Application Server Evaluation Method

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Abstract: *The paper describes an application server evaluation and selection for software systems implementation using client-server technology. The multi layer application architecture has been illustrated and the definition of application server made. On the base of application server analysis assessment criteria were chosen and particularly described, and criteria were classified in 11 categories. An application server selection method based on multiattribute comparing approach is offered. Results of comparing of seven application servers are considered.*

Key words: *Application Server, Multiattribute Comparing Approach, Java2 Enterprise Edition.*

INTRODUCTION

For the last ten years information technology industry has being evolved rapidly and a customer requirements for software functionality too. To satisfy these needs a client-server application model with multi-layer architecture has been developed (Fig. 1).

The advantage of this model is application functionality replacing from the client to the server layer. This gives an independence from the client resources and allows increasing the application performance and functionality. One of the first technologies that implemented this model was Java2 Enterprise Edition (J2EE) platform (based on Java language) [5] and later .Net technology appeared.
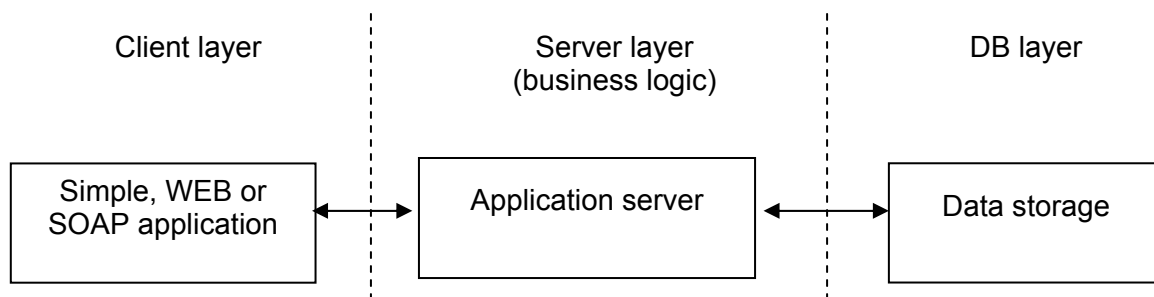

Figure 1. Classic 3-layer architecture

An application server is a kind of software which is placed on the server (middle layer) and connects client layer with data storage, realizing such services as server component management, fault tolerance, load balancing, transaction management, security management, server administrating tool and some other services [3].

Seven popular J2EE application servers were selected for comparing analysis: Borland Enterprise Server 5.2., IronFlare Orion 2.0.2., Oracle9i Application Server 9.0.2., BEA WebLogic Server 8.1 SP2, IBM Websphere Application Server 5.1., JBoss 2.4.4., Macromedia JRun 4 Service Pack 1a. These application servers take more than 80% of J2EE application servers' market [2].

Application servers can be used in developing and maintenance process of different systems classes, so each system has its own requirements to the application server. It is possible to classify systems with similar requirements in five groups:

- Large enterprise application development. In this group the requirements are distributed homogeneously, because this group requires server to support well primary functionality, additional functionality, performance, scalability opportunities, development and deployment opportunities. Server is used as single service.
- Large enterprise application development with requirements for additional functionality is similar to previous group, but more important is server additional functionality. Server is used only as a part of large platform.

- Large enterprise application development with requirements for performance and fault tolerance group. In this group banking or military system can be meant.
- Small and medium enterprise application development group. The most important requirements are low cost and good integration opportunities (for example, with freeware products to reduce costs).
- Specific cases. Group is used when server is used in cooperation with some defined system and this cooperation highly influences server performance and functionality (for example, Oracle server with Oracle DB).

To evaluate and select server for definite software system the method based on server's estimation according a set of criteria is offered.

APPLICATION SERVER ESTIMATION CRITERIA

Many criteria are used for comparing application servers. To simplify the process of comparing criteria are classified into 11 categories (some of them are used in [1]):
1. J2EE support, that checks server compliance to J2EE specification requirements.
2. EJB container and bean support. Category allows to estimate server components functionality.
3. WEB component support. This category summarizes WEB support possibilities.
4. Services, that is predestined for estimation of implemented services.
5. Additional functionality. Category consists of criteria which allow to estimate product additional functionality, supported extra services and technology, integration opportunities with extra tools.
6. Scalability opportunities. Category consists of scalability criteria.
7. Development and Deployment. This category allows to estimate a presence of tools for component development and deployment.
8. System Management contains criteria of system administration and control.
9. Product adaptation. Category includes such criteria as putting into operation and support opportunities;
10. Server performance.
11. Specific properties. Category consists of important criteria used in server comparing analysis, but not included in previously described categories.

