

Spotlight: Linear Referencing Systems

The Federal Highway Administration's (FHWA) GIS in Transportation program coordinated with the North Carolina Department of Information Technology – Transportation to summarize their work with Linear Referencing Systems (LRS) through ArcGIS Roads and Highways. They work closely with Arizona DOT and other States through the Roads and Highways User Group to benefit from the use of GIS-based LRS tools.

[RHUG: A Helpful Resource When Choosing ArcGIS Roads and Highways](#)

by RHUG Leads Erin Lesh, Patrick Whiteford, Ryan Koschatzky, and Shaun Perfect

The Roads and Highways User Group (RHUG) is a community of transportation agencies, vendors, and consultants who meet to discuss topics related to the ArcGIS Roads and Highways product. Many State Departments of Transportation (DOTs) use ArcGIS Roads and Highways as the system of record for satisfying the FHWA's Highway Performance Monitoring System (HPMS) reporting requirements. RHUG meets on the second Wednesday of every month to discuss experiences with implementations and integrations, share issues and best practices, discuss business workflows, and collectively work with Esri to enhance functionality. Conveniently, every meeting starts with an update on product status from Esri.

RHUG was formed in 2014 by a handful of DOTs that were each implementing the brand-new ArcGIS Roads and Highways product and seeking to collaborate and share experiences. Initially, RHUG was a means for these DOTs to discuss their implementations, issues encountered, and lessons learned. Shortly after, interest in RHUG propagated through the GIS in Transportation (GIS-T) community, especially as more and more customers made the jump predominantly from homegrown legacy systems to ArcGIS Roads and Highways. Over time, RHUG has become a collective voice for ArcGIS Roads and Highways customers and a way for the ArcGIS Roads and Highways Product Team to interact with their customers to gather useful information in setting product vision.

With RHUG, stakeholders have been able to leverage power in greater numbers to collectively make requests and help steer the product roadmap. RHUG has been successful in helping to define bug criteria for hotfixes/patches, to appeal for additional Esri resources, and to drive the timing of development of ArcGIS Roads and Highways. The RHUG community has also maintained a centralized and prioritized list of desired enhancements to the software that the Esri Product Team has been able to use in planning and delivering future releases.

In addition to collaboration and information-sharing, a major goal of RHUG has been to build mutually beneficial relationships among customers, vendors/consultants, and the ArcGIS Roads

and Highways product team. These relationships have and are continuing to help customers with implementations and upgrades, are helping vendors/consultants to understand client needs for support and third party products and integrations, and are helping the Esri product team to routinely interact with many of their customers and partners at one time.

Being part of the RHUG community provides many benefits to a wide array of people. The benefits to GIS transportation professionals that currently use or are planning to use ArcGIS Roads and Highways in the future are obvious, but it doesn't end there. Industry professionals as well as students or individuals just interested in how ArcGIS Roads and Highways works all benefit as members. Benefit results are seen as the RHUG community talks about the early stages of ArcGIS Roads and Highways integration (to one's existing transportation data) all the way to upgrading to the Pro environment with ArcGIS Roads and Highways and transferring ArcGIS Roads and Highways data to the cloud and everything in between. Collaboration efforts and knowledge-sharing among State DOTs, local and international transportation agencies, and private sector companies are a constant in the RHUG community and will continue to be on the rise as the number of community members increases. Many RHUG members also contribute to the Applications for Enterprise GIS in Transportation (AEGIST) pooled-fund study, which although vendor-agnostic, reinforces collaborative ideas and standardizations while using ArcGIS Roads and Highways.

All members in RHUG have a voice. We are constantly looking for members to present on their achievements in using ArcGIS Roads and Highways, their ideas on how to improve on ArcGIS Roads and Highways functionality, and ways to maximize efficiency while using ArcGIS Roads and Highways as well as other GIS transportation data processing and reporting. We are looking to include more States as they onboard to ArcGIS Roads and Highways and reach out to the towns, cities, and counties that also use the software for future data collaboration efforts.

The easiest way to become a member is to follow this link each month: <https://community.esri.com/t5/roads-and-highways-user-group-rhug-questions/rhug-monthly-user-meeting-agenda/m-p/1046315>. This will provide you with the monthly meeting connection information and agenda. Attached to the thread is the RHUG meeting agenda master.xlsx document, which has a list of all the previous meeting agendas and links to meeting recordings. To manage that more easily, subscribe through your Esri login account to receive notifications when information is updated or questions are posted to the community. Once logged in, click the Join Group on the left-hand side of the main RHUG page, then click the subscribe button on the upper right. We look forward to welcoming new and existing attendees in a future meeting!

