Migrating a Single Centerline LRS to a Dual Centerline LRS: A case study of Maryland DOT

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Background

One-Maryland-One Centerline (OMOC) Project

- **Phase I: Legacy Migration to R&H**
  - Currently in UAT

- **Phase II: Integration of locally maintained roadway centerline and corresponding business data with MDSHA’s centerline and business data.**
  - The requirements and design task completed, first pilot will start next month

- **Phase III: Implementation of reporting, data analysis and visualization tools.**
  - Extension of the first phase
• Shared Centerline Program began in 2001
  • Tested vertical integration of transportation data using Howard County, MD attributed centerline
  • SHA developed a methodology of attaching a unique-ID onto each road segment
  • This allowed both parties to do what they do best, local governments provide centerline and address information, and MDOT SHA provides roadway distance measurements, linear referencing capability, quality control, and data validation.
  • Neither governmental entity edited the other’s centerline data
• July 27, 2005,
  • The Maryland State Highway Administration (MDOT SHA) and the Maryland Association of Counties (MACO) received a 2005 Special Achievement in GIS award for its outstanding use of geographic information system (GIS) technology

• August 31, 2005,
  • MDOT SHA GIS staff had the opportunity to brief Jack Dangermond, on the Maryland Cooperative Street Centerline Program. Esri entered into a collaborative arrangement with MDOT SHA to provide each county participant a no cost license of an ArcGIS Server 9.2 license and an ArcGIS desktop license that will be dedicated to the Maryland federated street centerline synchronization project
Presentation Overview

• Change Management
• Training
• Reporting, Data Visualization
• Project Implementation Approach
• Route ID
• Network Migration
• Business Data Migration
Project Implementation Approach

Iterative Waterfall Model

- Project Initiation
  - Analysis
  - Requirements
  - Data Base Design
  - Migration Plan
  - User Exposure

- Iteration 1
  - Analysis
  - Requirements
  - Data Base Design
  - Migration Scripts
  - Implementation
  - Testing
  - User Exposure

- Iteration 2
  - Analysis
  - Requirements
  - Data Base Design
  - Migration Scripts
  - Implementation
  - Testing
  - User Acceptance

- Iteration 3
  - Analysis
  - Requirements
  - Data Base Design
  - Migration Scripts
  - Implementation
  - Testing
  - User Acceptance
• No changes to County, Mun_Sort, ID_Prefix, ID_Route No, and Ramp Number
• MP Suffix will have a place holder of a dash (–)
• Mainline, MP direction and Cal direction will be used to populate the new field Cardinality
• Exit Number and Ramp Number will have a place holder of a dash (–)
• Exit Number will be shorted to 3 characters with leading zero

24000IS00083  01NN***************  →  24000IS00083—1-----
24000IS00083  09SS***************  →  24000IS00083—2-----
01000CO00155  01NN***************  →  01000CO00155—1-----
01000MD00135A  01NN***************  →  01000MD00135A-1-----
01000MD00144AE01EE***************  →  01000MD00144AE1-----
02000RP00032  02WWMD10B  02  →  02000RP00032--1MD010B02
02000RP00032  02WWMD5  01  →  02000RP00032--1MD000501
Network Data Model

- If X, then A
  - X: Current network – routes in opposite direction with different lengths
  - A: Some business data stored on inventory route*

- If Z, then A
  - Z: Calibrated routes is same direction with different lengths
  - A: Some business data stored on inventory route*

- If Y, then B
  - Y: Changes routes so they are in same calibrated direction with same length
  - B: Business data stored on both sides of road

* Some business events are maintained on inventory and non-inventory (e.g., Functional Class)
Network Data Model

Controlled access divided – event data on log and reverse

Divided / undivided mixed - event data on log and reverse

Undivided - event data on log no reverse representation
# Network Migration QC Results

