
PORT OF TACOMA

Web-based CPC Rail Management System Documentation



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Abstract

The Port of Tacoma (Washington) desired to implement a real-time Web-based Rail Management System for the purposes of Intermodal decision support visualization and data display, management, planning, and for facilitating operational analysis. The Port currently uses Signal CC software and an array of distributed sensors throughout the Port facility for real-time rail data capture. The solution for rail analysis and visualization consisted of ArcIMS in a .NET environment linked to Signal CC and SQL Server 2000. The paper and presentation will detail the specifics of the project and demonstrate the software.

CPC Web RMS Project

Overview

The Port of Tacoma (POT) has invested in a series of AEI sensors and other infrastructure that collects rail car and container information. This collection of rail car and container data is then displayed and analyzed via a proprietary application software called "Signal AEI Manager." However, in an effort to disseminate this information to a larger number of users and interested parties, the Port of Tacoma desired to implement a Web-based solution. The solution called "Central Point of Coordination Rail Management System" was developed for the purposes of decision support visualization and data display, as well as management, planning, and facilitating operational analysis. This Web-based Rail Management System (RMS), created by Integral GIS, provides a gateway to the rail car and container information via the Internet to the different groups and individuals within the Port of Tacoma as well as different entities outside of the Port of Tacoma, such as the Tacoma Rail and Burlington Northern Santa Fe. In addition to providing a means of sharing information between different organizations in a near real-time environment, this Web RMS joins spatial data with tabular attributes, thus allowing the data to be displayed and analyzed in more meaningful mapping format.

Objective

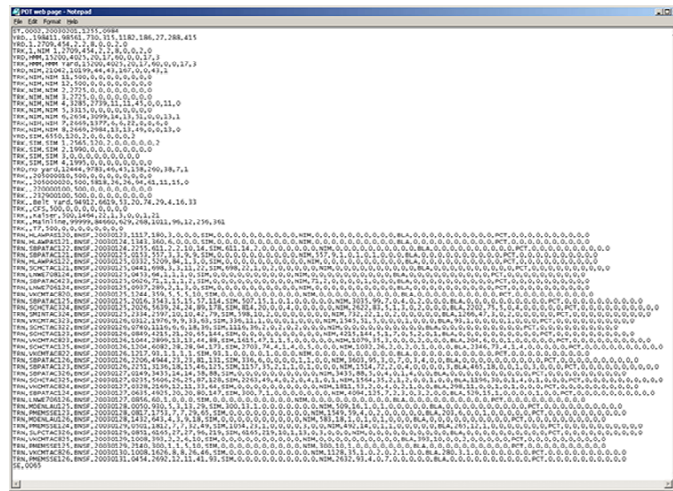
In order to achieve this objective of disseminating real-time rail data and making it more accessible to the different stakeholders both within the Port of Tacoma as well as outside the Port of Tacoma, Integral GIS would have to create a customized software solution using Microsoft SQL Server 2000, ASP.NET, and ESRI's ArcIMS. The CPC Web RMS contains the following components:

1. "CPC Web Rail Management System Tables" web page.
2. Web-based GIS interface (figure 7) integrating rail and container yard data with the currently developed Port Of Tacoma GIS.
3. Second web-based GIS interface (figure 10) displaying other data layers used only by certain Port Officials.
4. The CPC Web Rail Management System Equipment Inquiry page, a tool primarily used by current and future POT customers.

Challenges

Creating dynamic web pages in ASP.NET and having those web pages communicate directly with both Port of Tacoma's proprietary system and Microsoft SQL Server 2000 was a pretty simple task. However, the real challenge was to extract real-time train, track, and yard information collected from various AEI antennas within the Port of Tacoma. In order to extract this pertinent train, track, and yard information, methods were developed within SQL Server 2000 to accomplish these task.

Figure 1 – Train, Track, and Yard Data



Data Transformation Services (DTS) within SQL Server 2000 was used to parse Train, Track, and Yard information. Once SQL Server 2000 integrated the data into a meaningful format, the different components within Web-based RMS, built in ASP.NET, can now utilize the data.

CPC Web RMS Equipment Inquiry

The first component of the CPC Web Rail Management System is the equipment inquiry web page. Current and future Port of Tacoma customers will use this component to inquire about the status of their rail car or container. Currently, if customers wanted to make an inquiry, they would have to call the Port Of Tacoma or the mainline rail yard. However, the customer was often misinformed because, the mainline rail yard computer tracking system was not in sync with the Port of Tacoma Computer tracking system. Thus, information was often miscommunicated to the customer resulting in poor customer service and poor customer accountability.

However, with the new Equipment Inquiry Component in the CPC RMS, customers are able to make inquiries via the Internet by selecting either a rail car or container radio button, and then entering an appropriate tracking number. If the rail car or container information entered by the user is valid, the Signal CC AEI software returns the results of the user inquiry to the Equipment Inquiry Web page. Some of the information being displayed includes:

- The rail movement history within the POT of a rail car or container.
- Current rail car or container location within the POT rail yard.
- ETA if the rail car or container has not yet arrived at the POT.

