

Distributed knowledge engineering

Webstructor system

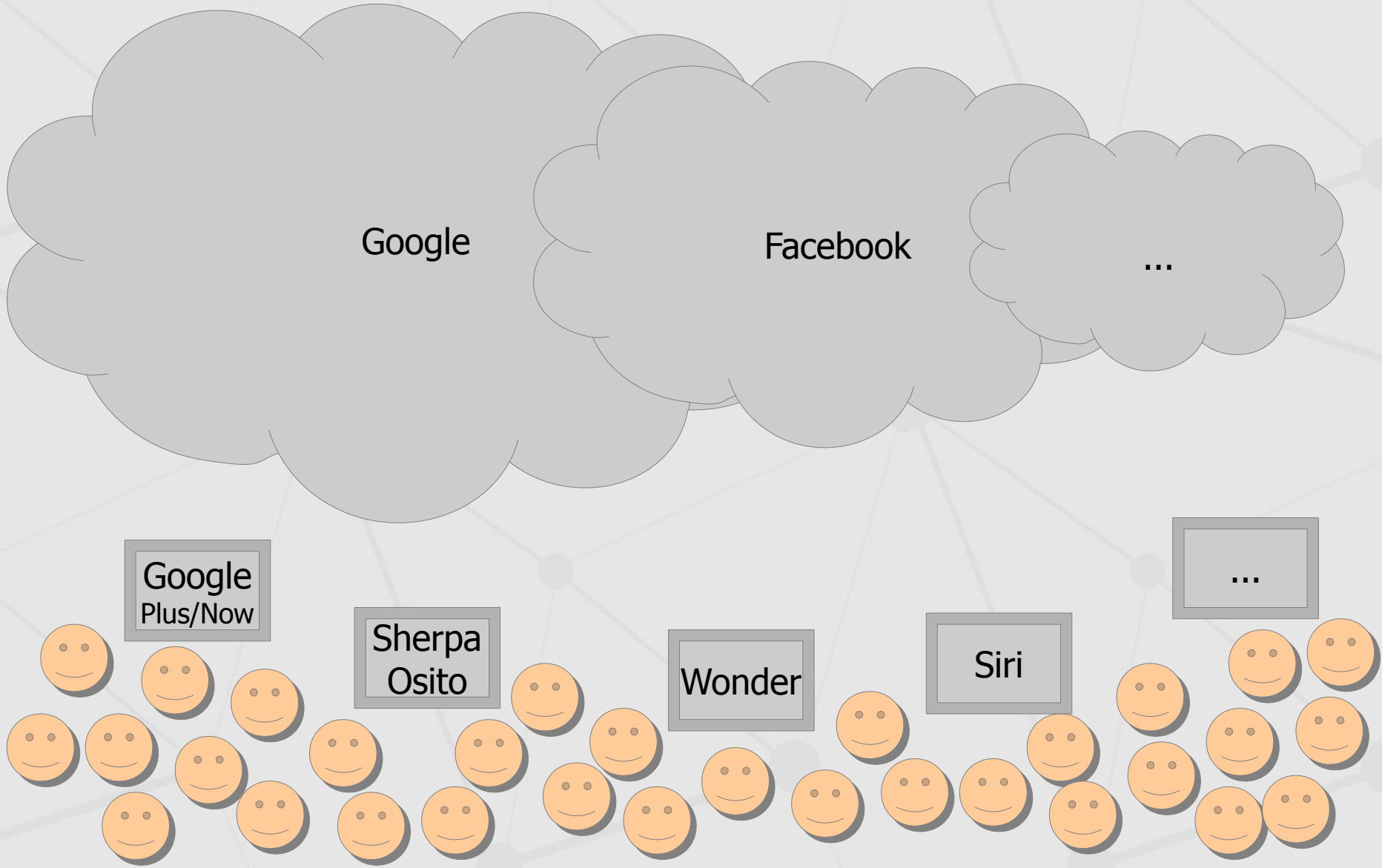
<http://www.webstructor.net/>

Anton Kolonin, 2013

- Decentralized globalization model
 - Requirements
 - Agent specialization
 - Topologies and functional clusters
 - Social evidence-based knowledge model
- Knowledge representation in graphs
- Webstructor system
 - Architecture and supported topologies
 - Hyper-graphs and subgraphs
 - Present applications
 - Object-Relational Language (ORL)
 - Project history

