RuggedDirector™

Version 1.0 User Guide

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RuggedDirector™ Version 1.0 User Guide

Serial redirection across IP networks for use with RuggedCom® RuggedServer™

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Preface

This guide documents RuggedCom's RuggedDirector™ serial redirection software utility which, in conjunction with RuggedCom RuggedServer™ networking products, extends the reach of traditional serial communications across IP networks.

Who Should Use RuggedDirector

This software is intended to be used by technical support personnel who are familiar with the operation of data networks and with the configuration and deployment of ROS®-based products in particular. Others who might find RuggedDirector useful are network and system planners and system programmers.

Document Conventions

This publication uses the following conventions:

Note

Means, "Reader take note". Notes contain helpful suggestions or references to materials not contained in this guide.

This document uses UTF-8 (Unicode) character encoding, and is available in both PDF and HTML formats.

More Information / Feedback

If you have questions or concerns about the contents of this guide or about the operation of RuggedDirector, please contact RuggedCom at `support@ruggedcom.com`.

Other documents of interest regarding RuggedCom equipment relevant to RuggedDirector are available at http://www.ruggedcom.com including:

- Rugged Operating System® (ROS®) User Guide
- RuggedSwitch® Installation Guide

Please check http://www.ruggedcom.com periodically for updates to RuggedDirector.

RuggedNMS™

RuggedNMS™ is a fully-featured enterprise grade network management software platform designed specifically for the rugged communications industry. RuggedNMS provides a comprehensive platform for monitoring, configuring, and maintaining mission-critical IP-based communications networks, such as those found in substation automation and “Smart Grids” for electric utilities, intelligent transportation systems, and advanced control and automation for industrial processes.

For more information on RuggedNMS™ please visit http://www.ruggednms.com.

1. Introduction to RuggedDirector™

1.1. Purpose

RuggedDirector™ is a software utility that creates virtual COM port-style serial device interfaces on computer systems running 32-bit Microsoft Windows XP or Microsoft Windows 7 operating systems. Each virtual serial port is connected across an IP network to a corresponding serial interface on a RuggedServer™ device.

Application software that ordinarily connects to a given device via local serial port hardware can thus be made to connect, transparently, to the same device via a remote ROS®-based RuggedServer serial server, located anywhere within reach of an IP network.

1.2. Features

- Transparent COM-port virtualization and redirection via IP.
- No application level support is necessary. RuggedDirector™ provides an application interface identical to that of hardware COM-ports.
- Compact, detailed main window displays a complete summary of all configured connections.
- Supports up to 128 simultaneous connections.
- Detailed port status, logging and tracing.
- Built-in knowledge of all models of RuggedCom RuggedServer™ assists in the configuration of multiple connections.
- Convenient telnet connection to serial server management interface.
- Background mode operation in System Tray.
- Access throughout the program to context-sensitive help.

1.3. Use Cases

Some common uses of RuggedDirector are:

- **Remote Monitoring / Control:** Serial devices may be controlled or monitored from computer systems at remote sites.
- **Consolidation / Centralization:** Multiple software applications running on a single central computer system can access serial devices at various remote sites across an IP network.

1.4. RuggedDirector™ Requirements

This section sets out the hardware, software, and networking environment required in order to correctly install and operate RuggedCom's RuggedDirector™ serial redirector application.

1.4.1. Installation / Operating Environment

The installation program contains the RuggedDirector application, integrated online help, PDF documentation, and all supporting software libraries required by the application. An Internet connection is not required to install and run RuggedDirector.

- RuggedDirector must be installed and run with administrative privileges on a computer running 32-bit Microsoft Windows XP or Microsoft Windows 7.
- The computer system must have a network card installed and configured to use TCP/IP and have a valid IPv4 address.
- Microsoft Internet Explorer is required to make use of the integrated help system.

1.4.2. Enabling Telnet In Windows 7

Microsoft Windows 7 disables telnet by default. The following steps enable telnet in Windows 7 in order to be able to take advantage of RuggedDirector's telnet connection feature:

1. Open the **Control Panel**.
2. Click on **Programs and Features**.
3. In **Programs and Features**, click on **Turn Windows features on or off**.
4. In the list of Windows features, check the box beside: "Telnet Client".
5. Click **OK**.

1.4.3. Privilege Level In Windows 7

Microsoft Windows 7 does not execute programs at the administrative privilege level by default. It is necessary to explicitly give administrative access to RuggedDirector for it to operate correctly. Perform the following steps to configure Windows 7 to run RuggedDirector with administrative privilege level:

1. Right-click on the RuggedDirector program icon (either the program icon itself, or a shortcut).
2. Click on **properties**.
3. Under the **compatibility** tab, in the **Privilege Level**section, check the "Run this program as administrator" option.
4. Click **OK** to complete the configuration.

1.4.4. Microsoft Windows Firewall

Depending on the settings of the network firewall built in to Microsoft Windows operating systems, a warning like the following one might be displayed when RuggedDirector attempts to make a network connection to a RuggedServer:

Figure 1.1. Windows Firewall Warning

If this warning is displayed, it is recommended to select Unblock in order that RuggedDirector may operate correctly.

2. User Interface

The RuggedDirector™ user interface centers on a main window, which displays all configured virtual serial port connections along with basic status and statistical information, along with commonly needed controls.

2.1. Main Window

The RuggedDirector™ main window is displayed after initialization:

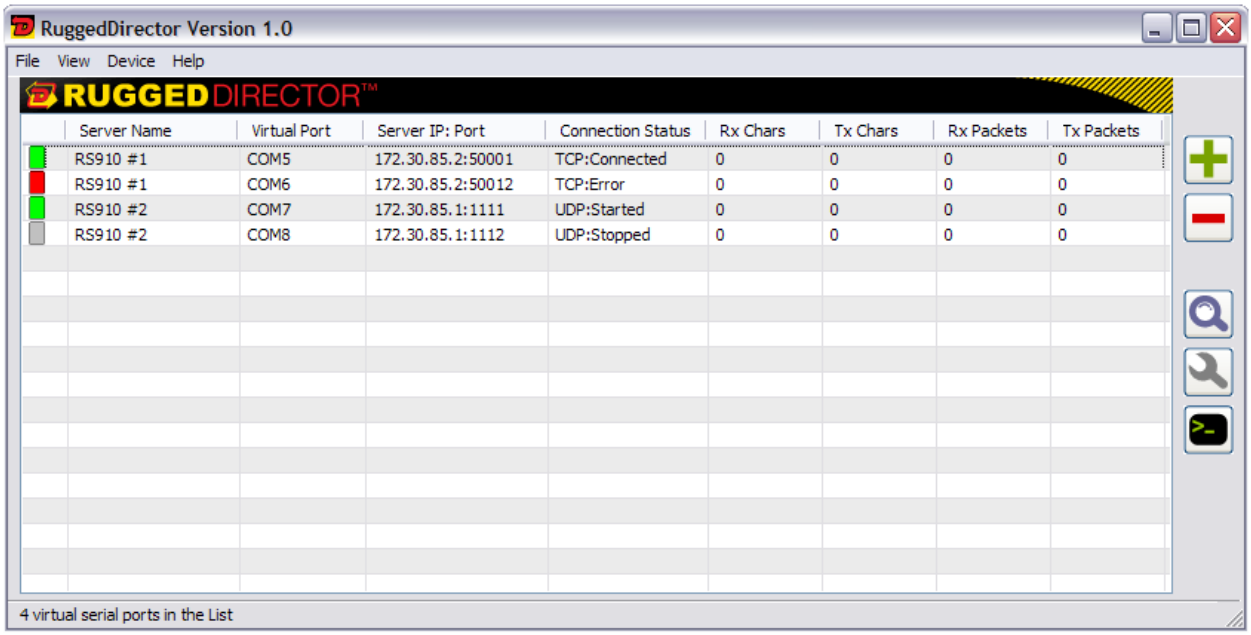


Figure 2.1. Main Window

The RuggedDirector main window consists of four main components:

- A series of columns summarizing key information.
- A column of navigational buttons on the right side of the window.
- A menu bar across the top of the window with a series of drop-down menus.
- A status bar along the bottom of the window, which displays context-sensitive program status.

