

JMRI DecoderPro

A conceptual overview

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Outline

- **Conceptual** overview of **JMRI** and **DecoderPro**
- Not a lot of detail
- **Won't** teach you how to use it
- **Will** try to explain why you would want it
- How DecoderPro fits into a typical DCC system
- Examples are from my Digitrax system

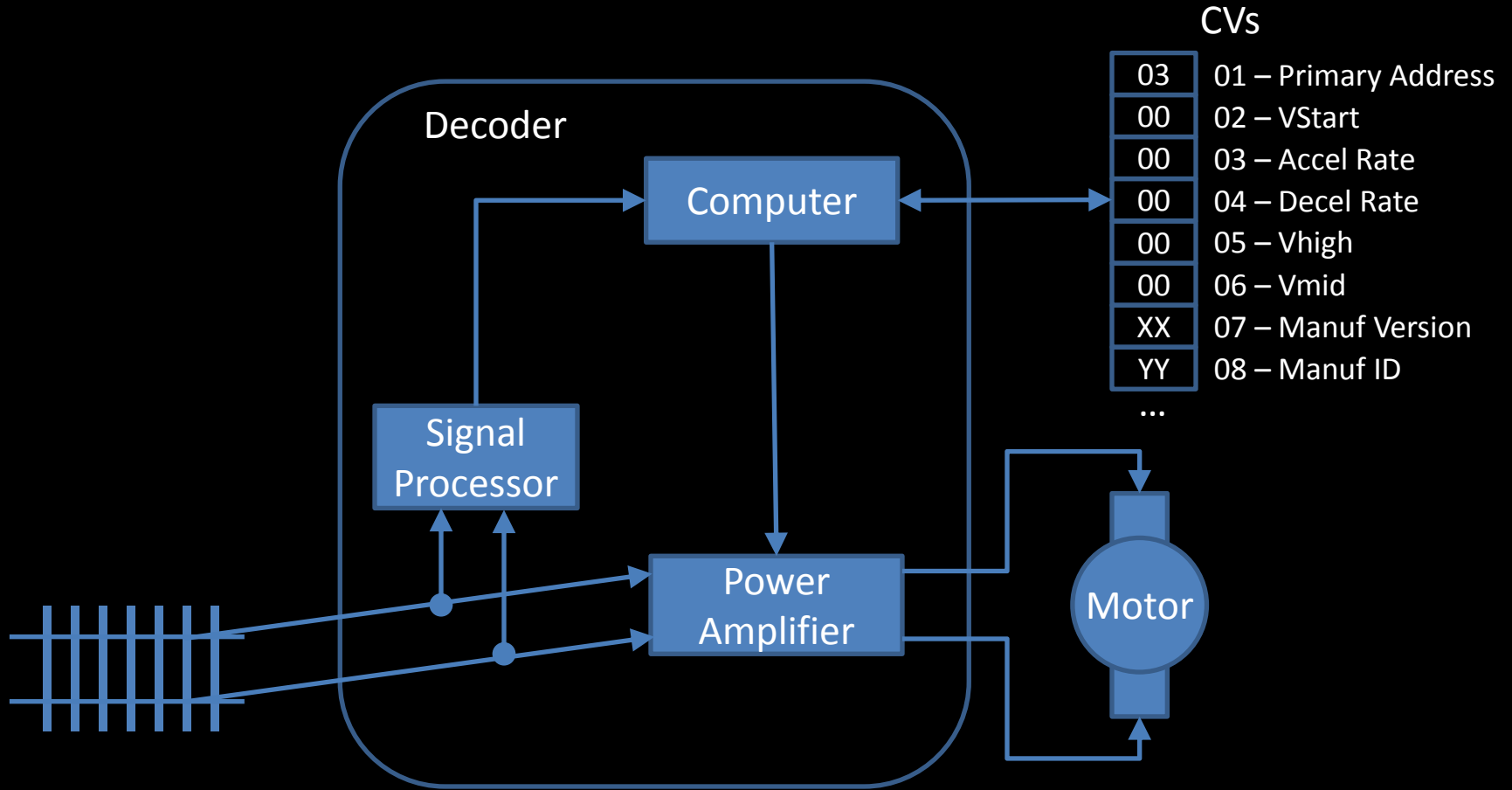
Decoder Programming 101

- Programming a decoder changes its **behaviour**
 - Simplest is its primary address
- Done with values stored in **Control Variables**
- All DCC systems *can* program decoders
- DecoderPro makes this **much** easier

Control Variables (CVs)

- Everything controlled by so-called **CV** values
 - CV = Configuration Variable = just a number
 - 1024 CVs allowed by NMRA standard
- Values range from 0 – 255 (1 byte, 8 bits)
 - e.g. CV 1 is the primary (short) address (1 – 127)
- Some are very complex
 - e.g. CV 29 holds 8 different things!

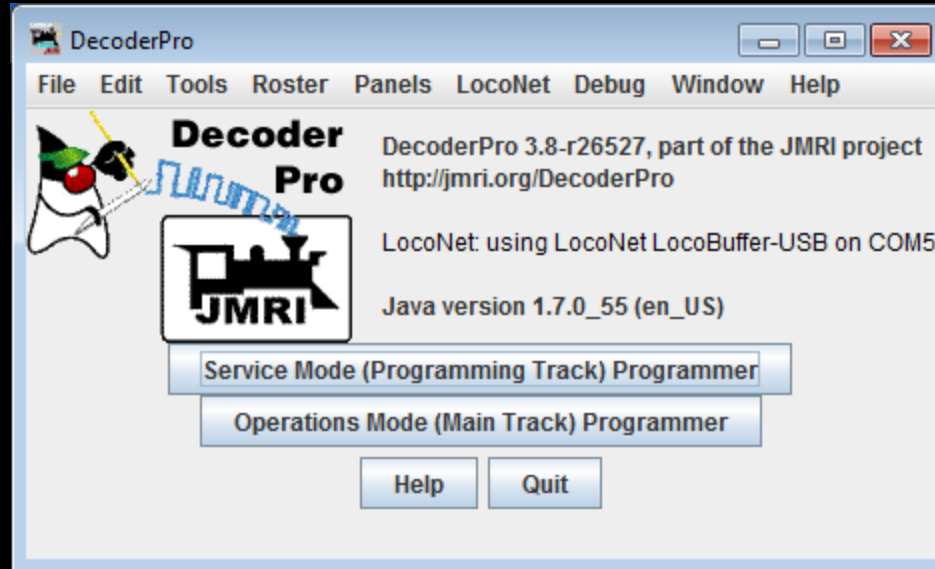
Decoder Architecture



Programming using a DCC System

- All systems can program any decoder
- Basic operation is to write a value into a CV
- That's it!
- Some will help with complex CVs like the long address in CV 17-18
- Simple in principle, but a **LOT** of details for you to sort out and keep track of
- This is where **DecoderPro** comes in...

What is Decoder Pro?



- A fancy piece of software that turns your **computer** into a **DCC throttle**
- **That's it!**
- ...but a *Very* sophisticated throttle

Why use DecoderPro?

- Why use it if your DCC system will work?
- Helps Identify decoders
- Displays CVs and their values with understandable names
- Allows all CV values to be stored in a **roster** file
- Various aids for selecting values (speed tables)
- Lets you think in **locomotive terms**, instead of just a bunch of numbers
- And a whole lot more!

