OS/OW Routing
Automated Routing for Oversized/Overweight Vehicles
Helps Protect Your Infrastructure and Keeps People and Products Moving Safely
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1. Introduction

Transportation agencies face a daily challenge as they strive to keep people and products moving safely and efficiently along our nation's highways. One of the most critical tasks they perform is the routing of oversized and overweight (OS/OW) vehicles through their jurisdiction without incident. These types of vehicles present a series of unique challenges you must address to ensure safe travel for all passengers throughout the road network. With public safety and protection of highway infrastructure as their top concerns, many states have begun searching for an automated method of routing these extra-large vehicles.

Most transportation agencies consistently have a number of key business drivers for implementing an OS/OW solution. In conjunction with our customers, Intergraph® has identified some of these key business drivers, which include:

- Reducing safety hazards by considering traffic patterns, roadway conditions, bridge postings, and horizontal/vertical clearances when researching a safe route for the vehicle to pass
- Minimizing damage to the roadway infrastructure by using the best equipped and shortest path for travel
- Ensuring safe routing of OS/OW vehicles by creating a map and driving directions for the permit
- Decreasing time from permit request to issuance
- Eliminating routing errors through use of existing roadway and structures data
- Reducing training time for route planning personnel (i.e., permit agents)
- Minimizing impact of institutional knowledge loss
- Increasing volume of safe routes issued and related permits
- Automating end-to-end route management and related permitting processes
- Improving administrative accounting and reporting of the OS/OW permitting and routing operations
- Sharing of temporary or on-the-fly roadway restrictions through an automated routing/restriction management system

A solution that meets these requirements must also take into account several different factors across the transportation enterprise. These include the integration of data from disparate business systems, internal business rules governing the routing of OS/OW vehicles, and a simple way to compute the route and deliver results to the requester.

Intergraph recognizes the need to automate OS/OW routing, and provides an Automated OS/OW Vehicle Routing solution. We offer modular, geospatially enabled applications you can use in conjunction with one another or independently to address business requirements for your transportation agency. Our routing solution combines commercial off-the-shelf (COTS) technology and industry best practices already deployed within the transportation community. Along with the technology available from Intergraph, certain data are required from each customer to support this solution. Each transportation agency typically maintains the data sources required for deploying an automated routing solution. You can implement Intergraph’s Automated OS/OW Vehicle Routing solution in conjunction with a third-party permitting application or completely standalone.

This white paper provides an overview of Intergraph’s approach to automated routing for OS/OW vehicles.
2. Automated Routing Solution Overview

Intergraph’s automated routing makes full use of your agency’s linear referencing system (LRS), along with existing roadway and bridge data, to build an intelligent routable network. As an alternative, transportation agencies can use a commercial data source such as NAVTEQ or TeleAtlas. The system can locate existing bridge and roadway inventory against these data sources, and use the data in the routing of OS/OW vehicles. Once these components are associated to the road, the network is now considered intelligent or restricted due to the constraints applied by the roadway and bridge parameters.

Once you’ve established the restricted routing network, you can test an OS/OW vehicle for safe passage. The system requires information about the vehicle from either a third-party permitting application or through a custom data-entry graphical user interface (GUI) from Intergraph. In addition to vehicle information, the solution requires points of origin, destination, and optional intermittent points. It then uses the information provided to determine a safe route that will accommodate the OS/OW vehicle by tracing the shortest path possible and comparing the vehicle/load parameters against the constraints imposed by the roadway and bridge data. Once it identifies a safe route, you can include detailed driving directions, along with a map, with the permit document.

If the solution is unable to determine a safe route for any reason, the route request is placed on hold for manual review and comment by the permitting and/or engineering staff. This allows for a more comprehensive review of the route request, to either override any network constraints violated and allowing the vehicle to pass, or to deny the route request. Your permitting or engineering staff can include any comments or special instructions to the carrier in the detailed driving directions, such as driving in a certain lane or maintaining a certain speed while traveling a specific section.