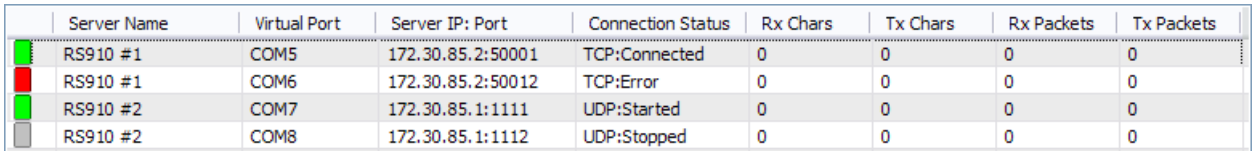
These components are described in detail in the following sections.

2.1.1. Connection Table

The main window display lists all the remote serial connections configured in RuggedDirector. The connection list may be customized in the following ways:

- **Sorting:** The entire display may be sorted on the basis of any one of the columns (including the Server IP:Port column). Clicking on a column title will sort the whole list in increasing order of the items in that column. Clicking again will sort in decreasing order.
- **Resizing:** Each column may be resized by clicking and dragging the rightmost edge of a column title.

2.1.2. Main Window Display Columns



	Server Name	Virtual Port	Server IP: Port	Connection Status	Rx Chars	Tx Chars	Rx Packets	Tx Packets
	RS910 #1	COM5	172.30.85.2:50001	TCP:Connected	0	0	0	0
	RS910 #1	COM6	172.30.85.2:50012	TCP:Error	0	0	0	0
	RS910 #2	COM7	172.30.85.1:1111	UDP:Started	0	0	0	0
	RS910 #2	COM8	172.30.85.1:1112	UDP:Stopped	0	0	0	0

Figure 2.2. Main Window Display Columns

RuggedDirector's main window displays configuration, status, and connection statistics for each serial redirector configuration entry. The columns displayed are:

Status Indicator The color of the indicator in the leftmost column represents the status of the corresponding connection, and changes in real time in response to changes in status. For more information on this feature, see the section on Color-coded Indicators.

Server Name The serial server name, to identify a particular connection. The name may be entered manually or generated automatically.

Virtual Port Virtual serial port number (e.g. COM5, COM6, etc.).

Server IP: Port The IP address and port number of the serial server to which the corresponding virtual serial port is redirected (e.g. 192.168.0.1:5555).

Connection Status The connection status represents the network connection between RuggedDirector and the corresponding serial server.

Rx Chars The number of bytes received via the virtual serial port.

Tx chars The number of bytes transmitted via the virtual serial port.

Rx Packets The number of packets received via the virtual serial port.

Tx Packets The number of packets transmitted via the virtual serial port.

2.1.2.1. Color-coded Indicators

An icon in the leftmost column of each entry displays the status of RuggedDirector's connection to the corresponding serial server:

- **Green** indicates that the connection is established and is ready to use.
- **Red** indicates that an error has occurred on this connection.
- **Gray** indicates that the connection is stopped or has not yet been started.

If the indicator is red, the status bar at the bottom of the window will display a brief explanation when the list item is clicked on.

The interpretation of the status indication varies slightly for TCP versus UDP connections.

TCP Connection Status Summary

Connected The corresponding virtual serial port connection has been started, RuggedDirector has successfully established a network connection with the RuggedServer and is ready to pass data on the virtual serial port.

Error An attempt to start the corresponding virtual serial port connection has been made, but RuggedDirector cannot connect to the specified serial server.

Stopped The corresponding virtual serial port connection has been stopped by the user.

UDP Connection Status Summary

Since UDP is not a connection-oriented protocol, the status of UDP-based virtual serial port connections must be reported differently.

Started The corresponding virtual serial port connection has been started, and RuggedDirector is able to reach the serial server via the network.

Error The corresponding virtual serial port connection has been started, and RuggedDirector is not able to reach the serial server via the network.

Stopped The corresponding virtual serial port connection has been stopped by the user.

2.1.2.2. Operations on Table Entries

Several operations and shortcuts are supported when clicking on individual list entries in the main window:

- **Clicking or Double-clicking** on an entry selects the entry.
- **Right-clicking** on an entry brings up the Right Mouse menu (note that all actions in the menu will apply to all currently highlighted entries rather than to only the entry that is being right-clicked).
- **Shift-clicking** on an entry selects a range of information between a previously clicked entry and the one currently being shift-clicked.
- **Ctrl-clicking** on an entry toggles the selection state of the corresponding item. This allows the detailed selection of a group, or of a discontinuous range.

Right Mouse Menu

The Right Mouse Menu, illustrated below, is accessed by right-clicking anywhere in the main window. Actions in this menu will apply to highlighted entries rather than only the entry that is being right-clicked.

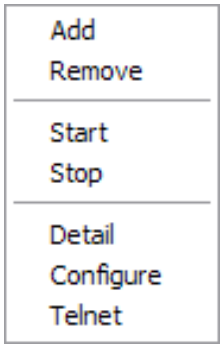


Figure 2.3. Right Mouse Menu

Add Add a virtual serial port configuration to the list via the **Add Virtual Port** dialog. For more information on this feature, see Section 2.2.1, “Add A Virtual Serial Port”.

Remove	Remove the selected virtual serial ports from the list.
Start	Enable bidirectional communication on the selected virtual serial port connection(s).
Stop	Disable bidirectional communication on the selected virtual serial port connection(s).
Detail	Display the Connection Monitor dialog for the selected device. For more information please see Section 2.2.3, “Connection Monitor”.
Configure	Display the configuration editor for the selected COM port. For more information see Section 2.2.2, “Configure A Serial Device”.
Telnet	Open a telnet session to the corresponding serial server's management interface.

2.1.3. Main Window Buttons

Five buttons are located in a column to the right of the main display window. These provide rapid and convenient access to the most commonly required functions of RuggedDirector. The buttons are described below.

- Add virtual serial ports - see **Add**, above.
- Remove virtual serial ports from a list - see **Remove**, above.
- Show COM port details - see **Detail**, above.
- Show the configuration editor - see **Configure**, above.
- Open a telnet session - see **Telnet**, above.

2.1.4. Main Window Menu Bar

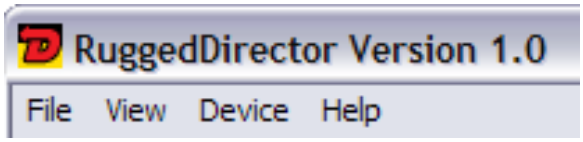


Figure 2.4. Main Menu Bar

The following sections describe the commands that are accessible from the main menu bar (pictured above) at the top of the main window.

File Menu

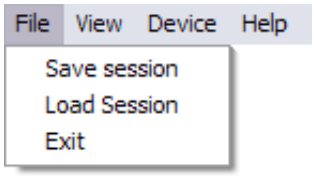


Figure 2.5. File Menu

Save session	Save the current configuration to a specified file.
Load session	Load a configuration from a specified file.
Exit	Terminate RuggedDirector.

View Menu

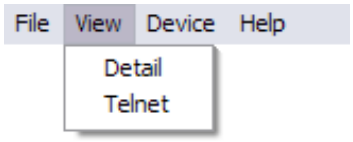


Figure 2.6. View Menu

Detail Display the Connection Monitor dialog for the selected virtual serial port. For more information, please see Section 2.2.3, “Connection Monitor”.

Telnet Open a telnet session to the selected serial server's management interface.

Device Menu

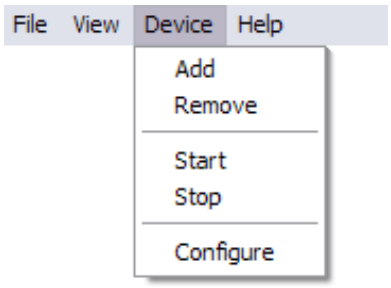


Figure 2.7. Device Menu

Add Add virtual serial ports to the list (bring up an Add Virtual Port dialog). For more information on this feature, see Section 2.2.1, “Add A Virtual Serial Port”.

