Enterprise Linear Referencing System Development in West Virginia

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West Virginia Department of Transportation
Division of Highways

Geospatial Transportation Information Section
Background
Project Status
Lessons
Near Future Plan
Qs & As
Background
Current LRS
Major Issues
Goal & Objectives
Current LRS

- Development Completed in 2008
  - Centerline Geometry: Acquired in 2003
  - Measures: DMI Driven Distances Acquired Since 1960’s

- State Maintained Routes Only

- One LRM: Countywide Milepoint LRM

- Maintained in Esri ArcGIS
  - Stored in SDE GDB on ArcSDE + MS SQL Sever
  - Edited in ArcGIS Desktop

- Published as Shapefiles/Web Services

- Published on Official Highway Maps
Issues

- No Non-State Maintained Public Roads
- A Statewide Milepoint LRM Needed
- Not Closely Tied to Road Inventory Log (RIL)
  - RIL: Official Roadway Measure Source
- No System Integration w/ Exterior Business Systems
  - Multiple Versions
Geospatial Strategic/Business Plan
- 1st Version in 2008
- 2nd Version in 2012

Goal
- To Develop an Enterprise LRS for WVDOT & External Users

Objectives
- Based on Modern LRS Data Model
- Statewide Road Network of All Public Roads
- Sole Official Source to Locate Features & Attributes
- Seamlessly Integrated with RIL
- Part of WVDOT Enterprise GIS Infrastructure
- Part of WVDOT Enterprise IS Infrastructure
- Easy to Maintain
- Development of LRS Data Model
  - Integration of RIL and LRS
- Data Preparation
  - Conflation of State Maintained Routes and Non State Public Roads
  - Integration of RIL and GIS
  - Data Cleanup
- Esri Roads & Highway (R&H) Solution
- Lack of Resources
  - Unstaffed
  - High Turn Over
  - No ELA
Project Status
2011: WVDOT initiated the project after Esri R&H demo at GIS-T. First LRS data model developed by Esri. Data cleanup started.

2012: Data cleanup continued. Data conflation completed. wvOASIS (ERP) became a key potential user of ELRS.

2013: Transcend Spatial & Esri hired to implement R&H and system integration and improve calibration. Model improved w/ a new LRM & railroads added. Data cleanup continued.

2014: A static copy of LRS was provided to wvOASIS in January. Data cleanup continued. Model improved w/ RIL added. ...
Major Sub-Projects

- Esri Roads & Highways Implementation
- Calibration System Improvement
- System Integration
Multiple Phases
- Phase 1: Prototyping
- Phase 2: Deployed in Test Environment
- Phase 3: Deployed in Production Environment → TBD

R&H Version 10.2.2

Comprehensive LRS Data Model
- Two LRM s
- Network Gaps
- Concurrent Routes
- RIL
- MIRE Data Items
- Extensible

Complete Roadway Centerline Dataset
- All Public Roads: State Maintained & Non-State Maintained
- Railroads
- Ramps
- Crossovers
- Dual Carriageways
Measures are reset at county boundaries for all routes except for Interstates whose measures are continuous across the state.

Widely Used at WVDOT

Route ID Definition

- Examples: 20201190017NB; 20201190017NB058AF
Measures are continuous for all routes across the state.

Route ID Definition
- Example: 1006400-MLNB00; 2011900-20NB17058AF
<table>
<thead>
<tr>
<th>COUNTY LIST</th>
<th>Sign System</th>
<th>Supplemental Code</th>
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<tbody>
<tr>
<td>01 Barbour</td>
<td>0 = Intersate</td>
<td>00 Not Applicable</td>
</tr>
<tr>
<td>02 Berkeley</td>
<td>2 = US</td>
<td>01 Alternate</td>
</tr>
<tr>
<td>03 Boone</td>
<td>3 = WV</td>
<td>02 Wye</td>
</tr>
<tr>
<td>04 Braxton</td>
<td>4 = CO</td>
<td>03 Spur</td>
</tr>
<tr>
<td>05 Brooke</td>
<td>5 = N/A</td>
<td>04 North</td>
</tr>
<tr>
<td>06 Cabell</td>
<td>6 = STATE PARKS AND FOREST ROADS</td>
<td>05 South</td>
</tr>
<tr>
<td>07 Calhoun</td>
<td>7 = FANS</td>
<td>06 East</td>
</tr>
<tr>
<td>08 Clay</td>
<td>8 = HARP</td>
<td>07 West</td>
</tr>
<tr>
<td>09 Doddridge</td>
<td>9 = Other</td>
<td>08 business</td>
</tr>
<tr>
<td>10 Fayette</td>
<td>0 = MNS (Municipal Non-State)</td>
<td>09 North Bound (Business)</td>
</tr>
<tr>
<td>11 Gilmer</td>
<td>U = USFR- United state forest road</td>
<td>10 South Bound (Business)</td>
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<tr>
<td>12 Grant</td>
<td>R= Railroads (WV State Rail Authority)</td>
<td>11 East Bound (Business)</td>
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<td>13 Greenbrier</td>
<td>12 West Bound (Business)</td>
<td>13 Truck Route</td>
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<tr>
<td>14 Hampshire</td>
<td>14 Bypass</td>
<td>14 Loop</td>
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<td>15 Hancock</td>
<td>15 Toll</td>
<td>16 Ramp</td>
</tr>
<tr>
<td>16 Hardy</td>
<td>18 Other</td>
<td>17 Other</td>
</tr>
<tr>
<td>17 Harrison</td>
<td>19 City Streets Non-State Roads Under</td>
<td>18 Other</td>
</tr>
<tr>
<td>18 Jackson</td>
<td>20 construction</td>
<td>19 Other</td>
</tr>
<tr>
<td>19 Jefferson</td>
<td>21 Footbridges</td>
<td>20 Connector</td>
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<tr>
<td>20 Kanawha</td>
<td>22 Historical Bridges</td>
<td>23 New/Proposed</td>
</tr>
<tr>
<td>21 Lewis</td>
<td>24 Crossover (bypass dual geometry)</td>
<td>25 Crossover (bypass dual geometry)</td>
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<tr>
<td>22 Lincoln</td>
<td>26 Emergency Crossover</td>
<td>27 Left Turn Lane</td>
</tr>
<tr>
<td>23 Logan</td>
<td>28 Right Turn Lane</td>
<td>29 Right Turn Lane</td>
</tr>
<tr>
<td>24 McDowell</td>
<td>30 Abandoned</td>
<td>31 Abandoned</td>
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* The direction will be NB, SB, EB, and WB on routes that always have dual geometry (sign system 1 and 2). The direction is 00 on routes that are bidirectional (single geometry, sign system 3 and above). Where WV or County routes switch from single to dual geometry, the main direction of travel (normally north bound or east bound) will have direction as 00 while the opposite direction will have directional characters (normally SB or WB).

