Industrial Ontologies Group (IOG)

Research Area: Intelligent Web Applications

Research topics of the group within the area:

Science:	*Technologies:*	*Application Areas:*
• Global Understanding Environment; • Knowledge Computing; • Semantic Web Services for Smart Devices; • Semantic Agent Programming Language; • Behavioral Coordination of Heterogeneous Systems; • Self-Maintained Resources in Semantic Web; • Intelligent Interface for Integrated Information; • Semantically-enriched Human Interfaces; • Semantics-Based Access Control; • General Adaptation Framework for Semantic Web; • Context-Sensitive Metadata Description; • Service Matching in Agent Systems;	• Semantic Web and Semantic Technology; • Agents and Multiagent Systems; • Distributed Systems; • Artificial Intelligence; • Integration, Interoperability, Middleware; • Service-Oriented Architecture, Cloud Computing; • Big Data; • Knowledge Management; • Software Engineering; • Ubiquitous Computing, Internet of Things; • Embedded Systems; • Executable Knowledge;	• Industrial Automation, Power and Process Industry; • Electronic Commerce, Flexible Services; • Future Internet, Devices and Interoperability; • Product-Centric Applications; • Collaborative Traffic, Education, Finance, Healthcare, Wellness; • Social Networks of Things; • eEducation; • … etc.

Members of the group (as December 2012):

- ***Professors:*** Vagan Terziyan (Head), Timo Tiihonen (Contact person);
- ***Postdocs:*** Olena Kaykova, Oleksiy Khriyenko*;*
- ***Ph.D. students:*** Michal Nagy, Michael Cochez*;*

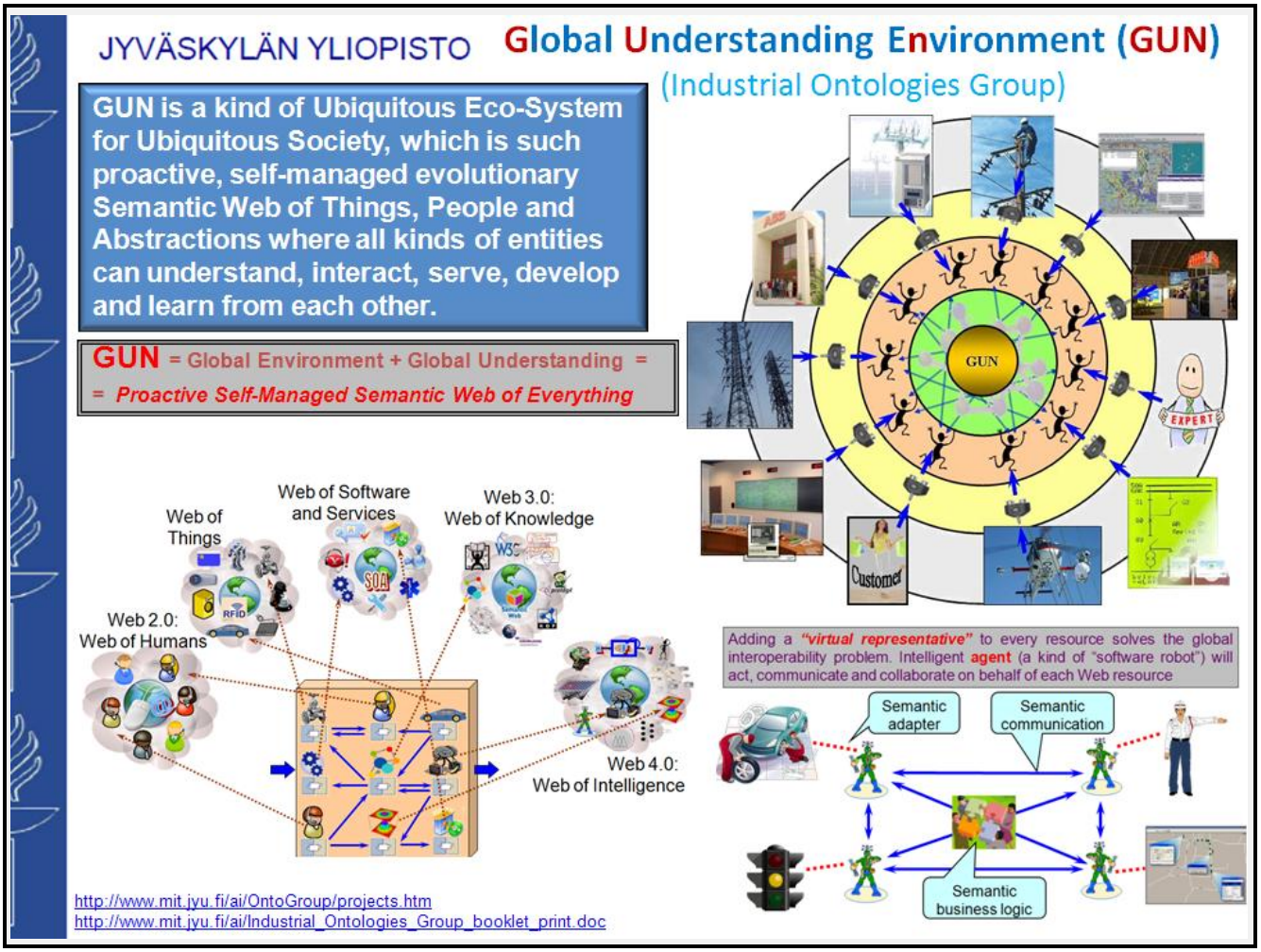
Main goals of research

Global Understanding Environment (GUN) **-** Ubiquitous Eco-System for Ubiquitous Society, which is such proactive, self-managed evolutionary Semantic Web of Things, People and Abstractions where all kinds of entities can understand, interact, serve, develop and learn from each other.

Design of distributed and self-managed Web-based and mobile applications, platforms, ecosystems and services which are:

- Able to automatically discover, compose and integrate heterogeneous components;
- Able to manage heterogeneous data/knowledge/intelligence sources;
- Able to create, deploy and exploit linked data;
- Able to browse and filter information based on semantic similarity and closeness;
- Able to create, exploit and visualize context-sensitive mashups and meshups;
- Able to perform automated and user-driven application/service orchestration and choreography;
- ...

… and utilizing for that emerging Knowledge-, Agent-, SOA-, Cloud Computing-, Machine-Learning-, Mobile-, Context-Aware- and Semantic Web-based technologies and tools.



Ψ (PSSI) -Projection of the IOG Research Roadmap

- ***P**roactivity* (Autonomic and Proactive Computing, Agent Technologies, DAI, MAS, …)
- ***S**emantics* (Semantic Web, Linked Data, Big Data, Semantic Technologies, …)
- ***S**ervices* (SaaS, SOA, SWS, Cloud Computing, …)
- ***I**ntelligence* (Machine Learning, Data and Web Mining, Computational and Business Intelligence, …)

Main results obtained until now

Science:	***Technology:***
• TRUST project supported by Tempus (EU) (2011-2013); • UBIWARE Tekes project (2007-2010); • iSCOPE (2011); • Tivit: Cloud Software program (2010-2012); • SWIMMER (2006-2007) • SmartResource Tekes project (2004-2006); • SCOMA Semantic Web portal (2005); • Idea Mentoring I and II, Nokia project (2004); • InBCT Tekes project: Semantic Facilitators for Web Information Retrieval (2004); • Etc.	• Executable Knowledge and Knowledge Computing; • Mastering Intelligent Clouds; • Middleware Platform for the Semantic Web; • Semantic Middleware for the Internet of Things; • Semantically-enhanced Resource Browser; • Social Networks Mashuper; • Event-based Notification System; • Semantic Middleware for Cooperative Traffic Systems and Services; • Agent Scenario for Forest Industry; • Agent-Based Approach for Electricity Distribution; • Semantic and Agent Technologies for Industrial Automation; • Data Integration Solution for Paper Industry; • Ontology-Based Portal for Educational Resources;

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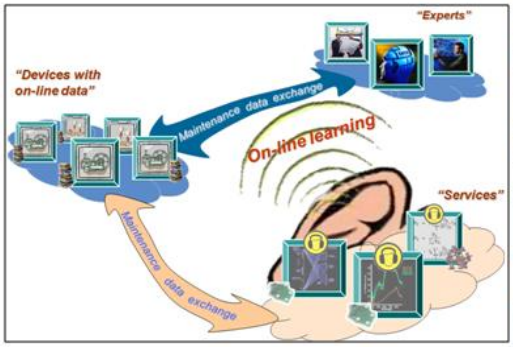
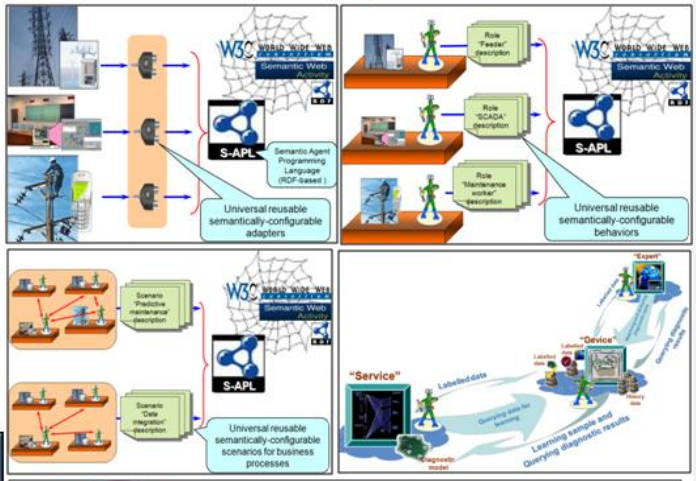
SmartResource

