

# A Self-Configurable Server for Controlling Devices Over the Simple Network Management Protocol

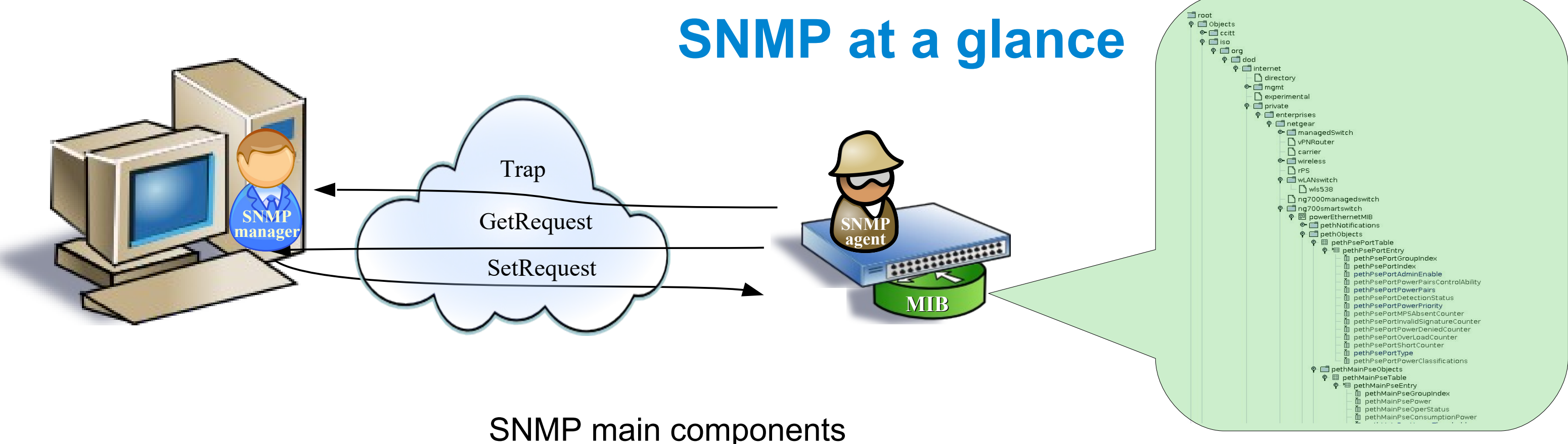


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## Abstract

The Simple Network Management Protocol (SNMP) is an open-source protocol that allows manufacturers to utilize it for controlling and monitoring their hardware. More and more SNMP-manageable devices show up on the market that can be used by control systems for accelerators. Some SNMP-enabled devices are being used at the free-electron laser (FLASH) and planned to be used at the European X-ray Free Electron Laser (XFEL) at DESY, Hamburg, Germany. To provide an easy and uniform way of controlling SNMP devices a server program has been developed. The server configuration with respect to device parameters control is done during its start-up and driven by the manufacturer Management Information Base (MIB) files provided with SNMP-enabled hardware. The list of parameters to control can also be tailored by user's configuration files.

The SNMP server integrates the various types of devices in a transparent way into the Distributed Object-Oriented Control System (DOOCS) used at FLASH and XFEL. Several SNMP devices of different types can be controlled by one SNMP server simultaneously.



SNMP main components

SNMP is an application-layer protocol defined by the Internet Architecture Board (IAB) in RFC1157 (May of 1990) for exchanging management information between network devices.

SNMP is an application layer protocol which uses User Datagram Protocol (UDP) for transport layer. SNMP requests are transmitted as UDP datagrams over a connectionless transmission interface between SNMP manager and SNMP agent.

Management Information Base (MIB) is a database containing information about elements to be managed. It represents Manageable Objects (MO) as resources. Every MO (device attribute) has a unique Object Identifier (OID) that can be used for queries. It also provides a map between numeric OIDs and a human-readable text.

SNMP agent is a daemon process running on a network device. It exposes device attributes to managers. SNMP managers control the attributes via Get/Set requests. Managers can have access to those attributes that are allowed by the agent. SNMP agents can also provide traps (asynchronous messages).

