Utility Network Management in ArcGIS: Migrating Your Data to the Utility Network

John Alsup & John Long
Presentation Outline

• Utility Network Preparation
  - Migration Patterns
  - Understanding the Asset Package
  - Preparing Source Data
  - Staging a Utility Network
  - Asset Package Modeling

• Migration Process
  - Strategies
  - Tools
  - Process
  - Annotation

• Post Processing
  - Controllers
  - Associations
  - Topology
  - Errors
Utility Network Preparation

John Alsup
Pre-Migration: Determine a Migration Pattern

- **Where are you going and do you have the data to support getting there?**
  - **Simple** – data migrated in its current form from the geometric network
  - **Basic** – model Esri will provide, includes modeling and representing the real world to support better analytics within and outside the GIS.
  - **Advanced** – a step beyond basic to support planning, design and extended modeling within the GIS.
Pre-Migration: Gain Understanding

• Understand the Target Asset Package
  - Asset Groups / Asset Types
  - Assembly / Device
  - Rules
  - Associations
  - Containment

• Understand the Source Data
  - Feature Classes
  - Domains
  - Subtypes
  - Attributes
  - Annotation Classes
  - Relationship Classes
Pre-Migration: Asset Package

• Asset Package – What is it
  - Data Schema
    - Feature Classes
    - Asset Groups / Asset Types
    - Domains
    - Attributes
  - Rules
  - Associations

• Asset Packages - Released
  - Water Distribution
  - Sewer
  - Stormwater
  - Wastewater
  - Gas Transmission & Distribution
  - Electric Transmission & Distribution
Pre-Migration: Source Data Preparation

- **Inventory Source Data**
- **Data Reviewer**
  - Quality Checks
- **Clean Source Data**
  - Resolve Data Inconsistencies
  - Resolve Poor Data Integrity
  - Service Territory
    - Assets completely contained
  - Station boundaries
    - Devices completely contained

### Basic Integrity
- **Attributes**
  - Null Values (existing required fields)
  - Relationship Class
  - Unique ID
  - Subtype Checks
  - Domain Check
  - Geometry
    - Invalid Geometry
    - Multipart Geometry
    - Short Segments
    - Self-Intersecting Lines

### Spatial Integrity
- **Geometry**
  - Duplicate Lines & Devices
  - Overlapping Lines
  - Disconnected Lines & Devices
  - Features outside service area

### Tracing Integrity
- **Connectivity**
  -Disconnected Lines & Devices
  - Missing Devices
    - Transformer
    - Regulator
    - Pumps
Pre-Migration: Source Data Preparation

• **Attribute checks**
  - Null – key attributes
    - Example: phase
  - Relationship class – may be used to create detailed features
    - Example: fuses – one device per unit record
  - Unique ID – links to external systems
  - Subtype – ensure valid subtypes
  - Domain – ensure valid domains

• **Geometry checks**
  - Invalid Geometry

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**Basic Integrity**

- **Attributes**
  - Null Values (existing required fields)
  - Relationship Class
  - Unique ID
  - Subtype Checks
  - Domain Check

- **Geometry**
  - Invalid Geometry
  - Multipart Geometry
  - Short Segments
  - Self Intersecting Lines
Pre-Migration: Source Data Preparation

• **Duplicate Lines and Devices**
  - Duplicate lines – lines stacked on top of each other
  - Duplicate devices – junctions stacked on top of each other
  - Overlapping lines – lines that partially overlap

• **Disconnected Lines and Devices**
  - Line not snapped to another line
  - Line not snapped to junction
  - Junction not snapped to a line

• **Features Outside Service Area**
Pre-Migration: Source Data Preparation

- **Tracing Integrity**
  - Disconnected lines and devices
  - Missing devices
    - Transitions between lines with no junction
      - Overhead conductor to underground
      - Pipe type (steel to plastic)
      - Conductor or pipe size
  - Connectivity
    - Disconnected Lines & Devices
    - Missing Devices
      - Transformer
      - Regulator
      - Pumps
Pre-Migration: Asset Package

• Schema
  - Feature Dataset – “UtilityNetwork”
    - Contains classes that match your utility network
    - Can easily add attributes and domains
  - Contains Tables That Define Your Utility Network
    - Manual modification not recommended
  - Asset Groups and Asset Types
    - Can add in asset package
    - Requires utility network modifications that should be performed in a utility network
  - Rules & Associations
    - Rules are model specific
    - Associations are data specific
Pre-Migration: Utility Network Staging

