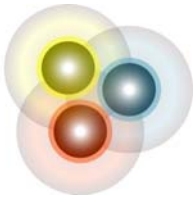
Service Web 3.0



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About STi2

The mission of STII2 short for Semantic Technology Institutes International is to establish semantics as a core pillar of modern computer engineering. It is supposed to be the leading international think tank in this field. STI2 is organised as an association of jointly interested scientific, industrial and governmental parties. STI2 actively takes the lead in developing new business models and in improving the way people and businesses communicate and interact. STI2 provides general services in the areas of

- *Research*
- *Technology*
- *Realization*

STi2 is supported by scientific, industrial and governmental parties of the world wide Semantic Web and Service community. STi2 is an initiative of the European Semantic Systems Initiatives (ESSI)[1], the European FP6 Project Knowledge Web[2], and DERI International[3].

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Abstract. Service Web 3.0 will help to realize a world where billions of parties are exposing and consuming services via advanced web technology. We will provide a comprehensive framework and infrastructure that integrates four complimentary and revolutionary technical advances into a coherent and domain interdependent service delivery platform: (1) Service Oriented Architectures (SOA) as a means to abstract from software to service ware; (2) Web technology as an infrastructure and underlying infrastructure for integration of services at a world wide scale. (3) Semantic Web technology as a means to abstract from syntax to semantics; and (4) Web 2.0 as a means to structure human-machine cooperation in an efficient and cost-effective manner. Herby we want to integrate the service world of large enterprises, SMEs, and end-users and enabling them as peers (i.e., service consumers as well as service providers) in a network of equals.

Contents

1. Introduction

After four decades of rapid advances in computing, we are embarking on the greatest leap forward in computing that includes revolutionary changes at all levels of computing from the hardware through the middleware and infrastructure to applications and more importantly in intelligence. **Service Web 3.0** will provide a comprehensive framework and infrastructure that integrates four complimentary and revolutionary technical advances:

- **Service Oriented Architectures (SOA)** as a means to abstract from software to service ware;
- **Web** technology as an infrastructure and underlying infrastructure for integration of services at a world wide scale.
- **Semantic Web** technology as a means to abstract from syntax to semantics; and
- **Web 2.0** as a means to structure human-machine cooperation in an efficient and cost-effective manner

Computer science is entering a new generation. The previous generation was based on abstracting from hardware. The emerging generation comes from abstracting from software and sees all resources as services in a *service-oriented architecture (SOA)*. In a world of services, it is the service that counts for a customer and not the software or hardware components that implement the service. Service-oriented architectures are rapidly becoming the dominant computing paradigm.[4] However, current SOA solutions are still restricted in their application context to in-house solution of companies. A service web will have billions of services. While *service orientation* is widely acknowledged for its potential to revolutionize the world of computing by abstracting form underlying hardware and software layers, that success depends on resolving fundamental challenges that SOA does not address currently.

SOAs will not scale without: properly incorporating principles that made the web scaling to a world wide communication infrastructure; signification mechanization of service discovery, negotiation, adaptation, composition, invocation, and monitoring as well as service interaction requiring data, protocol, and process mediation; and a balanced integration of services provided by human and machines. In a services-oriented world, services must be discovered and selected based on requirements, then orchestrated and adapted or integrated. Solving these problems is a major pre-requisite to realize a *web* of services interconnection *billion* of services (as the current web does for information sources) effectively "that enable context-awareness and discovery, advertising, personalization and dynamic composition of services."[5]

[4] M. Brodie, C. Bussler, J. de Brujin, T. Fahringer, D. Fensel, M. Hepp, H. Lausen, D. Roman, T. Strang, H. Werthner, and M. Zaremba: Semantically Enabled Service Oriented Architectures: A Manifesto and a Paradigm Shift in Computer Science, DERI Technical Report TR20051226, 26 December 2005. http://www.deri.at/fileadmin/documents/DERI-TR-2005-12-26.pdf

[5] ICT – Information and communication Technologies, Work Programme 2007, Page 13.

The mission of Service Web 3.0 is to provide solutions to integration and search that will enable the **Service Oriented Architecture (SOA)** revolution on a *world-wide scale*. Hereby we must focus on three major areas where we need to extend current approaches towards service orientation:

