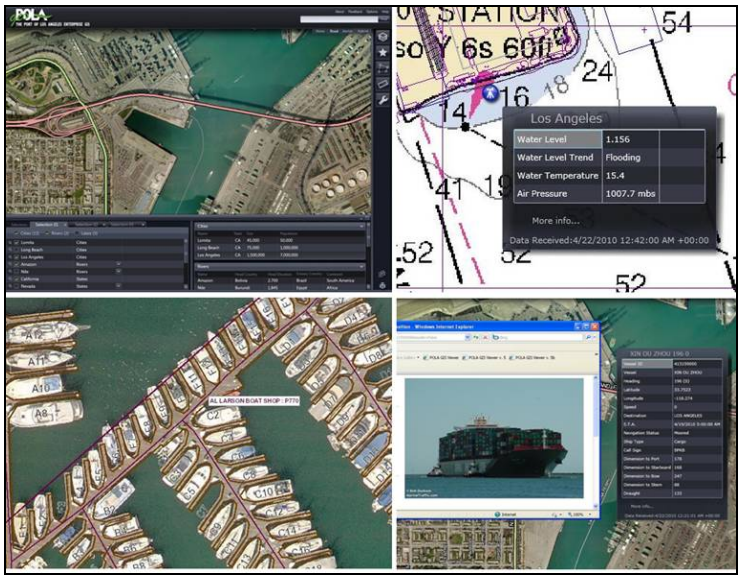
American Association of Port Authorities
2010 Application for Information Technology Award

ACHIEVING A COMMON OPERATING PICTURE

WITH AN INTEGRATED ENTERPRISE GEOGRAPHIC INFORMATION SYSTEM

"Recipient of ESRI's 2010 Special Achievement in GIS Award"



Prepared By:
Christine Thome
Project Manager

Submitted By:
Lance Kaneshiro
Chief Information Officer
Port of Los Angeles
www.portoflosangeles.org

Partner:
North South GIS
Daniel Elroi

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Appendix A1

1. PORT DESCRIPTION

The Port of Los Angeles (Port of LA), the busiest container port in the United States, is Southern California's gateway to international commerce. Located in San Pedro Bay, just 20 miles south of downtown Los Angeles, this booming seaport not only sustains its competitive edge with record-setting cargo operations, but is also known for progressive security measures, groundbreaking environmental initiatives, and diverse recreational and educational facilities.

The Port of LA encompasses 7500 acres, 43 miles of waterfront, 270 berths, 17 marinas, and features 27 cargo terminals, including dry and liquid bulk, container, breakbulk, automobile and omni facilities. Combined, these terminals handle almost 190 million metric revenue tons of cargo annually. The Port of LA moves approximately 8 million TEUs per year, and has been the busiest container port in the United States since 2000. It handles approximately 2,500 vessel calls per year. The Port of LA is also home to the World Cruise Center, which accommodates approximately 1.2 million passengers per year.

The Port of LA is a department of the City of Los Angeles and is often referred to as the Los Angeles Harbor Department. As a proprietary and self-supporting department, the Port of LA is not supported by taxes. Instead, revenue is derived from fees for shipping services such as dockage, wharfage, pilotage, storage, property rentals, royalties and other port services. Considered a landlord port, the Port of LA leases it property to tenants who then, in turn, operate their own facilities. In 2008, the Port of LA had $426 million in revenue.

The Port of LA has approximately 1,000 employees who are organized into 26 divisions.

2. INTRODUCTION – HIGHLIGHTS

The Port of LA's Information Technology Division (ITD) is pleased to present its Enterprise Geographic Information System (GIS) project for consideration of the 2010 AAPA Information Technology Award. As the recipient of ESRI's 2010 Special Achievement in GIS Award, this project has

already been recognized for its success, and in doing so, has positively raised the visibility of "Port IT" to those outside of our industry. Project highlights include:

- Producing meaningful strategic and tactical benefits, including a Common Operating Picture that enables the Port of LA to address immediate and long term issues and pursue new opportunities.
- A creative solution that integrates legacy and modern systems, static and dynamic data, and multiple platforms. In addition to its technical accomplishments, it used creative and effective approaches to overcome significant organizational challenges.
- Results that received acceptance of the system from users across the Port of LA, which has surpassed expectations and stimulated ideas for additional development. The results are also apparent based on external interest at trade shows and conferences that have showcased the Port of LA GIS.
- A sustainable enterprise GIS achieved by consolidating multiple divisional efforts and implementing the system within the ITD standard infrastructure and available staff skill sets.
- Its transferability to other ports desiring a Common Operating Picture model, whether from a small GIS, a large and integrated enterprise GIS, or enhancements to an existing GIS.

