

Ontology Summit 2012

Ontology for Federation and Integration of Systems

Cross-track A2 Summary

Anatoly Levenchuk & Cory Casanave Co-chairs

http://ontolog.cim3.net/cgi-bin/wiki.pl?OntologySummit2012_SystemsFederationIntegration_Synthesis

Panelists

- **Dr. Tommi Karhela** (VTT Technical Research Centre, FI) - "Ontology based Integration Platform for Modelling and Simulation - Simantics"
- **Mr. Anatoly Levenchuk** (TechInvestLab, RU) - "Ontology-based Systems Federation"
- **Mr. Dennis Wisnosky** (DoD, US) - " Leveraging Semantic Technology across systems to meet the goal of having an 'executable, integrated, consumable, solution architecture' "
- **Mr. Cory Casanave** (Model Driven Solutions, US) - "Semantic Information Modeling for Federation" (SIMF)

What is Federation and Integration?

- Federation
 - Combining multiple independently conceived data sources, services and/or systems and using them together for analytics, information sharing and other purposes
 - Applies to system of systems engineering
 - Systems Federation (bus) – a kind of network with interoperability
 - WIKIPEDIA: A Federation is multiple computing and/or network providers agreeing upon standards of operation in a collective fashion
- Integration:
 - Implies (but does not require) more control over the interacting components than does federation to achieve a composite system
 - Applies to systems engineering
 - Wikipedia: Systems integration, the engineering practices and procedures for assembling large and complicated systems from less-complicated units, especially subsystems

Business Case

- The ability to federate and integrate data, processes, services and systems components is at the foundation of the modern enterprise, business eco-system and open, collaborative government
- The cost of non-semantic approaches, that are largely coded transformations between fixed data structures, is high and introduces errors, inflexibility and risks
- Incremental improvements in our ability to integrate and federate with semantics can mean bottom-line profits for the enterprise and improved service to citizens for government at lower cost and reduced timeframes

Federation Semantics

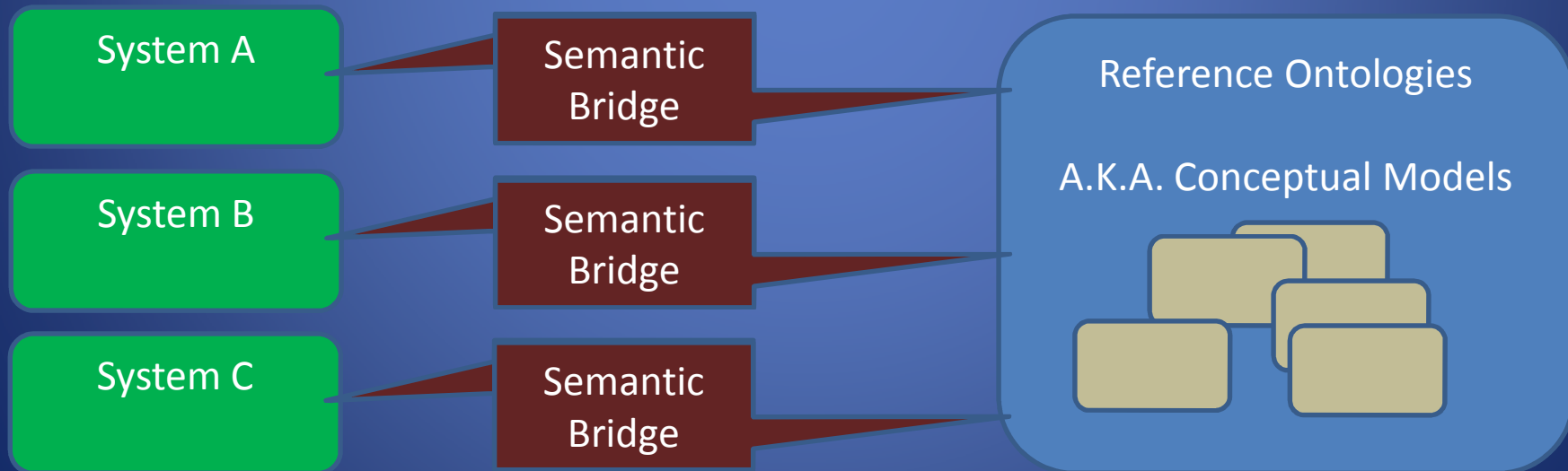
- Federation and integration always involves semantic analysis, even if done informally
- Ontologies provide methodologies and tools for capturing and leveraging semantic analysis to reduce the cost, time, errors and risk associated with manual federation and integration
- Ontologies can help directly drive federation and integration solutions using inference, rules and model driven architecture

