented bellow:

1. LAN settings group

IP Address

Standard DHCP

Build default: auto-generated in local-link address space (169.254.x.y)

Address to be used (Configured, DHCP or auto-generated) is verified with ARP probes. If address fails the test, a new request is sent to DHCP server or another random address is generated. Auto-generated mode is the fall-back if any other method fails or is not available.

Note: once an IP address is auto-generated and verified, the configuration process ends and the device starts operating. Even if a DHCP Server becomes available at a later time, the device will not attempt to reconfigure itself. A Network Reset is needed in order to restart the configuration process.

Subnet Mask

Standard DHCP option 1

Build default: 255.255.0.0 with local-link IP address

Broadcast Address

Standard DHCP option 28

Build default: IP Address OR complemented Subnet Mask

ARP Timeout

Standard DHCP option 35

Build default: 20 minutes

IP Time-To-Live

Standard DHCP option 23

Build default: 64

TCP Time-To-Live

Standard DHCP option 37

Build default: 40

DNS Servers (up to 3)
Standard DHCP option 6
Build default: none

Current firmware version does not use DNS to resolve host names. There is no processing module or service that needs to resolve remote machine names and all configuration parameters involving external machines are set using the IP address and not the DNS name. For this reason a DNS client is not implemented and this configuration parameter is ignored.

Domain Name
Standard DHCP option 15
Build default: no name

Classless Routes
(Almost)Standard DHCP option 121
Build default: none

Under testing. Please do not use for the moment (ignored).

Gateway
Standard DHCP option 3
Build default: none

When not defined, connections can be made only in the local subnet.
Please define and allow external connections to the *Update Server*.

Static Routes
Standard DHCP option 33
Build default: none

Under testing. Please do not use for the moment (ignored).

2. Time settings group

Time Server
Standard DHCP option 4
Build default: none

Current firmware version is not using a Time Server connection as fall-back for Real Time Clock synchronization. Only NTP Server options are available. Please do not use (ignored).

NTP Server
Standard DHCP option 42
Build default: none

Listen to NTP Broadcasts
Vendor option 1

Build default: yes

The device needs to synchronize the internal Real Time Clock from an external source because there is no battery backup. Every time the device is rebooted the internal clock starts from zero UTC (01.01.1970 00:00:00). A good time source is required mainly for logging timestamps.

If no time source is available, the messages timestamp will reflect the Time-Since-Boot.

Note: the precision of internal clock is better than 50ppm which could lead to a drift of up to 5 seconds per day. Periodic clock adjustment using a NTP Server is recommended for long term, unattended running. Using a broadcasting NTP Server in the local subnet (roughly once every minute) can synchronize automatically a large number of devices.

3. Logging settings group

Log Server

Standard DHCP option 7

Build default: none (no logging)

Log Server Port

Vendor option 9

Build default: 514 (UDP)

Log Facility

Vendor option 10

Build default: 16 (Local0)

Log Level

Vendor option 11

Build default: 3 (Info)

Log Level values are slightly different from standard to allow multiple debugging levels (see **nSCS Logging** section for details).

4. Update settings group

Enable Automatic Updates

Vendor option 8

Build default: no

Update Server

*Standard DHCP option 72(*see Note)*

Build default: update.disim.org (86.34.19.60)

Standard DHCP option 72 refers to “WWW Server” and it is used as *Update Server* address simply because updates are stored on the same server (www.disim.org). The name (update.disim.org) is hard-wired to a static address because there is no DNS client implemented.

However this parameter is configurable to allow redefinition of the update store. In large implementations it is advisable to maintain a local copy of update files in order to allow unnecessary external network traffic from each device (see **nSCS Firmware Update** for more details).

Update Server Port
Vendor option 12
Build default: 80 (http)

5. UPnP settings group

UPnP Enable
Vendor option 2
Build default: yes

The UPnP Server contains two parts: the UPnP advertise / discovery mechanism using multicast UDP messages and a HTTP Server responding to requests from clients.

This HTTP Server is shared between UPnP infrastructure and SOAP support (see bellow) and is enabled if any of those services is active.

This flag (*UPnP Enable*) controls the UPnP service: enabled means UPnP multicast engine + HTTP Server.

Tip: If enabled, the UPnP service can be used to discover the IP address currently used by the device (for example when auto-generated) by inspecting the "Presentation" field in NOTIFY messages.