3. GOALS AND OBJECTIVES/BUSINESS PROBLEM

The Port of LA has 26 organizational divisions performing different operations on an area that includes its own 7,500 acres plus the surrounding community. Although all divisions operate on the same geographic area, they lacked a Common Operating Picture because there was no central store of current, accurate, reliable, secure and accessible geographic data to support their activities. In fact, the Port of LA had three separate GIS systems in use in three different organizational divisions prior to this project. This lack of a Common Operating Picture resulted in inefficiencies, miscommunications, limited

analytical capabilities, greater risks, and perhaps most troubling, systematically reinforcing silo operations.

A Common Operating Picture was needed for the Port of LA to achieve its strategic goals, including:

- Port of LA's Strategic Plan 2006-2011, including supporting efficient management of land use, development, environmental, operations, facilities, infrastructure, and technology initiatives.
- Port of LA's Strategic Plan for Safety and Security, including enhancing safety of the port and the community, enhancing the capability to prevent an event that threatens the security of the port or the flow of cargo, and enhancing to capability of the port to respond to an incident, mitigate its effects and resume operations.
- Port of LA's IT Strategic Plan, including modernizing and integrating the information systems to support current business objectives.

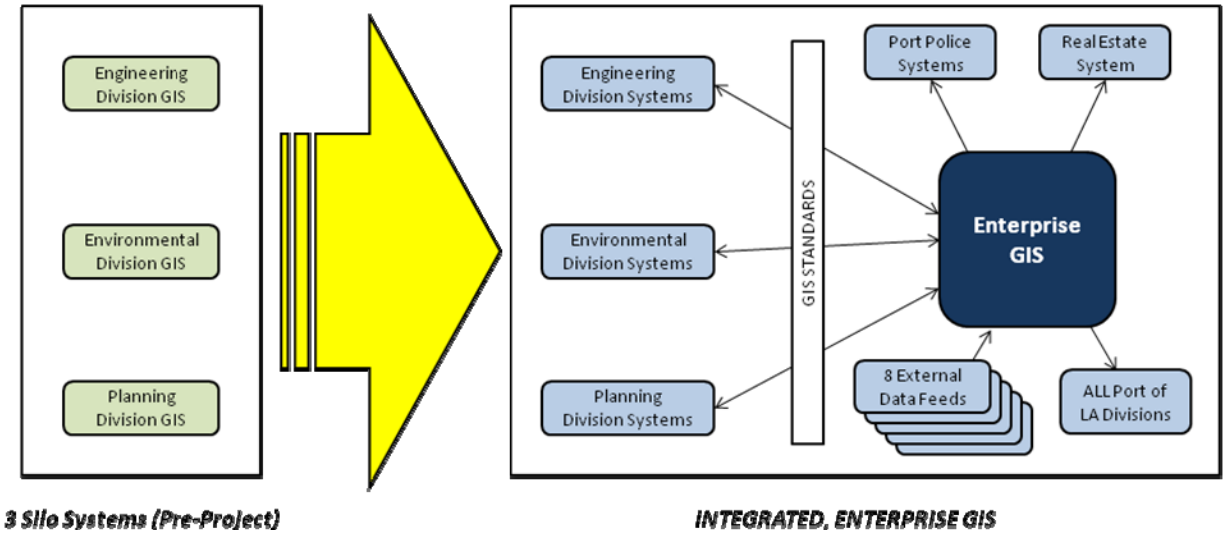
4. DISCUSSION

4A. Background

The Port of LA's need for a Common Operating Picture was clear. Three consultant studies within the past four years - the Engineering Division and Port Police Division each conducted their divisional GIS studies, and the Information Technology Division evaluated enterprise GIS needs - recommended an enterprise GIS. The current landscape of divisional GIS systems in the Engineering, Planning and Environmental Divisions had different platforms and versions, their own set of data, and separate staff, software licenses and hardware. Although each suited their division's needs, the systems provided limited value beyond their divisions. Furthermore, the need for an enterprise GIS was increasing beyond the studies' findings, because the Port of LA was implementing additional IT systems that would interface to GIS data. Although the need was clear, achieving this required a tremendous effort.

4B. Objectives and Methodology

In order to achieve the Common Operating Picture to support the Port of LA's strategic and tactical objectives described in Section 3 of this document, the GIS project addressed several technical, human and process sub-objectives.



Technical Objectives and Methodology

Technical Objective 1: Data Sharing

Methodology: At the core of the Port of LA's GIS solution is server software called ArcGIS Server, from the leader in GIS technology, ESRI. The software enables the storage and management of geographic data inside a relational database – SQL Server in the case of the Port of LA – making it possible for certain people to edit data in one part of the Port, and other people to see and use the data in another part of the Port in real-time. It is able to simultaneously handle data in different coordinate systems like WGS84, State Plane and UTM, and can overlay data collected with GPS units as well.