CV 29 Example

- Holds **8 different things**, one per bit.
 - Bit 0 = **Locomotive Direction**: "0" = normal, "1" = reversed. This bit controls the locomotive's forward and backward direction in digital mode only. Directional sensitive functions, such as headlights (FL and FR), will also be reversed so that they line up with the locomotive's new forward direction. See S-9.1.1 for more information.
 - Bit 1 = FL location: "0" = bit 4 in Speed and Direction instructions control FL, "1" = bit 4 in function group one instruction controls FL. See S-9.2.1 for more information.
 - Bit 2 = **Power Source Conversion**: "0" = NMRA Digital Only, "1" = Power Source Conversion Enabled, See CV#12 for more information,
 - Bit 3 = Bi-Directional Communications: "0" = Bi-Directional Communications disabled, "1" = Bi-Directional Communications enabled. See S-9.3.2 for more information.
 - Bit 4 = **Speed Table**: "0" = speed table set by configuration variables #2,#5, and #6, "1" = Speed Table set by configuration variables #66-#95
 - Bit 5 = "0" = **one byte addressing**, "1" = **two byte addressing** (also known as extended addressing), See S 9.2.1 for more information.
 - Bit 6 = Reserved for future use.
 - Bit 7 = Accessory Decoder: "0" = Multifunction Decoder, "1" = Accessory Decoder
- **Simple, isn't it!**

Long Address in CV 17 & CV 18

- CVs can only store between 0 – 255
- Long addresses, up to 9999, need two CVs
- Not a simple format!
- Example, address 1403
 - 1403 = 0x057B, but 2 high bits must be ones
 - Therefore, 0xC57B -> 0xC5 and 0x7B
 - CV 17 = 0xC5 (most significant bits)
 - CV 18 = 0x7B (least significant bits)
 - In decimal, 0xC5 = **197**, and 0x7B = **123**
- Again, Simple, isn't it!

Direct Editing of CVs

UP 1403

File Reset Window Help

Function Map Lights Analog Controls Consist Advanced Sound Sound Levels CVs

Roster Entry Basic Motor Basic Speed Control Speed Table

CV ^	Value (Deci...	State	Read	Write	Compare
1	3	Read	Read	Write	Com...
2	0	Read	Read	Write	Com...
3	1	Read	Read	Write	Com...
4	0	Read	Read	Write	Com...
5	0	Read	Read	Write	Com...
6	0	Read	Read	Write	Com...
7	34	Read	Read	Write	Com...
8	129	Read	Read	Write	Com...
13	0	Read	Read	Write	Com...
17	197	Read	Read	Write	Com...
18	123	Read	Read	Write	Com...
19	0	Read	Read	Write	Com...
20	38	Read	Read	Write	Com...

Long Address 1403

Read changes on sheet Write changes on she... Compare changes on sheet Read full sheet Write full she... C

Read changes on all sheets Write changes on all shee... Read all sheets Write all shee...

Programming Mode Paged Mode

OK

Long Address & CV 29 in DecoderPro

The screenshot shows the DecoderPro software interface for a UP 1403 decoder. The window title is "UP 1403". The menu bar includes "File", "Reset", "Window", and "Help". The interface has several tabs: "Function Map", "Lights", "Analog Controls", "Consist", "Advanced", "Sound", "Sound Levels", and "CVs". Under the "Analog Controls" tab, there are sub-tabs: "Roster Entry", "Basic", "Motor", "Basic Speed Control", and "Speed Table". The "Basic" sub-tab is selected.

Under "Basic", there are two radio buttons: "Short (one byte) address" (unselected) and "Long (two byte) address" (selected). Below these is the "Active DCC Address:" field with the value "1403".

Other settings include:

- Primary Address: 3
- Extended Address: 1403
- Address Format: Long (two byte) address (dropdown)
- Normal direction of motion: forward (dropdown)
- Speed steps: 28 speed step format (dropdown)
- Analog (DC) Operation: DC conversion enabled (dropdown)
- User Private ID #1: 0
- User Private ID #2: 0
- Manufacturer ID: 129
- Version ID: 34

At the bottom, there are buttons for "Read changes on sheet", "Write changes on she...", "Read full sheet", and "Write full she...". Below these are buttons for "Read changes on all sheets", "Write changes on all shee...", "Read all sheets", and "Write all shee...". The "Programming Mode" is set to "Paged Mode" (dropdown). The "OK" button is at the very bottom.

Long Address & CV 29 in DecoderPro

The screenshot shows the DecoderPro software interface for a UP 1403 decoder. The window title is "UP 1403". The menu bar includes "File", "Reset", "Window", and "Help". The interface has several tabs: "Function Map", "Lights", "Analog Controls", "Consist", "Advanced", "Sound", "Sound Levels", and "CVs". Under "Analog Controls", there are sub-tabs: "Roster Entry", "Basic", "Motor", "Basic Speed Control", and "Speed Table". The "Basic" sub-tab is active, showing the following settings:

- Short (one byte) address
- Long (two byte) address
- Active DCC Address:
- Primary Address:
- Extended Address:
- Address Format:
- Normal direction of motion:
- Speed steps:
- Analog (DC) Operation:
- User Private ID #1:
- User Private ID #2:
- Manufacturer ID:
- Version ID:

At the bottom of the interface, there are buttons for "Read changes on sheet", "Write changes on she...", "Read full sheet", and "Write full she...". Below these are buttons for "Read changes on all sheets", "Write changes on all shee...", "Read all sheets", and "Write all shee...". The "Programming Mode" is set to "Paged Mode". An "OK" button is at the very bottom.

