



# GIS for Federal Buildings: BISDM Version 2

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# Enterprise Real Property Management Track



## PAPER SESSIONS

### **Managing Federal Real Property**

*Thursday, February 18 – 8:30-10:00 – Room 143C*

Users from four different Federal agencies will explain some of their recent work in applying GIS to improve the management of their real property assets. Applications include supporting multiple sites, integrating with ArcGIS Web services and Google Earth, decision support solutions, and a facility data fusion solution.

### **Managing Real Property – Civilian Agency Applications**

*Thursday, February 18 – 10:30-12:00 – Room 143C*

Users from various Federal civilian agencies will share their experiences in spatially enabling real property management applications. Examples will include a spatially enabled decision support solution, an application to optimize your interior space utilization, plus asset management and project management solutions.

### **Managing Real Property – Defense Agency Applications**

*Thursday, February 18 – 2:00-3:30 – Room 143C*

Assets and services at Defense installations support numerous military missions and need to be managed in a cost-effective, safe, sustainable, and environmentally sound manner. In this session, you will hear from representatives of the Pentagon, Marine Corps, Navy, and Air Force on ways to improve the management of these vital assets.

## Technical Workshops

### **GIS for Federal Buildings: BISDM Data Model Version 2**

*Thursday, February 18 – 4:00-5:30 – Room 156*

This workshop will present recent revisions to the Building Interior Space Data Model (BISDM) version 2 template. The BISDM template has been successfully used and adapted in a number of real-world projects to meet a variety of enterprise integration and business application requirements in the past year.

### **GIS for Federal Buildings: 3D GIS for Facilities**

*Friday, February 19 – 8:30-10:00 – Room 156*

New 3D GIS capabilities in ArcGIS provide facility managers with a set of tools to manage and assess existing facilities, as well as evaluate planned facilities. Attendees will be introduced to the different 3D display platforms and various spatial analysis tools.

### **GIS for Federal Buildings: Data Input, Editing and Management**

*Friday, February 19 – 10:30-12:00 – Room 156*

As facilities managers consider implementing an enterprise solution, the most common issues are managing disparate data. How do I bring my paper drawings, spreadsheets, GIS, and CAD data into a common database to serve as the platform for an enterprise facilities management solution? This workshop will discuss the process, workflows, data models, and tools required to input, edit, and manage an enterprise facilities management database.

## User Group Meeting

### **SIG – Buildings & Facilities Data Theme**

*Friday, February 19*

*2:30-4:00*

*Room 156*

# Topics

- Quick History of BISDM effort
- Layout of BISDM Version 2 and Supporting Resources
- Core Object Model and Attribute Enhancements
- New Support for Assets and BIM-GIS integration PTC's
- BISDM Version 3 Highlights (Late Summer 2010)
  - support for 3D objects and transportation networks



## Quick History of BISDM Effort



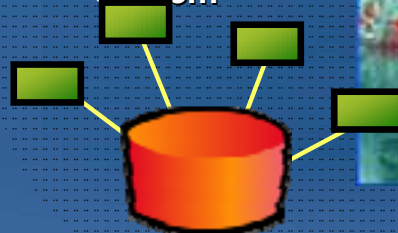
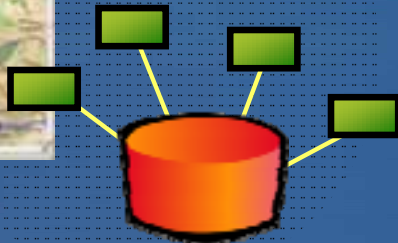
# GIS Is Core Technology

## It is used to build Information Systems

*Supporting Many Professions, Workflows and Application Domains*



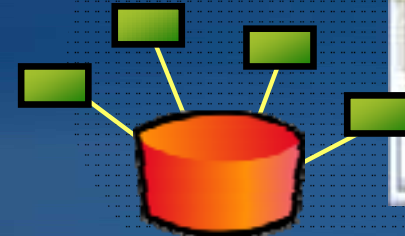
**Cartographic Information System**



**Image Information System**



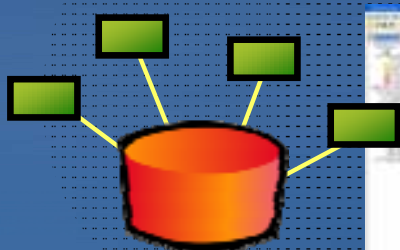
**Cadastral Information System**



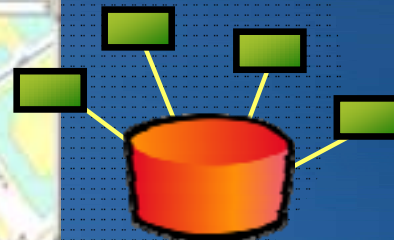
### Information Systems for

- Natural Resources
- Land Use Planning
- Transportation
- Land Management
- Business Analysis
- Geospatial Intelligence
- Defense
- Visualization
- Scientific Analysis
- Public Safety
- Demographics
- Health Care
- Cartography
- Asset Management

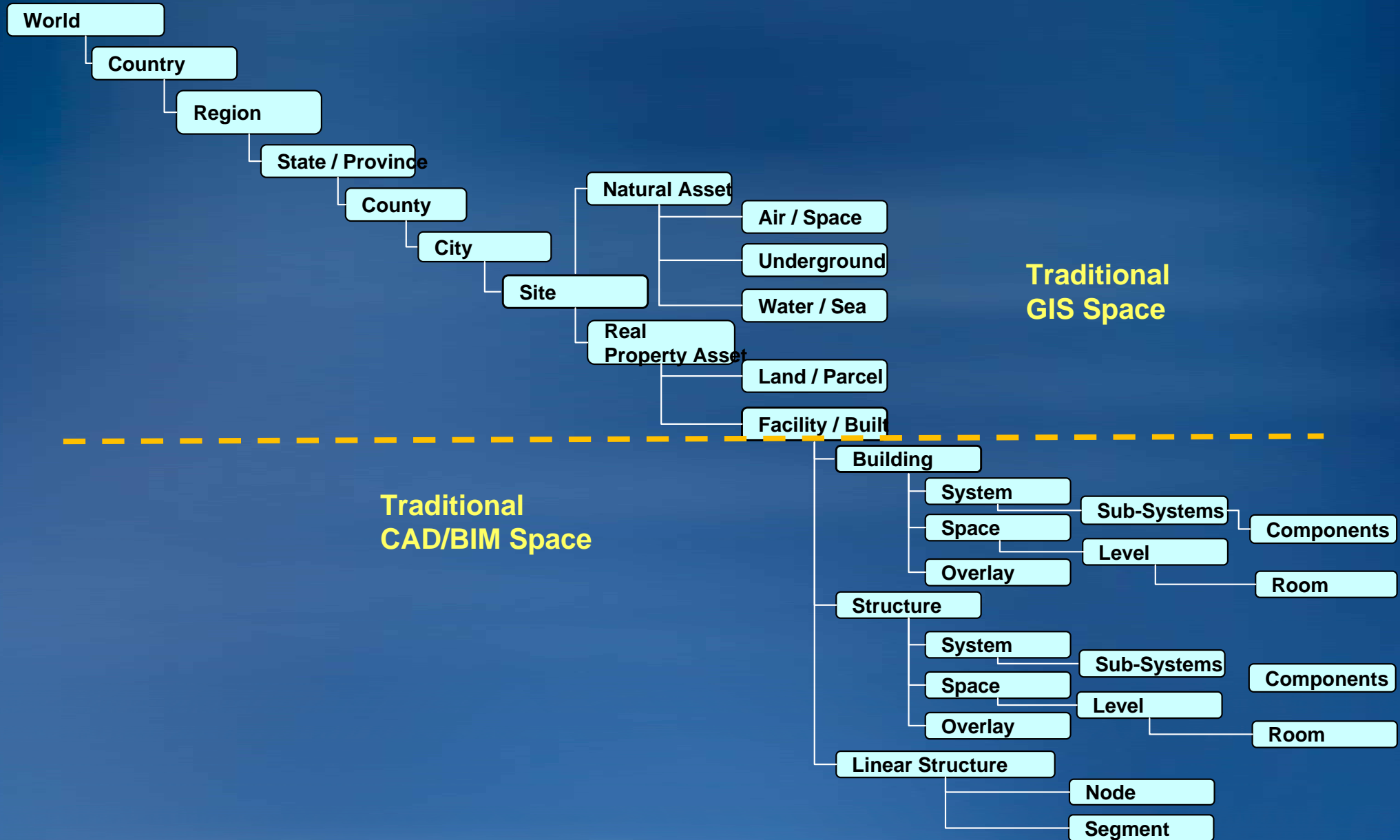
**Business Analysis System**



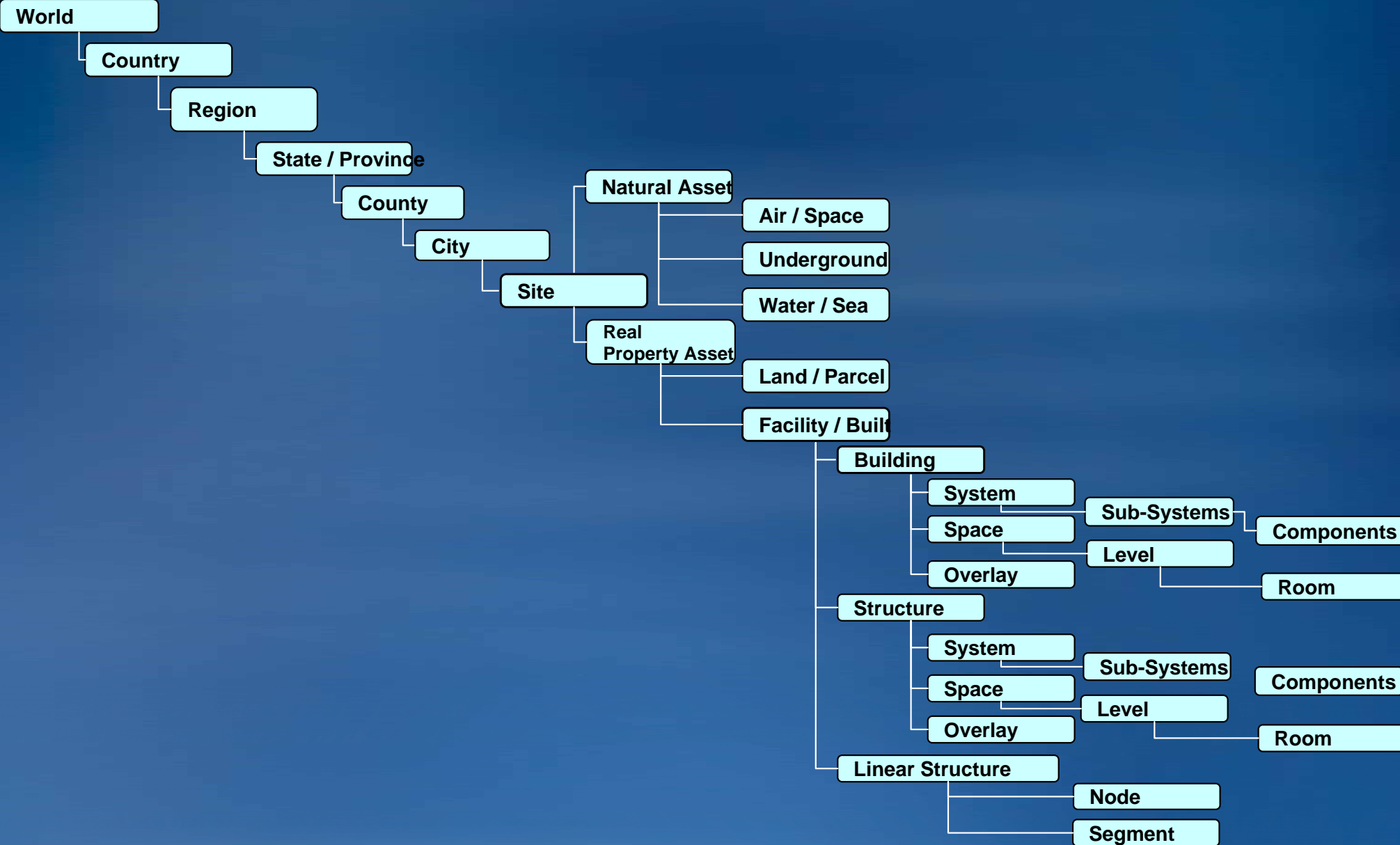
**Facility Management System**



# Total Scalability Using GIS



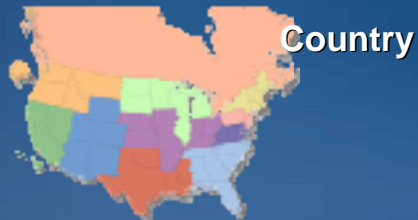
# Total Scalability Using GIS



# Manage, Analyze, and Report building data at all scales



Global



Country



Region



City

Campus



Building



Rooms  
Equipment  
Furniture



## Building Attributes:

*Owner / Occupant*

*Form / Function*

*Deferred Maintenance*

*Value (FRV) / Charge back*

*Asset Condition (CI)*

*Utilization/ Predominant Use*

*Sustainability / LEED*

## Building Systems:

*Fiber / Telecom*

*Power / Water / HVAC*

*Emergency / Security*

*Environmental / Energy Star*

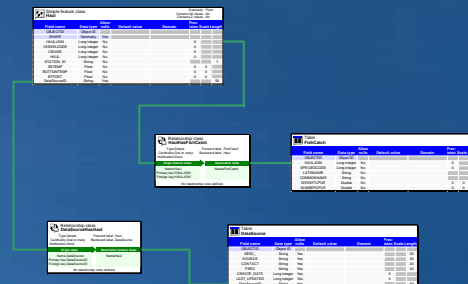
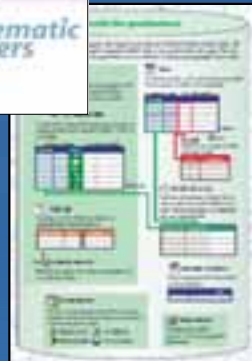
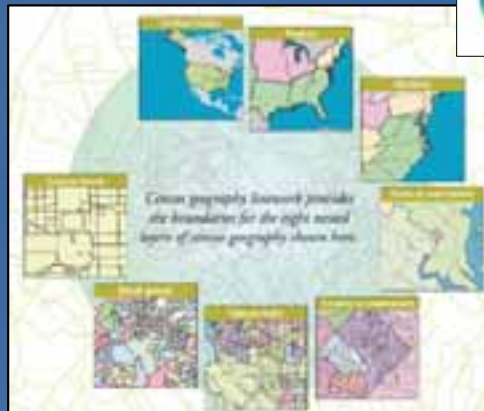
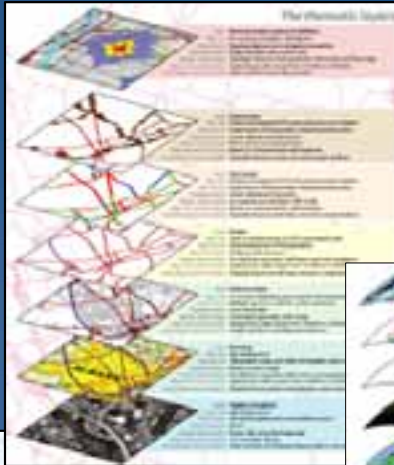
*Alternative Energy*



# ESRI Geodatabase Data Models

*Standardized Templates for Many Fields*

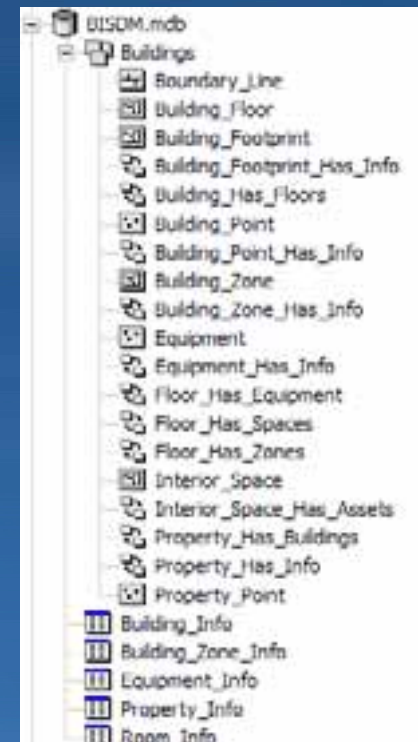
- Address
- Agricultural
- Atmospheric
- Base Map
- Biodiversity
- Carbon Footprint
- Census-Admin
- Boundaries
- Defense-Intel
- Energy Utilities
- Environmental
- Forestry
- Geology
- Groundwater
- Health
- Historic Preservation & Archaeology
- Homeland Security
- Hydro
- IHO
- Land Parcels
- Local Government
- Marine
- National Cadastre
- Petroleum
- Pipeline
- Telecommunications
- Transportation
- Water Utilities
- Building Interior Space



# ESRI's Building Interior Space Data Model (BISDM) for GIS

## *An user community effort*

- Started in summer 2007
- Build template to serve many uses cases and compatible technologies
- Real-world project tested
- Support property, building, and asset objects
- Models, supporting documentation, data loading tools, and sample viewers at [www.esri.com/datamodels](http://www.esri.com/datamodels)



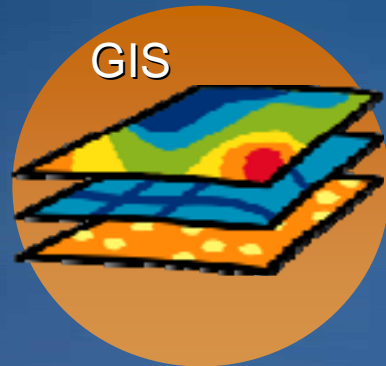
# Geodatabases support Real Property Industry Specifications