Primary Architectures

- Structure
 - Point-point
 - Via a reference ontology (e.g. conceptual model)
- Runtime
 - Extract Transform Load (ETL)
 - Semantic Bridges (Dynamic)
- Ontologies assist with any combination, but are particularly effective in avoiding point-point static integration. Semantic federation can be implemented as ETL or dynamic translation

Reference Ontologies

- Represent the semantics of a domain
- Can map to multiple representations/systems/structures
- A lattice of reference ontologies avoids the “universal ontology” problems



Federation at all levels

- Federation and integration is required
 - At the “instance” level: data-data
 - At the model or ontology level: concept-concept
 - At the language or meta-model level: language-language
- To be most effective, ontologies are applied at all levels

Service Federation

- Service federation (SOA) encompasses information exchange, interacting roles, choreography, security & privacy
- Service viewpoints can also be modeled using ontologies
- Services utilize “information centric” ontologies
- Service and domain ontologies are required to support the full life-cycle of integration and federation

Standards targeted at federation

- ISO 15926, HDQM, Gellish, IDEAS, RDF/OWL, SIMF (in progress)
- Important capabilities of federation standards and languages
 - The broadest possible context
 - Extensible
 - Enable anything to be said that is valid (i.e. no artificial restrictions)
 - Explicit ontological commitments that are followed consistently
 - Strong methodology so that the same thing is represented in the same way by different analysts, including,
 - Choice of alternative approaches left open by ontological commitments,
 - Consistent representation so the same thing would get pretty much the same representation from different analysts.
 - FOL (Minimum), HOL is actually needed
 - General languages for specifying federation & conceptual models as well as the general programming languages used for federation
 - Stakeholder (business) friendly

Semantic Web

- Includes: Linked Data, RDF & OWL
- Seen as mainstream for web data representation and “lite” semantics
- Is being used in production (e.g. DoD BTA)
- There are questions about representational capability and suitability for widespread federation and integration