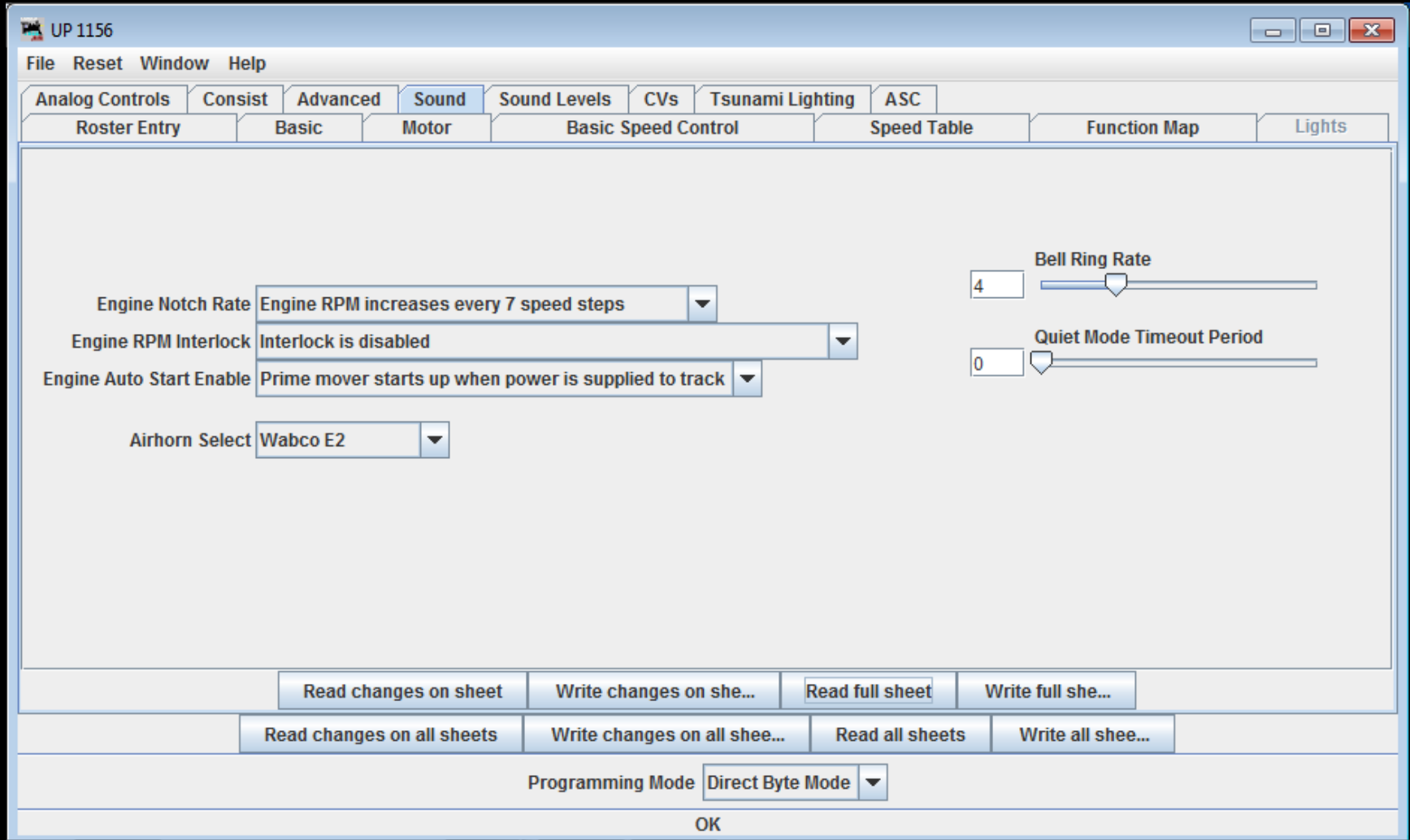
Manufacturer Specific CVs

- Over 100 CVs are reserved for manufacturer specific functions
- Need to consult the decoder documentation to know what CV values do what
- DecoderPro displays these as simple named options and valid selections, as it knows what kind of decoder is installed
- Biggest mess is with **Sound**

Sound CVs

- There are only 1024 direct CVs allowed
- Sound configurations need a LOT of CVs!
- Introduced the idea of **indexed** CV pages
- Gives a total of 61,440 indexed pages, each with 256 bytes of CV data available to manufacturers!
 - CV 31-32 is the base, CV 257-512 the data values
- **Messy, messy, MESSY!**

Sound in DecoderPro



Tsunami Lighting Effects

UP 1156

File Reset Window Help

Analog Controls Consist Advanced Sound Sound Levels CVs **Tsunami Lighting** ASC

Roster Entry Basic Motor Basic Speed Control Speed Table Function Map Lights

LIGHTING EFFECTS AND CONTROLS

Headlight F0(f) Effect Selection Automatic Direction

Headlight F0(f) Phase Selection Use phase A (normal)

Headlight F0(f) Grade Crossing Logic Disabled

Headlight F0(f) Rule 17 Mode Disabled (Headlight mapping)

Headlight F0(f) Light Type LED

Backup Light F0(r) Effect Selection Dimmable backup light

Backup Light F0(r) Phase Selection Use phase A (normal)

Backup Light F0(r) Grade Crossing Logic Disabled

Backup Light F0(r) Rule 17 Mode Disabled (Backup Light mapping)

Backup Light F0(r) Light Type LED

Hyperlight Flash Rate (0-15) 4

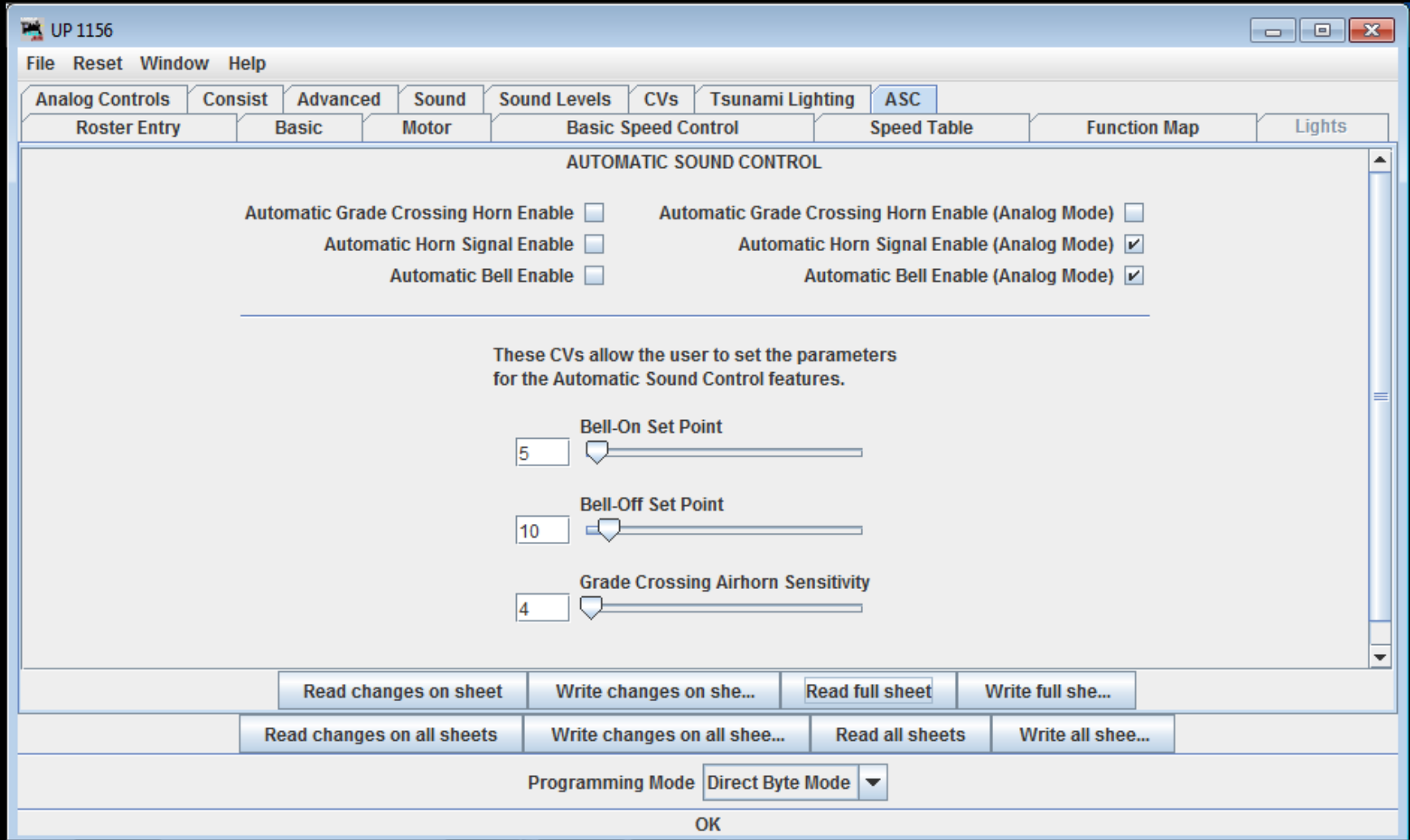
Read changes on sheet Write changes on she... Read full sheet Write full she...

Read changes on all sheets Write changes on all shee... Read all sheets Write all shee...

