

Layout Command Control (LCC)

Introduction

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Layout Command Control



What is LCC

**LCC is an information highway
for your model railroad layout**



What is LCC

LCC is a common language for layout elements to talk to each other

- Turnouts
- Signals
- Detectors
- Lights
- Panels
- PCs / Smart Phones
- Boosters
- Command Stations
- Throttles
- Power Managers
- Trains
- etc...

What is LCC

LCC is a layout control bus standard

- endorsed by the NMRA
- open royalty free to all manufacturers
- based on modern technology that is robust, fast, and easy to use

What is LCC *NOT*?

LCC does NOT replace DCC.

On the track – DCC

Beside the track – LCC

LCC is not dependent on DCC,
could run on DC or Märklin layouts
not locked to the DCC manufacturer

Legacy – a lesson from DCC

Before DCC

dozens of incompatible systems

20 years later

almost every manufacturer is

DCC compliant

60+ companies to choose from

Why is LCC better?

LCC uses current technology.

- 10x faster
- Robust, noise-immune, very simple wiring

Why is LCC better?

LCC uses plug and play installation.

- No address to configure – no conflicts
- Intuitive configuration interface
 - No CV variables
 - Self-describing nodes

← Configure node

Operating Mode

= Booster Only

Defines the operating mode of the system.

Output Voltage

= 12.00 N Scale

Booster output voltage (9.50 to 18.00 volts).

Booster Trip Current

= 3000

Current limit in amps at which the booster will detect an overload and shutdown (1 to 5 amps).



RAILCOM

RailCom Configuration

Cutout

= enable long cutout

RailCom detector cutout. Must be enabled to accept RailCom feedback

← Configure node

PWM frequency

= 20000

Specifies what frequency the motor should be driven at. Typical values are in the 3000-20000 range.



Enable motor kick

= 1

Repeatedly sends a high-power pulse to the motor to avoid stalling at low speed steps.



Motor kick delay

= 20

How many milliseconds to wait between motor kicks.



Motor kick length

= 5

Length of kick pulse in milliseconds to send to motor.



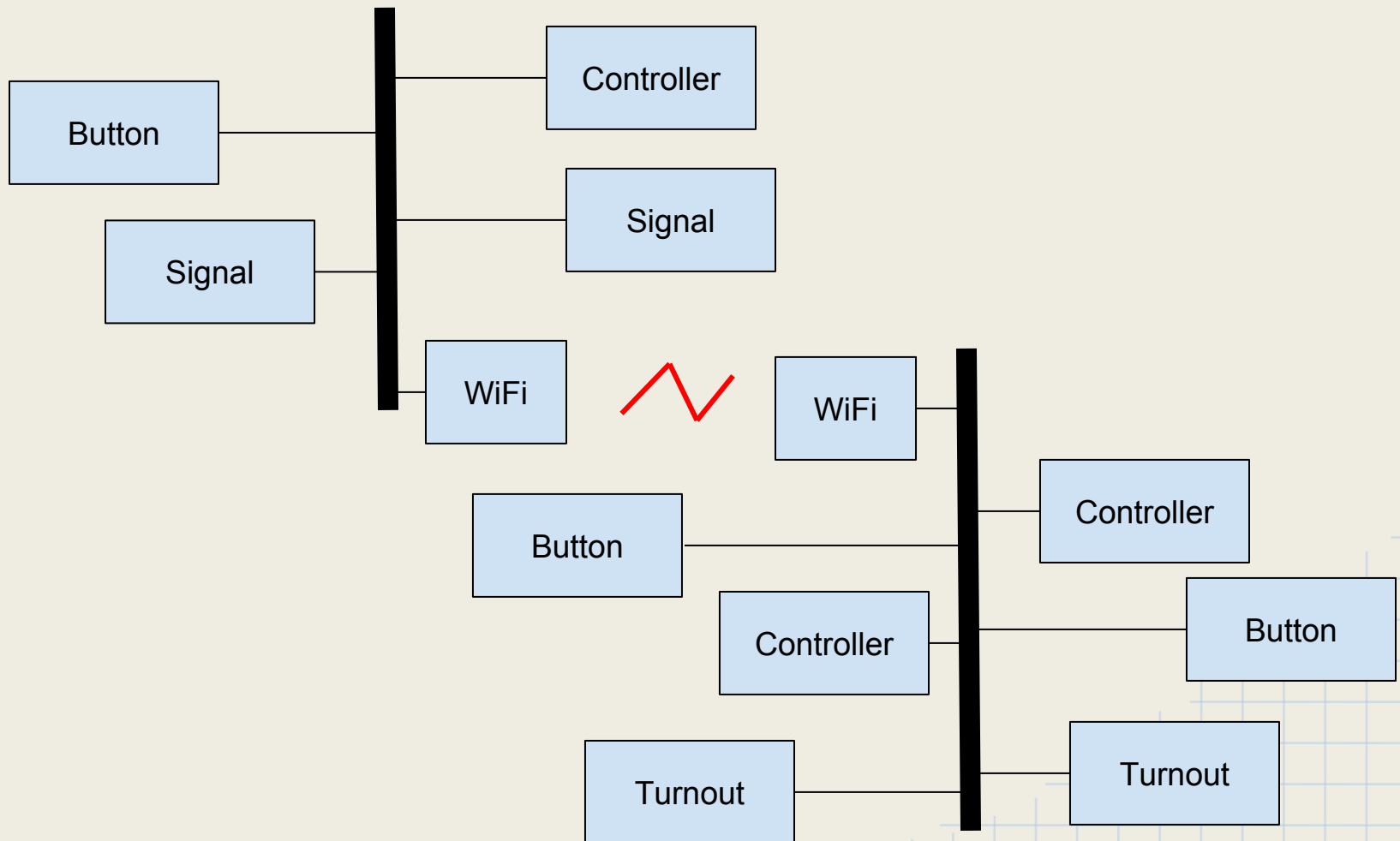
Load control

Why is LCC better?

