

Will SOA Scale ?

Dr. Pierfranco Ferronato
Soluta.net CIO and Funder
pferronato@soluta.net

13. SI-SE Fachtagung

Software Engineering für SOA

15-16. März 2007 Universität Zürich



This work is licensed under a Creative Commons License

Creative Commons

Attribution-NonCommercial-ShareAlike 2.0

You are free:

- to copy, distribute, display, and perform the work
- to make derivative works

Under the following conditions:

- Attribution.** You must give the original author credit.
- Noncommercial.** You may not use this work for commercial purposes.
- Share Alike.** If you alter, transform, or build upon this work, you may distribute the resulting work only under a license identical to this one.

For any reuse or distribution, you must make clear to others the license terms of this work.

Any of these conditions can be waived if you get permission from the copyright holder.

Your fair use and other rights are in no way affected by the above.

This is a human-readable summary of the Legal Code (Creative Commons).

Disclaimer

The Commons Deed is not a license. It is simply a handy reference for understanding the Legal Code (the full license) — it is a human-readable expression of some of its key terms. Think of it as the user-friendly interface to the Legal Code beneath. This Deed itself has no legal value, and its contents do not appear in the actual license.

Creative Commons is not a law firm and does not provide legal services. Distributing of, displaying of, or linking to this Commons Deed does not create an attorney-client relationship.

Soluta.net is constituted by a team of IT professionals that have a worldwide experience in Component-Based Development and Enterprise Architectures since 1994. Founders of Soluta.net have provided technical and architectural leadership for several European projects using advanced Internet-related technologies, component-based development, Web Services and wireless technologies in a number of domains, including telco, pharmaceutical, healthcare, facility management, CRM, EAI and tourism.



SOLUTA.NET

Dr. Pierfranco Ferronato is the Chief Architect and founder of Soluta.net. He has over 15 years of experience in all aspects of distributed systems development and is internationally recognized as an expert in large-scale architectures.

Dr. Ferronato has provided technical and architectural leadership for several European projects using advanced Internet-related technologies, component-based development, webservices and wireless technologies in a number of domains, including telecoms, pharmaceutical, ERP, CRM, EAI and tourism.

He is a Senior Consultant for the Cutter Consortium

He is a Consultant for the Ministry of innovation in Italy

He has defined the architecture of the Italian Electronic Healthcare System

SOLUTA.NET

SOA has been designed and envisioned for inside Enterprise integration as a means to bridge systems and to create a governance layer on top of existing platforms as either legacy or assets. Now the industry is heavily moving to B2B environments where the parties are not single department applications but rather Enterprises. Inside Enterprises there is administration ability of the SOA infrastructure, ability to handle the network, gain control over resources and IP, and everything is reasonably under control. Between enterprise this is not true any more – IPs may change, protocols are subject to be replaced without notice, UDDI needs to be shared among parties, UDDI becomes vital for indexing and discovering services, and models need to change at a pace which is faster than any ability to maintains coherence and harmonization via a coordination process. The entire B2B becomes a very loosely coupled community which brings news challenges in SOA architecture, and dealing with this reality requires re-thinking of the founding principles and technology of SOA. This talk will address these and other issues facing the next generation of projects that are already ingoing. The presentation will delve into these issues, tackling SOA and proposing new techniques, and borrowing concepts from real industrial and research projects that are currently under development and that the speaker is leading as an Enterprise Architect. He will describe P2P based approaches for service registry, decentralized model repositories, scale free network, and additional references to cutting edge technologies in the Business Ecosystem arena.

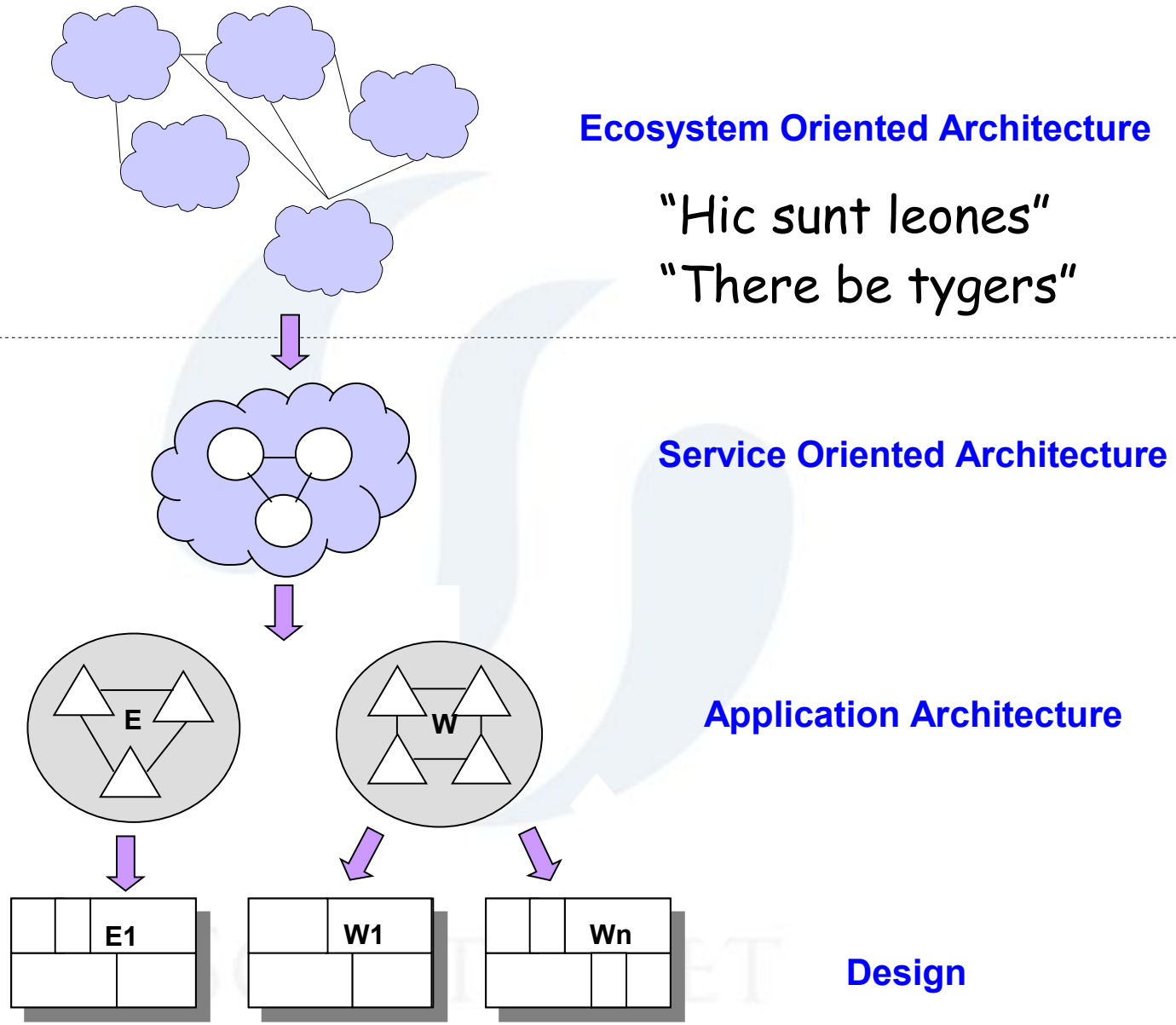
- ▶ The need for adaptation is due to the fast change rate in marketing, economy, market grow,...
- ▶ IT is growing rapidly, and we find ourself struggling with lots of problems and still find that everything has still to be invented
- ▶ Not mentioning the old annoying stories about:
 - ▶ “technology changes”
 - ▶ the integration of over 20 years of IT systems (legacy)
- ▶ Focus is moving from “intra enterprise” to “across enterprises”
 - ▶ Business communities are overlapping, it is not a partition
 - ▶ From Newtonian to Quantum Mechanics
- ▶ We do not have to seek the solution in other Engineering sectors
- ▶ We have to leverage what apparently are the weakness of IT
 - ▶ Dynamism, flexibility



- ▶ There is a solution space for problems
- ▶ No silver bullet exists in IT
 - ▶ It's a story of abstraction
- ▶ It's a story or lessons learned, nothing has been discarded
 - ▶ Func. Prog, struct. Prog, OO, ++, X, UML, MDA...
- ▶ When a problem increases in scope or complexity, there is always a time when the "usual" solution takes you to the "what the heck?!"
 - ▶ It means, it does not scale
 - ▶ It's not the same problem but just bigger, it's a new one!
 - ▶ We need a new solution space
- ▶ *"IF the only thing you have is a hammer, everything you see is a nail"*
- ▶ We need a new mindset

- ▶ SOA is an architectural style that evolved from EAI, RPC, CORBA, where the focus was on Application, Procedures, Objects to Services plus:
 - ▶ Loose coupling, aligning business with the services
- ▶ It does scale up, inside an enterprise
 - ▶ communication is hierarchical
 - ▶ Central control
 - ▶ A single functional reference model is feasible
 - ▶ the infrastructure is centrally managed and under control
- ▶ Functional and infrastructural changes are driven by the enterprise sole goal of increasing its business, hence those changes are harmonic and harmonized at the end, even though still hard to control
- ▶ But...how does it scale up across enterprises?
 - ▶ Is it a SOA or SOAs another SOA? 😊

Ecosystem Architecture



Adapted with permission from Mike Rosen



Issues

SOLUTA.NET



MEMBER



B2B

b2B

- ▶ A different mind-set that is partially a technological problem
- ▶ Real B2B is about:
 - ▶ complex Business transactions which are “money driven”
 - ▶ “Coopetition”
 - ▶ Absence of a Central Reconciliation Point
 - ▶ *Newtonian vs Quantum physics*
- ▶ Functional Reference Models
- ▶ Services
- ▶ Technology

- ▶ The “single reference model” is not a feasible objective (even if was attempted in the past, aka “Big Picture”)
- ▶ Standard reference models for each business domain
 - ▶ Lack of universal standard vocabulary
 - ▶ Standards exists
 - ▶ Domain Ontology
- ▶ Communities (mind the plural)
 - ▶ Overlapping models
 - ▶ Ontology based intelligent Search engines
- ▶ Domain Ontologies (mind the plural)
 - ▶ But “Competing standards” exists today (notice the oxymoron?)
- ▶ The owner of models and registries need to be the community itself

- ▶ Across enterprises requires a new set of business services
 - ▶ Payment
 - ▶ Business Contract & Negotiations
 - ▶ Billing
 - ▶ Trust
 - ▶ Reputation
 - ▶ Legal compatibility
- ▶ Re-think:
 - ▶ Service Discovery
 - ▶ Reliability-guaranteed delivery
 - ▶ Security
 - ▶ Long running Transactions
 - ▶ XML Firewall

- ▶ Multi registry (as in UDDIv3) is hierarchical
 - ▶ there is no “root” node in the Internet
 - ▶ It represents a single point of failure (SPoF)
- ▶ Registry replication need to be driven by requests not statically defined
 - ▶ It's too Administrative intense
- ▶ Registry of end-points
 - ▶ IP does not scale
 - ▶ Registry need to be updated
 - ▶ Support mobile devices, dynamic IP's, lease management (Jini like)
- ▶ Registry of service specifications
 - ▶ MDA: need to be a MOF compliant Model Repository
 - ▶ Semantic Research

