Appendix I
Rail Operations Analysis Methodology

Northwestern Pacific Railroad Financial Feasibility Study

Rail Operations Analysis Methodology

Purpose

A rail network computer model of the study area of the North Western Pacific route between Schellville and Samoa was developed to simulate anticipated train operations. This modeling instrument accurately represented the characteristics of the rail infrastructure, realistically simulated train movements and identified dispatching conflicts. It presented accurate comparisons of rail network performance associated with trip time analysis, capacity, and train delays at specified levels of service for proposed changes to infrastructure and train operations. In addition, it served as the cornerstone for the development of integrated operating plans and capital improvements that address the service priorities of the NCRA, while supporting the Caltrans statewide rail transportation goals. This working model was designed as a flexible tool that is easily modified and upgraded. It provides significant utility in evaluating the operational and infrastructure improvements that ultimately result in achieving the operational and service objectives of the Port of Humboldt, line shippers and the NCRA.

Background and Model Selection

There are a multitude of simulation software systems available for use in rail operations and capacity planning. The consultant team is a licensed user of three modeling/simulation software systems. It was determined that the best tool for this project was the Berkeley Simulation Software (BSS) Rail Traffic Controller (RTC) model.

The RTC modeling software is a sophisticated program designed to realistically simulate both freight and passenger rail operations either in a planning environment ***or an online control center***. The characteristic that sets RTC apart from all other rail modeling instruments is that it resolves complex multi-train conflicts in realistic ways. It has proven to be fully capable of handling many levels of train and/or track complexity. It does not simply resolve conflicts between pairs of trains, but rather looks globally at multi-train conflicts in much the same way as a dispatcher in a control center would.

The logic is also cost based. As the model dispatches, each train's cost and performance are constantly recomputed to ensure that trains stay on schedule to the extent possible, for a given track configuration. It is the dynamic costing and multi-train view that enables RTC to approximate the performance of a train dispatcher. In addition, RTC accurately depicts train movements in dark territory or can apply a complete interface for specifying signals with up to 5 aspects.

In addition, the history of successful capacity planning projects using this system is well documented over the past several years. RTC is now the standard among freight railroads and is becoming the standard for passenger operations. The majority of the Class I Railroads, including the UPRR, BNSF, CSX, Amtrak, KCS, TFM (Mexico) and others, have selected RTC for operations planning and capacity analysis.

Other features of RTC that are particularly valuable include the ways in which it displays simulation results. While timetables and time-distance charts are useful for analysis on simple networks, they do not show conflict resolutions at a sufficient level of detail. RTC solutions are displayed in all the traditional ways, but it is the animation with its multitude of color modes that brings the solution to life. Everything from train costs and schedule adherence to train lengths are viewed on one screen. The integrity of solutions are clearly illustrated, verifiable and presentable without examining abstract reports.

