



SmartPlant P&ID *Data Model*

The Resource for Automation



Introduction

- *Data Model Fundamentals*
- *Llama and Data Model*
- *SPPID Data Model*

What is the SPPID Data Model?

- *The persistent storage structure in a relational database for data that is manipulated by SmartPlant P&ID application*
- *Represented using UML*



Data Model Fundamentals

Using Unified Modeling Language



UML

- *Unified Modeling Language for Static and Dynamic Elements*
- *Class Diagrams represent Static Models*

Class Diagrams

- *Depicts classes within a model*
- *Classes have*
 - *name*
 - *attributes*
 - *operations*
 - *relationships*



Class Diagram Relationships

- *Inheritance or Sub Class*



- *Aggregation and Composition*



- *Association*



Relationships

- *Name*



- *Multiplicity*

- *one-to-one*



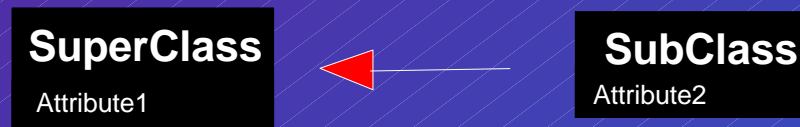
- *one-to-many*



- *many-to-many*



Item Attributions



- *Attribute1*

- *Attribute2*

- *Attribute1*

Filtered Relationships Attributes



is equivalent to



*Class2.Type1.Attribute2 can be
an ItemAttribution of Class1*



Llama and the Data Model

Application of the Data Model through Automation



Logical Model Automation

LLAMA

- *A Class library*
- *Classes represent the data model*
- *Methods reflect the data connectivity*
- *Provides a logical structure to access and manipulate data*

Class structure

Two classes for each Data Model entity





Attribute DataTypes

- Data Types and their usage in Llama



Attribute Data Types

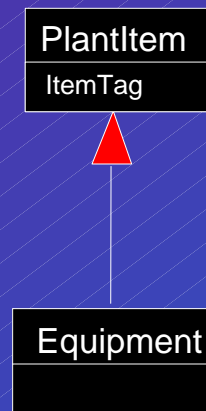
- Simple
 - String, Long, Date, etc.
- Enumerated (codelists)
 - Name (Variant)
 - Index (Long)
- Unitted (formatted)
 - Name (Variant)
 - SIValue (Double)

Item Attributes

Equipment
HTraceMediumTemp

LMEquipment.Attributes(“HTraceMediumTemp”)

Inherited Attributes



LMPlantItem.Attributes("ItemTag")

LMEquipment.Attributes("ItemTag")