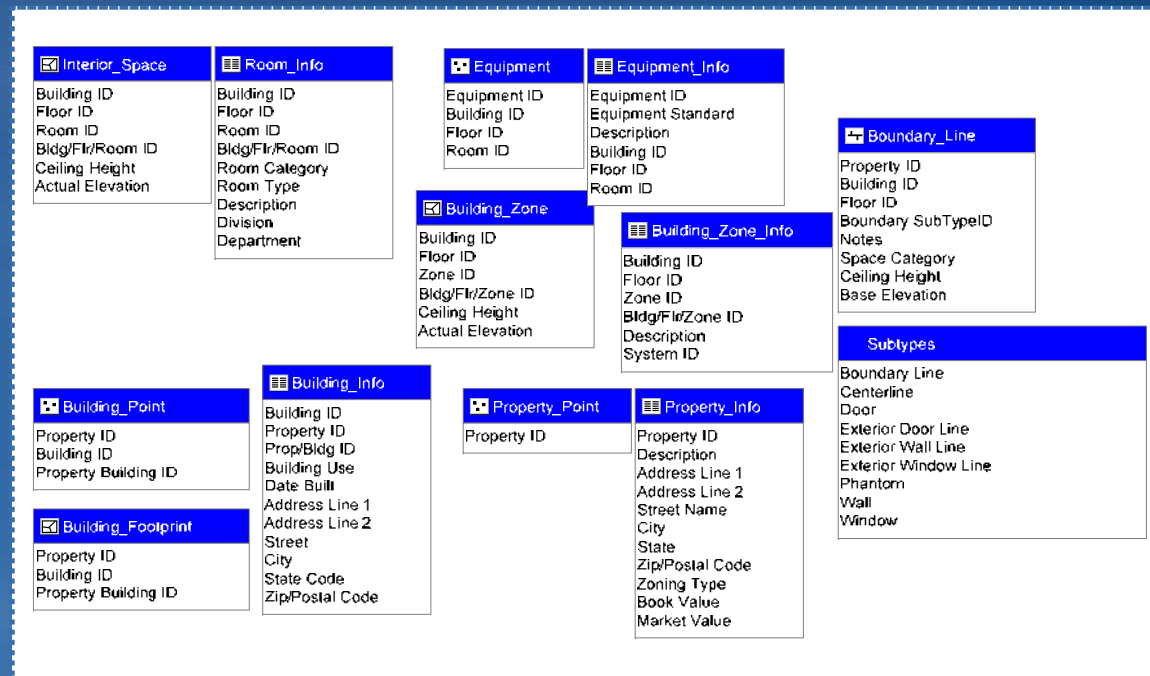
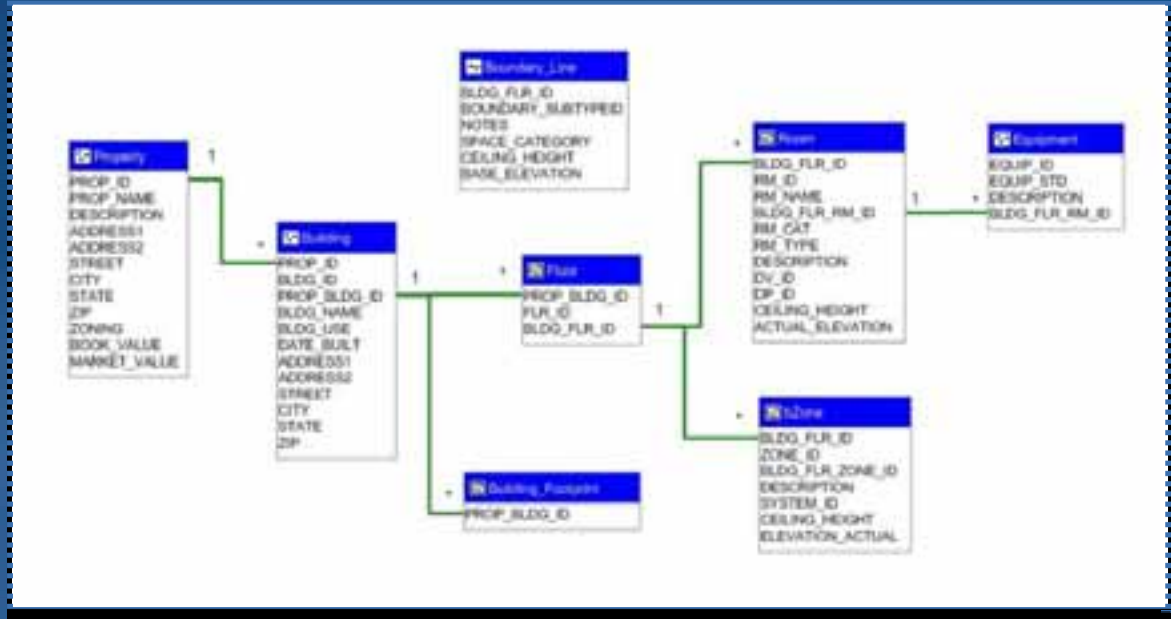
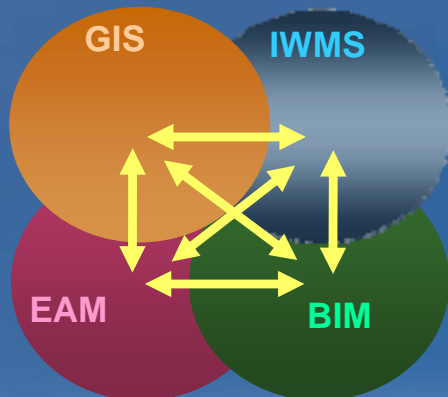
- Defining and measuring building space
  - BOMA and FICM
- Classifying building space -- form, function, assets
  - Open Standards Consortium for Real Estate (OSCRE)
  - OmniClass<sup>tm</sup>
- Building information models (BIM)
  - NBIMS a buildSMART initiative
  - Industry Foundation Classes (IFC)
- Building object information exchange
  - Construction Operations Building Information Exchange (COBIE) a buildSMART initiative

# Split and Merged BISDM's

- Merged
  - GIS only



- Split
  - GIS + BIM/EAM/IWMS





# ESRI Geodatabase Data Models

- Go to [www.esri.com/datamodels](http://www.esri.com/datamodels)

The screenshot shows the ESRI Support Center website. The header includes the ESRI logo, the text "ESRI Support Center Your online technical resource", and links for Customer Service, Training, and Contact Us. Below the header are tabs for Support Home, Software, Knowledge Base, Downloads, and User Forums. A search bar is present with the text "Search the Support Center for" and a "Go" button. The main content area is titled "Downloads for Data Models" and includes a breadcrumb trail: "You are here: Support Home > Downloads > Data Models > Downloads". The page contains several paragraphs of text about data models, including a section titled "Latest Data Model Downloads" which lists three models: "Hydro Data Model: Comprehensive Terrain Preprocessing Using Arc Hydro Tools" (December 9, 2009), "Building Interior Space Data Model: BISM 2.0 Data Loading Tools" (November 6, 2009), and "Building Interior Space Data Model: BISM 2.0 Campus Viewer" (November 6, 2009). The "Building Interior Space Data Model" is highlighted in a red box. Below this is a section titled "Select a Data Model Industry Group" with a table of data models. The table has columns for "Case Studies", "Design Templates", and "Tools". The "Building Interior Space" row is highlighted in a red box.

**Downloads for Data Models**

With the ArcGIS platform, the ESRI vision is to build many industry-specific data models. Our basic goals are to simplify the process of implementing projects, and to promote and support standards that exist in our user communities.

Academic and industry leaders collaborate with ESRI to create and design data model templates that can be used with one GIS platform. The result is this set of data model structures that can be implemented for each of the industries and scientific disciplines that ESRI serves.

Read about the goals and process in the [Introduction to ArcGIS Data Models](#), and visit the [Data Model tips and tricks](#) page designed as a resource for common methods and best practices.

Visit the [ESRI data model discussion forum](#) to share your ideas, thoughts, and questions with other users.

**Latest Data Model Downloads**

- Hydro Data Model:**  
[Comprehensive Terrain Preprocessing Using Arc Hydro Tools](#)  
December 9, 2009
- Building Interior Space Data Model:**  
[BISM 2.0 Data Loading Tools](#)  
November 6, 2009
- Building Interior Space Data Model:**  
[BISM 2.0 Campus Viewer](#)  
November 6, 2009

Select a Data Model Industry Group

Use this matrix to compare industry areas that have Case Studies and Design Templates available. Click the name of the data model for a general overview, Case Studies, and Design Templates, or click the check mark for detailed download information.

	Case Studies	Design Templates	Tools
<a href="#">Address</a>	☑	☑	☑
<a href="#">Agriculture</a>	☑		
<a href="#">Atmospheric</a>	☑	☑	☑
<a href="#">Basemap</a>	☑	☑	
<a href="#">Biodiversity</a>		☑	
<a href="#">Building Interior Space</a>	☑	☑	☑
<a href="#">Carbon Footprint</a>		☑	
<a href="#">Census-Administrative Boundaries</a>	☑	☑	
<a href="#">Defense-Intel</a>	☑	☑	
<a href="#">Energy Utilities</a>		☑	
<a href="#">Energy Utilities - MultiScale TM</a>		☑	
<a href="#">Environmental Regulated Facilities</a>		☑	
<a href="#">Fire Service</a>		☑	





