КОМПЬЮТЕРНЫЕ ТЕХНОЛОГИИ В ФИЗИКЕ

DESIGN OF WEB PLATFORM FOR SCIENCE AND ENGINEERING IN THE MODEL OF OPEN MARKET

A. P. Demichev [1]*, A. P. Kryukov*

Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow

This paper presents the design and operation algorithms of a web platform for convenient, secure, and effective remote interaction on the principles of the open market of users and providers of scientific application software and databases.

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INTRODUCTION

One of the successful modern trends in the development of Internet services is the emergence of a large number of intermediary websites that allow providers of any goods or services and their consumers to find each other and to directly interact. Besides the well-known online stores of software for mobile devices AppStore (apple.com/appstore) and GooglePlay (play.google.com), as well as the online auction site eBay (eBay.com), there are many other sites in different areas but with similar functionality. For example, the site italki.com provides a free market place for teachers and learners of a foreign language (distance learning via Internet, e.g., via Skype; more than 2 000 000 learners of foreign languages have used this site).

In the area of scientific and engineering research the intermediary sites are also becoming popular. In particular, these are the so-called research hubs, that is, the web platforms [1] providing the ability of remote installation and configuration of packages of application programs that can be used by other appropriately authorized users. The most famous and successful of such websites is the hub in the field of nanotechnology NanoHUB (www.nanohub.org) [2]. A giveaway price for using the NanoHUB resources is a freewill obligation to indicate in the publication, created with the use of these resources, the link to this website. It is clear that a distribution on such a basis of a software suitable for a full-fledged research, especially for commercial use, is impossible. Therefore, the NanoHUB administrators put the main emphasis on the educational purposes and respectively on rather simple software, unsuitable for commercial use.

On the other hand, many developers of application software or database creators in various branches of knowledge have the intention to provide its product for use by other researchers, but under certain conditions, in particular, of receiving certain payments for the use of the

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provided product. However, individual developing and maintaining hardware and software infrastructure supporting the delivery of a product under certain conditions, as well as charging fee for its use, is disadvantageous from a financial point of view and the time spent on its creation.

Therefore, a very important task is to develop a web platform where users of resources (application software and databases), presented in the form of web services, and their providers would be able to directly interact, while the web platform has to perform a range of tasks typical for the free open market. This paper presents the architecture and basic principles of operation of such a web platform.

1. WEB MARKETPLACE ARCHITECTURE AND ALGORITHMS

General architecture of the web platform for the marketplace has the three-layer architecture (see Fig. 1).
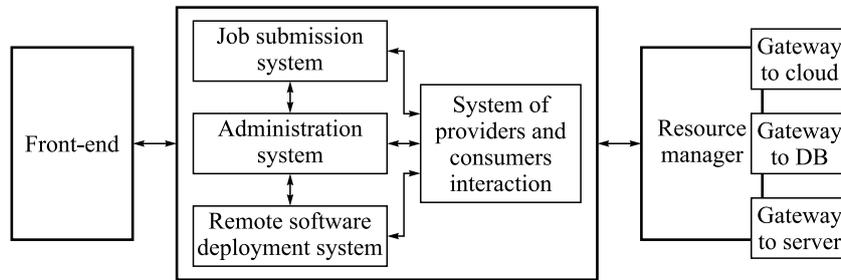