Filtered Relationships Attributes

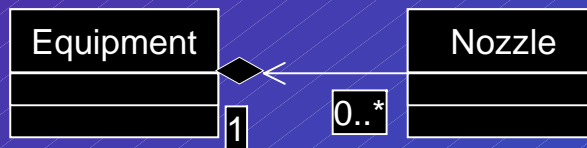


is equivalent to



*CaseProcess.Maximum.Pressure can be
an ItemAttribution of ModellItem*

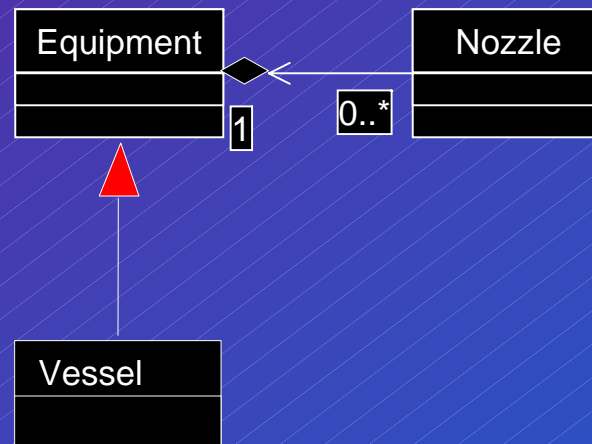
Relationships



LMEquipment.Nozzles → *LMNozzles*

LMNozzle.EquipmentObject → *LMEquipment*

Inherited Relationships



LMEquipment.Nozzles \longrightarrow *LMNozzles*

LMVessel.Nozzles \longrightarrow *LMNozzles*



Non-DataModel Objects

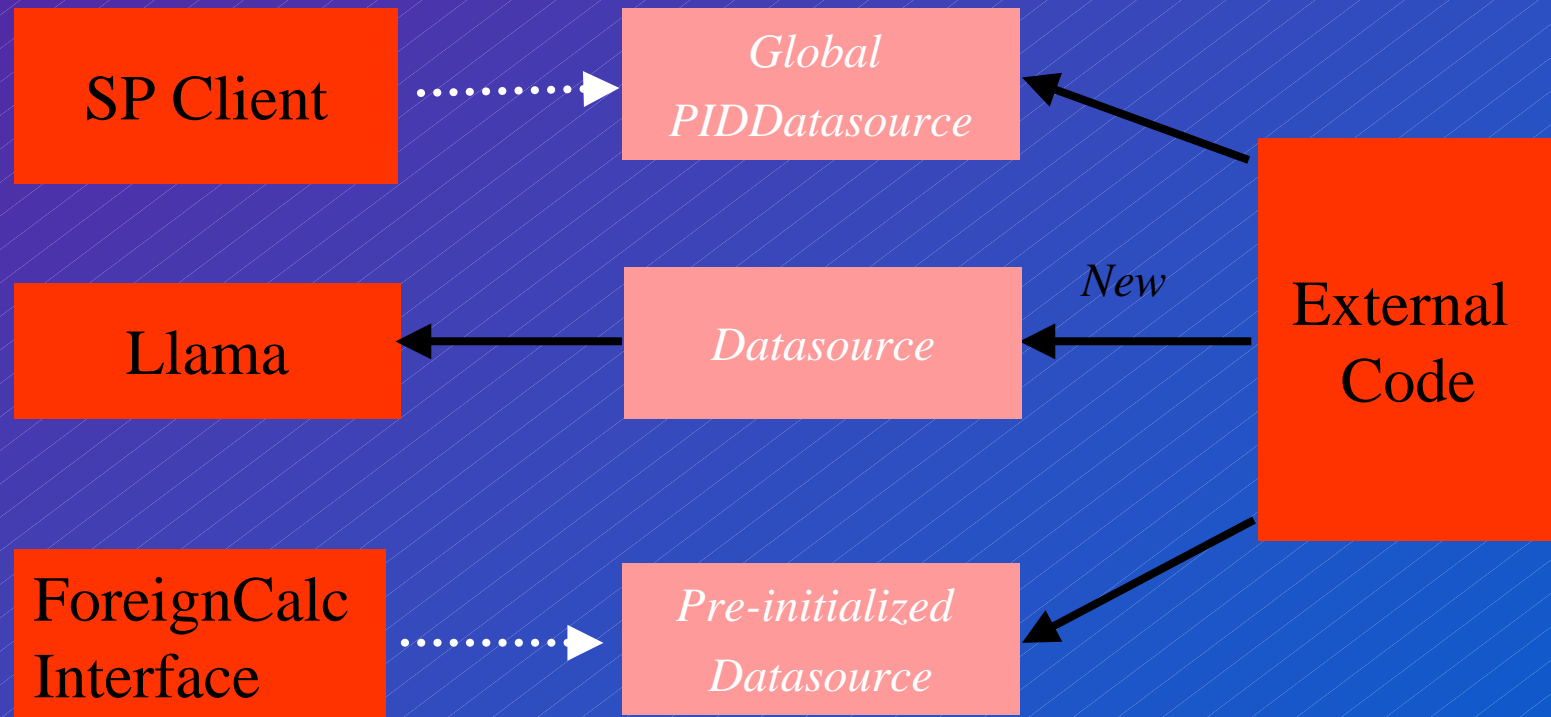
- Special Llama Objects



The LMADataSource

- *The Connection Object to SmartPlant P&ID data*
- *Database object*
- *Must exist for every use of Llama*

Source of LMADatasource





LMItem

- A generic item in Llama
- It is the common interface supported by every object class
- Every LMItem has all of the attributes of the item it represents

LMAAttribute

- A generic attribute in Llama
- It is the common interface for every ItemAttribution
- Every LMAAttribute has a Name and a Value
- The LMAAttribute can be retrieved from the LMAAttributes collection by Name

LMACriterion

- Relates an attribute and a value
- SourceAttributeName: name of ItemAttribution
- Operator: string form of the comparison
operator =, <, >, >=, etc.
- ValueAttribute: value of the ItemAttribution
- Conjunctive: Set to AND (-1) or OR (0) for
multiple criteria

LMAMFilter

- Filters for items using LMAMCriteria
- Criteria: collection of LMAMCriteria
- ItemType: the item type in the DataModel that is being filtered for
- Conjunctive: Set to AND (-1) or OR (0) for compound filter

LMAEnumAttList

- An LMAEnumAttList in Llama is referred to a SelectList data
- Property EnumeratedAttributes is a collection of SelectList value of this SelectList Data
- User can get a collection of LMAEnumAttList from LMADataSource.CodeLists property



LMAEnumratedAttribute

- An LMAEnumberatedAttribute in Llama is referred to a SelectList Value in a Select data
- Every LMAEnumratedAttribute has a Name and a Index



Llama Collections

- Count (): returns the size of the collection
- Nth (index as Long): the n'th item in collection
- Item (ID as Long): the item specified by ID
- Collect: uses the datasource to collect items
- AsLMAItems: converts collection to the common interface



