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SIPROTEC 5: (and for other DG EA products) Handling of SNMPv3 (secure SNMP) DGPI (asset monitoring) & DGSM (audit log) via SNMP

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SIPROTEC 5 Application

Handling of secure SNMP (SNMPv3), asset monitoring and security monitoring via SNMP

APN-091, Edition 1.0, 01.10.2021

Content

1 Introduction

This application note provides information about:

- SNMP basic information
- How to activate SNMP in SIPROTEC 5 devices and in other DG EA products
- **The focus** of this APN is on **SNMPv3 security** functionality and on the
  - **DG Product Inventory MIB** = DGPI (digitalGridProductInventory.mib)
  - **DG Security Monitoring MIB** = DGSM (digitalGridSecurityMonitoring.mib)
- How to set up the security related SNMPv3 functionality in SIPROTEC 5 and in other DG EA products
- How to set up the DGPI & DGSM functionality in SIPROTEC 5 and in other DG EA products

The newly available DGPI & DGSM for our SIPROTEC 5 triggered the creation of this Application Note, however SNMPv3 and the DG Product Inventory MIB and the DG Security Monitoring MIB are also implemented in other products from our DG EA portfolio. Therefore the handling and setting for these products are additionally described in the APN.

1.1 What is SNMP (https://www.manageengine.com/network-monitoring/what-is-snmp.html)

SNMP (Simple Network Management Protocol) is a network protocol used to monitor or control network components (e.g., Router, Switches, Server or IEDs like Protection relays, Automation units (RTUs) or Power Quality recorder from a central station.

SNMP is one of the widely accepted network protocols to manage and monitor network elements. Most of the professional–grade network elements come with bundled SNMP agent. These agents must be enabled and configured to communicate with the network monitoring tools or network management system (NMS).

The protocol controls the communication between the monitored devices (SNMP Agents) and the monitoring station (SNMP Manager).

1.2 SNMP basic components and their functionalities

A SNMP system consists of:

- SNMP Manager
- Managed devices
- SNMP agent
- Management Information Database Otherwise called as Management Information Base (MIB)

1.2.1 SNMP Manager

A manager or management system is a separate entity that is responsible to communicate with the SNMP agent implemented network devices. This is typically a computer that is used to run one or more network management systems.

SNMP Manager's key functions:

- Queries agents
- Gets responses from agents
- Sets variables in agents
- Acknowledges asynchronous events from agents

In the Siemens portfolio, the following systems can take over the function as SNMP Manager:

- SICAM SCC (with the option: Network Manager)
- SICAM PAS (but **limited**)
- SICAM GridEdge (but **limited**)
- SINEC NMS = Network Management System from Siemens Digital Industry

1.2.2 Managed Devices

A managed device or the network element is a part of the network that requires some form of monitoring and management e.g., SIPROTEC relays, Reyrolle5 relays, SICAM A8000 RTUs, SICAM Q100/Q200 power quality recorder

1.2.3 SNMP Agent

The agent is a program that is packaged within the network element. Enabling the agent allows it to collect the management information database from the device locally and makes it available to the SNMP manager, when it is queried for. These agents could be standard (e.g., Net-SNMP) or specific to a vendor.

SNMP agent's key functions:

- Collects management information about its local environment
- Stores and retrieves management information as defined in the MIB.
- Signals an event to the manager.
- Acts as a proxy for some non–SNMP manageable network node.

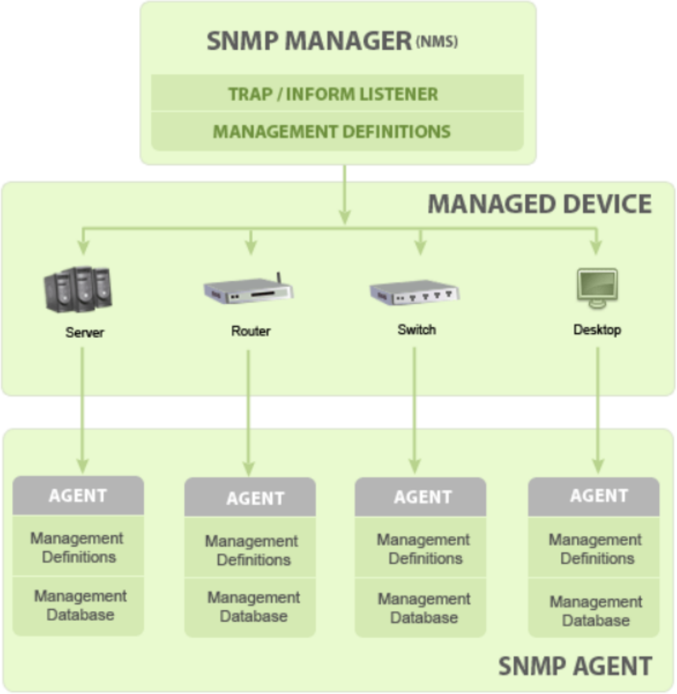


Figure 1.1 Basic SNMP Communication Diagram (https://www.manageengine.com/network-monitoring/what-is-snmp.html)

1.2.4 Management Information database or Management Information Base (MIB)

Every SNMP agent maintains an information database describing the managed device parameters. The SNMP manager uses this database to request the agent for specific information and further translates the information as needed for the Network Management System (NMS). This commonly shared database between the Agent and the Manager is called Management Information Base (MIB).

Typically, these MIB contains standard set of statistical and control values defined for hardware nodes on a network. SNMP **also allows the extension of these standard values** with values specific to a particular agent using **private MIBs**.

In short, MIB files are the set of questions that a SNMP Manager can ask the agent. Agent collects these data locally and stores it, as defined in the MIB. So, the SNMP Manager should be aware of these standard and private questions for every type of agent.

MIB structure and Object Identifier (Object ID or OID)

The Management Information Base (MIB) is a collection of Information for managing network element. The MIBs comprises of managed objects identified by the name Object Identifier (Object ID or OID).

Each Identifier is unique and denotes specific characteristics of a managed device. When queried for, the return value of each identifier could be different e.g., Text, Number, Counter, etc...

Every Object ID is organized hierarchically in MIB. The MIB hierarchy can be represented in a tree structure with individual variable identifier. For vendor specific MIBs the vendor must register its MIBs to keep the concept with unique identifiers. Siemens DG has registered for its private MIBs and has the node 22638.

In the following figures the basic structure showing the different Standard nodes with ID and the path for the private MIBs can be seen.

- Figure 1.2 is showing the standard path with IDs especially down to the MIB-2 what is supported and used for most of our products.
- Figure 1.3 is showing the path for the private MIB structure with IDs for different components of our portfolio.

- Figure 1.4 is showing the private path down for the common DG Project inventory MIB **(DGPI)**

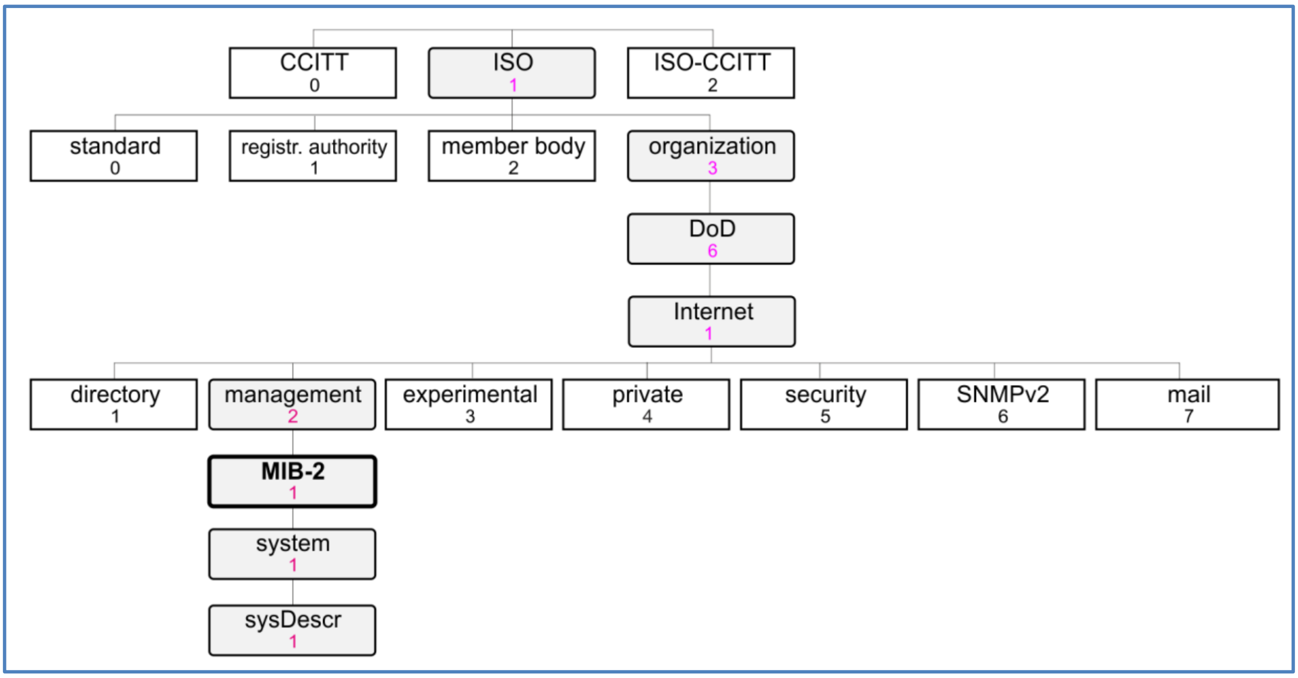


Figure 1.2 MIB structure for "Standard MIBs" with example path iso.org.dod.internet.management.MIB-2.system.sysDescr (1.3.6.1.2.1.1.1)

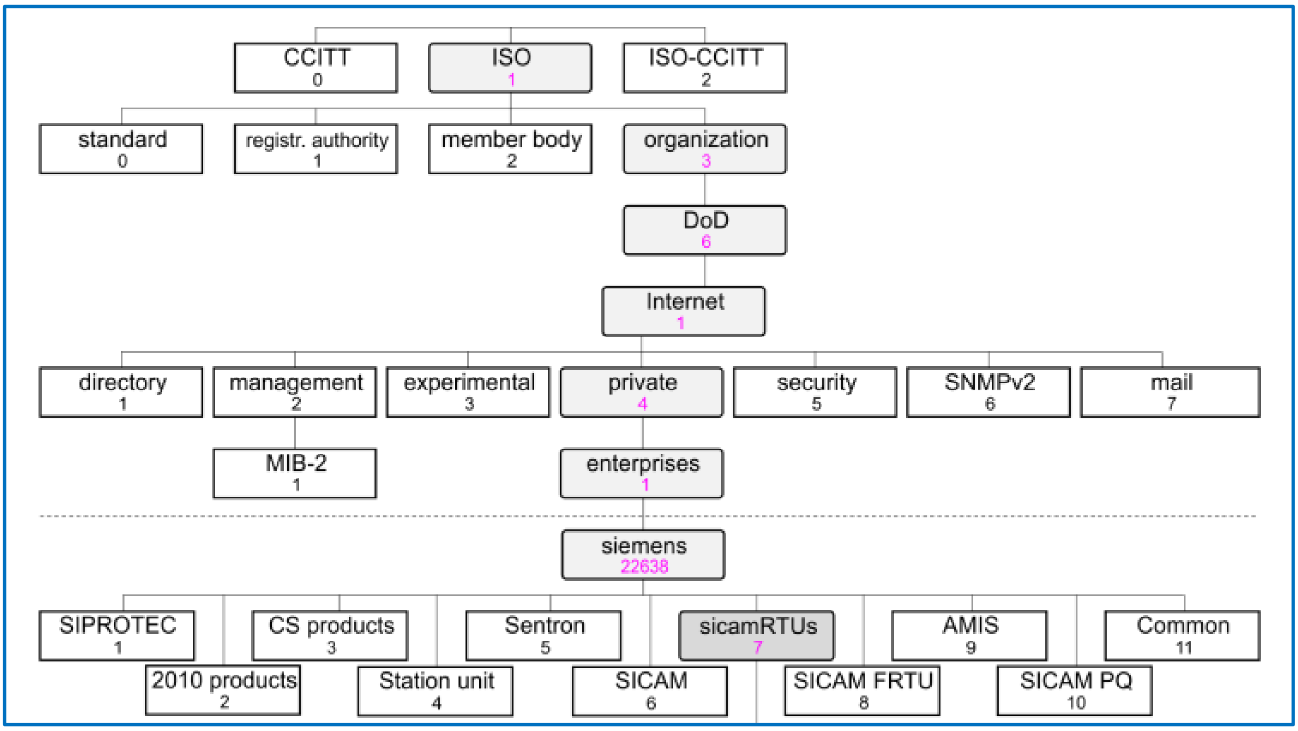


Figure 1.3 MIB structure for "Private MIBs for sicamRTUs with Path: iso.org.dod.internet.private.enterprises.siemens.sicamRTUs (1.3.6.1.4.1.22638.7)

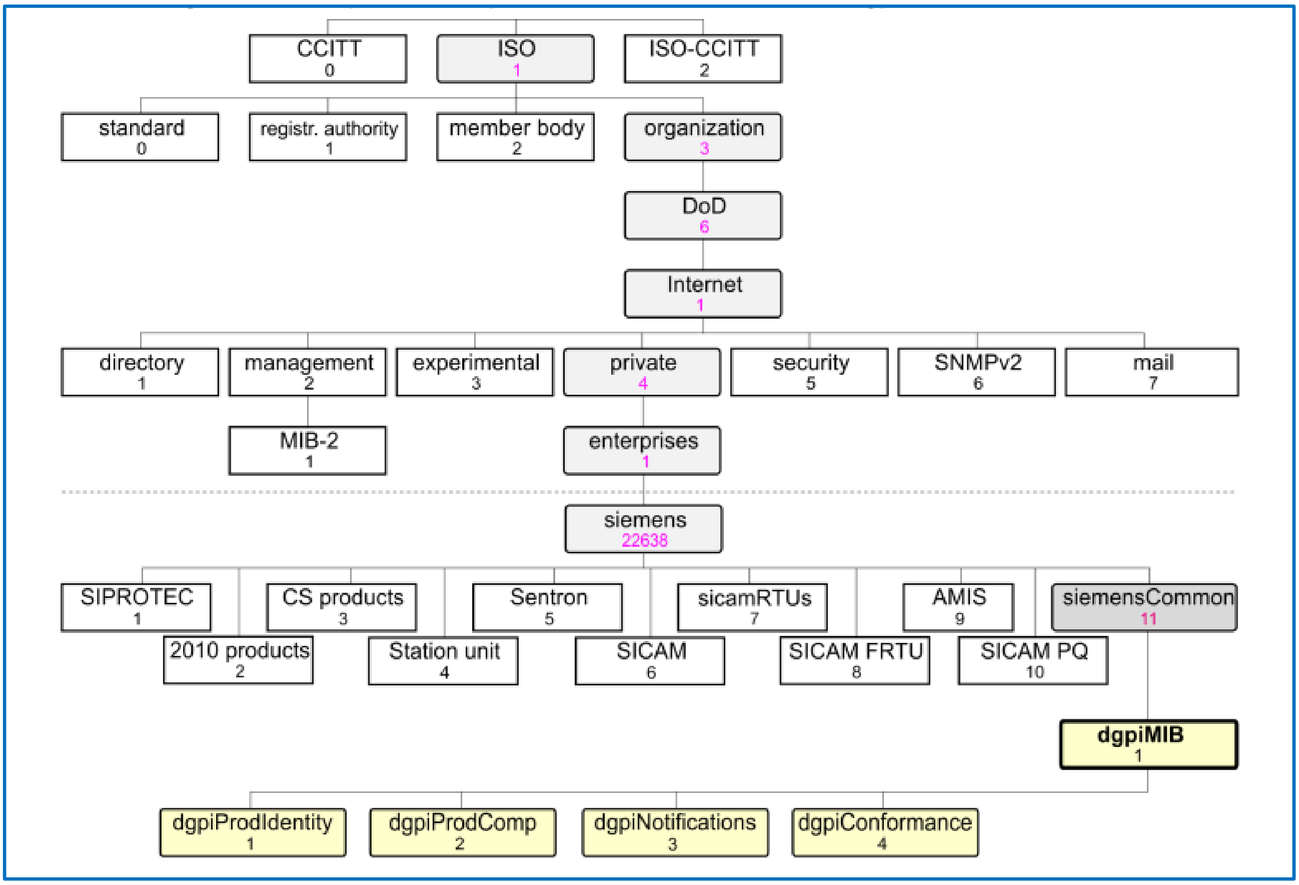


Figure 1.4 MIB structure for “common DG Project inventory MIB” with
Path: iso.org.dod.internet.private.enterprises.siemens.siemensCommon.dgpiMIB (1.3.6.1.4.1.22638.11.1)

In the following documents, you can find the supported “Standard” and “Private” MIBs of the DG EA products (see link collection in chapter ****)

[1] SIPROTEC 5 Communication Protocols – Manual (chapter 10.11.2/3)
[2] SIPROTEC 4/SIPROTEC Compact/Reyrolle IEDs Ethernet Module EN100 for IEC 61850 – Manual (chapter 6.1.4 / 7.4)
[3] Reyrolle 7SR5 Communication Protocol – Manual (chapter 7.8)
[4] SICAM PAS / PQS - Configuration and Operation – Manual (chapter 6.8)
[5] SICAM A8000 Series, Manual CP-8050 (chapter 13.23.2)
[6] SICAM A8000 Series CP-8000, CP-8021, CP-8022 – Manual (chapter 12.21.2)
[7] SICAM Q100 - 7KG95xx - Power Monitoring Device and Class A Power Quality Recorder (chapter 2.5.5.2)
[8] SICAM Q200 - 7KG97 - Multifunctional Recorder - Device Manual (chapter 2.5.5.2)

The “private” / “common DG MIBs” can be downloaded from SIOS portal / are stored on the installation DVD / or can be downloaded from the Web-UI of the device

[9] SIPROTEC 5 SNMP MIB
https://support.industry.siemens.com/cs/document/109742125/siprotec-5-snmp-mib?dti=0&pnid=24232&lc=en-WW

[10] SICAM RTUs SNMP MIB File
https://support.industry.siemens.com/cs/document/109773392/sicam-rtus-snmp-mib-file?dti=0&pnid=24232&lc=en-WW

[11] EN100 Communication Module – Protocols (MIBs for SIP4, SIP Compact, Reyrolle)
https://support.industry.siemens.com/cs/document/109745821/en100-communication-module-protocols?dti=0&pnid=24232&lc=en-WW

SICAM PAS (stored on the Software DVD)
SICAM Q100 (private MIB can be downloaded via the integrated Webserver); SICAM Q200 does not use a “Private” MIB

1.2.5 Basic commands of SNMP

The simplicity in information exchange has made the SNMP as widely accepted protocol. The main reason being concise set of commands, here are they listed below:

- **GET:** The GET operation is a request sent by the manager to the managed device. It is performed to retrieve one or more values from the managed device.
- **GET NEXT:** This operation is similar to the GET. The significant difference is that the GET NEXT operation retrieves the value of the next OID in the MIB tree.
- **GET BULK:** The GETBULK operation is used to retrieve voluminous data from large MIB table.
- **SET:** This operation is used by the managers to modify or assign the value of the Managed device.
- **TRAPS:** Unlike the above commands which are initiated from the SNMP Manager, TRAPS are initiated by the Agents. It is a signal to the SNMP Manager by the Agent on the occurrence of an event.
- **INFORM:** This command is similar to the TRAP initiated by the Agent, additionally INFORM includes confirmation from the SNMP manager on receiving the message.
- **RESPONSE:** It is the command used to carry back the value(s) or signal of actions directed by the SNMP Manager.

SNMP Traps:

SNMP traps enable an agent to notify the SNMP manager of significant events by an **unsolicited (spontaneous) SNMP message**. **SNMP Traps** are especially **of interest** for the DG Product Inventory MIB = **DGPI** and the DG Security Monitoring MIB = **DGSM**, because **security related events** (DGSM) and **changes of the device Hardware or Firmware** (DGPI only for CP-8031/50) **can be transferred spontaneous** to the SNMP Manager.

The Figures 1.5 and 1.6 show the Principe of the communication between SNMP Manager and SNMP Agent

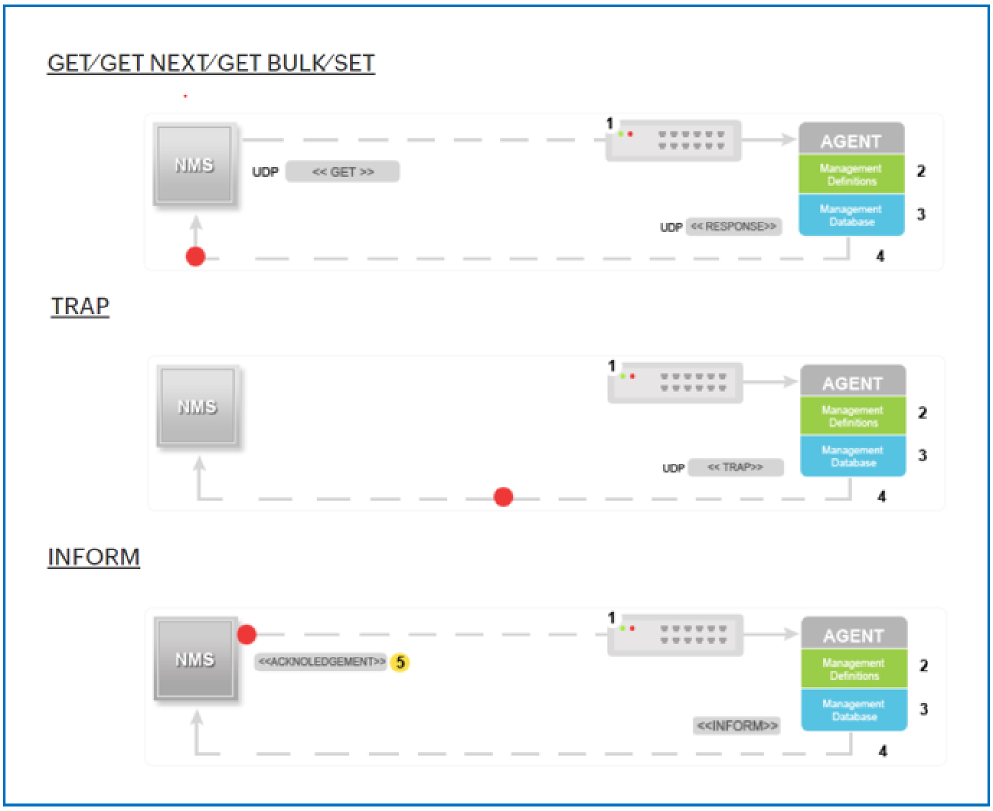
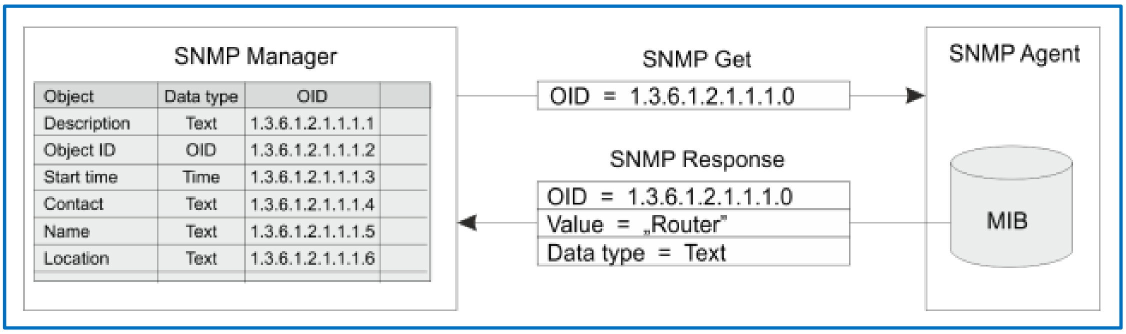


Figure 1.5 Principe of the communication between SNMP Manager and SNMP Agent
(https://www.manageengine.com/network-monitoring/what-is-snmp.html)



Object	Data type	OID
Description	Text	1.3.6.1.2.1.1.1.1
Object ID	OID	1.3.6.1.2.1.1.1.2
Start time	Time	1.3.6.1.2.1.1.1.3
Contact	Text	1.3.6.1.2.1.1.1.4
Name	Text	1.3.6.1.2.1.1.1.5
Location	Text	1.3.6.1.2.1.1.1.6

Figure 1.6 Example of a SNMP Get command chain

Being the part of TCP/IP protocol suite, the SNMP messages are wrapped as User Datagram Protocol (UDP) and intern wrapped and transmitted in the Internet Protocol.

By default, the **SNMP port is 161** and **TRAP/INFORM uses SNMP port 162** for communication.

1.2.6 SNMPv3

SNMPv3 defines the secure version of the SNMP. SNMPv3 protocol also facilitates remote network monitoring configuration of the SNMP entities. It is defined by RFC = Request for Comments. Though each version had matured towards rich functionalities, additional emphasis was given to the security aspect on each upgrade.

Security was one of the biggest weakness of SNMP until v3. Authentication in SNMP Versions 1 and 2 amounts to nothing more than a password (community string) sent in clear text between a manager and agent. Each SNMPv3 message contains security parameters which are encoded as an octet string. The meaning of these security parameters depends on the security model being used.

The security approach in v3 targets:

- Confidentiality – Encryption of packets to prevent snooping by an unauthorized source.
- Integrity – Message integrity to ensure that a packet has not been tampered while in transit including an optional packet replay protection mechanism.
- Authentication – to verify that the message is from a valid source.

SNMPv3 also defines the USM (**U**ser-based **S**ecurity **M**odel) and VACM (**V**iew-based **A**ccess **C**ontrol **M**odel), which were later followed by a transport security model (TSM).

- USM (User-based Security Model) provides authentication and privacy (encryption) functions and operates at the message level.
- VACM (View-based Access Control Model) determines whether a given principal is allowed access to a particular MIB object to perform specific functions and operates at the PDU level.
- TSM (Transport Security Model) provides a method for authenticating and encrypting messages over external security channels.