- **First of all**, the *web* principle and technology are applied to service orientation providing an open and dynamically changing environment of services open for third-party usage. Services will appear, disappear, change location; start free then based on pay-per-use, will be blocked, out of service, inspected for antitrust, etc, etc. A light-weight integration infrastructure must be provided that provide openness and easy adoption for service provider and consumer. Hereby, we can reuse existing solution as much as possible as a means to integrate service-orientation in open world-wide environment beyond the boundaries of single organizations.
- **Second**, we need to provide *semantic web technology* as a means to implement a scalable access layer to data and processes. Instead of accessing services through syntactical means like a name or an address they become usable through a description of their actual capability. Our objective is to make semantics a pillar of the software architecture of the next generation of computing. We will provide a comprehensive framework and architecture with which to augment the worldwide movement to service-orientation with semantics in the context of evolving, industrial Service-Oriented Architectures. A **semantic service bus** will be developed as a core technology that implements service usage through semantic descriptions.
- **Third**, we make usage of *Web 2.0 technology* as means to generate and access this semantic service layer. Properly including human interaction and cooperation will enable us to provide solution to certain tasks such as service ranking or mediation that remain otherwise unfeasible.[6] Web 2.0 and human computing approaches together with their underlying social consensus building mechanisms have proven the potential of **proper balancing services provided by humans and services provided by automated reasoning**. In the end, a service is not necessarily being provided by a computer program and, for example, current approaches for service discovery and (human) expert finders can be combined.

Based on these achievements, Service Web 3.0 will place computing and programming at the services layer providing the real goal of computing--problem solving in the hands of end users through a properly balanced cooperation approach.

In section 2, we will define the implications it has in putting SOA in the context of an open, distributed, and decentralized world wide solution. Section 3 defines the semantic access layer that is needed to provide scalable access to this world wide service web. Section 4 generalizes the concept of a service, introduces the usability aspect, and shows

[6] Humans are much better in solving certain tasks (capture recognition, image descriptions, common sense reasoning, i.e., http://video.google.com/videoplay?docid=-8246463980976635143&hl=en).

that only balanced approach of mechanization through semantics and human intervention can actually work. Section 5 describes some concrete usage scenarios how business relationships can be implemented through this new technology.

2. Integration Web and SOA

The web can be understood as a collection of principles and highly scalable means for electronic publication.

Major *principles* are:

- **Openness** implies that in principle everybody can contribute to it as a provider or consumer of information. Openness is a major and essential necessity to ensure the success of the platform. Usage of this infrastructure as a service provider or user must be as simple, smooth, and unrestricted as even possible.
- **Interoperability** is needed and provided through the integration of different proprietary and legacy solution through a common interface. The solution as such must be platform and vendor neutral to enable every provider and requester of information to join in.
- **Decentralized changeability** and dynamicity implies that content can appear, becoming modified, or disappearing in a non-controlled fashion. That is, provisioning and modification of content must be under distributed control of the peers rather being controlled by a central authority. Central control would hamper access and therefore scalability, an element of chaos or "messiness" must be tolerated.[7]
- **Central means to route requests or responses must be automized** in order to scale. Manually generated repositories are inherent non-scalable, costly, and immediately out-dated. One could argue that web sites like google are actually a centralized control or access. However, what they really implementing is an abstracting process on accessing and caching information. In the early days of the web sites were accessed by magic numbers (and latter by magic names) and list of bookmarked pages were valuable intellectual property. Through search engines this access is replaced by key word retrieval and ranking based on relevance factors. Therefore, the keyword form of Google is just lifting the address bar of a browser at a higher level of abstraction.[8]
- **Enabling n:m relationship** to maximize interaction. In difference to email, where the content is target to specific receivers, the web is based on anonymous distribution through publication. In principle, the information is disseminated to any potential reader, something mailing tries to achieve trough spam.

[7] I will never forget the moment in life where a German Professor was explaining me that the Web is crap because it can contain broken links.

[8] Still, means like google actually have the potential to become misused as central access control when they are started to be used to manipulate content access as a means to implement censorship or commercial interests.

Providing an infrastructure realizing these principles requires roughly *three important means*: world-wide addressing of service, world-wide delivery of service, and platform independent access of services.

- A web of services requires a **world wide addressing schema**. At an intermediate level it may be a unique name and at a more elaborated level it may be a description of the capability of a service, i.e., the degree it can be used to achieve a certain goal. In the case of the web, these are URIs.
- A **transport layer** (a protocol) to transmit request for and results of services. In the case of the web this is http.
- A platform independent **interface** to process service request and access. In case of the web this is html and browsers that interpret html.

Realizing these principles and providing a platform incorporating them is the first and major necessity to implement Service Web 3.0.

3. Integration Semantics and SOA

There are fundamental requirements for user-centric, service oriented and distributed environment which all together facilitate seamless provisioning of business services. These major principles are:

Service Oriented Principle. Service-orientation represents a distinct approach for analysis, design, and implementation which further introduces particular principles that govern aspects of communication, architecture, and processing logic. This includes service reusability, loose coupling, abstraction, composability, autonomy, statelessness, and discoverability. With respect to the service orientation which enables a service level view on the organization we further distinguish services from several views.

