Semantic Service Oriented Architecture

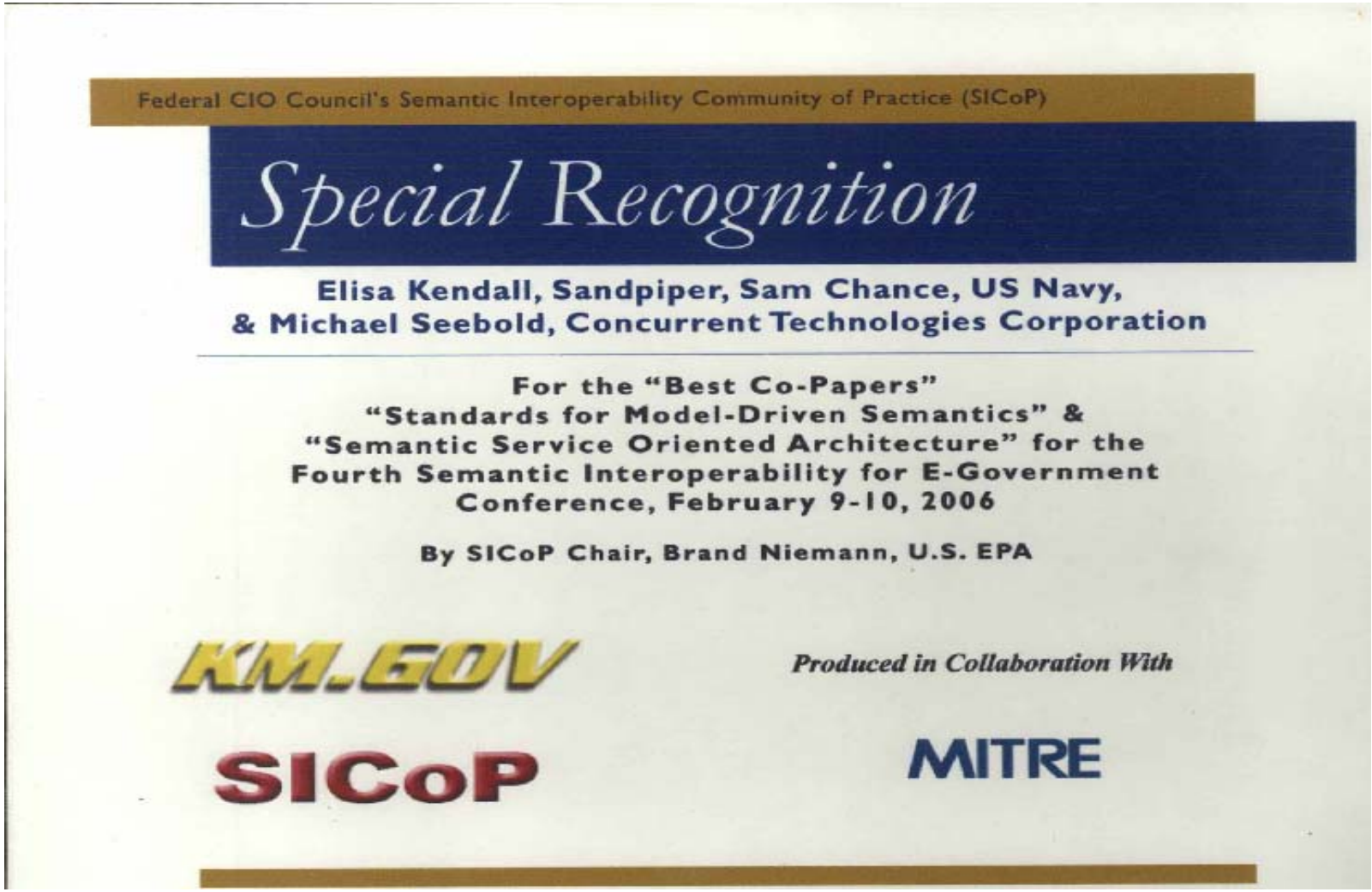
The SSOA Program

A Semantically Powered Architecture to Enable Inter-Agency Capabilities Sharing

February 23, 2006

Concurrent Technologies Corporation

Public Recognition



SSOA Problem Domain

Analysts Lack Awareness of Available Capabilities (Services)

- Sheer Volumes of Data and Services Compounds the Problem
  - Word of Mouth Awareness Typical
- Available [XML] Web Services Solutions are Pervasive, but…
  - Lack Ability to Easily Discover Services
  - Are Location Dependent; “Stale” References Possible
  - Have Weak, or No, Semantics
  - Include Ever-growing Multitude of Largely Unimplemented Standards (re: WS-*)
- When Found, Services Typically Not Easy to Use, Not Interoperable
  - Services are Not Described by “What They Provide”
  - Machine Interpretable Standards Immature, Not Implemented
  - Resulting Processes are Human-Centric, Ad-hoc and Intermittently Repeated
- Resulting in Fragmented, Sub-Optimal Analysis
  - Long Standing Problem – Analysts Aren’t Able to Focus on Analysis