- **Create a Utility Network**
- **Load Industry Asset Package to the Utility Network**
  - Do Not Version Yet
- **Perform General Utility Network Modifications**
  - Add Terminal Configurations
  - Add Network Categories
  - Add Domain Networks (if needed)
- **Update Domain Network**
  - Add Asset Groups (if necessary)
  - Add Asset Types by Modifying Asset Type Domains
  - Assign Terminal Configurations
  - Add Attributes (if required)
    - Integer domains Perform Faster than Text Fields
    - Avoided Large Text Fields (when possible)
Pre-Migration: Utility Network

- Export Utility Network to Asset Package
- Load Test Data
- Create a Utility Network
- Load Industry Asset Package to Utility Network (this time loading data)
  - Do Not Version Yet
  - Enable Topology (limit errors to less than 10,000 or fewer)
  - Review Errors
Migration Process

John Long
Utility Network Migration Tools Overview

• Data Interoperability Workspace Templates
  - Standardized Workspaces
    - Configurable with Schema Mapping
      - Source / Target Spreadsheet
  - Extendable
  - Target: Published Esri Asset Package
    - Water and Gas – No Advanced Transformations
    - Electric – Advanced Transformation
      - Assembly Builder

• Business Partner Migration Solutions
What’s Needed

• Utility Network Solution Deployment Tools
• Domain Specific Asset Package(s)
• Source Data (Pre-cleansed)
• ArcGIS Data Interoperability Extension
  - Water & Gas
    - ArcGIS Pro 2.1 and Above
    - Safe Software FME 2017.1.1.0 Build 17650 and Above
  - Electric
    - ArcGIS Pro 2.2 and Above
    - Safe Software FME 2018.0.1.0 and Above
• Domain Specific Migration Workspace Template(s)
Migration Process Overview

ArcGIS Data Interoperability Extension

Geometric Network Geodatabase

Source / Target Schema Mapping
- Asset Group / Asset Type
- Attributes
- Domains

Update Reader & Writer
- Point to Source Data
- Updated Asset Package
- Connect Translators

Migrated Asset Package & QA/QC
- Staging Database
- Validation Python Script

Domain Specific Asset Package

Load

Utility Network

Utility Network Migration Tools
Input Parameters

- **Source Features**
  - Existing Geodatabase

- **Schema Mapper File (Microsoft Excel)**
  - Asset Group / Asset Type Mapping
  - Attribute Mapping
  - Domain Mapping

- **Assembly Builder – For Basic and Advanced Representations Only**
  - XML

- **Asset Package**
General Configuration

• Reader Update
  - Import Feature Types from Source Geodatabase
    - Change Source Dataset_GEODATABASE_FILE Parameters to Source Geodatabase
    - Readers – Import / Update Feature Types

• Update Schema Mapper
  - Asset Groups / Asset Types
  - Domains and Subtypes
  - Attributes

• Modify Data Interoperability Workspace (if required)
  - Single Source to Multiple Targets
  - New Associations
  - Asset Package Changes
  - Data Specific Logic Changes / Enhancements
General Configuration - Continued

- **Update Assembly XML** – Basic or Advanced Only
- **Prepare Asset Package**
  - Change Spatial Reference of an Asset Package Tool
    - Update Projection to Source Data Projection
    - Export “Empty” Staging Asset Package
- **Update Asset Package**
  - Utility Specific Attributes
  - Asset Groups / Asset Types
  - Domains
- **Update Writer**
  - Update Workspace with Your Staging Asset Package
Data Mapping

- Asset Group / Asset Type Assignment
- Domain Look-up
  - Domains
  - Subtypes
- Attribute Mapping
  - “Set it to {Default Value}”
- Configuration Tables
  - Terminal Look-up
  - Line to Junction Mapping
Update Source Features

- Readers Menu > Import Feature Types
  - Define Source Dataset
  - Select the Feature Types that will be Migrated
- Features Not Named the Same as the Template
  - New Feature Types Added
- Disable or Disconnect Source Features that are Not Applicable
- Connect Unconnected Source Features to Appropriate Connection
- Reposition Source Features to the Appropriate Bookmark
  - Aesthetics and Workspace Readability
Assembly Builder

- XML File for Defining Assemblies
  - User Interface for Defining Assemblies XML – Future Release
- Addresses Composition of Individual Devices within an Assembly
- Addresses Location of Individual Devices within an Assembly
  - Relative Location of Assembly Insertion Point (0,0)
  - Device Arrangement from Left to Right
- Each Device in the Assembly is Created from Source Data
  - ArcGIS Feature = Assembly
  - Unit Records = Devices(s)
  - XML Record = Newly Defined Device(s)
- Terminals & Associations Defined in Tags
- Phase Expansion Tag
  - Expand for the Number of Phases on the Assembly
  - Extract Additional Attributes from Unit Table
Results

