# Discovering Network Diagrams and their Configurations

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*2021 ESRI*
*DEVELOPER SUMMIT*

# Topics

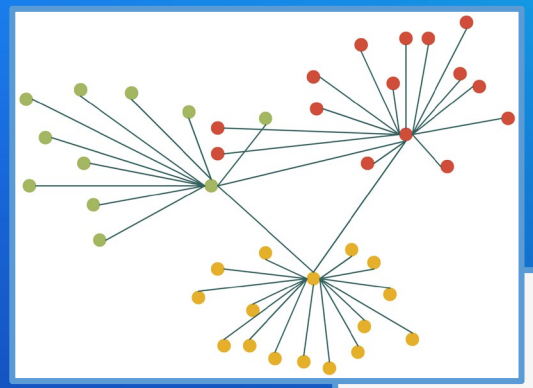
- Introduction
- Diagram Features and Diagram Layer
- Diagram Rules, Layouts and Templates
- Diagram Template Configurations
- Network Diagrams APIs
- Network Diagrams Benefits

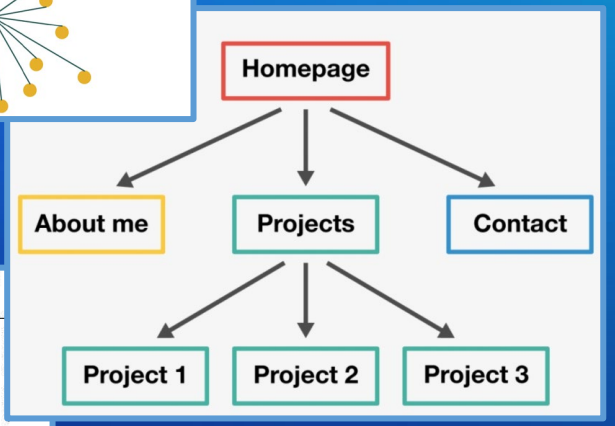
# Introduction

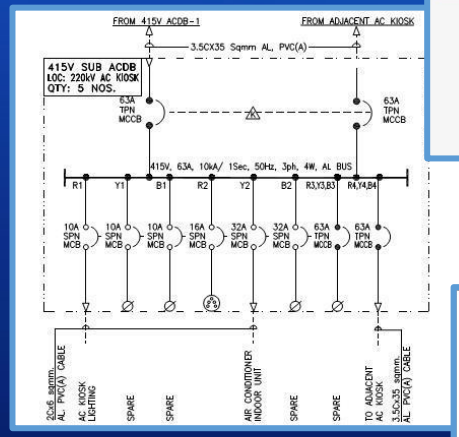
# What is a diagram?

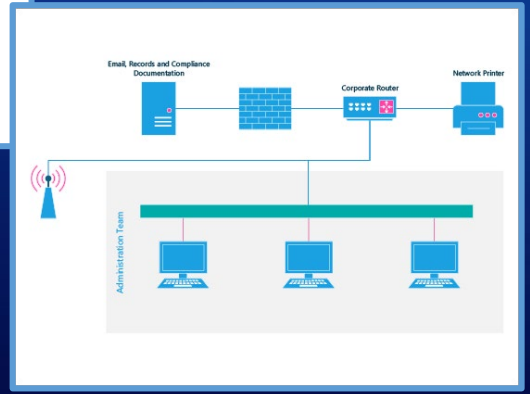
- A symbolic and simplified way to represent the components of a process, devices, or other objects.

- Representation of the data in different layouts
  - Grid Layout, Tree Form, etc.





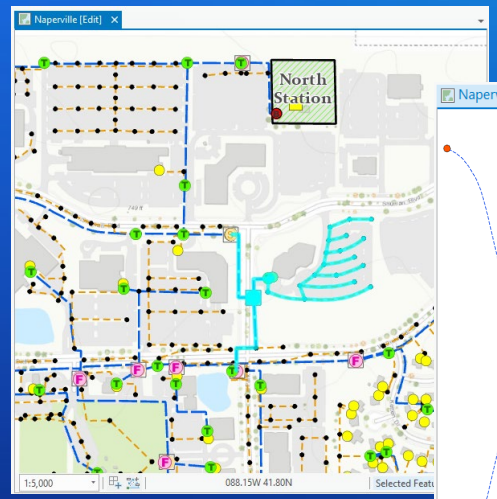



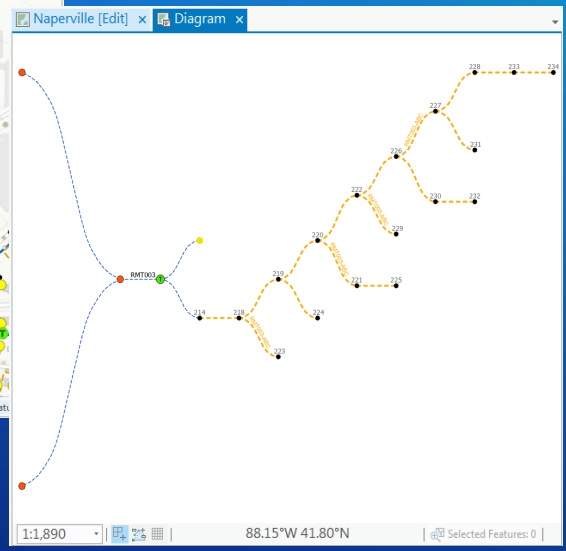
# About Network Diagrams

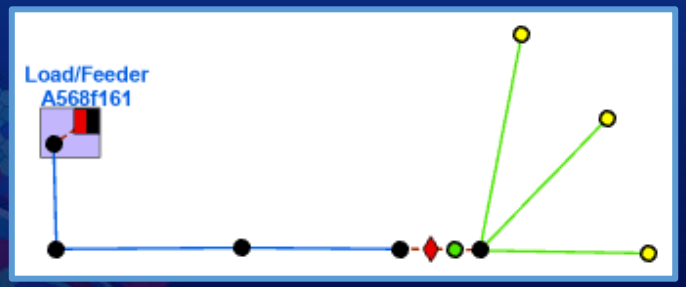
- Allows users to easily create simplified views of the network
- Available as part of the Utility Network and Trace Network
- Consumes the network topology

**Network map**

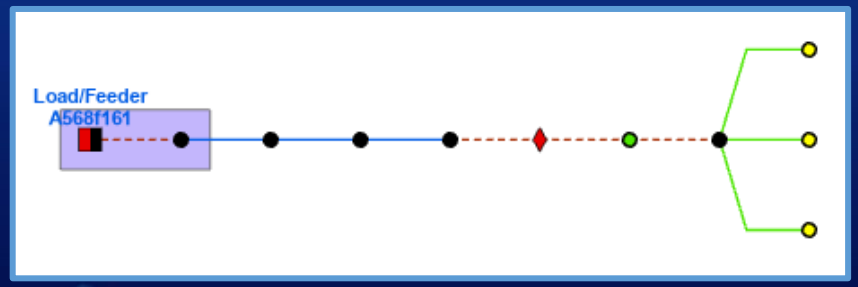



**Schematic view**

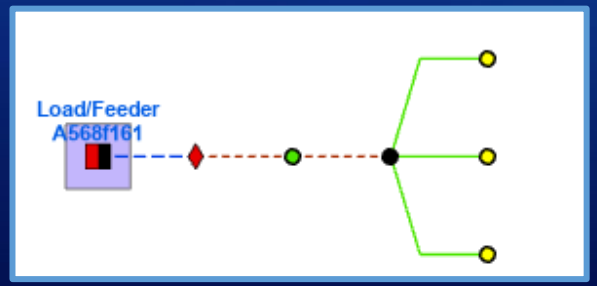



**Geo-Schematic view**



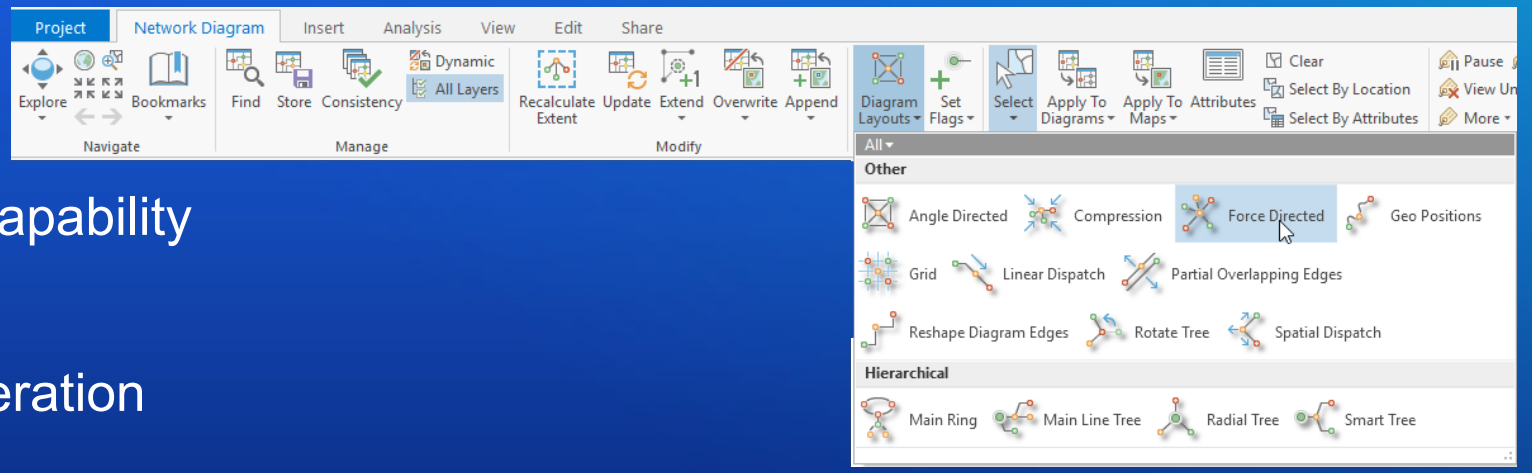

**Tree view**

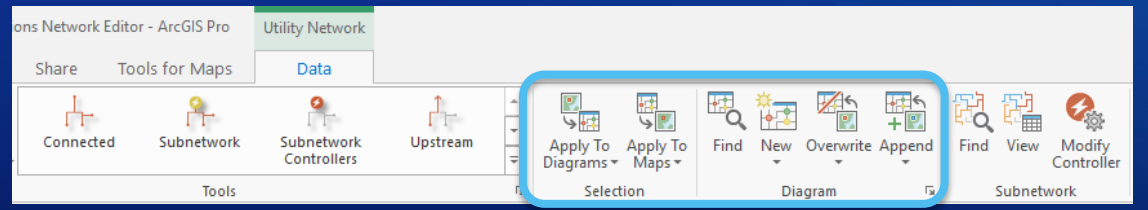


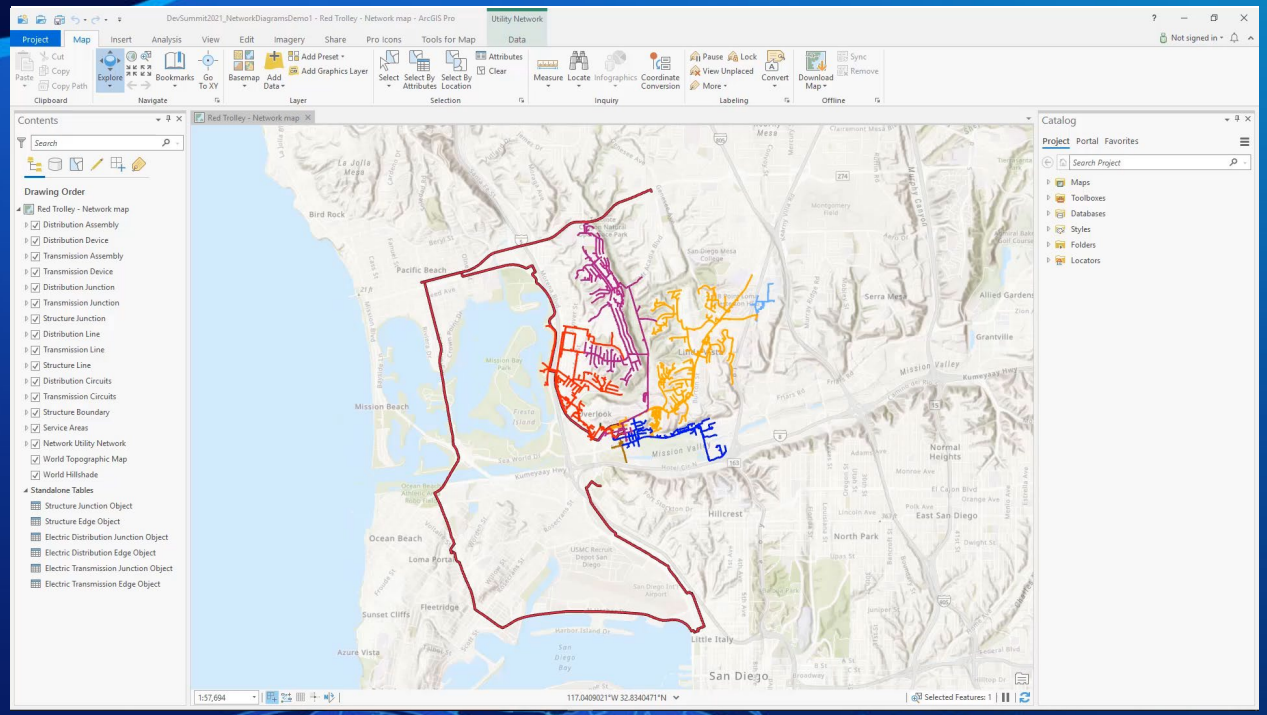

**Simplified tree view**

# Network Diagrams in Utility Networks and Trace Networks

- Use layout algorithms
- Allow manual editing
- Use layer appearance and labelling capability
- Stored in the database
- Created from traces executed at generation and update
- Updated based on the data changes while preserving layout