First, we distinguish two types of services from the point of the functionality they provide within the architecture, namely (1) Business Services and (2) Middleware Services. Business services are services provided by various service providers, their back-end systems – business services are subject of integration and interoperation within the architecture and can provide a certain value for users (e.g. purchasing a flight). On the other hand, middleware services are the main facilitators for integration and interoperation of business services (e.g. discovery, interoperability, etc.).

Second, we distinguish two types of services from the point of their abstraction in the architecture, namely (1) Web Services, and (2) Services. The Web Service is a general service which might take several forms when it is instantiated (e.g. purchase a flight) whereas the Service is actual instance of the Web Service which is consumed by a user and which provides a concrete value for a user (e.g. purchase of a particular flight from Innsbruck to Vienna). We use this distinction for Business Services in the architecture.

Semantic Principle. Semantics in general is considered as a rich and formal description of information and behavioral models enabling automation of certain tasks by means of logical reasoning. Combined with service oriented principle, semantics allows to define scalable, semantically rich and formal service models and ontologies allowing to promote total or partial automation of tasks such as service discovery, contracting, negotiation, mediation, composition, invocation, etc. Semantic service oriented approach to modeling and implementation of the organization enables scalable and seamless interoperation, reusability, discovery, composition, etc. of various Business Services.

Distributed Principle. Distributed principle is the process of aggregating the power of several computing entities to collaboratively run a single computational task in a transparent and coherent way, so that they can appear as a single and centralized system. Distributed principle is applied to the architecture middleware system which allows distributing its components over the network in a transparent way so that the execution process run in the middleware could be scaled across a number of physical servers over the network. Distributed principle is also applied to the Business Services allowing running a process spanning across several Business Services distributed over the network.

User-centric Principle. The user-centric principle puts the user in the center of the architecture. It refers to concepts like personalizing of Business Services, facilitating service usability, promoting multi-channel access and service delivery, building trust, achieving efficiency, accountability and responsiveness according to users' requirements, enabling seamless implementation of Business Processes across organizational boundaries, etc.

Realizing these principles and providing a platform incorporating them is the major necessity to implement Service Web 3.0. There are following four types of business services of an infrastructure which are a must for Service Web 3.0 to deliver its promises:

- The *problem-solving layer* which consists of (1) **Ontologies**, (2) **Applications** (e.g., e-tourism, e-government) and (3) **Developer tools** (GUI tools such as those for engineering ontology/web service descriptions; generic developer tools such as language APIs, parsers/serializers, converters, etc.).
- The *broker layer* which consists of (4) **Discovery**, (5) **Adaptation** (including selection and negotiation), (6) **Composition** (web service composition techniques such as planning), (7) **Choreography**, (8) **Mediation** ((a) Ontology mediation: techniques for combining Ontologies and for overcoming differences between Ontologies; (b) Process mediation: overcoming differences in message ordering, etc.), (9) **Grounding**, (10) **Fault Handling** (Transactionality, Compensation, etc.), and (11) **Monitoring**.
- The *base layer* that is providing the exchange formalism used by the architecture, i.e., (12) **Formal languages** (static ontology and behavioral, i.e., capability/choreography/orchestration languages, connection between higher-level descriptions, e.g., WSML), (13) **Reasoning** (techniques for reasoning over formal descriptions; LP, DL, FOL, behavioral languages, etc.) and (14) **Storage and Communication**.

- Finally, *vertical services* such as (15) **Execution management** and (16) **Security** (authentication/authorization, encryption, trust/certification).

The figure 1 presents the set of the business services needed for this.

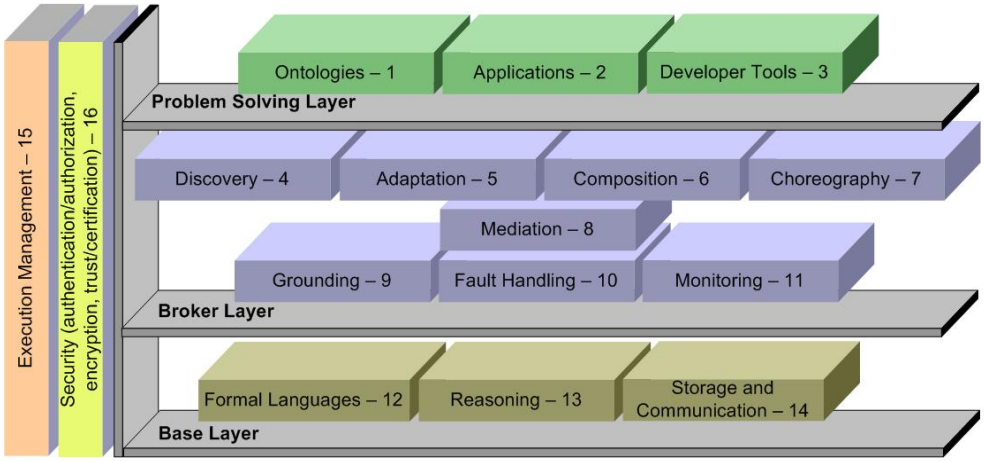

Figure 1. A semantic service bus

Realizing these principles and providing a platform incorporating them is the second necessity to implement Service Web 3.0.