SOAP/UPnP Server Port
Vendor option 13
*Build default: random or 17117 (*see Note)*

When only the *UPnP Server* is enabled, the port for the associated HTTP Server is configured randomly. Please note that the main HTTP Server implemented on device is always responding to standard port 80. This parameter cannot be set to this value (80).

If *SOAP Support* is enabled (see bellow) the default port for the SOAP/UPnP Server is 17117 and can be changed to another value using this parameter.

UPnP Time-To-Live
Vendor option 14
Build default: 4

Set this parameter to the required number of routers / gateways the UPnP announcements must traverse in order to reach all potential clients.

In auto-generated IP Address mode (local-link) this parameter is automatically set to 1 (local subnet only).

6. SIM Card Server settings group

SIM Card Server Enable
Vendor option 3
Build default: yes

Enable SIM Card Server functionality of the device.

SIM Card Server UDP Enable
Vendor option 4
Build default: no

Under testing. Please do not use for the moment (ignored).

SIM Card Server Port
Vendor option 21
Build default: 7117

Port number used for both TCP and UDP connections from SCS clients.

SIM Card Server Connection Timeout
Vendor option 22
Build default: 0 (disabled)

SIM Card Server can close client connections that are inactive for this interval.
Allowed value for this parameter is in the range of 300..43200 seconds (5 minutes to 12 hours).
Zero means the function is disabled.

SIM Card Server Keepalive Interval
Vendor option 23
Build default: 0 (disabled)

SIM Card Server can send void packets at specified interval over a client connection to test if still active. After a number of probes without response, when *Connection Timeout* limit is reached, the client connection is closed.
Allowed value for this parameter is in the range of 60..3600 seconds (1 minute to 1 hour).
Zero means the function is disabled.

SOAP Server Enable
Vendor option 5
Build default: yes

SOAP Server cannot be enabled unless the SIM Card Server is also enabled.
See SOAP/UPnP Server Port parameter for details about associated HTTP Server port.

Web page configuration

The nSCS device Web page is available at http://<ip address>/
The configuration parameters currently used by the device (Layer4) are shown in menu section **Status** / ***Settings***.
The **Configuration** menu section is dedicated to configuring the device. Configuration parameters groups are available in separate pages (LAN, Time, Log, etc.).
In each configuration page, the first row shows action buttons used to send configuration requests to the nSCS device.

Refresh – reload configuration parameters in all sections from device (last *Saved* values).

Save – save configuration values in all sections that are modified since last Save / Refresh.

Because Refresh and Save act globally on all configuration groups (sections) it is possible to navigate between pages and make modifications in any section before saving them to the device. Leaving a configuration page (section) will not loose the changes made there.

Defaults – reset all configuration parameters to factory defaults (all empty / not set, Use DHCP enabled).

Store – save modifications in non-volatile EEPROM (Layer2 to Layer1). This action is queued internally in the device and will be executed in the first available time slot. It will usually take less than one second and only a power failure during this time may prevent completion. At all times there is a backup copy of the entire Layer1 configuration so even if the storing process fails to complete, the device will still be usable with the last *Stored* configuration parameters.

Note: Actions that change configuration settings (Save, Defaults and Store) are protected by a password (see ***Access Protection*** *for more details).*

Network Reset – force a network down – up sequence. The device will close all connections (including the Web page client) and will reset the network adapter for about 5 seconds. When network is back up, the internal configuration sequence is performed, using currently saved values.

Tip: change configuration parameters as needed and ***Save*** *them. Then apply a* ***Network Reset****. The device will restart with Saved configuration settings (Layer2 in RAM). It is then possible to check if desired operating mode is performed and finally* ***Store*** *in non-volatile EEPROM (Layer1).*

Automatic configuration and status (application software)

Configurable parameters of nSCS devices and configuration operations can be performed without manual interaction in the Web page by using scripts or software applications. The only requirement for such a script or application is to be able to send **HTTP GET** requests to the device IP Address and parse the received response.

Example HTTP Request (TCP packet to device IP Address, port 80):

```
GET <URI> HTTP/1.1
Host: <ip_address>
User Agent: ...
```

Example HTTP Response:

```
HTTP/1.1 200 OK
Date: Mon, 04 Nov 2013 15:36:33 GMT
Server: nSCS-HTTPServer/0.20.104
Content-Type: text/plain; charset=utf-8
Content-Length: ...

<response_body>
```

Following table shows some possible values for the URI parameter of the GET request.

