
Distributed Systems and Web Technologies

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The information system shall represent the support of the put on and of the simplification of rules and administrative procedures in order to ensure a broad and non-discriminatory public access to public services and also to reduce tariffs for these services, along with the operating costs and the personnel costs.

IT&C market and the major brands have come up with new solutions and new architectures: SOA (Services Oriented Architecture), S+S or SaS (Software as Services) complex architectures, modulation, business solutions designed to streamline information and it's flow, to privilege the citizen access to services, signifying furthermore a careful spending of public money lead to a double vertical and horizontal integration of all services, transactions and applications.

Keywords: *distributed systems, web services, web technologies, Web 3.0 transition*

The governance, whichever the level and the enforcement of institutions, it is the most important investor and in the same time a user of information technology. The public administration is certainly crossing trough an important transformation process in the medium and long time term and its availableness in terms of implementation of modern information technologies is the key to this transformation. Since the

strategies and public policies define the role of the citizen as an active participant in governance and not only as a simple user, the public administration will have to learn to reorganize their held information for facilitating the transparency and democratic process of the making decision, for the consensus building and for the dialogue and deliberation. The most significant difference which proves the development based on components is that none of the individual components are made in accordance with other component that follows up their integrating services. Each component is grownup in accordance with a general profile so it can be integrated in different contexts and addressed to a larger market segment. Therefore the generality of the components is an efficient action because it allows software manufacturers to cover a wider market and in the same time allows to the buyers the possibility to add features without initial experience. But this is also an issue as these components have not been created having as purpose "the integration".

Taking in consideration all the above, one of the current objectives of public administration is the integration of implemented applications in order to increase their efficiency and the performance of the whole unit. The compatibility is a major issue raised by these component-based systems design. By compatibility,¹ we understand the ability of two entities to interact and this interaction should have a semantically meaning. For the traditional software development any subordinated way newly created is strongly customized according to requirements of the module super ordinate. This module super ordinate incorporates and uses the subordinated service. Therefore, all modules are compatible accordingly with its own specifications and with parent module specifications. Computer technologies meet these challenges offering various solutions, flexible and efficient solutions Web-based, which provides access to information anywhere and anytime in a secure environment². On the administration level, web services are a valid alternative for consistent developing.

¹ Colin Atkinson, Christian Bune, Hans-Gerhard Gross and Christian Pepper, *Component-Based Software Implement for Embedded Systems: An Overview of Current Research Trends*, (Berlin: Springer-Verlag Berlin), 2005, 2

² Jackson Jeffrey C., *Web Technologies: A Computer Science Perspective*, New Jersey: Prentice Hall, 2006

Web services

The ability to switch data is an essential element for success. In the same time at the level of one organization, we find implemented various solutions for solving specific problems and for stoking and making data's switch and therefore the communication are not an easy one between them. Web services have evolved as a practical solution, efficiency in terms of cost, which provides the fusion of that information coming from several applications, exceeding these barriers created by the use of the operating systems, platforms and different languages.

A web service provides a defined set of features to achieve an objective. If in the past a client could use only a application which was installed on a local machine, today you can access an application from any computer, from anywhere in the world by using different development platforms such as C++, Web, Java or Borland Delphi and web standards such as Hyper Text Transfer Protocol(HTTP), Extensible Markup Language (XML), Web Services Description Language (WSDL) and Simple Object Access Protocol (SOAP).

The web services objective is to provide any kind of application to a client no matter what is the platform developed or the architecture implemented, having in view to create an environment where every customer, regardless the device used, desktop or mobile, has the ability to identify a service network and use it as a local service.

Web services are widely used, to facilitate interoperability between different hardware and software solutions, between different computer architectures and application programming interfaces (API). Such interoperability provides immediate benefits that enable faster integration and lower costs of existing services.