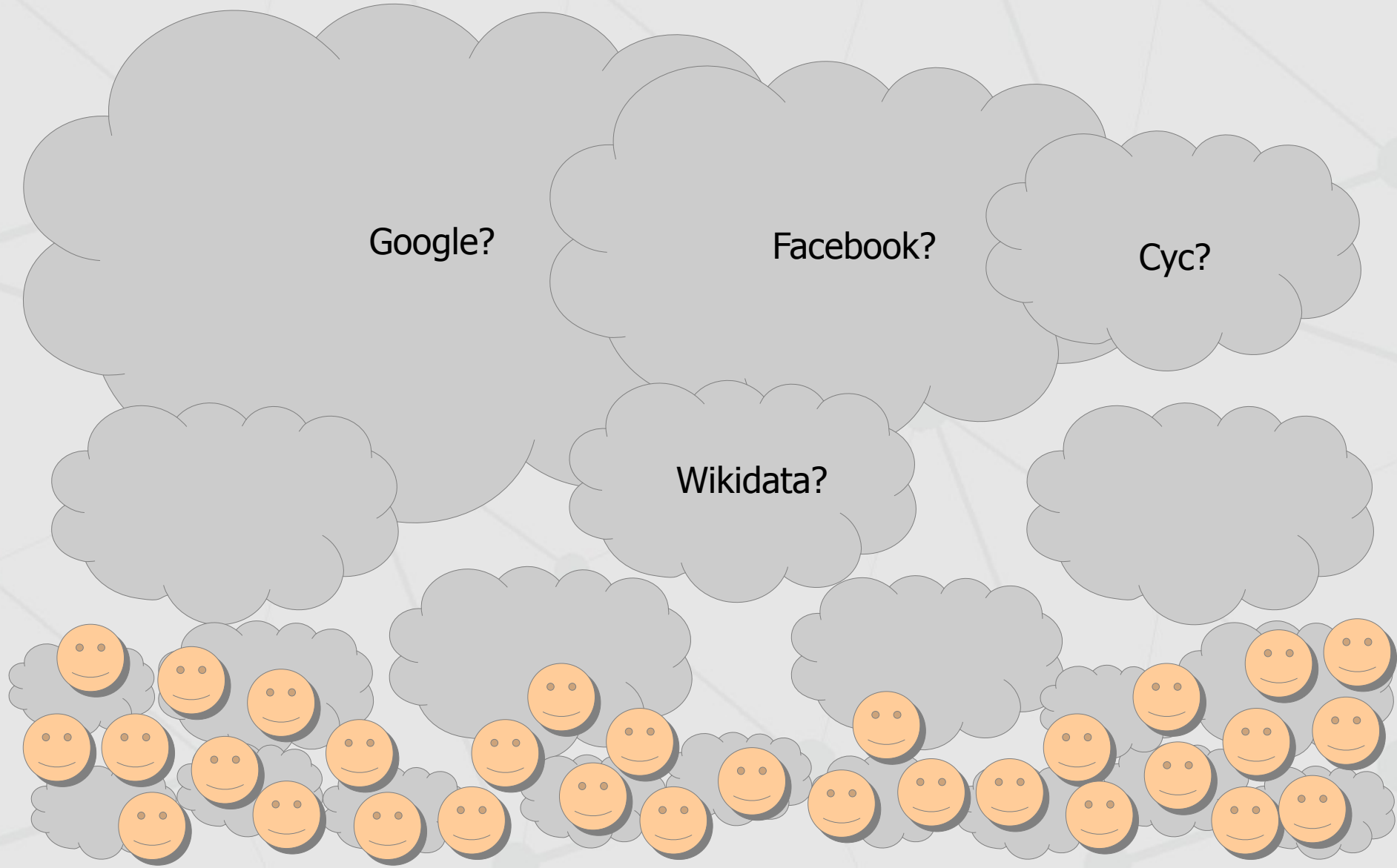
Distributed knowledge engineering

Centralized model



Distributed knowledge engineering

Decentralized model



Distributed knowledge engineering

Decentralized model

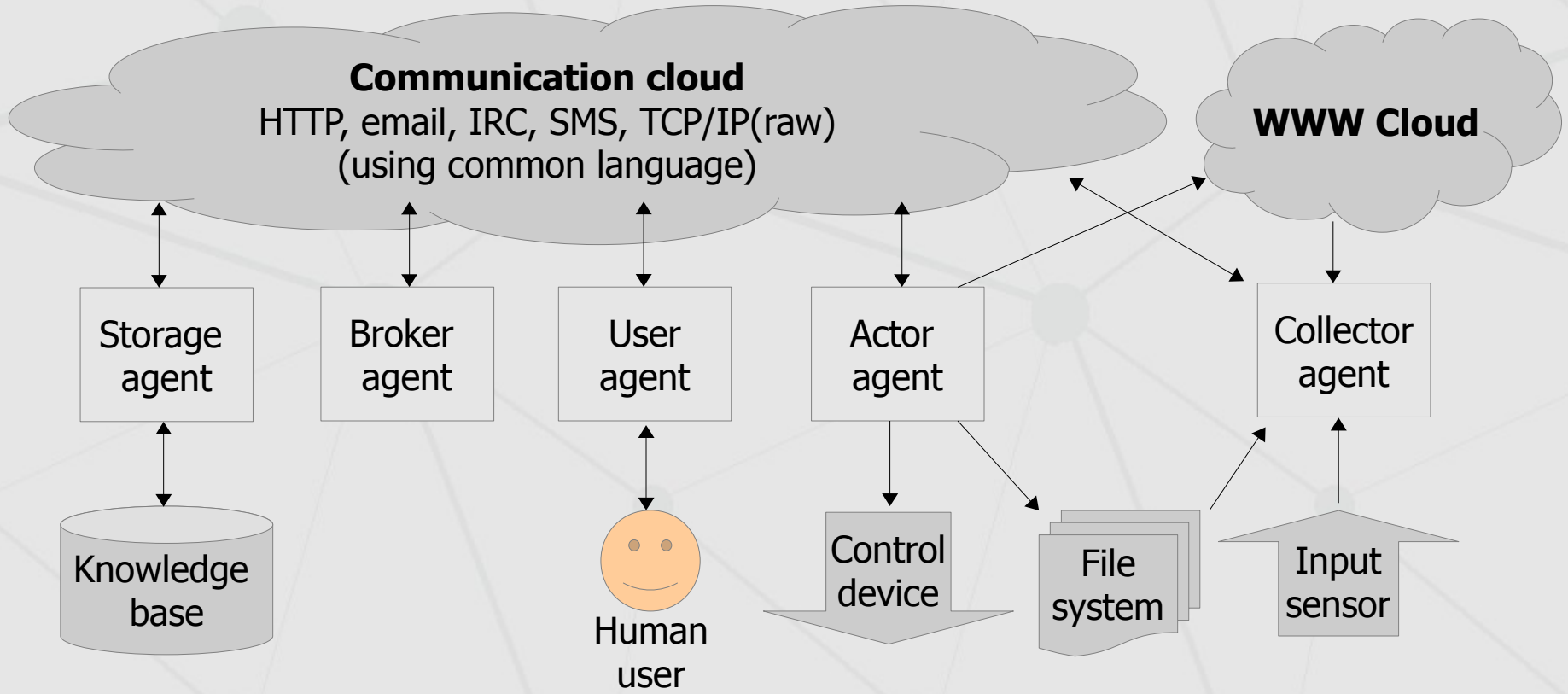
Requirements

- Network of computer **agents** as functional structure and rules of dynamic self-organization:
 - rich **historical memory** shared by communicating computer agents (e.g. accessible public banks of information);
 - rich **sensory environment** driving the communication and accessible **means of gathering novel information** (e.g. search, browsing and messaging against peer computer agents);
 - for an agent, **ability to explicitly expose its own knowledge** indicating confidence, proprietary rights and privacy levels of it;
 - unrestricted **fertility of diverse behavioral patterns** (i.e. computational algorithms) exposed by agents (capable for evolution upon feedback);
 - ease of peer-to-peer communication by means of **unified language** based on the same upper ontology (i.e. open knowledge transfer/manipulation protocol);
 - legal definition of the **responsibility for computer agent's actions** (e.g. search results, browse requests and messages) delegated to the person or corporation operating the agent hardware.

