Case Study: Using Geometric Networks with the PODS Model

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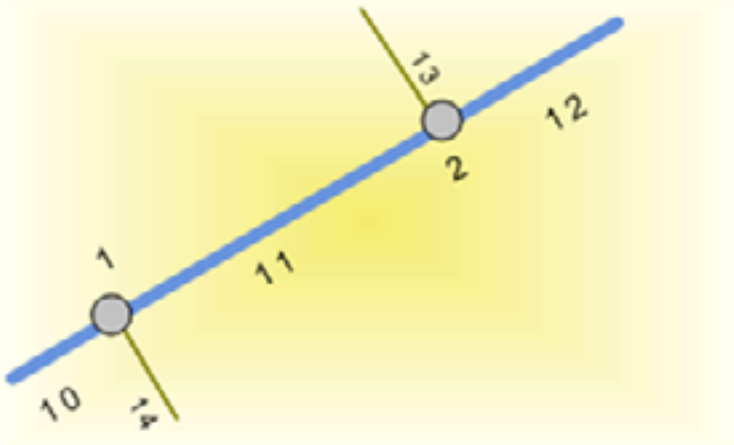
Ron Brush, New Century Software

Agenda

- Business cases and benefits of Geometric Networks for Pipeline Operators
- Challenges using Geometric Networks with PODS
- DCP Midstream business case
- CenterPoint Energy business case
- Project goals
- Description of the solution

What is a Geometric Network?



Water mains (Lines)

OID	Shape	Diameter	Material
10		8	Concrete
11		10	PVC
12		8	Concrete

Water services (Lines)

OID	Shape	Service ID	Material
13		1001	Cast iron
14		1002	Copper

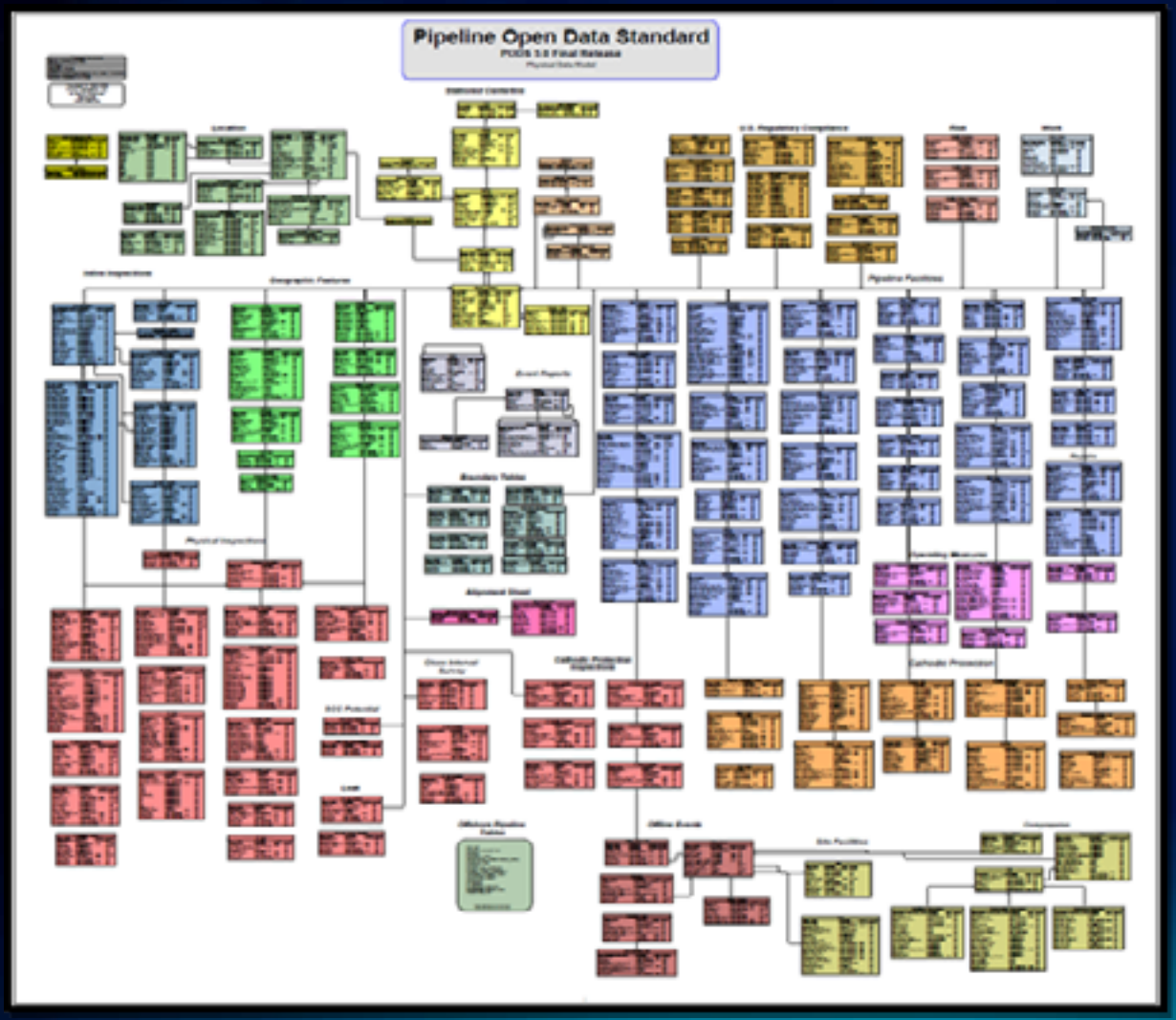
Water junction fittings (Points)

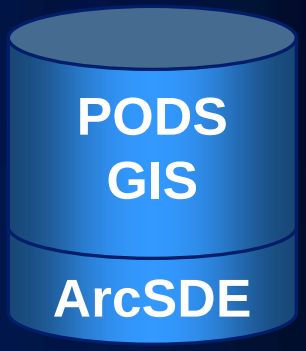
OID	Shape	Equip ID	Valve Type
1		816-32	T203
2		816-45	Y53

http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=What_is_a_geometric_network?

What is the PODS Model?