# Layout of BISDM Version 2 and Supporting Resources

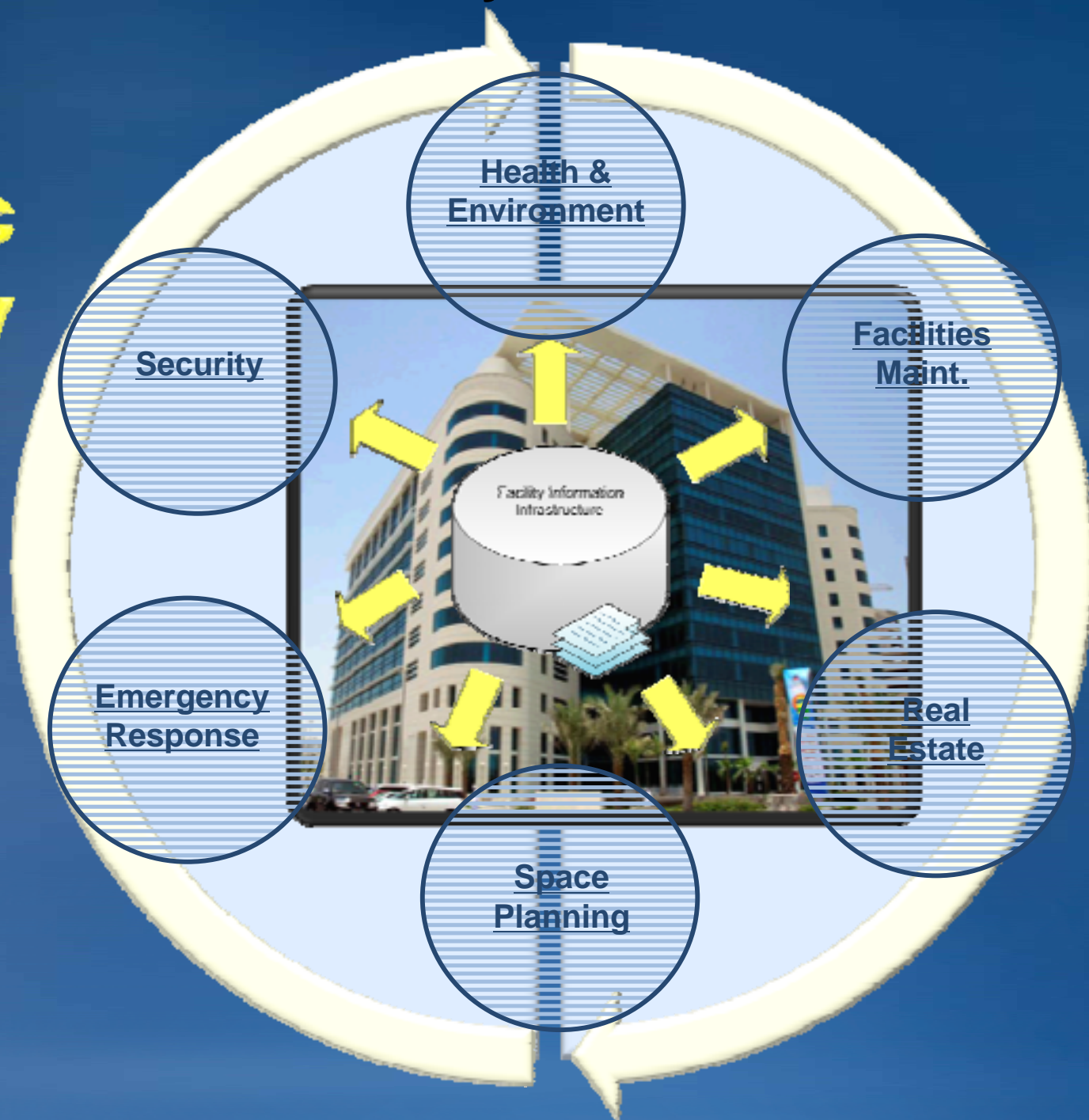


# Core Object Model and Attribute Enhancements

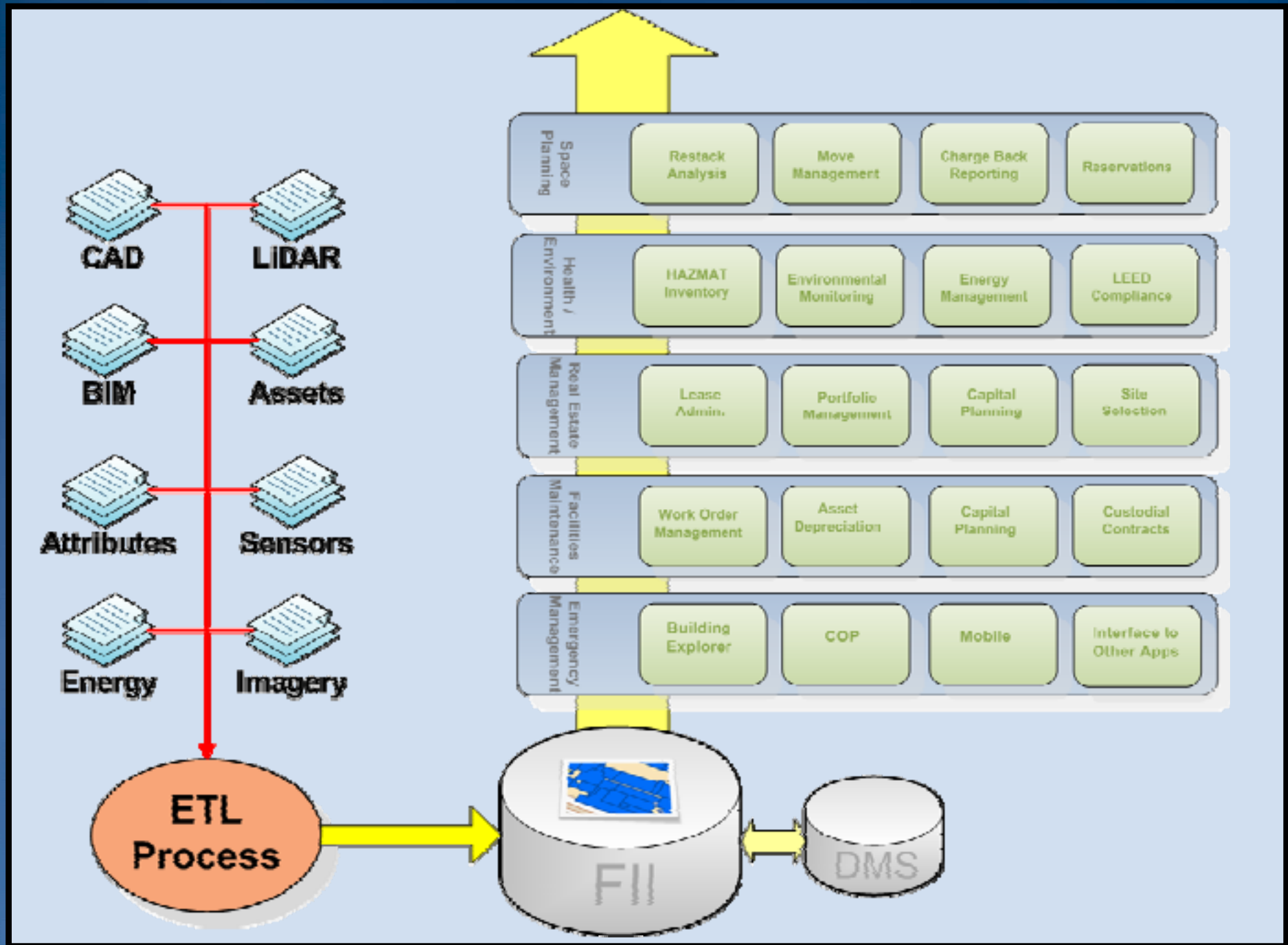
# Facilities GIS Serves Many Masters

**Public  
Safety**

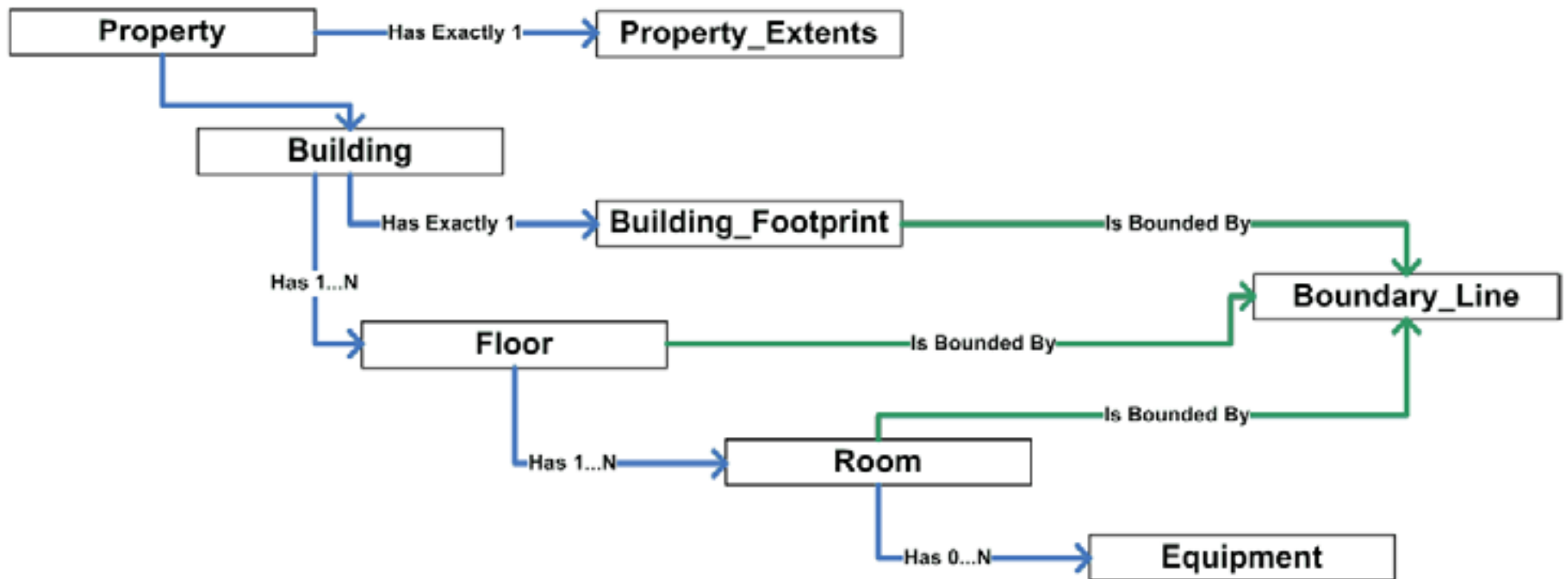
**Real  
Property**



# BISDM is designed to be adapted to many purposes



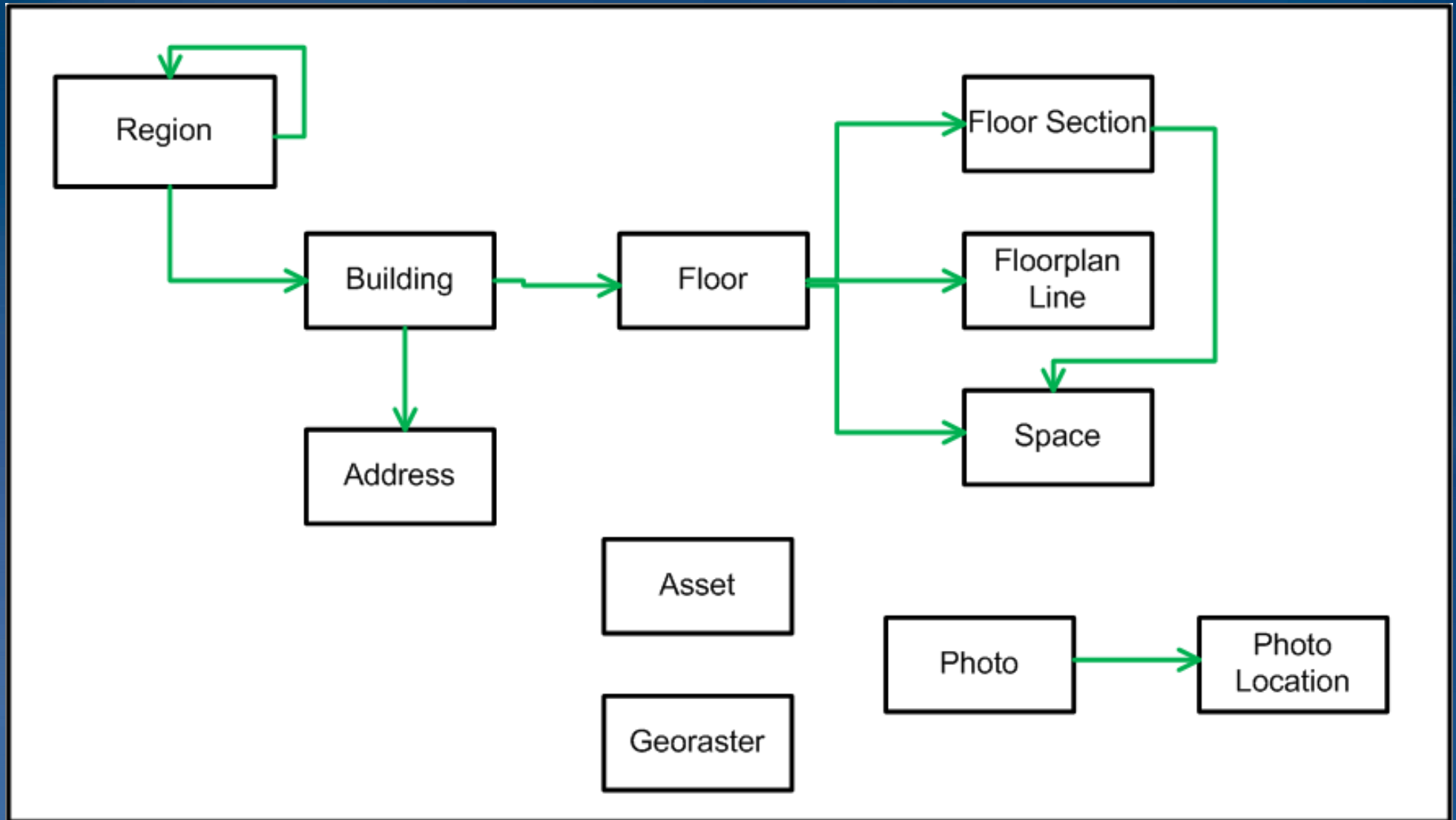
# BISDM 1.0



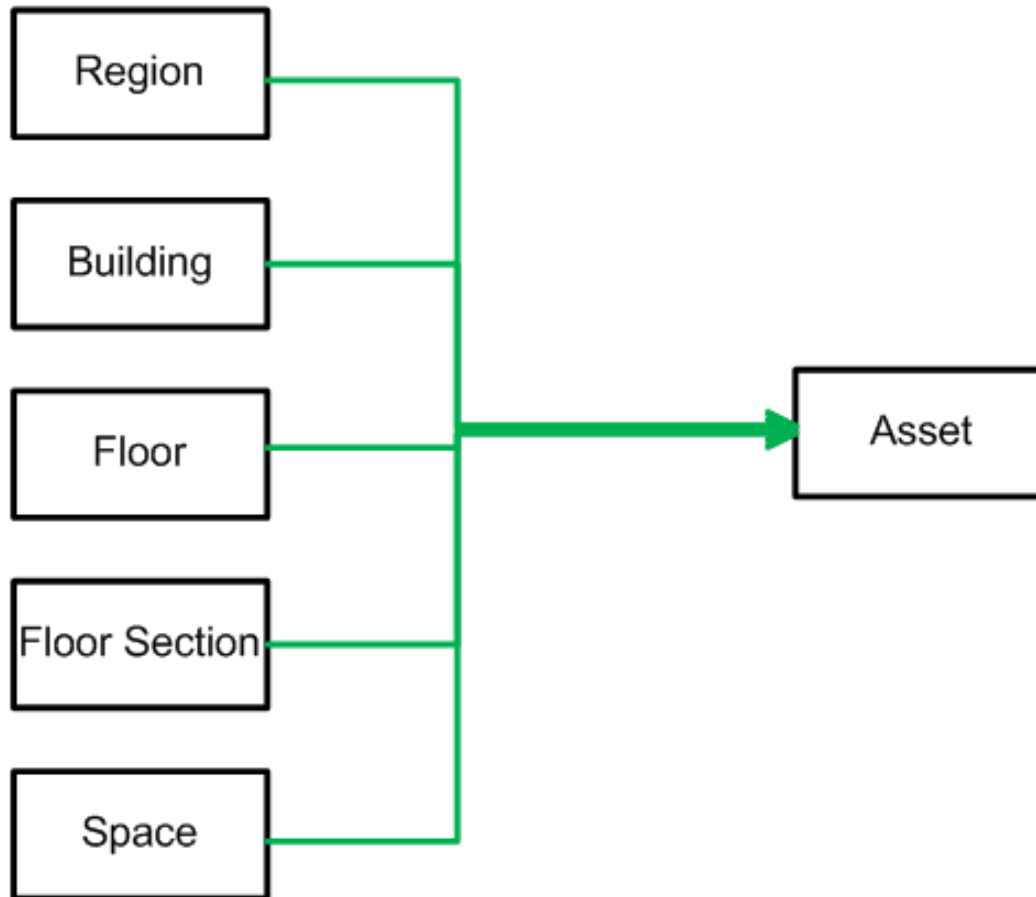
**Figure 3.** Data Model Hierarchical Structure Diagram



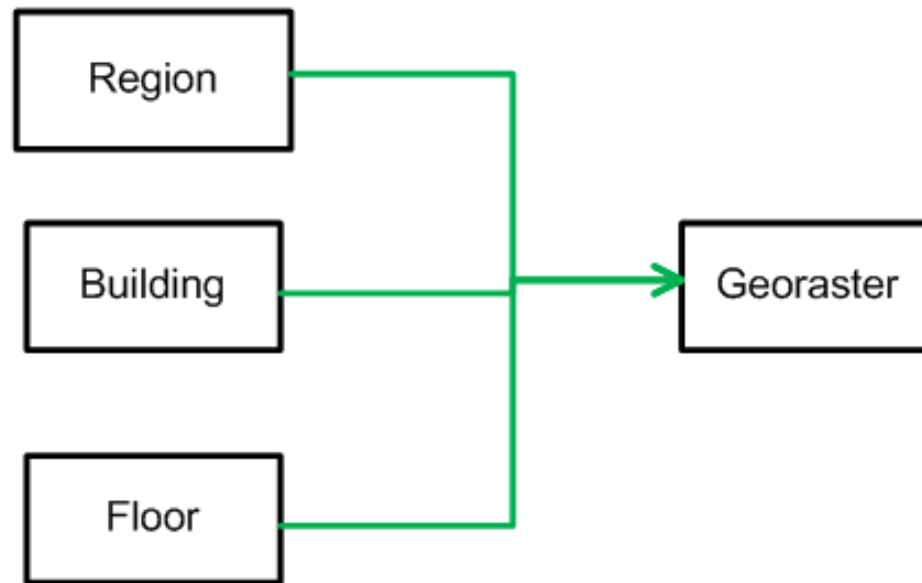
# BISDM 2.0



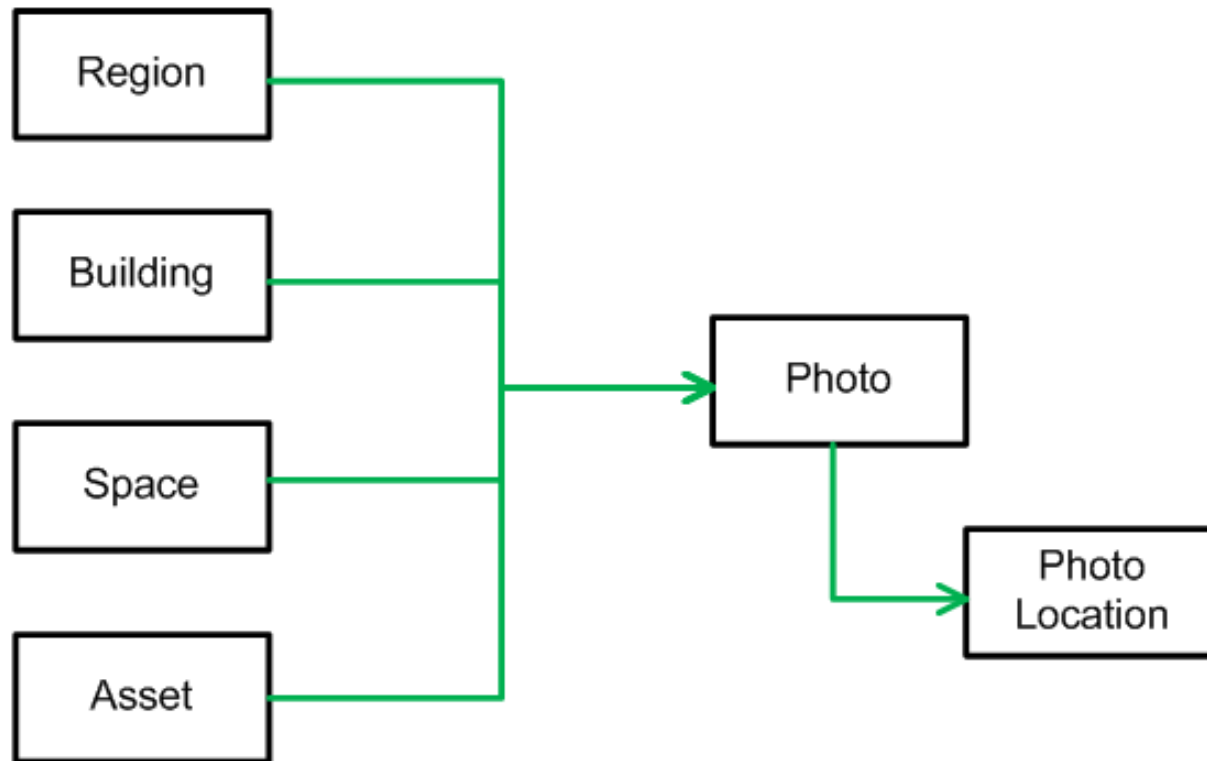
# BISDM 2.0




# BISDM 2.0




# BISDM 2.0




# BISDM 2.0

 Floor	Represents the floors contained in a building.
FLOORID	The unique identifier for the floor.
BUILDINGID	Used to identify the building in which this floor is found.
SHORTNAME	The floor number if there is one (e.g. 1, 1B, 2), otherwise null.
VERTICALORDER	Used to reliably sort the floors by vertical order as base elevation is not always known.
BASEELEVATIONM	The base elevation of the floor in meters.
DESCRIPTION	A short description of the floor (e.g. 'Basement').
LASTUPDATE	The last date when this record was updated
LASTEDITOR	The user name of the person that made the last update

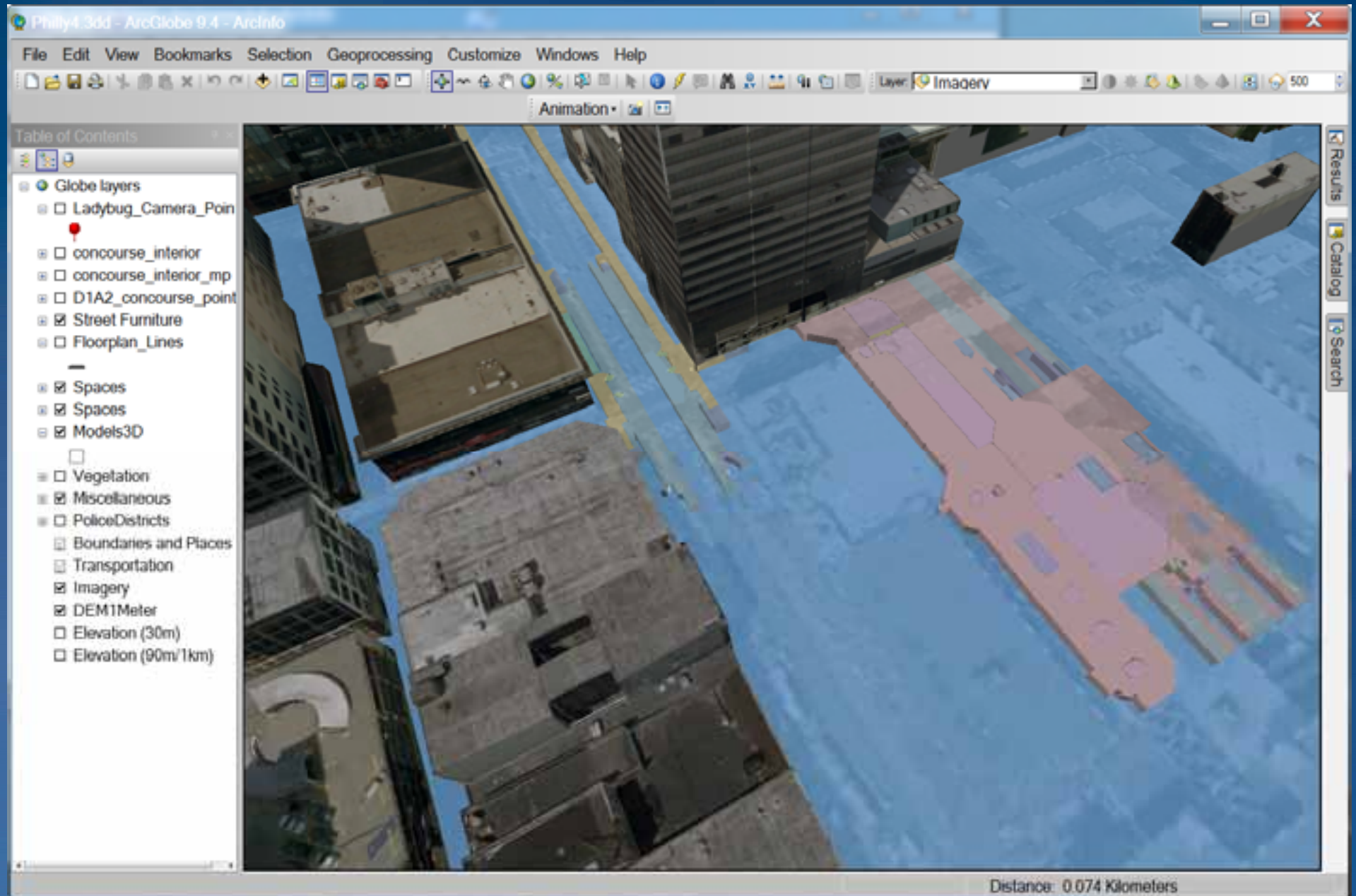
 FloorSection	Represents a logical or physical division of a single floor. One or more floor sections define a wing, zone, etc.
SECTIONID	The unique identifier for the floor section.
FLOORID	Used to identify the floor to which the floor section belongs.
SHORTNAME	The name of the floor section (e.g. 'East Wing').
SECTIONTYPE	Type of floor section
DESCRIPTION	A short description for the floor section.
HIGHVERTORD	High vertical order for a path that spans multiple floors
LOWVERTORD	Low vertical order for a path that spans multiple floors
LASTUPDATE	The last date when this record was updated
LASTEDITOR	The user name of the person that made the last update



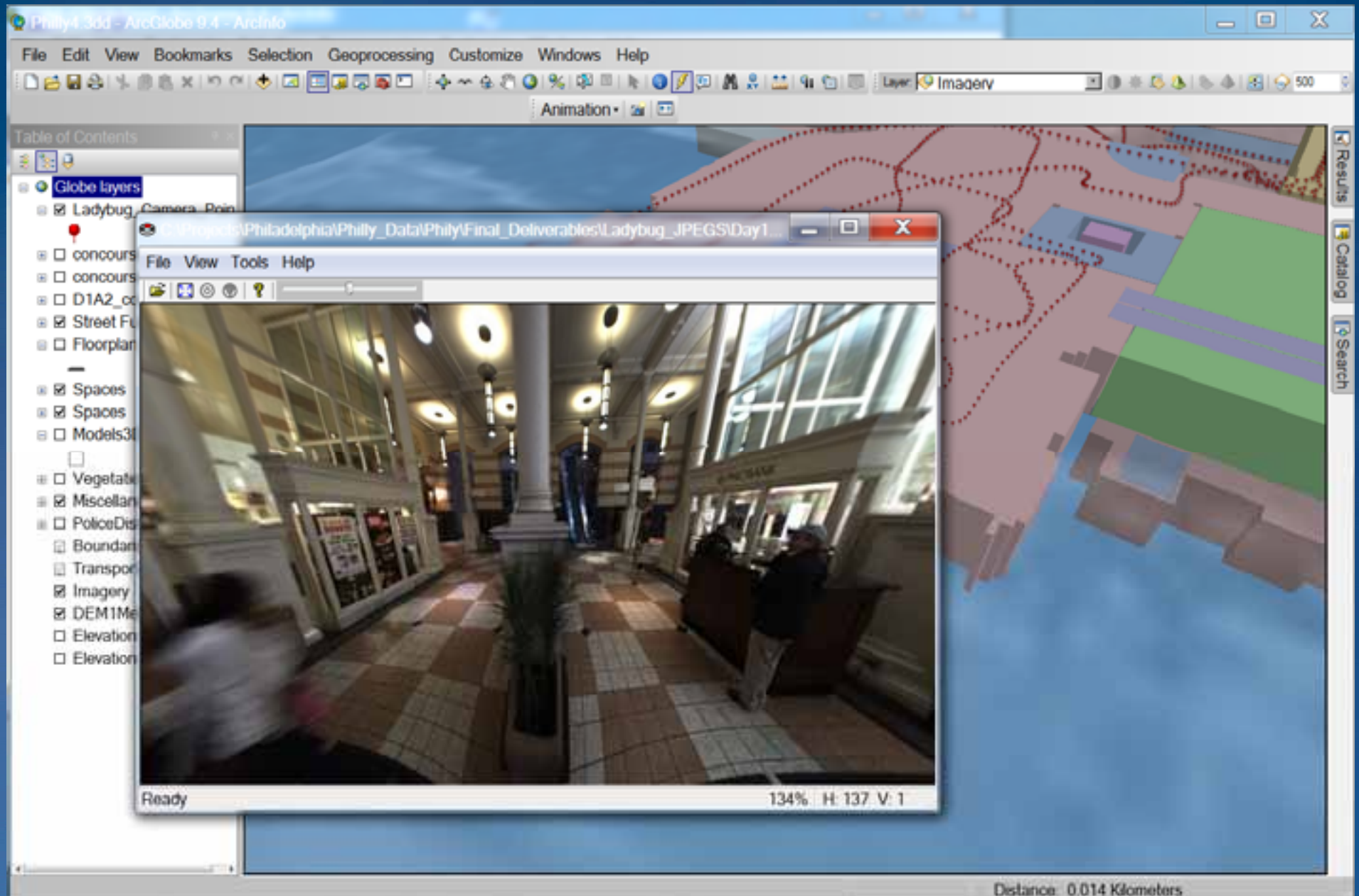
# BISDM 2.0

 InteriorSpace	Represents an interior space such as hallways, rooms, and stairwells.
SPACEID	The unique identifier for the space.
FLOORID	Used to identify the floor in which this space is found.
SECTIONID	Used to identify the floor section (e.g. wing, zone) in which the space is found.
SHORTNAME	The space name/number if there is one, otherwise null.
DESCRIPTION	A short description for the space.
SPACETYPE	Used to identify the space type if there is one, otherwise null.
LONGNAME	The space name if there is one, otherwise null.
MEASUREMENTSTD	The measurement standard to which the space boundaries are drawn (e.g. BOMA, FICM, etc). If null, no measurement standard can be assumed.
SPACECATEGORY	Used to identify the space category if there is one, otherwise null.
BASEELEVATION	The base elevation of the space if known, otherwise null.
CEILINGHEIGHT	The most common ceiling height for the space if known, otherwise null.
CEILINGMATERIAL	Used to identify the ceiling material for the space if known, otherwise null.
FLOORMATERIAL	Used to identify the floor material for the space if known, otherwise null.
DEPARTMENT	The department to which this space belongs (e.g. 'Engineering').
DIVISION	Company Division
NOTES	Used to store additional notes about the space.
ACCESSTYPE	Used to identify the access type for the space (e.g. private, public).
CAPACITY	The total number of occupants allowed in this space.
OCCUPANCY	The total number of occupants assigned to this space.
REPAREA	The reported area of the space in meters.
REPPERIMETER	The reported perimeter of this space.
REPWINDOWAREA	The reported window area for this space in meters.
STATUS	The status of the space (e.g. Closed for repair).
ORGANIZATION	Used to identify the organization assigned to the space.
LASTUPDATE	The last date when this record was updated
LASTEDITOR	The user name of the person that made the last update

