Product: DVRG

Integration of
DTV Recorder Generator DVRG
into a TCP/IP Network

Application Note

The DTV recorder generator DVRG is a useful tool for recording and replaying MPEG2 transport streams in addition to uncompressed video (ITU-R B.T. 601).

Due to their length and data rate the streams can become very large and might not be able to transfer through the internal CD-R drive. This application note describes how a Microsoft network can be setup for a quick file transfer and remote operation of DVRG.

ROHDE & SCHWARZ

Contents

1 Overview

Since the DVRG hosts an IBM compatible PC workstation with Microsoft® Windows NT® Embedded 4.0 operating system, networking is fairly easy. This application note describes all about how to set-up a TCP/IP connection to a remote PC and for video file transfer using Microsoft Network as well as remote operation of the instrument.

2 Software Features and Limits

Network Software Components

The drivers and software components of Windows NT® Embedded 4.0 are adapted to the primary dedication of the DVRG which is recording and replaying of video and transport stream files.

In order to prevent damage to the instrument functions, only the settings described below should be resorted to. The existing software should be modified only with the update software released by Rohde & Schwarz. It is advised, that only additional software packages released or authorized by Rohde & Schwarz for usage on DVRG are being installed.

Playing out or recording of video streams with a designated high data rate is a very sensitive process. In order to achieve data rates up to 270 Mbit/s of uncompressed SDI video (ITU-R B.T. 601) all server functionality within the Windows NT Embedded® has been removed. Accessing the drives of DVRG from a remote system thus is not supported. Installation of server software elements on the DVRG may result in harming the performance or damaging the operational system and can therefore not be advised.

Container File System CFS

In order to ensure a sufficient recording and play-out speed, video data like transport stream files (of types *.TRP and *.T10) and uncompressed video files (of types *.SDI and *.S10) are kept on DVRG in an application specific container file system (CFS). It resides on either one or two separate SCSI hard drives, which are independent from the system IDE drive. Assigning any drive letter to the SCSI drives with the system tool "Disk Administrator" is not advised and could result in malfunction of the unit.

The CFS drive is accessible for typical record and replay operations by the DVRG firmware either through the LC display, the front panel keys or

the DVRG Commander software. The drive letter F: is been used only internally.

Utility TS_Copy

To transfer files between the CFS and the Windows NT® operating system the application program "TS_Copy" is included into the software of the DVRG. It becomes accessible when DVRG is booted in "Workstation mode". This requires an external VGA monitor, a keyboard and mouse connected to the instrument and user interaction upon booting the instrument.

The user interface of "TS_Copy" comprises of two windows, one for the CFS files system and the other one for all Windows NT® locally accessible file systems. These could be:

➢   Internal IDE drive E:

➢   Internal CD-ROM or DVD-ROM G:

➢   External drive on remote system, mapped i.e. as H:

By clicking on any of the files in any of the two windows the conversion and transfer process towards the other drive is started.

Video File Exchange with a remote PC

A Microsoft Network connection is employed for file exchange. Since DVRG may only be used as a client in a network connection all operations are initiated from the "Workstation" desktop of DVRG. The transfer process can be performed either with the Windows Explorer or directly with a one-click operation using the "TS_Copy" utility through the network.

Using the Windows Explorer for transferring video stream files requires usually a following import or a previous export process with the "TS_Copy" tool anyhow. Otherwise the video file will not be available to DVRG standard operations record or re-play utilizing the container file system CFS.

To reduce the amount of operations to one transfer process at all the second option using the "TS_Copy" utility through the network is recommended. For that purpose the counterpart drive on the remote system has to be mapped as a network drive to the Windows NT® system of DVRG. How to achieve that and also how to establish a basic Microsoft Network connection over TCP/IP is described in this application note.

Connection of two DVRGs

In a network connection including two DVRG's a third PC system being the network server has to be present, since DVRG can perform client functionality only. Video file exchange between two DVRGs cannot be performed directly from one unit to the other. Separate connections of both DVRGs individually to the server have to be employed in that case.

Utility DVRG Commander

The DVRG Commander is part of the operating software on any DVRG if firmware release V1.21 or higher is installed. This useful software serves two purposes: It allows local control of the DVRG from the Windows NT interface in the Workstation mode. It also enables remote control of the DVRG from any Windows driven PC connected to the DRVG through a TCP/IP connection. This utility is described in section 6.

3 Hardware and Software Requirements

Hardware Requirements

To set-up a network the relevant PC needs to have an integrated Ethernet card. Laptops are typically equipped with an Ethernet interface card either internally or in the physical package of a PCMCIA card.

The interface of the DVRG is a 100baseT type, capable of handling data rates up to 100 Mbit/s. If large files are to be transferred, the same type of interface is recommended for the PC as well. A 10baseT interface (up to 10 Mbit/s) is also suitable, but will be significantly slower in data transfer speed.

The network connector type of DVRG is RJ45. An RJ45 to RJ45 patch type crossover cable has to be used towards another PC with an RJ45 connector. In connections through a network hub the patch type cable needs to be non-crossover, since the hub does an inversion of the signals inside. Other type of network connectors, like 75- coaxial thin-wire or the old thick wire connections can be interfaced through a hub as well.

Hardware Recommendation for a PC Peripherals Switch

To operate the DVRG in the "Workstation" mode a set of PC peripheral components consisting of a VGA monitor, a keyboard and a mouse need to be connected.

