QoS implementation in a federated identities system

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ABSTRACT
This article presents a prototype that supports distributed applications like in a federated identities system. The prototype is based on composition and orchestration of services and takes into account the quality of service (QoS). Our work aims to provide a user-oriented approach to faciliting the users to participate in the description of QoS requirements in order to further customize the results returned by the federated identities services.

Categories and Subject Descriptors
H.4.3 [**Information Systems Models and Principles]:** Systems and Information Theory – *Information theory*

General Terms
Theory, Management.

Keywords
Federated identities services, mobile agent, composition of services, QoS.

1. Introduction
Distributed applications and particularly federated identities applications introduce the concept of a distributed user profile, a profile that is not stored in a single location, but constructed using profiles located in a number of different places. In our case, user would have at least three subprofiles [1][2]: governmental, banking and telecom subprofiles. These profiles allow customizing elements of the services and its contents, i.e., the capabilities to accommodate services to the user's requirements and preferences. To make these services more personalized and also customizable by the user, we propose a framework with ascending customization degrees which reflect the share-out of intelligence between users and systems, as well as ever growing user involvement in service customization process.

This work is a continuation of work [3] already done to implement solution based on "Integration, Orchestration, and Customization": three keywords to rethink federated identities architecture. Previous work presented a dynamic approach of federated identities orchestration services based on multiagent coordination mechanisms. But this coordination solution remains informal. So in this paper, we will try to better detail the solution and especially to introduce the QoS as proof of the involvement of the user to specify his needs.
The rest of the article is structured as follows: in section 2, we explain our definition of QoS and what we mean by QoS in the context of federated services. The section 3 presents the modeling of the solution and our proposed scenario. The section 4 introduces the role of mobile agents in this solution. We conclude this paper in section 5.

2. QoS definition
The quality of service is a contract which determines the degree of satisfaction with a service. QoS is usually related to functional and non-functional concerns such as performance, security and availability. This negotiation can be the subject of exchanges between the service provider and the user. To describe it in the context of federated identities applications, we must determine the set of quantitative and qualitative characteristics of the system to achieve the functionality required for an application. Federated identities management allows a user to efficiently authenticate and use identity information from data distributed across multiple domains. In federated identities management we have three actors [4]:
– The Principal, or user, who has a particular digital identity;
– The Identity Provider (IdP), whose role is to authenticate the Principal once; the IdP then issues authentication assertions to a:
– Service Provider (SP), which provides services (e.g., access to protected resources) to authenticated users.

However, often these SPs offer the same services but with different performances [5]. Each SP has its own approach, sometimes in strict disregard of what is happening in the neighbour or in cooperation with neighbouring servers. These differences are attributed to different causes: different sources of data, collaboration with other servers (subcontracting, delegation of tasks), absence of cooperation with other providers, execution time…
In previous architectures of federated identities, none explicit treatment on the quality of service, required by the client requests, is provided. In other words, a client has no information enabling it to select the server that may provide a good quality of service; it is the problem of selecting the best service.

In our solution, the platform must be able to choose the configuration that offers the best quality of service at any time. This paper presents a method for assessing the QoS of services, skills exhibited by the other agencies ensuring a given service. This method is based on a model of quality of service with criteria representing intrinsic characteristics requested by the service and also measures performed on the entities used. So the method for QoS evaluation will necessarily contain a first step of specifying the requirements in terms of service and then a second stage of comparison of service provided by the organization with the characteristics described above. The assessment of QoS will be the result of this comparison.

However, to dynamically manage the notion of QoS, it is necessary first to model the information system, in such a way that is possible to implement easily the QoS indicators. Then, the defined indicators are measured through the data gathering in the SI. Finally, communication mechanisms between mobile agents must be established to correlate the information and optimize the overall QoS.

3. QoS modeling and proposed scenario

The proposed construction goes through different steps as follows:

Step 1: Service Research

This step seeks to answer the following questions:
How to find the services that we seek?
Should we centralize or distribute the knowledge on the services?

The location of a standard service is not complicated; the only information required is the semantics of the service rendered. For these services, we often have repositories of services, also known as directory service (eg UDDI) [6]. In the case of a platform for federated identities, where the resources (data and associated functions) are allocated dynamically on a non-static set of equipments; address and localization are not always known by a referential. However, their location can be a choice endpoint for a kind of service, eg I want the banking service of the district bank of the user.

