A Primer on Railroad Signals

Dick Johannes
March 13, 2010
The variety of signals seems endless
Key historical events

- 1840: Ball signals: LTC Rolt
- 1841: Semaphore – Charles Gregory
- 1851: Telegraph – Chas Minot
- 1870: Track Circuit – William Robinson
- 1871: Disk (Banjo) Signal – Thomas Hall
- 1904: Color light signals – William Churchill
- 1915: Position-light signals – Arthur Rudd
- 1924: Color Position signals – Frank Patenall
- 1925: Tri-color (G type) signals - GRS
1. What degree of prototype accuracy can do you want to achieve?

2. What era and region are you modeling?

3. How much can you afford?
Two types of “regions”

Interlockings & Junctions

Linear Blocks

10/22/2010
The Distinctions

• Linear blocks
  – **Unsupervised** (e.g. totally automated)
  – Default is “clear” or “green”
  – ABS (Automated Block Signaling)
  – APS (Absolute Permissive Signaling)

• Interlockings (Junctions & Sidings)
  – **Manually operated** (e.g. human controlled)
  – Default is “stop” or “red”
  – Mechanical interlocks
  – US&S panels
  – Computerized CTC
ABS - weakness

Time 0

Time 1

Time 2

10/22/2010
Dispatcher clears this train
The “OS” section
# Aspect Combinatorics

<table>
<thead>
<tr>
<th>UPPER HEAD</th>
<th>LOWER HEAD</th>
<th>ASPECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREEN</td>
<td>GREEN</td>
<td>281</td>
</tr>
<tr>
<td>GREEN</td>
<td>YELLOW</td>
<td>Not Used</td>
</tr>
<tr>
<td>GREEN</td>
<td>RED</td>
<td>281</td>
</tr>
<tr>
<td>YELLOW</td>
<td>GREEN</td>
<td>282</td>
</tr>
<tr>
<td>YELLOW</td>
<td>YELLOW</td>
<td>284</td>
</tr>
<tr>
<td>YELLOW</td>
<td>RED</td>
<td>285</td>
</tr>
<tr>
<td>RED</td>
<td>GREEN</td>
<td>283</td>
</tr>
<tr>
<td>RED</td>
<td>YELLOW</td>
<td>290</td>
</tr>
<tr>
<td>RED</td>
<td>RED</td>
<td>291</td>
</tr>
</tbody>
</table>
Aspects: NORAC*

Rule: 281
Name: Clear
Indication: Proceed not exceeding Normal Speed

Rule: 281a
Name: Cab Speed
Indication: Proceed in accordance with cab signal indication

Rule: 281b
Name: Approach Limited
Indication: Proceed approaching the next signal at Limited Speed

Rule: 281c
Name: Limited Clear
Indication: Proceed at Limited Speed until entire train clears all interlocking or spring switches

Rule: 282
Name: Approach Medium
Indication: Proceed approaching the next signal at Medium Speed

Rule: 282a
Name: Advance Approach
Indication: Proceed prepared to stop at the second signal. Trains exceeding Limited Speed must reduce to Limited Speed as engine passed the signal

10/22/2010


- Flashing

12
Aspects: NORAC* (cont)

Rule: 283
Name: Medium-Clear
Indication: Proceed at Medium Speed until entire train clears all interlocking or spring switches, then proceed at Normal Speed

Rule: 283a
Name: Medium Approach Medium
Indication: Proceed at Medium Speed until entire train clears all interlocking or spring switches, then approach next signal at Medium Speed

Rule: 284
Name: Approach Slow
Indication: Proceed approaching the next signal at Slow Speed

Rule: 285
Name: Approach
Indication: Proceed prepared to stop at the next signal. Reduce to Medium Speed as engine passes signal

Rule: 286
Name: Medium Approach
Indication: Proceed prepared to stop at the next signal. Reduce to Medium Speed as soon as signal is clearly visible

Rule: 287
Name: Slow Clear
Indication: Proceed at Slow Speed until entire train clears all interlocking or spring switches, then proceed at Normal Speed

Aspects: NORAC* (cont)

Rule: 288
Name: Slow Approach
Indication: Proceed at Slow Speed until entire train clears all interlocking or spring switches, then proceed at Medium Speed.

Rule: 290
Name: Restricting
Indication: Proceed at Restricted Speed until entire train clears all interlocking or spring switches and leading wheels have 1) passed a more favorable signal or 2) entered non-signaled territory.

Rule: 291
Name: Stop and Proceed
Indication: Stop then proceed at Restricted Speed until leading wheels have 1) passed a more favorable signal or 2) entered non-signaled territory.