Remove Remove the selected virtual serial ports from the list.

Start Enable bidirectional communication on the selected virtual serial port connection(s).

Stop Disable bidirectional communication on the selected virtual serial port connection(s).

Configure Show the configuration editor for the selected COM port. For more information on this feature, see the section on the Section 2.2.2, “Configure A Serial Device”.

Help Menu

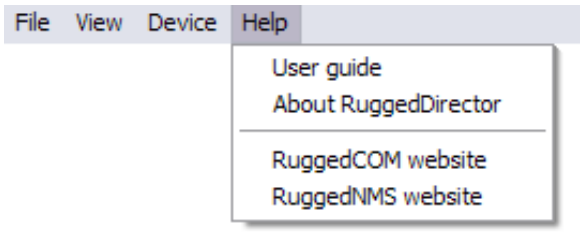


Figure 2.8. Help Menu

User guide Open the user guide for RuggedDirector.

About RuggedDirector	Shows the version number and support information.
RuggedCom website	Open the RuggedCom web site home page.
RuggedNMS website	Open the RuggedNMS web site home page.

2.2. Dialogs

The following sections describe in detail the three special-function dialog windows referred to from various places in the main interface window.

2.2.1. Add A Virtual Serial Port

This dialog is used to create a configuration set by specifying information for a remote RuggedServer, which may serve several serial port connections at once.

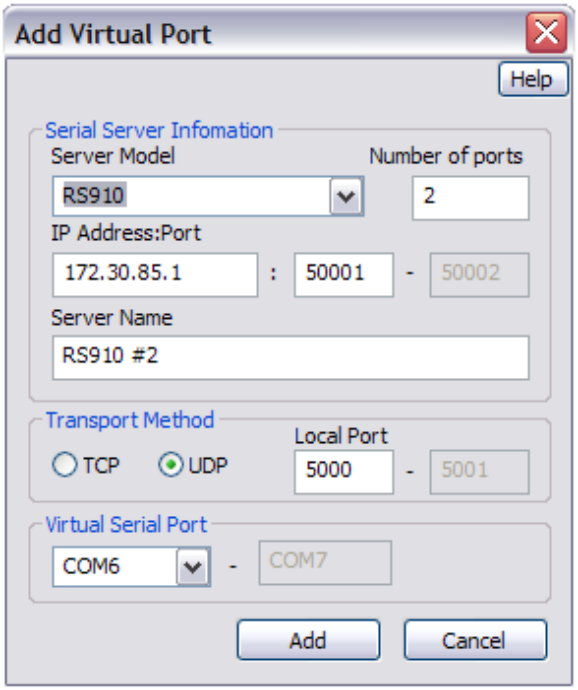


Figure 2.9. Add Virtual Serial Port Dialog

Server Model	The model of RuggedServer to connect to.
Number of ports	The number of ports to configure. This parameter is filled in automatically by RuggedDirector based on the RuggedServer model, but may be overridden.
IP Address:Port	The IP address and starting port number of the serial server. Note that the ending port number is generated based on the starting port and the total number to configure.
Server Name	A name that identifies a particular configuration. The name is generated automatically but may be overridden.
Transport Method	The IP protocol to use for connections in this configuration. Briefly, TCP guarantees delivery at the potential cost of increased latency, and UDP does not guarantee delivery, but can offer lower latency.

Local Port (UDP only)	The starting UDP port number of local (to RuggedDirector's system) connections to the serial server. Note that the ending port number is generated based on the starting port and the total number to configure. Note also that for TCP connections, this parameter is neither displayed nor needed.
Virtual Serial Port	The virtual system COM ports to create for this configuration. Note that the starting port is specified, and the remainder are automatically created incrementally, skipping any ports that may already have been allocated.
Add	Add the virtual serial port configuration to RuggedDirector.
Cancel	Cancel the operation.
Help	Display user guide information about the dialog.

Note

The number of ports that may be configured at a time is between one and the maximum serial port supported by the selected model of RuggedServer. The default IP port will be filled in after the server model is chosen. A unique name will be generated each time based on the server model and any existing configuration.

2.2.2. Configure A Serial Device

This dialog is used to modify the settings of an existing single configured connection.

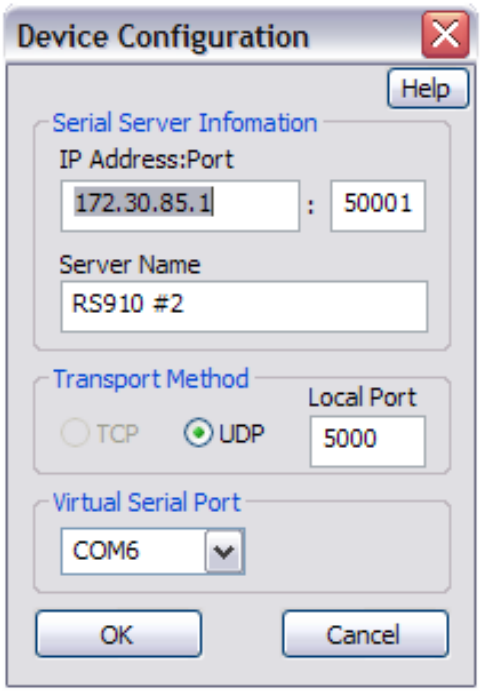


Figure 2.10. Configure Device Dialog

IP Address:Port	The IP address of the serial server and port number of the virtual serial port connection.
Server Name	A name that identifies the connection.

Transport Method	The IP protocol to use for connections in this configuration. Briefly, TCP guarantees delivery at the potential cost of increased latency, and UDP does not guarantee delivery, but can offer lower latency. Note that the transport method cannot be changed for an existing connection.
Virtual Serial Port	The virtual system COM ports to use for this connection.
OK	Save the configuration.
Cancel	Cancel the reconfiguration.
Help	Display user guide information about the dialog.

2.2.3. Connection Monitor

The Connection Monitor provides a comprehensive serial data "scope" for a selected connection which is updated in real time.

