Getting Started with SNMP

A tutorial

It is possible to view and control RAVE's network and audio features via software through access to the CobraNet management interface (MI) variables. RAVE products use the industry standard SNMP (simple network management protocol) to read and write to MI variables. This allows the user to dispense with the front panel rotary switches as the only means of device control. SNMP opens a new level of control and monitoring of RAVE devices operating on CobraNet networks. With SNMP we can configure bundle assignments, conductor functions, internal routing, provide channel duplication, access private bundles, monitor network statistics as well as read and write to a number of other parameters, hardware permitting. Arguably, the most significant of these variables are those that access bundle configuration and routing capabilities. These two features allow the user to build a CobraNet network with one-shot wiring. If a configuration change is needed in the future, a system designer can simply re-route the network bundles and the audio paths within them from the software interface.

To obtain access to the features that SNMP offers, it is first necessary to load the appropriate CobraNet firmware and assign an IP (internet protocol) address to each CobraNet device on the network. Currently, the easiest method of accomplishing this initial setup procedure is through use of the CobraNet Discovery utility. The Discovery utility enables remote code uploading via TFTP (trivial file transfer protocol). Additionally, Discovery allows viewing of CobraNet bundle assignments, MAC (media access control) addresses and enables assignment of IP addresses to CobraNet devices such as the RAVE products. Discovery also provides visibility to some basic statistics on network performance.

The CobraNet Discovery Utility

The CobraNet Discovery utility has been released in two flavors. Versions 2.x.x sense CobraNet devices and network statistics by reading specific Ethernet packet types on the network. Versions 3.x.x provide additional monitoring capabilities by viewing MI variables via SNMP. With versions 3.x.x the user can configure the Discovery utility to monitor a number of desired MI variables, although altering them is not currently an option.

The following procedure is a list of steps necessary to program a RAVE with SNMP capable firmware and then assign the device an IP address. This example is based on

CobraNet Discovery versions 3.x.x. CobraNet Discovery is available for free download from the Peak Audio website.

1. We first open the CobraNet Discovery application. This application requires the Windows 98, Windows 2000 or Windows NT operating system. Note that assignment of IP addresses under Windows NT requires administrative privileges.

   Figure 1 shows the Discovery application's "discovery" window. In this view, the leftmost green checkmarks indicate that two devices on the network are actively linked to the LAN. Moving from left to right, we see the MAC and IP addresses of the two devices followed by the receive and transmit bundle and status indicators. The bundle and status indicators report the following information:
   Rx = rxBundle/rxStatus/rxDropouts, Tx = txBundle/txReceivers/txDropouts.
   Note that bundle and status indicator information requires viewing MI variables via SNMP with newer versions of Discovery. We'll see these fields completed later in the tutorial after an IP address has been assigned.

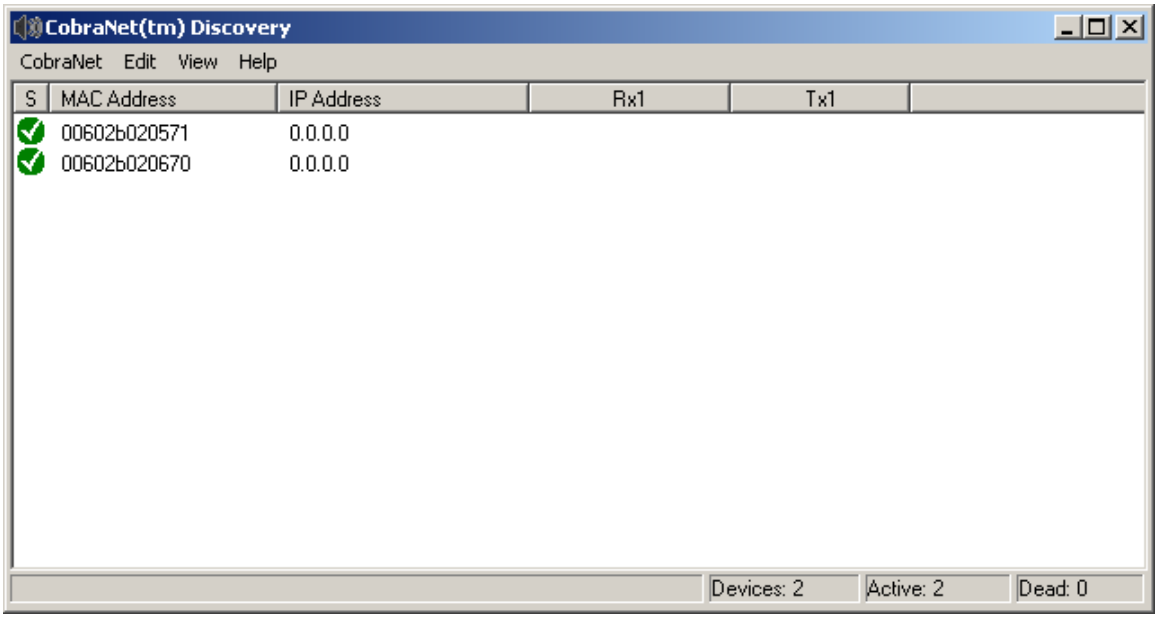

Figure 1

2. We can access network configuration parameters by clicking on "View → Options" or by right clicking anywhere on the Discovery pane and choosing "options" from the drop down menu. "Options" will open the "configuration" pane. Next, we go to the "network adapter" dialog box and choose the NIC adapter that we want to use to discover devices on the CobraNet network.

   After selecting the network adapter, we can manually enter the IP address range that we want to assign to the CobraNet devices. This range normally begins at the NIC address + 1. Optionally, the beginning default address may be automatically presented in the dialog box for us by the Discovery application. There is no need to enter new values if the range is acceptable.

After specifying the IP address range, we can "enable auto assignment" of IP addresses to the CobraNet devices by clicking on the associated checkbox. This will assign a unique IP address each time a new CobraNet device is added to the network. Note that IP addresses are not assigned to non-CobraNet devices. Figure 2 shows the configuration pane.

3. If we open the "discovery" window once again, the list of CobraNet devices are arranged by MAC address. If auto assignment was enabled, each MAC address should now have a unique IP address associated with it (refer to Figure 3 on page 4). Notice that the bundle values and status indicators are now filled in for the transmitters and receivers.

   If an IP address has not been assigned, we can enter one manually so long as it falls within the range specified on the "configuration" pane. To do this, we simply right click on the MAC address of the CobraNet device that we want to assign an address to. We then select "New IP Address…" from the drop down menu. A dialog box appears in which we can enter a unique IP address to the device. Optionally, we may reassign a new value to a device with an existing IP address. See Figure 4 on page 4.