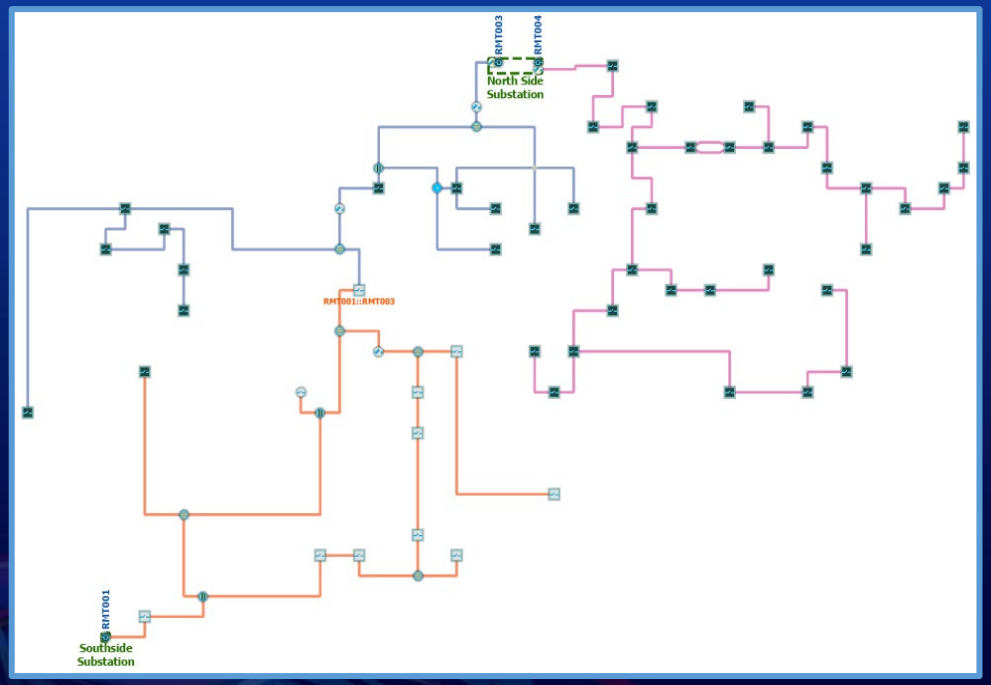


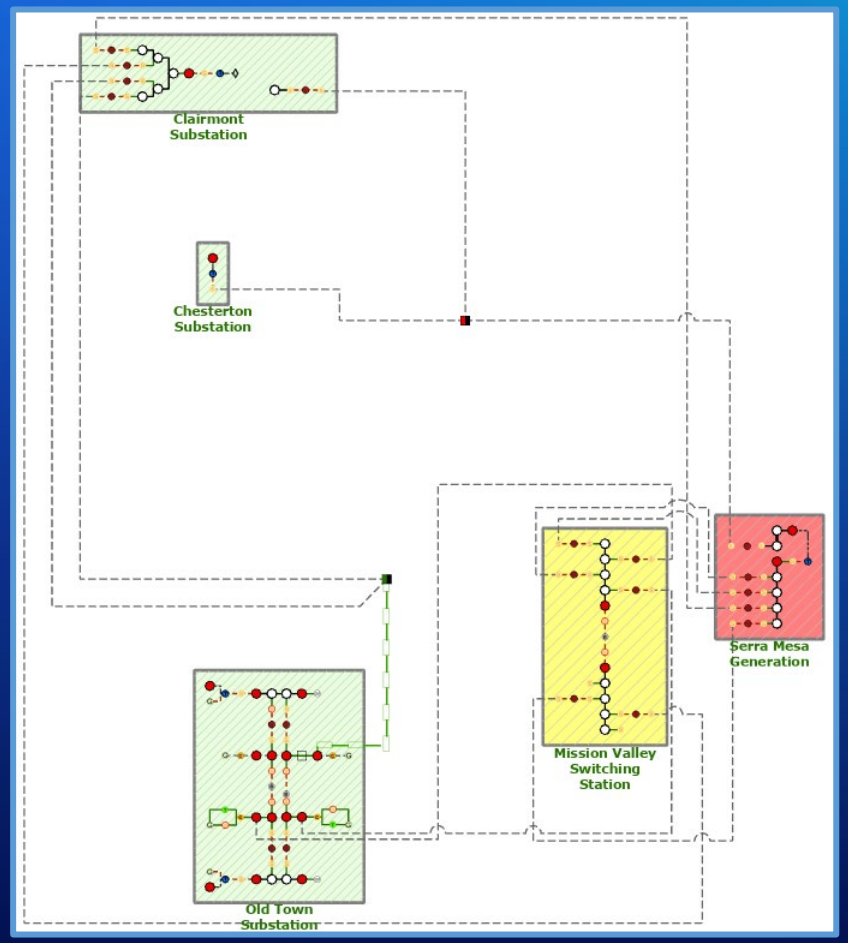

# Demo#1 Network Diagrams basis

# Diagram Features and Diagram Layer

# Diagram Features

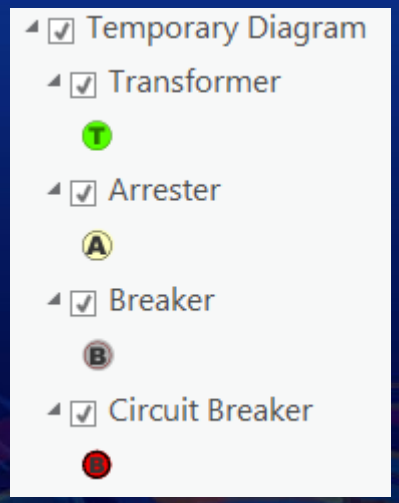
- Diagram junction depicted as symbol point geometry
- Diagram edge depicted as line geometry
- Diagram container depicted as polygon geometry

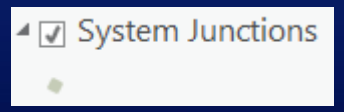


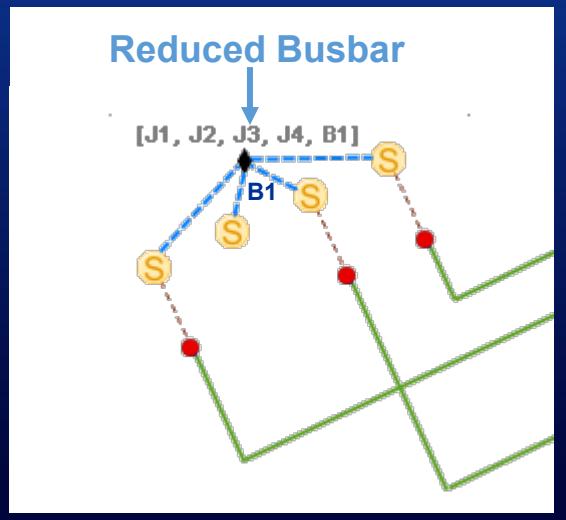



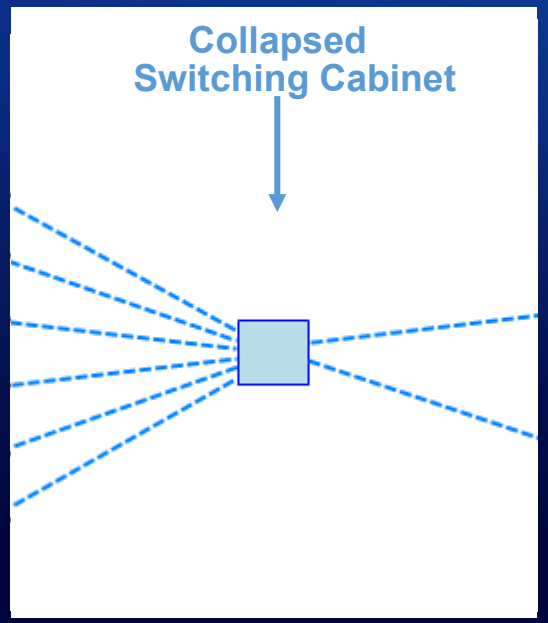
# Diagram Junctions

- Network point features (valves, transformers, switches, connection points)
- Junction objects
- System junctions
- Particular edges reduced as junctions in the diagrams
- Network polygon features collapsed as points in the diagrams (pumping/electric stations)



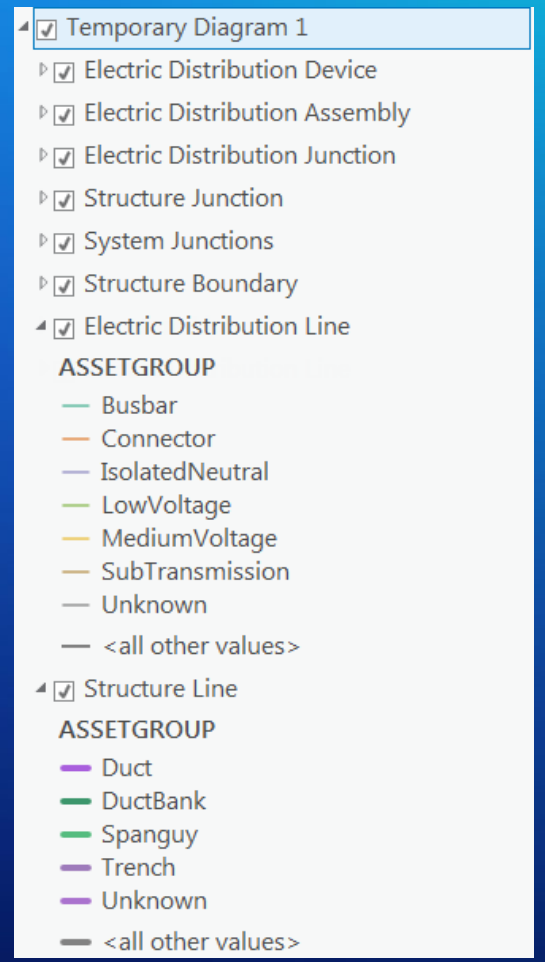



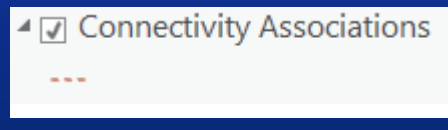



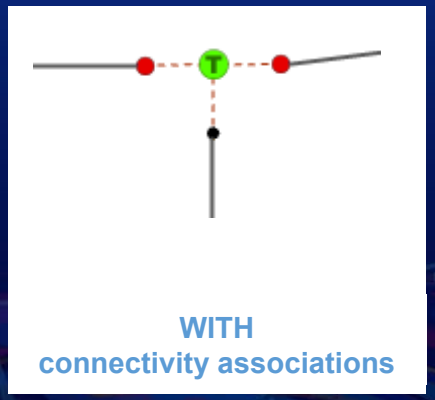



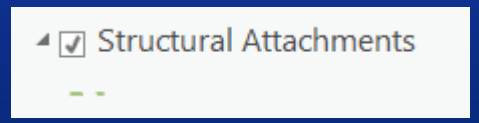
# Diagram Edges

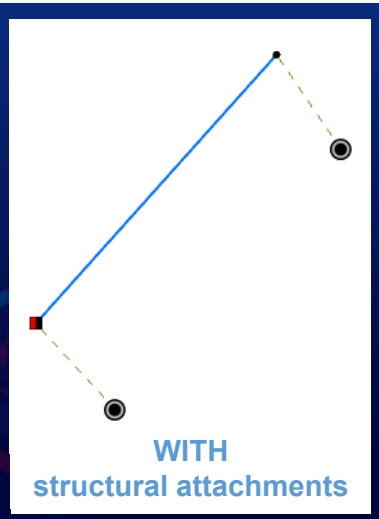
- Network line features
- Edge objects
- Junction-junction connectivity and structural attachment associations
- Reduction edges that aggregate several network features/objects