Technical Objective 2: Autodesk and ESRI Integration

Methodology: To address a common situation in organizations with engineering functions, the Port of LA's GIS enables two forms of significant interaction between the ESRI enterprise system and the Autodesk software used by the Engineering Division. From AutoCAD users' perspective, additional map

resources are available through GIS, such as a variety of aerial photographs, nautical charts, and map layers that originate in other Port divisions or from outside sources. These data sources can be brought in as background maps – fully rendered with complete cartographic representation and standardized symbols. The other interaction, and probably more important of the two, is the one that permits AutoCAD users to edit certain map layers that are of universal interest at the Port of LA, directly in the GIS database, rather than as standalone layers in AutoCAD drawings. In this fashion, AutoCAD users can participate in the sophisticated version- and user-management tools built into ESRI's software technology. This enables AutoCAD users to use an edit-QA-publish process that has been available to ESRI GIS users for many years. It also means that those edits that pass QA and that Engineering Division edits for the Port of LA as a whole, appear in all other GIS users' software right away.

Technical Objective 3: Data Integration

Methodology: Accomplishing the integration of data and systems, with an eye towards longevity rather than one-time quick results, required a rigorous approach. A thorough geodatabase design included the setting of standards for projection and coordinate systems, layer and dataset names, symbology, and metadata (the information about the data in the geodatabase). In particular this meant the migration of much CADD data from "paper space" to "model space", i.e. to real world coordinates, State Plane coordinates in the case of the Port of LA. Often times this required the correlation of CADD data to georeferenced and orthorectified aerial photos.

Technical Objective 4: Dynamic Data

Methodology: The GIS system incorporates a mechanism for "consuming" live data feeds in a variety of formats (e.g. - XML, Web Services, RSS, Telnet), and reformatting them into a uniform format that can be displayed in real time in the geoPOLA GIS viewer created for the Port, or stored in ArcGIS Server for long term storage, retrieval and analysis. GIS currently consumes and displays eight external data feeds:

- AIS vessel locations

- Radar targets from the Marine Exchange of Southern California
- Incidents from the California Highway Patrol
- Traffic speed sensors from California Department of Transportation
- GPS vehicle locations from AssetLinks
- GPS vehicle locations from WebSphere
- Exclusion areas from the Port Police's Operations Center
- PORTS weather stations from NOAA

Technical Objective 5: Data Dissemination

Methodology: One of the most powerful aspects of GIS is that it is a "two way street". Not only can multiple users edit data in it, using multiple software packages, but the data is disseminated via a variety of different software. Some users "consume" the data as raw data, while others users consume ready-made map layers (complete with data and cartographic representation), others consume ready-made maps as base maps for their GIS or CADD work, and others view the data through an interactive web mapping viewer. The following methods are used to disseminate the data, all of which can view the data with the same look-and-feel, to bring uniformity to the display of geographic data:

- NorthSouth GIS geoPOLA Web Viewer (whole maps) – Entire Port of LA
- ESRI ArcGIS (raw data, map layers, whole maps) – Environmental, Planning and Police Divisions
- Autodesk AutoCAD (whole maps) – Engineering Division
- Autodesk AutoCAD Map (raw data, whole maps) – Engineering Division
- NICE Situator (map layers) – Police Division can now provide a rich and up-to-date map data to its emergency management staff.
- AssetWorks AiM (whole maps) – Real Estate Division can view maps inside its lease management system, select properties on a map, and share its information with geoPOLA users.

Technical Objective 6: Port-wide GIS Viewer: geoPOLA

Methodology: One aspect critical to the success of the GIS system was the creation of a custom ArcGIS Server based Silverlight application viewable anywhere on the Port of LA's intranet. This configurable viewer is sensitive to each user's permissions via his or her Windows login through Active Directory

permissions. Exceptionally easy to use, the application "reveals" more functionality as users probe deeper into it. Users quickly differentiate between using Google maps and geoPOLA, since geoPOLA offers numerous ways to search and locate places in and around the Port of LA that are of unique interest to the Port of LA, and since it offers all of the Port of LA's own map data that is not available anywhere else. To accomplish this, a comprehensive list of Port of LA addresses, lease polygons, landmark names – both new and old, and other locations were collated and places in a search engine available to any geoPOLA user.

