

Products: R&S®DVM50, R&S®DVM100, R&S®DVM100L, R&S®DVM120, R&S®DVM400

# SNMP Example: DVM Management Center Monitoring in a Broadcast Network

## Application Note

The simple network management protocol (SNMP) can be used in a wide range of applications, as described in Rohde & Schwarz Application Note 7BM65 "The Simple Network Management Protocol: Remote Controlling for Monitoring Devices" [1]. In particular, the option of centrally managing monitoring sensors – such as the R&S®DVM for RF and baseband signals in digital broadcasting – shows the potential of this technology. However, the protocol alone is not enough to achieve this management functionality. Specialized management applications are needed that carry out the SNMP requests and display the results graphically.

This application note and the associated SNMP example application will show how the R&S®DVM family can be used for this type of application. Rohde & Schwarz customers can use the included source code (programming language: C#) to make the modifications needed for their own situations.



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### **1 Overview**

The simple network management protocol (SNMP) can be used in a wide range of applications, as described in Rohde & Schwarz Application Note 7BM65 “The Simple Network Management Protocol: Remote Controlling for Monitoring Devices“ [1].

In particular, the option of centrally managing monitoring sensors – such as the R&S®DVM for RF and baseband signals in digital broadcasting – shows the potential of this technology. However, the protocol alone is not enough to achieve this management functionality. Specialized management applications are needed that carry out the SNMP requests and display the results graphically.

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### **2 Where to Get the Software?**

The example application and the associated source code can be downloaded with this document from the Application Notes area of the Rohde & Schwarz homepage. In addition to the archived project, a standalone installation routine is also available.

### **3 Software Features**

The application “SNMP Example: DVM Management Center” polls the connected R&S®DVMs within the network every 7 seconds and checks the alarm states of their RF and baseband inputs. Based on the poll results, the overall alarm state of each R&S®DVM is displayed on a user-defined graphic (e.g. a map). The following states are possible:

- Red: Alarm is present at one of the inputs.
- Yellow: An alarm was present in the past, but currently there is no alarm at any input.
- Green: No current or past alarm at any of the inputs.
- Connectivity loss: No network connection to the device, or SNMP service not available.

To illustrate the polling principle at the inputs of an R&S<sup>®</sup>DVM, three possible polling examples are shown here:

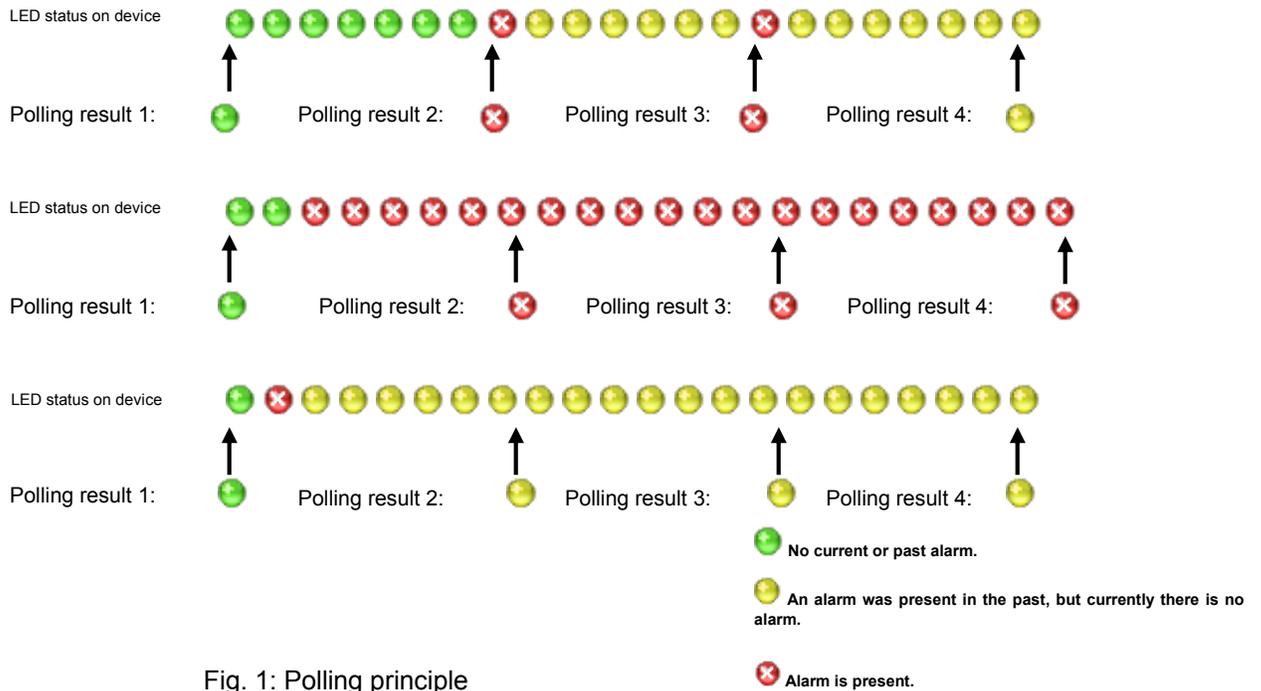


Fig. 1: Polling principle

As illustrated here, the polling process queries the current state of the inputs. Any "interim states" are not included.

An optional e-mail notification of the alarm states is possible. The user can define the following alert criteria (sorted by alarm level):

1. Connectivity Loss: After X (= number) sequential Connectivity Loss states, an e-mail is sent.
2. TS Sync Loss: After X (= number) sequential TS Sync Loss states, an alarm is issued for TS Sync Loss.
3. Continuous Alarm State: After X (= number) sequential Alarm states, an alarm is issued for Continuous Alarm State.
4. Entry in Alarm Report: If an alarm state is currently detected, or if an alarm state had been detected in the past, an alarm is immediately issued by making an entry in the Alarm Report.

To prevent multiple notifications about an existing, persistent alarm state, it is possible to set an alarm delay. This means that if one of the above alarm states occurs, a delay is activated for any subsequent notifications based on the critical alerting condition.

Finally, the graphical map display serves as the interface to the web interface of the R&S<sup>®</sup> DVM. Users can click on the corresponding symbol in the map to open a web display that allows closer observation of the monitoring states of the R&S<sup>®</sup> DVM.

## 4 Hardware and Software Requirements

### PC hardware requirements

	Minimum
<b>CPU</b>	Pentium II 450 MHz or better
<b>RAM</b>	128 Mbyte
<b>Hard Disk</b>	50 Mbyte free hard disk space
<b>Monitor</b>	SVGA color monitor, resolution 1024 x 768 or better

### PC software requirements

	Minimum
<b>OS</b>	Windows 98 / 2000 / Me / XP
<b>OS add-ons</b>	.NET Framework 2.0 or better Java 2 Plattform Standard Edition 1.5.0 or better

### R&S<sup>®</sup> DVM requirements

Please make sure that R&S<sup>®</sup> DVM firmware 4.10 or better is installed. Furthermore ensure that the required web server for the web interface is running. For installation instructions, please refer to the documentation for FW 4.10.

### 5 Hardware and Software Setup

To communicate with the SNMP agent of the R&S<sup>®</sup>DVM, an Ethernet connection between the manager and the Rohde & Schwarz instrument is required. To demonstrate the configuration of agent (R&S<sup>®</sup>DVM) and manager system (user PC), for example, two common network configurations are presented in the following:

- Direct connection of the R&S<sup>®</sup>DVM with the management system
- Linking of the R&S<sup>®</sup>DVM to existing corporate networks

**Note:** *An inappropriate configuration of the network parameter on a single device in a network can result in severe troubles for the whole network system.*

#### Direct connection

One setup particularly of interest in development is the connection of the R&S<sup>®</sup>DVM directly with the management system:

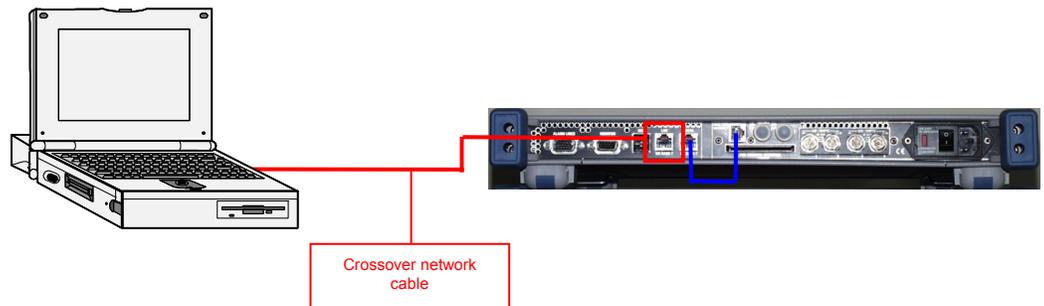


Fig. 2: Direct connection between measuring instrument and manager, using the R&S<sup>®</sup>DVM as an example