Definition of different **authentication** and privacy protocols. Authentication protocols like MD5 are recommended to encrypt the User/Password to establish the communication; Privacy protocols like AES are recommended to encrypt additionally the content of the message (depending on the source and used communication stack the below listed names can differ even if the algorithm a functionality is identical):

- MD5, SHA and HMAC-SHA-2 authentication protocols and the
- DES / CBC_DES and AES128 / CFB_AES_128 privacy protocols are supported in the USM.

2 Activation of SNMP functionality

The SNMP agent functionality is supported in the DG EA portfolio for our protection devices, for our substation automation devices and for our Power Quality recorder.

Protection devices:

- SIPROTEC 5 devices (with Ethernet ETH-** communication modules)
- SIPROTEC 4, SIPROTEC Compact, Reyrolle, (with EN100 communication module) and Reyrolle 5

Substation Automation Systems:

- SICAM PAS
- A8000 RTUs (CP-8000, CP-8021, CP-8022, CP-8031, CP-8050)

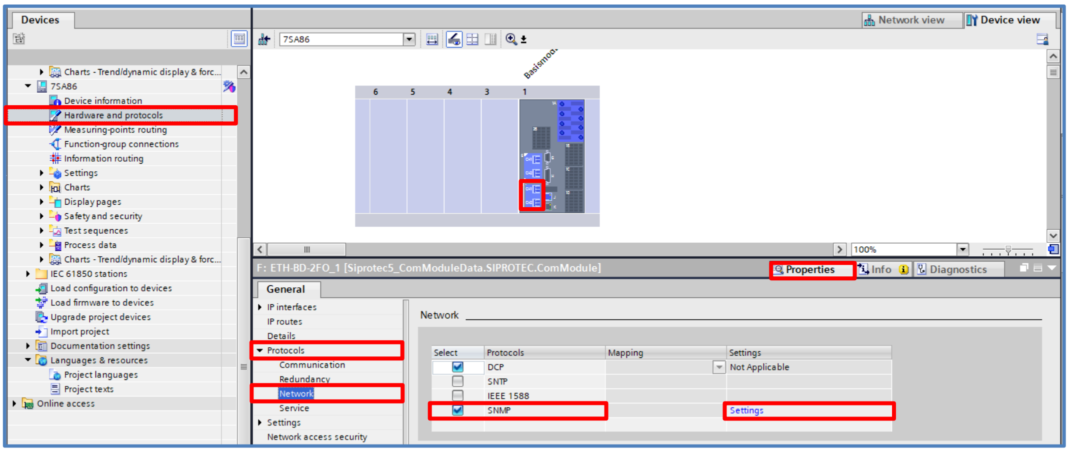
Power Quality recorder:

- SICAM Q100
- SICAM Q200

2.1 Activation of SNMP functionality in SIPROTEC 5 relays

The SNMP functionality in our SIPROTEC 5 relays can be activated on the Ethernet communication modules (ETH-BA-2EL, ETH-BB-2FO and ETH-BD-2FO) using the DIGSI 5 setting tool.

For activation of the SNMP function, open in the project tree the "Hardware and Protocol" Editor of the SIPROTEC 5 device: select in the main working area the communication module for what you want to enable the SNMP function and move in the "Properties" Area to "Protocol" -> "Network" and hook-up the SNMP function

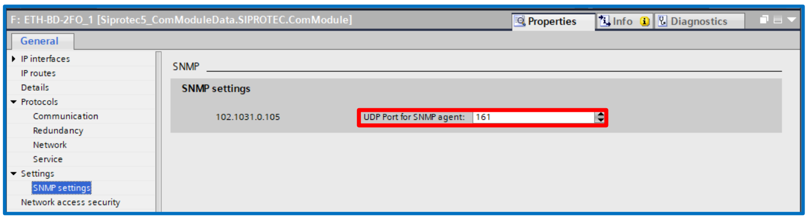


F: ETH-BD-2FO_1 [Siprotec5_ComModuleData.SIPROTEC.ComModule]

Select	Protocols	Mapping	Settings
☑	DCP		Not Applicable
□	SNTP		
□	IEEE 1588		
☑	SNMP		Settings

Figure 2.1 Enabling of SNMP in DIGSI 5

The default port for an SNMP Agent is 161 (see chapter 1.2.5); this port is used as default in the SIPROTEC 5 relays, in case you need to change the port number, please select "Settings"



F: ETH-BD-2FO_1 [Siprotec5_ComModuleData.SIPROTEC.ComModule]

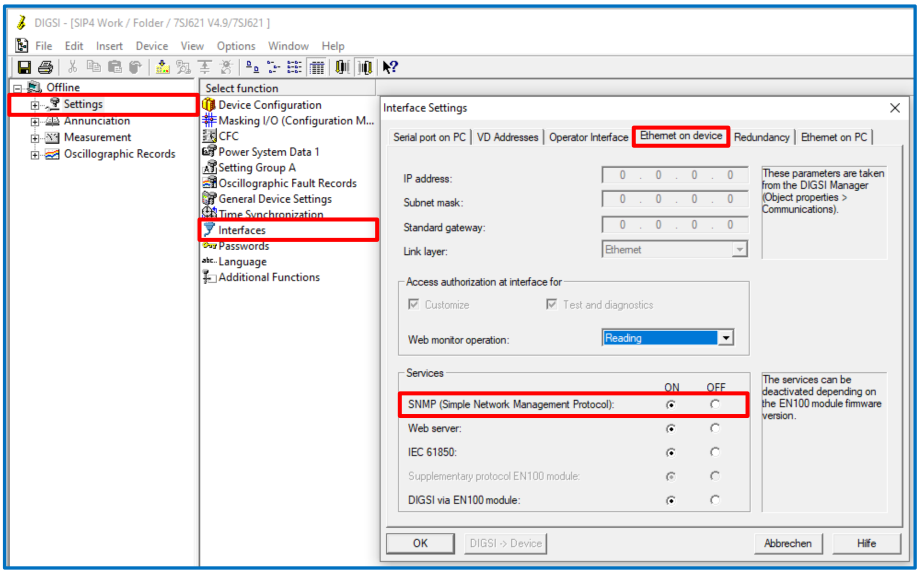
SNMP settings

102.1031.0.105 UDP Port for SNMP agent: 161

Figure 2.2 Modifying the used port of the SNMP Agent in DIGSI 5

2.2 Activation of SNMP in EN100 module for SIPROTEC relays

For SIPROTEC 4 and SIPROTEC Compact devices with EN100 module, the SNMP functionality is per default setting activated. You can check this by using DIGSI 4 and open the settings. Open "Interfaces" with double-click and select in the newly opened dialog box "Interface Setting": "Ethernet on devices" -> there you can see if the SNMP Service is activated.



IP address: 0 . 0 . 0 . 0
Subnet mask: 0 . 0 . 0 . 0
Standard gateway: 0 . 0 . 0 . 0
Link layer: Ethernet

These parameters are taken from the DIGSI Manager (Object properties > Communications).

Access authorization at interface for
☑ Customize ☑ Test and diagnostics
Web monitor operation: Reading

Services

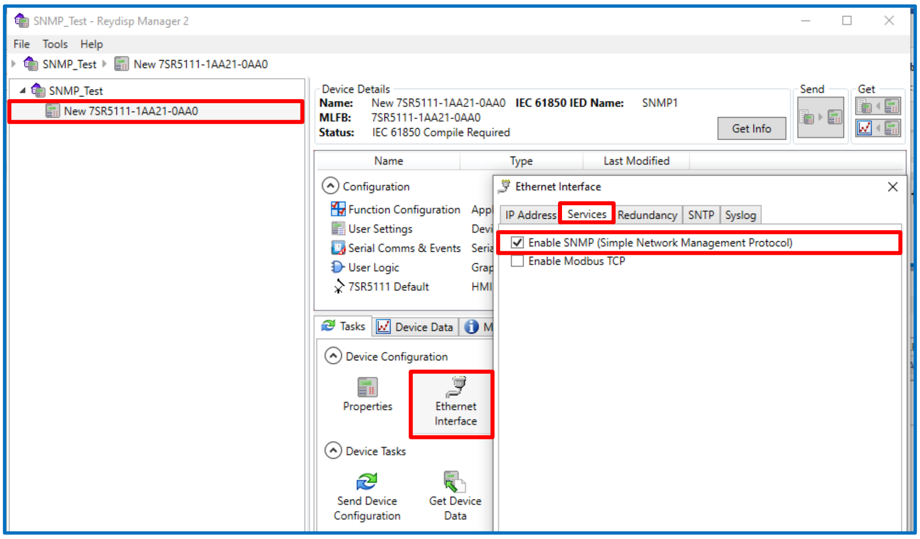
	ON	OFF
SNMP (Simple Network Management Protocol):	●	○
Web server:	●	○
IEC 61850:	●	○
Supplementary protocol EN100 module:	●	○
DIGSI via EN100 module:	●	○

The services can be deactivated depending on the EN100 module firmware version.

Figure 2.3 Checking of SNMP in DIGSI 4

2.3 Activation of SNMP in Reyrolle relays

For Reyrolle devices with EN100 module and Reyrolle 5, the SNMP functionality is per default setting activated. You can check this by using Reydisp Manager / Reydisp Manager 2 and select the Reyrolle relay. Select in the Editor Area "Ethernet Interface" with double-click and select in the newly opened dialog box: "Services" -> there you can see if the SNMP Service is activated.



Name: New 7SR5111-1AA21-0AA0 **IEC 61850 IED Name:** SNMP1
MLFB: 7SR5111-1AA21-0AA0
Status: IEC 61850 Compile Required

☑ Enable SNMP (Simple Network Management Protocol)
☐ Enable Modbus TCP

Figure 2.4 Checking of SNMP in Reydisp Manager / Reydisp Manager 2

2.4 Activation of SNMP functionality for SICAM PAS/PQS

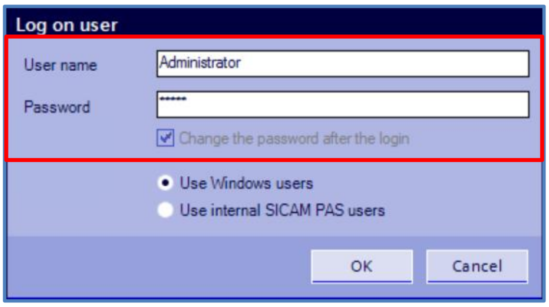
In this Application note **only the SNMP Agent functionality** is covered (SICAM PAS/PQS can also have the option to work as a SNMP Client -SNMP Manager-).

As SICAM PAS/PQS is a software-based system and can be installed on more-or-less any PC the SNMP Agent covered in this APN is not related to any information sent from the hardware where the SICAM PAS/PQS software is installed (depending on the PC-Hardware used there may be also SNMP agent functionality available from the PC supplier) but only information regarding the software and the SICAM PAS/PQS applications. The **DG common Product Inventory MIB** is providing information like product name, installed software and database versions, date of last configuration changes, and enabled features etc., and the **DG Security Monitoring MIB** is providing information concerning Security related logs, for example, user login/logout, start/stop of system components, modifications in the archive (import records, import PQDIF, delete records, delete reports, add or edit traffic lights).

The SNMP Agent functionality is not enabled via the SICAM PS/ PQS UI-Configuration like the other functions, but via the SICAM PAS/PQS User Administration. For the initial login after the new installation of SICAM PAS/PQS, enter the username: **Administrator** and the default password: **Admin**.

- To use the Windows access rights, select Use Windows users; or -
- To define individual access rights, select Use internal SICAM PAS/PQS users

The default password must be changed **(forced)** because it is public. Your new password will be maintained even if you have secured all other user rights by using the Windows access rights.



Log on user

User name: Administrator

Password: *****

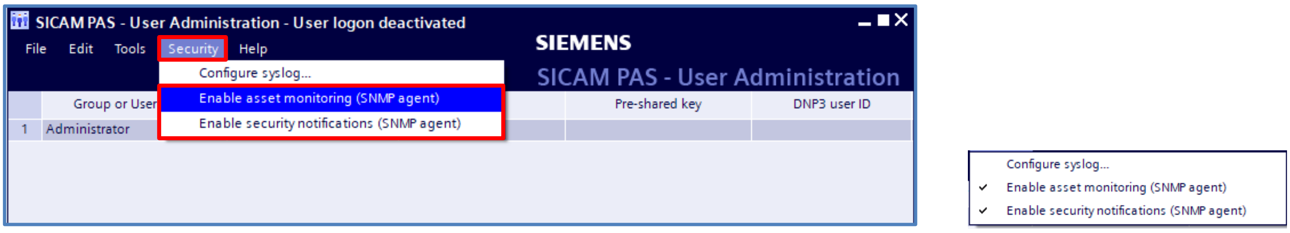
☑ Change the password after the login

● Use Windows users

○ Use internal SICAM PAS users

Figure 2.5 SICAM PAS – User Administration

After the SICAM PAS/PQS User Administration UI opens, you can activate / enable the SNMP Agent functionality for the DG Project Inventory MIB (Enable asset monitoring) and for the DG Security Monitoring MIB (Enable security notification) separately and independent from each other. For doing this, use the **"Security" menu button** and select in the selection drop-down **"Enable ..... (SNMP Agent)"**.



SICAM PAS - User Administration - User logon deactivated

File
Edit
Tools
Security
Help
Configure syslog...
Enable asset monitoring (SNMP agent)
Enable security notifications (SNMP agent)
SIEMENS
SICAM PAS - User Administration

	Group or User	Pre-shared key	DNP3 user ID
1	Administrator		

Configure syslog...
✓ Enable asset monitoring (SNMP agent)
✓ Enable security notifications (SNMP agent)

Figure 2.6 SICAM PAS – User Administration enabling SNMP Agents

After activation you can check the status in selecting again the "Security" menu button; the activated SNMP Agents are "hooked-up" (right side small picture in Figure 2.6)

2.5 Activation of SNMP functionality for A8000 RTUs

The SNMP function can be enabled either via the TOOLBOX II setting tool or via SICAM Device Manager. In this APN only the SICAM Device Manger as main setting tool for SICAM A8000 RTUs is described; in the CP-850 Manual [5] “SICAM A8000 Series, Manual CP-8050” (chapter 13.23.3) and in the CP-8000, CP-8021, CP-8022 - Manual [6] “SICAM A8000 Series CP-8000, CP-8021, CP-8022 – Manual” (chapter 12.21.3) you can find configuration of SNMP for TOOLBOX II.

2.5.1 Activation of SNMP functionality for CP-8000/8021/8022

For enabling the SNMP agent functionality, the tile “RTU Settings” must be selected form the main Dashboard for the CP-8000/21/22.

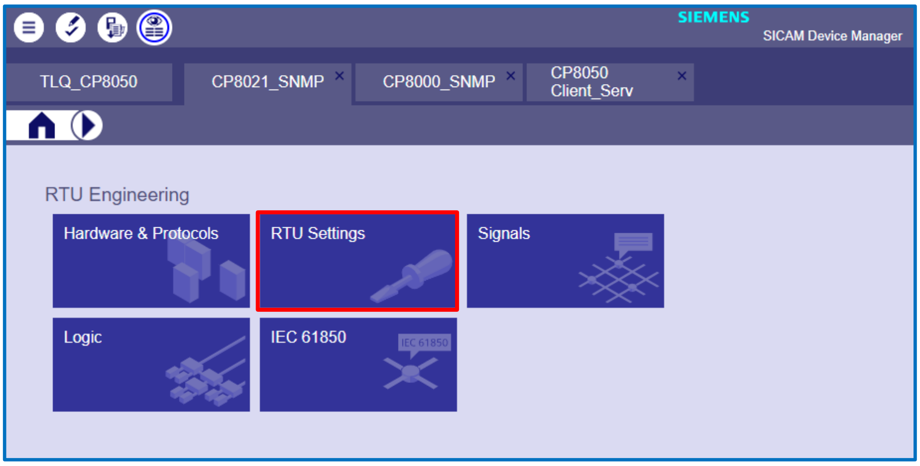
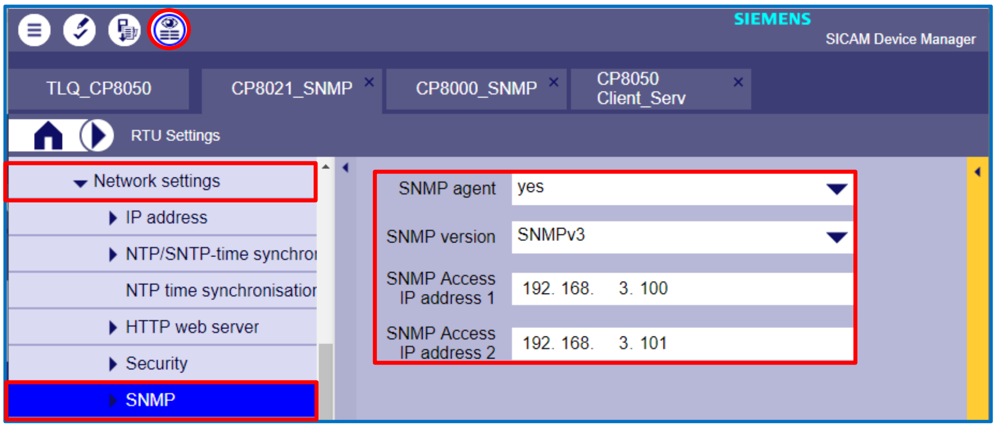


Figure 2.7 SICAM Device Manager main Dashboard

After selecting the tile **“RTU Settings”** a new setting windows will open. The settings for SNMP are advanced settings and needs to be activated via the ◉ button. Scroll down to **“Network settings”** and there you can find **“SNMP”.**

In the setting area you can enable the SNMP agent by selecting **“yes”** from the drop-down menu. Additionally, at least 1 IP address of the counter part of the SNMP agent = SNMP Manager (2 are possible) must be filled in. For the CP-8000/21/22 there is a selection for the SNMP version (either only SNMPv3 or SNMPv2 + SNMPv3)



SNMP agent: yes

SNMP version: SNMPv3

SNMP Access IP address 1: 192. 168. 3. 100

SNMP Access IP address 2: 192. 168. 3. 101

Figure 2.8 Enabling and setting of the SNMP agent in SICAM Device Manager

2.5.2 Activation of SNMP functionality for CP-8050/8031

For enabling the SNMP agent functionality, the tile **“Communication”** must be selected form the main Dashboard for the CP-8050/31.

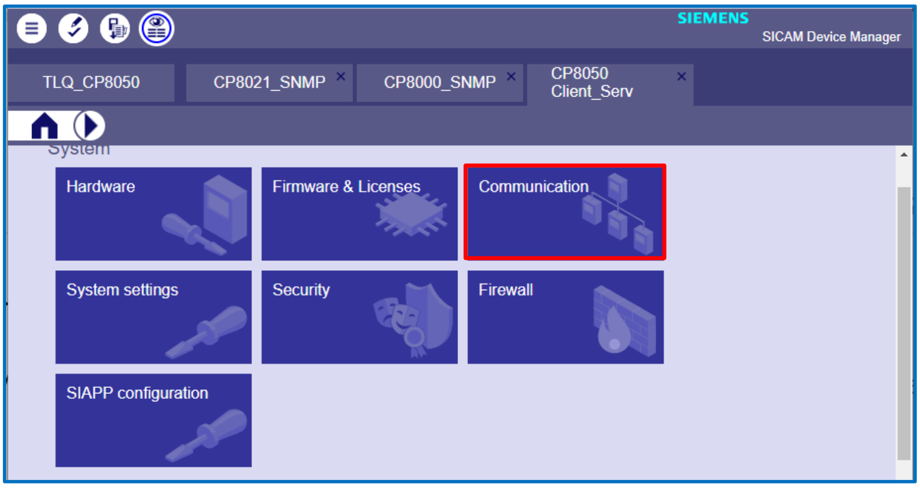
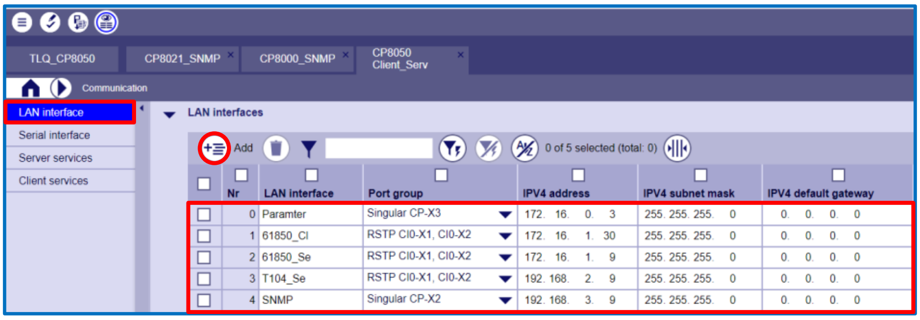


Figure 2.9 SICAM Device Manager main Dashboard

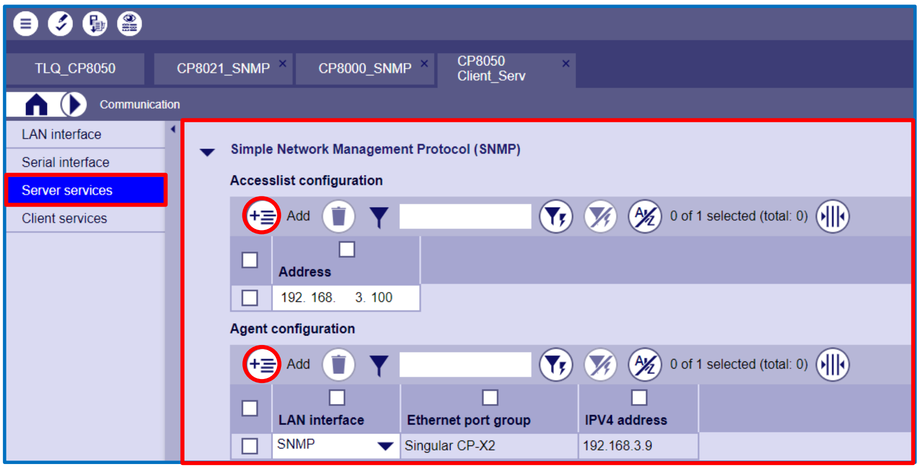
After selecting the tile "Communication" a new setting windows will open. Select first **"LAN interface"**. You can use for SNMP communication either an already existing LAN interface or create via the **"Add"-button** a new interface with the fitting IP-Address. **For the CP-8050/31 1 x physical interface (Port group) can have different IP-addresses**.



□	Nr	LAN interface	Port group	IPV4 address	IPV4 subnet mask	IPV4 default gateway
□	0	Paramter	Singular CP-X3	172. 16. 0. 3	255. 255. 255. 0	0. 0. 0. 0
□	1	61850_CI	RSTP CI0-X1, CI0-X2	172. 16. 1. 30	255. 255. 255. 0	0. 0. 0. 0
□	2	61850_Se	RSTP CI0-X1, CI0-X2	172. 16. 1. 9	255. 255. 255. 0	0. 0. 0. 0
□	3	T104_Se	RSTP CI0-X1, CI0-X2	192. 168. 2. 9	255. 255. 255. 0	0. 0. 0. 0
□	4	SNMP	Singular CP-X2	192. 168. 3. 9	255. 255. 255. 0	0. 0. 0. 0

Figure 2.10 Selecting / adding the LAN interface for SNMP communication

Select then **"Server services"** and scroll down to **"Simple Network Management Protocol (SNMP)"**. Use the **"Add"-button** under **"Access list configuration"** to enter the IP-address of the counter part of the SNMP agent = SNMP Manager (2 are possible) and under **"Agent Configuration"** the LAN interface used in the CP-8050/31 for the SNMP communication.



Simple Network Management Protocol (SNMP)

Accesslist configuration

□	Address
□	192. 168. 3. 100

Agent configuration

□	LAN interface	Ethernet port group	IPV4 address
□	SNMP	Singular CP-X2	192.168.3.9

Figure 2.11 Enabling and setting of the SNMP agent and connection to SNMP Manager

2.6 Activation of SNMP functionality for SICAM Q100/200

The settings of the SICAM Power Quality recorder SICAM Q100 & Q200 using an internal Web browser with HTML pages from the connected computer (preferred).

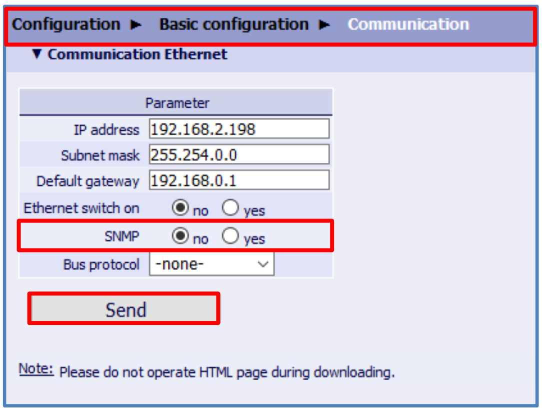
In addition, a parameterization of the device is possible with use of the 4 softkeys and display on the front of the device. Not all parameters can be changed (SNMPv3settings can only be modified via the Web UI).

The IP-Address for SICAM Q100 & Q200 is 192.168.0.55 (for Q200 in case you select 2 independent interfaces the default IP-Address for the second interface is 192.168.1.55)

After connection to the SICAM Q100/200 PQ recorder via the integrated Webserver, you need to navigate to "Configuration" -> "Basic configuration" -> "Communication".