Tekes Project (2004-2006)

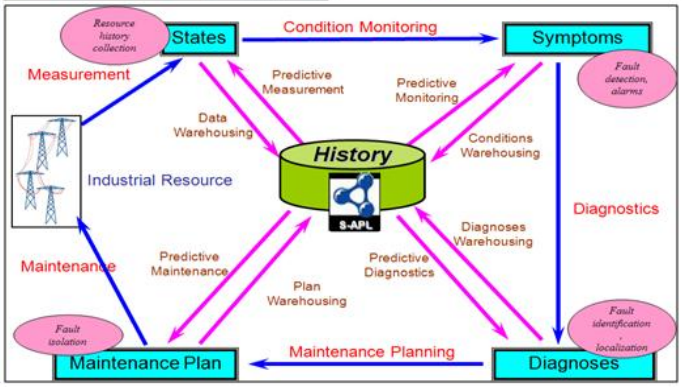
SmartResource project - our first step towards GUN





- SmartResource: "Proactive Self-Maintained Resources in Semantic Web" Tekes project (2004-2006) done by IOG.
- Project site:

  http://www.mit.jyu.fi/ai/OntoGroup/SmartResource.htm
- One of the most essential results of the SmartResource project was creation of the "Smart Resource Technology" for designing complex software systems. The technology allows considering each traditional system component as a "smart resource", i.e. proactive, agent-driven, self-managing. Such approach has shown certain advantages comparably to other software technologies, e.g. OOSE, SOA, Component-Based SE, Agent-Driven SE, Semantic SE, etc.



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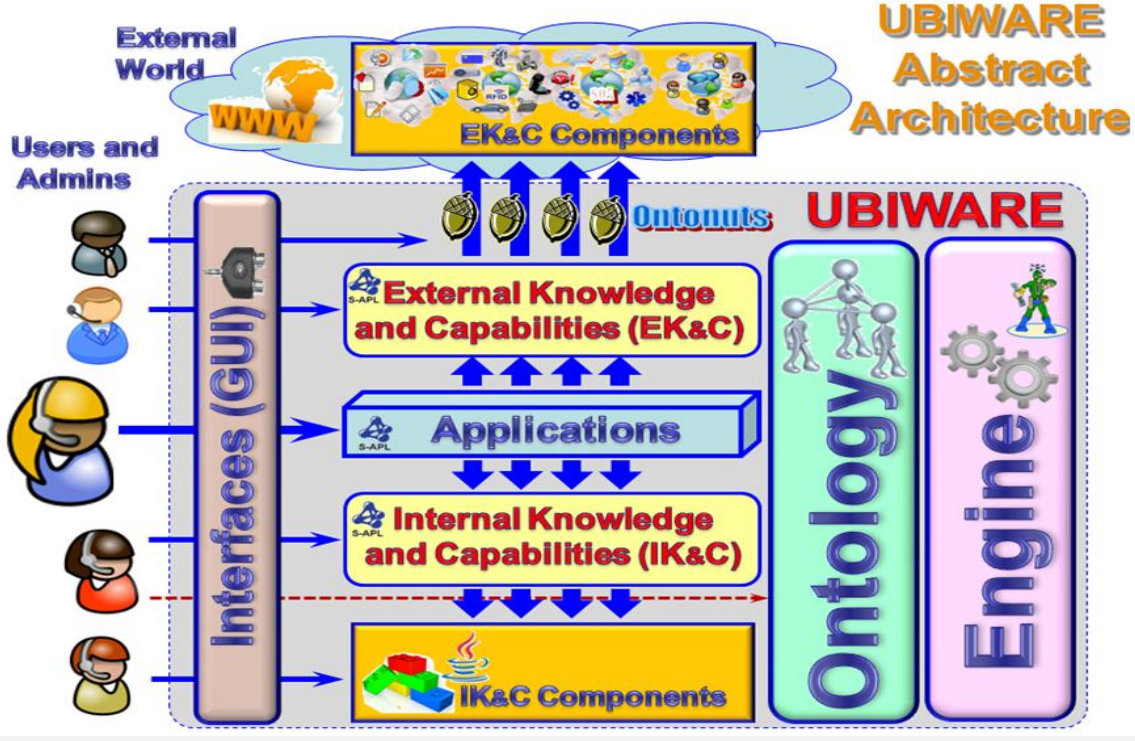
UBIWARE (Industrial Ontologies Group)



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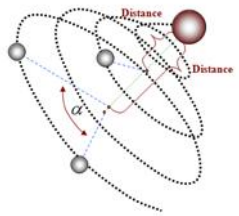
UBIWARE (4i ("for-eye") Browser)

4i Philosophy – "Visualization-as-a-Service"

4i-Browser is able to select resources from a semantic repository, which are semantically close to a given resource in certain customized context, and visualize (also with the help of external services) both: the resources and the closeness



To avoid an overlap (in case of a viewpoint from the top of the cone) of the images that belong to resources located next to each other, we have calculated the location angle (α) on each (step-based) cone cut. Additionally, we provided a possibility to rotate the cone to find the best view point.

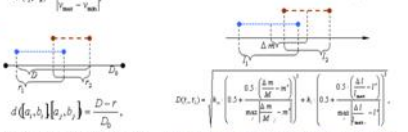
We decided to put the resources on a spiral that lies on a surface of the cone. The minimal distance between the resources has been taken as a step on an axis/height of the cone. Just that parameter (distance on the axis/height) shows the closeness of the resources.

- Numbers

$$d(v_1, v_2) = \left| \frac{v_1 - v_2}{v_{max} - v_{min}} \right|$$

where v_{max} and v_{min} are the maximum and minimum values from the sample.

- Intervals



$$d([a_1, b_1][a_2, b_2]) = \frac{D - r}{D_0}$$

$$r = \frac{s_1 + s_2}{2} - \frac{(b_1 - a_1) + (b_2 - a_2)}{2} \qquad D = \max(b_1, b_2) - \min(a_1, a_2)$$

$$D_0 = \max(b_y) - \min(a_y)$$

$$D(r_1, r_2) = \sqrt{\left(k_m \left(0.5 + \frac{0.5\left(\frac{\Delta m}{M} - m'\right)}{\max\left(\frac{\Delta m}{M} - m'\right)} \right)^2 + k_l \left(0.5 + \frac{0.5\left(\frac{\Delta l}{l_{max}} - l'\right)}{\max\left(\frac{\Delta l}{l_{max}} - l'\right)} \right)^2 \right)}$$

where m' and l' are medians of corresponding samples, the coefficients k_m and k_l regulate significance of the distance between the intervals and difference between the lengths of the intervals.

- Strings

Text field type 2

$$D(X, Y) = \frac{N'}{N}$$

where N' is a number of matched/equal instances and N is a general number of all instances in the lists of two comparable objects.

Text field type 3

$$d_j^H(v_1, v_2) = \frac{1}{M}\sum_{i=1}^{M}\left(\frac{C_{1i}}{C_1} - \frac{C_{2i}}{C_2}\right)^2, \quad d_j(v_1, v_2) = \frac{\sum_{i=1}^{n} d_j^i(v_1, v_2)}{n-1}$$

$$D(V_1, V_2) = \sqrt{\frac{\sum_{v_1, v_2 \in [v_1, v_2]} \omega_j \cdot d_j(v_1^j, v_2^j)^2}{\sum_{v_1, v_2 \in [v_1, v_2]} \omega_j}},$$

General distance between to objects:

$$D(X, Y) = \sqrt{\sum_{x_i, y_i \in X, Y} a_i \left(0.5 + \frac{0.5\left(d(x_i, y_i) - d_i^{'}\right)}{\max_j d(x_i, y_j) - d_i^{'}} \right)^2}$$