Furthermore, the motivation behind the Equipment Inquiry Function is that it not only increases customer service satisfaction and accountability, but that this component will help make the Port of Tacoma more efficient in its operations by tracking performance. For example, by recording the movement history of a rail car or container, the POT can determine the efficiency of its rail operators.

CPC Web RMS Tables

The second component to the CPC Web Rail Management System is CPC Web RMS tables. The underlying function to this component is to organize and display the AEI and EDI rail car and container data produced by Signal CC Software in a meaningful way. This component of the Web-based RMS receives a lot of attention and support from not only the POT, but from other rail entities like Burlington Northern Santa Fe and Union Pacific. The main reason why this component has been so popular is because it helps solve some of the inefficiency problems within the POT. For instance, before this system was in place, a POT employee would have to create these tables by hand, thus populating each of the tables with old data. In some cases, these tables could take up to six hours to create. However, with this component in place, POT Officials create dynamic tables on the fly with data that is only 2 minutes old.

One table that needed to be created had to display a list summary of inbound trains and a summary of the various rail yards around the POT. If a user clicks on a TRAIN_ID number, a detailed train summary page appears with information displayed in a tabular format. As a result, users are able to see information such as the train's ETA date, ETA time, car length and more. Similarly, if a user clicks on the detail button within the rail yard header, a brief summary on that particular rail yard appears in tabular format. Furthermore, the ability to produce two tables in near real-time, 'Tacoma Intermodal Equipment Flow' and 'Tacoma Westbound Plan' has been a great benefit to the POT and other rail entities like Burlington Northern Santa Fe and Union Pacific.

Figure 6 – Example of how the "Equipment Flow" data grid is displayed and formatted.

The screenshot displays a detailed data grid titled "TACOMA INTERMODAL EQUIPMENT FLOW REPORT". The grid lists various train IDs and their associated equipment counts across different rail yards. The columns are organized as follows:

- Train ID**: Unique identifier for each train.
- Date**: The date of the equipment flow.
- Time**: The time of the equipment flow.
- Yard Codes**: Columns for SIM, NIM, ELA/B, and PCT, each with sub-columns for different equipment types (e.g., Box, Flat, Tank, etc.).
- Counts**: Numerical values representing the quantity of equipment in each category.

The data is presented in a grid format with alternating row colors (white and light blue). At the bottom of the grid, there is a summary row labeled "Grand Total" and a "Close" button.

Although organization of tabular data into a meaningful format was an important result in the creation of the Web-based RMS, the underlying goal is to help the Port of Tacoma associated entities see the benefit of organizing tabular data in a spatial framework.

CPC Web RMS Map

Finally, the Web RMS Map is a Web-based GIS that allows for visualization of integrated real-time tabular rail and yard info and existing spatial infrastructure data layers. This component of the CPC RMS was built using ArcIMS 4.0. However, as this system evolves, this component is being converted from DHTML to ASP.NET. ArcIMS 4.0 is a software application built by Environmental Systems Research Institute (ESRI) and is used for distributing mapping and GIS data and services on the Web.

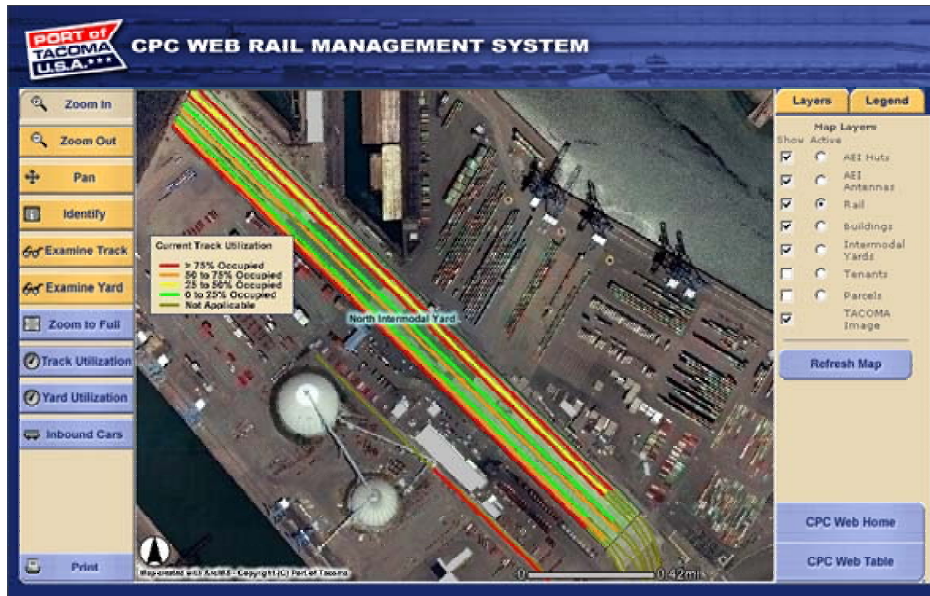
Based on the user's level of security one of two maps will be displayed, a basic map, which displays rail assets within the POT and an enhanced map, which displays both rail assets as well as other assets that are associated with the POT. (Please see figure 1.0 to see user's map accessibility) Each map has its own purpose, and thus conveys a different story. For instance, the primary function of component in the Web RMS is to assist Port of Tacoma Rail Operators as well as various rail entities like BNSF and UP by integrating rail car and container data exported by Signal CC software with the existing Port Of Tacoma GIS. With the RMS Map, users will be presented with a wide selection of interactive tools, like "zoom in," "examine yard," and "yard utilization." With these tools, users are able to interrogate the map. For example, by selecting the "yard utilization" tool, the user is able to interrogate a particular yard. As a result, this application will return a summary of the yard's utilization.