# BISDM 2.0



# BISDM 2.0



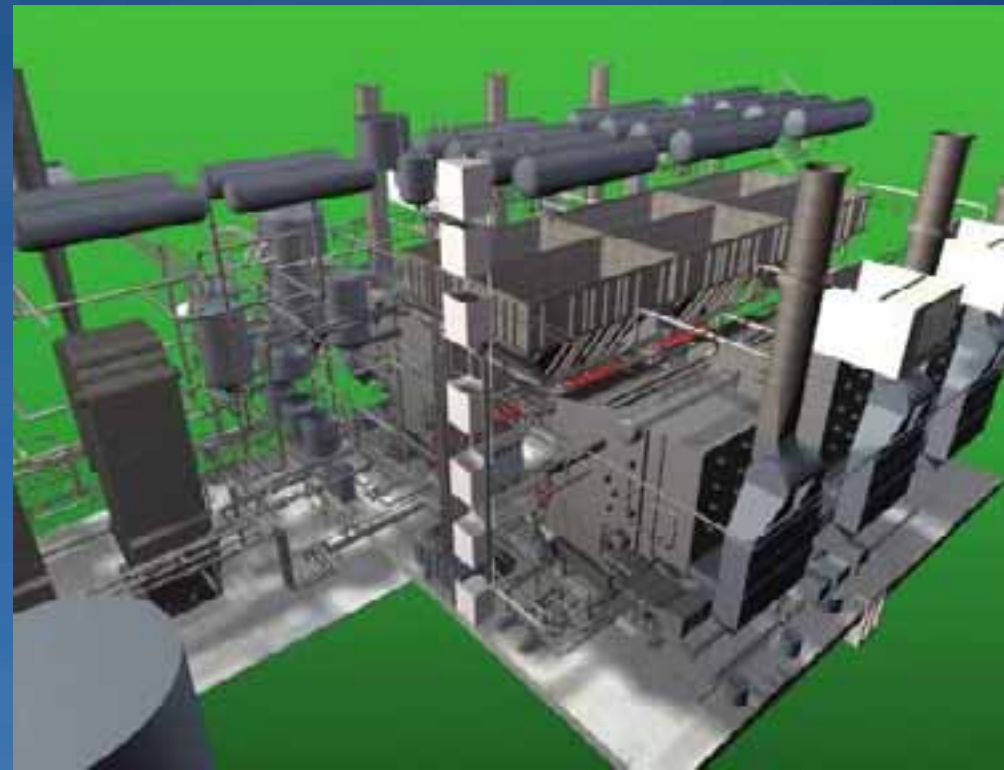
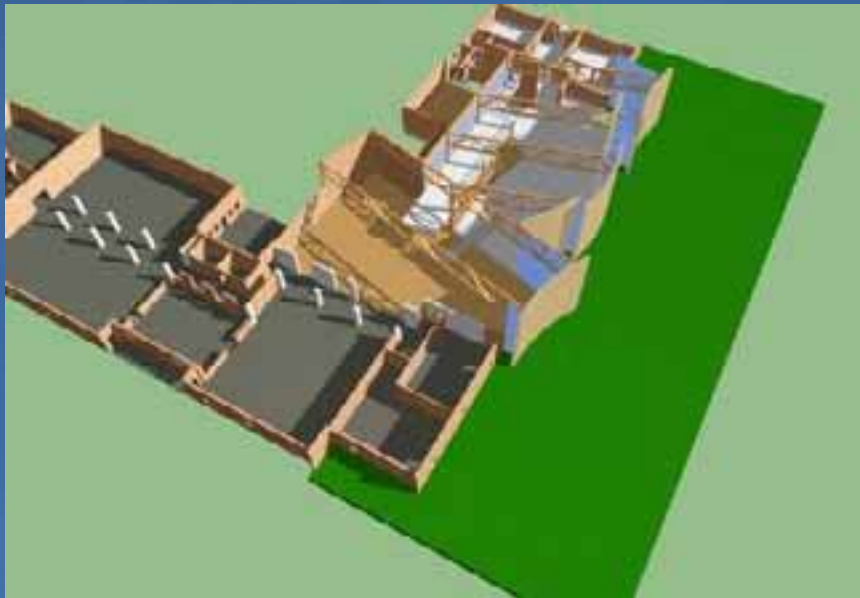




## New Support for Assets and BIM IFC's

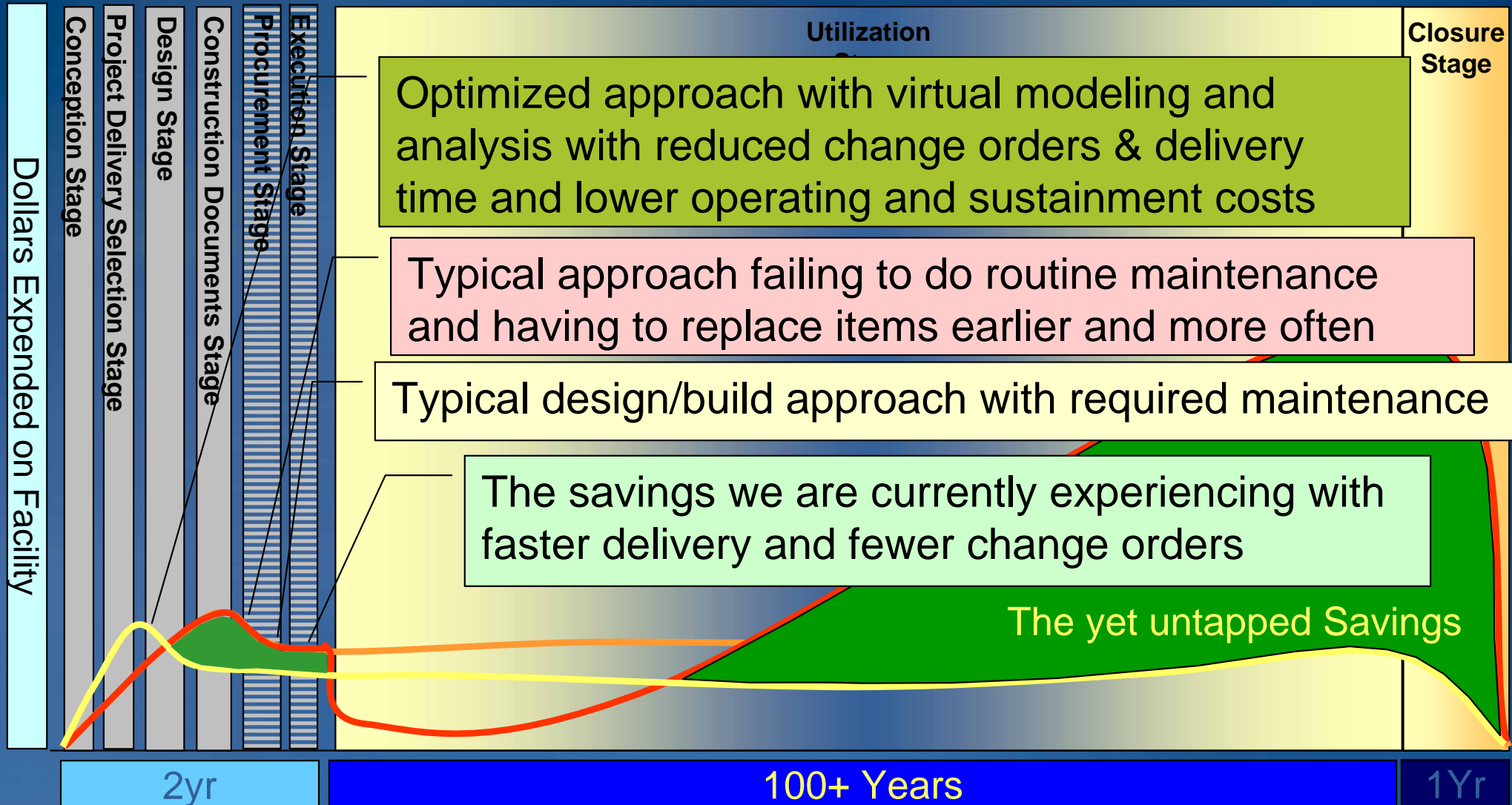
# BIM Provides Benefits for Design and Construction

- Improved design process
- 3-D visualization for owner
- Coordination between disciplines
- Interference checking
- Facilitates energy efficiency and LEED
- Automated quantity take offs
- 4-D scheduling
- Improved documentation of design intent
- Potentially used for fabrication





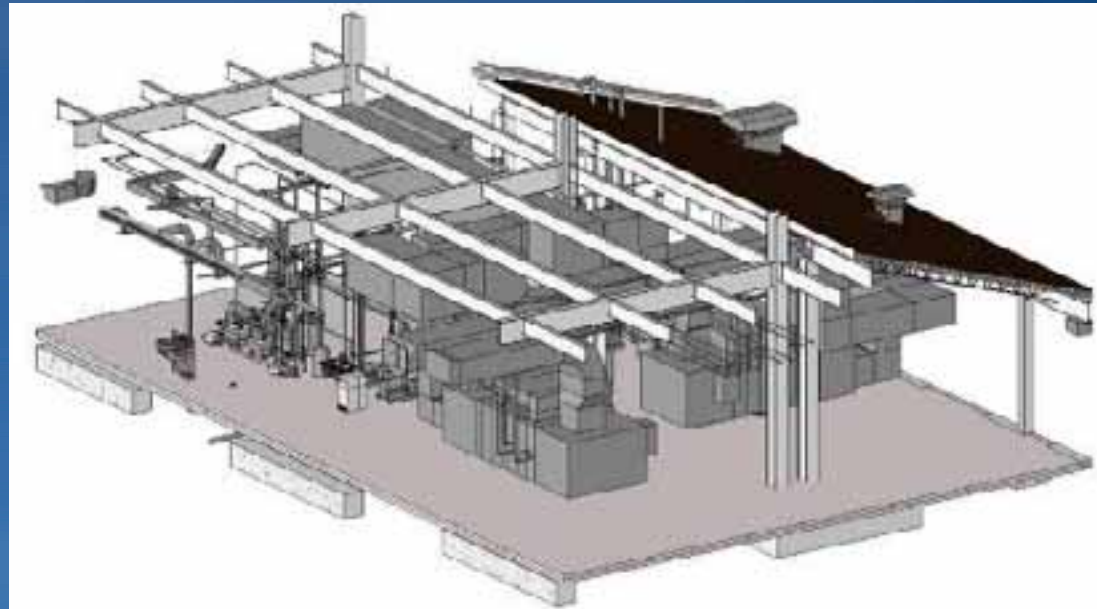
# BIM is Not being used for Lifecycle Asset Management



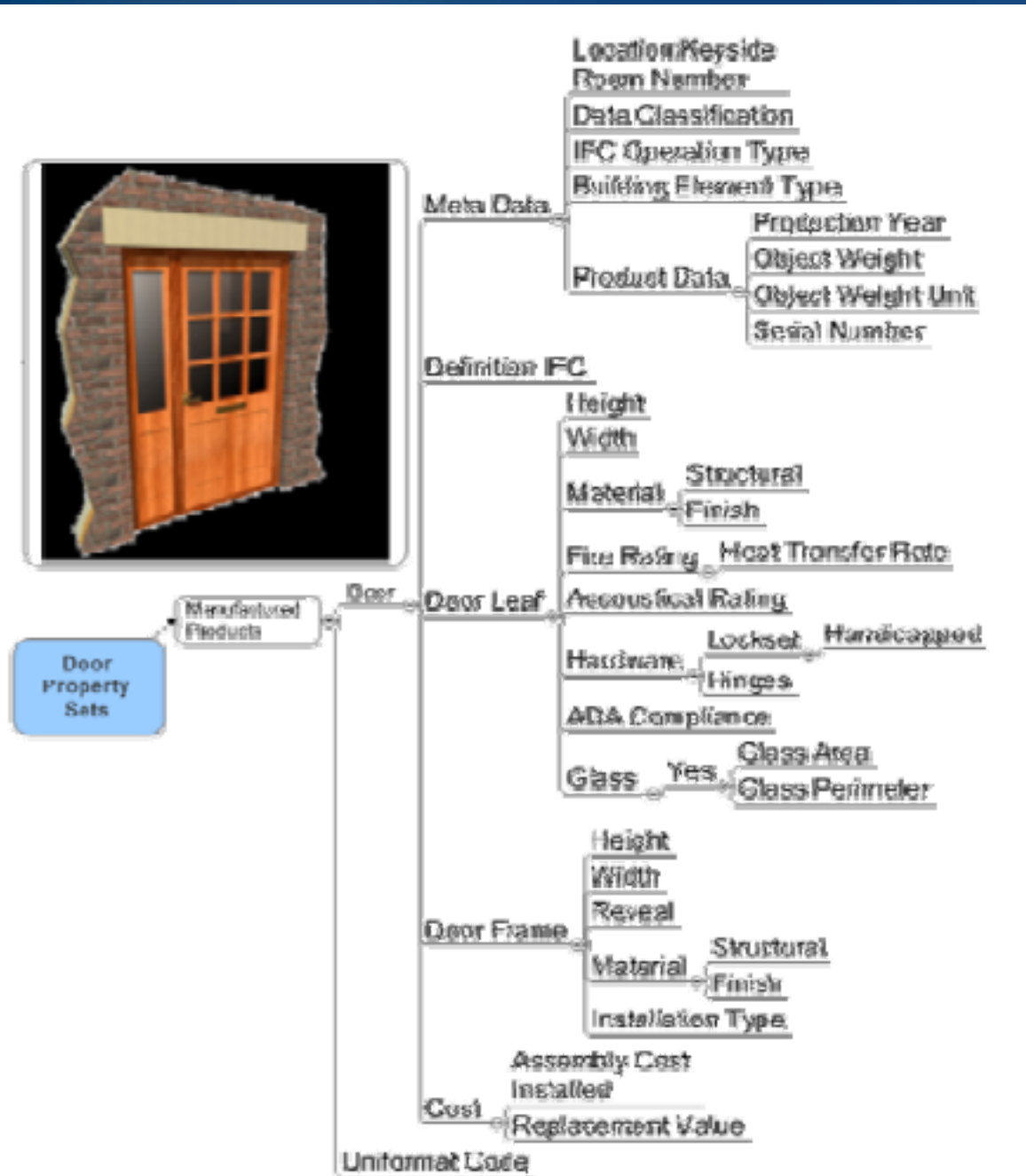
# Should We Use BIM As a Spatial Data Repository?

- File-based
- Proprietary data formats
  - Exports to IFC not uniform
- Not easily query-able across multiple facilities
- Not scalable to large number of users
  - BIM Server technology limited to design focus
- Limited security
- No clustering, failover, etc.

Not a Viable Solution –  
The Spatial Repository  
Should be GIS



# Elements in BIM are Created at a High Level of Detail

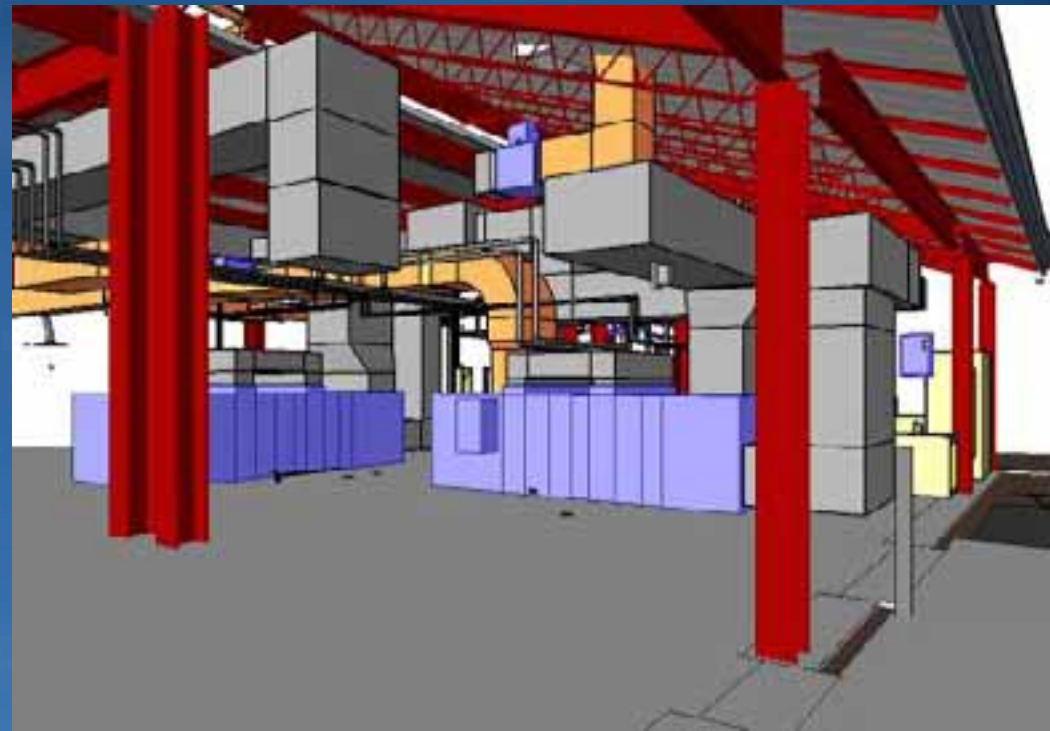


This data is required to convey the information needed to construct the facility.