Technical Objective 7: Standards Based System Resiliency

Methodology: The GIS system was built on top of the Port of LA's investment in enterprise-wide and standards-based infrastructure, unlike many segregated technology solutions. By layering the solution on the Port of LA's Virtual Server and SAN hardware, its enterprise licenses from Microsoft and ESRI, its IBM data backup systems, and the Port of LA's Active Directory authentication, GIS benefits from the Port's considerable IT support capabilities, rather than becoming a new point of failure in the Port. The GIS was designed for scalability – through server load balancing – which also serves as protection against hardware failures. Its backups occur at multiple levels to allow data editors to recover from user errors, IT professionals to recover from systemic corruption, and the Port of LA as a whole to rebuild after a catastrophic failure such as might result from an act of terrorism. By adopting the Port of LA's enterprise computing approach, rather than creating a stovepiped solution, GIS also strengthens the Port of LA's IT infrastructure.

Technical Objective 8: IT and Data Security

Methodology: The GIS is architected to handle security sensitive information and other Port Police information on separate physical services and pass data through managed firewalls between the administrative and security networks. Access to GIS is secured via the intranet, which includes enterprise IT security prevention and detection.

Human Factor Objectives and Methodologies

Human Factor Objective 1: User Acceptance

Methodology: The Enterprise GIS is, of course, an IT solution, but at the core of its success are people, and people's willingness to work together. Therefore, a crucial aspect of the project was getting people and organizations to share and collaborate. From its outset, the project took into account existing staff's experience with technology, and with its past experience with attempts to unify GIS at the Port. These skills and experiences were taken into account in order to design a technical system that matches the Port of LA's resources (people), rather than attempting to mold the resources to the solution.

Human Factor Objective 2: Enterprise Governance and Multi-Level/Multi-Divisional Participation

Methodology: In addition to garnering early executive support, the project created a governance structure consisting of a steering committee made up of division heads – the managers who set policy and direction and control budgets – and a technical committee made up of technical staff – the people who will execute the plan. Additionally, focus groups were formed of people who will be users of the system, who are not themselves experts in the area of GIS and spatial data technology – the "end users". The entire collection of people were involved and consulted with throughout the implementation of the system. This interactive method was strengthened by placing several key staff from the consulting group that built the GIS – NorthSouth GIS LLC – on-site at the Port of LA for extended durations, which enabled both formal and informal interactions to occur during the project.

Process Objectives and Methodologies

Process Objective 1: Disciplined Project Management

Methodology: With an aggressive seven-month implementation schedule and budget constraints, it was imperative to follow standard project management and system development methodologies. In addition, this project was led by a project manager with the right skill set for the technical details and the ability to work effectively with the business users to keep it moving along.

Process Objective 2: Sustainable Post-Project Processes

Methodology: The Port of LA integrated with current processes and skills for updating the data in order to implement a GIS that would be sustainable, and not a one-time project event. The Port of LA prioritized its resources and relied on its employees to actively participate and do the majority of the work. Going forward, each division that "owns" map layers in the GIS system has the ability to manage that data. The GIS maintains data accuracy with a feedback mechanism that encourages the correction of errors found in the data, especially from the field, where errors are most often discovered.

Process Objective 3: Holistic Future Development

Methodology: The GIS project built a foundation for GIS capabilities. To ensure that GIS continued after the project was done, a small investment was made to produce roadmaps for additional development and integration for several Port of LA divisions. As funding for additional development becomes available, these roadmaps will holistically build upon the success of an integrated, enterprise GIS.

4C. Hardware and Software Used

The hardware and software used on this project included:

- Hardware Infrastructure: HP-based ESX VMWare, IBM SAN
- Servers: Eleven VM Servers (Eight in Production and three in Staging configurations)
- OS: Primarily Windows 2008 64-bit, also Windows 2003 32-bit
- Database: SQL Server 2008 64-bit
- GIS Server: ArcGIS Server 9.3.1
- Web Server Technology: IIS 8, Silverlight 3, ArcGIS Server 9.3.1
- GIS Desktop Software: ArcGIS 9.3.1
- CADD Desktop Software: AutoCAD Map 9

4D. Cost

The project cost was approximately $1.9 million (excluding staff time), included:

- COTS Software - $100,000
- Infrastructure - $200,000
- Consulting - $350,000
- Custom software development - $725,000
- Data acquisition and development - $400,000

- Training - $115,000

4E. Performance Measures

The GIS system performance measures are:

- Display speed: Less than 5 seconds to refresh map display (comparable to Google Maps)
- Time between update of vessel feed and display in GIS: 30 seconds
- Time between naming of a radar target at Marine Exchange of Southern California and display in GIS: 30 seconds

4F. Award Criteria

The Port of LA completed four IT projects in the past year. However, the GIS project is the only to be nominated because we feel it best matches the AAPA IT Award criteria.