The primary functional components of Intergraph’s Automated Routing for OS/OW Vehicles solution include:

- System administrator
- Route planner
- Route manager
- System architecture
- Restriction management
- Optional integration with roadway video log
- Optional integration with commercial map providers (Google Maps, Microsoft® Bing Maps, etc.)
3. System Administrator

The system administrator function provides certain privileged users with a GUI for managing all aspects of the system. The primary components of the system administrator include:

- User account and group permissions
- Systemwide tolerances
- Administrative reports

3.1. User Account and Group Management

The system administrator function allows users who have been deemed an administrator on the system to manage user log-in and permissions on the system. Using the GUI, administrators can create, delete, modify, or assign user accounts to certain groups (Figure 1). Group-level permissions can allow a group of users certain permissions on the system at one time.

![Figure 1: Administrators can use a graphical user interface to create, delete, and modify user accounts and permissions.](image)

3.2. Systemwide Tolerances

The system administrator also provides authorized users the ability to manage systemwide parameters affecting the routing process (Figure 2). For example, the system allows safety tolerance factors for height and width, which is subtracted from the actual clearance factor provided by the enterprise data system. If a bridge vertical clearance provided by the bridge management system is 16 feet and the system...
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The administrator applies a three-inch safety factor, then the vehicle must be less than 15 feet, 9 inches to pass the clearance test. While the system administrator has certain systemwide privileges, you can implement the system to provide other authorized users with similar functionality for their user session only.

![Thresholds - Windows Internet Explorer](image)

*Figure 2: Authorized users can manage system-wide parameters that can affect the routing process.*

3.3. Administrative Reporting

Administrators on the system have access to powerful reporting capabilities for system performance measures of accountability, as well as financial reports. Accountability reports help determine the volume of route requests completed during a certain timeframe, identify what types of vehicles are being routed, and monitor the average time required for processing the route requests (Figures 3, 4, and 5).

![Accountability Summary Report - Windows Internet Explorer](image)

*Figure 3: Accountability reports help you determine the volume of permit requests completed during a certain timeframe.*
Figure 4: Accountability reports can help you monitor the average time required for processing route requests.

Figure 5: Accountability reports can also show you what type of vehicles are being routed.
4. Route Planner

The route planner is the primary GUI for all end-user operations. Web-browser technology makes the GUI simple and easy to use, and you can customize it to fit your specific requirements. This approach reduces implementation cost and training requirements for both internal and external implementations.

The route planner provides a simplistic approach to viewing of the vehicle and load information, as well as an interactive geographic information system (GIS)-based mapping window for creating and viewing the route graphic. You can visualize, print, and include map features and roadway restrictions in the permit document to graphically depict the route. You can also establish warning flags on data-entry fields to quickly inform the user of potential issues, such as an axle grouping being overweight, before the routing operation is performed. For example, data fields showing the axle weights could highlight in red if the maximum allowed weight is exceeded.

The primary components of the OS/OW Route Planner include:

- Vehicle pre-screening
- Route builder
- Restrictive route analysis
- Map interface
- Driving directions
- Route logging

4.1. Preliminary Vehicle Screening

Preliminary screening of a vehicle configuration is a common requirement in the routing of OS/OW vehicles to determine if automated route generation is possible. The screening is usually based on vehicle height, width, and weight thresholds defined by Department of Transportation (DOT) personnel. The pre-screening process evaluates the vehicle parameters to determine if it qualifies for automated route analysis.

If automated route generation is not possible for the vehicle, the system can provide alternative routes for the engineering and permit staff to review. This allows engineering and permit personnel to analyze the shortest path and identify structures that potentially could fail along that route.

4.2. Map Interface

Intergraph’s GeoMedia® WebMap Professional is the core software the route planner uses to provide a map for the OS/OW solution. A map is necessary for visualizing the selected route and other geographic information to ensure the end-user fully understands the route generated is safe for passage. The map interface includes standard map navigation functions, such as “zoom in,” “zoom out,” “pan,” and “zoom to area.” If desired, you can implement the OS/OW solution using commercial map viewers, such as Google Maps or Microsoft’s Bing Maps.
4.2. Driving Directions

Our solution generates detailed driving directions for the route. The directions for the selected route can include special restrictions entered by DOT personnel. Information created for the permit packet includes route designation, driving distances, and turning movements.

