### Introduction to LCC





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9/17/22



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### What is LCC?

- Layout Command Control
- It is a set of NMRA standards that defines a <u>peer-to-peer</u> network allowing layout elements to talk to each other.
  - Signals, turnouts, detectors, push buttons, toggle switches, lights, panels, throttles, etc.
- Network components are <u>self-describing</u> and <u>globally unique</u>.
- LCC can be used with any train control method: DCC, DC, AC, Lionel, Marklin, etc.

### **LCC Architecture**



An LCC system consists of a collection of **smart layout element controllers** called "Nodes" that communicate (exchange messages) with each other over a network.

The network can use one or more protocols such as CAN, Ethernet, Wi-Fi, etc.

# LCC & DCC compliment each other

### **DCC replaced**

GE ASTRAC Keller Onboard Dynatrol CTC-16 RailCommand Zimo Digital etc.

### LCC replaces

C/MRI (Chubb) CBUS (MERG) LocoNet (Digitrax) XpressNet (Lenz) AIU (NCE) Accessory Decoders etc.

### **DCC Runs Trains**



<u>Master-Slave</u>: All communication is between the command station (master) and the decoders (slaves). The slaves do not talk to each other.



### **LCC Runs Accessories**



<u>Peer-to-Peer</u>: No central computer. Nodes talk directly to each other.





In LCC parlance, one event (pushing a button) causes a Node to Produce an EventID that is Consumed by the same Node or a different Node to cause another event (turnout points move).

### **LCC Basic Concept**

Producers

Both





Tortoise DPDT Switch--Producer Motor--Consumer

Consumers



Signal Gate

LEDs

The most important concept for the user is that a "Node" is a piece of hardware that can send (Produce) an "EventID" or can react (Consume) to an "EventID".

A Producer event (such as pushing a button) is connected to a Consumer event (such as throwing turnout points) by associating each with the same EventID.

# **Commercial LCC Devices**

#### **RR-CirKits** (www.rr-cirkits.com)

- All purpose Nodes
- Real world I/O modules
- LCC-computer interface
- LCC power supply
- Connectors, flat cable, breakout boards, etc.
- Cat5 CAN bus

#### Logic Rail Technologies (www.logicrailtech.com)

- LCC fast clock
- Cat5 CAN bus

#### Train Control Systems (tcsdcc.com)

- DCC command station that is a Node
- Cat5 CAN bus and Wi-Fi
- LCC over Wi-Fi enabled throttles









# **RR-CirKits Building Blocks**

#### Interface



#### Computer USB to Cat5 CAN bus:

- Communicate with JMRI
- Configure LCC nodes



I/O Modules provide "real world" control:

- Turnouts, occupancy detectors, LEDs, etc.
- Connect to Nodes with 10-wire flat cable

### **RR-CirKits Nodes**



### TowerLCC

- General applications
- 16 I/O lines in two 10-pin connectors
- Cat5 CAN bus



### SignalLCC

- Signal applications
- 8 I/O lines in one 10-pin connector
- 16 LED drivers
- Cat5 CAN bus

# **RR-CirKits I/O Modules**



#### BOD-8

- 8 Block Occupancy Detector
- Uses remote CT coils





#### SMD-8

Stall Motor Driver for 8 stall motors

- Can drive up to 100 mA per line (external PS)
- Speed regulated output 4 to 12 VDC

Plus many others



#### BOD-4-CP

**Control Point Functions** 

- 4 block occupancy detection using CT coils
- 2 turnout motor drivers (external PS)
- 4 input lines

### **Demonstration Test Bed**





### **Demonstration Test Bed**

Push button 1 is attached to common & line 15. Push button 2 is attached to common & line 16. Connecting BOB to lines 9-16 of the TowerLCC

3

**RR-CirKits** 

RR-CirKits

### **Demonstration Test Bed**



Nodes are configured using a configuration tool from Java Model Railroad Interface or from Deepwoods Software.