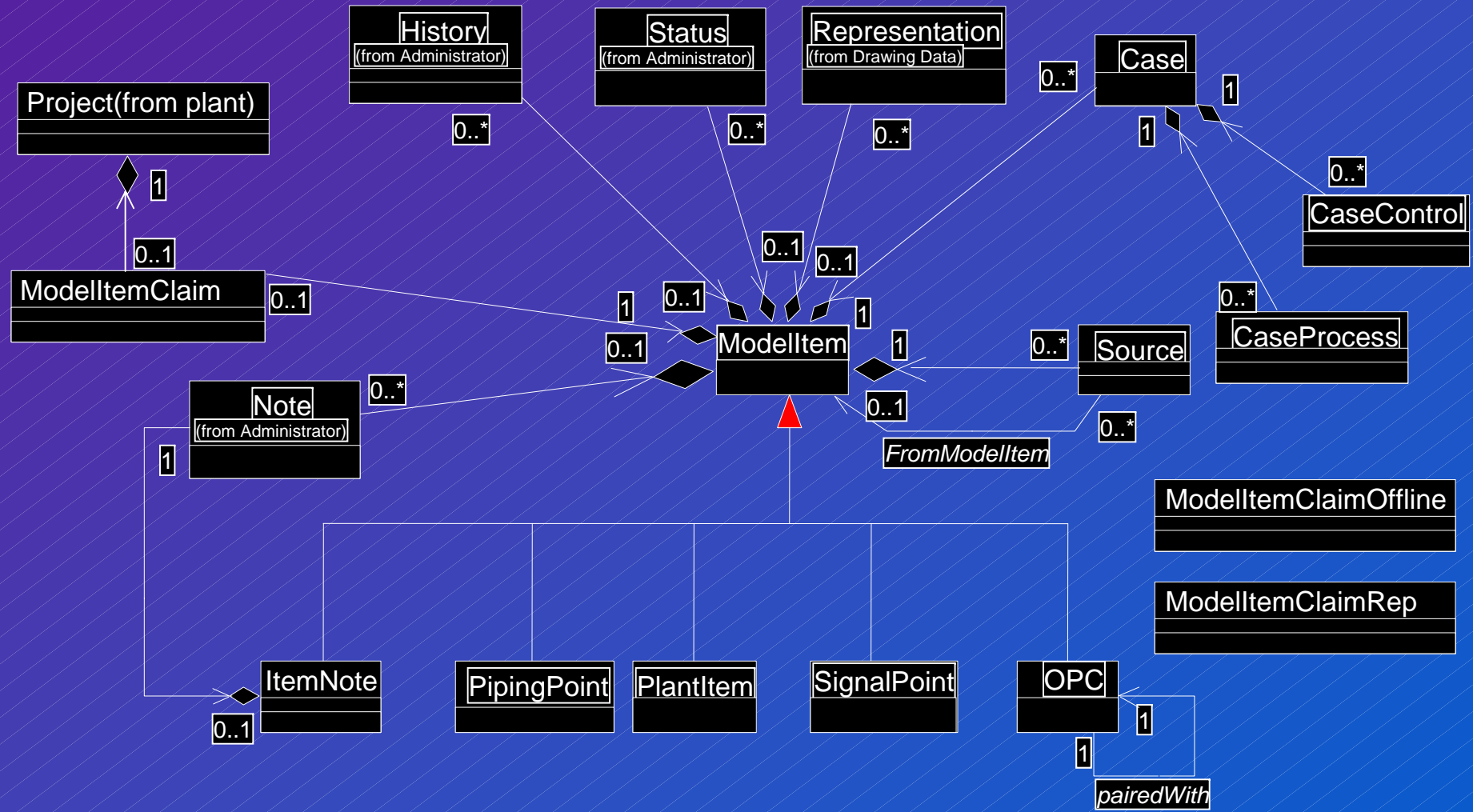
SmartPlant P&ID Data Model

The Graphical Representation

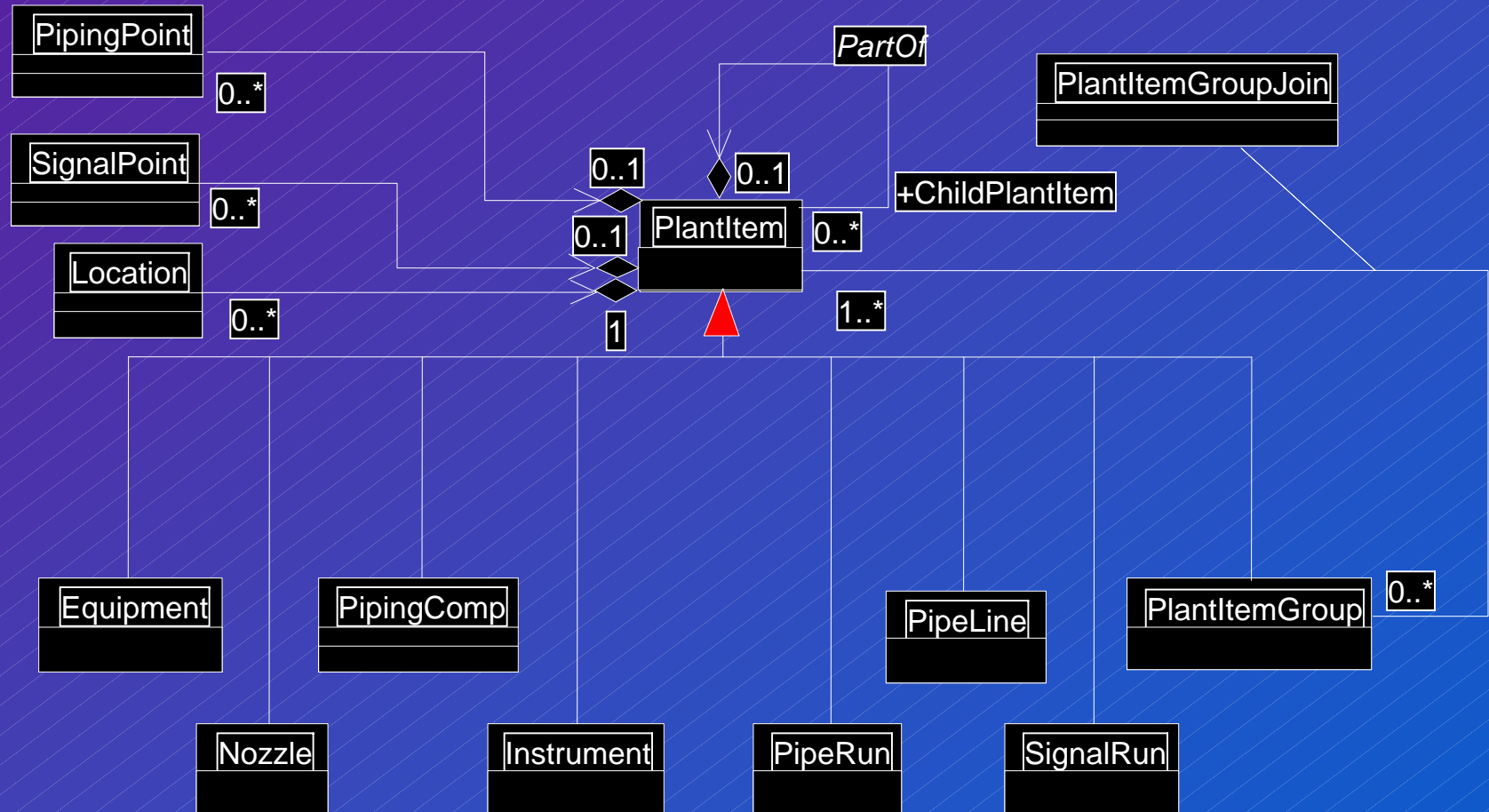
Smart Plant P&ID Data Model

- *Model Data*
 - *Entities related to the Process Engineer's perspective of the P&ID*
- *Drawing Data*
 - *Entities related to the graphical representation*

