A simulator for QoS Service choreography support

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Abstract

Service choreography allows the composition of services in a collaborative way, because of global description and descentralized coordination using interactions P2P among participants. However, since infraestructures and implementations aren't mature enough to enact choreographies, then to evaluate and analyse how the environment affects the QoS requirements and composition behavior into a choreography is a difficult task. To be able to do so, we propose to develop a choreography simulator in order to simulate enacting of choreographies.

In this work, we also propose a QoS model for implementing on the choreography simulator taking into account QoS composition, infraestructure and environment aspects. Furthermore, we adopted a choreography scenario about Content Delivery Network (CDN) providing streaming multimedia objects.

Problem statement

Among the various methods to compose services, Web services choreography is an efficient way to implement inter-organizational business processes, as the participants' business interactions are mutually independent (autonomous and heterogeneous) [**?**]. A service choreography is a description of peer to peer interactions among existing services, i.e., in this model there isn't the role of a central controller. The various services communicate with each other similarly to what occurs in a P2P applications [1].

Due to the increasing number of devices joining the Internet, a centralized approach like an orchestration may not be sufficiently scalable in terms of network bandwidth to deal with the ever escalating number of devices and services that may be available. Within such a scenario, a decentralized approach, like choreographies, may turn out to be more capable of dealing with such high complexity (trecho do artigo do Felipe e Eduardo).

During the enactment of services choreographies, the state of network elements (devices and links) plays a fundamental role. There must be guarantees of Quality of Service - QoS so that there are advantages of using a decentralized business model. A common method to define guarantees between a service provider and a client (which may also be a service) is by means of a Service Level Agreement - SLA. After the choreography be specified, constraints of QoS between each participant must be defined through SLAs [**?**]. To meet the SLA agreements there must be some mechanism for management at runtime. This mechanism must involve monitoring, control and decisions against violations or degradation of service quality. All the concern about guarantee of the QoS requirements of participants comes from the fact that the QoS of composite service, represented by the choreography, depends directly on the QoS of the separate services.

Currently, to implement and enact a real service choreography is still difficult because of immature technology support, especially by lack of Choreography aware engine execution [3]. Then, performance evaluations, QoS measurements, QoS requirements establishment, monitoring, and so on, aren't very developed.

Our solution

The objective of our work is to develop a simulator in order to enact services choreographies and enable QoS support taking into account the infrastructure and environment aspects. For achieve this, we use a QoS model about service, message and communication attributes involved in a service choreography. Moreover, to attest the efficacy of our simulator we adopt a choreography scenario about Content Delivery Network (CDN) providing streaming multimedia objects [2].

Based on [5] and [4] works, we propose a model QoS in three aspects: (a)service ,(b) message and (c) communication. The table 1 shows the QoS model composed by QoS attributes, metrics and respective failure types, that our simulator should support.

Table 1: QoS model

QoS aspect	QoS attribute	Metric	Failure type
Service	Execution time	ms	timeout
Service	Throughput	#requests/s	service not available
Message	Message format	-	failure probability
Communication	Latency	ms	communication error
Communication	bandwidth	Mb/s	communication error

Figure 1 shows the reference scenario [2] : a user requires, and eventually receives, a complex service managed through a choreography of different Web-Services, one of which (WS3 in the figure) controls the provisioning of streaming content. WS1 and WS2 show that several Web-Services are internally orchestrated. Such a scenario is used for assessment of choreography simulator.

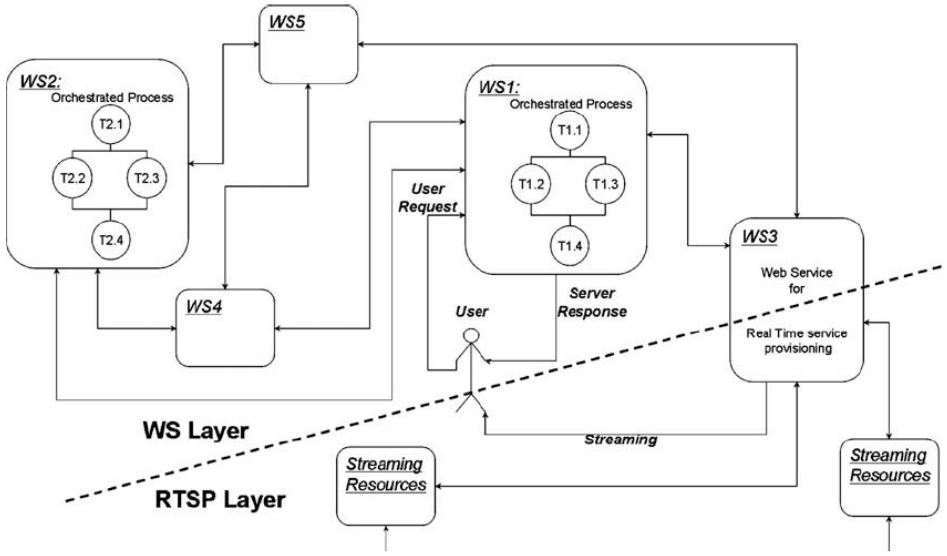

Figure 1: Choreography scenario about a CDN application[2]

The SimGrid framework [3] is a simulation-based framework for evaluating cluster, grid and P2P mechanisms. SimGrid uses tasks to perform the simulation. Such tasks have an intrinsic cost to be transmitted over the network and an execution cost. Resources are described through an XML file in which it is possible to list available resources and their characteristics such as computing power, as well as available links and routes to other resources. In another XML file the deployment of the simulated entities is described, ie, where each simulated entity, also referred to as a Process, is deployed. Since the SimGrid allows the simulation of distributed environments, we used it as the base to implement our simulator.

Execution environment

Regarding the software, ...

Evidence the solution works

The services were modeled as a set of working threads that receive a task sent over the network, execute it and then send another task over the network to act as a web service response. The available methods and computational effort needed to execute them, the amount of worker threads, medium size of the given responses, and service name are configurable through a deployment XML file. And the choreography topology (host, communication channels and links) is configured through a platform XML file. Above this infrastructure, a monitoring is developed, and it's responsible of to measure the QoS attributes specified in table 1 of individual services and to aggregate them in order to calculate global or composed QoS attributes as total time response.

...

Competitive approaches

Many simulators for distributed environments were proposed, eg., gridsim framework [**?**], Pi4SOA [5], and SimGrid framework [6]. The gridsim framework [**?**] is a distributed environment simulation engine based upon on events. It implements entities to emulate users. Users' requests are scheduled through a broker that allocates them into the simulated resources. Pi4SOA [7] presents a policy-based infrastructure to dynamically verify and control the collaboration process in SOA. It is also used as a starting point to develop an event driven policy enforcement in [8].

So, there is no simulations solutions for supporting service choreography enactment and even less with QoS support...

Current status

We have developed a simulator to perform the " initial" enactment of choreography, but our objectives for added support of QoS composition and communication infrastructure.

In this research project we are interested in the .... Our current efforts are focused on the quantitative analysis. We are evaluating the performance based on simulations, particularly interested in studying the effects of QoS composition on throughput of services and networks aspects such as latency and bandwidth.

Next steps

References

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