Programming Mode Direct Byte Mode

OK

Automatic Sound Control



Function Mapping

UP 1156

File Reset Window Help

Analog Controls Consist Advanced Sound Sound Levels CVs Tsunami Lighting ASC

Roster Entry Basic Motor Basic Speed Control Speed Table **Function Map** Lights

Use this sheet to determine which functions will control which outputs

Description	Output wire or operation		Bell	Air Horn	FX5	FX6	Short Horn	Dimming	Mute
	1 White	2 Yellow							
Forward Headlight F0(F)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Reverse Headlight F0(R)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Function 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Function 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Function 3			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Function 4			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Function 5			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Function 6			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Function 7							<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Function 8							<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Function 9							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Function 10							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Function 11							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Read changes on sheet Write changes on she... Read full sheet Write full she...

Read changes on all sheets Write changes on all shee... Read all sheets Write all shee...

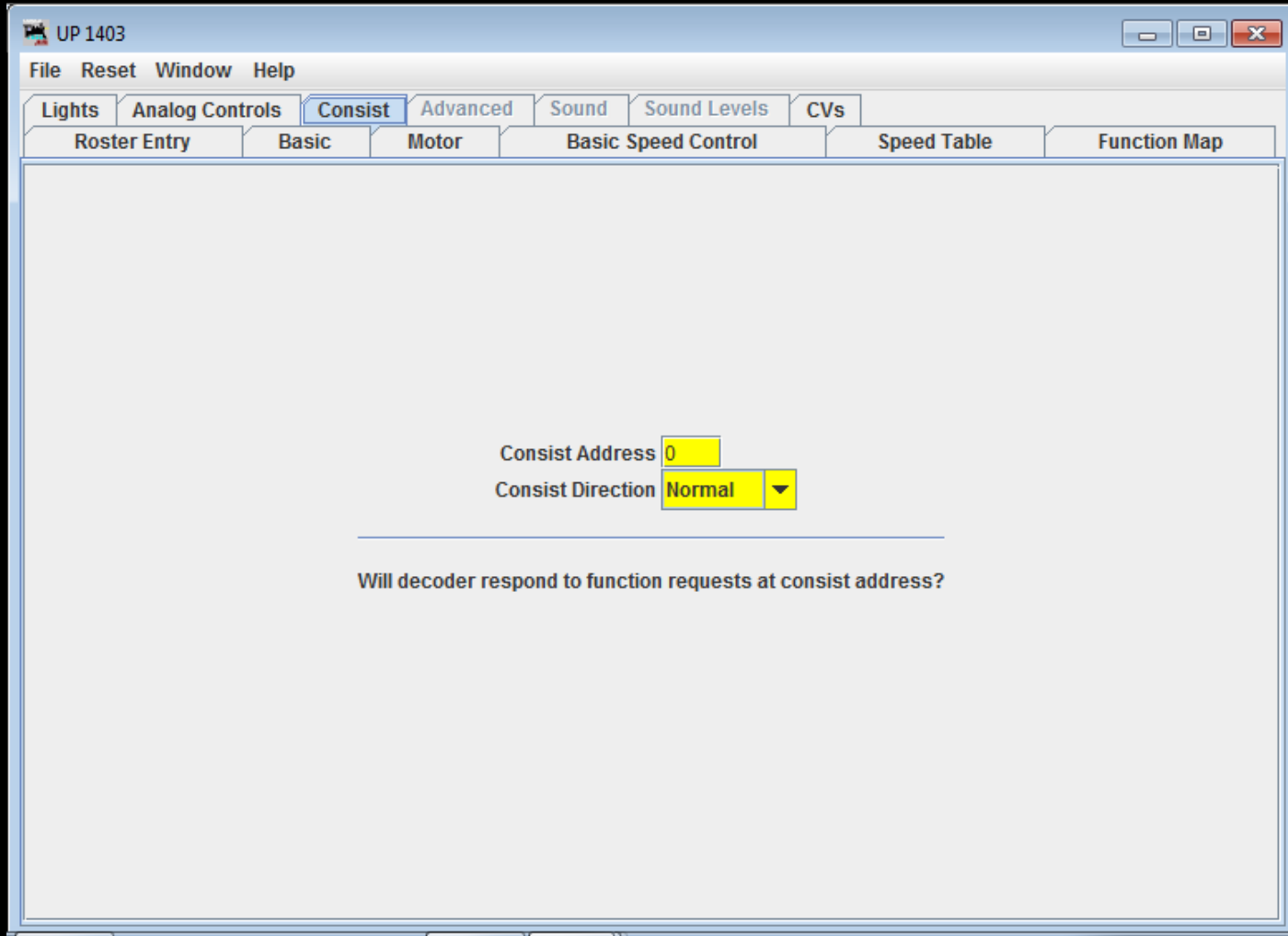
Programming Mode Direct Byte Mode

OK

Decoder Assisted Consisting

- Uses CV 19 for a **Consist Address**
- If CV 19 is anything other than 0, decoder will respond to that address
- Can get tricky with sound decoders for things like the horn and bell
 - Which address should it respond to?
- Again, DecoderPro can help

Simple Decoder Consisting



Sound Decoder Consisting

UP 1156

File Reset Window Help

Analog Controls **Consist** Advanced Sound Sound Levels CVs Tsunami Lighting ASC

Roster Entry Basic Motor Basic Speed Control Speed Table Function Map Lights

Consist Acceleration Rate (0-127) 0

Consist Address (0-127) 0

Loco Direction In Consist Normal

Consist Acceleration Sign Add value to base acceleration rate (increases acceleration delay)

Consist Braking Rate (0-127) 0

Consist Braking Sign Add value to baseline braking rate (increases braking delay)

Will decoder respond to function requests at consist address?

Consist Address Activation for F0(f) in Forward	Respond to locomotive address only
Consist Address Activation for F0(r) in Reverse	Respond to locomotive address only
Consist Address Activation for F1	Respond to locomotive address only
Consist Address Activation for F2	Respond to locomotive address only
Consist Address Activation for F3	Respond to locomotive address only
Consist Address Activation for F4	Respond to locomotive address only
Consist Address Activation for F5	Respond to locomotive address only
Consist Address Activation for F6	Respond to locomotive address only
Consist Address Activation for F7	Respond to locomotive address only
Consist Address Activation for F8	Respond to locomotive address only
Consist Address Activation for F9	Respond to locomotive address only

Decoder XML Sample

- `<variable CV="2" item="Vstart" default="10">`
- `<decVal max="31"/>`
- `<label>Start Volts</label>`
- `<label xml:lang="it">Volt Partenza</label>`
- `<label xml:lang="fr">V démarr.</label>`
- `<label xml:lang="de">Anfahrspannung</label>`
- `<comment>Range 0-31</comment>`
- `<comment xml:lang="it">Valori 0-
 31</comment>`
- `</variable>`

Address Overlap Issue

- Short addresses can be 1 – 127
- Long addresses can be 0 – 10,239
- What happened to 2 digit and 4 digits?
- Some systems limit short to 1 – 99 and long to 100 – 9999, others 1 – 127, 128 - 9999
 - Not consistent, so best to experiment
- Possible to have address 123 as either short or long, but expect problems

Other Benefits to DecoderPro

- All values stored in simple XML (text) files
 - One file per locomotive in a **Roster**
 - Think of it like a special spreadsheet file
- Easy to duplicate file for an exact copy
- Can easily restore all values to a decoder
- Easy to test different configurations
- Speed Table utility to help get shape right
- Function labels for smartphone throttles

Locomotive Roster

Roster: All Entries

File Edit Settings Actions LocoNet Window Help

+ New Loco Identify ? Help Off Programming Mode Paged Mode

ID	DCC Address	Icon	Decoder Model	Road Name	Road Number	Manufacturer	Model	Owner	Date Modified
UP 1156	56		Alco S4	UP	1156	Bachmann	Alco S4	Greg	Oct 16, 2014 10:15...
UP 1403	1403		DH121	UP	1403	Proto 1000	F3	Greg Ma...	Oct 8, 2014 10:32:...