LCC is future-proof.

- **Communications**
 - Today: CAN-bus
 - Tomorrow: WiFi with 1000x bandwidth
- **Scales well**
 - From two boards to thousands of modules

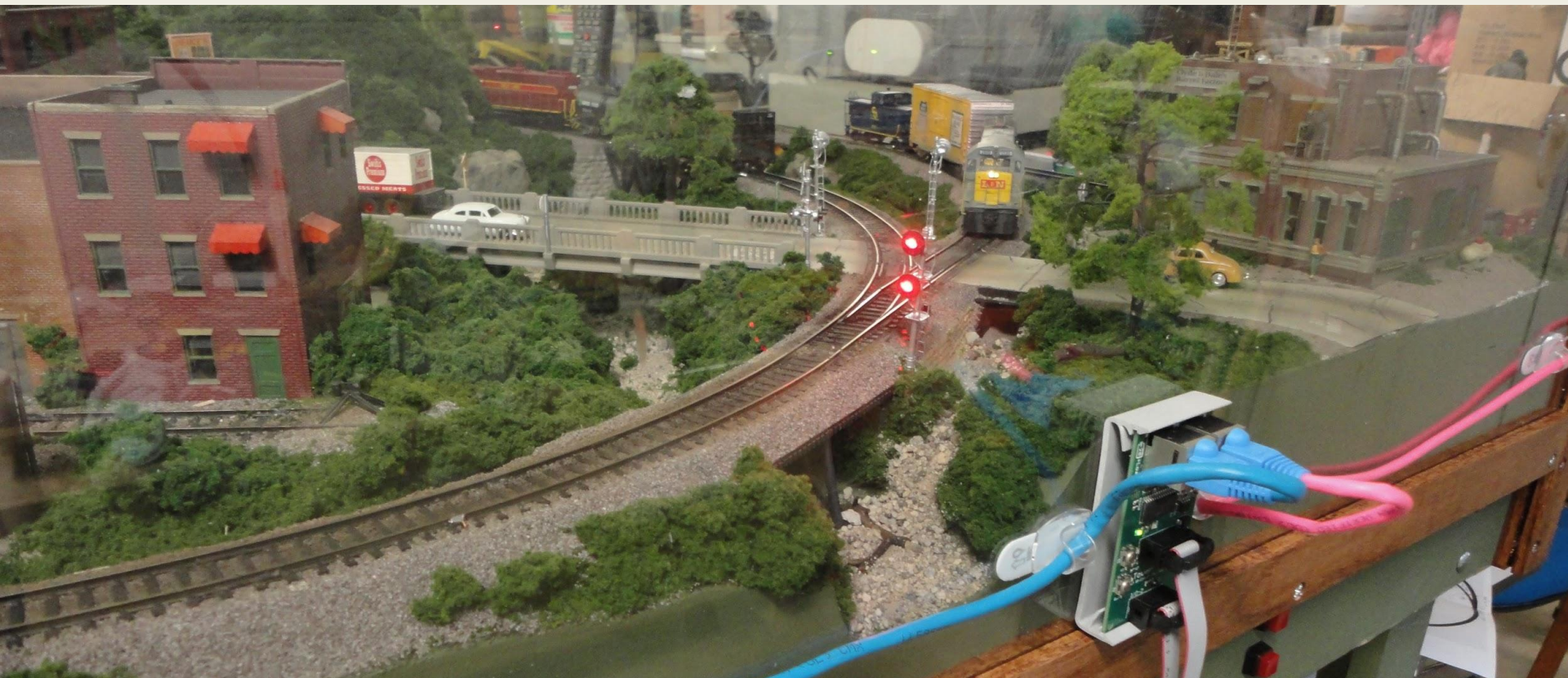
LCC can be routed



LCC today

You can get started with LCC today.