## DOOCS

DOOCS is a distributed control system that was developed for HERA and FLASH applications at DESY. It is an object-oriented system design from the device server level up to the operator console. DOOCS will also be used for the coming XFEL.

A DOOCS server as an SNMP manager provides an access to a controlled device by means of DOOCS properties. Every property usually defines an attribute inside of the controlled device. The property can be readable, writable or both.

## Design

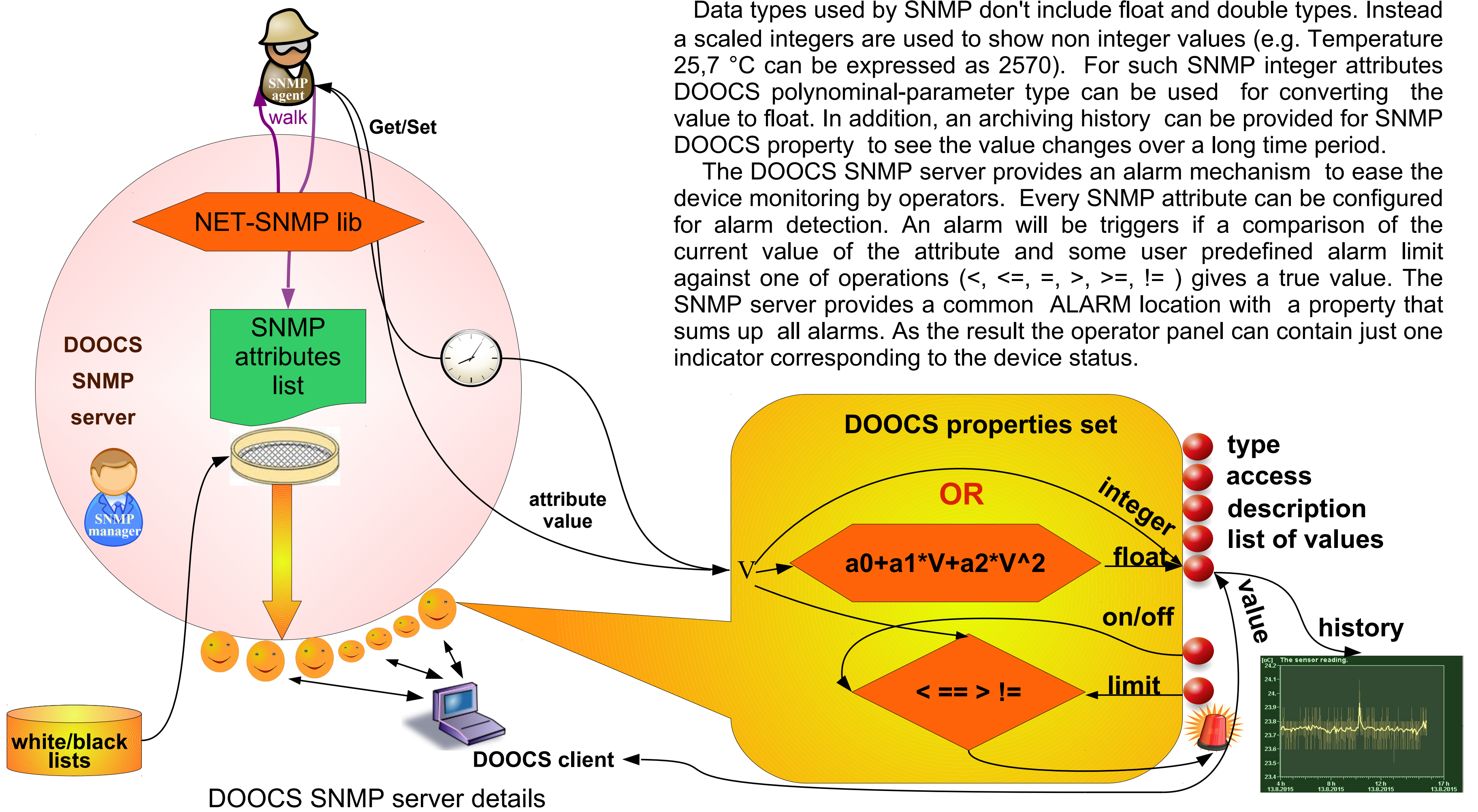
NET-SNMP library (<http://www.net-snmp.org/>) allows to retrieve the list of attributes from an SNMP agent, read and write attributes values.