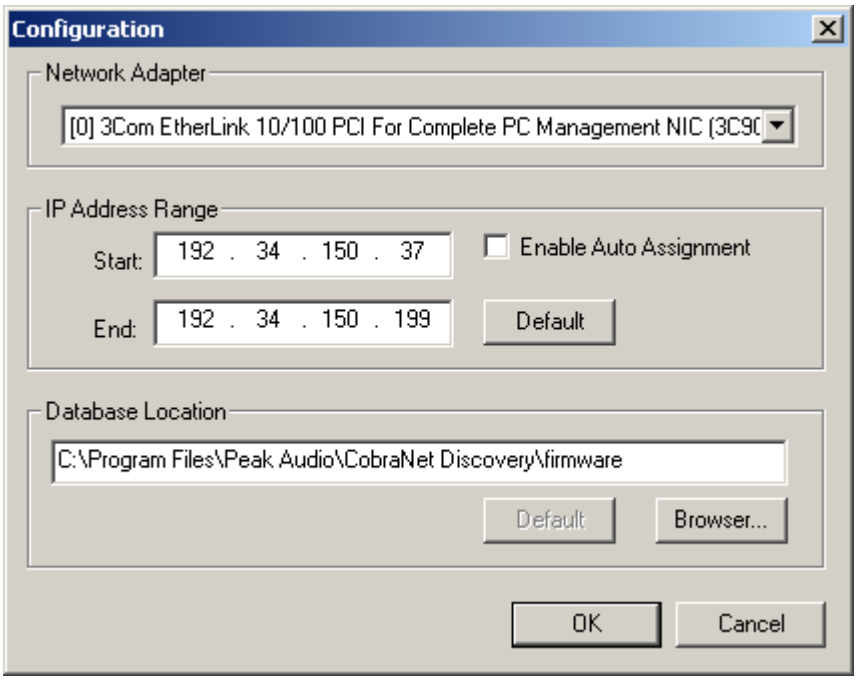

Figure 2

4. In order to be able to reprogram a CobraNet device, we need to properly supply the Discovery application with pointers to the firmware files and with a dependent file that is needed to compute checksums and recognize the type of device undergoing the upgrade. Firmware files should be placed into the "firmware" folder within the CobraNet Discovery directory. An example of the CobraNet Discovery directory location and included files is shown in Figure 5 (also on page 4). The dependent file is the "database.ini" file, which is available for free download from the Peak Audio website. This file should actually be placed *within* the "firmware" folder.