Note that this setup requires a crossover network cable. A crossover network cable can be identified by the differently arranged (crossover) wires on the RJ-45 connections:

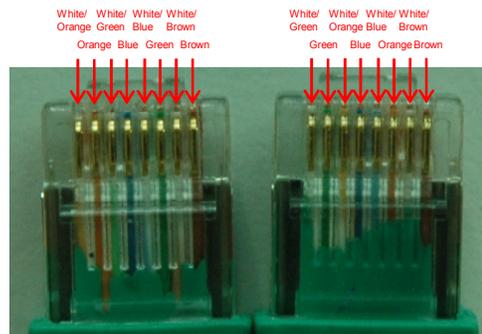


Fig. 3: Crossover network cable

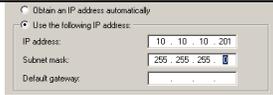
### Manual configuration of the network address

Both the management system and the R&S®DVM must be configured properly with respect to the network address. As discussed in section 3, both instruments must be logically located in one subnet.

For example, the following address configuration may be used:

	Manager	R&S® DVM
<b>IP address</b>	192.100.10.201	192.100.10.202
<b>Subnet mask</b>	255.255.255.0	255.255.255.0

To obtain the network configuration of a fixed IP address, proceed as follows under Windows:

1.	Using the right mouse button, click My Network Places and select Properties.	
2.	Right-click the required LAN adapter of the system; the properties of this network connection will be accessed.  <b>Note:</b> <i>In the case of the R&amp;S®DVM, do not change the configuration of the Private Analyzer Network adapter.</i>	
3.	Access the properties of the Internet Protocol (TCP/IP) entry.	
4.	Enter the IP address and subnet mask you want by enabling "Use the following IP address".	
5.	To accept your settings, close all windows with OK.	-

### Connecting the R&S® DVM to an existing network

The following setup is relevant particularly when operating the R&S® DVM in the actual monitoring environment:

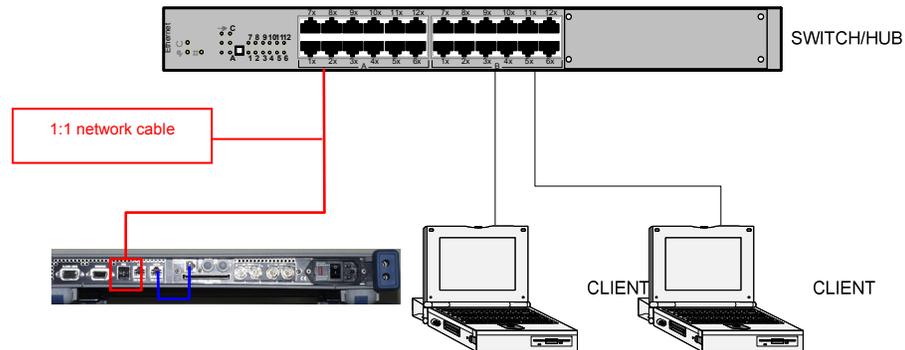


Fig. 4: Typical setup in a corporate network

In contrast to a crossover network cable, the two leads of straight-through network cables have identical wire arrangements.

### Dynamic configuration of the network address

A network configuration commonly used in companies is the dynamic allocation of IP addresses by dynamic host configuration protocol (DHCP) servers. Here, the configuration data (IP address, subnet mask) for the clients is automatically assigned.