Pipeline Open Data Standard – Relational Data Model





PODS™
Pipeline Open Data Standard

www.pods.org

Using Geometric Networks for Pipelines

Business cases and benefits for Pipeline Operators

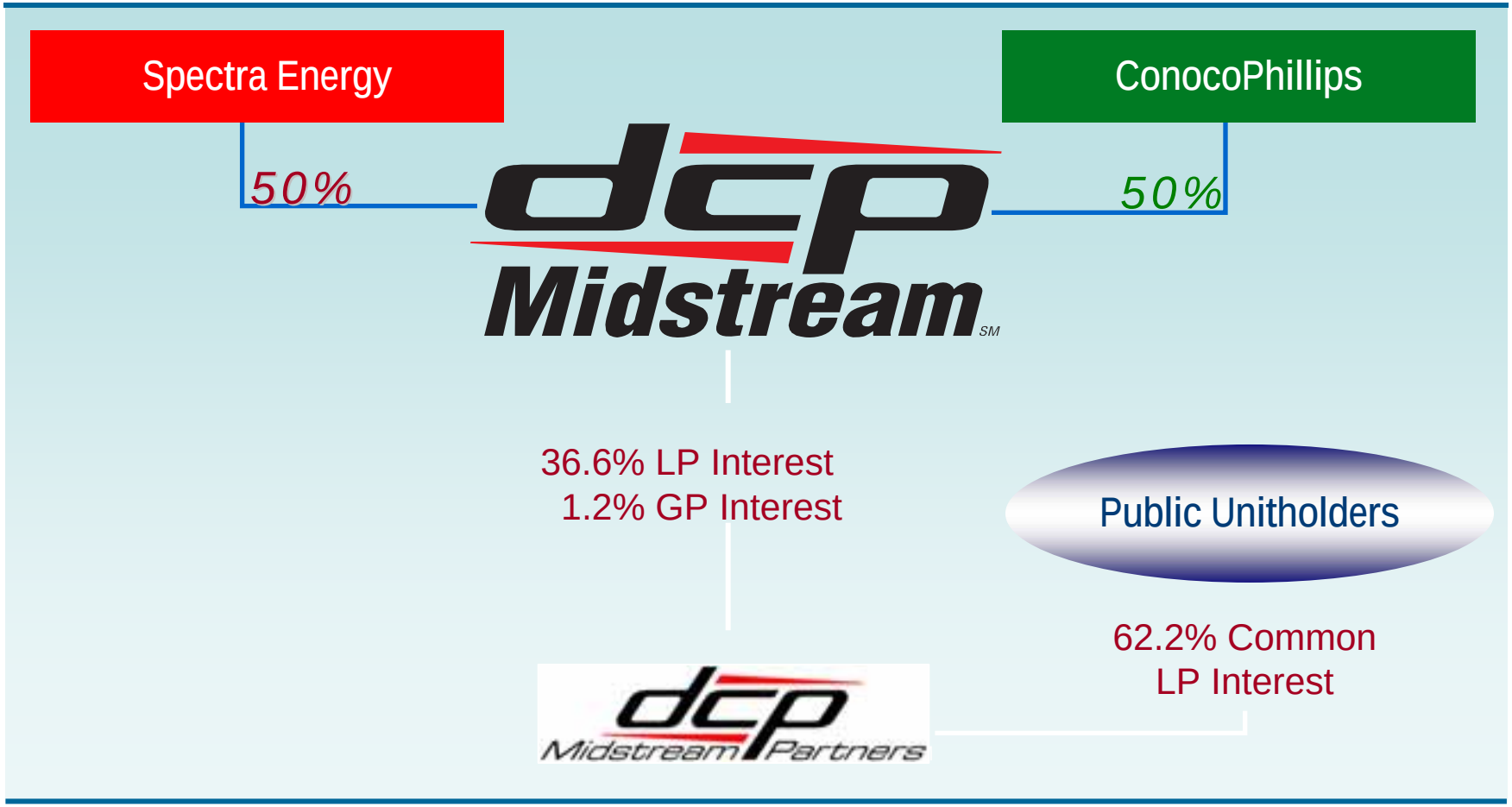
- **Network Connectivity to verify GIS accuracy**
- **Study service interruption by stopping product flow**
- **Perform true system MAOP calculations (versus segment MAOP)**
- **Calculation of more accurate drain-down volumes for liquid pipelines**
- **Schematic diagramming using ArcSchematics for analysis and illustration of connectivity**

Using Geometric Networks for Pipelines

Business cases and benefits for Pipeline Operators

- **Hydraulic flow simulation**
- **Class Location analysis using the network approach**
- **Study product additive flow - such as odorant or corrosion inhibitors**
- **Study discharge temperature for SCC**