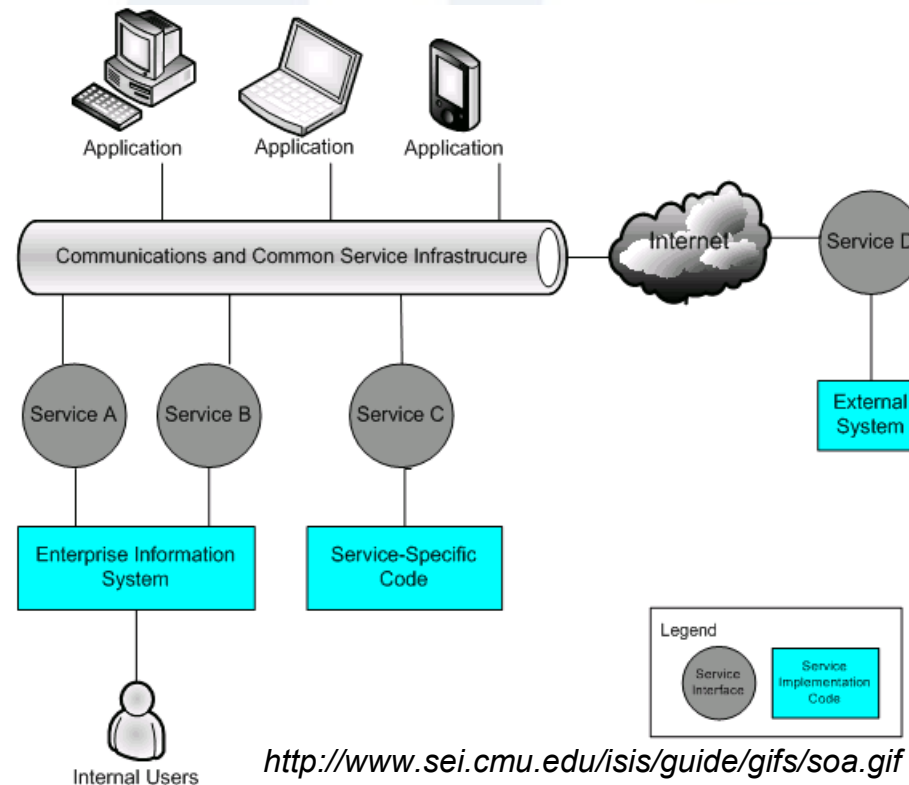
- ▶ Model dependency, versioning, inheritance, merge, copy of
- ▶ It's structure can not be managed
 - ▶ It can be barely done in a single ERP project, with great effort, this is of a great debate in IT, books, methodologies, approaches...
 - ▶ It does not scale up!
- ▶ Again we need to shift to a new mind set
 - ▶ Evolutionary based, "digital darwinism"
 - ▶ Create the rules (or better: meta rules) under with the system self sustains an self regulate
 - ▶ The chaos do converge to a stable status if we enable the right handles
- ▶ Meta-modelling! Meta models do change!!
- ▶ It represents a single point of failure (SPoF)

Topology

SOLUTA.NET

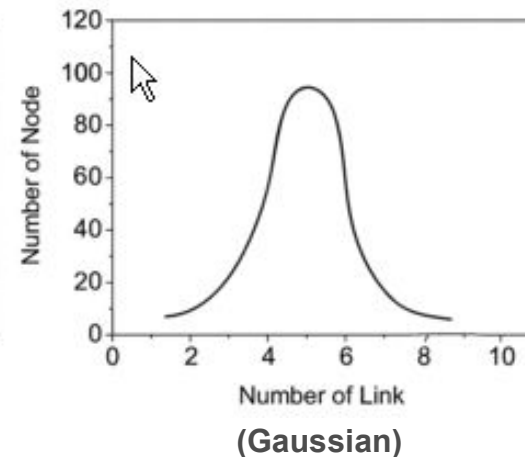
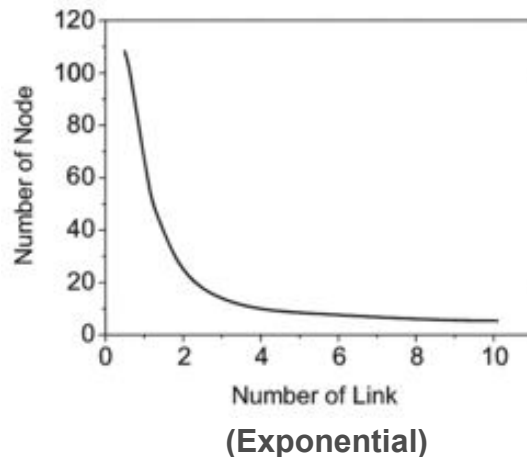


- ▶ ESB is conceived for intra organizations
- ▶ It assume a set of features that does not met the requirement and rule of the Internet
- ▶ We have to assume there is no “Common Pipe”

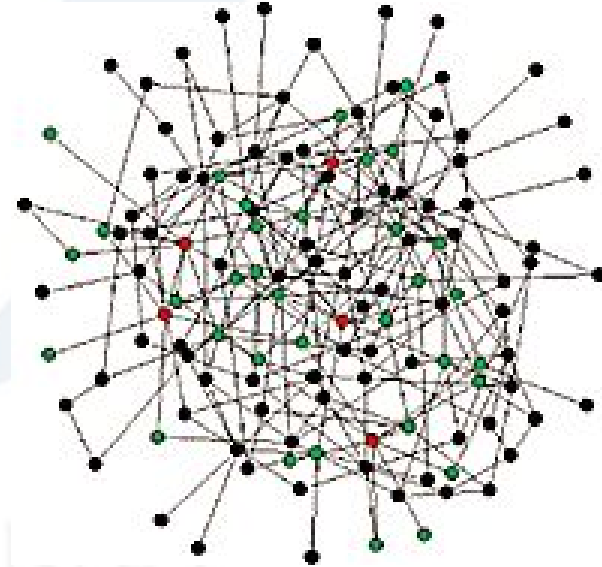
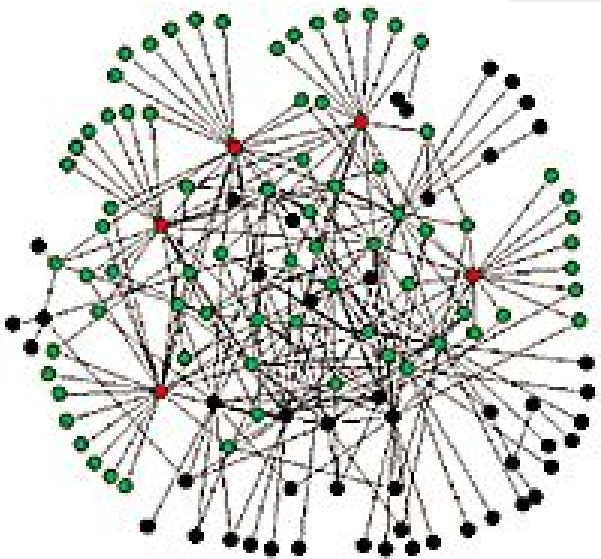


- ▶ There can not be a central governing administrator or institution
- ▶ The owner of models and registries need to be the community itself
 - ▶ Would you give the keys of your house to an external entity for the benefit of the community?
- ▶ Features required
 - ▶ scalable
 - ▶ owned by the community, no “big brother” issue
 - ▶ Redundant, hence resilient to disasters
 - ▶ self configurable, self healing
- ▶ DECENTRALIZED
 - ▶ Air traffic Control
 - ▶ Healthcare
 - ▶ Which topology?

- ▶ Exponential
 - ▶ Average linked nodes and no extremes
 - ▶ Fixed inventory of nodes
 - ▶ Random attachment of links
- ▶ Scale Free
 - ▶ Few linked nodes, few with many
 - ▶ Grow over time
 - ▶ Preferential attachment



- ▶ Clustering is not enough
- ▶ Need a shift in the approach
 - ▶ Scale free Networks
 - ▶ "Small world": six level of separation



SOLUTA.NET

- ▶ What if civil engineers build bridges as we build software?
- ▶ Why the process is so different?
- ▶ Cost or build vs cost of changing
 - ▶ Changing a pillar position costs 10 times more then building it
 - ▶ In IT changes cost a fraction of the cost of buiding
- ▶ Gives a false sense of security:
 - ▶ First we build then we change
 - ▶ Wrong
- ▶ There the need to assume the changes as part of the process not as an exception

- ▶ Apply the Ecosystem metaphor
 - ▶ Self sustains, reliable to external forces, self organize
- ▶ Decoupling SOA registry
 - ▶ Model Repository (design time)
 - ▶ Information Registry (runtime)
 - ▶ *information -> logical name of service*
 - ▶ Service Registry (runtime)
 - ▶ *logical name of service -> end-point of the services*
- ▶ Adopting a decentralized architecture
 - ▶ Decentralized data storage
- ▶ Dynamic network architecture
 - ▶ P2P architecture can help (*Don't have a prejudice*)
- ▶ Implementing a evolutionary based schema for model repository
 - ▶ Dependency, versioning, inheritance, merge... www.soluta.net pferronato@soluta.net

Conclusions

SOLUTA.NET



- ▶ SOA or SOAs is not another SOA, rather it is an **Ecosystem Oriented Architecture (EOA)**
- ▶ Across Enterprises
 - ▶ Not easy to solve
 - ▶ We are just scratching the surface
 - ▶ No clear answers yet
- ▶ Paradigm shift:
 - ▶ From modelling a machine to modelling a living organism
 - ▶ From building machines to nurturing digital species
- ▶ P2P has some strong prejudices:
 - ▶ File sharing, (c) infringing
 - ▶ Low performance in search
- ▶ Suggested ideas are not without side effects

We need a new mindset, a Digital Copernican Revolution in IT is due to come

DBE official Web Site

<http://www.digital-ecosystem.org>

DBE Paper by the EU

<http://tinyurl.com/nrjb8>

Paper "Pervasive Service Architecture for a Digital Business Ecosystem"

<http://arxiv.org/pdf/cs.CE/0408047>

DBE Project Summary

<http://tinyurl.com/oqgg6>

Paper "Toward a Semantically Rich Business Modelling Language for the Automatic Composition of Web Services"

<http://www.ebrc.info/kuvat/2072.pdf>

"Linked: The New Science of Networks", Albert-Laszlo Barabasi, Jennifer Frangos. ISBN: 0738206679