URI	Response Status	Response Body	Action

/Configuration	200 OK	list of nSCS_... configuration parameters	Refresh
/Configuration/Set?query_string	200 OK 206 Partial Content	list of nSCS_... configuration parameters	Save
/Configuration/Reset	200 OK	list of nSCS_... configuration parameters	Defaults
/Configuration/Store	204 No Content	None	Store
/Manage/NetReset	204 No Content	None	Network Reset

Note: The “206 Partial Content” response status is used to indicate that some parameters are set, other encountered errors (for example invalid name or value). The returned list contains actual parameter values. Compare the sent query string with returned values to locate possible errors.

The query string passed for the Configuration **Save** action is build the usual way:

/Configuration/Set?parameter1=value1&parameter2=value2&...

Accepted *values* are 0 / 1 for boolean variables and strings for all other parameters. Strings can be empty to set the associated parameter to “undefined” (use default).

There is no need to send a complete list of parameters with each request: only those who change value should be included in the query string.

The parameter list returned in the HTTP Response body contains all *parameter=value* pairs, one per line.

To find accepted *parameter* names, please send a **Refresh** request (*/Configuration*) and inspect the returned list.

Note that further versions may add new configurable parameters to the list, but names of existing parameters will never change.

Access Protection

Client connections to the Telnet and HTTP Servers provided by nSCS devices may sometimes require Authentication before proceeding.

For example, requests sent by the Web page (browser) or controlling application that could modify configuration settings or change the device operating mode are set to require prior authorization. Telnet sessions request a password to be entered (login) at the beginning.

nSCS devices provide a single user name “Administrator” with an unique attached password. Care must be taken when managing this password as it cannot be changed or reset unless it is known, therefore all-or-nothing access rights are granted to clients.

The default (factory preset) password for the Administrator is “admin”.

Authentication over Telnet is unsecure because password is sent in plain text over the TCP connection and can be easily sniffed with any network analyzer.

Therefore, avoid using Telnet connections from remote clients unless absolutely necessary. Local subnet connections are supposed to be protected by a firewall so there is less danger.

Regular browsers use two methods to handle Authentication requests: Basic and Digest.

Basic method is sending a Username and a Password in plain text so it’s of little use. Digest method requires the server (in this case the nSCS device) to memorize a random piece of data for each client and this cannot be implemented in nSCS.

The method used by nSCS is a derivative of Digest. A “LocalKey” is randomly generated after each boot and it’s shared by all clients. Based on this key and the connection IP address the server generates a “SessionKey” for each client. The browser responds with the hash of this key and the Password entered by user (the “LoginKey”) and that is validated by the server.

The “LoginKey” could be sniffed and reused by another client only if it connects from the same IP address and it uses the key during the same nSCS session.

Therefore, after authenticating to use any of the protected commands, it is a good practice to Restart/Reboot the nSCS device in order to invalidate the “LocalKey” and thus anything derived from it.

For controlling applications that want to pass commands to a nSCS device, the authentication mechanism should be implemented as follows:

1. Pass a request to the server (nSCS device).
2. If the requested resource is protected, the server will respond with “401 Unauthorized”.
3. In the response header the server set a cookie “sessionkey=...” with a 32 hex characters value
4. Application should hash using MD5 algorithm the following string:

   hostname**password**sessionkey

   where: hostname is the 15 characters nSCS device name (SCSyyyyww...)

   password should be a UTF-8 encoded string of 4..15 characters

   sessionkey is the binary block of 16 bytes parsed from the received cookie
5. Application repeats the initial request (step 1) with a Cookie header containing the received sessionkey and the computed loginkey.
6. If authentication pass, the server will respond with the normal answer to the requested resource. If not, the server will respond with “403 Forbidden” status.
7. The keys can be reused in subsequent requests without modification if sent from the same IP address and during the same nSCS session. If something changes during this time, the server will delete the sent keys (cookies), generate a new sessionkey and respond again with “401 Unauthorized” status. Client should regenerate a loginkey based on the new sessionkey and retry the request.

nSCS Logging

nSCS device is able to log a variety of information to an external destination. Internally the device features a ring buffer able to hold about 1000 messages. The buffer is flushed to the external destination (Log Server or Console) when available. The logger will push a “missed logs” message if the queue was forced to discard oldest messages to make room for new ones. At any time, if a Log Server is configured or Console connected over USB, the last log messages stored in internal buffer will be received in a continuous stream.