ID: UP 1156
Road Name: UP
Road Number: 1156
Manufacturer: Bachmann
Owner: Greg
Model: Alco S4
DCC Address: 56
Decoder Family: Bachmann Sound Value
Decoder Model: Alco S4
Filename: UP_1156.xml

Programming Track
 Programming On Main
 EditOnly

Program

Labels & Media Throttle

Service Mode Programmer LocoNet Is Online | Operations Mode Programmer LocoNet Is Online | Programmer Status: idle

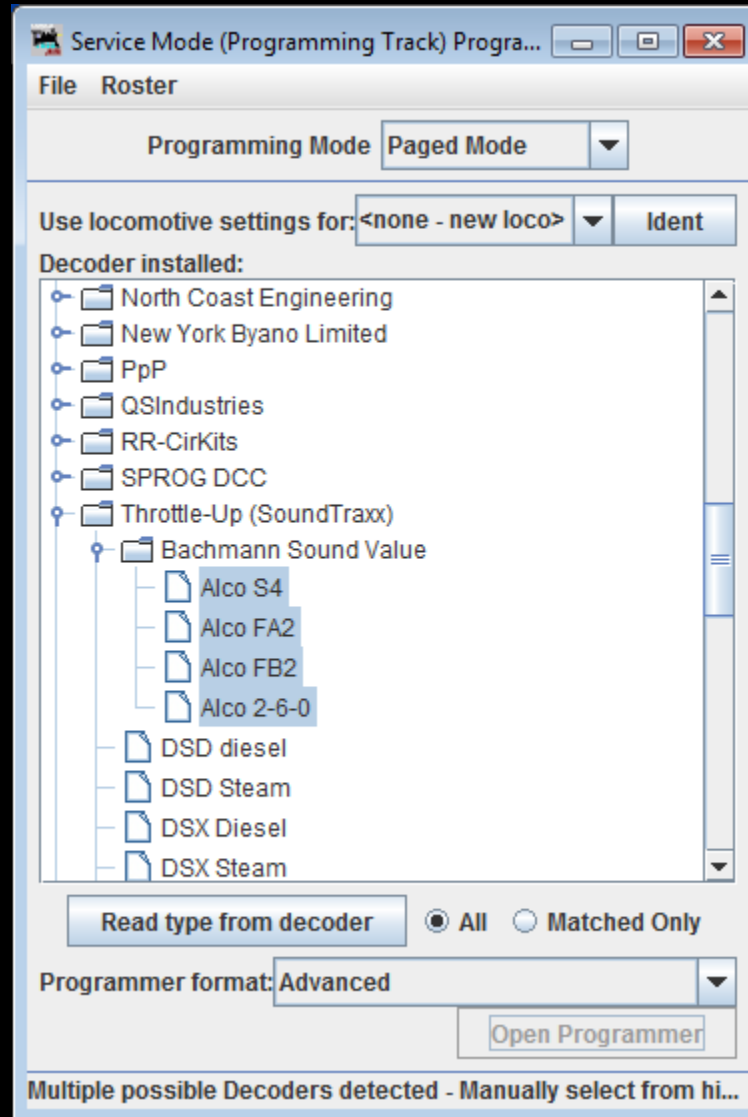
Roster XML Sample File

- `<locomotive id="UP 1403" fileName="UP_1403.xml" roadNumber="1403" roadName="UP">`
- `<decoder model="DH121" family="Basic STD" comment="" />`
- `<locoaddress>`
- `<dcclocoaddress number="1403" longaddress="yes" />`
- `<number>1403</number>`
- `</locoaddress>`
- `<values>`
- `<decoderDef>`
- `<varValue item="Primary Address" value="3" />`
- `<varValue item="Extended Address" value="1403" />`
- `<varValue item="Address Format" value="1" />`
- `<varValue item="Start Volts" value="0" />`
- `<varValue item="Version ID" value="34" />`
- `<varValue item="Manufacturer ID" value="129" />`
- `<varValue item="Kick Start" value="0" />`
- `...`
- `</decoderDef>`

Roster XML Sample File (cont'd)

- `<CVvalue name="1" value="3" />`
 - `<CVvalue name="2" value="0" />`
 - `<CVvalue name="3" value="0" />`
 - `<CVvalue name="4" value="0" />`
 - `<CVvalue name="5" value="0" />`
 - `<CVvalue name="6" value="0" />`
 - `<CVvalue name="7" value="34" />`
 - `<CVvalue name="8" value="129" />`
 - `<CVvalue name="17" value="197" />`
 - `<CVvalue name="18" value="123" />`
 - ...
 - `</values>`
 - `</locomotive>`
 - `</locomotive-config>`
- (Extended address for 1403)

Help Determine Decoder Type



Speed Tables

The screenshot shows the 'UP 1403' software interface. The menu bar includes 'File', 'Reset', 'Window', and 'Help'. The main menu has tabs for 'Function Map', 'Lights', 'Analog Controls', 'Consist', 'Advanced', 'Sound', 'Sound Levels', and 'CVs'. Below these are sub-tabs: 'Roster Entry', 'Basic', 'Motor', 'Basic Speed Control', and 'Speed Table'. The 'Speed Table' tab is active, displaying the instruction: 'Select this button to use a Speed Table for Speed Control' with a radio button selected for 'Use table in CVs 66 through 95'. Below this is a 'Speed Table' section with a grid of 256 CVs (0-255) and their corresponding speed values. The CVs from 66 to 95 are highlighted in yellow. At the bottom, there are buttons for 'Read changes on sheet', 'Write changes on she...', 'Read full sheet', and 'Write full she...', along with a 'Programming Mode' dropdown set to 'Paged Mode' and a status indicator 'idle'.

UP 1403

File Reset Window Help

Function Map Lights Analog Controls Consist Advanced Sound Sound Levels CVs

Roster Entry Basic Motor Basic Speed Control Speed Table

Select this button to use a Speed Table for Speed Control

Use table in CVs 66 through 95

To turn off, use Basic Speed Control pane

Speed Table

CV	Speed
0	0
9	9
18	18
28	28
37	37
47	47
56	56
66	66
75	75
85	85
94	94
103	103
113	113
122	122
132	132
141	141
151	151
160	160
170	170
179	179
188	188
198	198
207	207
217	217
226	226
236	236
245	245
255	255

Read changes on sheet Write changes on she... Read full sheet Write full she...

Read changes on all sheets Write changes on all shee... Read all sheets Write all shee...

