MULTIPLE INHERITANCE FOR A MODULAR BIM

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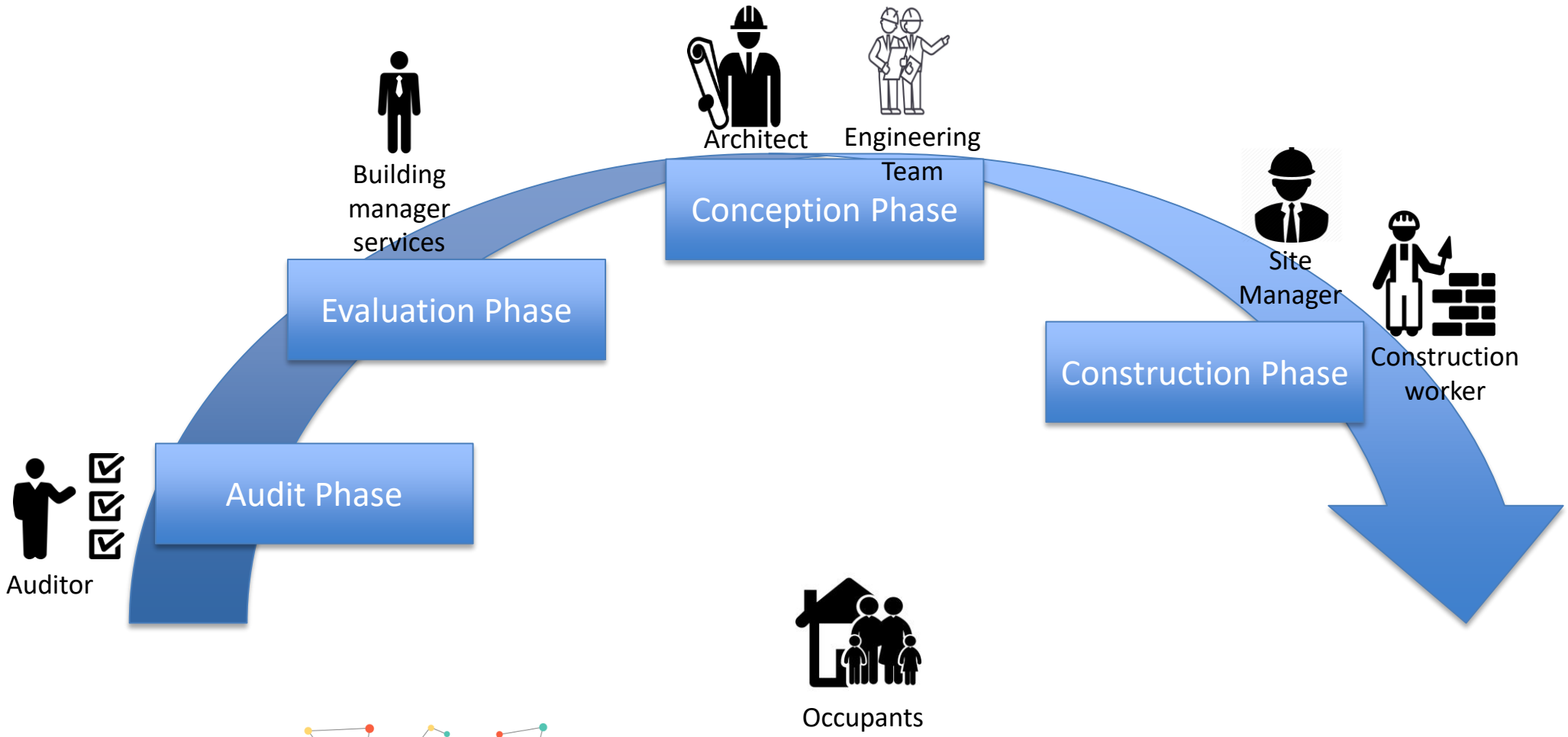
Edu BIM 2020

BIM4Ren

IFC: THE OPENBIM STANDARD

BIM AND INTEROPERABILITY

IN A RENOVATION USE CASE



BIM AND INTEROPERABILITY

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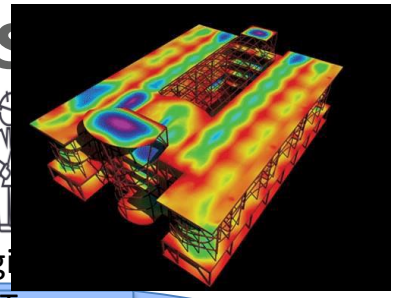