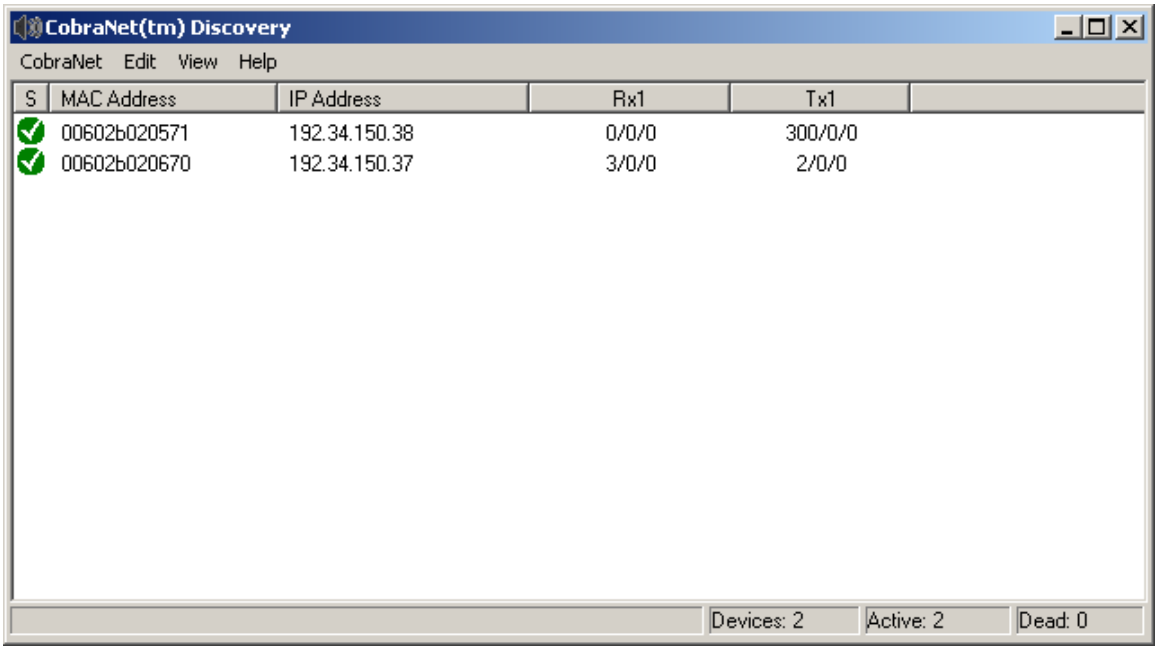

Figure 3

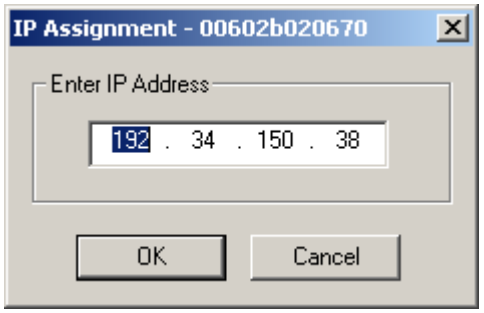

Figure 4

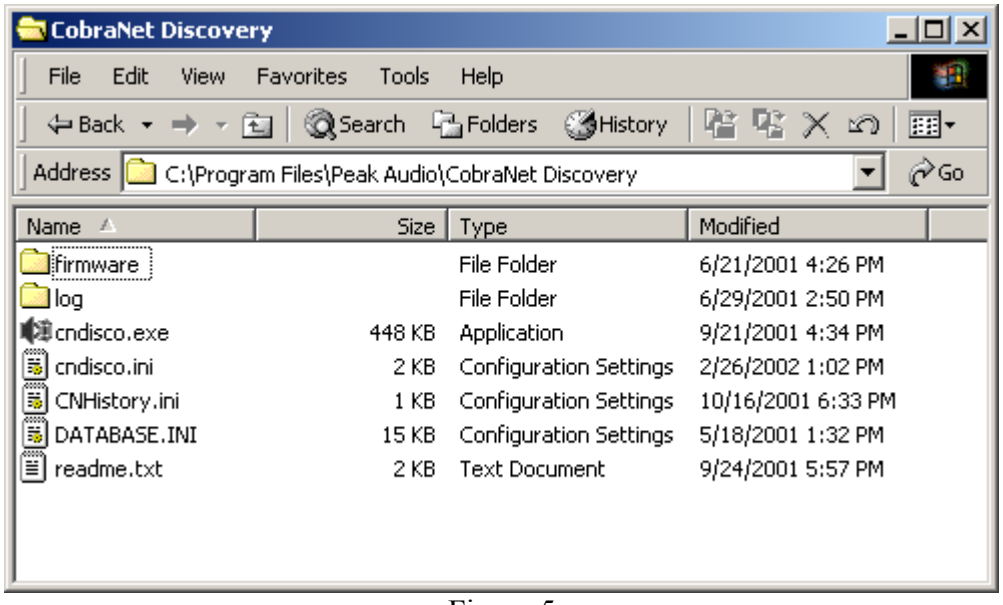

Figure 5

5. The next step is to upload SNMP capable code into the CobraNet device. To reprogram a RAVE (or other CobraNet device supporting TFTP upgrades via Discovery), select the appropriate device from the "configuration" pane by right clicking on its MAC address. Select the "Update Firmware…" option from the drop down menu. The Discovery utility will begin to read the flash boot sector of the selected device. A dialog box will then appear that indicates the "Current Firmware Version" and all "Compatible Firmware Versions" for the device. Figure 6 shows the "Update Firmware…" dialog box.

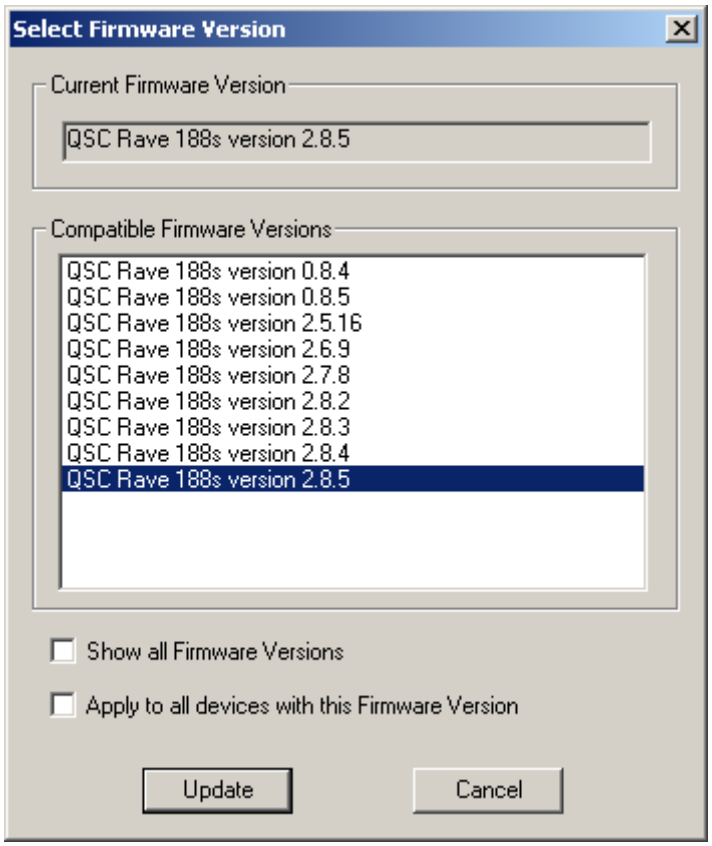

Figure 6

We next select the firmware that we want to upload into the CobraNet device. Finally, we need to select whether to upload all CobraNet devices of the same model or a just a single unit.

Discovery will indicate when the upload has completed successfully. Upon completion we need to invoke a power cycle or firmware restart event in order to enable the new firmware.

As mentioned previously, the Discovery utility also provides some visibility to MI variables. The program may be configured to report network statistics, error indicators and conductor activity. These monitoring features can be invoked by adding variables to the watch window (Discovery pane) via the "Column Chooser" option.

SNMP Basics

The goal of this presentation is to provide a *quick start* reference to get working with device control and monitoring using SNMP. It is not our intent to provide a thorough course detailing the SNMP protocol. However, some basic fundamentals are needed in order to navigate the array of available CobraNet parameters accessible from an SNMP capable application.

There are a number of off-the-shelf SNMP applications available that allow a user to view and configure device parameters over a network connection. QSC has evaluated some of these software applications in-house and most have a similar interface or "browser" for monitoring SNMP capable devices. Though this tutorial should be applicable to most SNMP applications, our presentation is specific to the MG-Soft SNMP "MIB Browser" and "MIB Compiler" suite. MG-Soft offers an assortment of affordable SNMP tools for purchase and many are available for free download on a trial basis. The trial applications are generally limited in function and may have a restriction on the number of devices that can be monitored simultaneously. A link to the MG-Soft tools is located on the QSC website. Optionally, they can be found at http://www.mg-soft.com.

SNMP is a network control and monitoring protocol that provides device communications via point-to-point messaging. SNMP network communication is at the internet protocol layer and therefore requires that each device have a unique IP address assigned. The SNMP protocol uses the reserved UDP/IP ports 161 and 162. UDP/IP (user datagram protocol over internet protocol) ports are used to establish communications between two devices on the network. The ports are needed to identify and direct specific data streams to the target applications running on the devices. What's important here is that CobraNet supports SNMP port 161 communications only. Port 161 is reserved for solicited events. RAVEs will therefore only invoke configuration of device parameters or return monitoring information based on *requests*. Port 162 is reserved for unsolicited events. RAVE products cannot deliver information to a monitoring device based on operating conditions such as faults, timer events or lost deliveries.

SNMP communications function in a client/server fashion. In the SNMP world, the client is the "manager" and the server is the "agent". The manager initiates a "read" and/or "write" request to the server. If able, the agent will service the request(s) and return a response to the manager. Each RAVE product, with CobraNet version 2.6.9 or above, ships with an SNMP agent included in the firmware. The manager is the SNMP application running on a PC or network console. In order to implement management functions with off-the-shelf software such as MG-Soft, the PC must have the "peakAudio" MIB (management information base) file installed within the application. The MIB is simply a file that associates the location of device parameters, which the agent points to on the target machine, with parameter OIDs (object I.D.s) in the desktop application. The MIB also provides textual descriptions of the available device parameters (in our case, the MI variables). The "peakAudio" MIB is available for free download from the Peak Audio website.

Peak Audio has been assigned the enterprise number 2680 from the Internet Assigned Numbers Authority (IANA). The "peakAudio" MIB appends the industry standard MIB tree with the 2680 identifier as well as all OIDs that follow the 2680 prefix.