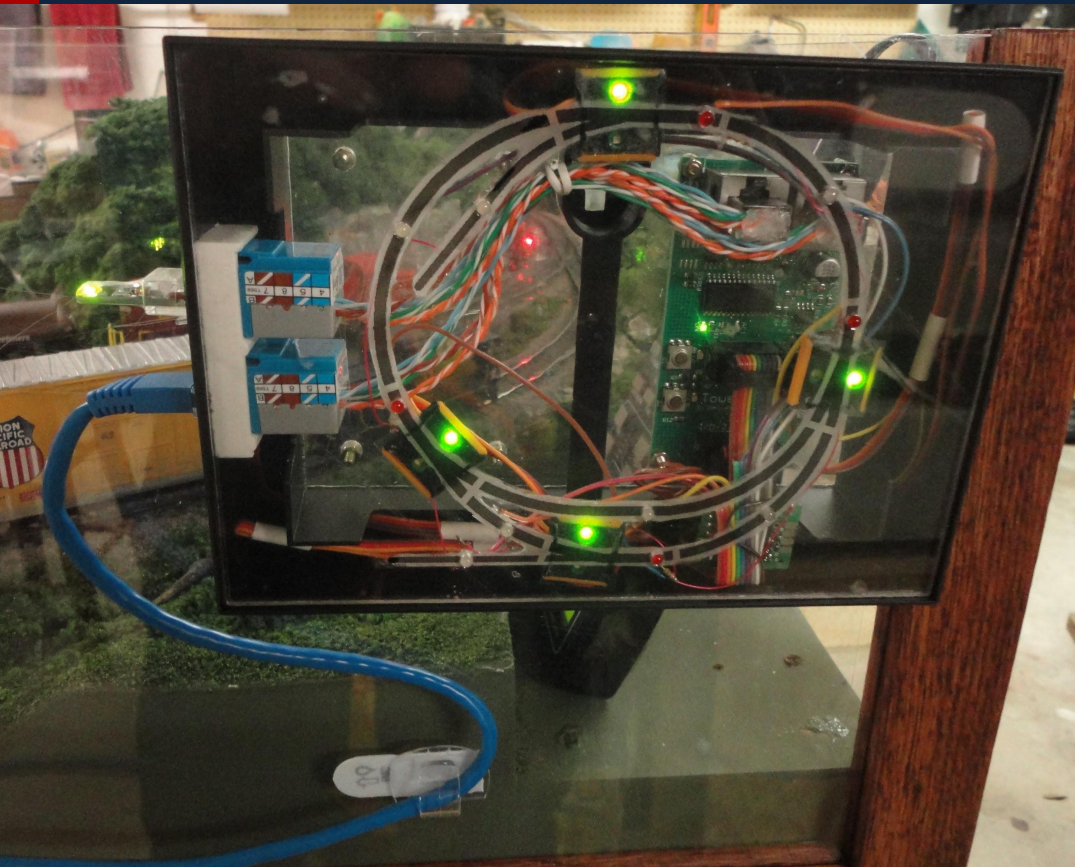
Full IO board offering from RR-CirKits





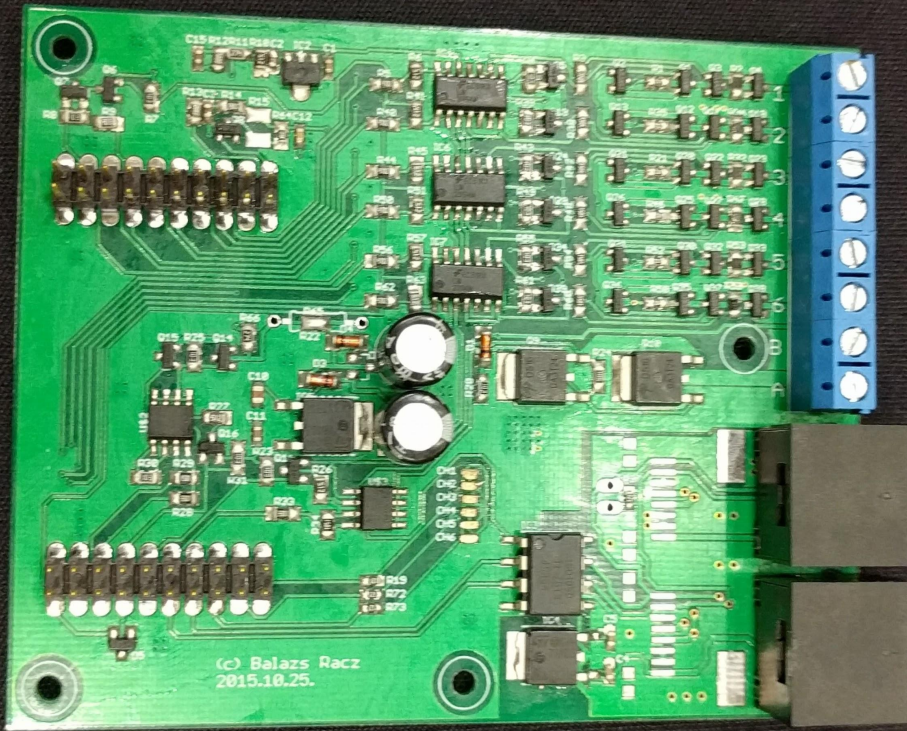
Once configured, the layout operates without a computer connected.