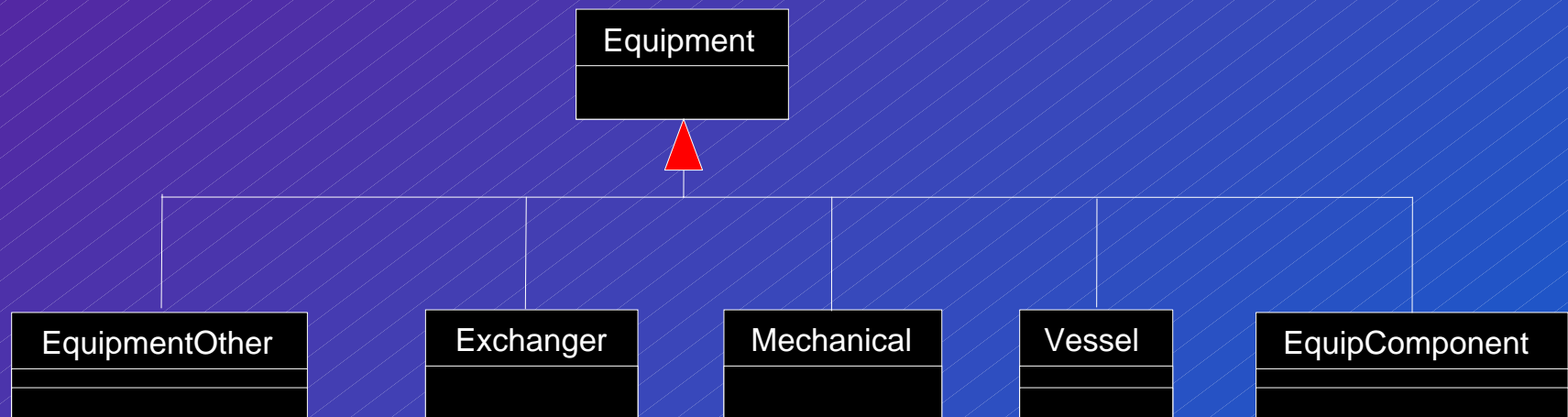
Model Data: Model Item



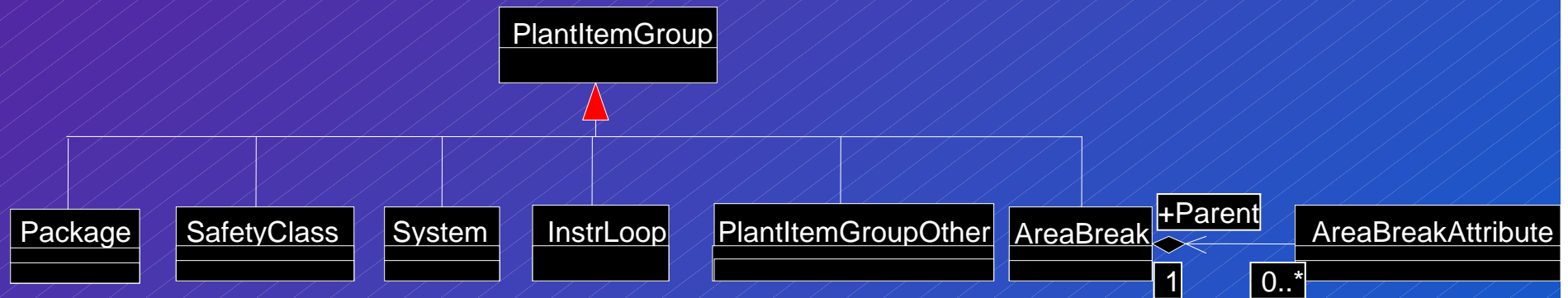
Model Data: Plant Item



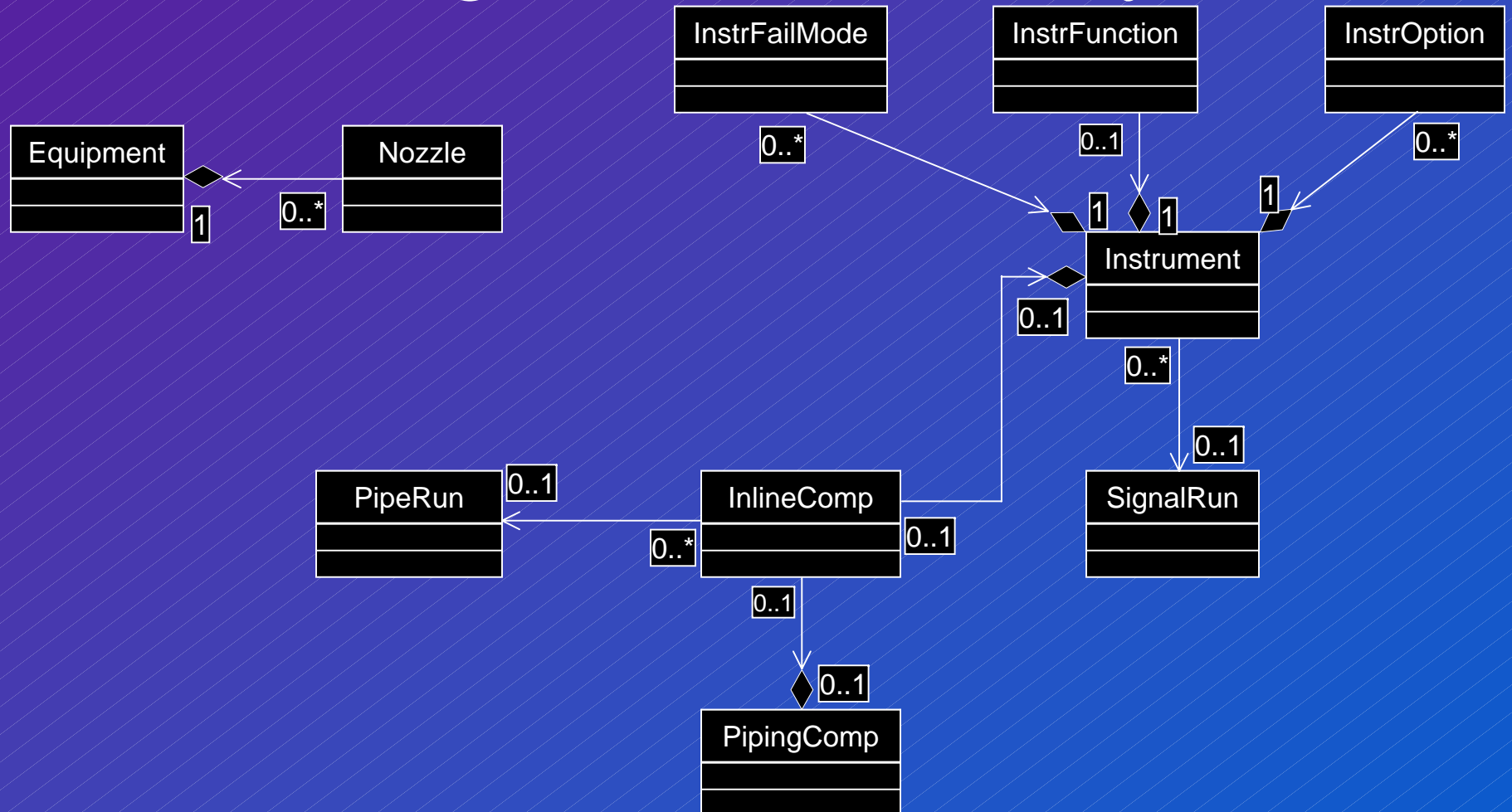
Model Data: Equipment



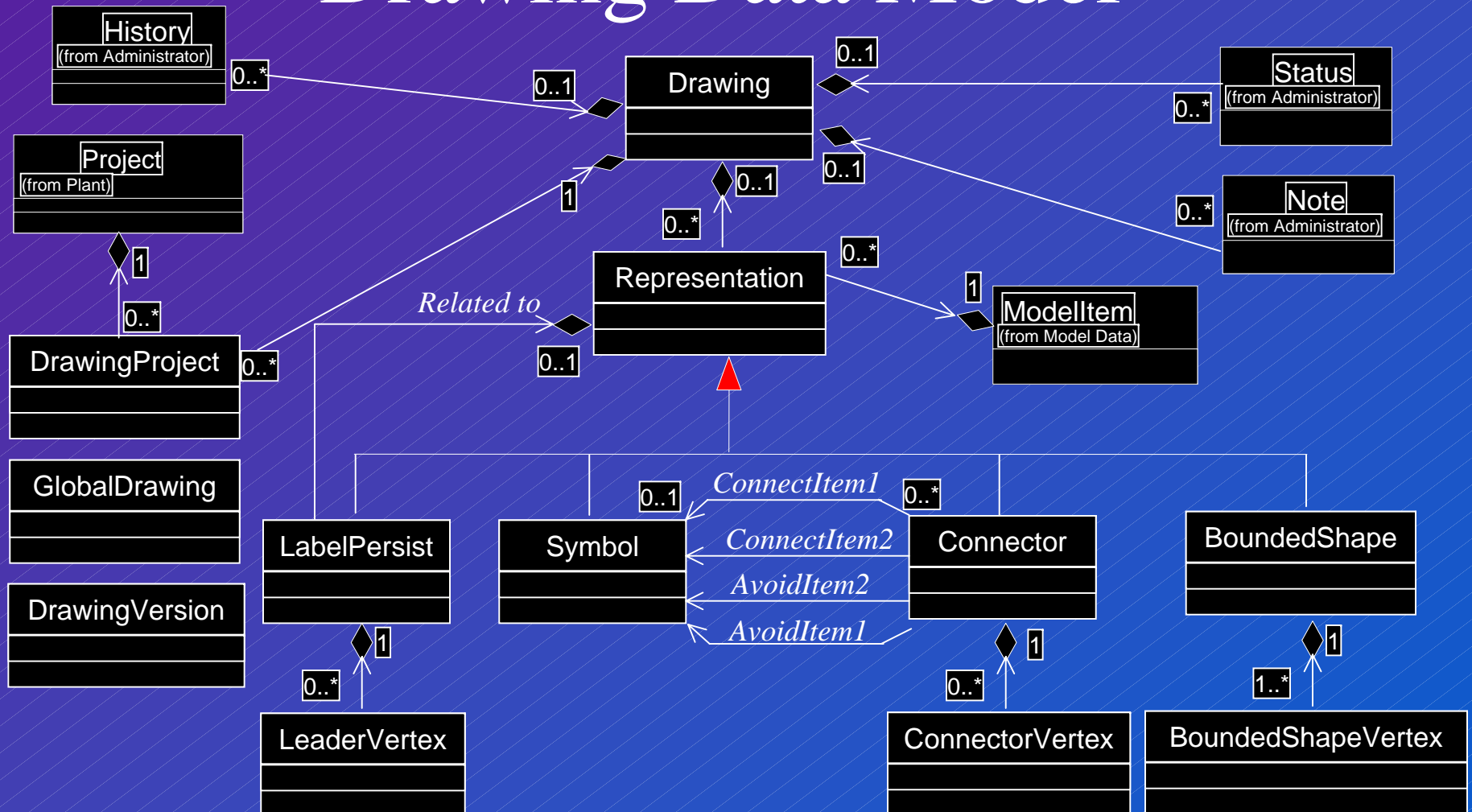