- **Asset Package – File Geodatabase**
  - Feature Classes
  - C_Associations Table
- **Error Report**
  - Redlined File Geodatabase
    - Feature Classes (Point, Line, Polygon)
    - Subtype
    - Global ID
    - Error Message
  - Error Spreadsheet
Annotation Migration

• Utility Network Best Practice
  - One Feature Linked Annotation Feature Class per Utility Network Feature Class
  - Multiple Annotation Classes within the Annotation Feature Class
  - Consolidate Non-Feature Linked Annotation Feature Classes Also
Annotation Migration Setup

- Delete Relationship Class Between Annotation and Source Feature
- Create Source Preservation Fields
  - Annotation Class
    - Source Feature Class Name
    - Original FeatureID
  - Feature Class
    - Source Feature Class Name
    - Original ObjectID
- Calculate Values Accordingly
  - Field Calculator
  - Data Management \ Calculate Field - Geoprocessing Tool
Annotation Consolidation

- **Merge Annotation Feature Classes into Target Single Annotation Feature Class**
  - Geoprocessing Tool
    - Data Management Tools / Append Annotation Feature Class
  - Note: Target Appended Annotation Class Must Reside in Same Workspace as the Original Source Annotation Feature Classes
- **Copy Merged Annotation Feature Class(es) to Staging Asset Package**
- **Join the Merged Annotation Feature Class(es) with Your Staging Asset Package (Where You Migrated Your Data)**
  - Use Preserved IDs and Source Feature Class Names
- **Calculate the New Object ID from the Base Feature Class to the Annotation Feature Class**
- **Re-establish the Relationship Class(es)**
- **Edit the Query of Each Annotation Subclass**
  - Extend Clause to Only Refer to the Subtype of the Base Features They Apply To
Annotation – ArcGIS Pro Upgrade

- Bring Annotation Feature Classes into ArcGIS Pro
- Upgrade Annotation Feature Classes Using “Upgrade Dataset” Tool
  - Once Annotation is Upgraded it is No Longer Useable in ArcMap
- Add Global IDs to the Annotation Feature Classes if they Do Not Exist
  - Geoprocessing Tool – “Add Global IDs”
- Migrate Relationship Class to ArcGIS Pro
  - Geoprocessing Tool – “Migrate Relationship Class”
  - Migrates from Object ID Based Relationship to Global ID Based Relationship
Utility Network Post Process

John Alsup
Post Processing

- Build controller input file
- Build associations input file(s), if not done by workbench
- Enable network topology
- Review errors if any
- Address errors
Post Processing

• Build controller input file
  - Built from device features that will be used to provide the
    - Subnetwork name
    - Any propagated information, like pressure, system, isolation zone, phase
Post Processing

• Build associations input file(s), if not done by workbench
  - Used for structures and explicit connectivity and containment
  - Items that do not “spatially connect”
  - Can use “proximity” searches to build
Post Processing

• Enable network topology
  - Provides list of errors encountered during topology validation
  - Limit to a reasonable number of errors, default is 10,000
Post Processing

- Review errors if any
  - Look for common themes
  - Build a GP tool to search for these common themes
    - Examples
      - Stacked features – use GP Tools find duplicate (in same class) and spatial select (different classes)
      - Invalid connectivity (features cannot spatially connect), use GP Tools Intersect
Post Processing

• Address errors
  - After identifying how to find them in larger datasets
    - GP Tools to delete, move or change asset group/asset type
    - Python code to move end points of lines, when necessary
Errors

• Schema
  - Wrong Data Type
  - Get Subtype Group Failed

• Data Integrity
  - Empty Geometry
  - Subtype Unknown

• Connectivity
  - Network Point Feature Not Connected
  - No Junction-Edge Rule
  - Multiple Junction-Edge Rules
  - Two Linear Features with Different Asset Groups Connected without a Rule
  - Linear Network Feature with Endpoint and Nothing Connected
  - More Than Two Lines Connected to a Point in Edge-Junction-Edge Connectivity
  - Two or More Points are Geometrically Coincident
Resources

- Esri Utility Network Configuration and Migration Tool Status
- Water Utility Network Migration Tools Preview
- Gas Utility Network Migration Tools Preview

- Business Partner Solutions
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<td>• Wednesday 2:30 – 4:30pm</td>
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<td>- John Alsup</td>
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<td>• Esri Showcase – Utility Industry Island</td>
<td>• Wednesday 2:30 – 6:00pm</td>
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<td>- John Long</td>
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