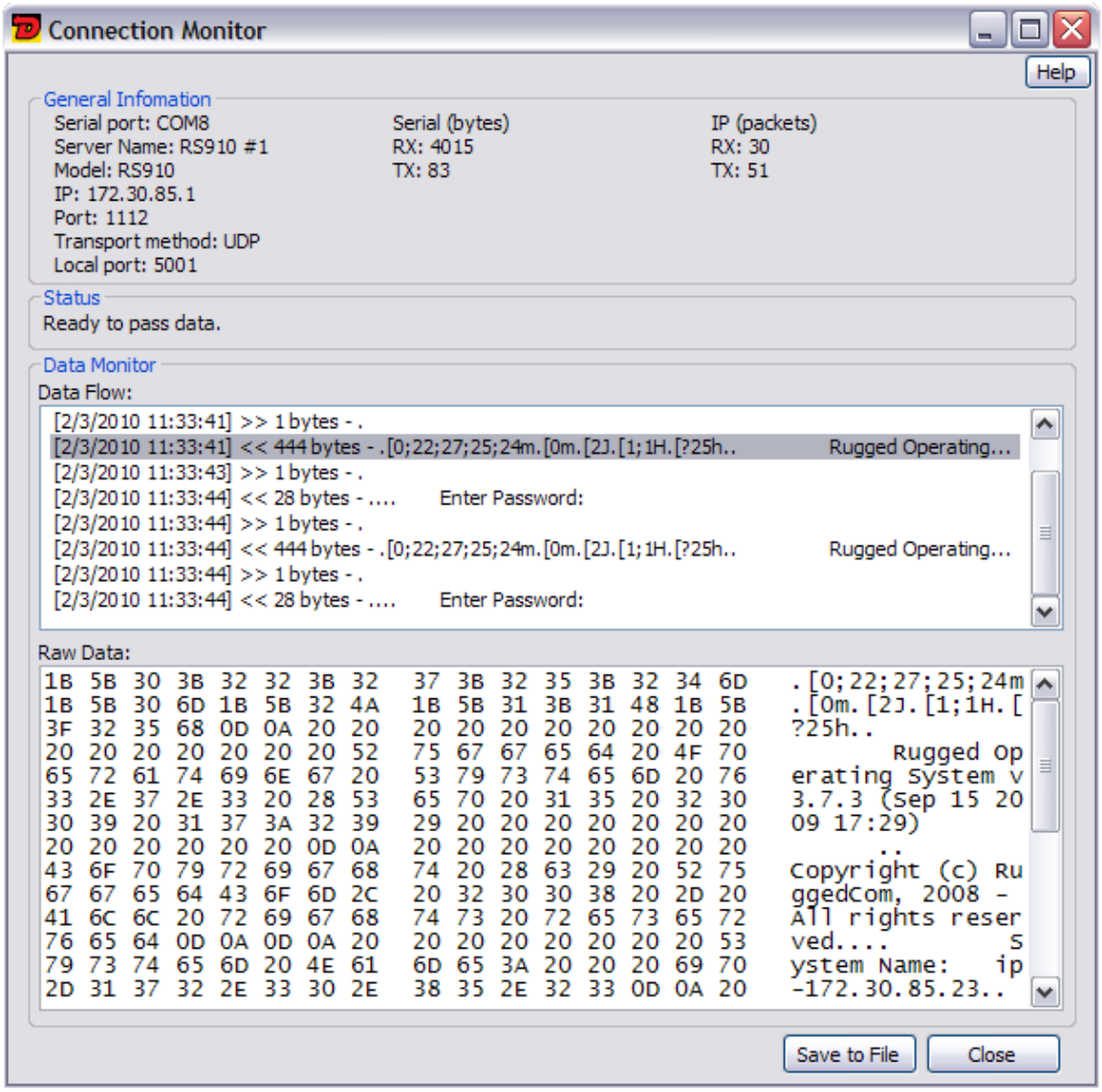


Figure 2.11. Connection Monitor Dialog

The buttons on the Connection Monitor dialog are:

Save to File	Save monitored data into a file.
Close	Close the window and suspend the monitor.
Help	Display user guide information about the dialog.

General Information

Serial port	Virtual serial port number (e.g. COM1, COM2, etc.).
Server Name	The serial server name.
Model	The model of RuggedServer connected to.
IP	The IP address of the serial server.
Port	The port number of the serial server connection.
Transport method	TCP or UDP
Local port (UDP only)	The local port number of the connection.
Serial (bytes), Rx	Number of bytes of serial data received.
Serial (bytes), Tx	Number of bytes of serial data transmitted.
IP (packets), Rx	Number of IP frames received.
IP (packets), Tx	Number of IP frames transmitted.
Status	The status of the virtual serial connection.

Data Monitor

Data Flow	A time-stamped listing of data transmitted and received on the virtual serial port connection. The time stamp is followed by either ">>" or "<<", respectively, for transmitted or received data. This is followed by the number of bytes in the exchange, and an ASCII string (possibly truncated so as to fit on one display line) of the actual data. Clicking on an entry causes the complete data of the exchange to be displayed in the **Raw Data** window.
Raw Data	Clicking on an entry in the **Data Flow** display causes the data of the entire selected exchange to be displayed in detail. Data are displayed in hexadecimal side-by-side with the corresponding ASCII representation.

3. Using RuggedDirector™

3.1. Configuring A New Virtual Serial Port Connection

In order to configure one or more virtual serial port connections between RuggedDirector and a RuggedServer™, one must first configure the RuggedServer to provide as many RawSocket connections as are required. Once these are configured, one may then configure RuggedDirector to connect to the RuggedServer ports.

Please refer to the ROS® User Guide for your RuggedServer for details on how to configure RawSocket connections. ROS User Guides for all models of RuggedServer may be found at http://www.ruggedcom.com/support/documents/.

The following information is needed at the RuggedServer in order to configure a RawSocket connection that may be connected to using RuggedDirector:

- RuggedServer serial port number(s)
- Connection method (TCP or UDP)
- RuggedDirector IP address
- TCP port number **or:**
- UDP port numbers at both RuggedServer and RuggedDirector ends

The ROS menu which is used to configure a RawSocket connection to a serial port on the RuggedServer is shown below for reference:

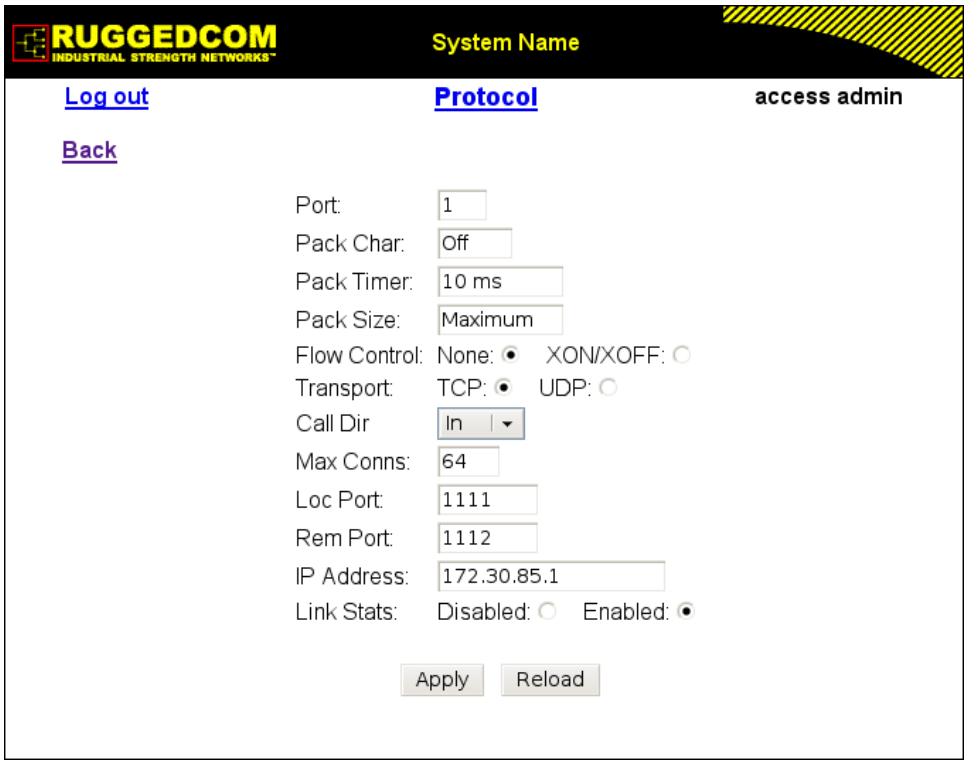


Figure 3.1. RuggedServer Raw Socket Protocol Configuration

The following information is needed at RuggedDirector in order to configure a virtual serial port connection to a RuggedServer:

- Starting COM port number
- Connection method (TCP or UDP)
- IP address / remote TCP port number **or:**
- IP address / local and remote UDP port numbers
- RuggedServer model

For detail on configuring a new connection or series of connections, please refer to Section 2.2.1, “Add A Virtual Serial Port”.

3.2. Multiple Connections To The Same Port

It is possible to connect several RuggedDirector virtual serial ports to the same serial port on a RuggedServer. It is important to set the **MaxConns** parameter for the RawSocket configuration (as seen in the figure above) to accept as many connections as are required.

3.3. Configuring Multiple Connections At Once

RuggedDirector will create virtual COM ports for as many serial ports as are supported by the model of RuggedServer being connected to. Any of these automatically created configuration entries may be modified afterwards. For example, RuggedDirector will create a configuration RS400 consisting of four serial ports. If only three connections are needed, the surplus one may be deleted.

In order for RuggedDirector's auto-configuration process to work, the following convention must be followed for the RuggedServer's own configuration. For all RuggedServer serial ports that are to be used with RuggedDirector:

- All of a given RuggedServer's serial ports must share the same IP address as the RuggedServer itself.
- The connection protocol (TCP or UDP) must be common to all ports.
- The TCP or UDP port numbers of each port must be in sequence.