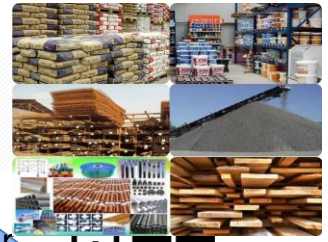
Building manager services

Engi Team

Evaluation Phase

uction Phase

Site Manager

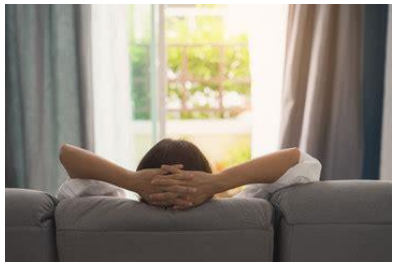


Construction worker

Audit Phase

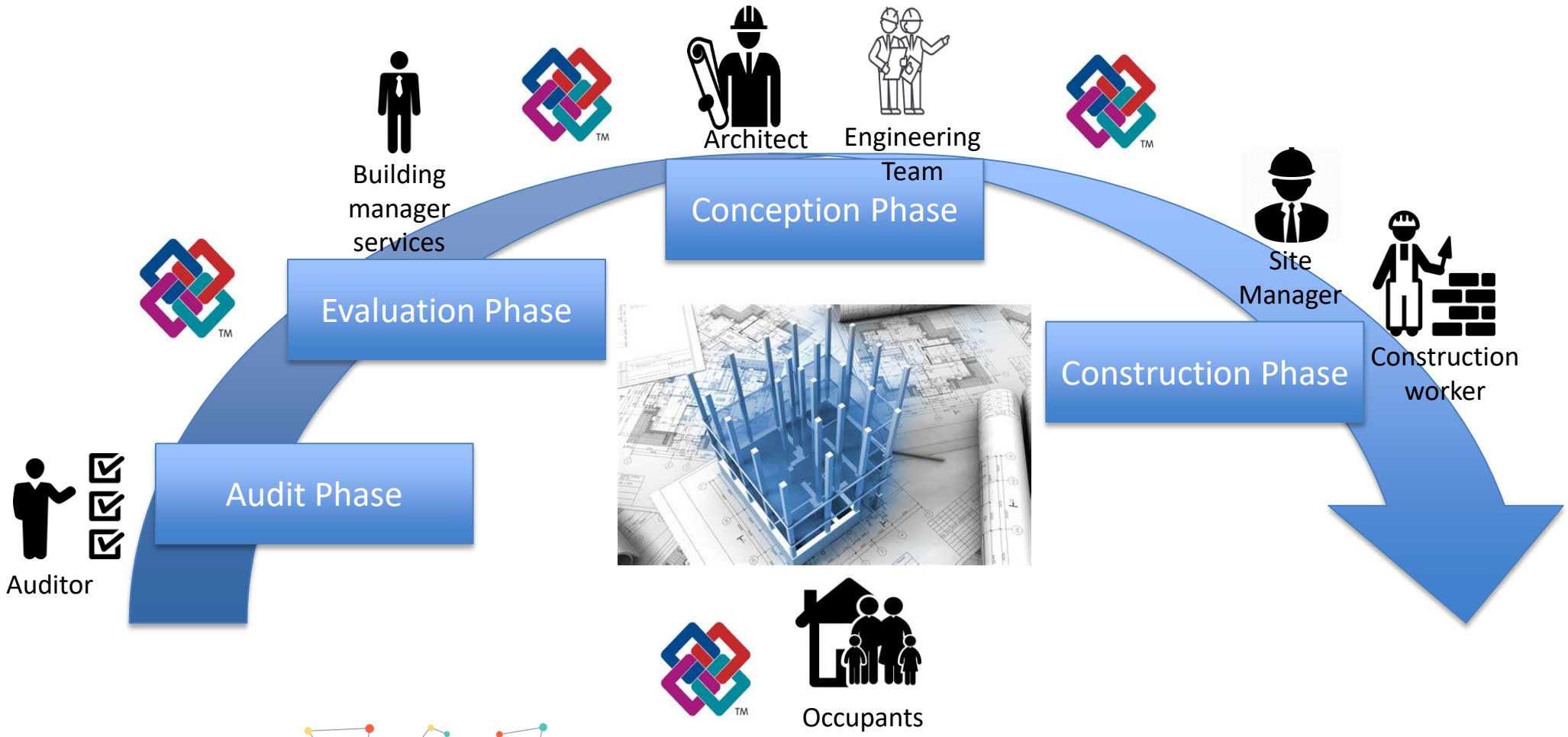
Auditor

Occupants



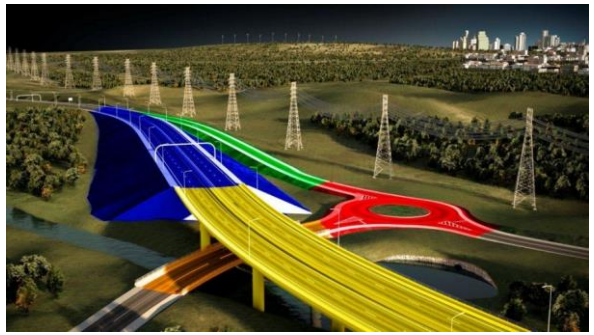
BIM AND INTEROPERABILITY

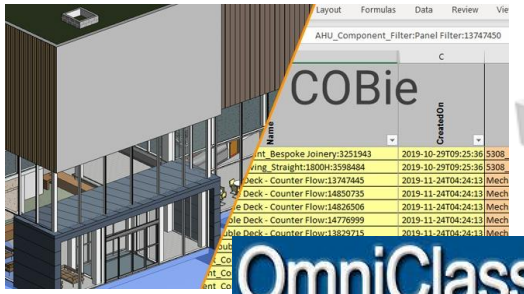
IN A RENOVATION USE CASE



IFC: A DIAGNOSIS

IFC: A GROWING EXCHANGE FORMAT





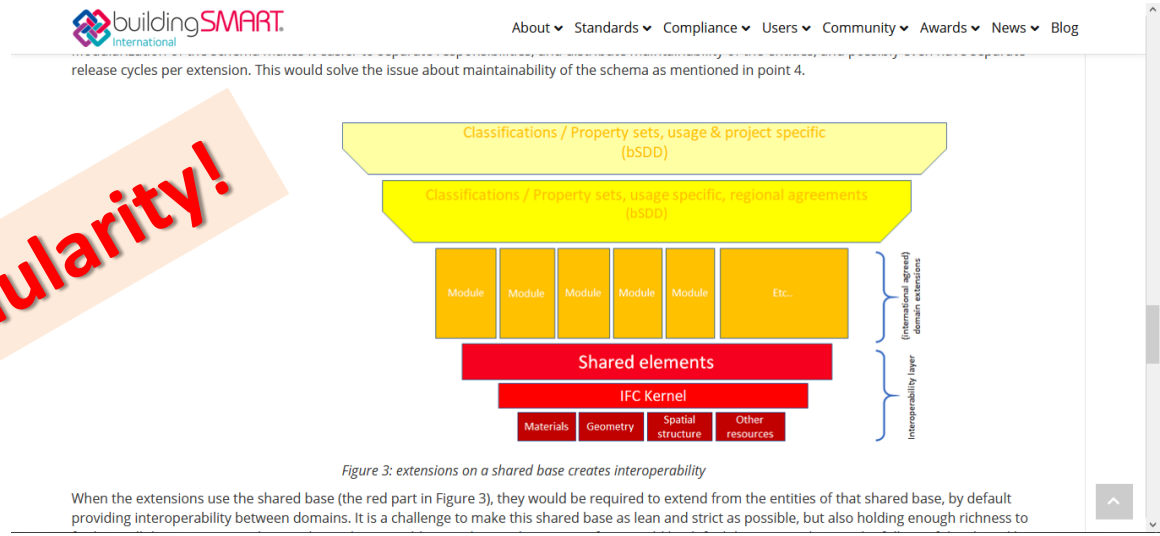
IFC Version	Date of publication	File Size (EXP)	#Types	#Entities
IFC 2x	2000-10	180 kB	228	370
IFC2x-ADD1	2001-10	188 kB	228	370
IFC2x2-Final	2003-05	238 kB	312	623
IFC2x2-ADD1	2004-07	188 kB	327	370
IFC2x3	2005-12	261 kB	397	653
IFC2x3-TC1	2007-07	261 kB	327	653
IFC4	2013-02	379 kB	391	766
IFC4-ADD1	2015-06	361 kB	398	768
IFC4-ADD2	2016-07	364 kB	397	776
IFC4-ADD2-TC1	2017-10	364 kB	397	776
IFC4x1	2018-06	371 kB	400	801
IFC4x2	2019-04	378 kB	407	816

A DIAGNOSIS ON IFC
20 YEARS AFTER…

- Everyone mentions IFC…
  - … but are software vendors really playing the game?
- Is the IFC schema **well-suited, easy enough**, to be applied by software vendors?
- IFC is competing with other standards (e.g. gbXML): it is not even well-suited for specific domains
  - **Does it have to be**?
- The IFC community may have issues **maintaining** the IFC schema
  - **Model-View definition** used to simplify it…
- The adopted design patterns are **sometimes 'exotic':**
