

This document is under formal review of the NMRANET Working Group. It has not been approved by the WG, reviewed by the Manager, S&C Dept., nor approved by the NMRA Board of Directors.

NMRA TECHNICAL NOTES	
S9.6/OpenLCB NMRAnet Proposal	
Use Cases	
All Scales	
01/01/10	S 9-6.10

## Use Cases

This document discusses how the OpenLCB™/S9.6 proposal for the NMRAnet™ layout control bus meets various use cases that have been considered during NMRAnet development. The proposal for NMRAnet S9.6 has been developed by the OpenLCB group via their web site at <http://openlcb.org/> and discussion group at <http://groups.yahoo.com/group/OpenLCB>. References here to "NMRAnet" refer to this proposal. Further details of NMRAnet are available in other Standards and Recommended Practice documents in the S9.6 group.

Each section describes a single use case, and then discusses the NMRAnet solution for that case.

## Entry Level User

- 10 A model railroader wants to learn about NMRAnet. He buys two inexpensive boards at his local hobby shop. He connects them on his layout to two pushbuttons and a turnout motor, does a simple configuration, and is able to control the turnout with the pushbutton.

## Solution

- 15 Alice wants to control her three track station. She has goes to her local store and buys one 8-button node, four turnout-controller nodes, and a power supply. When she gets home, she unpacks the nodes and connects each of the turnout-controllers to her four turnouts, E1, E2, W1, and W2. Then she connects the nodes together with the provided cables. Following the directions, she then uses the blue button on each of the turnout-controllers and ensures the attached turnout changes position.
- 20 Now she is ready to make the buttons control the turnouts. The buttons are labelled A-H. To connect A to turnout E1, she pushes the blue button on the E1 controller until the turnout is in the position she wants, and then the gold button – this tells the controller to learn this position. She then goes back to the button node and pushes the gold button, button A, and then the gold button again. This teaches the turnout controller to respond to button A. She then sets E1 to the other
- 25 position and trains it with button B. ( In more detail, on E1 she pushed blue repeatedly to position the turnout, then pressed gold, then pressed gold, B, gold on the button node). She repeats this with turnouts E2, W1, and W2 and C-H.

- 30 She finds that she occasionally forgets to compatibly position the turnouts at both ends of the station. However, she realizes that she can improve her scheme. She resets the nodes to factory settings as directed and then teaches button A to make all the turnouts select track 1. (In detail she: on E1 sets diverge and gold, on E2 sets diverge and gold, on W1 sets diverge and gold, on W2 sets diverge and gold, and finally on the button node pushes gold, A, and gold). She also makes buttons B and C select tracks 2 and 3.

35 Now she can control her station tracks with only three buttons, and there is no chance that they can be misaligned! Later, she changes it again so that A-C selected tracks 1-2 for entrance, and D-F selected them for exit.

## Expanding a Small Layout

40 A user has four NMRAnet boards working on his layout. He buys one more input board to provide extra pushbuttons to operate his yard ladder from the other end of the layout. He's able to configure the new board and put it into operation.

### Solution

45 Alice decides that it would be nice to be able to also control her station tracks from the other side of her peninsula. She buys another 8-button node (lets label these M-T), and hooks it to one of the other nodes. She then copies the learning from the first button node to this new one. (In detail: on the original set of buttons she pushes A and gold, and then on the new button-node she pushes gold, M and gold, and repeats the same process with the other buttons).

## Mid-size Layout Problem

50 A user has twelve NMRAnet boards operating. Something changes, and the system is no longer reliable. Certain operations no longer work, and others only work sometimes. The user attempts some debugging steps using features of the existing hardware, but is unable to locate the problem, so buys/borrows diagnostic device(s).

### Solution

55 Mike is at a loss, although he kept good records things have gone south on his layout. He calls up his friend and borrows his laptop with the NMRAnet configuration software and a NMRAnet-USB adapter. He plugs them into his layout LCB and turns it on. The program asks him to select the layout name or choose new. He chooses new, names his layout and the program lists his twelve boards. He drills down to each part of each node and sees what other nodes receive its events. He also sees whose events it receives. The program also draws a diagram of the nodes. He pushes some buttons and watches as the program animates the events send from one node and to the receiving nodes. He finds 60 his mistake, and makes changes to his configuration and tests again. Problem solved – he vows to buy a laptop.