Once the full list of attributes is available for the SNMP server it filters out the attributes of interest and creates the corresponding DOOCS properties. For every SNMP attribute a set of DOOCS properties is created. Along with the attribute value the set includes the properties containing the type, a description and some more information about the attribute. The filtering of attributes is implemented via white or black lists provided by users.

Reading SNMP attributes values is done via the DOOCS properties. One can use two ways for the values update:

- via the server internal timer update
- on access the DOOCS value property

## SNMP server implementation



DOOCS SNMP server details

## In Operation

On start-up the SNMP server reads out its configuration file. The file contains all information required to establish a connection to an SNMP agent: SNMP.HOSTNAME, SNMP.VERSION, READ\_COMMUNITY, WRITE\_COMMUNITY and SNMP.TIMEOUT. It also includes the directory name where the required MIB files are located, the MIB file name for the SNMP sub-tree and SNMP node name where the attributes of interest should be searched.

To reduce the number of DOOCS properties corresponding to SNMP attributes the mechanism of white/black list is used. For defining white or black list mode a dedicated DOOCS property is used. Its positive value means the white list mode, negative – the black list mode, zero – none of the lists will be applied. In case of the white list mode the server creates the DOOCS properties only for those SNMP attributes that have names matching the patterns in the white list. In case of the black list mode the SNMP attributes with the names that match the patterns in the black list will be ignored. In case of the white list mode the file can also contain the conditions for alarms applied to some or all attributes.

If during the start-up an SNMP agent is not reachable, the server will check the availability of the agent with some predefined time period. Once the agent is found, the DOOCS properties for the required SNMP attributes will be created. After that the server monitors the attribute values either periodically with a predefined period or by the DOOCS request to the SNMP server from a DOOCS client (e.g. user panel).