DCP Organizational Structure



DCP Midstream has strong sponsor support and an MLP growth vehicle

Strategic Assets With Scale & Scope

Competitive Advantages

Assets
- Largest G&P asset base
- Located in most major gas basins

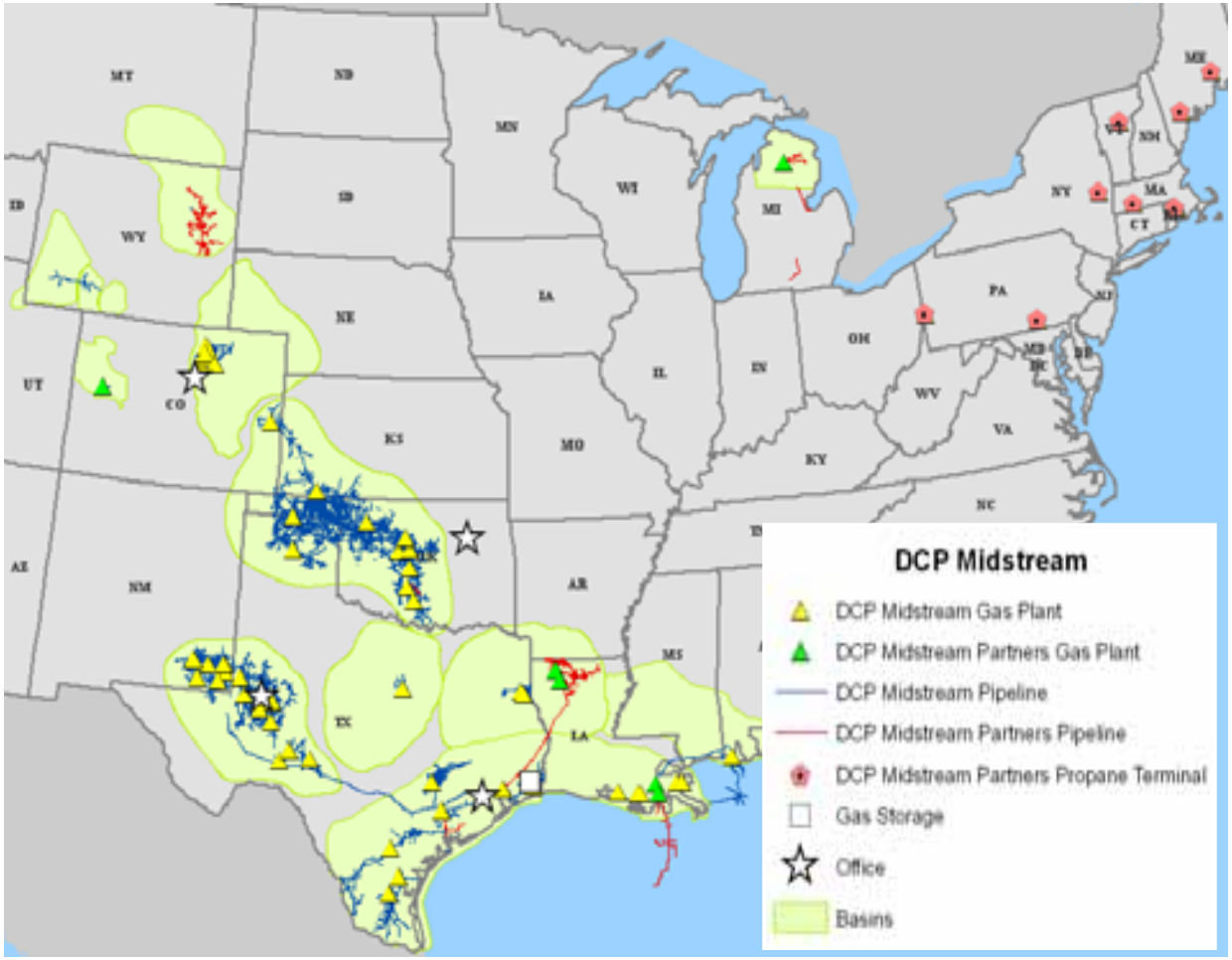
Scope & Business Model
- Broad G&P services model
- Integrated downstream (gas and NGL) operations

Customer
- Diverse contract portfolio
- Extensive / diversified customer base

YTD March 2009 Volumes

Total Throughput	7.0 TBtu/d
Gathered & Processed	5.8 TBtu/d
Natural Gas Liquids	331 MBpd

59 Plants, 10 Fractionators
62,000 Miles of Pipeline

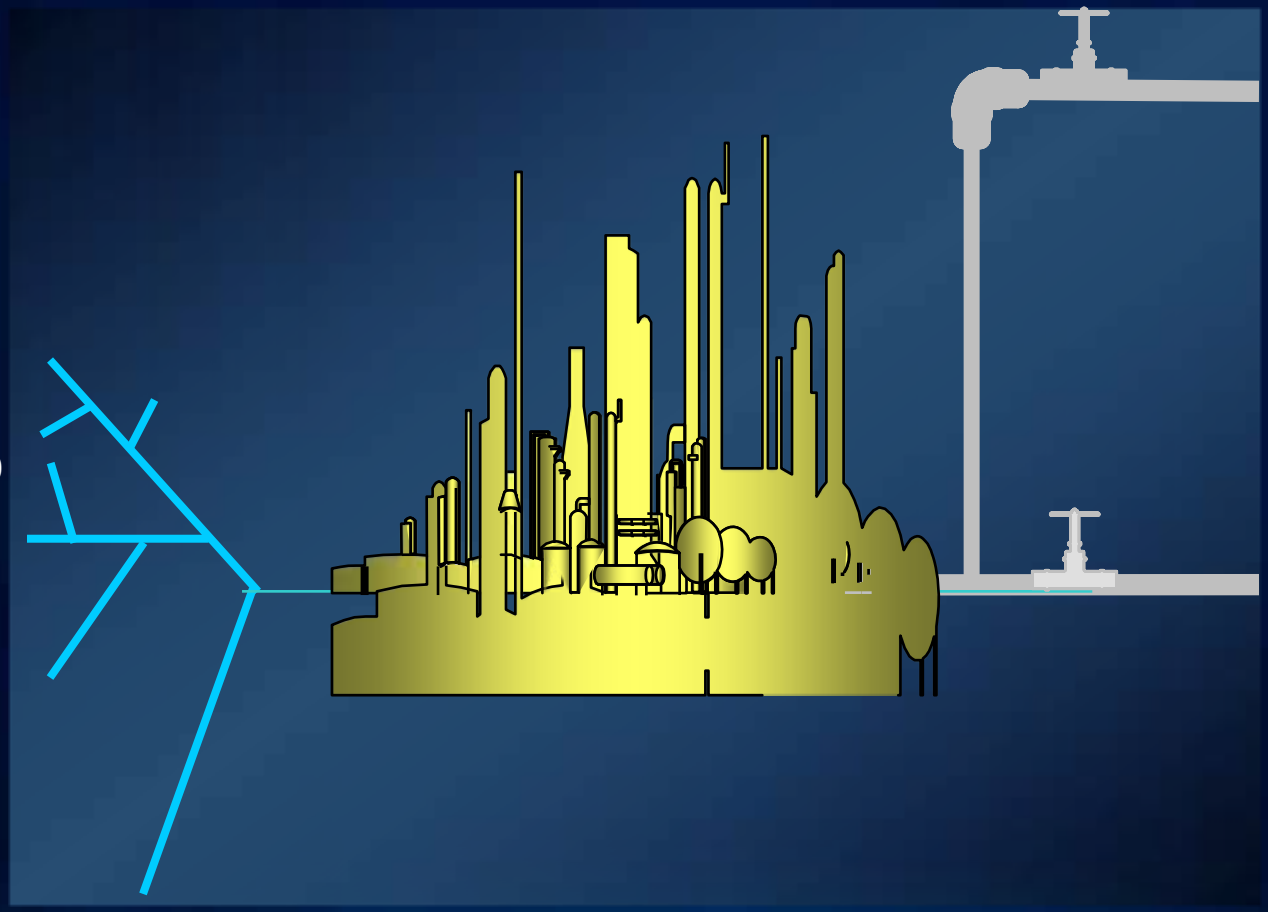


DCP Midstream has a leading industry position in the gathering and processing business … substantial oil-associated gas production