Closeness of two resources (objects) equals: $closeness = 1 - D$

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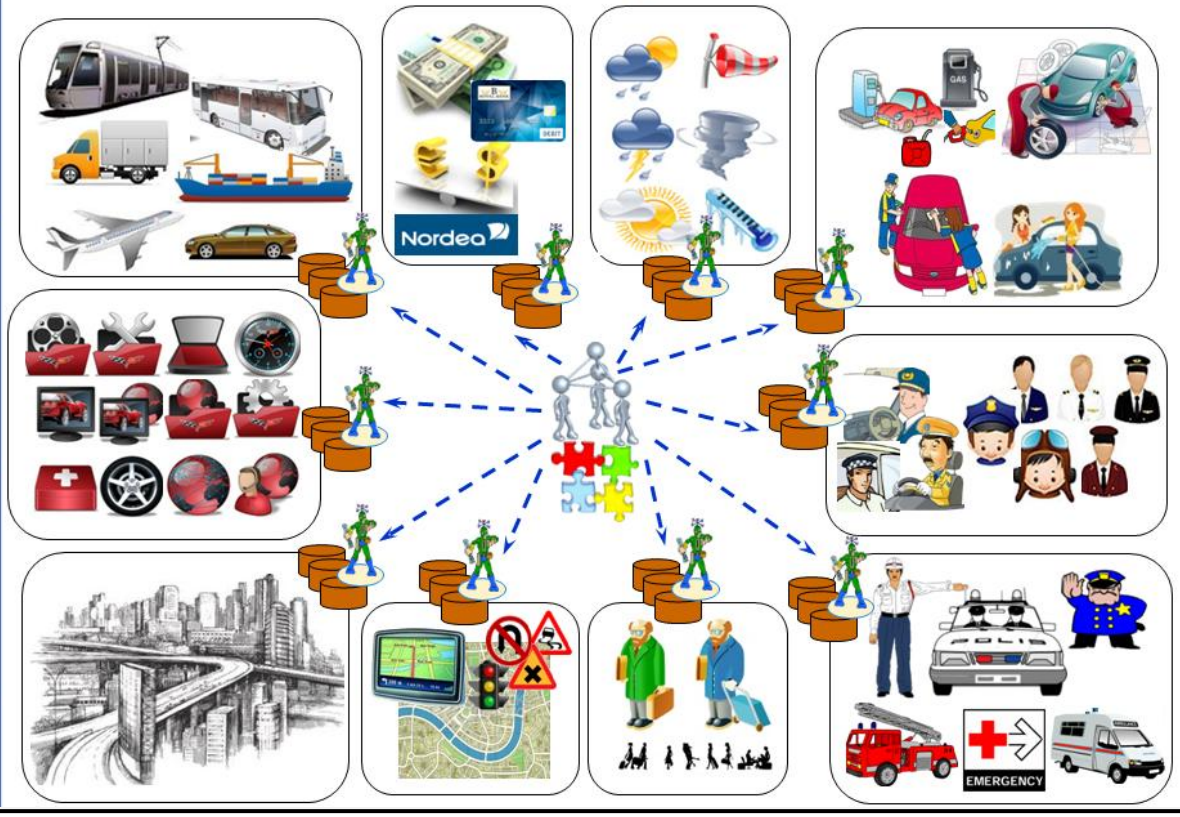
UBIWARE-Driven Distributed Data Sources Management (OntoNuts-supported)



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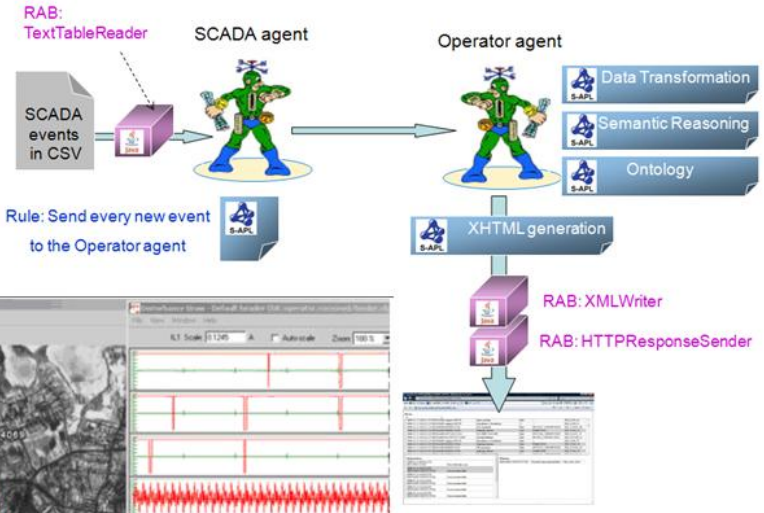
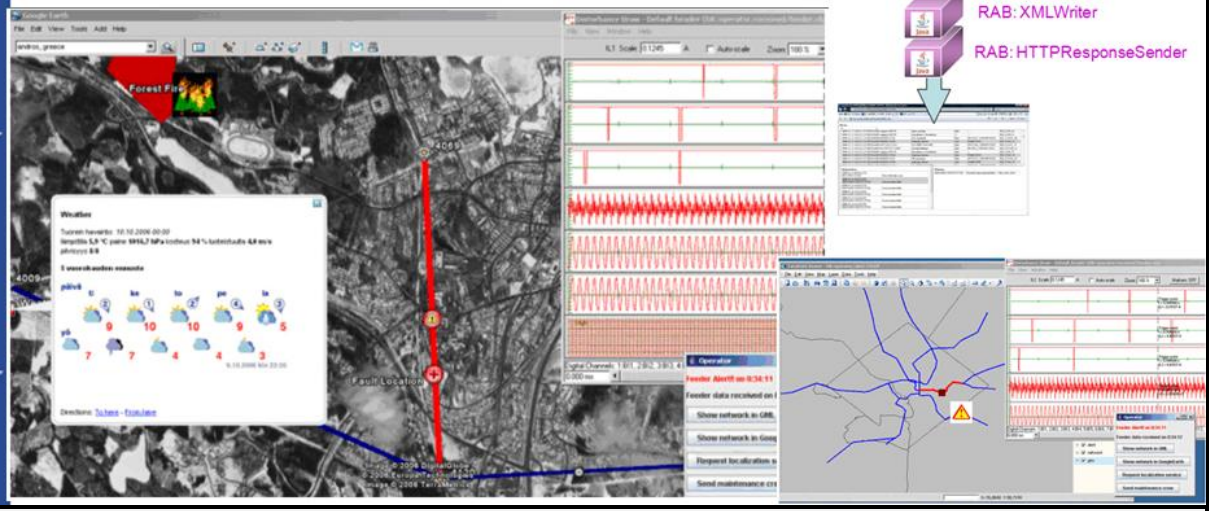
Semantic Monitoring of Power Networks on UBIWARE Platform

(Industrial Ontologies Group)

Software application on top of UBIWARE platform done as a case study to demonstrate added value of Semantic and Agent technologies for power network maintenance. Application connects different sources of information and service providers with some decision logic and visualizes results as a semantic mashup.





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"Mashupper" for Social Networks

(Industrial Ontologies Group)

Smart Social Phonebook

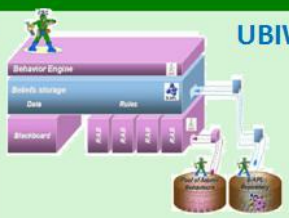
Industrial Ontologies Group[1]
University of Jyväskylä

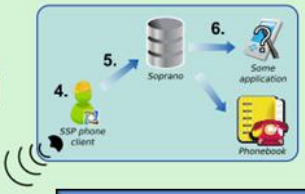
Introduction

The use of mobile internet, localization and social applications has rapidly increased in the last few years. Despite the increasing capabilities of modern communication devices, the use of cloud infrastructure brings several benefits to mobile applications.

We base our work on a multi-agent platform called Ubiware, which utilizes semantic technology to integrate data from different heterogeneous sources. We use Ubiware to build a cloud application called Smart Social Phonebook (SSP). SSP integrates user's friends' data (name, email address, phone number, etc.) from different social networks (Facebook, LinkedIn, Twitter, etc.). SSP periodically communicates with the phone and sends social network data updates, which are stored in Soprano storage on the phone.

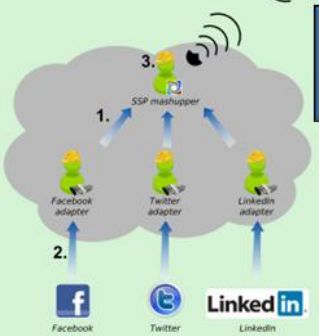
UBIWARE-Driven





1. An adapter agent is reading each friend's data from the external data source and sends it back to SSP mashupper.
2. SSP mashupper agent is periodically requesting data from all adapter agents.
3. SSP mashupper compiles the data and updates the friends' network.
4. Whenever the mashupper client has network access, it queries the SSP mashupper from the cloud and asks for friends' information updates.
5. All friends' data are pushed into Soprano trough SSP phone client.
6. Any local phone application can utilize the friends' data.

Monitors and integrates your profile and activities in various social networks



Benefits

1. Saving computational resources
The computation is happening in the cloud, not on the device.

2. Minimizing data transfer
Only differential updates are sent. No need to manage huge social network data on the device.

3. Scalability
Easy integration of other data sources.

4. Universality
The data is available to any application on the device.

Concerns

1. Privacy
The user needs to provide access information about his/her social network account(s).

Conclusion

SSP application supports the strategic agenda declared by the Cloud SW program by introducing a mobile client-oriented cloud application. SSP utilizes cloud infrastructure to perform computationally expensive and connection-intensive tasks. We apply innovative agent-driven middleware platform to handle proactive data collection and information integration tasks in the cloud. Next we populate the information obtained to the semantic storage on the mobile phone. The data can be accessed by a variety of mobile applications.