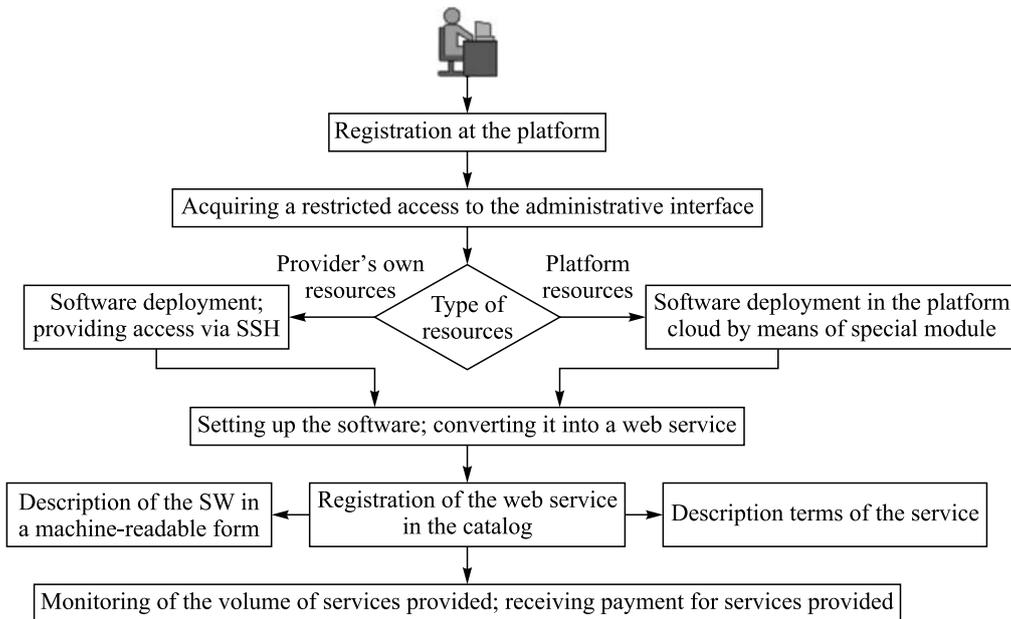Fig. 1. General architecture of the web marketplace

Fig. 2. Simplified algorithm of interaction of a provider with the web marketplace
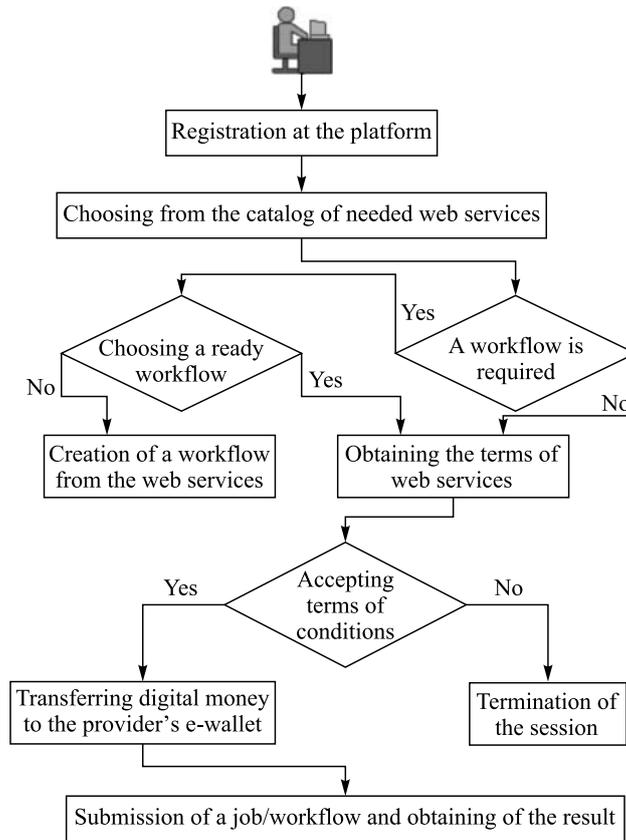
Fig. 3. Simplified algorithm of interaction of a consumer with the web marketplace

The first layer is the front-end that provides the user web interface; the second layer consists of the platform engine responsible for job submitting, obtaining results, execution of workfows, etc., the system of remote software deployment, the administration system (responsible for user management, tool configuration, audit trails, etc.), and the system of providers/consumers interactions; the third layer is a resource manager that exposes data and compute resources to the preceding layer. Also, the web platform has security infrastructure (see Sec. 2). Each of the systems of the second layer, in turn, consists of a set of the functional modules. For example, the system of job submission consists of modules of task launching, workflow processing, access to scientific databases, etc. (see, e.g., [1] and references therein). The most important system from the point of view of the purposes and tasks of the web marketplace is the system of providers/consumers interactions. The list of modules of this system includes: module of software registration; service catalog with search engine; logging module; billing module; integrator of conditions for workflows; module of verifying compliance with the terms of service; software deployment module; module of a tool setup; module of e-wallets; repository of the software codes; module for review and blog posting and for assigning rating marks.