  - **Proprety sets**/property definitions
  - Types as properties
  - Distance between a class and its properties

- **How to improve it?**

Modularity!



MANY 'MODULES' ALREADY EXIST

THE LINKED DATA COMMUNITY

- **Building Topology Ontology (BOT):** building structure/organization
- Products:
  - **Building Product Ontology (BPO):** product as an assembly of elements
  - **Ontology for Property Management (OPM):** description of properties
- **The SEAS Ontology**

  - **Imports:** ArchitectureOntology-2.0, BatteryOntology-1.0 , BooleanPropertyOntology-1.0 , BuildingOntology-1.0 , CityOntology-1.0 , ComfortOntology-1.0 , CommunicationOntology-1.0 , ComplexOntology-1.0 , DeviceOntology-1.1 , ElectricLightSourceOntology-1.0 , ElectricPowerSystemOntology-1.0 , ElectricVehicleOntology-1.0 , EnergyFormOntology-1.0 , EvaluationOntology-1.0 , FailableSystemOntology-1.0 , FeatureOfInterestOntology-1.0 , FlexibilityOntology-1.0 , ForecastingOntology-1.1 , GenericPropertyOntology-1.0 , GreenKPIOntology-1.0 , OfferingOntology-1.1 , OperatingOntology-1.0 , OptimizationOntology-1.1 , PeriodicSignalOntology-1.0 , PhotovoltaicOntology-1.0 , PlayerOntology-1.1 , PricingOntology-1.0 , SmartMeterOntology-1.1 , StatisticsOntology-1.0 , StreetLightSystemOntology-1.0 , SystemOntology-1.1 , ThermodynamicSystemOntology-1.0 , TimeOntology-1.0 , TradingOntology-1.1 , ZoneLightingOntology-1.0 , ZoneOntology-1.0

