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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

Express Mail Label No.: EV775732241US

INVENTORS

Inventor Name	Residence (City and either State or Foreign Country)
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Additional inventors are being named on the 1 separately numbered sheet attached hereto

TITLE OF THE INVENTION (280 characters maximum)

METHOD OAND APPARATUS FOR CONFIGURING DOCSIS LOGICAL CHANNELS

CORRESPONDENCE ADDRESS

Direct all correspondence to:

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OR

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Address					
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ENCLOSED APPLICATION PARTS (*check all that apply*)

- ☒ Specification Pages — Number of Pages 24
- ☐ CD(s), Number
- ☐ Drawings — Number of Sheets
- ☐ Other (specify)
- ☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

- ☐ Applicant claims small entity status. See 37 CFR 1.27.
- ☐ A check or money order is enclosed to cover the filing fees

Filing Fee Amount ($)

- ☒ The Director is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: **502117**. A Fee Transmittal in duplicate is attached. — $200.00
- ☐ Payment by credit card. Form PTO-2038 is attached.

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

- ☒ No.
- ☐ Yes, the name of the U.S. Government agency and the Government contract number are:

Respectfully submitted, Date March 24, 2006

SIGNATURE

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Docket Number: BCS04219

PROVISIONAL APPLICATION COVER SHEET
Additional Page

Docket Number: BCS04219

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Number 2 of 2

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1 Document Overview

This document defines the feature requirements for a standalone PC application program to be used to enhance the functionality of the BSR64k DOCSIS CMTS.

1.1 Audience

The document should be usable by:

- Development engineers who will design, implement, and test features
- Test engineers who will test this feature in the system
- Sustaining engineers
- Applications and service engineers
- Technical publications and training personnel
- Marketing planners and managers

1.2 Scope

This document will cover the High Level requirements specific to the operation, interface and the display of the PC application program. The feature requirements specified in this document are valid only for a BSR CMTS which provides a spare receiver and a matrix switch. While the PC application is specifically targeted for the BSR64k DOCSIS 2x8 CMTS card, it is also intended that this application will support the BSR2k when released.

2 Overview of the Feature

This feature provides a PC application that will interface with a BSR to be used to retrieve and display various measurement data in a format suitable for diagnostics of HFC plant and configuration issues. The PC application will store this data and allow the operator the ability to display the data in a graphical format. In addition, the application will simplify the process for configuring some CMTS parameters particularly related to logical channel configuration.

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The application will be loaded into the computer by downloading it from one of Motorola's support web sites. Once on the PC, the application will have its own installation program. The program will support a GUI similar to all Windows based programs.

The PC application will interface to the BSR and retrieve measurement data via two methods: 1) Telnet, and 2) SNMP.

For the purposes of this requirements specification, "shall" will be used to identify requirements which are mandatory in the produce. The term "should" will be used when a requirement is a goal but is not necessary for final product acceptance.

3 Feature Requirements

3.1 General

REQ 1. **At a minimum, the PC application shall be able to run on the Microsoft Windows 2000 and XP operating systems.**

The specifics of version numbers can be documented in more detail in the user documentation if there are issues running under particular operating system versions.

REQ 2. **The PC application shall run as a standalone application without any dependencies on other Windows applications.**

This application will not be dependant on other windows programs such as Excel, or other graphics plotting programs. In addition, the application will not be dependent upon other Telnet or SNMP applications to retrieve measurement data from the BSR.

REQ 3. **The PC application shall abide by Motorola's product standards for appearance and reliability.**

Motorola will supply file templates containing copyrights and/or restrictions.

3.2 Installation

REQ 4. **The PC application shall have its own installation program to allow users to easily install and run it on their computer.**

The installation will perform any necessary changes to the windows configuration including unpacking any necessary files to the pc's hard disk, changes to the registry or other environment changes, and an option to allow the user to install a short-cut to the application available on the PC-desktop.

REQ 5. **The PC application shall support an uninstall program.**

The uninstall functionality will conform to generally accepted Microsoft Windows practices including that it will be supported under the "Add and Remove Programs" functionality under Microsoft Windows and any operation system environment changes will be restored to their pre-installation state upon removal.

3.3 Data Interface

REQ 6. **The PC application shall support interfacing with the BSR using the Telnet protocol.**

The program shall have the ability to open a telnet connection to the BSR. This telnet connection may then be used to: 1) command measurements by the BSR, 2) retrieve configuration and operating conditions, and 3) retrieve resulting measurement data. Specifics of commands and configuration that must be supported are detailed below in the sections titled: 1) Menu Organization, and 2) Graphical Displays.

REQ 7. **The PC application should support interfacing with the BSR using the SNMP protocol.**

The program should have the ability to open an SNMP connection to the BSR. This SNMP connection may then be used to: 1) command measurements by the BSR, 2) retrieve configuration and operating conditions, and 3) retrieve resulting measurement data. Specifics of commands and configuration that must be supported are detailed below in the sections titled: 1) Menu Organization, and 2) Graphical Displays.

3.4 Menu Organization

REQ 8. **The PC application shall support the following Menu structure:**

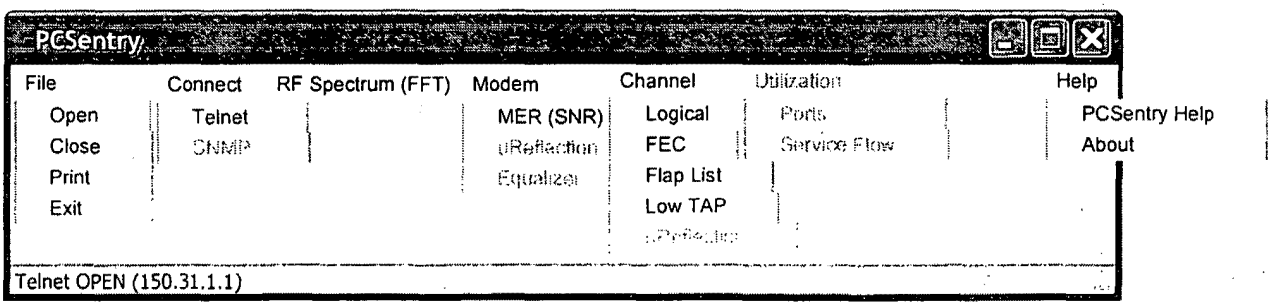

Figure 1. Sample PC Application Menu Structure.