LCC today



- Turnout control
 - Lights
 - Panels & buttons
 - Block detectors
 - RR xing
 - Signal drivers
 - Signal & CP logic
 - CTC panels
 - JMRI connection
 - Soft panels
 - LCC repeater
-
- Setup and configuration

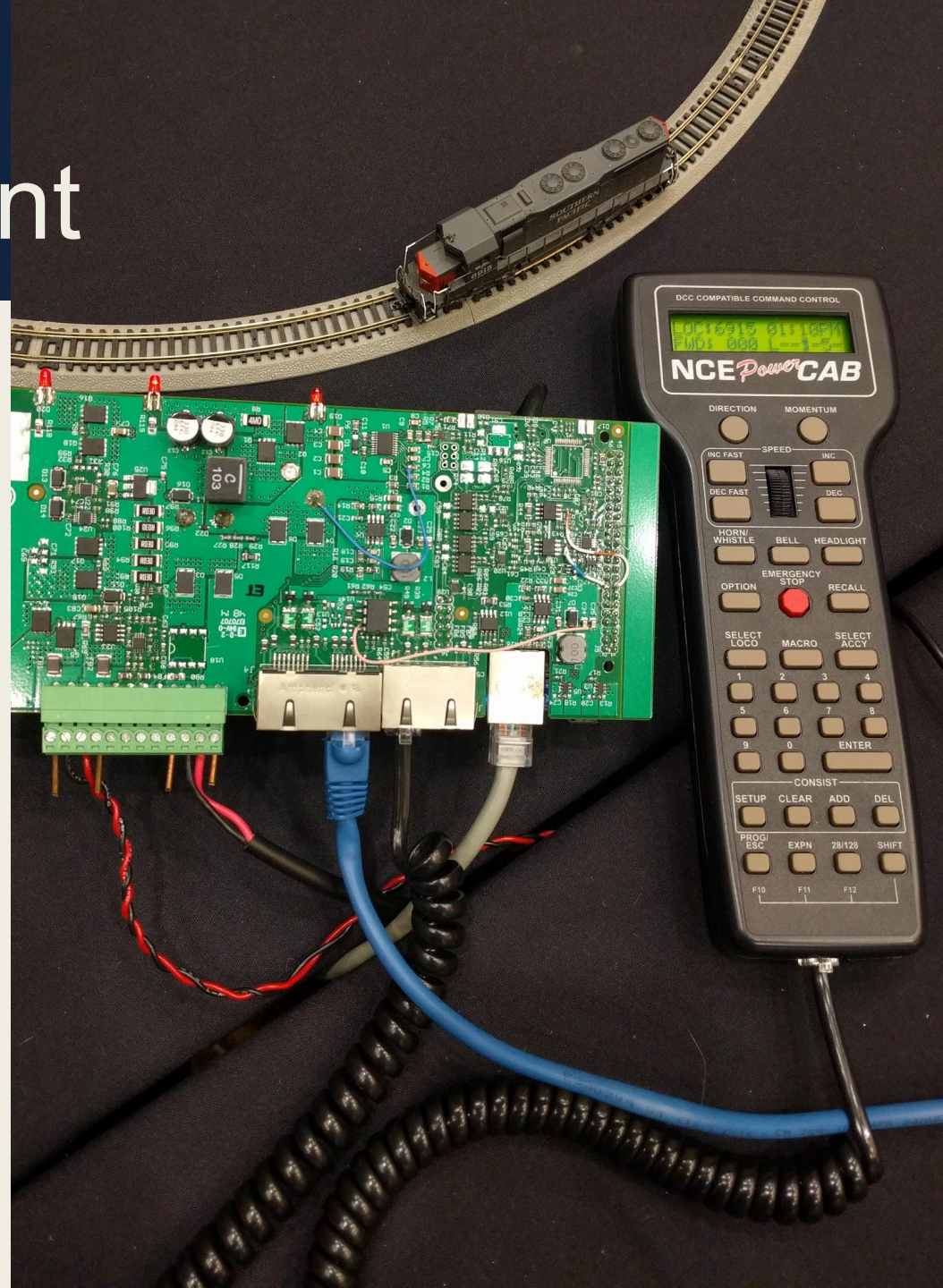
LCC is innovative



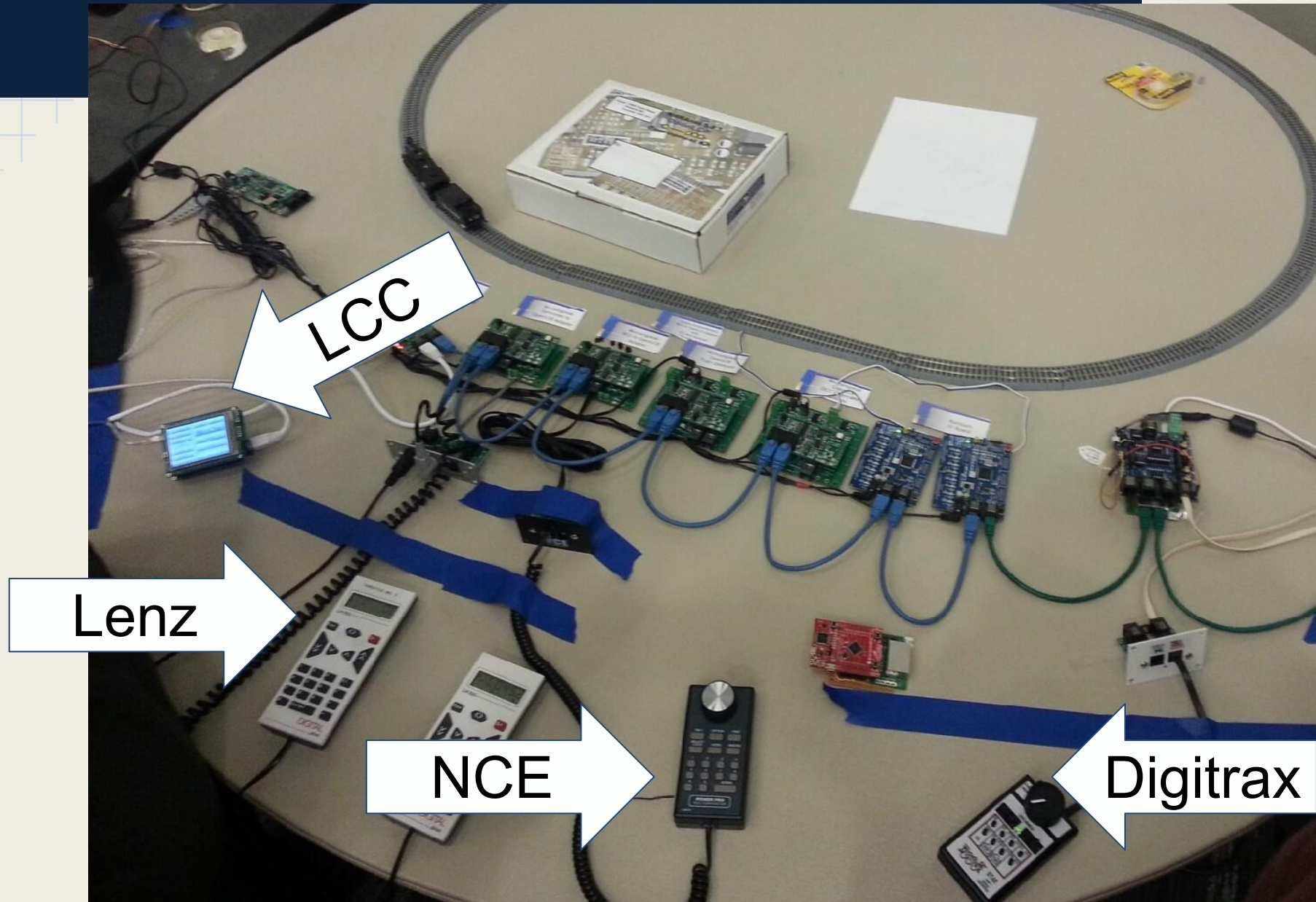
- 6-channel
- Block occupancy detector
 - Adjustable sensitivity
- Feedback via LCC
- Circuit breaker
 - Adjustable current limit
- Turn off staging track
- Railcom (transponding)
 - determine which train is on the track
- CV readout POM
- Staggered layout turn-on

LCC protects your investment

LCC command station
driving a DCC engine
using an NCE throttle



Gateways



Why should you switch?

Legacy bus – gateway to interface with LCC.

New features such as signaling?

Building a new layout?

Wiring

CAN-bus

- Simple inexpensive Cat5 cable
- up to 1000ft (300m) cable length
- up to 40 nodes per segment
- noise immune and error correcting
- powers small nodes

Gateways and repeaters