The Energy Value Chain From Wellhead to Burner-Tip

<u>Customers</u>

BP Amoco
ExxonMobil
Devon
Kerr-McGee
Apache
Anadarko
ConocoPhillips
Chevron-Texaco



<u>Customers</u>

Utilities
Industrial
Marketers

Petrochemical
Refineries
Industrials
Propane
Wholesalers

E&P

Gathering and Processing

Gas & NGL Marketing

DCP Midstream Business Case

- Summary of DCP System
  - PODS 4.02
  - ArcGIS 9.3.1
  - Oracle 10g
  - 62,000 miles gas gathering and transmission pipeline
- Business Needs
  - Class Location Analysis using Network Approach
  - WinFlow Hydraulic modeling
  - General traceability through the pipeline systems

Challenges using Geometric Network with PODS

Using Multiple Projection Systems

- **Edit Centerline in Different Projection Systems**

UTM

Geographic

- **Geometric Network is in One Projection**

PODS Model Does not Support Connectivity

The PODS data model supports pipeline features on a linear referenced centerline. However, the PODS model doesn't provide a convenient way to model the connectivity of the centerlines for this a geometric network is required. Using the Geometric Network Synchronizer creates and updates the geometric network derived layer.

The edge feature class associated with the geometric network is a derived layer, built from the PODS centerline, along with attributes from various PODS event tables.

This derived layer is automatically updated whenever users edit data in PODS or make edits to the centerline in ArcMap.