REQ 9. **The PC application Main Menu shall support a menu item called "Connect" and a drop-down menu item called "Telnet".**

Selection of the Connect-Telnet menu item will open a configuration window which allows the user to configure the parameters to open a telnet session to the BSR. The configuration window shall allow the user to configure the necessary Telnet connection parameters including: 1) BSR Telnet IP Address, 2) BSR Telnet password, and 3) BSR CLI Enable password. The configuration window shall allow the user to command the connection to be open or subsequently closed. The software will detect the current state of the telnet connection and respond with the appropriate menu (i.e., when the connection is open, the menu will display a button allowing the user to close the connection, and when the connection is closed, the menu will allow the user to enter the connection parameters and open the connection.)

REQ 10. **The PC application Main Menu should support a menu item called "Connect" and a drop-down menu item called "SNMP".**

Selection of the Connect-SNMP menu item will open a configuration window which allows the user to configure the parameters to open a SNMP session to the BSR. The configuration window shall allow the user to configure the necessary SNMP connection parameters. The configuration window shall also allow the user to command the connection to be open or subsequently closed.

REQ 11. **The PC application Main Menu window shall display an indication of the connection status.**

The status of the BSR connection will be shown on the status line of the Main Menu window (i.e., bottom left of the window). The status will reflect whether the connection is Open or Closed and whether the open connection is via Telnet or SNMP. The pc application is only required to support one open connection at a given time.

REQ 12. **The PC application Main Menu shall support a menu item called "File" and a drop-down menu item called "Open".**

Selection of the File-Open menu item will open a window which allows the user to select a file from the PC's hard disk. (See REQ 41 for further details.)

REQ 13. **The PC application Main Menu shall support a menu item called "File" and a drop-down menu item called "Close".**

Selection of the File-Close menu item will close the currently "active" graphics window.

REQ 14. **The PC application Main Menu shall support a menu item called "File" and a drop-down menu item called "Print".**

Selection of the File-Print menu item will print the currently "active" graphics window. (See REQ 40 for further details.)

REQ 15. **The PC application Main Menu shall support a menu item called "File" and a drop-down menu item called "Exit".**

Selection of the File-Exit menu item will close all open graphics windows and gracefully exit the application.

REQ 16. **The PC application Main Menu shall support a menu item called "RF Spectrum (FFT)".**

Selection of the RF Spectrum (FFT) menu item will open a window which allows the user to configure the parameters to command FFT measurements by the 9th receiver implemented in each of the BSR's available 2x8 CMTS cards. The configuration parameters shall include: 1) CMTS Slot [0..15], 2) CMTS Receiver port [0..7], 3) Mode [Tap-in], 4) Sample Size [256, 512, 1024, 2048], 5) FFT Window [Blackman, Blackman-Harris, Hamming, Hanning, Rectangular], and 6) Pre or Post Ingress Canceller. (Note, with release 4.1 of the BSR, only pre-ingress canceller FFT sampling is supported; however, future releases are anticipated to support post-ingress canceller.) The configuration window shall also allow the user to trigger FFT measurements by the BSR. Each time the FFT measurement is triggered, the PC application will open a new window with a graphical rendering of the resulting FFT measurements utilizing the configuration parameters selected by the operator. (See Section 3.5 REQ 29 for further details on this graphical display.)

REQ 17. **The PC application Main Menu shall support a menu item called "Modem" and a drop-down menu item called "MER (SNR)".**

Selection of the Modem-MER (SNR) menu item will open a configuration window which allows the user to configure the parameters to command MER (SNR) measurements by the 9th receiver implemented in each of the BSR's available 2x8 CMTS cards. The configuration parameters shall include: 1) CMTS Slot [0..15], 2) CMTS Receiver port [0..7], 3) Start Frequency [5000000..42000000 Hz], 4) End Frequency [5000000..42000000 Hz], 5) Channel Width [200000, 400000, 800000, 1600000, 3200000, 6400000], 6) Equalization [auto, off, on], 7) Ingress-Canceller [auto, off, on], 8) Modulation Type [auto, qpsk, 16qam], and 9) Cable Modem MAC address [xxxx.xxxx.xxxx].

The configuration window shall also include a separate panel within the same window which facilitates easy modem MAC address selection. A sample of one possible modem MAC address selection panel is provided in Figure 2. Various

modem parameters will be provided as the headers to the columns. At a minimum, the following parameters shall be included: 1) MAC Address, 2) SNR, 3) uReflection, 4) Modem Type, 5) CMTS Slot, 6) CMTS Port, 7) CMTS Logical Channel, 8) Spectrum Group, and 9) Modem No-Move indication. Each row will represent a different modem. The MAC address selection panel shall allow the operator to sort (alphabetize) the modems (rows) by clicking on a given column header. Selection of the same header shall result in the toggling between ascending and descending order. This panel shall support multiple key sorting. Multiple key sorting means that if the operator selects SNR header first (which sorts the modems in ascending order by SNR) and then selects the Modem Type header second, the resulting table will be sorted in ascending Modem Type and for modems with the same Modem Type, it will be sorted by ascending SNR. In addition, the window shall include a MASK selection for the following parameters: 1) Modem Type, 2) Slot, 3) Port, 4) Logical Channel, 5) Spectrum Group, and 6) No Move. The operator will be able to select from a pick-list for each of these parameters to limit the modems listed in the panel. For example, if the operator selected Slot 3 and Port 1, then only modems from Slot 3 and Port 1 will be displayed in the panel. All other modems will no longer be displayed. If the operator, selects the wildcard character (meaning all entries are valid), then all entries previously not displayed will reappear. This panel shall also support an Update button which will allow the data filling the panel to be refreshed. If the operator double-clicks a given row in the cable modem MAC selection panel, the associated MAC address shall be automatically filled in as the Cable Modem MAC address parameter in the configuration window.