Level and Nature of Benefits

The Common Operating Picture can be accessed by all 900+ computer users on the Port of LA intranet. Examples of how some organizational divisions use the GIS include:

- Port Police: Implementation of Integrated Command and Control at the Port Police Operations Center, the roll-out of the Threat Detection Center, and the implementation of Blue Force Tracking capabilities.
- Planning Division: Determining expenditures spent on bringing in and keeping a new tenant, by aggregating expenditures geographically.
- Engineering Division: Seeing the location and character of hazardous material sites. Also accessing historical, current, and tentative permit locations and their associated conditions.
- Environmental Division: Accessing the location of abandoned pipelines, determine current content of tanks, or mark protection zones areas (e.g. – spill) in the GIS for everyone to see.
- Construction and Maintenance Division: Accessing Engineering Division data directly in the field.
- Real Estate Division: Accessing integrated maps for its leased properties and facilities.
- Wharfingers: Seeing the ships, and the details of those ships, in the Port of LA in real time.

- Port Pilots: Accessing the latest sea bottom depths from Survey Division's hydrographic surveys.
- Public Relations and Communications: Planning special events, or seeing activities from other divisions (e.g. – construction) across the Port to communicate to the public.
- All Users: Locating destinations (in Port of LA terminology) and road conditions when traveling around the Port.

Creativity of the Solution

The Port of LA GIS is a creative solution, and we believe that this level of integration and collaboration has not been accomplished across an entire large port in the US. The Port of LA's GIS:

- Blends dynamic data *in relation to* the Port of LA's own data, including access to various *live* data sources, such as those depicting moving vessels, radar data, current traffic conditions and nearby police activities, all to appear in the same context as the "static" data.
- Provides flexibility in the level of detail and ability to "drill down" through the data, matching the needs at each situation (e.g. - avoiding information overload during initial response to emergencies), but supplies in-depth information during investigations, response and mitigation.
- Provides easy, but deep, access to information about the Port of LA, including utilities, pipelines, tanks and their content, hazardous material locations and characteristics, security cameras, floor plans, ownership and lease holding, prior police activities and investigations, and many others location-based data that exists *somewhere* at the Port (or at outside agencies) but not in an accessible location and format.
- Integrates the Engineering organization into the enterprise GIS, which is a common challenge because of the Autodesk and ESRI preferences.
- Integrates the GIS with legacy, custom systems, as well as other COTS systems so that the same source of data and same look and feel are available across the Port of LA. Thereby enabling rapid access to edits made throughout the port (e.g. - leases, camera locations).

Apparent Results

In addition to the results of the Common Operating Picture previously mentioned with benefits, the GIS project results are also apparent from its:

- Completion within the 7-month implementation schedule and on budget.
- High level of acceptance from all Port of LA divisions for delivering an enterprise GIS that they can now see, which have stimulated new and creative ideas for additional GIS uses and requests for additional development.
- Selection by ESRI for its 2010 Special Achievement in GIS Award. ESRI selects the winners for this award based on nominations from its internal managers. Neither the Port of LA nor its GIS consultants applied for this. Therefore it was a welcome surprise, which we believe speaks to the results of the Port of LA's GIS effort.

Cost Effectiveness

This project was very cost effective, for both the project phase and for future costs, by doing the following:

- Consolidating three separate GIS systems into an enterprise GIS to leverage resources, consolidate hardware and licensing, and share data across the enterprise.
- Integrating the GIS software into the ITD technical infrastructure and complying with standards.
- Investing significant Port of LA staff time to minimize consulting costs and ensure knowledge is gained for on-going support.
- Avoiding future costs from this initial investment because individual divisions can now leverage the enterprise GIS for their own needs at a small fraction of time and cost that it would have taken before. This is already being taken advantage of by:
    - Environmental – integrating maps into their environmental data management system
    - Real Estate – integrating maps into their lease management system

- Port Police – integrating Port data into a crime analysis system
- Construction and Maintenance – integrating to its Computerized Maintenance Management System to be able to mark service requests and repairs on maps out in the field and incorporate GIS into its work order system.

Transferability to the Port Industry

A Common Operating Picture from an enterprise GIS is transferrable to the Port industry, or any industry.

- The same tools and methodology can be applied to *any* port, whether for a small GIS, an integrated enterprise GIS, or enhancements to an existing GIS.
- The level of interest from external entities, which have heard about this project or seen it showcased at trade shows or conferences, confirms its transferability.

5. CONCLUSION

The Port of LA is very proud of its enterprise GIS, and believes that it is an excellent candidate for the AAPA Information Technology Award. The enterprise GIS has benefited the Port of LA, and with its recognition from external entities, we believe has benefited the "Port IT" community by demonstrating the value that Port IT can provide to those outside of our industry. A solution that supports many important business objectives, the Port of LA's GIS is a success story. A story that is the result of a tremendous amount of effort from many people across the organization in a very short period of time. A story that used creative, cost-effective approaches and the right combination of technology, human factors and process efforts to make it happen. And last, a story that the Port of LA is pleased to have the opportunity to share as a model for other ports also in need of a Common Operating Picture.

