Communications for Model Railroads

Seth Neumann
sneumann@pacbell.net
Agenda

• Design Considerations
• Modeling From the Prototype
• What Era are You Modeling?
• How to Put it Together
• Hints & Resources
Design Considerations

Era/Technology

Jobs you want to model

Prototype

Space in your Railroad room

Your Design
Communications for Operations

• Different eras had different dispatching models based on available communications
  – TT&TO: Telegraph/Telephone:
  – CTC: Telephone/Radio
  – DTC, TWC: Radio
Communications Time Line

- 1845: Telegraph invented
- 1850: Telegraph used by Railroads
- 1851: Charles Minot uses Telegraph to send 1st Train Order on Erie RR
- 1869: Telephone invented
- 1920s: Telephone in widespread use for TT&TO dispatching
- 1925: CTC appears, phone booths provided at ends of controlled sidings
- 1940s: Telegraph largely supplanted by Telephone
- WWII: CTC becomes common on western mainlines
- 1960s: Radio becomes widespread, Train Orders copied over radio
- 1980s: Radio becomes ubiquitous, TWC/DTC appear
Your Prototype

• What did your prototype do in your era?
  – Single track with passing sidings?
  – Double track, rule 251?
  – Style of dispatching:
    • TT&TO
    • CTC/TCS
    • Radio

• TT&TO requires Train Order Offices, preferably with Train Order signals
• CTC requires phones at each controlled signal
Modeling Jobs on The Railroad

Operations is modeling the work of the railroad. Like everything else in model railroading, jobs are selectively compressed: we like to do the fun parts but not the boring, tedious and dangerous parts. In the transition era there were 10 clerks for every one person in train service. We could not fit all of the clerks for one good op session in this room!
Jobs to Model:

- Dispatcher
- Train Crews
- Agent/Operators (for TT&TO)
  - One for whole layout?
  - One at each station?
  - Where you can fit them in?
  - Train crew becomes often magically becomes agent at each TO office
What communications are you trying to model?

- Communications among DS and Operators? (TT&TO)
  - Open speakers – a Radio Shack intercom is a quick and dirty choice IF the DS and Agent/Operators are in quiet places, isolated from the railroad. You could also build something using phone hardware OR
  - Telegraph (RR Morse or International Morse)
  - Use phones with amplified speaker across the line, provide Push to Talk and/or noise canceling microphone to control feedback
  - Remember real crews rarely OSd themselves, so having crew OS is generally a “model railroad thought”
- Communications between DS and crews (CTC)
  - Idea is to keep crews “isolated” (no radio chatter)
  - Need to go to a “station” or phone booth to talk
  - “Call Lamps” on relay shacks set by DS on the CTC machine

Understand your operational requirements!
Your Layout: Givens and ‘Druthers

• How much space do you have?
  – Do you have room for sound-isolated Agent’s stations?
  – Where to place telephones (by the station –TT&TO, at controlled signals –CTC)
  – Aisle width
  – Places to write

• How much chatter do you want in the layout room?

• Arrangements for displaying train order signals, (Semaphores, Searchlights, hooks below layout)

• Do you want prototypical phone instruments or would more comfortable and durable (and potentially less expensive) modern (but anachronistic) equivalents be better?
How should it work? - 1

• DS Calls a train:
  – DS sets Signal to “stop” at station in front of train
  – DS sets call lamp switch at that station
  – DS presses code button
  – lamp on “phone booth” lights & locks
  – Crew picks up phone (having seen lighted phone booth on arrival at station)
  – Crew announces “Hearst”
  – DS acknowledges, gives instructions
How should it work? - 2

• Train Crew calls from Siding:
  – Conductor goes off hook at phone and announces [“Hearst”]
  – DS hears speaker or DS phone buzzes
  – Or DS goes off hook – buzzer stops (speaker muted, if present)
  – DS answers
  – Everyone goes back on hook
How to Model under CTC - Planning