Figure 7 shows a view of the standard MIB tree with the “peakAudio” MIB loaded. Notice the OID value in the lower left-hand corner of the pane. The OID value presented indicates the value of the last branch or leaf entity in focus, which happens to be the Peak Audio enterprise module (“peakAudio” MIB). Notice the 2680 identifier.

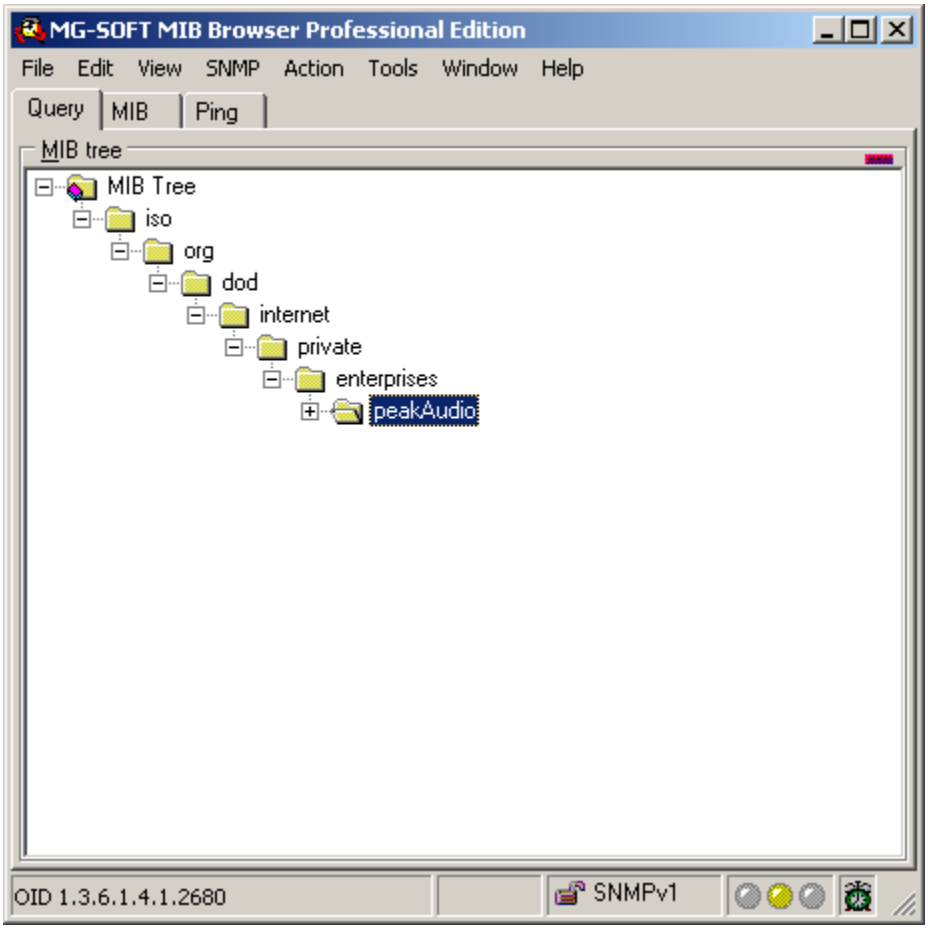

Figure 7

The SNMP MIB tree structure is organized in a parent/child/sibling fashion. Child entities are hierarchically subordinate, or belonging to, a parent entity. Siblings are hierarchically equivalent to adjacent entities. Adjacent entities may belong to parent entities themselves or have child entities subordinate to them.

The OID dotted notation will be appended when new *child* entities are opened within the MIB module or sub-branch. When new *siblings* are opened the OID value will increment but the dotted notation will not be appended.

> It should be noted once again that the new CobraNet Discovery application can read management variables via SNMP. New variables can be added to the watch list if the OID is known. The value of OIDs can be found empirically through use of the MG-Soft MIB Browser application. Peak Audio also publishes descriptions of all MI variables in the CobraNet Technology Datasheet. The datasheet includes the OIDs for each variable that is accessible via SNMP.

Figure 8 shows the “peakAudio” MIB tree with several child branches open and a group of leaves belonging to the “errors” branch. The leaves are siblings among each other. The dotted notation is extended for the “cobraNet” and “coreManager” child branches.

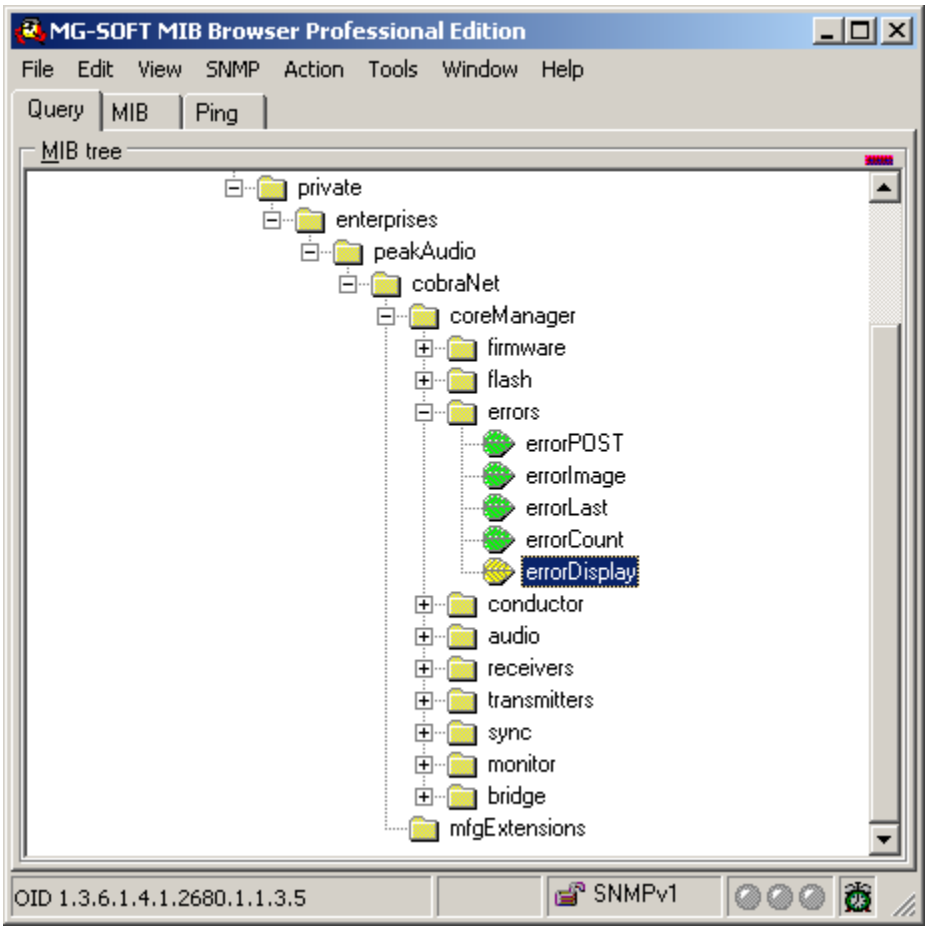

Figure 8

The core manager has one sibling, which is the “mfgExtensions” branch. The core manager also has a group of 10 siblings, all of which are child entities to the core manager. The present leaves are child entities to the “errors” branch and are all siblings amongst themselves. Since the fifth leaf is in focus, the OID shown in the lower left pane is ...2680.1.1.3.5 (we will omit the standard MIB tree notation that precedes the peakAudio MIB). Table 1 shows the breakdown of the OID shown in the image.