Besides, it was mentioned statements for the development of applications by combining multiple services into a single workflow. With this functionality, the applications will be easier to adjust because the services would be added or removed from that stream. Moreover, interoperability will allow application developers to replace a service with another one when technical or business reasons will require this. This development perspective regarding SOA (Service-Oriented Architecture)

becomes reality through standardization and technology development concerning web services.

The service-oriented architectures implemented with web services have fundamentally changed the business processes supported by those distributed processing. These technologies bring to the forefront the prospect of services available anytime, anywhere and on any platform. Through web services operators can provide for their users high added-value services, explore new business opportunities, increase their income and may increase the degree of customer retention. There by expanding business opportunities for developers allowing to promote their applications and develop solutions that work in different environments and platforms.

In the present, the intense use of infrastructures and mobile technologies is another trend that facilitates communication and information access from any location at any time. Convergence of mobile technologies and Web services, support the emergence of new business service models and accelerates the development of fixed and mobile internet technologies. Mobile technologies benefit from the advantages of interoperability offered by web services. Interoperable messaging structures lead to reducing time and integration costs, creating premises for the embracement of Web services and opening new opportunities for development.

The growing background of informatics systems brings together various notions and elements. Between them, the code is right the final language for expressing requirements. Languages can approach to the requirements, the tools can help you parse and assemble these requirements in formal structures but is always necessary the accuracy and therefore will always need the code³.

The use of information systems has contributed considerably to streamline business processes. Yet over time, organizations were forced to use more solutions for complete business automation and this resulted in the emergence of limitations or blockages caused by incompatibilities and lack of integration of the solutions used. This applications developed in

³ Robert C. Martin, *Clean Code: A Handbook of Agile Software Craftsmanship*, New Jersey: Prentice Hall PTR, 2008, 93

different technologies has become a standard communication need to be independent of platforms and systems used until then.

Over the years, there have been several attempts, most of which were representative:

- DCOM – Distributed Component Object Model provided by Microsoft
- RMI – Remote Method Invocation provided by the Sun
- CORBA – Common Object Request Broker Architecture provided by OMG

In this context was necessary to define and impose an open standard that does not belong to anyone and with the following main features:

- The independence of architecture, operating systems, databases and hardware such as PC, large machines or mobile devices
- Which can be used in every domain from simple solutions (P2P - Peer to Peer) to systems EAI (Enterprise Application Integration) and even systems B2B (Business to Business)
- To allow communication between applications running on low speed connections
- To be modular

Possible solutions listed above do not meet fully the characteristics. In this way has developed the web services (WS) standard. A web service is based on SOAP, WSDL and UDDI. To be able to use these services we need first a method by which to describe and organize data. This method is given by XML.

Extensible Markup Language (XML)

To have an electronic communication it should be used a standard trough it the information can be transmitted or received, plus it should be understood by both parties and systems involved in communication. This need has led to the definition of SGML (Standard Generalized Markup Language). This standard is based on so-called markers, used to delimit the beginning and end information. SGML standard was used for a long time (more than 15 years) by large firms in very specific applications. Along with the development of web technologies is required the use of a similar

standard, but to be more accessible and also to preserve its original standard in describing fully the information contained. This is the definition of XML as a derived standard from SGML as it is not belonging to any company and it is an open standard used on any platform and for any type of data transmission, preferable to implement web services.

XML – Extensible Markup Language, is a specification of World Wide Web Consortium (W3C) defining a meta-language for describing data. XML provides the technological basis for Web services technologies. Choosing XML for a project enables a large number of applications and access to a community of experienced engineers. XML enables structured data such as spreadsheets, contact lists, configuration parameters, financial transactions or technical drawings. XML is a set of rules to create text formats that allows data structure⁴. XML makes it easy for a computer to generate and read data, and ensure that the data structure is correct. XML avoids common pitfalls in language design: it is extensible, platform-independent and supports internationalization and localization. XML is fully compatible with Unicode character set.