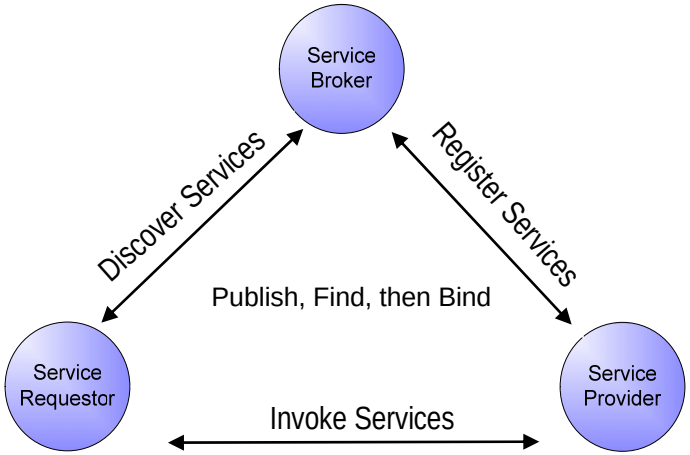
SSOA Provides Significant Value

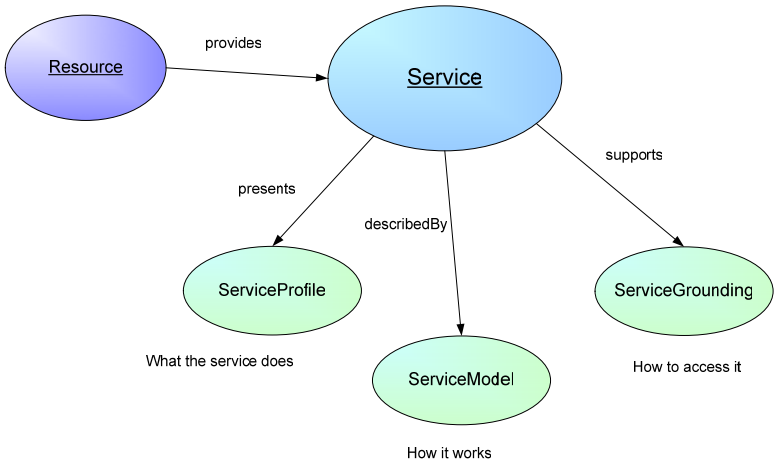
SSOA Compliments XML Web Services by Supporting a SOA that is:

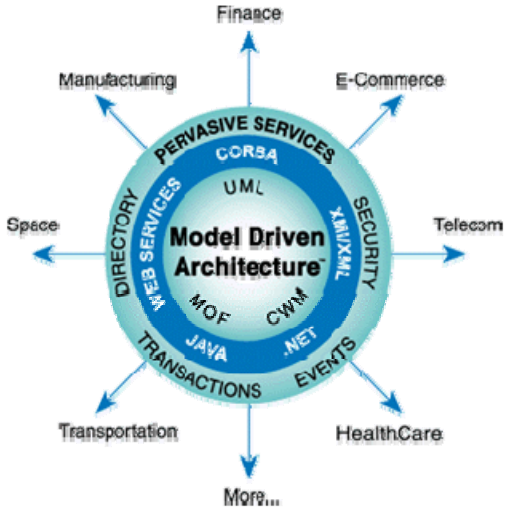
- Semantically Enabled
  - Powering Efficient Publishing, Discovery, and Execution of all Available Services
  - Recommending Interesting Services to End Users when New Services Come Online
  - Allowing Software Agents to Dynamically Construct Workflows and Substitute Services upon Failure
  - Designed and Implemented Based on Current and Emerging Semantic Web Standards
  - Providing the Ability to Compose Virtual Applications Based on Defined Semantic Attributes
- Powered By an Extended *Jini*™ Based Platform from Valaran
  - Flexible Location Independent Services, Spontaneous Networking & Services Interchange
  - Providing Self Healing from Network Failures
  - Allowing Near-Real Time Collaboration and Capabilities Sharing
  - Proactive System Health Monitoring of All Services
  - Grounded on a Proven Enterprise-Scale Distributed Computing Model
- Demonstrating the Ability to Share Resources Across Disparate Organizations
  - Enhancing Current SOA Projects by Acting as Risk Reduction/Complimentary Task

SSOA Technical Foundations

- Service Oriented Architecture (SOA)
- Semantics Based Computing
- Standards Based Design (SBD)
  - *ISO 11179 Metadata Registries Standard*
  - *ISO 19763 Meta-Model Framework Standard*
  - *ISO 24707 Common Logic Standard*
  - *OMG Ontology Definition Meta-Model Standard*
  - *W3C Semantic Web Services Framework*