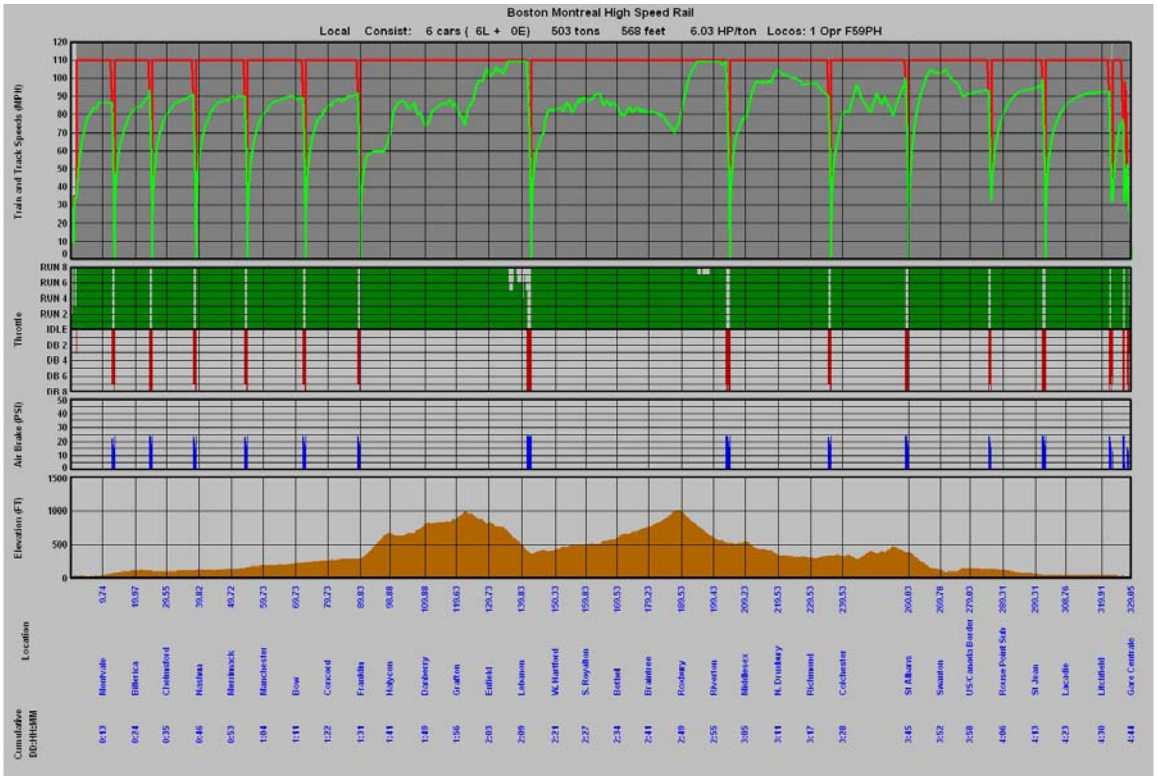
Other simulation systems currently in use require a post-processor to convert the run data into a graphical display form that can be viewed and analyzed. This additional step is time-consuming and compromises the integrity of results because the output data must be modified to make it presentable to operating personnel. This is not required when using RTC because what you see in animation is the genuine solution that the software has found.

Traditional event-based simulations may be adequate at modeling simple mainline track segment configurations, but they have not proven to be very responsive to larger or more complex networks. This is especially important in shared-use corridors where the dynamics of passenger and freight trains require a dispatching logic that effectively addresses meet, pass, overtake and routing issues. In summary, RTC was selected for this effort because of proven track record in being able to accurately simulate a full range of rail networks. Furthermore, results of RTC simulations have been accepted as evidence as part of legal proceedings in court cases involving railroads.

Features of the RTC Model

Evaluating Train Performance

RTC contains a uniquely effective train performance calculator (TPC). This tool was used to compute minimum run times for trains running from one specified point to another over the NWP route without interference from other trains. Experimentation with various stopping patterns, routing configurations, dwell times and locomotive and train-set types provided the ability to identify the most effective scheduling/dispatching solution for a particular train type, service attribute and associated specific physical characteristics.