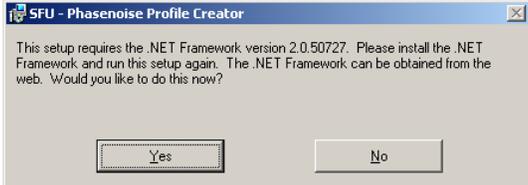
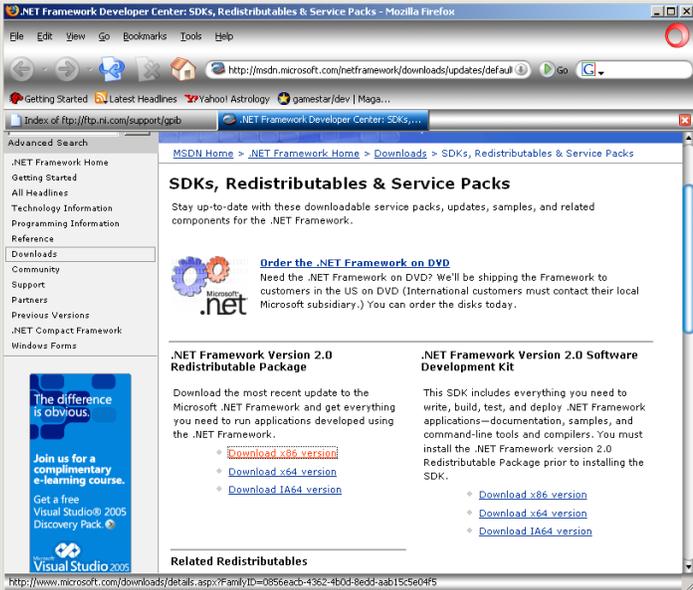
To enable an R&S® DVM to support this dynamic configuration, the network adapter must be configured as follows:

1.	Using the right mouse button, click My Network Places and select Properties.	
2.	Right-click the required LAN adapter of the system. The properties of this network connection will be accessed.  <b>Note:</b> <i>In the case of the R&amp;S® DVM, do not change the configuration of the Private Analyzer Network adapter.</i>	

## SNMP Example: DVM Management Center

3.	Access the properties of the Internet Protocol (TCP/IP) entry.	
4.	Enable the DHCP configuration by selecting "Obtain an IP address automatically".	
5.	To accept your settings, close all windows with OK.	-

## 6 Installation of the Standalone Application

1.	<p>Double-click the application setup file to launch it:</p> 
2.	<p>The application checks whether .NET Framework, Version 2 or later is installed on the computer. If not, this software can be downloaded from the Internet and installed:</p>  <p>Click "Yes" to open the Microsoft download page:</p>  <p>From here, you can download the software at no cost.</p>

3.	After .NET Framework has been installed (or if it was already installed), simply follow the installation instructions provided in the setup routine.
4.	After installation is complete, a link to the application is available in the Start menu under "Rohde & Schwarz": 

## 7 Using the Application "SNMP Example – DVM Management Center"

This section describes how to use the example application "SNMP Example – DVM Management Center" for central management of various R&S®DVMs and their states, as well as for sending out e-mail alarm notifications as needed.

The following screenshot shows the application's main window:

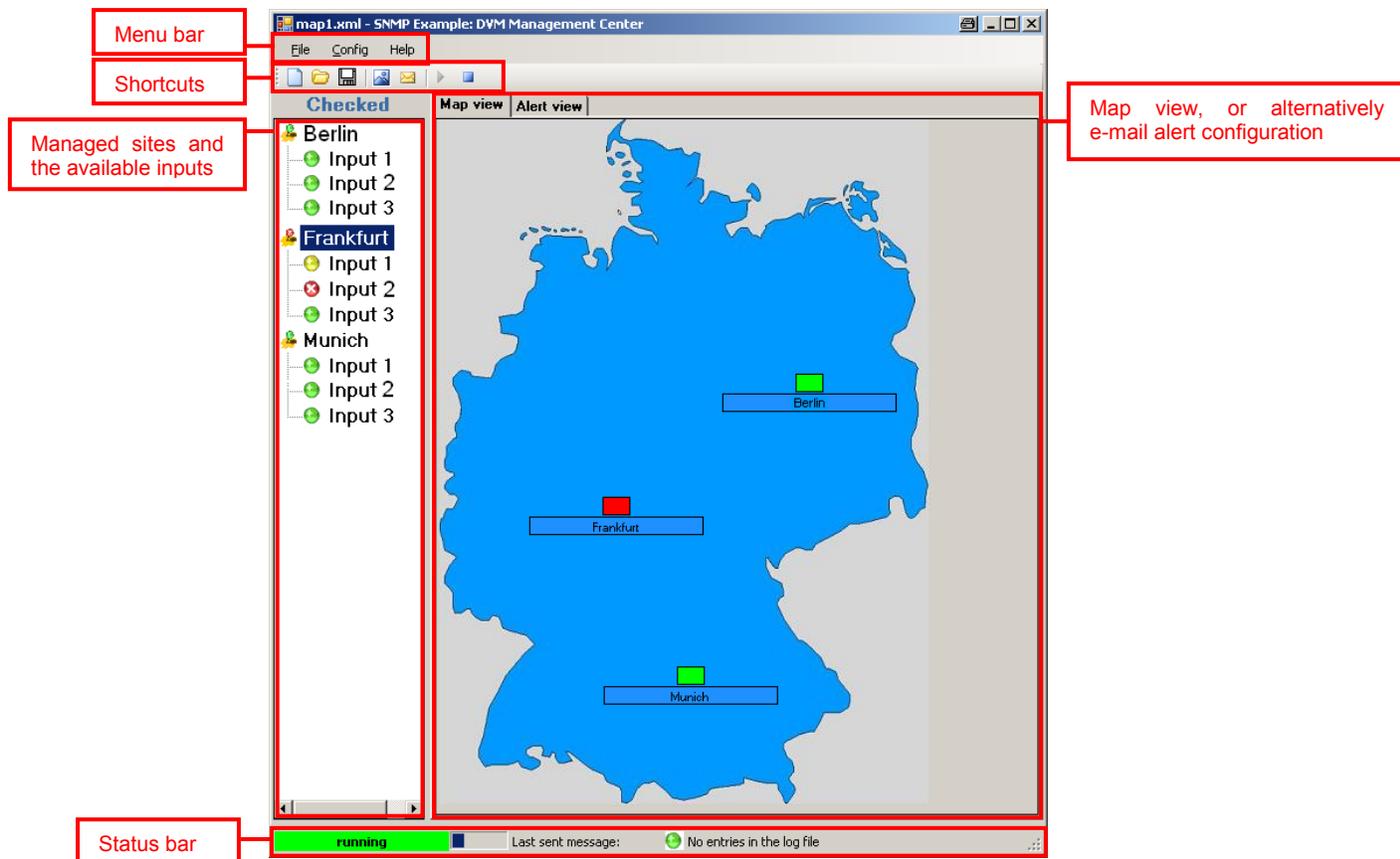
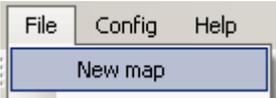
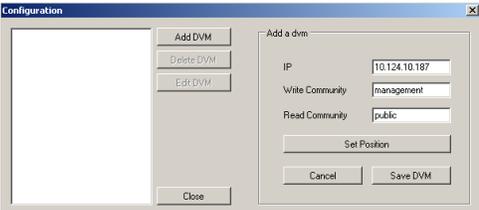
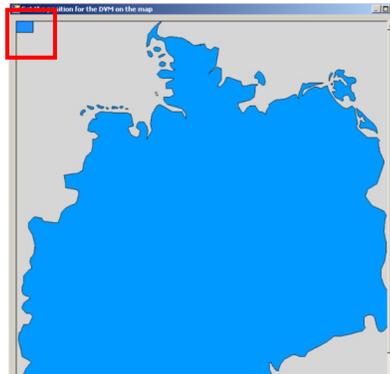


Figure 5: Main window of the example application

### First steps: Import a map and insert an R&S<sup>®</sup> DVM

1.	<p>Immediately after starting the application, you must create a map. In the "File" menu, click "New Map":</p>  <p>or, alternatively, click the "New Map" icon in the shortcut menu:</p> 
2.	<p>In the new window, click "Set" to select a background image:</p>  <p><b>Note:</b> The image files you will import must have been copied to the "lmg" directory in the software program path beforehand.</p>
3.	<p>Next, configure the R&amp;S<sup>®</sup> DVMs that will be displayed on the map. Click the button:</p>  <p>The Device Configuration window opens.</p>
4.	<p>Click "Add DVM" to define in more detail the R&amp;S<sup>®</sup> DVM to be added to the management application:</p>  <p>Define the device IP address as well as the read and write community.</p>
5.	<p>Click "Set Position" to position the corresponding symbol on the map:</p> 

6. In the new window, drag & drop the default label to the desired position. Close the window to accept the new position.