Since these peripheral components are been used initially for setup and later on for short periods of time only, a peripherals switch has been found very useful. Such kind of electronic switch, which is available as a PC utility, allows the usage of one set of PC peripherals with more than one PC. It has at least three of each peripheral port types for the connection of one full set as well as the DVRG and one or more PC's. A simple key press on the keyboard or on the switch itself changes the connection of the peripheral set from one PC or the DVRG to another PC.

A specific recommendation for such a peripherals switch is given in section 9 (ordering information). However the usage of the switch is not required. Therefore it is not shown in the circuit diagrams of the following section.

DVRG Mode of Operation Selection

In order to use all the software options referred to here in this application note, the DVRG always has to be booted in "Workstation mode". The wallpaper of that mode is displayed in Fig. 1:

Fig. 1:   Wallpaper of DVRG booted in "Workstation" mode

During the boot process of DVRG at a very early stage the boot menu will appear and lets the user choose between the "Standalone" and the "Workstation" mode. "Standalone" is the default selection. It will be entered after five seconds of choice. Although a Windows NT® environment is appearing in the "Standalone" mode also, this mode won't let anything been stored permanently on the hard drives. The C: drive is write protected in "Standalone" mode to ensure proper booting capability in any case, even when the unit was shut down or powered down accidentally.
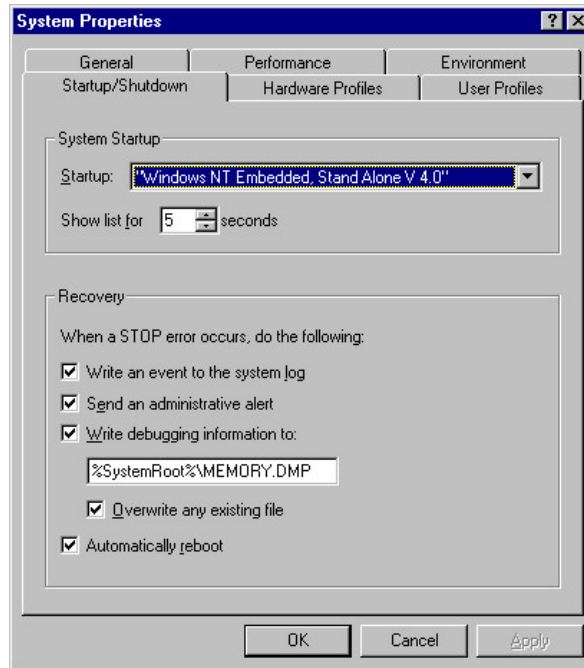
Workstation Mode

To avoid having to choose this mode manually during every boot process, the system can be changed in a way, so that the "Workstation" mode becomes the default boot mode. This change has to be applied in the Control Panel's "System Properties" folder under the tab "Startup/Shutdown" as shown in Fig. 2. The mode visible in the drag-down box is the default system startup mode.

Fig. 2: Windows NT® System Startup and Shutdown properties

Software Requirements

DVRG firmware V1.11 or higher is required for transfer tasks using "TS_Copy" utility. The DVRG Commander for remote control is included in firmware revisions V.121 or higher. Any other software requirement is part of the installed Microsoft Windows NT® Embedded.

The external PC to be connected with the DVRG through the network has to have one of the following operating systems:

> ➢ Microsoft® Windows 95 / 98 (*)

> ➢ Microsoft® Windows 2000

> ➢ Microsoft® Windows NT®

> (*) File size for transfers is limited to 2 Gbytes.

The following network components have to be installed on the remote PC:

> ➢ TCP/IP protocol

> ➢ File and Printer Sharing for Microsoft Networks

The availability of these components can be checked using the hints provided in section (5) "Setting up the Network".

If they are not available and need to be installed, a network administrator or the relevant Microsoft® documentation of the operating system should be consulted.

4   Connecting the DVRG and the Computer

To interconnect the DVRG with another PC either a direct link (point-to-point connection) or a link through a network including one or more hubs and optionally some routers has to be established.

Point-to-point Connection

In case of a direct link as shown in Fig. 3 a special cross-over patch type cable has to be used, where some of the 8 lines are reversed. Looking closely at the two RJ45 network connectors held next to each other one could easily see this crossing over of individual wires, since the connectors are normally transparent. The sequence of colors would be different for a crossover cable, but it would be exactly the same for a normal, straight cable, that cannot be used for a point-to-point connection:

point-to-point
crossover
connection
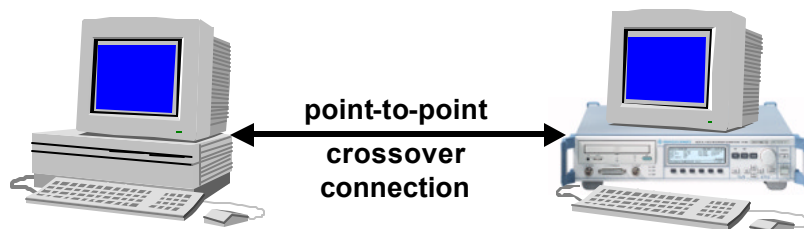
Fig. 3:   Direct network connection between DVRG and a PC

Connecting through a Network Hub, Switch or Server

When connecting both the DVRG and the PC through a network hub, simple straight patch type cables (8-pin RJ45-RJ45) are required like Fig.4 shows:

Hub

multiple
non-crossed-
-over connections
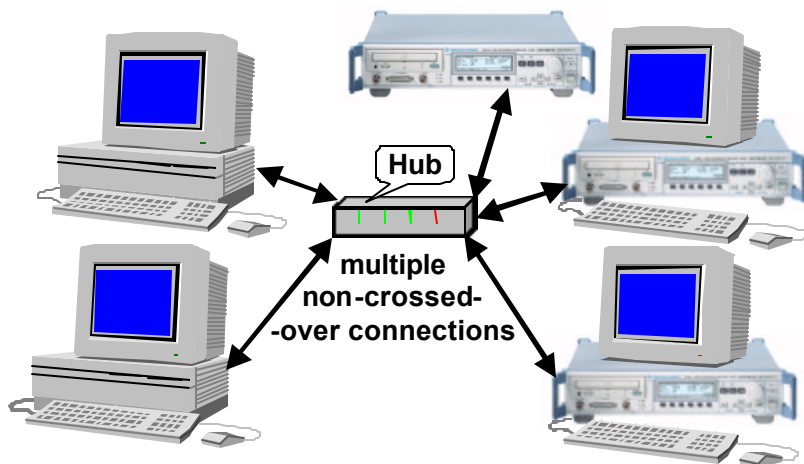
Fig. 4:   Network connection for multiple devices through a network hub

In connections through a network hub, it is the hub that is reversing the individual wires as required.

Although the connection of several DVRGs is showed in Fig. 4 the direct transfer of a file from one DVRG to another DVRG is not supported. Any file transfer has to be performed with separate connections of each DVRG one after the other to the same server system.

5 Setting up the Network

Network Identification

Both the DVRG and the computer need to have different "Computer names" given to. The workgroup assignment can be the same or different All network settings are found in the Control Panel's "Network" folder or in the "Properties" menu after right mouse click on the "Network Neighborhood" icon. Choosing the tab called "Identification" gives access to the workgroup and computer's names as shown in Fig. 5 & 7 for Windows 95/98 and NT®.
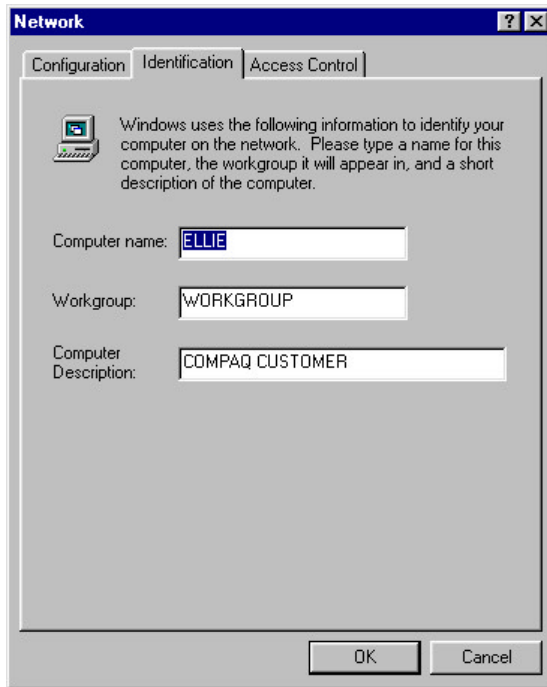

Fig. 5: Network identification in Windows 95/98
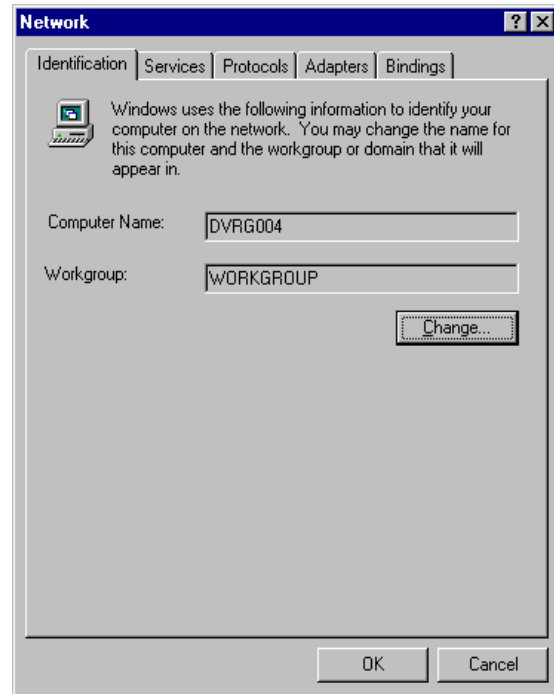
Fig. 7: Network identification in Windows NT®

Fig. 6: Network identification in Windows 2000

In Windows 2000 the concept of the graphical user interface for setting up and locating devices within the network is different. Both elements are combined in an Explorer type of window called "Network and Dial-Up Connections". It is available through the relevant submenu in the menu "Settings" or through the properties menu after right mouse click on "My Network Places".

The network identification is then found in the opening window under menu "Advanced". The window looks very similar to the other operating systems and is shown partly in Fig. 6 to the left.