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Decentralized model

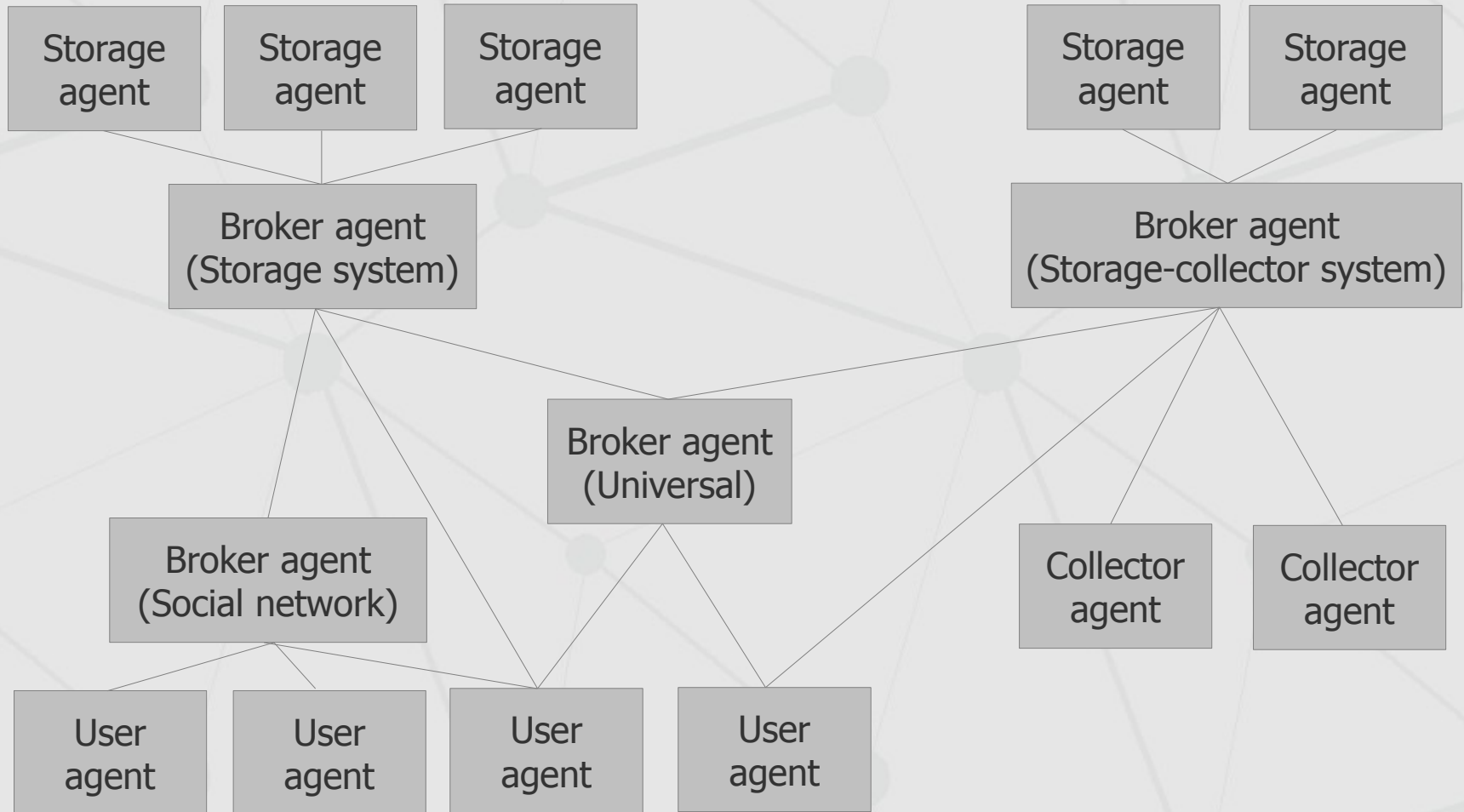
Agent specialization



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Decentralized model

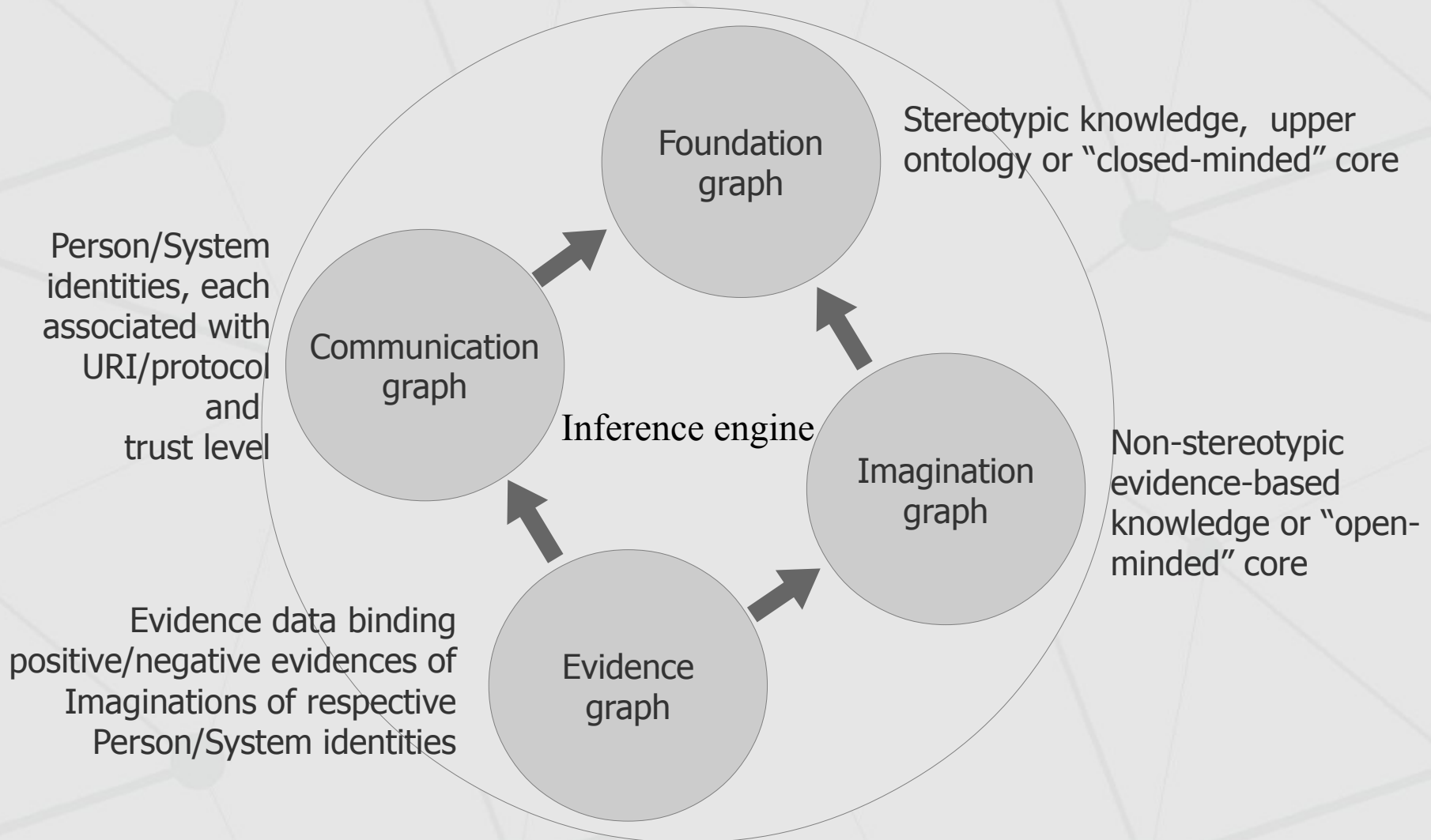
Topologies and functional cluster



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Decentralized model

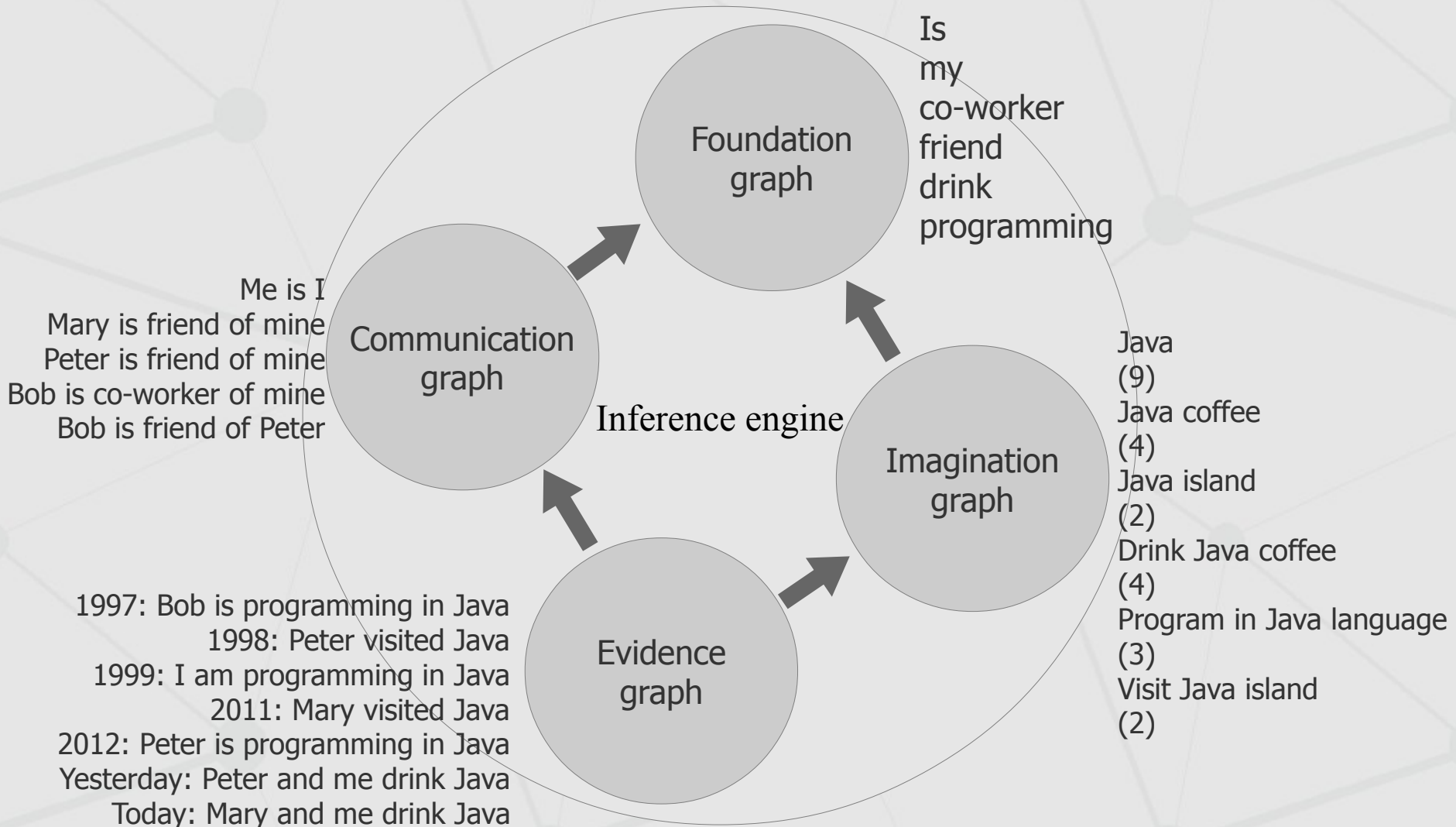
Social evidence-based data model



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Decentralized model