APPENDIX

Common Operating Picture

geoPOLA Viewer

Examples of Dynamic Data

Geodatabase Design Diagrams

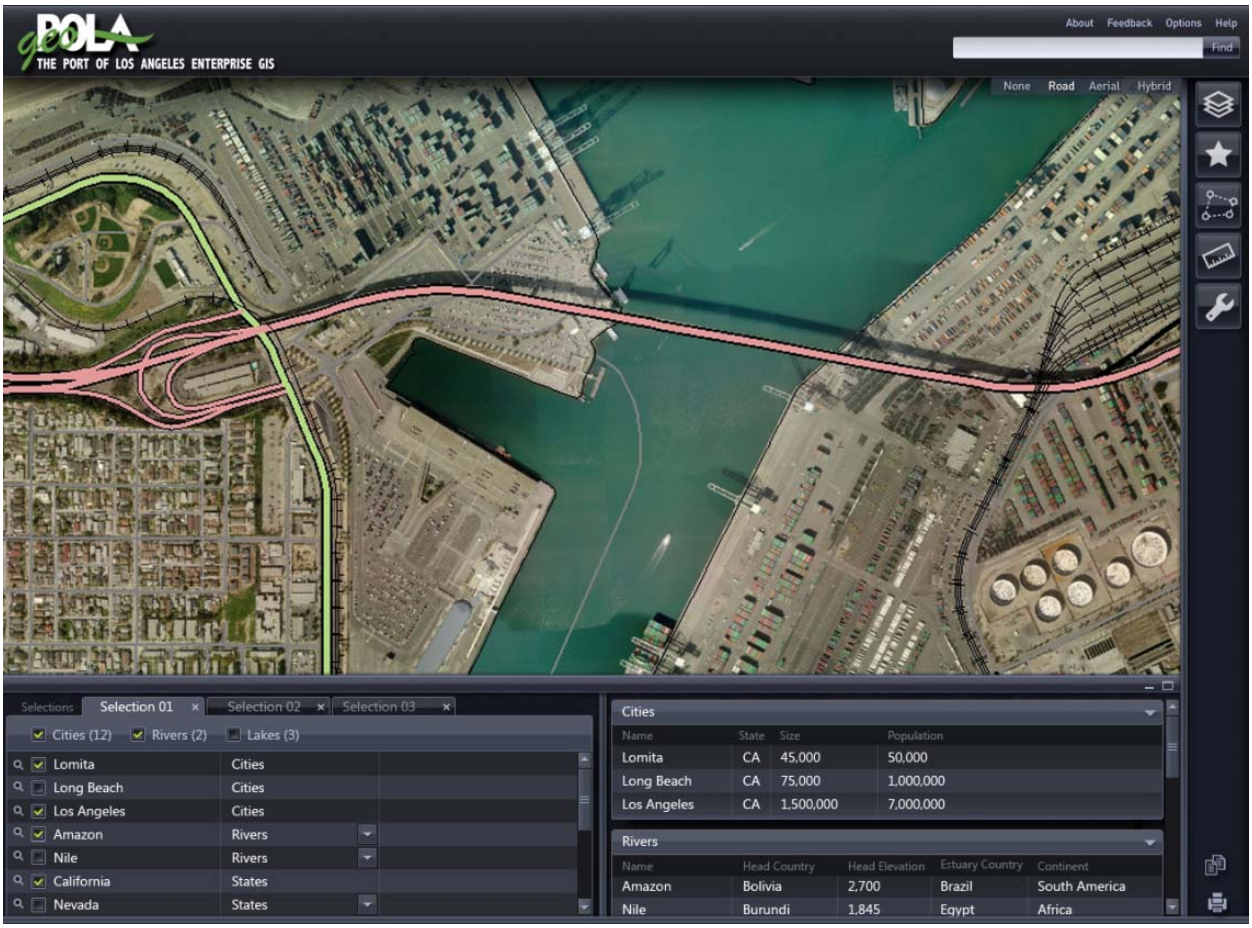
Hardware Configuration

COMMON OPERATING PICTURE

Same data, photography, maps across the Port of LA, regardless of the viewer or system.