Please beware of high network traffic when configuration is changed during normal operation.

Logging to an external Log Server complies with the Syslog Protocol (RFC 5424). Log messages are sent using UDP transport, to a configurable IP address and port.

The format of UDP packets is (only bolded sections are variable):

<**pri**>1 **yyyy-mm-dd**T**hh**:**mm**:**ss.ff**Z **hostname appname procid msgid** – **msg**

where:

pri = Log Facility * 8 + Log Severity (decimal number)

yyyy, **mm**, **dd**, **hh**, **mm**, **ss**, **ff** = message timestamp as UTC time or time-since-boot, with 1/100 second resolution. Please note that this is the time the message was posted by the processing module, not the time the packet was sent out. When mixing log messages from multiple sources, if internal clocks are not perfectly synchronized, received packets may not show timestamps in ascending order.

hostname is the nSCS device name (SCS...)

appname is name of the source of the log message. It can be:

MP the Main processor

HPxx Holder xx processor

SP the Service processor

procid is the name of the processing section inside the processor that sourced the message (System, Ethernet, DHCP, Upgrade, SIM Card, etc.)

msgid is the message type number (EventId)

msg is a descriptive string generated internally based on msgid and attached parameters (if any).

Please note that some log messages may not have a human readable description (for example debugging check points). In this case the meaning of the message is defined by msgid and a list of hexadecimal numbers (the attached parameters).

The configurable Log Level defines the Severity of log messages that are to be stored in the internal buffer. Only messages with Severity equal or above the preset Log Level are stored in the internal buffer (and then sent out). Messages of lower Severity are ignored (discarded).

The Log Level may be set to different values for MP, HP and SP. At boot all use the configured or default Log Level. Changing the Log Level for a single source allows a closer inspection of the operation of that source without flooding the log buffer with messages from other sources.

However, the Log Level for a source is unique and shared by all modules (**procid**) so it is not possible to set different levels for processing subsections inside that source. For example either all or none of received network packets can be logged by MP Ethernet module. It is not possible to see only TCP traffic, ignoring other packets or see DHCP errors only and debug information for the Update module.

The Log Severity levels defined in Syslog Protocol are slightly changed to allow more debugging levels.

0 – State Logs at any preset level (highest priority) information about device operating state.

1 – Error Logs errors encountered in any processing module. The error itself may not be relevant without operating information (messages of lower severity) but it can be a sign something is wrong and the Log Level can be raised to detect the operating stage that triggers the error.

2 – Warning Logs messages signaling something is not right but not fatal for the operation of the processing module.

3 – Info (default) Logs informative messages about sequence and processing phase. Useful to locate the source of Errors and Warnings.

4 – Debug Logs more detailed information about processing phase.

5..7 – Debug1..Debug3 Logs even more detailed information with sequence of bytes, packets content, etc. Please be sure to have a fast and reliable log destination if using any of those levels because of the massive amount of data.

There are numerous applications able to parse and display Log messages conforming to Syslog Protocol. Linux systems offer a built-in daemon for this purpose (see an example in **Annex C**).

nSCS Firmware Update

nSCS devices can perform automatic firmware updates of processors firmware.

There are four firmware parts, each targeting a specific processor on board. Firmware images are stored in files with extension **.fuf** (Firmware Update File), a proprietary format.

At boot, network reset or periodic intervals, the nSCS device attempts to connect to an Update Server, request the header of available update files, compare versions and (if needed) download and install the update(s).

If the connection cannot be made or the files are missing, a complain will be logged but this is not a fatal error.

Please also note that Automatic Update is not performed during normal operation of nSCS devices. If an update is detected on server but the device is operating, only a message will be logged. The update will be downloaded at a latter time, after next boot or network reset and only if Automatic Updates are enabled. The reason for this behavior is that updating firmware requires a device reset and that could disturb normal device operation and active client connections.

By default, the address of the Update Server is hardwired in firmware to “update.disim.org” HTTP Server.