** If the ramp is also part of an existing route, the route will remain the same as the connected route. Otherwise, the ramp route is the route for the highest sign system (interstate, US, etc.) or lowest route number if in same sign system with the addition of the exit number and ramp letter. The exit number is the mile point of the exit. Mile point is also used at the end of emergency crossover routeid.

*** In creating the route layer in ArcGIS we drew lines over every segment of road. This created the possibility of additional lines not in the RIL. Currently these pieces are mainly undocumented wye segments. The decision was made to use the sequence number (exit segment) of the field to account for duplicate routeid designation. For the first instance of any route, the sequence number is blank. For the first duplicate, the sequence number would be 001 and increment as needed (example: 02400320000200001). If second wye is present, routeid would be 024003200002000001.

**** Railroads in the LRS are only for WV State Rail Authority lines. County Code and sign system will always be 99, and R respectively. Each line has a unique route number. Small spurs will be given the main line route number and a unique Sub Route number. Supp. Code and Direction are 00.
DMI Driven Distance
   - State Maintained Routes: Interstates, US Routes, WV Routes, etc.

Geometry Length
   - Non-State Maintained Public Roads/Local Streets
   - Railroads
   - Ramps
   - Cross Overs
Sign System “R”
County Code “99”
Supplemental Code “99”
Geometry Length for Measures
RouteID Examples
  - Countywide Milepoint LRM: 99R0001019900
  - Statewide Milepoint LRM: R000101-990099
Objectives
- Review Current Calibration System
- Make Recommendations

Current Calibration
- Beginning & Ending Points
- Measures from RIL

Calibration in R&H
- Beginning & Ending Points
- Intersections
- Break Points for Network Gaps & Concurrent Routes
- Measures from RIL & Geometry Length
Two Web Services Published by R&H
  - LRS Network Updates
  - Relocate Events

Three Interfaces
  - R&H Interface w/ wvOASIS Agile’s Asset Management System
    - Version 7
  - R&H Interface w/ Deighton’s Pavement Condition System
    - Version 9
  - R&H Interface w/ Transmetric’s Traffic Server
Between Agile’s Asset Management System & Esri R&H
  - Agile’s System V. 7
  - R&H V. 10.2.2
Data Exchange for LRS Updates & Related Event Updates
Functional Design Completed May 2013
Being Tested
In Production by December 2014
Our Advanced Solution w/ Integrated Systems

Goals

- Replace multiple outdated, stand-alone system with one integrated ERP System
- Standardize business processes & practices across the state
- Facilitate timely access to information for daily business

Multiple Phases

- Phase B: Safety, ROW, Transportation Asset Inventory, LRS, & GIS
- Phase E: Transportation Asset Inventory, Transportation Operations Management, Capital Planning, Fleet, Facilities, Real Estate, & the Interface w/ Esri R&H
A Snapshot of LRS Was Provided.

Interface Completed

LRS Interface Design Kickoff

August 2013
January 2014
July 2014
January 2015
Lessons
Start Data Conflation ASAP if Needed
Start Data Cleanup ASAP
Leverage External Resources
Don’t Deploy Two Systems Simultaneously
Near Future Plan
Near Future Plan

By December 2014
- Deploy Esri R&H in Production Environment – Phase 3 (TBD)
- Deploy the Interface w/ Agile’s System

Keep Cleaning up the Data

Work w/ Business Programs to Improve Asset Data

Configure
- Support More Workflows

Customize
- Extend R&H Functionality
- Support Reporting
- Support More System Integration
- Make the Usage of LRS More User Friendly

Improve
- Add New LRM’s (Address Ranges, Cross Street Referencing, etc.)
Qs & As
### Thanks to

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<tr>
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