Like HTML, XML uses tags (words between ‘<’ and ‘>’) and attributes (with form “name”=”value”). While HTML specifies what each tag and attribute means and often, how they will appear the text marked with these in the browser, XML uses tags only to delimit the data segment, leaving the interpretation of these data into the application that read them. Programs that produce spreadsheets, contact lists and other structured data often keep the data on the hard, using a binary or text format. An advantage of text format is that it allows the user to view the file if it is necessary, to view the file without using the program that produced it the data can be read with other text editors. Also text format makes errors debug easier for developers. Like HTML, XML files are files that users are not forced to read them, but may do so if it is necessary. Compared with HTML, XML rules allow fewer variations. A forgotten tag or an attribute without quotes makes an XML file unusable, while in HTML is permitted. XML specification forbids to an application to try appreciating what the creator wanted to

⁴ Floarea Nastase, Pavel Nastase, *Web application technology: XML-DOM-ASP*, Bucuresti, Ed. Economica, 2002

make wrong, to a XHTML file. If an error occurs, the application must stop reading and report an error.

Because XML is a text format and uses tags to delimit data, XML files are almost always higher than binary formats. XML designers have taken this decision for some objective reasons. Text format advantages are obvious and disadvantages can usually be replaced to a new level. Disk space is cheaper than it was in the past. Compression programs can compress the files very well and very quickly. In addition, communication protocols like HTTP/1.1, basic protocol of the web, can compress data under way saving bandwidth as well as binary format.

XML 1.0 is the specification that defines what tags and attributes are. Beyond XML 1.0 is “XML family” is a set of modules (growing) that provides useful services to meet important task and commonly used. XLink describes in a standard way the addition of hyperlinks in an XML file. XPointer is syntax in development, used to identify parts of an XML document. A XPointer is similar to a URL, but instead to indicate a Web document, this indicate a part of an XML file. CSS, Style Sheet language can be used with XML as is used with HTML. XSL is advanced language Style Sheet being based on XSLT, a transformation language used to rearrange, add or delete tags and attributes. DOM is a standard set of functions for manipulating XML (and HTML) in a programming language. XML Schemes 1 and 2 help developers to precisely define the structure of XML files in the format they created. Other modules and utilities are still in development.

XHTML the follower of HTML is an important application XML, with the form of a document. XHTML has many of the HTML elements. The syntax was partially changed to meet XML rules. A format based on XML inherits XML syntax and a constraint in many ways (for example, XHTML allows to use “<p>”, but not “<r>”); also adds understood to syntax (XHTML said that “<p>” is “paragraph”, and not “price”, “person” or something else).

XML lets you define a new document format, by combining and reusing other document forms. Because the two formats can use elements or attributes with the same name, to eliminate confusion, XML has a mechanism called namespace (domain for names). XSL and RDF are examples of formats based on XML using namespaces. XML schema is designed with this support for modularization. This modularity in the

definition of an XML document makes possible to combine two schemes to form a third, which defines a combined document.

Resource Description Framework (RDF)

Resource Description Framework (RDF), defined of W₃C, is a XML text format that supports resource description and metadata applications such as camera or photo collections. For example, RDF can allow people identification in a photo album (for web) using information from a contact list; then mail client could automatically send an email to these people, alerting them that their photos are on the web (on-line). Such as HTML integrated documents, images, menu systems and forms, RDF are a tool that allows a deeper integration to transform the Web to becoming a semantic web.

Just as people need a convention to determine the meanings of words also and computers need the same thing to communicate efficient. Formal descriptions of a certain category (for example purchase or production) are called ontology and are a necessary part of the Semantic Web. RDF, ontology and representation enable computers to help people work; these are a part of the Semantic Web Activity.

Web Services Description Language (WSDL)

WSDL is an interface that describes in detail the functions that provide a web service. In other words, the WSDL is a description of functions that are provided by SOAP servers starting from the indicated UDDI.