Digital Ecosystems

www.digital-ecosystems.org

SOLUTA.NET

Thanks to Oliver Sims for revisioning the draft

Case studies

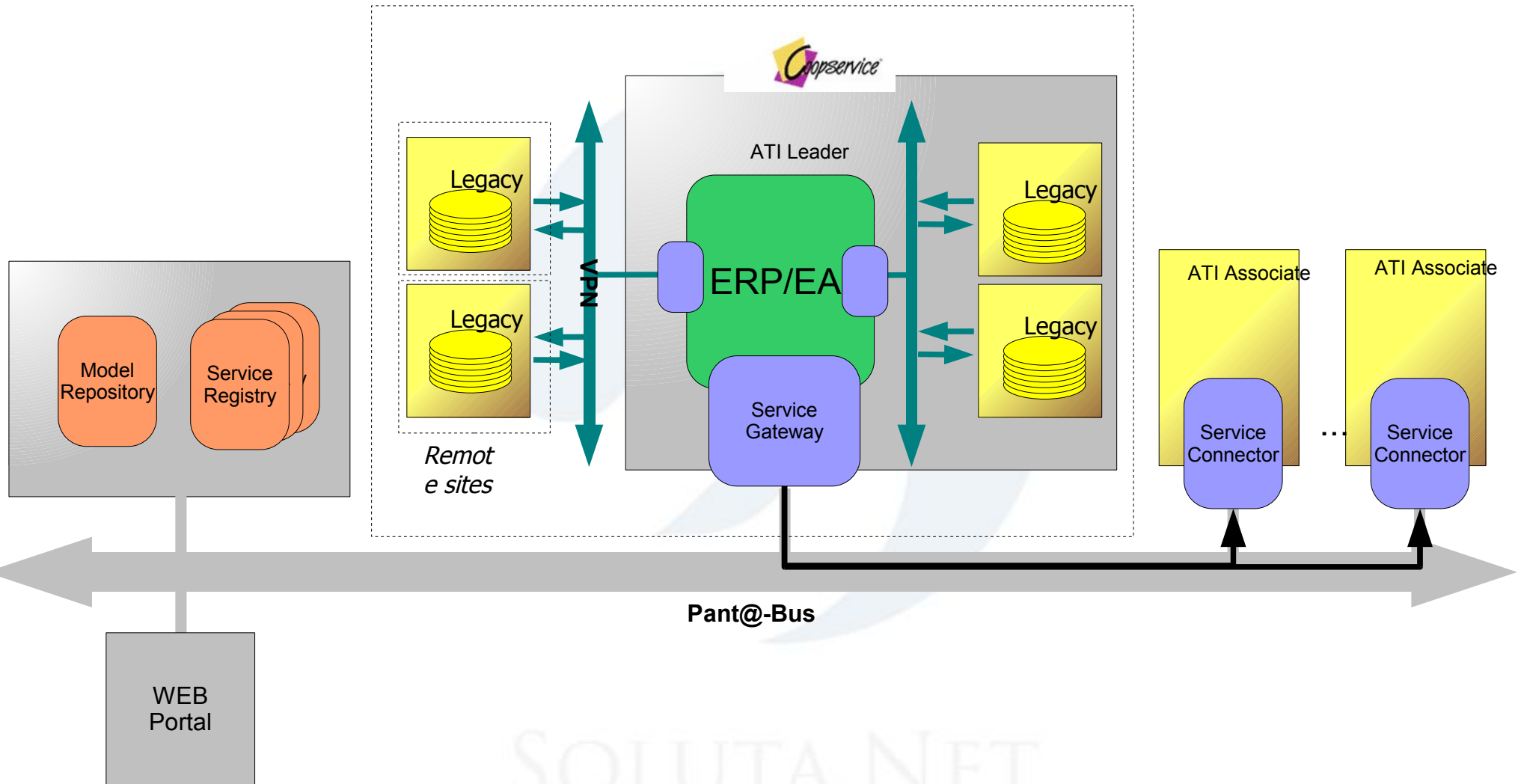
SOLUTA.NET



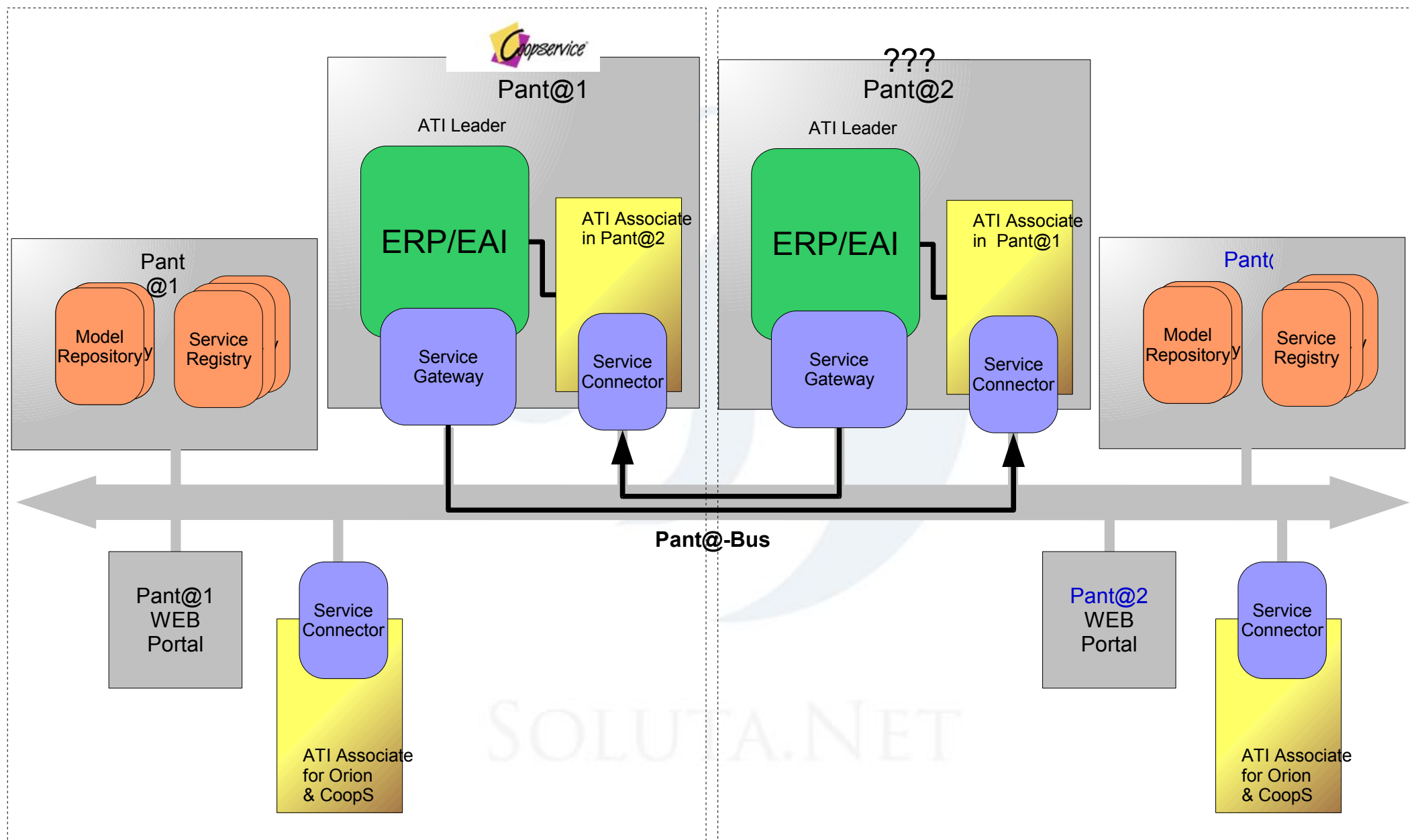
- ▶ Facility Management
- ▶ Healthcare
- ▶ Digital Ecosystem



SOLUTA.NET



SOLUTA.NET



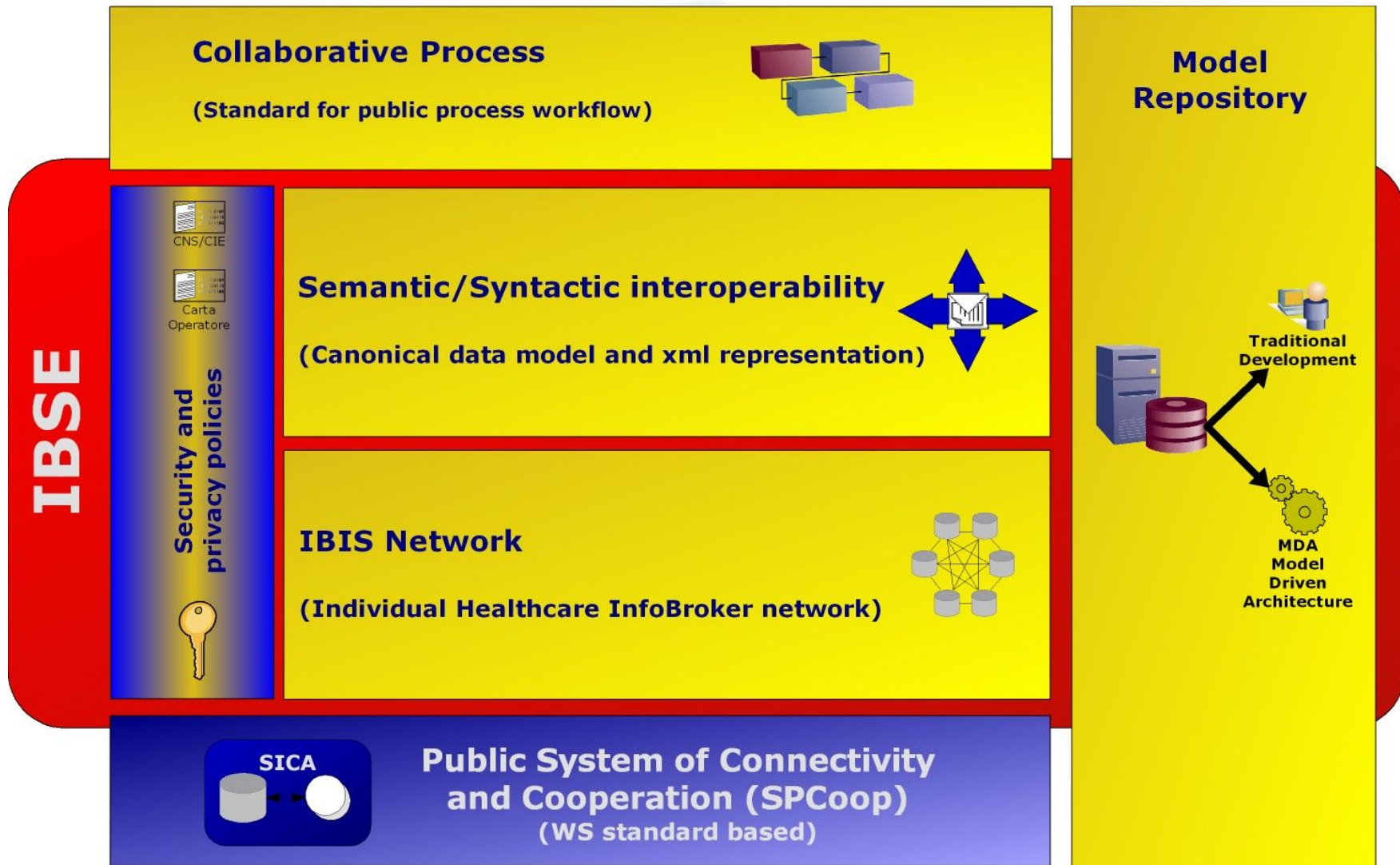
SOLUTA.NET

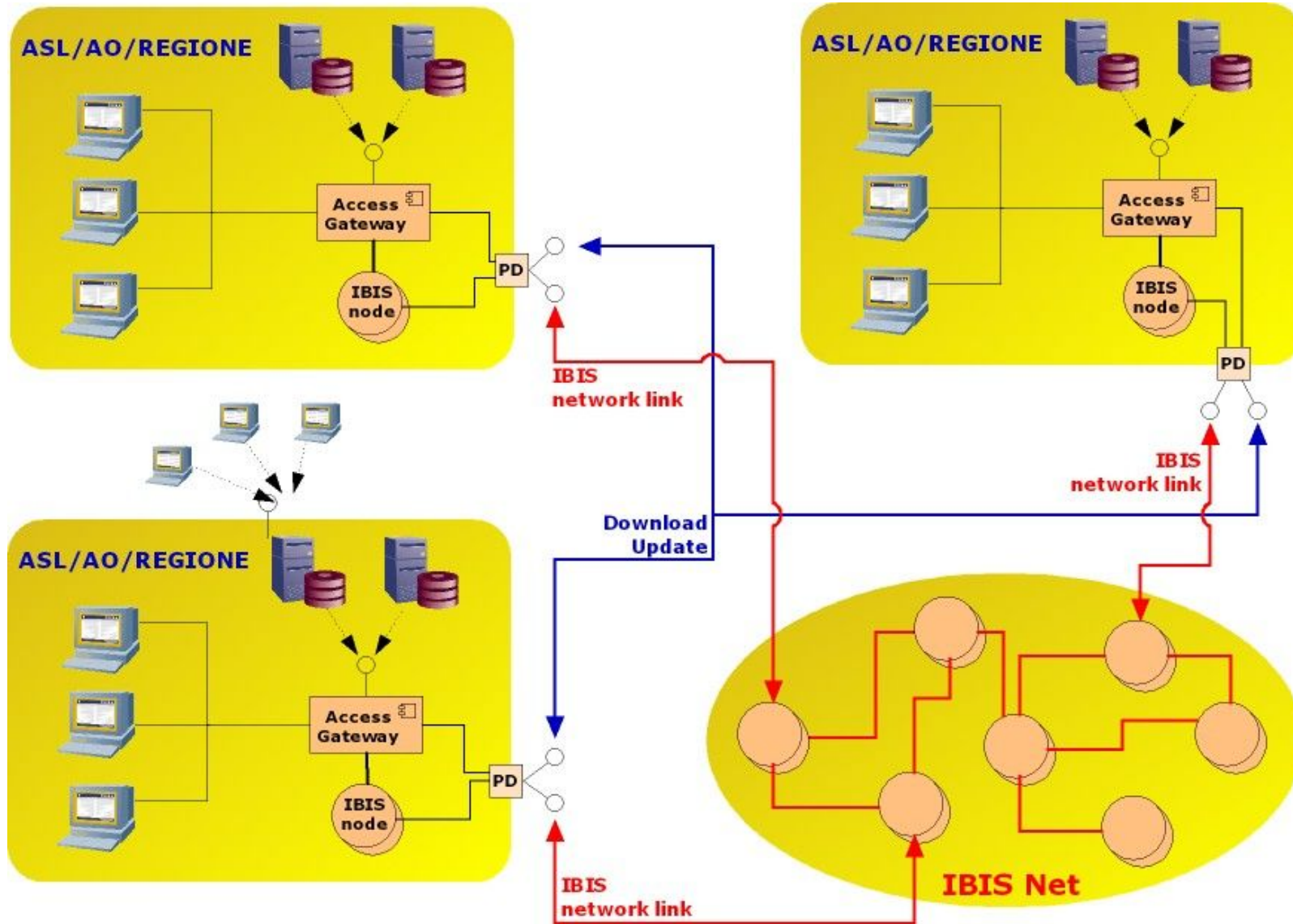
- ▶ Facility Management
- ▶ Healthcare
- ▶ Digital Ecosystem



SOLUTA.NET

- ▶ Unique in its kind, the architecture has been approved by the Italian Ministry of Health