Programming Mode Paged Mode

idle

Monitor LocoNet on Digitrax

The screenshot shows a window titled "Monitor LocoNet" with a menu bar containing "Window" and "Help". The main area displays a list of received messages (Rx) with timestamps and hex addresses, followed by the command "Set speed of loco in slot 2 to [value]". The values range from 8 to 95 in increments of 8. At the bottom, there are control buttons and checkboxes: "Clear screen", "Freeze screen", "Show raw data" (checked), "Show timestamps" (checked), "Window always on top" (unchecked), and "Auto scroll" (checked). There is also a "Filter Bytes:" field, "Add Message" button, and "Choose log file", "Start logging", and "Stop logging" buttons.

```
22:30:03.569: [Rx - A0 02 08 55] Set speed of loco in slot 2 to 8.
22:30:03.897: [Rx - A0 02 10 4D] Set speed of loco in slot 2 to 16.
22:30:04.177: [Rx - A0 02 18 45] Set speed of loco in slot 2 to 24.
22:30:04.287: [Rx - A0 02 20 7D] Set speed of loco in slot 2 to 32.
22:30:04.411: [Rx - A0 02 28 75] Set speed of loco in slot 2 to 40.
22:30:04.599: [Rx - A0 02 30 6D] Set speed of loco in slot 2 to 48.
22:30:04.786: [Rx - A0 02 38 65] Set speed of loco in slot 2 to 56.
22:30:04.989: [Rx - A0 02 40 1D] Set speed of loco in slot 2 to 64.
22:30:05.145: [Rx - A0 02 48 15] Set speed of loco in slot 2 to 72.
22:30:05.285: [Rx - A0 02 50 0D] Set speed of loco in slot 2 to 80.
22:30:05.425: [Rx - A0 02 58 05] Set speed of loco in slot 2 to 88.
22:30:05.535: [Rx - A0 02 60 3D] Set speed of loco in slot 2 to 96.
22:30:05.659: [Rx - A0 02 68 35] Set speed of loco in slot 2 to 104.
22:30:05.831: [Rx - A0 02 70 2D] Set speed of loco in slot 2 to 112.
22:30:05.971: [Rx - A0 02 78 25] Set speed of loco in slot 2 to 120.
22:30:06.096: [Rx - A0 02 7F 22] Set speed of loco in slot 2 to 127.
22:30:06.221: [Rx - A0 02 7F 22] Set speed of loco in slot 2 to 127.
22:30:07.625: [Rx - A0 02 77 2A] Set speed of loco in slot 2 to 119.
22:30:07.734: [Rx - A0 02 6F 32] Set speed of loco in slot 2 to 111.
22:30:07.968: [Rx - A0 02 67 3A] Set speed of loco in slot 2 to 103.
22:30:08.795: [Rx - A0 02 5F 02] Set speed of loco in slot 2 to 95.
```

Clear screen Freeze screen Show raw data Show timestamps Window always on top Auto scroll

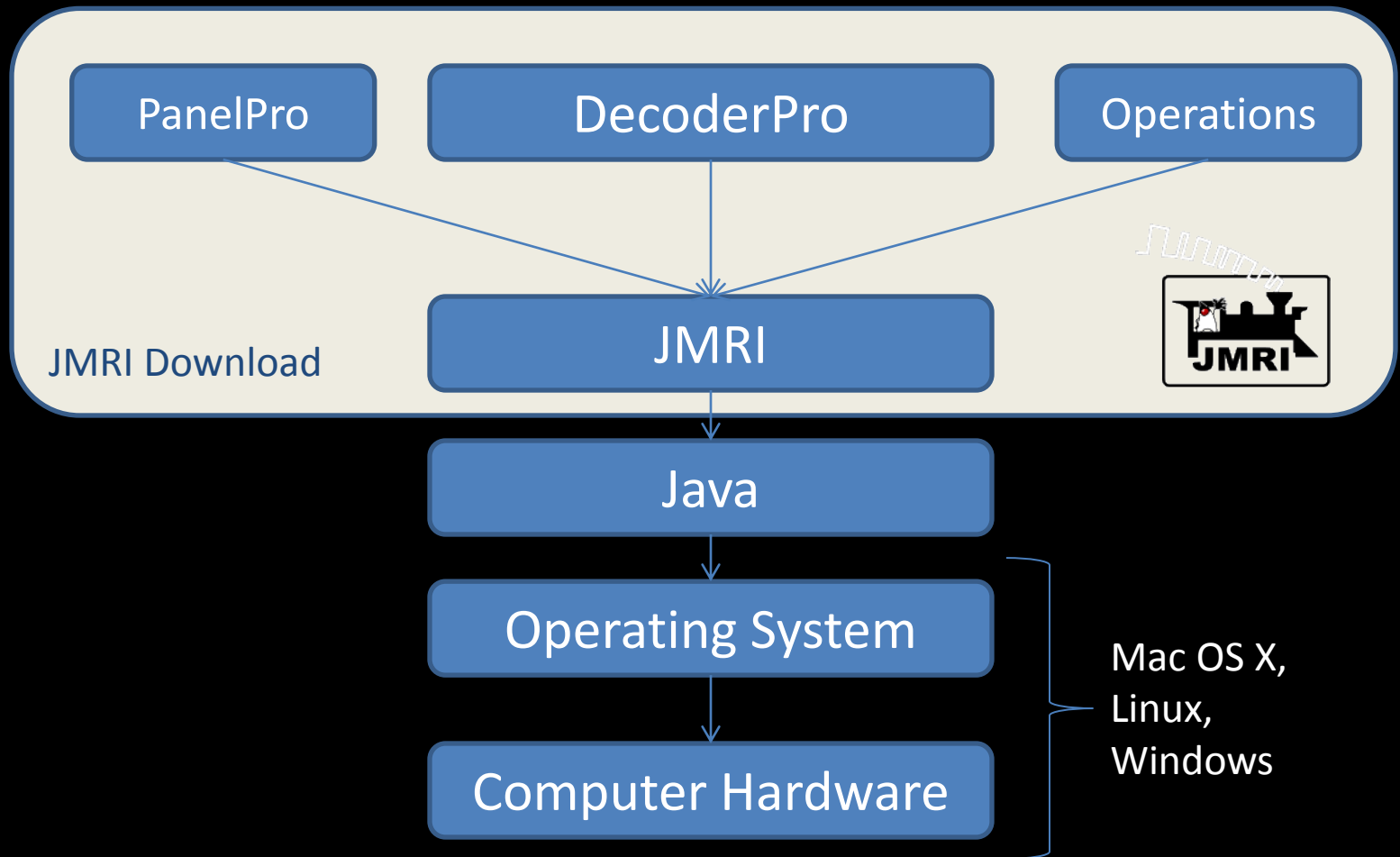
Filter Bytes: Choose log file Start logging Stop logging