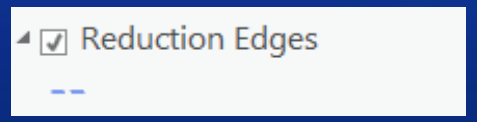


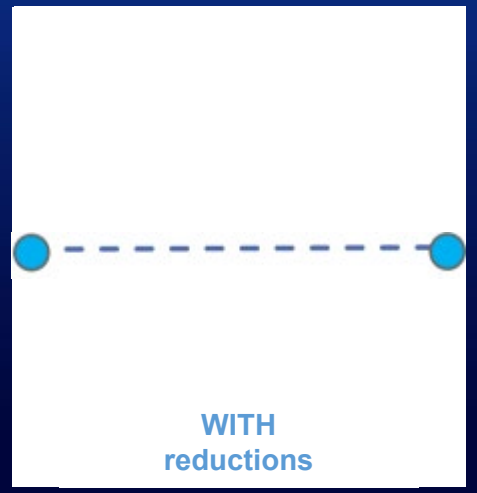



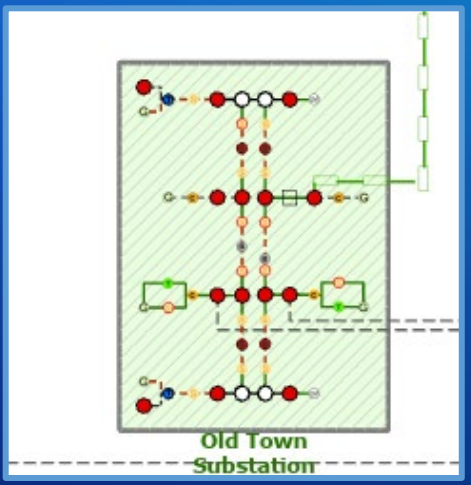



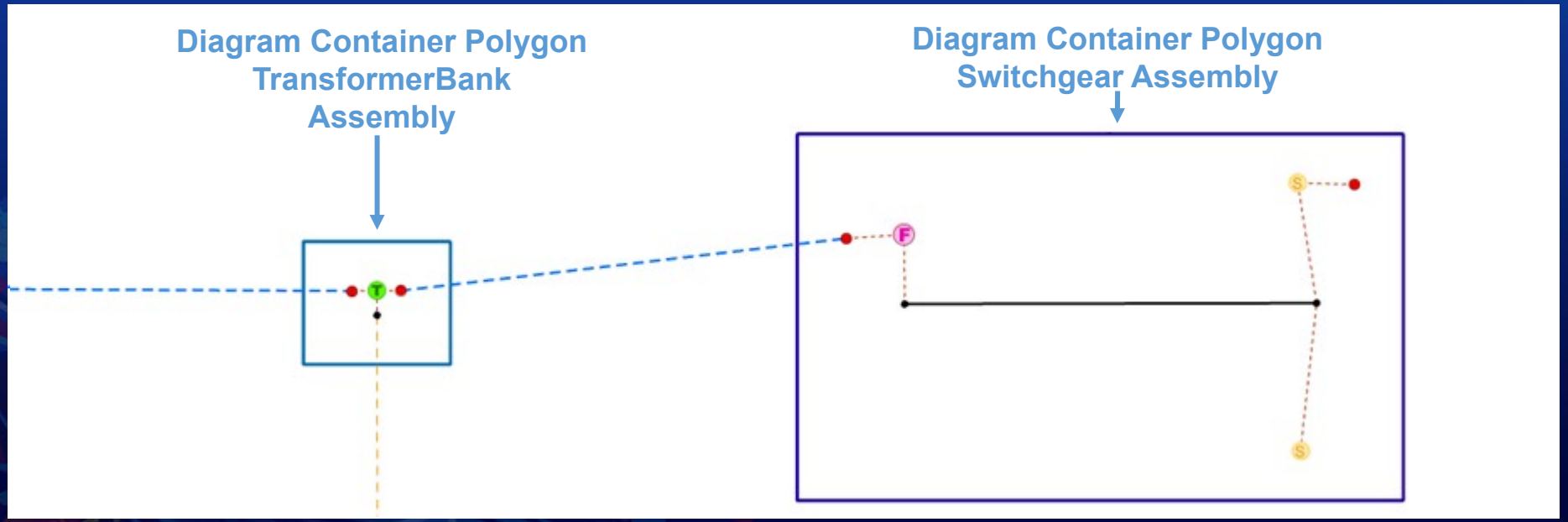



# Diagram Containers

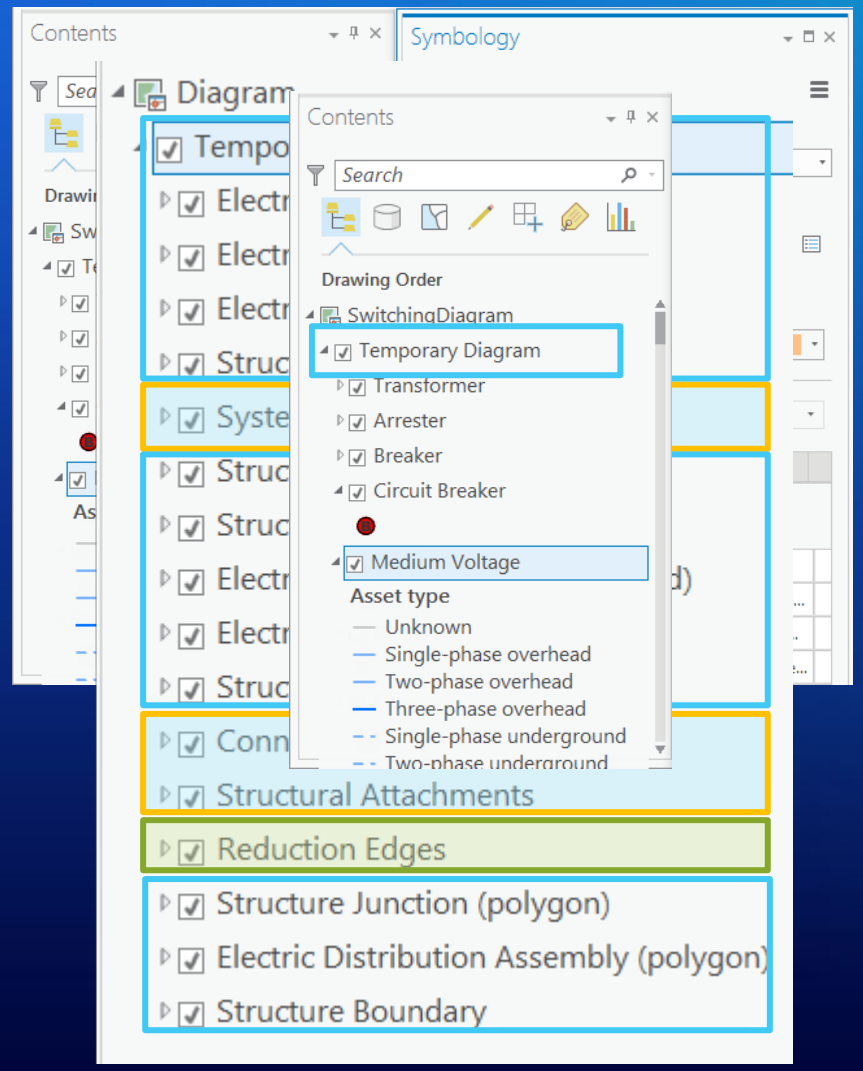
- Structure junctions, assemblies, devices
- Structure junction objects
- Polygon structure boundaries

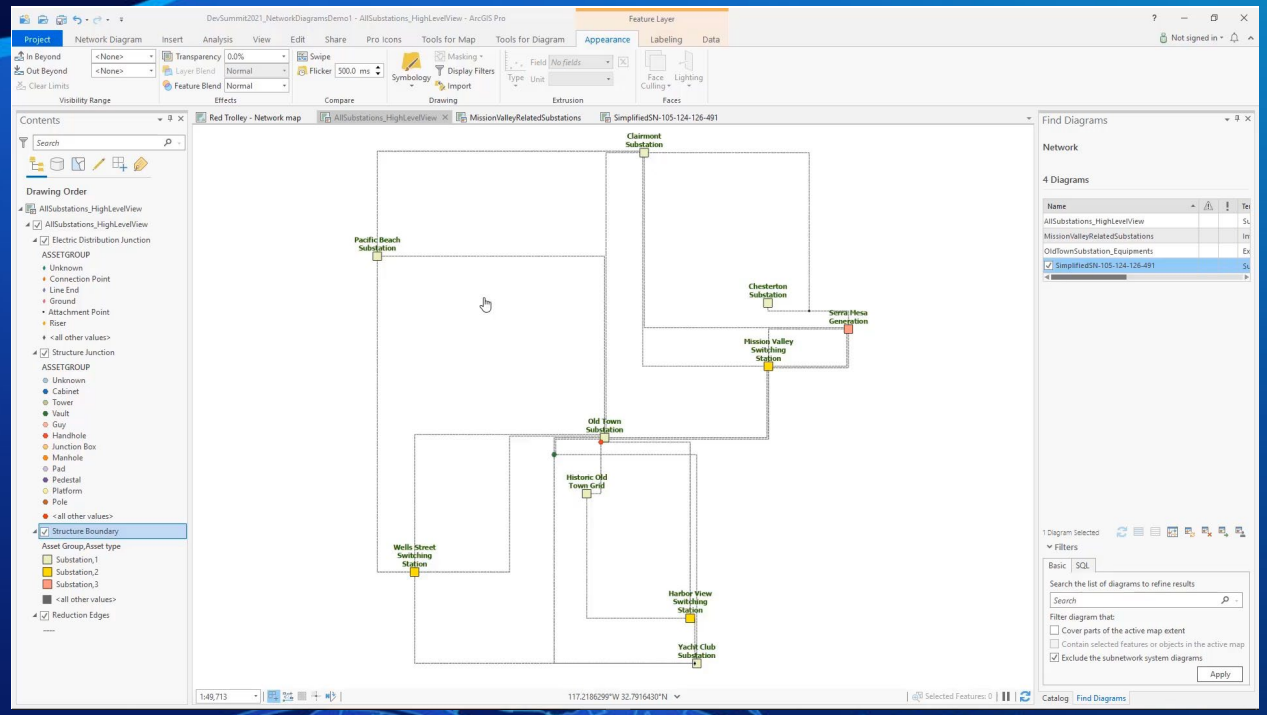


# Diagram Layer

- Composite layer whose sublayers are feature layers
- Each sublayer get benefits from core layer properties and labeling capability
- A diagram sublayer may reference:
  - Diagram features that represent network features or network objects
  - Diagram features that represent internal network elements. For example, connectivity associations, structural attachments, system junctions
  - Pure diagram features (reduction edges)



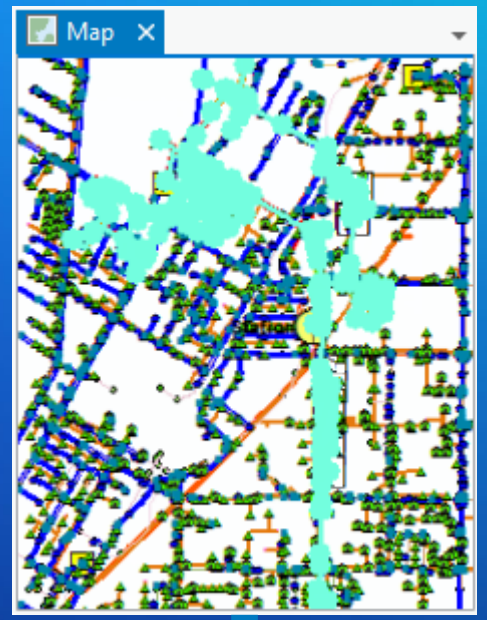


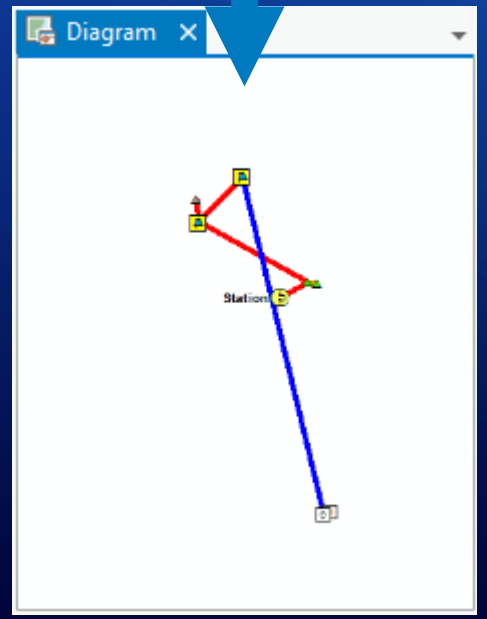

# Demo#2
# Manual editing of diagram features

# Diagram Rules, Layouts and Templates

# Diagram Rules

- Executed during network diagram generation
- Start from input network feature/object sets
- Used to progressively build the content of network diagrams
- Configured to modify the diagram contents by
  - Discarding certain network features or objects,
  - Adding extra network features or objects,
  - Simplifying diagram content by aggregating network features or objects
- Re executed at each diagram update

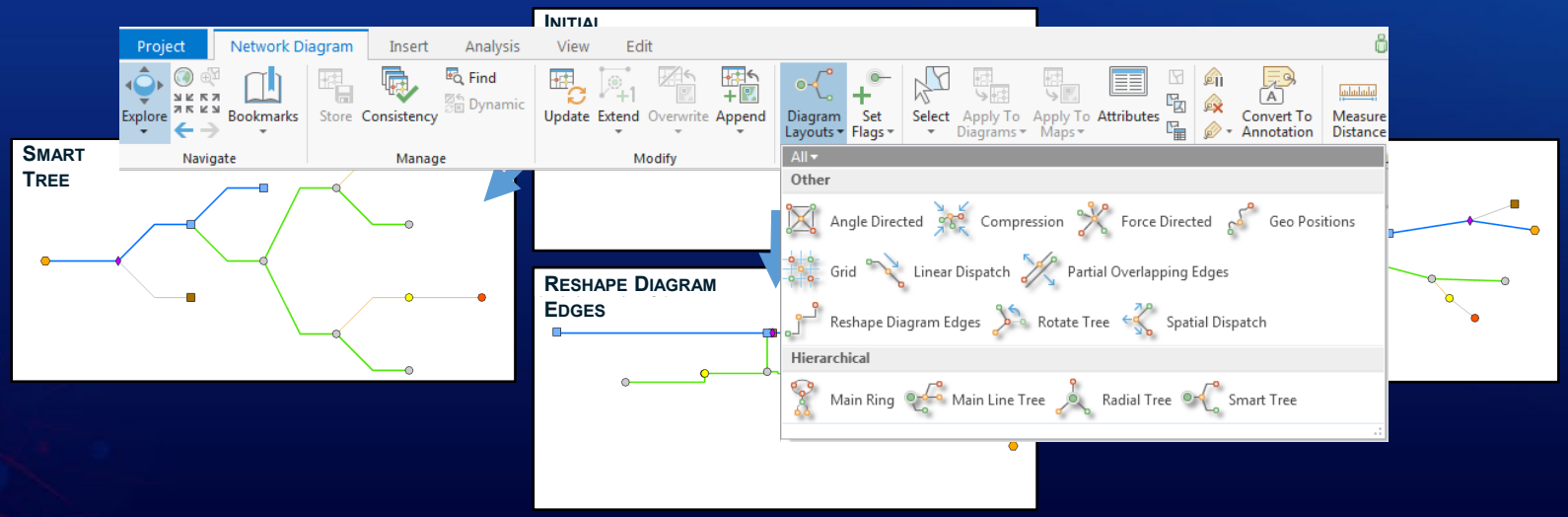


# Diagram Layouts

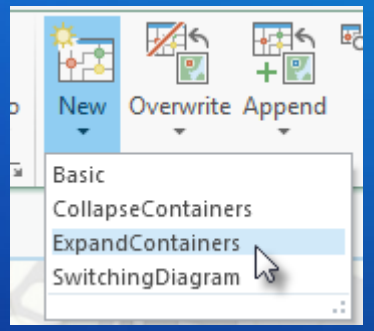
- Used to clarify and normalize spacing between diagram features
- Run on demand on all or parts of any open network diagram
- Configured to automatically execute at diagram generation and update

- Three categories of layouts
  - Tree layouts
  - Refinement layouts
  - Schematic layouts



# Diagram Templates

- **Any network diagram is based on a diagram template**
  - **Select diagram template to create a new diagram**



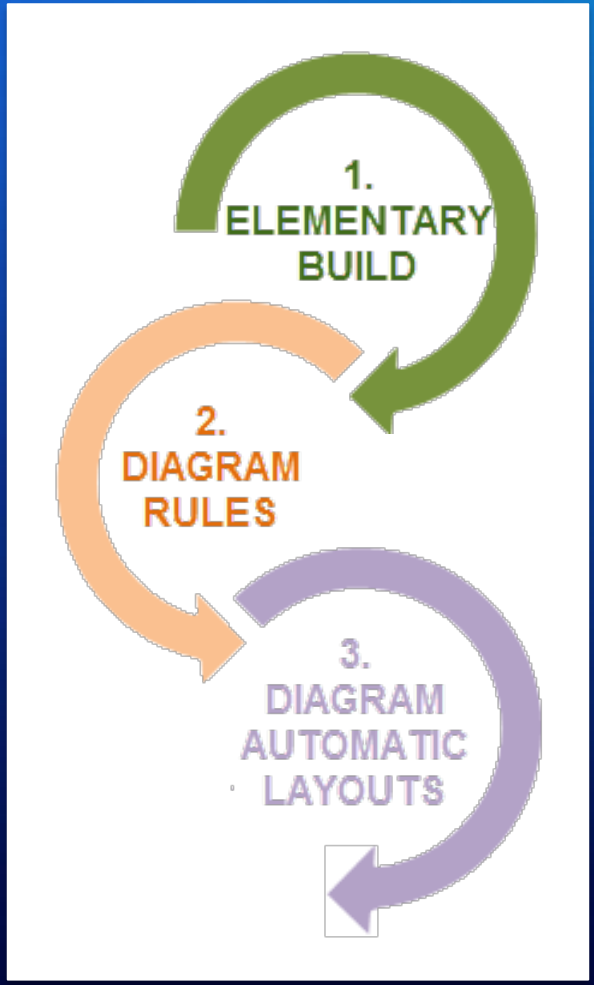

- **A diagram template contains**
  - **Configuration properties defining the network diagram contents**
    => diagram rule and layout definitions
  - **Layer properties defining the network diagram presentation**
    => diagram layer definition

# Diagram Generation Process

1. **Elementary Build phase**
   - A diagram feature for each input network feature or object
   - Any diagram edge with its extremity junctions
   - Any content with its container

2. **Diagram Rules phase [OPTIONAL]**
   executed each-in-turn to build and refine the diagram graph

3. **Diagram Automatic Layouts phase [OPTIONAL]**
   chained each-in-turn to lay out the diagram content