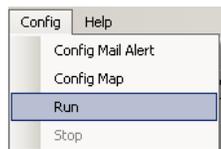


7. Now close the configuration window. The main window now displays the map with the R&S®DVM:



8. Click the "Save" shortcut to save the map .

9. To start monitoring, go to the "Config" menu and click "Run".

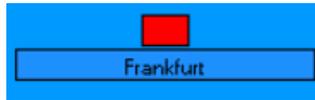


Or you can use the shortcut to start the monitoring:

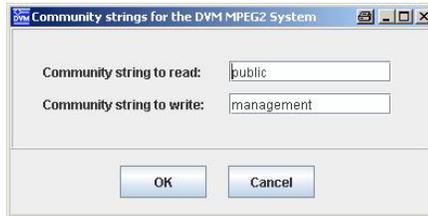


## Opening the R&S® DVM web interface

- To access the R&S® DVM web interface, move the cursor over the site symbol of an R&S® DVM and click it with the left mouse button:



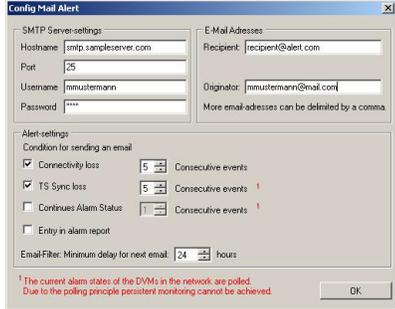
- This opens a Java applet window where you can enter the read and write community for the device. The default settings for Read/Write are Public/Management. For more information about configuring the read/write community, refer to [1].



- The web interface for the selected R&S® DVM is now open:

Name	Color	Rate [Mbit/s]
TS (ID 1101)		38.013836
PSI/SI		2.696286
Service 28106 [Das Erste]		8.227251
Service 28107 [Bayrisches FS]		3.359506
Service 28108 [hr-fernsehen]		3.489045
Service 28109 [arte]		5.460129
Service 28111 [WDR K.In]		3.550934
Service 28112 [BR-alpha]		4.835486
Service 28113 [SWR Fernsehen BW]		3.456661
Service 28114 [Phoenix]		3.444949
Service 28130 [Test-R]		3.043090
Null Packets (PID 8191)		2.547791
User Private PID		0.000000

## Configuring the alerting function

1. Open the "Alert View" tab:
 
2. Click "Config Mail Alert".
 
3. In the new window, define how errors will be alerted:
 
4. Close the window to activate the mail alerting function.
 
5. The e-mail notifications are formatted as follows:
 

IP: 10.124.10.187  
 Site Name: --10.124.10.187--  
 Type of error: Connectivity loss

**Subject:** "DVM mail alert" + IP address of the R&S<sup>®</sup> DVM with errors

**Body:** "IP address, site name, and type of error for the R&S<sup>®</sup> DVM with errors"

### 8 Source Code Documentation

The application was implemented using the Microsoft Studio .NET 2005 development environment. The separate source code archive contains the entire project solution for Studio .NET 2005.

#### Introductory remarks regarding .NET

The common language runtime (CLR) forms the basis of the .NET technology. The CLR is the runtime environment for various high-level languages adapted to .NET.

This virtual machine – which is another term for the runtime environment – runs the standardized intermediate code CIL (common intermediate language). In practice, this means that compilation directly into the machine code does not occur during the development process. Instead, an intermediate code is generated at the end of the development process.

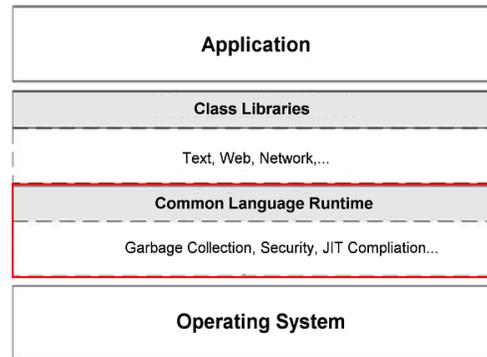


Figure 6: .NET Concept

In addition, the framework class library (FCL) provides the developer with several thousand user classes. These classes allow functions such as text processing and database access, among others. With the size of software projects increasing all the time, one thing is essential: security.

The CLR efficiently ensures that unused memory is released, manages access rights to resources, and traps exceptions.