The list of criteria and their descriptions is shown in Table 1.

Table 1

Categories and description of criteria

Criterion name	Categories and description of criteria
J2EE support	
Component support	JSP (Java Server Page), Servlet, EJB, Applet, J2EE client application support
Protocol support	HTTP, SSL, RMI (Remote Method Invocation), RMI-IIOP (RMI over Internet Inter-Orb Protocol), JavaMail
Unit support	WAR (Web Application Archive), JAR (Java Archive) and EAR (Enterprise Application Archive) unit support
Services support	JDBC, JNDI support
Technology version support	J2EE technology versions support
EJB container and bean support	
Container functionality	Running EJB services outside container, built-in primary key generation
Session bean support	Stateless and stateful bean support
CMP additional opportunities	CMP engine effectiveness, replacement opportunities

CMP entity finder methods	CMP beans finder process effectiveness
Message-driven bean support	Message-driven bean support, message server functionality
WEB component support	
WEB server support	Answers to such questions: "Does application server contains embedded WEB server", "Is there an opportunity to integrate application server with third party WEB servers", "WEB server offered opportunities"
WEB container support	WEB container functionality
WEB services support	SOAP (Simple Object Access Protocol), WSDL (WEB Services Description Language) and UDDI (Universal Description, Discovery and Integration) registry
Services	
Transaction support	Transaction type and attributes, XA mode (two-phase commit) support
Database support	Database connections pooling, specifying of minimum/maximum number of connections
Security	Types of authentication support; method, application and role based authorization support; secure client connection support
Naming service	Naming service support
Services flexibility	Checks the opportunity to add user-defined services, turn off non-used services, the level of services dependency on other components
Additional functionality	
Additional functionality	Estimates the opportunity of server to be a part of a large platform, server's extra functionality
Integration opportunities	An opportunity to integrate server and its components with third party products
Other technology support	Extra technology, language and protocol support
Scalability opportunities	
Clustering	Clustering process and its efficiency estimation
Fault tolerance	Criterion estimates is this opportunity supported, for all clustered components
Load balancing	load balancing of server components
Development and Deployment	
Tool common functionality	Criterion allows to estimate common software package, integrated tools for development, deployment and debugging, other tool support
Server component development	Estimates the complexity of server component creation and import using application server tools
Server component deployment	Estimates the complexity of server component deployment using application server tools
System robustness in development time	Criterion shows server and extra tool stability and answers those questions: were any defects stated, did they influence during development, deployment and testing process? Was there need in patches, new versions?
Unit independence	The criterion allows to estimate WEB server, virtual machine and other components replacing opportunities without server work interruption
Compatibility opportunities	How difficult to migrate from one server version to another (from older to newer and vice versa), migration to another application server
System Management	
Server installation	Criterion contains the estimation of such requirements: server installation and configuration, client support with all required components, installation

opportunities	process automation, installation speed, uninstall opportunity, version upgrade opportunities, database drivers automatic installation and compatibility with required databases
Server and services administration	Shows if all servers and services can be controlled, started and stopped. Server, services and container property updating opportunities
Server components administration and control	Does server support deployed server component redeploying, removing and monitoring, opportunity to see component settings from management tool
Debugging and logging	This criterion allows to estimate server opportunities to see and modify debugging, logging, event levels and to see log fails
Product adaptation	
Putting into operation opportunities	Has application server any local dealers. Do they offer putting into operation, support and consulting services, server support from developers (official sites)
System required resources and platforms	How much resources are required for server installation, normal functioning, under which operational systems can be used server
Documentation, samples and examples	Documentation about product and its components (delivered with server and from official sites). Documentation completeness and comprehensibility. Quality of samples and complicated points explanation
Product distribution level	Product distribution in the world, in local area, information amount in the Internet network
Prices	Product prices, version modification prices, different edition offerings (standard, enterprise etc.), services prices
Version issues	How often are new issues offered, its stability? How often patches are issued?
Server performance	
Server performance	Server performance
Performance costs	Allow to estimate server operation costs and depend on server price (hardware, software) and performed operation amount per second
Specific properties	
Intuitive understanding	Criterion allows to estimate how intuitively easy to understand application server, its components administrative tools, interfaces and work with them. Compared interface differences with previous server versions (users have accustomed to them)
Certificates, awards	Server certificates and awards are the evidence of its quality
Specific points	Criterion estimates server specific points, which influence overall result of estimation. For example, application server developer can develop different product too (hardware, software). With this product application servers cooperation can be better (databases, computers, other applications)

SERVER SELECTION METHOD

Suppose there is some problem to develop a software system using client-server technology. The most appropriated server should be selected. But there is no opportunity to detect the best server unambiguously, because each server has advantages and disadvantages. For server selection the method based on multi attribute comparing approach can be used [4]. This method consists of five steps.