- ▶ Facility Management
- ▶ Healthcare
- ▶ Digital Ecosystem



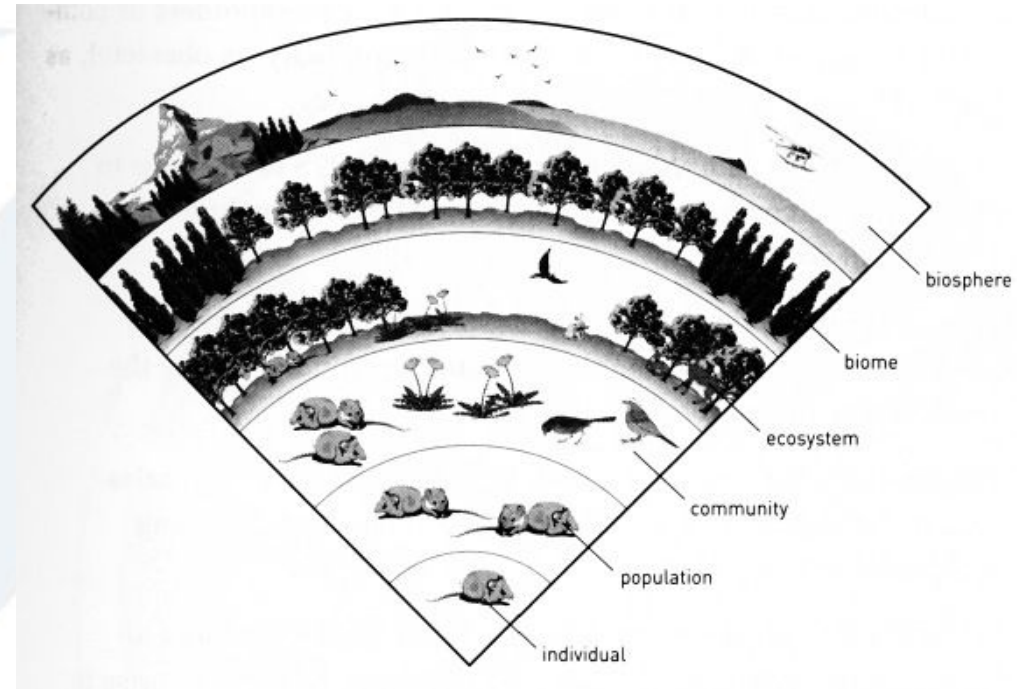
SOLUTA.NET



Digital Business Ecosystem

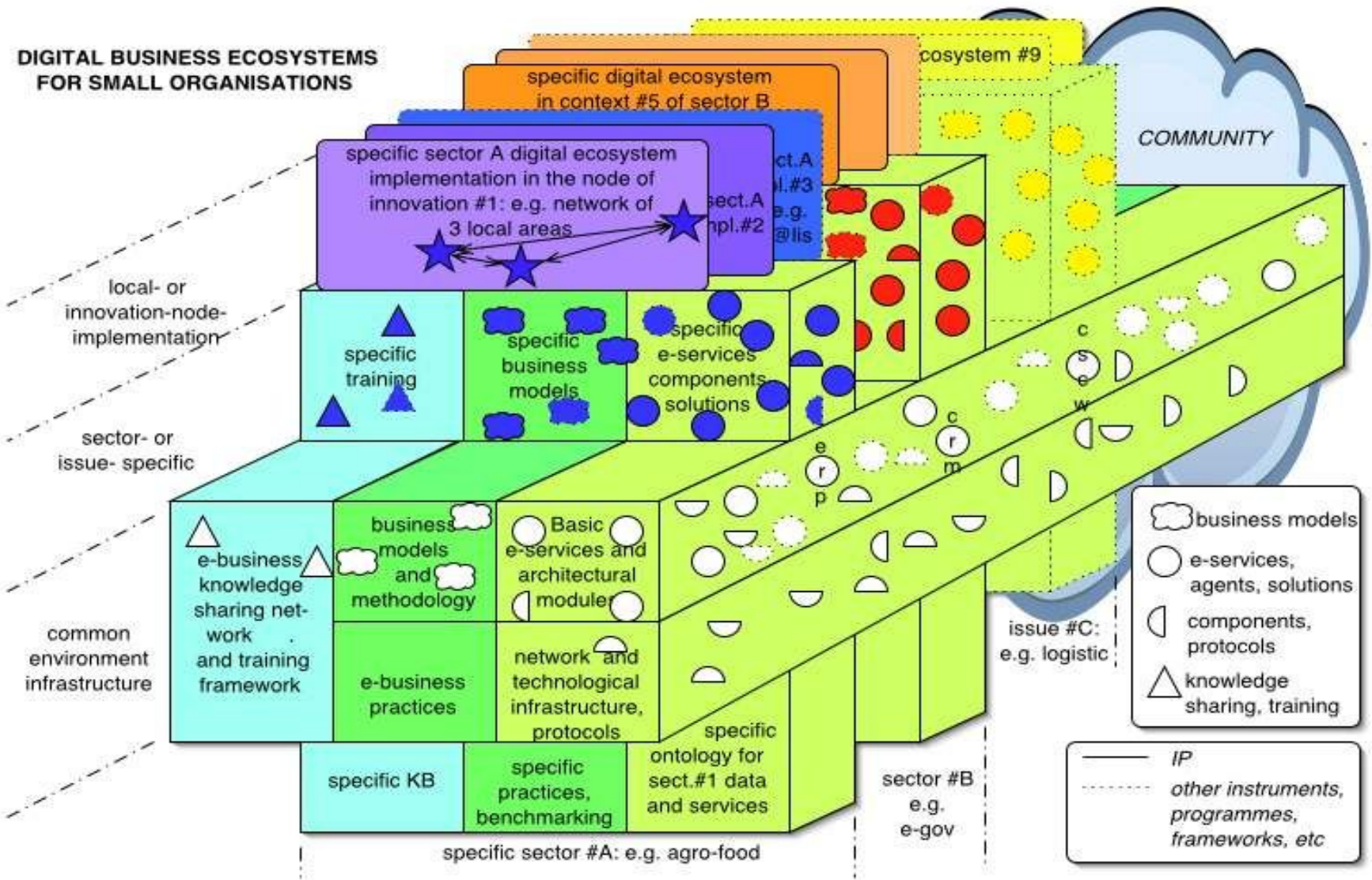
- ▶ **The Digital Business Ecosystem is being created by the DBE Project, which is a 3-year, €14M pan-European project, involving 120 researchers and specialists from 20 organisations, including some of the big names in computing and business. The project is supported by the European Commission's 6th Framework Programme for research and development in Information Society Technologies.**
- ▶ **The DBE project is currently developing the 'evolutionary' technology that is the key to the DBE. This involves harnessing the principles of self-organisation and self-optimisation from the various fields of science and nature and applying them to interactions between businesses. These interactions form value chains that can be thought of as the 'organisms' that inhabit the ecosystem and that will change and evolve over time. The project integrates expertise from the worlds of science, computing, business, and economic development.**

- ▶ No central control, no plans defined in advance
- ▶ Fault tolerant: No central point of failure
- ▶ Leverage diversity and autonomy
- ▶ Adaptation to the local conditions
- ▶ Auto selection and evolution
- ▶ **But** you need an
 - ▶ infrastructure supporting the life (composed of living organisms too - rec. Concept)
 - ▶ a critical mass of individuals and biodiversity (bootstrap problem)