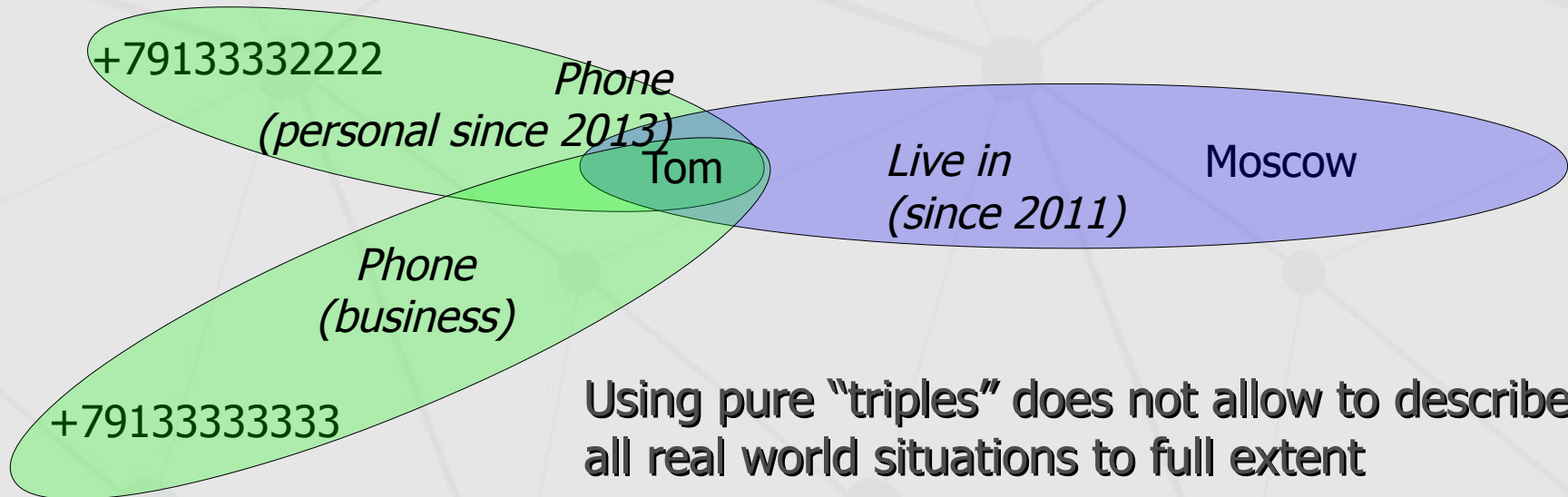
Social evidence-based data model



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Knowledge representation in graphs

Tom lives in Moscow since 2011, his phones:
+7913333222 (personal since 2013), +79133333333 (business)

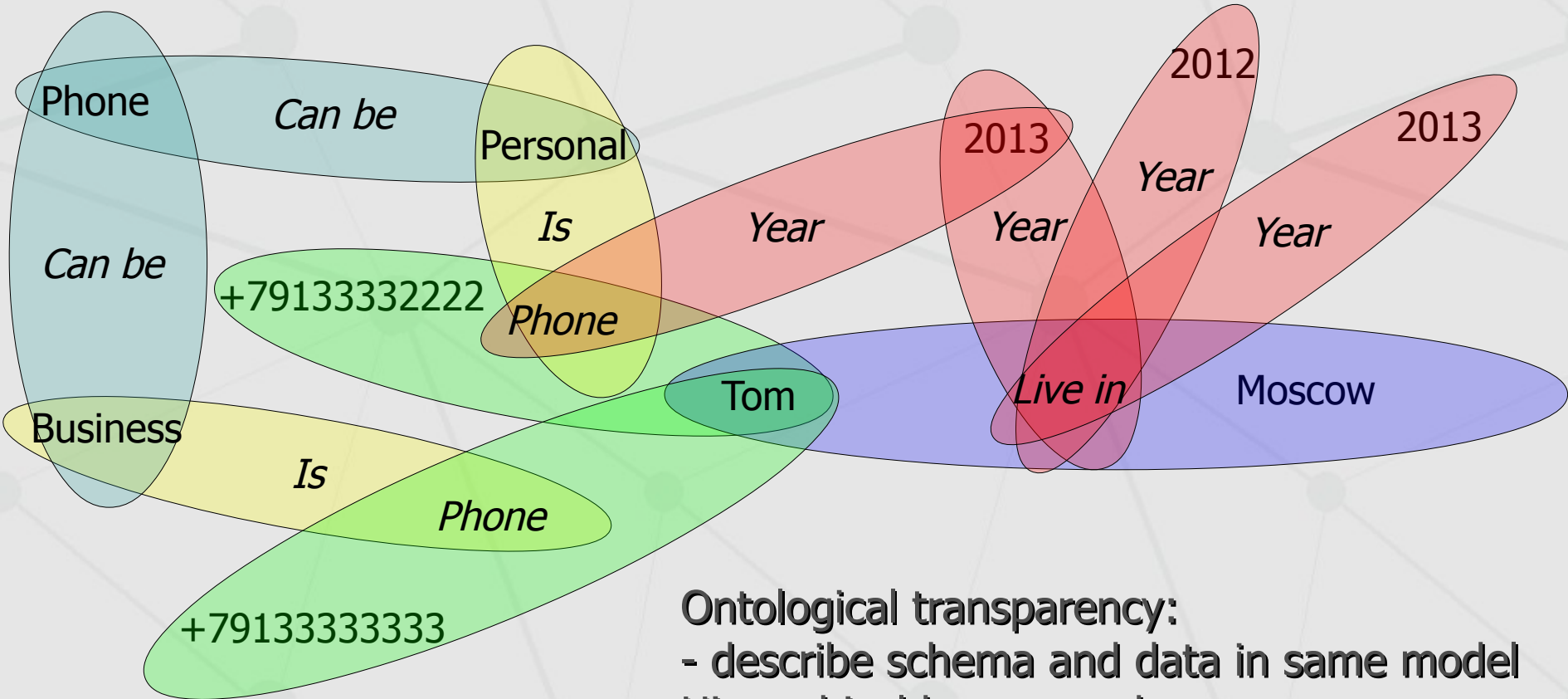


Using pure "triples" does not allow to describe all real world situations to full extent

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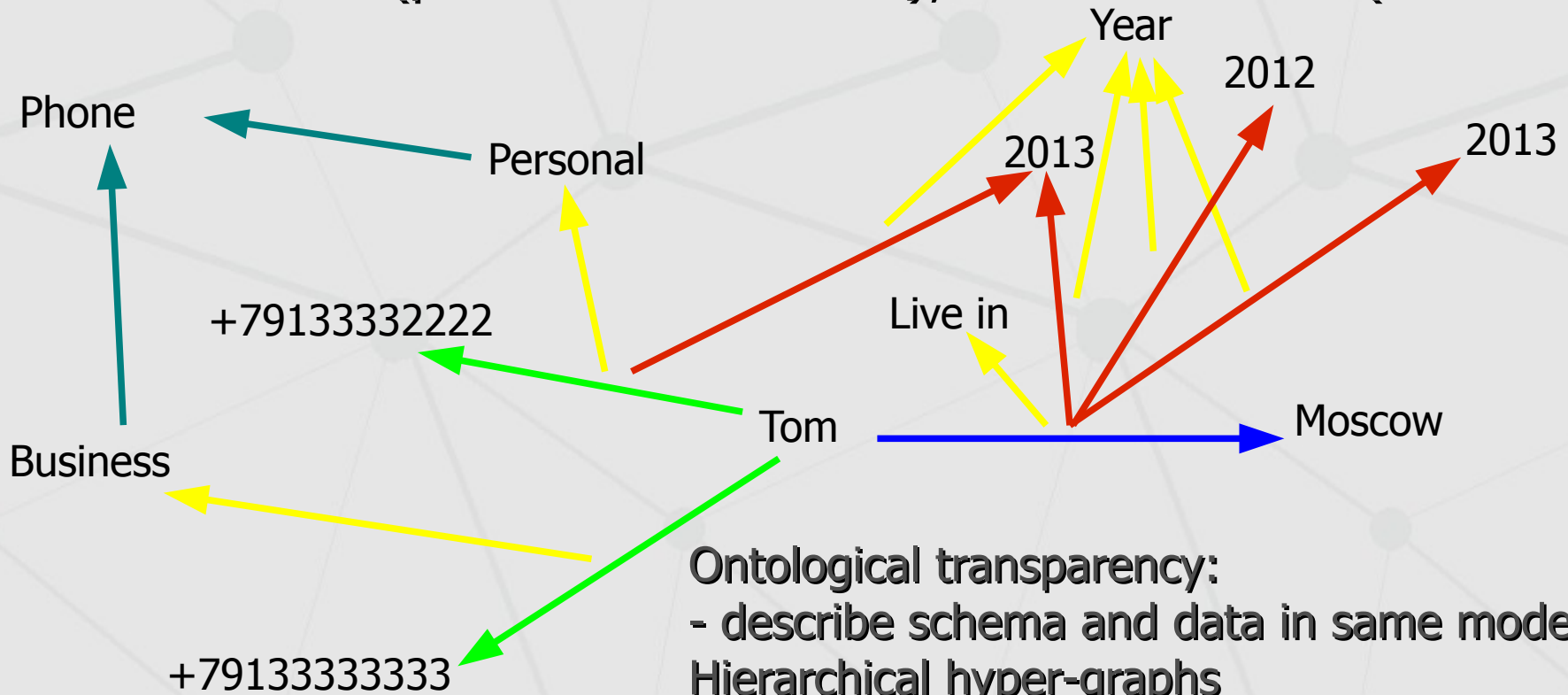
Ontological transparency:

- describe schema and data in same model
- Hierarchical hyper-graphs
- involving links in other links

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Ontological transparency:

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Hierarchical hyper-graphs

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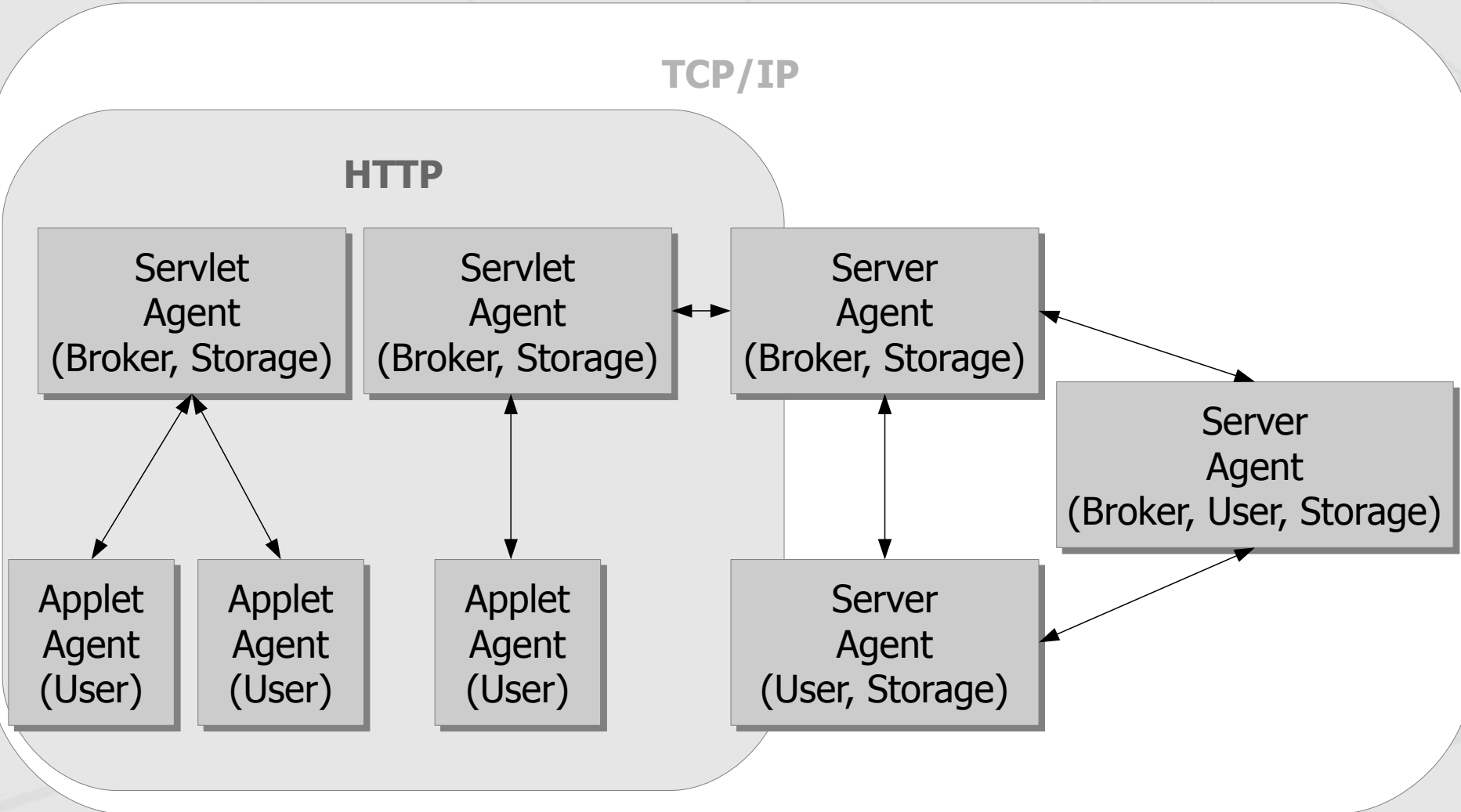
Ultimate normalization

- down to binary relations (theoretically)

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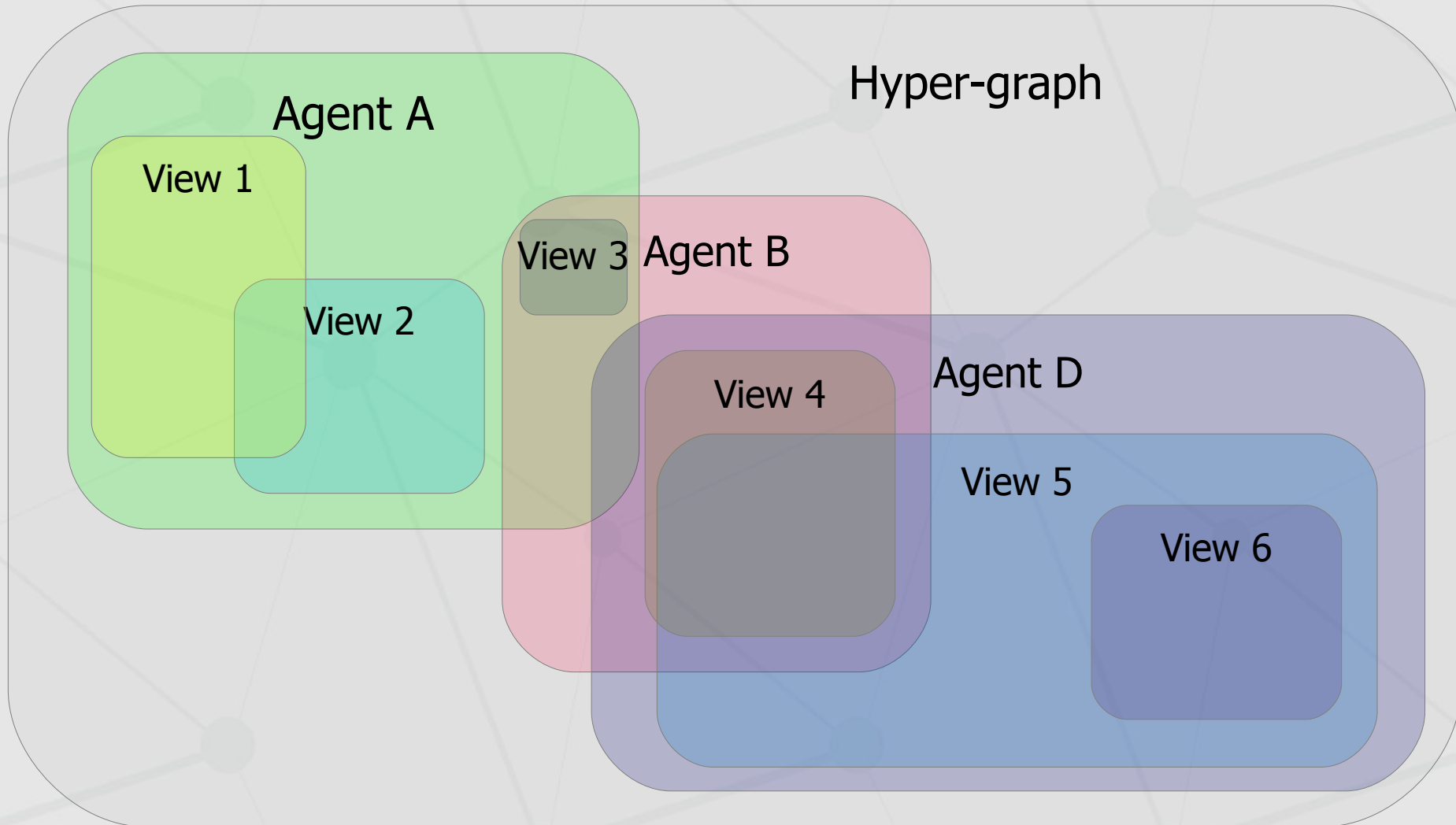
Architecture and possible topologies



