Technical report ECE.P54.2006.2

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Project54 XM Satellite Radio Application

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1 Introduction

A software module has been developed for the Project54 (P54) system [1] enabling P54 control of an XM Satellite Radio. The P54 embedded computer replaces the traditional XM radio control head. The normal functions of the radio control head are accessed through touch screen interaction with the P54 XM Radio application or by voice command. In order to use the XM radio with the P54 system, a configuration procedure must first be completed. This document describes the procedure for completing the configuration and using the XM Radio Application.

2 Hardware Setup

To begin the XM Radio configuration, connect the XM receiver hardware to the P54 Intelligent Transportation Systems Data Bus (IDB) [2] as shown in figure 1. The XM radio Common IDB Interface may be connected to any available RJ45 port on the network and does not need to connect directly to the computer Common IDB Interface as indicated in the figure. The address of the XM Common IDB Interface is 1C. The Embedded PC must have the P54 system software installed prior to performing the XM Radio configuration.

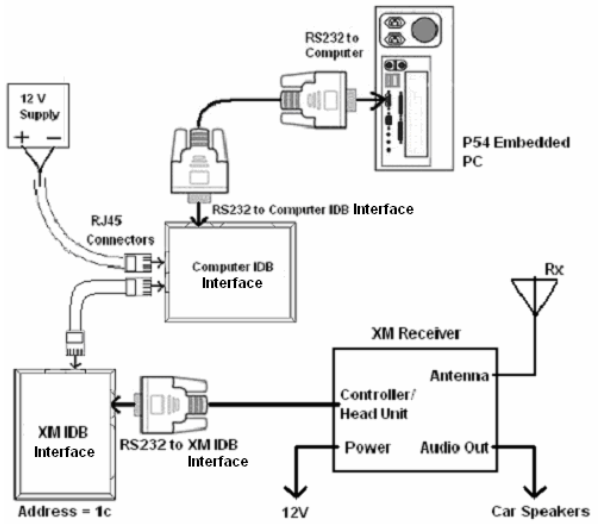

Figure 1 – XM Configuration Hardware Setup

2.1 XM Receiver to RS232 Interface Cable

The XM Receiver in figure 1 features an 8 pin mini-DIN style connector for the Controller/Head Unit port. A custom interface cable must be constructed to connect the XM receiver controller port to the 9-pin serial RS232 port of the XM Common IDB Interface. Additionally, pins 6 and 7 of the 8-pin connector must be connected to the positive voltage supply and pin 8 must be connected to ground. Figure 2 shows the wiring diagram for connecting the 9-pin serial RS232 cable to the 8 pin connector.

Cable Connection Pinout	
8 pin mini-DIN to	**RS232 DB-9**
Pin 1	Pin 3
Pin 2	Pin 2
Pin 3	Pin 5
Pin 6	+12 Volts
Pin 7	+12 Volts
Pin 8	Ground

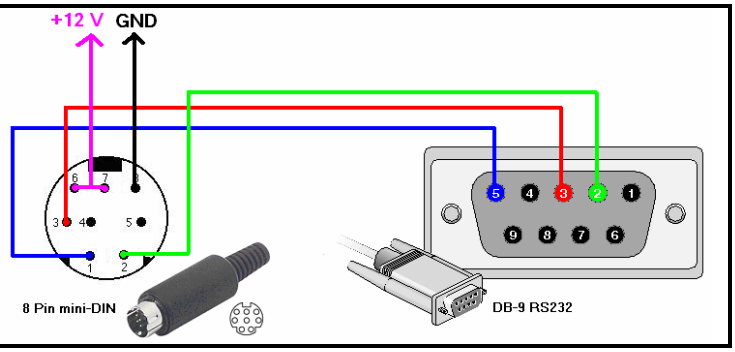

Figure 2 - Cable Pinout for Connecting XM Receiver to Common IDB Interface

3 XM Setup Application

Once the XM Radio Hardware has been connected to the IDB network, start the XM Setup Application by running the file *XM Setup.exe*. Prior to opening, the XM Setup Application will test the IDB network to determine if there is an active connection. If the test is successful, the application will open normally as shown in figure 3.