4. Integration Web 2.0 and SOA

Web 2.0 has brought a collection of interesting advances to the World Wide Web. First, we will describe the convergence of web and web service technology. Second, we will discuss the transformation of the web from a means for individuals to publish into a platform that organizes communities and finally as a means for social consensus building. Realizing these principles and providing a platform incorporating them is the third necessity to implement Service Web 3.0.

4.1 Mashing Web and Web Services

Thanks to the programming paradigm of Asynchronous JavaScript and XML (AJAX), Web sites become more interactive and user friendly, to an extent that was previously only achieved by desktop applications. Given the ubiquity and abundance of Internet band with today, both stationary as well as wireless, we can see a convergence between

classical desktop applications and Web applications. The Web is becoming a valid platform to host all kinds of software services (see Figure 2).

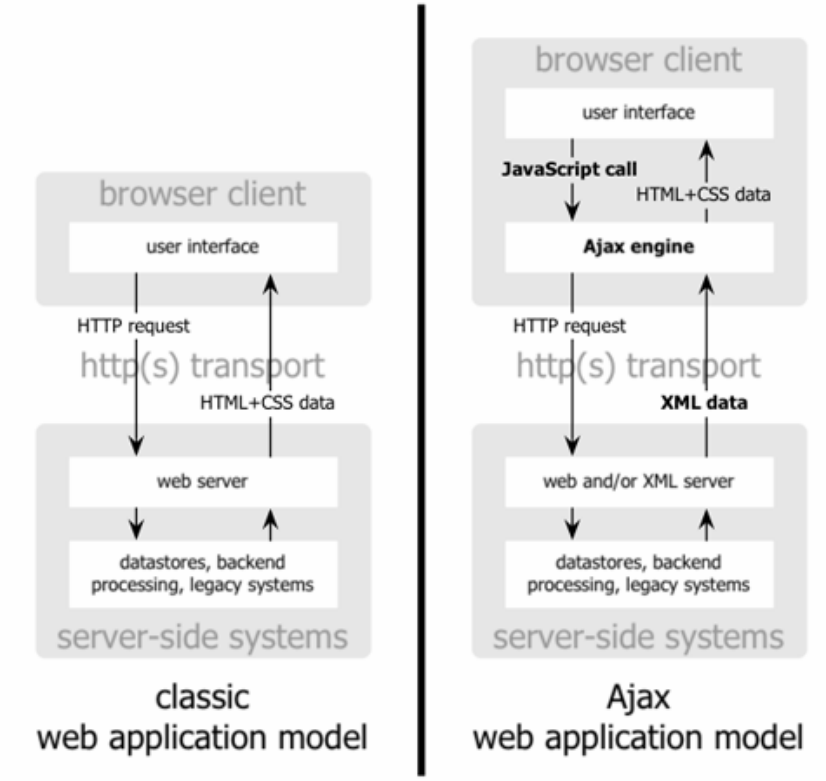

Figure 2: AJAX Architecture

AJAX adds the ability to dynamically update the appearance of a Web page to the static "request/response" pattern between Web browser and Web application, where only whole Web pages are displayed. Hence, users experience a more fluid and interactive Web application.

Web Service standards such as SOAP and REST are already a prominent component of Web 2.0. Often, external datasets are "mashed" up with a Web application using their SOAP or REST based interfaces. Thus, Web 2.0 applications often form graphical interfaces for (enterprise) applications based on the SOA (Service Oriented Architecture) paradigm, which has established itself as a prominent architecture for modern backend applications.

Mashup applications integrate data and functionality form several other Web applications via their exposed Web APIs and provide added value through this integration, e.g. integrating a mapping application with a phone number reverse lookup application to display the location of the phone number on a map (see figure 3).

