Implementing ArcGIS for Pipeline Referencing (APR) using the Pipeline Open Data Standard (PODS)

European PUG - November, 2017, London, UK
Introduction and Outline

• Peter Veenstra
  • GIS Technologist – TRC
  • PODS Board of Directors Member
  • Chairperson of PODS Next Gen Committee
• Outline
  • PODS Association & NG Initiative Update
  • Initial Findings on Implementing PODS Next Gen using APR
  • Thoughts on Data Management
PODS Association

- Best Practice
- Proven, Open, Neutral
- Advocacy Services for Member Organizations
- Deep Industry Knowledge Base

The combined experience of our Working Group volunteers represents ~120 Years Combined Experience
2016/2017 – Status Update

▪ Key Deliverables
  – PODS Lite - 360 downloads and 1,043 views since April!
  – Next Gen
  – Operators Forum – A packed room & lively information exchange
  – PODS 6.1 – Available for member review October 2017

▪ Improved Communication and Visibility
  – Increased outreach to Members
  – Member Portal
  – More Events & Presentations
  – Streamlined Organizational Policies, Procedures and Tools
Status Report

January 2017
PODS Lite Geodatabase (APR)

August 2017
PODS Lite for RDBMS
Test Plans for RDBMS and Geodatabase

October 2017
PODS Lite Member Review

Q3/4 2017
Updated Documentation
• Physical Model
• Logical Model
• Data Dictionary
• Design Principals
• Model Overview

Q4 2017
Working Groups
• History
• ILI\Offline Inspection Storage

Q4 2017
New PODS Member Portal

- Register for Events
- Download PODS Data Models
- Interact with other PODS Members
- Engage with PODS Volunteers

“PODS Models Technical Information Exchange” in Community Forums – discussion/input

- Next Gen Modules: Integrity/ILI; US Regulatory; Cathodic Protection/Inspection (CIS); Physical Inspections; Risk
What is PODS Next Generation (NG)?

- Re-engineered PODS data model
  - Streamline the core elements
  - Improved Data Model Documentation
  - Improved Data Model Specifications
  - Improved Data Model Performance
  - Interoperability

- Location Model
  - Linear Referencing and/or
    - Coordinate-only location model
  - Network Model

- Modules (eg. New Construction)
  - ILI Modules
  - Module Reference Data (Look up and conditional domains)

- Implementation Patterns (Spatial, Relational, Hybrid, Geodatabase)
  - RDBMS Spatial Data Types: Oracle Spatial
  - SQL Server Spatial
  - ESRI Geodatabase Native Data Format
  - Open Source: PostGRES/PostGIS data format
  - Relational
    - RDBMS Spatial Data Types: Oracle Spatial
    - SQL Server Spatial

- New to Next Generation of PODS Standards

- Business Intelligence
  - Conceptual Data Model
  - Logical Data Model
  - Data Dictionary
  - Governance (Model Use, Editing Standards, Data Content Specifications)

- Reference Modes
  - Continuous (2D/3D)
  - Interrupted (2D/3D)
  - Referent Point and Offset (MilePost)
  - XYZ

- Software
  - ShapeChange
  - Enterprise Architect
  - Module Validator

- Best Practices
  - Schema/Module Specification, Definition, Creation and Validation
  - Application Specification, Creation and Validation
  - Managing History, Work Orders, Documents, Re-routes and Activities
  - Feature/Condition Provenance
  - Managing Metadata

- Module Management
  - Data Exchange

- New to Next Generation of PODS Standards

- Offline Storage
- Big Data Support

- History
  - Definitions and Explanations
PODS Lite

- Free for use by all from [www.pods.org](http://www.pods.org)
  - 360 downloads and 1,043 views since April
  - Subset of the full data model (Next Gen Core)
  - Designed to provide look-and-feel for testing and evaluation purposes
  - Sufficient content to allow North American operators to test loading and generating annual regulatory NPMS reports

- Preview of PODS 7.0 Core (Next Gen)

- Preview of Location Model design
  - Moving location information to event tables
  - Supporting both Linear Referencing and Coordinate-based location and management (or neither, if desired)
NG Modeling Approach: Two Tools

1. Enterprise Architect (with GML and ArcGIS Extensions)
   Creates a GML Logical model (one model to rule them all)

2. ShapeChange
   Generates Physical Models
   - SQL DDL: Oracle, SQL Server, PostgreSQL with and without spatial types
   - Geodatabase: ArcGIS EA model and then from there to Workspace XML
   - DES: GML 3.2/3.3 + Schematron
Data Exchange Specification (DES)