[1] Prof. Vagan Terziyan, Sergiy Nikitin, Michael Cochez (contact person), Michal Nagy, Joonas Kesäniemi

http://www.mit.jyu.fi/ai/OntoGroup

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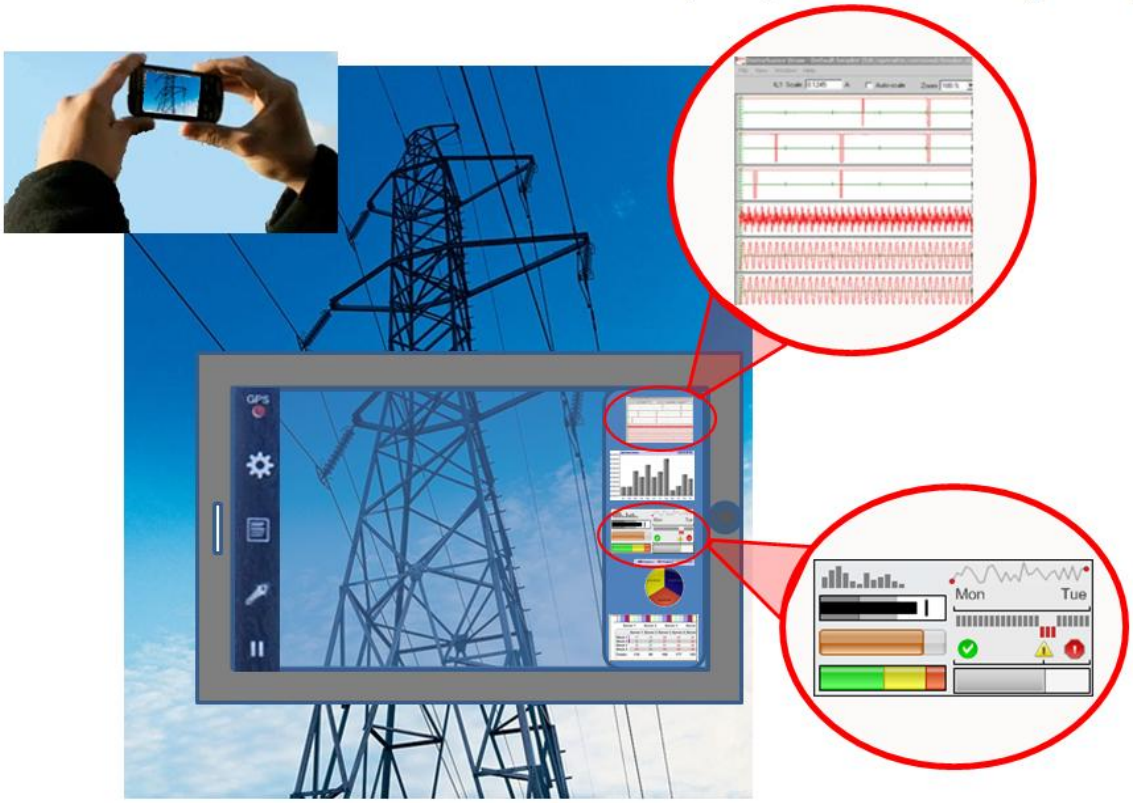
"Executable" Mixed Reality:

Business Intelligence on Top of Linked Data

(concept of Industrial Ontologies Group)



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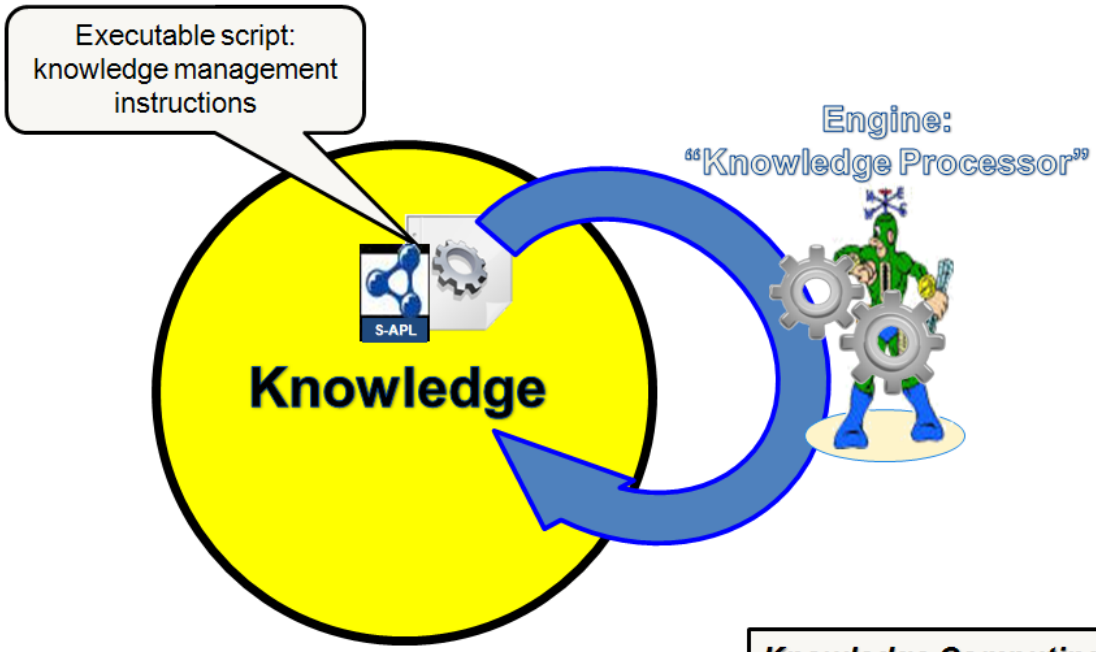
"Executable Knowledge"

[Concept of Industrial Ontologies Group]



Executable Knowledge is such a knowledge, which contains explicit (executable) instructions on how to manage itself (i.e. self-management enabled)

Knowledge Computing – Executable Knowledge Management

[Industrial Ontologies Group]

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UBIWARE-Driven Heterogeneous Systems Integration (OntoNuts-supported)

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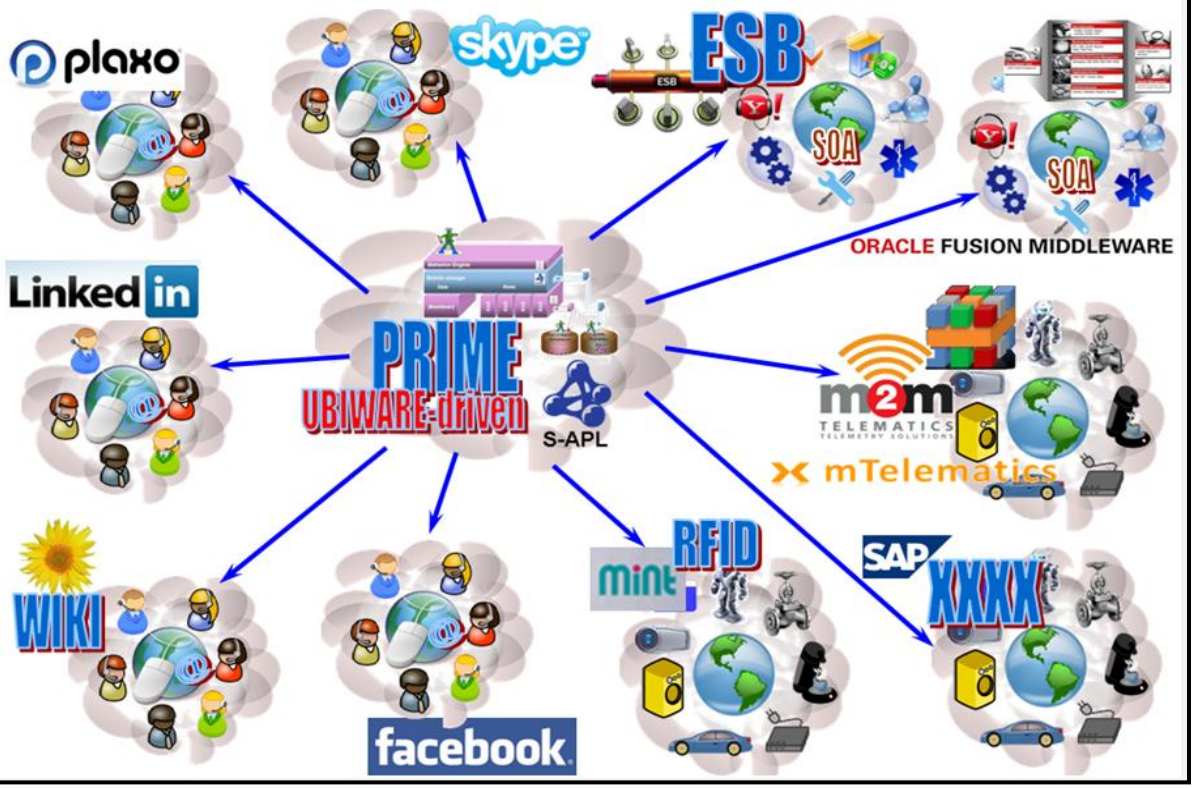
PRIME: PRoactive Inter-MiddlewarE as 2-nd order middleware (Future Vision)