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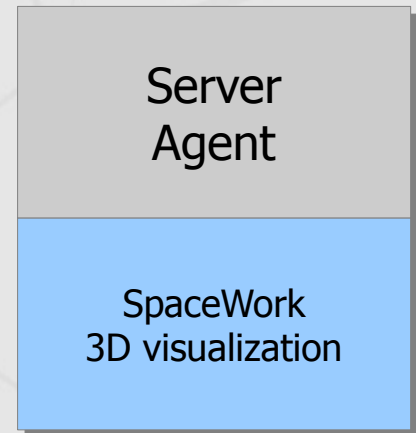
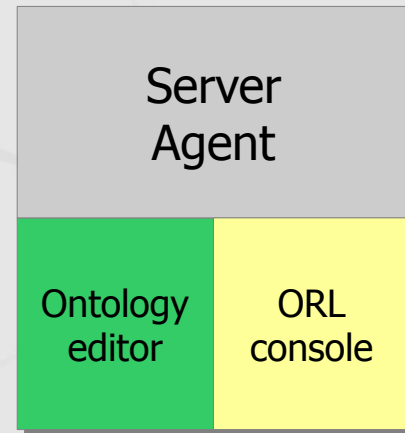
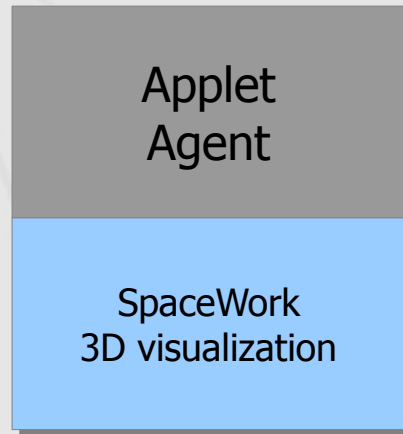
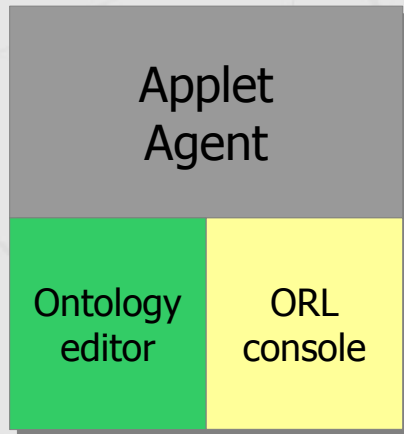
Global hyper-graph and subgraphs of agents



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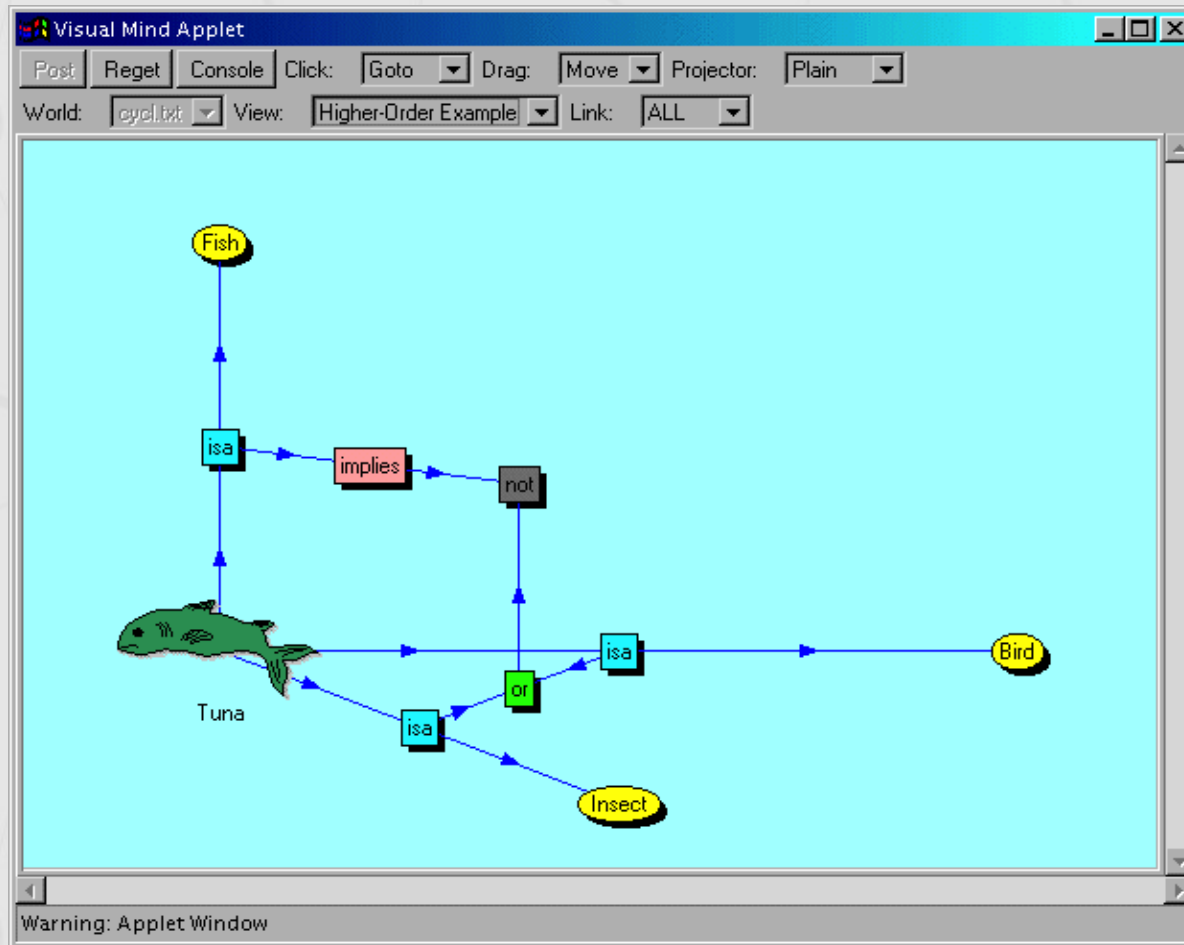
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Existing applications



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Visual ontology and logical formulae editor

