# An approach on software interface selection

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***Abstract* — The aim of this paper is to show one way of the most convenient software interfaces selection for the implementation of special sampled distributed applications. The different types of software interfaces were described (functional profiles and middleware) as well as the attributes of computer networks that influence on target software interface selection. The best solution of the software interface selection was realized as combination of the attributes impact to the software interface and their significance to the distributed applications. The final result shows how some of software interface is convenient for realization of distributed applications.**

***Keywords* — functional profiles, middleware, software interface, distributed application**

## I. INTRODUCTION

THE information infrastructure, with its elements, presents a ground of modern information society development. All social activities use the advantages of the information communications technologies and developed applications that make life more human and comfortable. These applications have distributed nature because of their segmented construction. These segments operate on different networks with various software and for several users. The successful implementation of these types of applications requests a particularly intelligent communication platform with software interfaces that are adopted on distributed operation way. There are two types of software interfaces that are very significant for this role. One of them is *functional profile* that presents special composed stack of protocols for the particularly distributed application. Other one is *middleware*, as a set of program services that is capable of solving the problem of heterogeneity and interoperability. Many networks attributes have influence on the selection of software interface type. They also bear importance on quality of application realization. Both impacts need to be combined in the searching of the best solution for software interface selection. The way of classification of distributed applications and different types of interfaces as well as procedure of software interfaces selection was presented in this paper.

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## II. STRUCTURE FOR DISTRIBUTED APPLICATIONS REALIZATION

### A. Information Infrastructure

Within the development of information society, the goal is achieving as efficient as possible performance of different applications, which are used in everyday life. There are different interest groups such as: end users, telecommunication industries, information technology, amusement and emitting, standardization bodies, regulators. For their requests, in order to be achievable, it is necessary to prepare such information infrastructure that will make performance of all types of applications possible. Because of that, development and definition of information structure was seen from *global* (GII- Global Information Infrastructure) [1] through *regional* (EII-European Information Infrastructure) [2], to *national* (NII-National Information Infrastructure) [3]. But, information infrastructure is not only physical equipment used for connection and transfer of different types of information. These also include a wide range of different devices, information themselves, applications and software, followed by network standards and transferring codes for interconnection and interoperation between networks, and in the end people, especially those who create information, develop applications and services, construct devices and teach others to use their potentials. [4]

### B. Distributed Applications

In the field of applications there are also some ongoing changes in development that make different human activities possible to be carried out on distance. The whole process of creation of these applications is already now independent enough from the type of equipment and software as well as from geographical destination of creation or usage. These complex applications are mostly multimedia (data, sound, picture) and they are being projected out of components which are distributed on many computer resources or networks. In order to find solutions for easier implementation of these applications, it is important to analyze and classify applications and determine priorities of their realization.

There are several subjects in the world that defined different classifications on the basis of further information sources: GII- Global Information Infrastructure-ITU [1], Development Strategy of Republic Croatia [5], European Council [6], International Standard Classification after ISO [7], European Commission of EU [8], Open Data Network

USA [3], United Nation Development Program Agency - UNDP[9], ITU - Broadband ISDN services [10].

The research shows that oftenest in usage of certain distributed applications ($DA_i$) indicates priority in their development and usage.

The list, in the Table 1, presents the most requested applications where the order indicates priority in their implementation.

TABLE 1: SELECTED DISTRIBUTED APPLICATIONS

| $DA_i$ | Application | Ofteness |
|---|---|---|
| $DA_1$ | Electronic business | 8 |
| $DA_2$ | Telemedicine | 7 |
| $DA_3$ | Distance learning | 6 |
| $DA_4$ | Electronic libraries | 5 |
| $DA_5$ | Electronic publishing | 4 |
| $DA_6$ | Teleworking | 3 |
| $DA_7$ | Electronic mail | 3 |
| $DA_8$ | Data base review | 3 |
| $DA_9$ | Video conferences | 3 |
| $DA_{10}$ | Entertainment | 3 |

### C. Communications Platform

For executing distributed applications it is very important to establish such information infrastructure which will make efficient and quality connection of applications. For that purpose, software interface is being used, the one that can be reviewed mostly through function profiles and through middleware.