A simplified algorithm of interaction of a provider with the web marketplace is depicted in Fig. 2.

Application software to be converted into web service (Software as a Service; SaaS model) can be deployed both on provider's own hardware and on the dedicated platform resources. The first way especially fits the requirements of providers who want to completely exclude full access for users and platform administrators to the software (both to source code and to binary executables): the provider can allow only restricted set of commands for software execution and obtaining the results. A natural solution in the second case (dedicated platform resources) is the use of virtual machines that provide both safety (isolation of installed software) and feasibility of using the operating system required for the application software to be installed. Since a cloud infrastructure provides tools for managing virtual machines, the web platforms allowing software installation must provide access to cloud systems in the framework of Platform as a Service (PaaS) model.

The interaction of consumers with the web marketplace is presented in Fig. 3. The scope of this publication compels us to omit many details of the algorithms.

The administration system of the web platform provides user registration, moderation of software installation, user support and Quality of Service (QoS) obligations from the side of providers offering their own computing resources. It is worth noting that the possible types of services which providers can offer via the web marketplace include ready and debugged workflows, constructed from the software available on the marketplace in the spirit of the BPaaS (Business Process as a Service) model [3].

2. SECURITY INFRASTRUCTURE OF THE WEB MARKETPLACE

The web marketplace together with computer resources, where the application software and databases are deployed, is a special case of the distributed computing systems (DCS). To provide secure access to the resources of DCS with the account of the rights of a given user as well as of the politics of a given service or resource, a DCS security infrastructure is needed. This infrastructure should be sufficiently reliable and at the same time user friendly.

Within creation of the DCS, the new technique of authentication of users [4] which is based on login/password pair together with a sessional key is developed. Key difference of this method from the most popular approach based on public key infrastructures (PKI) [5] is the non-utilization of proxy certificates for execution of user requests.

Another new principle which is suggested to be used for security arrangement is the use of hashes for signing requests in the framework of a DCS. For confirmation of legality of each request in DCS signatures in the form of specially created unique hashes with unlimited validity period are used. The use of the unique hashes allows one to solve, on the one hand, a problem of protection of request contents while processing within DCS, and, on the other hand, to solve the problems caused by limited period of validity of usual proxy certificates. Registration of the unique hashes allows one to provide authentication and authorization of requests.

Protection of the confidential information transferred over communication links is provided by use of standard means of cryptography protection (TLS/SSL). Authorization with role determination of access rights of users is carried out by means of the mechanism of dynamic mapping of users to local accounts of a computing resource with the appropriate rights. Support of delegating of the rights of the users to other web services entering the DCS for the coordinated work of components of the system is carried out by online authorization

of requests by means of special RESTful service, namely, the service of authentication and authorization.

In general, the suggested approach leads to essential simplification of both the registration of new users in the system and their operations in the distributed system. Some lowering of the security caused by the sessional key without password is compensated by restriction of its validity time. After validity expiration of the key, the user requests a new key either via the special web interface or through API of the appropriate service.

CONCLUSIONS

A prototype of the web marketplace suggested in this paper is currently being developed at SINP MSU. The technological basis of this prototype is the service-oriented architecture (SOA) [6], as well as the REST architectural style [7]. For the data interchange between services the JSON format (http://www.json.com) is used. Operation of users is supposed in two modes: through a web browser and via the command line interface. The latter mode is intended for advanced users and allows one to automate a set of actions.

The approach proposed in this work will allow one to solve an important problem associated with the use of the SaaS concept in scientific and technical fields, due to the limited set of programs and packages offered by the providers of SaaS services. Currently the provision of services for providers of application software in the context of science-oriented web sites are worked out insufficiently deeply. Though in some developments there are services for remote installation of an application software [1], they are still insufficient to provide creation of a web site capable to carry out all range of tasks which is characteristic for the free open market. The results of the work presented in this article will fill this gap and provide the program and methodological basis for the emergence of self-organizing and based on the principles of sustainability web marketplaces in various scientific, engineering, and production areas.

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