Add Message

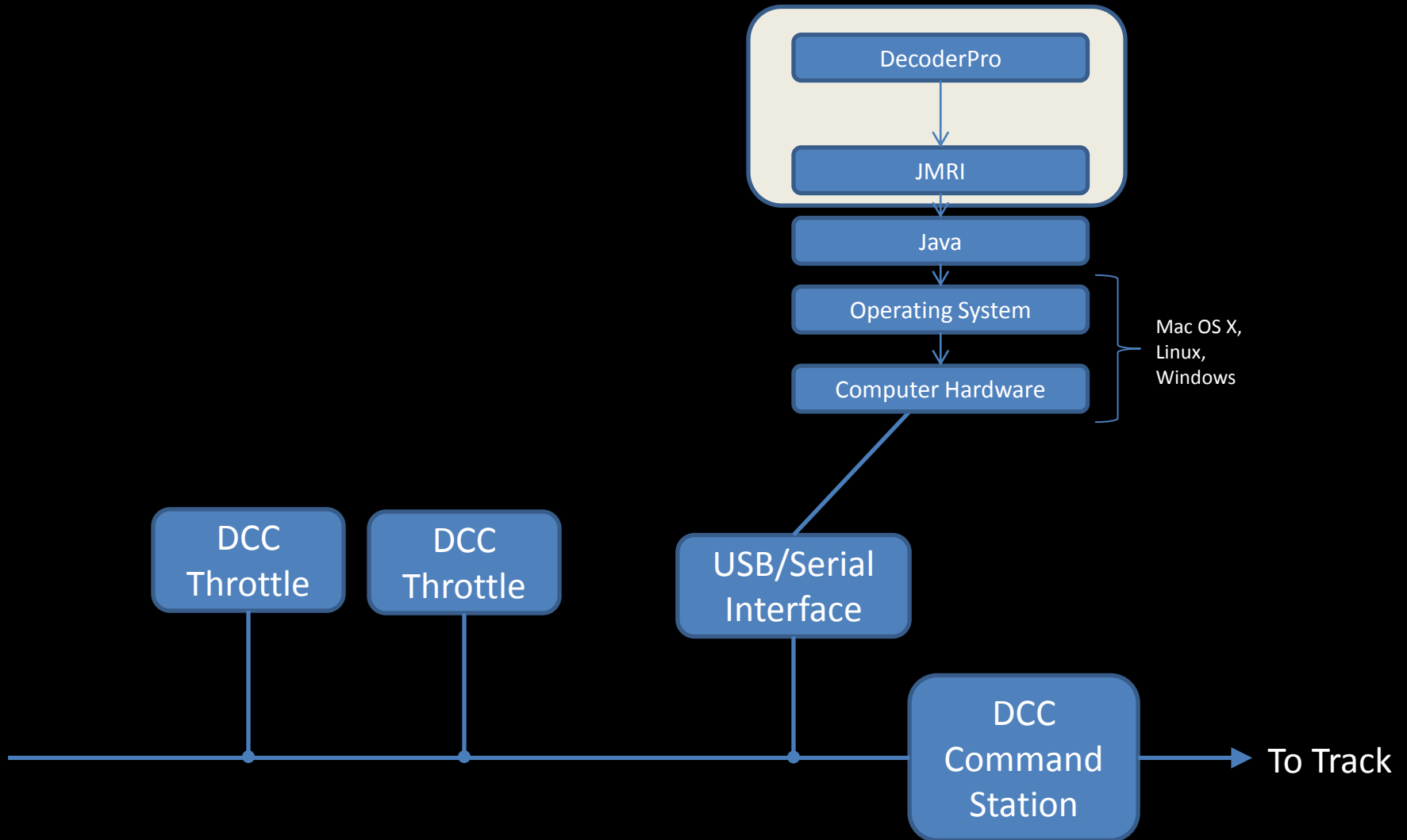
So, What do you need?

- **DecoderPro**, part of the Java Model Railroad Interface project (JMRI)
- **Java** platform for Mac OS X, Linux or Windows
 - JMRI and Java are free downloads
- An hardware **interface device** between your computer and DCC system
 - I use a LocoBuffer-USB for Digitrax

