

Possibilities for Modeling and Integration of Business Processes*

Hristina Daskalova, Vladislava Grigorova, Tatiana Atanassova

Institute of Information Technologies, 1113 Sofia

E-mails: daskalovahg@abv.bg v.grigorova@abv.bg atanasova@iit.bas.bg

Abstract: *Web-based modeling of business processes is considered. The technological chain for generating loosely coupled systems, using the technology of Web-services is described. Requirements that concern the language describing the sequence of actions in the business process, as well as the infrastructure that will realize these actions, are determined. Standards for orchestration and choreography are discussed. Integration in enterprise applications using development of software technologies on the basis of a distributed service-oriented architecture is shown on the example of IBM solutions.*

Keywords: *business process, web services, orchestration, choreography, grid-environment.*

I. Introduction

The methods for modeling business processes may be divided with respect to the moment of their release – either created before the development of Web-services or directly based on Web-services and service-oriented architectures. The Web-services give a possibility for creating an integrated platform. They are tools for interoperation of information systems that are not human centralized. There exists an opinion that the first actual languages for models description, such as ebPML, BPML, XLANG, WSFL, BPEL4WS, EDOC, XPDL and UML 2.0 will lose their independent existence, but will continue to be used in combination with the second ones. After the development of version 1.1 of the specification of BPEL4WS language and its renaming into BPEL, its positions have considerably improved in comparison with the remaining languages.

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A completely new step in modeling is the release of Process Modeling Notation (BPMN), which advantages are recognized by BPEL developers as well. BPMN graphical objects are supported by a large selection of attributes, which can be directly presented in BPEL language. Future consolidation of the two mutually complementary approaches to modeling – BPMN notation and BPEL language, is expected. The purpose is to offer such form of presenting the models in business, which will be comprehensible both for the developers and for the persons who monitor the business processes. The technological chain for generating weak-connected systems, using the technology of Web-services and BPMN may include: design of the processes with the help of BPMN tools; modeling and optimization of the processes; description of the services by BPEL tools and orchestration of the services.

The elaboration of the business processes on the basis of Web-services uniting has determined two aspects of interaction and the respective introduction of the notions “orchestration” and “choreography”. Orchestration concerns the process, which is realized and can interact with external and internal Web-services, while choreography is responsible for the succession of the messages generated by the participants in it. The standards of orchestration and choreography must meet some technical requirements, which make possible the application of the Web-services [1] in the development of business processes.

II. Requirements towards business processes development

These requirements concern the language describing the sequence of actions in the business process, as well as the infrastructure that will realize these actions:

- In order to guarantee security and universality of the computing environment, a possibility is required for asynchronous demanding of the services and the realization of asynchronous Web-services needs a mechanism for requests correlation. There exists a concept that the asynchronous services could be the core of weak- connected architectures, which use messages exchange. During the design of the interface, messages exchange is foreseen, at that not only in transmitting data to Web-services providers, but also in receiving the corresponding data. In order to react to the input message, it is necessary to know the address, where to send the generated message with some information about its correlation with the input initiated message (there is a WS-Addressing specification in BPEL for this purpose). The large integration processes suppose the participation of a human operator in the automatic process and a process including a human response is not synchronous.

- The architecture of the business process must provide control in extreme situations and preserve the transactions as well. Besides processing of errors and time-outs, the orchestrated Web-services must guarantee accessibility to the resources during the execution of time-consuming distributed transactions. When using different methods of compensating transactions, the transactions coordinator may cancel some operations (due to the process or the user).

- The orchestration of the Web-services must be dynamic, flexible and adaptive in order to meet the altering requirements of business. For this purpose the logic of the process of the Web-services used is divided, which is enabled by the mechanism of orchestration. With the help of this mechanism, the working flow of the business process is managed, the respective Web services are invoked and the steps for their

realization are determined. The approach makes possible the replacement of the services in the working flow.

- The design includes also a possibility to combine the services at a high level, based on the existing orchestrated processes. The recursive composition is realized presenting the processes as interfaces to Web-services.

III. Standards for orchestration and choreography

XLANG (XML-based language) developed by Microsoft, was initially designed to describe successive, parallel and multi-variant working flows for BizTalk Server [2]. There is not any principal possibility in BizTalk Server to express the business process by traditional programming languages, but the process is defined by graphical means, which enable the determination of the logical sequence of the steps aimed at solving a certain business problem and also the description of the conditions, cycles and other characteristics in the behaviour of the business process with the help of special forms. When describing the interfaces of the Web-services, XLANG uses Web Services Description Language (WSDL), suggested by World Wide Web Consortium (W3C). The main task of XLANG consists in defining the business processes and in the organization of the messages exchange among the Web-services. This language has tools for processing extreme situations and supports long-term transactions.