A typical RuggedDirector / RuggedServer configuration is illustrated below:

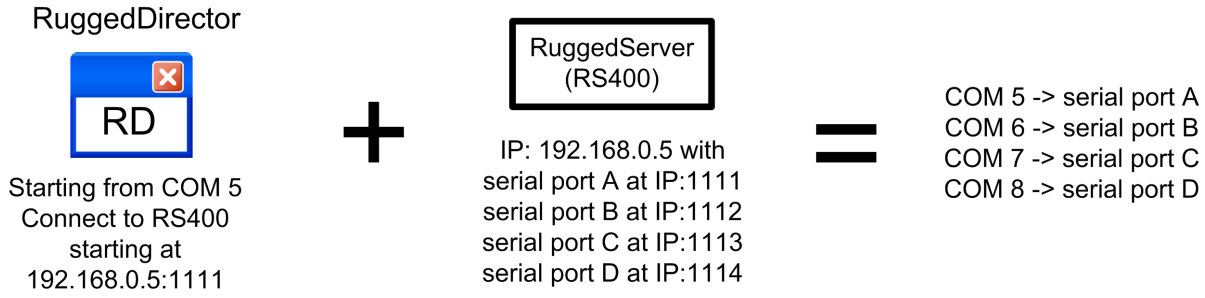


Figure 3.2. Add Range Configuration

Only currently unassigned COM ports will be displayed in the selection drop box. The auto-configuration process skips unavailable COM port numbers when creating a series of virtual ports. For

example, if the user wants to add three ports starting with COM5, but COM 7 and 8 are in use, then RuggedDirector will create configurations for COM5, COM6, and COM9. To remove an existing virtual port form the list, simply select the relevant line in the main window and press the remove button.

3.4. Serial Port Monitoring

RuggedDirector provides a data monitor for serial debugging purposes. The data monitor may be used to capture all serial traffic both transmitted and received and displays it in a scope-like user interface. Refer to Section 2.2.3, “Connection Monitor” for details.

3.5. Configuration Auto-Saving

Connections configured using RuggedDirector™ are persistent: configuration information is saved automatically at the time RuggedDirector is terminated[1], and is reloaded each time RuggedDirector is started.

[1]Configuration is usually saved explicitly via the **Save session** option. See Section 2.1.4, “File Menu” for details.

4. Theory Of Operation

This chapter describes the operation of RuggedDirector™ from a network perspective.

4.1. Principles Of Operation

RuggedDirector™ is capable of creating up to 128 virtual serial ports connected to ports on RuggedCom RuggedServer™ devices. Applications on the same system as RuggedDirector can use these virtual ports as though they were physical serial ports. No special configuration or modification is necessary to existing applications.

For each virtual serial port connection, RuggedDirector monitors data transmitted via the port by connected applications, and either encapsulates them in either UDP datagrams, or transmits them in a TCP stream, depending on the connection method specified at configuration time. The encapsulated data is received the RuggedServer at the other end of the TCP/IP or UDP/IP network connection, and transmitted via its configured physical serial port. The connection is bidirectional. Serial traffic originating at a serial device is received by the RuggedServer, transmitted via TCP or UDP to RuggedDirector, and forwarded to the serial application.

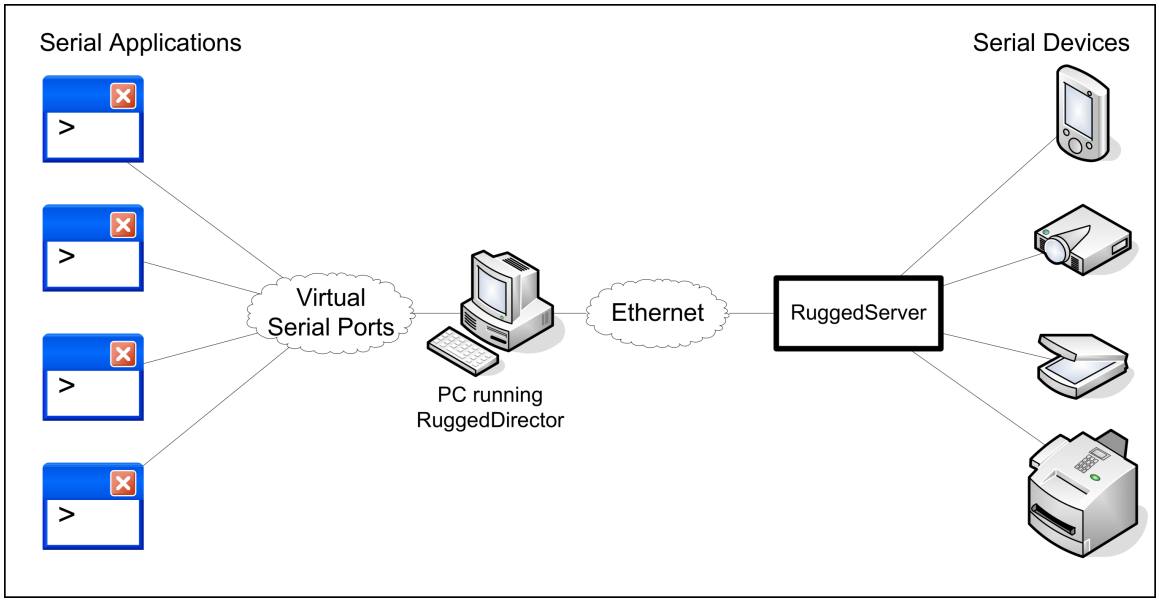


Figure 4.1. Principles Of Operation

4.2. Serial Control Signals

RuggedDirector will only support control signals locally (i.e. between RuggedDirector and connected applications). Only serial data is forwarded across the network. The full set of signals that RuggedDirector presents to an application connecting to one of its virtual serial ports is listed below:

Transmitted Data (TxD)	Binary data sent from the PC to the serial device.
Received Data (RxD)	Binary data received by the PC from the serial device.
Request To Send (RTS)	The serial application asserts the RTS signal in order to signal that it wishes to transmit data.

Clear To Send (CTS)	When a serial device (in this case, RuggedDirector) receives an RTS signal, it in turn asserts CTS back to the application, indicating that data can be transmitted. RuggedDirector does this unconditionally.
Data Terminal Ready (DTR)	Asserted by the PC to indicate that it is ready to be connected.
Data Set Ready (DSR)	Asserted by a serial device (in this case, RuggedDirector) to indicate that it is powered on and is ready to receive data from the PC.

RTS, CTS, DTR, DSR signals are only simulated locally between serial applications and RuggedDirector. These control signals will not be transmitted in either direction over the network. The figure below illustrates the serial signals.