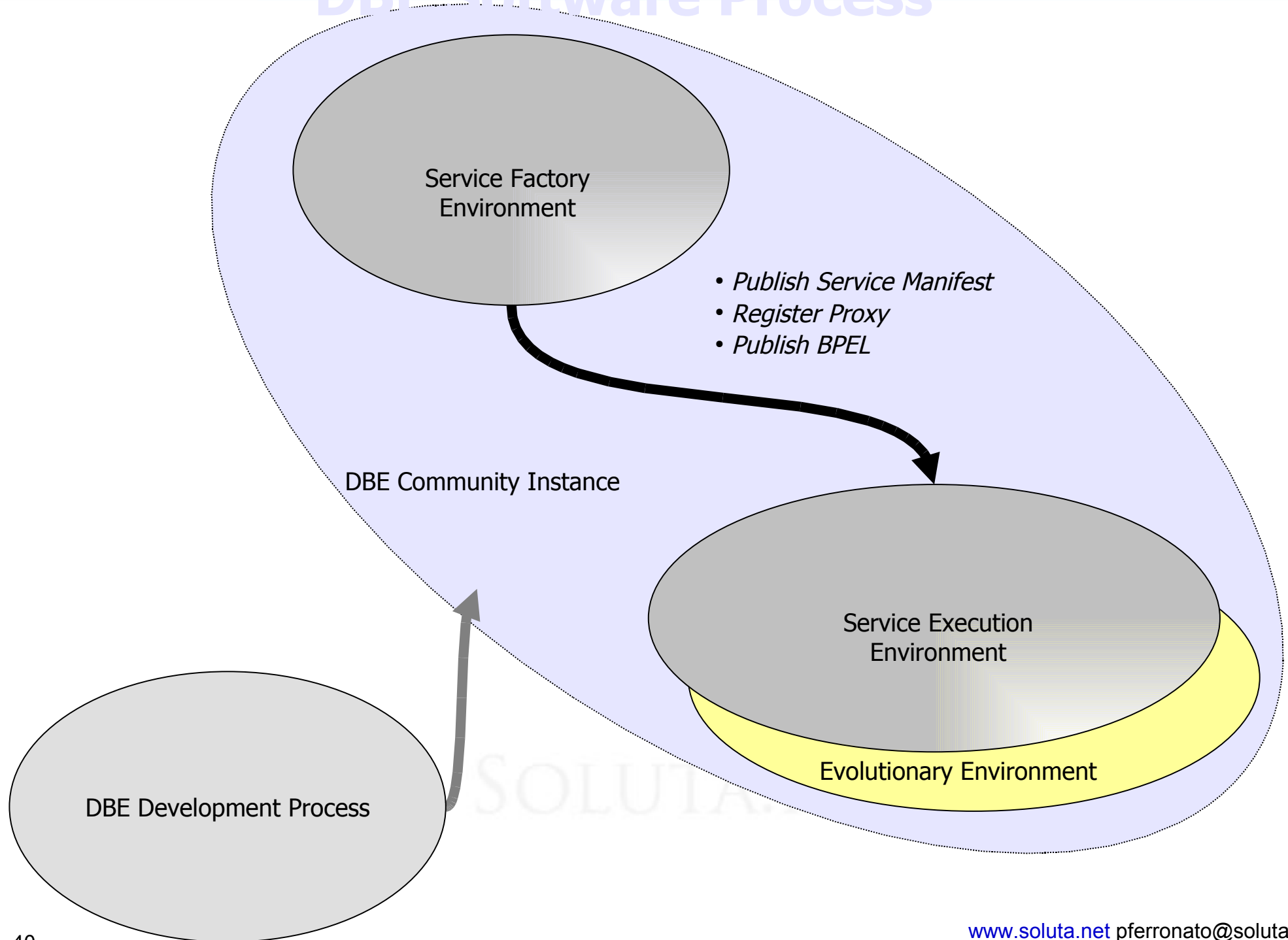


SOLUTA.NET

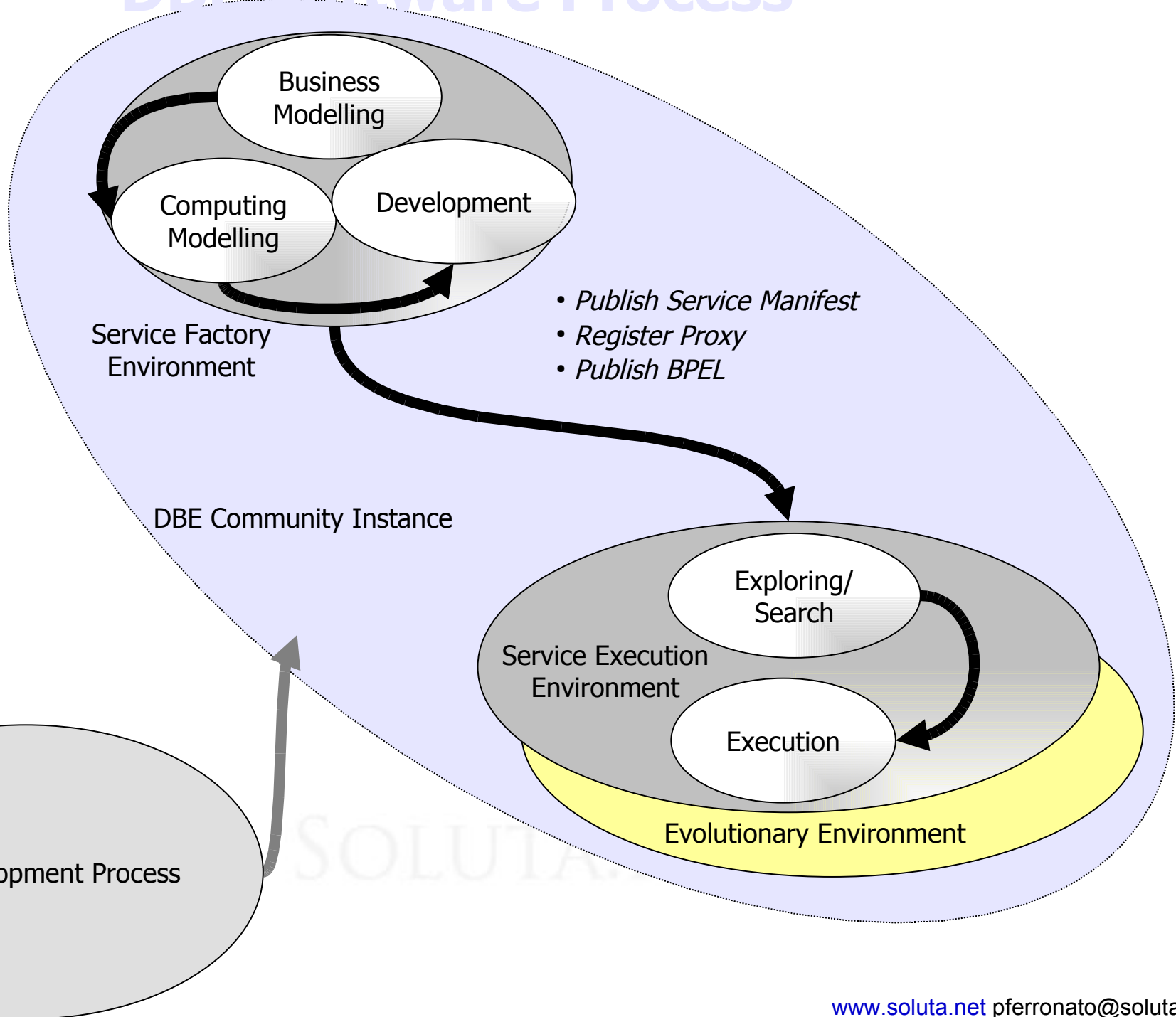
DBE Conceptual model



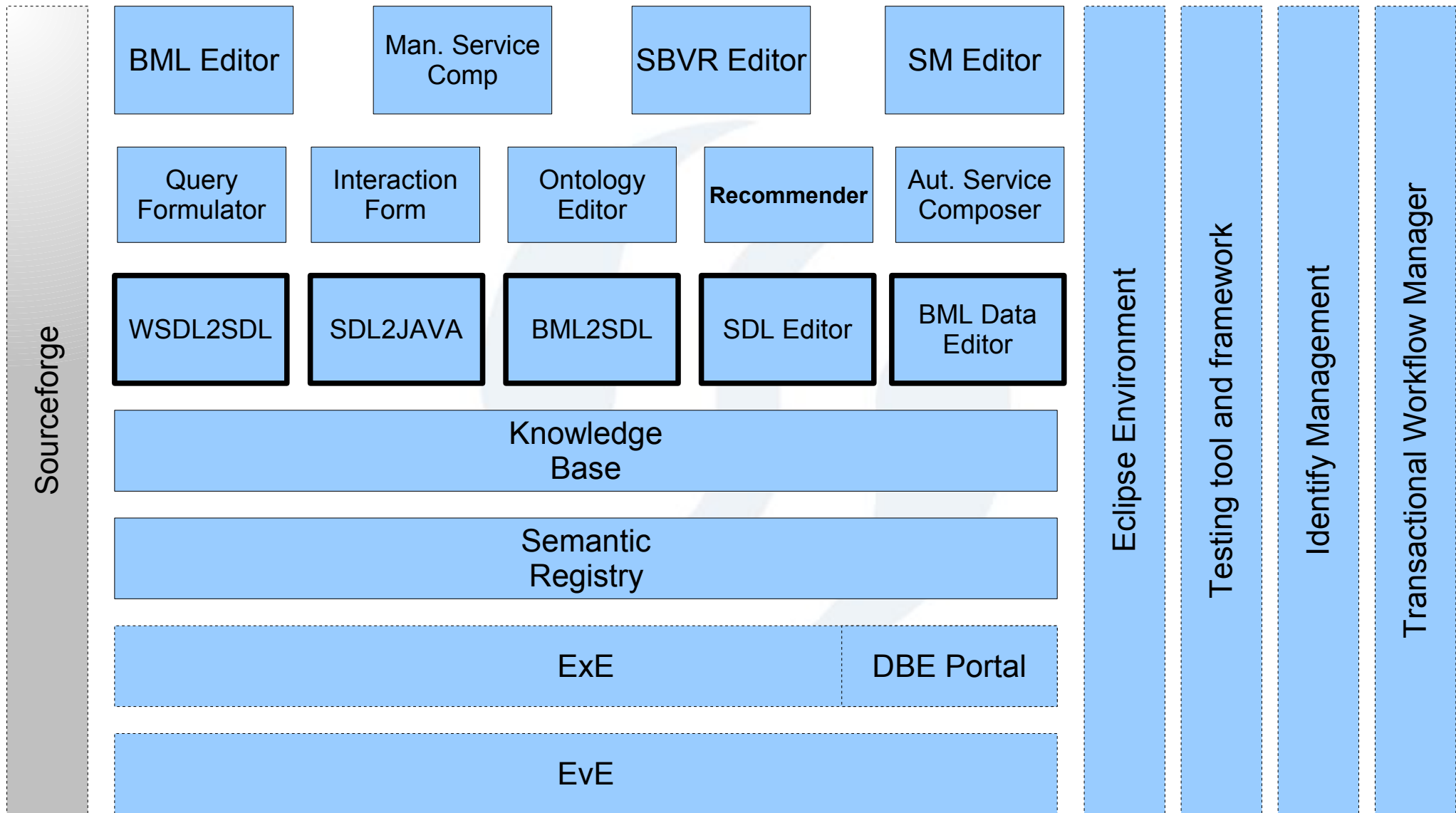
DBE Software Process



DBE Software Process



SF: a cluster of components

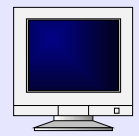


- ▶ Service Factory Env.
 - ▶ Service Modelers/Editors
 - ▶ Development environment
 - ▶ Repository of models
 - ▶ Service Composer
- ▶ Service Exec. Env.
 - ▶ Decentralized P2P Service Registry
 - ▶ Decentralized P2P network for service deployment
 - ▶ Structural Services
 - ▶ Basic Services

- ▶ Accounting
- ▶ Payment Systems
- ▶ Information carriers
- ▶ Identity Management
- ▶ Recommendation
- ▶ Reputation Management and rating
- ▶ Products Catalogue

SOLUTA.NET

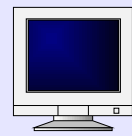
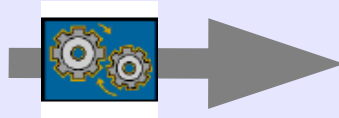
Service Factory