- Three XML Files: Schema Definition/Rules; Data; Schema Mapping File
- Used as a transfer file format between databases and software systems
- Will be a standard schema, with consistent attribute names and datatypes
- ‘Transfers’ data between systems – becomes a ‘PODS Standard Data Format’
- Why XML?
  - Industry Standard File Format
  - Used for data exchanged and is ‘extensible’
  - Has built in schema and content validation protocols
  - Machine and human-readable
  - Structured, consistent and defensible
DES Generation Process

PODS Logical Model

READ

ShapeChange

GENERATE

PODS Data Exchange Mapping (.csv)

PODS Data Exchange Schema (.xsd)

USE

USE

Exchange Creation (Export) Tool

USE

PODS Compliant Database/Geodatabase/System

SELECTED

Generation

Data Exchange XML Document (.xml)
DES: Mapping Process Source to Target

PODS 6.0 or earlier data model

Relational

Logical Model

Next Gen

PODS Next Gen Data Model (GDB or Relational)

DES Schema (xml)

DES Schema Validation (xsd)

DES Mapping File (txt)

DES (Data) (xml)
DES Transfer Process

PODS Database / Geodatabase / System (any version)

PODS Data Exchange Mapping (.csv)
PODS Data Exchange Schema (.xsd)

USE
USE

Exchange Creation (Export) Tool

Data Exchange XML Document (.xml)

USE
USE

Import Tool

PODS Next Gen Compliant Database / Geodatabase
Future - Modules

- ‘Added’ on to PODS Core
- Contain tables, attributes, relationships and domains describing a particular topic.
- Provide operators the option of what they want to include in their module beyond the core
- Depend solely on the core
- Can be developed by operators but there will be official PODS Modules available from the PODS website
- Priority ranked by the TCDM, NG, and TCG teams
FAQ: PODS Lite

What is the difference between PODS Lite and PODS Core?

<table>
<thead>
<tr>
<th>PODS Lite</th>
<th>PODS CORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>First glimpse at Next Generation PODS - released for testing and R&amp;D and to provide a flavor of the Core</td>
<td>PODS Lite + additional tables = Next Generation PODS Core</td>
</tr>
<tr>
<td>All the tables in PODS Lite are part of PODS CORE</td>
<td>An expanded set of tables, attributes, domains and relationships that builds on the PODS Lite offering</td>
</tr>
<tr>
<td>The Basis of PODS CORE</td>
<td>Contains ALL of PODS LITE plus more</td>
</tr>
<tr>
<td>FREE!</td>
<td>Requires current PODS Membership to access and use</td>
</tr>
</tbody>
</table>
FAQ: Terms

The one thing that confuses me is the terms – PODS Next Generation, PODS Lite, PODS CORE, PODS 7.0 Model – Help!

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next Generation</td>
<td>the initiative to transform the data model</td>
</tr>
<tr>
<td>PODS Lite</td>
<td>the first release, as a POC and to support APR (strategic)</td>
</tr>
<tr>
<td>PODS CORE</td>
<td>the basis of all future PODS model work and is the initial release of the PODS 7.0 Model</td>
</tr>
<tr>
<td>PODS 7.0 Model</td>
<td>the CORE tables, the Data Exchange Specification and any additional tables that are developed in future, to be determined and yet to be released MODULES</td>
</tr>
</tbody>
</table>

The reason for these different terms is because data models and supporting documentation aren’t created instantly – we needed to move forward and show progress.
FAQ: Do I need ESRI APR?

Do I need ESRI APR to use PODS Lite or PODS 7.0

– No

– PODS Lite and the core of PODS 7.0 utilize the same table structure for managing centerlines and linear referenced networks as ESRI APR but they do not require ESRI APR to function

– PODS Service Providers and operators can develop their own processes, routines and software for managing data in PODS 7.0 format if they choose.
FAQ: How does this align with ESRI APR?

- Implements ESRI ArcGIS for Pipeline Referencing (APR) core for management of linear referenced network route systems

- This does not mean that PODS Next Gen will only work with APR. It does mean that APR can be easily implemented with a PODS Next Gen data model.

- APR can work with any data model – not just Esri’s UPDM – as long as the data model meets certain minimal requirements.

- PODS Next Gen data model will meet those requirements.