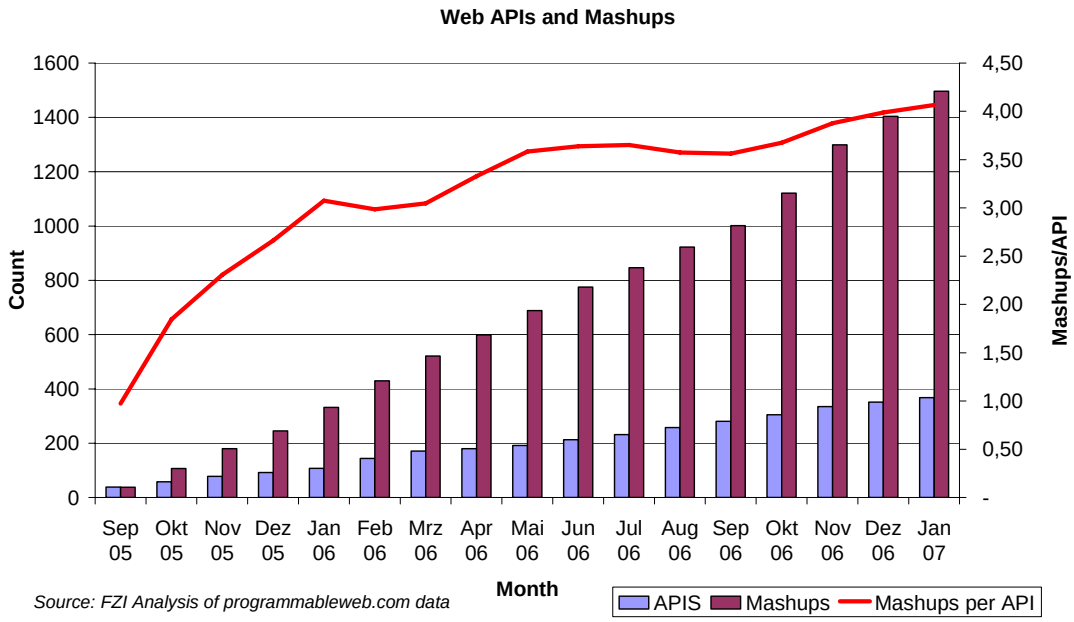

FIGURE 3: Increasing number of Web APIs and Mashups

The dynamics of Mashups has just been unleashed. Figure X indicates the growth of publicly available Web service APIs. From 39 mashups and APIs that have been listed in September 2005 on programmableweb.com, we can now find 352 Web APIs that are used in 1404 mashup Web sites in December 2006 – a growth of more than 600% in Web APIs and almost 3600% in mashups.

New services like openkapow (http://www.openkapow.com) and Yahoo pipes (http://pipes.yahoo.com) will further accelerate this growth in the coming years by providing visual development environments, which allow web developers in easy point and click interfaces to mashup and connect any service on the Web and republish the integrated anything on the web. This addresses one of the main problems with mashups, i.e. that it is not that easy to create a mashup.

For example, the Yahoo!'s new pipes services presents such an user interface for the integration and republishing of RSS news feed providing a drag and drop editor that allows people to connect internet data sources, process them, and redirect the output. Yahoo! describes it as "an interactive feed aggregator and manipulator" that allows to "create feeds that are more powerful, useful and relevant." While still an early development, Yahoo! Pipes gives a glimpse on the enormous promise in turning the web into a programmable environment for everyone.

Semantic mashup sites have to extend the simple means to visual mashup composition that is just appearing by providing additional significant intelligent processing (A) and

data reconciliation (B) mechanisms .Thereby the creation of mashups should become even simpler. With the recently defined and researched Semantic Web standards, many mashups can even happen on the fly, and over more than just two data sources.

For example it is easy to imagine a community page that grabs the FOAF file of all members from their respective social network pages, enrich the data about their addresses with coordinates from a GIS server, grabs some data on concerts of their favourite bands, and finally integrates a calendar and a map view of this mixed data to allow them to plan their common visits to the concerts.

With a rising number of Web Apis and mashups, also a new form of mashup will appear, namely *aggregators*, these are similar to mashups superficially, but they are driven by a different goal. The primary goal of aggregating sites is to collect data from heterogeneous and multiple sources and republish the cleaned, integrated and aggregated data at a single point-of-access. Intelligence will be needed to discover and merge instances with the same identity, by mapping different ontologies based on mappings created by experts and that can be used by all the users of the aggregating page, by filtering.

4.2 Mediating and Creating Communities

A wave of individualization and democratization of the Internet is connected to the term “Web 2.0”. So-called “social software” promotes user participation. Examples for this social phenomenon are social networks such as myspace.com and friendster.com, but also personal Web blogs and the contribution to common content management platforms such as Wikis (see figure 4).

In all cases the social phenomenon is based on increased and simplified user participation:

- In social networks it is easy to discover new friends and easy to express characteristics about oneself or opinions about others.
- In WebLogs or “Blogs” and the creation of online content has been simplified to a simple textbox and a submit button, abstracting from the tedious content creation process behind creating HTML files and uploading data to a Web server.
- In Wikis, a “special” simplified syntax allows to easily interlink several documents.