Network Protocols and Components

Microsoft Network is using the TCP/IP protocol, which has to be installed and linked to the network cards both on the DVRG and the PC. The default installation of DVRG already includes the TCP/IP protocol and its proper linking. With Windows NT® the protocols and their bindings can be found in the "Network" properties under the tabs named accordingly.
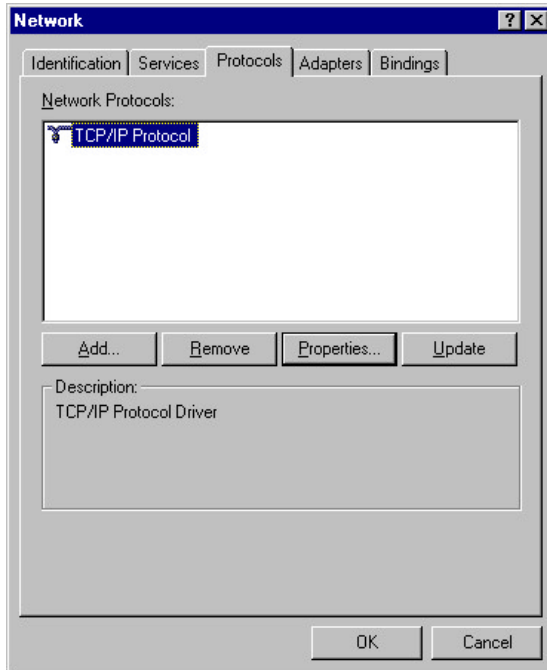
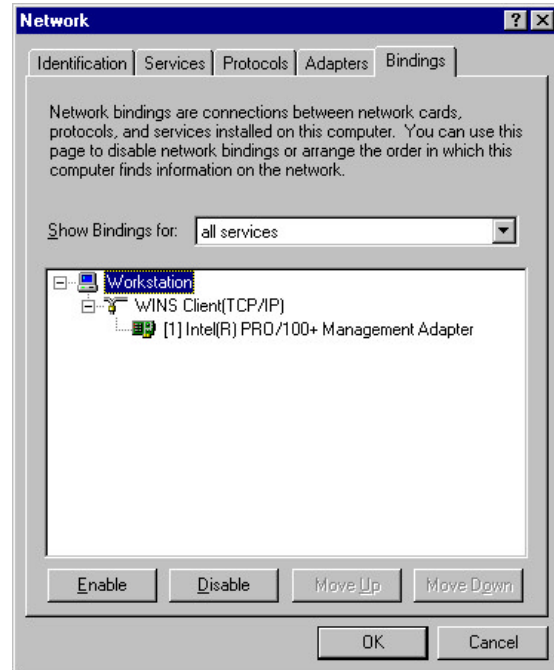Fig. 8:   Network protocols in Windows NT®

Fig. 9:   Network bindings in Windows NT®

The availability of the TCP/IP address and it's proper linking in Windows 95/98 can be checked in the Network properties too by choosing the tab "Configuration". It should include the TCP/IP protocol linked to the network card (not shown here) as well as the "File and Printer sharing for Microsoft Networks" (Fig. 10).
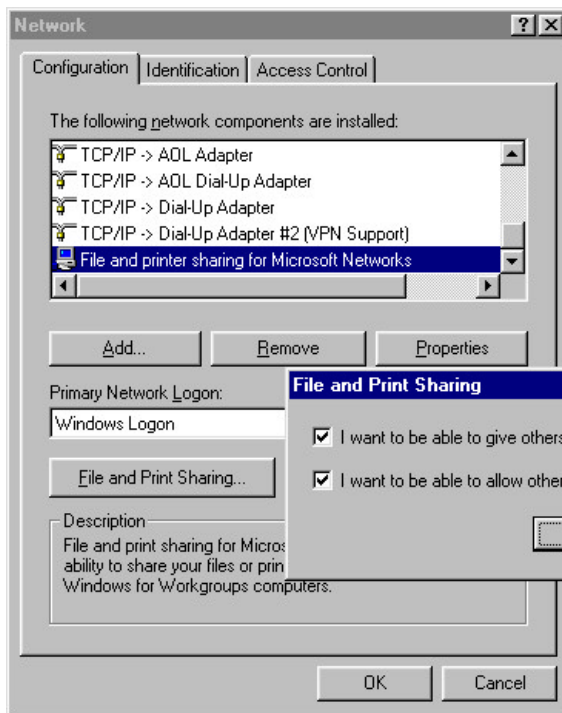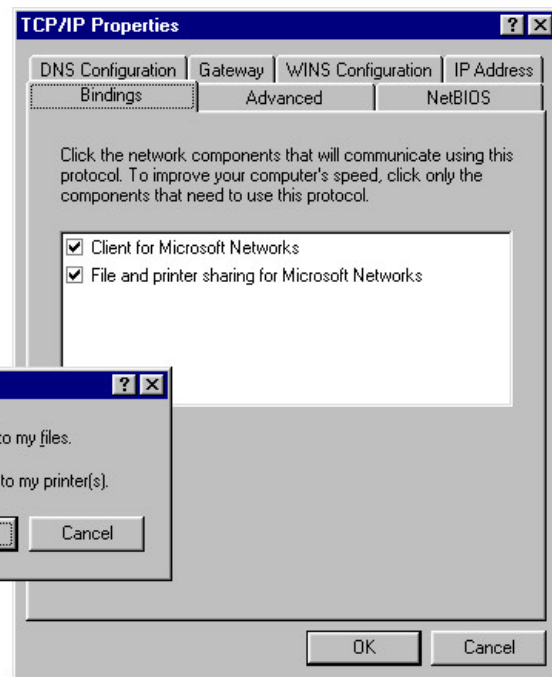

Fig. 10: Network configuration in Windows 95/98

Fig. 11: TCP/IP bindings in Windows 95/98

Clicking the button "File and Print Sharing" opens up a small window, in which both boxes have to be check marked like in the shown example.