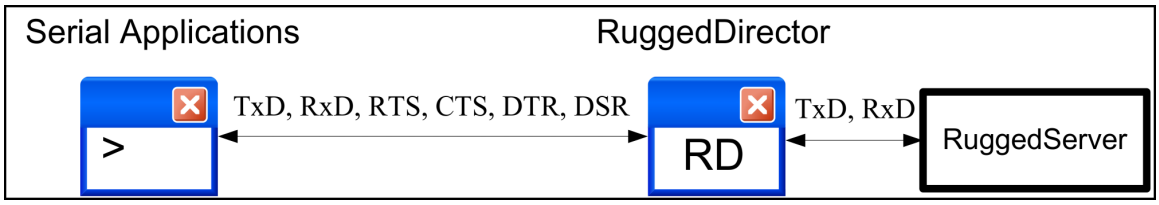


Figure 4.2. Serial Signals

Appendix A. Sample Trace File

```
RuggedDirector(TM)
Serial Trace

---General Infomation---
Serial port: COM5
Server Name: RS910 #1
Model: RS910
IP: 172.30.85.2
Port: 50001
Transport method: TCP

---Traffic Count---
Serial (bytes)
RX: 2822
TX: 26
IP (packets)
RX: 15
TX: 18

---Data---
[2/4/2010 9:47:20] >> 1 bytes
0D                                                .


[2/4/2010 9:47:21] << 432 bytes
1B 5B 30 3B 32 32 3B 32  37 3B 32 35 3B 32 34 6D   .[0;22;27;25;24m
1B 5B 30 6D 1B 5B 32 4A  1B 5B 31 3B 31 48 1B 5B   .[0m.[2J.[1;1H.[
3F 32 35 68 0D 0A 20 20  20 20 20 20 20 20 20 20   ?25h..
20 20 20 20 20 20 20 52  75 67 67 65 64 20 4F 70          Rugged Op
65 72 61 74 69 6E 67 20  53 79 73 74 65 6D 20 76   erating System v
33 2E 37 2E 33 20 28 53  65 70 20 31 35 20 32 30   3.7.3 (Sep 15 20
30 39 20 31 37 3A 32 39  29 20 20 20 20 20 20 20   09 17:29)
20 20 20 20 20 20 0D 0A  20 20 20 20 20 20 20 20         ..
43 6F 70 79 72 69 67 68  74 20 28 63 29 20 52 75   Copyright (c) Ru
67 67 65 64 43 6F 6D 2C  20 32 30 30 38 20 2D 20   ggedCom, 2008 -
41 6C 6C 20 72 69 67 68  74 73 20 72 65 73 65 72   All rights reser
76 65 64 0D 0A 0D 0A 20  20 20 20 20 20 20 20 53   ved....        S
79 73 74 65 6D 20 4E 61  6D 65 3A 20 20 20 50 41   ystem Name:   PA
53 53 30 31 0D 0A 20 20  20 20 20 20 20 20 4C 6F   SS01..        Lo
63 61 74 69 6F 6E 3A 20  20 20 20 20 20 4C 6F 63   cation:      Loc
61 74 69 6F 6E 0D 0A 20  20 20 20 20 20 20 20 43   ation..        C
6F 6E 74 61 63 74 3A 20  20 20 20 20 20 20 43 6F   ontact:       Co
6E 74 61 63 74 0D 0A 20  20 20 20 20 20 20 20 50   ntact..        P
72 6F 64 75 63 74 3A 20  20 20 20 20 20 20 52 53   roduct:       RS
39 30 30 4C 2D 48 49 44  2D 54 58 54 58 56 31 0D   900L-HID-TXTXV1.
0A 20 20 20 20 20 20 20  20 4D 41 43 20 41 64 64   .        MAC Add
72 65 73 73 3A 20 20 20  30 30 2D 30 41 2D 44 43   ress:   00-0A-DC
2D 30 30 2D 32 31 2D 37  33 0D 0A 20 20 20 20 20   -00-21-73..
20 20 20 53 65 72 69 61  6C 20 4E 75 6D 62 65 72      Serial Number
3A 20 52 53 39 30 30 4C  2D 30 35 30 37 2D 30 30   : RS900L-0507-00
```

```
31 39 0D 0A 0D 0A 20 20  20 20 20 20 20 20 45 6E   19....        En
74 65 72 20 55 73 65 72  20 4E 61 6D 65 3A 20 20   ter User Name:


[2/4/2010 9:47:30] >> 1 bytes
61                                                 a


[2/4/2010 9:47:30] << 1 bytes
61                                                 a


[2/4/2010 9:47:31] >> 2 bytes
64 6D                                              dm


[2/4/2010 9:47:31] >> 1 bytes
69                                                 i


[2/4/2010 9:47:31] >> 1 bytes
6E                                                 n


[2/4/2010 9:47:33] << 4 bytes
64 6D 69 6E                                        dmin


[2/4/2010 9:47:34] >> 1 bytes
0D                                                 .


[2/4/2010 9:47:35] << 28 bytes
0D 0A 0D 0A 20 20 20 20  20 20 20 20 45 6E 74 65   ....        Ente
72 20 50 61 73 73 77 6F  72 64 3A 20               r Password:


[2/4/2010 9:47:35] >> 1 bytes
61                                                 a


[2/4/2010 9:47:35] << 1 bytes
78                                                 x


[2/4/2010 9:47:35] >> 1 bytes
64                                                 d


[2/4/2010 9:47:35] >> 1 bytes
6D                                                 m


[2/4/2010 9:47:35] << 1 bytes
```

```
78                                                  x


[2/4/2010 9:47:35] << 1 bytes
78                                                  x


[2/4/2010 9:47:36] >> 1 bytes
69                                                  i


[2/4/2010 9:47:36] >> 1 bytes
6E                                                  n


[2/4/2010 9:47:36] << 1 bytes
78                                                  x


[2/4/2010 9:47:36] << 1 bytes
78                                                  x


[2/4/2010 9:47:36] >> 1 bytes
0D                                                  .


[2/4/2010 9:47:37] << 1132 bytes
1B 5B 30 6D 1B 5B 31 3B  30 48 1B 5B 32 4B 1B 5B   .[0m.[1;0H.[2K.[
30 3B 32 32 3B 32 37 3B  32 35 3B 32 34 6D 1B 5B   0;22;27;25;24m.[
31 3B 31 48 1B 5B 3F 32  35 6C 50 41 53 53 30 31   1;1H.[?25lPASS01
1B 5B 30 3B 32 32 3B 32  37 3B 32 35 3B 32 34 6D   .[0;22;27;25;24m
1B 5B 31 3B 33 35 48 4D  61 69 6E 20 4D 65 6E 75   .[1;35HMain Menu
1B 5B 30 3B 32 32 3B 32  37 3B 32 35 3B 32 34 6D   .[0;22;27;25;24m
1B 5B 31 3B 36 35 48 20  20 20 61 64 6D 69 6E 20   .[1;65H   admin
61 63 63 65 73 73 1B 5B  3F 32 35 6C 1B 5B 30 6D   access.[?25l.[0m
1B 5B 32 3B 30 48 1B 5B  32 4B 1B 5B 33 3B 30 48   .[2;0H.[2K.[3;0H
1B 5B 32 4B 1B 5B 34 3B  30 48 1B 5B 32 4B 1B 5B   .[2K.[4;0H.[2K.[
35 3B 30 48 1B 5B 32 4B  1B 5B 36 3B 30 48 1B 5B   5;0H.[2K.[6;0H.[
32 4B 1B 5B 37 3B 30 48  1B 5B 32 4B 1B 5B 38 3B   2K.[7;0H.[2K.[8;
30 48 1B 5B 32 4B 1B 5B  39 3B 30 48 1B 5B 32 4B   0H.[2K.[9;0H.[2K
1B 5B 31 30 3B 30 48 1B  5B 32 4B 1B 5B 31 31 3B   .[10;0H.[2K.[11;
30 48 1B 5B 32 4B 1B 5B  31 32 3B 30 48 1B 5B 32   0H.[2K.[12;0H.[2
4B 1B 5B 31 33 3B 30 48  1B 5B 32 4B 1B 5B 31 34   K.[13;0H.[2K.[14