Model Data: PlantItemGroup



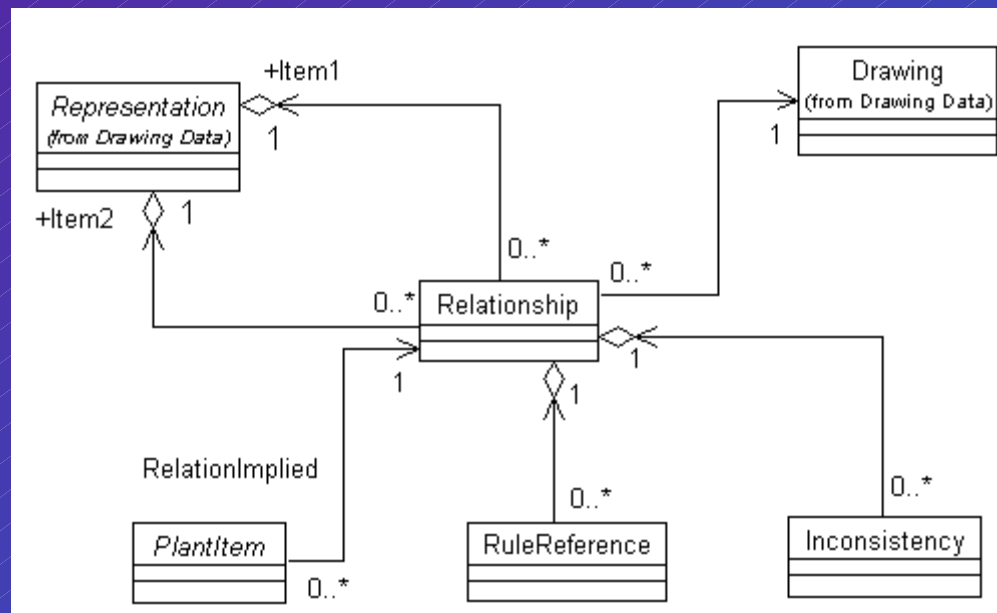
Logical Connectivity



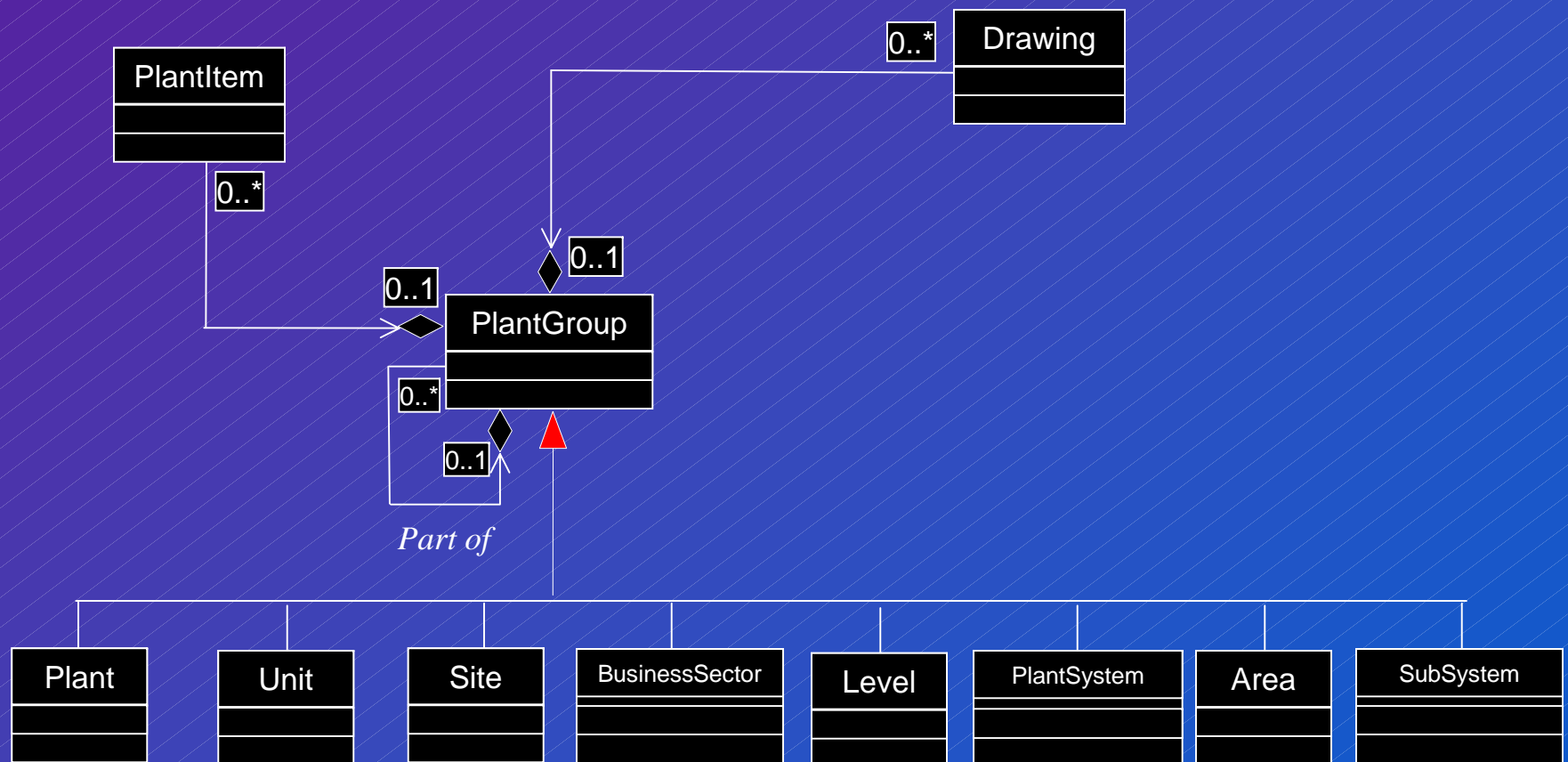
Drawing Data Model

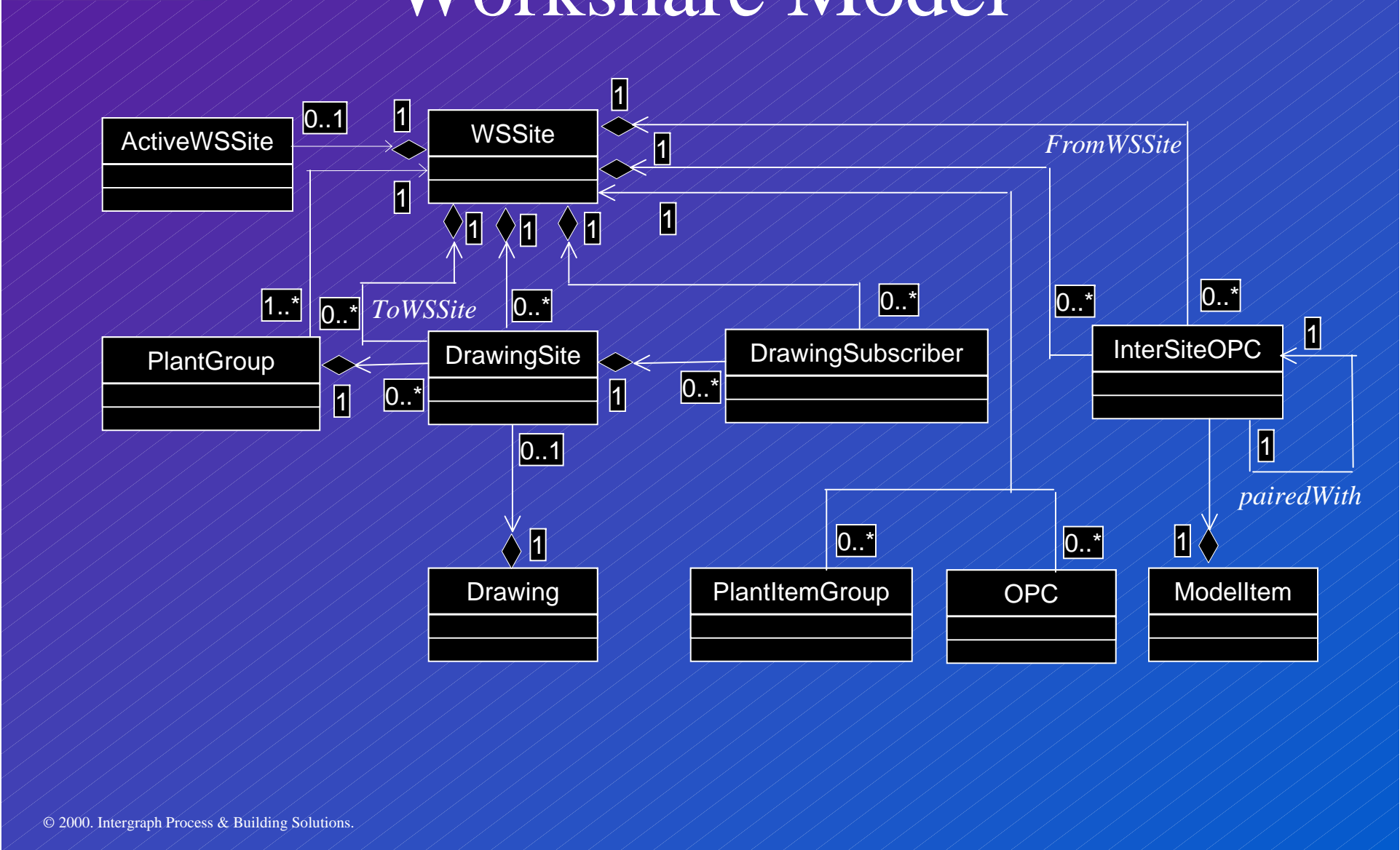


Relationship Model

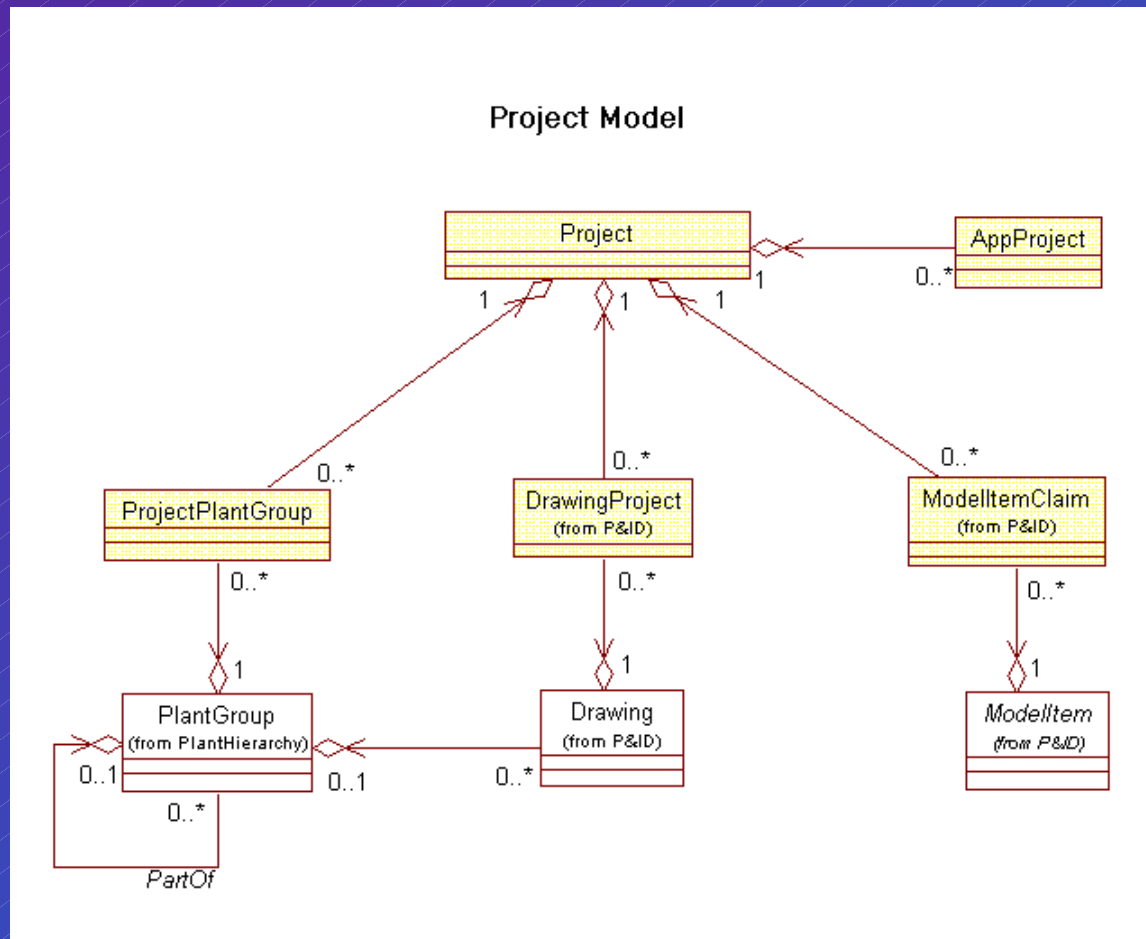


Plant Schema Model





Project Model





Plaice

- The Placement Automation



Place (Main)

- PIDCreateItem
- PIDPlaceSymbol
- PIDPlaceLabel



Place (Misc.)

- PIDPlaceRun/PIDAutoJoin
- PIDPlaceGap
- PIDPlaceBoundedShape
- PIDPlaceAssembly



Remove

- PIDDeleteItem
- PIDRemovePlacement



Replace

- PIDReplaceSymbol
- PIDReplaceLabel
- PIDReplaceOPC



Other

- PIDApplyParameters
- PIDConnectPointLocation
- PIDSnapToTarget
- PIDSetCopyPropertiesFlag
- PIDDataSource



