Insight into the Utility Network

Erik Hoel and Tom Brown

March 13, 2018
Utility network

New network framework to support utility and telco solutions

Vision:

• Provide utility customers with the ability to model, edit, and analyze complex networks of facility infrastructure using all Esri platform clients

• Enable key modeling concepts to better support a true representation of what is on the ground, while fostering an easy exchange of network information with other mission critical systems
Utility network project

Key differentiators

- Cross platform support
- Services based architecture
- Updated network model
  - Connectivity associations
  - Containment associations
  - Structural attachments
  - Multiple terminals
  - Expanded tracing framework
  - Built in support for network diagrams
  - Validation framework
  - Basic source management
  - Export capabilities

- Updated transaction model
  - Based on change tracking model
  - More flexible, less overhead

- Attribute rule framework
  - Cross platform scripting capabilities
  - Scripts execute as features are updated

- Enhanced editing experience
  - Expanded feature template model
  - Snapping based on connectivity rules

- Composite map and subtype layers
- Central storage of maps and projects
Utility network
Building a better framework

- Improved framework from Esri makes for a better overall solution for your organization
Utility network

One or more domain networks

- Conceptually, the utility network is composed of a structure network and one or more domain networks
  - Each domain has a collection of networks (e.g., in electric domain: transmission, distribution, and structural; the gas and water domains could also include cathodic protection)
  - An organization determines which of the networks is relevant for their business (e.g., some will not manage or maintain transmission, only distribution, or vice versa)
Demo

Utility network model
Connectivity associations

• Utility networks support connectivity based on x, y, and z coincidence
  - In addition, non-coincident features can also be connected

• Connectivity associations are used to model connectivity between two devices that are not necessarily geometrically coincident

• Connectivity associations are defined between two point features or between a line end and a terminal
  • Connectivity rules limit what can be connected
Containment associations

- Containment is used to model the association between devices and structures where the device is “contained” in the structure
  - E.g., a valve inside a pump station
- Only structures and assemblies can be containers
  - Devices cannot be containers, only content
  - Devices that are containers defined in data model
- Structures and assemblies can also be content
  - Lots of things can reside in a pump station or substation
- Containment associations can be supported on point, line, and polygon features
Structural attachment associations

- Structural attachment associations are used to model the associations between devices and above ground structures where the device is “attached” to the structure
  - e.g., a transformer on a power pole
  - Allows users to report all structures associated with a subnetwork
- Structural attachment capabilities are specified at the asset type level
  - An asset type can only support either structural attachments or containment; it cannot support both
  - Structural attachment rules are used to constrain what may be attached to what
Terminals

- A terminal represents a connection point on a device
- Terminals support more realistic modeling of devices
  - Important for CIM as well as sophisticated analytics without data extraction
- Terminals are defined for certain devices; not all devices need to support terminals
  - Devices that serve as subnetwork controllers (sources or sinks)
  - Devices that require a high and low side for analytic purposes (e.g., transformers)
  - Devices whose traversal is asymmetric (e.g., network protector or a check valve)
  - Devices that require valences larger than two
Terminals

- Bypass switches are used to either energize or de-energize a Device.
- When the Device is de-energized, it can safely be serviced or removed.
- Valid paths (enabled edges):
  - normal: edge 2, edge 5
  - bypass: edge 1
- Domains are used to constrain valid paths.
Terminals

Complex valves - dual flow 4 port diverter

• Another complex example from the water network domain

• With a dual flow 4 port diverter valve, A can be connected to B in parallel with C to D, or A can be connected to D in parallel with B to C

• Valid paths (enabled edges):
  - AB-CD: edge 1, edge 6
  - AD-BC: edge 3, edge 5
Subnetwork management

- Subnetworks are connected subportions of the network that are used for:
  - Driving analysis operations
  - Labeling/annotation, map making
  - Assigning units of work
  - Visualization (circuit map)
  - Exporting portions of the network