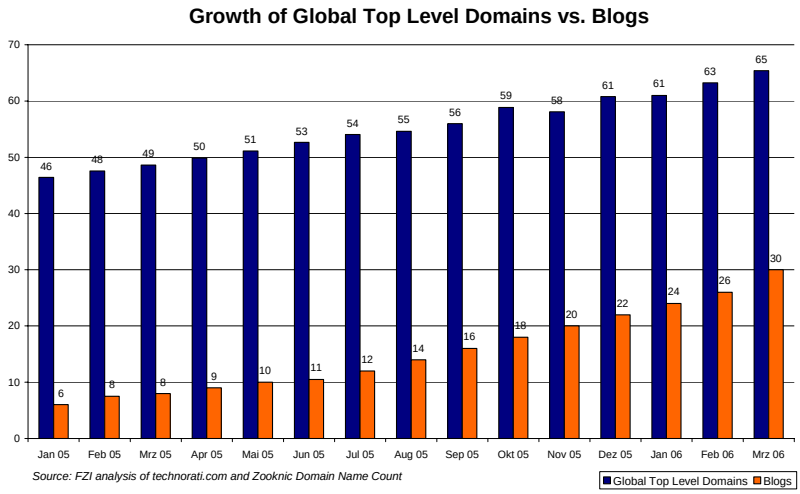

Figure 4: Growth of blogs vs. growth of top level domains

Again, with growth come problems that require more intelligence to be solved or elicit the need for further automatism.

Wikipedia – the World largest encyclopedia and most prominent Wiki – contains many lists of things to answer the information need of its users. These lists are manually edited and notoriously outdated, as they are not linked with the content on the individual pages that are used to form the list (see figure 5).

Figure 5: List of female tennis players (from http://en.wikipedia.org)

To avoid such inconsistencies, manually generated lists should be replaced by automatically generated lists. This would be possible, if Wikis were able to expose their content in a structured way responding to structured queries instead of text-only queries.

Structured data in Wikipedia, although visually present, cannot be queried in general, a perceived lack of functionality that among others yields problems such as Inter-language consistency, an issue highly relevant to multilingual Europe, is also difficult to maintain in Wikipedia and inconsistencies are easily to spot for structured data. For example, at time, the population of Edinburgh at the time of this writing is different in English, German, and French Wikipedia.

Related to the lack of structured data and often a source of confusion to Wikipedia users is the inflationary use of categories, such as "Rivers in Buckinghamshire", "Asteroids named for people", and "1620s deaths" – all those categories can be easily replaced by a handful of structured data annotations which could be queried in combination to create such categories.

The open and flexible data models of the Semantic Web can become key to add structured data to Wikipedia and thereby not only tackle the aforementioned problems but also provide further intelligent information retrieval possibilities…

Bloggers are free to write about anything they want in their blogs, but most frequently bloggers comment on things that exist on the Web. In this sense, they created focused annotations of Web resources. Unfortunately the fact that Web sites are commented or annotated is not understandable to anyone but the reader of the blog. For example, it may be useful to model criticism annotations using a numerical rating and aggregate such ratings across various blog entries from different authors to come up with a rating of a Web site.. At the moment, blog entries that embody criticisms may contain a numerical rating but that rating is rarely recorded in a machine-readable form. Using an ontology to model such annotations would make it easier to do automated filtering and analyses, such as finding the average rating for a given resource; such analyses are already done by specialized data mining sites, but they usually do not track anything more semantic than just the frequency with which specific sites are hyperlinked to.

Also, because blogs are managed on a per-user basis, users have the flexibility to adopt such ontologies to mark up their annotations. Additionally, in moving blogging to the Semantic Web, an obvious extension is allowing blogs to talk about arbitrary Semantic Web resources. This extension not only broadens the set of available topics but also allows resources that previously had to go unnamed (e.g., "teddy bear model #22321") to be identified more precisely, improving
search capabilities.

Blogs act as logs of messages, usually written to a general audience but at times focused towards specific parties. This phenomenon is most evident when an event of interest occurs, such as a product release. A flood of blog posts appear coincidentally, and the debate that ensures results in blogs containing entries that comment on other blog entries. This structure is reminiscent of email or newsgroups: a blog entry has a sender, a set of

(sometimes targeted) recipients, a subject line, and often one reply-to entry (or more, although today notating that a blog entry is in reply to another blog entry may need to be done with human readable prose and a hyperlink, depending on the blogging system in use).