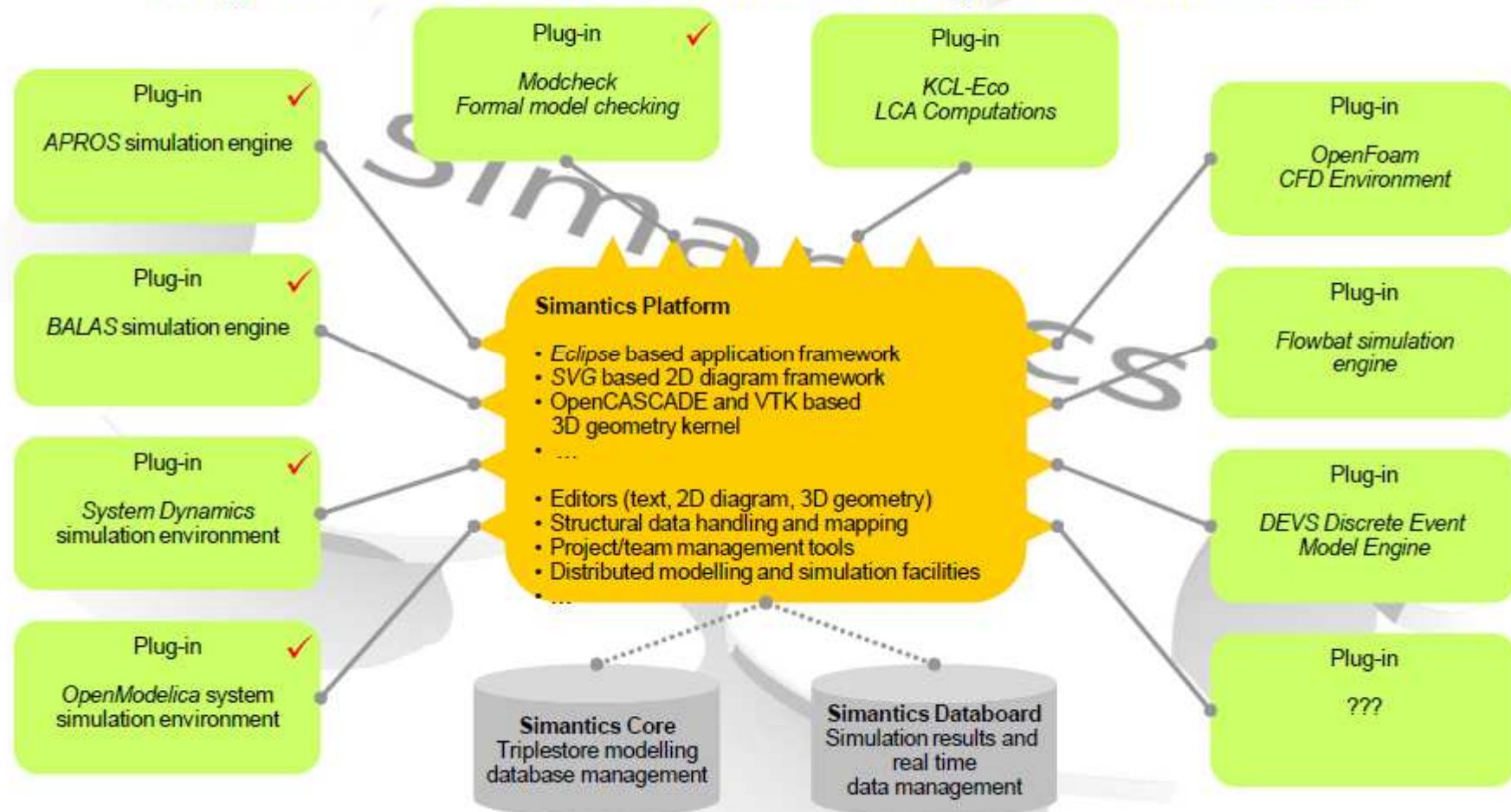
Federation/Integration Examples

- Product Lifecycle Management (PLM)
- Financial systems integration
- Federation of simulation systems
- Federation of modeling languages
- Space systems integration
- Enterprise architecture
- Federation of medical records
- Supply chains
- Information sharing to prevent terrorism

Difficulties

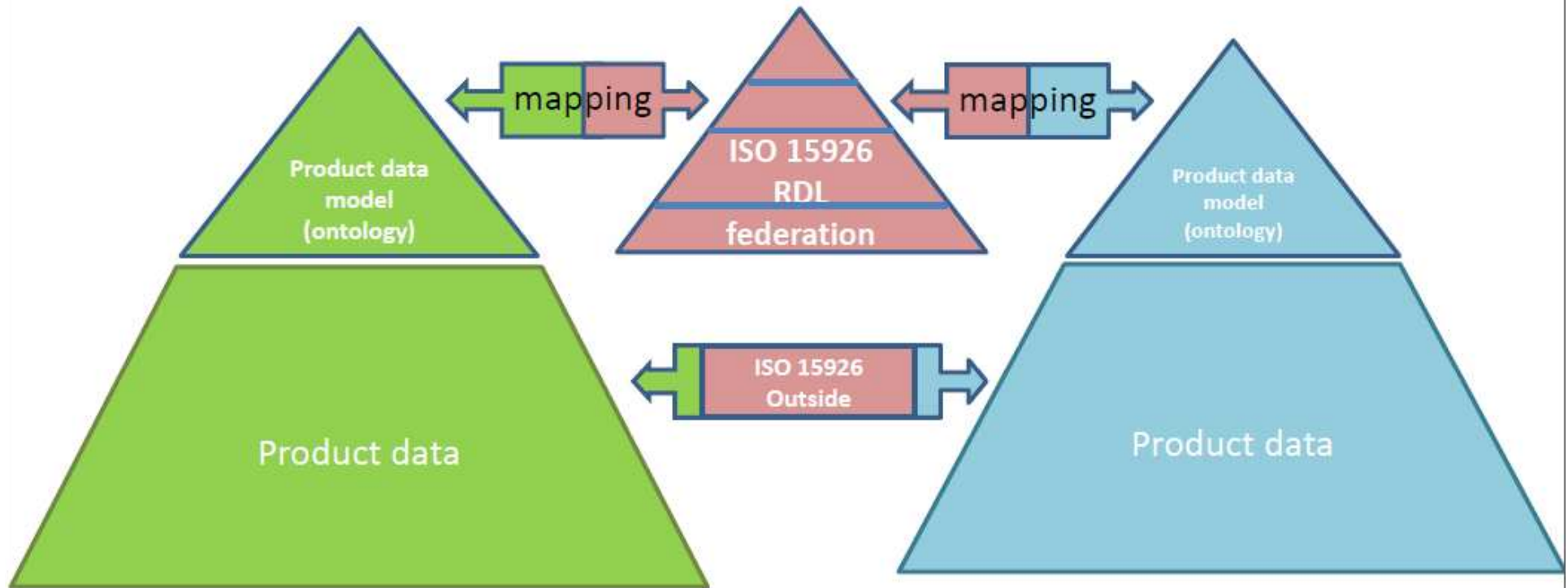
- Absence of authoritative reference ontologies
- Limited support for distributed ontology development: Versioning, granularity, provenance, etc.
- Performance issues, particular when using federated ontologies and advanced logics
- Different tools, languages and methodologies used by different practitioners
- No ontology of system federation/integration - leads to fragmentation of methods, models, tools & frameworks