SEAS
Smart Energy Aware Systems

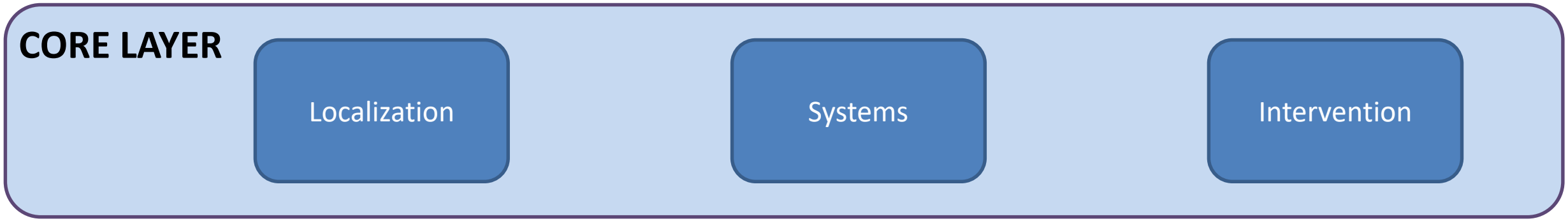
A MULTI-LAYER DESIGN PATTERN BASED ON MULTIPLE INHERITANCE

A THREE LAYER PATTERN

CORE LAYER

To describe specific aspects of a building, and to attach elements in it according to some specific properties

- **BOT**: Structure of the building – **Goal: localize elements ('spatially')**
- **SOT**: Systems/network topology (MEP…) – **Goal: what is the role of an element within the network? To which elements it is directly connected?**
- **Intervention**: History of intervention – **Goal: keep trace of works performed (kind, criticality…)**

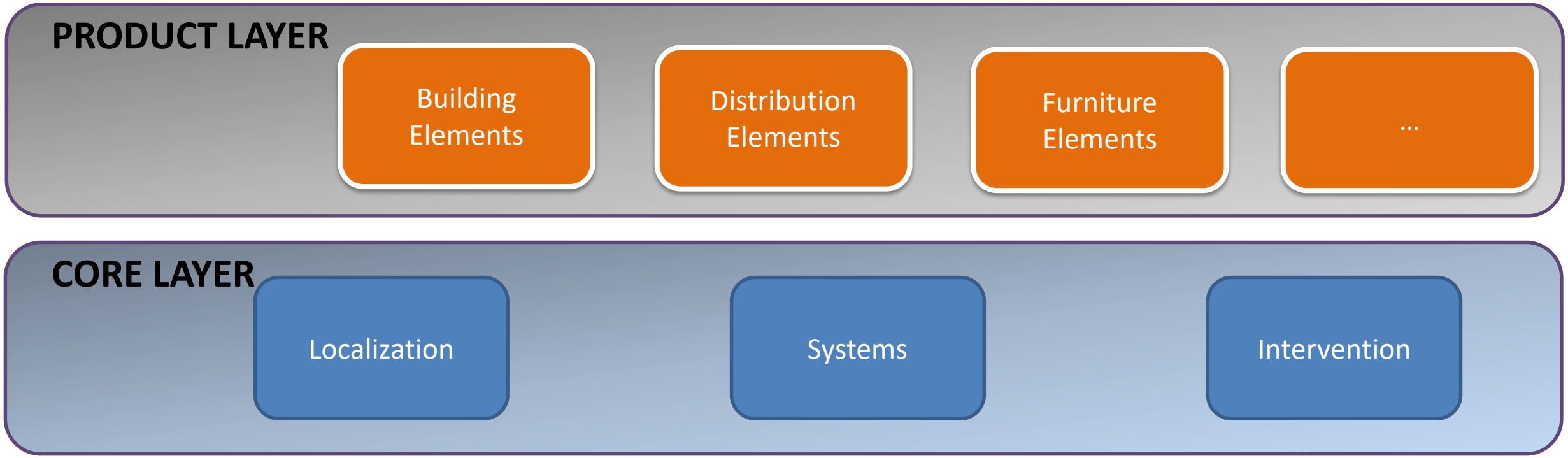


A THREE LAYER PATTERN

PRODUCT LAYER

Categorization of the elements that compose the building

- Taxonomies (no properties)
- Connection with catalogue of objects
- What granularity?

