Visualizing Railroad Operations
A Tool for Traffic Planners and Dispatchers

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Presentation Topics

• Background Information
• The *Railroad Traffic Planner* Tool
• Possible Uses for Dispatching
• Conclusions
Background
Information...
Brief Project History

• The Volpe Center and MIT have been developing the Railroad Traffic Planner for the FRA since 1996 as part of a project to explore the benefits of various “knowledge display interfaces”

• Traffic planners at MBTA Commuter Rail and Guilford Rail System participated in the design and testing of early versions of the application

• Fulcrum Corporation joined the team in 2003 to support “technology transfer” to additional railroads

• North Shore Railroad and the Paducah and Louisville Railway are the latest demonstration sites
Goals

• Proof-of-concept software to identify potential benefits of this type of planning tool

• Iterative, user-centered approach
Railroad Traffic Planning

• The application was initially developed for traffic planners who create and modify train schedules (not dispatchers).

• Traffic Planning requires complex decision-making and many trade-offs:
  - Even small changes can take many hours when using paper schedules.
  - They rarely have time to explore schedule alternatives and find the “best” solutions.
Estimating the Future

- Planners need to determine the operational sequence of future events
  - Who will arrive where and when?
  - How will track restrictions impact the schedule?
  - How can the flow best be managed?
Stringline Diagrams

• A string shows the times and locations of a scheduled trip

  \[
  \begin{array}{c|ccccc}
    Time & 10:30 & 10:35 & 10:40 & 10:45 & 10:50 \\
    \hline
    Sharon & \text{String for a trip from Sharon to Providence} \\
    Mansfield & \text{} \\
    Attleboro & \text{} \\
    South Attleboro & \text{} \\
    Providence & \text{} \\
  \end{array}
  \]

• Railroads have used non-computerized stringline diagrams for many years
Strings Show Many Things

- Span along time axis represents duration
- Span along location axis represents distance
- Horizontal line indicates that train is stopped
- Intersecting lines show that trains will meet if on same track or pass if on separate tracks
- Slope of line indicates direction and relative speed

![Diagram showing train routes and time axis](image)

- Train going to Providence
- 30-minute stop
- Meet or pass
- Slower section
- Train leaving Providence

(Providence)
Side-By-Side Comparison

Paper Schedule

### Railroad Traffic Planner Schedule

- Strings show entire trips, rather than just the stops
- With strings, it is easier to see where and when trains will be close together
- On the computer, strings can be moved around easily
The Railroad Traffic Planner Tool...
Overview Image

Main Window

Settings Files

Popup Windows
Selecting a Line

• Select a line from the *Rail Map* to set the *location* axis of the stringline diagram

• “Location” includes:
  – Mile numbers
  – Track configuration
  – Waypoint names
Adding Trips (Strings)

- Provide the following information to create a new string
  - Train Type
  - Train ID
  - Direction
  - Start or End Day and Time
  - Start and End Waypoints
  - Dwell Times at Stops
  - Tracks

Press Add to make the string
Showing Tracks, Times and Speeds

Click to Show Times

Click to Show Speeds

Corresponding tracks turn green when string is selected

(times)

(speeds)
Adjusting the View

• Zoom to focus on parts of the schedule

Sliders show extent of zoom
Several Ways to Revise Trips

• Click and drag

• Use toolbar buttons

• Enter changes
Exporting to Table Format

• Schedules can be exported and then opened as text files or spreadsheets

• Traditional tabular format can be easily shared with others
Adding Track Restrictions

- Provide the following information to take a track out of service or restrict the speed

<table>
<thead>
<tr>
<th>Restriction Type</th>
<th>Start and End Day and Time</th>
<th>Start and End Waypoints</th>
<th>Tracks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed Restriction</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- In this example, Track 1 is out of service from Hyde Park to Route 128 from 8:00 to 9:00 am

Press Add to make the track restriction
Effects of Track Restrictions

- In this example, a speed restriction slows down a train and creates a new meet.

- Speed is restricted to 10 mph on Track 1.

- Trip is 13 minutes longer and there is a new meet.
GPS Tracking

• “Near-real-time tracking” hardware and software can be included to support planning activities
  – Automatically draws strings

• Devices can be installed on locomotives, inspection vehicles, and maintenance equipment

• Not appropriate for safety-critical applications
  – Supplements existing data, but is not adequate to replace existing safety processes
GPS Devices on a Locomotive

- Cell phone enclosed in a weather-resistant “pod” on the outside of the train

- A battery pack with overload protection and other features is plugged into the locomotive power supply
GPS Tracking Display

- Display near-real-time or archived data
Possible Uses for Dispatching...
Dispatcher Training Tool

- Show how to identify places where additional activities can be inserted
- Help new employees learn to estimate future positions and anticipate problems
- Teach how decisions can impact traffic flow in various territories
Dispatcher Planning Tool

• Stringline display could support both preliminary planning and reacting to unexpected events

• Sample activities:
  – Analyze meets and passes
  – Decide how to insert unscheduled events
  – Estimate future positions
Conclusions...
Potential Benefits

• Preliminary findings show that this type of tool has the potential to provide safety and productivity benefits

• It can help users:
  – Compare different options
  – Identify windows of opportunity
  – Set more realistic expectations for customers and other railroads
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We want to learn more about how this type of tool might be useful for dispatchers.

Please share your questions and comments with us.

Thank you!