- Subnetworks correspond to circuits in electric, and pressure zone in gas or water
  - Structure networks do not have subnetworks
Demo

Subnetwork management
Tracing

- Tracing is exposed in Pro as commands, as a GP tool, through the managed SDK, and as REST endpoints in the Utility Network Analyst service.
  - Pro will come with basic preconfigured tools in the gallery.
  - Business Partners and users can modify the gallery, adding and removing preconfigured tools.
Network diagrams

• Integrated mechanism for utility network users to work with diagrams

• Comes with pre-configured schematic diagramming capabilities

• Default diagramming capabilities can be expanded to create simplified/enriched diagrams
Network diagrams

• Comes with a collection of layout algorithms to lay out diagrams content

• Users can control diagram persistence

• Diagram owners can control access rights on persisted diagrams

• Partners extend with custom layout routines
Demo

Analysis and diagrams
Validation of network topology

• Validation of data in the utility network is similar to topology validation

• The utility network information model will facilitate the specification of connectivity, containment, and attachment rules as part of the data model

• When features violate the specified rules, error features are created

• The user experience for discovery and inspection of errors is similar to ArcGIS Topology
  • Errors will be persisted in system maintained error tables at the workspace level
  • These error tables will be shared across the system
Transaction model

- Uses a new versioning model implementation
  - User experience is the same as with the current versioning model

- Three primary workflows will be supported:
  - High isolation (long transactions) when connected through Feature Service
  -Disconnected local editing (ArcGIS Pro or Runtime based apps) using Feature Services and Sync
  - Short transaction connected to the Feature and Utility Analyst services

- Benefits of the new versioning model:
  - No need to reconcile/compress nightly
  - Performance - well performing and scalable database queries
  - Temporal properties - history capabilities built-in, parallel posting, and future support for partial posting
Attribute rules

- Configurable Attribute Rules will be exposed for the purpose of automatically populating field values for features
  - E.g., \([\text{fieldA}] = [\text{fieldB}] + "::" + [\text{fieldC}]\)

- Cross platform scripting language ensures updates applied regardless of where edit performed (desktop, mobile, web)

- Attribute rule types:
  - **Calculation rules** – expressions that are used to populate attributes based upon other attributes on a single feature or other related feature
  - **Constraint rules** – expressions that specify permissible attribute configurations on a feature; when the constraint is violated, an error is raised when storing the feature
Editing

- Snapping based on defined connectivity rules
- Preset Template option for repeatable configurations
  - Automatic defining of containment, connectivity, and structural attachment associations during feature creation
- Storage of feature templates in the data source (e.g., the Geodatabase catalog)
  - Storage of template’s definition (Group and Preset)
  - Storage of access requirements across the platform
Service-based architecture

- Extensions to existing services:
  - Feature Service

- New services:
  - Utility Network Service
  - Network Diagram Service
  - Version Management Service
Network management

Partners continue to complete the solution

• Partners continue to extend and complete the solution
  • Partner solutions deliver: Design, Analytics, Analysis, Integration, Productivity, etc.

• Solution can be extended in different ways
  • Configurations, custom tools (desktop), services (including interceptors), custom applications (mobile and web), etc.
Network management

Moving to the utility network

• Partners continue to play key role in completing solution and assisting users in moving forward
• Esri provided data models
• Sample geoprocessing models and scripts to load your data
Continuing the growth of the platform

Device
- View, Query
- Simple Design/Inspections
- Tracing

Desktop
- Design, Maintenance
- Analysis, Modeling
- Map Authoring

Enterprise
- Utility Network
- Transaction Model
- Editing Tools
- Attribute Rules

Web
- Simple Editing, QA/QC
- Tracing
- Executive Dashboards

Server
- Online Content and Services
Utility network

Building a better framework

- Improved framework from Esri makes for a better overall solution for your organization
Please provide your feedback