WA-Trans; Washington’s Geospatial Transportation Network: Architecture, Processes, and Interesting Problems

Transportation Pooled Fund: Software Tools for Sharing and Integrating GIS Data

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Presentation Content

- Project background and architecture,
- Identify administrative processes needed for data in WA-Trans,
- Overview of infrastructure,
- Obtaining Provider Data and the Data Provider Portal,
- Change Detection and Change Management,
- QA/QC of provider data in the WA-Trans database,
- Data Integration Processes,
- Promotion to Production,
- Production Data and the Data User Portal
Basic GIS Terminology

- **Feature**: A record in a relational table that has a *core geospatial* component.
- **Attribute**: Describes a feature. Not specifically spatial, but may add spatial or non-spatial information about a feature.
- **Geometry**: The actual pictorial representation of the feature. In the case of WA-Trans we have vectors to represent pieces of roadway (called *segments*) or other linear transportation feature and *points* for intersection and other types of single location features.
WA-TRANS
Washington Transportation Framework for GIS
Project Organization:

- Facilitated by the Washington State Department of Transportation (WSDOT),
- Collaboratively organized,
- Includes counties, cities, planning organizations, tribal nations, transit organizations, freight interests, federal agencies and private organizations, *other states*,
- Planned and advised by a steering committee from different levels and disciplines of government,
Developing Partnerships

- Geospatial Integration and Sharing Data Consortium (GISDC)
  - California Department of Transportation (Caltrans),
  - Idaho Department of Transportation (IDT),
  - Nebraska Department of Roads (NDOR),
  - Ohio Department of Transportation (ODOT),
  - Oregon Department of Transportation (ODOT),
  - Tennessee Department of Transportation (TDOT)

GOAL: Share development of the needed data structures, infrastructures, agreements, processes and experiences so we can collaboratively develop, maintain and share our statewide transportation data as envisioned by each state. We are looking for more partners!
WA-Trans Work / Data Flow

**Preparing Data for WA-Trans**
- Provider Data
  - Provider logs into Data Provider Internet Portal
  - Provider Data is Transformed to WA-Trans
- Detected Changes are Applied to WA-Trans
- Agreement Points are Integrated
- Different Linear Measures are Applied, Calibrated and Related
- Combined Data is Checked for Quality

**Serving WA-Trans Data**
- WA-Trans Complete Statewide Data
- Data User Accesses WA-Trans Data User Internet Portal and selects data and format for download
- WA-Trans data is transformed to the user selected output format
- Data user is provided WA-Trans Data for use in a GIS or tabular database

*Washington State Department of Transportation*
The differences between the three WA-Trans databases is based on function.

- **WA-Trans Loading Database**
  - Initial Loading of data,
  - Structured for Change Detection,
  - Change Mgmt. moves data to Staging

- **WA-Trans Staging Database**
  - Structured for QA/QC, Integration and processing for production,
  - Maintains a copy of “raw” incoming data data used for Change detection,

- **WA-Trans Production Database**
  - Data ready to serve to public,
  - Structured for delivery of products meeting WA-Trans users business needs,
  - Contains history of the WA-Trans Data
The LRS, Segments and the Database

<table>
<thead>
<tr>
<th>Segment Geometry</th>
<th>Seg ID</th>
<th>Seg ID</th>
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</thead>
<tbody>
<tr>
<td>Seg Geom ID</td>
<td>Seg Geom ID</td>
<td>Seg GUID 1</td>
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<tr>
<td>Geom GUID 1</td>
<td>Seg GUID 2</td>
<td>Seg GUID 3</td>
</tr>
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<td>Geom GUID 3</td>
<td>Seg GUID 2</td>
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<table>
<thead>
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<th>Route Description</th>
<th>Route Descr ID</th>
<th>To Seg End Point ID</th>
<th>From Seg End Point ID</th>
<th>LRS Type</th>
<th>Seg ID</th>
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<td>Route Descr To Pt GUID 4</td>
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<td>Seg GUID 9</td>
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<td>Route Descr From Pt GUID 2</td>
<td>Route Descr To Pt GUID 5</td>
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<td>Route Descr To Pt GUID 6</td>
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<td>Route Descr To Pt GUID 11</td>
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<tr>
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<th>From Seg End Point ID</th>
<th>Seg ID</th>
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<td>Seg GUID 3</td>
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<th>Reference Point</th>
<th>Seg Point ID</th>
<th>Point Type ID</th>
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<tr>
<td>Ref Point GUID 2</td>
<td>TypeID 1</td>
<td></td>
</tr>
<tr>
<td>Ref Point GUID 3</td>
<td>TypeID 1</td>
<td></td>
</tr>
</tbody>
</table>

| Route Descr. 2 | Route Descr. 1 | Road Address | Segment + Segment Geometry 1 |
Segments and End Points