MAC	SNR	uReflection	Modem Type	Slot	Port	Spec Grp	No Move
0123.4567.890A	20.1	23.1	1.0	3	1	SpmGrp 2	
0123.4567.890B	27.2	23.1	1.1	3	1	SpmGrp 3	
0123.4567.890C	23.1	23.1	1.1	3	1	SpmGrp 1	☑
0123.4567.890D	23.1	23.1	1.0	3	1	SpmGrp 1	☑
0123.4567.890E	24.1	25.7	1.0	3	1	SpmGrp 1	
0123.4567.890F	23.1	23.1	1.1	3	1	SpmGrp 2	
0123.4567.891A	23.1	26.8	2.0	3	1	SpmGrp 3	
0123.4567.891B	30.5	41.2	2.0	3	1	SpmGrp 3	
0123.4567.891C	23.1	23.1	1.1	3	1	SpmGrp 3	☑
MASK			?	3	1	?	?

Figure 2. Sample Cable Modem MAC Selection panel.

The configuration window shall allow the user to trigger the SNR measurements by the BSR. Each time the SNR measurement is triggered, the PC application will

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open a new window with a graphical rendering of the resulting SNR measurements. (See Section 3.5 REQ 30 for further details on this graphical display.)

REQ 18. The PC application Main Menu should support a menu item called "Modem" and a drop-down menu item called "uReflection".

Selection of the Modem-uReflection menu item will open a configuration window which allows the user to configure the parameters to command uReflection measurements by the 9th receiver implemented in each of the BSR's available 2x8 CMTS cards. The configuration parameters shall include: 1) CMTS Slot [0..15], 2) CMTS Receiver port [0..7], 3) Start Frequency [5000000..42000000 Hz], 4) End Frequency [5000000..42000000 Hz], 5) Channel Width [200000, 400000, 800000, 1600000, 3200000, 6400000], 6) Modulation Type [auto, qpsk, 16qam], and 7) Cable Modem MAC address [xxxx.xxxx.xxxx].

The configuration window shall also include a separate panel within the same window which facilitates easy modem MAC address selection as supported with the MER (SNR) menu item.

The configuration window shall allow the user to trigger the uReflection measurements by the BSR. Each time the uReflection measurement is triggered, the PC application will open a new window with a graphical rendering of the resulting uReflection measurements. (See Section 3.5 REQ 31 for further details on this graphical display.)

REQ 19. The PC application Main Menu should support a menu item called "Modem" and a drop-down menu item called "Equalizer".

Selection of the Modem-Equalizer menu item will open a configuration window which allows the user to select a modem from a list of modems similar to the cable modem MAC address selection panel used in REQ 17 and REQ 18 except that double clicking a particular row (cable modem) will cause the PC application to open a new window with a graphical rendering of the resulting Equalizer for the selected modem on the active channel. (See Section 3.5 REQ 32 for further details on this graphical display.)

REQ 20. The PC application Main Menu shall support a menu item called "Channel" and a drop-down menu item called "Logical".

Selection of the Channel-Logical menu item will open a configuration window which allows the user to perform three classes of operations: 1) Display a list of modems currently registered on the BSR in a filtered/sorted mode, 2) Analyze and Optimize the modem list for Logical Channel Configuration, and 3) Reconfigure the BSR to a new Logical Channel configuration (including moving modems).

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A sample of one acceptable implementation of the channel configuration window is provided in Figure 3.

Similar to that specified in REQ 17 and shown in Figure 2, the channel configuration window shall include a panel which displays a list of modems on the BSR. As was the case above in REQ 17, the operator shall be able to: 1) sort on multiple keys by using the mouse to click on the header of a given column, 2) support an Update button which will allow the modem data filling the panel to be refreshed, and 3) include a MASK selection for the following parameters: 1) ~~Modem Type, 2) Slot, 3) Port, 4) Spectrum Group, and 5) No Move.~~ The panel shall also include two graph buttons: "Graph SNR" and "Graph uRefl". Each time the "Graph SNR" button is pressed, the PC application shall open a new graphics window relating SNR versus modem MAC address as measured on the currently active channel. Each time the "Graph uRefl" button is pressed, the PC application shall open a new graphics window relating uReflections versus modem MAC address as measured on the currently active channel. Only the modems listed in the panel will be displayed on the graph. Thus, modems which are MASKED are not displayed on the graph. The modems shall be graphed along the x-axis in the same order as they are sorted in the modem panel. (See Section 3.5 REQ 33 for further detail on the SNR versus modem display and Section 3.5 REQ 34 for further detail on the uReflection versus modem display.)