• Assumes you have a CTC Board
• Determine where the DS will work. Is it a separate room?
• Determine where the phones will be. Do you have room for a phone at each end of each controlled siding?
• Find a clean, well lighted place for the common equipment. Be sure there is room to work, you’ll be spending some time here!
How to Model it - Station

- There are many ways to do stations
- Here’s what Tommy Holt did: (note the Call Lamp on the phone)
- I recommend the stations have PTT and/or noise canceling mics
- Enforce communications discipline! Don’t talk until the line is clear.
## Possible Station Solutions

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Custom w/ PTT</td>
<td>Most flexible, best performance</td>
<td>$100</td>
</tr>
<tr>
<td>Vintage</td>
<td>swap meets, web vendors</td>
<td>$50-250</td>
</tr>
<tr>
<td>554 Wall Set</td>
<td>Whatever you can find, garage sales</td>
<td>&lt; $50</td>
</tr>
<tr>
<td>WallMart Cheapie on modular plate</td>
<td>Buy a few spares, anachronistic. Some control circuits won’t work</td>
<td>$15</td>
</tr>
</tbody>
</table>
Stations

Vintage Custom 554
“Space Saver”

- W.E 211 type “space saver”
- Doesn’t take much space in aisle
- Needs external speech network and ringer/buzzer*
- Appropriate for 20’s thru 80’s
- Originally had E or F type handset – consider replacing with G type handset (correct for 50s and 80s)
- Phoneco >= $125
302 Set

- 302 type desk set
- Has internal speech network
- Appropriate for 30s through early 50s
- Equipped with F type handset
- Phoneco >= $199
500/554 Set

- 500 type desk set
- Designed by Henry Dreyfus of NYC fame
- Improved internal speech network
- Appropriate for 50s through early 80s
- Equipped with G type handset
- Has extra hook switch contacts
- Phoneco >= $99, often available cheap at garage sales and swap meets
Roll your own

- Electrically a 500 set
  - G type handset
  - 425e network
  - Cradle and hookswitch
- Can be panel or Fascia mounted

Courtesy of Jack Burgess
How to Model it - Dispatcher

• If there is a separate, sound-isolated room for the CTC machine, I recommend using the microphone/speaker/footswitch arrangement. Depending on your precise era, you may want to match the photos of your dispatcher’s office at that date.

• If not, it’s probably best to use a noise canceling headset. These are available from many vendors and can work with virtually any phone. Your regular dispatchers may use one at work.

• In any case the DS should be able to work with both hands free.
## Possible Dispatcher Solutions

<table>
<thead>
<tr>
<th>Solution</th>
<th>Source</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scissor Mount with Headset (listen on headset)</td>
<td>Antique telephone suppliers</td>
<td>&lt; $500</td>
</tr>
<tr>
<td>“PA” type microphone with speaker</td>
<td>Commercial sources</td>
<td>$50-250</td>
</tr>
<tr>
<td>Modern Phone with headset (listen on headset)</td>
<td>HelloDirect, etc</td>
<td>&lt; $250</td>
</tr>
<tr>
<td>Modern Phone with buzzer, relay control</td>
<td>Whatever you can find, garage sales</td>
<td>$ 50</td>
</tr>
</tbody>
</table>
Dispatcher Phones
Dispatcher Arrangement

Foot Pedal

TIP
RING
Mic/Speaker Arrangement
Dispatcher Foot Switch

• Use a period phone style switch
• Use a commercial switch
• Use the switch from your resistance soldering rig with an AC relay
• Make one
Foot Switch Options
Common Equipment

- Power Supply – 24VDC regulated, a (250mA regulated) wall wart will work
- A “Battery Feed” coil. These are balanced chokes found in classic telephone circuits
- Amplifiers for DS (mic/spkr) or a pair of relays and a buzzer.
- Connecting blocks, wire etc.
What is “Battery Feed?”