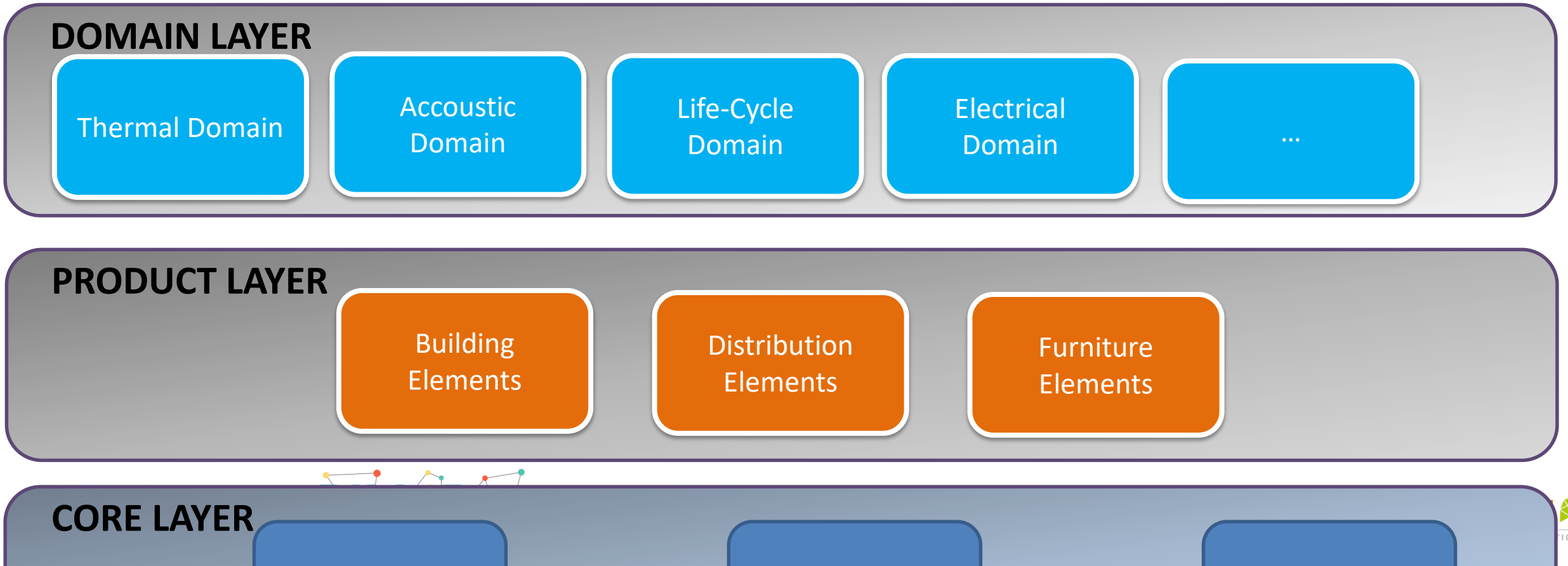


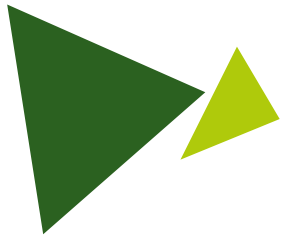
A THREE LAYER PATTERN

DOMAIN LAYER

Specific domain properties

- Attached to abstract/generic concepts





DOMAIN LAYER

- Thermal Domain
- Accoustic Domain
- Life-Cycle Domain
- Electrical Domain
- ...

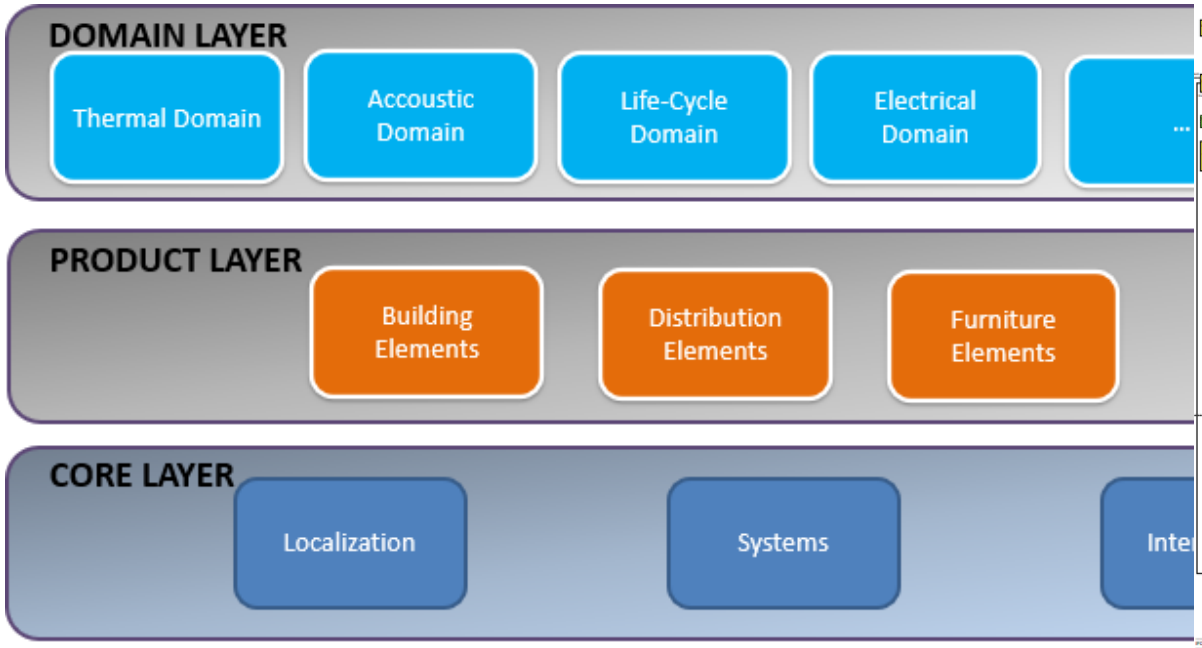
PRODUCT LAYER

- Building Elements
- Distribution Elements
- Furniture Elements

CORE LAYER

- Localization
- Systems
- Intervention

WHAT'S NEW?