<table>
<thead>
<tr>
<th>Segment</th>
<th>Endpoint 1</th>
<th>Endpoint 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>B</td>
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<tr>
<td>2</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>E</td>
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<tr>
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<td>E</td>
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<tr>
<td>6</td>
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<td>F</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>G</td>
</tr>
<tr>
<td>8</td>
<td>G</td>
<td>E</td>
</tr>
</tbody>
</table>
Physical Architecture used for this Pilot

Web Tier
Description: Combination Web Server and Application Server
Software:
- ArcGIS 9.3
- Latitude Geocortex Essentials v1.5
- Safe Software FME Server

Application Tier

Data Tier
Description: Development SQL Server (Interns)

SQL Version: SQL 2003 Standard
GIS Software: ArcGIS 9.3
WA-Trans Work / Data Flow
Basic Data Provider
Rules of the Road

- Only the Data Provider really knows their own GIS data,
- Data Providers will continue to maintain their data in their own GIS systems,
- Changes to provider data, their business processes, or their systems will be kept to a minimum,
- Data Providers are encouraged to maintain connected road centerline data at their jurisdictional boundaries,
- Providers will submit their current GIS data on a regularly scheduled update cycle,
- WA-Trans processes are designed to support and facilitate continued improvement of data by the provider
New Provider/Changed Data Initiation Process

- Organization particulars and contacts?
- Is this the best source of GIS transportation data for this jurisdiction?
- What kind of data and in what form?
- Attribution characteristics, e.g. perpetual identifiers, LRS data, Address data?
- Is data maintained for other jurisdictions, e.g. cities?
- What is the LRS and/or Address data used for?
- What are the domains for the system lookup data?
- Relationship with other jurisdictions?
“Seamless, connected, consistent and continuous data between jurisdictions, boundaries and other framework layers”
With Agreement Points
WA-Trans Work / Data Flow

1. **Provider Data**
   - Provider logs into Data Provider Internet Portal
   - Provider Data is Transformed to WA-Trans

2. **Preparing Data for WA-Trans**
   - Detected Changes are Applied to WA-Trans
   - Agreement Points are Integrated
   - Different Linear Measures are Applied, Calibrated and Related
   - Combined Data is Checked for Quality

3. **Serving WA-Trans Data**
   - WA-Trans Complete Statewide Data
   - Data User Accesses WA-Trans Data User Internet Portal and selects data and format for download
   - WA-Trans data is transformed to the user selected output format
   - Data user is provided WA-Trans Data for use in a GIS or tabular database

**Washington State Department of Transportation**
Data Provider Portal Demonstration

Data Provider Application > Select Zip File To Upload

Place panel description here!

Organization Name: Franklin County
User Name: Michael Leierer leierem@wsdot.wa.gov
Transportation Mode: Road
Please Select Zip File to Upload: Browse...

< Back  Next >
WA-Trans Work / Data Flow

1. Provider Data
   - Provider logs into Data Provider Internet Portal
   - Provider Data is Transformed to WA-Trans
   - Data is Quality Checked
   - Data Changes Since the Last Upload Are Detected

2. Preparing Data for WA-Trans
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Washington State Department of Transportation
WA-Trans Translator Goals

- WA-Trans wants to minimize impact to data providers and data users while making the most usable product possible.

- The translator is a critical success factor, because it significantly minimizes or removes the need for data providers and users to change their data structures or business processes.

- The first time data is put into or taken out of WA-Trans will be time consuming. After that the goal is for it to be a very simple upload or download process.
Barriers to Translating Data
Read Source Data

Alter source data as necessary to meet standards of centralized database

Create attribution necessary for a centralized database

Map all source and created attributes to appropriate database attributes

Write changes to centralized SDE SQL Database

QA/QC
Pierce County Data after Translation to SDE SQL Database

Pierce County ESRI Coverage files
WA-Trans Work / Data Flow

Provider Data → Provider logs into Data Provider Internet Portal → Provider Data is Transformed to WA-Trans → Data is Quality Checked → Data Changes Since the Last Upload Are Detected

Detected Changes are Applied to WA-Trans → Agreement Points are Integrated → Different Linear Measures are Applied, Calibrated and Related → Combined Data is Checked for Quality

WA-Trans Complete Statewide Data → Data User Accesses WA-Trans Data User Internet Portal and selects data and format for download → WA-Trans data is transformed to the user selected output format → Data user is provided WA-Trans Data for use in a GIS or tabular database
Where does Change Detection start?

1. Data Provider Portal
   - Retrieve source data
   - Validate source data
   - Read Source Data

2. Alter source data as necessary to meet standards of centralized database
3. Create attribution necessary for a centralized database
4. Map all source and created attributes to appropriate database attributes
5. Write changes to centralized SDE SQL Database
6. Detect changes
7. QA/QC
Transform and Load Data -> Perform Initial QA/QC on Provider Records and Produce Report

- FME Process: Compare new Geometry with previous Geometry (stored in Staging) and Write ONLY changed records to staging

QA/QC Report To Data Providers

- SQL Process: Compare new Attribution with previous Attribution (stored in Staging) and Write ONLY changed records to staging

WA-Trans Loading Database -> WA-Trans Staging Database

Washington State Department of Transportation
The “Truth” of the data

- What do we really know about providers data?