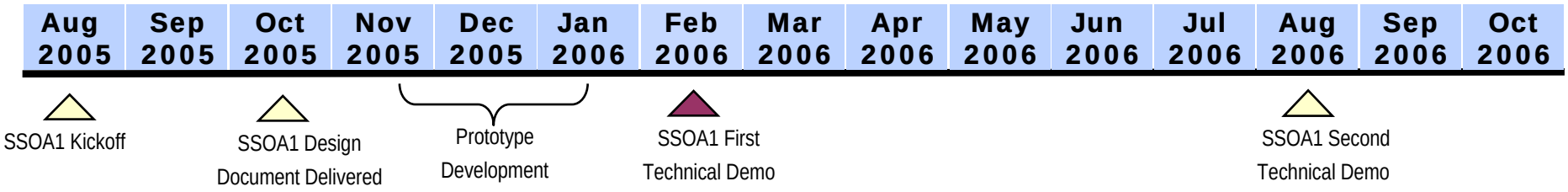






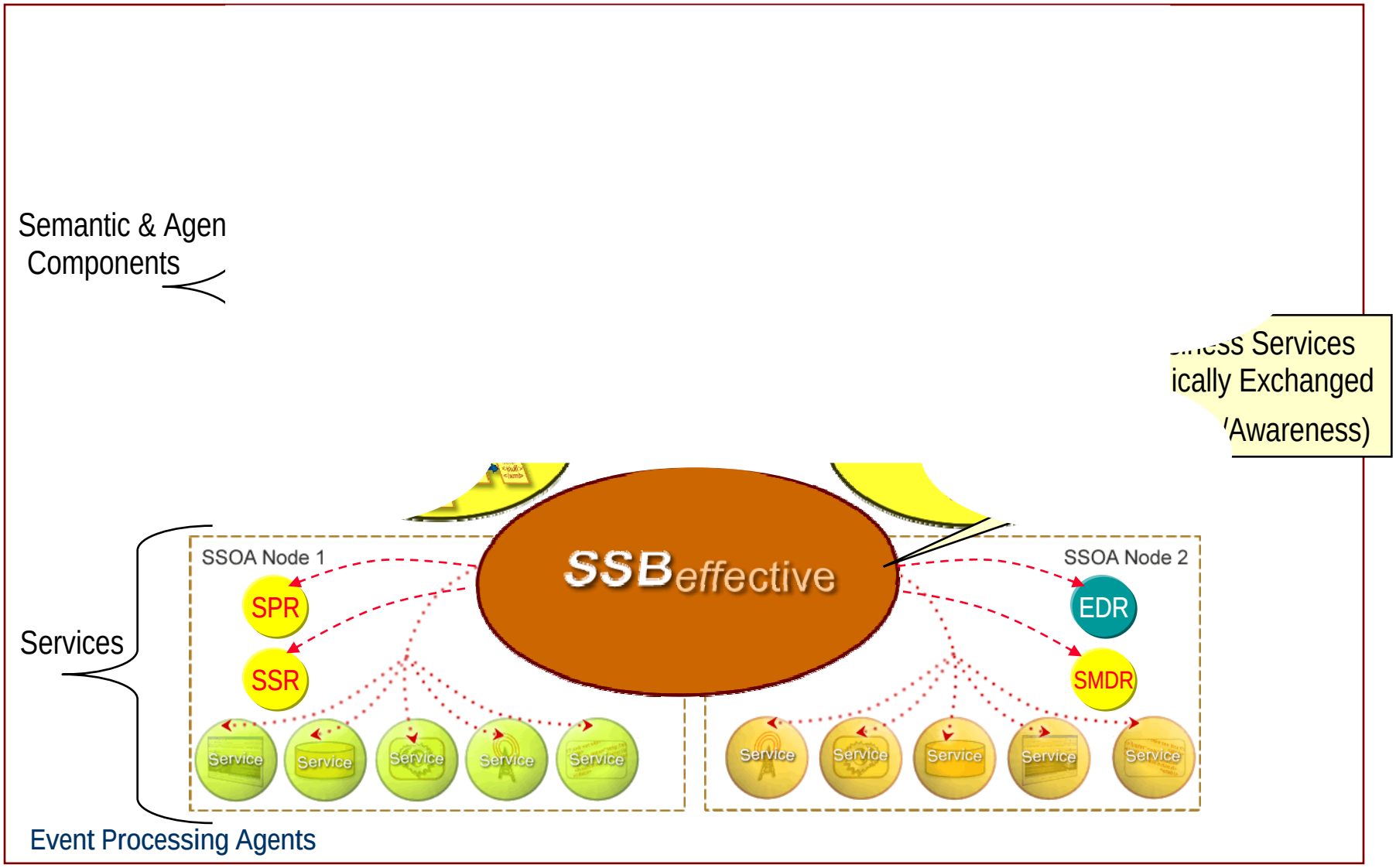
SSOA1 Project Timeline & Team

SSOA1 Project Timeline

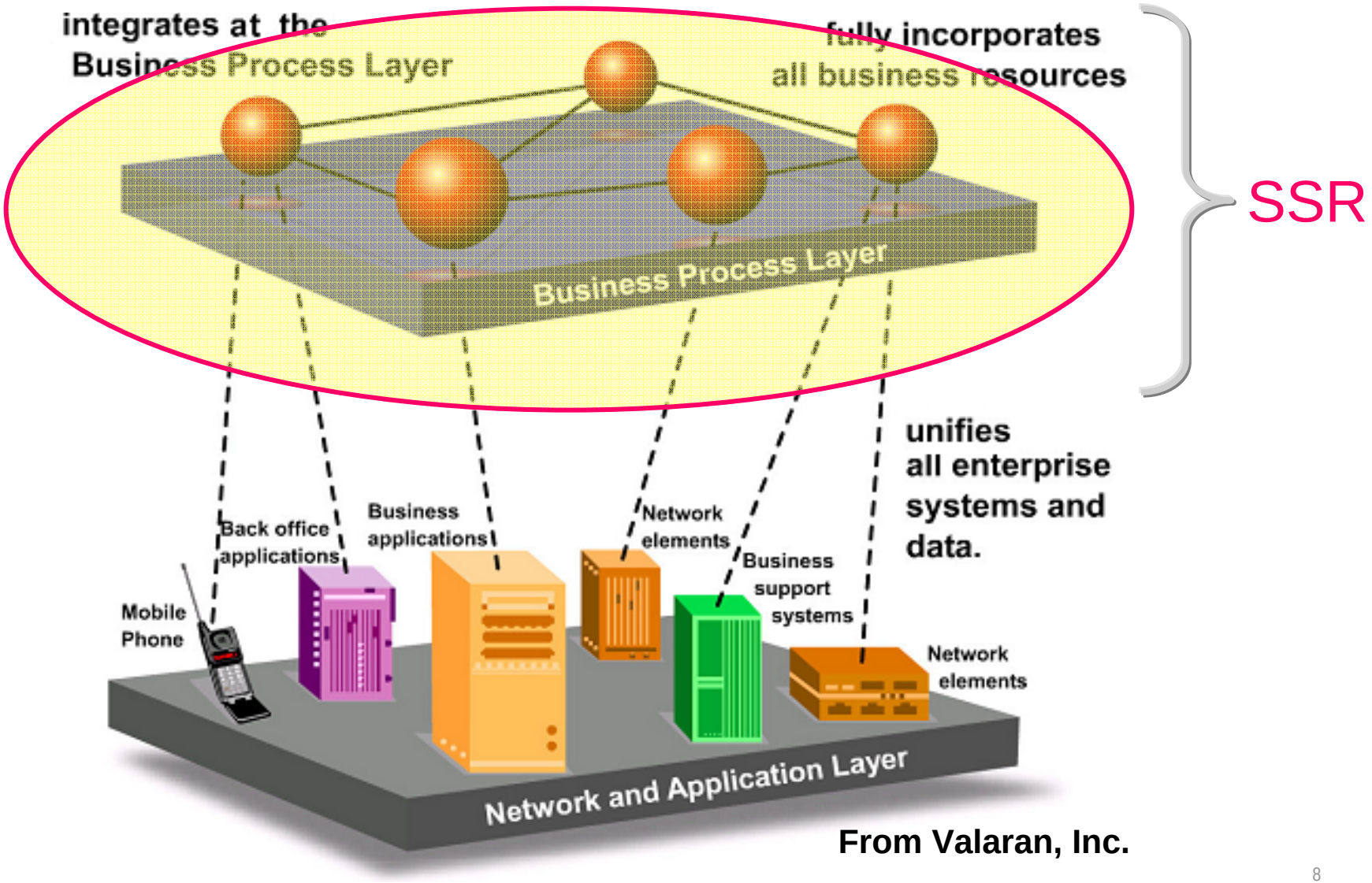


- SSOA1 Development Team
  - CTC is Prime Contractor
  - Acquire & Integrate COTS Components:
    - Ontology Works – Provides Common Logic (CL) based Ontology Services for Semantic Integration of Data and Services Across Distributed and Heterogeneous Enterprise Resources
    - Valaran Corporation – Provides a Jini™-based Platform for Developing Service Oriented Architectures (SOA) for Integrating and Managing Distributed and/or Fluid Applications.
    - Agent Logic – Provides Enterprise Agent Server™ Technology – a Server-based Event Detection and Response Platform that Detects and Responds to Events Across Disparate Sources