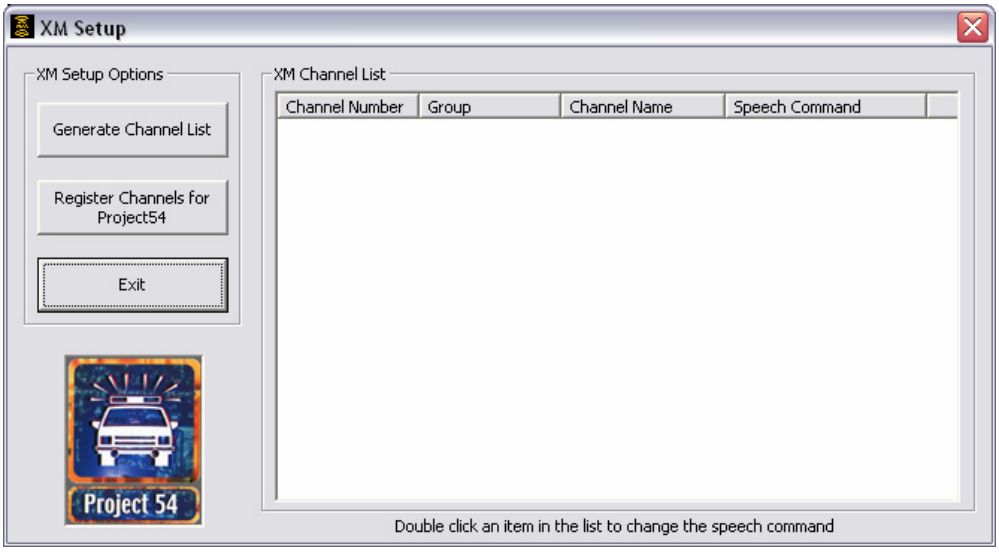

Figure 3 – XM Setup Application

3.1 In Case of Connection Error

If the XM Setup Application is unable to communicate with the XM receiver through the IDB network, the error message shown in figure 4 will be displayed and the setup application will not open. Verify all hardware connections (figure 1) and try cycling power before proceeding. The embedded computer must have the P54 system software installed in order to run the XM Setup Application.

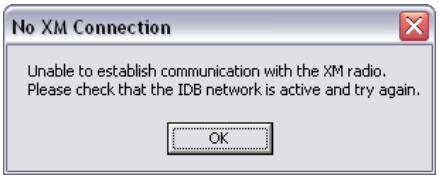

Figure 4 - XM Connection Error

3.2 Generate the Channel List

Once the XM Setup application opens successfully as shown in figure 3, the first step in the configuration process is to generate the list of available radio channels. Press the button *Generate Channel List* to begin scanning the available XM Radio channels. A progress dialog will be displayed as shown in figure 5. The channel scan can be stopped at any time by pressing *STOP*. Stopping the channel scan prior to completion will result in a partial channel list. The channels that are not scanned will be unavailable when using the P54 XM Radio Application. A complete scan of all available XM channels will take approximately 5 minutes.

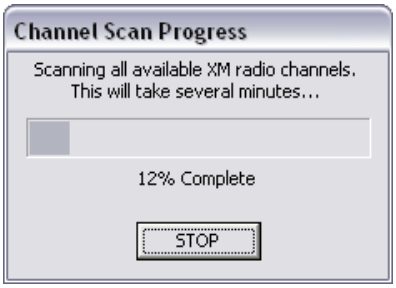

Figure 5 - Channel Scan Dialog

3.3 Edit Speech Commands

After the channel scan has completed, the *XM Channel List* shown in figure 3 will be populated with information regarding each of the available channels. For each available channel, the channel number, group and name will be displayed as well as the speech command used for selecting that channel by voice command within the P54 XM Radio Application. The use of speech commands to select XM radio channels within the P54 XM Radio Application will be covered in section 4.

To change the speech command associated with any channel, double click on that channel entry in the *XM Channel List.* The selected channel will be highlighted and the

Change Speech Command dialog will open as shown in figure 6. This dialog will display information regarding the selected channel and will provide an edit box for changing the speech command associated with that channel.

