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Increasing availability of SOA systems

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This paper is devoted to question of efficiency of multiservice systems, with based on service-oriented architecture. In paper also proposed to use replication as method to increase availability of services. The algorithm of replication for service instance is designing, this algorithm based on popularity of the service and bandwidth of communication channel. Using this algorithm will provide the required availability of services and at the same time reduce the load on backbone links.

Keywords: *SOA, service registry, service provider, replication, registry response*

В статье рассматриваются вопросы повышения эффективности мультисервисных систем, использующих сервис-ориентированную архитектуру. В качестве метода повышения доступности сервисов предлагается использование репликации. Разработан алгоритм репликации экземпляра сервиса, основанный на анализе его популярности и пропускной способностей каналов связи. Использование данного алгоритма позволит обеспечить требуемую доступность сервисов и в то же время снизить нагрузку на магистральные каналы связи.

Ключевые слова: *SOA, реестр сервисов, поставщик услуг, репликация, ответ реестра*

У статті розглядаються питання підвищення ефективності мультисервісних систем, що використовують сервіс-орієнтовану архітектуру. В якості методу підвищення доступності сервісів пропонується використання реплікації. Розроблено алгоритм реплікації примірника сервісу, заснований на аналізі його популярності та пропускної спроможності каналів зв'язку. Використання даного алгоритму дозволить забезпечити необхідну доступність сервісів та в той же час зменшити навантаження на магістральні канали зв'язку.

Ключові слова: *SOA, реєстр сервісів, поставщик послуг, реплікація, відповідь реєстру*

1. General statement of the problem and its actuality

Data replication is one of the most effective methods of providing service availability. Replication is a process that involves copying data from one source to many others and vice versa. One of the tasks of replication is to provide a mechanism for synchronization copies of each other. This is done by the transaction [1].

SOA usually satisfy following characteristics and principles: loose coupling, location transparency and protocol independence. In the initial stages of design, we cannot forecast the service quality exactly [2].

But users in SOA may occur in different place. Because of the difference of network speed in different places, single service is not capable of satisfying all users' requirements no matter how it is deployed. Instead, replicated services might be able to resolve this challenge. An example of using replication may be situation where the number of requests to specific service increases significantly in a short period of time. Traffic of request must be replicated on the local server to reduce the network traffic

and increase the availability of services. The implementation of this replication algorithm was performed as part of the interaction of SOA components.

2. Replication algorithm

The replicas in SOA system are different from traditional data replicas. According to the characteristics of SOA service replicas should have following properties: real-time (user can choose random one service replica to access and can get the response immediately), independency (in the case when some replica is crashed, it will not affect other service replicas) and consistency (user only need to execute operation at one service replica) [2]. In the most general form of the service-oriented architecture assumes existence of three parties: the service provider, service consumer and service registry [3]. Their interaction is represented by the following scheme: the provider registry services in registry and the consumer accesses to the registry to get address of the required resources (or service). The replicated services for SOA is shown in Figure.1.

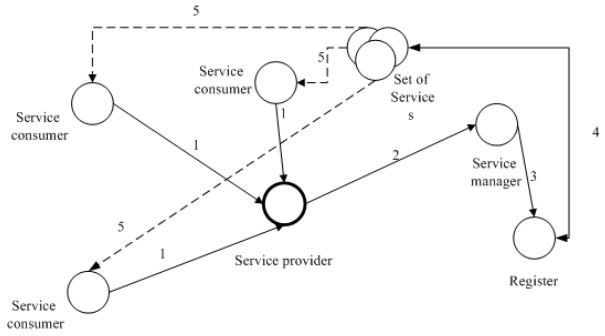

Fig.1. Service replication in SOA

Where is: 1) request for service changes; 2) request for search the replica; 3) location in register; 4) creating copies of service; 5) response after search

In according with the developed replication algorithm (figure 2) the local service registry must check counters with request to services after a certain period of time. In the case when counters of request to services $cnt(R,F_i)$ exceed the replication threshold $rep(F)$ the registry must to make a decision about service replication [4]. Before this operation registry searches its database for the server, which has the resources necessary to accommodate this replication. If such a server exists, the registry sends a request to the service F for creating copy. In the response registry specifies the location for future copy. After the replication operation the registry sends a response. The response indicates whether the successfully completed the replication operation and the address of replication. This information will be also sent to the remote service registry to create a mark of copy and specify its address. If the server is not found in the database of registry, then the replication will be canceled and the registry starts scanning the next counter of service. After completion of the test all counters are reset $cnt(R,F_i) = 0$.

If the registries of the counter requests of service exceed the replication threshold $rep\ (F)$ then registry will replicate this service. Registry searches its database for the server, which has the resources necessary to accommodate this replica. If such a server exists, the registry sends a request to service F for creating copy. In the response registry specifies the location of future copy (see Fig. 2).