DOT personnel can upload the map, including a bold and highlighted route, and driving directions to the final permit packet. Figure 6 is an example of the detailed directions generated along with the route.

1. From I-95 S @ MP 184.339, start South on I-95 S in Dillon Co. Travel for 9.35 miles.
2. Continue straight, road becomes I-95 S in Florence Co. Travel for 7.01 miles.
3. Continue straight, road becomes I-95 S in Darlington Co. Travel for 1.57 miles.
4. Continue straight, road becomes I-95 S in Florence Co. Travel for 36.44 miles.
5. Bear Right onto Exit 150 leading to SC 403 S in Florence Co. Travel for 0.21 miles.
6. Continue Left on Exit 150 leading to SC 403 S in Florence Co. Travel for 0.02 miles.
7. Bear Left onto SC 403 S in Florence Co. Travel for 0.17 miles.
8. Turn Left onto Exit 150 leading to I-95 N in Florence Co. Travel for 0.03 miles.
9. Continue Left on Exit 150 leading to I-95 N in Florence Co. Travel for 0.27 miles.
10. Bear Right onto I-95 N in Florence Co. Travel for 2.83 miles.
11. End at I-95 N @ MP 152.794 in Florence.

Figure 6: The final permit packet includes detailed driving directions.

4.2. Route Logging

Route logging is provided as a back-office process. The tool captures necessary information for creating infrastructure use and system accountability reports. The database stores information from the logging process and makes it available to the business systems via the integrated data model. The data logged can be associated with the permit and contain route identification and milepoint/location information.

The following information about a route is captured through logging and can be associated with the permit:

- Linear referencing system (LRS) key or route identifier
- LRS or route milepoint

This data enables linear analysis and event overlay capabilities using existing business data stored in the source systems. The OS/OW solution assumes the DOT will use linear referencing and dynamic segmentation to analyze this data in conjunction with internal business systems to determine the potential impact of OS/OW loads on the network.

Figure 7 on the following page is an example dialog used to define the properties of a route with the route planner.
Figure 7: A dialog box defines the properties of the route for the route planner.

Figure 8 shows how you can further refine the method used to calculate the route. In this example, you can select the route classification, such as “interstate only,” “all state highways,” or “shortest path (all roads),” to restrict the routing operation to only those route classifications. Intergraph’s Automated Routing solution generates the route in accordance with the origin, destination, way points, and route designation specified.

Figure 8: This figure illustrates how you can select roads and highways to restrict the routing operation.
5. System Architecture

Intergraph developed the automated routing solution using industry-standard software platforms, development practices, and relational database management technology. The solution provides powerful functionality through the use of Microsoft’s .NET programming tools, Oracle’s database management system, and Intergraph’s geospatial technologies, with implementation options that include Google Maps and Microsoft Bing Maps, among others. In addition, this approach allows integration with most GIS, permitting, and other business systems. As mentioned earlier, Intergraph’s solution can also take advantage of commercial roadway centerline data, such as NAVTEQ, to allow access to additional truck routing-specific attributes that can impact route generation. The solution is implemented using Intergraph’s standard routing Web service (delivered standard with Intergraph’s GeoMedia WebMap Professional software), among other custom Web services and workflow-specific functionality, to perform the automated routing tasks. The solution integrates with other commercially available technology and business systems data to complete the solution.

Figure 9 is a generic architecture diagram of the automated routing for OS/OW vehicles solution.