2680	1	1	3	5
peakAudio	cobraNet	coreManager	errors	errorDisplay

Table 1

Using Mg-Soft

Setting up the MG-Soft software suite for use with the "peakAudio" MIB requires three primary steps: (1) compiling the MIB for use with MG-Soft's MIB Browser (2) configuring the MG-Soft SNMP application, including IP address entry of all CobraNet devices (3) opening the MIB tree and working with the CobraNet management variables.

The following is a description of the steps necessary to change the transmit bundle assignment on a RAVE 188s device. This description assumes that the RAVE in question has previously been assigned an IP address and is running the appropriate firmware necessary, as described in previous sections of this tutorial.

Step one

Once we've downloaded the MG-Soft application and "peakAudio" MIB, we can open the MG-Soft "MIB Compiler" application. Depending on the view properties, we should normally see some type of split window. One of the panes should indicate the MIB modules available and MIB group(s) supported. The other pane is the workspace and generally shows any MIB modules that are being compiled and/or edited. If we open the "File → Compile" menu option, we can immediately compile the Peak MIB from its present location. If we open the "File → Open" option, we can bring the "peakAudio" MIB into the workspace, select the MIB and then compile it. Once compiled, the application will ask us if we would like to save the compiled MIB in the standard MIB database directory (SMIDB). Figure 9 shows the MG-Soft MIB Compiler application with the "peakAudio" MIB module in the workspace.

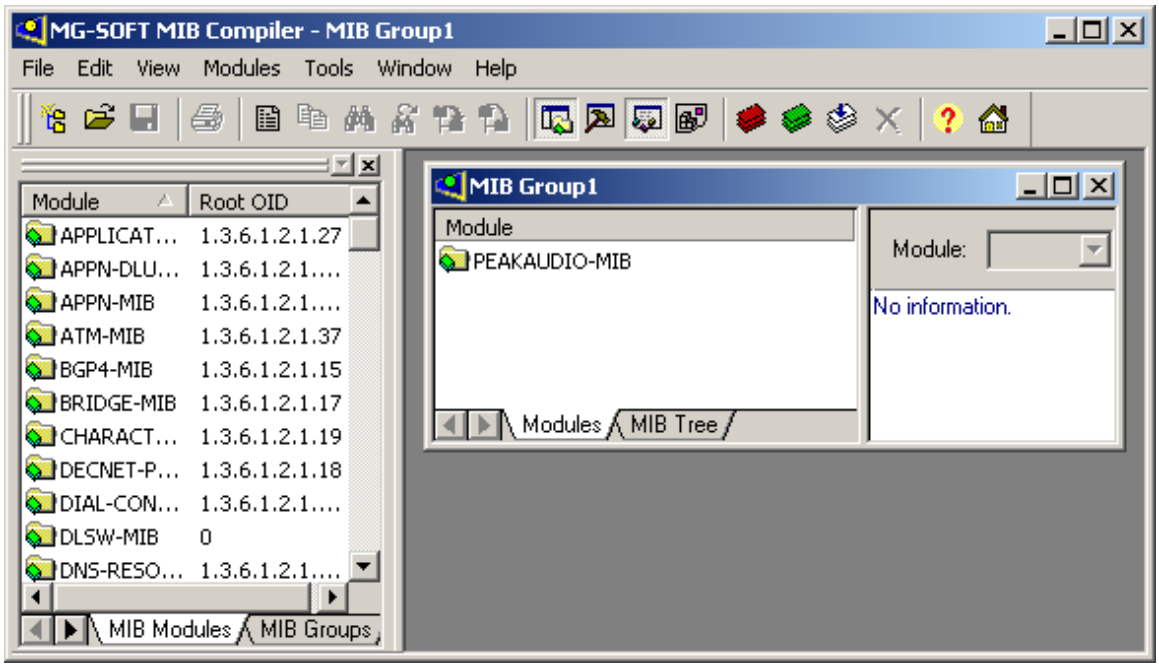

Figure 9

Step two

We'll now open MG-Soft's "MIB Browser" application. We should see a window with the tabs: Query, MIB and Ping. Select the "MIB" tab. Depending on the view properties, a split window should be displayed. The upper pane indicates the currently "Loaded MIB modules" and the lower pane contains the available "MIB modules" that we can load into the browser. To be sure the available list of MIBs is current, we should click the refresh button (circular arrow surrounding an exclamation point between the upper and lower panes) or invoke the "Action → Refresh MIB Module Lists" from the drop down menu on the toolbar. This will make sure that the PEAKAUDIO MIB gets loaded into the module list. Next we'll load the "PEAKAUDIO-MIB" and "RFC1213-MIB" modules by selecting them in the lower pane and clicking the upward red arrow ↑ located between the upper and lower panes. The RFC1213 MIB is used to access "system" parameters, such as device name, and is not necessary for configuration of CobraNet related MI variables. Figure 10 shows the MIB window of the MG-Soft MIB Browser application with the loaded MIB modules.