Fig. 11 shows the list of bindings with the required components already activated. This display becomes available through the properties' button when the TCP/IP component is highlighted in the list of Fig. 10.

IP Address and Subnet Mask

The TCP/IP protocol used by the Microsoft Network identifies individual devices by a unique IP address, a combination of 4 separate byte values. It furthermore supports the concept of dividing the network into subnets, each of them consisting of a part of the net only. Devices belonging to the same subnet only can communicate directly on the Microsoft Network. A subnet mask defines that part of the network an individual network member can address. This mask tells the network interface by the set bits which bits and bytes of the IP address of another device have to match the own address so that communication can be established.

For the purpose of file transfers the *subnet masks* of the DVRG and the PC have to *match each other* exactly and the IP addresses of both devices have to match in all positions, which correspond to the set bits in that mask.

A few examples will help to understand this topic. The first one is not likely to establish communication, since the two subnet masks are different:

Device	PC (95/98)	DVRG (NT®)
IP address	172. 18. 33. 100	172. 18 33. 254
Subnet Mask	255. 255. 0. 0	255. 255. 255. 0

The second example doesn't allow communication either, because the third byte of both IP addresses are different while the third byte of the subnet mask is set to 255 (0xFFh). All set bytes in the subnet mask call for matching address bytes at the same position:

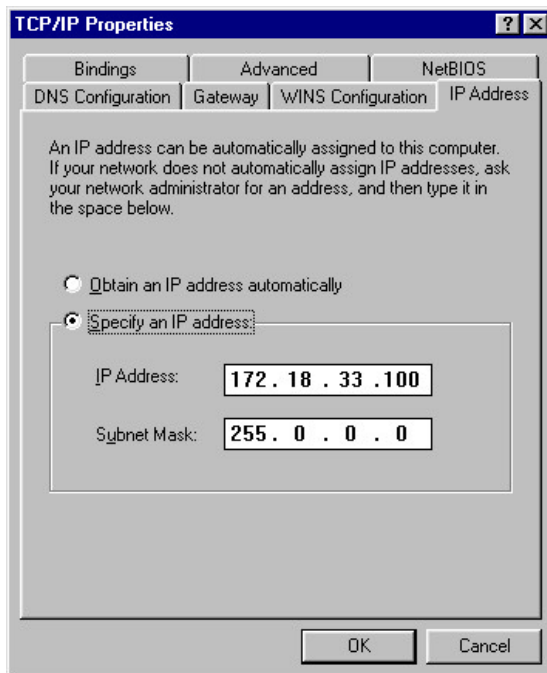|		
IP address	172. 18. 34. 100	172. 18 33. 254
Subnet Mask	255. 255. 255. 0	255. 255. 255. 0

A working example is shown below.

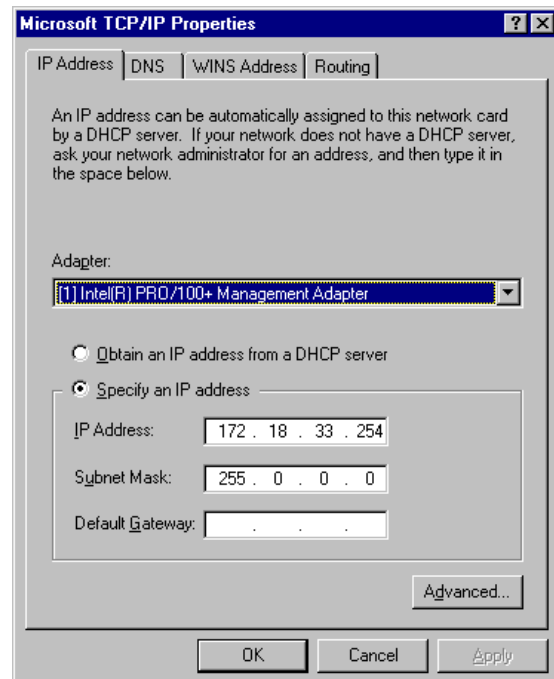*Fig. 12: IP address setting in Windows 95/98*

Fig. 13: IP address setting in Windows NT®

In cases where only remote control with the DVRG Commander is desired, matching of the subnet masks is not required.