For SICAM Q100 the SNMP agent functionality is enabled via selection **yes in the Checkbox**
For SICAM Q200 the SNMP agent functionality is activated and assigned to one or two Ethernet channels (the option Ch1 and the option Ch2 are only available for **Function** = Two interfaces)

NOTE: Only after pressing the "Send" button the changes are activated in the SICAM Power Quality Recorder



Configuration ► Basic configuration ► Communication

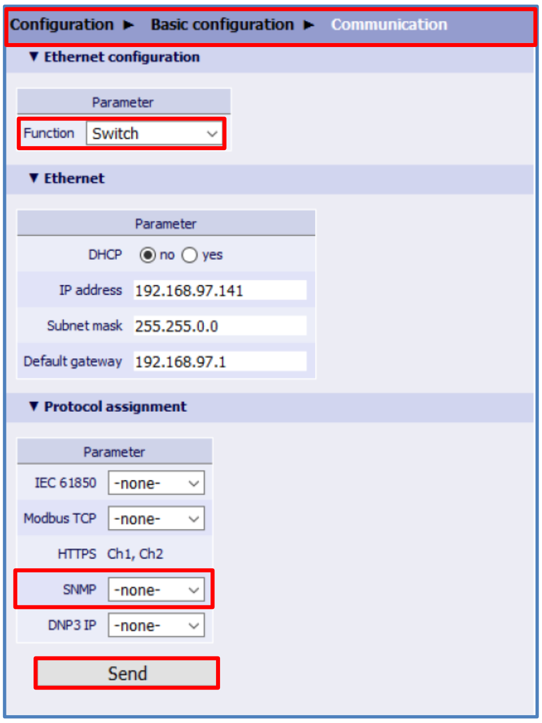
▼ Communication Ethernet

Parameter	
IP address	192.168.2.198
Subnet mask	255.254.0.0
Default gateway	192.168.0.1
Ethernet switch on	● no ○ yes
SNMP	● no ○ yes
Bus protocol	-none-

Send

Note: Please do not operate HTML page during downloading.

SICAM Q100



Configuration ► Basic configuration ► Communication

▼ Ethernet configuration

Parameter	
Function	Switch

▼ Ethernet

Parameter	
DHCP	● no ○ yes
IP address	192.168.97.141
Subnet mask	255.255.0.0
Default gateway	192.168.97.1

▼ Protocol assignment

Parameter	
IEC 61850	-none-
Modbus TCP	-none-
HTTPS	Ch1, Ch2
SNMP	-none-
DNP3 IP	-none-

Send

SICAM Q200

Figure 2.11 Enabling and setting of the SNMP agent for SICAM Q100 and SICAM Q200

3 User administration of SNMPv3

3.1 SNMPv3 general information

SNMPv3 defines the secure version of the SNMP. SNMPv3 protocol also facilitates remote network monitoring configuration of the SNMP entities.

Security was one of the biggest weakness of SNMP until v3. Authentication in SNMP Versions 1 and 2 amounts to nothing more than a password (community string) sent in clear text between a manager and agent. The meaning of these security parameters depends on the security model being used.

The security approach in v3 targets:

- Confidentiality – Encryption of packets to prevent snooping by an unauthorized source.
- Integrity – Message integrity to ensure that a packet has not been tampered while in transit including an optional packet replay protection mechanism.
- Authentication – to verify that the message is from a valid source.

SNMPv3 also defines the USM (**U**ser-based **S**ecurity **M**odel) and VACM (**V**iew-based **A**ccess **C**ontrol **M**odel).

- USM (User-based Security Model) provides authentication and privacy (encryption) functions and operates at the message level.
- VACM (View-based Access Control Model) determines whether a given principal is allowed access to a particular MIB object to perform specific functions and operates at the PDU level.

Definition of different **authentication** and privacy protocols:

- MD5, SHA and HMAC-SHA-2 authentication protocols and the
- CBC_DES and CFB_AES_128 privacy protocols are supported in the USM.

3.2 SNMPv3 availability in DG EA products

The secure SNMPv3 version is available in the following DG EA products

- SIPROTEC 5 relays with Ethernet communication module:
  - **since V1**
- SIPROTEC 4 / Compact / Reyrolle relays with EN100 communication module:
  - needs **EN100 Firmware Version V4.35 or higher**
- Reyrolle 5 relays:
  - **device FW V2.20 or higher and**
  - **communication FW 1.20 or higher**
- SICAM PAS
  - SNMP Client (Manager): V7.01 or higher
  - SNMP Agent: **V8.13 (DGPI)** or higher / **V8.16 (DGSM)** or higher
- SICAM A8000
  - CP-8000 / CP-8021 / CP-8022: **CPC80 Central Processing/Communication Release 09 or higher**
  - CP-8050: **CPCI85 Central Processing/Communication Release 0101 (V1.01) or higher**
  - CP-8031: **CPCI85 Central Processing/Communication Release 0441 (V4.41) or higher**
- SICAM PQ recorder:
  - SICAM Q100: **Firmware version 2.30** or higher and **Hardware Version /DD** or higher
  - SICAM Q200: Since **Firmware Version V1.0**
  - SICAM P855: not supported yet (after new Hardware version will be released)

3.3 User administration with SNMPv3 in DG EA products

Essential for the secure communication between the SNMP Agent and the SNMP Manager is the use of SNMPv3, because only with this version the secure communication is possible.

SNMPv3 protocol facilitates a remote configuration from the SNMP Manager of the SNMP Agents user and user rights. Depending on the DG EA product used, there are two possibilities to add and manage the user and the user rights:

- Add and manage the initial users via the device setting tool, that is possible for:
    - SICAM A8000 RTUs
    - SICAM Q100 & Q200 Power Quality Recorder
- Using already existing default / initial user accounts, created with enabling of the SNMP functionality:
    - SIPROTEC 5
    - SIPROTEC 4 / Compact; Reyrolle / Reyrolle 5
    - SICAM PAS

3.3.1 User administration for DG EA products with default user accounts

From the DG EA product portfolio SIPROTEC 5, SIPROTEC 4 & Compact, Reyrolle and Reyrolle 5 protection relays with Ethernet Communication interface and the SICAM PAS substation system are using default user accounts with default credentials.

NOTE:
This default user accounts and especially the default credentials are needed for the first connection and are used as "template" for creation of secure new user accounts with new credentials. After that is done the "template / default" user accounts should be deactivated or better deleted to keep the system secure.

The management of the user accounts are done from a SNMP Manager or a MIB Browser. In this Application Note the **MIB Browser from iReasoning** is used to have an easy grasp of the workflow.

You can download this MIB Browser from: https://ireasoning.com/download.shtml. The same or greater functionality is also covered by an open-source tool called **net-snmp** which can also be downloaded from http://www.net-snmp.org/ (the net-snmp is not coming with a UI but needs to be handled by command line, recommended only for experts)

Attention:
The MIB Browser **Free Personal Edition** **is not supporting** the needed functionality, therefore the MIB Browser **Professional Edition** coming with a 30-day trial period is required.

Precondition for the SNMPv3 user management are the following Standard MIBs what must be available in the MIB Brower before you start:

- rfc3414 SNMP **U**ser-based **S**ecurity **M**odel **(USM)**.mib (or old rfc2574)
- rfc3415 SNMP **V**iew-based **A**ccess **C**ontrol **M**odel **(VACM)**.mib (or old rfc2575)

You can use **"SNMPLink.org - Standard (RFC, IANA, ATM Forum) MIB Documentation"** for accessing and downloading Standard MIBs: http://www.snmplink.org/OnLineMIB/Standards/

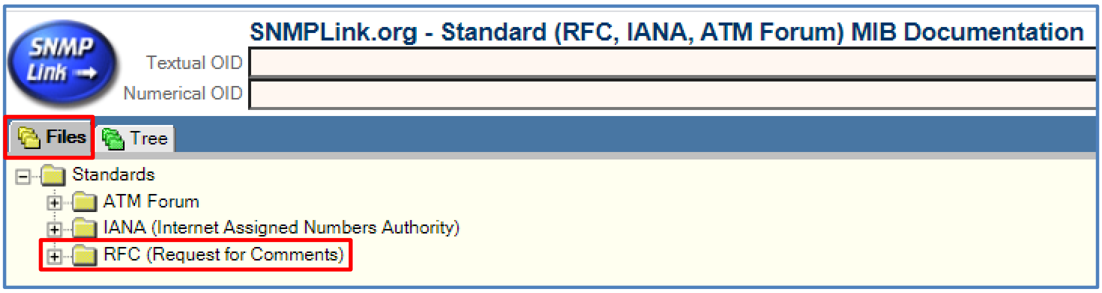
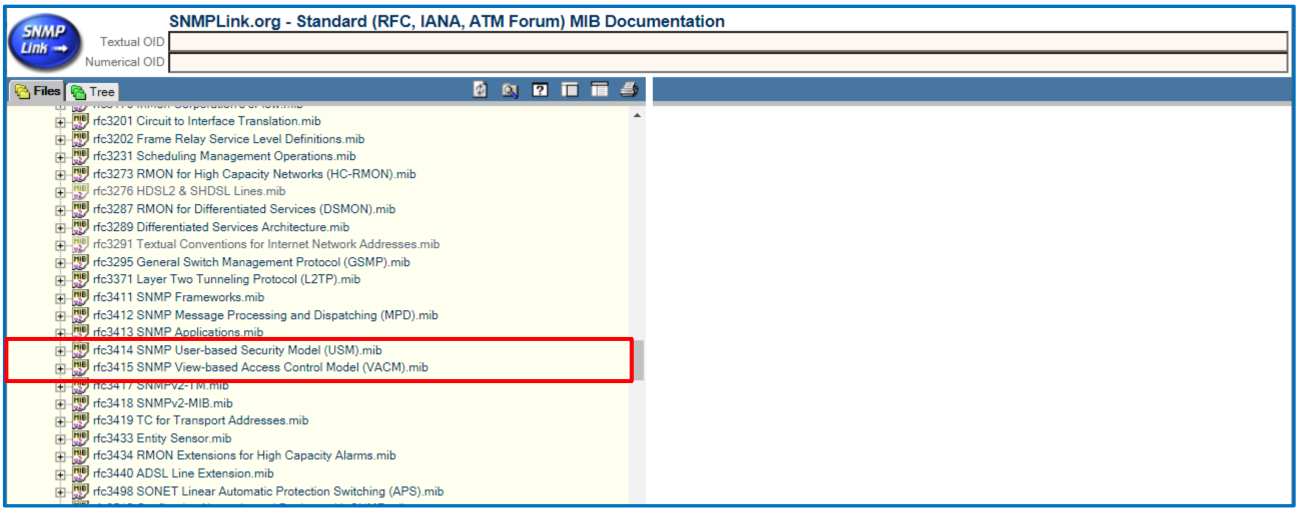

SNMP Link
SNMPLink.org - Standard (RFC, IANA, ATM Forum) MIB Documentation
Textual OID
Numerical OID
Files
Tree
Standards
ATM Forum
IANA (Internet Assigned Numbers Authority)
RFC (Request for Comments)

Figure 3.1 SNMP MIB documentation from SNMPLink.org

Open the RFC (Request for Comments) folder under “Files” by clicking on the + sign.

Scroll down until you find the MIB you need (here rfc3414 / rfc3415) and click the MIB (Figure 3.2). In the left-side Window, a new “selector” MIB is created showing the tree structure to the selected MIB the selected MIB will be shown in the right-side Window (Figure 3.3)



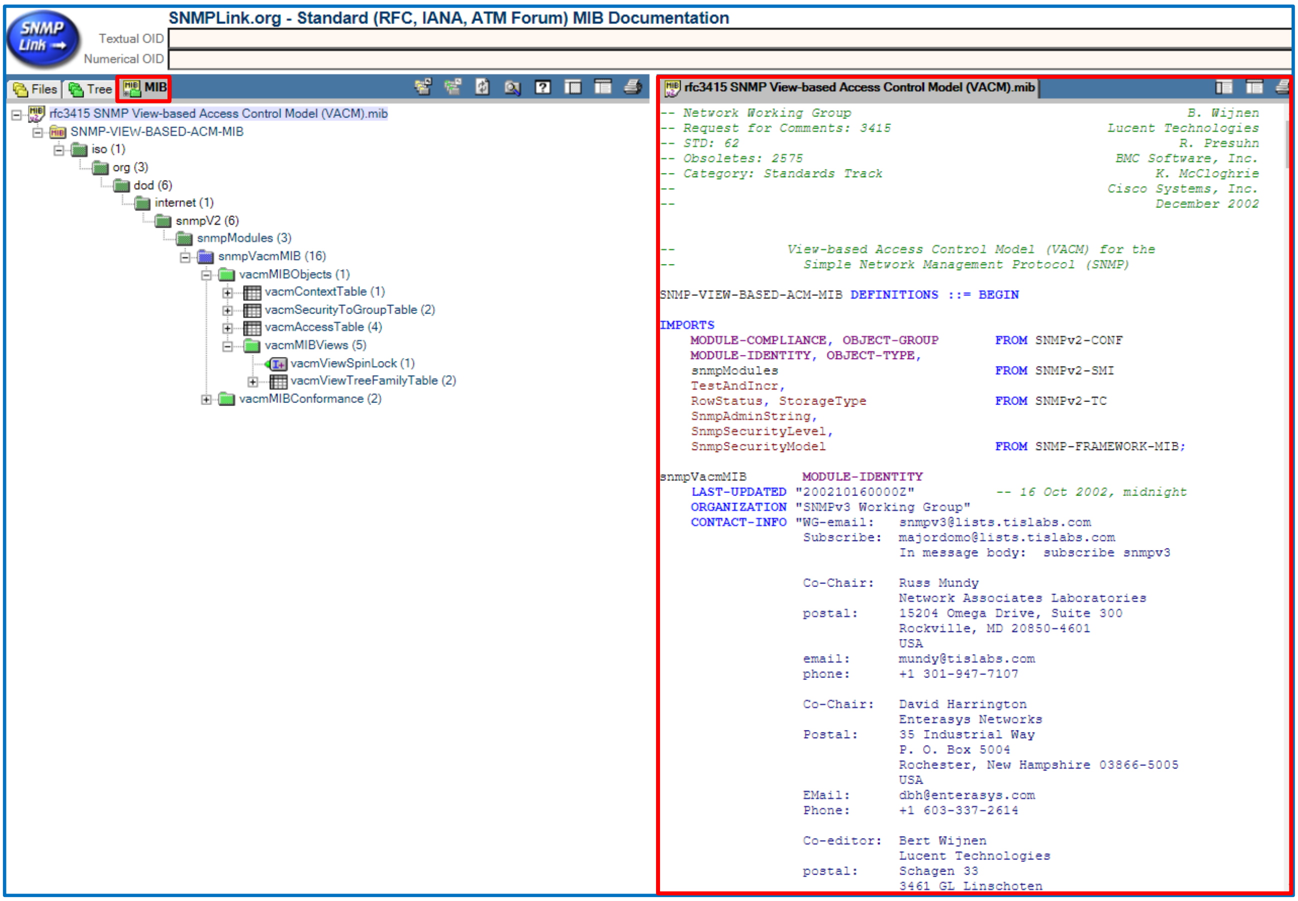
SNMPLink.org - Standard (RFC, IANA, ATM Forum) MIB Documentation

- rfc3201 Circuit to Interface Translation.mib
- rfc3202 Frame Relay Service Level Definitions.mib
- rfc3231 Scheduling Management Operations.mib
- rfc3273 RMON for High Capacity Networks (HC-RMON).mib
- rfc3276 HDSL2 & SHDSL Lines.mib
- rfc3287 RMON for Differentiated Services (DSMON).mib
- rfc3289 Differentiated Services Architecture.mib
- rfc3291 Textual Conventions for Internet Network Addresses.mib
- rfc3295 General Switch Management Protocol (GSMP).mib
- rfc3371 Layer Two Tunneling Protocol (L2TP).mib
- rfc3411 SNMP Frameworks.mib
- rfc3412 SNMP Message Processing and Dispatching (MPD).mib
- rfc3413 SNMP Applications.mib
- rfc3414 SNMP User-based Security Model (USM).mib
- rfc3415 SNMP View-based Access Control Model (VACM).mib
- rfc3417 SNMPv2-TM.mib
- rfc3418 SNMPv2-MIB.mib
- rfc3419 TC for Transport Addresses.mib
- rfc3433 Entity Sensor.mib
- rfc3434 RMON Extensions for High Capacity Alarms.mib
- rfc3440 ADSL Line Extension.mib
- rfc3498 SONET Linear Automatic Protection Switching (APS).mib

Figure 3.2 SNMP MIB tree under Files, showing all standard MIBs

Now you can select the complete text of the MIB from the right-side Windows (e.g., with CTRL “a”) and copy everything (e.g., with “CTRL “c”), create a next *.txt document and paste the text in there (e.g., with CTRL “v”) and save the text document.

Now rename the documents e.g., to VACM-MIB / USM -MIB and important also the type of the document to **.mib**: VACM-MIB.mib and USM-MIB.mib (USM MIB is already in the iReasoning MIB-Browser, but maybe not in another Browser)



```
-- Network Working Group                                         B. Wijnen
-- Request for Comments: 3415                            Lucent Technologies
-- STD: 62                                                       R. Presuhn
-- Obsoletes: 2575                                       BMC Software, Inc.
-- Category: Standards Track                                  K. McCloghrie
--                                                      Cisco Systems, Inc.
--                                                            December 2002


--              View-based Access Control Model (VACM) for the
--                Simple Network Management Protocol (SNMP)

SNMP-VIEW-BASED-ACM-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-COMPLIANCE, OBJECT-GROUP        FROM SNMPv2-CONF
    MODULE-IDENTITY, OBJECT-TYPE,
    snmpModules                            FROM SNMPv2-SMI
    TestAndIncr,
    RowStatus, StorageType                 FROM SNMPv2-TC
    SnmpAdminString,
    SnmpSecurityLevel,
    SnmpSecurityModel                      FROM SNMP-FRAMEWORK-MIB;

snmpVacmMIB       MODULE-IDENTITY
    LAST-UPDATED "200210160000Z"           -- 16 Oct 2002, midnight
    ORGANIZATION "SNMPv3 Working Group"
    CONTACT-INFO "WG-email:   snmpv3@lists.tislabs.com
                  Subscribe:  majordomo@lists.tislabs.com
                              In message body:  subscribe snmpv3

                  Co-Chair:   Russ Mundy
                              Network Associates Laboratories
                  postal:     15204 Omega Drive, Suite 300
                              Rockville, MD 20850-4601
                              USA
                  email:      mundy@tislabs.com
                  phone:      +1 301-947-7107

                  Co-Chair:   David Harrington
                              Enterasys Networks
                  Postal:     35 Industrial Way
                              P. O. Box 5004
                              Rochester, New Hampshire 03866-5005
                              USA
                  EMail:      dbh@enterasys.com
                  Phone:      +1 603-337-2614

                  Co-editor:  Bert Wijnen
                              Lucent Technologies
                  postal:     Schagen 33
                              3461 GL Linschoten
```

Figure 3.3 MIB tree structure and text description

The user administration via a SNMP Manager or like shown here via the MIB-Browser from iReasoning will take several steps:

Step 1:
Ensure that the needed USM- and VACM-MIB is loaded; if not load / import the missing MIBs first

Step2:
Connect your SNMP agent device via default user account to the SNMP Manager (in our case iReasoning MIB-Browser)

Step 2a:
Check if the connection was successful.

Step 3:
Create a new user with new credentials as "clone" from the default user

Step 4:
Add the new created user into the access list (**V**iew-based **A**ccess **C**ontrol **M**odel)

Step 4a:
Check is the new user account with new credentials is working

Step 5:
Delete the default user accounts

Step1: Ensure that the needed USM- and VACM-MIB is loaded

Open the iReasoning MIB-Browser and check what MIBs are already loaded.

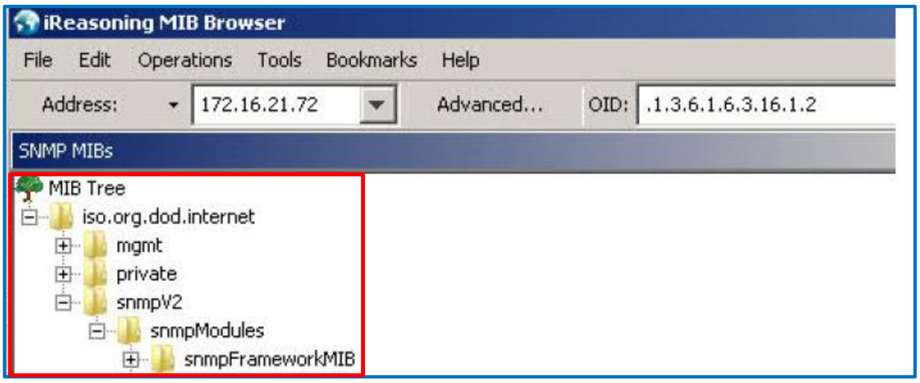


Figure 3.4 iReasoning MIB-Browser with installed MIBs

The USM MIB is already loaded when using the **Professional Edition** with 30-day trial period, but not the VACM-MIB.

The saved VACM-MIB.mib (Figure 3.3) must now be loaded / imported first into the MIB Tree of the iReasoning MIB-Browser.

Select “File” and in the dop-down menu “Load MIBs”. A new dialog box will open to select the location folder on your PC or USB drive => select there the location where you saved the VACM-MIB.mib (eventually you need to enter as File type *.*) and the file itself and press the “Open button” for importing the MIB file.

For the “Private” / “Common DG” MIBs (see chapter 1.2.4) the same loading / importing process is used.

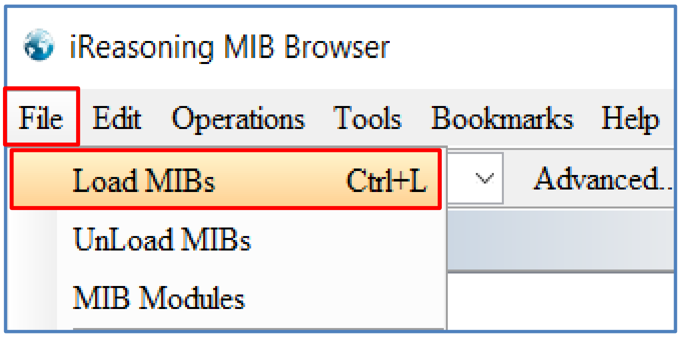


Figure 3.5 Loading VACM-MIB into the MIB Tree

Check after the import if the VACM-MIB is now visible in the MIB Tree of the iReasoning MIB-Browser.

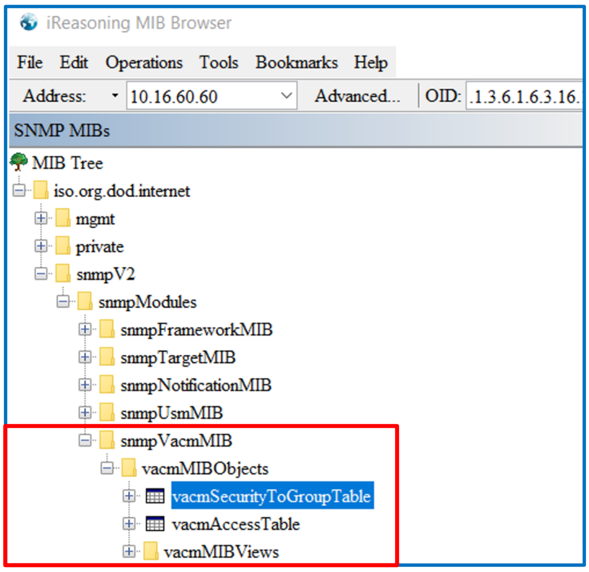


Figure 3.6 iReasoning MIB-Browser with installed MIBs

Step2: Connect your SNMP agent device via default user account to the SNMP Manager

For the first connection form your physical device with SNMP Agent functionality to the SNMP Manager / iReasoning MIB-Browser, you need to use the initial / default user account with the default credentials.