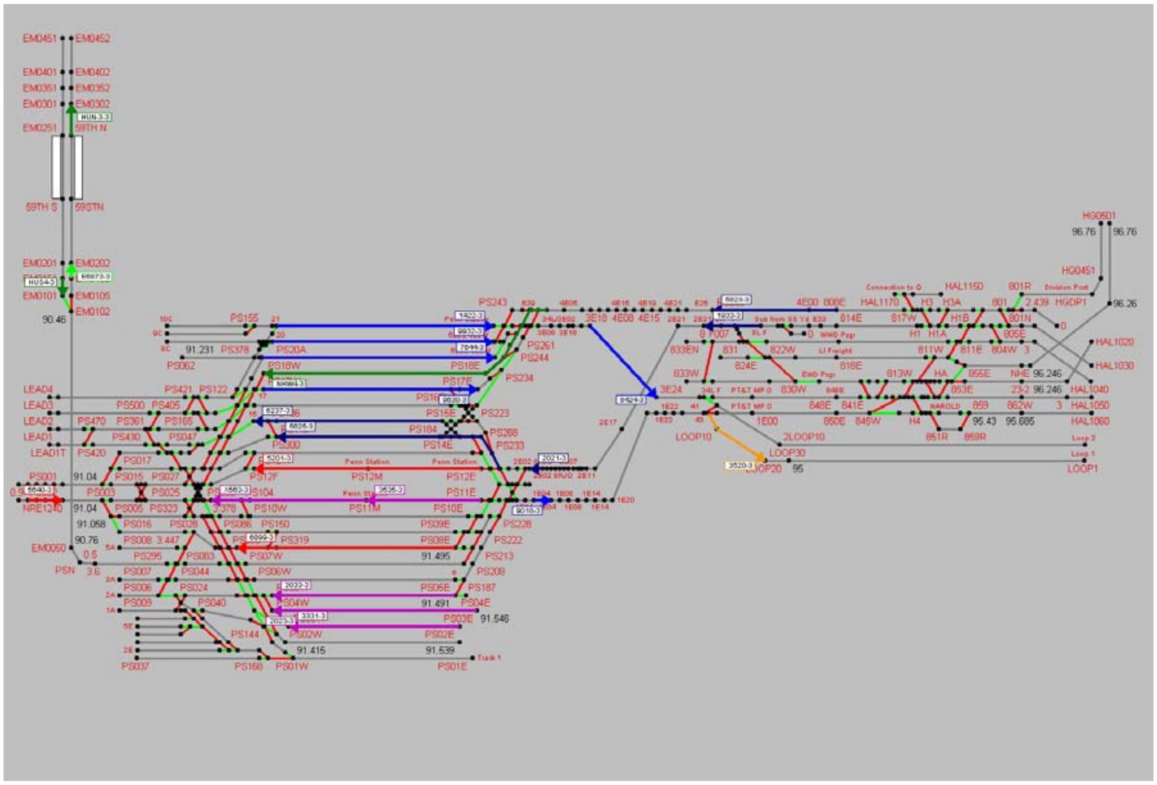
TPC Speed Profile

Developing Realistic Operating Plans

RTC eliminated the traditional practice of developing schedules and train movement alternatives based on average run times, an oversimplification that historically contributed to unachievable operating plans. Arrival and departure times (as well as other parameters) were modified using RTC to improve schedules and craft the most fluid train dispatching scenarios.

Train movements were simulated with the goal of achieving a cost-effective, overall system solution. This approach provided results based upon examination of varying departure times, dwell times for trains picking up and setting off cars, and the dynamics of speed variables in order to test the feasibiliyt of schedules and the capabilities of the physical plant.

In summary, the RTC model replicated and predicted actual train movements, accurately identifying feasibible trip times, crew assignments and operating cost statistics. Each simulation case analysis delivered precise comparisons of capacity and speed and trip time at specific (and varied) levels of train service within a specified definition of infrastructure and physical characteristics.