WSDL can be seen as an XML document that describes the routines used in applications, describes the web server location, data form that are received from the communication routines and used parameters. Using a WSDL document can automatically generate classes to access web service. In this way the programmer is relieved from the duty to write these classes manually. A WSDL file is an XML document that describes a Web service using the six main elements:

- Port type - groups and describes operations that are performed by service;

- The port - specify an address for a combination, for example defines a communication port
- The message - describing the names and formats supported by service
- Types - defines data types (such as were defined in XML schema) used by the service for sending messages between client and server.
- The joint - defines the communication protocols supported by the operations that provide services
- The service - specific URL address to access the service.

WSDL document describing a Web service acts as a contract between client and server web service. By adhering to this contract, the service provider and consumer can exchange data in a standardized way regardless of application and platform that operates.

Simple Object Access Protocol (SOAP)

To use a web service is necessary to use a way of data "packing" organized in the form of XML's, to facilitate reading and interpretation by the web server. In this way appeared SOAP (Simple Object Access Protocol) standard that can be viewed as an envelope, containing information. The media does not change from XML, and binary format is unconverted. Are avoided past issues of inconsistency between different operating systems and platforms used.

SOAP is an XML-based protocol defined by the W3C for exchanging data over HTTP, being a simple and standardized method for sending XML messages between applications. Web services use SOAP to send messages between a service and its client/clients. Because all browsers and Web services support HTTP, SOAP messages can be transmitted between applications regardless of platform or programming language. This quality provides web services their interoperability feature. SOAP messages are XML documents that contain some or all of the following:

- The envelope - which specifies that the XML document is a SOAP message that contains the message itself
- Header (optional) - contains relevant information related message, such as the date on which the message was sent on authentication, etc.

- Content - including message
- Error - carries information about an error occurred on the server or client level in a SOAP message

Dates are sent between the client (clients) and Web service using SOAP messages of request and response type, whose format is specified in the WSDL definition. Because both the client and server adhere to the WSDL contract when SOAP messages are created, guaranteeing that the messages are consistent. SOAP protocol is being continuously improved and standardized in order to achieve more effective interoperability.

Universal Description Discovery and Integration (UDDI)

UDDI (Universal Description Discovery and Integration) makes publication easy to search and locate available Web services to be called, is a standard sponsored by OASIS (Organization for the Advancement of Structured Information Standard). Often described as the Yellow Pages of Web services, UDDI is a specification for creating an XML-based registry, presenting information about organizations and web services they offer. UDDI provides organizations a uniform way by which they can present their services and discover services offered by other organizations. Although implementations can vary, usually UDDI describes services using WSDL and communicate via SOAP messages.

UDDI can be a private service within an organization or function as a public service on the Internet. Registering a Web service in UDDI registry is an optional step. To search a web service, a developer can query the UDDI registry to obtain the WSDL for the service that wants to use. Developers can also design their Web services so that customers receive automatic updates on any changes of a service in a UDDI registry.

Service-Oriented Architecture (SOA)

SOA (Service Oriented Architecture - software architecture based on services) is a type of software architecture that involves distributing application functionality into smaller, distinct units - called service - that can be distributed in a network and can be used together to create

applications for business⁵. The large capacity of these services that can be reused in different applications is a feature of service-based software architectures. These services communicate with each other by sending information from one service to another. SOA is often seen as a solution to distributed programming and modular programming.

SOA is a flexible, standardized architecture that contribute to better connect the various applications and facilitates the exchange of information between them. SOA unifies business processes by structuring large applications in a collection of small modules called services. These applications can be used by different groups of people both within and outside their company. Typically are implemented functionality that most people would know that service such as for example: completing an application online for an account, view a form or a bank account statement online or make an order of an air ticket online. Main factors that ensure the SOA projects success are evaluating technology options, design, development, delivery and administration. In addition, the need to clearly understand the service-oriented processing must be complemented by understanding their own development environments, the constraints and strategic objectives, to determine the optimal platform to achieve these objectives.