- Connect multiple bus segments together
- Optional backbone via Ethernet or WiFi
- or interface to legacy system

Credits

- **Prime Contributors:** Bob Jacobsen, Alex Shepherd, David Harris, Stuart Baker, Balazs Racz, Jim Kueneman, Don Goodman-Wilson, John Plocher
- **Developer Group**
 - 10 to 15 actively working on code at any time
 - 25 to 50 regular contributors and supporters
 - Many of the same people as supporting JMRI
- **User Group**
 - Started November 2009
 - July 2016 we have 226 addresses
- **NMRA liaison:** Stephen Priest
- **NMRA w.g. chairman:** Karl Kobel

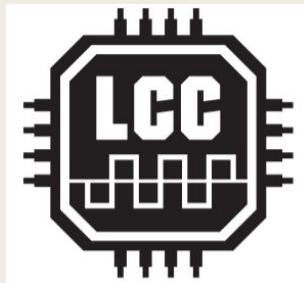
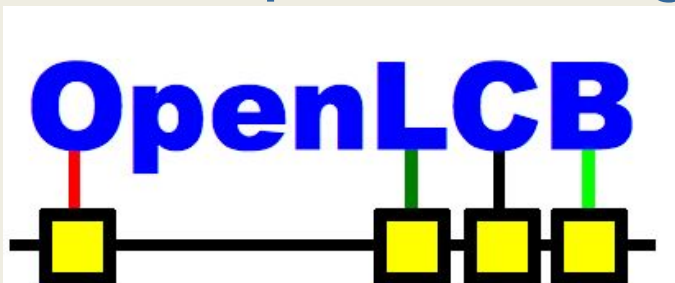
User Group

Yahoo Users Group

- openlcb@yahoogroups.com
- LayoutCommandControl@yahoogroups.com

Useful Links

- <http://openlcb.org>
- <http://openlcb.com>
- <http://nmra.org>, choose S&RP scroll to 9.7



Backup slides

This is the end of the presentation.
More slides with in-depth
information follow; these were
presented during the 2015 clinic.