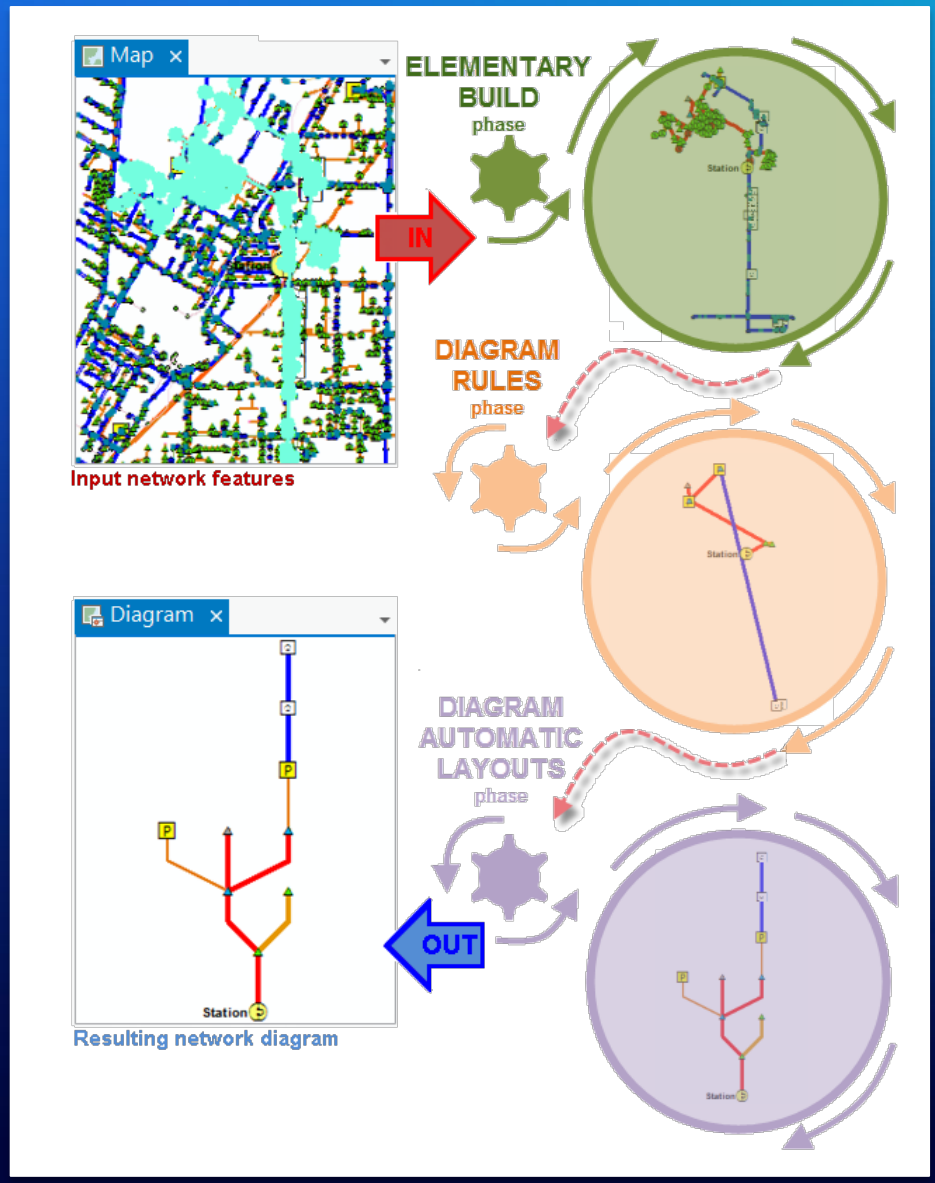

**NOTE: This process is also quite the same at diagram update**

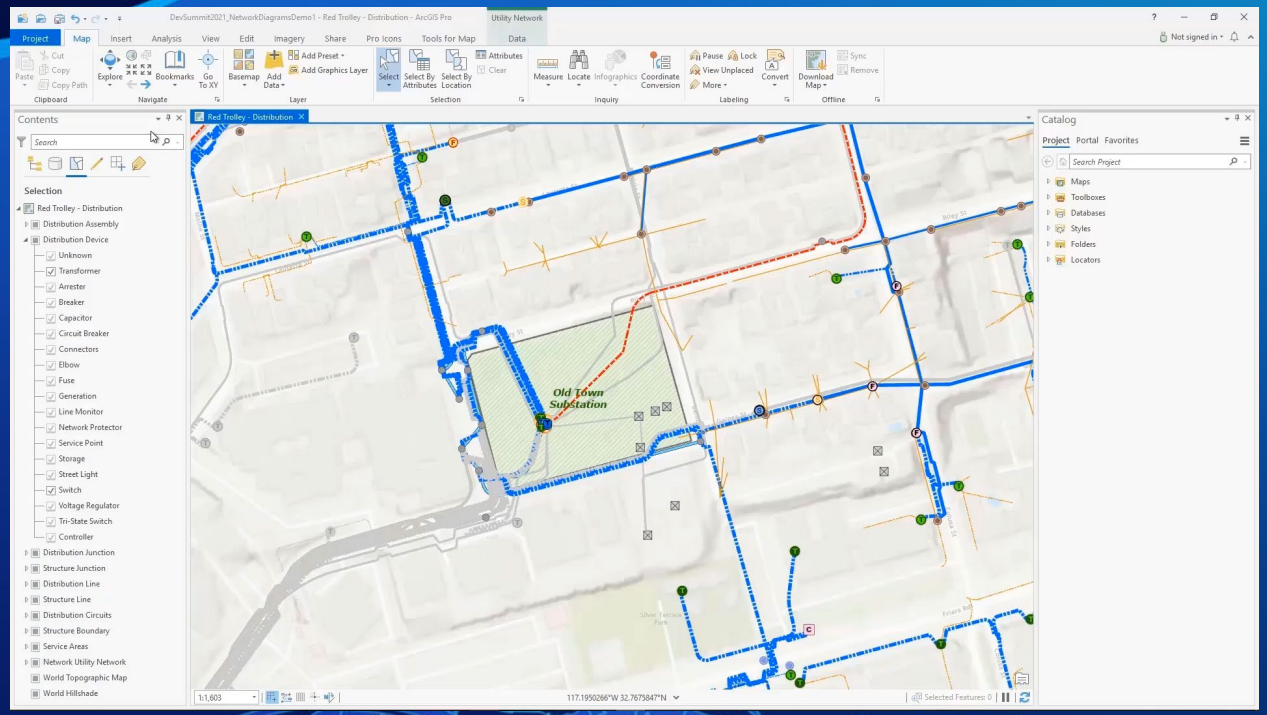
# Diagram Generation Process

- Diagrams generation process sample
  1. Elementary Build phase
  2. Diagram Rules phase

     To reduce most of the non-critical intervening elements
  3. Diagram Automatic Layouts phase

     To execute a Smart Tree layout



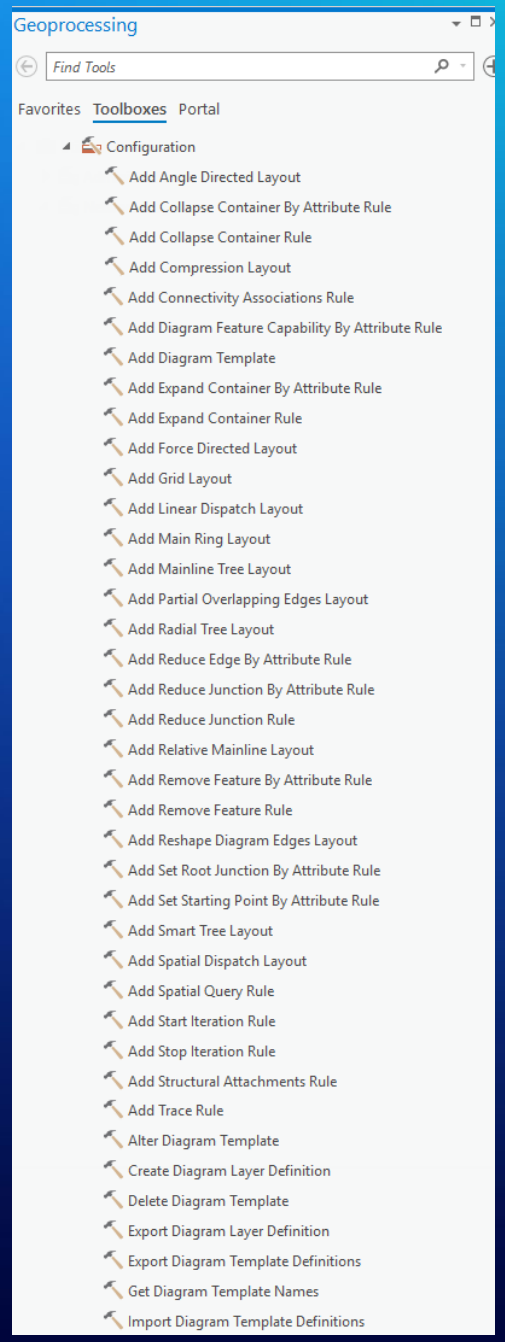



# Demo#3
# Network diagram sample generations

# Diagram Template Configurations

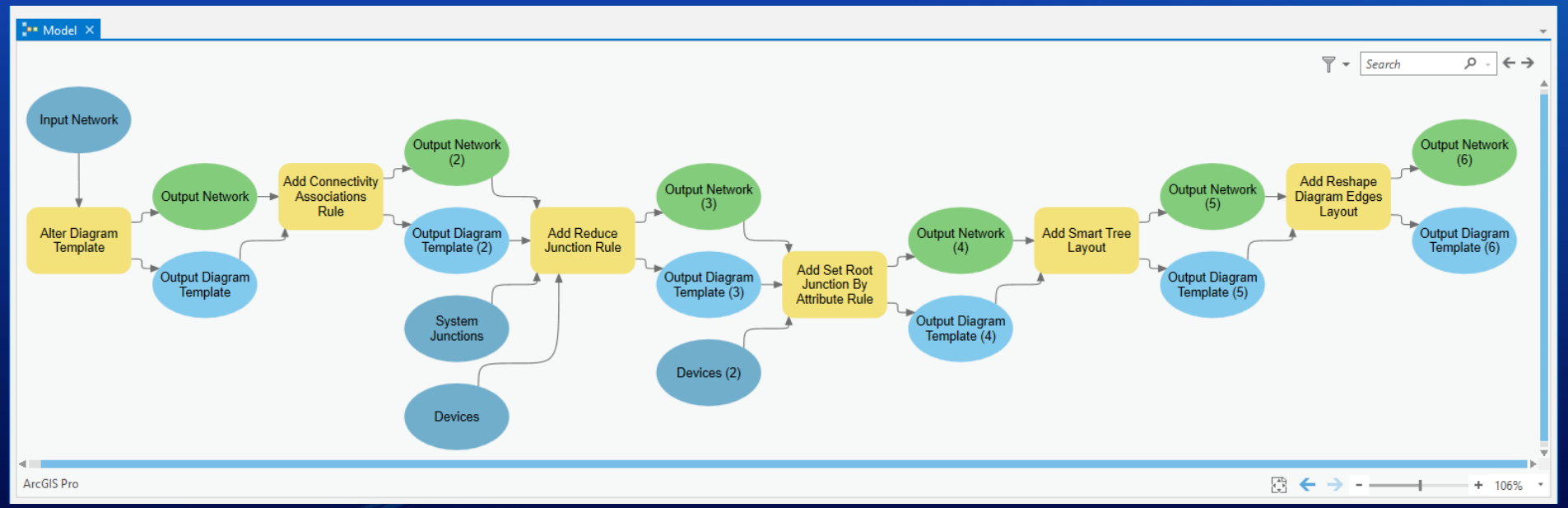
# Diagram Template Configuration Tools

- **Exposed as a collection of geoprocessing tools**
- **Administrative tools**
- **Used to configure how the content of network diagrams will be**
  - **Built** => diagram rule and layout definitions
  - **Displayed** => diagram layer definition
- **Executed from either**
  - **A network in a file geodatabase**
  - **A network in an enterprise geodatabase**



# Diagram Rule and Layout Definition

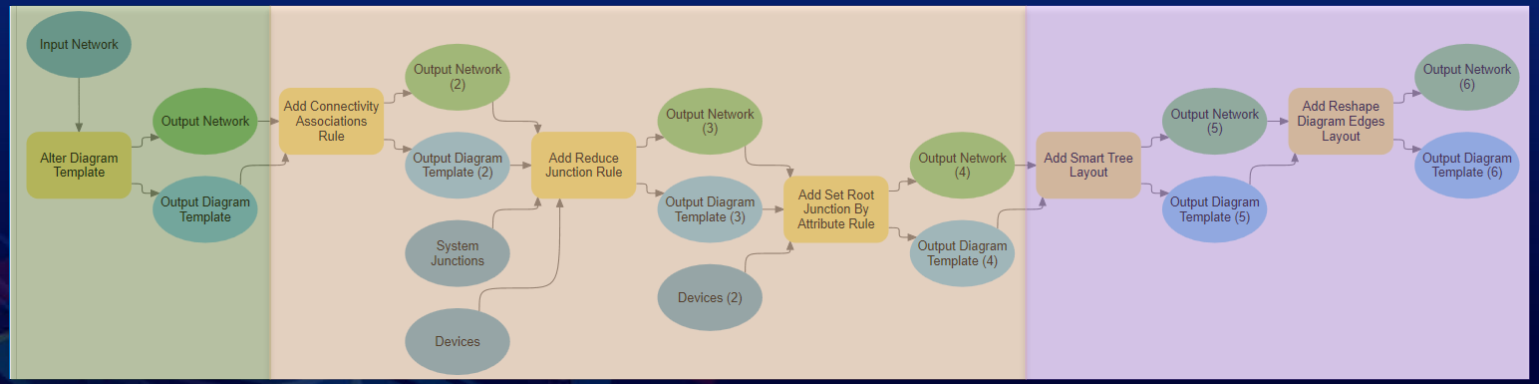
- Diagram rule and layout configuration tools easy to chain using
  - Python scripts
  - Geoprocessing models