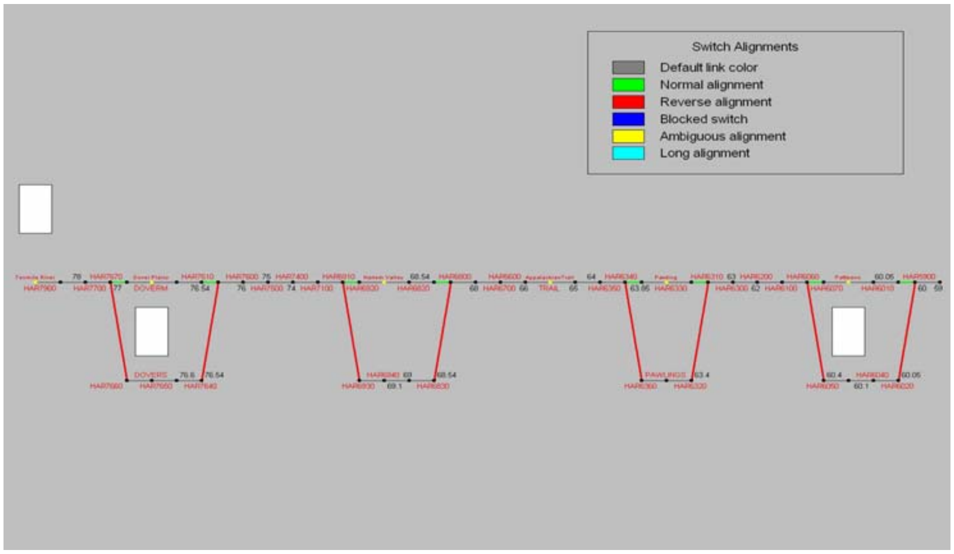
Network with Trains Running

Adding New Service

The effects of adding new trains to the corridor were evaluated using the RTC model. The simulation measured performance resulting from new service by specific train as well as at the more aggregated level of all trains over the entirel route. These simulations were defined with sufficient duration to encompass all days of the week to duplicate and examine different service requirements, i.e. every other day versus daily etc.

Evaluating Passing Sidings

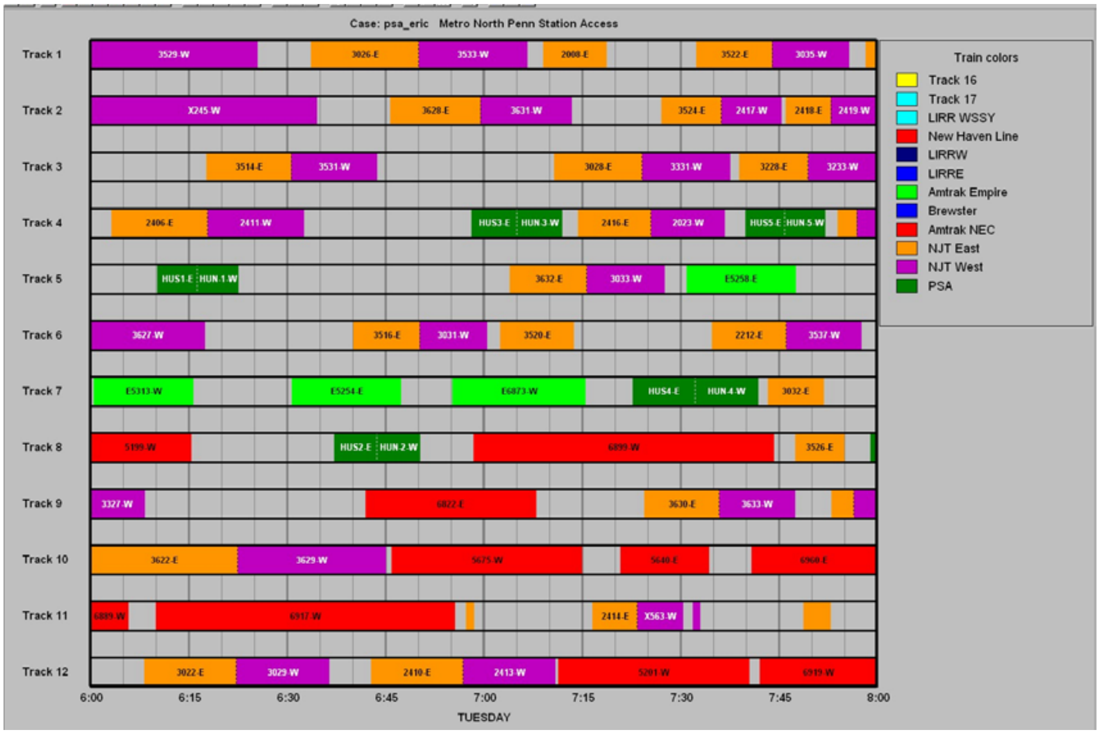
The utility of passing sidings or long segments of main track in multiple track territory is determined by their size and location. The location and size for a passing siding or additional main track segment varies based upon speed limits and service requriements. The RTC simulation model contributed to the analysis which determined whether sidings were of appropriate length and location for the size and speed of the trains being operated, and in identifying the best train sizes and operating speeds to match a specific track configuration.