One of the key components of the architecture is the ability to use existing roadway and bridge data from disparate business systems without interfering with or disrupting those systems. The automated routing system is implemented with Intergraph’s transportation data clearinghouse. Custom links or automated processes are established during implementation to connect the disparate data sources with the centralized data clearinghouse. The clearinghouse contains an optimized and highly tuned data schema for managing the data from the disparate systems to provide optimized routing operations. This allows the automated routing system to gain full access to data needed for the routing process, while not affecting
the disparate system. Intergraph makes every attempt possible to use industry-standard database and gateway technology to minimize maintenance overhead and reduce risk. Various types of systems that provide data to the data clearinghouse include:

- LRS and (GIS)
- AASHTOware PONTIS
- AASHTOware Virtis
- AASHTOware Trans*port
- Pavement management data sets
- Roadway administrative and physical characteristics
- Construction or traveler information for temporary roadway constraints
- Other roadway and bridge data as deemed necessary by the agency for routing

The architecture has a series of objects and processes that address the communication between the various systems. Figure 10 illustrates these.

One of the strengths of this architecture is that while many complex operations occur in the background for accessing necessary data, it remains transparent to the end-user. Administrators can integrate any data that plays a role in creating safe routes for the passage of OS/OW vehicles without interruption to the disparate system or the end-user of the automated routing solution.
6. Restriction Management Module

Intergraph’s Automated Routing for OS/OW Vehicles solution makes full use of existing roadway and bridge data for constraints on the network when performing analysis for a route. As such, all hazards are not accounted for through the enterprise data sources in a timely manner. Often data edits cannot be made to the enterprise system quickly enough and most transportation agencies require the ability to enter on-the-fly restrictions or road constraints due to the dynamic nature in which certain events occur.

For this purpose, Intergraph provides a roadway restriction management module to empower users, based on their roles on the system, with additional capabilities to enter roadway restrictions for a route changing the roadway’s capacity on-the-fly. The solution also provides the ability to override an enterprise data constraint when conditions change in the field and the enterprise system can’t be updated quickly enough. The restriction management module also allows for entry of route notifications, which is simply information that might impede travel, but not necessarily prevent the route from being used.

The data produced by the restriction manager is temporal in nature and is housed within a standard relational database, making it useful to other business systems, such as an external traffic information Web portal or intelligent transportation system.

Among the types of existing enterprise data typically used for constraints on the network are existing roadway and bridge information, such as travel direction, speed, bridge posting, speed zones, etc. Other types of data you can use to restrict movement on the network include:

- Curb-to-curb clearance (horizontal)
- Vertical clearance
- Turning movements
- Traffic patterns
- Road system type (e.g., Interstate, U.S. route, state route, local route)
- Others as deemed needed by specific customer requirements

In addition, the restriction manager uses several types of data to establish temporary roadway constraints. Data commonly used to set temporary restrictions include:

- Crash event
- Construction projects (lane closure, reduction in roadway capacity)
- Events such as parades, processions, etc.
- Temporary route notifications

Figure 11 on the following page is an example of how you can use restriction management to override or restrict turning movement. Figure 12 shows how you can use the restriction manager to set a temporary turn restriction on the network.
Figure 11: This screenshot shows how you can restrict turning movements.
The module also allows you to enter notifications that do not prevent the routing operation, but provide a notice to the permit document of information that might be important to the carrier operating on a particular route. An example of a route notification might be that traffic slows well beyond the posted speed during a certain time of the day or week.
7. Conclusion

The challenges of routing OS/OW vehicles through a state’s highway system are time-consuming and difficult. With public safety and protection of the highway infrastructure as top priorities, Intergraph’s Automated Routing for OS/OW Vehicles solution enables states to provide an automated method of routing such vehicles in a timely and safe manner. The solution consists of several components that take into account the many roadway hazards for a particular vehicle to ensure safe passage, minimize impact to the roadway infrastructure, and ensure the motor carrier community is able to operate efficiently without undue burden.

As today’s economic climate requires all organizations to do much more with less, this solution will help transportation agencies overcome shrinking resource pools. In addition, our solution will provide DOTs with the tools to decrease the time from permit request to issuance, overcome the loss of institutional knowledge as experienced personnel leave or retire, reduce training time for new personnel, and ensure better accuracy through automation.
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