Enterprise Linear Referencing System: Where Are We?

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October 8, 2014

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Geospatial Transportation Information Section
Agenda

- Background
- Project Status
- Lessons
- Near Future Plan
- Qs & As
Background
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 Using 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
- No Temporality
- A Statewide Milepoint LRM Needed
- Disconnection from Road Inventory Log (RIL)
  - RIL: Official Roadway Measure Source
- No System Integration w/ Exterior Business Systems
  - Multiple Versions ➔ Out of Sync
Geospatial Strategic/Business Plan
  o 1\textsuperscript{st} Version in 2010
  o 2\textsuperscript{nd} Version in 2012

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

Objectives
  o Based on Modern LRS Data Model (e.g. Temporality)
  o Support FHWA Requirements
  o Statewide Road Network of All Public Roads
  o Sole Official Source to Locate Features & Attributes
  o Seamlessly Integrated with RIL
  o Part of WVDOT Enterprise GIS Infrastructure
  o Part of WVDOT Enterprise IS Infrastructure
  o 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
  - Understaffed
  - Few Experts on R&H
  - Few Successful Cases of R&H Implementation
Project Status
2011: WVDOT initiated the project after Esri R&H demo at GIS-T. First LRS data model developed by Esri.
Data conflation started. Data cleanup started.

2012: Data conflation completed. Data cleanup continued. 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
  - Planning

R&H Version 10.2.2
Comprehensive LRS Data Model

- Two LRMs
- Network Gaps
- Concurrent Routes
- Road Inventory Log
- Model Minimum Inventory of Roadway Element (MMIRE)
- Extensibility
Complete Roadway Centerline Dataset

- All Public Roads
  - State Maintained
  - Non-State Maintained
- Ramps
- Crossovers
- Dual Carriageways
- Railroads
- Railroad Trails
Workflow Manager Extension
  o Versioning

Three Generic Workflows
  o Commissioner’s Order Process
  o Route Editing
  o Event or Roadway Characteristics Editor (RCE) Editing

Three Roles
  o LRS Manager
  o Route Editor
  o RCE Editor
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>
</tr>
</thead>
<tbody>
<tr>
<td>01 Barbour 20 Kanawha 39 Preston</td>
<td>1 = Interstate</td>
<td>00 Not Applicable</td>
</tr>
<tr>
<td>02 Berkeley 21 Lewis 40 Putnam</td>
<td>2 = US</td>
<td>01 Alternate</td>
</tr>
<tr>
<td>03 Boone 22 Lincoln 41 Raleigh</td>
<td>3 = WV</td>
<td>02 Wye</td>
</tr>
<tr>
<td>04 Braxton 23 Logan 42 Randolph</td>
<td>4 = CO</td>
<td>03 Spur</td>
</tr>
<tr>
<td>05 Brooke 24 McDowell 43 Ritchie</td>
<td>5 = N/A</td>
<td>04 North</td>
</tr>
<tr>
<td>06 Cabell 25 Marion 44 Roane</td>
<td>6 = STATE PARKS AND FOREST ROADS</td>
<td>05 South</td>
</tr>
<tr>
<td>07 Calhoun 26 Marshall 45 Summers</td>
<td>7 = FANS</td>
<td>06 East</td>
</tr>
<tr>
<td>08 Clay 27 Mason 46 Taylor</td>
<td>8 = HARP</td>
<td>07 West</td>
</tr>
<tr>
<td>09 Doddridge 28 Mercer 47 Tucker</td>
<td>9 = Other</td>
<td>08 business</td>
</tr>
<tr>
<td>10 Fayette 29 Mineral 48 Tyler</td>
<td>0 = MNS (Municipal Non-State)</td>
<td>09 North Bound (Business)</td>
</tr>
<tr>
<td>11 Gilmer 30 Mingo 49 Upshur</td>
<td>R = Railroads [WV State Rail Authority]</td>
<td>10 South Bound (Business)</td>
</tr>
<tr>
<td>12 Grant 31 Monongalia 50 Wayne</td>
<td>T = Trails</td>
<td>11 East Bound (Business)</td>
</tr>
<tr>
<td>13 Greenbrier 32 Monroe 51 Webster</td>
<td>U = USFR - United state forest road</td>
<td>12 West Bound (Business)</td>
</tr>
<tr>
<td>14 Hampshire 33 Morgan 52 Wetzel</td>
<td></td>
<td>13 Truck Route</td>
</tr>
<tr>
<td>15 Hancock 34 Nicholas 53 Wirt</td>
<td></td>
<td>14 Bypass</td>
</tr>
<tr>
<td>16 Hardy 35 Ohio 54 Wood</td>
<td></td>
<td>15 Loop</td>
</tr>
<tr>
<td>17 Harrison 36 Pendleton 55 Wyoming</td>
<td></td>
<td>16 Toll</td>
</tr>
<tr>
<td>18 Jackson 37 Pocahontas 99 Reserved for Other Statewide Continuous Features</td>
<td></td>
<td>17 Ramp</td>
</tr>
</tbody>
</table>