All BIM products export BIM data to and Industry Foundation Classes (IFCs)

# BIM to GIS Integration Issues

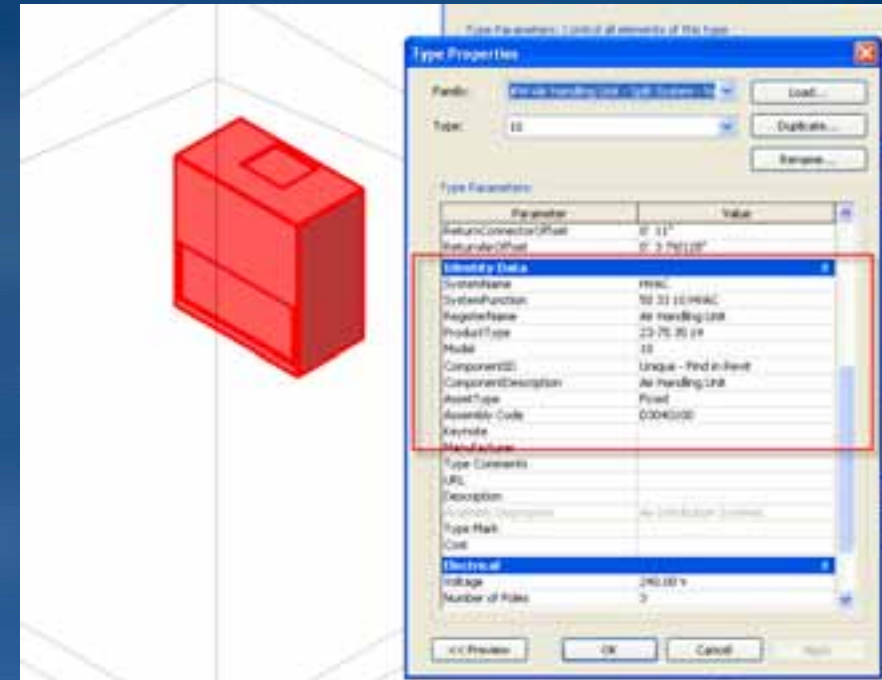
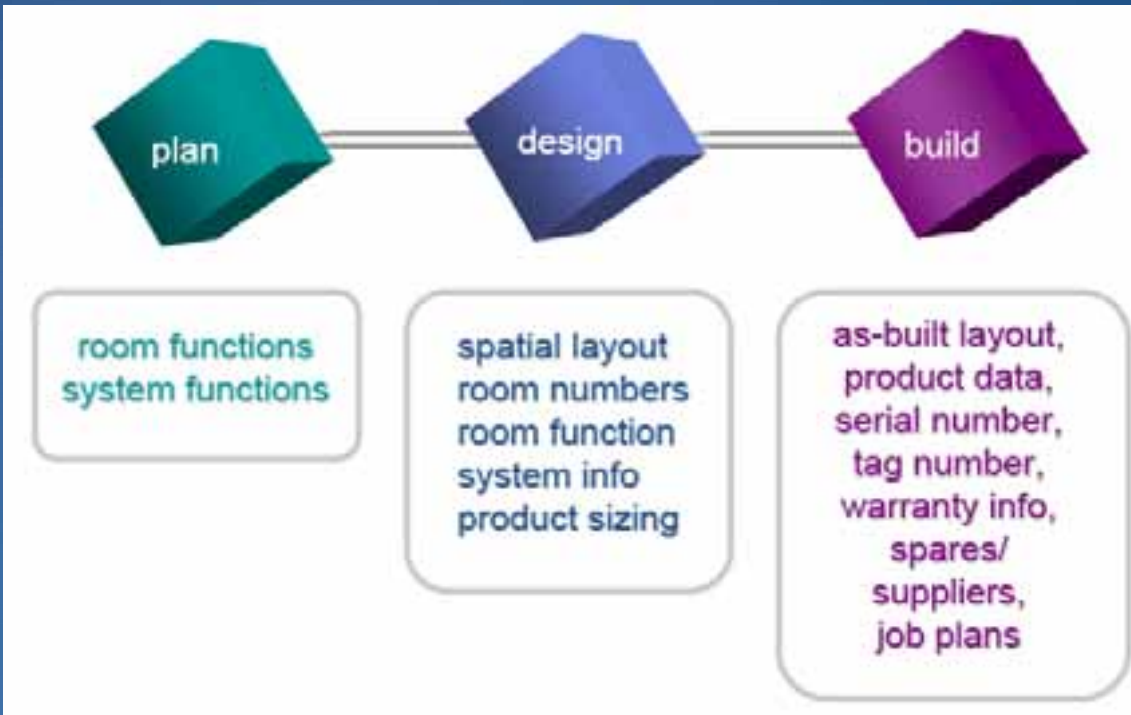
- BIM is MUCH richer in detail than a GIS database should be
- BIM contains all the information needed to construct a building, but not to manage it
  - Space polygons
  - Occupant information
  - Asset details (make, model, etc.)
  - Equipment maintenance data
- The missing data is supplied by COBie





# Construction Operations Building Information Exchange (COBie) adds Tabular Information to BIM

- Capture tabular data needed by the owner as it is created by
  - Designers
  - Constructors
  - Commissioning Agents
- Industry participation
  - BIM vendors now export to COBIE
  - CMMS/CAFM vendors import COBIE



- Some of the COBie data belongs in GIS
- GIS Asset tables need to store a sufficient level of detail



# BISDM Asset Data Feature Classes

## Proposed Assets Class Names:

ConveyanceArea(polygon)	}	Conveyance
ConveyanceFlow(line, geometric network)		
ConveyanceJunction (point, geometric network)		
ElectricalEquipment(point)	}	Electrical
ElectricalConductor(line)		
ElectricalArea(polygon)		
FireProtectionEquipment(point)	}	Fire Protection
FireProtectionConduit(line)		
FireProtectionArea(polygon)		
HVACEquipment(point)	}	HVAC
HVACConduit(line)		
HVACArea(polygon)		
PlumbingFixture(point)	}	Plumbing
PlumbingConduit(line)		
PlumbingArea(polygon)		
StructuralFixture(point)	}	Structural
StructuralMember(line)		
StructuralArea(polygon)		

Mimics the  
structure of  
IFCs

# Conveyance Feature Classes

## BuildingHasConveyanceArea

1

\*

## ConveyanceArea

ASSETID  
ASSETALIAS  
BUILDINGID  
DESCRIPTION  
CAPACITY  
CONVEYANCEUSE  
CONVEYANCETYPE  
DOORQUANTITY  
ADACOMPLIANT  
FLOORSSERVED  
KEYACCESSFLOORS

The footprint of an area designated for transporting people or goods.

PK. Unique identifier for the conveyance asset. FK to a CMMS.  
Common name for the conveyance Area (e.g. NW Stairwell, Main Lobby Escalator)  
The Building ID of the building in which the area resides  
Description of the area  
Load capacity of the system (e.g. lbs of passengers or freight)  
How the conveyance system is used (e.g. Passenger, Freight)  
The type of conveyance system (e.g. Elevator, Escalator, Stairwell)  
Number of doors to which the area can be entered/exited  
Is the conveyance system ADA Compliant?  
Comma separated list of floors served  
Comma separated list of secure floors served

Domain: DYesNo  
FieldType: String

Code	Name
Yes	Yes
No	No

Domain: DConveyanceUse  
FieldType: String

Code	Name
Freight	Freight
Passenger	Passenger

What is the primary commodity transported by the conveyance system

## ConveyancePath

ASSETID  
ASSETALIAS  
BUILDINGID  
DESCRIPTION  
MAXFLOWVOLUME  
ADACOMPLIANT  
FLOORSSERVED  
KEYACCESSFLOORS  
HIGHVERTORD  
LOWVERTORD  
EMERGENCYUSE

A linear representation of conveyance for networking/routing purposes

PK. Unique identifier for the conveyance asset. FK to a CMMS.  
Common name for the conveyance object (e.g. NW Stairwell, Main Lobby Escalator)  
The Building ID of the building in which the area resides  
Description of the path  
Maximum Flow Volume through this path (e.g. persons/minute; tons/hour)  
Is the conveyance system ADA Compliant?  
Comma separated list of floors served  
Comma separated list of secure floors served  
High vertical order for a path that spans multiple floors  
Low vertical order for a path that spans multiple floors  
Type of emergency served by this path

Domain: DEmergencyType  
FieldType: String

Code	Name
None	None
Fire	Fire
Tornado	Tornado
Earthquake	Earthquake
Hurricane	Hurricane
FlashFlood	Flash Flood

Type of Emergency

Domain: DConveyanceType  
FieldType: String

Code	Name
Elevator	Elevator
Escalator	Escalator
Stairwell	Stairwell
MovingWalkway	Moving Walkway

What is the specific type of conveyance object (relates to IFC standard object or other table of this type within external system like CMMS)

Conveyance

# Electrical Feature Classes (Typical of Others)

## ElectricalArea

ASSETID  
ASSETALIAS  
BUILDINGID  
DESCRIPTION  
AREATYPE

Area footprint of large electric equipment or designated electric equipment zones

PK, Unique identifier for the electrical area asset. FK to a CMMS.  
Common name for the electric equipment area (e.g. Breaker Room, Generator Pad)  
The Building ID of the building in which the area resides or is associated  
Description of the area  
Type of electric area (e.g. closet, fenced area; )

Domain: DElectroAreaType  
FieldType: String

Code	Name
Closet	Closet
Room	Room
FencedArea	Fenced Area
Pad	Pad

Type of area for electrical equipment/purposes

## ElectricalConductor

ASSETID  
ASSETALIAS  
BUILDINGID  
DESCRIPTION  
CONDUCTORTYPE

A conductor wire through which electricity flows

PK, Unique identifier for the conductor asset. FK to a CMMS.  
Common name for the asset  
The Building ID of the building in which the conductor resides  
Description of the asset  
Type of electrical conductor or conduit

Domain: DElectroConductorType  
FieldType: String

Code	Name
CableCarrierSegment	Cable Carrier Segment
CableSegment	Cable Segment
ElectricalCircuit	Electrical Circuit

Type of electrical conductor or circuit, defined from IFC

## ElectricalEquipment

ASSETID  
ASSETALIAS  
BUILDINGID  
DESCRIPTION  
EQUIPMENTTYPE

A point representation for electrical fixtures and equipment

PK, Unique identifier for the electrical equipment asset. FK to a CMMS.  
Common name for the equipment object (e.g Backup Generator, Main Floor Circuit Breaker)  
The Building ID of the building in which the asset resides  
Description of the asset  
Type of electrical equipment

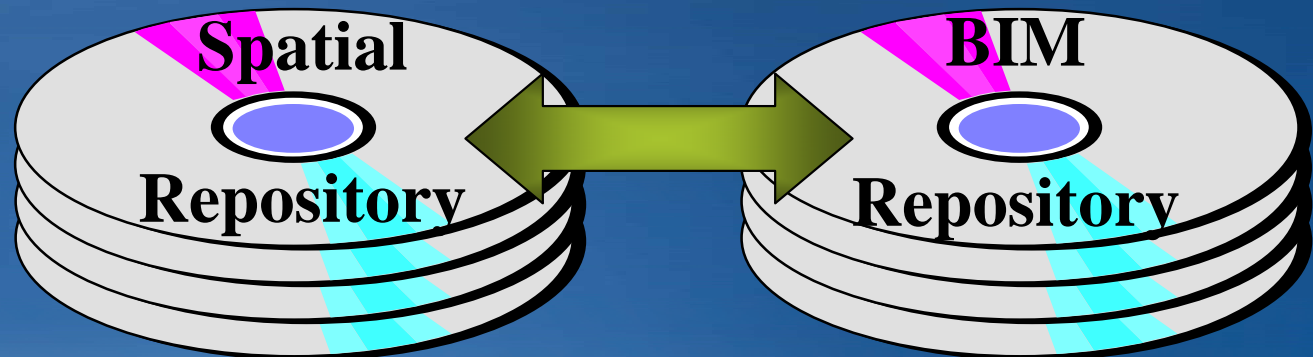
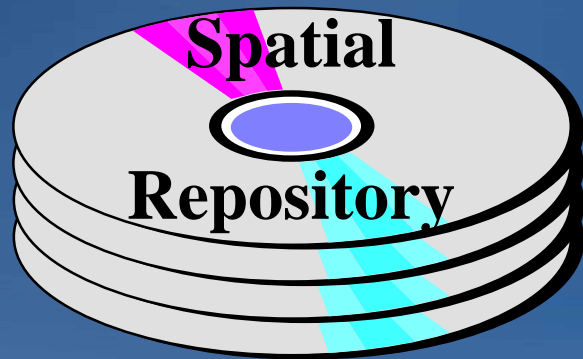
Domain: DElectroEquipmentType  
FieldType: String

Code	Name
CableCarrierFitting	Cable Carrier Fitting
CableFitting	Cable Fitting
Generator	Generator
Motor	Motor
JunctionBox	Junction Box
Lam	Lam
LightFixture	Light Fixture
Outlet	Outlet
ProtectiveDevice	Protective Device
SwitchingDevice	Switching Device
Transformer	Transformer

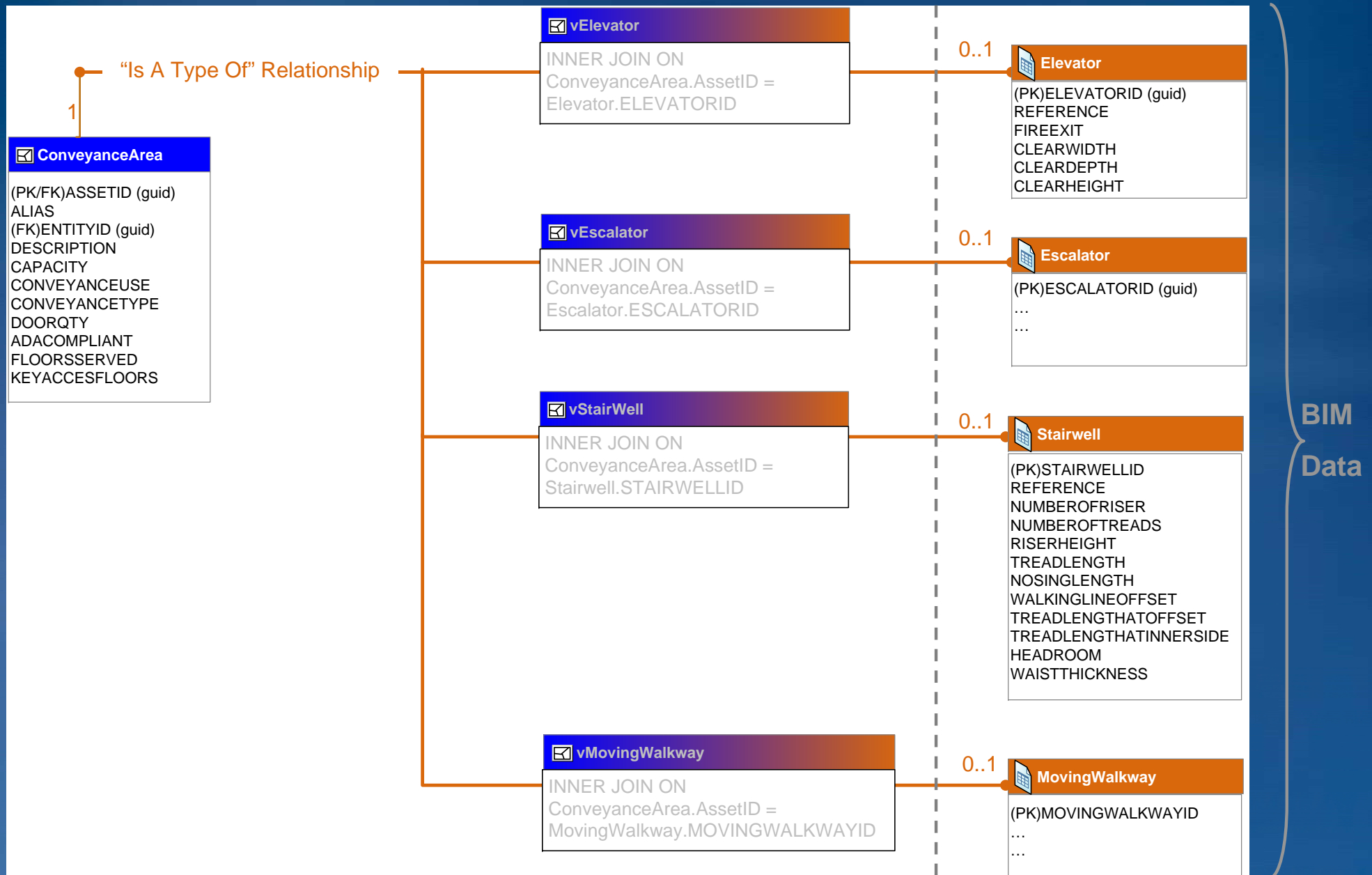
Type of electrical equipment, defined from IFC

# Two Scenarios for Managing Asset Data in GIS

- **Limited asset detail available**
  - No BIM
- Attributes maintained in GIS
- Simple data model
- **BIM detail available**
  - Too much data to be maintained entirely within GIS
  - BIM data stored in external database
    - RDBMS
    - BIM Server
    - CMMS (COBie data)
  - Split data model