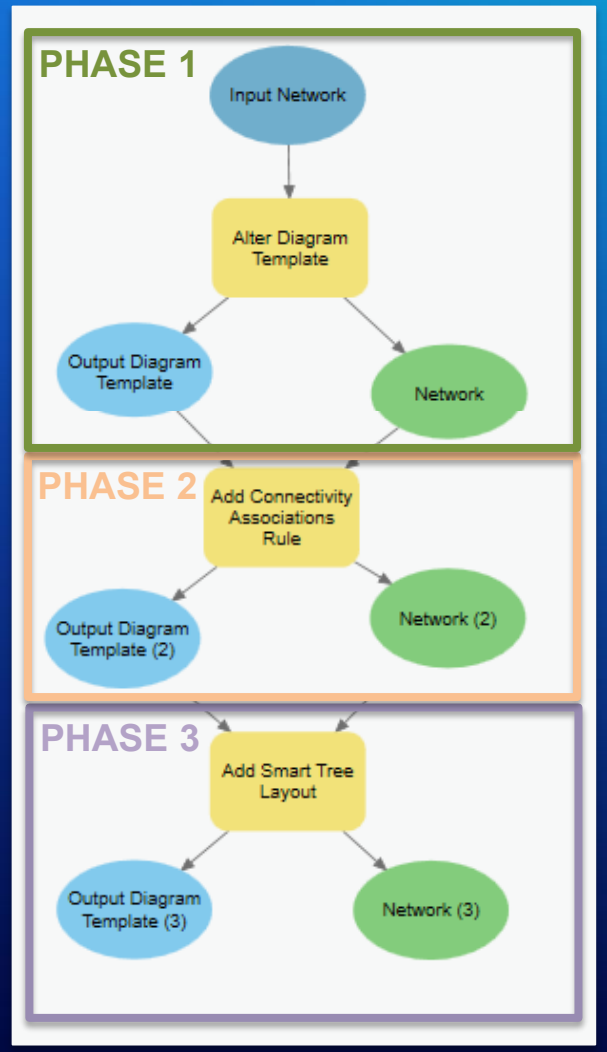



- Model Builder or Python scripting recommended vs running tools one-by-one in the Geoprocessing pane

# Diagram Rule and Layout Definition

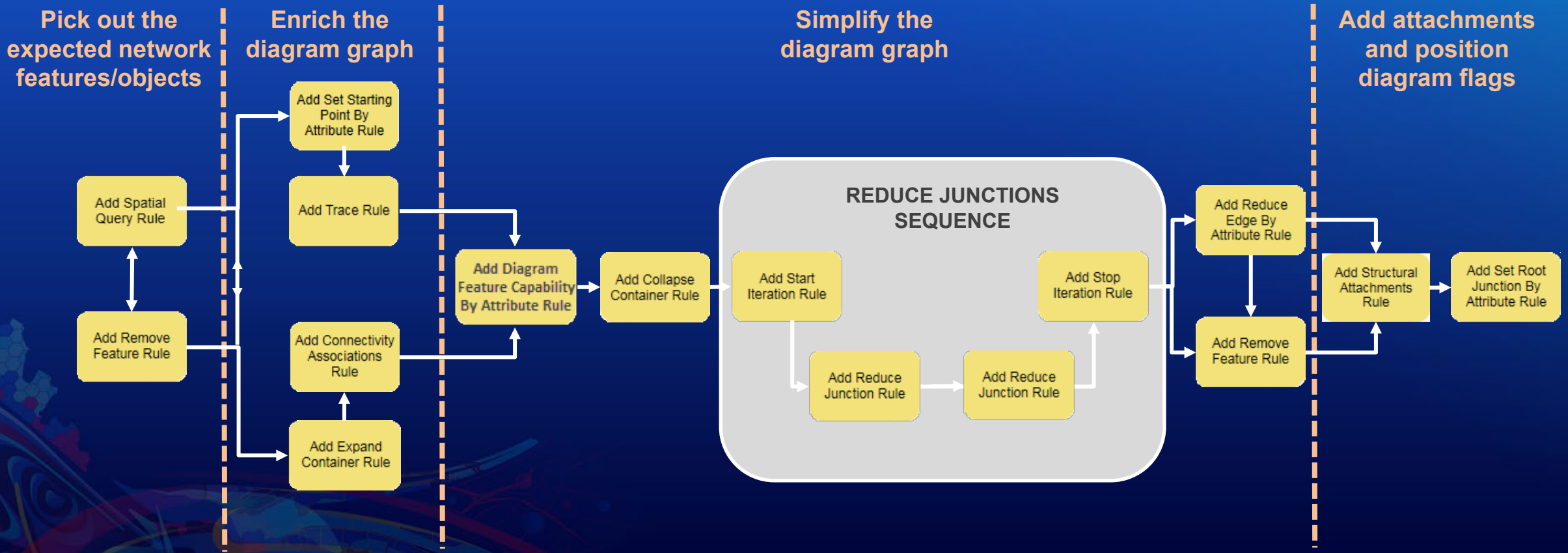
- **Advantages of using geoprocessing models**
  - **Chaining of geoprocessing tools organized in three main phases like during network diagram generation process**
    - **PHASE 1 – ELEMENTARY BUILD (using the Alter Diagram Template tool)**
    - **PHASE 2 – RULE SEQUENCE (using the Add <xxx> Rule tools)**
    - **PHASE 3 – LAYOUT SEQUENCE (using the Add <xxx> Layout tools)**
  - **Help to ensure the position of each diagram rule and layout**



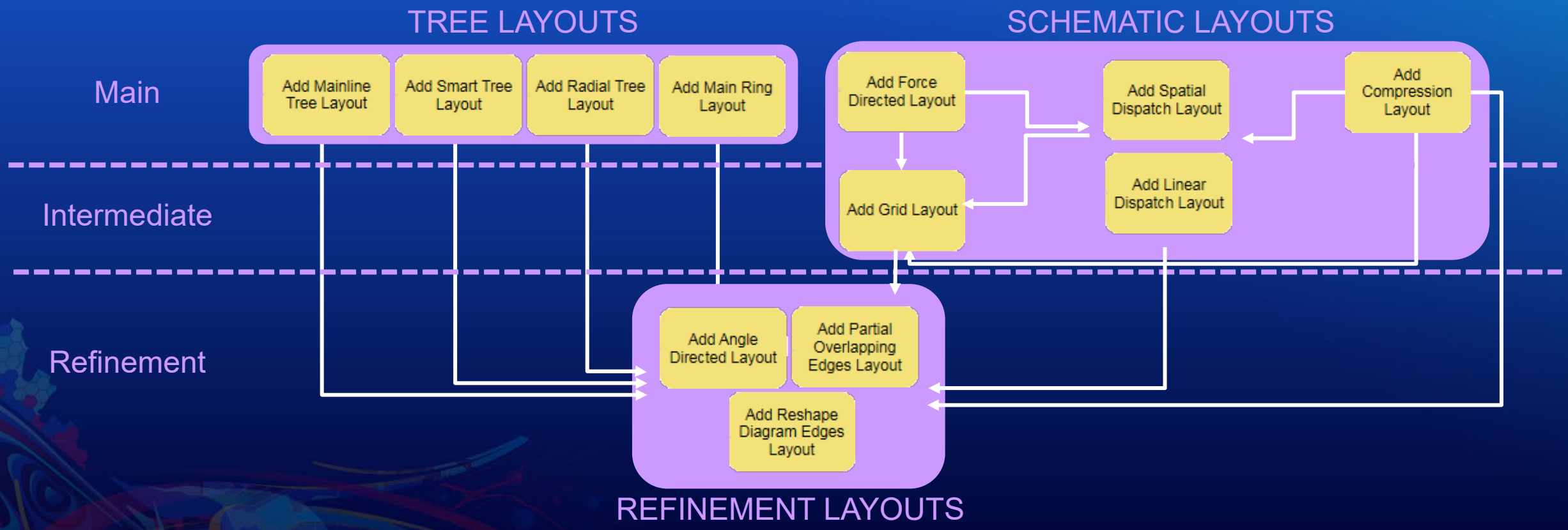
# Phase 2 - Diagram Rule Sequence Definition

- Diagram rule position in the rule sequence depends on the type of rule



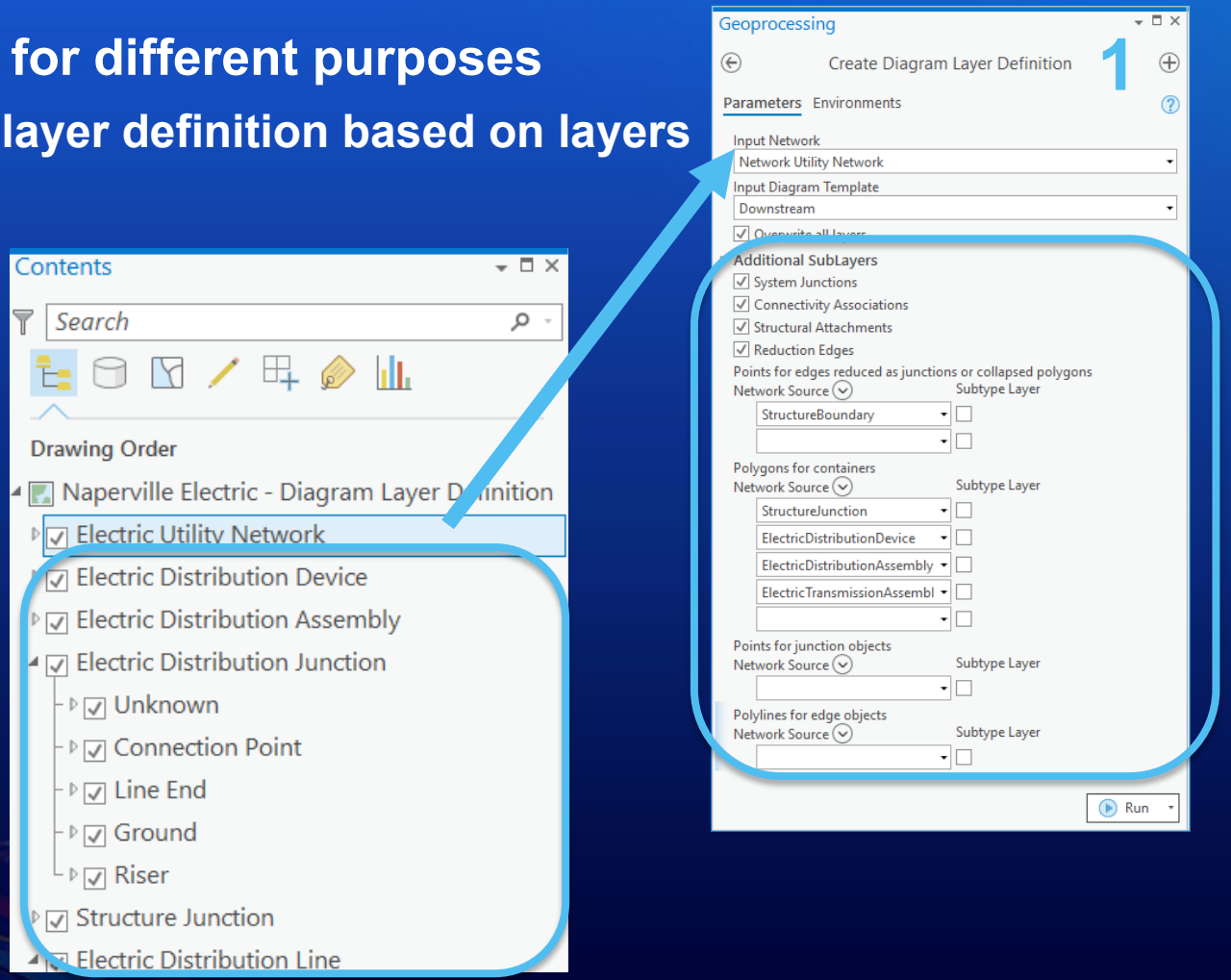
# Phase 3 - Diagram Layout Sequence Definition

- **Diagram layout position in the layout sequence depends on the type of layout**



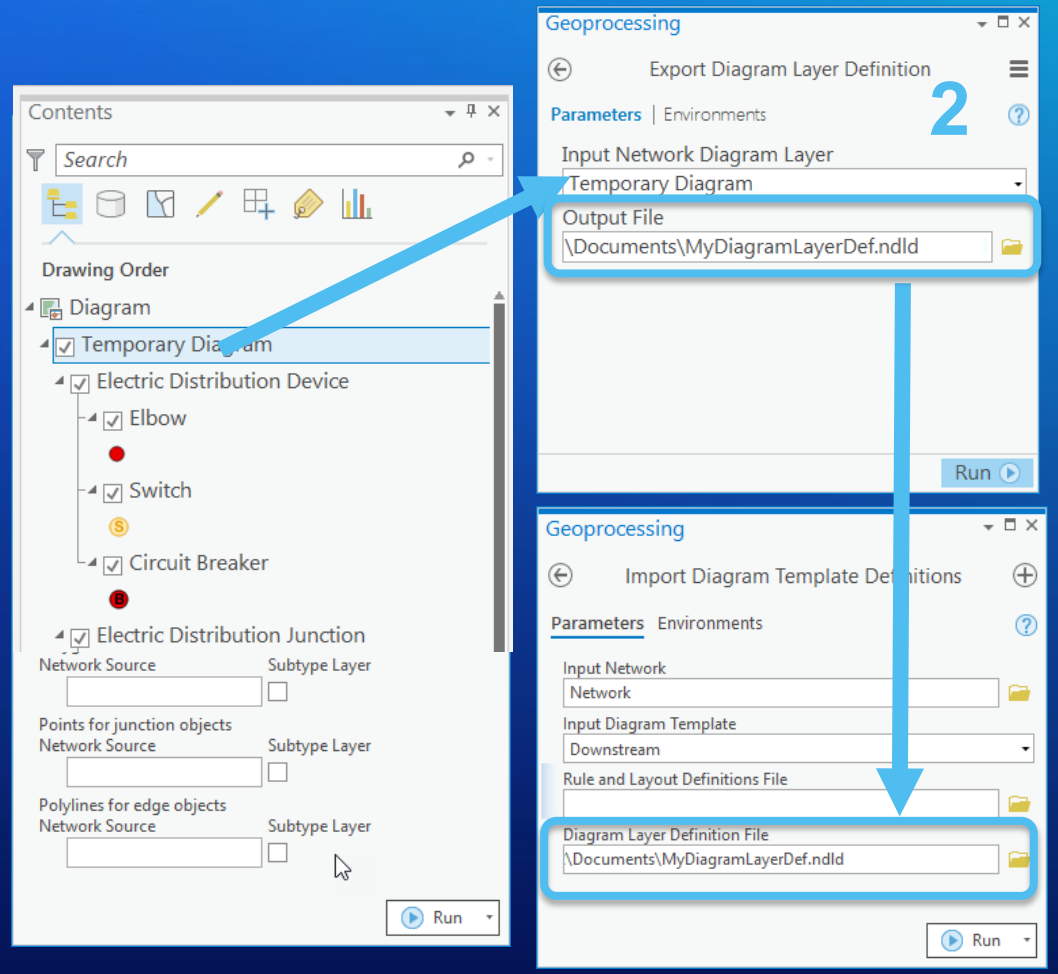
# Diagram Layer Management Tools

- **Different tools to use for different purposes**
  1. **Initialize a diagram layer definition based on layers in a network map**