For isolated or secured deployments of nSCS devices, it is possible to configure an alternate IPAddress : Port for the Update Server (see **nSCS Update settings**).

The HTTP Server responding to the configured address:port must be able to handle **GET** requests with the **Host** request header set to **update.disim.org** (no DNS lookup) and honor **Range** request header for partial file downloads. The HTTP Server should not process the FUF file in any sense and must send it in binary format. If needed, a MIME association should be configured for the file extension **.fuf** to **application/octet-stream**.

The four update files searched by nSCS devices on the Update Server are:

/nSCS/MPBase.fuf – update file for Main Processor base firmware

/nSCS/MPSys-MM-mm.fuf – update file for Main Processor application firmware

where MM and mm are the version numbers of the compatible **MPBase** firmware

/nSCS/SPSys.fuf – update file for Service Processor firmware

/nSCS/HPSys.fuf – update file for Holder Processors firmware

The reason for versioning the **MPSys** file name is to allow different releases to coexist at end-user sites. Application firmware can be updated over an existing base while other installations are using a completely different release.

However, it is recommended to apply the complete update packet of four files simultaneously and move to a new release because of the possible internal interactions between processors.

To setup a local *Update Server* perform the following actions:

1. Setup a HTTP Server to respond on a local (fixed) TCP address:port.
2. Configure a virtual server named **update.disim.org**
3. Create a folder named **nSCS** in the document root of the virtual server
4. Configure the virtual server address:port in all nSCS devices that should update through this mirror
5. Inspect the log files of the virtual server and nSCS devices to confirm that HTTP connections (after next boot or network reset) are made to the right destination
6. Periodically inspect the **Update Files** section at **www.disim.org** server. Click on the file name to download and save it into the **nSCS** folder of the virtual server. nSCS devices will pick it from there at the next update check.
7. Don’t forget to reset the network periodically while the server is in idle state to allow updates to be installed.

Hardware / Functional Characteristics

Main System
ASIX11015 processor @100MHz
Ethernet adapter IEEE802.3, 10BASE-T/100BASE-TX, Half/Full-duplex, Auto-MDIX, Flow control
Proprietary firmware with fast IPv4 stack (ARP, IP, ICMP, IGMP, UDP, TCP)
Automatic configuration (by DHCP, RFC2131)
Logging to external host with configurable level (Syslog Protocol, RFC5424)
Real Time Clock synchronization (by SNTP, RFC4330)
Telnet Server (RFC854)
HTTP Server v1.1 (RFC2616)
UPnP Server (conforming to DeviceArchitecture v1.0 - www.upnp.org)
DiSIM SCServer (v2 compatible)
DiSIM SOAP Server (v2 compatible)
Automatic upgrades

SIM Holders
Conforming to IEEE 7816 and 3GPP TS.102.221 specifications
Support for SIM Cards Class ABC (5V default / 3V / 1.8V)
Support for SIM Protocol T=0
Fixed SIM Clock 4MHz
Support for SIM Speed divider 372:1(default), 512:2 ... 512:32
Support for SIM Clock Stop (warm stand-by)
SIM Presence (insert) sensor