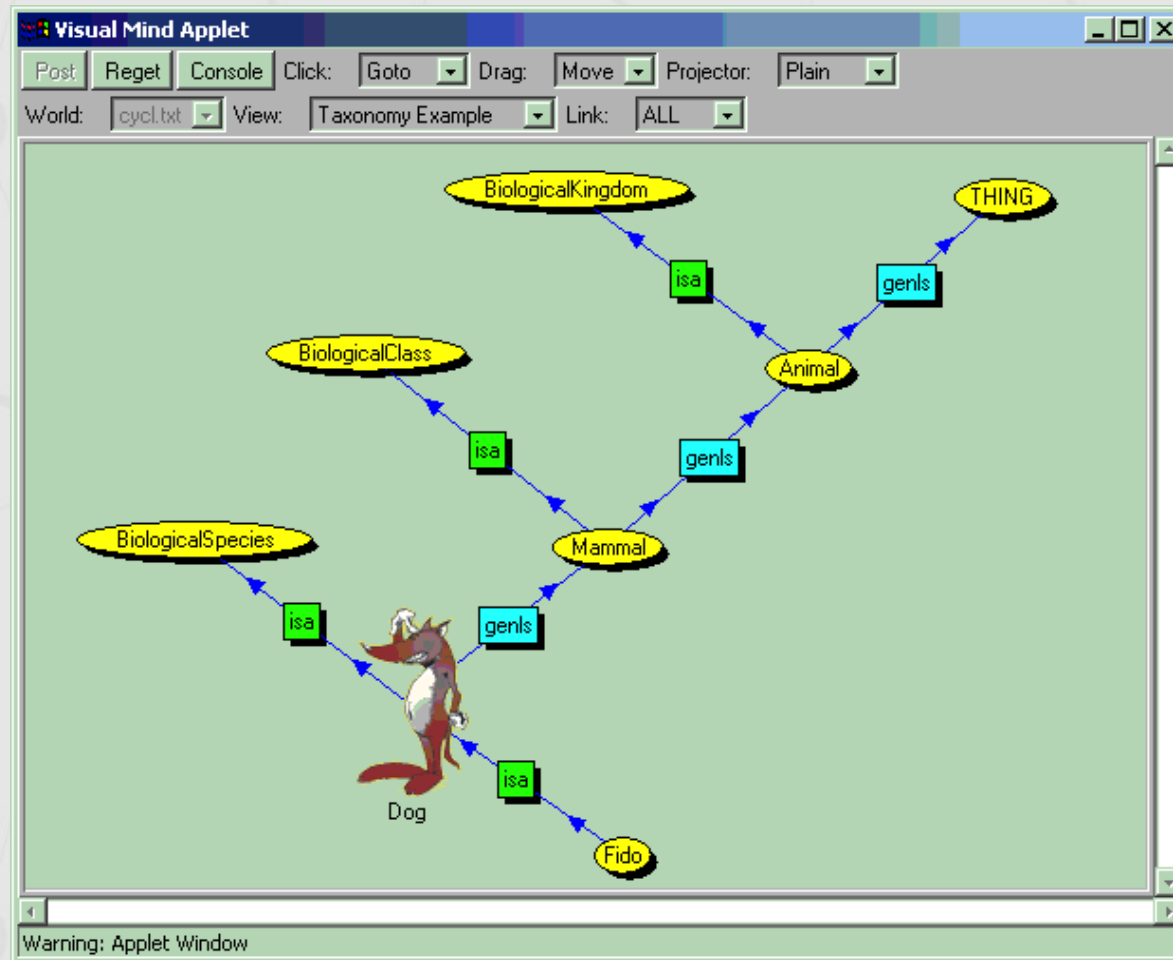


«If tuna is a fish, that implies it is not an insect or a bird.»

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Representing Cyc «micro-theory»

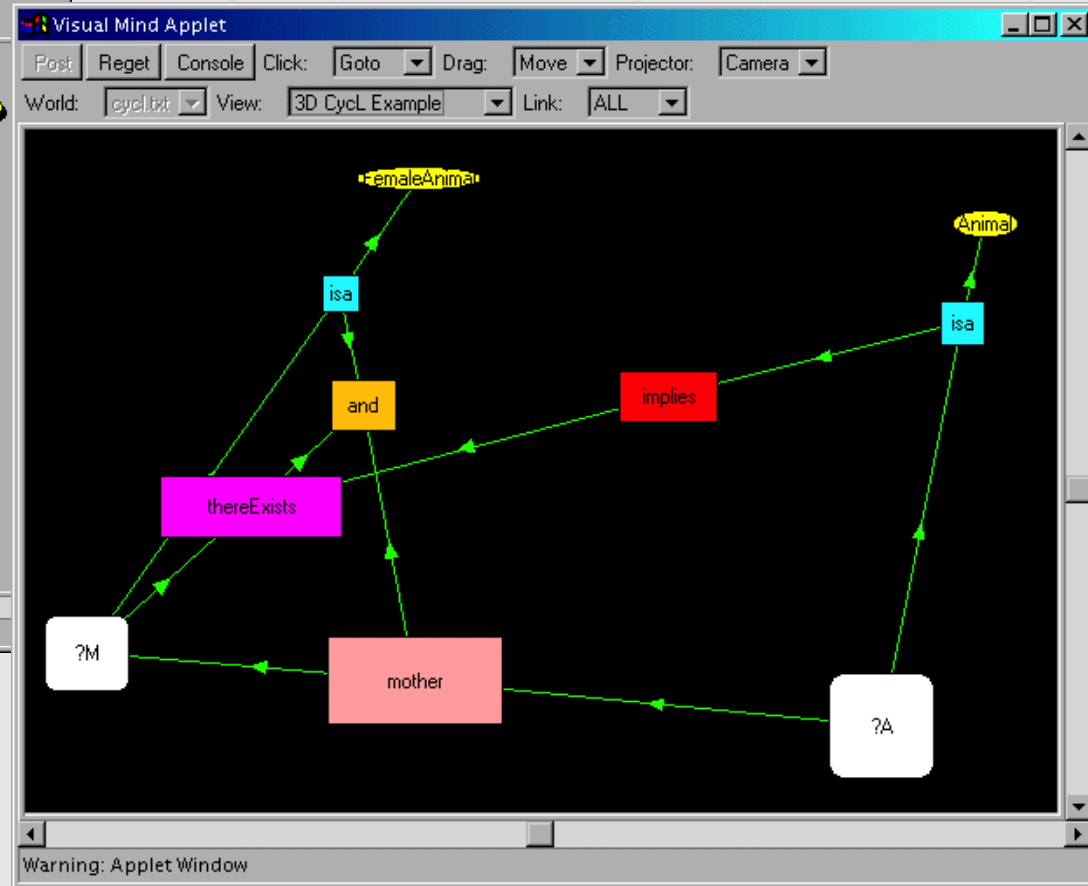
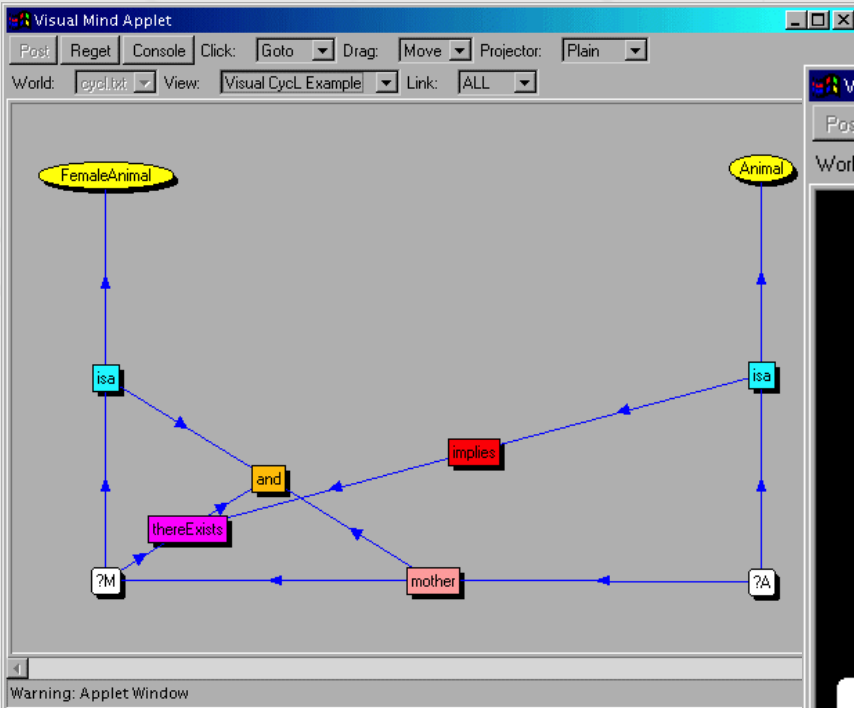


Fragment of «biological kingdom» of Cyc «upper ontology»

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Visual editor of CycL assertions