Proof of concepts

Prototypes

- Gateways to Ethernet, WiFi, Internet
- DCC command station with LCC throttle
 - Gateways to legacy throttles
 - use Digitrax, NCC, Lenz throttles on the same layout with LCC!
 - OpenLCB throttle with touch screen
 - Android application

Future concepts & ideas

- These are all possible within the existing standards, but a manufacturer needs to develop and market the product
- Gateways to legacy buses
 - Connect your existing bus to LCC
 - Make your boards appear on the LCC bus
 - LocoNet, XpressNet, NCE
 - C/MRI
- Applications for tablets and smartphones
 - Panels, accessory control, throttle

Under the Hood

Nodes communicate with each other by:

- **Events**
 - Globally unique 'something happened' notice
 - These are 'broadcast' to all nodes
- **Datagrams**
 - Short blocks of specific data
- **Streams**
 - Data connections for things like voice or video

Basic Concepts -- Nodes

- Nodes retain their own settings
- Nodes describe their own settings and users can enter their own descriptions
- A node may be as small as a decoder
- A whole computer could also be a node
- All nodes have a unique id
 - just like Ethernet devices
 - huge address space, never conflict

Basic Concepts -- Network

- Nodes can also be assigned a human-readable name and description
- There is no “master” node
- No PC required!
- All nodes are equal peers
- Discovery protocol
 - allows network browsers
 - configuration tools

Basic Concepts -- P/C

- Event Reports contains Event ID and is broadcast to entire network
- Consumers can choose to act or not without requiring explicit activation by producer
- Multiple producers can produce same event
- Multiple consumers can consume same event
- Allows true many-to-many network architecture
- Event ID's can be moved from node to node

What can I buy today

RR-CirKits



RR-CirKits

power and bus termination

RR-CirKits
LCC buffer USB
CAN/USB Adapter Rev. B
Ver. 1.0 04/05/05
Roy Per USB TX RX

RR-CirKits
LCC Power-Point
LCC Buffer Supply
and Termination
LCC Power 25V
LCC ON

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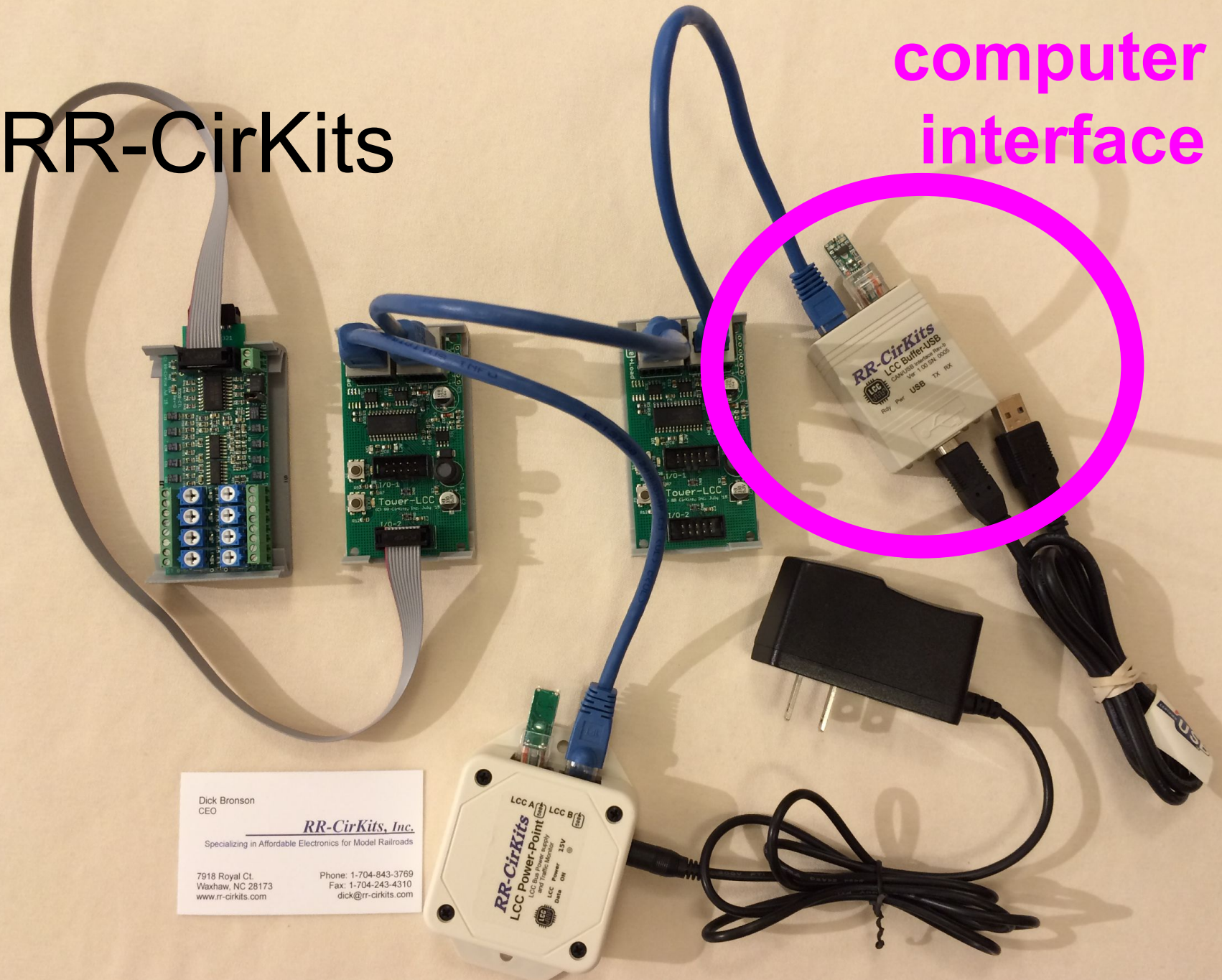
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RR-CirKits

computer
interface



Dick Bronson
CEO

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Specializing in Affordable Electronics for Model Railroads