### Simple network management protocol (SNMP) library

SNMP++.NET v. 1.21 can be used as the SNMP stack for .NET development:

SNMP++.NET v. 1.21

Copyright (c) 2003-2006 Military Communication Institute, Zegrze, Poland

Author: Marek Malowidzki

This software is based on SNMP++ from Jochen Katz, Frank Fock, which is in turn based on SNMP++2.6 from Hewlett Packard:

Copyright (c) 2001-2003 Jochen Katz, Frank Fock

Copyright (c) 1996 Hewlett-Packard Company

The library consists of the following five DLLs:

- Mib.Dll
- SnmpComp.dll
- SNMPPDII.dll
- TableReader.dll
- Tools.dll

For additional information regarding this library, as well as how it can be integrated into several applications, refer to Rohde & Schwarz Application Note 7BM65 "Simple Network Management Protocol – Remote Controlling for Monitoring Devices".

### Class overview

The solution includes the following classes, organized by function:

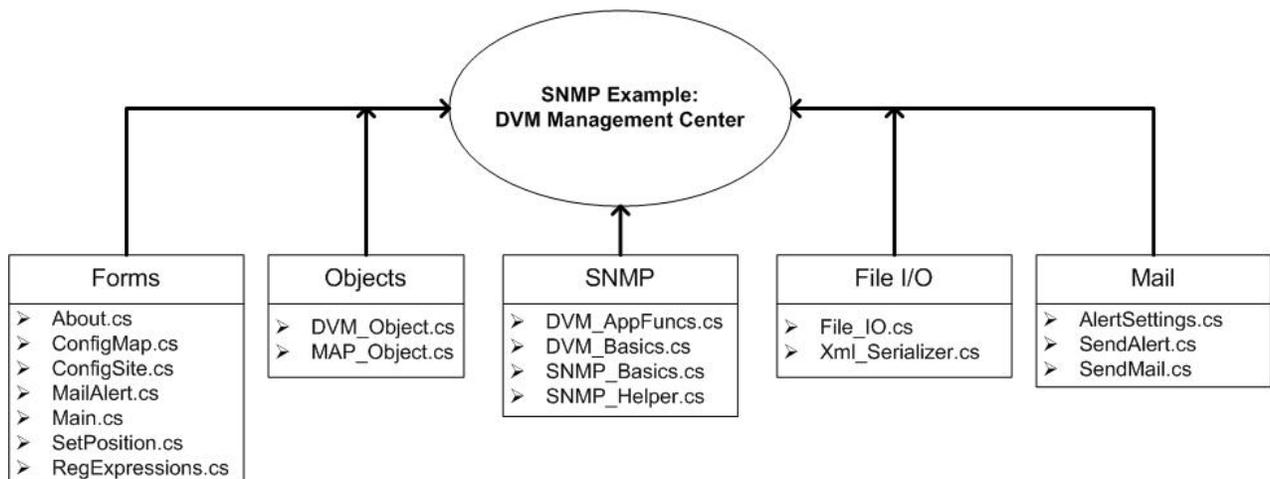


Figure 7: Class overview

## ***SNMP Example: DVM Management Center***

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Functionally related classes were assigned a common name space.

### DVM\_Management\_Center.Forms

- About.cs: Help window with contact address.
- ConfigMap.cs: Configuration window for the map graphic.
- ConfigSite.cs: Configuration window for the managed R&S®DVMs.
- MailAlert.cs: Configuration window for managing the e-mail notification function.
- Main.cs: Main window of the application.
- SetPosition.cs: Window for positioning the R&S®DVMs on the map.
- RegExpressions.cs: Regular expressions class for checking entries in formulas for validity.

### DVM\_Management\_Center.Objects

- DVM\_Object.cs: Class representing the functions and attributes of an R&S®DVM.
- MAP\_Object.cs: Class that manages the map and the objects it contains.

### DVM\_Management\_Center.SNMP

- DVM\_AppFuncs.cs: Contains functions that return values that are read out via SNMP in a format appropriate for the application.
- DVM\_Basics.cs: Contains individual R&S®DVM-specific SNMP polls.
- SNMP\_Basics.cs: Serves as the interface to the SNMP library.
- SNMP\_Helper.cs: Functions for converting the returned SNMP values.

## ***SNMP Example: DVM Management Center***

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### DVM\_Management\_Center.FileIO

- File\_IO.cs: Functions for write and read access to text files.
- Xml\_Serializer.cs: Used to create or read XML files.