(https://www.jmri.org/)





(https://www.deepsoft.com/home/products/modelrailroadsystem/downloadmr/)



Add a connection using either "LCC" or "OpenLCB" (no functional difference). Choose the hardware connection, in this case "CAN over LCC-Buffer (USB)"



Open the "LCC" (or "OpenLCB") menu and click on "Configure Nodes".



Nodes are <u>self-describing</u> and <u>globally unique</u>. Note the JMRI computer is also a Node.



Nodes are <u>self-describing</u>. All the information about how the Node can be configured is contained in its CDI.

Configure RR-CirKits - Tower-LCC (0)	2.01.57.00.01.A8)					- • <b>×</b>
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>						
Segment: NODE ID						
Segment: Node Power Monitor						
Segment: Port I/O						
Segment: Conditionals						
Segment: Track Receiver						
Segment: Track Transmitter						
2						
Sensor/Turnout creation						
	Refresh All	Save Changes	Backup	Restore	lore	

Each of the TowerLCC I/O lines can be configured as an output, input, or both. I/O lines are logic level and each line can be configured so its "On" state is either 5V or OV.

Line 6 Line 7 Line 8	Line 9 Line 10 Line 11	Line 12 Line 13 Line 1	4 Line 15 Line 16	Line 6
Line Description	Lille 2	Line 5	Lille 4	Lille 5
		Refresh Write		
Output Function				
None 🔻 Refresh	Write			
Receiving the configured Co	mmand (C) event(s) will drive o	or pulse the line:		
Input Function				
Normal 🔻 Refresh	Write			
The configured Indication (P	event(s) will be sent when the	e line is driven:		
Low (0V) 🔻 Refresh	Write			

We have two pushbuttons attached to lines 15 & 16 of the TowerLCC. The buttons are normally open so the line input is 5V until the button is pressed. Then it becomes 0V.

Line 3	Line 10 Line 11	Line 12 Line 13	Line 14 Line	15 (PB1) Line 16	Line 6	Line 7
Line Description	Line 2	Line 5	Line 4	Line J	Line v	Line
PB1			Refresh	Write		
Output Function						
None 🔻 Re	fresh Write					
Receiving the co	nfigured Command (C) e	vent(s) will drive or pu	ulse the line:			
Low (0V) 🔻	Refresh Write		r.			
Input Function						
Normal	Refresh Write					
The configured l	deation 1	be sent when the line	e is driven:			
Low (0V)	weiresh Write					

We only need to define one event for each push button so an EventID is sent out when a button is pushed.

Event 1       Event 2       Event 3       Event 4       Event 5       Event 6         Command       (C) When this event occurs       02.01.57.00.01.A8.00.A8       Refresh       Write       More       Copy       Paste       Set         Action       the line state will be changed to       Event 5       Event 6       Event 6       Event 6
Command         (C) When this event occurs         02.01.57.00.01.A8.00.A8         Refresh       Write       More       Copy       Paste       Set         Action         the line state will be changed to
02.01.57.00.01.A8.00.A8     Refresh     Write     More     Copy     Paste     Set       Action     the line state will be changed to
Action the line state will be changed to
None Refresh Write
Input On Refresh Write
Indicator (P) this event will be sent
02.01.57.00.01.A8.00.AE Refresh Write More Copy Paste Se

We have a tortoise switch machine attached to a SMD-8. The SMD-8 output for our tortoise is attached to TowerLCC line 1. We have chosen the "On" state of this line to be 0V.

Line u	Line 9 Line 10	Line 11 Line 12	Line 13 Line 1	4 Line 15 (PB1)	Line 16 (PB2)	Line C	V 100 7
	Line 1 (1W1)	Line 2	Line 3	Line 4	Line 5	Line o	Line /
TM1	сприон		Refre	esh Write			
Output F	unctie						
Steady	Refresh V	Vrite					
Receivin	ig the contract	and (C) event(s) v	vill drive or pulse the	line:			
Low (0)	/) 🔻 Refresh	Write					
Input Fu	nction						
None	▼ Refresh	Write					
The con	figured Indication (P)	event(s) will be sent	when the line is drive	en:			
	A Bofrach	Write					

We need to configure two events for this line so one EventID will make the line "On" and another will make the line "Off", resulting in the two tortoise positions.