Gateway Address

Large-scale network installations use gateways to interconnect different subnets and route all communication towards outside the actual subnet. If the actual subnet uses a gateway its TCP/IP address has to be entered into the relevant field next to the subnet mask.
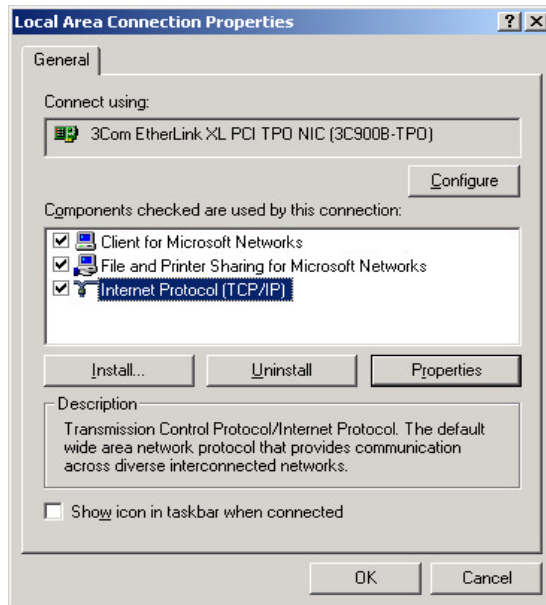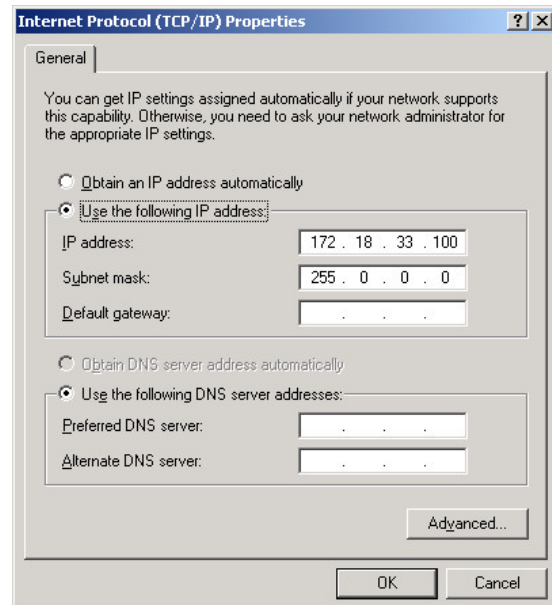

Fig. 14: Connection properties in Windows 2000

Fig. 15: IP address setting in Windows 2000

To view and modify the network setting in Windows 2000 the properties menu after right mouse click on the icon "Local Area Connection" in the "Network and Dial-up Connections" explorer has to be chosen. Fig. 14 illustrates the kind of window appearing. "File and Printer Sharing for Microsoft Networks" as well as "Internet Protocol" have to be activated by the checkmarks. Clicking the "Properties" button with the "Internet Protocol highlighted opens the window for setting the IP address (Fig.15).

Connecting and Mapping a Network Drive

If all settings from above are been done properly and the systems are connected as described in section 4, the remote system should automatically become visible upon opening the Network Neighborhood on DVRG with the desktop icon. This is shown in Fig. 16.

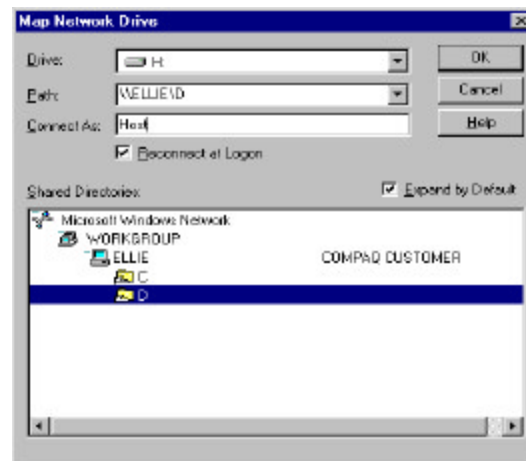*Fig. 16: Network Neighborhood on DVRG with remote system named "Ellie" visible*

Fig. 17: Mapping a network drive in the Windows Explorer on DVRG

If the drive is visible in the Network Neighborhood it will be visible also in the Windows Explorer. However there is no drive letter assigned to it, so it won't be accessible to the "TS_Copy" tool described in section 2 of this document. For that purpose the remote drive has to be mapped.

This can be achieved using the relevant menu command in the Windows Explorer. A window as shown in Fig. 17 will open and a new drive letter may be chosen from the top scroll-down bar. The relevant drive on the remote system has to be selected with the mouse and a user name and password has to be specified upon request. The checkmark "Reconnect at Logon" provides for an automatic reconnection every time the DVRG is booted up again.
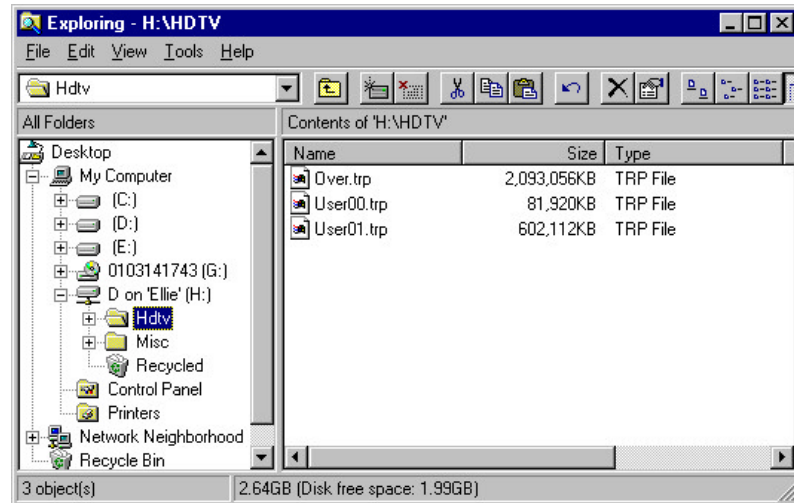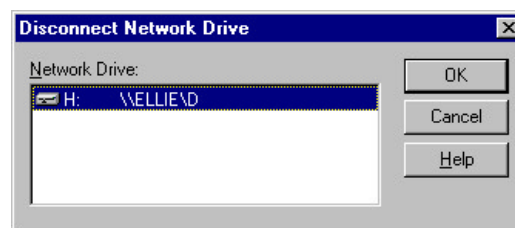

Fig. 18: Windows Explorer with a mapped network drive

By confirming all settings wit the OK button the remote drive is now available through the drive letter H: in the example shown in Fig. 18. From that moment on his letter will also appear in the "TS_Copy" utility allowing for a direct transfer from the container files system to the drive residing on the remote system.