### DVM\_Management\_Center.Mail

- AlertSettings.cs: Stores the configuration settings for e-mail notifications.
- SendAlert.cs: Class that generates a specific notification e-mail within the application.
- SendMail.cs: General class for sending e-mails.

## **Description of the core functionality**

Within the main window (Main.cs), a timer initiates the polling of the managed R&S<sup>®</sup>DVMs every 7 seconds. The class DVM\_AppFuncs.cs is then accessed to poll the following information:

- Pro Controller:  
Site name and analyzer MAC addresses
- For every input on every analyzer:  
Input name, input type, input configuration, folder name, and AnalyzerPort bit field

The polled values are then assigned to an instance of DVM\_Object.cs and interpreted. Every DVM object contains all management information, as well as a TreeView node for displaying the site tree and a label/text component of the map display. Each time a new R&S<sup>®</sup>DVM is added in the GUI, a new DVM object is also created. The management information (e.g. site name, IP address, etc) is stored in an XML file by means of the XML\_Serializer.cs class.

As described in the introductory chapters, it is possible to initiate an e-mail notification based on the polling results. The SendMail.cs class sends these notifications via simple mail transfer protocol. Derived from SendMail.cs, the SendAlert.cs class functions as an interface to the application.

## 9 References

- [1] Gsoedl, Harald (2007). Application Note 7BM65. Simple Network Management Protocol. Remote Controlling for Monitoring Devices. Munich: Rohde & Schwarz GmbH & Co. KG website: <http://www.rohde-schwarz.com>.

## 10 Additional Information

Our Application Notes are regularly revised and updated. Check for any changes at <http://www.rohde-schwarz.com>.

Please send any comments or suggestions about this Application Note to [Broadcasting-TM-Applications@rohde-schwarz.com](mailto:Broadcasting-TM-Applications@rohde-schwarz.com).

## 11 Ordering Information

Option		Number
DVM100	MPEG2 Monitoring System	2085.1600.03
DVM100L	MPEG2 Monitoring System	2112.7050.02
DVM120	MPEG2 Monitoring System	2085.1700.03
DVM-B1	MPEG Analysis Board	2085.3283.02
DVM-K1	TS-Monitoring	2085.5211.02
DVM-K2	TS-Capture	2085.5234.02
DVM-K10	In Depth Analysis	2085.5228.02
DVM-K11	Data Broadcast Analysis	2085.5311.02
DVM-K12	Template Monitoring	2085.5328.02
ZZA-111	Rack mount kit	1096.3254.00
DVM50	MPEG2 Monitoring System	2085.1900.03
DVM50-K10	In Depth Analysis	2085.5434.02
DVM400	Digital Video Measurement System	2085.1800.03
DVM400-B1	MPEG Analysis Board	2085.5505.02
DVM400-B2	TS Generator	2085.5511.02
DVM400-B3	Upgrade TS Generator TRP Recorder/Player	2085.5528.03
DVM400-B4	Upgrade TS Generator TRP Recorder/Player (214MBIT/S)	2085.5534.03
IP		
DVM400-B40	Gigabit Ethernet interface module	2085.5557.02
Decoder		
DVM-B30	Video and audio hardware decoder	2085.5570.02
DVM400-B30	Video and audio hardware decoder	2085.5540.02
DVM-K30	HD/SD-SDI output	2085.5440.02
DVM-K31	Video and audio monitoring	2085.5457.02
DVM-K32	HDTV decoding upgrade	2085.5486.02
RF		
DVM-B50	DVB-C, J63, A/C Receiver Module	2085.5605.02
DVM-B51	DVB-S/DVB-S2 Receiver Module	2085.5611.02
DVM-B52	DVB-T/H Receiver Module	2085.5628.02
DVM-K52	Second DVB-T/H receiver path	2085.5470.02
DVM-B500	RF carrier board	2085.5634.02
DVM-B520	RF carrier board	2085.5640.02
DVM400-B500	RF carrier board and decoder extension	2085.5563.02
Streams		
DV-HDTV	HDTV Sequences	2085.7650.02
DV-DVBH	DVB-H Stream Library	2085.8704.02
DV-H264	H.264 Stream Library	2085.9052.02
DV-TCM	Test Card M Streams	2085.7708.02
DV-ASC	Advanced Stream Combiner	2085.8804.02/03



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