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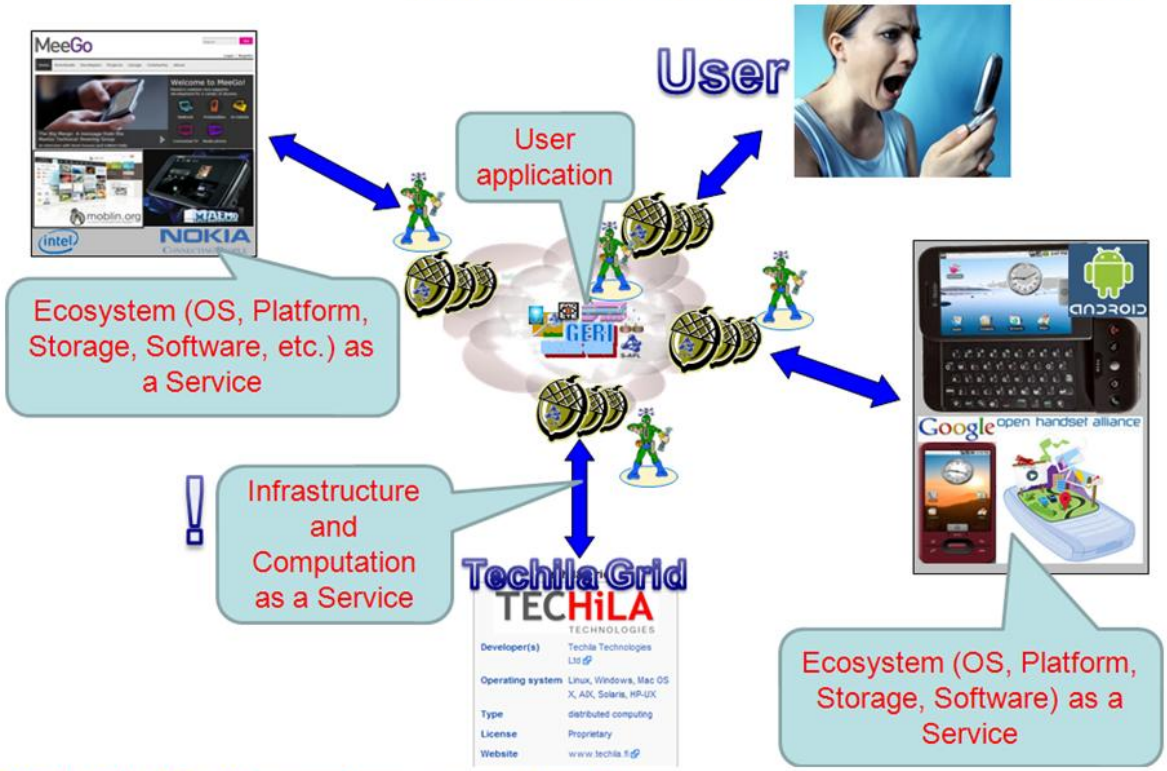
GERI: Global Enterprise Resource Integration to enable "Ecosystem-as-a-Service" (Future Vision)



GERI: Mobile Ecosystem-as-a-Service

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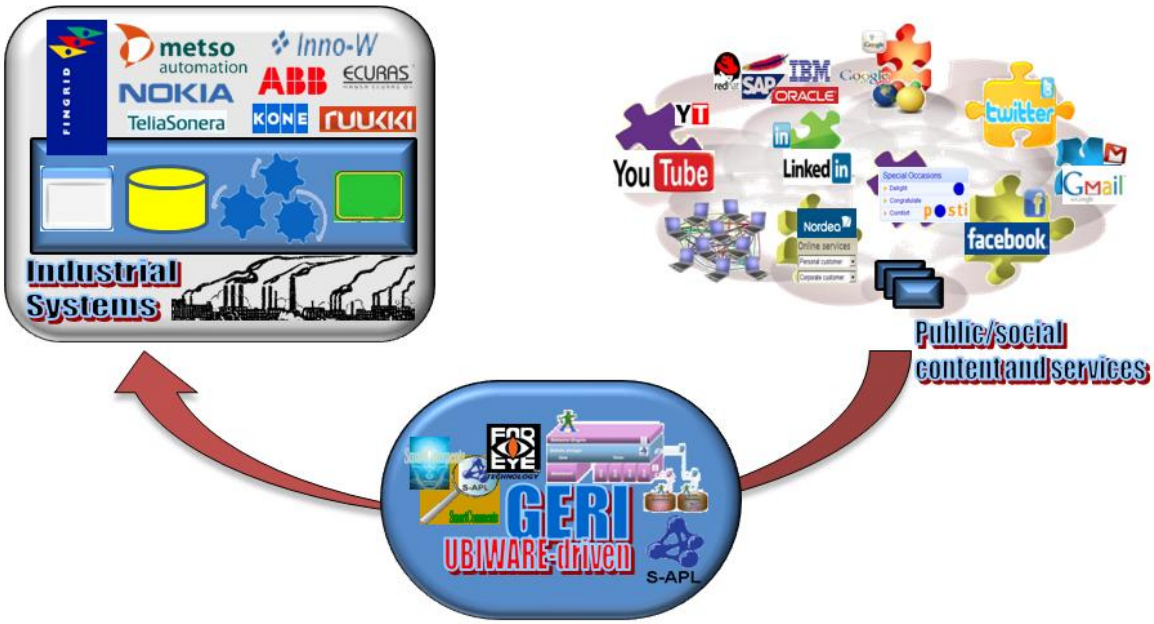
GERI: Global Enterprise Resource Integration to enhance industrial systems with public/social context and services (Future Vision)



GERI: Social Enhancement of Industrial Systems

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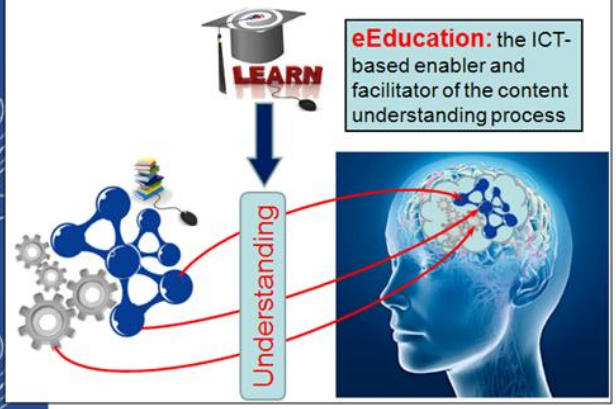
Our activities in Tivit (Services)

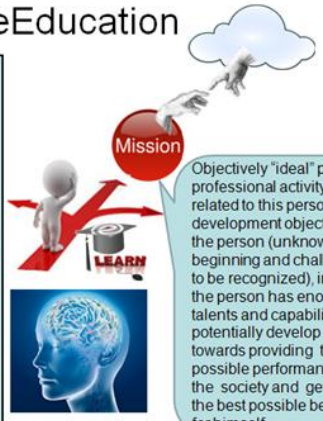
What is eEducation



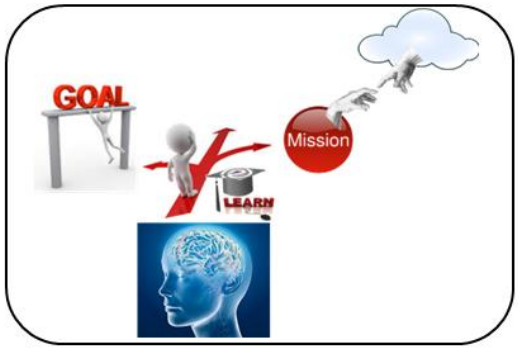
eEducation: the ICT-based enabler and facilitator of the content understanding process

What is eEducation

eEducation: the ICT-based life-long personal development navigator towards personal mission (supports mission recognition, personal development planning and provides appropriate for the mission knowledge and skills understanding support).



Objectively "ideal" potential professional activity (and related to this personal development objective) for the person (unknown in the beginning and challenging to be recognized), in which the person has enough talents and capabilities to potentially develop himself towards providing the best possible performance for the society and getting the best possible benefits for himself



One of current activities of the Industrial Ontologies Group: *Towards Life-Long Personal Development Pocket Advisor*

JYVÄSKYLÄN YLIOPISTO

Our recent activities in Tivit (Cloud Software)

Multi-channel communication framework

Steeri[1] *(industrial partner)*

Industrial Ontologies Group[2] *(research partner)*

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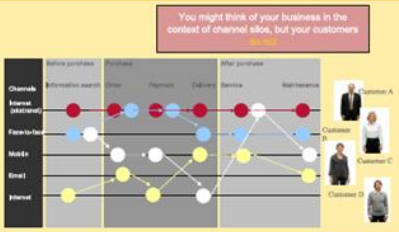
Business case

Business challenge
Multichannel communication is increasingly challenging as the amount of channels evolves and the actions need to be coordinated towards customers.



Cloud communication service
- Easy mean for different systems to implement communication through different channels
- A way to gather, measure and understand communication regardless of channel. Manage communication threads.
- Enabling a multichannel hub to orchestrate the communication

Components

Abstract message
- known user ID, but not address yet
- known several channel-dependent texts
- channel defined using a utility function

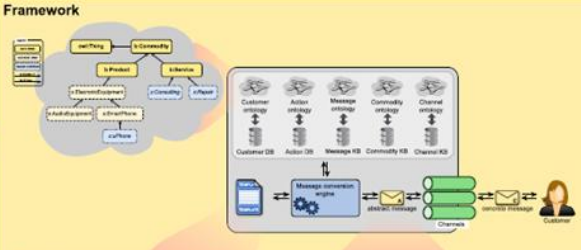
Concrete message
- known concrete address
- known concrete text with attachments
- known concrete channel

Data
- modelled using ontologies (written in OWL)
- stored in RDF
- queried in SPARQL

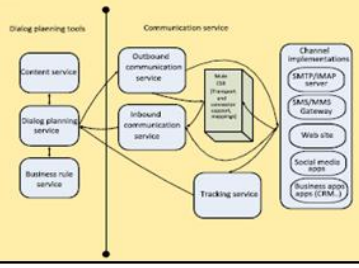
Message template
- Prescription for abstract message generation
- Recipient(s) defined a by set of user preferences
- Content defined using variables
- Abstract channel defined through utility functions

Communication channel
A way to send onland recieve a message (email, SMS, Facebook message, Tweet, etc.)