WSFL (Web Services Flow Language) of Microsoft allows the description of public and private processes. It determines the data exchange, the succession of the execution (a flow model) and the expressing of each step in the flow in the form of specific operations (global model). WSFL supports WSDL interface, which enables the solution of recursive composition problems, possesses means for dealing with exceptional situations, but does not support transactions.

The United Nations Organization center for co-operation in the area of commerce and electronic business (UN/CEFACT) has developed the Electronic Business Extensible Markup Language – ebXML, on the basis of XML. This standard provides a set of program documents, facilitating the co-operation between business partners. It includes the Business Process Specification Schema (BPSS), which makes possible the determining of the choreography and the communication protocols among the Web-services.

Hewlett-Packard Company has offered a standard for modeling sequences of interactions of the Web-services – Web Services Conversion Language (WSCL), released in March 2002. This standard is discussed by the working group in choreography and Web-services of W3C.

The companies Sun Microsystems, SAP, BEA and Intalio have developed a specification of the language describing the interfaces – Web Services Choreography Interface (WSCI), which expands WSDL language with the purpose to organize shared work [3]. In the general case WSCI determines the choreography or the exchange of messages among the Web-services. The specification ensures correlation between the messages, rules for ranking, processing of extreme situations, transactions and dynamic interaction. It supports base as well as structural actions.

BPML (Business Process Modeling Language) is a language designed to describe the business processes on the basis of XML. Its specification is developed by the Business Process Management Initiative organization. At first BPML was intended to

present the course of actions of a system controlling the business processes. Later on a possibility was added to it for WSCI support. BPML has constructions depicting the actions of the working flow of the business process similarly to BPEL [4]. It allows structural actions, successive and parallel processing, cycles and synchronization of the processes, base actions for transmitting and receiving of messages, requests invoking. It enables planning of the tasks and contains functions for data long-term storing. The data exchange among the participants is realized in XML format, using roles and definitions of the partners, similarly to BPEL constructions. BPML supports a recursive composition, intended to form integrated processes from components, and provides both long-term and short-term transactions. The developers can actuate some of the built-in processes and transactions. BPML has a mechanism to process extreme situations.

UML (Unified Modeling Language) is used for specification, visualization and documentation of the design process of object-oriented software systems. Diagrams are used to introduce three types of models: functional, objective and dynamic. The graphic notation in UML has textual equivalents in the object-oriented programming languages, for example JAVA.

In May 2003 Microsoft, IBM, Siebel, BEA Systems and SAP have developed together a version of the specification of BPEL4WS language. This specification, called BPEL, enables the modeling of the behaviour of the Web-services in the interaction of the business processes [5]. Its constituent part is a grammar on the basis of XML, describing the logic of control in the co-ordination of the Web-services, participating in the working flow of the business process. The mechanism of orchestration in conformance with the grammar can coordinate the actions and compensate the process as a whole in case of errors occurrence. BPEL is an extension of WSDL, which determines the list of the possible operations and BPEL describes the order of their execution. WSDL indicates the public points for input and output of every BPEL process and the types of data in WSDL determine the information exchanged among the requests of the business process. WSDL allows referring to external services, necessary for BPEL process, which supports executable and abstract business processes also. The process, which is executable, models the behaviour of the participants under a certain interaction, i.e. a given working flow. The abstract process or the business protocol is not an executable process, it defines the public messages among the participants, but it does not reflect the inner details of the working flow of the business process (the executable processes model the orchestration, while the abstract – the choreography of the Web-services).

BPEL4WS specification supports both base and structural actions. The base action is an instruction for interaction with a factor, external with respect to the process. The base actions serve the reception of requests, responds and Web-services invoking. The structural actions control the working flow of the business process as a whole, determining the sequence of Web-services demands. These actions support also the execution of the cycles and the dynamic branches. In their essence they define the main logic of programming in BPEL. Two other important elements in BPEL are the partner connections and the variables. The variables identify certain data in the messages flow. When BPEL process receives a message, it assigns a value to the respective variable, so that the next requests may refer to this data. The variables are used to control the long stored data in the course of processing the requests for Web-

services. The partner link may denote any request, with which a given process interacts. Each partner relation has its corresponding role in the business process. BPEL and BPML allow defining of the executable business process, while WSCI is mainly oriented towards interaction and it requires each one of the participants to determine its WSCI interface. The protocol for joint work concerns the organization of the messages exchange among several participants in the business process, while the executable process is a given working flow and it is under the control of the separate participant. BPEL supports the executable processes and the organization of the interactions among them as well. BPML and WSCI can work together in such a way, that BPML models the execution of the business process and WSCI – the choreography of the Web-services.