- We need to be careful with our judgments of providers data,

- We will have to accept that we will have some bad data in production,

- With a reliable source, QA/QC reports and user feedback providers will possibly improve their data
WA-Trans Work / Data Flow
Provider Data and QA/QC Reports; Connectivity Report
WA-Trans Work / Data Flow

Provider Data → Provider logs into Data Provider Internet Portal → Provider Data is Transformed to WA-Trans → Data is Quality Checked

Data Changes Since the Last Upload are Detected

Preparing Data for WA-Trans

Detected Changes are Applied to WA-Trans → Agreement Points are Integrated → Different Linear Measures are Applied, Calibrated and Related → Combined Data is Checked for Quality

Serving WA-Trans Data

WA-Trans Complete Statewide Data → Data User Accesses WA-Trans Data User Internet Portal and selects data and format for download → WA-Trans data is transformed to the user selected output format → Data user is provided WA-Trans Data for use in a GIS or tabular database

Washington State Department of Transportation
Implementation of Agreement Points

Provider X’s New, Snapped Segment
Provider X’s Original Segment

Agreement Point

Provider Y’s New, Snapped Segment
Provider Y’s Original Segment
WA-Trans Work / Data Flow

Provider Data → Provider logs into Data Provider Internet Portal → Provider Data is Transformed to WA-Trans → Data is Quality Checked

Data Changes Since the Last Upload Are Detected

Different Linear Measures are Applied, Calibrated and Related

Prepared Data for WA-Trans

Detected Changes are Applied to WA-Trans

Agreement Points are Integrated

Combined Data is Checked for Quality

Preparing WA-Trans Data

WA-Trans Complete Statewide Data

WA-Trans data is transformed to the user selected output format

Data User is provided WA-Trans Data for use in a GIS or tabular database

WA-Trans data is accessed by Data User Internet Portal and selects data and format for download

Serving WA-Trans Data

Washington State Department of Transportation
Coincident Data (two examples)

1. Between jurisdictions there are coincident segments near the boundaries,
   a) We need to maintain attribution for both jurisdictions

2. Within a jurisdiction there may be multiple files with different geometries,
   a) One file may contain a centerline with LRS attribution,
   b) Another file may contain a centerline with Address Range attribution
   c) Centerlines will not be exactly the same as they are maintained by two separate offices
Coincident Segments at Boundaries

King County

Pierce County

County Boundary
Pierce County
King County

Washington State Department of Transportation
Coincident Segments within a jurisdiction
WA-Trans Work / Data Flow

Provider Data → Provider logs into Data Provider Internet Portal

Provider Data is Transformed to WA-Trans → Data is Quality Checked

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Serving WA-Trans Data

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Washington State Department of Transportation
WA-Trans Data User Portal
WA-Trans Work / Data Flow

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Preparing Data for WA-Trans

WA-Trans Complete Statewide Data → Data User Accesses WA-Trans Data User Internet Portal and selects data and format for download → WA-Trans data is transformed to the user selected output format → Data user is provided WA-Trans Data for use in a GIS or tabular database
Defined Output Datasets for Users

- WA-Trans contains Transportation Framework data, and is not a final ready to use transportation product,
- WA-Trans data contains and is structured to allow the creation of different user defined products,
- It is possible to create products specifically for a data user.

WA-Trans is currently focusing on several defined output datasets that include centerline data for:

1. Geocoding and E911 uses,
2. Planning and event location to include all available LRS attribution,
3. Specific business uses as WSDOT.
HPMS, Functional Class and WA-Trans – the connection

The benefit of representing the same data in WA-Trans as is used in FHWA reporting is two-fold.

- The Roadway needs reported to the US Congress, used to determine dollars available for Washington’s roads, are based on the most accurate data available as reported by local agencies to WA-Trans.

- Data carried in the HPMS-FC system is used to verify eligibility for the project funds and also for FHWA oversight. This use of HPMS-FC data, as represented in WA-Trans, will increase with HPMS 2010 reporting*.

* Increased HPMS 2010 reporting requirements include AADT for all Federal Aid roadways, a GIS of the Functional Classification System, and more extensive Pavement Data.
WA-Trans Data Progress and Plans
How To Get Involved

- TPF 5(108) – Software Tools for Sharing and Integrating GIS Data,
- “http://www.pooledfund.org”,
- Seeking 4 more partners (at least),
- We can also partner with other levels of government and private companies,
- Our goal is to having working prototypes in an Open GIS environment as a result as well as processes and other useful templates and information.
Links for more Information

Interview with V1 Magazine “WA-Trans Provides a Vision for Road Data Integration”

www.vector1media.com/dialogue/interview/wa%11trans-provides-a-vision-for-road-data-integration/
Transportation Pooled Fund: Software Tools for Sharing and Integrating GIS Data

http://www.pooledfund.org/projectdetails.asp?id=340&status=4

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www.wsdot.wa.gov/mapsdata/transframework/default.htm