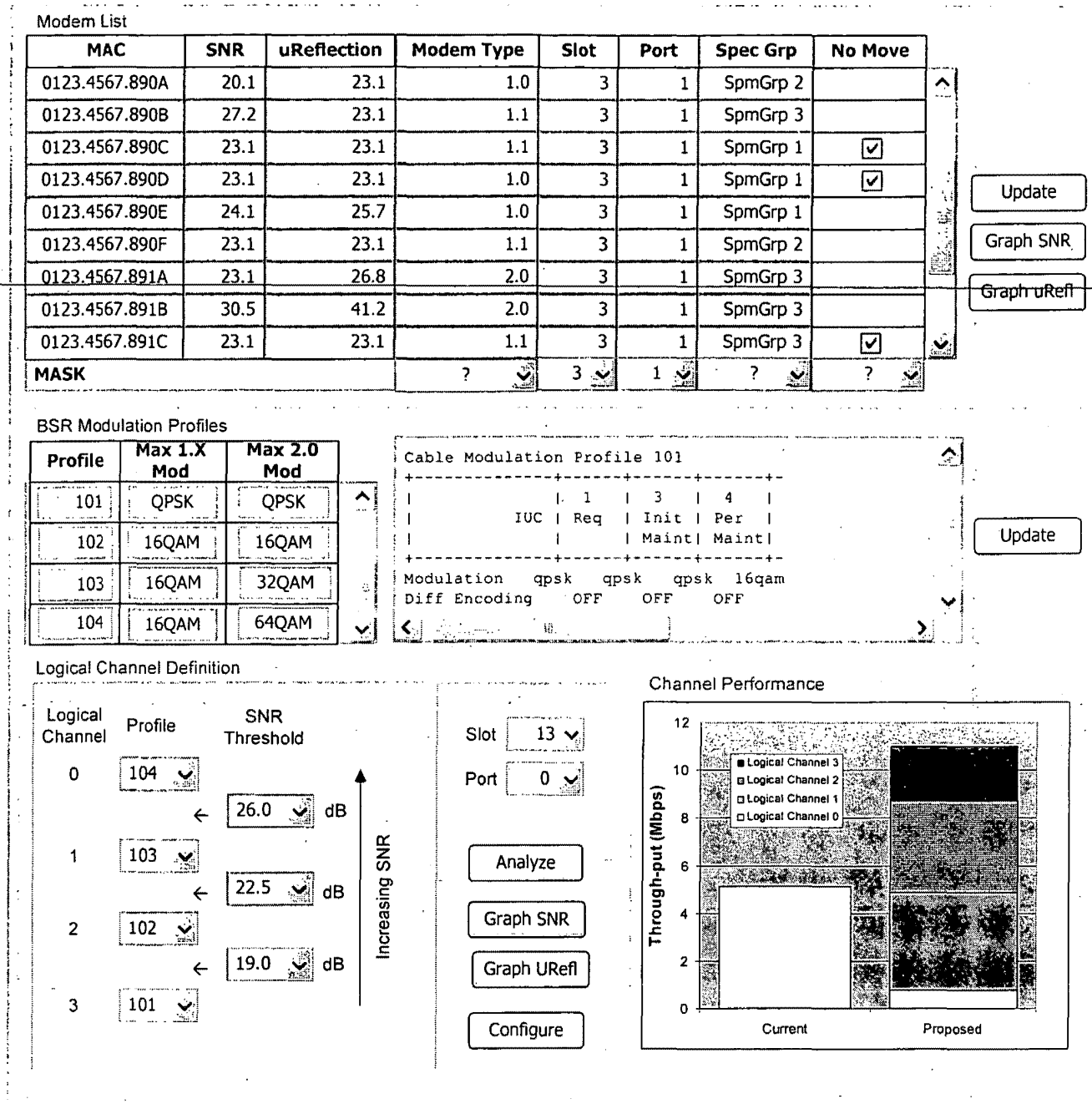

Figure 3. Sample of Channel Configuration Window.

The channel configuration window shall also include a panel which displays the modulation profiles as configured on the BSR. This panel will be divided into two areas: 1) summary, and 2) details. The summary section will provide a tabular

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representation of all the profiles currently defined on the BSR. Each row represents a different profile. In addition, to the profile number, each row will display the maximum 1.x modem modulation used in the profile (as defined by IUC 5 and 6), and the maximum 2.0 modem modulation used in the profile (as defined by IUC 9, 10, 11). The operator will be allowed to scroll through the list of profiles. The details section will display all the parameters for a single modulation profile defined on the BSR. The operator can select which profile is displayed in the details section by double clicking on a specific row in the summary section. This panel shall also support an Update button which will allow the data filling the BSR modulation profiles to be refreshed.

The channel configuration window shall also include a third panel which displays the logical channel definition, analysis, and configuration options. The operator shall be allowed to select profiles (from those displayed in the Modulation Profile panel) for each of 4 logical channels. Further, the operator shall be allowed to specify the SNR threshold (in dB) that separates each logical channel. The operator shall also be allowed to select a particular BSR slot and port for which the logical channel definition may be analyzed. This panel shall include an analyze button which, when pressed, will trigger the display of a bar chart (within the panel) which compares the theoretical through-put of the channel as currently configured with the through-put expected if the logical channel configuration were implemented. This bar chart will be a stacked bar which allows the operator to visualize the contributions to total through-put resulting from each of the logical channels. (Note, this bar chart will not be in a separate window and will be overwritten each new time the operator presses the analyze button or modifies any of the logical channel definition parameters.) The logical channel definition panel shall also include two graph buttons: "Graph SNR" and "Graph uRefl". Each time the "Graph SNR" button is pressed, the PC application shall open a new graphics window relating SNR versus modem MAC address as measured on the currently active channel. Each time the "Graph uRefl" button is pressed, the PC application shall open a new graphics window relating uReflections versus modem MAC address as measured on the currently active channel. Only the modems from the slot and port selected in the logical channel definition panel shall be displayed on the graphs. The modems shall be graphed along the x-axis in increasing order of SNR of uReflections. (See Section 3.5 REQ 33 for further detail on the SNR versus modem display and Section 3.5 REQ 34 for further detail on the uReflection versus modem display.) Finally, the logical channel definition panel shall include a configure button which will reconfigure the settings for the BSR's selected slot and port to match the logical channels defined. When the operator presses the configure button, the pc application shall move each cable modem to the appropriate logical channel as dictated by its measured SNR and the SNR thresholds configured. The

pc application shall use the UCC or DCC commands as necessary to move the modems to their corresponding logical channel.

It is desirable for the operator to be able to manually override individual modems assigned to a logical channel. For example, this would facilitate a mechanism for the operator to define a logical channel using a profile of 256QAM (which is non-DOCSIS standard) and then only move Motorola 2.0 modems to this logical channel. As a goal, the pc application should provide a mechanism for the operator to view the lists of modems categorized by logical channel and manually reassign them as desired prior to analyzing or configuring the channel. It would be preferable for this to a simple drag-and-drop type of function to minimize the efforts of the operator when undertaking any manual overrides.

REQ 21. The PC application Main Menu shall support a menu item called "Channel" and a drop-down menu item called "FEC".

Selection of the Channel-FEC menu item will open a configuration window which allows the user to select a CMTS slot which will then cause the PC application to open a new window with a graphical rendering of FEC performance on each of the ports for the given CMTS slot. (See Section 3.5 REQ 35 for further details on this graphical display.)

REQ 22. The PC application Main Menu shall support a menu item called "Channel" and a drop-down menu item called "Flap List".

Selection of the Channel-Flap List menu item will open a configuration window which allows the user to select a CMTS slot which will then cause the PC application to open a new window with a graphical rendering of Flap List count for each of the ports of the selected CMTS slot. (See Section 3.5 REQ 36 for further details on this graphical display.)

REQ 23. The PC application Main Menu shall support a menu item called "Channel" and a drop-down menu item called "Low TAP".