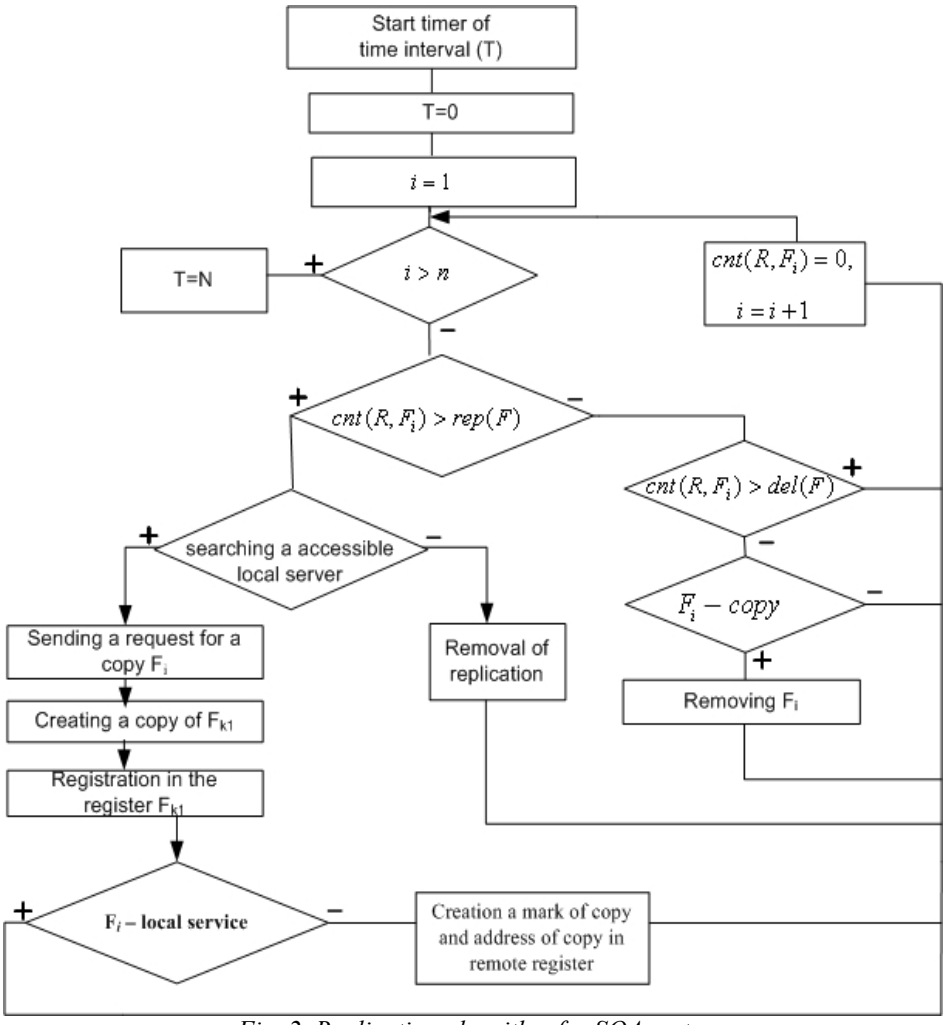

Fig. 2. Replication algorithm for SOA systems

After the replication operation the registry sends a response. The response indicates whether the successfully completed the replication operation and the address of replication. This information will be also sent to the remote service and registry creates a mark of copy and specifies its address. If a registry database accessible server not found, then the replication will be canceled. Registry begins to check a next counter of service. After completion of the test all counters are reset $cnt(R,F_i)=0$.

Notation: N – duration of time interval; T - timer; i - number of service the registry; n - number of services in the registry; $cnt\,(R, F_i)$ – counter of service F_i ; $rep\,(F)$ – replication threshold; *del(F)* - deletion threshold)

If the total number of requests to the replica will be below the deletion threshold at server will run removing process. If the request counters for the registry $cnt\,(R, F_i)$ less than replication threshold $rep\,(F)$ and more than deletion threshold $del\,(F)$ counter will be reset. Registry starts scanning the counter of the next service.

As noted before an important task in the implementation of the algorithm is the choice of a mechanism of replication to ensure data consistency. To ensure data consistency in service-oriented systems should be used protocols based on the primary copy. One of the most widespread protocols of this type is the primary-backup protocol discussed in [4]. In this paper proposes to modify the protocol to be applied to service-oriented systems. The principle of this protocol is shown on Fig. 3. Using the following notation: 1) request for service changes; 2) request to search the replica and the issuance of their addresses; 3) registry response; 4) signal to update the backup copies; 5) update confirmation; 6) confirmation of changes.

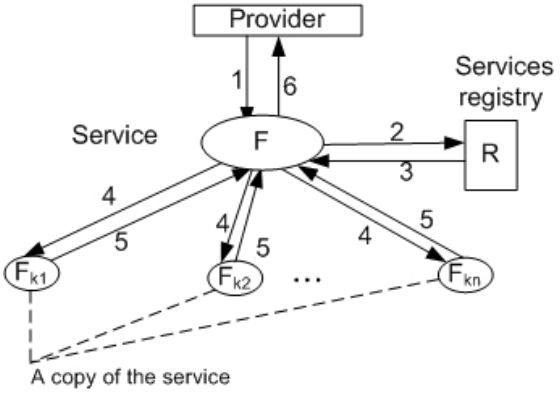

Fig. 3. The primary-backup protocol

Provider for the operation sends a request to change the data to the service. In the service provider wants to make changes. This service provides updating their data and then sends the request to the local registry services on the availability of copies of the marks and their addresses. If such copies do not exist, the upgrade process is completed, and the service becomes available again. If the response will indicate the presence of copies and their addresses the service will send data updates to all its replicas [5]. After the arrival of confirmations about the update to all replicas, the service sends to provider a confirmation about changes. The update process occurs as an atomic operation or a transaction that ensures consistency of all copies of the service.