The following initial / default user and credentials are defined:

SIPROTEC 5: ETH-BA-2EL / ETH-BB-2FO / ETH-BD-2FO communication modules

User	Authentication Algorithm	Authentication Password	Encryption/Privacy Algorithm	Privacy Password	Access Rights
Initial[1]	**No**	**No**	**No**	**No**	**Read**
templateMD5	**MD5**	**12345678**	**DES**	**12345678**	**Read, Write**
templateSHA	**SHA**	**12345678**	**DES / AES**[2]	**12345678**	**Read, Write**

[1] User „initial" is not available in ETH-BD-2FO module due to security reasons

[1] Encryption algorithm is AES for ETH-BD-2FO module due to security reasons, in the rest of the modules it is DES

SIPROTEC 4 / Compact / Reyrolle: EN100 E+/O+ communication modules

User	Authentication Algorithm	Authentication Password	Encryption/Privacy Algorithm	Privacy Password	Access Rights
Initial	**No**	**No**	**No**	**No**	**Read**
managersha256aes	**SHA256**	**sha256authpw**	**AES**	**sha256privpw**	**Read, Write**

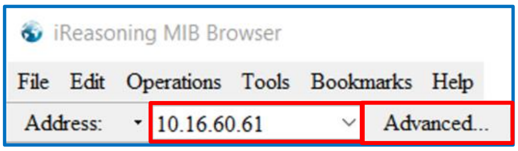
Reyrolle 5:

User	Authentication Algorithm	Authentication Password	Encryption/Privacy Algorithm	Privacy Password	Access Rights
Initial	**No**	**No**	**No**	**No**	**Read**
templateMD5	(HMAC-) **MD5**	**12345678**	**DES**	**12345678**	**Read, Write**
templateSHA	(HMAC-) **SHA**	**12345678**	**AES**	**12345678**	**Read, Write**

SICAM PAS/PQS:

User	Authentication Algorithm	Authentication Password	Encryption/Privacy Algorithm	Privacy Password	Access Rights
Admin	**SHA512**	**12345678**	**AES128**	**12345678**	**Read, Write**

For establishing an online connection, you need to put the IP-Address of your SNMP Agent device in the Address fields and press the "Advanced..." button

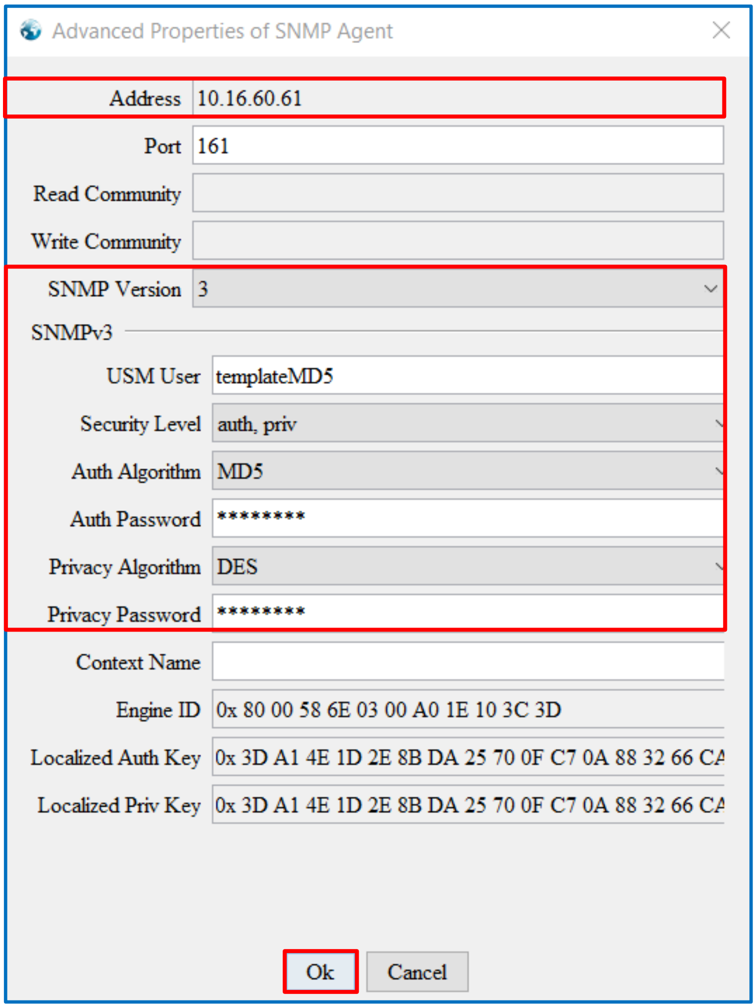


Address: 10.16.60.61

Figure 3.7 Connecting to the SNMP Agent device

The Advanced Properties Dialog-Box will open; there you need to enter the port number 161 (standard SNMP port, if not modified in DIGSI 5) and the SNMP Version: 3

The user and credentials as shown in the tables above (depending what device type is connected) needs to be entered and for the "Security Level": auth, priv. When finished with the entrees, press the "Ok" button



Address 10.16.60.61

Port 161

Read Community

Write Community

SNMP Version 3

SNMPv3

USM User templateMD5

Security Level auth, priv

Auth Algorithm MD5

Auth Password ********

Privacy Algorithm DES

Privacy Password ********

Context Name

Engine ID 0x 80 00 58 6E 03 00 A0 1E 10 3C 3D

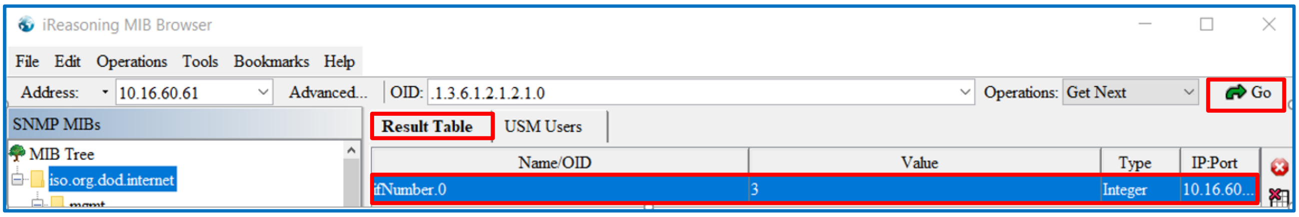
Localized Auth Key 0x 3D A1 4E 1D 2E 8B DA 25 70 0F C7 0A 88 32 66 CA

Localized Priv Key 0x 3D A1 4E 1D 2E 8B DA 25 70 0F C7 0A 88 32 66 CA

Figure 3.8 Entering the user and credential information

Step 2a: Check if the connection was successful

Press the ‘Go’ button and you should get some SNMP readings on the ‘Result Table’



Address: 10.16.60.61

OID: .1.3.6.1.2.1.2.1.0

Operations: Get Next

Name/OID	Value	Type	IP:Port
ifNumber.0	3	Integer	10.16.60...

Figure 3.9 Checking if the connection was successful

Step 3: Create a new user with new credentials as “clone” from the default user

To create a new User, **you need to clone an existing default User** which will be the recommended way instead creating a new user.

Important:

You need to be logon on with an **Account based on the same Auth Protocol you want to clone**. Otherwise, the password change for Authentication may fail.

Go to **“Tools”** an select in the drop-down menu **“Manage SNMP v3 USM Users”** (Figure 3.10) and select in the right-side working area “**USM Users”** an **select the line you want to use as template (MD5/SHA)** and **press ‘Clone’** (Figure 3.11)

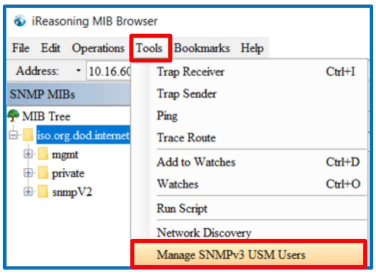
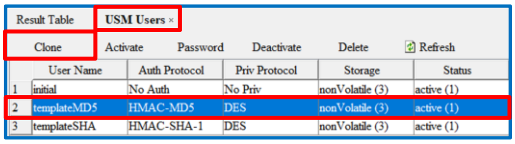


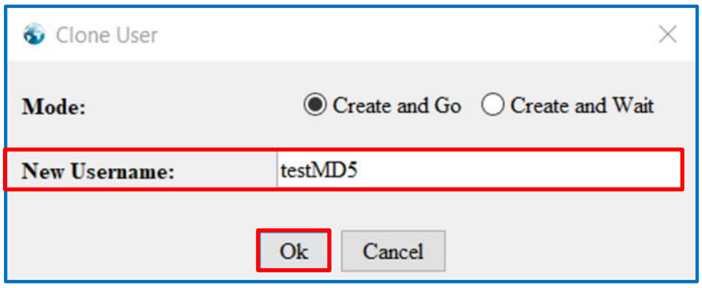
Figure 3.10 Managing SNMPv3 Users



	User Name	Auth Protocol	Priv Protocol	Storage	Status
1	initial	No Auth	No Priv	nonVolatile (3)	active (1)
2	templateMD5	HMAC-MD5	DES	nonVolatile (3)	active (1)
3	templateSHA	HMAC-SHA-1	DES	nonVolatile (3)	active (1)

Figure 3.11 Selecting the default / initial user as Template for the new user

After pressing the Clone button has been pressed a new dialog windows will be opened (Figure 3.12); enter there the **New Username** and press the **Ok button,**



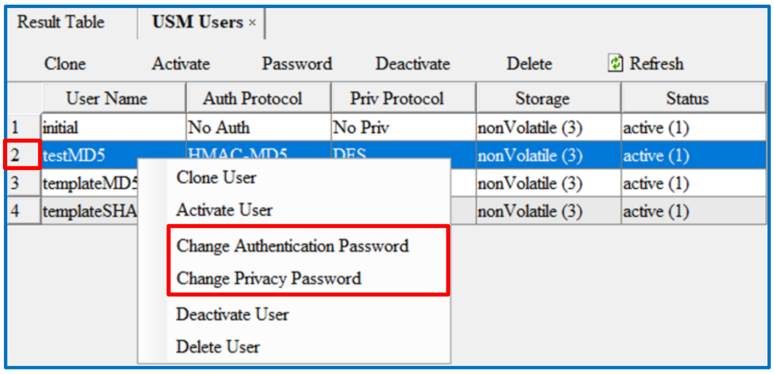
Mode: ● Create and Go ○ Create and Wait

New Username: testMD5

Figure 3.12 Entering the new username

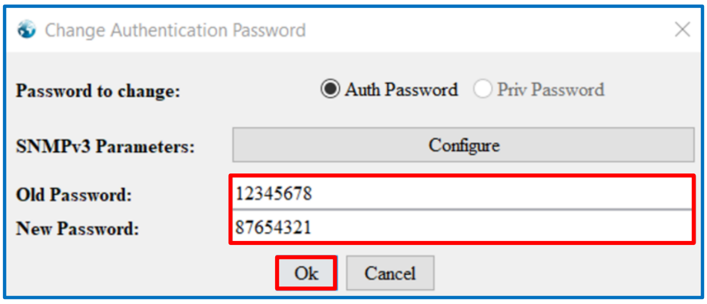
Right click on the new user (Figure 3.13) and change the Authentication/Privacy password (Figure 3.14 for Auth. PW)

You need to provide **the old password and the new password**. Password requires minimum 8 characters which can include (not must) uppercase and lowercase letters, numbers, and special characters.



	User Name	Auth Protocol	Priv Protocol	Storage	Status
1	initial	No Auth	No Priv	nonVolatile (3)	active (1)
2	testMD5	HMAC-MD5	DES	nonVolatile (3)	active (1)
3	templateMD5			nonVolatile (3)	active (1)
4	templateSHA			nonVolatile (3)	active (1)

Figure 3.13 Modify the credentials for the new user



Password to change: ● Auth Password ○ Priv Password

SNMPv3 Parameters:

Old Password: 12345678

New Password: 87654321

Figure 3.14 Modify the credentials for the new user

Step 4: Add the new created user into the access list (View-based Access Control Model)

The new user is now entered and known for **U**ser-based **S**ecurity **M**odel; but needs to be added and activated with its rights additionally into the **V**iew-based **A**ccess **C**ontrol **M**odel group.

For doing this, please select in the MIB Tree under **snmpVacmMIIB -> vacmSecurityToGroupTable** (Figure 3.15) and select **"Table View"** to open the Table with activated Users.

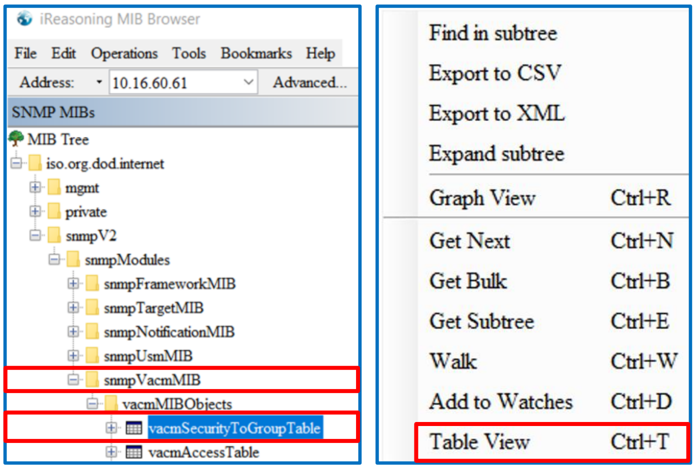
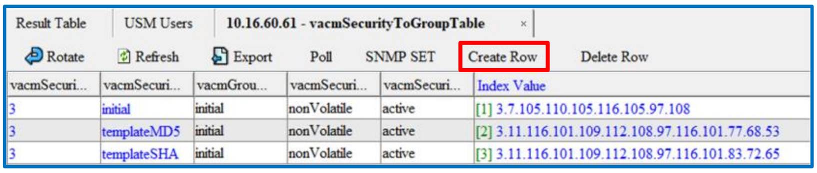


Figure 3.15 VACM node for opening the Table with activated users

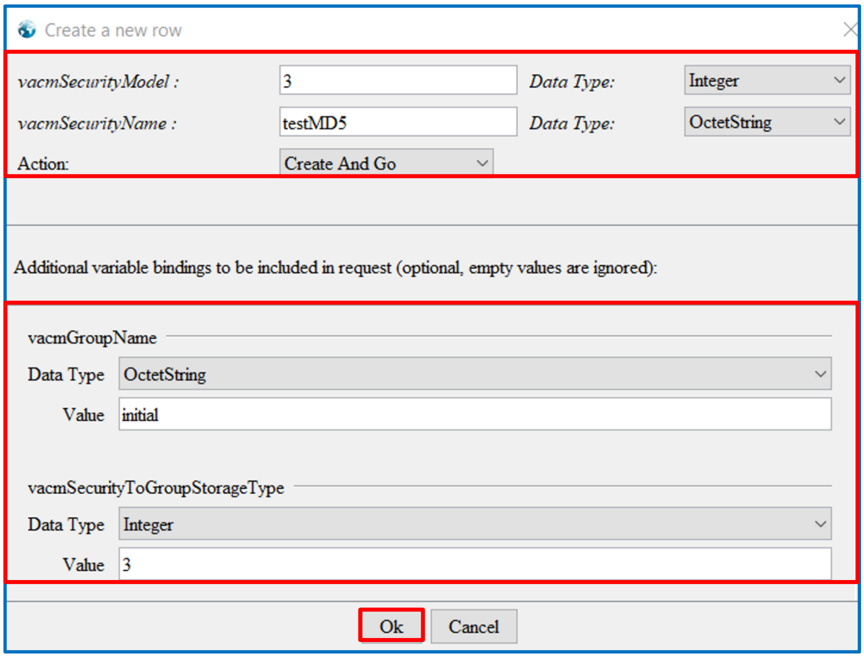
You can see the default / initial users in this table, **but not the newly cloned user**. Select in the working area the **VACM-SecurityToGroup Table** and **push "Create Row"** (Figure 3.16)



vacmSecuri...	vacmSecuri...	vacmGrou...	vacmSecuri...	vacmSecuri...	Index Value
3	initial	initial	nonVolatile	active	[1] 3.7.105.110.105.116.105.97.108
3	templateMD5	initial	nonVolatile	active	[2] 3.11.116.101.109.112.108.97.116.101.77.68.53
3	templateSHA	initial	nonVolatile	active	[3] 3.11.116.101.109.112.108.97.116.101.83.72.65

Figure 3.16 Creating a new entree for the new user

In the new Dialog-Box (Figure 3.17), you need to enter **exactly the name of the new closed user under vacmSecurityName and the shown other setting**s. When finished, press the **Ok button**.


Create a new row

vacmSecurityModel :	3	*Data Type:*	Integer
vacmSecurityName :	testMD5	*Data Type:*	OctetString
Action:	Create And Go		

Additional variable bindings to be included in request (optional, empty values are ignored):

vacmGroupName

Data Type	OctetString
Value	initial

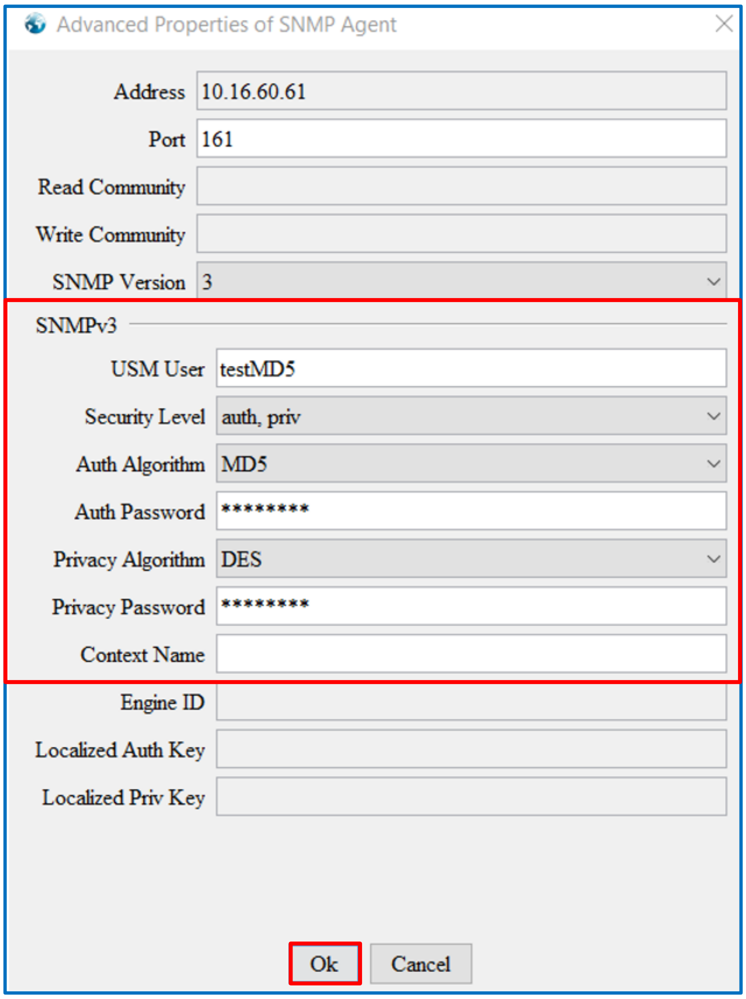
vacmSecurityToGroupStorageType

Data Type	Integer
Value	3

Figure 3.17 Entering the detail for the new user

Step 4a: Check is the new user account with new credentials is working

Check by clicking on **"Advanced"** (see Figures 3.7) and use the new **username & settings** as shown in Figures 3.19



Advanced Properties of SNMP Agent

Address: 10.16.60.61

Port: 161

Read Community:

Write Community:

SNMP Version: 3

SNMPv3

USM User: testMD5

Security Level: auth, priv

Auth Algorithm: MD5

Auth Password: ********

Privacy Algorithm: DES

Privacy Password: ********

Context Name:

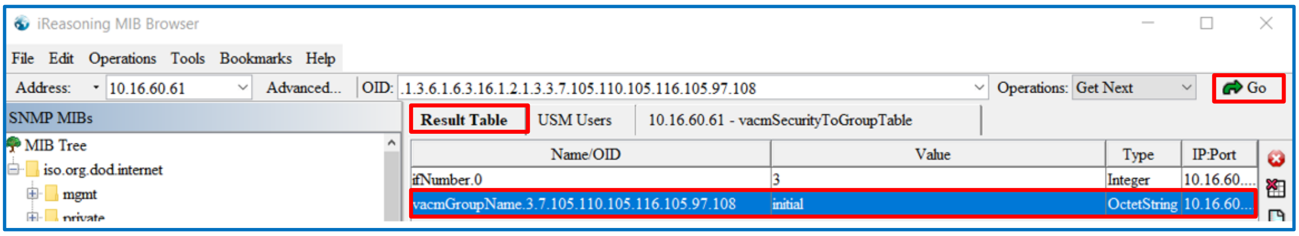
Engine ID:

Localized Auth Key:

Localized Priv Key:

Figure 3.18 Entering the detail for the new user

After the login information under the newly created user has been entered press the **"Go" button** and you should get some new SNMP readings on the **"Result Table"** (Figure 3.19)



iReasoning MIB Browser

Address: 10.16.60.61 Advanced... OID: .1.3.6.1.6.3.16.1.2.1.3.3.7.105.110.105.116.105.97.108 Operations: Get Next

Name/OID	Value	Type	IP:Port
ifNumber.0	3	Integer	10.16.60....
vacmGroupName.3.7.105.110.105.116.105.97.108	initial	OctetString	10.16.60...

Figure 3.19 Checking if the newly created user is activated

Step 5: Delete the default user accounts

It is strongly recommended deactivating or better removing the Default / Initial Accounts and no longer used Accounts in in the USM Users Table. Only than the Cyber Security Aspect is really considered.

Open the USM User Table via “Tools” and drop-down menu “Manage SNMPv3 USM Users” (Figure 3.20)

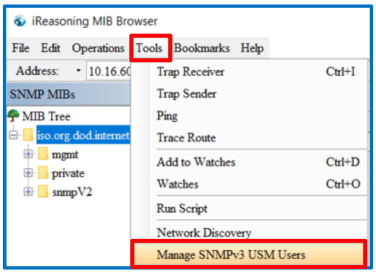
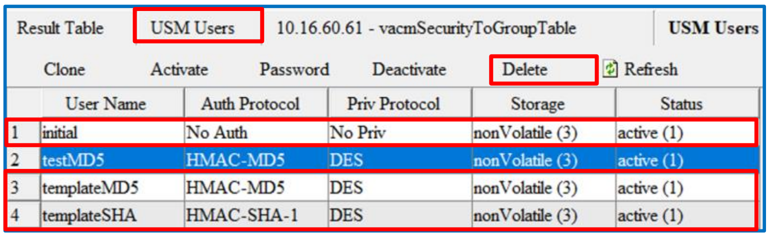


Figure 3.20 Managing SNMPv3 Users

Select the “USM Users” Tab and select one Default / Initial User or no longer used/needed User and press the “Delete” button, repeat this for all other Default / Initial User or no longer used/needed User until all of them are deleted.



	User Name	Auth Protocol	Priv Protocol	Storage	Status
1	initial	No Auth	No Priv	nonVolatile (3)	active (1)
2	testMD5	HMAC-MD5	DES	nonVolatile (3)	active (1)
3	templateMD5	HMAC-MD5	DES	nonVolatile (3)	active (1)
4	templateSHA	HMAC-SHA-1	DES	nonVolatile (3)	active (1)

Figure 3.21 Selecting the default / initial user as Template for the new user

Note:
If the parameterization / activation for SNMP is removed and these changes are loaded in the device, all previous settings made for SNMP on the Ethernet communication module are deleted. This means that the initial state applies when parameterizing /activating the SNMP again. If you modify the configuration of SIPROTEC5 device without modifying SNMP, then SNMP remains just as before. This behavior is driven by Cyber Security rules and should be generally valid.

3.3.2 User administration for DG EA products via device setting tools

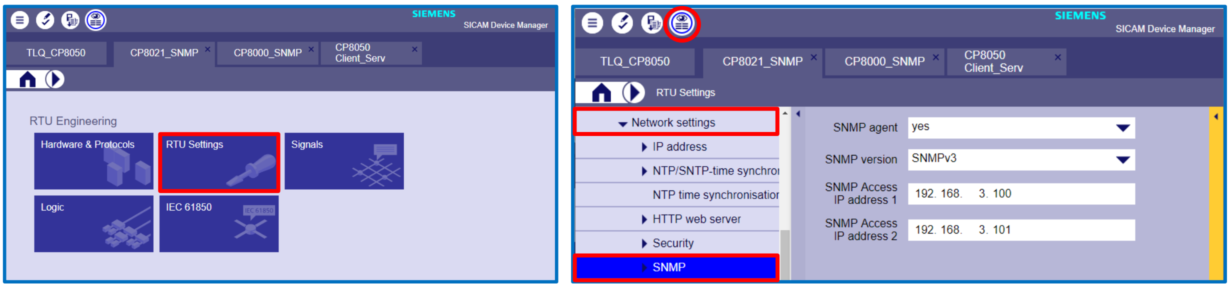
The following DG EA products are not using default / initial users for the SNMP Agent functionality, but the users must be defined within the device setting tools

- SICAM A8000 RTUs (CP-8000/21/22 and CP8050/31)
- SICAM Power Quality Recorder (Q100 & Q200)

Settings for A8000 RTUs CP-8000/21/22:

Please see the screenshots shown in Figure 2.7 and 2.8 showing the activation of the SNPM Agent functionality

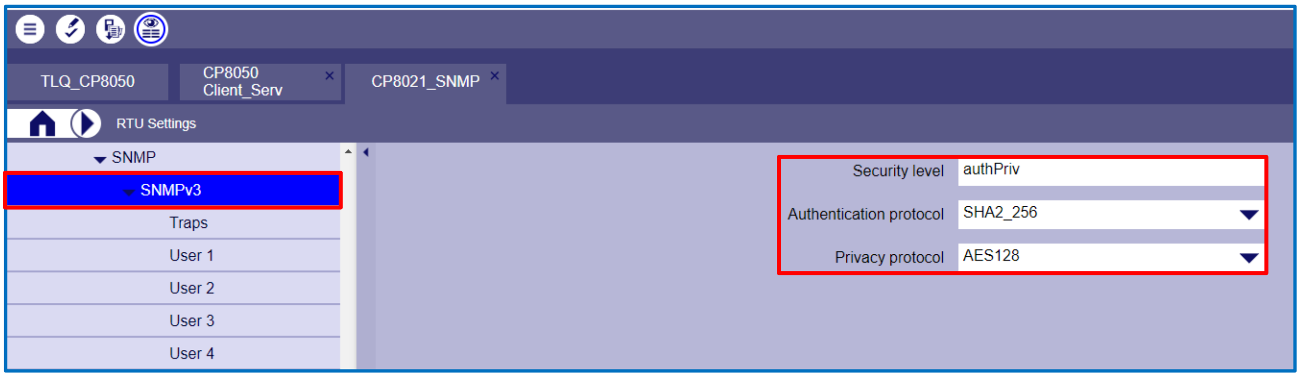
Main Dashboard -> select there **RTU Settings** enable in RTU Settings the **expert view** and scroll down to **Network Settings** and select **SNMP**



SNMP agent: yes
SNMP version: SNMPv3
SNMP Access IP address 1: 192. 168. 3. 100
SNMP Access IP address 2: 192. 168. 3. 101

Figure 3.22 SNMP Settings for CP-8000/21/22

Under the node SNMP you can find the settings for the **SNMPv3** security settings (Figure 3.23). The Security level is fixed and cannot be changed (highest level for SNMPv3).



Security level: authPriv
Authentication protocol: SHA2_256
Privacy protocol: AES128

Figure 3.23 SNMP Security Settings for CP-8000/21/22

The used algorithms for the Authentication and the Privacy protocol can be selected from a drop-down menu (Figure 3.24) and are common for all users what are created.

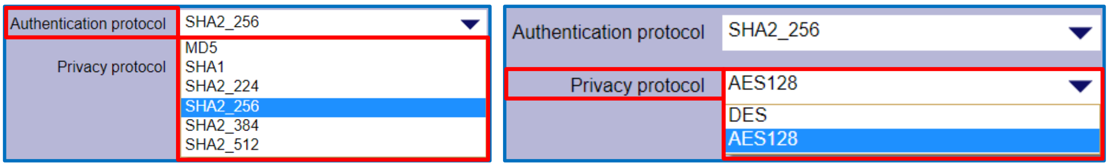
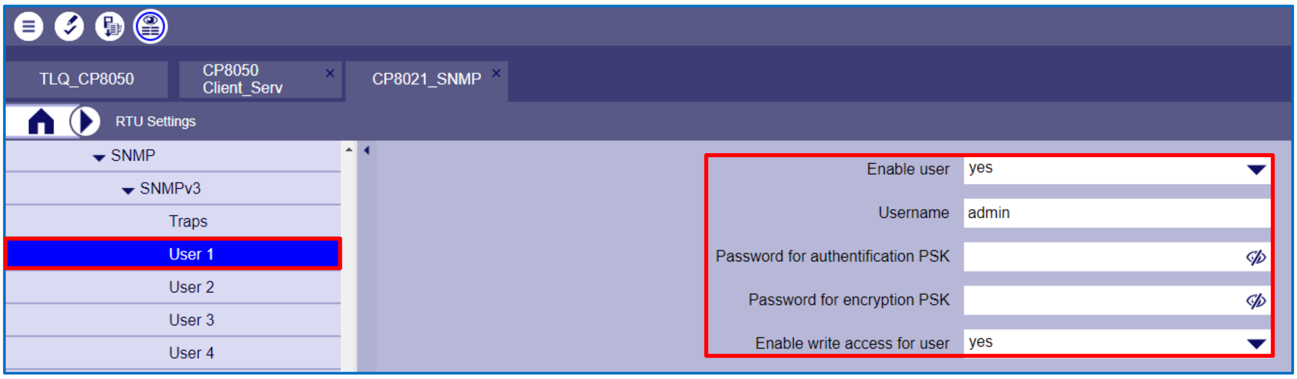


Figure 3.24 SNMP Security Algorithms for CP-8000/21/22

Up to 4 users can be created (Figure 3.25). Each user must be **enabled** (preparation in advance possible and enabling later) and have a Username and Passwords for the Authentication and for the Privacy (Encryption). Also, the allowed rights read only or read and write rights can be selected here.