😤 Configure RR-CirKits - Tower-LCC (02.01.57.00.01.A8)	Configure RR-CirKits - Tower-LCC (02.01.57.00.01.A8)
Event  Event 1 Event 2 Event 3 Event 4 Event 5 Event 6 Command (C) When this event occurs	Event Event 2 Event 3 Event 4 Event 5 Event 6 Command (C) When this event occurs
O2.01.57.00.01.A8.00.00     Refresh     Write     Copy     Paste     Search       Action       the line state will be change       On (Line Active)       Image: Copy       Image: Copy <td>O2.01.57.00.01_A8.00.01     Refresh     Write     More     Copy     Paste     Search       Action     the line state will be changed to the</td>	O2.01.57.00.01_A8.00.01     Refresh     Write     More     Copy     Paste     Search       Action     the line state will be changed to the
Event       Event 1       Event 2       Event 3       Event 4       Event 5       Event 6         Upon this action       Image: Comparison of the second of the se	Event       Event 1       Event 2       Event 3       Event 4       Event 6         Upon this action       Image: Comparison of the second of t
(P) this event will be sent         02.01.57.00.01.48.00.06         Refresh       Write         More       Copy         Paste       Search	(P) this event will be sent         02.01.57.00.01.A8.00.06         Refresh       Write         More       Copy         Paste       Search         Sensor/Turnout creation
Refresh All         Save Changes         Backup         Restore         More	Refresh All Save Changes Backup Restore More

To link push button 1 to the "On" position of the tortoise, we copy and paste the Producer event 1 EventID from push button 1 to the Consumer event 1 of the line controlling the tortoise.

Event		
Event 1 Event 2 Event 3 Event 4 Event 5 Event 6		
Command (C) When this event occurs	Configure RR-CirKits - Tower-LCC (02.01.57.00.01.A8)	
02.01.57.00.01.A8.00.AE Refresh Write More Copy Paste Search	Event	
Other uses of this Event ID:	Event 1 Event 2 Event 3 Event 4 Event 5 Event 6	
Port I/O.Line(15,PB1).Event(1).Indicator	Command	
Action	(C) When this event occurs	
the line state will be changed to	02.01.57.00.01.A8.00.A8 Refresh Write More Copy Paste	Search
On (Line Active)  Refresh Write	tion	
Frind .	the we have will be changed to	
	None Refresh Write	
Event 1 Event 2 Event 3 Event 4 Event 5 Event 6		
Upon this action	= Event	
None Refresh Write	Event 1 Event 2 Event 3 ent 4 Event 5 Event 6	
Indicator	Upon this action	
(P) this event will be sent	Input On 💌 Refresh	
02.01.57.00.01.A8.00.06 Refresh Write More Copy Paste Search	Indicator	
	P) this event will be cent	
sor/Turnout creation	02.01.57.00.01.48.00.4E Refresh Write More Conv. Paste	Search
	Copy Pase	Jearch
Refresh All Save Changes Backup Restore More		
Noron na ouro onangoo Suchupa Reditica Morea		
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To link push button 2 to the "Off" position of the tortoise, we copy and paste the Producer event 1 EventID from push button 2 to the Consumer event 2 of the line controlling the tortoise.