To access it, three ways are generally possible:

- Flood: the consumers of services carry out a search by broadcast (multicast or broadcat). Then, the services providers respond only to the consumer (unicast) that did the research, providing the necessary information to contact them. This assumes that each node stores and updates its list of available services.

- Announcement: service providers periodically announce their presence by diffusion, as well as a date of validity of this announcement. Users can recover data localisation from these announcements.

- Semantics routing: choose intelligently servers nodes to achieve the required service, this can be achieved by taking advantage of the caches, traces of the old executions

We can distinguish three types of service discovery. The three approaches are not necessarily mutually exclusive but rather complementary. The choice between these will be based on various criteria (eg frequency of Appeal or the utilization ratio of a service). But in all cases, we adopt a technique based on mobile agents that will implement one of these methods or a combination of the three.

Step 2: Composition

The first stage of localization will lead to the construction of affinities networks [7] between organizations and the discovery of SPs which allow responding to the user's requests. Organizations belonging to the system are organized into arborescence; this facilitates cooperation to respond to requests. The continuation of this section presents the process of services composition.

The affinity network constructed by the localization process is modeled by an undirected graph (O, P), where O is the set of organizations, P is the set of logical links representing the affinity relationships between organisations.

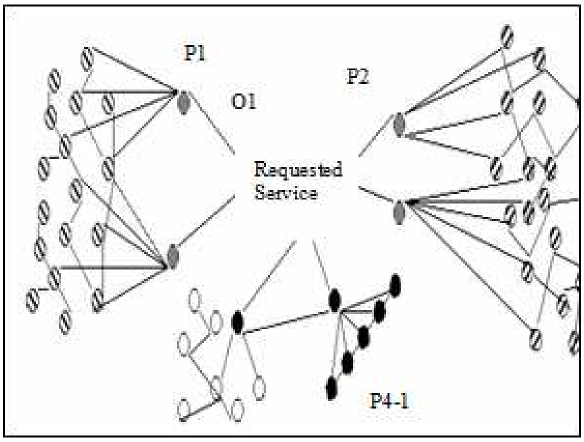

Figure 1. Affinities network

The previous figure illustrates an example of an affinities network and how organizations cooperate with each other to forge a response to a request.

To illustrate the result provided by this step we give the following example: a user, who seeks to enroll her child in the nursery, will make its request to the organization O1. This organization, based on its affinity graph, knows that to better meet requirements of this request must go through the following organizations O5, O7 and O2. This is calculated by weighting links of affinities graph with QoS vectors, which will be explained in the next section.

Step 3: Selection and composition of services

To answer a user's query, the SP usually works with other SPs, which we call in our context “organizations”. Thus, the business service requested by the user will be divided into several sub-services and the quality of service required by the user will be the sum of the QoS offered by these collaborations.

This step consists in selecting and implementing appropriate services from a range of services to achieve the final service. To guarantee the quality of service required by the user, selecting the best service is performed using quality of service vectors. In this way, we have weighted links between the organizations. The weighting is modeled by a vector noted $\mathbf{V_{OiOj}}$ that reflects the quality of service offered by the organization i for the implementation of the sub-service requested by the organization j.

Quality is a key factor in the customization, it can express extrinsic preferences on origin of information, its accuracy, its freshness, its validity duration, the time required to produce it or the credibility of its source. The attributes of this dimension express the quality expected or hoped; it will be faced with the actual quality produced by the sub-service. It should be noted that the quality of an informational product does not be always measured on the product itself, but sometimes on its source of production or production process. The quality of factual information (accuracy of the address of a person) is not measured as the quality of a statistical aggregate.

Each vector is composed as follows:

$\mathbf{V_{OiOj}=\{F,E,V,C\}}$ with

- ✓ F: This parameter gives an indication of the freshness of the information. The immediate propagation of updates made on the sources is a complex problem especially at the level of a system built on a large number of sources. It should be noted that according to the types of applications, services have different freshness requirements. It is therefore important to tell every user the degree of freshness of the information made available. It should be noted that the degree of freshness of certain information may strongly influence the consistency and accuracy in others.