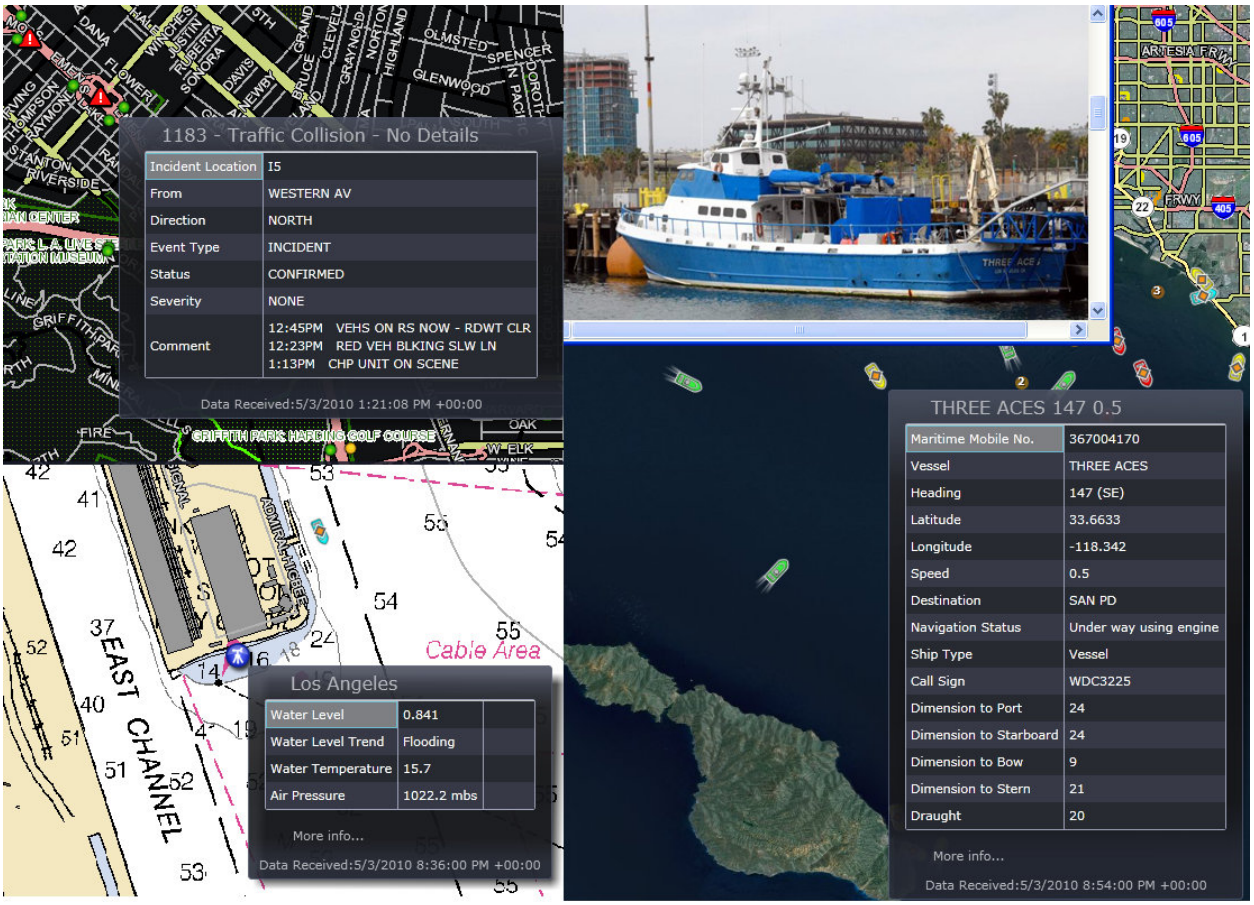
geoPOLA Viewer

Available to all Port of LA users on the intranet.