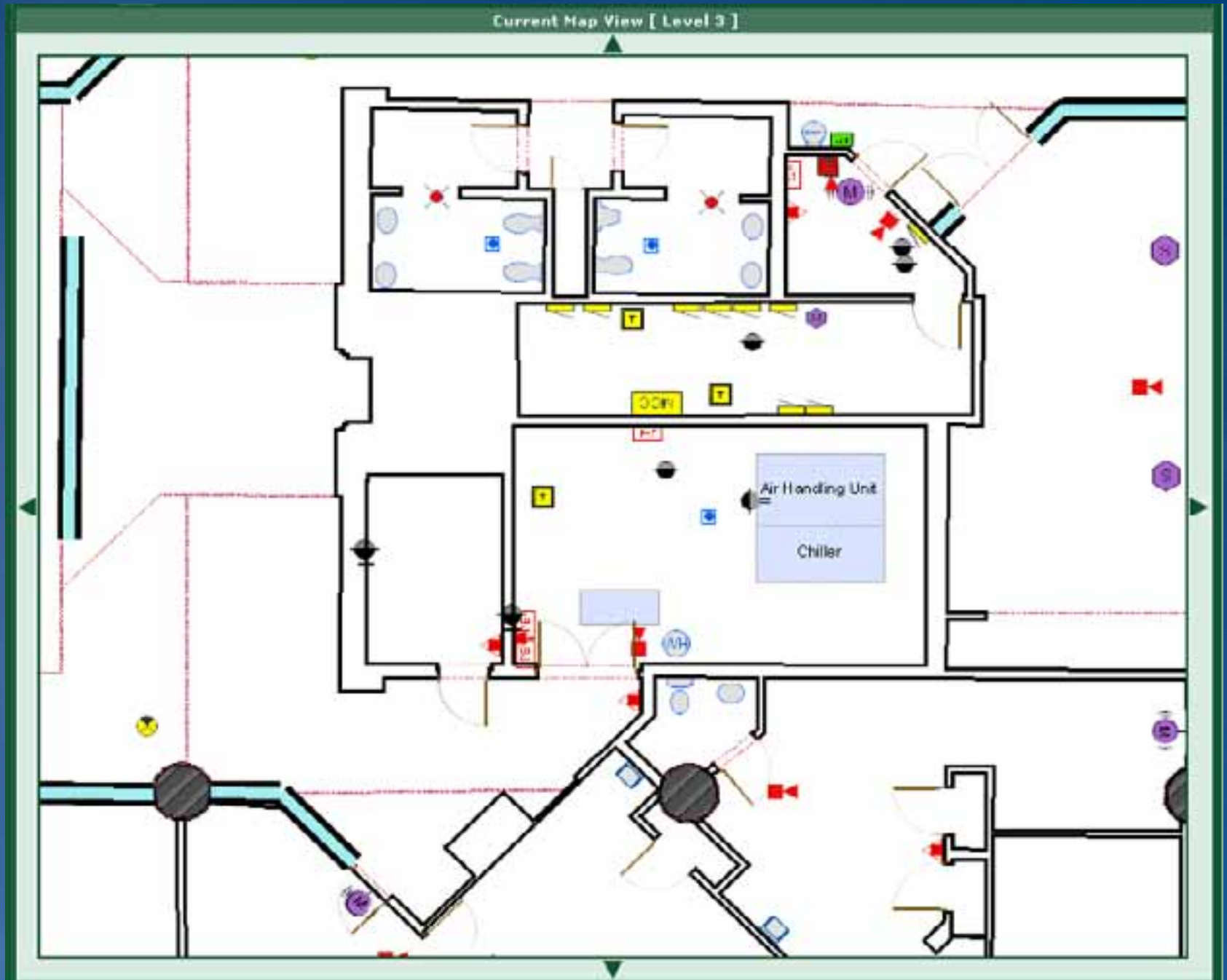


# “Split” Data Model to Interface with External Database (or Future BIM Server)





# Asset Feature Classes in GIS



# GIS Feature with Attribution

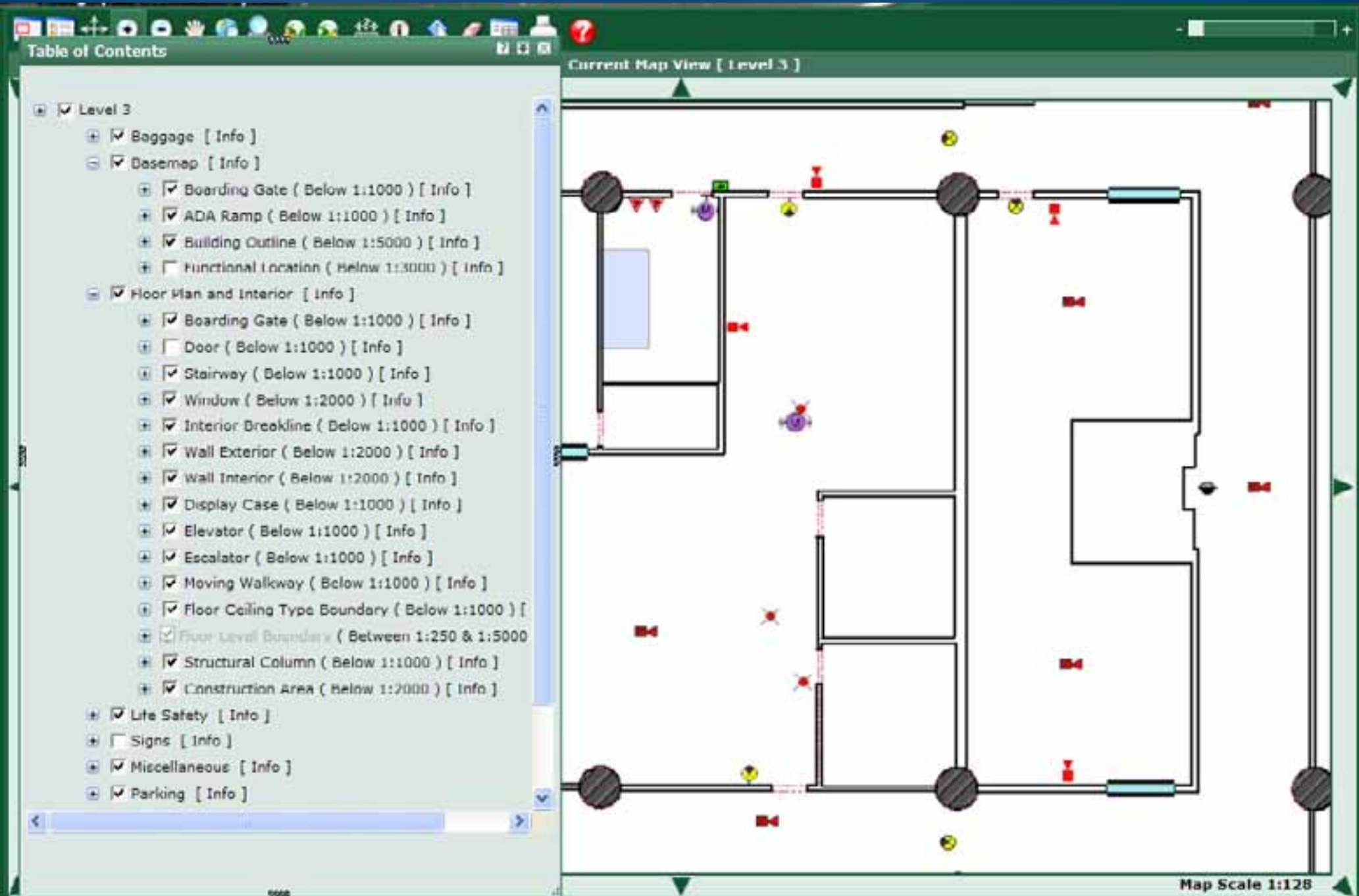
The screenshot displays a GIS application interface. The main map area shows a floor plan with black walls, yellow rooms, and purple hexagonal features labeled 'S'. A red alarm icon is also visible. The top toolbar contains standard GIS navigation tools. The top status bar indicates 'Current Map View [ Level 1 ]'. The bottom status bar is labeled 'Attribute Information'. On the right, the 'Additional Information' panel shows 'Airport Views'. The 'Identify Results' panel is open, displaying a list of features and their attributes.

**Identify Results**

- Level 1 (670382.9503, 886194.0511)
- Level 1 (670382.9503, 886194.0511)
  - ☒ Visual Audible Alarm
    - ☐ Phoenix Sky Harbor International (PHX)

OBJECTID	1333
Airport Name	Phoenix Sky Harbor International (PHX)
Confidence	Field Verification +-3 inches
Level ID	Level 1
SymbolRotation	0
Alarm ID	
Alarm Type	Ceiling Mounted Audible with Integral Strobe
Project ID	
Test Date	
SE_ANNO_CAD_DATA	
- Level 1 (670393.5694, 886190.2443)
  - ☒ Floor Type Boundary
  - ☒ Ceiling Type Boundary
- Level 1 (670391.9165, 886192.2479)
  - ☒ Floor Type Boundary
  - ☒ Ceiling Type Boundary

# Interior Features In Table of Contents





# BISDM Version 3 Highlights

# 3D Transportation Networks

*Interior networks, integrated with exterior networks*

- Can represent different modes of transportation
  - Hallways, stairs, escalators, elevators
- The ability to do route tracing
  - Ability to insert blocks in the network
  - Ability to block certain directions
- The ability to do transportation analysis
  - Nearest Facility
  - Travel distance and time analysis
  - Location/allocation
- Supported by new functionality available in 10
  - New Geometric support for vertical lines, including 3D length
  - New network solvers that produce 3D results



# 3D Transportation Networks

## Basic Components

Simple feature class FloorLines						Geometry	Polyline
						Contains M values	Yes
						Contains Z values	Yes
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
SHAPE	Geometry	Yes					
Floor_Number	Long integer	Yes	1		0		
Building_ID	GUID	No					50
Name	String	Yes					
SLength	Double	No			0	0	
Wheelchair	Short integer	Yes	1	YesNo	0		
SHAPE_Length	Double	Yes			0	0	

### Subtypes of FloorLines

Subtype field Floor\_Number  
Default subtype 1

List of defined default values and domains for subtypes in this class

Subtype Code	Subtype Description	Field name	Default value	Domain
1	First Floor	No values set		
2	Second Floor	No values set		
3	Third Floor	No values set		

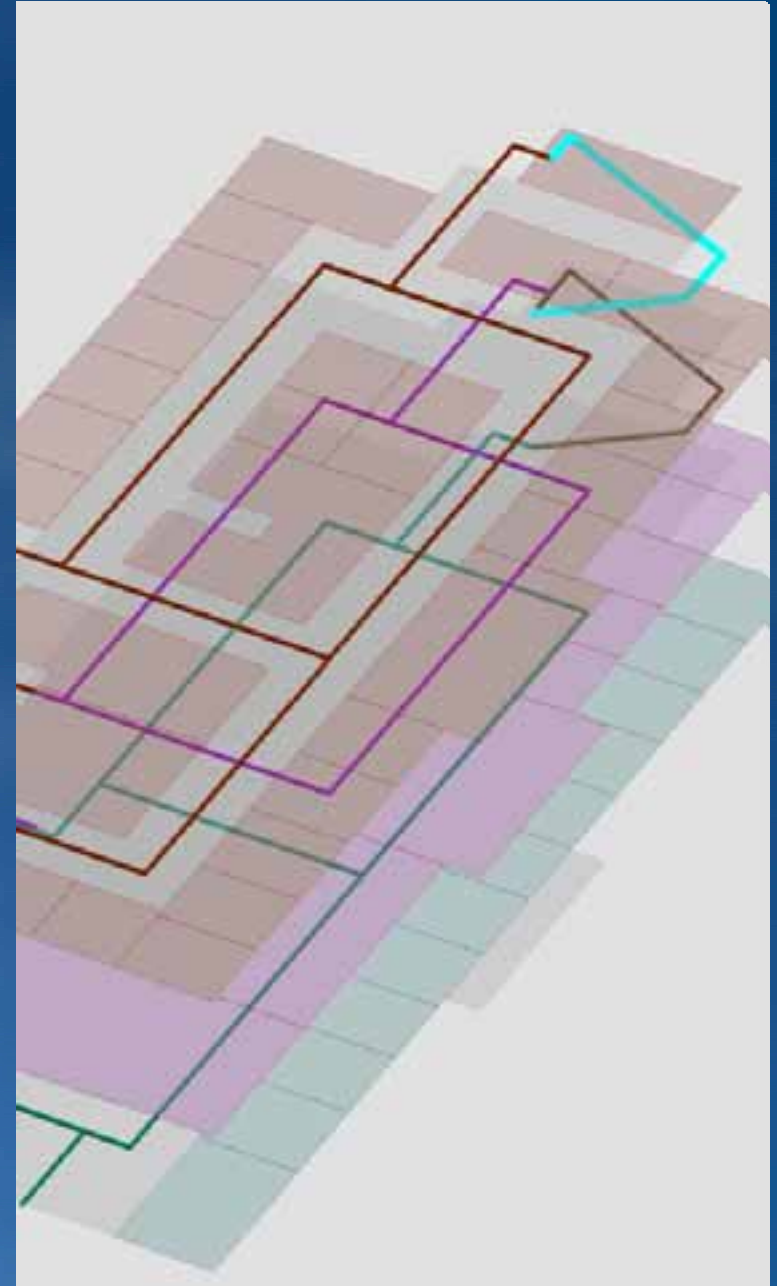
Simple feature class FloorTransitions						Geometry	Polyline
						Contains M values	Yes
						Contains Z values	Yes
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
SHAPE	Geometry	Yes					
TYPE	Short integer	Yes	0		0		
FromZLev	Short integer	Yes			0		
ToZLev	Short integer	Yes			0		
Building_ID	GUID	No					50
Name	String	Yes					
SLength	Double	No			0	0	
WheelChair	Short integer	Yes	0	YesNo	0		
SHAPE_Length	Double	Yes			0	0	

### Subtypes of FloorTransitions

Subtype field TYPE  
Default subtype 0

List of defined default values and domains for subtypes in this class

Subtype Code	Subtype Description	Field name	Default value	Domain
1	Stairs	No values set		
2	Elevators	No values set		



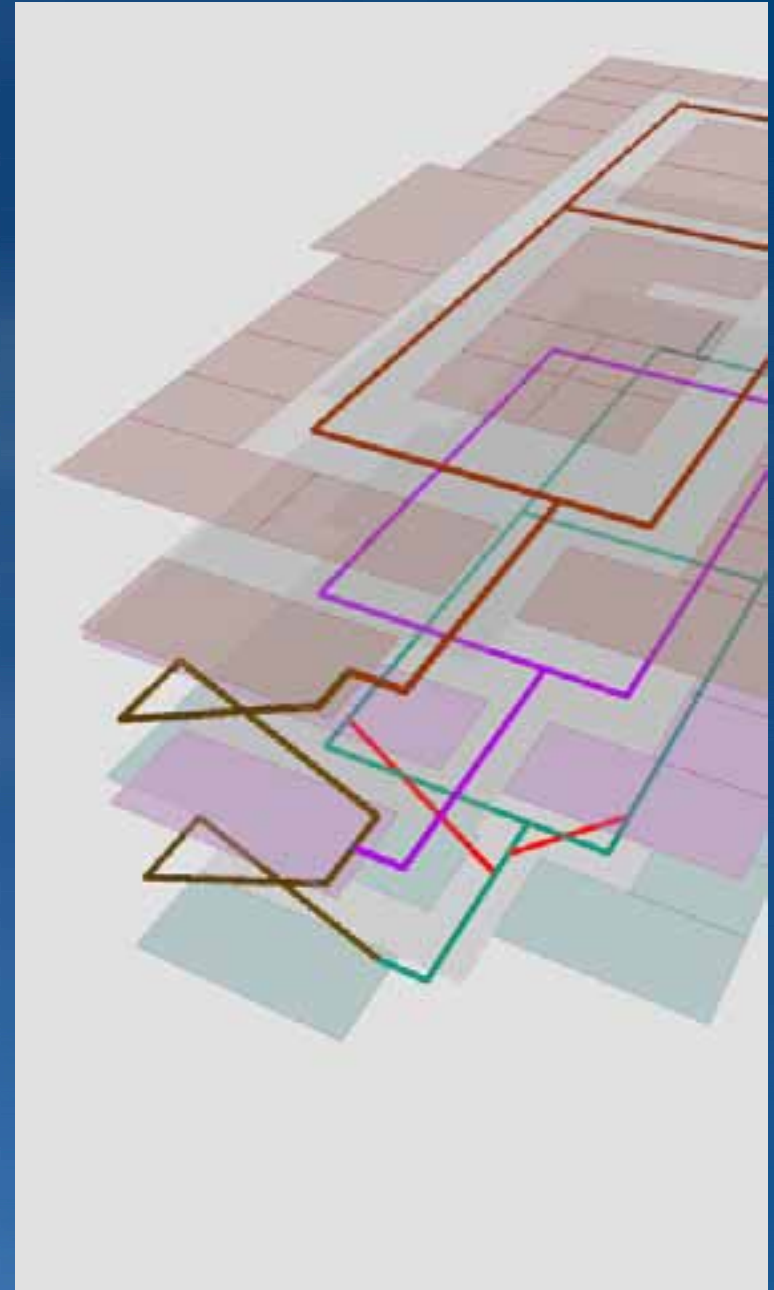
# 3D Transportation Networks

## Modifiers to network behavior, and core objects

Simple feature class DelayTurns		Geometry Polyline		Contains M values No		Contains Z values Yes	
Field name	Data type	Allow nulls	Default value	Domain	Prec- ision	Scale	Length
OBJECTID	Object ID						
SHAPE	Geometry	Yes					
Edge1End	String	Yes	N				1
Edge1FCID	Long integer	Yes			0		
Edge1FID	Long integer	Yes			0		
Edge1Pos	Double	Yes			0	0	
Edge2FCID	Long integer	Yes			0		
Edge2FID	Long integer	Yes			0		
Edge2Pos	Double	Yes			0	0	
Edge3FCID	Long integer	Yes			0		
Edge3FID	Long integer	Yes			0		
Edge3Pos	Double	Yes			0	0	
WalkTime	Double	No			0	0	
SHAPE_Length	Double	Yes			0	0	

Simple feature class RestrictedTurns		Geometry Polyline		Contains M values No		Contains Z values Yes	
Field name	Data type	Allow nulls	Default value	Domain	Prec- ision	Scale	Length
OBJECTID	Object ID						
SHAPE	Geometry	Yes					
Edge1End	String	Yes	N				1
Edge1FCID	Long integer	Yes			0		
Edge1FID	Long integer	Yes			0		
Edge1Pos	Double	Yes			0	0	
Edge2FCID	Long integer	Yes			0		
Edge2FID	Long integer	Yes			0		
Edge2Pos	Double	Yes			0	0	
Edge3FCID	Long integer	Yes			0		
Edge3FID	Long integer	Yes			0		
Edge3Pos	Double	Yes			0	0	
SHAPE_Length	Double	Yes			0	0	

Simple feature class Transportation_ND_Junctions		Geometry Point		Contains M values No		Contains Z values Yes	
Simple feature class StopsSchema		Geometry Point		Contains M values No		Contains Z values Yes	
Field name	Data type	Allow nulls	Default value	Domain	Prec- ision	Scale	Length
OBJECTID	Object ID						
SHAPE	Geometry	Yes					
Name	String	Yes					50



# 3D Transportation Networks

## Components used in specific network solvers

Simple feature class OfficeCenters		Geometry Point		Contains M values No		Contains Z values Yes	
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
Shape	Geometry	Yes					
Building_ID	GUID	No					
Floor_ID	GUID	No					
Space_ID	GUID	No					
WING	String	No					3
NAME	String	No					50
FLOOR_NUMBER	Short integer	Yes	1		0		