Framework



Architecture



API

Security
- Token
- User & Password

Message elemetns
- Subject
- Content
- ContentType
- Message Items
- Personalization

Interaction elements
- Thread
- Purpose
- Direction
- Channel

Participants element
- Sender
- Receiver

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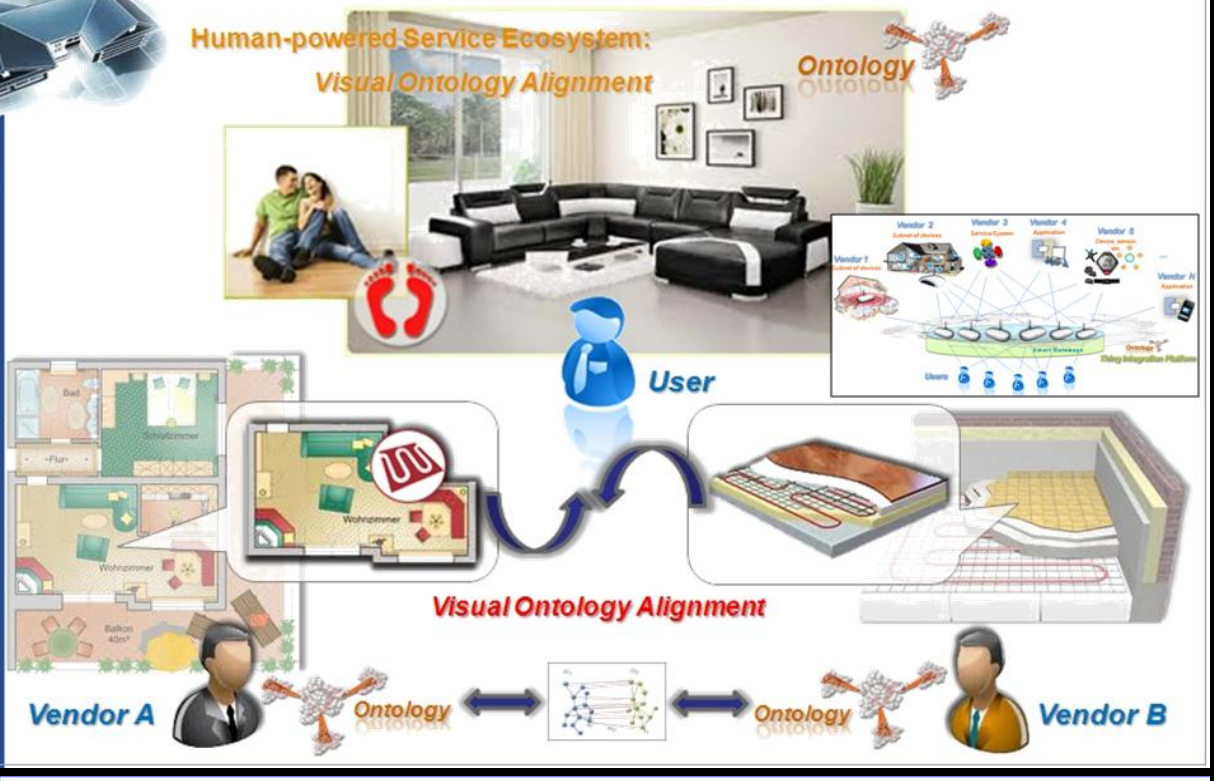
Our recent activities in Tivit (Internet of Things)



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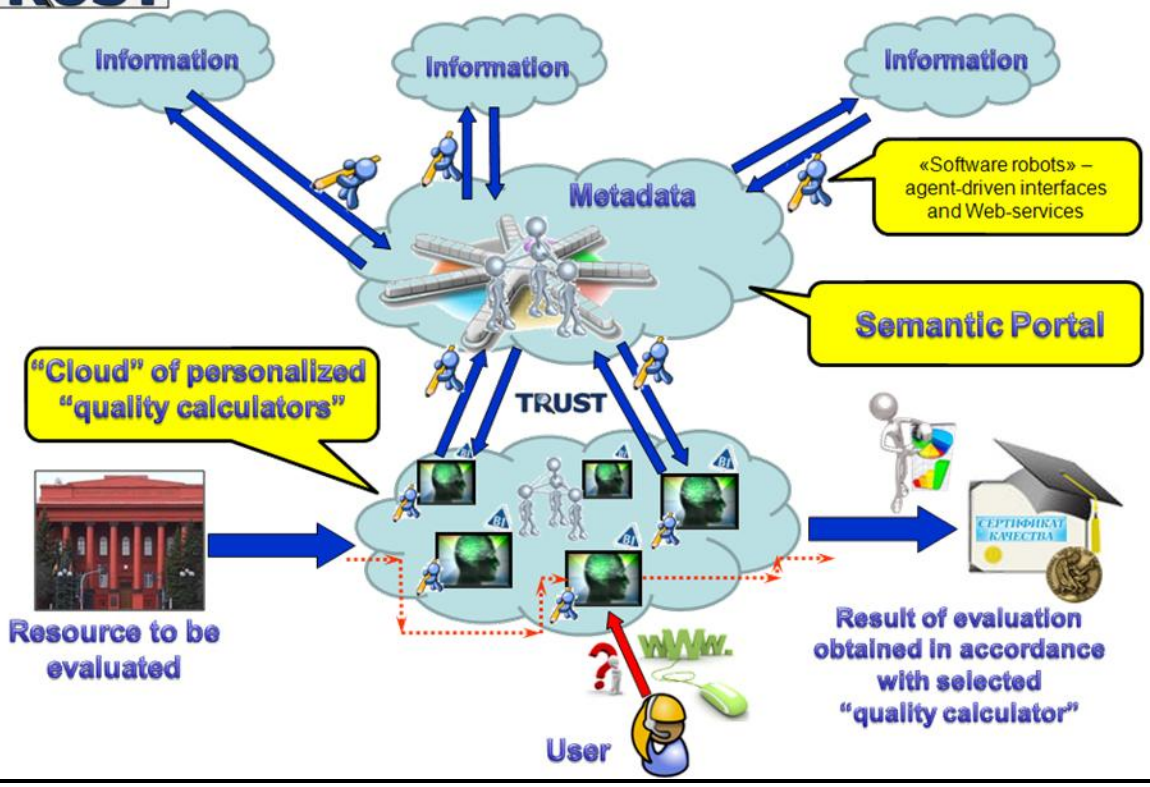
Our recent activities in TEMPUS: TRUST: Towards Trust in Quality Assurance Systems (Architecture of Semantic Portal)



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IOG-Driven: New International and Interdisciplinary Master Program: WISE

WISE: "Web Intelligence and Service Engineering"

International Master Program

Department of Mathematical Information Technology,
University of Jyväskylä, Finland

http://www.cs.jyu.fi/ai/WISE.pdf

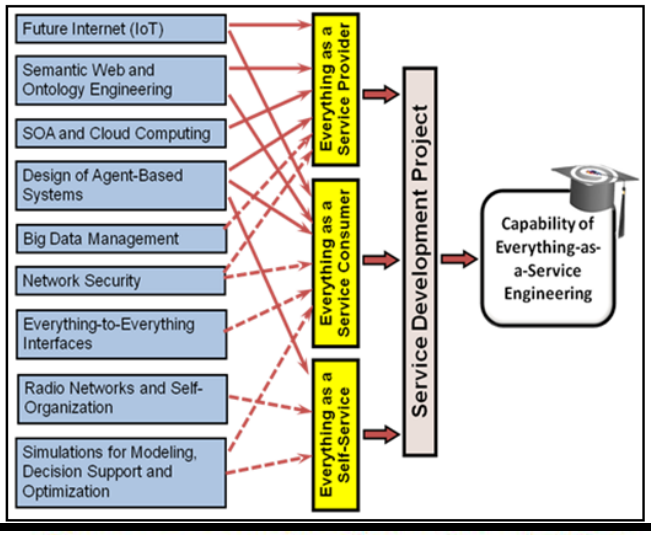
APPLY NOW!

Deadline for applications: 15 February 2013 for studies starting in September 2013.

Key Objective: Everything-as-a-Service Engineering: Designing intelligent software applications for the *web-based service economy* .

Official Web Site of the WISE Program: https://www.jyu.fi/en/studywithus/programmes/wise

Program Mission : on completion of the programme, the graduates will be able to use and design complex self-managed Web-based public and industrial systems, *digital ecosystems*, platforms, services and applications; will be able to connect their designs with publicly available data and Web-based capabilities as services; will be able to figure-out and approach various challenging aspects of wicked problems world-wide, which require self-managed service-based architectures for their solutions; understand and professionally utilize for that purpose knowledge on enabling technologies and tools; perform academic doctoral level studies; will be skilful in international communication due to the integrated language and communication studies. Students, who will graduate from the programme with a Master of Science in Natural Sciences from the Department of Mathematical Information Technology, will think beyond the routine and will be able not just to adapt to a change but to help to create and control it.