Challenges using Geometric Network with PODS

Using data from multiple layers in PODS

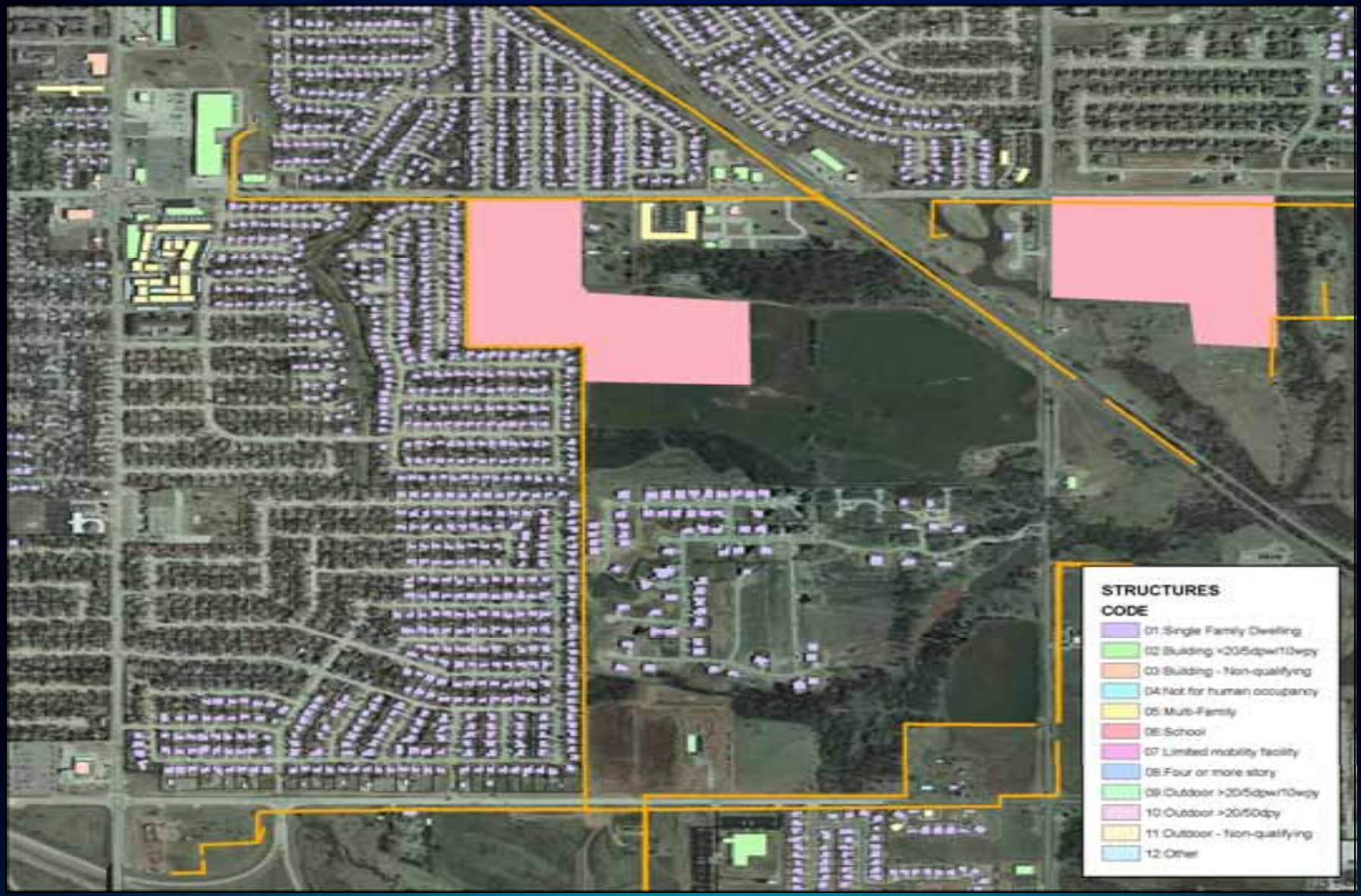
- **Dynamic Segmentation of data**

Geometric Network must stay synchronized <u>as data is edited</u>

Engineering - System Optimization
Hydraulic Modeling Using WinFlow

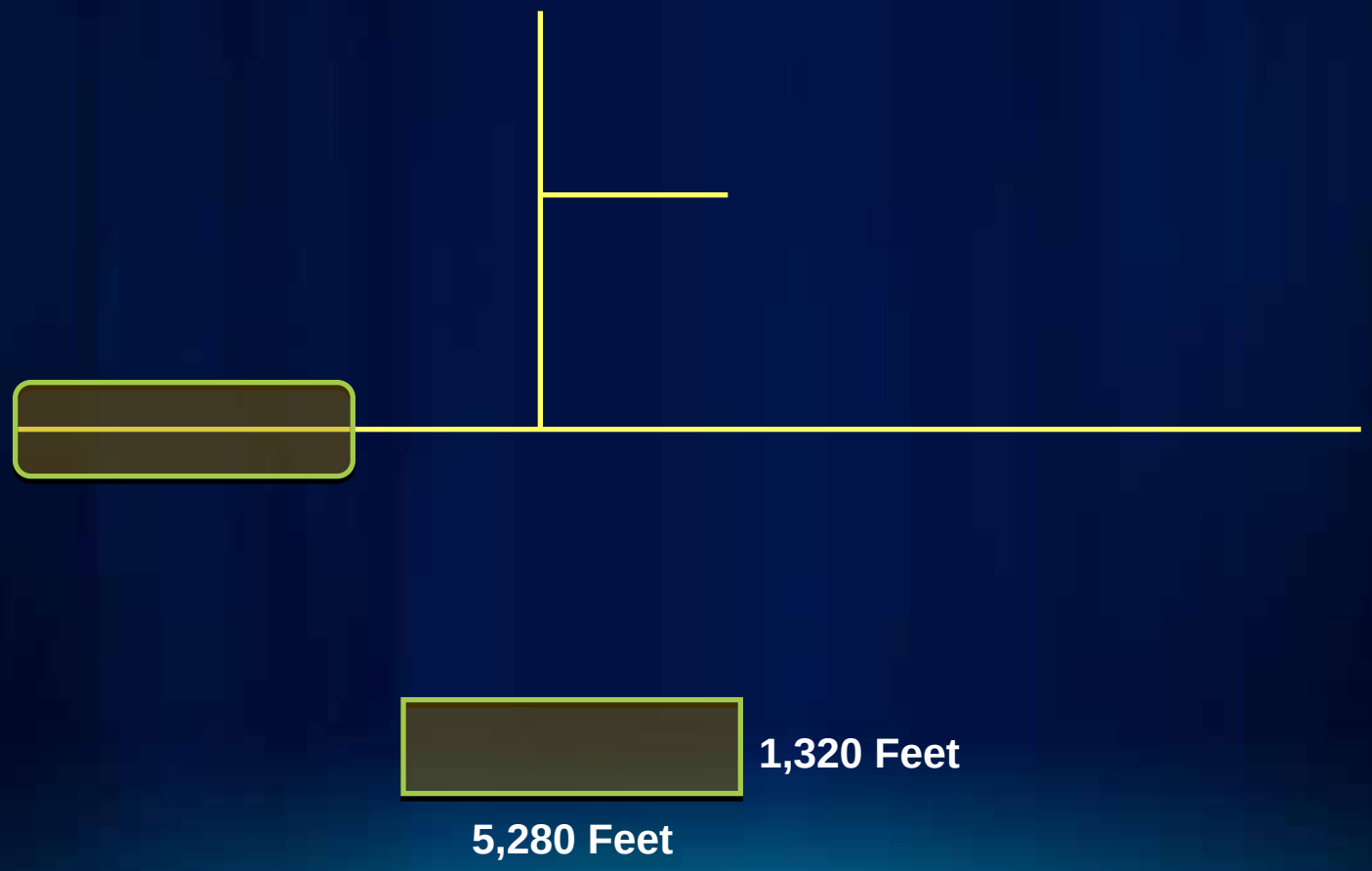
Pipeline Integrity

Identifying Structures Along DOT Pipelines



Class Location Analysis

Using the Network Approach for Class Location Unit



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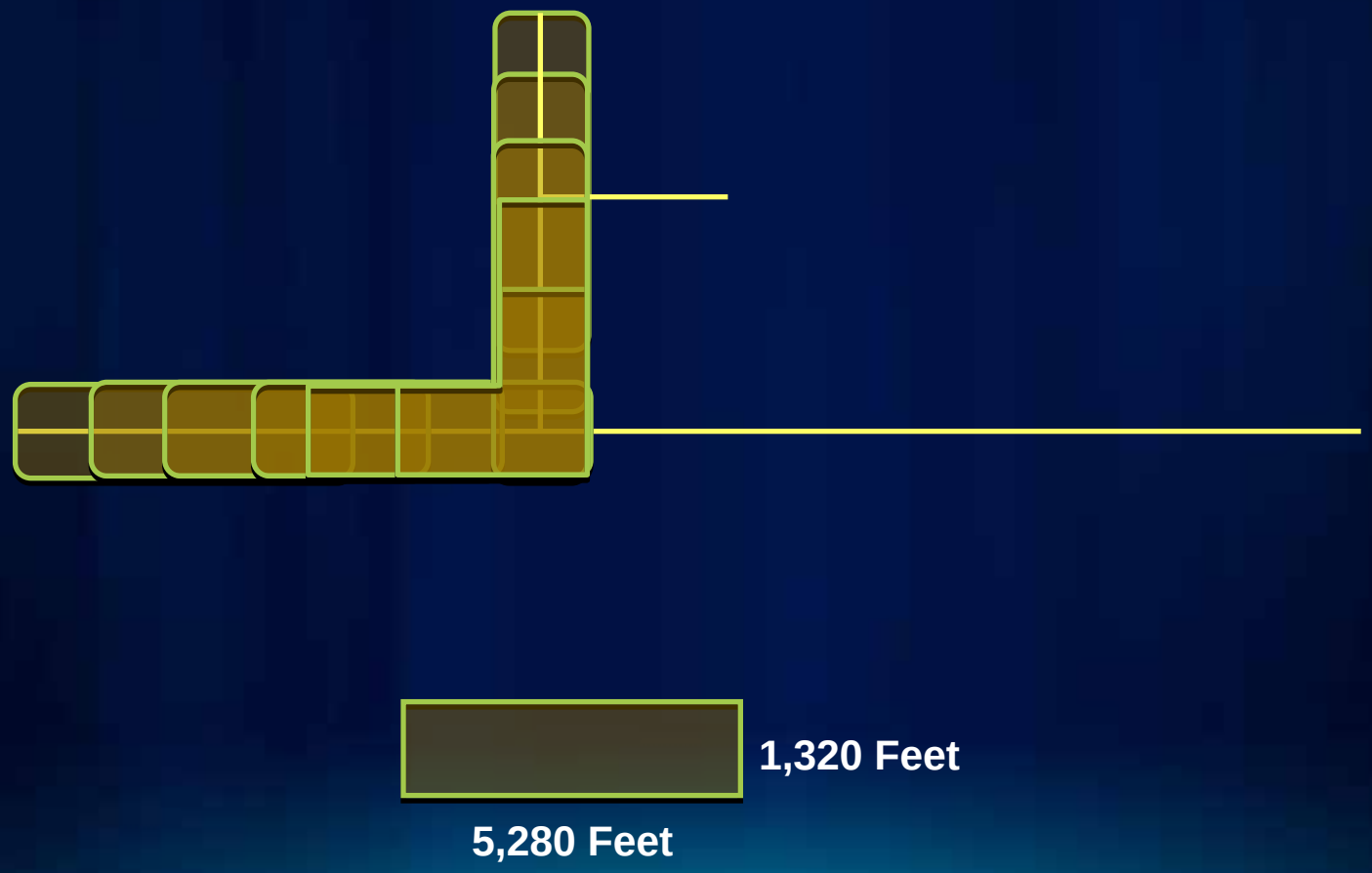