Step 1. On the base of the system requirements categories of criteria are estimated, giving weights w_i for each of them. So, **W = { w$_1$, w$_2$, …, w$_n$ }**, where **n** – number of categories (n=11), **w$_i$** - *i*-category's weight coefficient (value from 0 till 1). The sum of **w$_i$** (i=1, 2, …, n) is equal to 1. Value **w$_i$** depends on overall category criteria importance for the system.

<u>Step 2</u>. Analogically criteria of each category are estimated: $Z_i = \{ z_{i1}, z_{i2}, \ldots, z_{im} \}$, where z_{ij} - *i*-category's *j*-criterion weight coefficient (value from 0 till 1), **m** – number of criteria in category *i*. The sum of z_{ij} (i=1, 2, …, m) is equal to 1. Value z_{ij} depends on criterion importance in category.

<u>Step 3</u>. Each of application servers is estimated, assigning such value $t_{ij}(x_k)$ to every criterion *j* of separate category *i* that corresponds to possibility to realise the system requirements. Each server is evaluated by each criterion with value in range of 0..1 and usually it is done by experts (0 – feature not supported, 1 – fully supported by server) When all criteria of a server x_k is estimated can calculate a server's evaluation $V_i(x_k)$ appropriate to category *i* using formulae:

$$V_i(x_k) = \sum_{j=1}^{m} z_{ij} t_{ij}(x_k), \qquad (1)$$

where $t_{ij}(x_k)$ – server *x* *i*-category's *j*-criterion estimation;
   z_{ij} – *i*-category's *j*-criterion weight coefficient;
   m   – number of criteria in category *i*;
   K   – number of examined servers.

<u>Step 4</u>. The overall evaluation of each server x_k is calculated using formulae:

$$V(x_k) = \sum_{i=1}^{n} w_i V_i(x_k), \qquad (2)$$

where $V_i(x_k)$ – server x_k *i*-category's evaluation;
   w_i – *i*-category's weight coefficient;
   n   – number of categories (n=11),

<u>Step 5</u>. Each server has $V(x_k)$ evaluation value for each of the requirement groups, so the best server is one which has best score for selected requirement group.

SERVER COMPARING RESULTS

Based on server experts opinion each server was evaluated by each criterion and category. Using criteria importance weights in requirement groups overall results were obtained (Table 2).

Table 2

Server evaluation results

Requirement group \ Server	Large enterprise application requirements	Large enterprise application development with requirements for additional functionality	Large enterprise application development with requirements for performance and fault tolerance	Small and medium enterprise application requirements	Specific cases
Borland	0.7899	0.7654	0.7660	0.7435	0.5704
Orion	0.6861	0.5965	0.6520	0.7430	0.4600
Oracle	0.8760	0.8972	0.8773	0.7449	0.9007
WebLogic	0.8683	0.8017	0.8918	0.7601	0.6904
WebSphere	0.8410	0.8229	0.8485	0.6790	0.8919
JBoss	0.4997	0.4138	0.3896	0.6697	0.3596
JRun	0.7423	0.6770	0.7298	0.8143	0.6410

Oracle, JRun and BEA WebLogic servers got best overall score in according requirement groups during application servers estimation process. Using grey colour are selected servers with best overall results in groups.

CONCLUSIONS AND FUTURE WORK

The comparing analysis of application servers and most applicable server selection for definite systems' class has led to the following conclusions:

- described method can be useful for IT companies, to reduce expenses of application server selection and usage;
- selected criteria and categories and comparing method can be used in the future, comparing other application servers developers or new versions of compared servers;
- developed estimation methods are flexible, so criteria list can be extended accordingly application servers evolution;
- the method can be used to detect most applicable servers for other groups requirements satisfaction (requires only criteria weights changes accordingly to group needs).

Future work: recommendations of criteria weights for different requirement groups should be offered. It gives customer an opportunity to change base weights of criteria accordingly to his specific requirements. Other technology application servers should be investigated and compared (.Net and others).

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