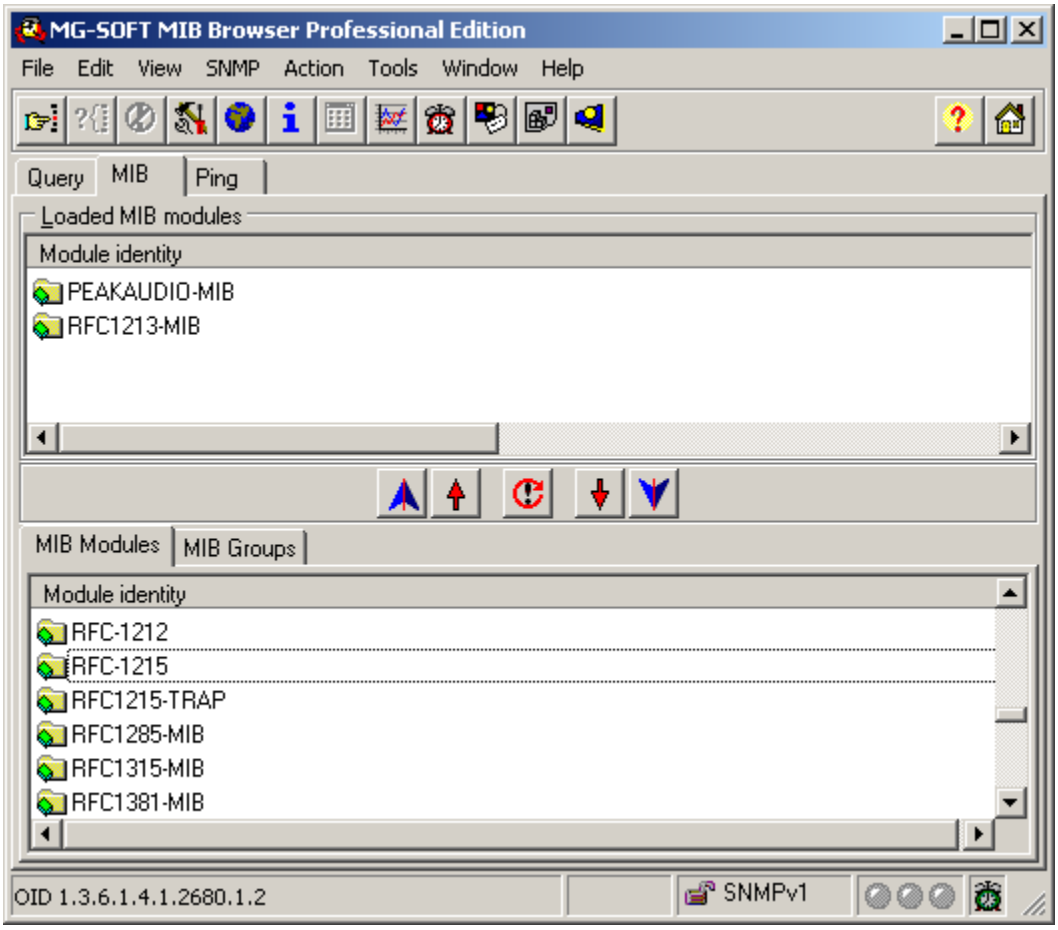

Figure 10

We will now return to the “Query” window and configure the browser. Below the toolbar is a “Remote SNMP Agent” text box used for entering the IP address of the CobraNet devices on the network. Next to the text box is a hammer icon. If we click on the hammer icon we can access the browser protocol preferences (configuration setup). The browser should be configured in order to support the “peakAudio” MIB. The MIB supports SNMP version 1 only. Additionally, the MIB supports solicited messages only. As discussed previously, port 161 is reserved for solicited messages. The “read community” should be set to public. This allows us to monitor all supported variables available in the loaded MIB tree. The “set community” should be set to private. This prevents the user from being able to alter variable values that belong to the standard MIBs that are not directly related to the CobraNet interface or manufacturer’s product. Peak Audio has provided some support for the standard MIB-II variables, which are accessible through the RFC1213 MIB. MIB-II variables allow the user or network administrator to provide a system name to the device, provide contact and location information and to determine the physical (MAC) address of the device among other things. Figure 11 shows what the basic configuration of the protocol preferences setup should look like.

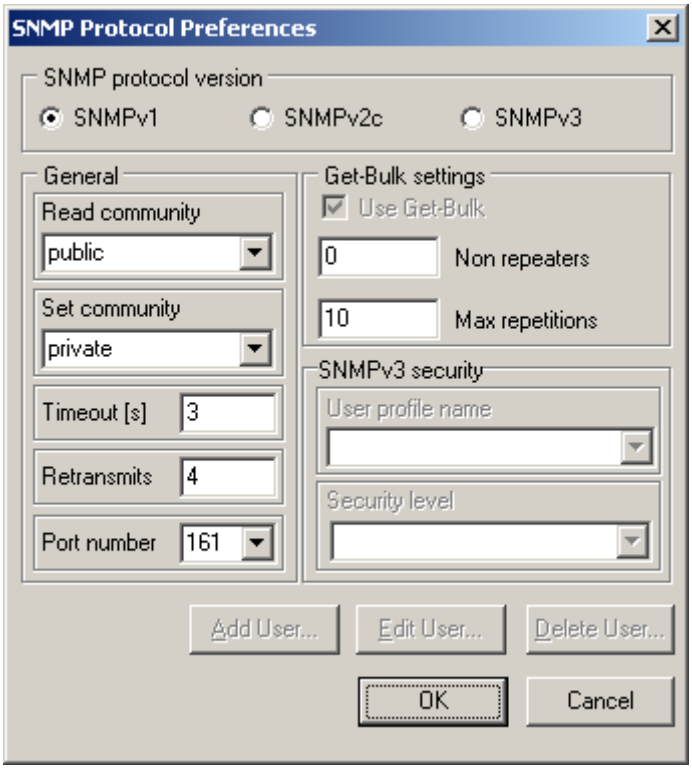

Figure 11

Timeout and Retransmit values should be set appropriately for the network design. “Timeout” is normally set for one or two seconds. Longer intervals may be required for very large networks with heavy traffic conditions. “Retransmits” represents the number of times a lost or unacknowledged message is resent to the intended recipient. Bulk parameters are not available with SNMP version 1.

After configuring the protocol preferences we can enter the RAVE 188s IP address in the "Remote SNMP Agent" text box. Figure 12 shows the Query window with the RAVE 188s IP address entered in the "Remote SNMP Agent" text box.