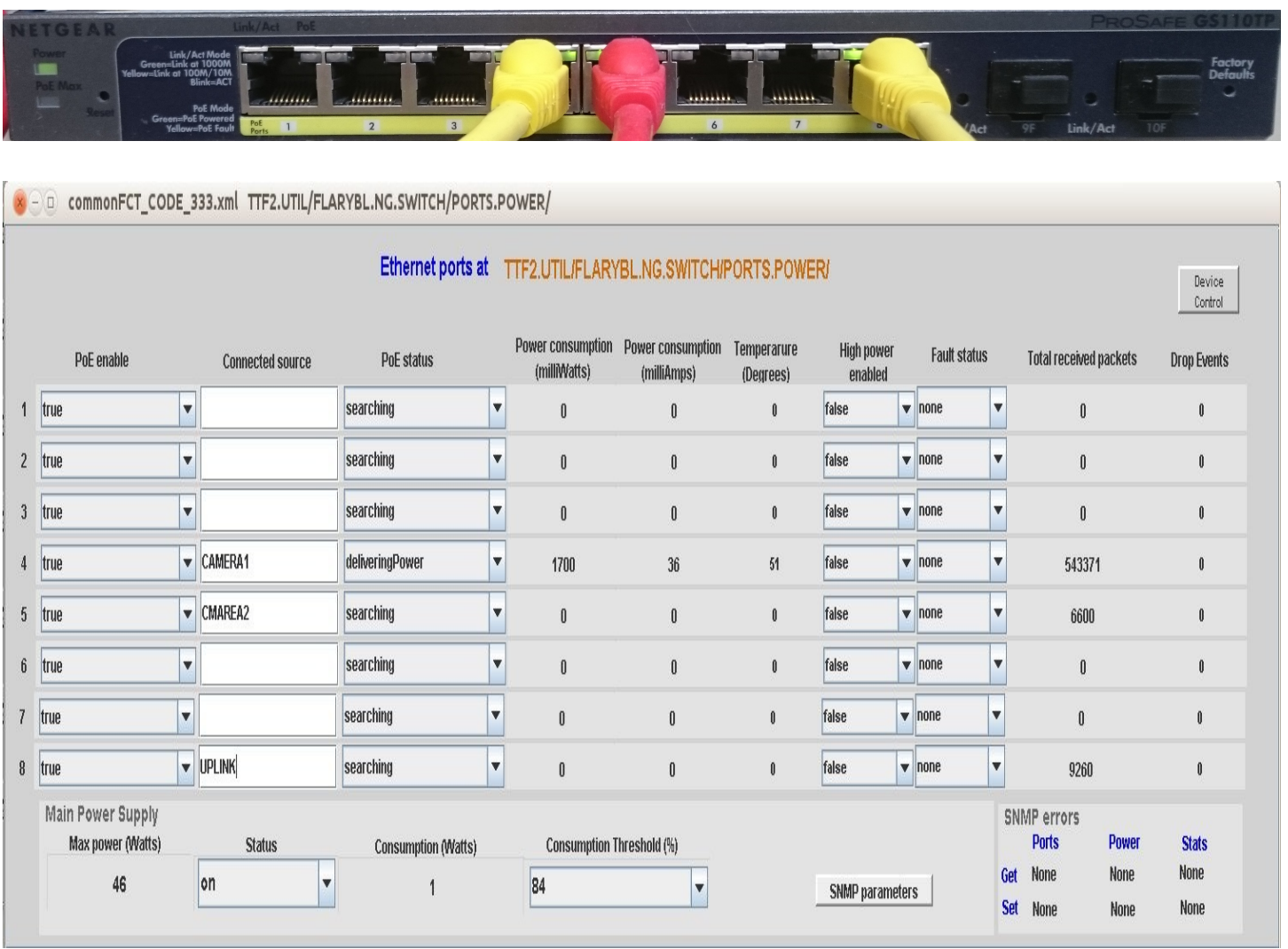
The SNMP server can control several SNMP devices of different types simultaneously. One DOOCS SNMP location is dedicated to a group of attributes of one SNMP agent. It means that several SNMP locations of one server can control several groups of properties from one SNMP agent as well as from many independent SNMP agents. Due to the multi-threaded implementation of the SNMP server the interactions with SNMP agents are completely independent.

A dedicated DOOCS location is used for alarm indication. Its ALARM DOOCS property is set to non-zero value if there is at least one SNMP attribute with non-masked alarm. All SNMP DOOCS properties configured with alarm detection have additional DOOCS properties that allow to reset, mask alarms, or change the alarm limits or the comparison operation. This tree like alarm propagation schema allows to build simple GUIs for monitoring alarms in many SNMP devices controlled by one SNMP server.