SSOA System View



Powerful Jini-Based Abstraction



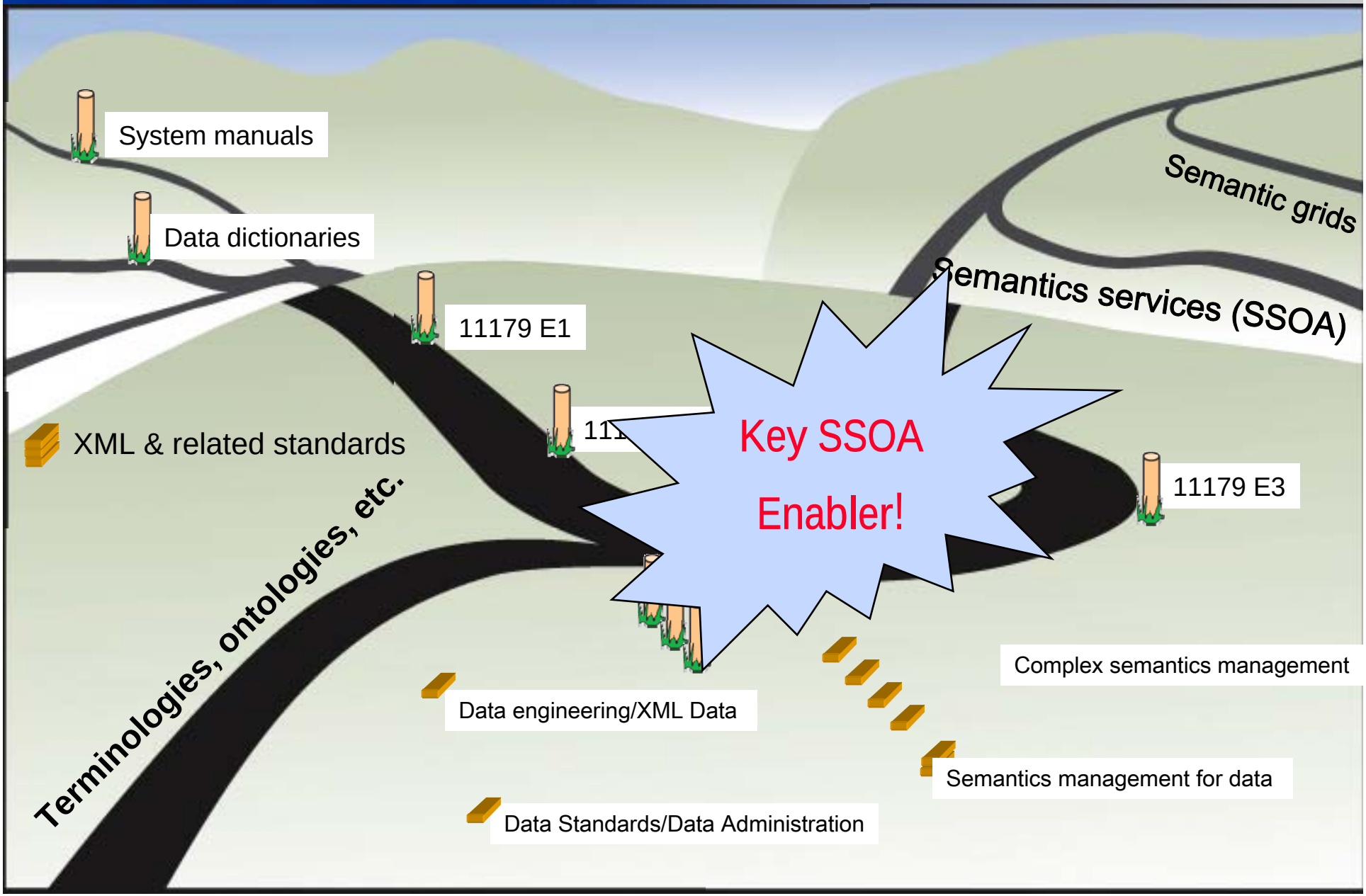
From Valaran, Inc.

XMDR Project Is Key Enabler

- Multi-Agency, Collaborative Project
- Extend Semantics Management Capabilities of ISO/IEC 11179
- Cross-Domain, Various Structures
- Test & Demo Extended Capabilities of Reference Implementation (RI)
- Produce Design for Operational 11179 Registries
- Adapt & Adopt Emerging (Semantic) Technologies
- Propose Revisions to 11179 Parts 2 & 3 (Ver. 3)
- Help Resolve Registration & *Interrelation* Issues for Complex Metadata Standards

www.xmdr.org

Where have we been? Where are we now?...& where are we planning to go?