*1) Functional profiles*

The standards make allowance for presence of different options and parameters such as so called companion standards. In this way, interoperability as basic goal of OSI model is being damaged, because it is possible to make choice of inconsistent or maladjusted alternatives. Therefore, functional profiles are being determined as subset of OSI standards, which are especially formatted to support specific user needs [11]. It is very often said that functional profiles are standards of standards [12] or second-order standards [13].

Main elements of taxonomy for OSI profiles are given in document TR 10000 (ISO/IEC). The taxonomy is a structure and classification inside the profiles that are being reviewed. All profiles are classified in six classes, and each profile has its own unique mark: Transport profile T and U, Relay profile R, Application profile A and B, Format interchange profile F.[14].

Functional profiles should define subsets of standards which should respond to a given request for execution of an application. Taking into consideration a technology of internet, protocol sets, i.e. functional profiles are mostly defined so as one Internet Protocol Suite.

Most often, the information transport is defined as a set of TCP/IP or UDP/IP protocols. Afterwards, different protocols which define performance of certain application are upgraded. These are: SNMP-Simple Network Management Protocol, CMIP-Common Management Information Protocol, HTTP-Hypertext Transport Protocol and others.

*2) Middleware*

Contemporary development of infrastructure supports applications, whose parts are distributed on different computers and different locations. Most frequently, all of the new services and applications are distributed, objectively based and almost all communication is done in layers. Distributed organization of all subjects in process of completing applications brings significant number of problems such as heterogeneity, coordination of components, network communications, possibility of error occurring in few spots, security issues, reliability, scalability etc. Since the time is a very important factor, these applications should be developed and restored fast, because of the market competition. For this reason special programs, called *middleware*, are developed, which offer a set of the most important services that development expert sees through corresponding interface.

With a help of middleware, network connects users and applications effectively, regardless of different communication protocols, computer platforms and implementation languages. Middleware services offers primitives of higher level of abstraction, which can be used by development experts and neglect less important details of lower layers [15]. On this, way the experts can focus only on application requests.

The most frequent classification of middleware is the one with five categories; distributed transactions, remote procedure call, messages forwarding, distributed objects and remote method invocation, also agent's activities on service architecture.

Platform of middleware is actually inter-platform for distributed applications, which is found on border area between network and application layer [16]. Because of that, this can be seen as one special layer in a referent model. It is some kind of intelligent software interface between networks and applications. When the cooperation is going on only between the data than the solutions with functional profiles and web technologies is very acceptable. If the cooperation exists between services, then a much greater efficiency is achieved by using the middleware technology. [17]

## III. DEFINITION OF NETWORK ATTRIBUTES

The attributes of computer's network have significant influence on choice of software interfaces, which would be most suitable for specific distributed application type. The definitions and description of certain number of attributes:

***Reliability ($S_1$)*** - Within technical systems, reliability is nearly the most frequent used quality parameter. It is the probability that the concrete technical system will operate properly in certain time and given working condition.

***Scalability ($S_2$)*** – An attribute to adjust increase and decrease of system load. Informatics solutions must assure functionality, but also efficiency, in the case of load change, for instance number of users or transactions.

***Delay ($S_3$)*** - This is an attribute that gives basic characteristic of a network. It influences significantly on an overall quality of performing an application. It defines how much time needs for bites to travel through the network from one to another computer. There are many types of

delay such as: propagation delay, switching delay, access delay, queuing delay. [18]

***Security ($S_4$)*** - For good performance on computer networks and Internet, one of the most important parameters is security. Assessment of overall security on the network includes many different parameters, from physical network security to data-loss or unauthorized-access security. User's identity is also very important for overall security. Security represents the measure of resistance of system on random occurrences or intentional activities which lead to destroy, damage or loss of valuable resources.

***QoS Management ($S_5$)*** - This attribute represents assessment of Quality of service (QoS) on all layers of computer system which means quantitative and qualitative characteristics on computer system which are necessary to achieve requested "end to end" functionality of one application and all layers of distributed system. [19].

***Video quality ($S_6$)*** - This attribute is especially important by multimedia applications. It contains more quality features such as delay, bandwidth and compression, what depends on application type.