Figure 8 – Executing the yard utilization tool for the North Intermodal Yard



Likewise, by selecting the track utilization tool, the user is able to interrogate a particular track. As a result, this application will return a summary of the track's utilization.

Figure 9 – Executing the track utilization for the North Intermodal Yard

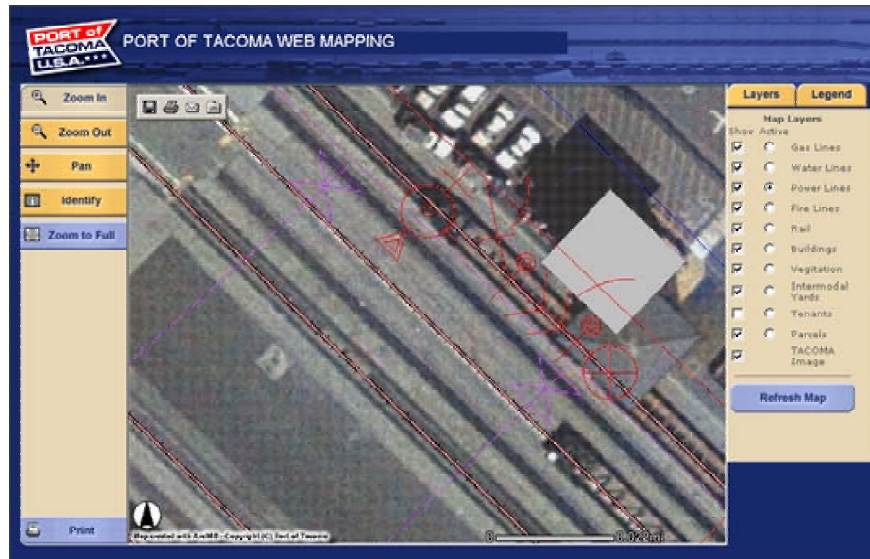


During the design requirements phase of the CPC RMS Map component, Kelly Smith Director of Rail Operations at the Port of Tacoma realized that the POT could use a similar component to the Web RMS Map for the purpose of asset management. As a result, a general map was developed and integrated into the CPC RMS.

The primary purpose for 'Port Wide Department Map' is to assist decision support and disaster relief personnel, such as maintenance, real estate, and engineering. On "Port Wide Department Map", users are able to display various data layers such as utility lines, sewer lines, parcels of property, and land ownership. Similar to 'Web RMS Map', users are presented with a selection of interactive tools, which allow him/her to drill down and interrogate different aspects of the map. For example, if the POT was performing renovation to the North Intermodal Yard, the maintenance department can immediately locate all the gas lines, water lines, power lines, and fire lines thus potentially minimizing construction mistakes.

Post 9/11 events have drastically forced US public attention to acknowledge a threat and vulnerabilities since the Munich Olympics in 1973. Therefore, the functional objective of the 'Port Wide Department Map' was to enable planners and decision-makers to anticipate natural and man-made influences affecting their operations, so that risk and their consequences can be avoided or mitigated. This GIS component will provide decision-makers and planners with the capability to visually compare content and details as they relate to one another spatially. For example, in the case of a ruptured gas line, Port personnel maybe able to quickly assess other assets that may have been damaged.

Figure 11 – Displays nearby assets that maybe affected by a ruptured gas line.



Web RMS Map provides rail operators with a quick visual reference of Port assets, and limited viewing options keep the map easy-to-use. Similar to Web RMS Map, Port Wide Department Map provides a means of sharing information in a visual medium between different entities in a near real-time environment. The unique feature with these interactive maps is that, as the original data set are modified with new data, the data layers being displayed in the map will also reflect those changes since they reference those original data set. Therefore, the maps will never become obsolete.

Conclusion

This is just the beginning, and though these four components don't completely solve all of the POT rail challenges, the objective was to observe how the rail management group reacted to these new tools. The feedback from the rail management group has been positive, and their excitement and feedback is fueling the future enhancements for the CPC Web RMS.

Acknowledgments

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