Plug-in Architecture for Modelling and Simulation



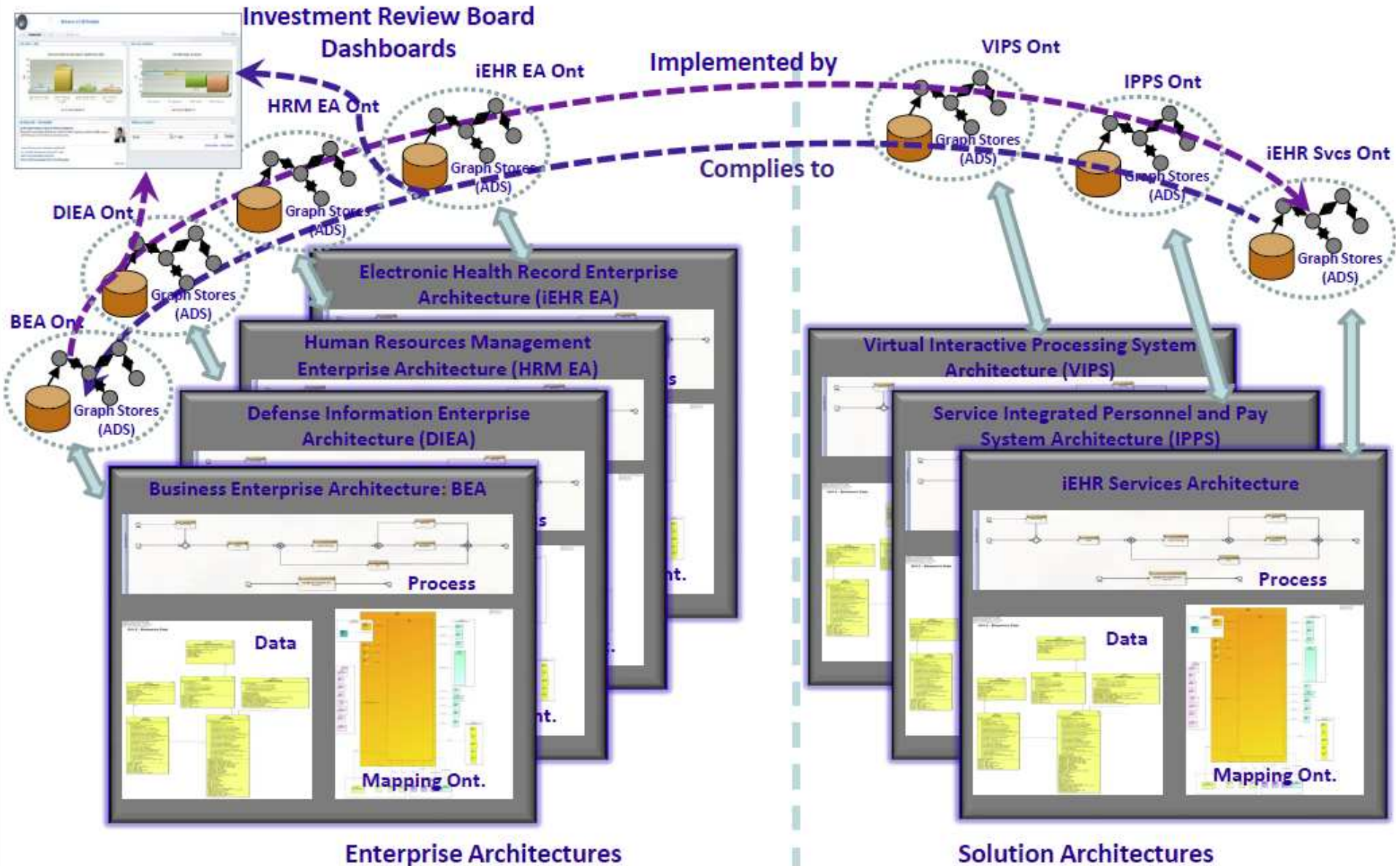
For more information, visit: www.simantics.org