***Throughput ($S_7$)*** - It is the average speed of successful delivery of information or data quantity that can be sent through network in time unit from one computer to another. The similar attribute is bandwidth.

***Jitter ($S_8$)*** – Very often the term jitter is used for package delay variation. It is the number that says how much delay can be lesser or greater than its average value. That is very important parameter by multimedia applications.

***Identification ($S_9$)*** – One of basic precaution measures for unauthorized access to computer resources is construction of corresponding control mechanism. The sophistication of the access control mechanisms should be in parity with the value of the information being protected. Username is mostly a form of identification which is being used in access to a certain resource.

***Authenticity ($S_{10}$)*** – It is important element of control mechanism for access, which is based on verification of identity confirmation. There are three different types of information that can be used for authentication: something you know, something you have, or something you are. Strong authentication requires providing information from two of the three different types of authentication information. On computer systems in use today the password is the most common form of authentication.

***Privacy ($S_{11}$)*** –This is security system for very sensitive personal information, and which are necessary for performance of some operational jobs (example: paying with cards). All private information about users is strongly kept and are available only to authorized persons.

## IV. Attributes Impact on Interface Type Selection

In realization of distributed applications, a very important role is taken by software interface that provides efficient usage of available resources and qualitative operations' result. The assessment of convenience of software interface on satisfaction of each single network attribute will be done. Also assessment of a single attribute importance for qualitative execution of chosen application will be made. Finally, it is to be calculated which resulting effect of these attributes will occur, showing how much certain software interface corresponds to a certain distributed application. Following software interfaces are to be treated in this procedure:

**Fp** - *Functional profiles*. These are special sets of protocols that are formed on information infrastructure so that preconditions of efficient and qualitative action of chosen distributed application are satisfied.

**$MW_1$** - *Transaction middleware*. This intermediary program supports transactions with distributed components so that it offers transaction abstraction. It uses a two-phase commit protocol for distributed transactions implementation [20].

**$MW_2$** - *Procedural middleware*. Remote Procedure Call, RPC was introduced by Sun in 1980's as a part of Open Network Computing ,ONC platform. Consortium X/Open accepted RPC as a standard and as a part of Distributed Computing Environment, DCE.

**$MW_3$** - *Message-oriented middleware* (MOM) gives asynchronous communication between distributed applications and components through abstraction of chain of messages which is available through network using mechanism of electronic mail.

**$MW_4$** - *Object-oriented middleware*. This type of middleware uses object-oriented techniques such as identification of objects through references and succession. When object requests some services from other object or component, then Object Request Broker accepts request, sends it to provider and give the result back to the client.

**$MW_5$** - *Service-oriented middleware*. Here, realization on distributed systems is done by being based on Service Oriented Architecture, SOA) [21]. Each part of the system (agent) gives good defined services to other parts of system (agents) to perform a requested problem. These services represent the exchange of messages, methods of messages transport and describing services. [22].

Attributes impact on software interfaces is presented on Table 2.

TABLE 2: ATTRIBUTES IMPACT ON SOFTWARE INTERFACES

| | Fp | $MW_1$ | $MW_2$ | $MW_3$ | $MW_4$ | $MW_5$ |
|---|---|---|---|---|---|---|
| $S_1$ | 4 | 5 | 3 | 4 | 4 | 4 |
| $S_2$ | 5 | 4 | 2 | 4 | 5 | 4 |
| $S_3$ | 5 | 4 | 2 | 4 | 4 | 4 |
| $S_4$ | 5 | 5 | 4 | 5 | 4 | 4 |
| $S_5$ | 4 | 4 | 3 | 4 | 4 | 4 |
| $S_6$ | 4 | 4 | 3 | 5 | 6 | 5 |
| $S_7$ | 4 | 4 | 4 | 4 | 4 | 6 |
| $S_8$ | 5 | 4 | 2 | 5 | 4 | 4 |
| $S_9$ | 4 | 5 | 3 | 4 | 5 | 4 |
| $S_{10}$ | 4 | 4 | 3 | 5 | 4 | 5 |
| $S_{11}$ | 4 | 5 | 2 | 5 | 5 | 4 |

The qualitative model of assessment for attributes impact on software interfaces will be used with following gradation: bad - 2; sufficient - 3, good - 4, very good - 5,

excellent - 6. All these attributes ($S_1$-$S_{11}$) are described in chapter III.