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Our recent plan for FP7

Objective ICT-2013.5.1 Personalised health, active ageing, and independent living
Target outcome: (c) Personalised Services for Independent Living and Active Ageing
Funding scheme: STREP, approximate EC contribution budget ~3 M €

Title: ICT integrated care empowering seniors for active and healthy ageing
Acronym: AHAPower

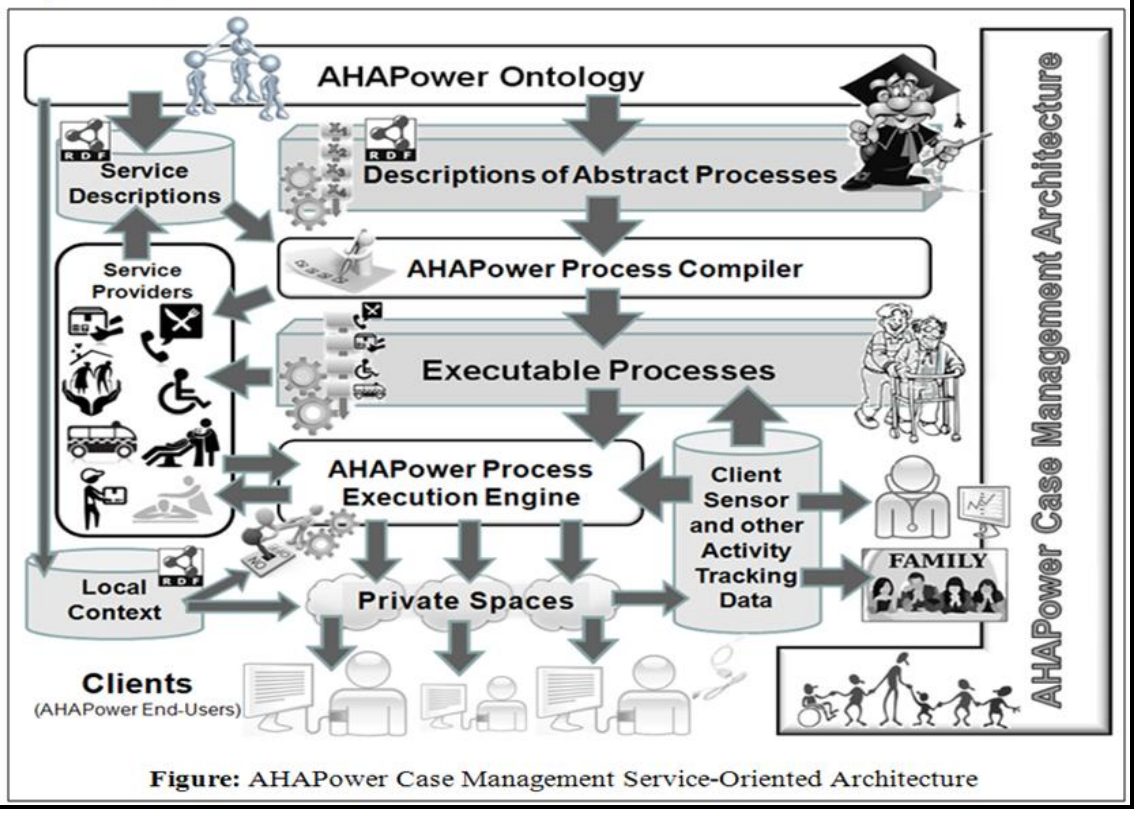

Figure: AHAPower Case Management Service-Oriented Architecture

Samples of best publications:

Edited books and book chapters

1. Kesaniemi J., Terziyan V., Agent-Environment Interaction in MAS - Introduction and Survey, In: F. Alkhateeb, E. A. Maghayreh and I. A. Doush (Eds.), *Multi-Agent Systems - Modeling, Interactions, Simulations and Case Studies*, IN-TECH Publishing, Vienna, Austria, April 2011, pp. 203-226. (Chapter IX).
2. Katasonov A., Terziyan V., Using Semantic Technology to Enable Behavioural Coordination of Heterogeneous Systems, In: Gang Wu (ed.), *Semantic Web*, IN-TECH Publishing, Vienna, Austria, Jan. 2010, pp. 135-156. (Ch. VIII).
3. Nagy M., Katasonov A., Khriyenko O., Nikitin S., Szydlowski M., Terziyan V., Challenges of Middleware for the Internet of Things, In: A. D. Rodi (ed.), *Automation and Control - Theory and Practice*, IN-TECH Publishing, Vienna, Austria, December 2009, pp. 247-270. (Chapter XIV).
4. Terziyan V., Katasonov A., Global Understanding Environment: Applying Semantic and Agent Technologies to Industrial Automation, In: M. Lytras and P. Ordonez De Pablos (eds.), Emerging Topics and Technologies in Information Systems, IGI Global, 2009, pp. 55-87 (Chapter III).
5. Kaykova O., Khriyenko O., Kovtun D., Naumenko A., Terziyan V., Zharko A., Challenges of General Adaptation Framework for Industrial Semantic Web, In: A. Sheth and M. Lytras (eds.), *Semantic Web-Based Information Systems: State-of-the-Art Applications*, CyberTech Publishing, 2007, pp. 61-97 (Chapter III).
6. Terziyan V., Challenges of the "Global Understanding Environment" based on Agent Mobility, In: V. Sugumaran (ed.), *Application of Agents and Intelligent Information Technologies*, IGI Publ., 2007, pp. 121-152 (Chapter VII).
7. V. Ermolayev, N. Keberle, O. Kononenko, V. Terziyan, Proactively Composing Web Services as Tasks by Semantic Web Agents, In: L.J. Zang (Ed.), *Modern Technologies in Web Services Research*, IGI, 2007, pp. 217-246 (Ch. XI).
8. Bramer M., Terziyan V. (eds), Industrial Applications of Semantic Web, *Proceedings of the 1st International IFIP/WG12.5 Working Conference on Industrial Applications of Semantic Web*, Springer IFIP, Vol.188, 2005, 340 pp.

Journal papers

9. Terziyan V., Kaykova O., From Linked Data and Business Intelligence to Executable Reality, In: *International Journal on Advances in Intelligent Systems*, Vol. 5, Ns. 1&2, 2012, pp. 194-208.
10. Terziyan V., Katasonov A., Cardoso J., Hauswirth M., Majumdar A., PRIME: Proactive Inter-Middleware for Global Enterprise Resource Integration, In: *Eastern-European Journ. of Enterprise Techn.*, Vol. 3/12 (51), 2011, pp. 3-16.
11. Terziyan V., Kaykova O., Zhovtobryukh D., UbiRoad: Semantic Middleware for Cooperative Traffic Systems and Services, In: *International Journal on Advances in Intelligent Systems*, Vol. 3, Ns. 3 and 4, 2010, pp. 286-302.
12. Terziyan V., SmartResource – Proactive Self-Maintained Resources in Semantic Web: Lessons learned, In: *International Journal of Smart Home*, Special Issue on Future Generation Smart Space, Vol.2, No. 2, April 2008, SERSC Publisher, pp. 33-57.
13. Khriyenko O., Terziyan V., A Framework for Context-Sensitive Metadata Description, In: *International Journal of Metadata, Semantics and Ontologies*, 2006, Vol.1, No.2, pp 154-164.
14. Naumenko A., Nikitin S., Terziyan V., Service Matching in Agent Systems, In: *International Journal of Applied Intelligence*, In: M.S. Kwang (Ed.), Special Issue on Agent-Based Grid Computing, Vol. 25, No. 2, 2006, pp. 223-237.
15. Veijalainen J., Terziyan V., Tirri H., Transaction Management for M-Commerce at a Mobile Terminal, In: *Electronic Commerce Research and Applications*, Special Issue on Mobile Technology and Services, Vol. 5, No. 3, 2006, Elsevier, pp. 229-245.
16. Naumenko A., Nikitin S., Terziyan V., Zharko A., Strategic Industrial Alliances in Paper Industry: XML- vs. Ontology-Based Integration Platforms, In: *The Learning Organization*, Special Issue on: Semantic and Social Aspects of Learning in Organizations, Emerald Publishers, 2005, Vol. 12, No. 5, pp. 492-514.
17. Kaykova O., Khriyenko O., Kovtun D., Naumenko A., Terziyan V., Zharko A., General Adaption Framework: Enabling Interoperability for Industrial Web Resources, In: *International Journal on Semantic Web and Information Systems*, Idea Group, Vol. 1, No. 3, July-September 2005, pp.31-63.
18. Terziyan V., Semantic Web Services for Smart Devices Based on Mobile Agents, In: *International Journal of Intelligent Information Technologies*, Vol. 1, No. 2, April-June 2005, Idea Group, pp. 43-55.
19. Terziyan V., A Bayesian Metanetwork, In: *International Journal on Artificial Intelligence Tools*, Vol. 14, No. 3, 2005, World Scientific, pp. 371-384.
20. Terziyan V., Zharko A., Semantic Web and Peer-to-Peer: Integration and Interoperability in Industry, In: *International Journal of Computers, Systems and Signals*, IAAMSAD, Vol. 4, No. 2, 2003, pp. 33-46.
21. Ermolayev V., Keberle N., Plaksin S., Kononenko O., Terziyan V., Towards a Framework for Agent-Enabled Semantic Web Service Composition, *Intern. J. of Web Service Research*, Idea Group, Vol. 1, No. 3 , 2004, pp. 63-87.