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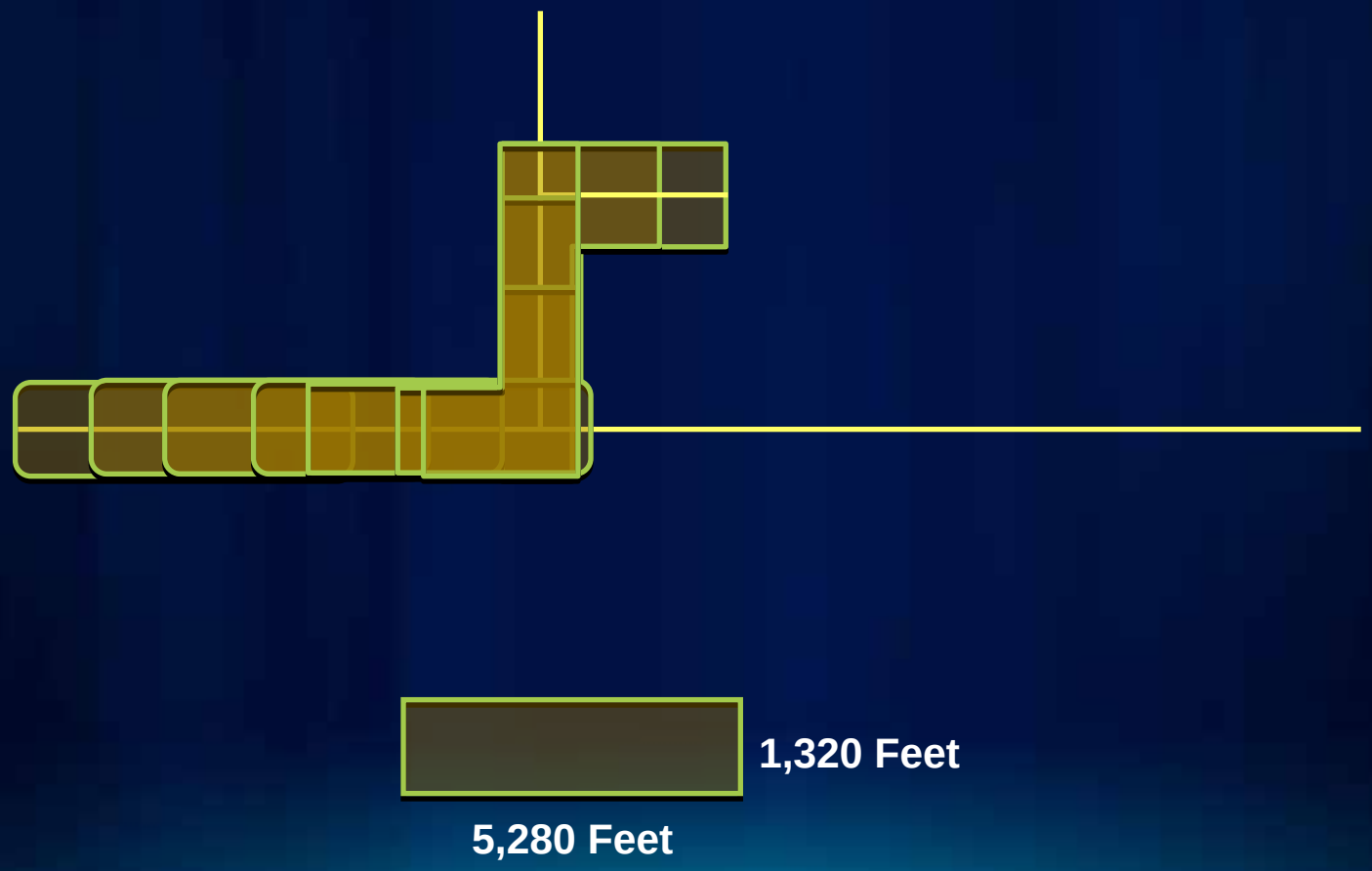