Thus, Semantic blogging needs to extend the blogging paradigm with the possibility to add additional metadata to a blog entry. This metadata can cover a variety of aspects, ranging from information about the entry itself, such as the author or date of publication (using vocabularies such as RDF Site Summary (RSS 1.0)7), information about the structure of the blog and relations to other communication sites to metadata describing the topics mentioned in the entry (a blog entry about a meeting would e.g. include metadata about that meeting, such as date and location, people attending or details of project related to the meeting, whereas an entry discussing a book would include bibliographic metadata for that book). Moreover, this metadata is expressed in a semantic format such as the Resource Description Framework (RDF), which allows further inferencing and machine reasoning over data.

4.3 Consensus building mechanisms

One of the gravitational principles of Web 2.0 is that we can see the Web as Platform[9]. Going from the good old Web (now baptised as Web 1.0) to the current exciting Web 2.0 has changed our ways to perceive and interact with the Web and its content. The Web 1.0 publishing mechanism was very clear; it was conceptually designed for the publication of documents. There were publishers of content who pushed fixed data for subscribers in a static "one way" lane. Consequently there were little chances for feedback and even less for consensus (e-mail contact information when available). With the apparition of Web 2.0, the style of communication changed completely and now, there is a "two ways" lane of interaction and each resource in the Web is a vehicle for community interaction. There are some examples in Web 2.0 where this paradigm is tested beyond any foreseen limit: Wikipedia.

In Wikipedia, the principle is simple: anyone can contribute to the construction of Wikipedia. "Content creation and editing are highly egalitarian; any registered user can create a new article, and anyone, registered or not, can make any change to an existing article, or undo anyone else's change"[10]. Probably the most controversial and at the same time amazing thing of Wikipedia is how humans have been able to reach consensus in certain topics that could be controversial. People with different interests and background have been working closely to build together contents that have been improved continuously. In words of Jimmy Wales, founder of Wikipedia: "If you write something

[9] What is the Web 2.0? Design Patterns and Business Models for the Next Generation of Software, by Tim O'Reilly
[10] Enterprise 2.0: The Dawn of Emergent Collaboration, by Andrew P. McAfee

that annoys other people, it is just going to be deleted. So if you want your writing to survive, you really have to strive to be cooperative and helpful"[11].

Wikipedia works by building consensus (see Figure 6). Consensus is an inherent part of the wiki process. The basic process works like this: someone makes an edit to a page, and then everyone who reads the page makes a decision to either leave the page as it is or change it. Over time, every edit that remains on a page, in a sense, has the unanimous approval of the community (or at least everyone who has looked the page). "Silence equals consent" is the ultimate measure of consensus — somebody makes an edit and nobody objects or changes it. Most of the time consensus is reached as a natural product of the editing process[12].

When there are disagreements, they are resolved through polite discussion and negotiation, in an attempt to develop a consensus. If Wikipedia finds that a particular consensus happens often, it is written down as a guideline, to save people the time having to discuss the same principles over and over. Normally consensus on conflicts is reached via discussion on talk pages. In the rare situations where this doesn't work, it is also possible to use the Wikipedia:Dispute[13] resolution processes, which are designed to assist consensus-building when normal talk page communication gets stuck.

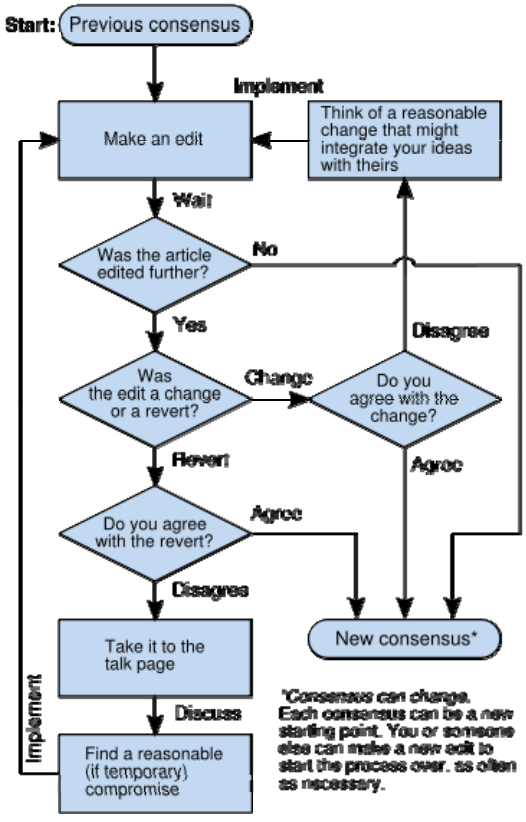

Figure 6. Wikipedia consensus process flowchart

[11] Best of the Web: Extreme Blogging, by M. Rand
[12] http://en.wikipedia.org/wiki/Wikipedia:Consensus
[13] http://en.wikipedia.org/wiki/Wikipedia:Dispute_resolution

If we want to combine billions of services and detect from their behaviour if they are reliable (just because somebody says that a service is reliable it does not means it is true) we need to define measurable ways to combine human trust with computer trust. In a world in which humans still play an important role in services (mouth to mouth and human feedback are still more accurate that QoS metrics) we are bound to integrate social skills in service transactions.