3B 30 48 1B 5B 32 4B 1B  5B 31 35 3B 30 48 1B 5B   ;0H.[2K.[15;0H.[
32 4B 1B 5B 31 36 3B 30  48 1B 5B 32 4B 1B 5B 31   2K.[16;0H.[2K.[1
37 3B 30 48 1B 5B 32 4B  1B 5B 31 38 3B 30 48 1B   7;0H.[2K.[18;0H.
5B 32 4B 1B 5B 31 39 3B  30 48 1B 5B 32 4B 1B 5B   [2K.[19;0H.[2K.[
32 30 3B 30 48 1B 5B 32  4B 1B 5B 32 31 3B 30 48   20;0H.[2K.[21;0H
1B 5B 32 4B 1B 5B 32 32  3B 30 48 1B 5B 32 4B 1B   .[2K.[22;0H.[2K.
5B 32 33 3B 30 48 1B 5B  32 4B 1B 5B 32 34 3B 30   [23;0H.[2K.[24;0
48 1B 5B 32 4B 1B 5B 30  3B 32 32 3B 32 37 3B 32   H.[2K.[0;22;27;2
35 3B 32 34 6D 1B 5B 34  3B 33 30 48 41 64 6D 69   5;24m.[4;30HAdmi
6E 69 73 74 72 61 74 69  6F 6E 1B 5B 30 3B 32 32   nistration.[0;22
```

```
3B 32 37 3B 32 35 3B 32  34 6D 1B 5B 35 3B 33 30   ;27;25;24m.[5;30
48 45 74 68 65 72 6E 65  74 20 50 6F 72 74 73 1B   HEthernet Ports.
5B 30 3B 32 32 3B 32 37  3B 32 35 3B 32 34 6D 1B   [0;22;27;25;24m.
5B 36 3B 33 30 48 45 74  68 65 72 6E 65 74 20 53   [6;30HEthernet S
74 61 74 73 1B 5B 30 3B  32 32 3B 37 3B 32 35 3B   tats.[0;22;7;25;
32 34 6D 1B 5B 37 3B 33  30 48 4C 69 6E 6B 20 41   24m.[7;30HLink A
67 67 72 65 67 61 74 69  6F 6E 1B 5B 30 3B 32 32   ggregation.[0;22
3B 32 37 3B 32 35 3B 32  34 6D 1B 5B 38 3B 33 30   ;27;25;24m.[8;30
48 53 70 61 6E 6E 69 6E  67 20 54 72 65 65 1B 5B   HSpanning Tree.[
30 3B 32 32 3B 32 37 3B  32 35 3B 32 34 6D 1B 5B   0;22;27;25;24m.[
39 3B 33 30 48 56 69 72  74 75 61 6C 20 4C 41 4E   9;30HVirtual LAN
73 1B 5B 30 3B 32 32 3B  32 37 3B 32 35 3B 32 34   s.[0;22;27;25;24
6D 1B 5B 31 30 3B 33 30  48 50 6F 72 74 20 53 65   m.[10;30HPort Se
63 75 72 69 74 79 1B 5B  30 3B 32 32 3B 32 37 3B   curity.[0;22;27;
32 35 3B 32 34 6D 1B 5B  31 31 3B 33 30 48 43 6C   25;24m.[11;30HCl
61 73 73 65 73 20 6F 66  20 53 65 72 76 69 63 65   asses of Service
1B 5B 30 3B 32 32 3B 32  37 3B 32 35 3B 32 34 6D   .[0;22;27;25;24m
1B 5B 31 32 3B 33 30 48  4D 75 6C 74 69 63 61 73   .[12;30HMulticas
74 20 46 69 6C 74 65 72  69 6E 67 1B 5B 30 3B 32   t Filtering.[0;2
32 3B 32 37 3B 32 35 3B  32 34 6D 1B 5B 31 33 3B   2;27;25;24m.[13;
33 30 48 4D 41 43 20 41  64 64 72 65 73 73 20 54   30HMAC Address T
61 62 6C 65 73 1B 5B 30  3B 32 32 3B 32 37 3B 32   ables.[0;22;27;2
35 3B 32 34 6D 1B 5B 31  34 3B 33 30 48 4E 65 74   5;24m.[14;30HNet
77 6F 72 6B 20 44 69 73  63 6F 76 65 72 79 1B 5B   work Discovery.[
30 3B 32 32 3B 32 37 3B  32 35 3B 32 34 6D 1B 5B   0;22;27;25;24m.[
31 35 3B 33 30 48 44 69  61 67 6E 6F 73 74 69 63   15;30HDiagnostic
73 1B 5B 30 3B 31 3B 32  37 3B 32 35 3B 34 6D 1B   s.[0;1;27;25;4m.
5B 32 34 3B 31 48 3C 43  54 52 4C 3E 1B 5B 30 3B   [24;1H<CTRL>.[0;
32 32 3B 32 37 3B 32 35  3B 32 34 6D 20 20 1B 5B   22;27;25;24m  .[
30 3B 31 3B 32 37 3B 32  35 3B 34 6D 5A 2D 48 65   0;1;27;25;4mZ-He
6C 70 1B 5B 30 3B 32 32  3B 32 37 3B 32 35 3B 32   lp.[0;22;27;25;2
34 6D 20 1B 5B 30 3B 31  3B 32 37 3B 32 35 3B 34   4m .[0;1;27;25;4
6D 53 2D 53 68 65 6C 6C  1B 5B 30 3B 32 32 3B 32   mS-Shell.[0;22;2
37 3B 32 35 3B 32 34 6D  20 1B 5B 30 3B 31 3B 32   7;25;24m .[0;1;2
37 3B 32 35 3B 34 6D 58  2D 4C 6F 67 6F 75 74 1B   7;25;4mX-Logout.
5B 30 3B 32 32 3B 32 37  3B 32 35 3B 32 34 6D 20   [0;22;27;25;24m
1B 5B 30 6D 1B 5B 30 4B  1B 5B 30 6D 1B 5B 31 3B   .[0m.[0K.[0m.[1;
30 48 1B 5B 32 4B 1B 5B  30 3B 32 32 3B 32 37 3B   0H.[2K.[0;22;27;
32 35 3B 32 34 6D 1B 5B  31 3B 31 48 1B 5B 3F 32   25;24m.[1;1H.[?2
35 6C 50 41 53 53 30 31  1B 5B 30 3B 32 32 3B 32   5lPASS01.[0;22;2
37 3B 32 35 3B 32 34 6D  1B 5B 31 3B 33 35 48 4D   7;25;24m.[1;35HM
61 69 6E 20 4D 65 6E 75  1B 5B 30 3B 32 32 3B 32   ain Menu.[0;22;2
37 3B 35 3B 32 34 6D 1B  5B 30 3B 32 32 3B 32 37   7;5;24m.[0;22;27
3B 35 3B 32 34 6D 1B 5B  31 3B 36 35 48 20 20 20   ;5;24m.[1;65H
20 20 20 34 20 41 4C 41  52 4D 53 21                  4 ALARMS!


[2/4/2010 9:47:38] >> 3 bytes
1B 5B 41                                           .[A


[2/4/2010 9:47:38] >> 3 bytes
1B 5B 41                                           .[A
```

```
[2/4/2010 9:47:38] << 75 bytes
1B 5B 30 3B 32 32 3B 32  37 3B 32 35 3B 32 34 6D   .[0;22;27;25;24m
1B 5B 37 3B 33 30 48 4C  69 6E 6B 20 41 67 67 72   .[7;30HLink Aggr
65 67 61 74 69 6F 6E 1B  5B 30 3B 32 32 3B 37 3B   egation.[0;22;7;
32 35 3B 32 34 6D 1B 5B  36 3B 33 30 48 45 74 68   25;24m.[6;30HEth
65 72 6E 65 74 20 53 74  61 74 73                  ernet Stats


[2/4/2010 9:47:38] >> 3 bytes
1B 5B 41                                           .[A


[2/4/2010 9:47:38] << 73 bytes
1B 5B 30 3B 32 32 3B 32  37 3B 32 35 3B 32 34 6D   .[0;22;27;25;24m
1B 5B 36 3B 33 30 48 45  74 68 65 72 6E 65 74 20   .[6;30HEthernet
53 74 61 74 73 1B 5B 30  3B 32 32 3B 37 3B 32 35   Stats.[0;22;7;25
3B 32 34 6D 1B 5B 35 3B  33 30 48 45 74 68 65 72   ;24m.[5;30HEther
6E 65 74 20 50 6F 72 74  73                        net Ports


[2/4/2010 9:47:38] >> 3 bytes
1B 5B 41                                           .[A


[2/4/2010 9:47:39] << 73 bytes
1B 5B 30 3B 32 32 3B 32  37 3B 32 35 3B 32 34 6D   .[0;22;27;25;24m
1B 5B 35 3B 33 30 48 45  74 68 65 72 6E 65 74 20   .[5;30HEthernet
50 6F 72 74 73 1B 5B 30  3B 32 32 3B 37 3B 32 35   Ports.[0;22;7;25