Latest (2009-2012) conference papers

22. Khriyenko O., Terziyan V., Kaykova O., User-Assisted Semantic Interoperability in Internet of Things. Visually-Facilitated Ontology Alignment through Visually-Enriched Ontology and Thing Descriptions, In: *Proceedings of the Sixth International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies*, September 23-28, 2012, Barcelona, Spain, IARIA, pp. 104-110.
23. Cochez M., Terziyan V., Quality of an Ontology as a Dynamic Optimisation Problem, In: V. Ermolayev, et al. (eds.): *Proceedings of the 1st International Workshop on Dynamics and Evolution in Intelligent Systems (DEIS-2012)*, Kherson, Ukraine, June 6-10, 2012, CEUR-WS.org/Vol-848, ISSN 1613-0073, pp. 249-256.
24. Khriyenko O., Collaborative Service Ecosystem: Step Towards the World of Ubiquitous Services, In: Proceedings of the *IADIS Multi Conference on Computer Science and Information Systems 2012 (MCCSIS-2012): IADIS International Conference Collaborative Technologies 2012*, 17-23 July, 2012, Lisbon, Portugal, pp. 185-190.
25. Khriyenko O., Service Based Education Environment: Step towards Technology World Consumption, In: Proceedings of the *IADIS Multi Conference on Computer Science and Information Systems 2012 (MCCSIS-2012): IADIS International Conference e-Learning 2012*, 17-23 July, 2012, Lisbon, Portugal, pp. 475-480.

26. Khriyenko O., Nagy M., Semantic Web-driven Agent-based Ecosystem for Linked Data and Services, In: *Proceedings of the Third International Conferences on Advanced Service Computing (SERVICE COMPUTATION 2011)*, 25-30 September, 2011, Rome, Italy, 8 pp.
27. Khriyenko O., Cochez M., Open Environment for Collaborative Cloud Ecosystem, In: *Proceedings of the Second International Conference on Cloud Computing, GRIDs, and Virtualization (CLOUD COMPUTING 2011)*, 25-30 September, 2011, Rome, Italy, 7 pp.
28. Terziyan V., Kaykova O., Towards Executable Reality: Business Intelligence on Top of Linked Data, In: *Proc. of the First Intern. Conf. on Business Intelligence and Techn. (BUSTECH 2011)*, 25-30 Sept., 2011, Rome, Italy, pp. 26-33.
29. Nikitin S., Terziyan V., Nagy M., Mastering Intelligent Clouds: Engineering Intelligent Data Processing Services in the Cloud, In: J. Gilipe, J. Andrade, and J.-L. Ferrier (Eds.), In: *Proceedings of the 7th International Conference on Informatics in Control, Automation and Robotics (ICINCO-2010)*, Vol. 1, Funchal, Madeira, Portugal, 15-18 June, 2010, pp. 174-181.
30. Khriyenko O., Nikitin S., Terziyan V., Context-Policy-Configuration: Paradigm of Intelligent Autonomous System Creation, In: Joaquim Filipe and Jose Cordeiro (Eds.), In: *Proceedings of the 12th International Conference on Enterprise Information Systems (ICEIS-2010)*, 8-12 June, 2010, Funchal, Madeira - Portugal, pp. 198-205.
31. Nikitin S., Terziyan V., Lappalainen M., SOFIA: Agent Scenario for Forest Industry, In: J. Filipe and J. Cordeiro (Eds.), In: *Proceedings of the 12th International Conference on Enterprise Information Systems (ICEIS-2010)*, Vol. 1, Funchal, Madeira, Portugal, 8-12 June, 2010, pp. 15-22.
32. Terziyan V., Kaykova O., Zhovtobryukh D., UbiRoad: Semantic Middleware for Context-Aware Smart Road Environments, In: G.O. Bellot, H. Sasaki, M. Ehmann and C. Dini (Eds.), *Proceedings of the Fifth International Conference on Internet and Web Applications and Services (ICIW-2010)*, May 9-15, 2010, Barcelona, Spain, IEEE CS Press, pp. 295-302. (Best paper award).
33. Khriyenko O., Terziyan V., Similarity/Closeness-Based Resource Browser, In: *Proc. of the Ninth Intern. Conference on Visualization, Imaging and Image Processing (VIIP-2009)*, July 13-15, 2009, Cambridge, UK, pp. 184-191.
34. Kesäniemi J., Katasonov A., Terziyan V., An Observation Framework for Multi-Agent Systems, In: R. Calinescu et al. (Eds.), In: *Proceedings of the Fifth International Conference on Autonomic and Autonomous Systems (ICAS 2009)*, April 21-25, 2009, Valencia, Spain, IEEE CS Press, pp. 336-341.
35. Katasonov A., Terziyan V., Semantic Approach to Dynamic Coordination in Autonomous Systems, In: R. Calinescu et al. (Eds.), In: *Proceedings of the Fifth International Conference on Autonomic and Autonomous Systems (ICAS 2009)*, April 21-25, 2009, Valencia, Spain, IEEE CS Press, pp. 321-329. (Best paper award).
36. Terziyan V., Zhovtobryukh D., Katasonov A., Proactive Future Internet: Smart Semantic Middleware for Overlay Architecture, In: J. L. Mauri et al. (Eds.), In: *Proceedings of the Fifth International Conference on Networking and Services (ICNS-2009)*, April 21-25, 2009, Valencia, Spain, IEEE CS Press, pp. 149-154.
37. Nikitin S., Katasonov A., Terziyan V., Ontonuts: Reusable Semantic Components for Multi-Agent Systems, In: R. Calinescu et al. (Eds.), In: *Proceedings of the Fifth International Conference on Autonomic and Autonomous Systems (ICAS 2009)*, April 21-25, 2009, Valencia, Spain, IEEE CS Press, pp. 200-207.

Completed M.Sc. and Ph.D. theses related to the group

1. Cochez M., Semantic Agent Programming Language: Use and Formalization, MSc. Thesis, Department of Mathematical Information Technology, University of Jyväskylä, March 2012.
2. Nikitin S., Dynamic Aspects of Industrial Middleware Architectures, In: Jyvaskyla Studies in Computing, PhD Thesis, Jyvaskyla University Printing House, March 2011.
3. Pilli-Sihvola V., Intelligence as a Service, M.Sc. Thesis, Department of Mathematical Information Technology, University of Jyväskylä, December 2010.
4. Bleier A., A Framework for Market-Based Coordination in Multi-Agent Systems, M.Sc. Thesis, University of Osnabruck and Department of Mathematical Information Technology, University of Jyväskylä, September 2008.
5. Khriyenko O., Adaptive Semantic Web based Environment for Web Resources, PhD. Thesis, Department of Mathematical Information Technology, University of Jyväskylä, Vol. 97, December 2008.
6. Naumenko A., Semantics-Based Access Control in Business Networks, PhD. Thesis, Department of Mathematical Information Technology, University of Jyväskylä, Vol. 78, June 2007.
7. Katasonov A., Dependability Aspects in the Development and Provision of Location-Based Services, PhD. Thesis, Department of Computer Science and Information Systems, University of Jyväskylä, Vol.61, April 2006.
8. Zhovtobryukh D., Context-Aware Web-Service Composition, PhD. Thesis, Department of Mathematical Information Technology, University of Jyväskylä, Vol. 72, December 2006.
9. Tsaruk Y., Information Base for Representation of Management Information in DIFFSERV , M.Sc. Thesis, Mathematical Information Technology Department, University of Jyväskylä, June 2005.
10. Kovtun D., Mobile Services for Wireless Private Area Networks based on Ad Hoc Connectivity, M.Sc. Thesis, Mathematical Information Technology Department, University of Jyväskylä, December 2004.
11. Naumenko A., Analysis and Semantic Description of Role Based Access Control Models, M.Sc. Thesis, Mathematical Information Technology Department, University of Jyväskylä, October 2004.
12. Nikitin S., Web-Service for Computational Error Estimation, M.Sc. Thesis, Mathematical Information Technology Department, University of Jyväskylä, August 2004.
13. Khriyenko O., Distributed Mobile Web Services based on Semantic Web , M.Sc. Thesis, Mathematical Information Technology Department, University of Jyväskylä, October 2003.
14. Kononenko O., Ontological Support for Industrial Maintenance of Smart-Devices , M.Sc. Thesis, Mathematical Information Technology Department, University of Jyväskylä, October 2003.
15. Zharko A., Peer-to-Peer Ontological Discovery of Mobile Service Components in Semantic Web , M.Sc. Thesis, Mathematical Information Technology Department, University of Jyväskylä, October 2003.

Samples of invited talks

- Terziyan V., Global Understanding Environment: Towards Self-Managed Web of Everything, Keynote Speech at: International Workshop on Self-Managing Solutions for Smart Environments (S3E-2011) within 6th International Conference on Grid and Pervasive Computing (GPC-2011), 11 May, 2011, Oulu, Finland.
- Terziyan V., Semantic and Agent Technologies for Distributed e-Health, Keynote Speech at: Sosiaali- ja Terveydenhuollon Tietojen-käsittelyn Tutkimuspäivät (Social and Health Care Data-Processing Days), 28 May, 2009, University of Jyväskylä, Finland.
- Terziyan V., Several invited lectures and lecture series (France, Netherlands, Vietnam, Ukraine, Finland).

Organized conferences or workshops

- ***International IFIP/WG12.5 Working Conference on Industrial Applications of Semantic Web (IASW-2005)***, 25-27 August 2005, Jyväskylä, Finland.

Awards

- ***Diploma of the finalist of LINJA-idea competition organized by Finnish Transport Agency,*** Finland, 2011;
- ***Award from Agora Center for being most international research group in Agora;***
- ***Several best paper awards at the conferences.***

More Info

Brief presentation of the group: http://www.mit.jyu.fi/ai/Industrial_Ontologies_Group.ppt .
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