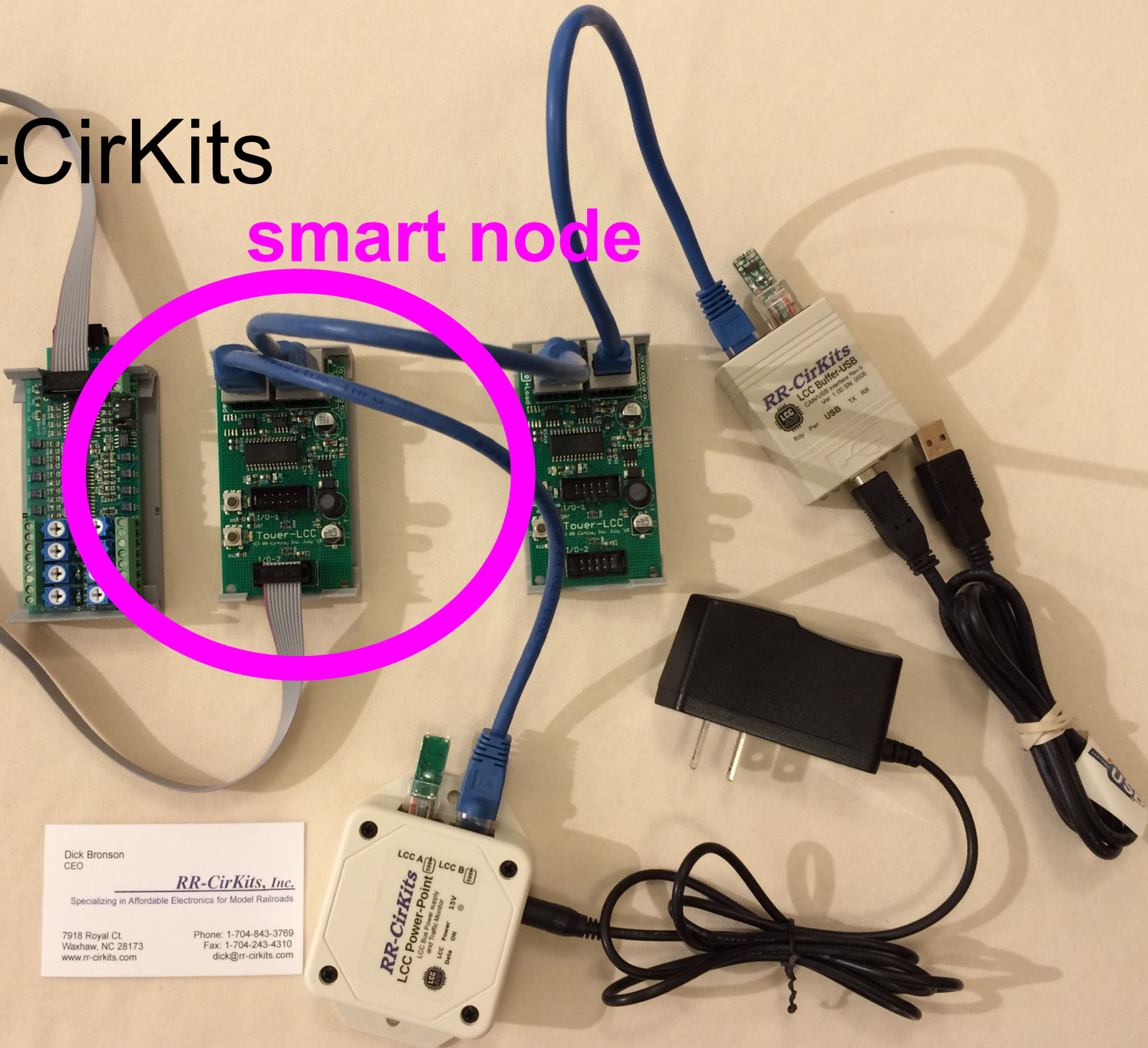
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smart node