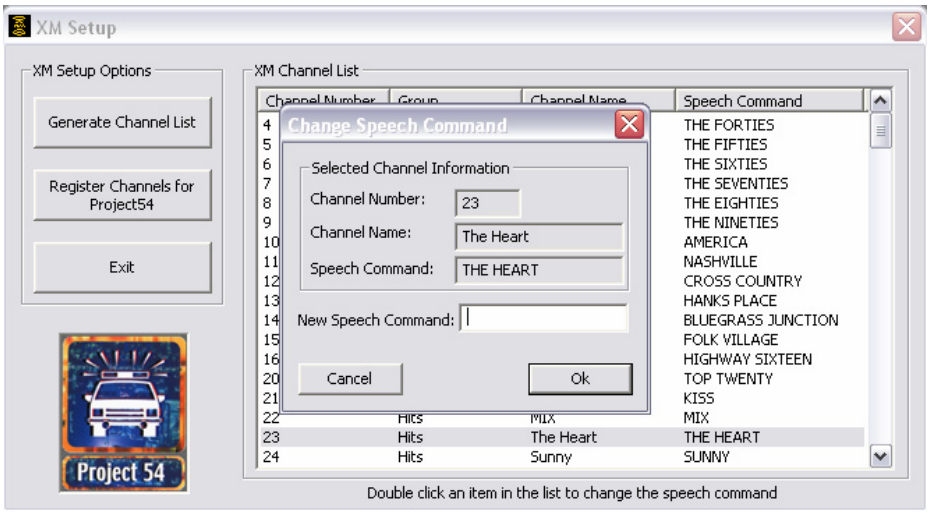

Figure 6 - Change Speech Command Dialog

Type the desired channel selection speech command into the edit box labeled *New Speech Command* and press *OK* to update the information. The spoken command associated with each channel should adhere to the following guidelines for compatibility with the speech recognition engine used by the P54 system software:

- Do not include any special characters (*, &, ^, $, #, @, !,', etc)
- Enter commands in ALL CAPS
- Spell out all numbers (The 40s = THE FORTIES)
- Include a space between letters in acronyms (CNN News = C N N NEWS)

The setup application will automatically perform checks for compliance with the first two guidelines and will ensure that no duplicate entries are present. It is recommended that you verify all speech commands and make any appropriate changes prior to registering the channel list.

3.4 Register the Channel List

The final step in the configuration process is to register the list of available channels so that those channels will be available when using the P54 XM Radio Application. After the channel list has been generated and all speech commands have been verified, press the button *Register Channels for Project54* to complete the

configuration process. Registering the XM channel list will create the registry keys required to operate the P54 XM Radio Application. Once registered, a channel list can be reviewed and changes can be made to any speech commands by re-running the XM Setup Application. Running the setup application after a channel list has been registered will automatically load the channel list information from the registry for viewing and editing purposes.

4 Project54 XM Radio Application

The Project54 XM Radio Application enables full control of all XM Radio functionality through a P54 Graphical User Interface (GUI). The XM Radio functions are accessed via touch screen control of the P54 XM Radio Application or through user issued speech commands. Figure 7 shows the Project54 XM Radio Application GUI. The text fields used for displaying the current XM Radio channel information have been highlighted and labeled in the figure.