In a transactional electronic world when some service is failing it has to undo previous atomic actions, in order to ensure that nothing has changed since the service was previously ordered to execute. Compensation, substitution, agreement are terms that Business Services are introducing to capture the human ability to reach consensus: the electronic handshake.

Some online marketplaces, like the academic Kashba, the commercials onSale or eBay introduce collaborative reputation mechanisms to help users to decide on what risk are decided to give to their transactions based on the reputation of the other party. If some partner fail to fulfil his agreement, his reputation is damaged and future transactions may be jeopardized. In the other hand, users that commits to their words and are honest, enjoy from a better reputation and can make deals more often.

It is a reality that humans trust more those people they know, especially if they know them for good. The net of contacts around the Web is incredibly dense and with the help of initiatives like FOAF, people are able to annotate information about them and about the people they know, and usually, trust. The use of initiatives like FOAF in the field of Services will allow software agents, and humans, to know something more about the reliability and reputation of a service. If some service I know and use (e.g. my flight booking service) has been combined, successfully, with some geographical location service, I will have more information about its reliability than before. At the end, this is all about trust and reputation, from human to computers, computers to computers and human to humans.

5. Scenarios

Web Services are the major building block in the developing evolution of the Internet from a network of information to a network of services. The amount of services which will be offered on the Internet is expected to rise dramatically in the next few years, necessitating the emergence of a new kind of search engine: a Service Broker, which can offer suitable Web Services to interested Customers, who will then use these Services in their own integration solutions (thus becoming the Service Requestors in the terms of the SOA paradigm).

The scenario described in this section shows the results of applying these technologies in a specific area: full scale e-Commerce solutions usable for everybody. Due to the

envisioned availability of a large set of e-Commerce and content business services, which can be combined to cover all needed functionalities of such an integrated e-Commerce solution, the emergence of two new market areas can be expected: a B2C and a C2C market.

The B2C area will cover Service Providers offering a collection of business services which can be used by a Customer to build his or her own e-Commerce solution. The Service Provider does not directly offers these services, but rather requests a Service Broker to provide the infrastructure for a customer to find, purchase and consume the offered services. The Broker can also offer the possibility to combine services from several providers and offer suitable service packages, covering a wide range of functionalities (e.g. including web shop solutions, payment services, monitoring and marketing services etc.).

Additionally a C2C market will evolve: Customers use their business services bought via a Service Broker to create their own e-Commerce solutions which they can use to perform e-Commerce with other consumers in a flexible and dynamical manner, while simultaneously lowering the acceptance threshold of consumers to peruse such solutions. Typical customer needs to set up their own e-Commerce solution include the sale of used cars, selling or trading collectibles and offering photo and multimedia content to other users. Thus the vision of flexible C2C e-Commerce, where every interested party can easily make offers and buy products is fulfilled.

These trends will radically change the existing networked solutions of large service providers. For example, BT is undergoing a complete network transformation. At the heart of this transformation is the £10 billion 21st century network (21CN) initiative. 21CN is an IP-based, multi-service network, and is the driver for a radical change. As an end-to-end Internet Protocol (IP)-based network, 21CN will consolidate BT's 16 separate network platforms into one. It will replace the complex network and systems infrastructure with a physically simpler and more reliable network, to ensure the delivery of the next generation of converged services faster, more efficiently and more cost-effectively. As part of the massive 21CN programme, BT have launched a project named Web21C.

Web21C is the name of the programme to launch new software based services from BT and 3rd parties, and it builds on BTs investments in 21CN. Web21C allows 3rd parties to use BTs network as a platform for delivery of their services, for which we get revenue. These are not typically other network competitors, but a new breed of partner - software companies; developers and content providers. These partners can use tools we provide to take advantage of network and other assets we have, for a share of the revenue, or other source.

Critical to the success of Web21C will be the use of Common Capabilities. Common Capabilities refers to a set of common re-usable components designed to underpin BTs product set. An example of a Common Capability would be 'Authentication' which is used for validation of customers. Third parties will now be able to use this set of re-

usable ‘off-the-shelf’ components to build their own solutions for customers. This service will not just be limited to consumers. Increasingly, small and large business, as well as government, is going towards a "shared services" model where applications and content are provided to them on a subscription basis from a supplier.

Benefits for customers are that they get a company dedicated to helping them thrive in this changing world with a much wider range of services to choose from. Complementary benefits for BT are that it can serve its customers in new and innovative ways; extend its markets, and grow its business.