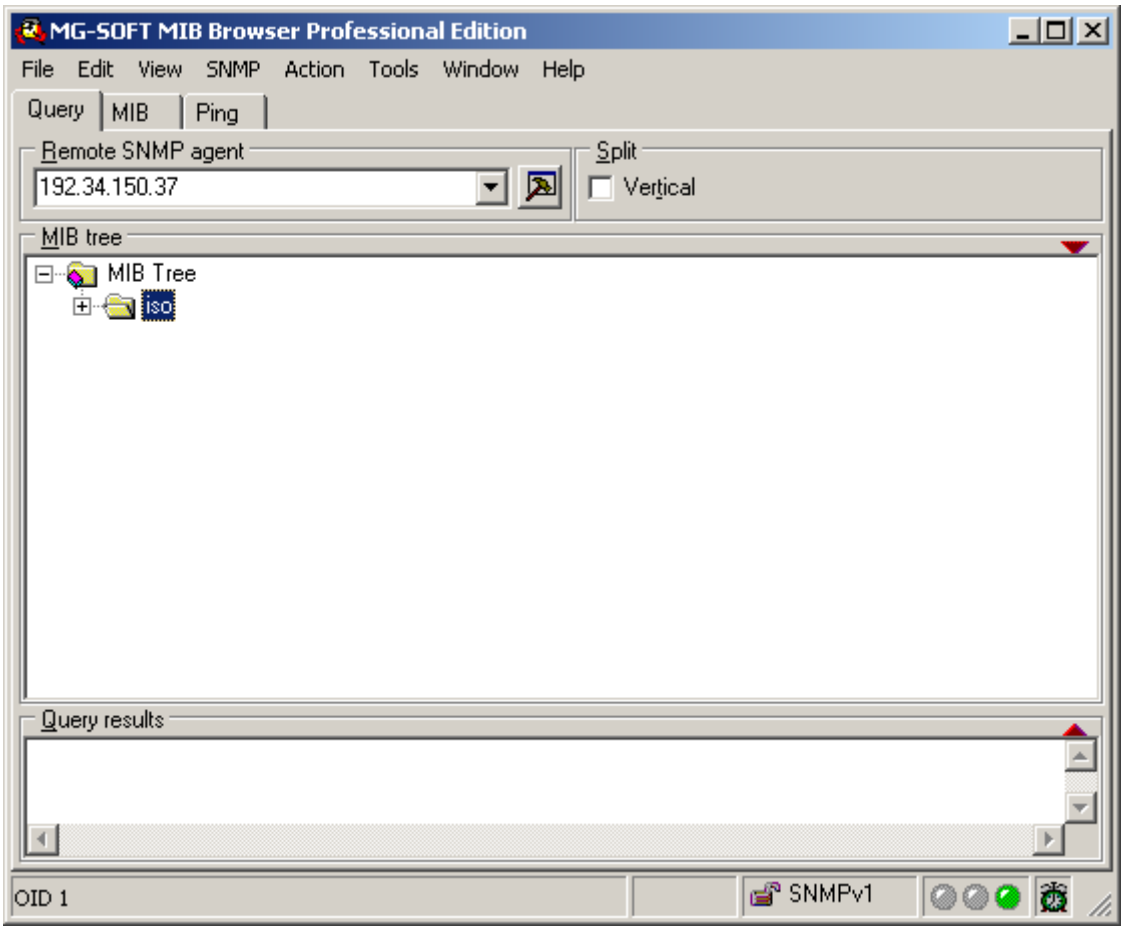

Figure 12

Step three

At last, we're ready to work with the MIB browser to configure the RAVE 188s. The first step is to expand the MIB tree until all branches of the "coreManager" are visible. The MIB browser application can be configured to expand to the same OID value each time the program is opened. It is also possible to right click and use the "expand" command to open all child entities from the branch in focus. Optionally, each branch may be opened individually.

We will further expand the "transmitters" branch from beneath the "coreManager". From the transmitters branch we can access the "txChannel" variables by expanding the "txEntry" parent entity. Configuration of the "txChannel" variables will allow us to alter

the bundle assignments for delivering audio over the network, which is our goal with this portion of the tutorial. Figure 13 shows the expanded MIB tree with the “transmitters”, “txTable” and “txEntry” entities expanded. The “txChannel” leaf is shown as one of the available child entities (MI variable parameters) in the MIB tree.

There are a number of avenues in the browser application to gain access to the “txChannel” variables. For the purposes of this tutorial we will right click on the “txChannel” leaf and select the “Info → No Instance” option from the drop down menu.

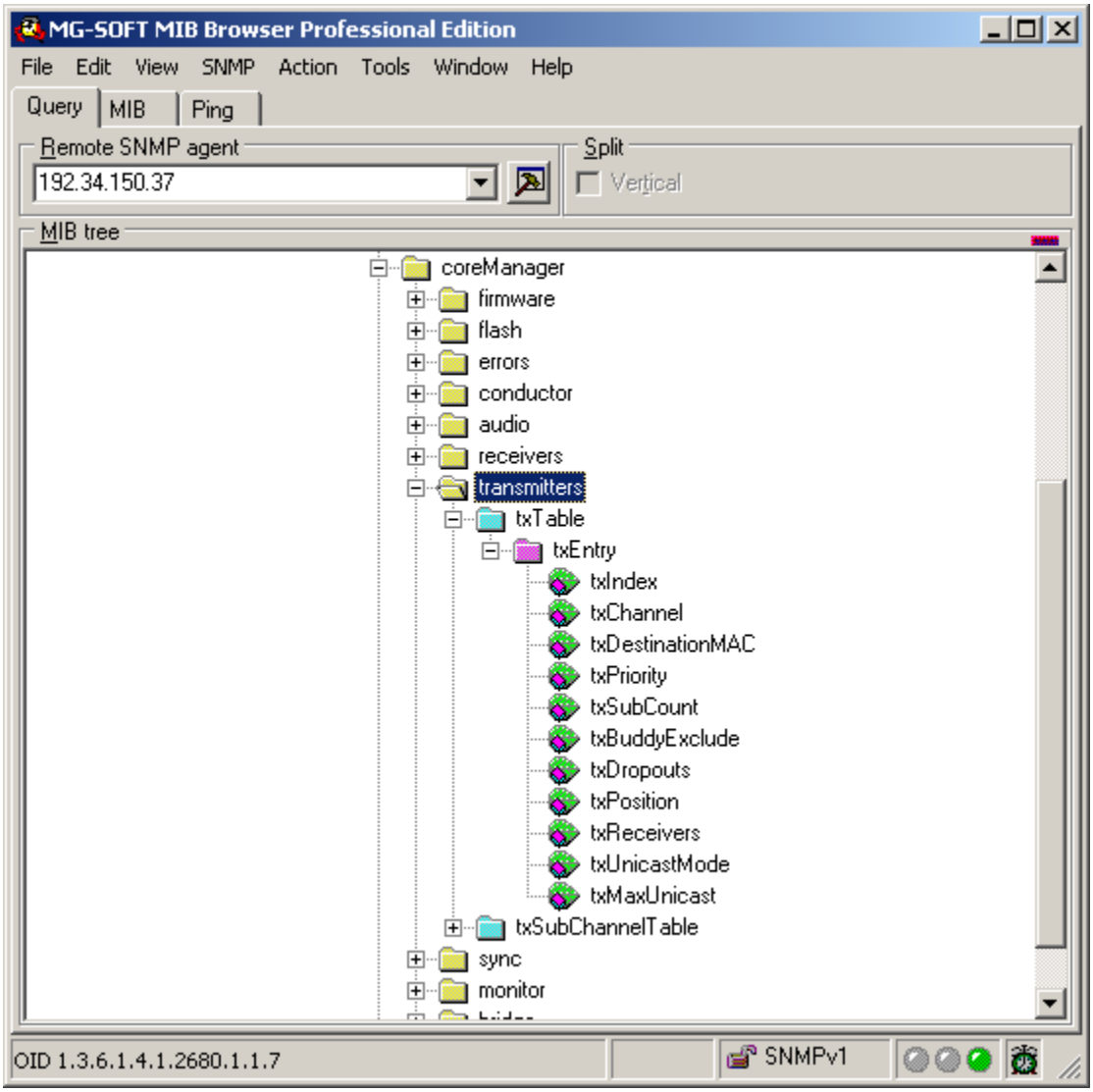

Figure 13

When multiple instances of a variable are available, such as a device with multiple transmit bundles, the instances options allow the user to select which variable to access. In our case, we want to see all instances so that we can get an idea of the variables structure.