## SNMP server applications

### NETGEAR GS110TP control

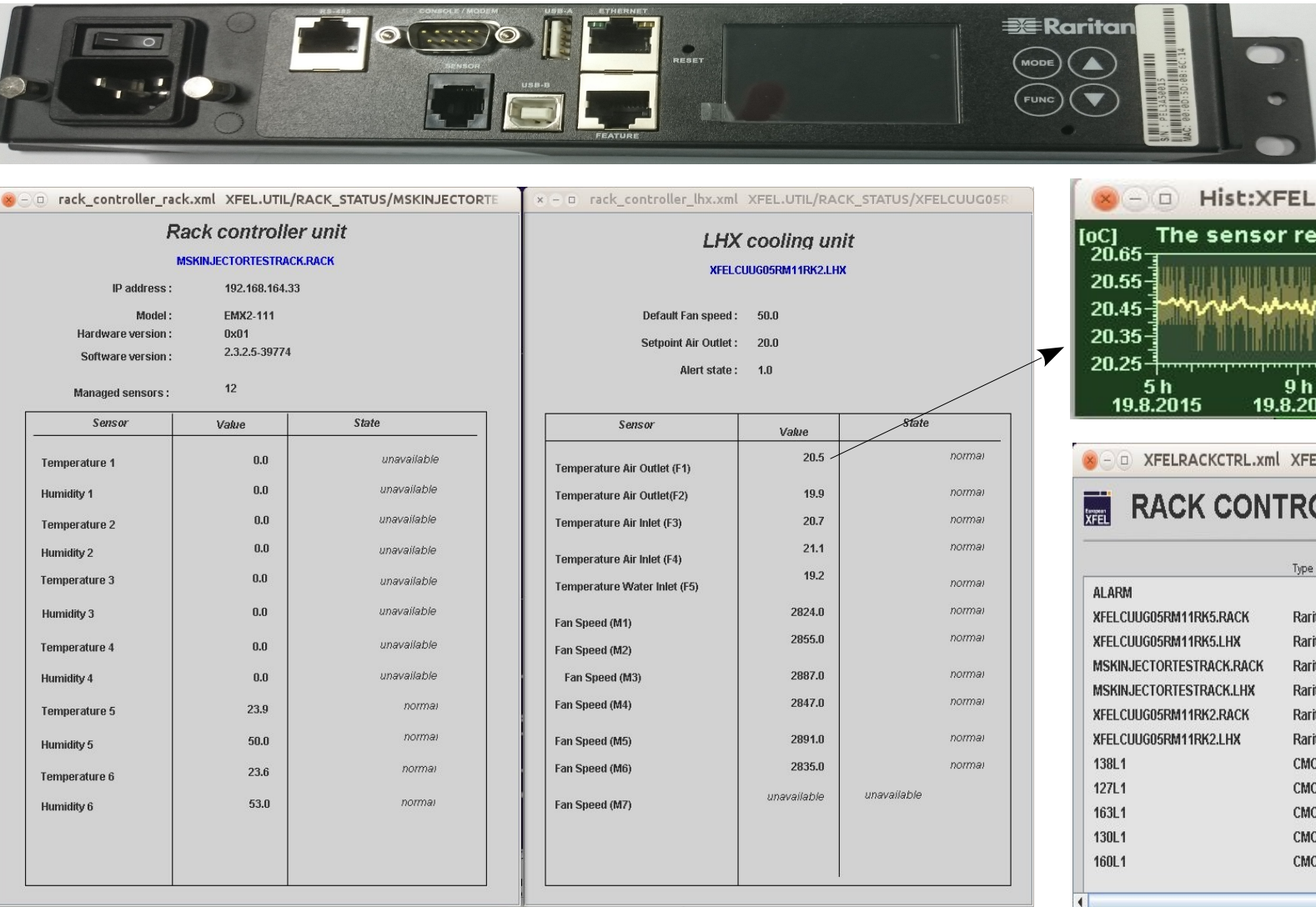
NETGEAR GS110TP network switch is heavily used at DESY (FLASH, XFEL) to integrate for network cameras into diagnostics system. The switch offers eight 1 Gigabit ports with Power-Over-Ethernet (PoE) capability. The switch has a SNMP agent providing a reach set of switch attributes. The major SNMP attributes were selected for the SNMP server.



NETGEAR GS110TP panel

### Raritan's smart rack controller

Raritan's environmental rack controller allows to use any of Raritan's sensors such as temperature, humidity, air pressure, etc. EMX2-111 is used for performing the climate control of the Schroff racks. Two panels are used to monitor parameters of every crate via the SNMP DOOCS server: Rack controller Unit (rack climate parameters), LHX cooling unit (cooling equipment parameters).