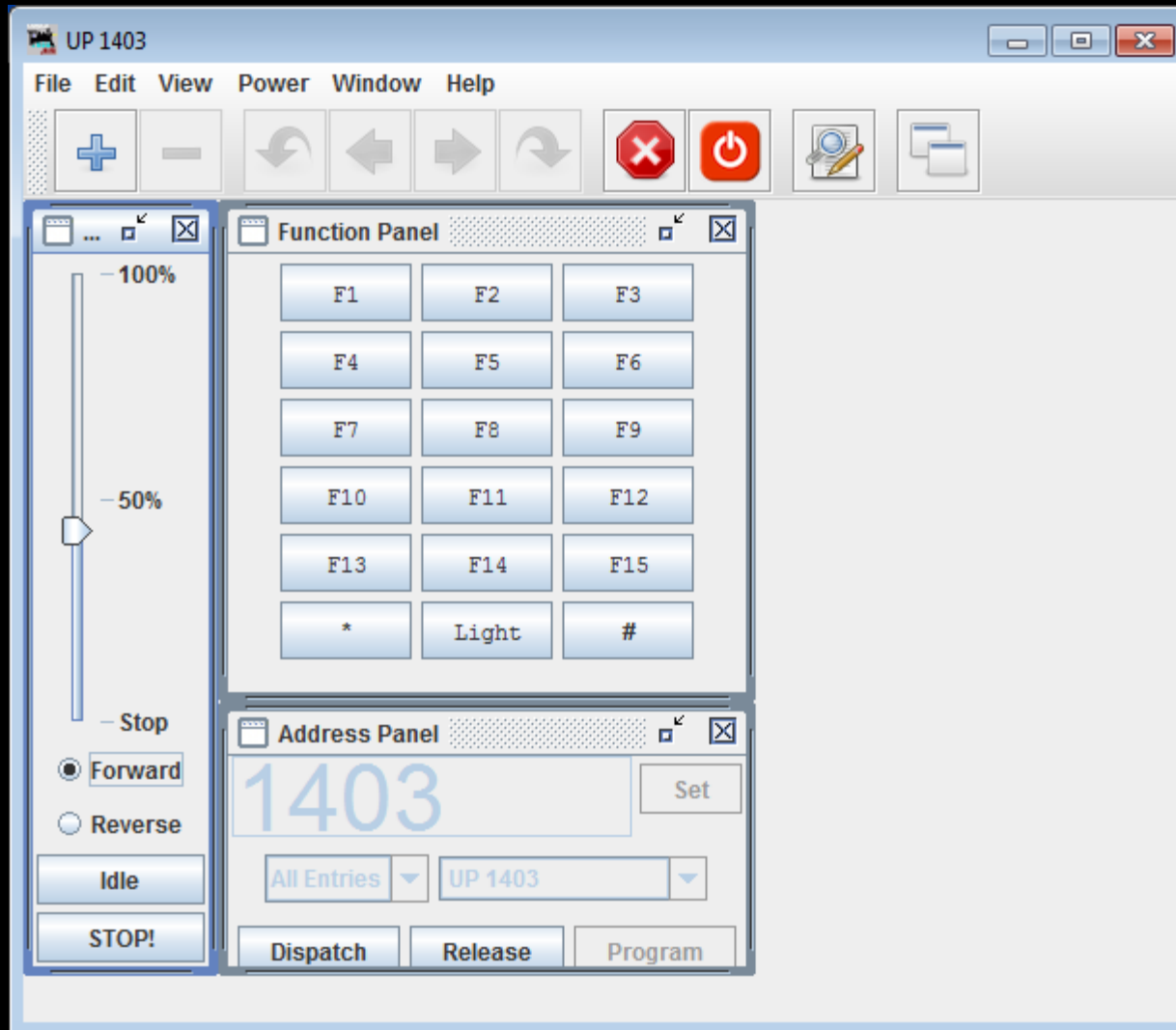
DecoderPro, JMRI, and Java



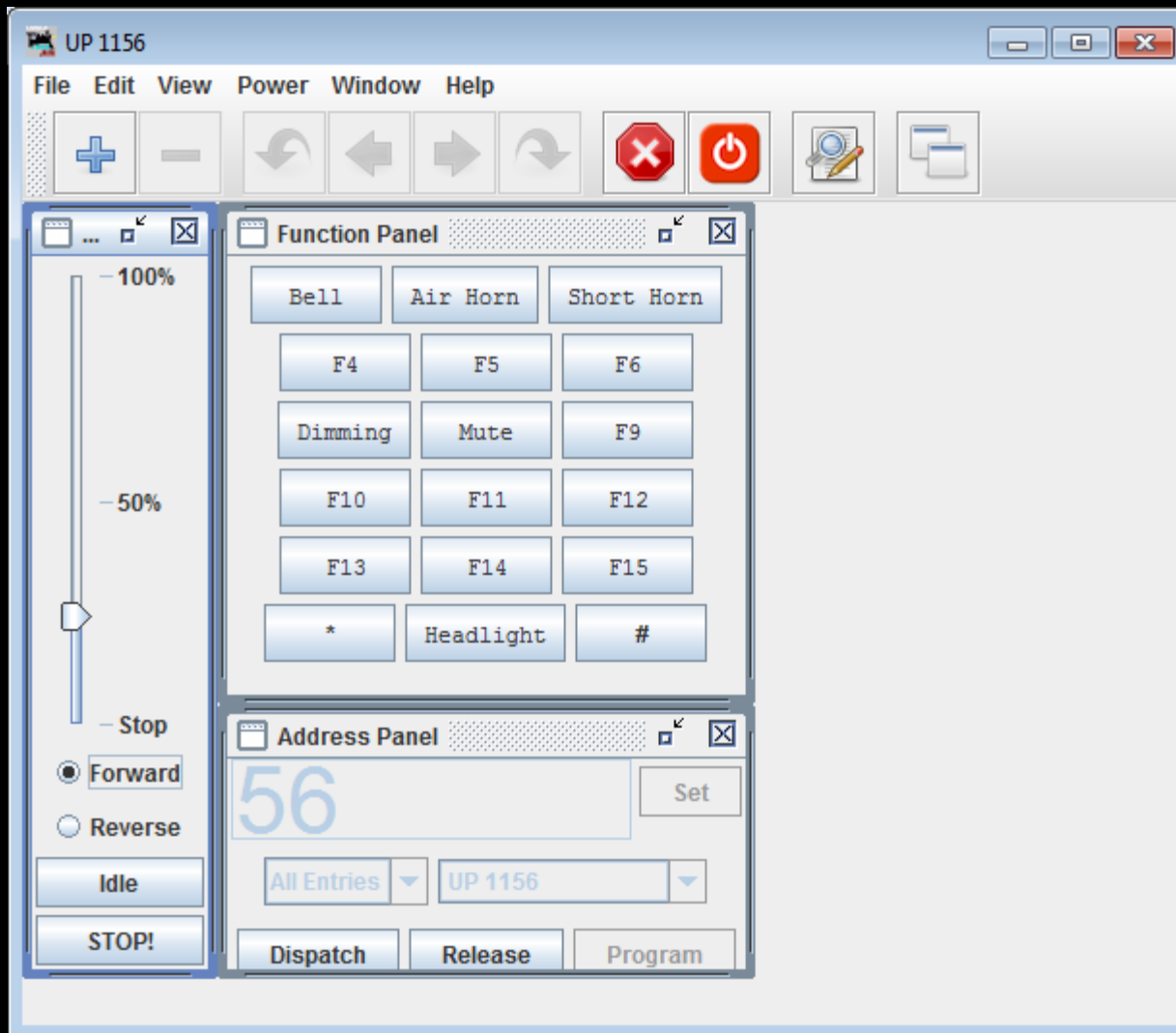
JMRI Connected as a Throttle



Simple Decoder Throttle



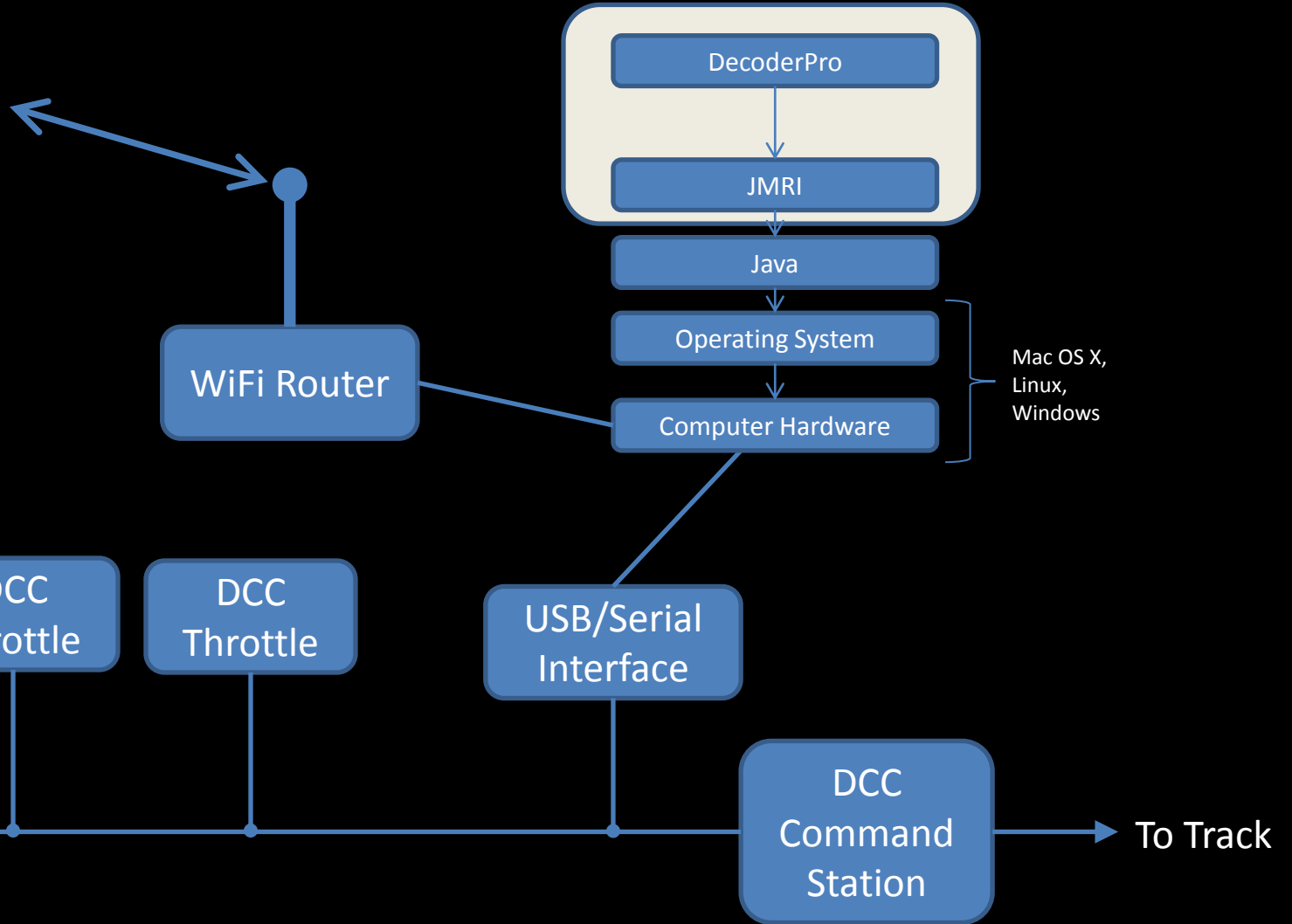
Sound Decoder Throttle



WiThrottle

- Use your Apple or Android smartphone as a wireless throttle
 - **WiThrottle** for iOS
 - **EngineDriver** for Android
- Talks over WiFi to a service running in DecoderPro
- Just another throttle
- WiFi wireless seems to be more reliable than Digitrax radios

WiThrottle Diagram



It's Just a Throttle

- Remember this!
 - DecoderPro **cannot** do anything beyond what your existing DCC system can do, as it uses the *same command station* to do everything

Links

- NMRA DCC standards: nmra.org
- JMRI: jmri.org
- Java: java.com
- WiThrottle: www.withrottle.com
- Engine Driver: enginedriver.rrclubs.org
- LocoBuffer-USB: www.rr-cirkits.com