In 2004 IBM and BEA have issued a common document “BPELJ: BPEL for Java”, which suggests another language – BPELJ, being a combination between BPEL and Java. The purpose is to place closer the description of the processes to software products development. BPELJ enables the including of BPEL fragments in Java-codes, called Java snippets.

The uniting of Web-services with Business Process Execution Language for Web Services increases the efficiency of the applications integration. The Web-services allow the transfer of the integration processes from a software level to the level of messages exchange among applied functions, formed as requests. Microsoft and IBM companies have a leading role in the standardization of the technology of the Web-services and they offer their own realization of the mechanisms for applications integration (for example the last version of BizTalk Server 2004). The construction of a working environment, based on Web-services passes through two stages of work with the services – publishing and orchestration. The publishing of services gives opportunities to use services with the help of interface protocols. The orchestration combines the services in a united business application and accomplishes their co-ordination. The necessity in products, similar to Oracle BPEL Process Manager [11] is grounded on the fact that the logic of the orchestration is sufficiently complicated and must correspond to the surrounding environment. It is an appropriate tool, which gives the organizations the possibility to model and implement business processes using BPEL. The latter is recognized as an outstanding one in the organization of the orchestration and services execution in service-oriented architectures, which causes diminishment of the complexity and speeds up the realization of the integration projects. Oracle BPEL Process Manager is the first version of a BPEL-machine, completely corresponding to the standard and ready for release.

An existing functionality is used for publishing and this functionality becomes accessible through the network. There are some standards describing how to create an interface to this functionality (WSDL) and a data model (XML and XML Schema), supporting different protocols. The service thus issued may be considered as a main element (block), which can exchange input and output XML messages with its environment. Oracle BPEL Process Manager (Fig.1) comprises a BPEL Designer (Fig. 2), allowing graphical interface to BPEL-processes (forming a BPEL machine), built-in integration services for connection to SOAP and other protocols, and a BPEL Console, supporting Web interface.