What is XMDR?
eXtended MetaData Registries

- A Set of *Collaborative Initiatives* by Groups With Shared Goals
  - Extend the ISO/IEC 11179 Metadata Registry Standard (XMDR-S)
    - EPA, NCI, DOD, LBNL, Mayo Clinic, USGS, Ecoterm, UNEP, GBIF
  - Align & Harmonize Various Related Metadata Standards (XMDR-H)
    - ISO WG2: 11179, 19763, 20944, 24707; OMG: ODM, CWM;
    - Say Which Is Which
    - (Several of the Above Groups Have Members on These Committees)
- An Open Source *Implementation & Testbed* (XMDR-IT) To
  - Assemble & Test Metadata From Diverse Sources & Structures
    - E.G., Terminologies, Ontologies, Etc. For Health, Environment, Geography, …
  - Explore Emerging Semantic Technologies (E.G., RDF, OWL, CL, ...)
  - Demonstrate New Capabilities
    - E.G., Ontology Lifecycle Management & Harmonization

Why Do We Need Metadata Registry Extensions? …In Order To

- Enhance Capabilities to Capture, Retrieve *Semantics* of Information Artifacts
  - Data Elements, Value Domains) in Metadata Registries Using Terminologies, Taxonomies, Ontologies, Etc.
- Improve Representation of Relationships Between Data and Concept Structures
  - Objects, Data Elements & Domains
  - Ontologies, Taxonomies, Thesauri, Terminologies, …
- Register Complex Semantic Metadata (Concept Structures, Terminologies) in More Formal, Systematic Ways
  - (e.g., Description Logic) to Facilitate Machine Processing for…
    - Creating and Managing Names, Definitions, Terms, Etc.
    - Linking Together Data Elements, Etc. Across Multiple Systems
    - Discovering Relationships Among Data Elements & Terms

XMDR Semantic Extensions Goals

- Sharable Data That Can Easily be Identified And Aggregated Across Organizations
  - Unambiguous Metadata Characteristics To Convey Semantic, Syntactic And Lexical Meaning
    - Human AND Machine Understandable
- Registration And Management of Everything Useful for Administering And Managing Data, Including Concept Systems, Ontologies, Etc.
- Machine Understanding of Semantics to Facilitate Inference, Aggregation, And Agent Services

XMDR Prototype bridges different realms of metadata standards

Information Artifacts

Conceptual Models
(of the "real world")

OMG Standards:
MOF, UML, CWM
schemas, models, …

Terminology Standards
ISO 1082,
thesauri, …

XMDR Prototype

11179 ed. 3 Metadata Registry Standards

- **Data Elements**
- **Value Domains**
  - e.g, enumerated
- **…..**

- **Data Element Concepts**
- **Conceptual Domains**
- **Concepts**
- **Ontologies**
- **…..**

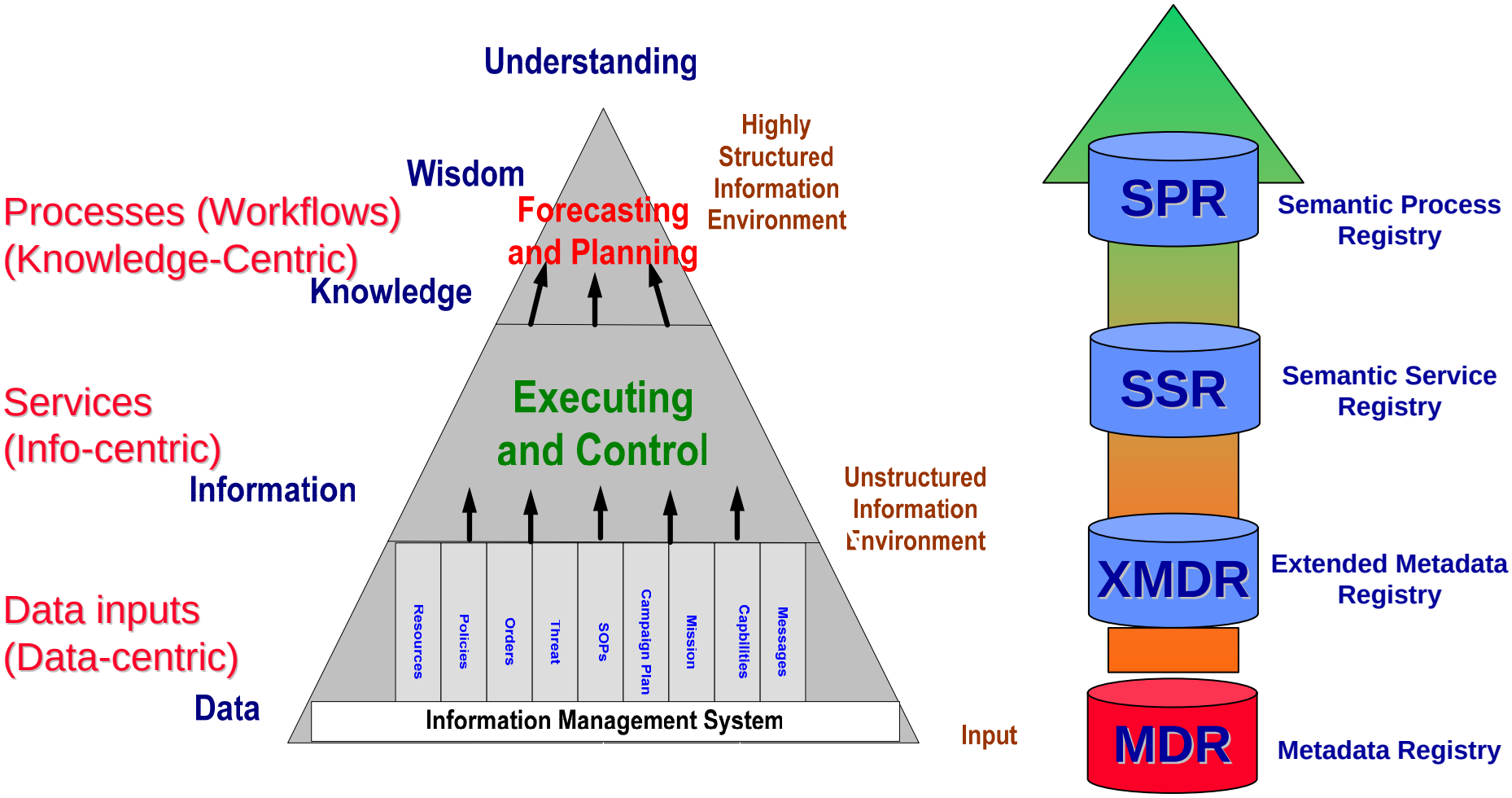
Ontology Standards:
OWL, KIF,
CL, XTM,
….