If the network connection is no longer required the opposite command "disconnect net-work drive" is available. Otherwise the DVRG will reconnect upon every start-up.

Fig. 19: Disconnect a network drive in the Windows Explorer

6   Remote Control with the DVRG Commander

The utility DVRG Commander is part of the DVRG operating software, if a firmware release equal or higher than V1.21 is installed. To use it for remote operation purposes the single executable following file DVRG_Commander.exe has to be copied to the destination system.

The DVRG Commander is simply started by executing this "exe" file out of the Windows Explorer. It is always a good idea to create a desktop icon for easy starting of applications.

The DVRG Commander tries to establish connection to the DVRG that is

was used with before. If that fails and also typically if it is started for the first time, an error message like shown in Fig. 20 appears on the screen.

Fig. 20: DVRG Commander connection error upon

Occasionally it has been observed that this error message box is not appearing in the forefront of the desktop remaining hidden behind the opening image of the DVRG Commander and therefore invisible. In this case it has to be brought into the foreground by pressing the ALT- and TAB-keys a few times until it appears and it can be acknowledged.

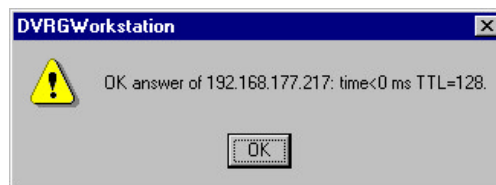By choosing the "Setup" item in the "Basefunction" menu the following dialog is opened:
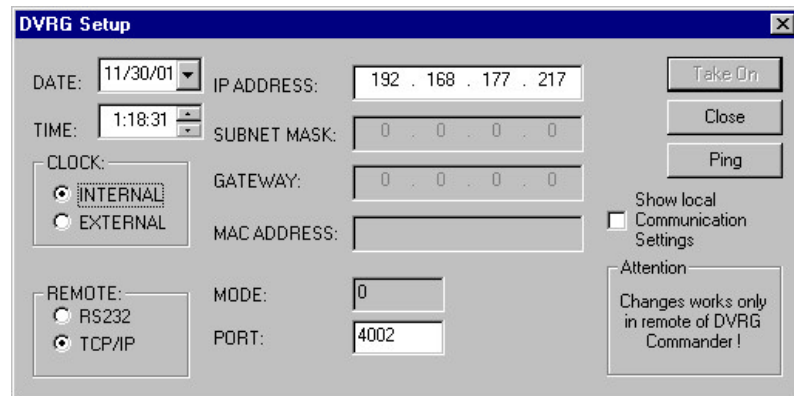
Fig. 21: Communication Set-up of the DVRG Commander.

To establish a proper connection port 4002 has to be addressed. Of course the considerations about TCP/IP addresses made in section 5 of that document are valid here as well.

The button "Ping" allows for an easy test of the remote connection to the remote host and shows the speed of the connection (Fig. 22).

Fig. 22: Ping command with the DVRG Commander

The "Ping" functionality can be used also for troubleshooting purposes. To permanently set the entries, the button "Apply" has to be used. After successfully establishing a connection, the window can be closed manually with the "Close" button.

In rare cases it has been found, that the DVRG Commander doesn't connect instantaneously leaving the operator unable to use the main interface (Fig. 23 on next page). It is advisable to close and reopen the DVRG Commander again in order to successfully establish connection then.
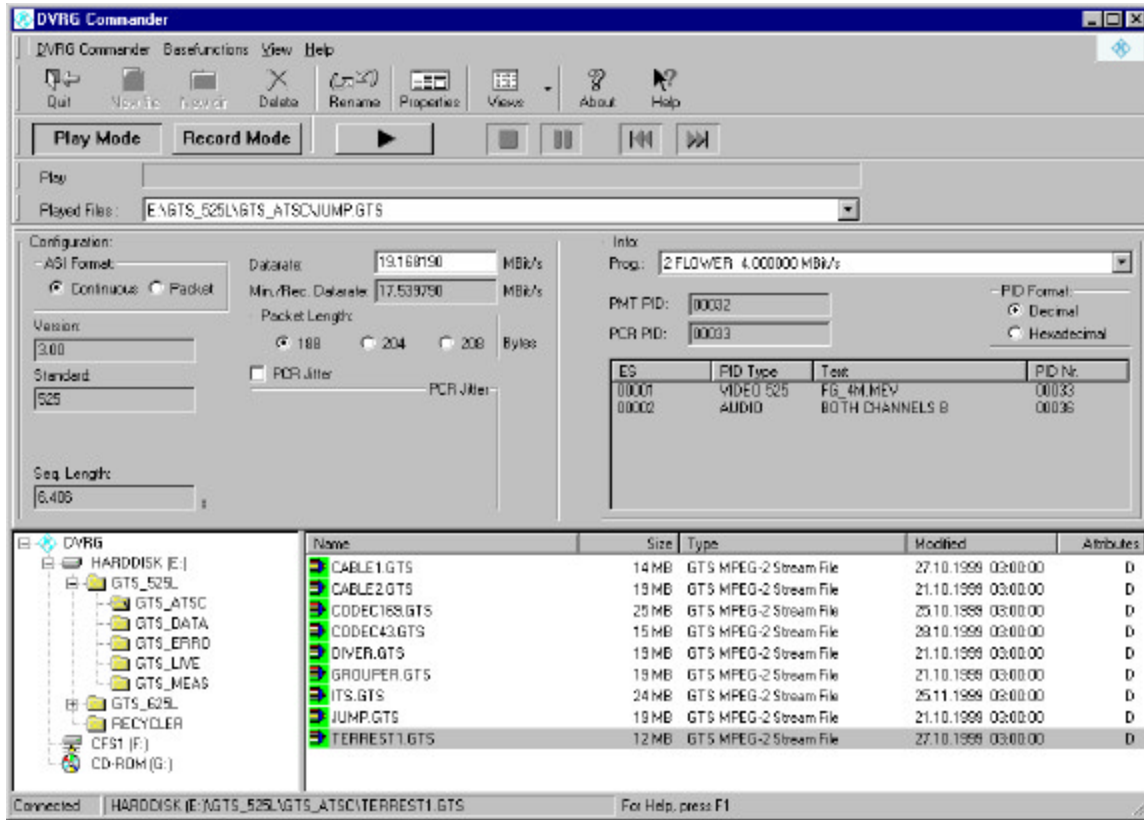
Fig. 23: User interface of the DVRG Commander