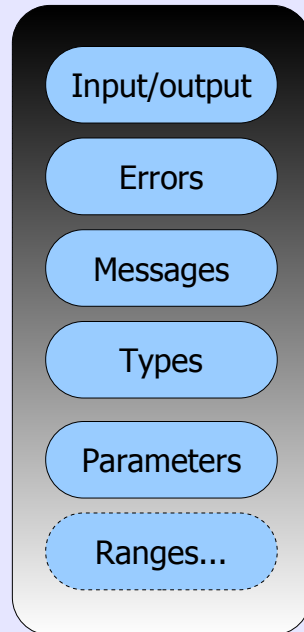
Integrated CIM Editor



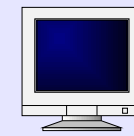
Computational Independent Viewpoint



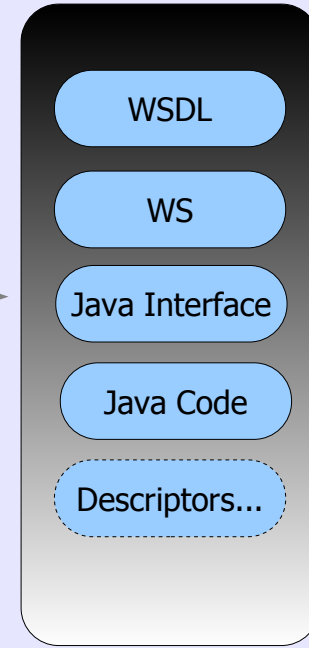
Integrated PIM Editor



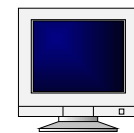
Platform Independent Viewpoint



Integrated PSM Editor

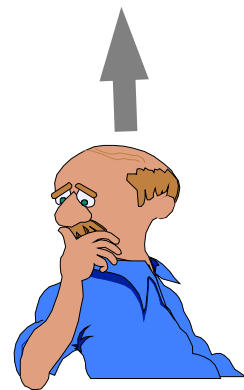


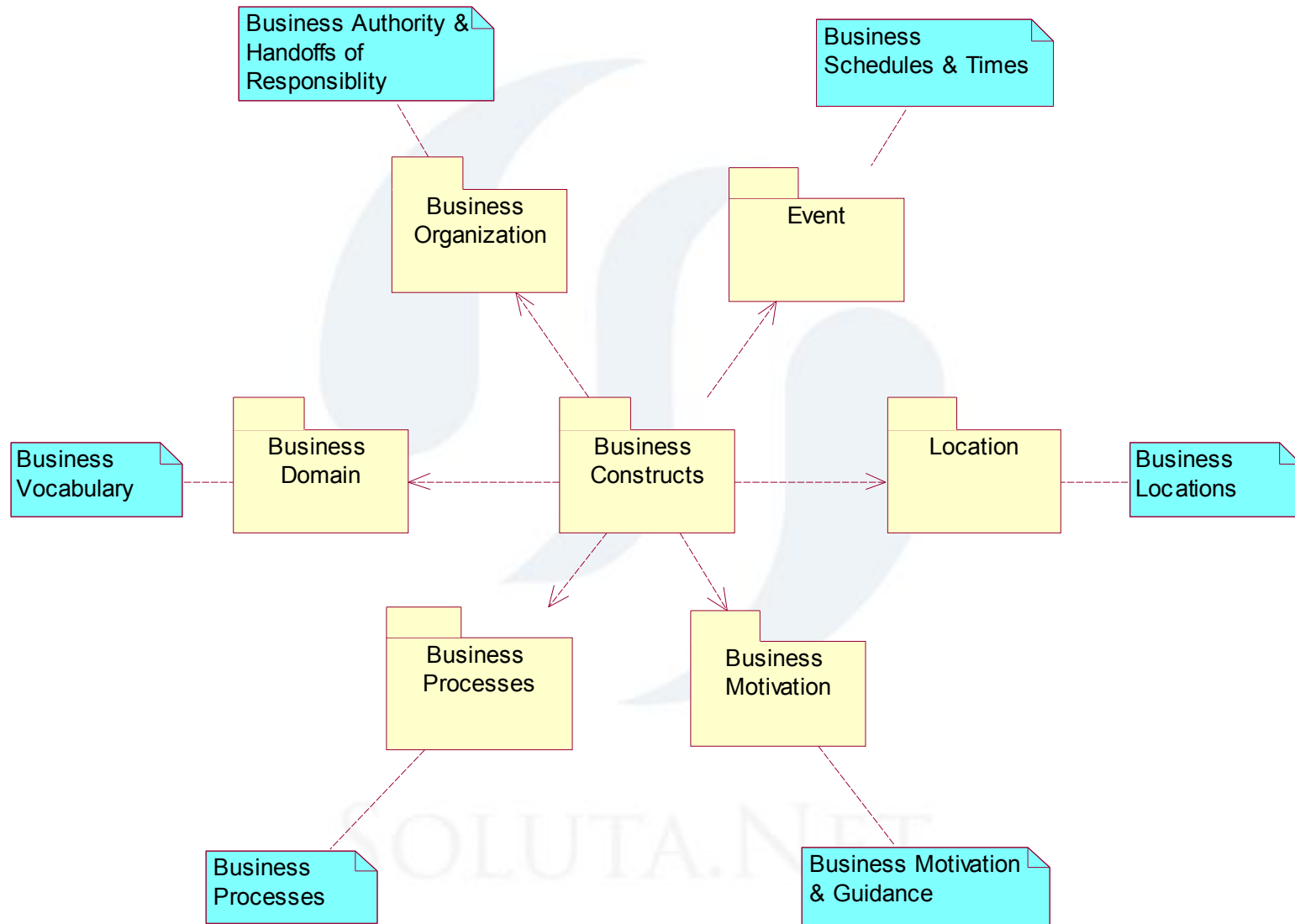
Platform Specific Viewpoint



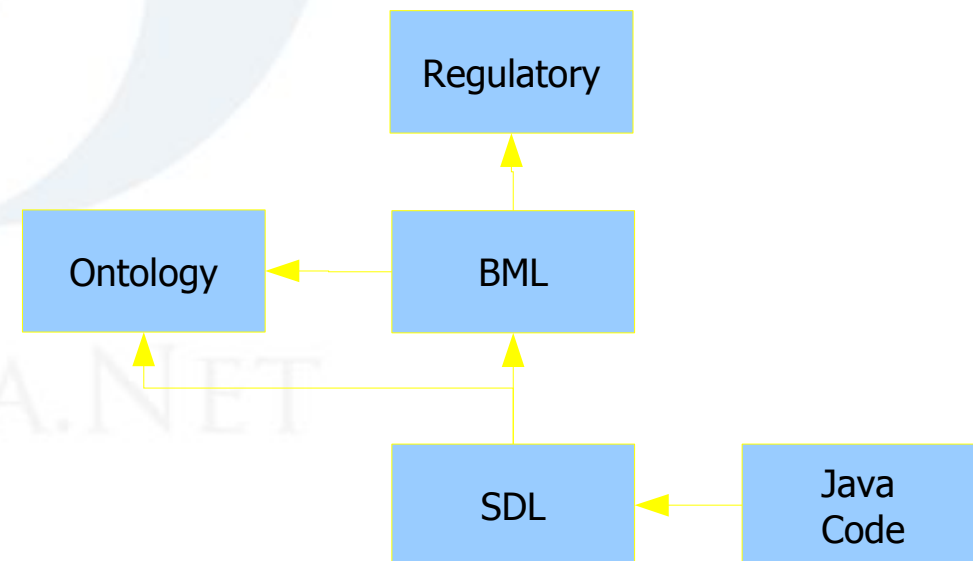
Software Artifacts

SOLUTA.NET

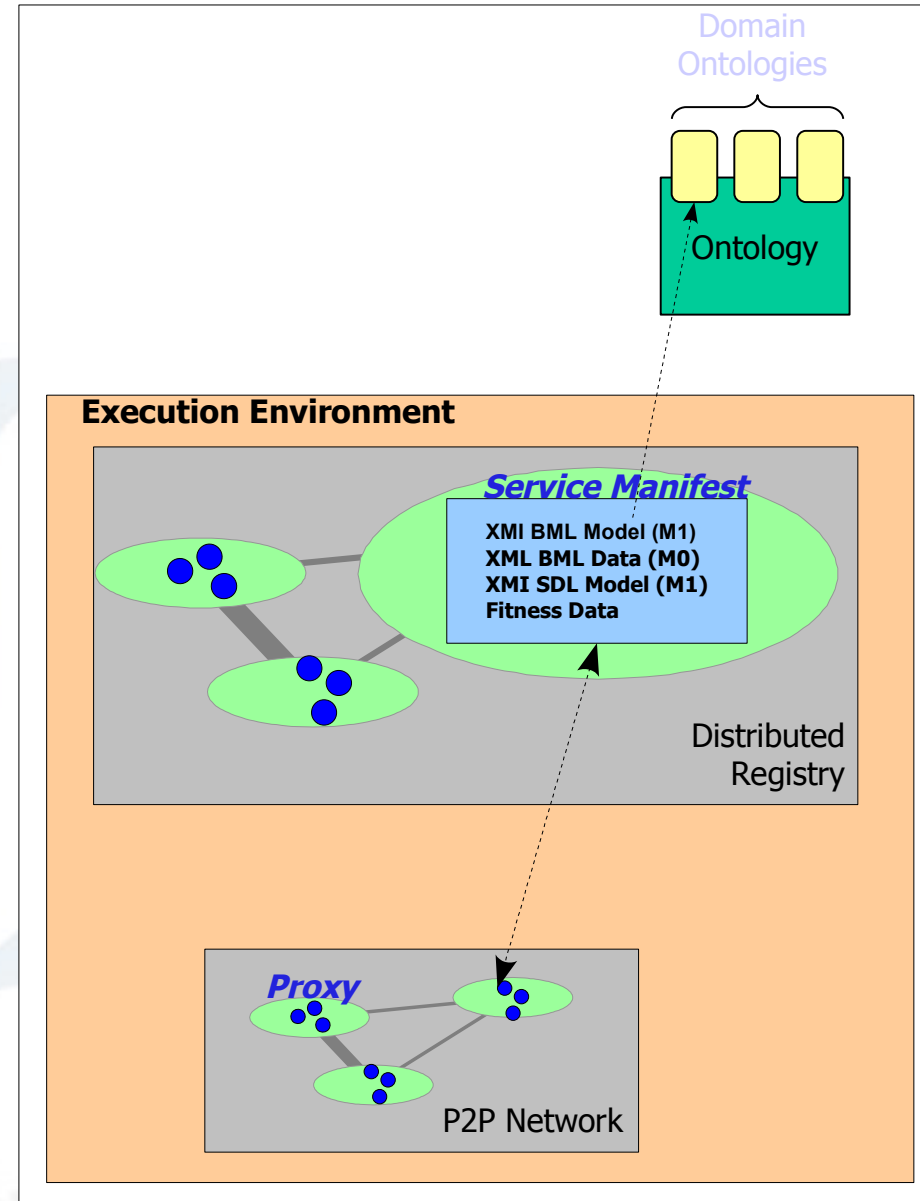




- ▶ Service Description Language (SDL)
 - ▶ PSM description of a service
 - ▶ The SDL describes the technical specification of a DBE service.
 - ▶ The SDL is able to describe the DBE service in a double-faceted fashion. One facet refers to the Semantic Description of DBE Services and the other refers to the description of the DBE Service Interaction Specification.
 - ▶ SDL is a semantically rich abstraction of the WSDL
 - ▶ Binded with BML
 - ▶ Binder with Ontology



- ▶ Service Manifest
 - ▶ PIM of a Service
- ▶ It contains
 - ▶ Complete representation of a Service
 - ▶ Business models + computational model + Information
 - ▶ Reference to 'foreign' ontology
 - ▶ XMI encoding of the models