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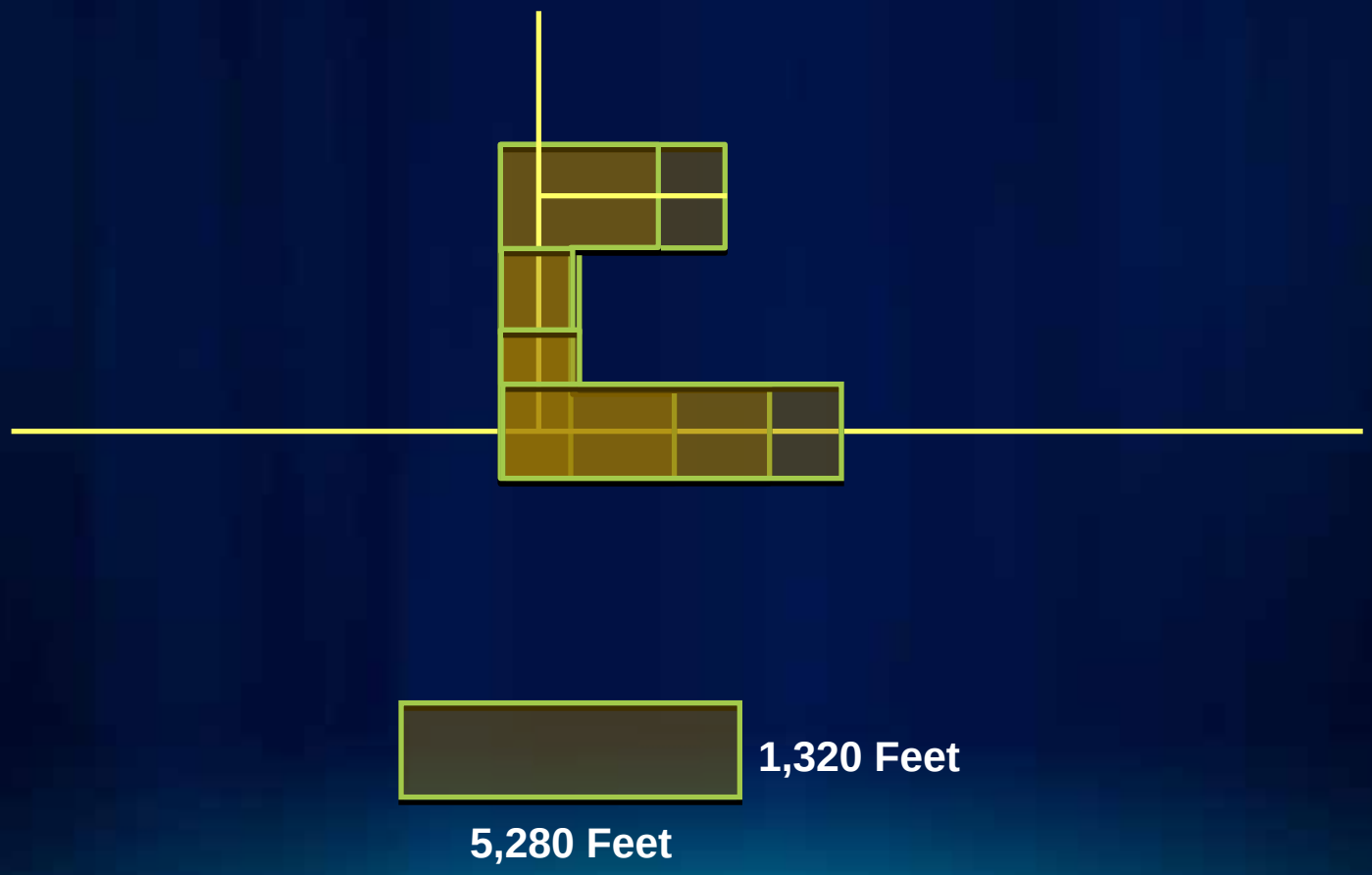


CenterPoint Energy

CenterPoint Energy Gas Transmission

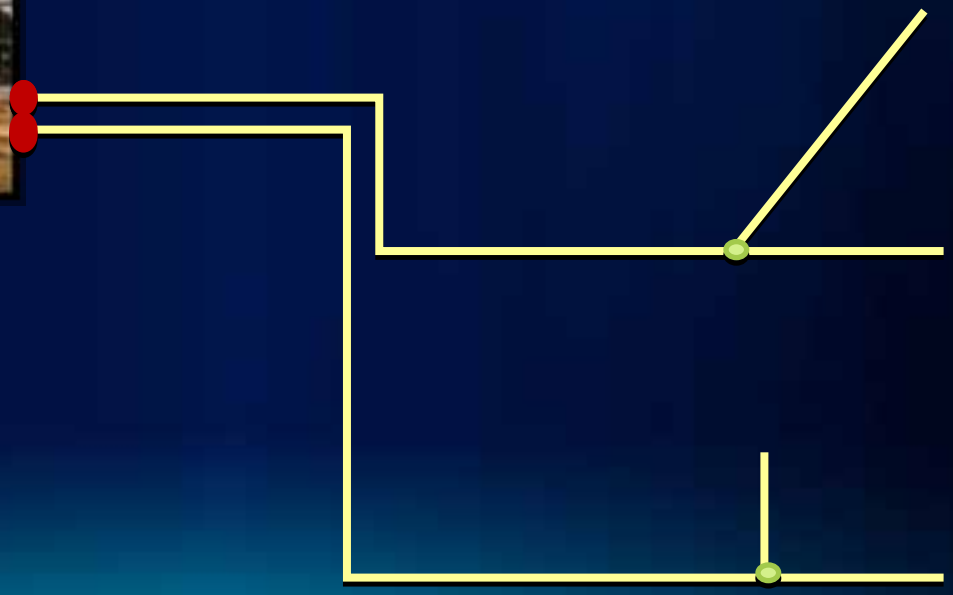
Mississippi River Transmission

- **Summary of CenterPoint System**
  - **PODS 3.2**
  - **ArcGIS 9.3.1**
  - **Oracle 10g**
  - **8,000 miles gas transmission**
  - **3,000 miles gas gathering**
- **Business Needs**
  - **Odorant Flow Analysis**
  - **Discharge Temperature Analysis - SCC**

Heat Discharge Analysis

1. Odorant Flow Analysis

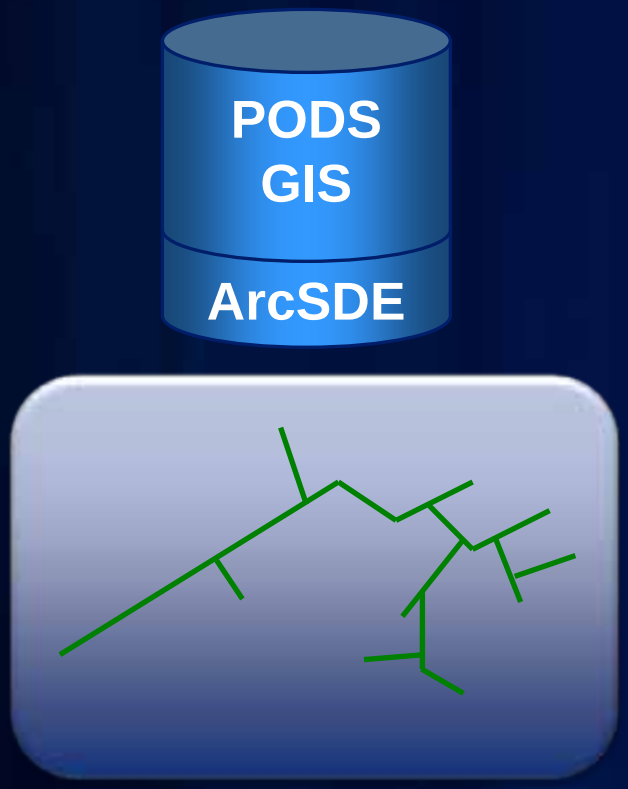
2. Temperature Analysis for Stress Corrosion Cracking (SCC)