Web services benefits

Between the main benefits, that Web services make available we find:

- integration of data and applications;
- versatility;
- code reuse
- reduce costs

Web services provide the interoperability premises that involve the use of XML technologies that are independent of the developer, platform or programming language and HTTP as a means of transport by which any application can communicate with another. To exchange data with a service, the client requests only the WSDL definition and no need for either party to

⁵ Thomas Earl, *Service-Oriented Architecture (SOA): Concepts, Technology nad Design*, (New Jersey: Prentice Hall, 2005)

know how the other is implemented or in what format information is stored. These advantages allow organizations to easily integrate applications and different data formats. Web services are versatile by design. Can be accessed by users via a web-based client interface or can be accessed by other applications or Web services. A client can even combine data from multiple Web services, for example to provide the user an application that updates collections or ERP systems using a single interface-even if the systems are incompatible. Because systems exchange information using Web services, a change in the revenues for example, will not affect the web service. The ability to reuse the code is another positive aspect of web services flexibility and interoperability. The service can be used by many clients that engage operations provided to achieve different objectives. Instead of creating a custom service for each query unique, parts of service are simply reused, if necessary. All these benefits translate into significant cost savings. Facilitate interoperability means eliminating the need to create custom applications that involve high costs for data integration. Investments made in infrastructure development and systems can be easily used and combined to achieve a high added value. The benefit of using web services is that these represent an independent standard of platform and the programming environment used, and for the programming languages with included support, these automatically occupy themselves of packing/unpacking SOAP messages and the transfer of parameters/results. Thus, the programmer can use the time to focus on the including method function and not on the sending and receiving data.

eGovernment and transition to Web 3.0

The European commission has emphasize which are the main steps that Europe needs to do for responding to the next wave of information revolution, which will intensify in the next years, because of some trends like social networking, the decisive orientation to online services, providing services based on GPS and mobile TV, as well as the fast evolution of using smart tickets.

The Europe lies in a position that allows it to exploit these trends as a result of its politics that support the telecommunication networks opened and oriented to competition, as well as the security and protecting personal

information. In the commission reports come up a new broadband performance index which compare the performance from a national level as regards of key elements like connection speed, price, competition, and the coverage area. The internet of the future will radically change the society where we live. The Web 3.0 concept signify availability anytime and anywhere for the business and social environment, using the secured and fast networks. Means the end of differentiation between fixed and mobile lines. Webs 3.0 announce a significant increase in using digital technologies until 2015. The Europe owns the know-how and the capacity at the network level to accomplish this transformation.

The users from Europe have access to the improved and much faster internet services: much more than a half of them had access to the broadband internet over 2 Mbps, at the end of year 2007, a speed which is two times bigger than a year ago and which support television over the Internet. The broadband connections cover 70 % of rural population amongst those 27 member states, total coverage reaching 93 %. In the last year the coverage of the broadband connections, in rural environment, in 25 member states, has increased by 8 %, prospects of increasing have maintaining for the current period. This opens the way for a new generation of Internet, and the potential for the European economy is clearly. While a quarter of Europeans have used 2.0 websites in 2007, the bussines applications for social networking will rapidly evolve. It is also stipulate an worldwide increasing with 15% during 2006-2011, of a business web-based software.

Small applications will need a total internet coverage. The concept Internet of things represent a wireless interaction based on the Internet between machines, vehicles, sensors and other objects. The evolution of mobile devices allows the exchange of information or pay online by accessing the internet. It is estimated that by 2015 over a billion mobile devices will support such capabilities.

This context opens up new opportunities for business sector with condition of maintaining the high level of investment in expanding access areas to the high-speed connections and sustaining the work and research. In the announcements of European commission it is specified that the union.

Conclusions

Communication between processes is the key element of distributed systems. This is based on sending messages to a lower level provided by the network. The expression of communication through messaging is more difficult than using primitives based on shared memory available on undistributed platforms.

Modern distributed systems often consist of thousands or even millions of processes spread across a network in which communication is not secure, an example being the internet. Development of applications on a wide coverage area is extremely difficult if the facilities of communication primitive's computer networks are not replaced with something else.

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