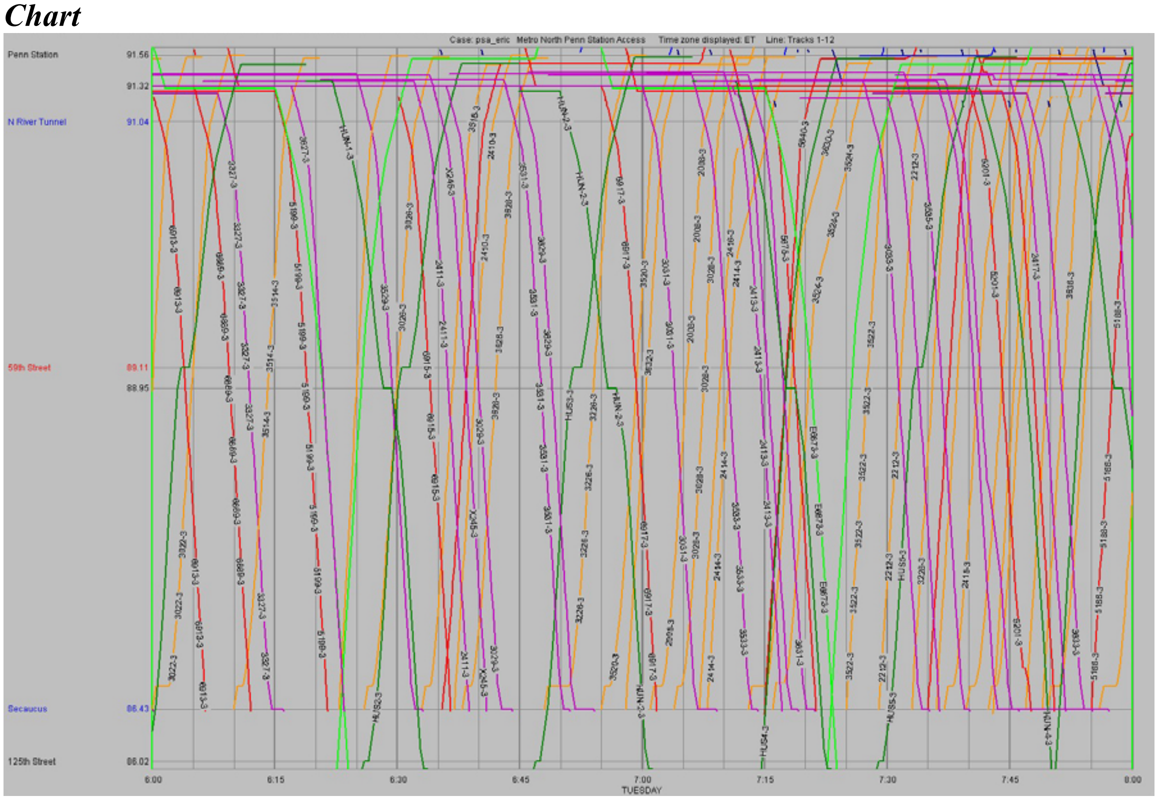
Sidings

Stringlines and Track Occupancy Charts

In addition to producing traditional stringline graphs (time/distance plots), RTC generates track occupancy charts that display which trains occupy specific tracks at any time through the simulation. This is very useful for identifying "slots" at station platforms, and for evaluating track utilization in yards and intermodal facilities. The times displayed for a train are from head-end arrival to rear-end departure. These track occupancy graphics also provide a clear picture of train "linkages". For example, in the following track occupancy graphic, train 3516E arrives into track 6 and departs as train 3031W. Conversely, train 3520E on track 6 retains its identity and departs eastward. The trains are displayed in their proper time slots, thus providing the ability to observe train movements in either a "turn" (3516E to 3031W) or a "run-through" (3520E to 3520E) dynamic.



Track Occupancy Chart



Stringline Graph

Description of the RTC Simulation Model Primary Functional Modes

Network Creation and Modification
Defines and builds the track and signal network and modifies parameters in existing networks. This mode specifies the infrastructure configuration that replicates the physical characteristics and control system of the railroad to be modeled.