Selection of the Channel-Low TAP menu item will open a new configuration window which allows the user to select a maximum modem count. The application will populate a list of modems within this window similar to the cable modem MAC address selection panel used in REQ 17 except that this list will contain specific modems from a single upstream channel that are projected to reside at low value taps near the ends of the HFC cable runs. These modems are expected to be the most likely to cause problems (as far as physical layer performance is concerned) and should be highest priority for any proactive plant maintenance activities. Specifically, the pc application will display a maximum of the user-entered number of modems within a list which is derived by taking the modem list of a single CMTS upstream channel and sorting as follows: 1) Effective cable

modem transmit level (which is actual modem transmit level – CMTS receive level), 2) downstream SNR, and 3) upstream SNR. It is believed that modems transmitting hot and with simultaneous low downstream and upstream SNR are likely modems at the end of cable runs on low value taps and most likely will be susceptible to plant issue before other modems are.

REQ 24. **The PC application Main Menu should support a menu item called "Channel" and a drop-down menu item called "uReflection".**

Selection of the Channel-uReflection menu item will open a configuration window which allows the user to select a CMTS slot and upstream port which will then cause the PC application to open a new window with a graphical rendering of uReflection for the selected port of the selected CMTS. (See Section 3.5 REQ 37 for further details on this graphical display.)

REQ 25. **The PC application Main Menu shall support a menu item called "Utilization" and a drop-down menu item called "Ports".**

Selection of the Utilization-Ports menu item will open a configuration window which allows the user to select a CMTS slot which will then cause the PC application to open a new window with a graphical rendering of utilization performance for each of the ports of the selected CMTS slot. (See Section 3.5 REQ 38 for further details on this graphical display.)

REQ 26. **The PC application Main Menu shall support a menu item called "Utilization" and a drop-down menu item called "Service Flow".**

Selection of the Utilization-Service Flow menu item will cause the PC application to open a new window with a graphical rendering of utilization performance for each of the service flows configured on the CMTS. (See Section 3.5 REQ 39 for further details on this graphical display.)

REQ 27. **The PC application Main Menu shall support a menu item called "Help" and a drop-down menu item called "About" which allows users to see what version of the program they are running.**

REQ 28. **The PC application Main Menu shall support a menu item called "Help" and a drop-down menu item called "PCSentry Help" to assist users on how to operate the program.**

Selection of the PCSentry Help menu item will "pop-up" an explanation of various menus and command options for the user to review. Motorola will supply the text which is contained within the on-line help explanations.

3.5 Graphical Displays

REQ 29. The PC application shall display FFT (Power versus Frequency) data in graphical format.

When triggered to display the FFT as directed according to REQ 16, the application should open a single window which displays two graphs, as shown in Figure 4. Both of these graphs shall utilize X-Y scatter plots with points connected by straight lines. The top graph will reflect the entire FFT spectrum as collected by the BSR 9th receiver from 0 to 81.92 MHz. The bottom graph will reflect a scaled or zoomed version of the top graph. In the example in Figure 4, 23 to 28 MHz is displayed. The application should allow the operator to select (via the mouse) a portion of the full FFT display on the top graph which is then zoomed in on and displayed on the bottom graph. The Quinn-Curtis Graphics tool-kit supports such a capability; however, the developer is not limited to use this specific tool-kit. Both the FFT and zoomed FFT displays shall include vertical gridlines to facilitate easily reading at what frequency the energy is located. As an additional capability of the FFT

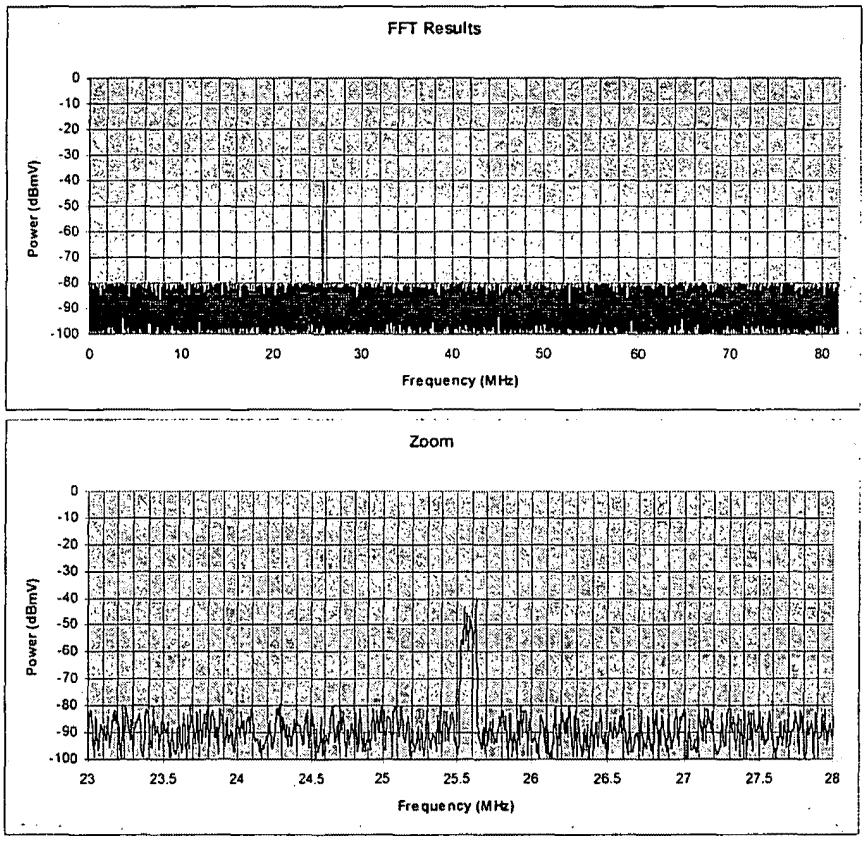

Figure 4. Sample of FFT Window with Zoom panel below.

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display window, the pc application shall allow the operator to place two vertical marker bars on the display. The pc application shall then compute the total power present between the two vertical marker bars. This total power shall be displayed within the FFT graphics window. In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the FFT was triggered, the configuration parameters used (see REQ 16), and the FFT results.