### Subtypes of OfficeCenters

Subtype field FLOOR\_NUMBER  
Default subtype 1

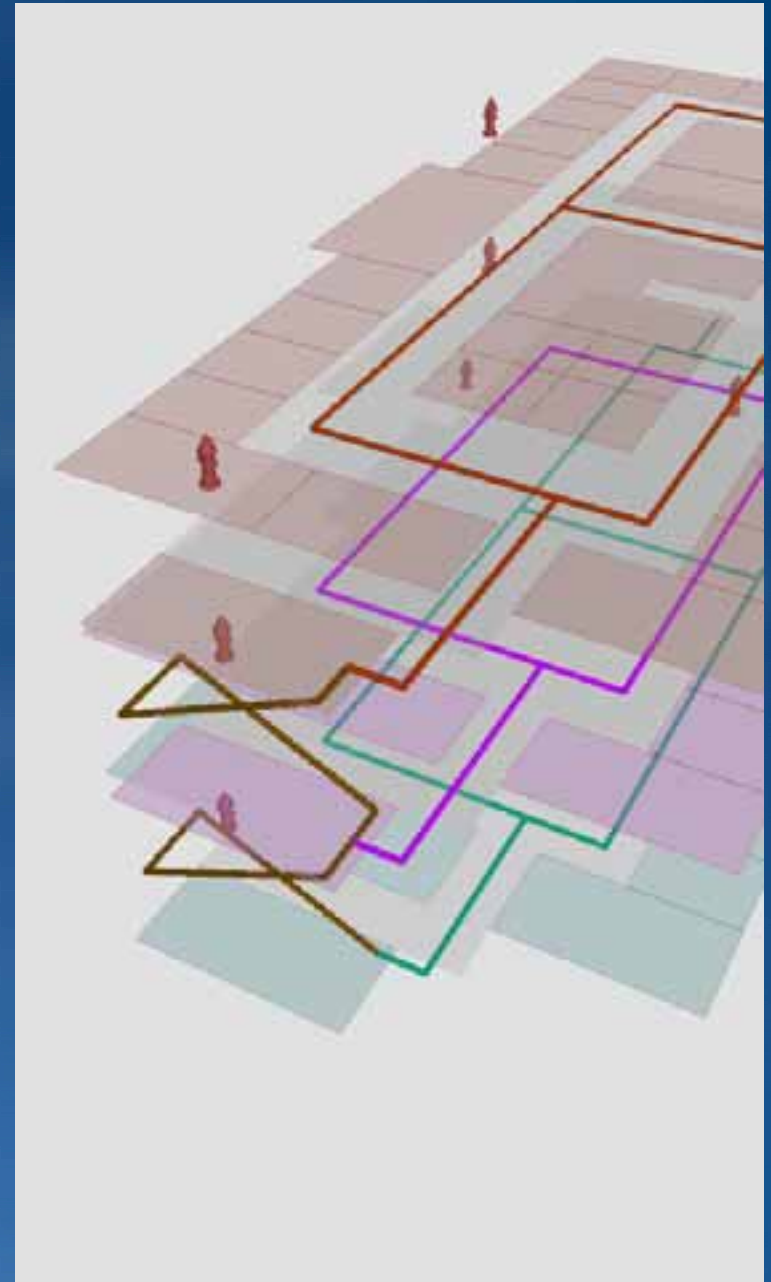
List of defined default values and domains for subtypes in this class

Subtype Code	Subtype Description	Field name	Default value	Domain
1	First Floor	No values set		
2	Second Floor	No values set		
3	Third Floor	No values set		

Simple feature class Electrical Panels		Geometry Point		Contains M values No		Contains Z values Yes	
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length

Simple feature class FireHydrants		Geometry Point		Contains M values No		Contains Z values Yes	
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length

Simple feature class Vending Machines		Geometry Point		Contains M values No		Contains Z values Yes	
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale	Length
OBJECTID	Object ID						
Shape	Geometry	Yes					
Building_ID	GUID	No					
Floor_ID	GUID	No					
Space_ID	GUID	No					
WING	String	No					3
NAME	String	No					50
FLOOR_NUMBER	Short integer	Yes	1		0		



# 3D Transportation Networks

## Interior networks, integrated with exterior networks

### Basic components of the network

Simple feature class FloorLines						
		Geometry	Polyline			
		Contains M values	Yes			
		Contains Z values	Yes			
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale Length
OBJECTID	Object ID					
SHAPE	Geometry	Yes				
Floor_Number	Long integer	No	1		0	
Building_ID	GUID	No				50
Name	String	Yes				
SLength	Double	No			0	0
Wheelchair	Short integer	Yes	1	YesNo	0	
SHAPE_Length	Double	Yes			0	0

The basic network of hallways inside a building, as a collection of simple lines (no curves), with a separate subtype for each floor to aid in editing.

What Floor (should this be the floor\_id GUID?)  
Unique ID of the building  
Name of the segment, if it has a unique name  
3D Length, calculated using GP tool  
Example of a restriction attribute

Simple feature class FloorTransitions						
		Geometry	Polyline			
		Contains M values	Yes			
		Contains Z values	Yes			
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale Length
OBJECTID	Object ID					
SHAPE	Geometry	Yes				
TYPE	Short integer	Yes	0		0	
FromZLev	Short integer	Yes			0	
ToZLev	Short integer	Yes			0	
Building_ID	GUID	No				50
Name	String	Yes				
SLength	Double	No			0	0
WheelChair	Short integer	Yes	0	YesNo	0	
SHAPE_Length	Double	Yes			0	0

The transitions between different floors of a building. Stored in a separate feature class to account for difference in times going up, or coming down.

Categories of transitions between levels  
From lower floor (should this be the floor\_id GUID?)  
To upper floor (should this be the floor\_id GUID?)  
Unique ID of the building  
Name of the segment, if it has a unique name  
3D Length, calculated using GP tool  
Example of a restriction attribute

#### Subtypes of FloorLines

Subtype field: Floor\_Number  
Default subtype: 1

List of defined default values and domains for subtypes in this class

Subtype Code	Subtype Description	Field name	Default value	Domain
1	First Floor	No values set		
2	Second Floor	No values set		
3	Third Floor	No values set		

#### Subtypes of FloorTransitions

Subtype field: TYPE  
Default subtype: 0

List of defined default values and domains for subtypes in this class

Subtype Code	Subtype Description	Field name	Default value	Domain
1	Stairs	No values set		
2	Elevators	No values set		

### Modifiers to network behavior

Simple feature class DelayTurns						
		Geometry	Polyline			
		Contains M values	No			
		Contains Z values	Yes			
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale Length
OBJECTID	Object ID					
SHAPE	Geometry	Yes				
Edge1End	String	Yes	N			1
Edge1FCID	Long integer	Yes			0	
Edge1FID	Long integer	Yes			0	
Edge1Pos	Double	Yes			0	0
Edge2FCID	Long integer	Yes			0	
Edge2FID	Long integer	Yes			0	
Edge2Pos	Double	Yes			0	0
Edge3FCID	Long integer	Yes			0	
Edge3FID	Long integer	Yes			0	
Edge3Pos	Double	Yes			0	0
WalkTime	Double	No			0	0
SHAPE_Length	Double	Yes			0	0

Indicates delays on the network, for example wait times at elevators.

Length of delay

Simple feature class RestrictedTurns						
		Geometry	Polyline			
		Contains M values	No			
		Contains Z values	Yes			
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale Length
OBJECTID	Object ID					
SHAPE	Geometry	Yes				
Edge1End	String	Yes	N			1
Edge1FCID	Long integer	Yes			0	
Edge1FID	Long integer	Yes			0	
Edge1Pos	Double	Yes			0	0
Edge2FCID	Long integer	Yes			0	
Edge2FID	Long integer	Yes			0	
Edge2Pos	Double	Yes			0	0
Edge3FCID	Long integer	Yes			0	
Edge3FID	Long integer	Yes			0	
Edge3Pos	Double	Yes			0	0
SHAPE_Length	Double	Yes			0	0

Restricted turns are used to model one way exits, such as fire escapes and security doors.

### Components created/required by Network Analyst

Simple feature class Transportation_ND_Junctions						
		Geometry	Point			
		Contains M values	No			
		Contains Z values	Yes			
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale Length
OBJECTID	Object ID					
SHAPE	Geometry	Yes				

Junctions generated by network analysts for purpose of processing.

Simple feature class StopsSchema						
		Geometry	Point			
		Contains M values	No			
		Contains Z values	Yes			
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale Length
OBJECTID	Object ID					
SHAPE	Geometry	Yes				
Name	String	Yes				50

Place holder feature class where stops along a route can be placed for use in geoprocessing.

### Components used in specific network solvers

Simple feature class OfficeCenters						
		Geometry	Point			
		Contains M values	No			
		Contains Z values	Yes			
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale Length
OBJECTID	Object ID					
Shape	Geometry	Yes				
Building_ID	GUID	No				
Floor_ID	GUID	No				
Space_ID	GUID	No				
WING	String	No				3
NAME	String	No				50
FLOOR_NUMBER	Short integer	Yes	1		0	

This is an example of a feature you might want to route people to and from. However, it could be any point feature such as assets.

Unique ID of the building  
Unique ID of the floor  
Unique ID of the space  
Name of the wing, for use in search  
Name of the office, for use in search

What Floor (should this be the floor\_id GUID?)

#### Subtypes of OfficeCenters

Subtype field: FLOOR\_NUMBER  
Default subtype: 1

List of defined default values and domains for subtypes in this class

Subtype Code	Subtype Description	Field name	Default value	Domain
1	First Floor	No values set		
2	Second Floor	No values set		
3	Third Floor	No values set		

Simple feature class Electrical Panels						
		Geometry	Point			
		Contains M values	No			
		Contains Z values	Yes			
Field name	Data type	Allow nulls	Default value	Domain	Precision	Scale Length
OBJECTID	Object ID					
SHAPE	Geometry	Yes				
Building_ID	GUID	No				
Floor_ID	GUID	No				
Space_ID	GUID	No				
WING	String	No				3
NAME	String	No				50
FLOOR_NUMBER	Short integer	Yes	1		0	

#### Simple feature class FireHydrants

Subtype field: FLOOR\_NUMBER  
Default subtype: 1

List of defined default values and domains for subtypes in this class

Subtype Code	Subtype Description	Field name	Default value	Domain
1	First Floor	No values set		
2	Second Floor	No values set		
3	Third Floor	No values set		

# 3D Transportation Networks

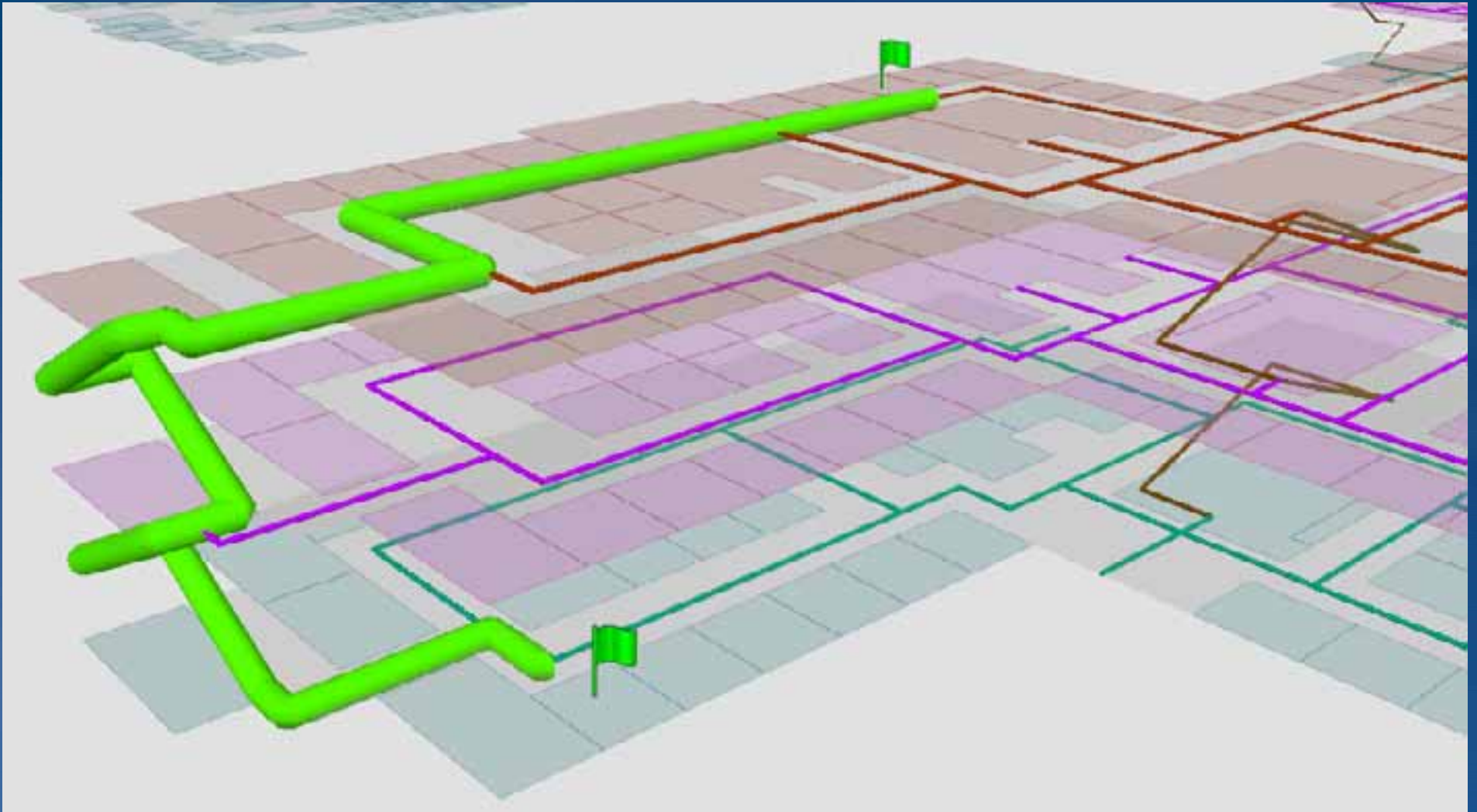
*BISDM 3D Network Implementation*

**Demo**



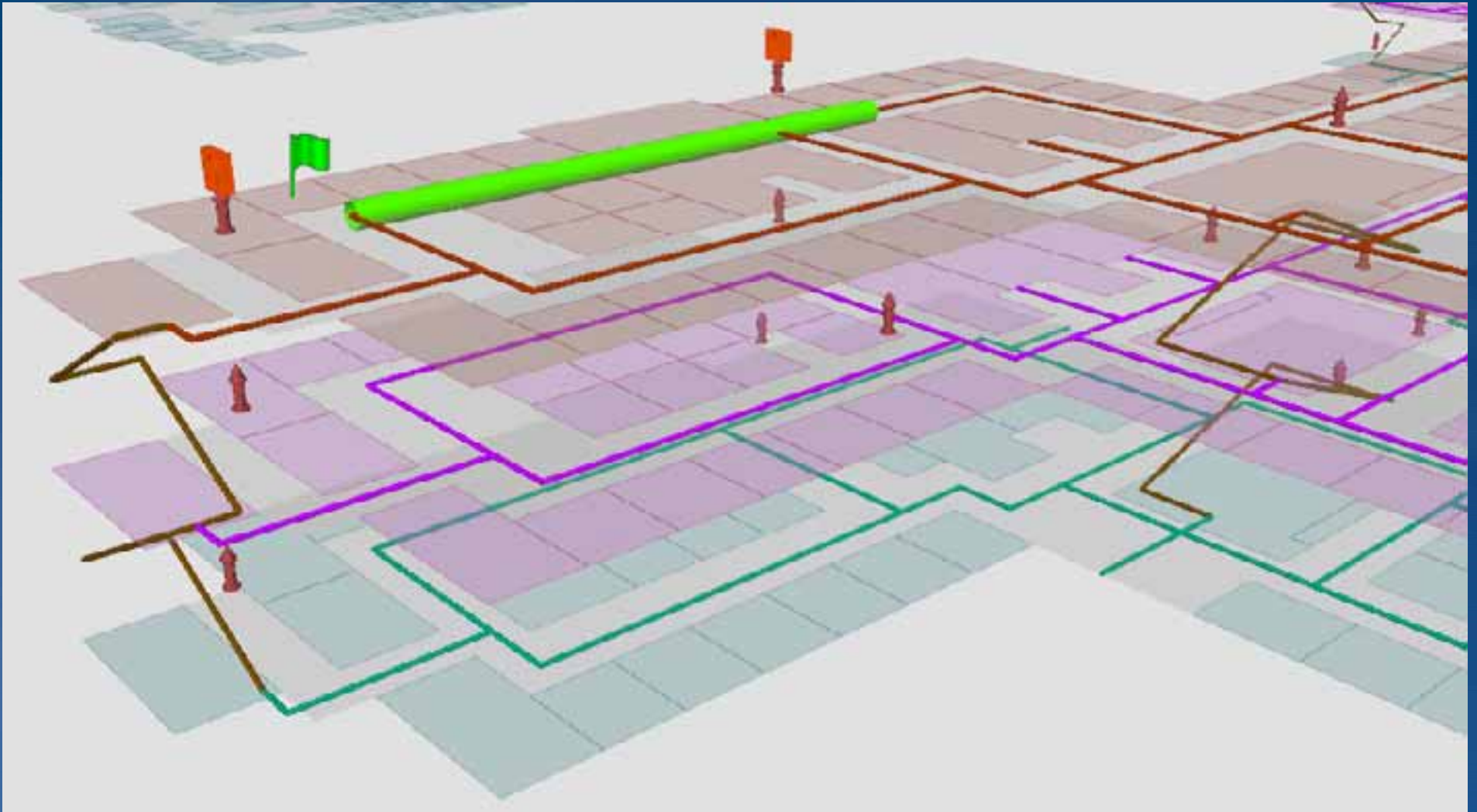
# 3D Transportation Networks

## *3D Network Analysis - Routing*



# 3D Transportation Networks

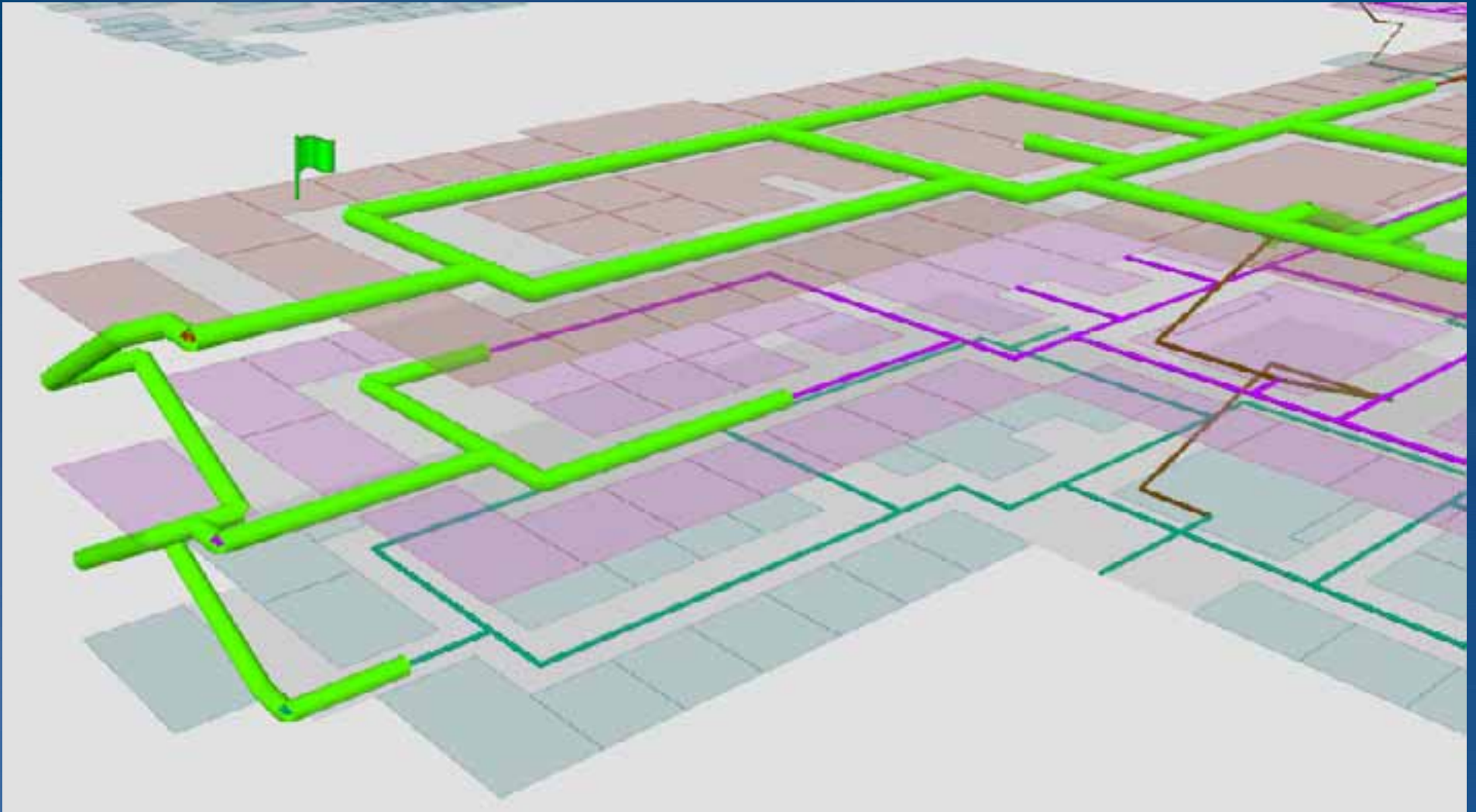
## *3D Network Analysis – Nearest Facility*