Rule: 292
Name: Stop Signal
Indication: Stop.

Rule: 296b
Name: Speed Limit Sign
Indication: Proceed at speed posted on the Approach Speed Limit Sign until entire train has passed the Resume Speed Sign.

Rule: 296c
Name: Resume Speed Sign
Indication: Resume speed after entire train has passed the Resume Speed Sign.

- Flashing
The Modeler’s Aspects

Rule: 281
Name: Clear
Indication: Proceed not exceeding Normal Speed

Rule: 292
Name: Stop Signal
Indication: Stop

Rule: 285
Name: Approach
Indication: Proceed prepared to stop at the next signal. Reduce to Medium Speed as engine passes signal

Rule: 290
Name: Restricting
Indication: Proceed at Restricted Speed until entire train clears all interlocking or spring switches and leading wheels have 1) passed a more favorable signal or 2) entered non-signaled territory.

10/22/2010
Create a linear schematic
Create a linear schematic
Create a linear schematic

- Label blocks
- Label signals (Name east/west or north/south)
- What’s CTC and what’s block trackage between CTC
Three key implementation questions

• What is the incoming information needed and how do I get it?
• How do I process the incoming information?
• How do I output the processed information?
Inputs

- Where are my trains?
- What direction are they moving?
- What train is it?
- How are my turnouts set?
## Detection

<table>
<thead>
<tr>
<th>Method</th>
<th>Isolated from Track Power</th>
<th>Reliability</th>
<th>Modification of Rolling Stock</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reed Switches</td>
<td>Yes</td>
<td>Fair</td>
<td>Yes</td>
<td>High</td>
</tr>
<tr>
<td>Optical</td>
<td>Yes</td>
<td>Fair</td>
<td>No</td>
<td>Low</td>
</tr>
<tr>
<td>Infrared</td>
<td>Yes</td>
<td>Good</td>
<td>No</td>
<td>High</td>
</tr>
<tr>
<td>Twin-T</td>
<td>No</td>
<td>Very Good</td>
<td>Yes</td>
<td>Medium</td>
</tr>
<tr>
<td>Induction</td>
<td>Yes</td>
<td>Very Good</td>
<td>Yes</td>
<td>Low</td>
</tr>
</tbody>
</table>
Processing

• **Hardware**
  – Logic Rail
  – Custom Signals (Atlas)
  – Integrated Signal Systems
  – Circuitron
  – Dallee

• **Software**
  – JMRI
  – CMRI
  – Railroad & Co
  – Signals by Spreadsheet
Outputs

- Strictly hardware
  - Gets complex and expensive with more complex track plans
  - Less flexible

- Hardware and Software
  - More flexible
  - Requires programming (somehow)
Controlling the System

Screen shot from Dick Bronson’s Hartford National Clinics
Controlling the System
Controlling the System
Controlling the System
Controlling the System
The double saw-by
Choices

- Ignore interlockings and just do ABS/APS
- Just do 1 or a few interlocks and ignore the “blocks” in between
- How long is a block?
  - 3 average train lengths?
  - 100 scale feet?
- How many aspects?
- Dark areas? How do you handle them?
Consider emulation

• Block or signal animators
  – Logic rail
  – Circuitron

• Just use Red/Green indications for R/N position at turnouts

• Will look pretty good and unless you are actually using them to operate may suffice
A passing siding

6 detectors $78
10 Signals $340
16 signal heads to illuminate $199
2 tortoises and DCC decoders $60

$677

10/22/2010
The Future?

Cab Signals
• Leg up for the modern modeler?
• No fixed signals
• Location, direction & speed
• DCC throttles with LCDs
• BiDirectional DCC
• Could stop locomotive
References (Books)

References (Web Sites)

- Carsten Lundstens site: http://www.lundsten.dk/us_signaling/index.html
- Norac Simulator: http://raildata.railfan.net/java/DivRte/NORAC.htm
- Railroad Signals: http://www.railroadsignals.net/
- Railroad Signals of the US: http://www.railroadsignals.us/
- JMRI: http://jmri.sourceforge.net/
- CATS: http://home.comcast.net/~kb0oys/
- CMRI: http://www.jlenterprises.net/
- Custom Signals: http://www.customsignals.com/
- ISS: http://www.integratedsignalsystems.com/
- Signals by Spreadsheet: http://www.signalsbyspreadsheet.com/
- Railroad Circuits: http://rr-cirkits.com/
- Logic Rail: http://www.logicrailtech.com/
References (Journals)

THANK YOU