## Large Layout Upgrade

65 A model railroad has 40 NMRAnet boards controlling a large layout. To upgrade a major yard, the user wants to replace 12 boards with new ones that offer new (non-NMRAnet) features. He captures the existing setup, replaces old boards with new ones, configures the equipment and is back in operation.

### Solution

Joe has been assigned the non-trivial task of upgrading the yard with the new boards the planning committee bought. He tells the NMRAnet configuration program to make a fixed record of the configuration of the twelve boards he is replacing, and saves it to disk, twice, he's paranoid. He then

70 proceeds to disconnect the original twelve boards and replace them with the new ones. Sometime later ... he brings up the configuration program, and it informs him there are twelve new boards on the layout. "Tell me something I don't know" he mutters. He brings up another copy and retrieves his stored configuration. He notes that some of the names of things have changed (new and improved!), but he can manage. He uses the old configuration to find nodes from which he can teach the old events  
75 from – this is easy, on the screen he just grabs the node's consumer or producer entry and drags it to one or more of the new nodes consumers and/or producers. The nodes are linked and using the old events. "Sweet" he thinks. Now he sets about to use all those new capabilities that these new nodes have – "Wow, it was worth it, these babies are hot".

## Distant Control Panel

80 A model railroad has turnouts and signals controlled via NMRAnet. The owner wants to put a physical control panel in his house, a separate building, and operate it via NMRAnet.

### Solution

Mike has been operating his layout from afar using a 'glass' control panel on his computer connected to his layout via his Wifi router. However, it doesn't have the same satisfaction as having a real control  
85 panel. He decides to build one, and he installs a number of CAN NMRAnet nodes to interface it. The big day arrives and now he needs to configure it. He connects a CAN-to-Ethernet bridge and plugs it into his networks. He boots up his configuration program, links to the bridge and sets it up to talk to his layout. He then links to his layout, and the program announces there are lots of new nodes. Using drag-and-drop he links his new nodes into the existing layout. This is relatively easy, as he is just duplicating  
90 his old controls. In fact he can just drag one whole old node onto a new one and all its events are duplicated. The whole process takes only 5 minutes. Mike thinks "Now, let's get down to some serious operating".

## Large Layout Expands

A large model using CAN, but not any attached computers, grows enough that it needs to have another  
95 CAN segment. This must be possible without reconfiguring all the existing nodes, event IDs, etc.

### Solution

Hugh realizes he has a problem – the NMRAnet-CAN bus running his layout is not big enough, he's maxed out the number of nodes. He talks to the local guru, and the guru says – no problem, just divide your CAN into two parts and join the parts with a CAN-to-CAN bridge. Hugh is doubtful, it can't be  
100 that simple, won't he need to change node ids and change his event programming? The guru reassures him – it is that simple – no need to change anything, the nodes will still see all the other nodes events, just as before. Hugh takes him at his word, picks up a bridge and, after five minutes deciding where to break the CAN bus, inserts the bridge and is running trains again.

## Connect Multiple Programs

105 The user wants to run multiple programs from multiple vendors in his home computer that simultaneously connect to the layout NMRAnet and control/monitor it.

## Solution

Mike visits Hugh and brings some new NMRAnet software on his laptop. “This software will let us make a mock-up of your layout showing the location and connections between your nodes. I just need to plug it into your layout”. Hugh copies it to his laptop, and plugs it into the opposite end of the layout – instant yard diagram and operations.

## Remote Dispatcher

A model railroad has turnouts and signals controlled via NMRAnet. NMRAnet is used to install a CTC panel at a distant location. The panel could be either a physical panel or on a computer screen.

## 115 Solution

See Distant Control Panel.

## Modular Layouts

A modular club has fifty modules, each of which as a CAN NMRAnet with two or three nodes controlling the module. These modules are separately built, with no central administration. For example, a new member might be bringing four modules that have never run with the club before, or a member may have just completed a couple new modules. They are brought to a central location for a meet, where they are all connected together in some pre-planned orientation. The NMRAnets are connected in some fashion, and used to operate the entire layout from both central and distributed locations.