nfigure RR-CirKits - Tower-LCC (02.01.57.00.01.A8)	
Event Event 2 Event 3 Event 4 Event 5 Event 6	
Command         (C) When this event occurs         02.01.57.00.01.A8.00.BA       Refresh       Write       More       Copy       Paste       Search         Other uses of this Event ID:       Port I/O.Line(16,PB2).Event(1).Indicator       Action       the line state will be changed to         Off (Line Inactive) <ul> <li>Refresh</li> <li>Write</li> </ul>	Configure RR-CirKits - Tower-LCC (02.01.57.00.01.A8)
Event         Event 1       Event 2       Event 3       Event 4       Event 5       Event 6         Upon this action         None <ul> <li>Refresh</li> <li>Write</li> <li>Indicator</li> <li>(P) this event will be sent</li> <li>02.01.57.00.01.A8.00.06</li> <li>Refresh</li> <li>Write</li> <li>More</li> <li>Copy</li> <li>Paste</li> <li>Search</li> <li> </li></ul>	Event     Event 2     Event 3     Event 4     Event 6       Upon this action     Input On     Refresh     rite       Indicator     Indicator     Indicator
Sensor/Turnout creation	(P) this event will be sent 02.01.57.00.01.A8.00.BA Refresh Write More Copy Paste Search
Refresh All         Save Changes         Backup         Restore         More	Sensor/Turnout creation
	Refresh All Save Changes Backup Restore More

We can use one push button instead of two if we use an "Alternating" input. We just need to make use of a second event for the "off" state of the line.

Configure RR-CirKits - Tower-LCC (02.01.57.00.01.A8)		Configure RR-CirKits - Tower-LCC (02.01.57.00.01.A8)
Image: Select Input/Output line.         Line 10       Line 11       Line 12       Line 13       Line 14       Line 15 (PB1)       Line 16 (PB2)         Line 10       Line 11       Line 2       Line 3       Line 4       Line 5       Line 6       Line 7         Line 10       Line 11       Line 2       Line 3       Line 4       Line 5       Line 6       Line 7         Line Description       PB1       Refresh       Write         Output Function       None ▼       Refresh       Write         Receiving the configured Command (C) event(s) will drive or pulse the line:       Low (0V) ▼       Refresh       Write         Input Function	Line 8 Line 9	Event       Event 2       Event 3       Event 4       Event 5       Event 6         Command       (C) When this event occurs       02.01.57.00.01.A8.00.A8       Refresh       Write       More       Copy       Paste       Search         Action       the line state will be changed to       None       Refresh       Write       Write         Event       Event 1       Event 2       Event 3       Event 4       Event 6       Upon this action         Input Off       Refresh       Write       Write       Indicator       Indicator         (P) this event will be sent       02.01.57.00.01.A8.00.AF       Refresh       Write       More       Copy       Paste       Search

Just copy and paste event 2 EventID for push button 1 into event 2 of the line controlling the tortoise to replace PB2.

Event	
Event 1 Event 2 Event 3 Event 4 Event 5 Event 6	
Command	Configure RR-CirKits - Tower-LCC (02.01.57.00.01.A8)
(C) When this event occurs	Event
02.01.57.00.01.A8.00.AF Refresh Write More Copy Paste Search	Event 1 Event 2 Event 3 Event 4 Event 5 Event 6
Other uses of this Event ID: Part I/O Lipo(15 PP1) Event(2) Indicator	Command
Action	(C) When this event occurs
the line state will be changed to	02.01.57.00.01.A8.00.A8 Refresh Write More Copy Paste Search
Off (Line Inactive)	Action
	tige state will be changed to
Event	Refresh Write
Event 1 Event 2 Event 3 Event 4 Event 5 Event 6	Funt
Upon this action	Event Count 2 Event 4 Event 6
None 🔻 Refresh Write	Event 1 Event 2 Event 4 Event 5 Event 6
Indicator	
(P) this event will be sent	Input Off Refresh Write
02.01.57.00.01.A8.00.06 Refresh Write More Copy Paste Search	(P) this event will be sent
nsor/Turnout creation	02.01.57.00.01.48.00.AF Refresh Write More Copy Paste Search
Refresh All         Save Changes         Backup         Restore         More	Sensor/Turnout creation
	Refresh All Save Changes Backup, Restore, More,