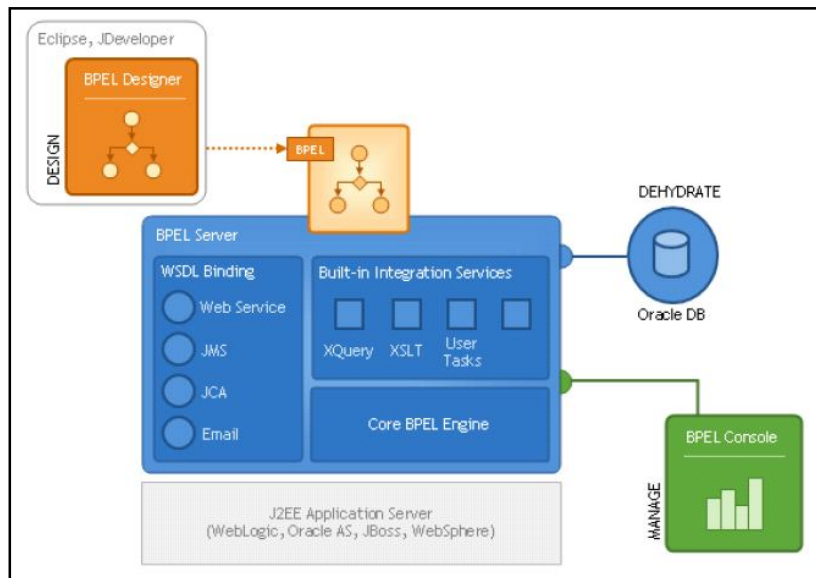


Fig. 1. Oracle BPEL process manager

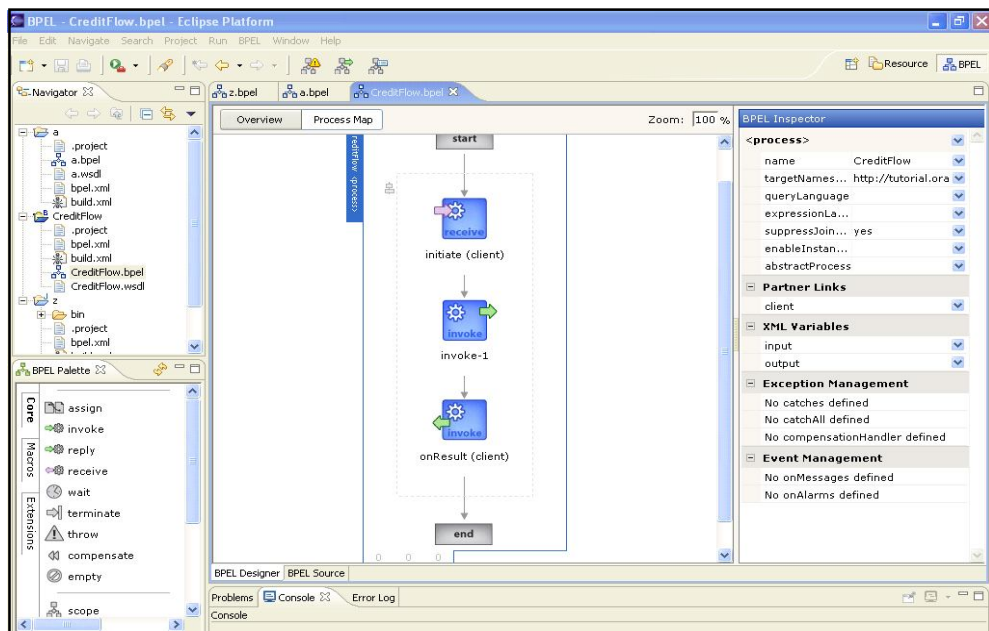


Fig. 2. BPEL process model designer

IV. IBM solutions for business integration

The strategic solution of the integration problems is the use of some software platforms tested in time and practice at industrial level, EAI (Enterprise Application Integration). The platform of IBM, WebSphere proved to be one of the leading and best functional

instruments of EAI. All products of WebSphere family may be referred to the category of the integration software insurance, but in this case the solutions realized within the frames of IBM Business Integration attract special interest.

The main problems of business integration include: integration of the users experience; information integration; applications integration; integration of the business partners; processes integration. The business integration uses a set of possibilities for service-oriented architectures which comprise: organization of interactions and control of the business operations, application of the information resources in the enterprises, connection with the business partners, and availability of a common network for co-operation among decision makers solving specific problems in business. The software platform of IBM – WebSphere Business Integration [6, 7] possesses these possibilities; it suggests a method for creating solutions in business integration that applies the modeling tools to determine the requirements towards the solution and also the necessary means for generating and connecting the service-oriented software components. IBM has declared as its priority the development of its software technologies on the basis of a distributed service-oriented architecture (SOA). The solutions of WebSphere Business Integration Server Foundation make possible the creating and integrating of the applications within the frames of SOA. This is the first IBM product with built-in support of Business Process Execution Language (BPEL, Fig. 3) – as a standard specification for realization of business logic. With the help of WebSphere Business, manifold usable services can be created on the basis of the existing Web-services and ready applications, and also combine the services connecting the business processes with the software applications. IBM division Global Services proposes services connected with SOA. IBM Assessments for Service Oriented Architectures analyzes the functional and technical aspects of the planned introduction of SOA. Strategy and Planning for Service Oriented Architectures enables the determining of the business and technological possibilities necessary for the realization of the advantages of the Web-services oriented computing technologies. The Application Renovation and Integration for Service Oriented Architectures intends to re-build the old applications and make them a part of SOA. Besides this, the subdivision Component Business Modeling, uniting IBM Research and Business Consulting Services, suggests the classification of the organizations activities into activities, performed by associates, by processes or by systems.

The software platform WebSphere Business Integration integrates the internal systems of the enterprise, the systems for business partners and also the control of the business operations; it supports the solutions with integrated tools as a result of the integration of metadata in Eclipse, including Eclipse Modeling Framework, realizing Meta Object Facility. Thus the integration of the meta-models is maintained, which enables the exchange of solutions elements also with the help of instrumental tools.

Ontologies are fundamental structures for systems that operate with information and are base for Semantic Web. Ontology-based Web Services for Business Integration is a semantic Web services for the industrial sector that shows service discovery, composition, and business process transformation. It supports the infrastructure for next-generation, semantic Web services middleware that enables business process integration, including business-to-business (B2B) exchange. It is a demonstration of technology that can facilitate enhanced discovery, composition, and transformation of business processes through semantic enablement and intelligent agents.