125 The club does not want to expend any effort preallocating numbers, making sure that module configurations conflict or anything like that; they just want to plug together the OpenLCB CAN backbone and operate the entire layout from both central and distributed locations. All the modules must still continue to operate without reprogramming or reconfiguration; there's just not enough time for that. Connections between modules need to be added easily, either by multiple manual operations (pushing local buttons) taking place in parallel, or multiple computers attached to the layout with configuration tools.

## Solution

John is in charge of the meet. He tells the attendees to connect their modules together into multiple CAN segments, observing the limitations of length and drive capabilities of the nodes. He assigns segment leaders and instructs them to configure and debug each segment in isolation by connecting a computer with configuration software. XML files describing the modules that some attendees brought help in this, but the nodes themselves contain enough information to allow them to be connected and integrate their existing block detection and signaling systems.

140 If the number of modules was smaller, then John would have connected the segments together using CAN-to-CAN relay nodes, but he decides to connect the segments together using an Ethernet backbone, using Ethernet-to-CAN bridges. This will reduce the bandwidth requirements on each of the segments because the bridges will automatically only pass events between the segments that are actually required, rather than all packets. Working with his segment leaders, they quickly integrate the

145 segments onto the backbone. Since they have multiple panels, both real and virtual, attendees can observe and control the layout from disparate points on the layout.

## Remote Diagnostics

A club layout is operated via NMRAnet. There's something not quite right about the signalling, and one of the members wants to check the operation of the signals. He makes a remote connection to the layout and checks the status and configuration of the hardware from his home computer.

### 150 Solution

Bob receives a call from his friend Hugh at the clubhouse that there's some trouble on the layout. Bob doesn't have time to drive across town and back, but fortunately his club has an Ethernet connection to the layout, and even better they have it attached to the local area network (LAN) and to the wider internet through their router – he can just log in from home! He opens his copy of the configuration  
155 program on his home computer and connects to the layout. It appears that one of the signals is not responding, and this has lead to a cascade of failures downstream from the signal. He phones Hugh back and tells him to check the connections on that signal. Hugh crawls under the layout and discovers a plug has pulled out – it must have been accidentally hooked out by someone in the work party mid-week. Everything seems back to normal. Hugh thanks John. John replies “Its all in a day's work for a  
160 NMRAnet repairman”.

## Aggregation of Modular Clubs

Dozens of clubs put together dozens of NMRAnet segments and hundreds of modules that have been separately configured. A large FREMO meet would be an example. Collision avoidance must be easily arranged; event and node identifications that are already configured into the modules should already be  
165 unique, without any need to reprogram ones that might be duplicates. It must be possible to build automated tools for translating and disambiguating event IDs or numbers. Conventions and/or tools for connecting across the boundaries are needed so that e.g. signaling systems can work with adjacent modules they've never met before. It must be possible to build automated tools for health monitoring across the layout.

### 170 Solution

See Modular Layouts. In this case, thanks to prior planning, each club has provided an XML file describing the events that must be connected to allow the integration of the signaling and other systems. Hugh and John use the configuration program to build a schematic diagram of the entire layout. They then drill down to each interface between layout segments and connect the edge nodes of each segment together. They quite quickly repeat the exercise on each adjacent pair of segments, with the help of the leads of the pairs of segments. Since every node has a unique ID and unique Events, they are not worried about conflicts or having to change ranges of events on any modules – reprogramming hundreds of nodes would not be inviting.

## Table of Contents

Use Cases.....	1
Entry Level User.....	1
Solution.....	1
Expanding a Small Layout.....	2
Solution.....	2
Mid-size Layout Problem.....	2
Solution.....	2
Large Layout Upgrade.....	2
Solution.....	2
Distant Control Panel.....	3
Solution.....	3
Large Layout Expands.....	3
Solution.....	3
Connect Multiple Programs.....	3
Solution.....	3
Remote Dispatcher.....	4
Solution.....	4
Modular Layouts.....	4
Solution.....	4
Remote Diagnostics.....	4
Solution.....	4
Aggregation of Modular Clubs.....	5
Solution.....	5