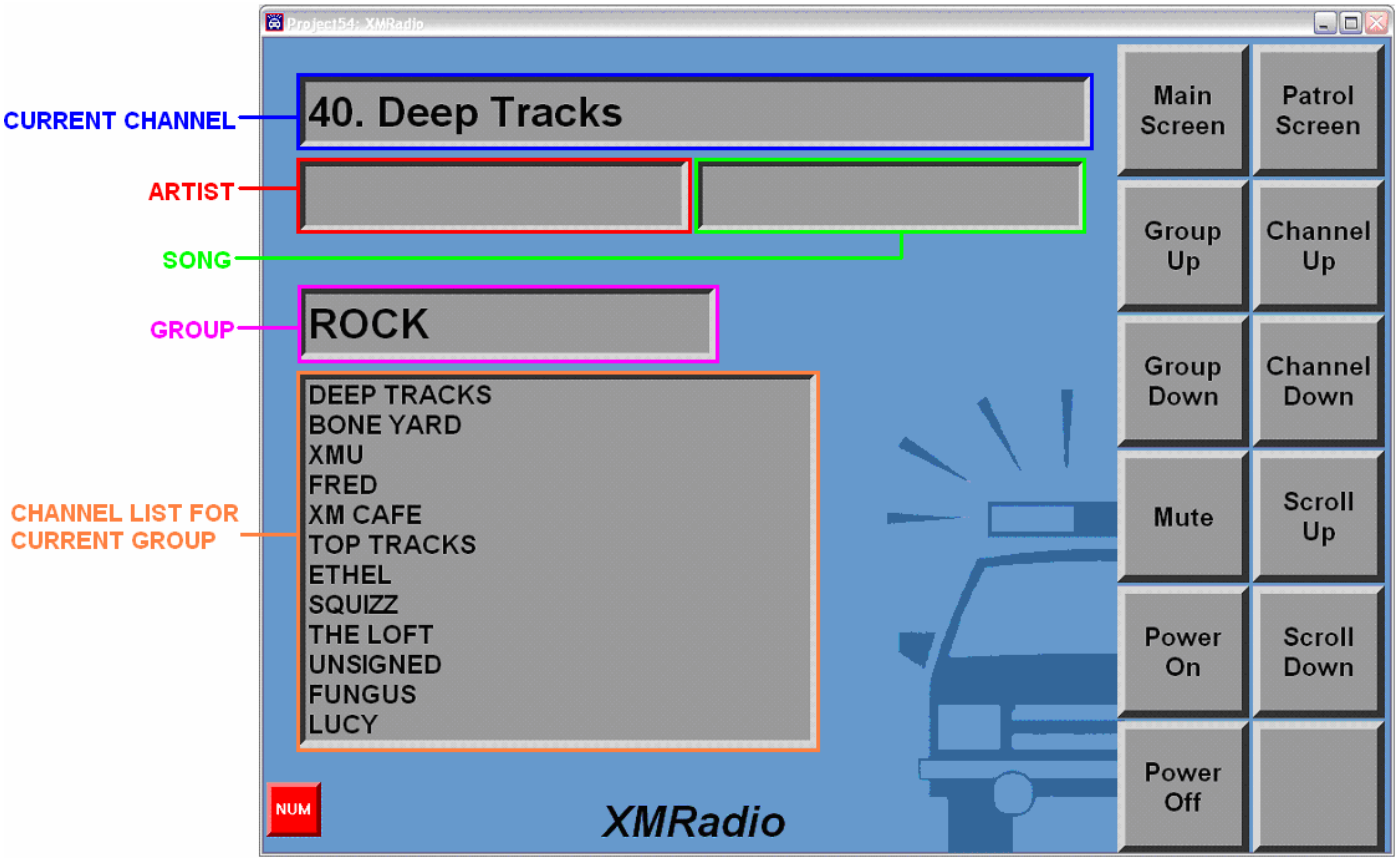

Figure 7 - P54 XM Radio Application GUI

4.1 Touch Screen Control

Each button shown on the right hand side of the P54 XM Application GUI can be used to control a function of the XM Radio Application. To execute any of the functions shown, simply press the corresponding button on the screen. Table 1 provides a summary of all button functions.

GUI Button	Function	GUI Button	Function
Group Up	XM Channels are grouped based on music type or content. Press this button to select the next channel group.	Mute	When pressed, the audio output of the XM radio will be muted until the button is pressed a second time, which will un-mute the radio.
Group Down	Press this button to select the previous channel group.	Power On	Turn On the XM Radio receiver hardware.
Channel Up	Press this button to select the next channel in numerical order.	Power Off	Turn Off the XM Radio receiver hardware.
Channel Down	Press this button to select the previous channel in numerical order.	Main Screen	Switch to the P54 Main Screen Application.
Scroll Up	Press this to scroll up through the channel list for the current group.	Patrol Screen	Switch to the P54 Patrol Screen Application.
Scroll Down	Press this to scroll down through the channel list for the current group.		

Table 1 - P54 XM Radio Application GUI Button Functions

4.2 Speech Control

All of the XM Radio Application functions listed in table 1 can be accessed through speech interaction with the P54 XM Radio Application. The vehicle mounted Push-To-Talk (PTT) button is used for enabling all speech interaction with the P54 system [1]. While holding down the PTT, speak the name of the GUI button associated with the desired function, then release the PTT. This will execute the function associated with the speech command. For example: holding down the PTT, saying “Mute” and then releasing the PTT will mute the audio output from the XM Radio.

Valid speech commands for controlling the P54 XM Radio Application include all GUI button names, the names of all channel groups and the names of individual channels within the currently selected channel group. Table 2 provides a summary of valid speech enabled functions and the method used to perform each.

Speech Enabled Function	Method While holding down PTT, *"say this":*
All GUI Button Functions	*"the name of the GUI button"*
Switching to a specific named group of channels (Instead of changing groups using "Group Up" and "Group Down")	"GROUP" + *"the name of the group to switch to"* Valid group names include the following: • Christian • Classical • Comedy • Country • Dance • Decades • Hits • Jazz and Blues • Kids • Latin • Lifestyle • News • Rock • Sports • Talk and Entertainment • Traffic Weather • Urban • World Example: saying "GROUP ROCK" would select the Rock channel group.
Switching to a specific named channel within a group (Instead of changing channels using "Channel Up" and "Channel Down")	*"the name of the desired channel as shown in the channel list for the current group (see figure 7)"* Note: The desired channel must be listed in the current group.

Table 2 - P54 XM Radio Application Speech Command Summary

5 References

[1] W. Thomas Miller, III, Andrew L. Kun and William H. Lenharth, "Consolidated Advanced Technologies for Law Enforcement Program," IEEE Intelligent Transportation Systems Conference, Washington, DC, October 3-6, 2004

[2] Michael E Martin, "Development of the Common Intelligent Transportation System Data Bus Interface for the Project54 System," Master's Thesis, University of New Hampshire, 2002