3B 32 34 6D 1B 5B 34 3B  33 30 48 41 64 6D 69 6E   ;24m.[4;30HAdmin
69 73 74 72 61 74 69 6F  6E                        istration


[2/4/2010 9:47:39] << 71 bytes
1B 5B 30 3B 32 32 3B 32  37 3B 32 35 3B 32 34 6D   .[0;22;27;25;24m
1B 5B 34 3B 33 30 48 41  64 6D 69 6E 69 73 74 72   .[4;30HAdministr
61 74 69 6F 6E 1B 5B 30  3B 32 32 3B 37 3B 32 35   ation.[0;22;7;25
3B 32 34 6D 1B 5B 31 35  3B 33 30 48 44 69 61 67   ;24m.[15;30HDiag
6E 6F 73 74 69 63 73                               nostics


[2/4/2010 9:47:39] >> 1 bytes
0D                                                 .


[2/4/2010 9:47:39] << 928 bytes
1B 5B 3F 32 35 6C 1B 5B  30 6D 1B 5B 32 3B 30 48   .[?25l.[0m.[2;0H
1B 5B 32 4B 1B 5B 33 3B  30 48 1B 5B 32 4B 1B 5B   .[2K.[3;0H.[2K.[
34 3B 30 48 1B 5B 32 4B  1B 5B 35 3B 30 48 1B 5B   4;0H.[2K.[5;0H.[
32 4B 1B 5B 36 3B 30 48  1B 5B 32 4B 1B 5B 37 3B   2K.[6;0H.[2K.[7;
30 48 1B 5B 32 4B 1B 5B  38 3B 30 48 1B 5B 32 4B   0H.[2K.[8;0H.[2K
1B 5B 39 3B 30 48 1B 5B  32 4B 1B 5B 31 30 3B 30   .[9;0H.[2K.[10;0
48 1B 5B 32 4B 1B 5B 31  31 3B 30 48 1B 5B 32 4B   H.[2K.[11;0H.[2K
1B 5B 31 32 3B 30 48 1B  5B 32 4B 1B 5B 31 33 3B   .[12;0H.[2K.[13;
```

```
30 48 1B 5B 32 4B 1B 5B  31 34 3B 30 48 1B 5B 32   0H.[2K.[14;0H.[2
4B 1B 5B 31 35 3B 30 48  1B 5B 32 4B 1B 5B 31 36   K.[15;0H.[2K.[16
3B 30 48 1B 5B 32 4B 1B  5B 31 37 3B 30 48 1B 5B   ;0H.[2K.[17;0H.[
32 4B 1B 5B 31 38 3B 30  48 1B 5B 32 4B 1B 5B 31   2K.[18;0H.[2K.[1
39 3B 30 48 1B 5B 32 4B  1B 5B 32 30 3B 30 48 1B   9;0H.[2K.[20;0H.
5B 32 4B 1B 5B 32 31 3B  30 48 1B 5B 32 4B 1B 5B   [2K.[21;0H.[2K.[
32 32 3B 30 48 1B 5B 32  4B 1B 5B 32 33 3B 30 48   22;0H.[2K.[23;0H
1B 5B 32 4B 1B 5B 32 34  3B 30 48 1B 5B 32 4B 1B   .[2K.[24;0H.[2K.
5B 30 3B 32 32 3B 37 3B  32 35 3B 32 34 6D 1B 5B   [0;22;7;25;24m.[
34 3B 32 38 48 43 6F 6E  66 69 67 75 72 65 20 41   4;28HConfigure A
6C 61 72 6D 73 1B 5B 30  3B 32 32 3B 32 37 3B 32   larms.[0;22;27;2
35 3B 32 34 6D 1B 5B 35  3B 32 38 48 56 69 65 77   5;24m.[5;28HView
20 4C 61 74 63 68 65 64  20 41 6C 61 72 6D 73 1B    Latched Alarms.
5B 30 3B 32 32 3B 32 37  3B 32 35 3B 32 34 6D 1B   [0;22;27;25;24m.
5B 36 3B 32 38 48 43 6C  65 61 72 20 4C 61 74 63   [6;28HClear Latc
68 65 64 20 41 6C 61 72  6D 73 1B 5B 30 3B 32 32   hed Alarms.[0;22
3B 32 37 3B 32 35 3B 32  34 6D 1B 5B 37 3B 32 38   ;27;25;24m.[7;28
48 56 69 65 77 20 53 79  73 74 65 6D 20 4C 6F 67   HView System Log
1B 5B 30 3B 32 32 3B 32  37 3B 32 35 3B 32 34 6D   .[0;22;27;25;24m
1B 5B 38 3B 32 38 48 43  6C 65 61 72 20 53 79 73   .[8;28HClear Sys
74 65 6D 20 4C 6F 67 1B  5B 30 3B 32 32 3B 32 37   tem Log.[0;22;27
3B 32 35 3B 32 34 6D 1B  5B 39 3B 32 38 48 56 69   ;25;24m.[9;28HVi
65 77 20 43 50 55 20 44  69 61 67 6E 6F 73 74 69   ew CPU Diagnosti
63 73 1B 5B 30 3B 32 32  3B 32 37 3B 32 35 3B 32   cs.[0;22;27;25;2
34 6D 1B 5B 31 30 3B 32  38 48 56 69 65 77 20 50   4m.[10;28HView P
72 6F 64 75 63 74 20 49  6E 66 6F 72 6D 61 74 69   roduct Informati
6F 6E 1B 5B 30 3B 32 32  3B 32 37 3B 32 35 3B 32   on.[0;22;27;25;2
34 6D 1B 5B 31 31 3B 32  38 48 4C 6F 61 64 20 46   4m.[11;28HLoad F
61 63 74 6F 72 79 20 44  65 66 61 75 6C 74 73 1B   actory Defaults.
5B 30 3B 32 32 3B 32 37  3B 32 35 3B 32 34 6D 1B   [0;22;27;25;24m.
5B 31 32 3B 32 38 48 52  65 73 65 74 20 44 65 76   [12;28HReset Dev
69 63 65 1B 5B 30 3B 31  3B 32 37 3B 32 35 3B 34   ice.[0;1;27;25;4
6D 1B 5B 32 34 3B 31 48  3C 43 54 52 4C 3E 1B 5B   m.[24;1H<CTRL>.[
30 3B 32 32 3B 32 37 3B  32 35 3B 32 34 6D 20 20   0;22;27;25;24m
1B 5B 30 3B 31 3B 32 37  3B 32 35 3B 34 6D 5A 2D   .[0;1;27;25;4mZ-
48 65 6C 70 1B 5B 30 3B  32 32 3B 32 37 3B 32 35   Help.[0;22;27;25
3B 32 34 6D 20 1B 5B 30  3B 31 3B 32 37 3B 32 35   ;24m .[0;1;27;25
3B 34 6D 53 2D 53 68 65  6C 6C 1B 5B 30 3B 32 32   ;4mS-Shell.[0;22
3B 32 37 3B 32 35 3B 32  34 6D 20 1B 5B 30 3B 31   ;27;25;24m .[0;1
3B 32 37 3B 32 35 3B 34  6D 58 2D 4C 6F 67 6F 75   ;27;25;4mX-Logou
74 1B 5B 30 3B 32 32 3B  32 37 3B 32 35 3B 32 34   t.[0;22;27;25;24
6D 20 1B 5B 30 6D 1B 5B  30 4B 1B 5B 30 6D 1B 5B   m .[0m.[0K.[0m.[
31 3B 30 48 1B 5B 32 4B  1B 5B 30 3B 32 32 3B 32   1;0H.[2K.[0;22;2
37 3B 32 35 3B 32 34 6D  1B 5B 31 3B 31 48 1B 5B   7;25;24m.[1;1H.[
3F 32 35 6C 50 41 53 53  30 31 1B 5B 30 3B 32 32   ?25lPASS01.[0;22
3B 32 37 3B 32 35 3B 32  34 6D 1B 5B 31 3B 33 34   ;27;25;24m.[1;34
48 44 69 61 67 6E 6F 73  74 69 63 73 1B 5B 30 3B   HDiagnostics.[0;
32 32 3B 32 37 3B 35 3B  32 34 6D 1B 5B 30 3B 32   22;27;5;24m.[0;2
32 3B 32 37 3B 35 3B 32  34 6D 1B 5B 31 3B 36 35   2;27;5;24m.[1;65
48 20 20 20 20 20 20 34  20 41 4C 41 52 4D 53 21   H      4 ALARMS!
```

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B.3.1.

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B.3.3.

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B.4.1.

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B.4.1.1.

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B.4.1.2.

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B.4.2.

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B.5.1. Indemnification in favour of yourself

B.5.1.1.

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