Enable user: yes
Username: admin
Password for authentification PSK:
Password for encryption PSK:
Enable write access for user: yes

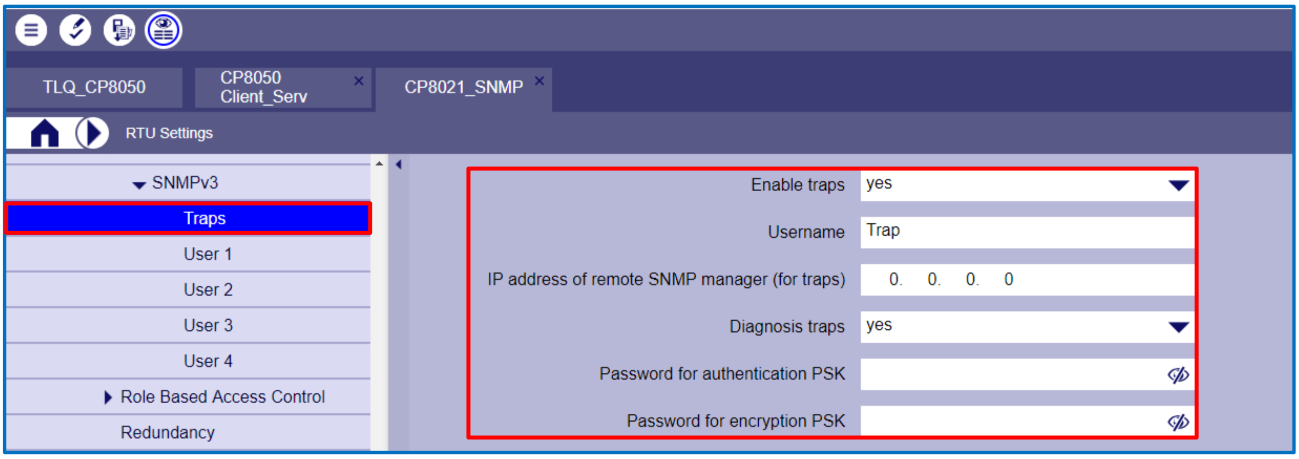
Figure 3.25 SNMPv3 User

The A8000 RTUs also allow unsolicited / spontaneous sent information to the SNMP Manager => so-called **Traps**; this is **only possible for diagnostic information via the private sicamRTU MIB** (see [6] SICAM A8000 Series CP-8000, CP-8021, CP-8022 – Manual Chapter 12.21.5.2).

The Trap function is running per default over port 162 and needs to be enabled (**Enable traps and Diagnostic traps**) for the SNMP Agent and of course also protected via **passwords for the Authentication and for the Privacy**.

The IP-Address of the SNMP Manager receiving the spontaneous sent information also needs to be entered here

Note:
The necessary settings and action on SNMP Manager / iReasoning side for receiving traps will be covered in Chapter 5.



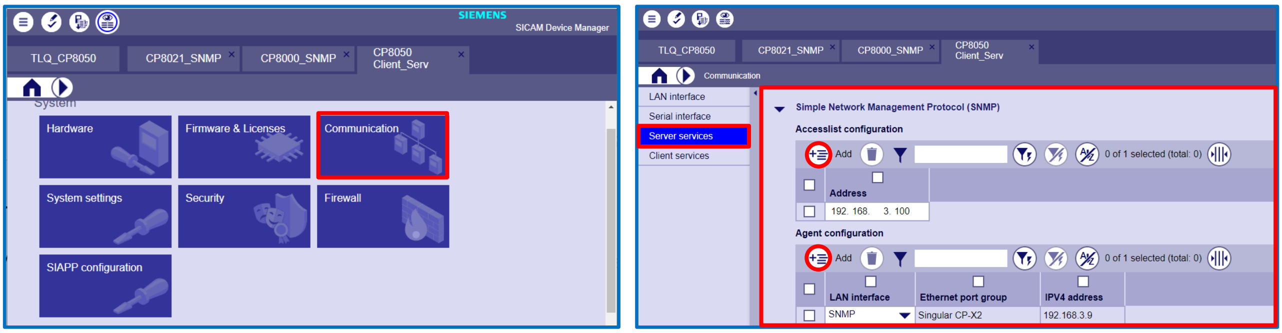
Enable traps: yes
Username: Trap
IP address of remote SNMP manager (for traps): 0. 0. 0. 0
Diagnosis traps: yes
Password for authentication PSK:
Password for encryption PSK:

Figure 3.26 SNMPv3 Trap configuration

Settings for A8000 RTUs CP-8031/50:

Please see the screenshots shown in Figure 2.9 and 2.11 showing the activation of the SNPM Agent functionality

Main Dashboard -> select the **Communication** tile and define under **Accesslist configuration** up to two SNMP Manager IP-addresses what can access the information and under **Agent configuration** the network(s) for the communication of the SNMP information exchange (Figure 3.27).



Simple Network Management Protocol (SNMP)

Accesslist configuration

□	Address
□	192. 168. 3. 100

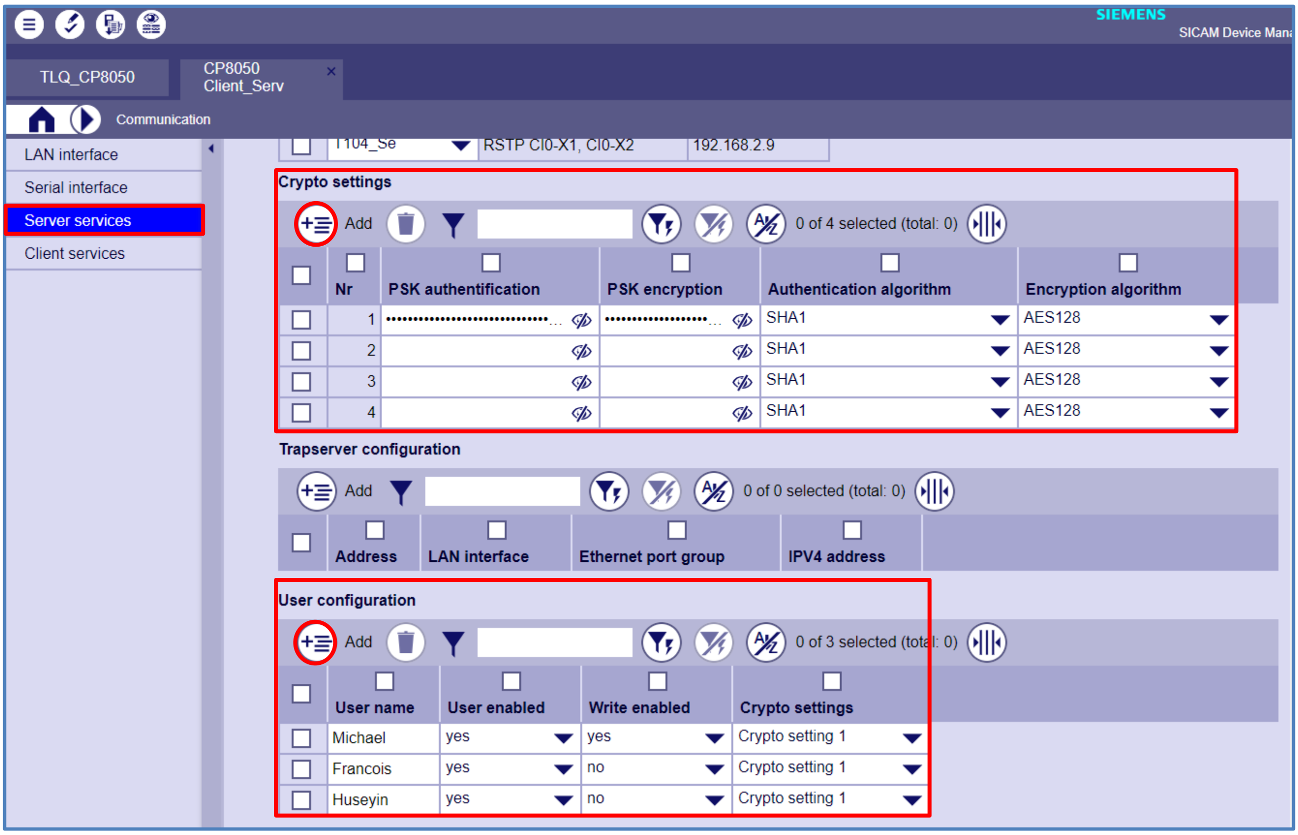
Agent configuration

□	LAN interface	Ethernet port group	IPV4 address
□	SNMP	Singular CP-X2	192.168.3.9

Figure 3.27 SNMP Settings for CP-8000/21

Up to 4 users can be created under **User Configuration** (Figure 3.28) via the **Add button**. Each user must be **enabled** (preparation in advance possible and enabling later) and have a Username and must be **assigned** to one of five possible sets of credentials (Passwords for the Authentication and for the Privacy / Encryption). The allowed rights read only or read and write rights can be selected here. Under **Crypto Settings** the credentials are created via the **Add button** and then configured (up to five sets are possible).

The used algorithms for the Authentication and the Privacy protocol can be selected from a **drop-down menu** (Figure 3.29). Up to five different crypto settings can be created (for up to 4 users & 1 credentials for the traps)



□	T104_Se	RSTP CI0-X1, CI0-X2	192.168.2.9

Crypto settings

□	Nr	PSK authentification	PSK encryption	Authentication algorithm	Encryption algorithm
□	1	•••••••••••••••••••••••••••••...	••••••••••••••••••...	SHA1	AES128
□	2			SHA1	AES128
□	3			SHA1	AES128
□	4			SHA1	AES128

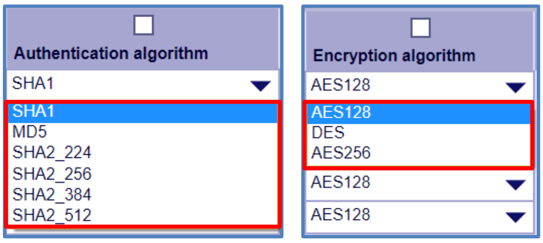
Trapserver configuration

□	Address	LAN interface	Ethernet port group	IPV4 address

User configuration

□	User name	User enabled	Write enabled	Crypto settings
□	Michael	yes	yes	Crypto setting 1
□	Francois	yes	no	Crypto setting 1
□	Huseyin	yes	no	Crypto setting 1

Figure 3.28 SNMPv3 Users with properties and assigned credentials (privacy / encryption & authentication)



Authentication algorithm: SHA1

- SHA1
- MD5
- SHA2_224
- SHA2_256
- SHA2_384
- SHA2_512

Encryption algorithm: AES128

- AES128
- DES
- AES256

AES128

AES128

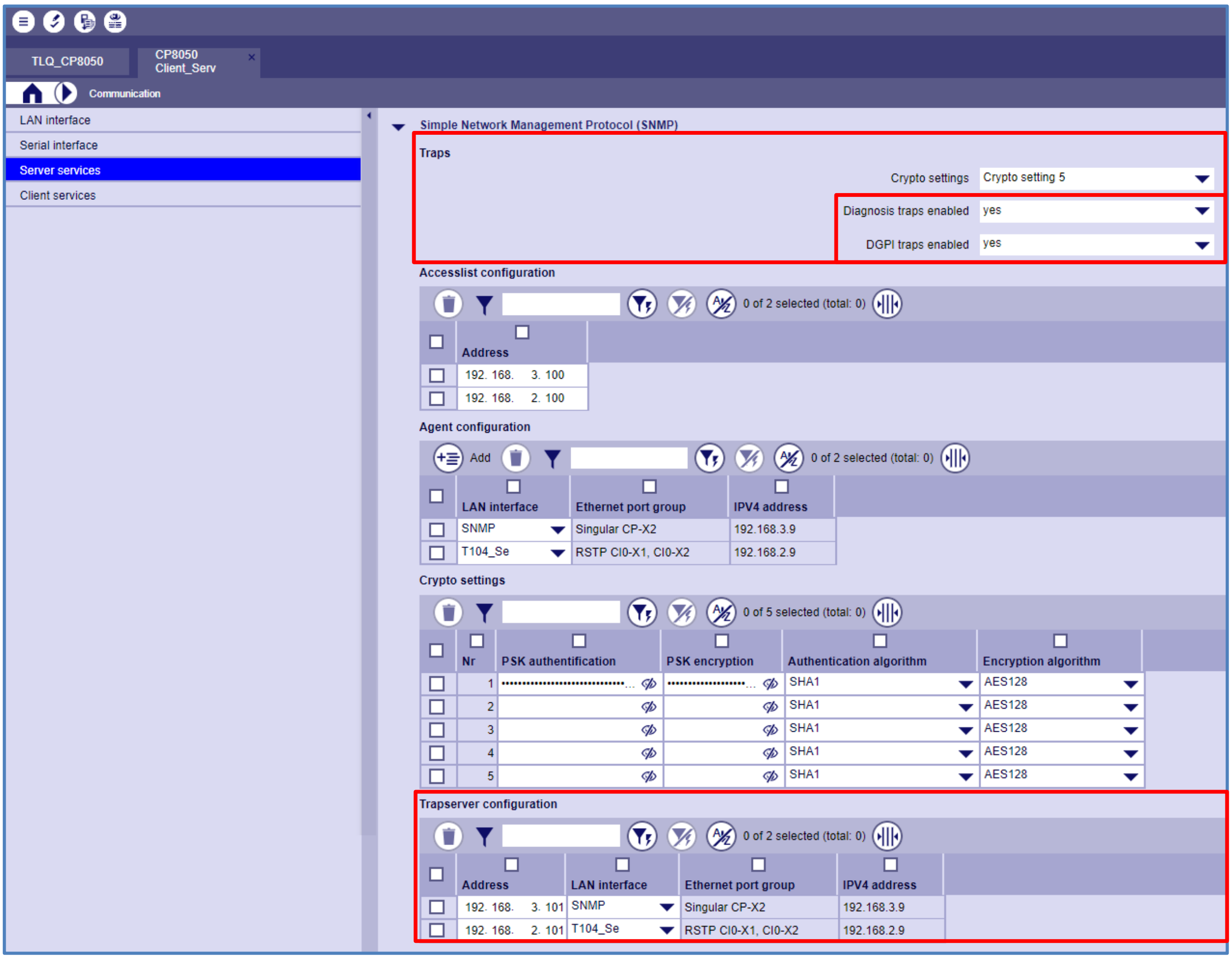
Figure 3.29 SNMP Security Algorithms for CP-8031/50

The A8000 RTUs also allow unsolicited / spontaneous sent information to the SNMP Manager => so-called **Traps**; this is **available for diagnostic information via the private sicamRTU MIB** and for information via the **DG Product Inventory MIB** (see [5] SICAM A8000 Series, Manual CP-8050 Chapter 13.23.5.2&3).

The Trap function is running per default over port 162 and needs to be enabled (**Enable traps and Diagnostic traps**) for the SNMP Agent and of course also protected via **passwords for the Authentication and for the Privacy**.

Under **Trapserver configuration** up to two receivers for the traps can be entered (**IP-Address and used LAN**) of the SNMP (Figure 3.30). As soon as at least one Trapserver is configured a **new entrée directly under the SNMP node** appears where the **used Crypto Settings for the traps** must be entered and the **Traps for Diagnostic and/or DGPI can be enabled**

Note:
The necessary settings and action on SNMP Manager / iReasoning side for receiving traps will be covered in Chapter 5.



Simple Network Management Protocol (SNMP)

Traps

Crypto settings: Crypto setting 5

Diagnosis traps enabled: yes

DGPI traps enabled: yes

Accesslist configuration

0 of 2 selected (total: 0)

□	Address
□	192. 168. 3. 100
□	192. 168. 2. 100

Agent configuration

Add 0 of 2 selected (total: 0)

□	LAN interface	Ethernet port group	IPV4 address
□	SNMP	Singular CP-X2	192.168.3.9
□	T104_Se	RSTP CI0-X1, CI0-X2	192.168.2.9

Crypto settings

0 of 5 selected (total: 0)

□	Nr	PSK authentification	PSK encryption	Authentication algorithm	Encryption algorithm
□	1	•••••••••••••••••••••••••••••••...	•••••••••••••••••••...	SHA1	AES128
□	2			SHA1	AES128
□	3			SHA1	AES128
□	4			SHA1	AES128
□	5			SHA1	AES128

Trapserver configuration

0 of 2 selected (total: 0)

□	Address	LAN interface	Ethernet port group	IPV4 address
□	192. 168. 3. 101	SNMP	Singular CP-X2	192.168.3.9
□	192. 168. 2. 101	T104_Se	RSTP CI0-X1, CI0-X2	192.168.2.9

Figure 3.30 SNMPv3 Trap configuration

Settings for SICAM Q100 & Q200 Power Quality Recorder:

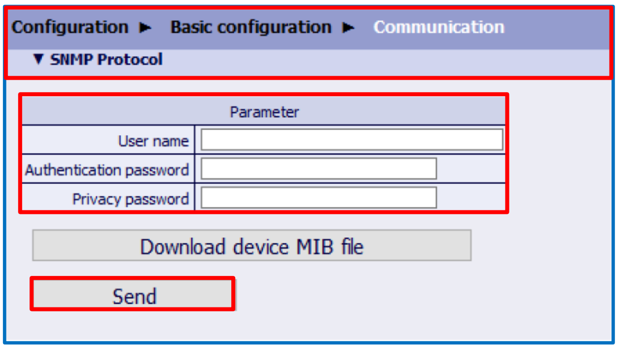
The settings of the SICAM Power Quality recorder SICAM Q100 & Q200 using an internal Web browser with HTML pages from the connected computer. The IP-Address for SICAM Q100 & Q200 is 192.168.0.55 (for Q200 in case you select 2 independent interfaces the default IP-Address for the second interface is 192.168.1.55)

After connection to the SICAM Q100/200 PQ recorder via the integrated Webserver, you need to navigate to "**Configuration**" -> "**Basic configuration**" -> "**Communication**".

Precondition: The SNMP protocol must be assigned to 1 Ethernet interface. To change the SNMPv3 settings in the Configuration tab, proceed as follows:

In the navigation window, **click SNMP protocol**.

- **Only 1 user** is possible, adding or removing of extra users is not possible
- With the default values (all are empty), access via SNMPv3 is not possible. The parameters must be set before accessing data via SNMP access
- The valid character range for username and passwords is limited to:
  - Numbers (0-9)
  - Latin characters (A-Z, a-z)
  - Basic special characters in the ASCII-character code range (33 to 126)
- Maximum length of a username is 32 characters.
- Maximum length of a SNMPv3 password is 24 characters.
- Passwords must be at least 8 characters long.
- **Authentication with MD5 algorithm**
- **Encryption with DES algorithm**
- SNMP must be enabled via parameterization.
- Only read access is allowed.
- RFC1213 MIB and the device-specific MIB (only for Q100 -> for Q200 the "Download device MIB file" button is not available, because only standard MIBs are used) are supported.
- Changes of SNMPv3 settings are only possible via Web browser, not via the device display
- **Click Send. The changed passwords are immediately valid.**



Parameter	
User name	
Authentication password	
Privacy password	

Figure 3.31 Configuration Tab, SNMPv3 Settings for SICAM Q100

4 DG common MIBs DGPI and DGSM

Out of special interest and nowadays required more and more information about assets (like installed hardware components and installed firmware versions) and security relevant information (like login attempts, start/stop of system components, modifications ...).

These can be provided via special SNMPv3 MIBs; for Siemens Smart Infrastructure Digital Grid Products two common MIBs has been released for this purpose:

- DG Product Inventory MIB = DGPI (digitalGridProductInventory.mib) => asset information
- DG Security Monitoring MIB = DGSM (digitalGridSecurityMonitoring.mib) => audit log via SNMP trap

The following DG EA products support the **DGPI** = DG Product Inventory MIB:

- **SIPROTEC 5**
  - Only the Ethernet communication module **ETH-BD-2FO** supports the DGPI MIB
  - Needed Firmware & Protocol version: V8.80 or higher
- **SIPROTEC 4 / SIPROTEC Compact**
  - EN100 E+/O+ with Firmware Version V4.35 or higher
  - IEC61850_SNMP_MIB_V01.07.01or higher
- **Reyrolle 5**
  - Device FW: V2.30 or higher and fitting communication FW (planned for end of 2021)
- **SICAM A8000 RTUs**
  - CP-8000/21/22: CPC80 revision 15 or higher
  - CP-8031/50: CPCI85 revision 02 or higher
  - SICAMRTUs_SNMP_MIB_V05.00.00 or higher
  - CP-8031/50 supports spontaneous / unsolicited information for DPGI = trap
- **SICAM PAS/PQS**
  - Version V8.13 or higher

The following DG EA products support the **DGSM** = DG Security Monitoring MIB:

- **SIPROTEC 5**
  - Only the Ethernet communication module **ETH-BD-2FO** supports the DGSM MIB
  - Needed Firmware & Protocol version: V8.80 or higher
- **SICAM PAS/PQS**
  - Version V8.16 or higher

For the security relevant information unsolicited / spontaneous notification is essential to have the important audit related information as soon as possible (spontaneously) available. => **DGSM Security Monitoring MIB**

Therefore, SNMP defines for such kind of information the **SNMP traps** (see chapter 1.2.5) using as default UDP port 162 for sending spontaneously the information from the SNMP Agent to the SNMP Manager.

4.1 Preparation for the DGPI and DGSM MIBs

As necessary preparation, the needed MIBs must be loaded and additional work on the SNMP Manager (iReasoning in this APN) and on the SNMP Agent must be done for enabling the trap functionality and allow to receive notification (spontaneous) information.

4.1.1 Loading the needed standard and DG common MIBs

Before enabling the SNMP Manager to receive trap information from a SNMP Agent it is necessary to load / Import the necessary Standard and DG Common MIBS like described in Chapter 3.3.1 Step1.

The following Siemens common MIBs needs to be loaded / Imported (see chapter 5 for download links)

1. SIEMENS-SMI.mib
2. DGPI MIB (Siemens Smart Infrastructure Digital Grid Product Inventory MIB)
3. DGSM MIB (Siemens Smart Infrastructure Digital Grid Security Monitoring MIB)

The following Standard MIB needs to be loaded / Imported:
(e.g., download Standard MIBs from: http://www.snmplink.org/OnLineMIB/Standards/)

4. Target & Notification MIB (RFC 3413, formerly 2573) and Transport Mappings SNMPv2 (RFC 3417)

After successful loading / importing of above mention MIBs you can see them in the MIB Tree of iReasoning (Figure 4.1).

The Siemens Common MIBs under:
.. **private -> enterprises -> siemens** (SIEMENS-SMI.mib creates the node) -> **siemensCommon**.