The FFT graphics window should also include a panel which displays the configuration data used to generate the FFT results.

REQ 30. The PC application shall display MER (MER/SNR versus Frequency) data in graphical format.

When triggered to display the MER (SNR) as directed according to REQ 17, the application should open a single window which displays two graphs similar to that displayed for the FFT results show in Figure 4. However, these graphs shall both utilize vertical bar charts. The top graph will reflect the entire MER spectrum as collected by the BSR 9th receiver from 5 to 42 MHz. The bottom graph will reflect a scaled or zoomed version of the top graph. The application should allow the operator to select (via the mouse) a portion of the full SNR display on the top graph which is then zoomed in on and displayed on the bottom graph. The Quinn-Curtis Graphics tool-kit supports such a capability; however, the developer is not limited to use this specific tool-kit. In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the MER measurement was triggered, the configuration parameters used (see REQ 17), and the MER results.

The MER graphics window should also include a panel which displays the configuration data used to generate the MER results.

REQ 31. The PC application should display uReflection (uReflection versus Frequency) data in graphical format.

When triggered to display the uReflection as directed according to REQ 18, the application should open a single window which displays two graphs similar to that displayed for the FFT results show in Figure 4. However, these graphs shall both utilize vertical bar charts. The top graph will reflect the entire uReflection spectrum as collected by the BSR 9th receiver from 5 to 42 MHz. The bottom graph will reflect a scaled or zoomed version of the top graph. The application should allow the operator to select (via the mouse) a portion of the full uReflection display on the top graph which is then zoomed in on and displayed on the bottom graph. The

Quinn-Curtis Graphics tool-kit supports such a capability; however, the developer is not limited to use this specific tool-kit. In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the uReflection measurement was triggered, the configuration parameters used (see REQ 18REQ 12), and the uReflection results.

The uReflection graphics window should also include a panel which displays the configuration data used to generate the uReflection results.

REQ 32. The PC application should display Equalizer data in graphical format. Equalizer graphics should include: 1) Magnitude of coefficients versus tap location, 2) Real coefficients versus tap location, 3) Imaginary coefficients versus tap location, 4) Phase versus tap location, 5) Group delay versus tap location, and 6) FFT of the complex equalizer coefficients versus tap location.

When triggered to display the equalizer data as directed according to REQ 19, the application should open a graphics window with a single plot of the Magnitude of the equalizer coefficients versus tap location. These graphs shall utilize X-Y scatter plots with points connected by straight lines. The graphics window displayed by the application shall support a mechanism (buttons, pull-down menu selection, etc.) which allows the operator to change the display to any of the other equalizer graphics listed above. In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the equalizer data was captured, the cable modem's active upstream channel rate, and the equalizer coefficients.

REQ 33. The PC application shall display MER (MER/SNR versus Modem MAC address) data in graphical format.

The Channel Configuration window defined in REQ 20, requires support for four graphics buttons. In all four cases, the resulting graph that is displayed will be similar and will reflect a vertical bar chart where either MER (SNR) or uReflection is reflected on the y-axis, and Modem MAC address is reflected on the x-axis. (Note, the application will only be required to display actual MAC addresses on the x-axis if there are less than 15 modems within the list to plot. If greater than 15 modems are contained within the list, no actual labeling will be displayed on the x-axis. This is to allow readability of the MAC addresses.) However, there will be slight differences between the displays of the graphs provided on the Modem List section of the Channel Configuration window and the Logical Channel Definition section.

When the operator selects the "Graph SNR" button, found on the Modem list panel, the pc application shall open a single window which displays two graphs. The top graph will reflect the MER (SNR) for all modems listed in the modem list panel (see REQ 20) versus Modem MAC address. The bottom graph will reflect a scaled or zoomed version of the top graph. The application should allow the operator to select (via the mouse) a portion of the full SNR display on the top graph which is then zoomed in on and displayed on the bottom graph. (This is similar to the functionality described previously.) In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the MER (SNR) values were retrieved from the BSR and the MER results per modem.

The MER graphics window shall include the ability to color code the vertical bars in the display by the following parameters: 1) spectrum group, 2) modem type (DOCSIS 1.0, 1.1, 2.0), and 3) Logical Channel.

In addition, Motorola's DOCSIS 2.0 cable modems also support higher order modulations up to 256QAM. As a result, Motorola anticipates the need in the future, for the operators to be able to setup a logical channel whereby only Motorola Modems would be assigned to a single logical channel. As a goal, it will be desirable to be able to code the color of the vertical bars by vendor type or at least Motorola and non-Motorola modems.

When the operator selects the "Graph SNR" button, found on the Logical Channel Definition panel, the pc application shall open a single window which displays two graphs. The top graph will reflect the MER (SNR) for only those modems registered on the slot and port being configured in the logical channel definition panel. (See REQ 20) (Note, for this graph, the SNR will always be displayed in increasing order from left to right.) The bottom graph will reflect a scaled or zoomed version of the top graph. (This is similar to the functionality described previously.) In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the MER (SNR) values were retrieved from the BSR and the MER results per modem.

The MER graphics window shall include the ability to color code the vertical bars in the display by the following parameters: 1) modem type (DOCSIS 1.0, 1.1, 2.0), and 2) Logical Channel.

In addition, Motorola's DOCSIS 2.0 cable modems also support higher order modulations up to 256QAM. As a result, Motorola anticipates the need in the future, for the operators to be able to setup a logical channel whereby only Motorola Modems would be assigned to a single logical channel. As a goal, it will be

desirable to be able to code the vertical bars by vendor type or at least Motorola and non-Motorola modems.

REQ 34. The PC application should display uReflection (uReflection versus Modem MAC address) data in graphical format.

The Channel Configuration window defined in REQ 20, requires support for four graphics buttons. In all four cases, the resulting graph that is displayed will be similar and will reflect a vertical bar chart where either MER (SNR) or uReflection is reflected on the y-axis, and Modem MAC address is reflected on the x-axis. (Note, the application will only be required to display actual MAC addresses on the x-axis if there are less than 15 modems within the list to plot. If greater than 15 modems are contained within the list, no actual labeling will be displayed on the x-axis. This is to allow readability of the MAC addresses.) However, there will be slight differences between the displays of the graphs provided on the Modem List section of the Channel Configuration window and the Logical Channel Definition section.