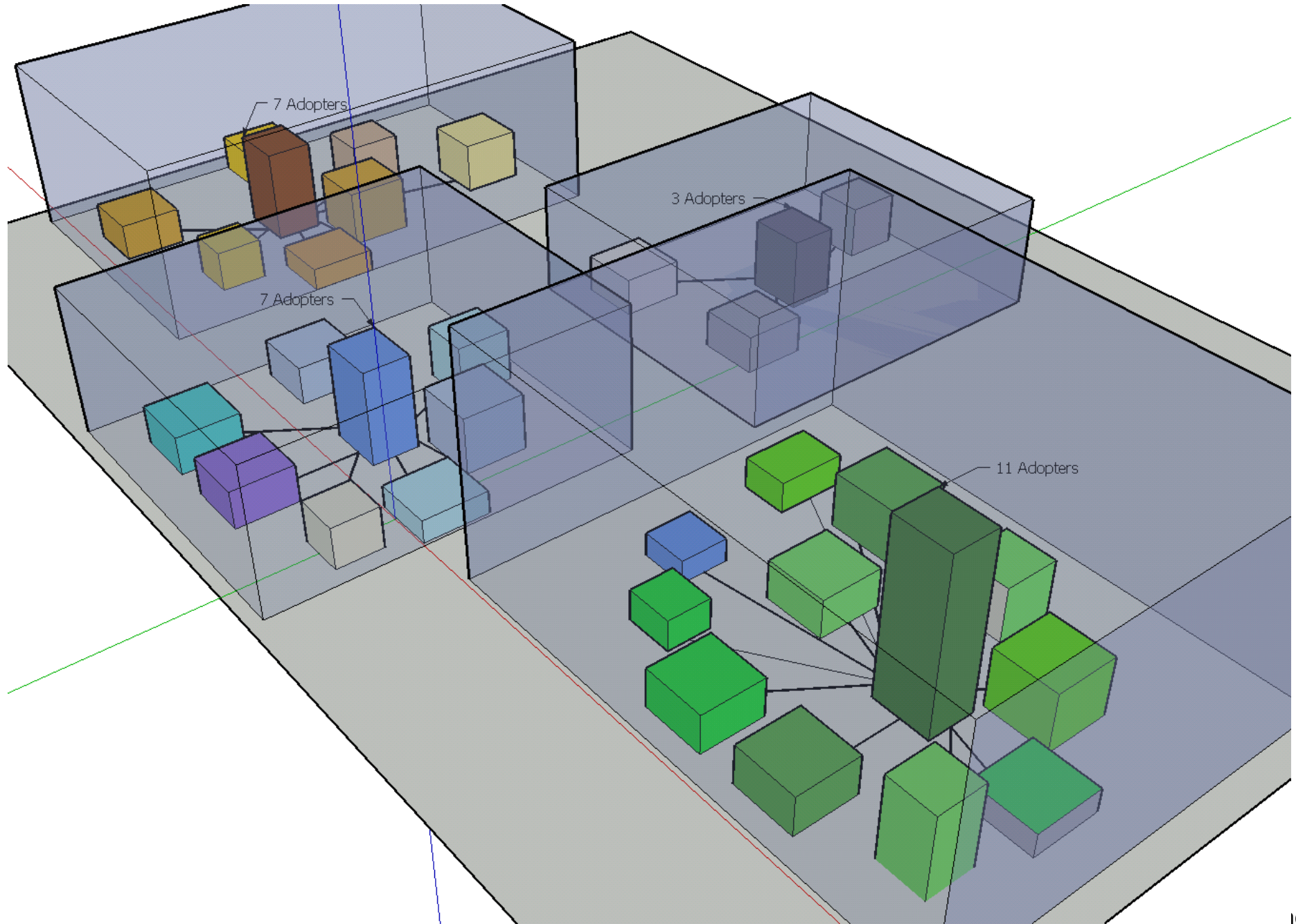


SOLUTA

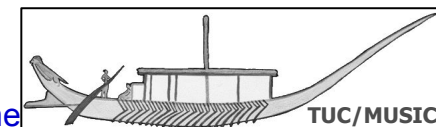
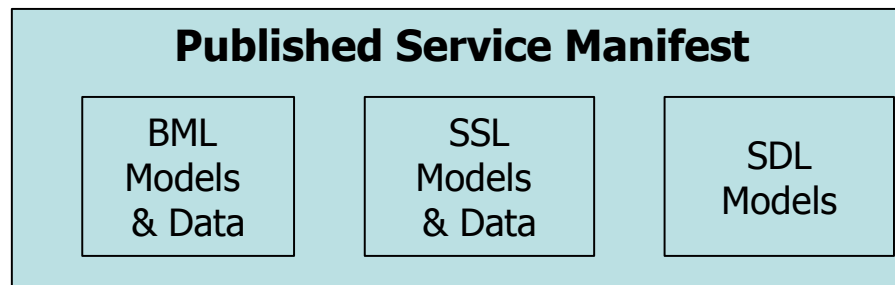
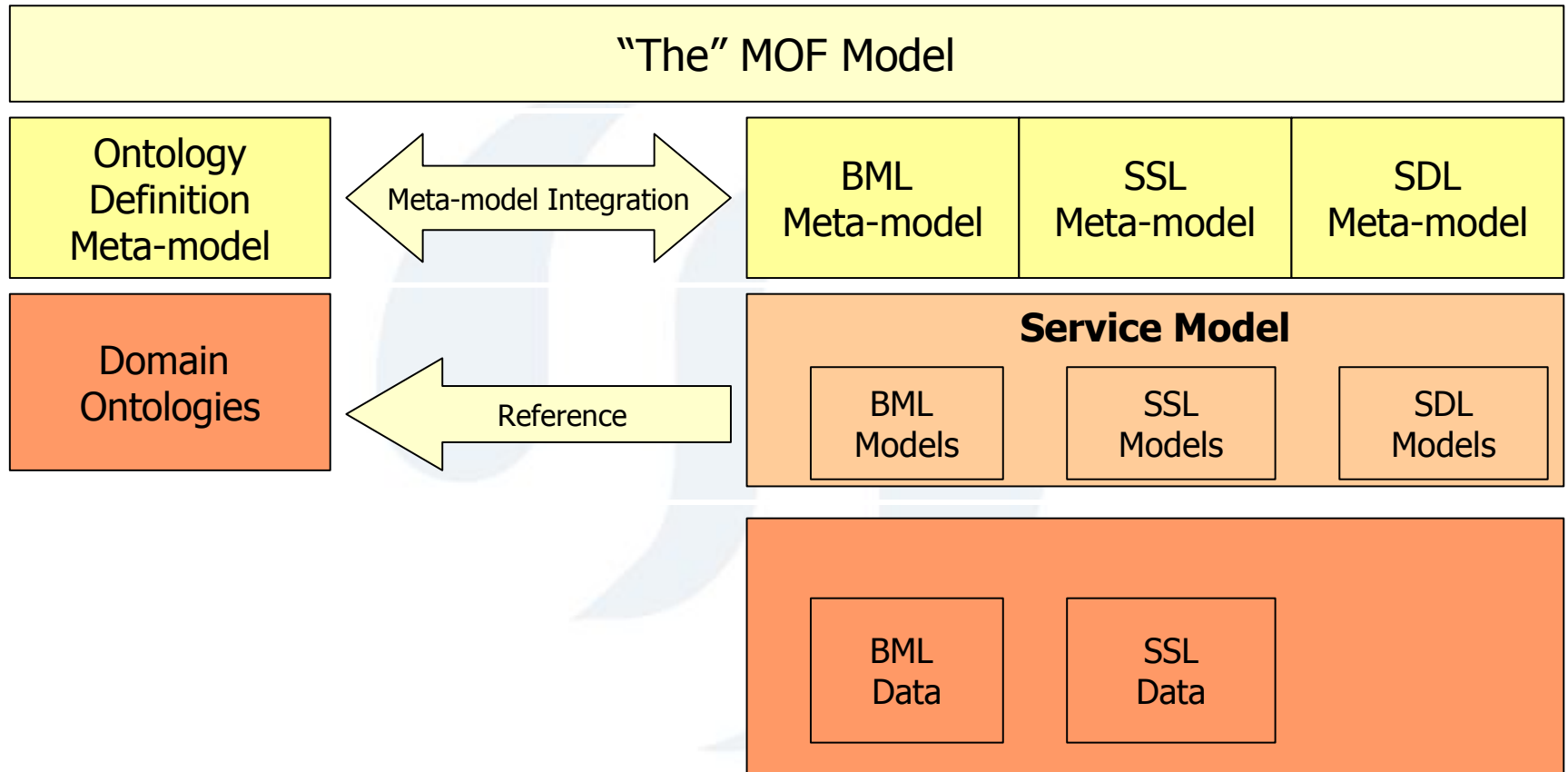
- ▶ Owned by the communities
 - ▶ Functional specifications are Open
 - ▶ No Intellectual property
- ▶ No single point of failure
 - ▶ Technical issue
 - ▶ Political issue
- ▶ All the storage areas are decentralized, P2P based
- ▶ All the resources are redundant
- ▶ Each EMS offer some resources to the community
- ▶ No Governor
 - ▶ Technical
 - ▶ No database/network DBE Admin!
 - ▶ Functional
 - ▶ There is NOT a Master functional reference model

- ▶ The DBE does not want to over impose a reference model for both business and computation
 - ▶ Previous EU projects failed here
- ▶ No DBE Commission or committee
 - ▶ "A camel is a horse designed by a Comitee"
 - ▶ Thousands of millions of users vs a 10 people committee
- ▶ "Let's the marked decide"
 - ▶ Models become standard because of market need and pressure
- ▶ "As fast as the market"
 - ▶ Do not wait for commission standardization
 - ▶ It is ready when it is needed and applied

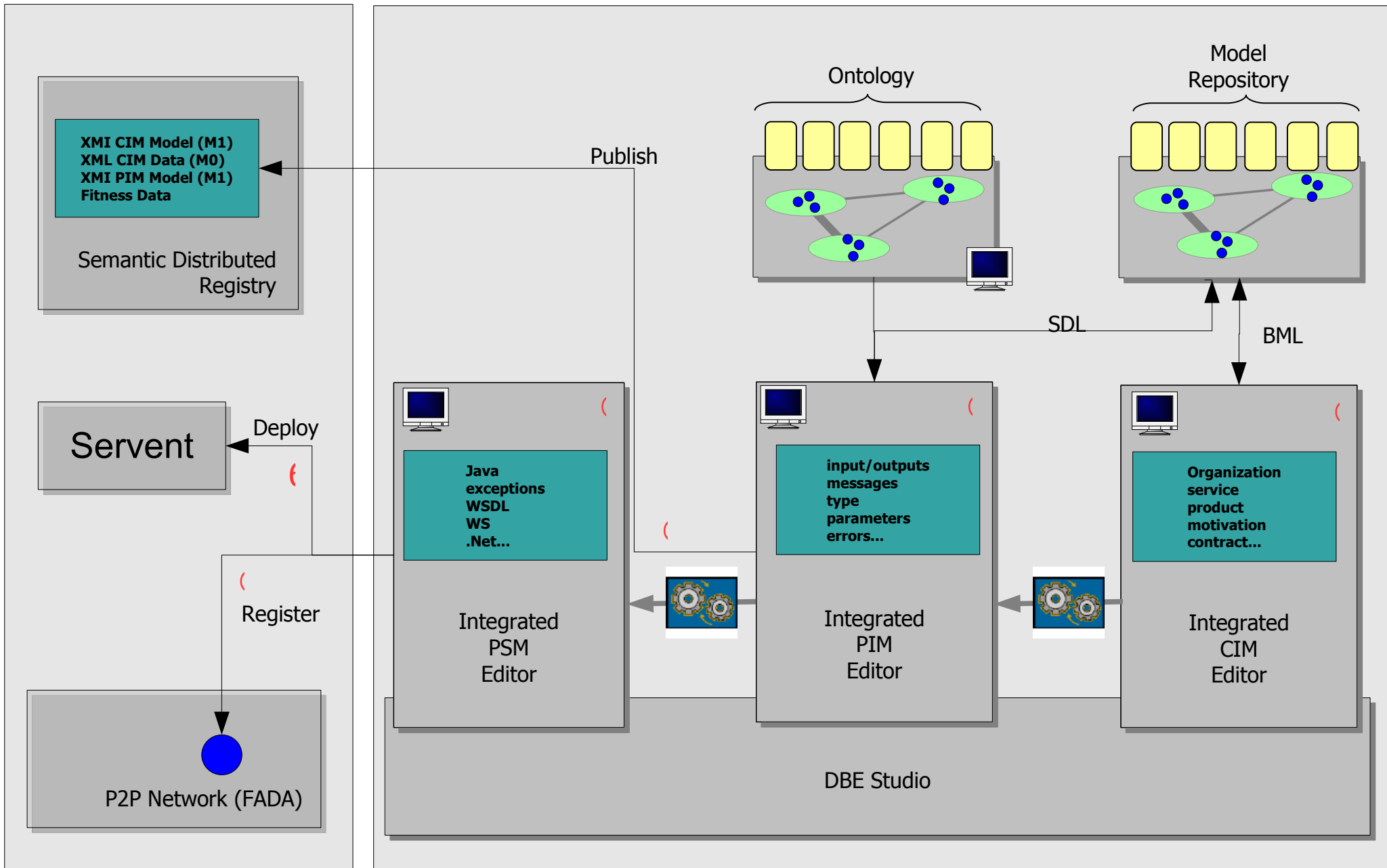
- ▶ Scenario
 - ▶ “Based on a profile information, the DBE recommendation process finds a more convenient taxi service that is promptly replaced with no fuss”
- ▶ A more convenient service BUT with a different SDLs will create inertia in the adoption
- ▶ Effective business models will be reused over and over
- ▶ Models will be enhanced and will “evolve” to address the market more closely
- ▶ We expect that services pertaining to the same domain, will naturally converge to cluster of models