- Power
- DC v. AC
- What is “impedance?” (Z)
  - Think of it as AC resistance
  - A component (usually a choke coil) can have low DC R but high AC Z!
Battery feed alternatives

- Telco style Intercom
- Battery feed relay (24 or 48V)
- Audio Freq chokes
- Retard coil (2A, 31A, 401A KTUs,)
- PBX is not recommended

The goal is to have a relatively low DC Resistance (to power the phone) while keeping the impedance (AC resistance) at voice frequency as high as possible so we don’t lose speech energy through the power supply (so we can hear).
Simple Phone System

Handset: RCVR

Network:
- GN
- RR
- R
- C
- B

Hook Switch: TIP

Battery Feed Inductor:
- 5
- 1
- 4
- 3

Power Supply: 18-24 VDC

“A”
Noise/Adequate Volume

- Use high impedance battery feed if possible
- Busy indicator to warn of conversation in progress (user discipline)
- Push-to-talk (PTT) and/or noise canceling handsets
- DO NOT use amplified handsets: they amplify the noise in the room, too!
- Large systems (more than 4 stations off hook at once) may require a distribution amp
Large System Issues

- Have more stations (5 – 20)
- More phones off hook as crews tend to call in every time they see a red signal
- More phones means more ambient noise and less volume – combining loss
- Traditional phones don’t work well with > 4 off hook – Communications Discipline!
- Systems with active combiners and amplification work better with large numbers of phones off hook
- Ken Thompson, Bruce Chubb made systems like this
- Contact me if you are interested
Other

- Use Cat 5 ($120/kft), has 4 pair, or CAT 3 (if you can find it) for station wiring
- Use twisted pair, helps reject noise (leakage from DCC)
- Use terminal strips or telephone style 66 blocks for connections
Radio

- Use FRS radios (some layouts still have 5 channel)
- All units should use headsets to keep noise down, except isolated dispatcher
- Can modify a handheld for PTT service
- Do not use VOX
- Don’t need to use subchannel if there isn’t much interference – quicker response
Phone Resources

- Phoneco 608-582-4124
  - www.phonecoinc.com
- Antique phone collectors site
  - atcaonline.com/diagrams.html
- Graybar (San Jose) 408 441-9009
  - www.graybar.com
- Telephone Components
  - http://www.telephonecomponents.com
- Hello Direct
  - http://www.hellodirect.com/
- Radio Shack, Fry’s, HDB etc.
- I have a limited number of telephone sets available. Contact me at sneumann@pacbell.net
Print Resources

• My 4 Part Article in the Dispatcher’s Office
  Starting with April 2011
Special Thanks to:

- Thom Anderson
- Kirk Baer
- Mike Burgett
- Pat Flynn
- Tommy Holt
- Kermit Paul
- Dave Stanley

- Steph Kerman
- Ludwell Sibley
- Napa Club
Decision Chart for System

TT&TO?

CTC/TCS?

TWC/DTC?
TT&TO/CTC Decisions

Dispatcher Isolated

- Phone with headset
  - Period/Modern
- Mic/speaker Arrangements
Signaling Stations

- If Manned (yards, open TO office) include audible signal (low voltage buzzers work well)
- If not manned, some kind of visual indication that latches until cleared by DS:
  - TT&TO Train order board or signal (toggle switches at DS)
  - CTC “Maintainer Call” light on signal shack (MC keys on CTC board)
Signaling Dispatcher

• Indicate to DS that a station needs to talk
• The prototype usually had an open speaker across the line, works well in the mic/speaker case
• DS set can be arranged to have receiver always live (for a headset)
• Or you can use a buzzer to indicate a station needs to talk.
TWC/DTC Decisions

• Track Warrants and Direct Train Control depend on radio
• Use FRS radios
• If more traffic than one channel, consider 2 channels
• High traffic locations (such as yards) may use phone or talk back intercoms