When the operator selects the "Graph uRefl" button, found on the Modem list panel, the pc application shall open a single window which displays two graphs. The top graph will reflect the uReflection for all modems listed in the modem list panel (see REQ 20) versus Modem MAC address. The bottom graph will reflect a scaled or zoomed version of the top graph. The application should allow the operator to select (via the mouse) a portion of the full uReflection display on the top graph which is then zoomed in on and displayed on the bottom graph. (This is similar to the functionality described previously.) In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the uReflection values were retrieved from the BSR and the uReflection results per modem.

The uReflection graphics window shall include the ability to color code the vertical bars in the display by the following parameters: 1) spectrum group, 2) modem type (DOCSIS 1.0, 1.1, 2.0), and 3) Logical Channel.

In addition, Motorola's DOCSIS 2.0 cable modems also support higher order modulations up to 256QAM. As a result, Motorola anticipates the need in the future, for the operators to be able to setup a logical channel whereby only Motorola Modems would be assigned to a single logical channel. As a goal, it will be desirable to be able to code the color of the vertical bars by vendor type or at least Motorola and non-Motorola modems.

When the operator selects the "Graph uRefl" button, found on the Logical Channel Definition panel, the pc application shall open a single window which displays two graphs. The top graph will reflect the uReflection for only those modems registered on the slot and port being configured in the logical channel definition panel. (See REQ 20). (Note, for this graph, the uReflection will always be displayed in increasing order from left to right.) The bottom graph will reflect a scaled or zoomed version of the top graph. (This is similar to the functionality described previously.) In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the uReflection values were retrieved from the BSR and the uReflection results per modem.

The uReflection graphics window shall include the ability to color code the vertical bars in the display by the following parameters: 1) modem type (DOCSIS 1.0, 1.1, 2.0), and 2) Logical Channel.

In addition, Motorola's DOCSIS 2.0 cable modems also support higher order modulations up to 256QAM. As a result, Motorola anticipates the need in the future, for the operators to be able to setup a logical channel whereby only Motorola Modems would be assigned to a single logical channel. As a goal, it will be desirable to be able to code the vertical bars by vendor type or at least Motorola and non-Motorola modems.

REQ 35. The PC application shall display FEC (FEC versus CMTS port) data in graphical format.

When triggered to display the FEC as directed according to REQ 21, the application should open a single window which displays the percent of FEC codewords which are corrected and uncorrectable. This display will be presented in the form of a stacked bar chart which will be structured as follows: The y-axis will represent the Percent of FEC codewords and will scale from 0 to 100 %. The x-axis will be a single bar for each upstream channel supported on the CMTS slot. The lower bar of the stacked bar configuration will represent the percent of FEC codewords transmitted on a given port which were corrupted during transmission but were not correctable by the FEC algorithm. The second or stacked bar will represent the percent of FEC codewords which were corrupted during transmission but were correctable by the FEC algorithm. As a goal, the actual percent correctable and percent uncorrectable should be displayed with each bar. In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the FEC measurements were logged, and the actual FEC statistics.

The FEC graphics window should also include a panel which displays the configuration data used to generate the FEC results (CMTS slot, date, time, etc).

REQ 36. The PC application shall display flap list (flap list count versus CMTS port) data in graphical format.

When triggered to display the flap list count as directed according to REQ 22, the application should open a single window which displays flap list count. This display will be presented in the form of a bar chart which will be structured as follows: The y-axis will represent the flap list count. The x-axis will be a single bar for each upstream and downstream port supported on the CMTS slot. As a goal, the actual flap list count should be displayed with each bar. In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the flap list count was logged, and the actual counts by port.

The utilization graphics window should also include a panel which displays the configuration data used to generate the flap list counts (CMTS slot, date, time, etc).

REQ 37. The PC application should display uReflection (uReflection versus cable modem transmit level) data in graphical format.

When triggered to display the uReflection as directed according to REQ 24, the application should open a window which displays a stacked bar chart of uReflections versus cable modem upstream transmit level. The y-axis will represent uReflections and the x-axis will be upstream modem transmit level. Since there are multiple modems at each transmit level, each bar will be graphed as a stacked bar with the lower bar representing the minimum uReflection at a given transmit level and the upper bar representing the maximum uReflection at a given transmit level. It is expected that some quantization will have to be achieved to create a reasonable number of transmit level bars. For example, we might plot transmit level bars in increments of 2 dB. The uReflection versus cable modem transmit level bar graph will provide two mechanisms to allow the user to dive down into the details of the uReflections stacked bar chart through the following: when the user selects a particular bar with the mouse and right clicks with the mouse key, a menu shall be displayed which allows the user to open up two additional graphs. These graphs are: 1) uReflection versus cable modem, and 2) uReflection versus cable modem upstream transmit level.

When the operator selects the first option (uReflection versus cable modem), the pc application should open a new window which displays a bar chart illustrating uReflections on the y-axis, and different modems on the x-axis. That is, there will be a single bar for each modem. As a goal, the pc application should also display a

bar chart directly beneath the uReflection bar chart which illustrates the MER (SNR) versus each modem. This plot allows the operator to easily identify the modems for which uReflection is a dominant impairment.

When the operator selects the second (uReflection versus cable modem upstream transmit level), the pc application should open a new window which displays a scatter plot illustrating uReflections on the y-axis, and increasing modem upstream transmit level on the x-axis. While there was quantization in the original plot in that each bar potentially represented many modems, this scatter plot will be displayed such that each point will represent a single modem (transmit level to uReflection) data point. In addition, this scatter plot shall include both horizontal and vertical gridlines to facilitate easily reading the data points.

In addition, each of the three graphics window described above shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the uReflection measurements were logged, and the actual uReflection statistics.

The uReflection graphics window should also include a panel which displays the configuration data used to generate the uReflection results (CMTS slot, date, time, etc).

REQ 38. The PC application shall display utilization (utilization versus CMTS port) data in graphical format.