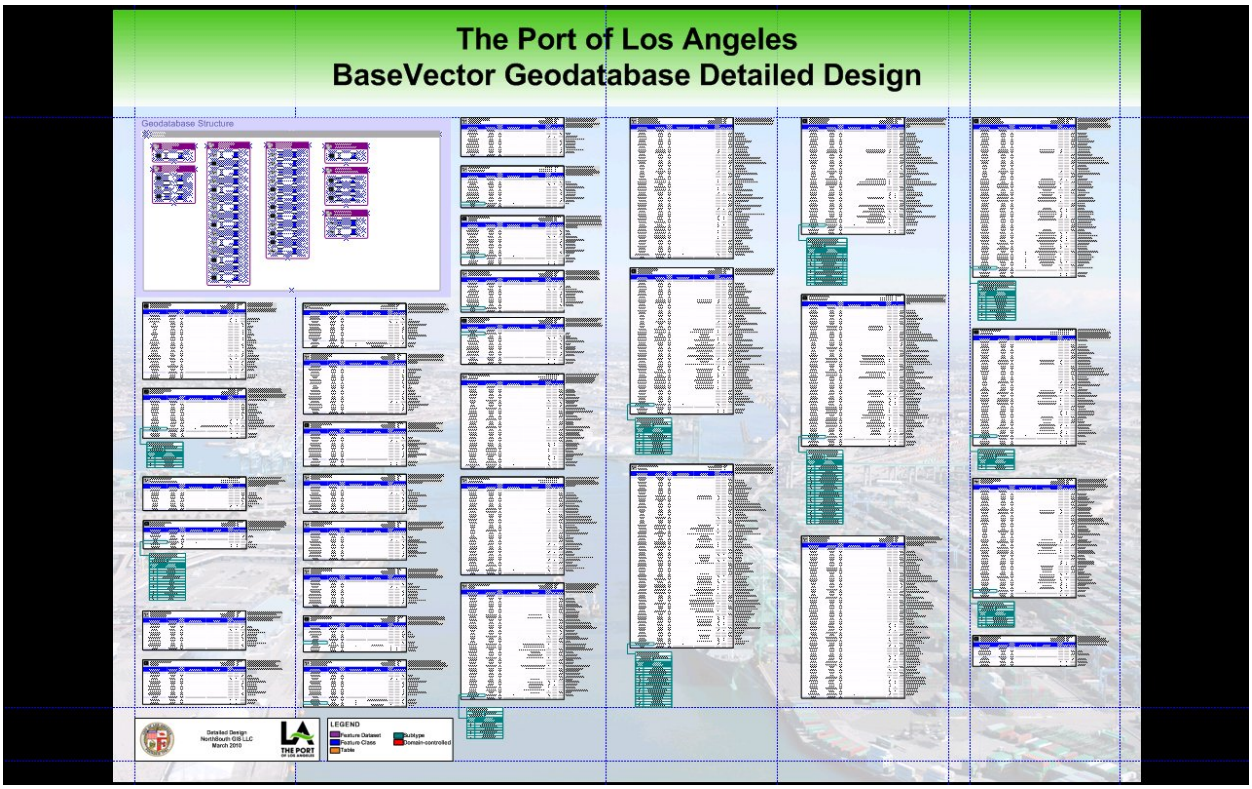


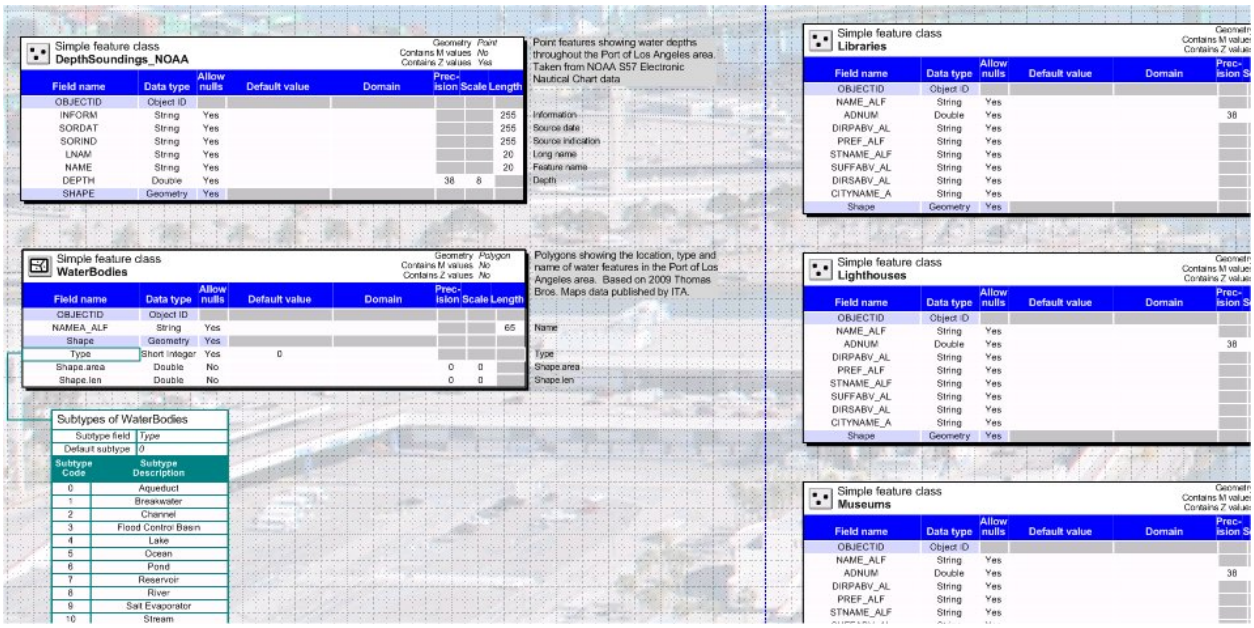
EXAMPLES OF DYNAMIC DATA

Live traffic, water conditions, and vessel information in the Port of LA.



Geodatabase Design Diagrams





HARDWARE CONFIGURATION

High availability architecture