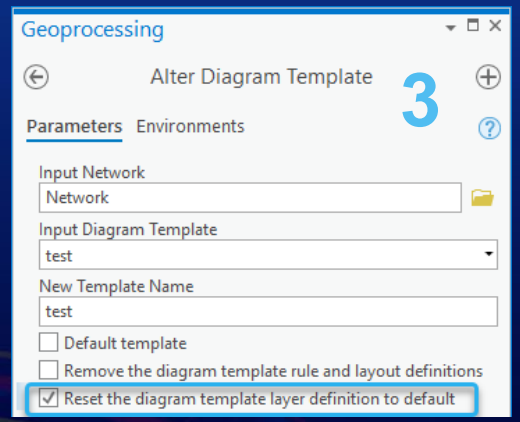
# Diagram Layer Management Tools

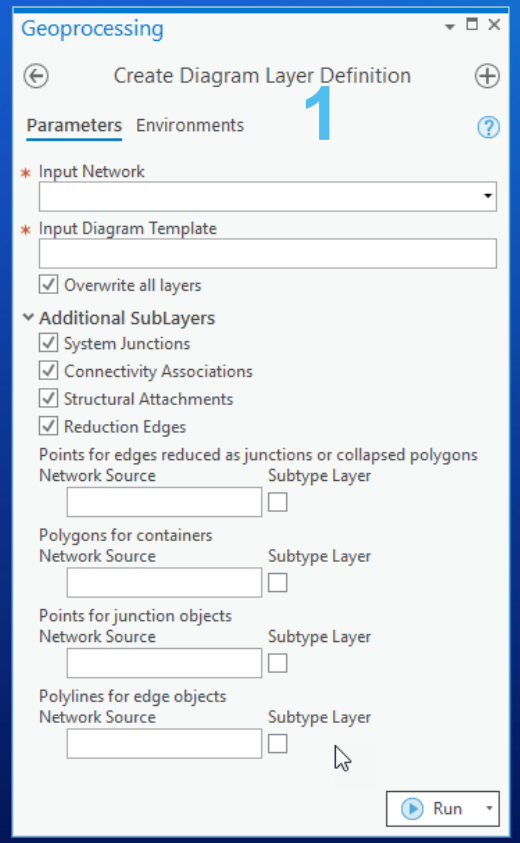
- **Different tools to use for different purposes**
  1. **Initialize a diagram layer definition based on layers in a network map**
  2. **Refine an existing network diagram layer, then export the definition of the refined network layer and reimport it on the template**

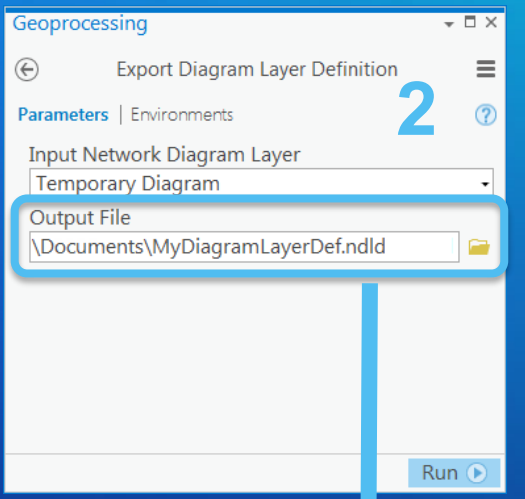


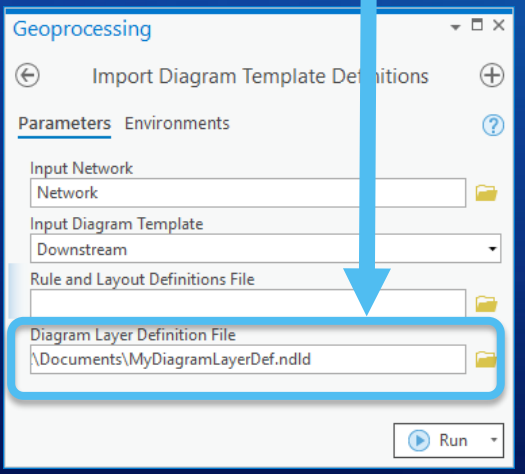
# Diagram Layer Management Tools

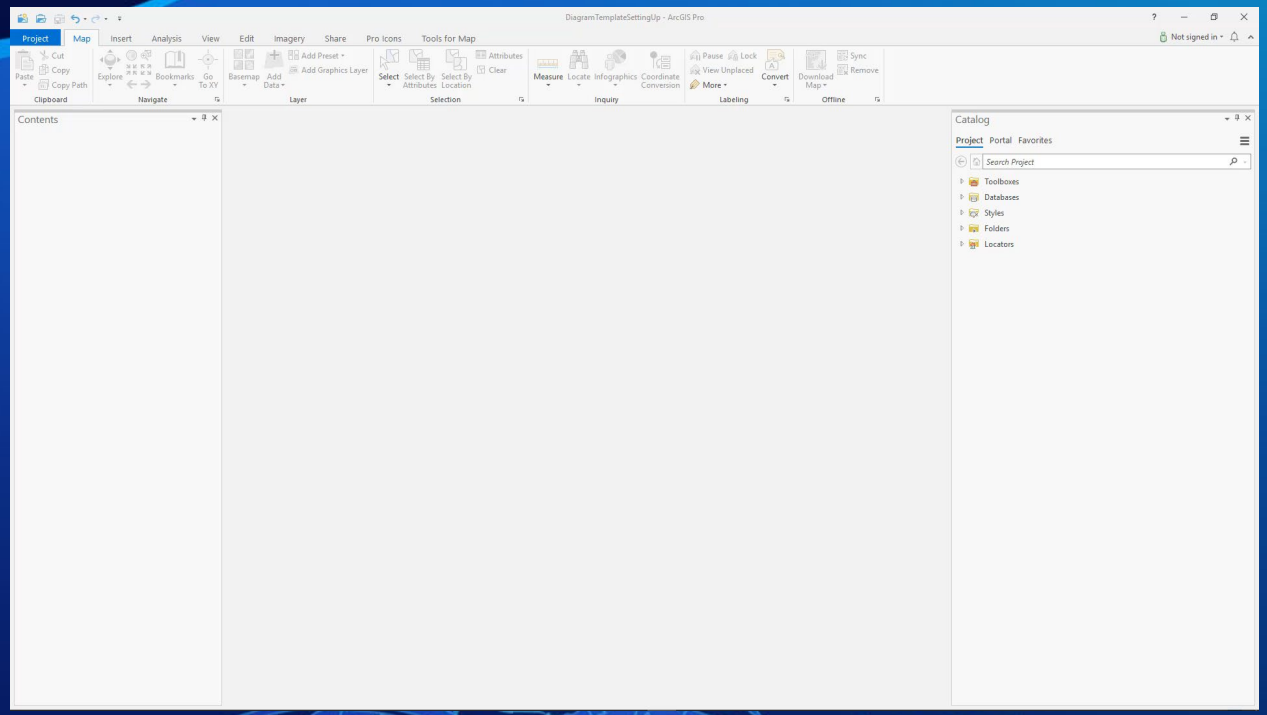
- **Different tools to use for different purposes**
  1. **Initialize a diagram layer definition based on layers in a network map**
  2. **Refine an existing network diagram layer, then export the definition of the refined network layer and reimport it on the template**
  3. **Reset diagram layer definition on a template**



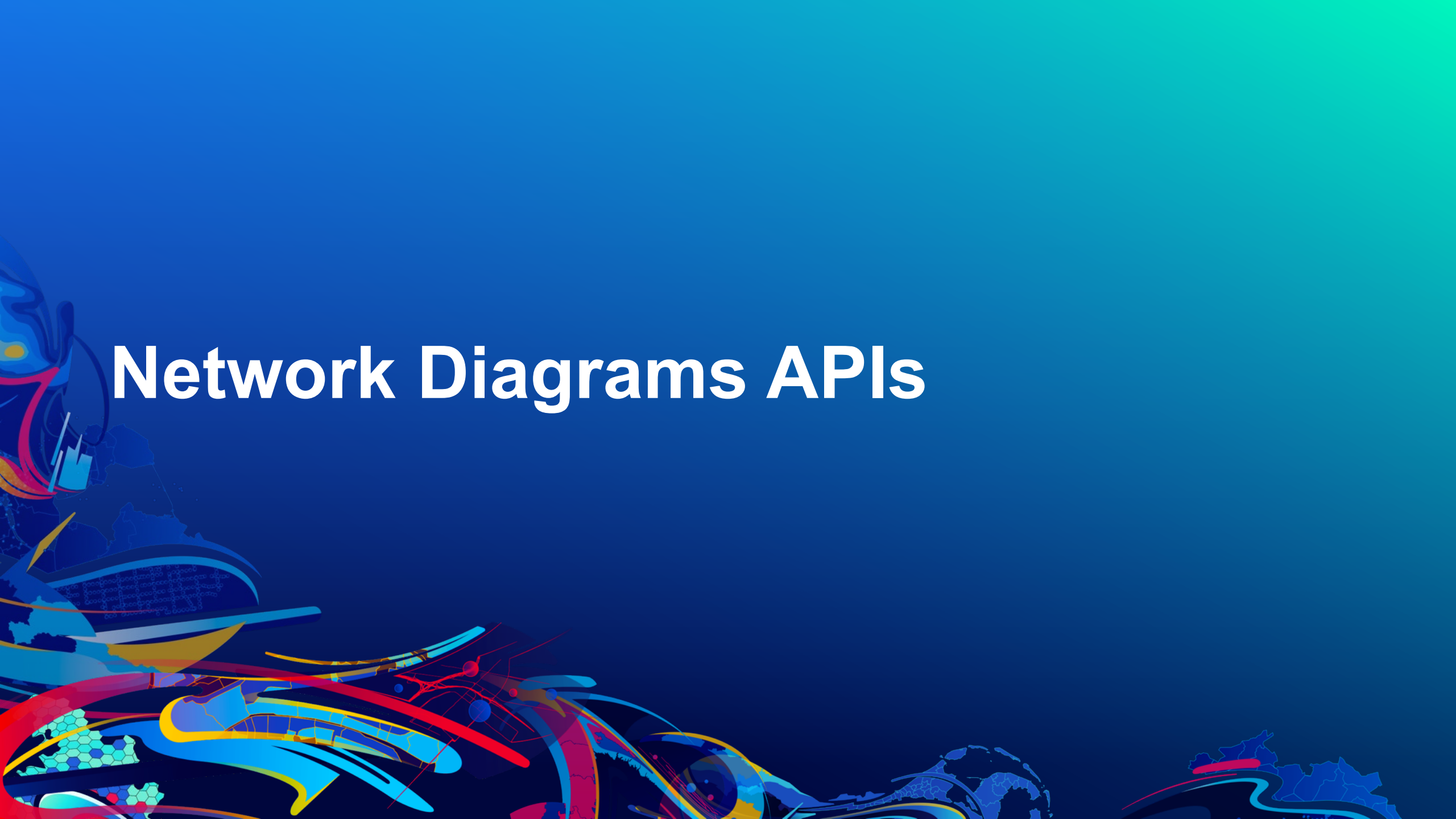






# Demo#4
# Create a template to explore and control network data

# Network Diagrams APIs

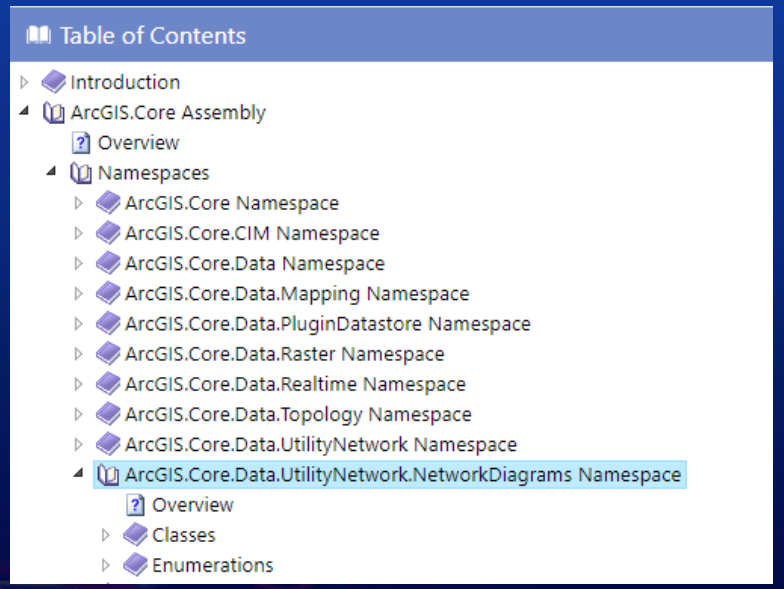


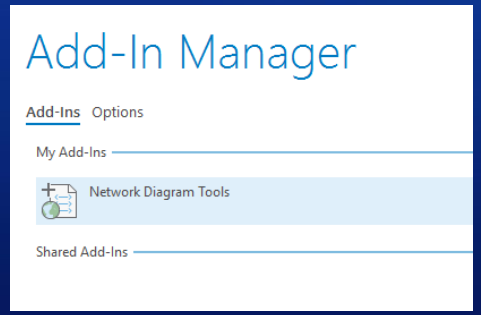
# Network Diagrams APIs

- ArcGIS Pro SDK for .NET
- ArcGIS REST API
- ArcGIS Developer Enterprise SDK

# Network Diagrams ArcGIS Pro SDK for .NET

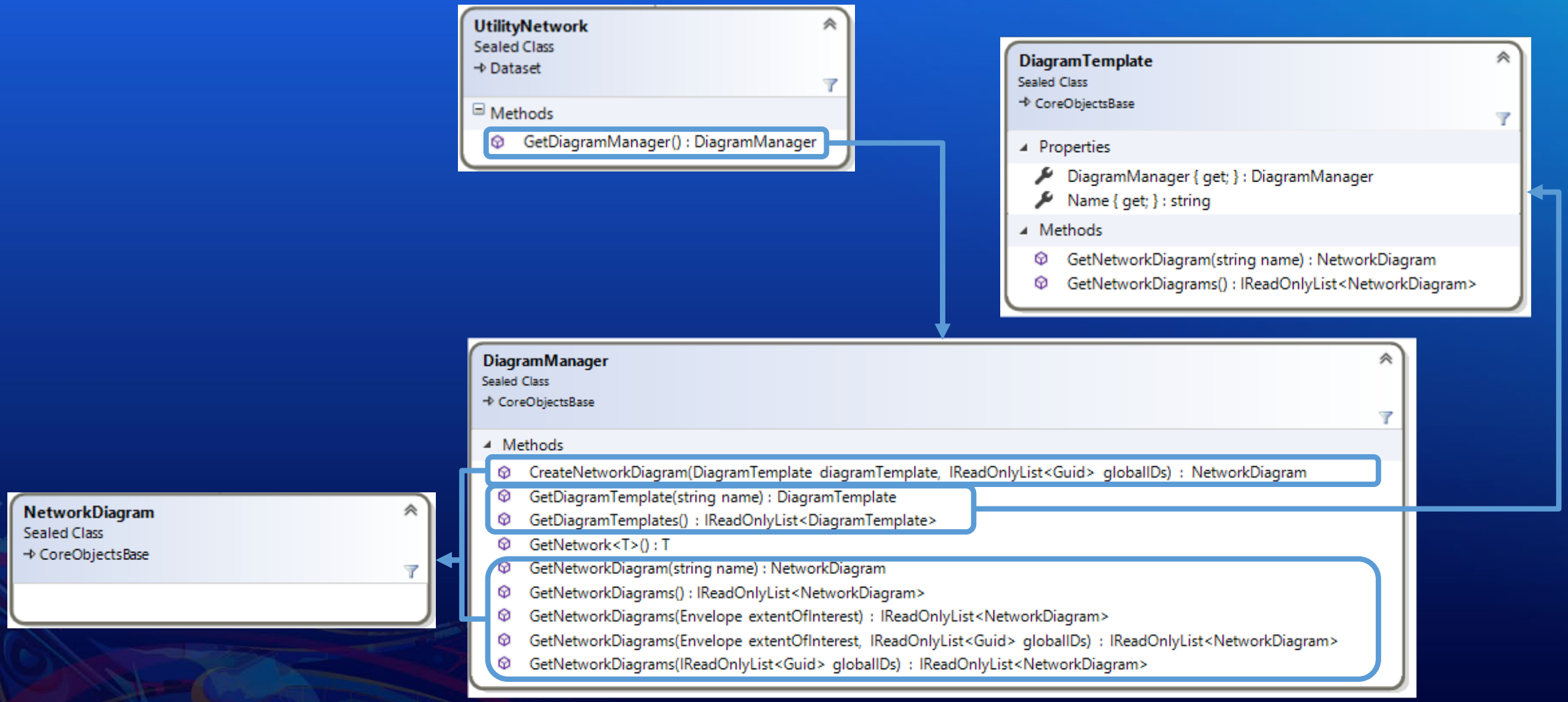
- Introduced with ArcGIS Pro 2.1
- Extend the core network diagram functionality in ArcGIS Pro
- Develop add-in commands and tools