The Standard Target & Notification MIB under:
..snmpV2 -> snmpModules

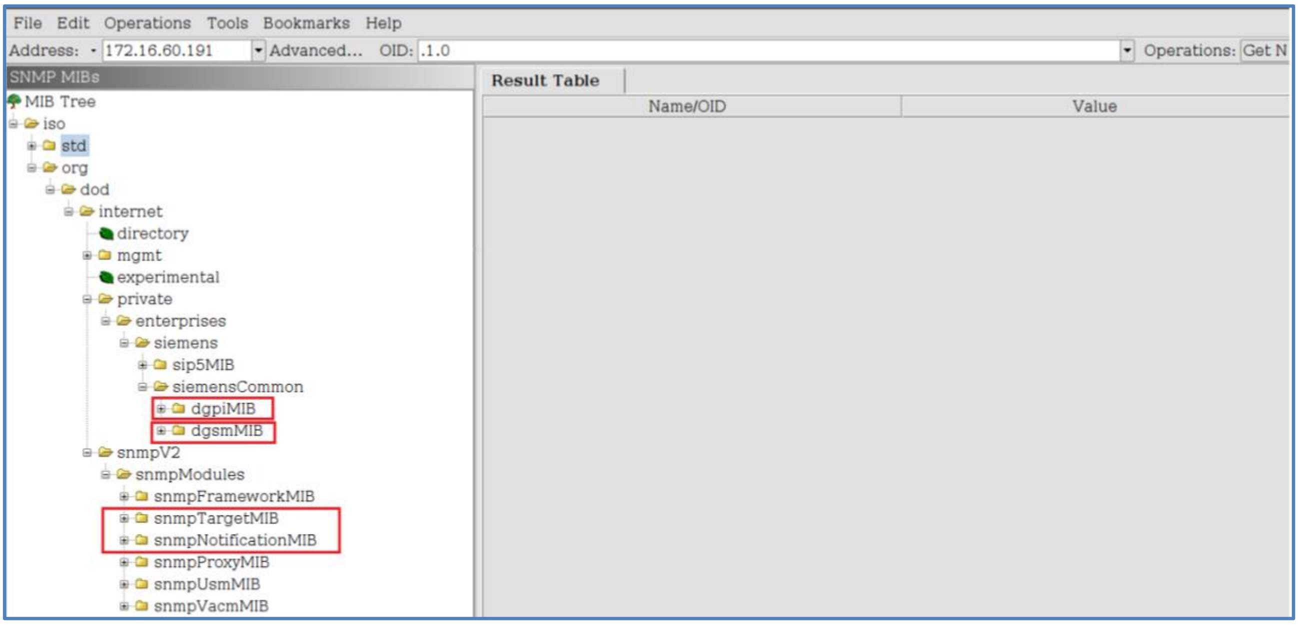


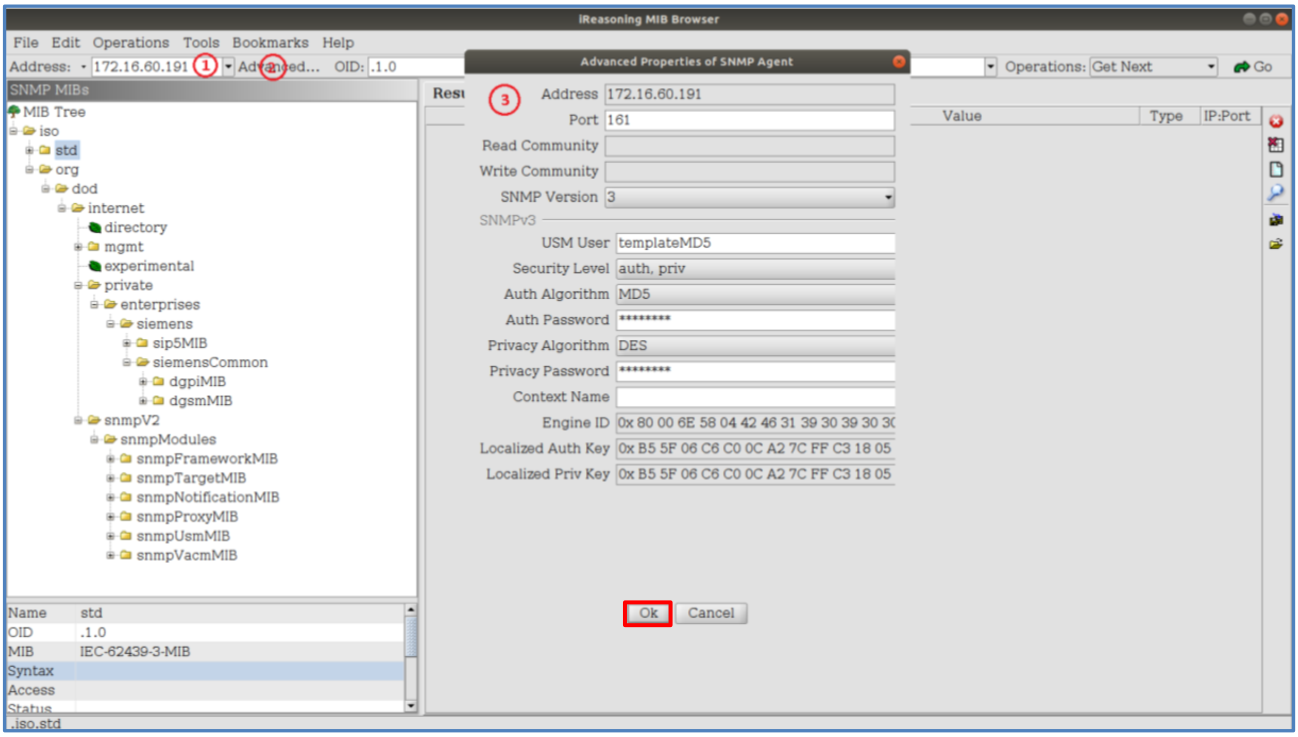
Figure 4.1 MIB Tree with needed MIBs for DGPI and DGSM MIBs and for traps preparation

4.1.2 Receiving security monitoring notifications -> Target-MIB

For receiving traps from the SNMP Agent, you need to configure this functionality on the SNMP Manager side (iReasoning MIB-Browser in this APN). First an online connection must be established between SNMP Agent and SNMP Manager (see chapter 3.3.1): you need to **put the IP-Address** (1) of your SNMP Agent device in the Address fields and press the **"Advanced..."** (2) button.
Best would be if you use for the connection an already created new user (and deleted the default initial users), but of course it is also possible using a default / initial user for testing everything first before deleting the default / initial users.

Figure 4.2 is showing the steps to establish the online connection with a default **user** (templateMD5) **with the credentials** (3) as shown in Chapter 3.3.1 Step2)

User	Authentication Algorithm	Authentication Password	Encryption/Privacy Algorithm	Privacy Password	Access Rights
templateMD5	**MD5**	**12345678**	**DES**	**12345678**	**Read, Write**
templateSHA	**SHA**	**12345678**	**AES**	**12345678**	**Read, Write**



Address: 172.16.60.191

Advanced Properties of SNMP Agent

Address: 172.16.60.191
Port: 161
Read Community:
Write Community:
SNMP Version: 3

SNMPv3

USM User: templateMD5
Security Level: auth, priv
Auth Algorithm: MD5
Auth Password: ********
Privacy Algorithm: DES
Privacy Password: ********
Context Name:
Engine ID: 0x 80 00 6E 58 04 42 46 31 39 30 39 30 3(
Localized Auth Key: 0x B5 5F 06 C6 C0 0C A2 7C FF C3 18 05
Localized Priv Key: 0x B5 5F 06 C6 C0 0C A2 7C FF C3 18 05

Name	std
OID	.1.0
MIB	IEC-62439-3-MIB
Syntax	
Access	
Status	

Figure 4.2 Connecting to the SNMP Agent device with user and credentials

The next step after the connection has been successfully established is, to configure the Address table and the Parameter table in the node **snmpTargetObjects**. There is no default setting related to notifications, you need to create your own row for each table and set the parameter for the tables.

Step1: Creating a new row for the Address Table (Figure 4.3)

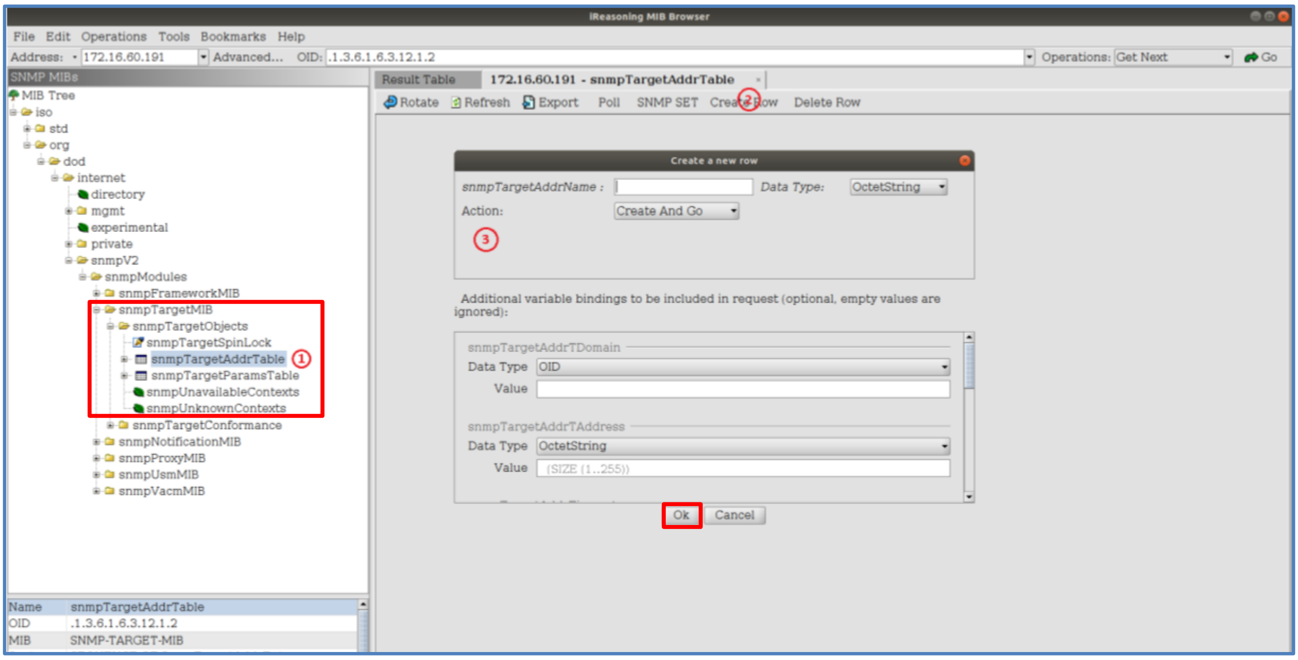
1. Select in the node **snmpTargetMIB** -> snmpTargetObjects **-> snmpTargetAddrTable**
2. In the main working area press "**Create Row**"
3. Enter in the new Pop-up Windows the values shown in below table (RFC 3417 required to "translate" the AddrTDomain)

Name	**Value**
snmpTargetAddrName	TrapTarget
snmpTargetAddrTDomain	.1.3.6.1.6.1.1
snmpTargetAddrTAddress	0xAC103CB400A2 (IP-Address of the trap receiver -SNMP Manager-)
snmpTargetAddrTagList	NotifyTag
snmpTargetAddrParams	TargetParam

The Address must be entered in HEX, see the example below how to convert the IP-Address of the SNMP Manager

```
snmpTargetAddrTAddress: 0xAC  10  3C  B4      00A2
                       IP ↓   ↓   ↓   ↓        ↓ Port
                       172. 16 .60. 180   :   162
```

4. When finished, press the **Ok button**



snmpTargetAddrName :

Data Type: OctetString

Action: Create And Go

Additional variable bindings to be included in request (optional, empty values are ignored):

snmpTargetAddrTDomain

Data Type OID

Value

snmpTargetAddrTAddress

Data Type OctetString

Value (SIZE (1..255))

Name	snmpTargetAddrTable
OID	.1.3.6.1.6.3.12.1.2
MIB	SNMP-TARGET-MIB

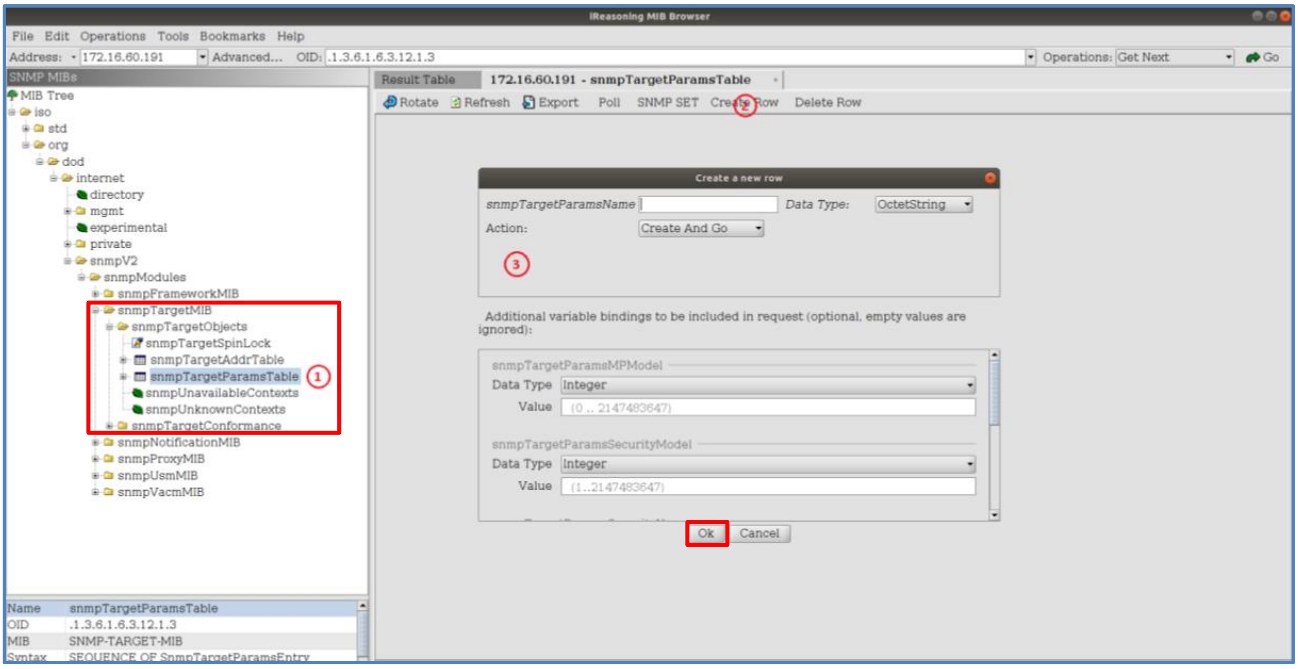
Figure 4.3 Creating a new row for trap receiving in the address table

Step2: Creating a new row for the Parameter Table (Figure 4.4)

1. Select in the node **snmpTargetMIB** -> snmpTargetObjects **-> snmpTargetParamsTable**
2. In the main working area press “**Create Row**”
3. Enter in the new Pop-up Windows the values shown in below table (...SecurityName must fit to your used username)

Name	Value
snmpTargetParamsName	TargetParam
snmpTargetParamsMPModel	3
snmpTargetParamsSecurityModel	3
snmpTargetParamsSecurityName	templateMD5 (is only an example, must fit to real user)
snmpTargetParamsSecurityLevel	3

4. When finished, press the **Ok button**



Address: 172.16.60.191

OID: .1.3.6.1.6.3.12.1.3

Operations: Get Next

snmpTargetParamsName:

Data Type: OctetString

Action: Create And Go

Additional variable bindings to be included in request (optional, empty values are ignored):

snmpTargetParamsMPModel
Data Type: Integer
Value: (0 .. 2147483647)

snmpTargetParamsSecurityModel
Data Type: Integer
Value: (1..2147483647)

Name	snmpTargetParamsTable
OID	.1.3.6.1.6.3.12.1.3
MIB	SNMP-TARGET-MIB
Syntax	SEQUENCE OF SnmpTargetParamsEntry

Figure 4.4 Creating a new row for trap receiving in the Parameter table

4.1.3 Receiving security monitoring notifications -> Notification-MIB

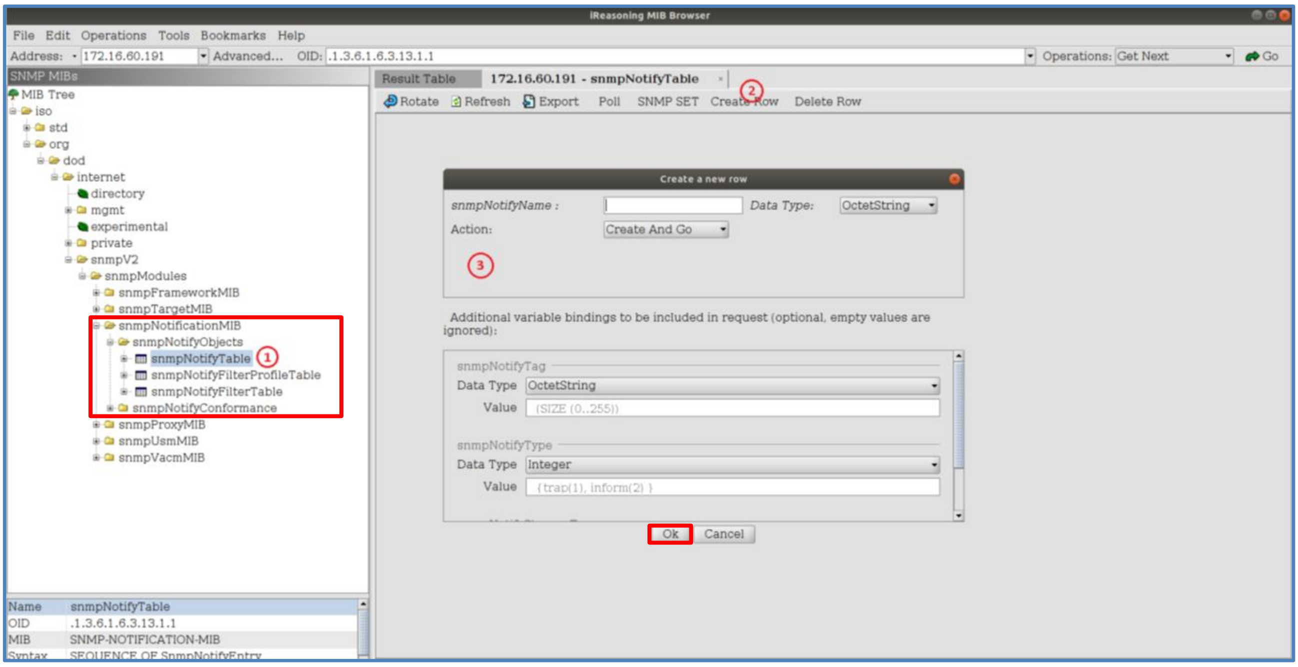
The SNMP Manager (here iReasoning MIB-Browser) must be enabled to receive trap information sent from a SNMP Agent; that must be done via settings in the snmpNofificationMIB.

Step3: Creating a new row for the Parameter Table (Figure 4.5)

1. Select in the node **snmpNotificationMIB** -> snmpNotifyObjects **-> snmpNotifyTable**
2. In the main working area press "**Create Row**"
3. Enter in the new Pop-up Windows the values shown in below table

Name	Value
snmpNotifyName	Trap
snmpNotifyTag	NotifyTag
snmpNotifyType	1

4. When finished, press the **Ok button**



Address: 172.16.60.191 Advanced... OID: .1.3.6.1.6.3.13.1.1 Operations: Get Next Go

172.16.60.191 - snmpNotifyTable

snmpNotifyName :
Data Type: OctetString
Action: Create And Go

Additional variable bindings to be included in request (optional, empty values are ignored):

snmpNotifyTag
Data Type: OctetString
Value: (SIZE (0..255))

snmpNotifyType
Data Type: Integer
Value: { trap(1), inform(2) }

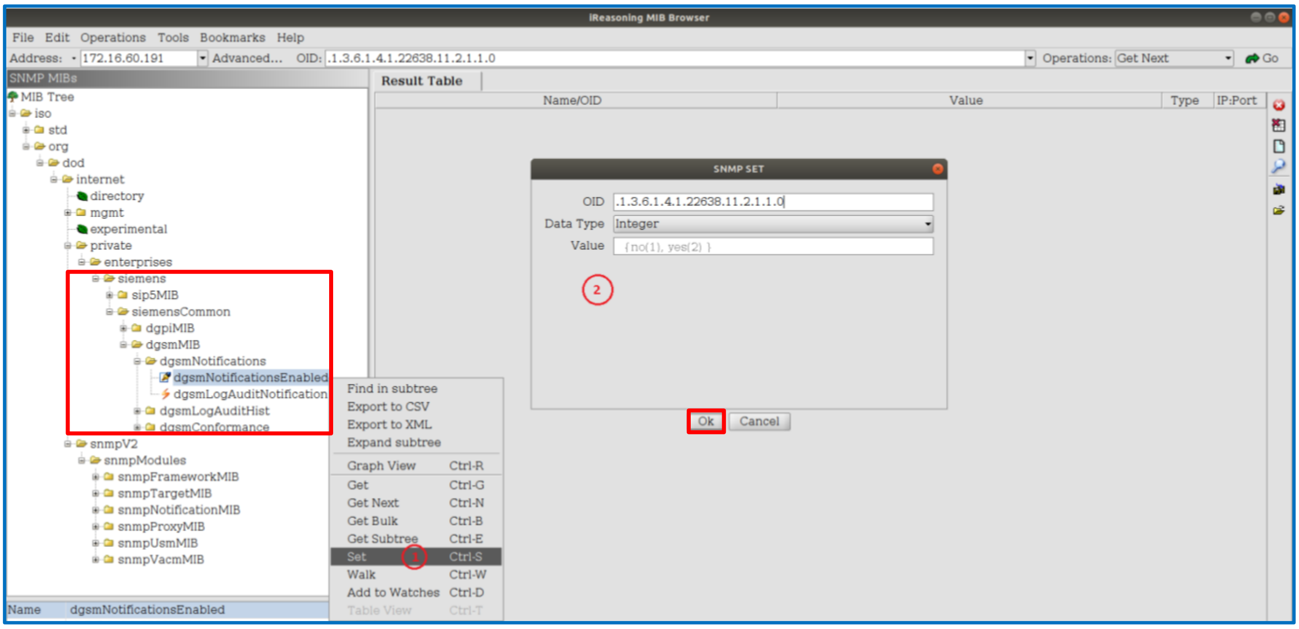
Name: snmpNotifyTable
OID: .1.3.6.1.6.3.13.1.1
MIB: SNMP-NOTIFICATION-MIB
Syntax: SEQUENCE OF SnmpNotifyEntry

Figure 4.5 Creating a new row for trap receiving in the Notify table

4.1.4 Enabling SNMP traps on SNMP Agent side

The feature of the SNMP Agent to send traps must be enabled. In the CP-8050/31 that is done in the engineering tool, but for other products the default setting is set to “no”. To check or change the setting you need to have an online access to the SNMP Agent.

- Select under siemens -> siemensCommon -> dgsmMIB -> **dgsmNotificationEnabled** (for CP-8050 also dgpi possible)
- Open the context menu with right mouse click and select “Set” (1)
- Fill in as Value “**2**” (enabled or yes; “1” means disabled or no) (2)
- Confirm with the **Ok button**



Address: 172.16.60.191 Advanced... OID: .1.3.6.1.4.1.22638.11.2.1.1.0 Operations: Get Next Go

OID: .1.3.6.1.4.1.22638.11.2.1.1.0
Data Type: Integer
Value: { no(1), yes(2) }

Name: dgsmNotificationsEnabled

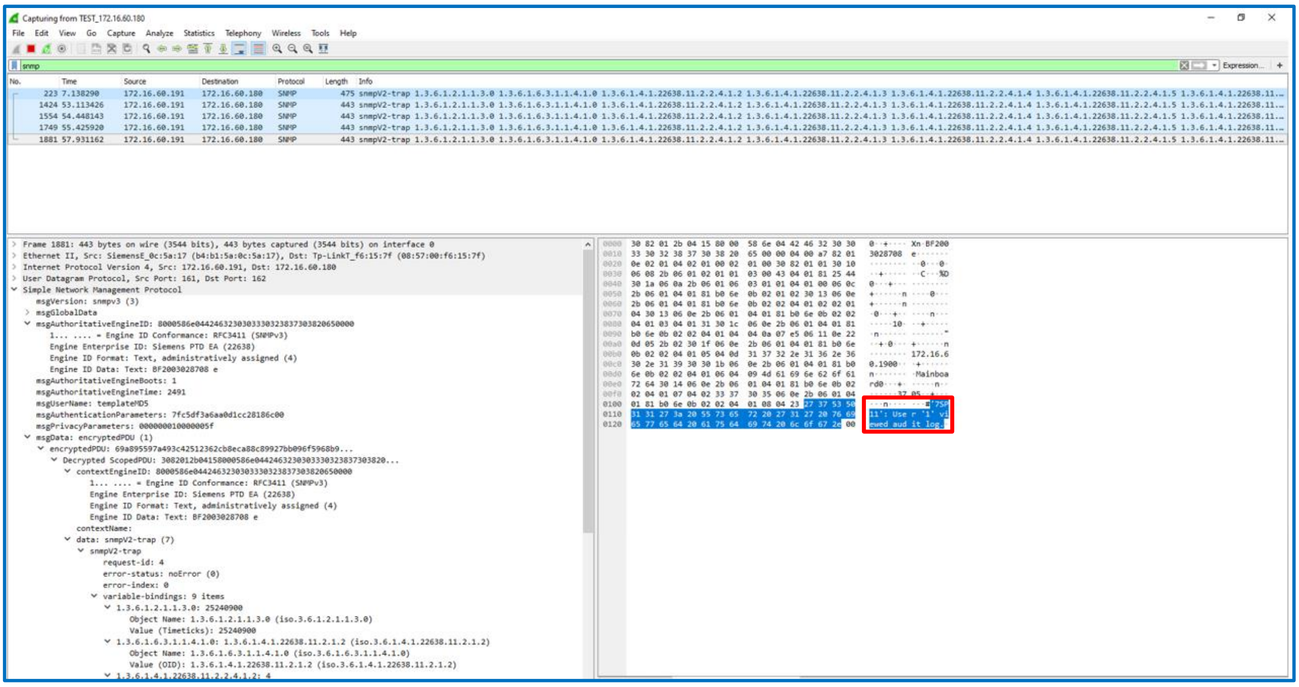
Figure 4.6 Enabling / checking trap sending on SNMP agent

4.1.5 Testing SNMP traps

After the steps described in chapter 4.1.1 to 4.1.4 has been done, you should test if everything as working as desired and the device / SNMP Agent is sending Security relevant event as trap.