- PODS Association Members can therefore use APR to manage information in a ESRI Geodatabase.
Location Model

Schema for route centerline management

**Routes (Network)**
Route features

**Centerline Sequence**
Key table for M-N relationship between Centerline and Route

**Calibration Points**
Point feature class that stores route measures

**Centerline**
Line feature class that stores route geometry

Separate feature class for each LRM

...with support for Engineering Stationing
What is ArcGIS for Pipeline Referencing (APR)

- ESRI Software Product

- Schema and Data Structure within Geodatabase
  - Networks and events are stored as ‘features’

- Tools for managing networks using coordinate position or linear referenced position
  - Software manages LRS location

- A location service bus for locating things on or along a network

- Resources for further learning (ESRI/PODS Websites)
Implementing APR with PODS Next Gen

- Working with two clients implementing APR (one on UPDM, one on PODS Lite)
  - One purely transmission (tons of ILI data)
  - One mixture of gathering and transmission
  - Data modeling and mapping exercise
    - Utilized PODS Lite and extended the schema to match existing data model (ahead of the curve of PODS for releasing modules)

- PODS Lite installer builds the required schema
  - PODS Lite was missing a PipelineName (had PipelineID)

- APR Provides multiple network support – continuous, engineering
  - Implemented everything on engineering network and allow ESRI to add derived network attributes
  - Decision on what network to utilize for locating events on
APR Software Components

- APR 10.5 (ArcGIS Pro 1.1+, ArcGIS Desktop/Server 10.5)

- Utilizes ArcGIS Desktop, Arc PRO and ArcGIS Server
  - ESRI wants users to utilize ArcPRO
  - ArcPRO offers full support for GUID datatype (for primary keys)
  - Some tools are still in ArcGIS Desktop (don’t support GUIDS)
    - Loading Routes
    - Being able to configure LRS events for derived networks
  - Python script to configure LRS networks and event responses (Configuration is 100% scriptable)
  - All tools need to be moved to ArcPRO
Event Configuration

- “Retire” in APR may not be the same as a RETIRE in pipeline terminology
  - Use Case – Want to cut out or isolate all events between KP 2.5 and 5.0
    - APR will not cut or split these events, needs to be performed manually before-hand
    - OTHERWISE ...
  - Any linear event spanning or crossing over or passing-thru this section will be retired
- “Stay-Put” – may not be the same as in APDM/PODS data models
  - CLEditResponse=Relative or Absolute
  - The geometry may change it’s position during a re-route (or measure update) but the measure stay’s put
  - Change the work flow from ‘edit route to update events’ to ‘update events and then edit route’
If you utilize existing schema to configure the ALRS network ensure that the data and the spatial resolution and tolerance are congruous.

Required some testing and configuration trial-and-error to ensure that the existing schema was supported for the data being loaded into the create the LRS network features.
Event Editor Extension

- Web-based server technology used for editing event information
- Metadata Attributes
  - Utilize the geodatabase editor extension tool to update CreatedBy/ModifiedBy data
  - PODS Lite offers more pipeline specific metadata attributes than core APR, so these must be updated manually (not performed out of the box by APR tools)
- Understanding web-based feature layers, feature services and map services through the PORTAL interface for managing editing permissions important
  - Event editor and map service creates a lock on the geodatabase
- Understand how the ESRI time-slicing attributes works
  - Splitting a pipe segment creates two segments, one which maintains the original PK attribute
Opportunity for Training and Customization

- Documentation of Workflows
- Customization of APR to make it more ‘pipeline specific’ in terms of functionality
Concluding Thoughts

- Value of PODS Association and PODS Data Model
  - System of Record for Location of Assets
- Pipeline Data Management
  - Integrate data at the query/publication layer
    - Integrate systems by ID, Coordinate, Tag, Keywords
    - Let systems do what they do well
    - Let users build data the way they know how
- Offer a consistent technology platform for integration
- Cradle to grave digital mind-set
Questions?

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Our Mission
We understand our clients’ goals and embrace them as our own, applying creativity, experience, integrity and dedication to deliver superior solutions to the world’s energy, environment and infrastructure challenges.

Our Vision
We will solve the challenges of making the Earth a better place to live – community by community and project by project.
Our Values

We commit to these values to guide our decisions and our behaviors:

**Safety:** We create a working environment that promotes safe performance.

**Quality:** We always strive for excellence in the services we provide and in the results we produce for our clients.

**Integrity:** We are committed to the highest ethical standards.

**Creativity:** We believe in looking at challenges and opportunities from new angles and in exercising our curiosity.

**Accountability:** We take responsibility for all of our decisions and actions.

**Teamwork:** We work together to succeed.

**Passion:** We deliver superior results because we care deeply about what we do.