Conceptual mapping (ISO 15926)

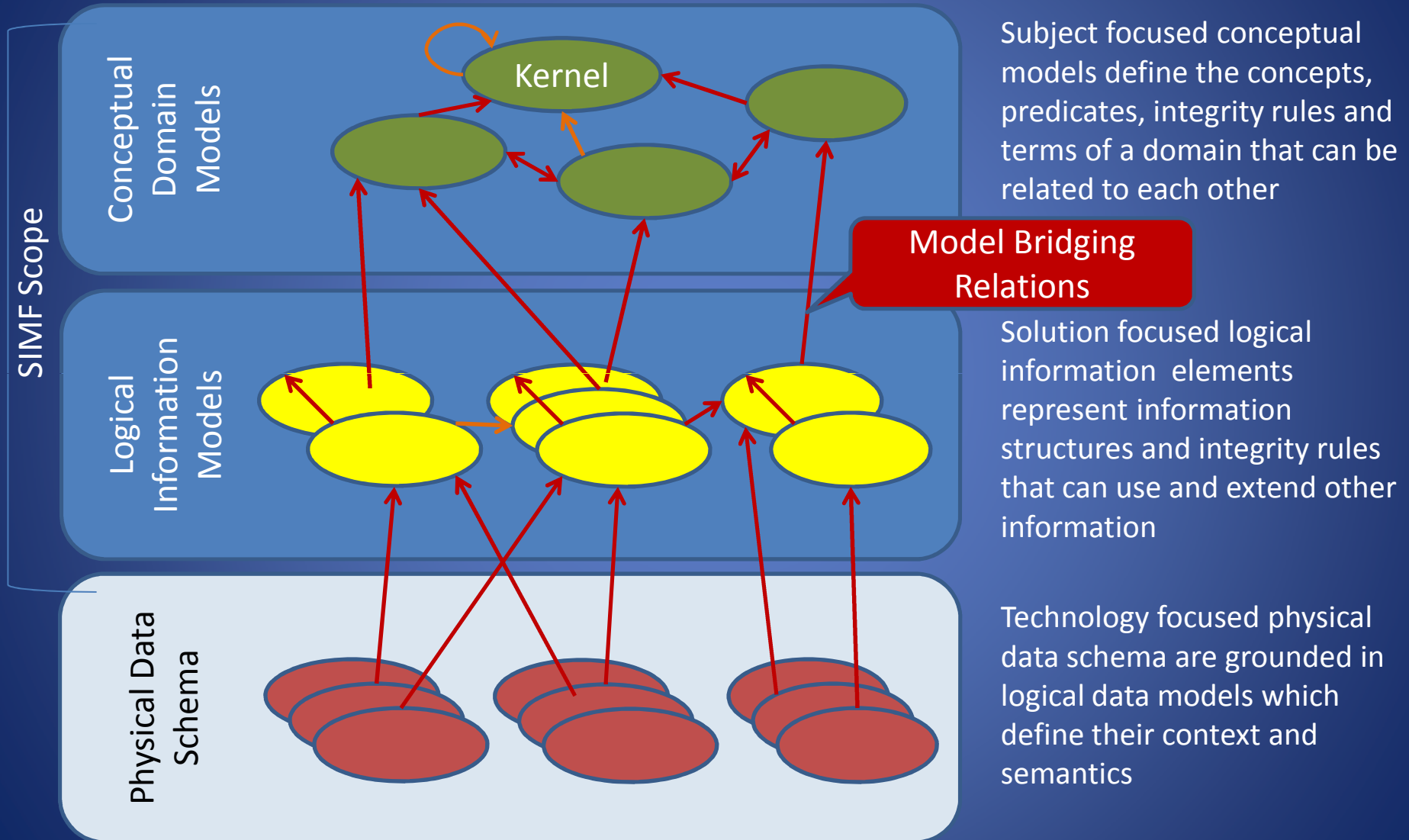


1	ISO 15926	Rule	ISO 15926	2
circle	radius	$\text{radius} * 2$	diameter	окружность

Federation through Semantic Architecture



Semantic Information Modeling for Federation (SIMF) Architecture (OMG Standard in progress)



Summary

- Ontologies are an emerging best practice for federation and integration
- Ontologies are part of a model driven architecture solution scenario – ontologies are models
- Standards and agreement on languages and reference ontologies are still emerging
- Semantic federation and integration improves agility while reducing time, cost and risk
- Current ontological tools and methods are sufficiently mature for use in production federation and integration projects