You can trigger a security relevant event for example via the local HMI of a SIPROTEC 5 relay when opening the “security log” in navigating: Main Menu -> Test&Diagnosis -> Logs -> Securitylog

Experts can use Wireshark to capture the SNMP messages and see if this action (viewed audit log) has been reported. Please note that, to analyze encrypted SNMPv3 PDU, decryption must be allowed in the Wireshark. You can check 4.1.7 Decrypting SNMPv3 PDUs in Wireshark chapter to see how it is achieved.



snmp

```
No.     Time       Source         Destination    Protocol  Length Info
  223 7.138290     172.16.60.191  172.16.60.180  SNMP      475 snmpV2-trap 1.3.6.1.2.1.1.3.0 1.3.6.1.6.3.1.1.4.1.0 1.3.6.1.4.1.22638.11.2.2.4.1.2 1.3.6.1.4.1.22638.11.2.2.4.1.3 1.3.6.1.4.1.22638.11.2.2.4.1.4 1.3.6.1.4.1.22638.11.2.2.4.1.5 1.3.6.1.4.1.22638.11...
 1424 53.113426    172.16.60.191  172.16.60.180  SNMP      443 snmpV2-trap 1.3.6.1.2.1.1.3.0 1.3.6.1.6.3.1.1.4.1.0 1.3.6.1.4.1.22638.11.2.2.4.1.2 1.3.6.1.4.1.22638.11.2.2.4.1.3 1.3.6.1.4.1.22638.11.2.2.4.1.4 1.3.6.1.4.1.22638.11.2.2.4.1.5 1.3.6.1.4.1.22638.11...
 1554 54.448143    172.16.60.191  172.16.60.180  SNMP      443 snmpV2-trap 1.3.6.1.2.1.1.3.0 1.3.6.1.6.3.1.1.4.1.0 1.3.6.1.4.1.22638.11.2.2.4.1.2 1.3.6.1.4.1.22638.11.2.2.4.1.3 1.3.6.1.4.1.22638.11.2.2.4.1.4 1.3.6.1.4.1.22638.11.2.2.4.1.5 1.3.6.1.4.1.22638.11...
 1749 55.425920    172.16.60.191  172.16.60.180  SNMP      443 snmpV2-trap 1.3.6.1.2.1.1.3.0 1.3.6.1.6.3.1.1.4.1.0 1.3.6.1.4.1.22638.11.2.2.4.1.2 1.3.6.1.4.1.22638.11.2.2.4.1.3 1.3.6.1.4.1.22638.11.2.2.4.1.4 1.3.6.1.4.1.22638.11.2.2.4.1.5 1.3.6.1.4.1.22638.11...
 1881 57.931162    172.16.60.191  172.16.60.180  SNMP      443 snmpV2-trap 1.3.6.1.2.1.1.3.0 1.3.6.1.6.3.1.1.4.1.0 1.3.6.1.4.1.22638.11.2.2.4.1.2 1.3.6.1.4.1.22638.11.2.2.4.1.3 1.3.6.1.4.1.22638.11.2.2.4.1.4 1.3.6.1.4.1.22638.11.2.2.4.1.5 1.3.6.1.4.1.22638.11...
```

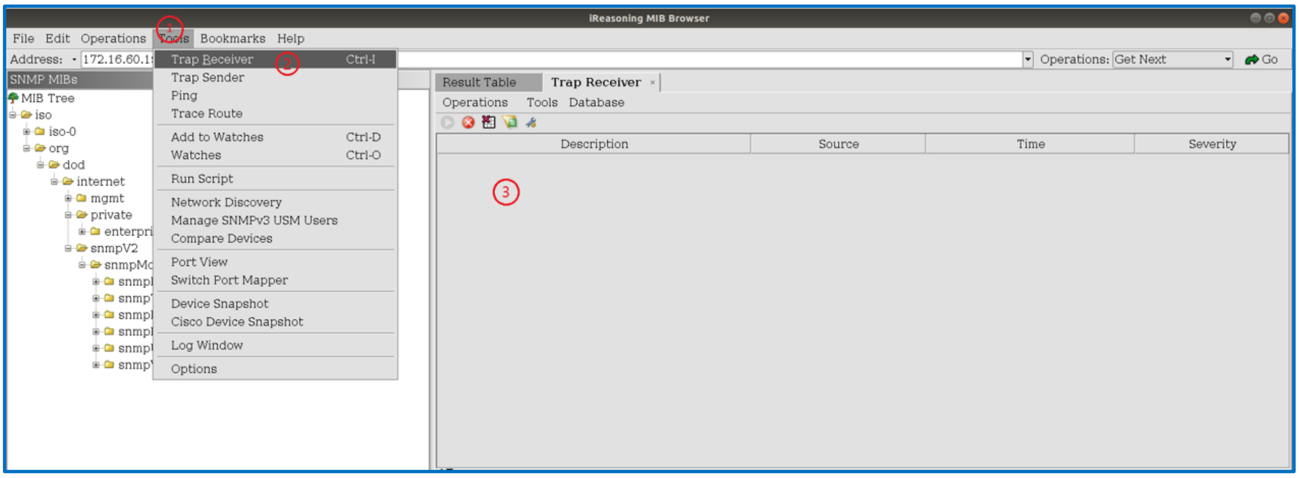
```
> Frame 1881: 443 bytes on wire (3544 bits), 443 bytes captured (3544 bits) on interface 0
> Ethernet II, Src: SiemensE_0c:5a:17 (b4:b1:5a:0c:5a:17), Dst: Tp-LinkT_f6:15:7f (08:57:00:f6:15:7f)
> Internet Protocol Version 4, Src: 172.16.60.191, Dst: 172.16.60.180
> User Datagram Protocol, Src Port: 161, Dst Port: 162
v Simple Network Management Protocol
    msgVersion: snmpv3 (3)
  > msgGlobalData
  v msgAuthoritativeEngineID: 8000586e04424632303033303238373038206500000
      1... .... = Engine ID Conformance: RFC3411 (SNMPv3)
      Engine Enterprise ID: Siemens PTD EA (22638)
      Engine ID Format: Text, administratively assigned (4)
      Engine ID Data: Text: BF2003028708 e
    msgAuthoritativeEngineBoots: 1
    msgAuthoritativeEngineTime: 2491
    msgUserName: templateMD5
    msgAuthenticationParameters: 7fc5df3a6aa0d1cc28186c00
    msgPrivacyParameters: 000000010000005f
  v msgData: encryptedPDU (1)
    v encryptedPDU: 69a895597a493c42512362cb8eca88c89927bb096f5968b9...
      v Decrypted ScopedPDU: 3082012b04158000586e04424632303033303238373038 20...
        v contextEngineID: 8000586e04424632303033303238373038206500000
            1... .... = Engine ID Conformance: RFC3411 (SNMPv3)
            Engine Enterprise ID: Siemens PTD EA (22638)
            Engine ID Format: Text, administratively assigned (4)
            Engine ID Data: Text: BF2003028708 e
          contextName:
        v data: snmpV2-trap (7)
          v snmpV2-trap
              request-id: 4
              error-status: noError (0)
              error-index: 0
            v variable-bindings: 9 items
              v 1.3.6.1.2.1.1.3.0: 25240900
                  Object Name: 1.3.6.1.2.1.1.3.0 (iso.3.6.1.2.1.1.3.0)
                  Value (Timeticks): 25240900
              v 1.3.6.1.6.3.1.1.4.1.0: 1.3.6.1.4.1.22638.11.2.1.2 (iso.3.6.1.4.1.22638.11.2.1.2)
                  Object Name: 1.3.6.1.6.3.1.1.4.1.0 (iso.3.6.1.6.3.1.1.4.1.0)
                  Value (OID): 1.3.6.1.4.1.22638.11.2.1.2 (iso.3.6.1.4.1.22638.11.2.1.2)
              v 1.3.6.1.4.1.22638.11.2.2.4.1.2: 4
```

```
0000  30 82 01 2b 04 15 80 00  58 6e 04 42 46 32 30 30   0··+····Xn·BF200
0010  33 30 32 38 37 30 38 20  65 00 00 04 00 a7 82 01   3028708 e·······
0020  0e 02 01 04 02 01 00 02  01 00 30 82 01 01 30 10   ··········0···0·
0030  06 08 2b 06 01 02 01 01  03 00 43 04 01 81 25 44   ··+·······C···%D
0040  30 1a 06 0a 2b 06 01 06  03 01 01 04 01 00 06 0c   0···+···········
0050  2b 06 01 04 01 81 b0 6e  0b 02 01 02 30 13 06 0e   +······n····0···
0060  2b 06 01 04 01 81 b0 6e  0b 02 02 04 01 02 02 01   +······n········
0070  04 30 13 06 0e 2b 06 01  04 01 81 b0 6e 0b 02 02   ·0···+······n···
0080  04 01 03 04 01 31 30 1c  06 0e 2b 06 01 04 01 81   ·····10···+·····
0090  b0 6e 0b 02 02 04 01 04  04 0a 07 e5 06 11 0e 22   ·n·············"
00a0  0d 05 2b 02 30 1f 06 0e  2b 06 01 04 01 81 b0 6e   ··+·0···+······n
00b0  0b 02 02 04 01 05 04 0d  31 37 32 2e 31 36 2e 36   ········172.16.6
00c0  30 2e 31 39 30 30 1b 06  0e 2b 06 01 04 01 81 b0   0.1900···+······
00d0  6e 0b 02 02 04 01 06 04  09 4d 61 69 6e 62 6f 61   n········Mainboa
00e0  72 64 30 14 06 0e 2b 06  01 04 01 81 b0 6e 0b 02   rd0···+······n··
00f0  02 04 01 07 04 02 33 37  30 35 06 0e 2b 06 01 04   ······3705··+···
0100  01 81 b0 6e 0b 02 02 04  01 08 04 23 27 37 53 50   ···n·······#'7SP
0110  31 31 27 3a 20 55 73 65  72 20 27 31 27 20 76 69   11': User '1' vi
0120  65 77 65 64 20 61 75 64  69 74 20 6c 6f 67 2e 00   ewed aud it log.
```

Figure 4.7 Checking SNMP traps with Wireshark

You can also receive trap with the iReasoning MIB-Browser. (Figure 4.8)

- Click “Tools – Trap Receiver” (1 & 2)
- to open Trap Receiver window (3)
- configure user parameters for trap receiver (Figure 4.9)



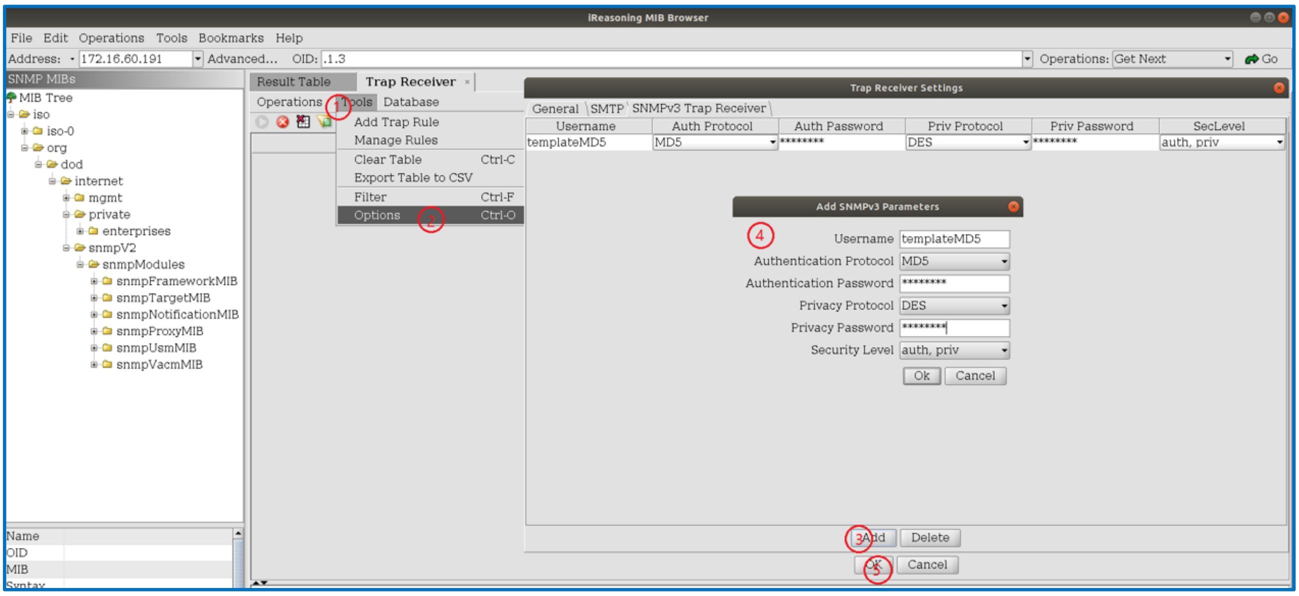
Address: 172.16.60.1

Operations: Get Next

Figure 4.8 Preparing Trap Receiver

To configure the Trap Receiver in iReasoning the following steps needs to be done:

- Select the context menu for Trap Receiver with **Tools** (1)
- Select **Options** (2)
- Use the **Add button** for adding a Trap Receiver (3)
- Enter in the new pop-up Window a **valid user with his credentials** (4)
- Confirm the setting with the **Ok button** (5)



Address: 172.16.60.191 OID: .1.3 Operations: Get Next

Username	Auth Protocol	Auth Password	Priv Protocol	Priv Password	SecLevel
templateMD5	MD5	********	DES	********	auth, priv

Username templateMD5

Authentication Protocol MD5

Authentication Password ********

Privacy Protocol DES

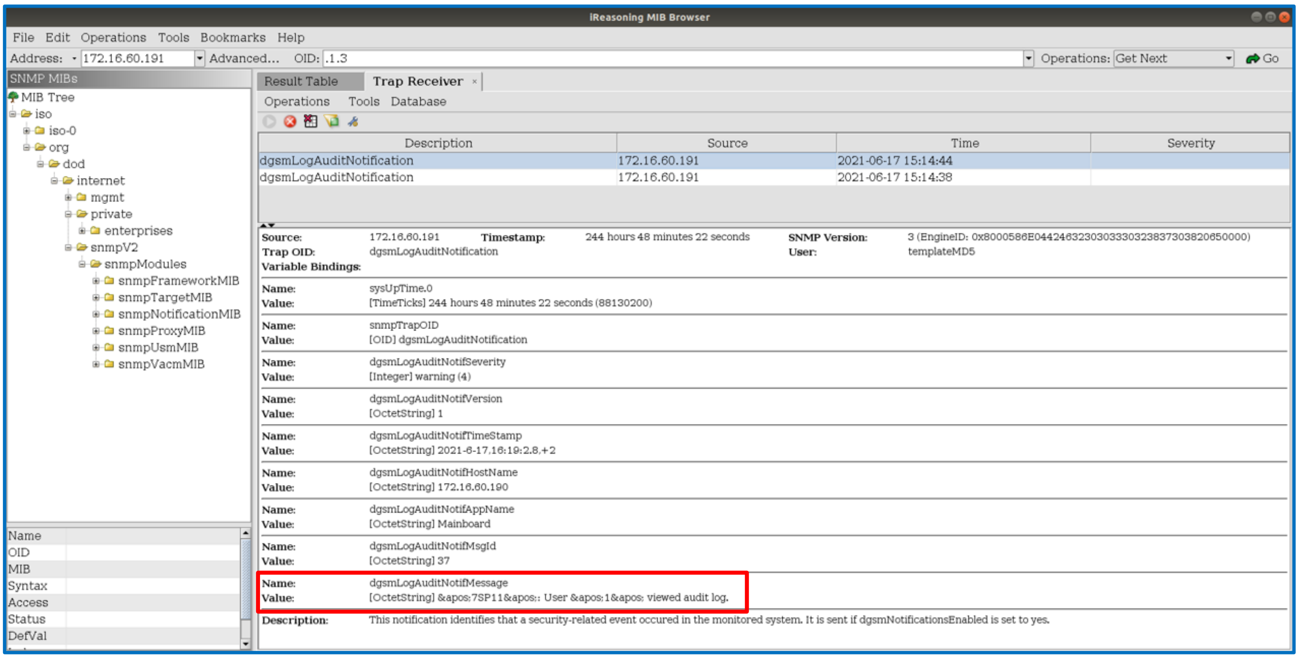
Privacy Password ********

Security Level auth, priv

Figure 4.9 Configuring Trap Receiver

Now trigger a security relevant event for example via the local HMI of a SIPROTEC 5 relay when opening the “security log” in navigating: Main Menu -> Test&Diagnosis -> Logs -> Securitylog

And check if this event is visible (Figure 4.10)



Description	Source	Time	Severity
dgsmLogAuditNotification	172.16.60.191	2021-06-17 15:14:44	
dgsmLogAuditNotification	172.16.60.191	2021-06-17 15:14:38	

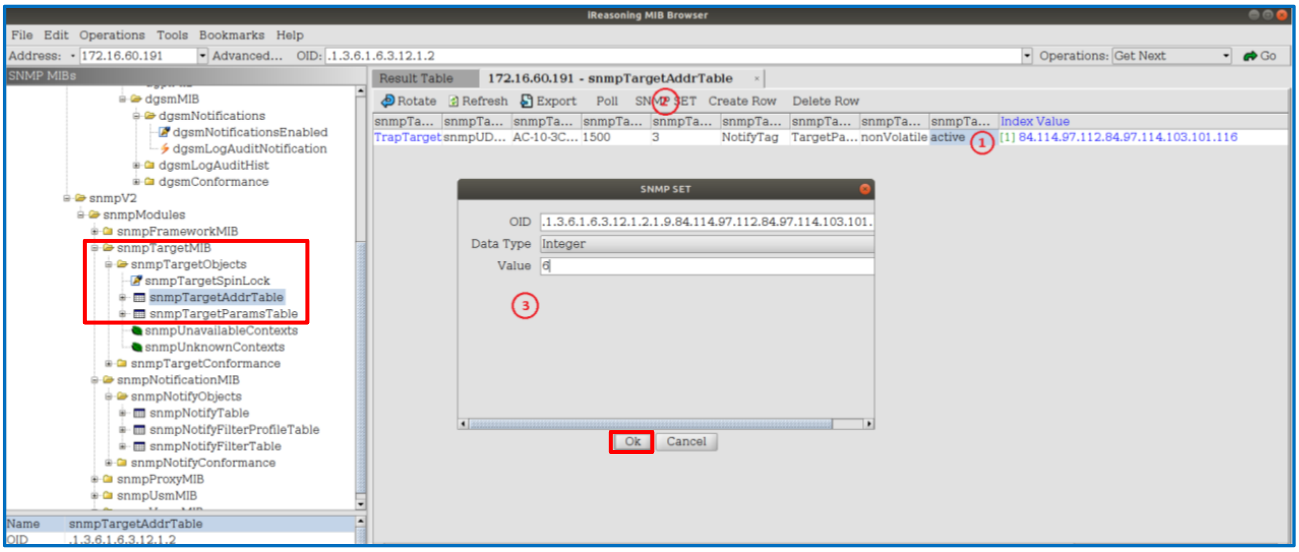
```
Source:            172.16.60.191      Timestamp:   244 hours 48 minutes 22 seconds     SNMP Version:   3 (EngineID: 0x8000586E0442463230303330323837303820650000)
Trap OID:          dgsmLogAuditNotification                                         User:           templateMD5
Variable Bindings:

Name:              sysUpTime.0
Value:             [TimeTicks] 244 hours 48 minutes 22 seconds (88130200)

Name:              snmpTrapOID
Value:             [OID] dgsmLogAuditNotification

Name:              dgsmLogAuditNotifSeverity
Value:             [Integer] warning (4)

Name:              dgsmLogAuditNotifVersion
Value:             [OctetString] 1

Name:              dgsmLogAuditNotifTimeStamp
Value:             [OctetString] 2021-6-17,16:19:2.8,+2

Name:              dgsmLogAuditNotifHostName
Value:             [OctetString] 172.16.60.190

Name:              dgsmLogAuditNotifAppName
Value:             [OctetString] Mainboard

Name:              dgsmLogAuditNotifMsgId
Value:             [OctetString] 37

Name:              dgsmLogAuditNotifMessage
Value:             [OctetString] &apos;7SP11&apos;: User &apos;1&apos; viewed audit log.

Description:       This notification identifies that a security-related event occured in the monitored system. It is sent if dgsmNotificationsEnabled is set to yes.
```

Figure 4.10 Checking Trap Reception

4.1.6 Deleting SNMP settings

In case you want to delete the rows created above (chapter 4.1.2 / 4.1.3), set the value to '6' as shown in Figure 4.11.

- Select in the (**snmpTargetAddrTable** / snmpTargetParamsTable) the row / line you want to delete (1)
- Use the **SNMP SET** menu option (2)
- Enter in the new pop-up Menu as **Value "6"** (3)
- Confirm with the **Ok button**



snmpTa...	snmpTa...	snmpTa...	snmpTa...	snmpTa...	snmpTa...	snmpTa...	snmpTa...	snmpTa...	Index Value
TrapTarget	snmpUD...	AC-10-3C...	1500	3	NotifyTag	TargetPa...	nonVolatile	active	[1] 84.114.97.112.84.97.114.103.101.116

OID .1.3.6.1.6.3.12.1.2.1.9.84.114.97.112.84.97.114.103.101.

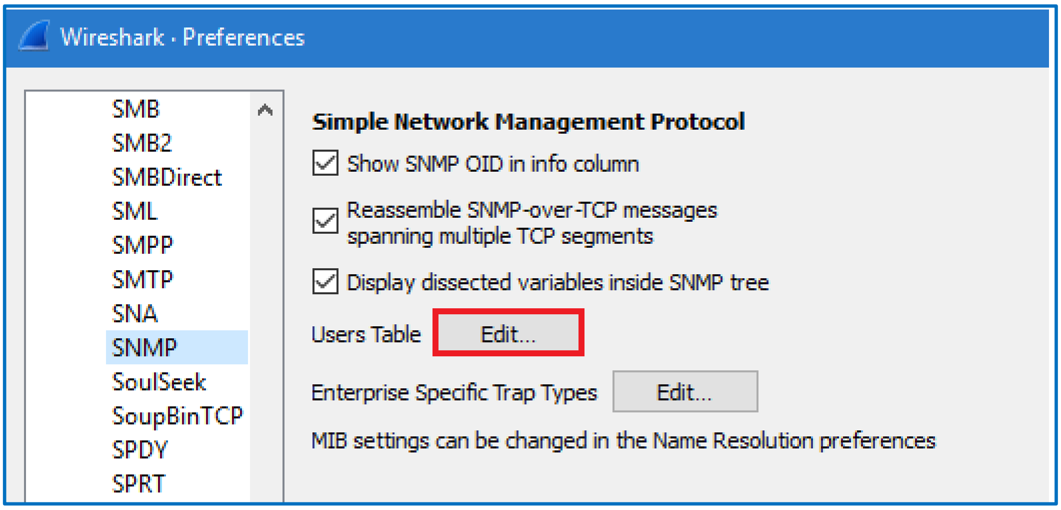
Data Type Integer

Value 6

Figure 4.11 Deleting the created rows

4.1.7 Decrypting SNMPv3 PDUs in Wireshark

- Open the captured packets using the Wireshark application
- Go to Edit > Preferences > Protocols
- Select SNMP from the protocol list
- Edit the user table settings:



Simple Network Management Protocol

☑ Show SNMP OID in info column

☑ Reassemble SNMP-over-TCP messages spanning multiple TCP segments

☑ Display dissected variables inside SNMP tree

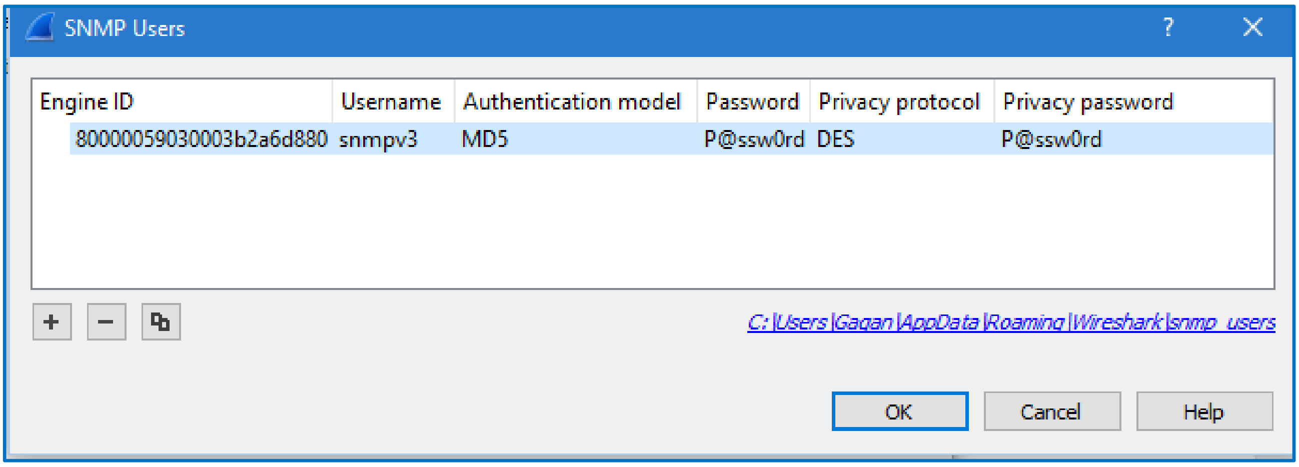
Users Table Edit...

Enterprise Specific Trap Types Edit...

MIB settings can be changed in the Name Resolution preferences

Figure 4.12 Wireshark SNMP Protocol Settings

- Click on Add button and put the following details:
  - Engine ID
  - SNMPv3 username
  - Choose the authentication model (MD5 | SHA1)
  - Put the password for authentication model
  - Choose the privacy protocol (DES | AES | AES192 | AES256)
  - Put the privacy password



Engine ID	Username	Authentication model	Password	Privacy protocol	Privacy password
80000059030003b2a6d880	snmpv3	MD5	P@ssw0rd	DES	P@ssw0rd

Figure 4-13 Wireshark SNMPv3 Users

4.2 Reading DGPI and DGSM information

After the preparation described in chapter 4.1 has been done, you can now use the SNMP Manager to access the information provided via the DGPI MIB.

4.2.1 Getting values of the DGPI product inventory MIB

Expand the MIB tree and find “**dgpiProductComponentsTable**” (Figure 4.12) and open with right click the Menu content. You can use all Get or Walk commands, but the best overview of the asset information will be presented when selecting “**Table View**” (see Figure 4.13 & 4.14).