When triggered to display the Utilization as directed according to REQ 25, the application should open a single window which displays percent utilization. This display will be presented in the form of a bar chart which will be structured as follows: The y-axis will represent the percent of utilization and will scale from 0 to 100 %. The x-axis will be a single bar for each upstream and downstream port supported on the CMTS slot. In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the utilization measurements were logged, and the actual utilization statistics.

The utilization graphics window should also include a panel which displays the configuration data used to generate the utilization results (CMTS slot, date, time, etc).

REQ 39. The PC application shall display utilization (utilization versus service flow) data in graphical format.

When triggered to display the Utilization as directed according to REQ 26, the application should open a single window which displays percent utilization. This

display will be presented in the form of a bar chart which will be structured as follows: The y-axis will represent the percent of utilization and will scale from 0 to 100 %. The x-axis will be a single bar for each service flow configured on the CMTS. In addition, the graphics window displayed by the application shall support a button which allows the operator to save the data using CSV format to an ASCII file on the PC's hard disk. The ASCII file shall include date and time the utilization measurements were logged, and the actual utilization statistics.

The utilization graphics window should also include a panel which displays the configuration data used to generate the utilization results (date, time, etc).

3.6 Printing and File Retrieval

REQ 40. The PC application shall provide (for each open graphics window) the ability to print the graph.

The Quinn-Curtis graphics tool kit provides print support for the various graphics and a host of printers.

REQ 41. The PC application shall allow the user to select a file stored on the hard drive and display the extracted data in the appropriate graphical format.

The pc application is required to support saving (in ASCII CSV format) various graphs (See REQ 29 through REQ 39). In addition, the pc application shall allow the user to select one of these files and, upon selection, open a new graphics window which displays the saved data. If the user selects a file which was not generated by the pc application, the application shall provide an error message indicating that it is a non-compatible file.

4 Requirements List

REQ 1. At a minimum, the PC application shall be able to run on the Microsoft Windows 2000 and XP operating systems.4

REQ 2. The PC application shall run as a standalone application without any dependencies on other Windows applications. 4

REQ 3. The PC application shall abide by Motorola's product standards for appearance and reliability. 4

REQ 4. The PC application shall have its own installation program to allow users to easily install and run it on their computer. 4

REQ 5. The PC application shall support an uninstall program. 5

REQ 6. The PC application shall support interfacing with the BSR using the Telnet protocol. 5

REQ 7. The PC application should support interfacing with the BSR using the SNMP protocol. 5

REQ 8. The PC application shall support the following Menu structure: 5

REQ 9. The PC application Main Menu shall support a menu item called "Connect" and a drop-down menu item called "Telnet". 6

REQ 10. The PC application Main Menu should support a menu item called "Connect" and a drop-down menu item called "SNMP". 6

REQ 11. The PC application Main Menu window shall display an indication of the connection status. 6

REQ 12. The PC application Main Menu shall support a menu item called "File" and a drop-down menu item called "Open". 6

REQ 13. The PC application Main Menu shall support a menu item called "File" and a drop-down menu item called "Close". 6

REQ 14. The PC application Main Menu shall support a menu item called "File" and a drop-down menu item called "Print". 7

REQ 15. The PC application Main Menu shall support a menu item called "File" and a drop-down menu item called "Exit". 7

REQ 16. The PC application Main Menu shall support a menu item called "RF Spectrum (FFT)". 7

REQ 17. The PC application Main Menu shall support a menu item called "Modem" and a drop-down menu item called "MER (SNR)".7

REQ 18. The PC application Main Menu should support a menu item called "Modem" and a drop-down menu item called "uReflection". 9

REQ 19. The PC application Main Menu should support a menu item called "Modem" and a drop-down menu item called "Equalizer". 9

REQ 20. The PC application Main Menu shall support a menu item called "Channel" and a drop-down menu item called "Logical". 9

REQ 21. The PC application Main Menu shall support a menu item called "Channel" and a drop-down menu item called "FEC". 13

REQ 22. The PC application Main Menu shall support a menu item called "Channel" and a drop-down menu item called "Flap List". 13

REQ 23. The PC application Main Menu shall support a menu item called "Channel" and a drop-down menu item called "Low TAP". 13

REQ 24. The PC application Main Menu should support a menu item called "Channel" and a drop-down menu item called "uReflection". 14

REQ 25. The PC application Main Menu shall support a menu item called "Utilization" and a drop-down menu item called "Ports". 14

REQ 26. The PC application Main Menu shall support a menu item called "Utilization" and a drop-down menu item called "Service Flow". 14

REQ 27. The PC application Main Menu shall support a menu item called "Help" and a drop-down menu item called "About" which allows users to see what version of the program they are running. 14

REQ 28. The PC application Main Menu shall support a menu item called "Help" and a drop-down menu item called "PCSentry Help" to assist users on how to operate the program. 14

REQ 29. The PC application shall display FFT (Power versus Frequency) data in graphical format. 15

REQ 30. The PC application shall display MER (MER/SNR versus Frequency) data in graphical format. 16

REQ 31. The PC application should display uReflection (uReflection versus Frequency) data in graphical format. 16

REQ 32. The PC application should display Equalizer data in graphical format. Equalizer graphics should include: 1) Magnitude of coefficients versus tap location, 2) Real coefficients versus tap location, 3) Imaginary coefficients versus tap location, 4) Phase versus tap location, 5) Group delay versus tap location, and 6) FFT of the complex equalizer coefficients versus tap location. 17

REQ 33. The PC application shall display MER (MER/SNR versus Modem MAC address) data in graphical format. 17

REQ 34. The PC application should display uReflection (uReflection versus Modem MAC address) data in graphical format. 19

REQ 35. The PC application shall display FEC (FEC versus CMTS port) data in graphical format. 20

REQ 36. The PC application shall display flap list (flap list count versus CMTS port) data in graphical format. 21

REQ 37. The PC application should display uReflection (uReflection versus cable modem transmit level) data in graphical format. 21

REQ 38. The PC application shall display utilization (utilization versus CMTS port) data in graphical format. 22

REQ 39. The PC application shall display utilization (utilization versus service flow) data in graphical format. 22

REQ 40. The PC application shall provide (for each open graphics window) the ability to print the graph. 23

REQ 41. The PC application shall allow the user to select a file stored on the hard drive and display the extracted data in the appropriate graphical format. 23

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