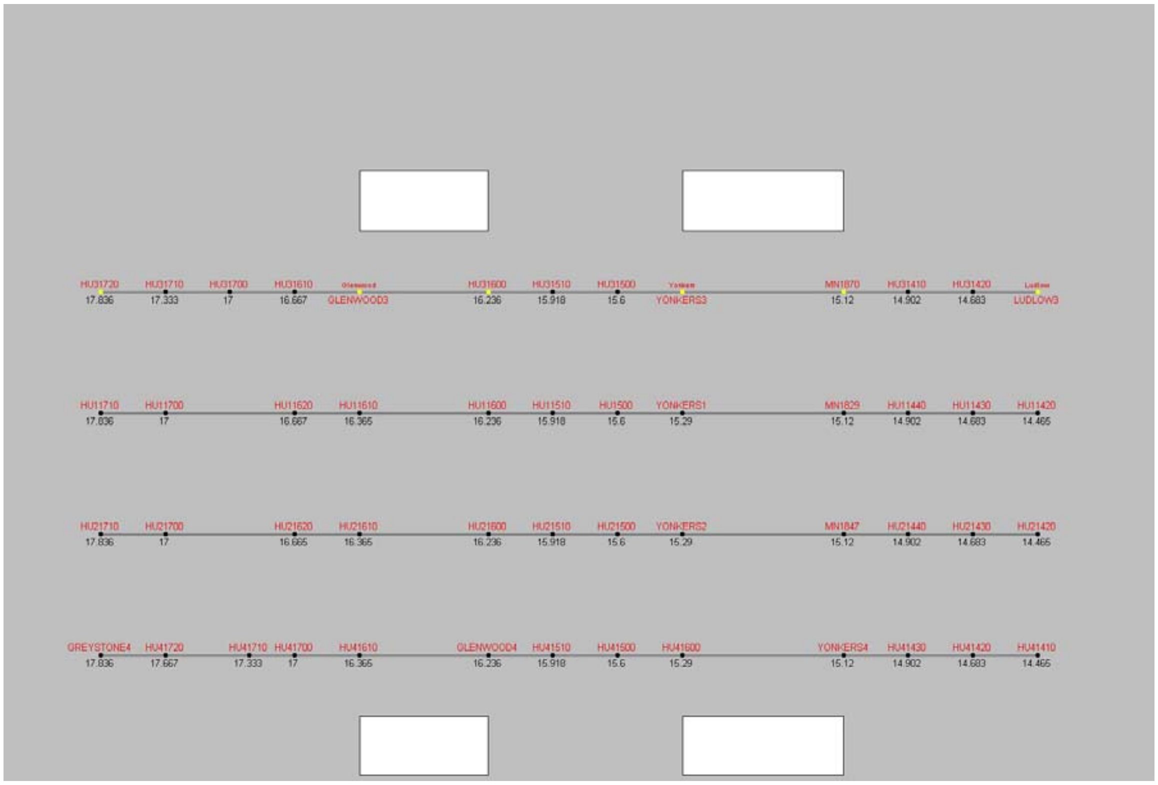
Single Train TPC
Simulates the performance of one train running through a network without interference from other trains to obtain a minimum achievable physical run time.

Full train dispatch simulation
Simulates the movement of many trains interacting with one another throughout the network. While in this mode, RTC applies the operating rules in effect to resolve both following and opposing movements between trains. All train performance computations are fully integrated with the conflict-resolution and path-seeking logic. RTC identifies, accumulates and reports train delays by individual train as well as by train type.

RTC Networks

The fundamental building blocks resident in RTC networks are "links" and "nodes". Nodes represent specific locations and links represent the track connecting the nodes. Only when an accurate description of track and signal layouts using links and nodes is defined in the model can useful results be obtained.

The ***minimum*** level of network detail in RTC requires nodes that represent switch points, foul points, signal block boundary locations, station stops, speed change locations and major grade change locations. The corresponding links connecting the nodes are coded with accurate lengths and speed limits (maximum authorized speed), while the ruling grades are computed from the elevations. Networks can be refined further with link curvature and tightly spaced nodes to increase the accuracy of the train performance computations over specific track geometry.



Links and Nodes

RTC's TPC

The integrated TPC utilizes accurate locomotive and trainset performance specifications in addition to length, weight, etc. The TPC applies this data in combination with tractive effort curves, dynamic braking curves and air brake characteristics to replicate the dynamics of each specific trainset traveling over the defined physical characteristics of the network.