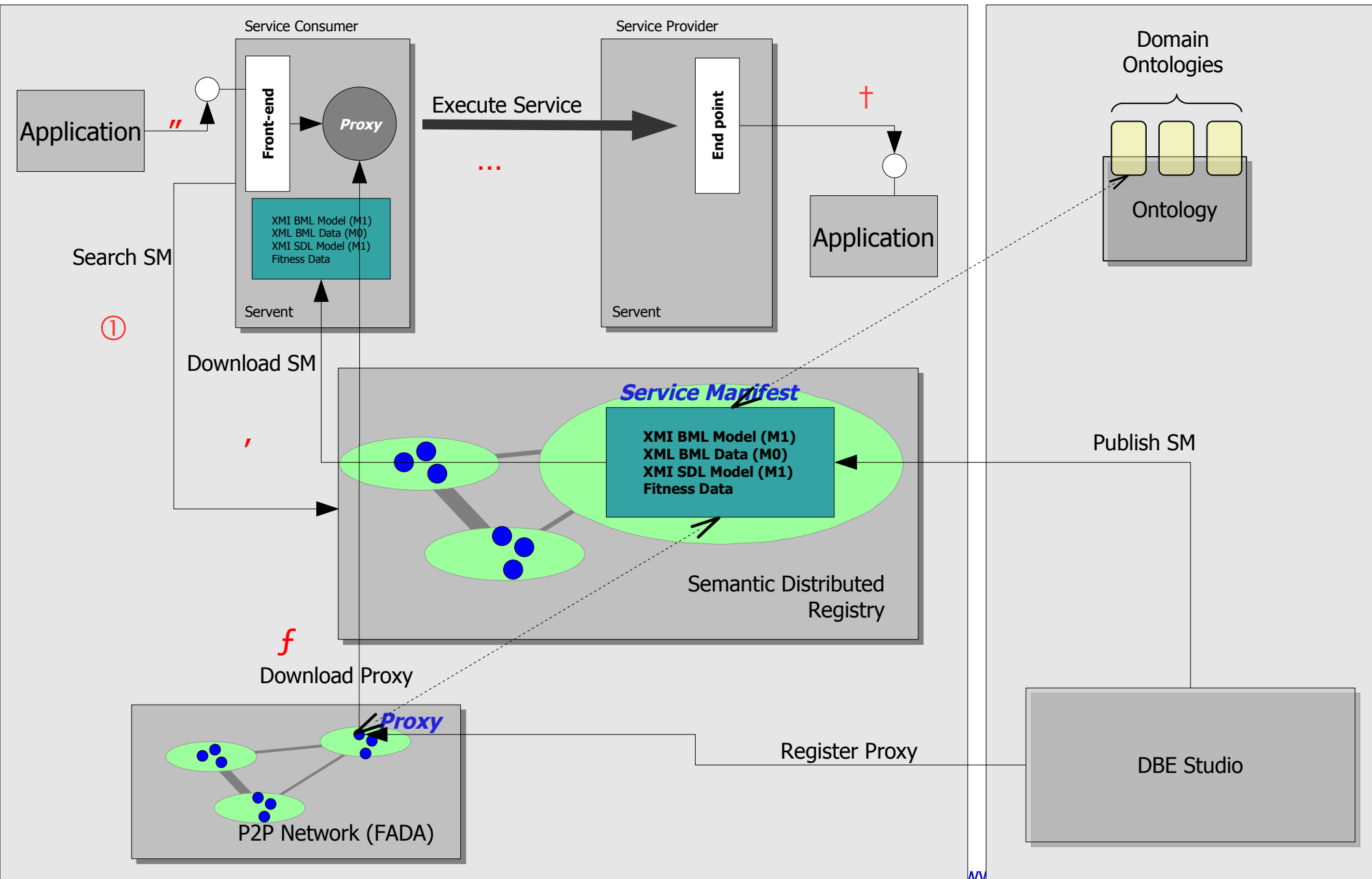
MDA-based Models Representation in DBE



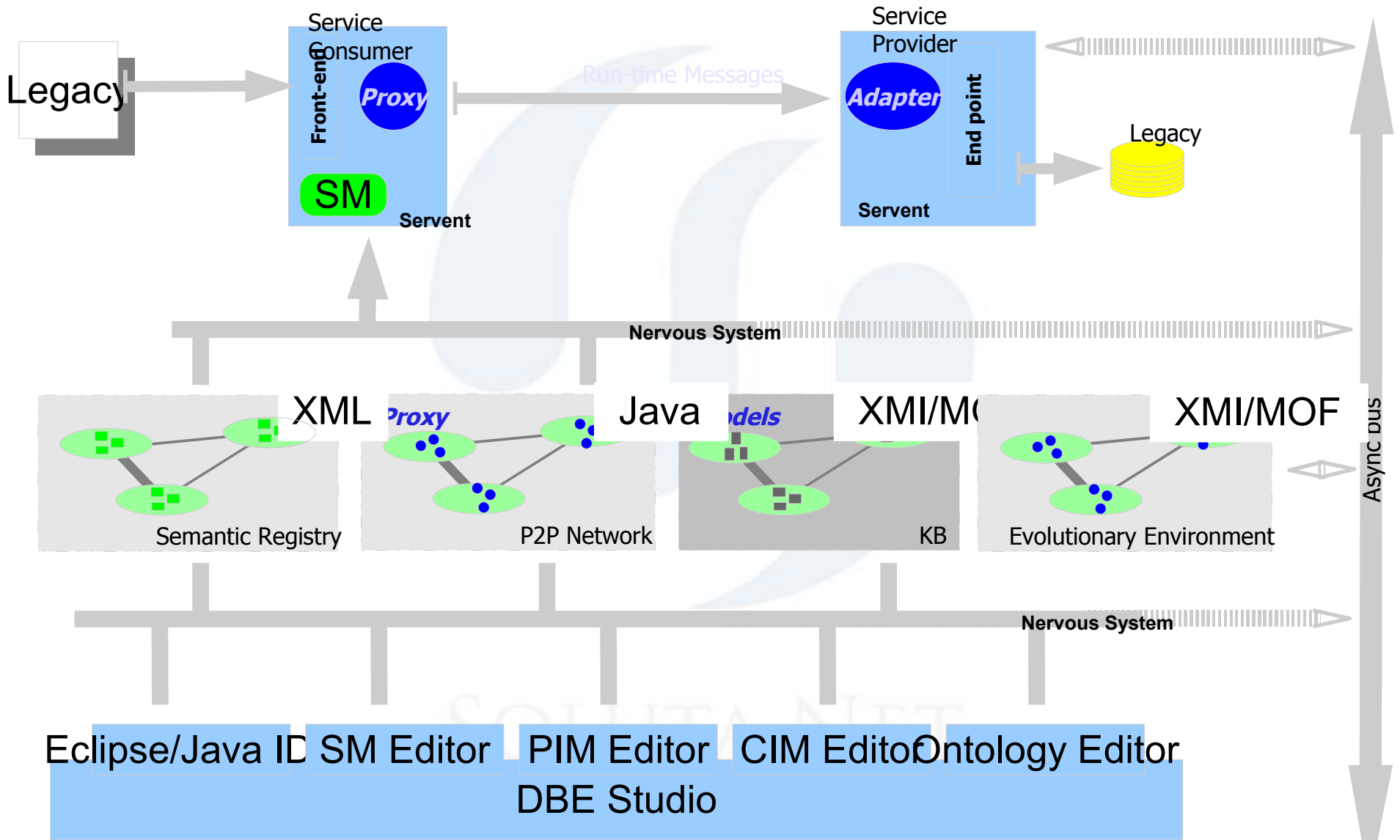
Service Factory



Execution Environment

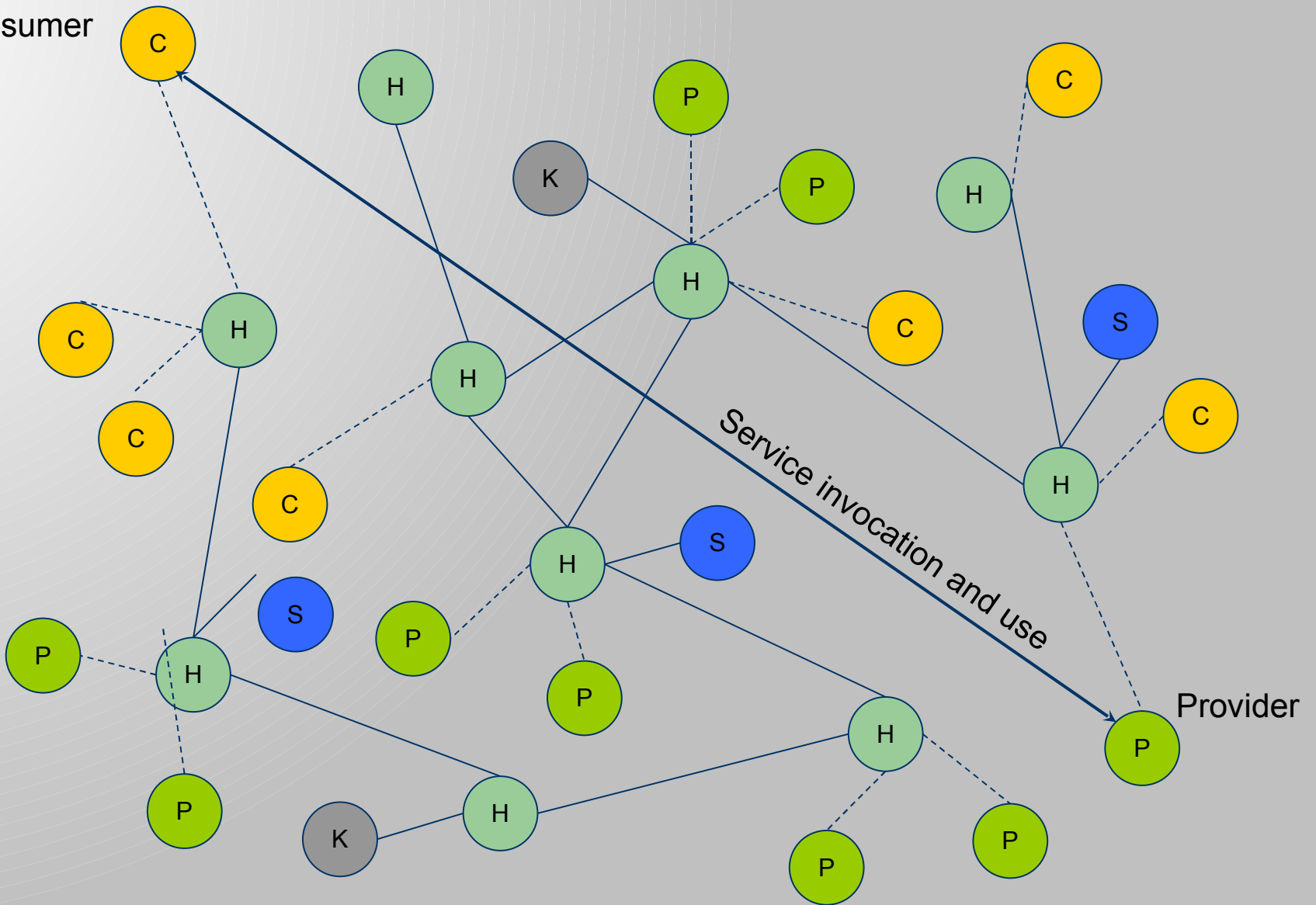


Topology



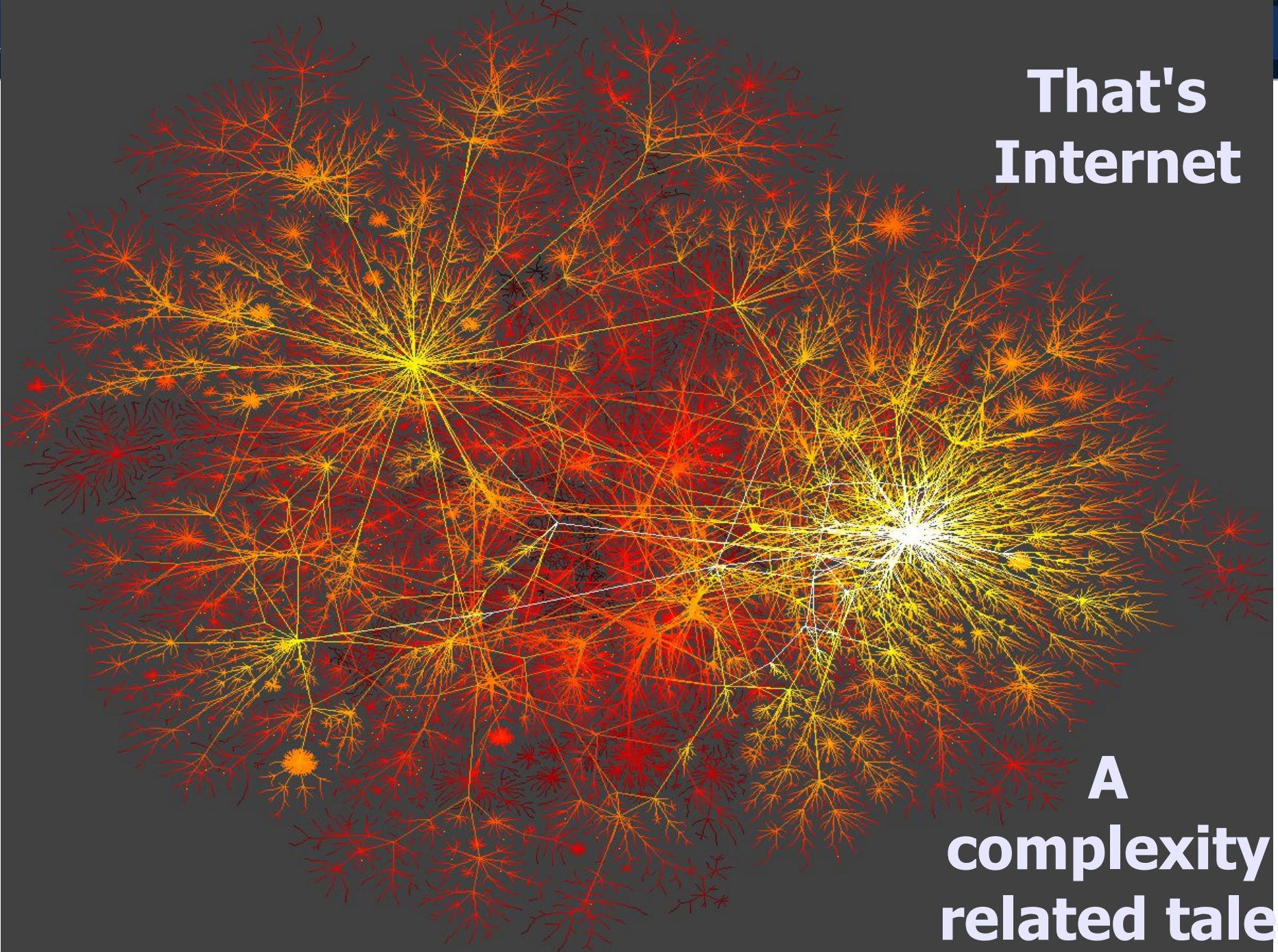
Network Topology

Consumer



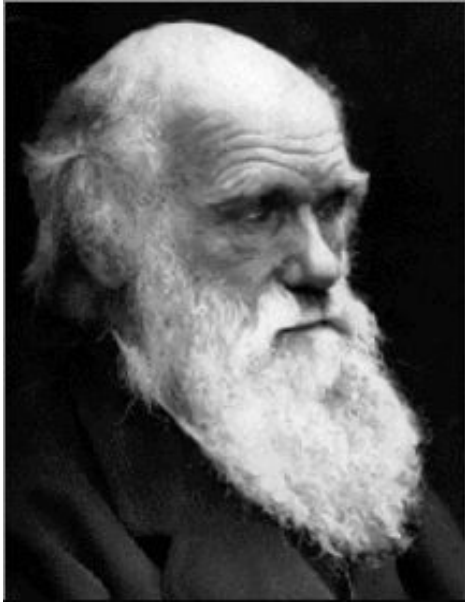
● Provider
 ● Nervous System
 ● Consumer
 ● TWFM
 ● Knowledge base

That's Internet



A
complexity
related tale

- ▶ Official Web Site
 - ▶ <http://www.digital-ecosystems.org>
- ▶ EU Project Officer
 - ▶ <http://www.nachira.net/de/index.htm>
- ▶ Paper "Pervasive Service Architecture for a Digital Business Ecosystem"
 - ▶ <http://arxiv.org/pdf/cs.CE/0408047>
- ▶ Paper "Toward a Semantically Rich Business Modelling Language for the Automatic Composition of Web Services"
 - ▶ <http://www.ebrc.info/kuvat/2072.pdf>
- ▶ http://www.bim.tut.fi/opetus/kurssit/2920425/S2003/swbus240903_DBE_dini.pdf
- ▶ DBE Paper by the EU
 - ▶ http://europa.eu.int/information_society/topics/ebusiness/godigital/sme_research/doc/dbe_discussionpaper.pdf
- ▶ Project Summary
 - ▶ http://www.ee.ic.ac.uk/philippe/dbe_summary_cc.pdf
- ▶ IST Project Fact Sheet
 - ▶ http://dbs.cordis.lu/fep-cgi/srchidadb?ACTION=D&CALLER=PROJ_IST&QM_EP_RCN_A=71142



“It is not the strongest of species that survive, nor the most intelligent, but the one most adaptable to change.”

Charles Darwin
1809 - 1882

SOLUTA.NET