DOMAIN LAYER
Thermal Domain
Accoustic Domain
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...
PRODUCT LAYER
Building Elements
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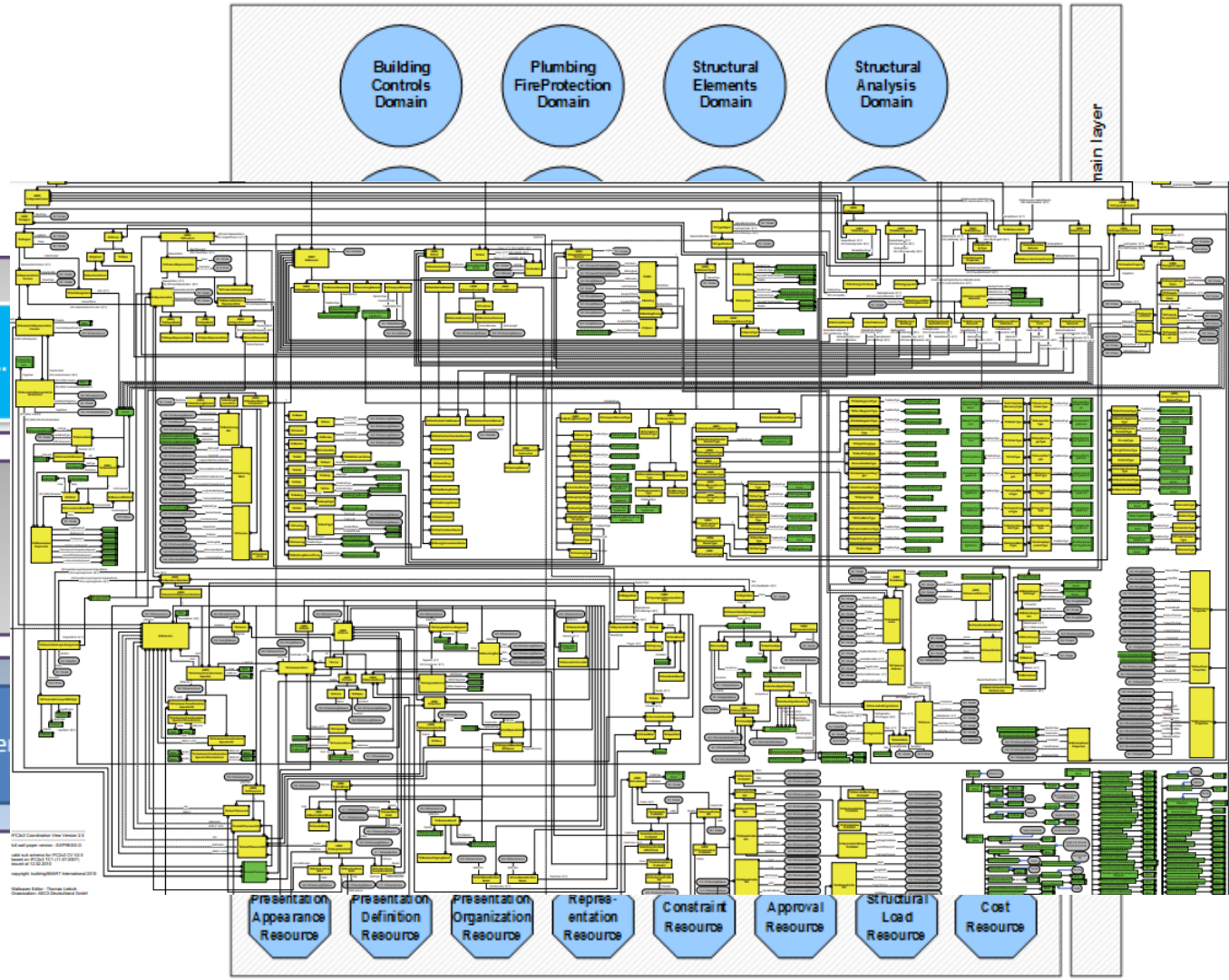
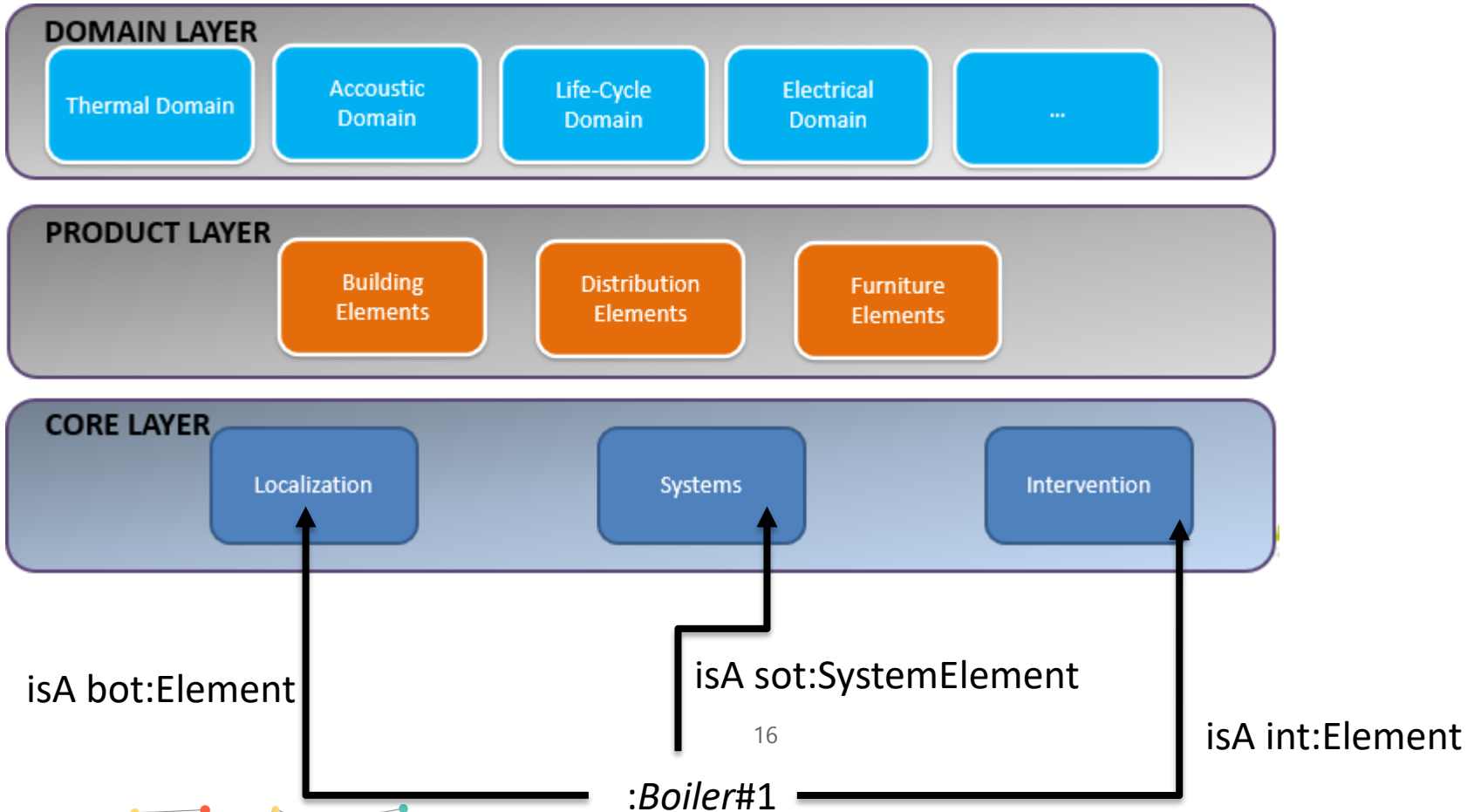
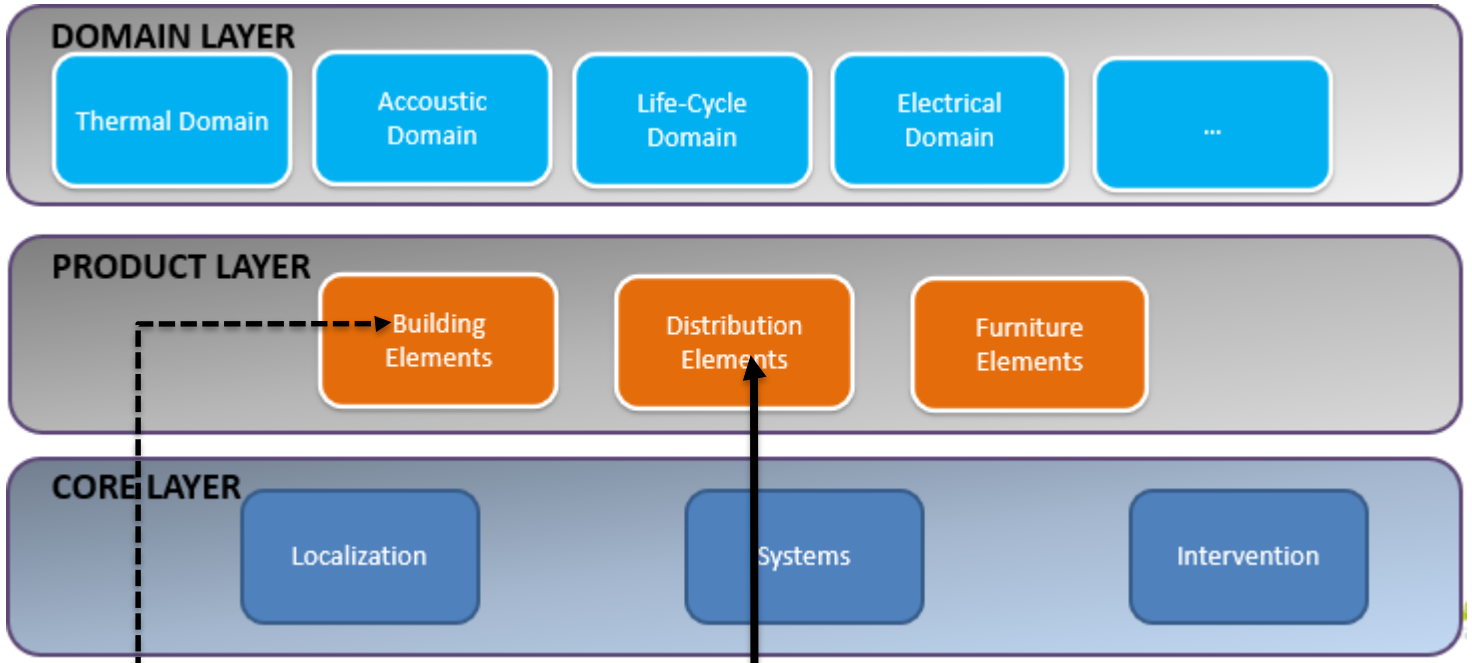
Furniture Elements
CORE LAYER
Localization
Systems
Inte