To importance assessment of certain attributes on chosen application with graduation from 1 (the lowest) to 10 (the highest) will be used in Table 3.

TABLE 3: IMPORTANCE OF ATTRIBUTES FOR APPLICATIONS

| | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ | $S_9$ | $S_{10}$ | $S_{11}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **$DA_1$** | 9 | 8 | 6 | 9 | 7 | 1 | 5 | 6 | 7 | 9 | 7 |
| **$DA_2$** | 10 | 3 | 8 | 9 | 9 | 10 | 9 | 9 | 8 | 9 | 9 |
| **$DA_3$** | 6 | 5 | 6 | 5 | 4 | 1 | 6 | 2 | 7 | 6 | 8 |
| **$DA_4$** | 3 | 7 | 3 | 3 | 3 | 1 | 5 | 3 | 3 | 5 | 6 |
| **$DA_5$** | 3 | 4 | 4 | 5 | 4 | 4 | 8 | 4 | 4 | 7 | 5 |
| **$DA_6$** | 6 | 7 | 5 | 7 | 7 | 1 | 8 | 6 | 5 | 7 | 6 |
| **$DA_7$** | 8 | 8 | 6 | 8 | 7 | 1 | 9 | 5 | 5 | 8 | 7 |
| **$DA_8$** | 8 | 6 | 5 | 6 | 6 | 1 | 8 | 5 | 6 | 7 | 6 |
| **$DA_9$** | 9 | 6 | 9 | 7 | 7 | 8 | 8 | 8 | 5 | 7 | 5 |
| **$DA_{10}$** | 6 | 6 | 6 | 5 | 7 | 1 | 7 | 5 | 5 | 6 | 5 |

For final assessment on theme which software interface corresponds better or worse in realization of some chosen applications, product of two matrices above has been made, and these results were gotten.

TABLE 4: THE CHOICE SOFTWARE INTERFACE TYPES FOR APPLICATION

| | Fp | $MW_1$ | $MW_2$ | $MW_3$ | $MW_4$ | $MW_5$ |
|---|---|---|---|---|---|---|
| **$DA_1$** | 325 | **328** | 209 | **328** | 320 | 316 |
| **$DA_2$** | 401 | 408 | 268 | **418** | 412 | 409 |
| **$DA_3$** | 242 | **250** | 158 | 246 | 246 | 243 |
| **$DA_4$** | 184 | 183 | 115 | **186** | **186** | 184 |
| **$DA_5$** | 225 | 225 | 152 | 233 | 229 | **235** |
| **$DA_6$** | 285 | 284 | 186 | **287** | 280 | 284 |
| **$DA_7$** | 315 | 316 | 207 | **317** | 310 | 315 |
| **$DA_8$** | 278 | **282** | 184 | 281 | 276 | 280 |
| **$DA_9$** | 346 | 342 | 224 | **351** | 348 | 347 |
| **$DA_{10}$** | **258** | 257 | 167 | 258 | 254 | 257 |

It can be concluded that for every chosen application there is corresponding software interface, for instance $MW_5$ for $DA_5$. Somewhere there can be two interfaces with same importance for application, for example $MW_3$ and $MW_4$ for $DA_4$. There, it was shown that $MW_3$ satisfies greatest number of chosen applications. It can be concluded how much other software interfaces can satisfy requests.

## V. CONCLUSION

Functional profiles and middleware are very important parts of communication platform and play significant role on information infrastructure in realization of task on distributed applications implementation. On that reason this paper illustrates one approach of software interface selection on the basis of network attributes analysis. The relevant factors in application implementations procedure are different network attributes that help in assessment of convenience software interface selection for some determined distributed application. Whole presented procedure give a result which offer *one model of selection* the type software interface (*functional profile* or *some of middleware*) for observed distributed applications. It could useful as basis for further analyzis and discussion. Of course, the principles and technique used in this paper could be applied for impact investigations other elements of information infrastructure on other types of distributed applications.

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