* 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 routeid will remain the same as the connected route. Otherwise, the ramp routeid is the routeid for the highest sign system (interstate, us, etc) or lowest route number if in same sign system with the addition of the ext 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: 0240032002000200 is the first wye on route 32. If second wye present routeid would be 024003200200020001).

**** Railroads and Rail Trails in the LRS are only for WV State Rail Authority lines. County Code and sign system will always be 99, and R or T 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
- Ramps
- Cross Overs
- Railroads
- Railroad Trails
Sign System “R”
County Code “99”
Supplemental Code “99”
Sub-Route Code for Tracks
Direction Code “00”
Geometry Length for Measures
RouteID Examples
  - Countywide Milepoint LRM: 99R0001019900
  - Statewide Milepoint LRM: R000101-990099
Calibration System Improvement

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 APIs Published by R&H
- LRS Network Updates
- Event Relocation

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

System Testing in November 2014

In Production by July 2015
Our Advanced Solution w/ Integrated Systems

Goals
- Replace multiple outdated, stand-alone system w/ 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.

Scope

Budget Development

Safety, Right of Way, Utility, Transportation Asset Inventory, LRS

GL, Budget Control, AP, Revenue Accounting, Pcard, Grants, Cost Accounting, Project Accounting, Cash Management, Fixed Assets, Investments, Purchasing, Contracts, Inventory, Travel Expense, Financial Transparency, CAFR

HR/Payroll, Time & Leave, Position Control, Class & Comp, Benefits, Learning, EE Relations, Billing, EES

Transportation Ops & Assets, Safety, FHWA Billing, Fleet, Facilities & Real Estate, Travel, Federal Reciprocity, LRS, Transportation Asset Inventory

Phase A Envision
- Build
- Achieve

Phase B Envision
- Build
- Achieve

Phase C Envision
- Build
- Achieve

Phase D Envision
- Build
- Build
- Achieve

Phase E Envision

LRS Interface Design Kickoff

August 2013

January 2014

July 2014

January 2015
Lessons
Lessons

- Have a Strategic/Business Plan
- Do an Enterprise System Design
- Leverage External Resources
- Don’t Deploy Two Systems Simultaneously!
Near Future Plan
By March 2015
- Deploy Esri R&H in Production Environment – Phase 3 (TBD)
- Get the Interface w/ Agile’s System Ready for Deployment

Keep Cleaning up the Data

Work w/ Business Programs to Improve Asset Data

Configure
- Support More Workflows
- Make RCE More User Friendly

Customize
- Extend R&H Functionality
- Support More System Integration
- Make LRS More User Friendly

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

IRD
- Chuck Larson

AgileAssets
- Abhishek Bhargava
- Eric Perrone
- Phil Hardy
- Siamak Saliminejad
- Tyler Pauley
- Etc.

Esri
- Adrien Litton
- Bruce Field
- Jackie Magnant
- Silvia Casas
- Will Isley
- Etc.

Transcend Spatial
- Andrea Compton
- Bill Schuman
- Jesse Jay
- Steven Korzekwa
- Etc.

Others
- Carrie Haight
- Dustin Lowers
- Everett Perry
- Jessica Perkins
- Kyle Weatherholt
- Lingyang Chen
- Marla Johnson
- Robert Maynard
- Robin Goff
- Roger Dorsey
- Shiriedel Acayan
- Etc.