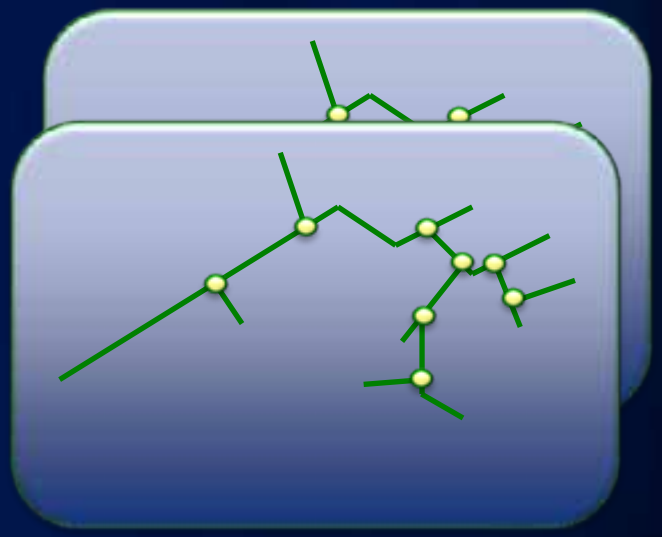
Project Goals

1. Ability to edit centerline in local projection and store Geometric Network in Lat/Long
2. Ability to select attributes in the Geometric Network from PODS features
3. Dynamic segmentation on multiple PODS linear features for analysis purposes
4. Build one or more Geometric Networks from PODS and keep them synchronized as edits are made
5. Support user-defined snapping overrides

Solution Overview



1. User Edits PODS Centerline in ArcGIS



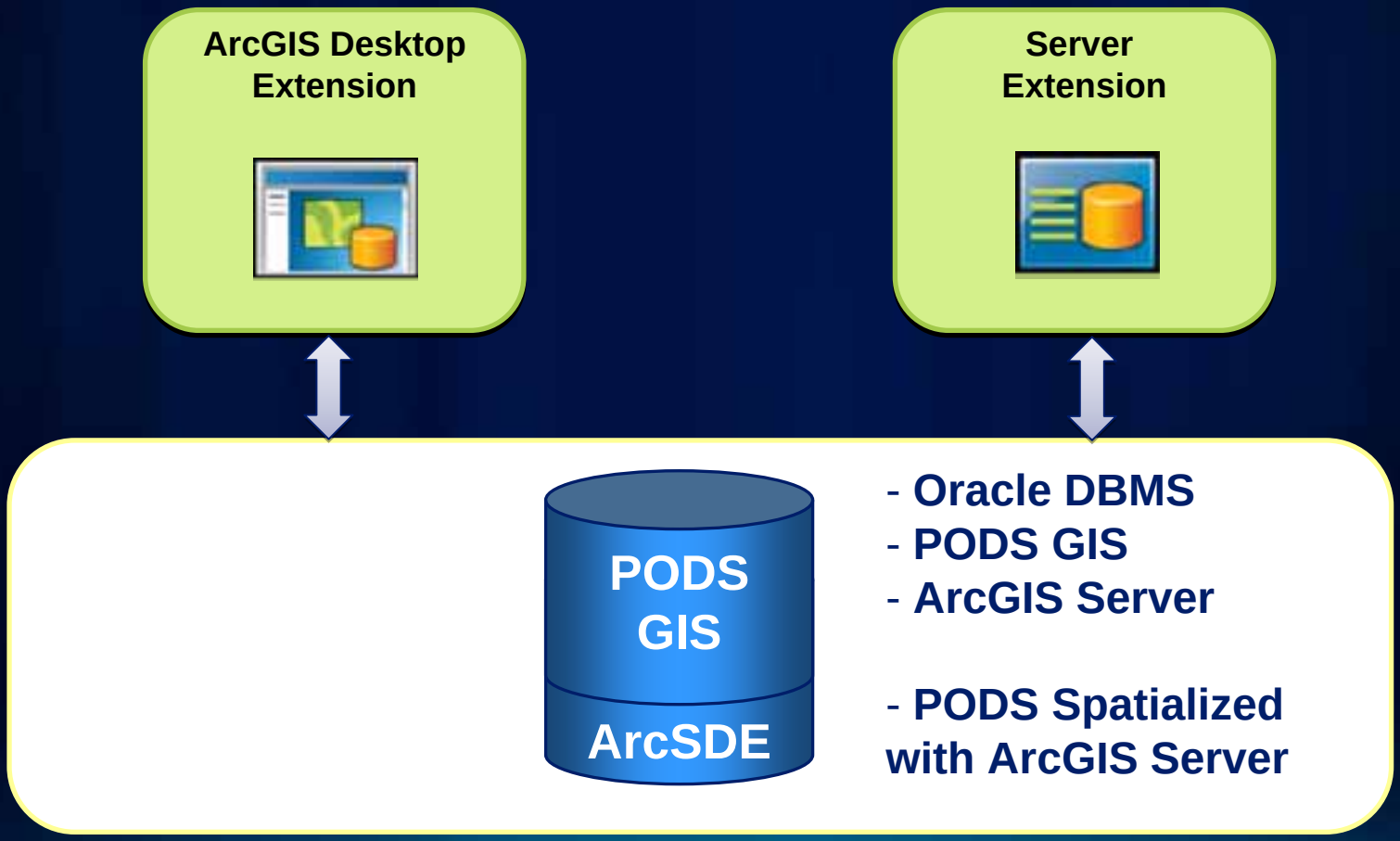
2. Geometric Network Synchronizer automatically updates Geometric Network(s) to reflect changes.

Solution Description

Geometric Network Synchronizer – ArcGIS Extension

- **Manual or Automatically rebuild Geometric Network**
- **Preserves Linear Referencing**
- **Dynamic Segmentation of Linear features**
- **Snapping Overrides – Connect and Disconnect**

Solution Architecture



Summary

- Joint Partnership with DCP Midstream and CenterPoint
- Developed solution on PODS Relational Model spatialized with ArcGIS Server
- Many pipeline uses for Geometric Networks
- Data can be edited in any projection
- Geometric Network is dynamically segmented and linear referenced

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