Incorporating more structured and formal semantic components to facilitate data integration, harmonization & information discovery

XMDR Prototype Available

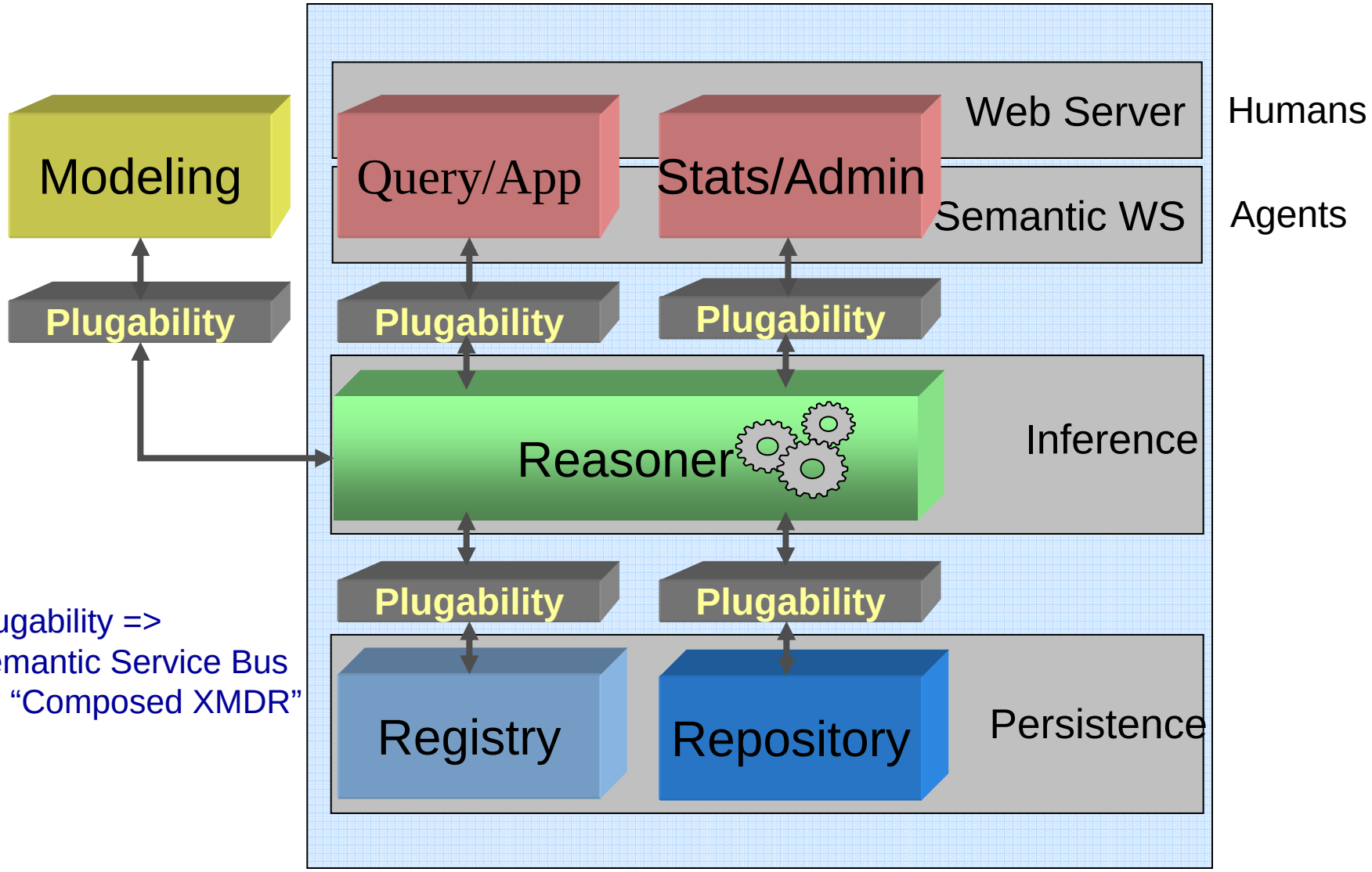
- XMDR Site
  - http://www.xmdr.org
- Prototype
  - http://xmdr.lbl.gov/xmdr/
- Complete set of current test queries are at
  - http://del.icio.us/kberket/xmdr