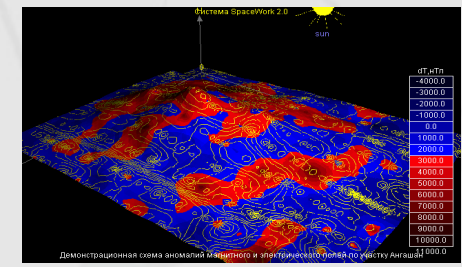
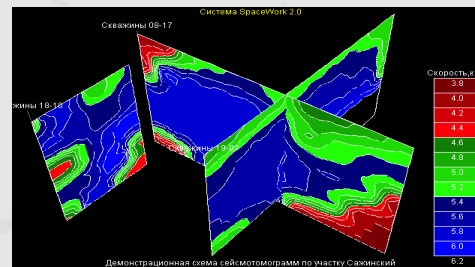
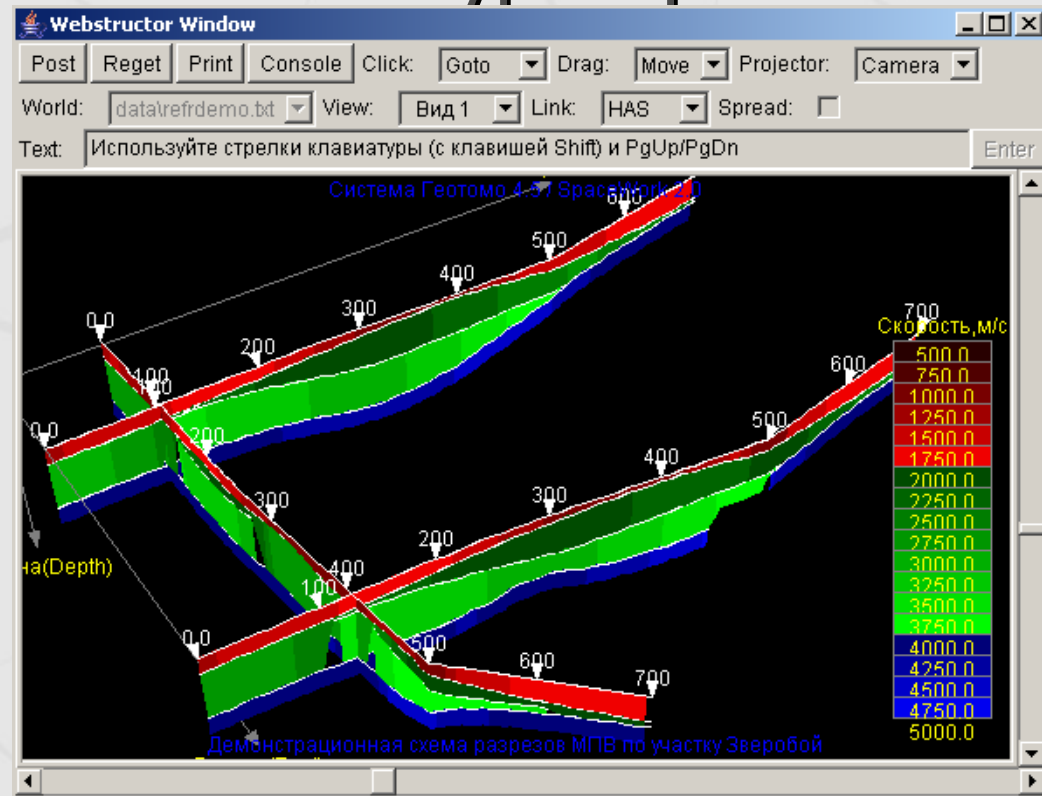
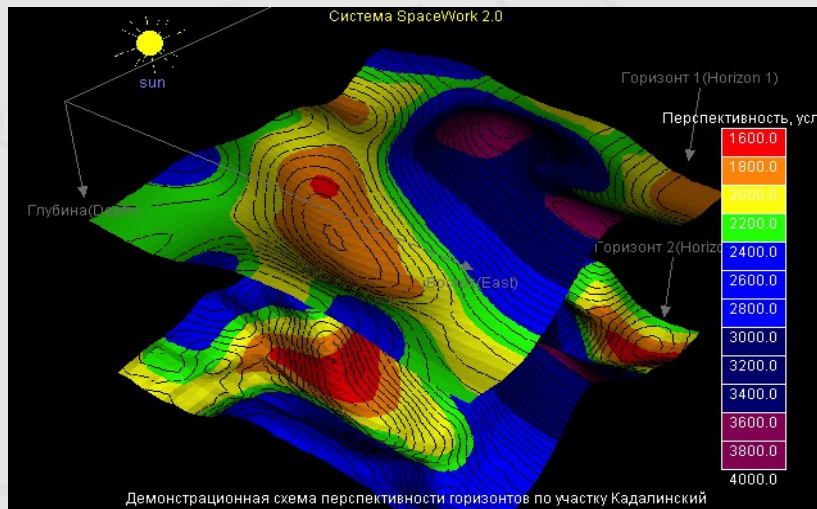
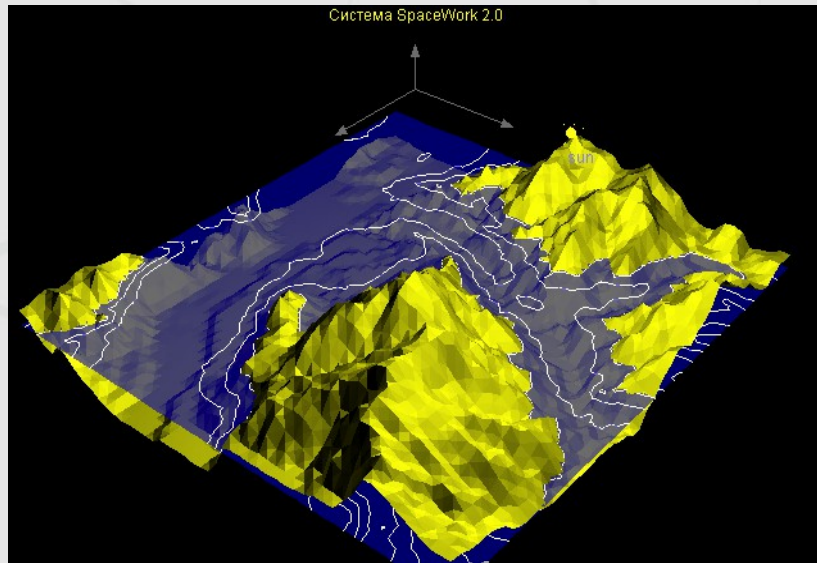


(implies (isa ?A Animal) (thereExists ?M (and (mother ?A ?M) (isa ?M FemaleAnimal))))

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Visualization of multi-dimensional hyper-spaces



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Object Relational Language (ORL)

- Syntax assumes few fundamental objects such as **thing**, **property**, **name**, numeric or literal **constant**, **array**, **set** (where a set can be either **mandatory** or **optional**) and **query**.
- Within particular implementation of the language, there can be specific scope of terms describing an application object model as **keywords**.
- Description of any schema (classes, attributes, etc.) is done in the same linguistic space as description of data objects and values – ontological transparency.
- Description of functional schemata (functions, methods and operators) is also possible in the same linguistic space however compact (scripting) notation is also possible.
- Centric feature of language is query (somewhat resembling structured query applicable to relational model), which is used as reference (instead of pointers or identifiers) describing structured data as well as functional schemata.
- Enables flexible expression of any sorts of hyper-graphs.

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Object Relational Language (ORL)

English	ORL
Here are the items A, B and C where A has properties X and Y while B and C are in relationship Z.	ITEM A,B,C;; A HAS (X), (Y);; B Z(C);;
In order to reach goal 1 one needs condition 2 and 3 to be held true while 2 can be true only if condition 4 happens.	CONDITION C2,C3,C4;; GOAL G1 REQUIRES (C2),(C3);; CONDITION(C2) REQUIRES (C4);;
Each morning need to perform this and that in order, having such and such done at once next.	PROCESS TIME "8:00"; REPEAT (DAILY); ORDER DO THIS, DO THAT;; FORK DO SUCH, DO SUCH;;;
What is that my stuff you mentioned yesterday or the day before?	STUFF(OWNER (ME), UPDATE (AUTHOR (YOU), {TIME "2013-03-22", TIME "2013-03-21"}).TELL;
What were the relationships between P and Q last year?	PROPERTY(OWNER (P), THING (Q), TIME "2012").TELL;
Let me know once they roll out next version of the product.	DO EMAIL TO "me@at.org";; WHEN PRODUCT(VENDOR (THEY)).VERSION CHANGE;;

Distributed knowledge engineering Webstructor system

История проекта

- 1995-1996 CTC Company
 - Semantic graph employed to fully describe the operational space of a software system to carry out data management, inter-personal interactions, interactive form processing, report generation and action script development.
- 1997-1999 ProPro Group
 - Object relational language (ORL) for inter-agent communication developed to enable development of corporate business automation system for stock exchange domain.
- 2001 Webstructor Project
 - Agent software for peer-to-peer knowledge creation and interchange developed as part of Webstructor project, based on ORL.
- 2006 IT Solutions, Ltd.
 - **Virtual 3D environment** Space Work for the purpose of visualization and sharing of complex scientific data created on basis of Webstructor environment.
- Future plans
 - Implement social evidence-based data model with multi-lingual support, full ORL specification and open-source reference implementation.

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