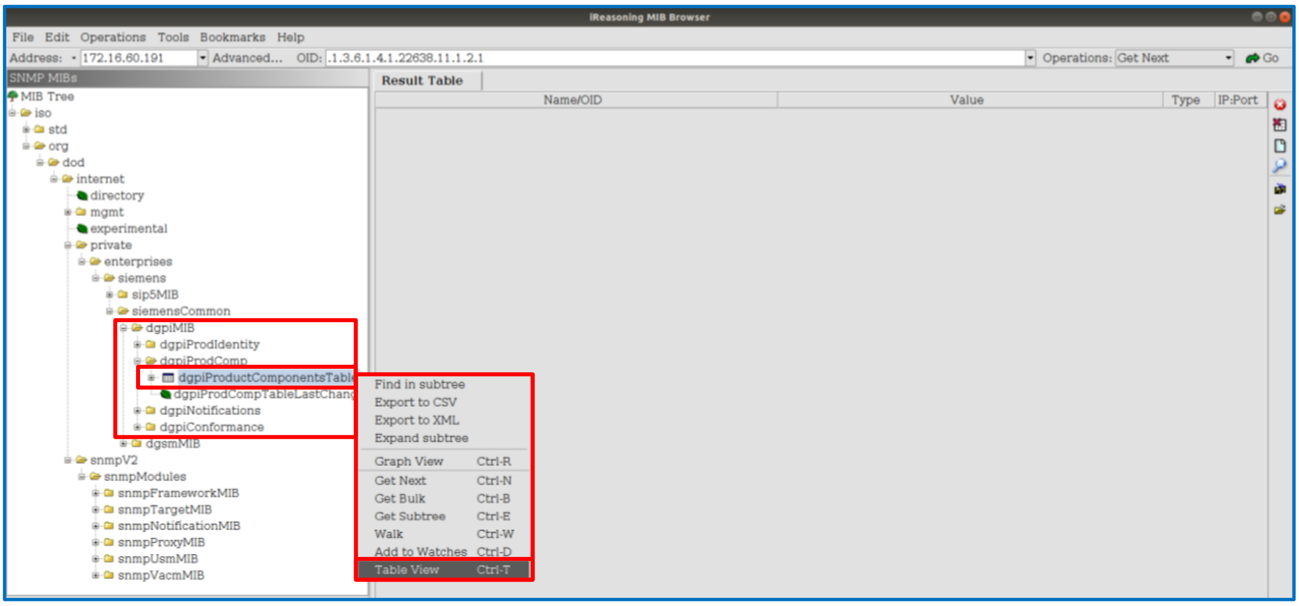
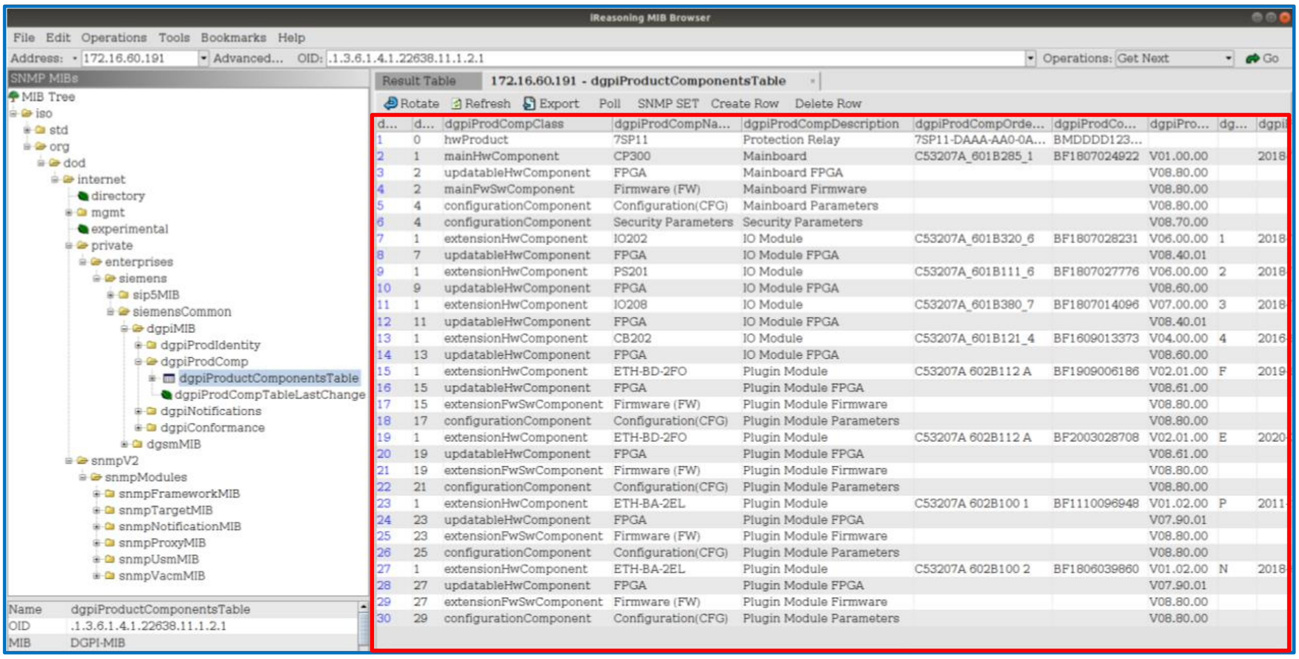


Figure 4.14 Opening the Table View for the DGPI asset information

After this selection the DGPI Product Component Table is opened in the main window, showing the asset information. Each entry in this table represents single component in device which can be various types defined in the **“dgpiProdCompClass”** column. The components have hierarchical relation linked in **“dgpiProdCompContainedIn”** and **“dgpiProdCompContainedIn”** columns. The component id in the **“dgpiProdCompContainedIn”** represents the parent component’s index id. Ie: Component Id=5: “Configuration(CFG)” is a subcomponent of id=4 “Mainboard Firmware” and that’s the subcomponent of id=2 “CP300” Hardware and that’s the subcomponent of id=0 root component 7SP11 device for below figure.

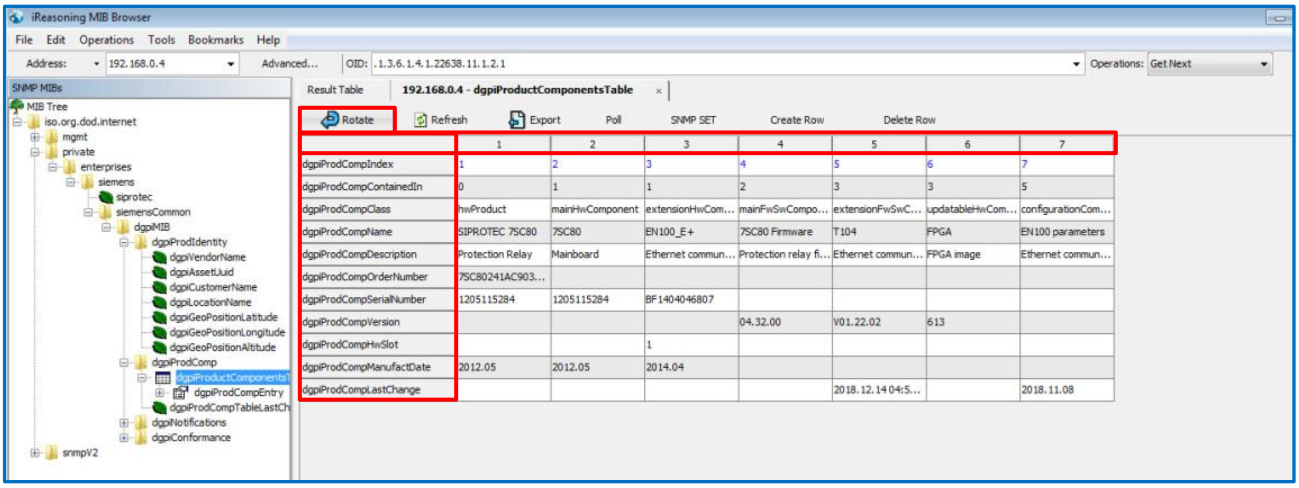


Name	dgpiProductComponentsTable
OID	.1.3.6.1.4.1.22638.11.1.2.1
MIB	DGPI-MIB

d...	d...	dgpiProdCompClass	dgpiProdCompNa...	dgpiProdCompDescription	dgpiProdCompOrde...	dgpiProdCo...	dgpiPro...	dg...	dgpi
1	0	hwProduct	7SP11	Protection Relay	7SP11-DAAA-AA0-0A...	BMDDDD123...			
2	1	mainHwComponent	CP300	Mainboard	C53207A_601B285_1	BF1807024922	V01.00.00		2018
3	2	updatableHwComponent	FPGA	Mainboard FPGA			V08.80.00		
4	2	mainFwSwComponent	Firmware (FW)	Mainboard Firmware			V08.80.00		
5	4	configurationComponent	Configuration(CFG)	Mainboard Parameters			V08.80.00		
6	4	configurationComponent	Security Parameters	Security Parameters			V08.70.00		
7	1	extensionHwComponent	IO202	IO Module	C53207A_601B320_6	BF1807028231	V06.00.00	1	2018
8	7	updatableHwComponent	FPGA	IO Module FPGA			V08.40.01		
9	1	extensionHwComponent	PS201	IO Module	C53207A_601B111_6	BF1807027776	V06.00.00	2	2018
10	9	updatableHwComponent	FPGA	IO Module FPGA			V08.60.00		
11	1	extensionHwComponent	IO208	IO Module	C53207A_601B380_7	BF1807014096	V07.00.00	3	2018
12	11	updatableHwComponent	FPGA	IO Module FPGA			V08.40.01		
13	1	extensionHwComponent	CB202	IO Module	C53207A_601B121_4	BF1609013373	V04.00.00	4	2016
14	13	updatableHwComponent	FPGA	IO Module FPGA			V08.60.00		
15	1	extensionHwComponent	ETH-BD-2FO	Plugin Module	C53207A 602B112 A	BF1909006186	V02.01.00	F	2019
16	15	updatableHwComponent	FPGA	Plugin Module FPGA			V08.61.00		
17	15	extensionFwSwComponent	Firmware (FW)	Plugin Module Firmware			V08.80.00		
18	17	configurationComponent	Configuration(CFG)	Plugin Module Parameters			V08.80.00		
19	1	extensionHwComponent	ETH-BD-2FO	Plugin Module	C53207A 602B112 A	BF2003028708	V02.01.00	E	2020
20	19	updatableHwComponent	FPGA	Plugin Module FPGA			V08.61.00		
21	19	extensionFwSwComponent	Firmware (FW)	Plugin Module Firmware			V08.80.00		
22	21	configurationComponent	Configuration(CFG)	Plugin Module Parameters			V08.80.00		
23	1	extensionHwComponent	ETH-BA-2EL	Plugin Module	C53207A 602B100 1	BF1110096948	V01.02.00	P	2011
24	23	updatableHwComponent	FPGA	Plugin Module FPGA			V07.90.01		
25	23	extensionFwSwComponent	Firmware (FW)	Plugin Module Firmware			V08.80.00		
26	25	configurationComponent	Configuration(CFG)	Plugin Module Parameters			V08.80.00		
27	1	extensionHwComponent	ETH-BA-2EL	Plugin Module	C53207A 602B100 2	BF1806039860	V01.02.00	N	2018
28	27	updatableHwComponent	FPGA	Plugin Module FPGA			V07.90.01		
29	27	extensionFwSwComponent	Firmware (FW)	Plugin Module Firmware			V08.80.00		
30	29	configurationComponent	Configuration(CFG)	Plugin Module Parameters			V08.80.00		

Figure 4.15 Table with the asset information

You can change the representation via the "Rotate" button; the columns and lines will be changed (the content of the columns is now shown in the lines and vise-versa) what gives you a better overview (Figure 4.14 -attention is from another device-)

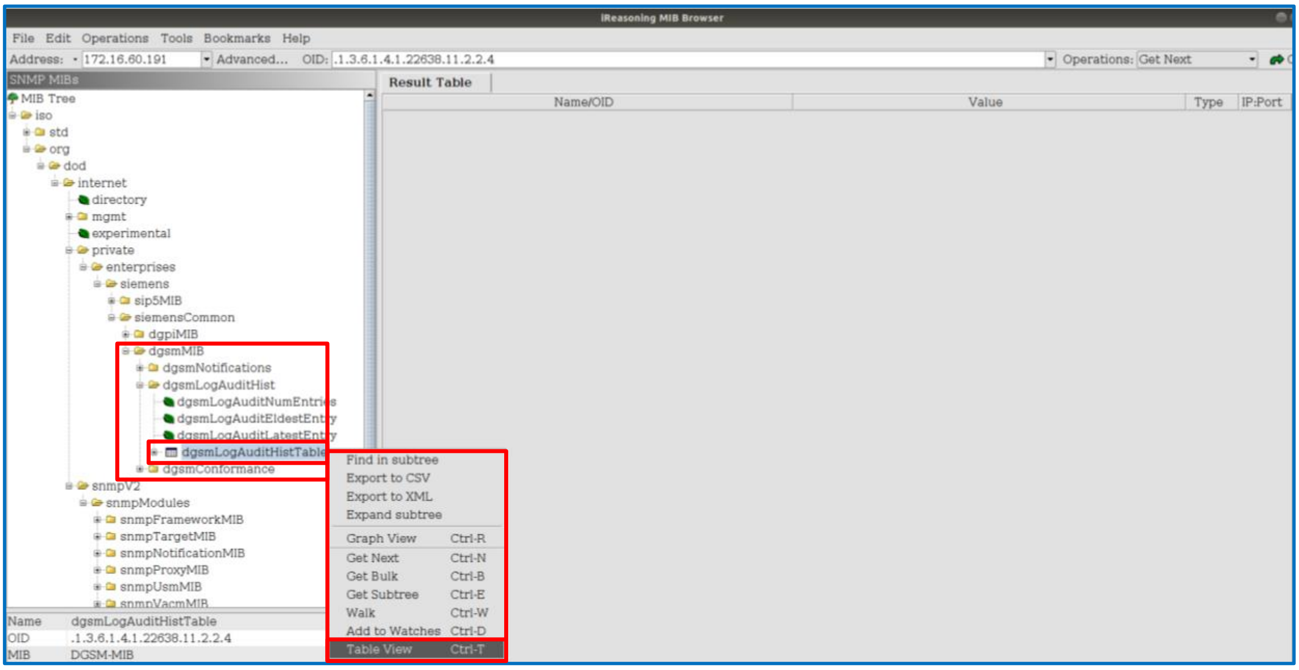


	1	2	3	4	5	6	7
dgpiProdCompIndex	1	2	3	4	5	6	7
dgpiProdCompContainedIn	0	1	1	2	3	3	5
dgpiProdCompClass	hwProduct	mainHwComponent	extensionHwCom...	mainFwSwCompo...	extensionFwSwC...	updatableHwCom...	configurationCom...
dgpiProdCompName	SIPROTEC 7SC80	7SC80	EN100_E+	7SC80 Firmware	T104	FPGA	EN100 parameters
dgpiProdCompDescription	Protection Relay	Mainboard	Ethernet commun...	Protection relay fi...	Ethernet commun...	FPGA image	Ethernet commun...
dgpiProdCompOrderNumber	7SC80241AC903...						
dgpiProdCompSerialNumber	1205115284	1205115284	BF1404046807				
dgpiProdCompVersion				04.32.00	V01.22.02	613	
dgpiProdCompHwSlot			1				
dgpiProdCompManufactDate	2012.05	2012.05	2014.04				
dgpiProdCompLastChange					2018.12.14 04:5...		2018.11.08

Figure 4.16 Table with the asset information -rotated view-

4.2.2 Getting values of the DGSM Security Monitoring MIB

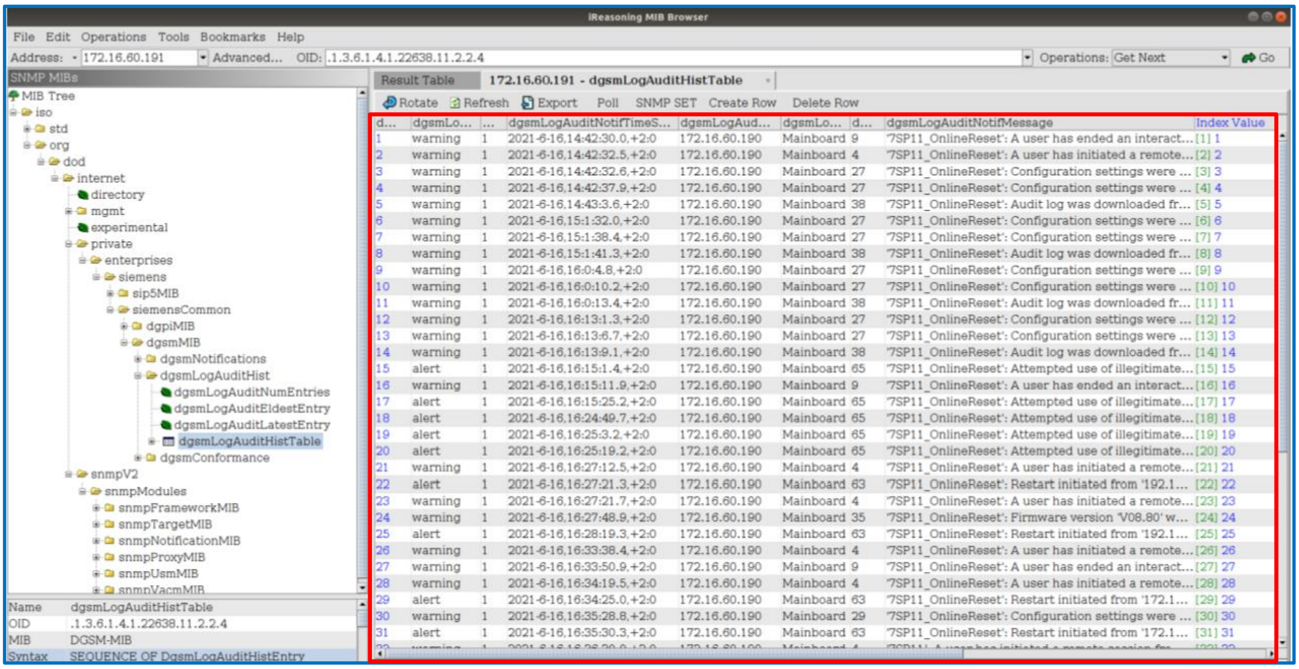
Expand the MIB tree and find “**dgsmLogAuditHistTable**” (Figure 4.15) and open with right click the Menu content. You can use all Get or Walk commands, but the best overview of the Security information will be presented when selecting “**Table View**” (see Figure 4.16). The **Audit Log History Table stores up to the last 50 via trap send security related information**.



Name dgsmLogAuditHistTable
OID .1.3.6.1.4.1.22638.11.2.2.4
MIB DGSM-MIB

Figure 4.17 Opening the Table View for the DGSM security monitoring information

After this selection the DGPI Product Component Table is opened in the main window, showing the asset information. You can change the representation via the “Rotate” button; the columns and lines will be changed (the content of the columns is now shown in the lines and vise-versa). For Security Monitoring events the rotation view is not so helpful. It is better to see the sequence of security events via the “standard” view.



Name dgsmLogAuditHistTable
OID .1.3.6.1.4.1.22638.11.2.2.4
MIB DGSM-MIB
Syntax SEQUENCE OF DgsmLogAuditHistEntry

d...	dgsmLo...	...	dgsmLogAuditNotifTimeS...	dgsmLogAud...	dgsmLo...	d...	dgsmLogAuditNotifMessage	Index Value
1	warning	1	2021-6-16,14:42:30.0,+2:0	172.16.60.190	Mainboard	9	'7SP11_OnlineReset': A user has ended an interact...	[1] 1
2	warning	1	2021-6-16,14:42:32.5,+2:0	172.16.60.190	Mainboard	4	'7SP11_OnlineReset': A user has initiated a remote...	[2] 2
3	warning	1	2021-6-16,14:42:32.6,+2:0	172.16.60.190	Mainboard	27	'7SP11_OnlineReset': Configuration settings were ...	[3] 3
4	warning	1	2021-6-16,14:42:37.9,+2:0	172.16.60.190	Mainboard	27	'7SP11_OnlineReset': Configuration settings were ...	[4] 4
5	warning	1	2021-6-16,14:43:3.6,+2:0	172.16.60.190	Mainboard	38	'7SP11_OnlineReset': Audit log was downloaded fr...	[5] 5
6	warning	1	2021-6-16,15:1:32.0,+2:0	172.16.60.190	Mainboard	27	'7SP11_OnlineReset': Configuration settings were ...	[6] 6
7	warning	1	2021-6-16,15:1:38.4,+2:0	172.16.60.190	Mainboard	27	'7SP11_OnlineReset': Configuration settings were ...	[7] 7
8	warning	1	2021-6-16,15:1:41.3,+2:0	172.16.60.190	Mainboard	38	'7SP11_OnlineReset': Audit log was downloaded fr...	[8] 8
9	warning	1	2021-6-16,16:0:4.8,+2:0	172.16.60.190	Mainboard	27	'7SP11_OnlineReset': Configuration settings were ...	[9] 9
10	warning	1	2021-6-16,16:0:10.2,+2:0	172.16.60.190	Mainboard	27	'7SP11_OnlineReset': Configuration settings were ...	[10] 10
11	warning	1	2021-6-16,16:0:13.4,+2:0	172.16.60.190	Mainboard	38	'7SP11_OnlineReset': Audit log was downloaded fr...	[11] 11
12	warning	1	2021-6-16,16:13:1.3,+2:0	172.16.60.190	Mainboard	27	'7SP11_OnlineReset': Configuration settings were ...	[12] 12
13	warning	1	2021-6-16,16:13:6.7,+2:0	172.16.60.190	Mainboard	27	'7SP11_OnlineReset': Configuration settings were ...	[13] 13
14	warning	1	2021-6-16,16:13:9.1,+2:0	172.16.60.190	Mainboard	38	'7SP11_OnlineReset': Audit log was downloaded fr...	[14] 14
15	alert	1	2021-6-16,16:15:1.4,+2:0	172.16.60.190	Mainboard	65	'7SP11_OnlineReset': Attempted use of illegitimate...	[15] 15
16	warning	1	2021-6-16,16:15:11.9,+2:0	172.16.60.190	Mainboard	9	'7SP11_OnlineReset': A user has ended an interact...	[16] 16
17	alert	1	2021-6-16,16:15:25.2,+2:0	172.16.60.190	Mainboard	65	'7SP11_OnlineReset': Attempted use of illegitimate...	[17] 17
18	alert	1	2021-6-16,16:24:49.7,+2:0	172.16.60.190	Mainboard	65	'7SP11_OnlineReset': Attempted use of illegitimate...	[18] 18
19	alert	1	2021-6-16,16:25:3.2,+2:0	172.16.60.190	Mainboard	65	'7SP11_OnlineReset': Attempted use of illegitimate...	[19] 19
20	alert	1	2021-6-16,16:25:19.2,+2:0	172.16.60.190	Mainboard	65	'7SP11_OnlineReset': Attempted use of illegitimate...	[20] 20
21	warning	1	2021-6-16,16:27:12.5,+2:0	172.16.60.190	Mainboard	4	'7SP11_OnlineReset': A user has initiated a remote...	[21] 21
22	alert	1	2021-6-16,16:27:21.3,+2:0	172.16.60.190	Mainboard	63	'7SP11_OnlineReset': Restart initiated from '192.1...	[22] 22
23	warning	1	2021-6-16,16:27:21.7,+2:0	172.16.60.190	Mainboard	4	'7SP11_OnlineReset': A user has initiated a remote...	[23] 23
24	warning	1	2021-6-16,16:27:48.9,+2:0	172.16.60.190	Mainboard	35	'7SP11_OnlineReset': Firmware version 'V08.80' w...	[24] 24
25	alert	1	2021-6-16,16:28:19.3,+2:0	172.16.60.190	Mainboard	63	'7SP11_OnlineReset': Restart initiated from '192.1...	[25] 25
26	warning	1	2021-6-16,16:33:38.4,+2:0	172.16.60.190	Mainboard	4	'7SP11_OnlineReset': A user has initiated a remote...	[26] 26
27	warning	1	2021-6-16,16:33:50.9,+2:0	172.16.60.190	Mainboard	9	'7SP11_OnlineReset': A user has ended an interact...	[27] 27
28	warning	1	2021-6-16,16:34:19.5,+2:0	172.16.60.190	Mainboard	4	'7SP11_OnlineReset': A user has initiated a remote...	[28] 28
29	alert	1	2021-6-16,16:34:25.0,+2:0	172.16.60.190	Mainboard	63	'7SP11_OnlineReset': Restart initiated from '172.1...	[29] 29
30	warning	1	2021-6-16,16:35:28.8,+2:0	172.16.60.190	Mainboard	29	'7SP11_OnlineReset': Configuration settings were ...	[30] 30
31	alert	1	2021-6-16,16:35:30.3,+2:0	172.16.60.190	Mainboard	63	'7SP11_OnlineReset': Restart initiated from '172.1...	[31] 31

Figure 4.18 Table with the security monitoring information

5 Link collection to further documents

[1] SIPROTEC 5 Communication Protocols - Manual
https://support.industry.siemens.com/cs/document/109742443/siprotec-5-communication-protocols-manual?dti=0&pnid=24237&lc=en-WW

[2] SIPROTEC 4/SIPROTEC Compact/Reyrolle IEDs Ethernet Module EN100 for IEC 61850 - Manual
https://support.industry.siemens.com/cs/document/109744540/siprotec-4-siprotec-compact-reyrolle-ieds-ethernet-module-en100-for-iec-61850-with-electrical-optical-100-mbit-interface?dti=0&pnid=24238&lc=en-WW

[3] Reyrolle 7SR5 Communication Protocol - Manual
https://wse06.siemens.com/content/P0009270/Documents/7SR5%20Communication%20Protocol%20Manual,%202,%20en_US.pdf

[4] SICAM PAS / PQS - Configuration and Operation - Manual
https://support.industry.siemens.com/cs/document/109758084/sicam-pas-pqs-configuration-and-operation?dti=0&pnid=24615&lc=en-WW

[5] SICAM A8000 Series, Manual CP-8050
https://support.industry.siemens.com/cs/document/109757272/sicam-a8000-series-manual-cp-8050-?dti=0&pnid=24618&lc=en-WW

[6] SICAM A8000 Series CP-8000, CP-8021, CP-8022 - Manual
https://support.industry.siemens.com/cs/document/109757713/hb-sicam-a8000-series-cp-8000-cp-8021-cp-8022?dti=0&pnid=24618&lc=en-WW

[7] SICAM Q100 - 7KG95xx - Power Monitoring Device and Class A Power Quality Recorder - Device Manual
https://support.industry.siemens.com/cs/document/109744874/sicam-q100-7kg95xx-power-monitoring-device-and-class-a-power-quality-recorder-device-manual?dti=0&pnid=24644&lc=en-CN

[8] SICAM Q200 - 7KG97 - Multifunctional Recorder - Device Manual
https://support.industry.siemens.com/cs/document/109744896/sicam-q200-7kg97-multifunctional-recorder-device-manual?dti=0&pnid=24645&lc=en-CN

[9] SIPROTEC 5 SNMP MIB
https://support.industry.siemens.com/cs/document/109742125/siprotec-5-snmp-mib?dti=0&pnid=24232&lc=en-WW

[10] SICAM RTUs SNMP MIB File
https://support.industry.siemens.com/cs/document/109773392/sicam-rtus-snmp-mib-file?dti=0&pnid=24232&lc=en-WW

[11] EN100 Communication Module – Protocols (MIBs for SIP4, SIP Compact, Reyrolle)
https://support.industry.siemens.com/cs/document/109745821/en100-communication-module-protocols?dti=0&pnid=24232&lc=en-WW

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