<table>
<thead>
<tr>
<th>Check</th>
<th>Source</th>
<th>R&amp;H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multipart Line</td>
<td>1864</td>
<td>1428 (CL) 1857 (routes)</td>
</tr>
<tr>
<td>Non-Linear Segment</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>Polyline or Path Closes on Self</td>
<td>1282</td>
<td>1286</td>
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<tr>
<td>Duplicate Vertex</td>
<td>1285</td>
<td>1291</td>
</tr>
<tr>
<td>Cutbacks</td>
<td>34</td>
<td>3</td>
</tr>
<tr>
<td>Evaluate Polyline Length</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Find Dangles</td>
<td>5739</td>
<td>310</td>
</tr>
<tr>
<td>Orphan</td>
<td>295</td>
<td>54</td>
</tr>
<tr>
<td>Duplicate Calibration Points – Same Measure</td>
<td>418</td>
<td>4</td>
</tr>
<tr>
<td>Duplicate Calibration Points – Different Measure</td>
<td>3340</td>
<td>3351</td>
</tr>
<tr>
<td>Execute SQL – Measure &lt; 0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Calibration Points not on routes</td>
<td>546</td>
<td>134</td>
</tr>
<tr>
<td>Detect Non-Monotonic Routes</td>
<td>X</td>
<td>2,154</td>
</tr>
</tbody>
</table>
Leave and Re-enter
Business Data Migration

- Migration QC Statistics
Business Data Migration

• Source to Target
Business Data Migration

Diagram:
- Left Outside
- Right Outside
- Left Inside
- Right Inside
- Right Outside

Logos:
- Transcend Spatial Solutions
- MOOT
- Maryland Department of Transportation
Business Data Migration

Existing Widths: Diagrammed

Undivided Highway

- Left
- Right

Divided Highway

- Left
- Right

ROW

Unpaved Shoulder

Paved Shoulder

WBCM: Architecture, Engineering, Construction

Transcend Spatial Solutions
The First Curve Ball, Cross Sectional Data

Auxiliary Lanes
Average Lane Width
Curb
Pavement Markings

Pavement Type
Pavement Width
Shoulder Type
Shoulder Width

LRM to LRM
Second Curve Ball, Dividedness

• Disconnected Spatial and Business Data
  • Discontinuity between spatial representation and business data.
    • Differences in geometric vs calibrated lengths
    • Variance in spatial vs business definition of dividedness
Second Curve Ball, Dividedness

Translates to Inventory route

Overlapping records – one record located on Inventory route and one record located on Non-inventory route

HMIS division point 2.023

Spatial division point 2.003

Migrated to Non-inventory

Migrated to Inventory
Second Curve Ball, Dividedness

- Median: business definition of dividedness
- Created a buffer at the begin and end of Median event
- Located spatial division point of dividedness
- If begin or end of median event is within 150’ of division point, median extent used to create calibration point at the spatial division point
### Second Curve Ball, Dividedness

**Identify LRS Route Locations**

<table>
<thead>
<tr>
<th>Type of Issue</th>
<th>Total Number</th>
<th>Tolerance</th>
<th>Remaining issues</th>
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</thead>
<tbody>
<tr>
<td>Gaps (Partial Matches)</td>
<td>1,992</td>
<td>100 ft</td>
<td>952</td>
</tr>
<tr>
<td>Gaps (Partial Matches)</td>
<td>1,992</td>
<td>150 ft</td>
<td>583</td>
</tr>
<tr>
<td>Overlaps</td>
<td>861</td>
<td>100 ft</td>
<td>216</td>
</tr>
<tr>
<td>Overlaps</td>
<td>861</td>
<td>150 ft</td>
<td>143</td>
</tr>
</tbody>
</table>

**Table**

<table>
<thead>
<tr>
<th>OBJECTIDyne</th>
<th>SHOULDER</th>
<th>ROUTE_ID *</th>
<th>FROM_MEAUGH</th>
<th>TO_MEAUGH</th>
<th>SHOULDER_TYPE_RT</th>
</tr>
</thead>
<tbody>
<tr>
<td>433</td>
<td>433</td>
<td>01000US30343AL24</td>
<td>2.091</td>
<td>3.015</td>
<td>Surface shoulder exists – bituminous concrete (AC)</td>
</tr>
</tbody>
</table>
Project Team - MDSHA

- Jerry Einolf
- Michel Sheffer
- Kevin Powers
- Chris Sklar
- Ryan Geraci
- John Beall
- Lynn Shenk
- Lena Friedman
- Yen Wang
Project Team – WBCM, Transcend

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- Adam Stevens