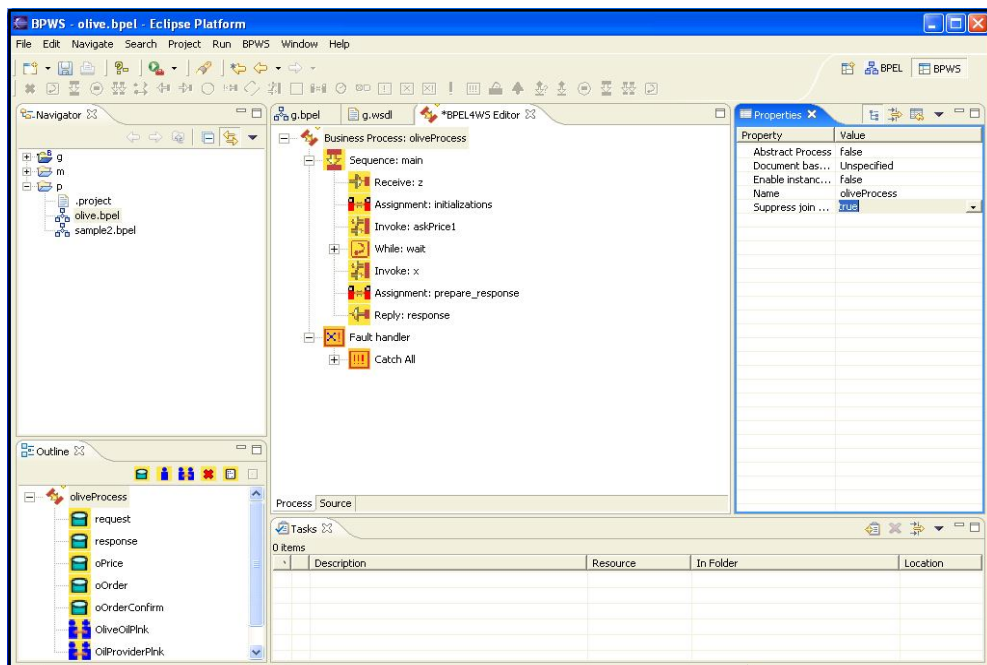


Fig. 3. BPEL4WS editor

V. Features of the grid-environment connected with business

Primarily, there is difference between the computing grid-environment and this for business, concerning the Web-services and formed as a concept of Grid services. Standardization is being elaborated in this area within the frames of Global Grid Forum. Architecture that combines the main Grid technologies with Web-services is suggested, intended for formation of components of an infrastructure for integration, virtualization and control of various resources in virtual organization. Despite the difficulties in the technical realization, the main characteristics of the grid-architecture and the requirements towards it are already outlined:

- Grid – this is methodology and technology uniting a large part of modern computer infrastructure (servers, data stores, applications, control systems, etc.);
- From the viewpoint of technologies, grid is not a ready product, nor a set of products, nor a component of a product or service, but a way to organize an infrastructure, based on distributed architecture and on dynamic distribution of the loading of the complete set of applications;
- From the viewpoint of the user, grid is a service, providing the necessary computing resources on a request. The Grid-system is not adjusted after altering the list of tasks, neither after altering the loading in a given problem. The complexity of the solutions is not visible for the user and he pays for the service only, not for the infrastructure built.

The Grid is built on already existing technologies and consists of a set of services, registered in repositories, which indicates where each service is accessible and where

the service used must be paid for. It must be based on industrial standards that enable the operation with components of different manufacturers. The services proposed must be quick and protected. It is expected that a grid for business will be realized if the economic effect achieved gives good reason for the technical complications and expenses.

VI. Conclusion

The realization of an infrastructure is expected, in which the central place will be occupied by the process directed towards business problems solution, characterized by the following: all stages of the business process are supported in the stage of their creation as well as during their execution; the components and the functions of the process are presented as self-defining services; there is a possibility to integrate different necessary sources of information and applied functionality in the process, independently on the way of their realization and their physical location; there is a possibility to automate the flow of information and messages for events within the frames of the process; there is a possibility to specify and monitor some agreements for the level of serving all services, actuated in the process; each stage of the process may be added, removed or altered without any influence on the other stages, etc.

The tendency towards automation of the business processes with the help of weak-connected components will give the infrastructure the possibility to react with respect to the changes in business and will develop the idea for an adaptive enterprise and also make considerable steps in its realization.

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