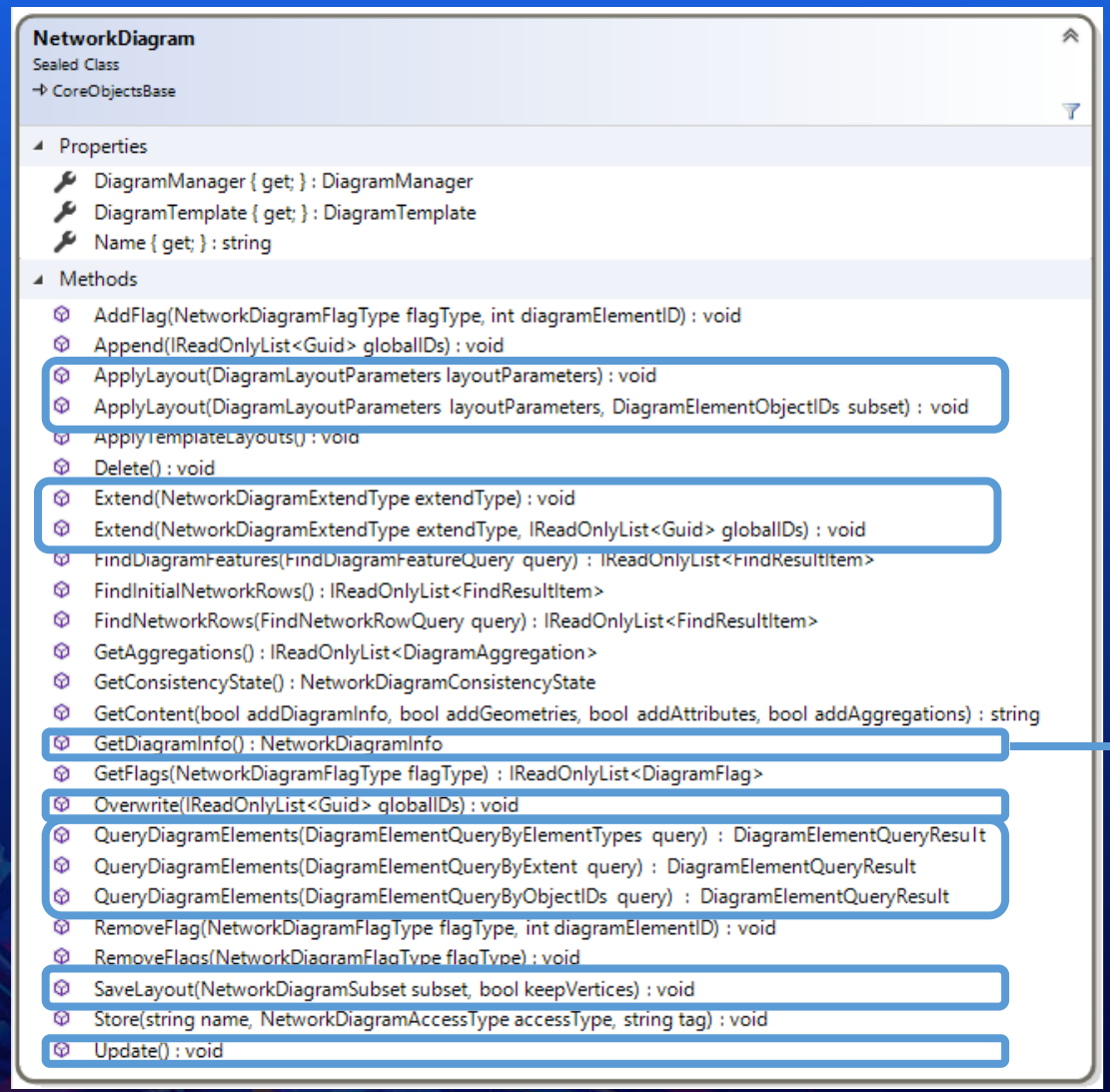



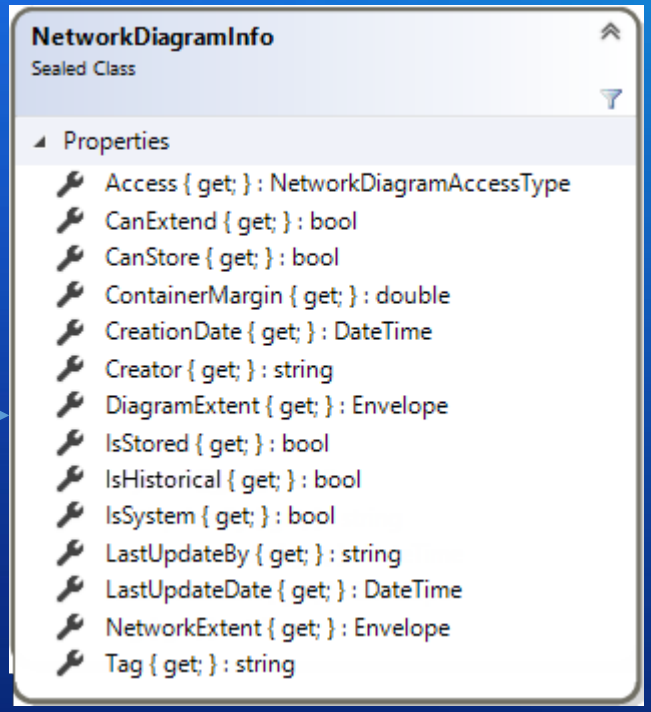

See https://pro.arcgis.com/en/pro-app/latest/sdk/api-reference/#topic17701.html

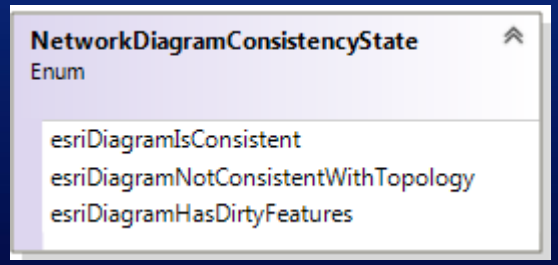
# Network Diagrams ArcGIS Pro SDK API - Diagram Manager

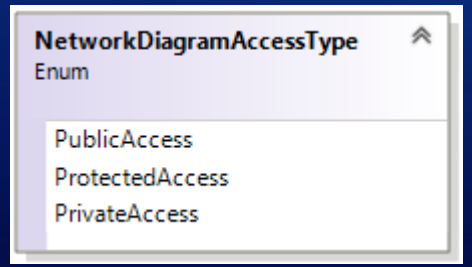


# Network Diagrams ArcGIS Pro SDK API - Network Diagram

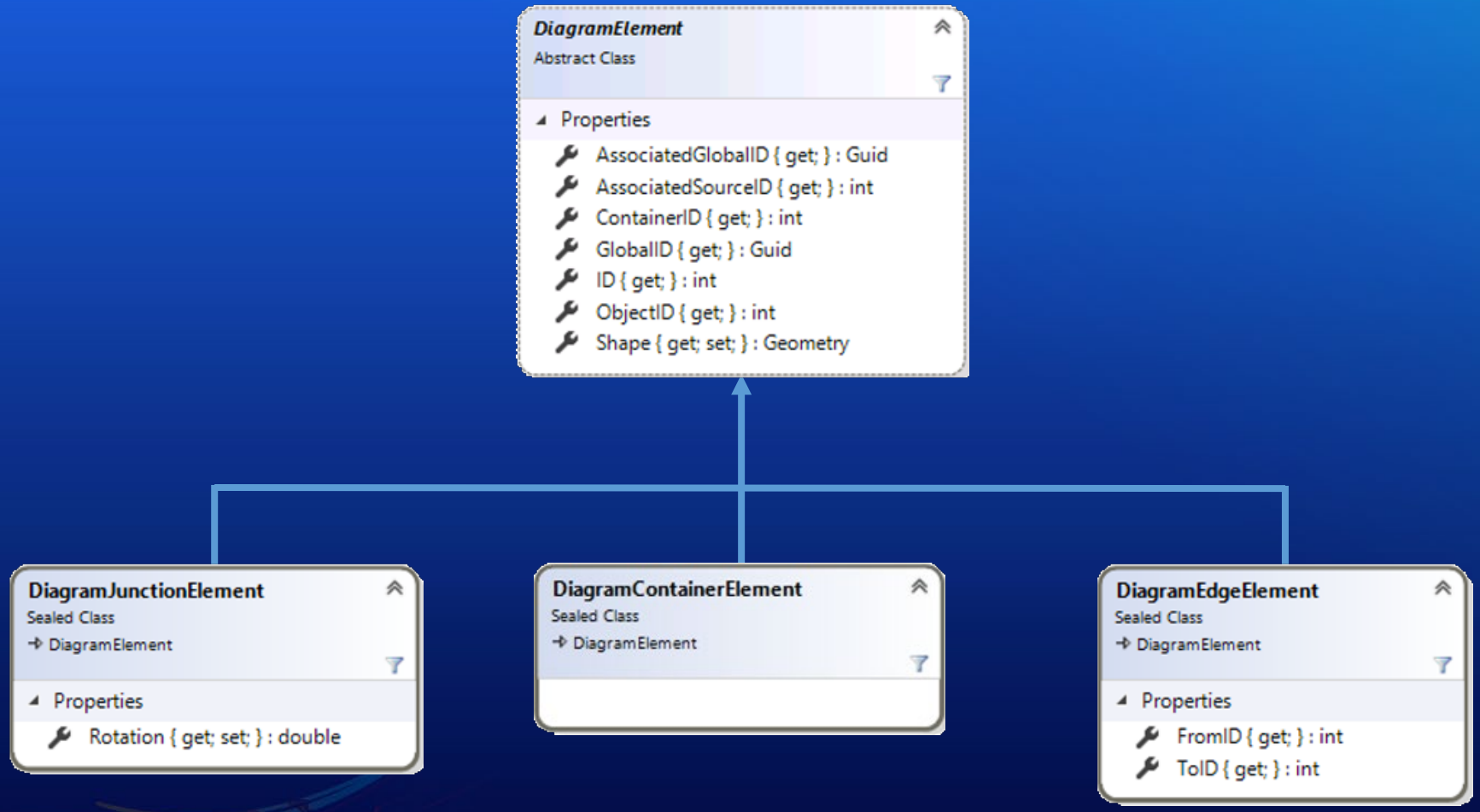


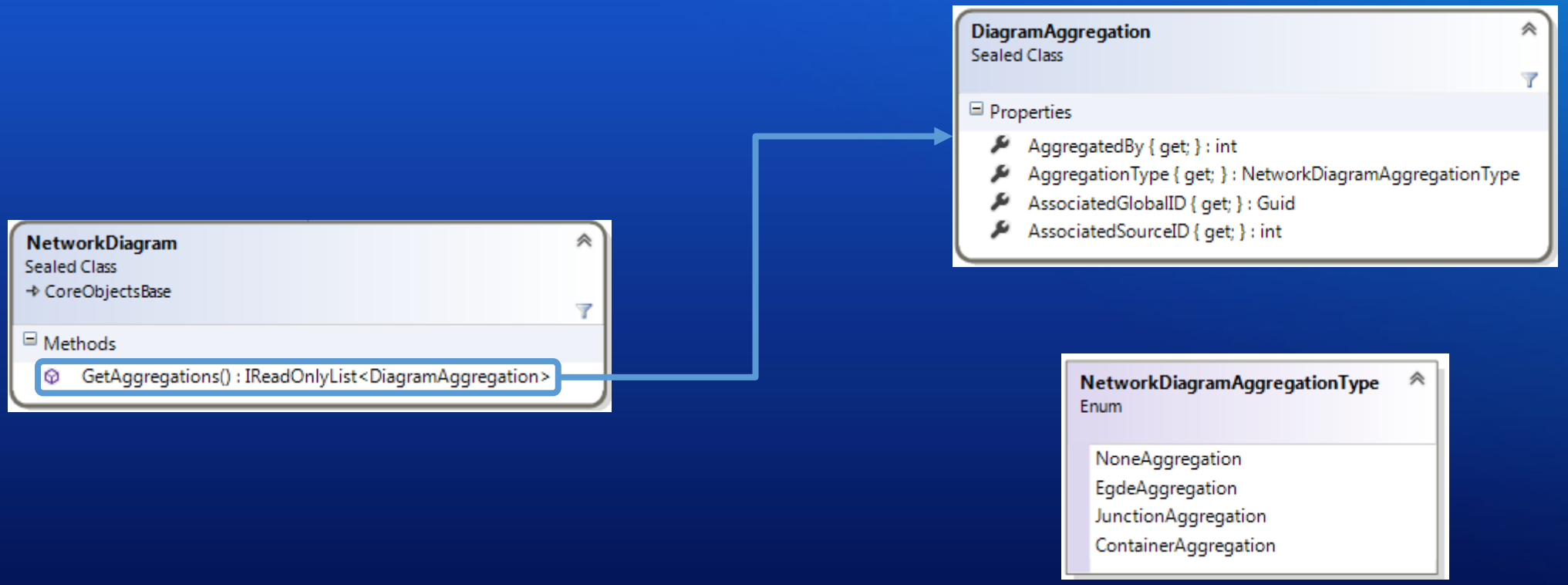



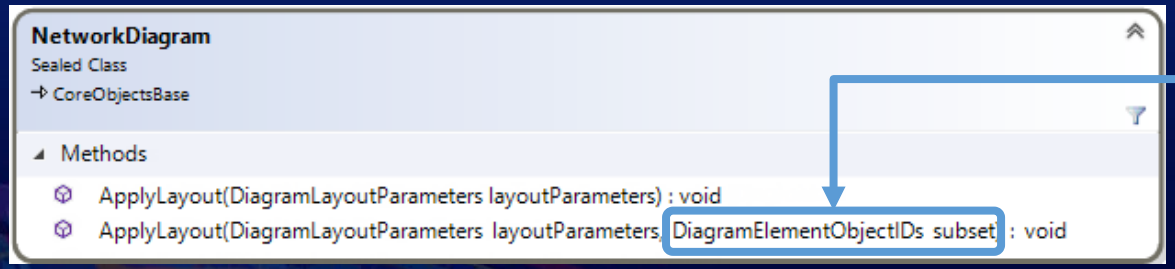
# Network Diagrams ArcGIS Pro SDK API - Diagram Element

