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Our guest writer this month is Mark Sarmiento of FHWA's Office of Planning. Mark directs FHWA's GIS in Transportation program and is a leading expert on promoting the use of GIS at State Departments of Transportation (DOTs) and metropolitan planning organizations (MPOs).

The Road to a National Routable Network
Article by Mark Sarmiento, FHWA Office of Planning

Understanding the condition of the Nation's highways and analyzing the flow of people and goods on them are core parts of FHWA's mission to promote safety, mobility, and economic growth. In 2012, FHWA expanded the requirements for State DOTs to submit their Highway Performance Monitoring System (HPMS) data. In the past, State DOTs only provided HPMS data on roads they owned and maintained. With expanded requirements, State DOTs now provide FHWA with a geospatial layer representing all the public roads within their State. FHWA's primary motivation was obtaining the necessary data to measure significant reductions in traffic fatalities and serious injuries on all public roads. The change was also intended to ensure State DOTs inspected and inventoried their highway bridges and tunnels. In addition to meeting these two primary goals, the expanded requirement has also provided FHWA with an opportunity to address another need: the creation of an efficiently maintained national routable road network.

The NHPN

This is not the first time FHWA has developed a national routable road network. The National Highway Planning Network (NHPN) has been in use since the early 1990s when it was originally created by Oak Ridge National Laboratory. Subsequent versions of the NHPN have been further developed by FHWA: first to help with the 1995 designation of the National Highway System (NHS), and then to maintain a record of the NHS, the NHS Intermodal Connectors, the Eisenhower Interstate System, and the Strategic Highway Network (STRAHNET). The NHPN enabled the development of the Freight Analysis Framework (FAF), which provides a picture of freight movement within the country and is the highway component of the National Transportation Atlas Database (NTAD). The NHPN has allowed many users to analyze and visualize highway transportation issues at the national and regional levels.

Data usefulness relies heavily on its accuracy and precision, and over time this became a challenge for the NHPN. It was showing its age. The network had a base scale of 1 to 100,000, and while that was adequate in the 1990s and early 2000s, it became insufficient as users' analyses started to require higher resolution data. In addition, a dedicated source of funding to support periodic changes in the data collection requirements did not exist. This meant that updates to the network only occurred when funding was available, which was about once every five years. The result was a product that was not as accurate, precise, and up-to-date as users needed.

Updating the NHPN

In the early 2010s, there was an effort to improve the spatial accuracy of the network, taking advantage of the new requirement for State DOTs to submit HPMS data on all public roads. The State-submitted public roads data were compiled into the All Roads Network of Linear Referenced Data, or ARNOLD, which offered an opportunity to enhance FHWA's existing road network dataset. With that in mind, a project moved forward to use the line work of ARNOLD to update the NHPN. FHWA selected the ARNOLD roads that matched the coverage of the NHPN, and then conflated the NHPN attributes over to the new network. The end result was a new NHPN that was more precise in location and contained the latest system updates (NHS, Interstate, and STRAHNET) available at that time. Unfortunately, because the project did not address the need for recurring updates and relied on infrequent funding, the NHPN became less accurate as system changes took place. Another strategy was needed.

A New Network

By 2018, State DOTs were smoothing out the wrinkles of updating their datasets of all public roads. ARNOLD was becoming a valuable resource within FHWA, especially since it had links to HPMS, often at a scale of 1 to 5,000 or better, and represented all the public roads in the country. However, it was a large dataset with no connections across State borders. A need for an NHPN-like, integrated national network still existed.

Instead of the previous approach, conflating attributes from NHPN to the line work of ARNOLD, this new network would be built from scratch. The new network would consist of roads that were part of the NHS and had a Functional Class of Minor Arterial and higher. The network's geometry would come from ARNOLD, while the network's attributes, like NHS—annual average daily traffic, speed limits, and road names—would come from HPMS. This new network would allow users to model and analyze traffic flows across the country, as well as represent roads that were important at the national level, like the NHS, the Interstate Highway System, and STRAHNET. The resulting network would inherit the locational precision of ARNOLD, connect at State borders, and remain a more manageable size. It would be easy to update since it was a part of ARNOLD and would take advantage of annual updates to ARNOLD. It would serve as the successor to the NHPN.

Surprisingly, it took some time to determine the name for this network. It did not have the same attributes as the NHPN, even though it covered the same area. So it was not simply a newer version of the NHPN. It was derived from ARNOLD, but it was not all of ARNOLD. Because it was a subset of the ARNOLD network, FHWA named it the American Routable Network or ARN.

FHWA completed work on the first version of ARN at the end of 2019, and awareness of this new resource is now spreading. This network is a work-in-progress that will benefit from continual improvements to ARNOLD and HPMS. Most importantly, this effort emphasized how the FHWA offices that were part of the development of ARN have a desire to avoid duplicating efforts in creating a national routable spatial network, to build upon existing efforts in this area, and to work together to efficiently satisfy the needs of FHWA in meeting its mission.

Other News

Newly Available

Peer Exchange Report: Emergency Management
This newly available report provides highlights from our September 2019 peer exchange focused on how agencies can leverage GIS platforms in an emergency management scenario. The report is available here:
https://www.gis.fhwa.dot.gov/reports/Emergency_Management_Peer_Exchange_Sept2019.aspx.

Peer Exchange Report: GIS Data Integration
In November 2018, Washington DOT hosted a joint peer exchange organized by FHWA's Office of Transportation Safety and FHWA's GIS in Transportation Program. The exchange focused on ways to effectively transition an agency from legacy systems to an enterprise-level GIS infrastructure and data use. The report is available here:
https://www.gis.fhwa.dot.gov/reports/GIS_Data_Integration_Peer_Exchange_Nov2018.aspx.

Past Events

FHWA Webinar on Using GIS for Local Agency Data Collection
In March 2020, FHWA hosted a webinar focused on Massachusetts DOT's (MassDOT's) efforts to collect data from local agencies using GIS. MassDOT shared their efforts to improve data collection across multiple programs through implementing the Local Aid Grant Workflow. The webinar also reviewed the MassDOT Road Inventory Submission Application (RISA). RISA provides a web-based mapping interface for the municipal authorities to interactively add, update, and review its roadways in the Roads and Highways Database in a multi-user, collaborative environment. A summary and recording of the webinar is available here:
https://www.gis.fhwa.dot.gov/webinars/webinar42_Local_Agency_Data_Collection.aspx.

FHWA Webinar on MIRE Data: A GIS Perspective
In January 2020, FHWA hosted a webinar on State DOT efforts to implement new Model Inventory of Roadway Elements (MIRE) requirements. Arizona DOT discussed their implementation process, including the guiding principles of route dominance, one source of truth, and training and knowledge management. Arkansas DOT shared lessons from using Intersection Manager and ArcGIS Online to manage and visualize their MIRE data. A summary and recording of the webinar is available here:
https://www.gis.fhwa.dot.gov/webinars/webinar41_MIRE_Data-A_GIS_Perspective.aspx.

Case Study on Data Collection for Asset Management
The GIS in Transportation team has interviewed several State DOTs about their use of different techniques for collecting geospatial data for the purpose of asset management. A report summarizing the case studies and the agencies' lessons learned will be made available here: https://www.gis.fhwa.dot.gov/reports.aspx.

Case Study on Data Dashboards
The GIS in Transportation team is preparing a report on the use of data dashboards at State DOTs for monitoring operations, measuring progress toward strategic goals, and presenting data to the public and other external stakeholders. A case study report describing several dashboard projects and best practices will be made available here: https://www.gis.fhwa.dot.gov/reports.aspx.

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