Feature: National Road Network Webinar Summary

FHWA promotes geographic information systems (GIS) as a means to more effectively manage and improve transportation systems. One of the ways that FHWA does this is through its GIS in

Transportation program,* which identifies timely and critical GIS issues and topics in transportation and connects transportation agencies with available resources and best practices. The webinar summarized here is part of a quarterly series organized through the GIS in Transportation program.

Justin Clarke, Transportation Specialist, and Thomas Roff, Transportation Specialist, of FHWA, presented on FHWA efforts to develop a National Road Network Project (NRNP). As defined by Congress, NRNP incorporates requirements and a process framework to improve the quality of the Highway Performance Monitoring System (HPMS) road network in three areas:

- Connectivity of networks at intra- and interstate borders,
- Spatial representation of multi-carriageway roadways, and
- Spatial accuracy of networks.

The project also identified tools for improved network edge matching and standardized reporting of data that are attached to State linear road networks. The NRNP webinar hosted on May 24, 2022, was attended by 195 participants.

Background

FHWA maintains the HPMS to collect state-level roadway information. Following updates during the last decade, the HPMS now includes state-level spatial road networks for all public roads. HPMS spatial networks (referred to as ARNOLD) are now a critical source for several national applications. ARNOLD is updated annually, directly sourced from State DOTs and includes all public roads.

Although the networks created from HPMS provide extensive, state-to-state connectivity, complete intersection models, and consistent roadway representation between States would increase their application. Recent attempts to use ARNOLD for natural disaster impact assessment have highlighted the need for these enhancements. With dedicated funding from Congress, the FHWA embarked on a project to enhance ARNOLD—the National Road Network Pilot or NRNP—with the goal to produce a national route file with improved spatial network connectivity across jurisdiction lines, refined data to network relationships, and improved spatial accuracy. These enhancements are expected to lead to improved usability of ARNOLD for applications including travel monitoring, safety analysis, freight modeling, and emergency response.

National Network Schematic Chart

ARNOLD generates national network connectivity, which is the key access point to illustrate Agencies' convergent needs and goals. Consistent research, input from previous data submittals, clear base guidelines, and communication and coordination skills with other States and U.S. road specifications are involved when creating projects for planning analysis, crash

* See the FHWA GIS in Transportation website for details: <https://gis.fhwa.dot.gov/>.

analysis, or other types of analysis. In addition, participation and coordination with national or Federal highway programs help to inform and improve network development connectivity.

Elements of NRN Development

To support State network improvements to meet National Road Network (NRN) goals, FHWA created a pilot grant program, the NRNP, focused on southeastern coastal States. These State road networks, frequently impacted by hurricanes, are often incorporated into disaster relief maps. The pilot grants support State exploration of ways to improve State road networks and create national road network connectivity.

Pilot Workflow

The NRNP includes seven States (and one district): Alabama, Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, and Virginia. Each submitted a project statement and funding request to FHWA. Participating States were encouraged to formulate projects in support of one or more of the three NRN focus areas: network connectivity including interstate borders; intra-state borders, and topological connectivity of the network; spatial representation, including multi-carriageway roadways and intersections; and finally, spatial accuracy standards. State projects will continue through 2023, and FHWA will develop a summary of the collective State network improvements after the State work is complete.

Connection Points

To assist with state-to-state connectivity, FHWA partnered with the U.S. DOT Volpe National Transportation Systems Center (Volpe) to create a set of match points where ARNOLD routes cross State borders. The Volpe team used automated processes to align a State network to create these points. Points were shared with NRNP States in a spatial feature set that also included roadways near State borders, roads at or along borders, and demarcation of roads at each side of a match point. As part of the NRN project, where necessary FHWA will establish an adjudication process to support State adjustments of these match points.

Looking Forward

FHWA's ARNOLD geometry checks address a variety of common errors including duplicate features and vertices, non-monotonic measures, spikes and kickbacks, overlaps, self-intersection, duplicate routes IDs, and non-simple features. ARNOLD-based products, however, continue to demonstrate inconsistency for national network applications. Through the NRN and NRNP, FHWA is taking steps to implement a workflow to improve national networks based on HPMS data. State-to-state connectivity for all roads will require regular State partnerships, and national-level coordination. The NRN program and improved ARNOLD data quality and completeness assist with network connectivity, and will lay the foundation for more consistent and widely used FHWA networks in the future.

Other News

Newly Available

Case Study on Crowdsourced Data and Safety

This case study report focuses on the use of crowdsourced data collection methods and how transportation agencies use this data to improve transportation safety. To gather information for this report, the U.S. DOT Volpe National Transportation Systems Center interviewed eight transportation agencies and developed a case study focusing on their experiences. The purpose of this document is for State DOTs and MPOs to consider the notable practices that these agencies used in collecting, analyzing, and utilizing different crowdsourced data types to improve safety. To learn more about this, visit: <https://www.gis.fhwa.dot.gov/Reports.aspx>.

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