The usages of the DVRG Commander concerning the remote operations itself is rather self-explanatory and beyond the scope of that application note.

7   Troubleshooting

If a network connection cannot be established, the hardware connections and software settings have to be checked thoroughly according to the given instructions of sections 4 and 5. It is also advisable to re-boot all systems, although this may not explicitly be required during modification of individual settings.

When rebooting the DVRG it should be checked, that the DVRG is booting in the "Workstation" mode (see section 3 – Requirements)
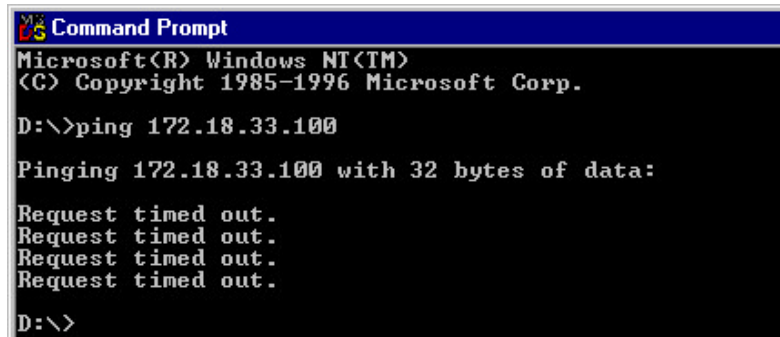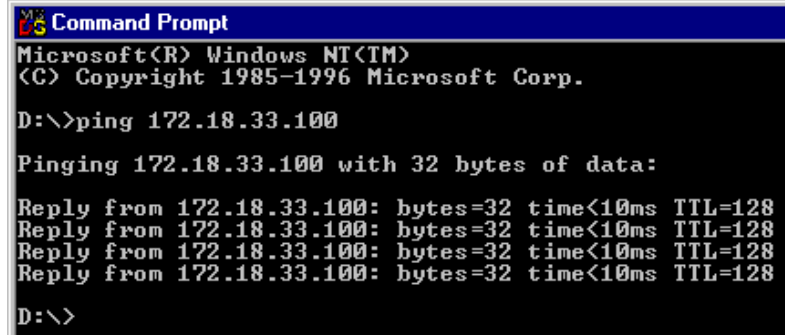

Fig. 24: Ping command with negative result due to missing network link

An easy way to check the basic network link is always the ping command in the MS-DOS prompt window. If the results are looking like in Fig. 24, the PC's are basically not able to communicate. If all cable connections are established, the network addresses themselves do not fit each other, the address masks do not match properly or the gateway address might be wrong or missing.

Fig. 25: Ping command to a system with an active network link

A proper network link will result in four responses to the ping command as shown in Fig. 25. If the remote system still doesn't show up in the Network Neighborhood window as in Fig. 16, the following issues have to be checked specifically:

➢ Network identification (according Fig.5, 6 and 7)

➢ File sharing on the remote system (according Fig. 10, 11 and 14)

➢ Client for Microsoft Networks not active (acc. Fig. 11)

8 Literature

DVRG Operating Manual	2083.1360.12
Application Note: Transfer of Video Stream Files on DTV Recorder Generator DVRG	7BM37_*E

9 Ordering Information

Rohde & Schwarz instrument	Type	Part number
DTV Recorder Generator DVRG	DVRG	2083.1302.02
Additional hard disk	DVRG-B2	2083.1919.03
SDI (ITU-R B.T. 601) record and play	DVRG-B4	2083.1948.02
Option CD-R R/W drive (DVD read only)	DVRG-B5	2083.1948.02
Option SMPTE310M interface	DVRG-B6	2083.1954.02

Non Rohde & Schwarz device	Manufacturer	Part number
Proconnect 2 port compact switch	Linksys	PS2KVMSK