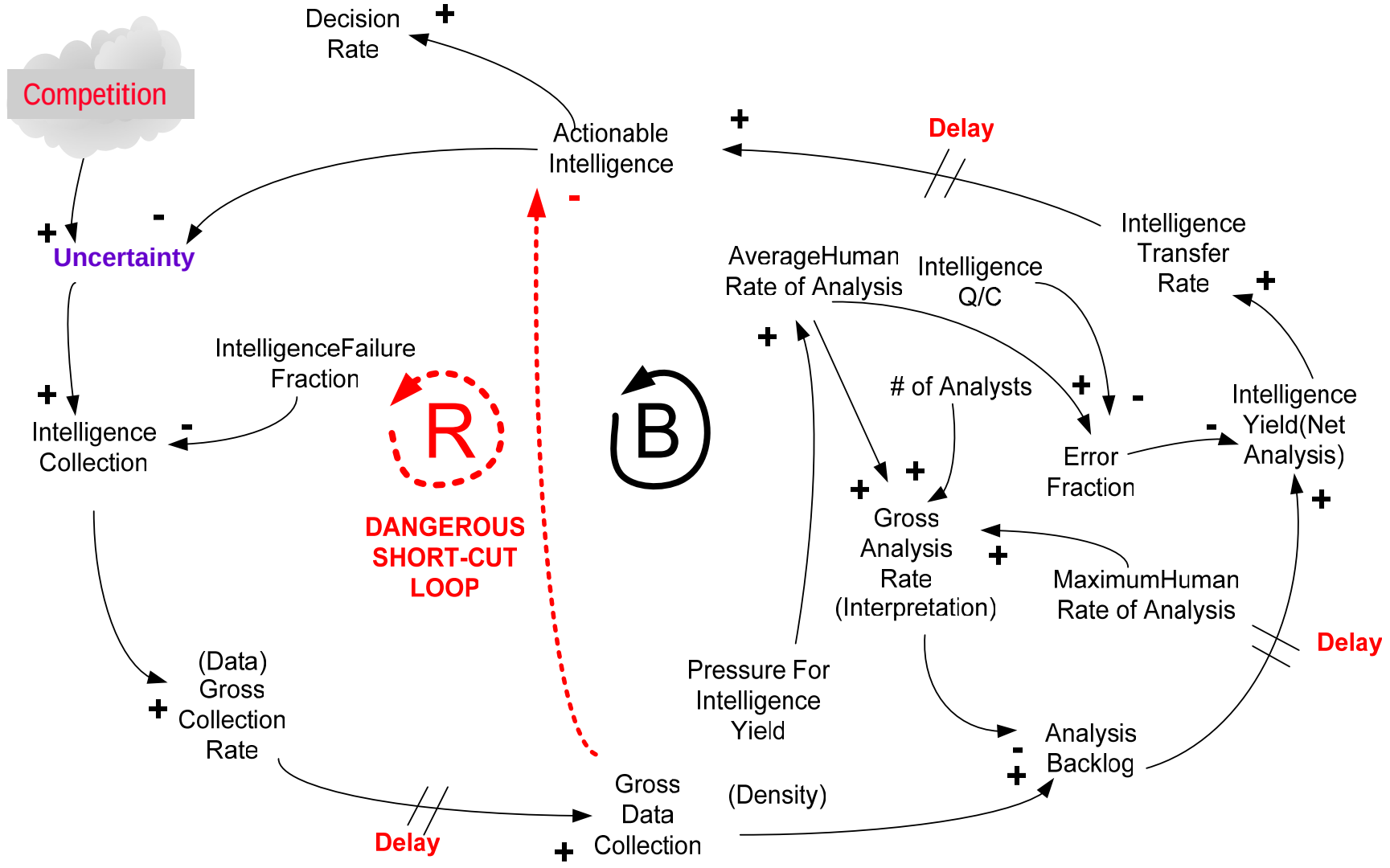
The Meta-* Factor



(Chorfas, 2002)

Virtual XMDR App from Re-usable Services



Plugability =>
Semantic Service Bus
=> “Composed XMDR”

Conclusions