To obtain quantitative characteristics of the network, reflecting the benefits of using replication algorithm was developed network model. This model operates in two

modes - without replication and with replication. The model has been implemented by using simulation environment OMNeT++.

Graphic representation of the model considered the telecommunications network depicted in Fig. 4.

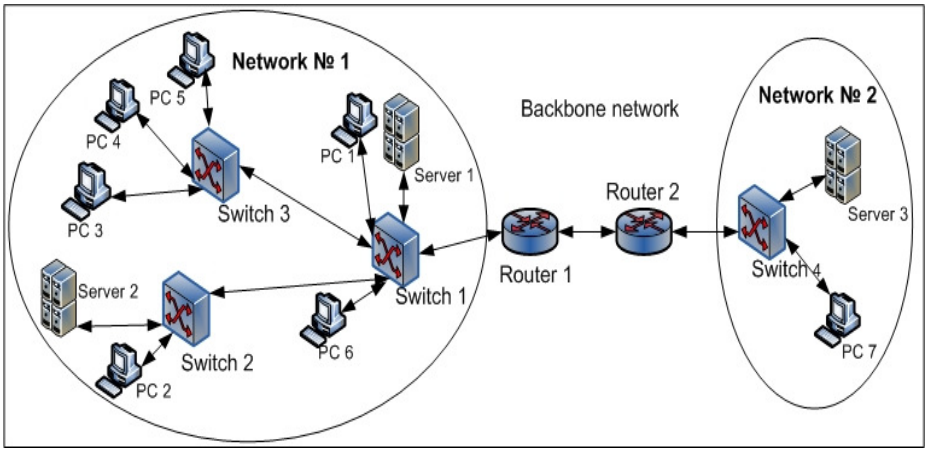

Fig. 4. The model of telecommunication network

3. Simulation Results

In a comparative analysis of the model in two modes was received the following results:

1. A level of transmission traffic over a backbone network is considerably reduced it is concentrated within the local network (see Fig. 5). The remainder traffic was generated by sending updates between replicas. The replica is removed in the case of reducing the number of requests for copies of the resource to the deletion threshold.

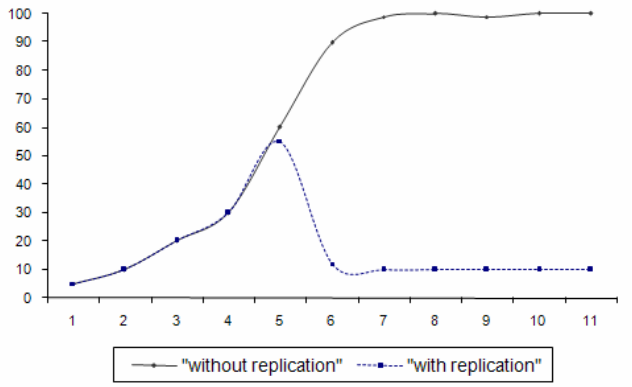

Fig. 5. The dynamic of traffic on the backbone network (a ratio of the traffic service to the total bandwidth)

2. In the mode with replication the level of denial of service was reduced. Creating a copy of the resource allows unloading a remote server, that was overloaded with requests from other networks (see Fig. 6).

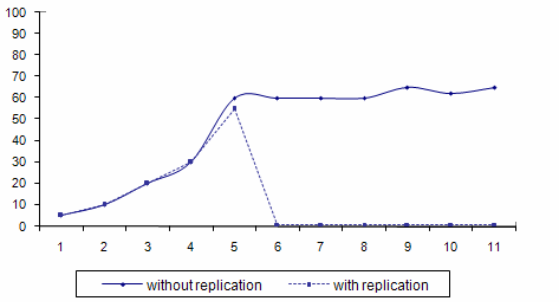

Fig. 6. The dynamic of denial of service (a ratio of the number of requests to non-serviced requests)

Threshold value is one of the key issues for decision to create a replica of this method. Replica creation threshold is strongly dependent on the types of services to be implemented in the network. In this paper, investigations were carried out for one type of traffic – the data transfer. Replication issues real-time services, computer services and other type of services are the subject of further research.

Conclusions

Availability of network services can be improved by using the replication method. Also, the replication method allows reducing time to access to network resources and network traffic, especially over the backbone network. Thus, the use of this method makes possible to perform load balancing over backbone network and improve the quality of service in multiservice networks in general.

In experimental result during the running time, the service delay and unstable network will block the whole business process. Replicated services are a good choice to resolve this problem.

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