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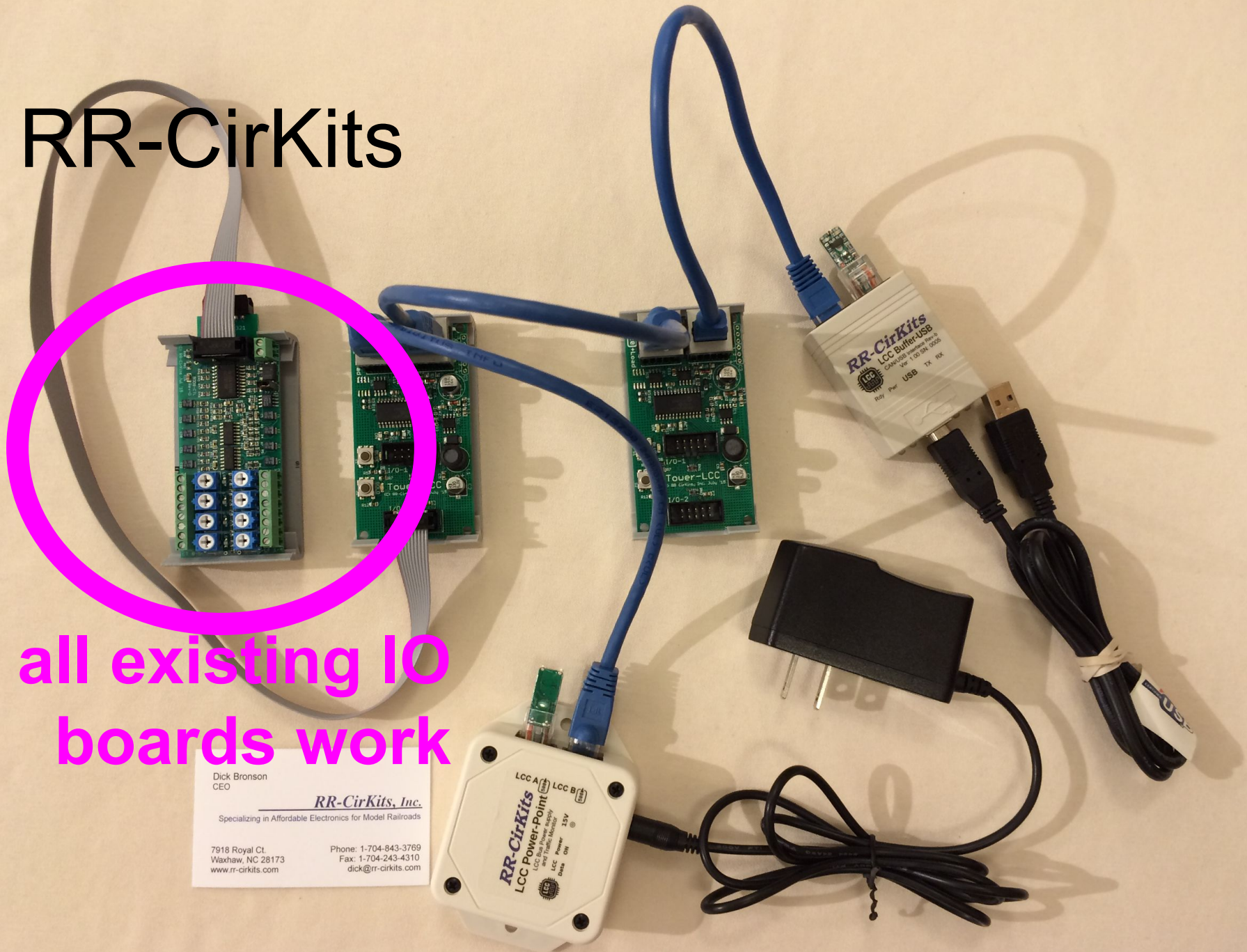
all existing IO
boards work

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Relation of OpenLCB vs LCC

OpenLCB

- a development community
- a set of standards they produce

LCC

- the set of OpenLCB standards which are adopted as the NMRA standard

Why open standards?

- Available royalty-free to all manufacturers
- Hardware from different manufacturers will work together – mix and match as desired
- Not locked in to one supplier
- Open path to innovative products, tailored to your needs

Adoption status

- OpenLCB
 - First documents adopted in 2012
 - Useful set completed & adopted in Feb 2015
 - Updated set with fixes based on comments adopted Feb 2016
- LCC
 - NMRA board voted to adopt the OpenLCB set from Feb 2015
 - Adopted in 2016 and sent to

Adoption process

- OpenLCB
 - Public working group discusses ideas and writes specs (standard and technical note)
 - Prototypes are built
 - Vetted specs are adopted
- LCC
 - OpenLCB group forwards documents to NMRA
 - They choose which ones to adopt
 - Those are adopted verbatim

Product availability

Ask your favorite supplier at the train show!

When will they have LCC-compatible products?

Selling products

- RR-CirKits
 - Full IO board selection

In active development

- Train Control Systems (TCS)

Hobbyist / development tools

- Contact openlcb@yahoogroups.com for code you can run

Why should I switch?

Q: I have a lot of LocoNet / XpressNet / CMRI / NCE / etc products. How do I get onto LCC?

A1: Ask your manufacturer.

A2: Gateway nodes could bridge to legacy bus.

Current use-cases

- Physical and network layers, plugs & cabling
- The standards cover basic layout control
 - Turnouts, signals, block detection
 - Panels, buttons, lights, etc.
 - Signaling and control point logic (cue node)
- Configuration and network management
 - Discovery: what nodes are there?
 - Configuration of nodes
- Computer interface (optional)
 - JMRI support

Current use-cases

- Logic can be in a node or in a different node: these are called Cue Nodes.
- Firmware upgrade.

Work in progress

- Time, Fast clock, and diurnal cycles
- Simpler protocol over TCP
- Search protocol
- Throttles on OpenLCB
 - Including connection to existing command stations
 - Or a native OpenLCB command station
 - Or native OpenLCB (wireless) trains