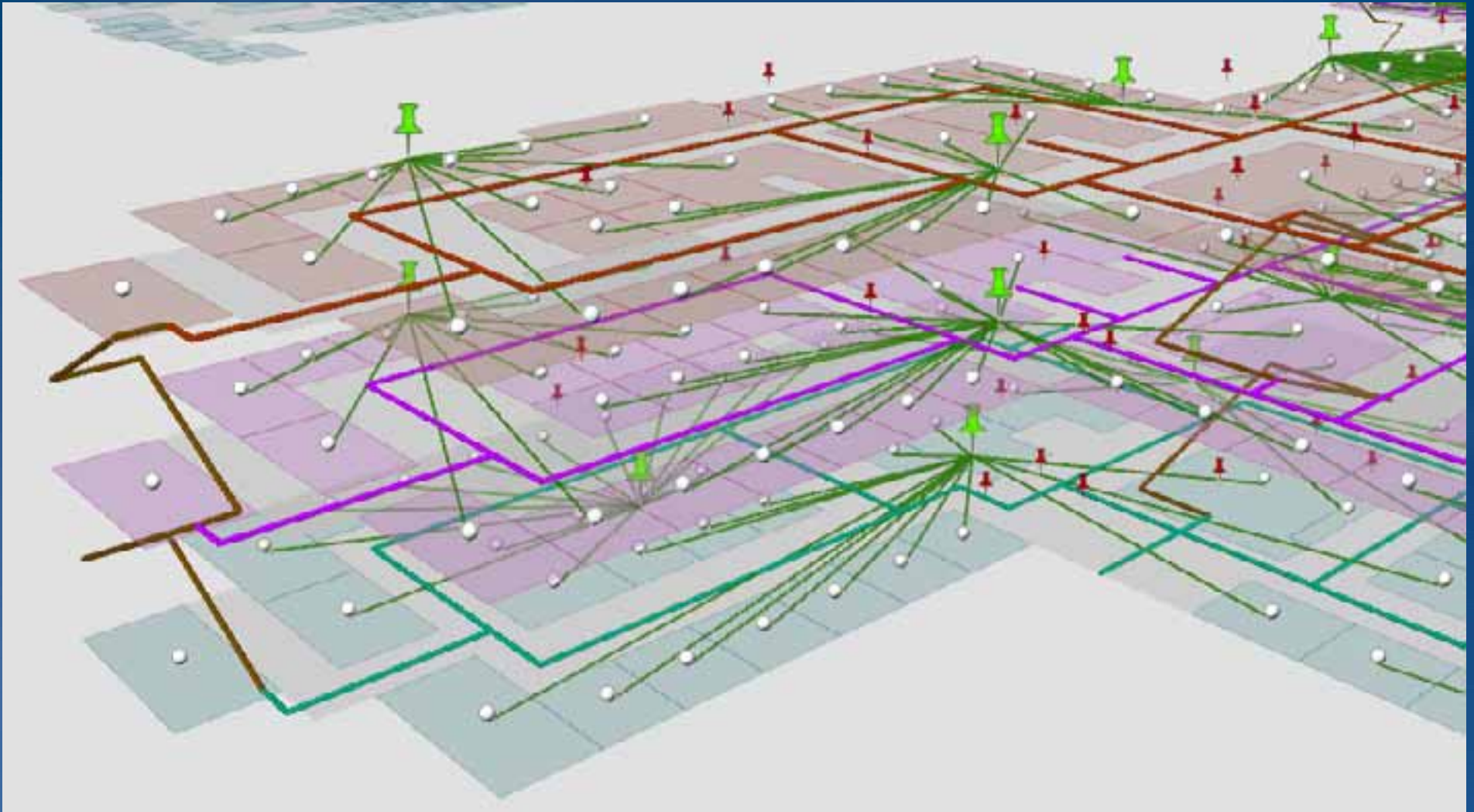
# 3D Transportation Networks

## *3D Network Analysis – Network Reach*



# 3D Transportation Networks

## *3D Network Analysis - Allocation*



# 3D Transportation Networks

## *Schedule and next steps*

- Will be available with the next release of the BISDM model
  - Expected in the late Summer of 2010
- Dependant of the capabilities of ArcGIS 10
  - Requires Network Analyst
  - Does NOT require 3D Analyst
- Demonstration dataset will be available
- Next steps
  - Expansion of the network model to support 3D utilities
    - Starting with electrical and telecom
    - Followed with gas, water, waste-water
  - Currently possible by the creation of custom solvers
  - Generic “out of box” solution in development

*For more information, go to [www.bisdm.org](http://www.bisdm.org)*



# Expanding the core model from 2D to 3D

## *Method of representation, and creation*

- Changes to methods of storing Z values
  - Storing Zs as part of the geometry
  - Only necessary for points, lines, and polygons
- Changes to geometric method of representation
  - Conversion of
    - Polygons to a multipatch volumes
    - Lines to a multipatch surfaces
  - Editing multipatches to create more complex volumes
  - Generating multipatches from lidar point clouds

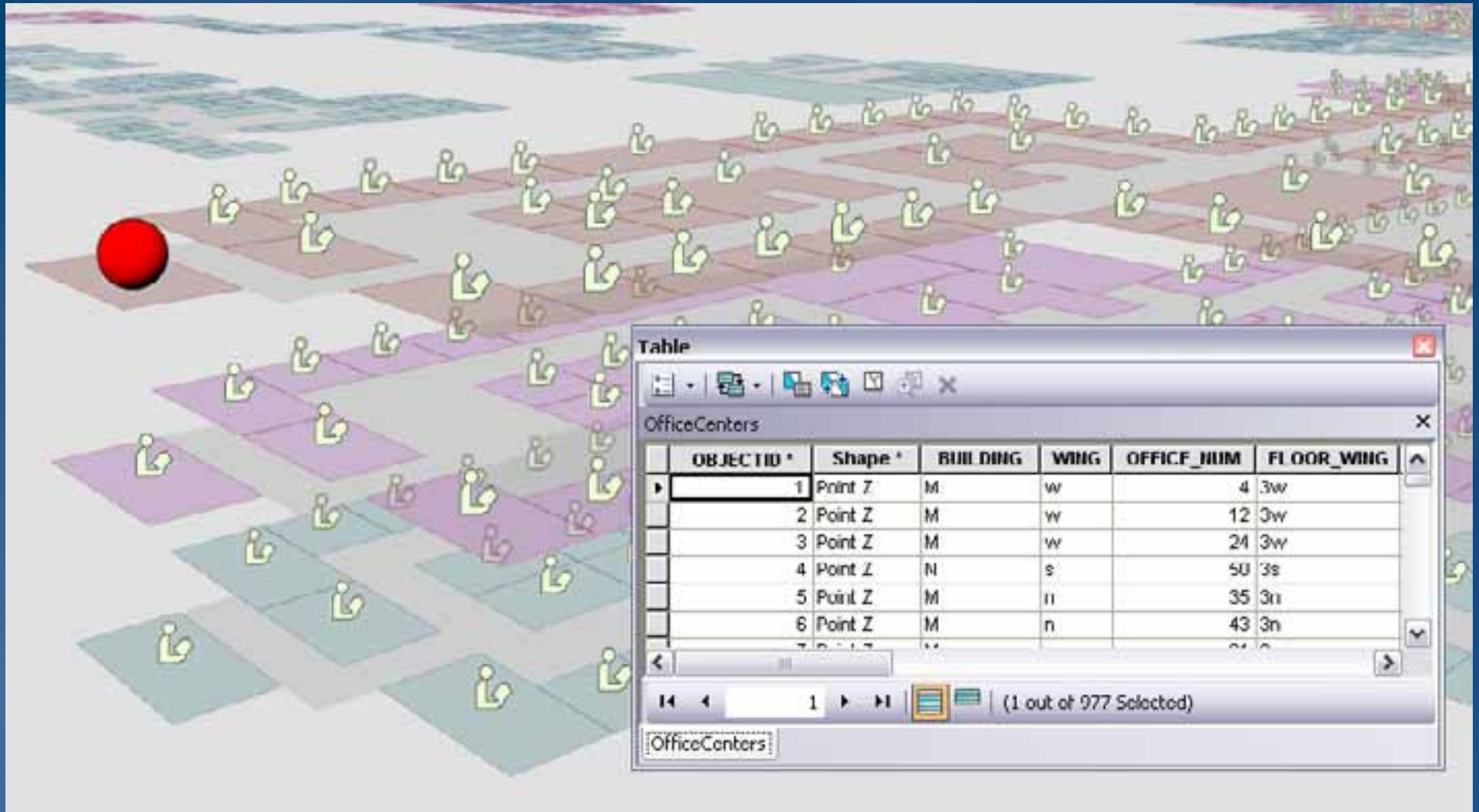
# Expanding the core model from 2D to 3D

## *Changes to methods of storing Z values*

- Can be done by
  - Creating a new feature class, Z enabled, based on old scheme
  - Loading old data into new feature class
  - Set z values based on an attribute via code
- Disadvantages
  - Harder to update elevations
  - Harder to select features by elevation
    - Can be mitigated by storing as attribute as well
  - Not as easy to do for features that have multiple Zs
- Advantages
  - Can use Feature Classes directly in geoprocessing
  - Consistent behavior between feature classes
  - Supports 3D Editing

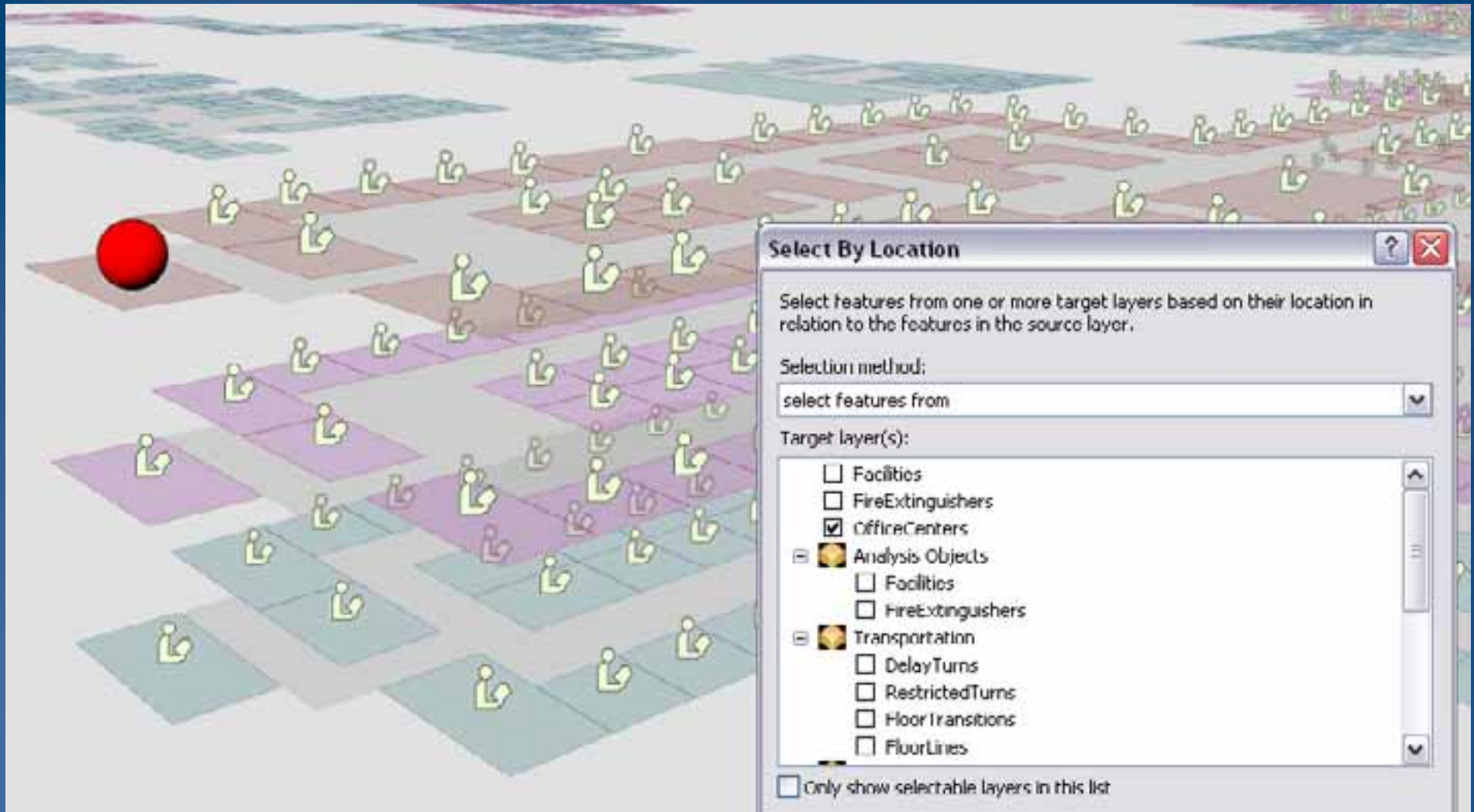
# Expanding the core model from 2D to 3D

*Changes to methods of storing Z values*



# Expanding the core model from 2D to 3D

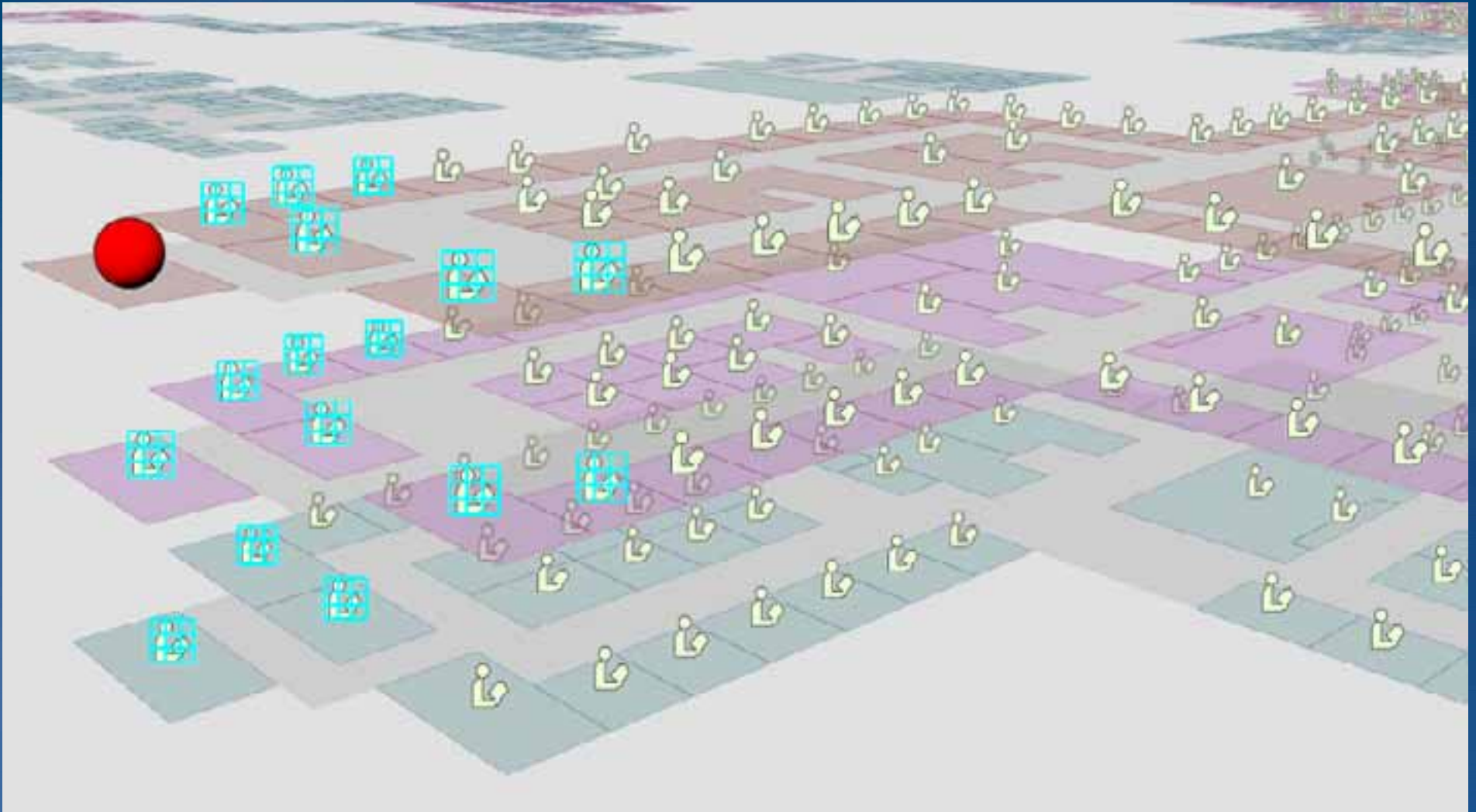
*Changes to methods of storing Z values*





# Expanding the core model from 2D to 3D

*Changes to methods of storing Z values*





# Expanding the core model from 2D to 3D

## *Changes to geometric method of representation*

- Changes to geometric method of representation
  - Conversion of
    - Polygons to a multipatch volumes
    - Lines to a multipatch surfaces
  - Editing multipatches to create more complex volumes
  - Generating multipatches from lidar point clouds

# Expanding the core model from 2D to 3D

## *Changes to geometric method of representation*

- Can be done by
  - Extruding a space layer by room height
  - Use Layer 3D to Feature Class to convert them to Multipatches
  - If edits are required
    - Export the multipatch to a Collada model
    - Edit the model in SketchUp, or another detailed 3D editing program
    - Replace the original multipatch using 3D Editing
- Disadvantages
  - Harder to edit
- Advantages
  - Can be used to calculate room volumes
  - Can be used in 3D Set Operator Analysis

# Questions / Feedback