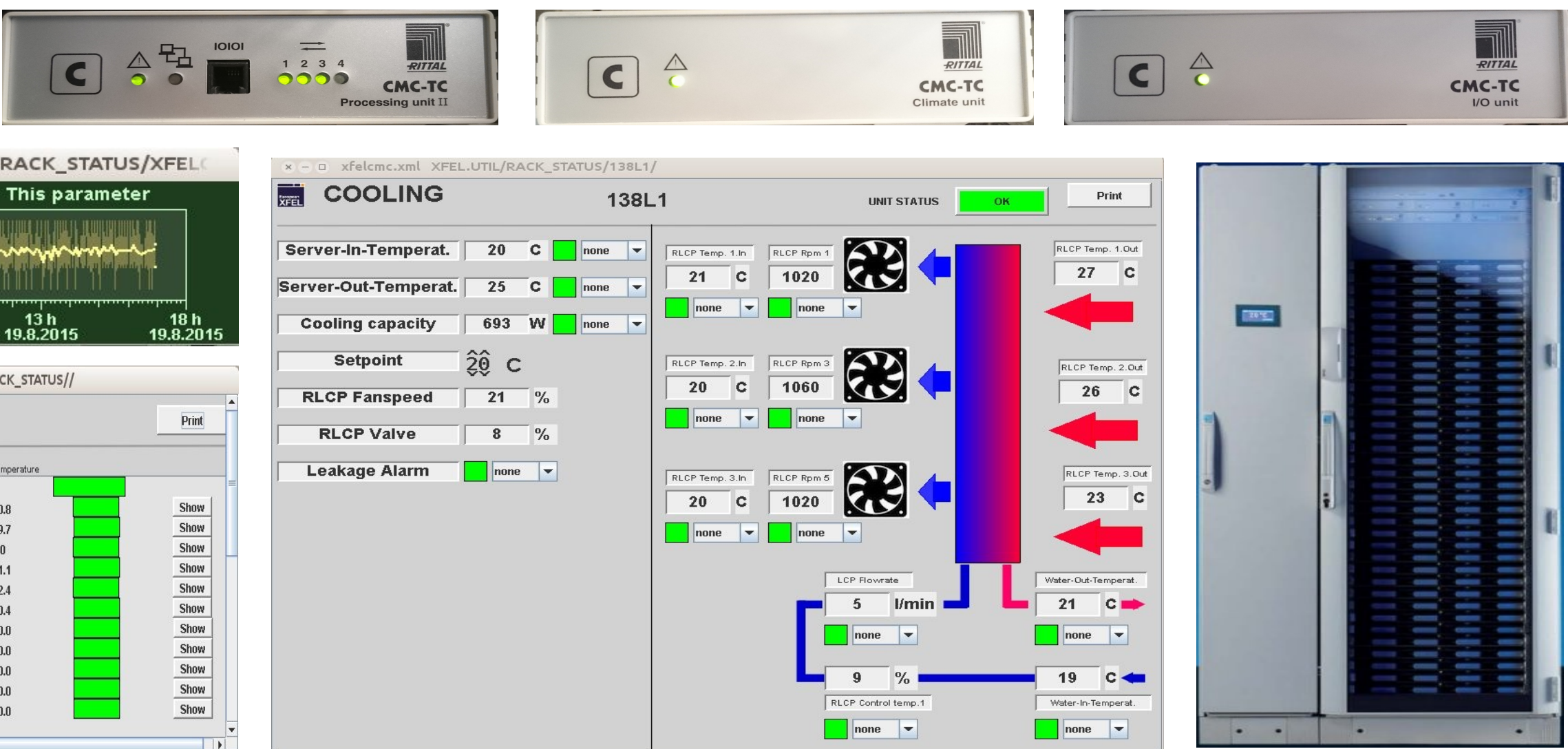
Raritan's smart rack controller panel

### Rittal's LCP-smart and CMC Rack climate control

Rittal's Liquid Cooling Package (LCP) smart is a rack system that serves to dissipate high heat losses of devices built into the enclosure. The package is equipped with a Basic CMC unit. Its task is to monitor all connected sensors and control the cooling devices.

A set of devices (CMC-TC processing unit, CMC-TC climate unit, CMC-TC I/O unit) can be used for the climate control in any rack system equipped with the required sensors and cooling devices.

One panel per rack is used to monitor its status and parameters.



Rittal's rack climate control panel

Rittal's LCP smart