- ✓ E: This parameter gives an indication of the completeness of the information.

- ✓ V: This parameter gives an indication of the validity of the information. To do this, the notion of lifetime information, or "certificate of validity" is important. For any information, set a date of creation and a validity period (renewable or not) is absolutely essential.

- ✓ C: This parameter gives an indication of the credibility of the source. The source of information is the first criterion for its credibility and quality. In many cases, problems to distinguish credible information from less credible or wrong information, is related to the problems of accurate assessment of the source. There is no simple method to objectify the credibility of sources. And given the importance of the criterion "Source", we split into two criteria: N: Name & R: References. It seems essential to identify the source responsible for propagation of attributes. The transmission of names and references of the institution producing information is a fundamental guarantee of the credibility of the site.

- ✓ T: This parameter gives an indication of the time needed to produce the information.

Similarly, O_i is the organization source of data and O_j the target organization.

The operation of matching compares two QoS vectors to ensure their strict equivalence, isolate their common elements or enumerate their differences. This operation therefore consists of three distinct primitives:

- ✓ Testing equivalence of two vectors (Equivalence (VOiOj, VOjOi)),

- ✓ Calculating the intersection of two vectors (Match (VOiOj, VOjOi)),

- ✓ Calculating differences between two vectors (Mismatch (VOiOj, VOjOi)).

5. Rapprochement of Agents and Services Composition

This section explains how to compare the QoS provided by each organization for a given sub-service. We propose architecture based on mobile agents that travel through many organizations in search of a specific service and return the results to the requesting service in the form of a comparative table containing the different QoS characteristics of sub-service and the link to the organization that offers the best sub-service in terms of QoS (figure2).

$$\begin{pmatrix} O1 & V_{O1O2} & V_{O2O5} \\ O4 & V_{O4O6} & \ldots\ldots \\ & & \end{pmatrix}$$

Figure 2. QoS matrix transported by a mobile agent

The proposed architecture is structured in two levels:

1st level: represents the business service asking for a subcontracting of tasks. It is responsible for the emission of broadcast search request for a subcontractor service.

2nd level: represents the gateway to transfer the request to mobile agents in charge of its resolving. It should be noted that these steps require the use of three types of agents:
-“Receipt “agent: it manages the receipt of the request and its preparation for sending.
-“Diff” agents: migrate to different sites to find the required information.
-“Filtr” agent: it takes care of filtering and merging the results returned by the agents Diff.

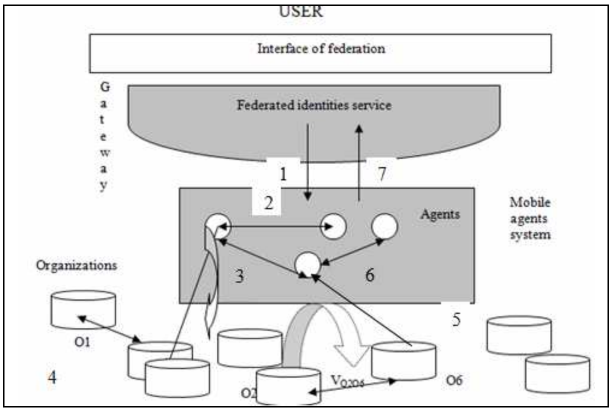

Figure 3. Mobile Agents system

The preceding figure introduces the proposed scenario:

1. Request sent via the communication interface with the mobile agent system.
2. Launch of the “Recept” agent and creation of “Diff” agents.
3. Diff agents migrate to available sites to search characteristic of service requested by the business service.
4. Construction of affinities graph and return of “Diff” agents.
5. Sending results to the filtering agent.
6. Filtering agent sorts the results and sends the response to “Recept” agent.
7. “Recept” agent sends the results to the requesting service.

6. Conclusion

In this article, we presented a decentralized and adaptive system for the discovery and composition of services in dynamic large-scale networks like federated identities platform. This system enables to answer to user’s requests by composing appropriate services and by taking account the quality of service requested. The next stage of this work concerns the implementation of this solution to show the interest of this approach by the experimental results as well as quantitative properties such as complexity in terms of time and communication.

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