Building Controls Domain
Plumbing FireProtection Domain
Structural Elements Domain
Structural Analysis Domain
main layer
Presentation Appearance Resource
Presentation Definition Resource
Presentation Organization Resource
Repres-entation Resource
Constraint Resource
Approval Resource
Structural Load Resource
Cost Resource

MULTIPLE INHERITANCE (INSTANTIATION)



MULTIPLE INHERITANCE (INSTANTIATION)



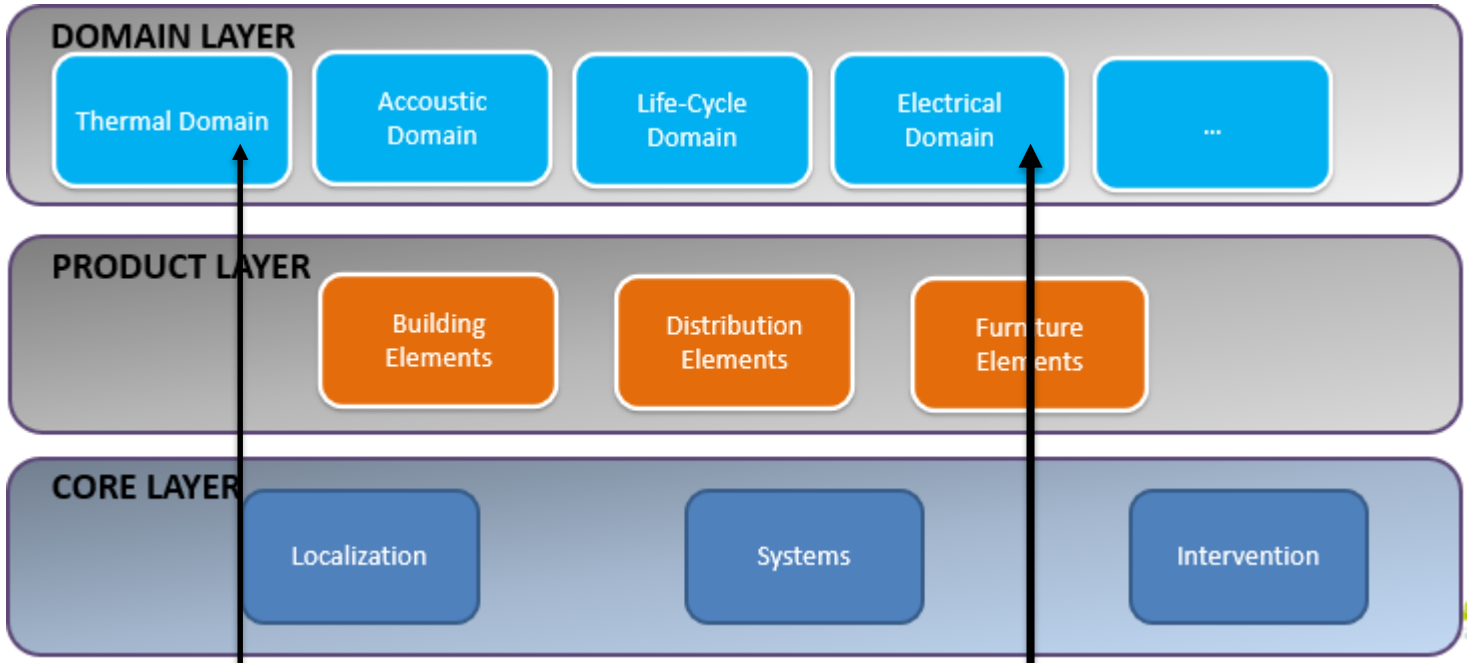
isA built:IfcWall

_:*Wall*#235

isA dist:Boiler

_:*Boiler*#1

MULTIPLE INHERITANCE (INSTANTIATION)



isA therm:Storage

isA therm:Heater

isA elec:Consumer

_:*Boiler*#1

DISCUSSION

A FULLY MODULAR APPROACH

- Each module is independent from all the other ones
  - Requires the creation of classes to which elements can be bound
  - We are **not creating A BIM but BIMs**
  - **MVDs is implemented by modules**: each stakeholder works with the data he needs using the required modules
- The mechanism is simple: only based on **multiple inheritance/instantiation**
  - **Modelling language independent**
- No more property sets: classes with attributes
  - **Direct link** from an object to its attributes
- External modules can be re-used
  - Currencies? What does the AEC community need to agree on?
- Each module should be kept as simple as possible
- The model can be extended in different ways for the need of a project:
  - Create/Import new modules
  - Extend existing ones (through… **inheritance!**)

A FULLY MODULAR APPROACH

- When creating a module, need to ensure there is no overlaps with other modules (no duplicated concepts)

- Is it always possible to create generic classes to which objects can be instantiated?
  - In particular in the domain layer – some properties are specific to products (e.g. number of cells on solar panels)

- Some modules/concepts may not really fit in the 3-layers patterns:
  - Context of the construction site

- **Future work:**
  - To be discussed within bSI/Mediaconstruct
  - Working on conversion from IFC to such model.

MERCI!

NOBATEK/INEF4

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