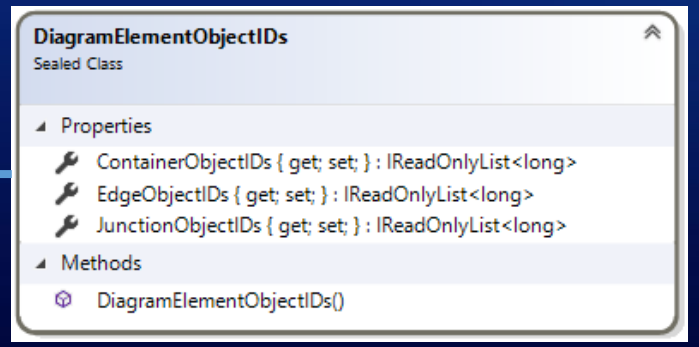


# Network Diagrams ArcGIS Pro SDK API - Diagram Aggregations



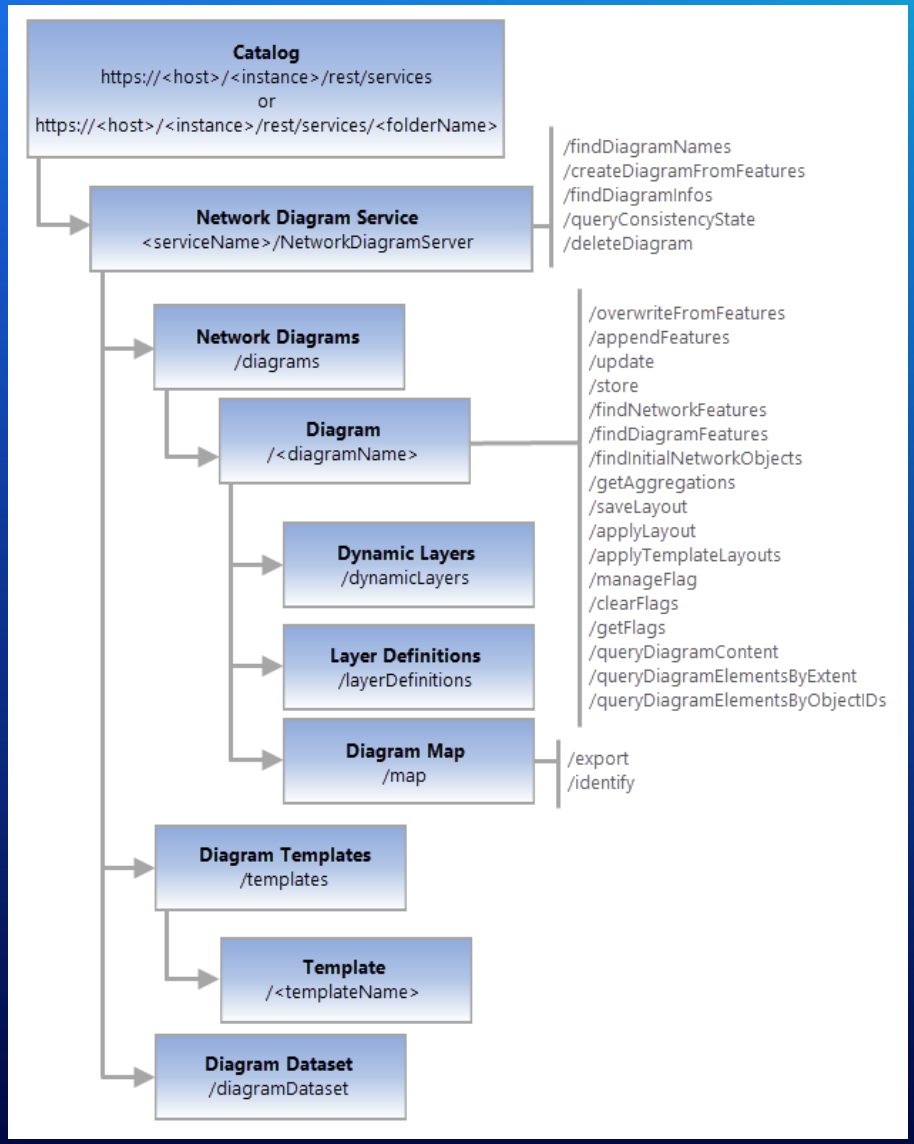
# Network Diagrams ArcGIS Pro SDK API - Diagram Layouts

# Network Diagrams ArcGIS REST API

- Introduced with ArcGIS Enterprise 10.6
- To develop your web applications based on network diagram services
- REST resource hierarchy related to  a network diagram service
  - Information about the service itself
  - Various network diagram functions




See https://developers.arcgis.com/rest/services-reference/network-diagram-service.htm

# Network Diagrams ArcGIS Developer Enterprise SDK

- New in ArcGIS Enterprise 10.9
- Part of the Geodatabase library
- To create SOEs that target network diagrams
- OMD close to the Pro SDK OMD

```
public IDiagramDataset GetDiagramDataset()
{
  IBaseNetwork unBaseNetwork = GetUtilityNetwork();

  if (unBaseNetwork != null)
    return unBaseNetwork.DiagramDataset as IDiagramDataset;

  return null;
}
```

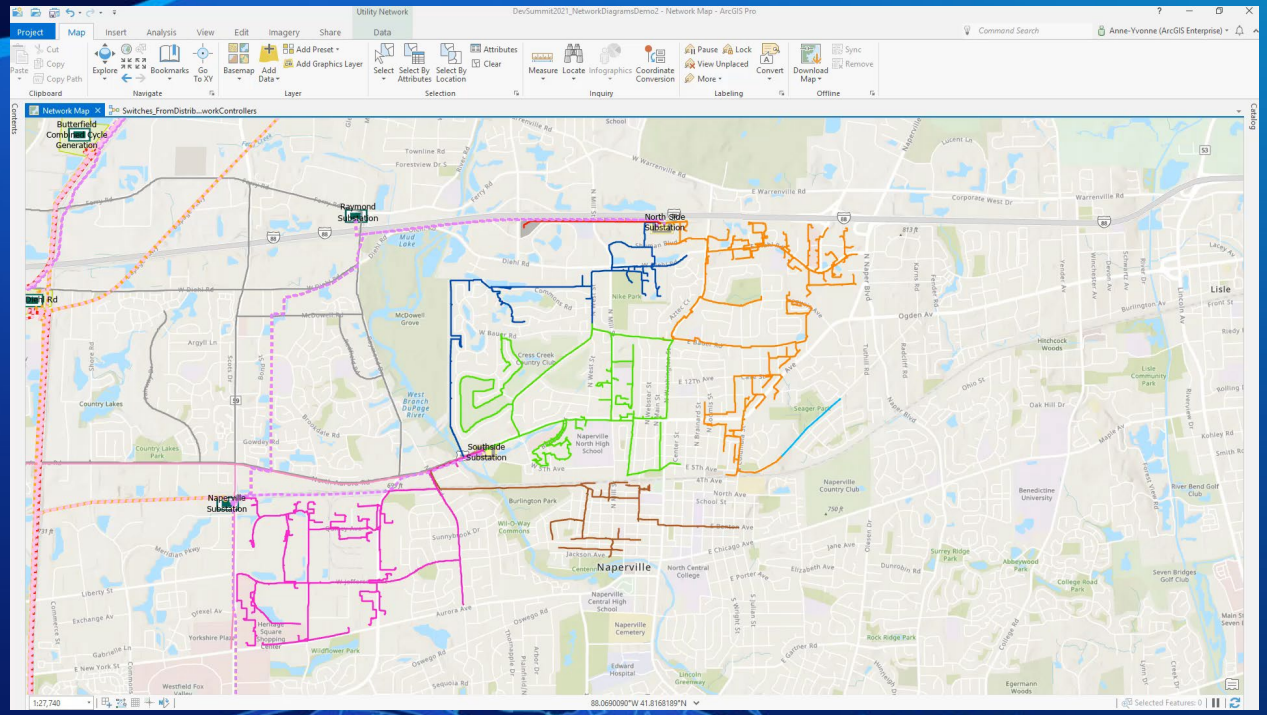
```
public IEnumDiagramTemplate GetDiagramTemplates(IDiagramDataset DiagramDataset)
{
  if (DiagramDataset != null)
    return DiagramDataset.DiagramTemplates;

  return null;
}
```

```
public IEnumNetworkDiagram GetDiagrams(IDiagramDataset DiagramDataset)
{
  if (DiagramDataset != null)
    return DiagramDataset.NetworkDiagrams;

  return null;
}
```

See https://developers.arcgis.com/enterprise-sdk/guide/net/work-with-network-diagrams-net/

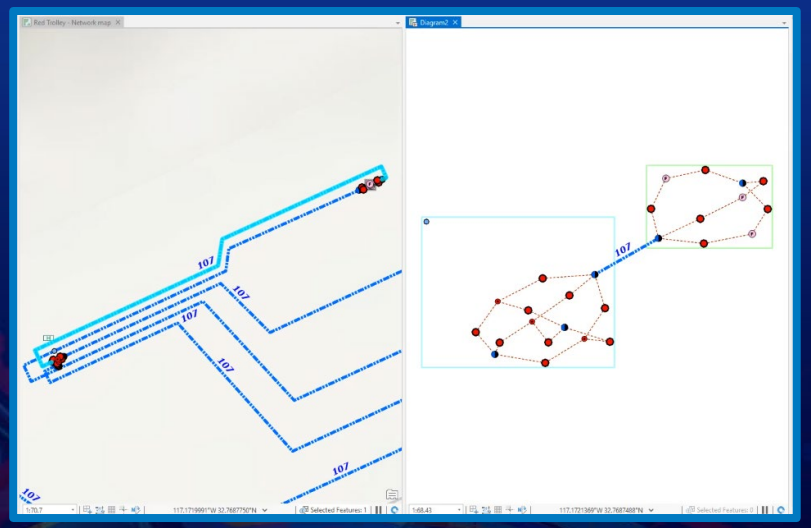


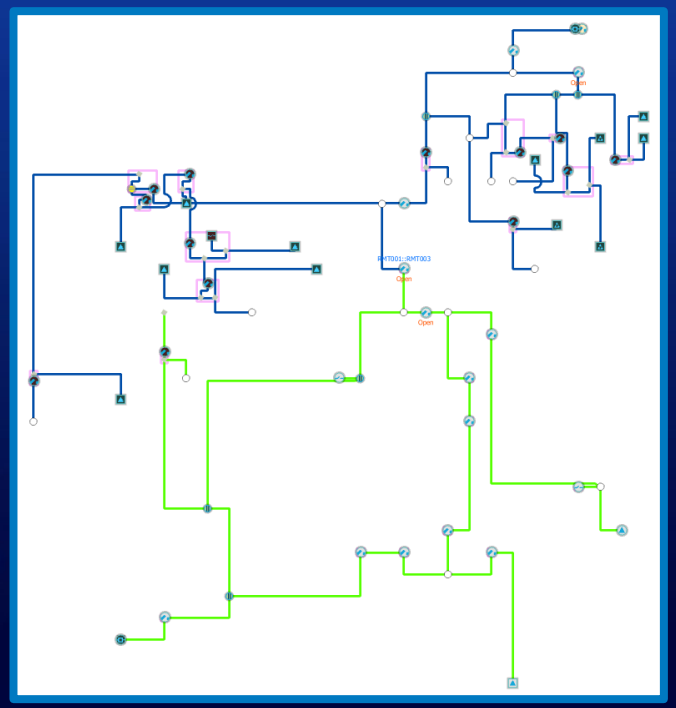

# Demo#5
# Switching diagrams, sample add-ins and web app

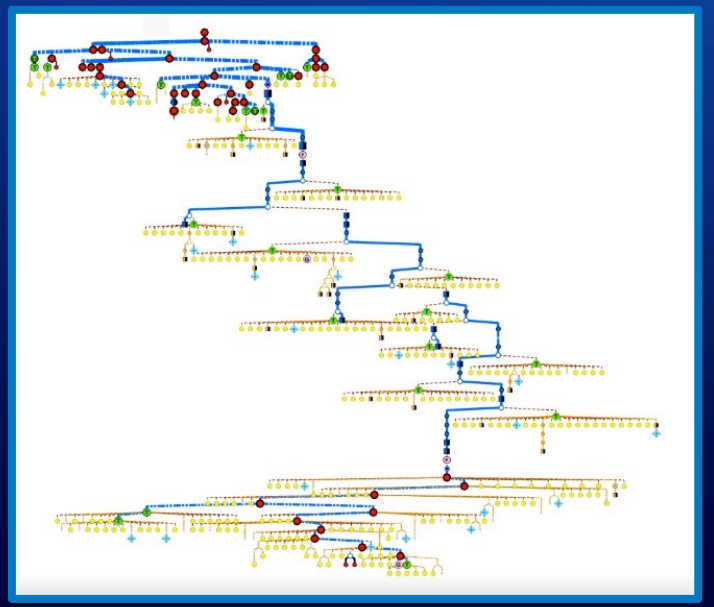
# Network Diagrams Benefits

# Network Diagrams Benefits

- Explore networks and control data quality
- Provide clear and synthetic views of your network areas
- Built from preset network traces that reflect the current network status at update







# To Learn More

- **ArcGIS blogs**
  - https://www.esri.com/arcgis-blog/products/utility-network/data-management/best-practices-to-configure-great-diagram-templates/
  - https://www.esri.com/arcgis-blog/products/utility-network/data-management/optimizing-layer-definitions-on-your-diagram-templates/
- **Tutorial to set up templates to create diagrams showing interconnected substations**
  - https://www.youtube.com/watch?v=h58hZNFvSXI&feature=youtu.be
- **Help Systems**
  - https://pro.arcgis.com/en/pro-app/latest/help/data/network-diagrams/about-network-diagrams.htm
  - https://pro.arcgis.com/en/pro-app/latest/tool-reference/network-diagram/an-overview-of-the-network-diagram-toolbox.htm

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