Once the info window is displayed we can see that there are two transmitters available to the RAVE 188s. These transmitters are indicated with the “txChannel.1” and “txChannel.2” variables. The bundle value assigned to the first transmitter is shown in the right portion of the pane under the “value” heading. If we right click on this leaf we should see the “Set” window with the OID for “txChannel.1” in the “OID to Set” text box. We should also see the proper IP address for the RAVE 188s in the “Remote SNMP Agent” box. Before we alter the bundle assignment by changing the value in the set window, we should verify that the protocol preferences are correct at the leaf level. This step is really only necessary with older versions of MG-Soft and only applies to the first time the application is configured. We can verify the parameters by once again selecting the hammer icon in the upper right corner of the set window. If all parameters are correct, we can return to the set window. Altering the bundle assignment is simply a matter of entering a new value, in decimal, into the “Value to Set” text box and then clicking the “set” button at the top left corner of the window. The set button is the one with the hammer, screw driver and wrench icon. After setting the new bundle value we can verify the change by viewing the results in the info window and through any audible or front panel indicators with the RAVE device. Note that the info window may require a refresh if the polling rate is set for a wide interval. Figure 14 shows the set window and the resulting bundle value (txChannel.1) in the info window.

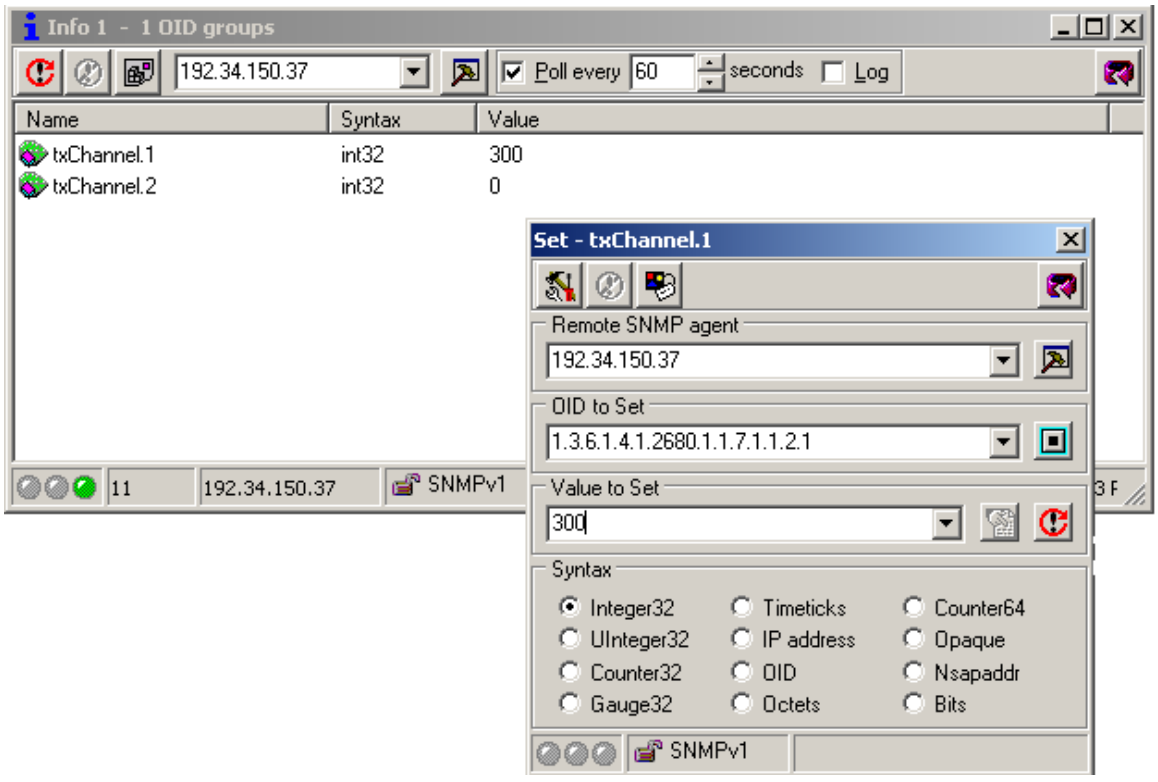

Figure 14

Although there seem to be a lot of steps to enact a small change, the process moves quickly once we're acquainted with the procedure. Additionally, the MG-Soft MIB Browser application can be setup to jump right to the set operation for a given variable. If bundle assignments are the main interest, the user may wish to setup the application to jump directly to the transmitters' info window or the set window.

Additional Features

There are well over 100 individual variables that can be altered on the RAVE products using the SNMP interface. The latest CobraNet firmware also allows the user to configure the interface (RAVE device) to retain any MI configurations in permanent memory. This allows us to configure conductor properties and preferences for a given device, setup redundant functions, setup synchronization options, perform complex audio routing, copy audio channels, configure serial communications (RS232) for point-to-point or global delivery and control and monitor an assortment of other parameters. Once configured, we can retain the parameters after a reset, power cycle or firmware restart event.

Since SNMP is a widely accepted control and monitoring protocol in the network and IS industries, all devices on a LAN or WAN can be configured from a single source. This provides a network administrator the ability to manage network switches, gateways, routers, printers, desktop devices and CobraNet products all from a single application. Additionally, some SNMP applications provide a network view of all devices on the LAN or WAN and may allow the manager to enable fault tolerance, redundant links and packet filtering as well as a host of other functions from a central control point.

An additional benefit of using SNMP is that a user can opt for using one of a number of off-the-shelf software applications or create a custom GUI with widely available tools. Manufacturers also have the ability to extend the "peakAudio" MIB with the manufacturer's extension agent (mfgExtensions). This allows users to control and monitor product-specific parameters and CobraNet MI variables from the same off-the-shelf SNMP application or custom GUI.

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