PIDAutomation

Methods to Manipulate Drawings

Drawing Manipulation Methods

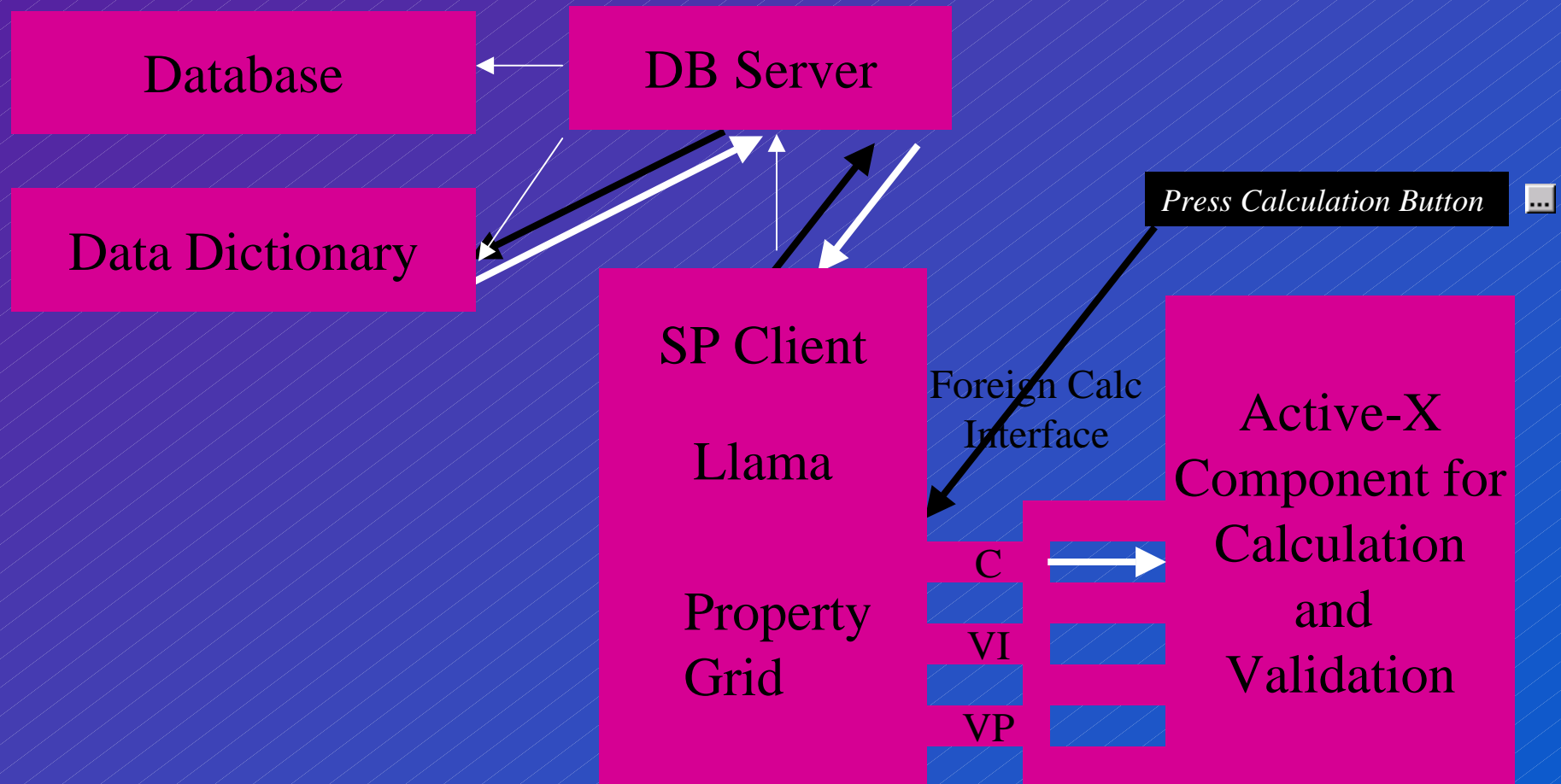
- Drawings.Add
- Drawings.OpenDrawing
- Drawing.CloseDrawing



Calculation/Validation Interface

- A Resource for Integration

Calculation



Calculation

- DoCalculate (
DataSource as LMADataSource,
Items as LMAItems,
PropertyName as String,
Value as Variant)
as Boolean



Property Validation

- **DoValidateProperty** (
 DataSource as LMADataSource,
 Items as LMAItems,
 PropertyName as String,
 Value as Variant)
as **Boolean**



Property Validation

- **DoValidatePropertyNoUI** (
DataSource as LMADataSource,
Items as LMAItems,
PropertyName as String,
Value as Variant)

Item Validation

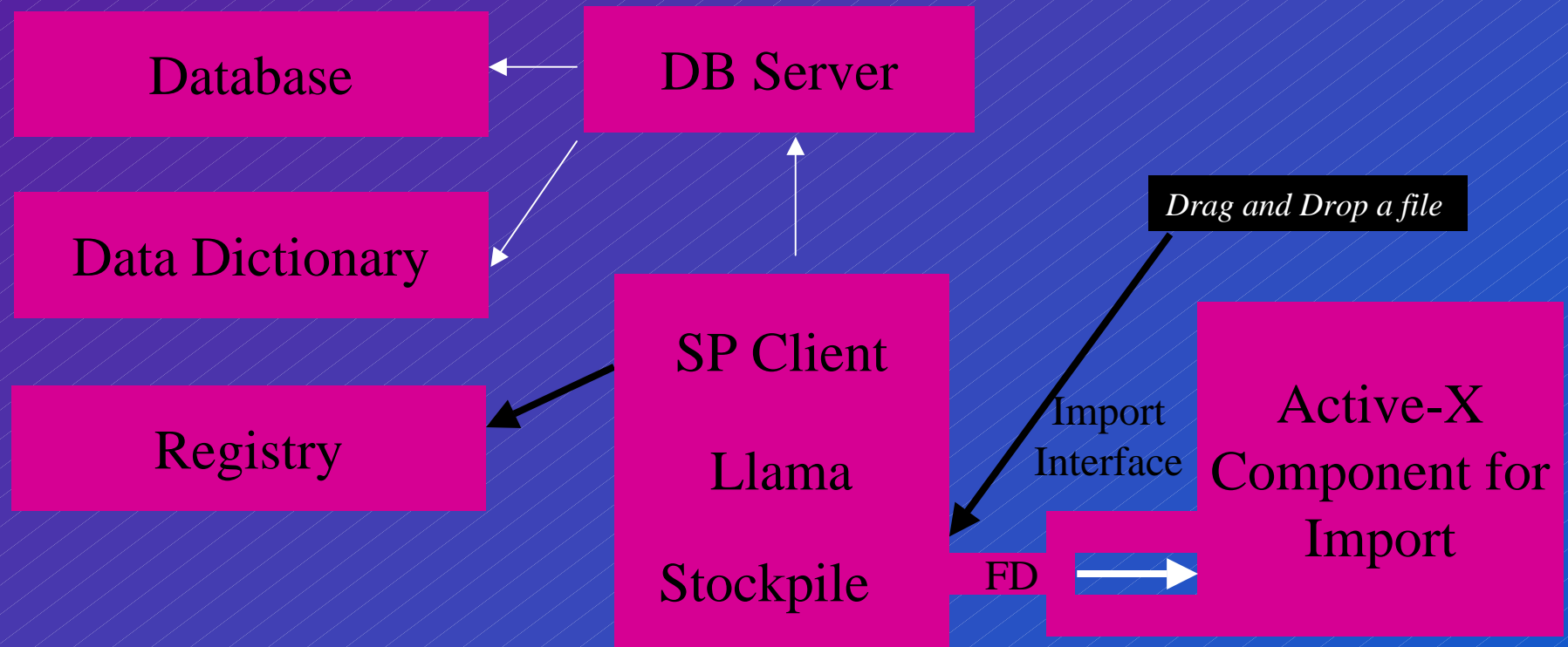
- **DoValidateItem** (
DataSource as LMADataSource,
Items as LMAItems,
Context as
ENUM_LMAValidateContext)
as **Boolean**



Import Interface

A Resource for Data Transfer

Import of Foreign Data





Import Interface

- **FileDrop** (
filename as String,
datasource as Object)



LMAutomationUtil

ethods to get From/To information for
PipeRun



Methods to get From/To

- RunsNavigation
- RunsNavigationAll