Annex B

Configuration example for a Linux **ISC DHCP Server**

File **/etc/dhcp/dhcpd.conf**

```
# ...global DHCP options

# Classless static routes definition
#option classless-static-routes code 121 = string;

##### DISIM Devices ##############################
option space DISIMDev;

##### General options for all Lan DISIM devices
# Subnet Mask by standard option "subnet-mask"
# Broadcast Address by standard option "broadcast-address"
# ARP Timeout by standard option "arp-cache-timeout"
# IP Time-To-Live by standard option "default-ip-ttl"
# TCP Time-To-Live by standard option "default-tcp-ttl"
# Domain Name by standard option "domain-name"
# DNS Servers by standard option "domain-name-servers"
# Classless Routes by (standard) option 121 (includes DefaultGateway)
# Default Gateway by standard option "routers"
# Static Routes by standard option "static-routes"
# Time Server by standard option "time-servers"
# NTP Server by standard option "ntp-servers"
# Listen to NTP broadcasts (default on)
option DISIMDev.ListenNTPBcast code 1 = boolean;
# Log Server by standard option "log-servers"
# Log Server Port (default 514)
option DISIMDev.LogServerPort code 9 = unsigned integer 16;
# Log Facility (16..23->Local0..Local7, default Local0)
option DISIMDev.LogFacility code 10 = unsigned integer 8;
# Log Level (0..7->state|error|warning|info|debug|debug1|debug2|debug3, default 3)
option DISIMDev.LogLevel code 11 = unsigned integer 8;
# Enable Automatic Update (default off)
option DISIMDev.AutoUpdate code 8 = boolean;
# Update Server by standard option "www-server"
# Update Server Port (default 80)
option DISIMDev.UpdateServerPort code 12 = unsigned integer 16;
# UPnP Server Enable (default on)
option DISIMDev.UPnPEnable code 2 = boolean;
# UPnP Server Port (default random)
option DISIMDev.UPnPServerPort code 13 = unsigned integer 16;
# UPnP Time-To-Live (default 4)
option DISIMDev.UPnPTTL code 14 = unsigned integer 8;

##### nSCS10 options
# SCServer enable (default on)
```

```
option DISIMDev.SCServerEnable code 3 = boolean;
# SCServer UDP transfers enable (default off)
option DISIMDev.SCServerUDPEnable code 4 = boolean;
# SCServer Port (default 7117)
option DISIMDev.SCServerPort code 21 = unsigned integer 16;
# SCServer Connection Timeout (300..43200 seconds, default 0 - disabled)
option DISIMDev.SCServerConnTo code 22 = unsigned integer 16;
# SCServer Keepalive Interval (60..3600 seconds, default 0 - disabled)
option DISIMDev.SCServerKeepalive code 23 = unsigned integer 16;
# Old SOAP Server Enable (default on)
# Shares the secondary HTTP Server with UPnP Server. If UPnP Server not enabled
# or UPnP Server Port not defined, the SOAP/UPnP Server Port defaults to 17117.
option DISIMDev.OldSOAPEnable code 5 = boolean;

#####
class "vendor-classes" {
   match option vendor-class-identifier;
}

##### Vendor Class for nSCS Devices is "DISIM.nSCS10"
subclass "vendor-classes" "DISIM.nSCS10" {
   vendor-option-space DISIMDev;
   option log-servers 10.0.0.1;
   option www-server 10.0.0.2;
   option DISIMDev.LogFacility 1;
   option DISIMDev.LogLevel 4;
   option DISIMDev.UPnPEnable off;
   option DISIMDev.SCServerEnable on;
   option DISIMDev.OldSOAPEnable on;
   # Define host sections to assign per-host options based on MAC
   host SCS_xxxxxxxxxxxx {
      hardware ethernet 00:50:C2:DD:D0:00;
      fixed-address 10.0.0.3;
      option DISIMDev.SCServerPort 18001;
      option DISIMDev.UpnPServerPort 18002;
      }
}
```

Annex C

Configuration example for a Linux **rsyslog** daemon

File /**etc**/**rsyslog.conf**

```
# ...rsyslog options

# provides UDP syslog reception
$ModLoad imudp
$UDPServerRun 514
# or any other port number as configured by Log Server Port parameter

# ...more rsyslog options

# Include config files in /etc/resyslog.d/
# or at least SCS.conf
```

File /**etc**/**rsyslog.d**/**10-SCS.conf**

```
# Use different log files for each device
$template SCSLogFormat,"%timereported:1:10:date-rfc3339% %timereported:12:22:date-rfc3339% %app-name%[%procid%] %msgid%: %msg:::drop-last-lf%\n"
$template SCSLogFile,"/var/log/SCS/%hostname%.log"
#or
#$template SCSLogFormat,"%timereported:1:10:date-rfc3339% %timereported:12:22:date-rfc3339% %hostname% %app-name%[%procid%] %msgid%: %msg:::drop-last-lf%\n"
#$template SCSLogFile,"/var/log/scs.log"
# Log local? messages received through UDP listener from SCS hosts to file
if $syslogfacility-text startswith 'local' and $hostname startswith 'SCS' and $inputname == 'imudp' then -?SCSLogFile;SCSLogFormat
# Discard message (stop logging to other destinations)
& ~
```

A good thing would be to prevent external logs (not captured above) to pollute local system log files.

File /**etc**/**rsyslog.d**/**99-imudp.conf**

```
# Catch external messages not processed up to this point (comment if not needed)
if $inputname == 'imudp' then -/var/log/imudp.log
# ...and discard
& ~
```