

Community-Commerce Brokering Arena for Opportunistic Cloud Services Offerings

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Abstract—Community clouds are formed when a cloud infrastructure is created to support the needs of multiple, independent service consumers that have shared concerns. Such infrastructures may allow member organizations to share resources on an opportunistic basis, i.e., one entity may provide services to the other members during off-peak times, and may in turn consume services from other members. Thus each member provides permanent or transient services according to their competencies and excess. This paper sets forth a conceptual architecture, examines the opportunities offered by such systems, and initiates a conversation on the business implications. Community-commerce brokering expands the choices for business from “where can I buy/use a service” to “whom do I want to sell my excess services to”.

Keywords - Cloud computing; community clouds; clearinghouse services; brokering services, community-commerce; service-oriented business ecosystems.

I. INTRODUCTION

Cloud Computing (Specifically, Infrastructure-as-a-Service and Software-as-a-Service) offers valuable delivery methods that allow large enterprises to provide specialized and non-specialized services to others. Specialized services might be: mortgages, human resources, healthcare and insurance, etc. Non-Specialized services might be – utility computing (storage and computing power), or commodity services such as e-mail. In addition, many enterprises have engineered their internal networks to accommodate peaks in service consumption for particular Information Technology (IT) services. Some of these companies have considered offering core competencies to other enterprises, for a fee, but they may also wish to provide, for a fee, underutilized storage and processing assets. Moreover, some group of independent companies may wish to provide services that work in combination with one another, each company providing a service appropriate to their competencies, establishing a Community-Commerce brokering system or “c-commerce” [3][6].

However, these companies may not want to offer services to competitors or the general public, for competitive and security reasons. Instead, they may wish to form consortia in which resources are shared on an opportunistic basis, within a community cloud framework. Such consortia have been called Service-Oriented Business Ecosystems (SOBE) [4][7]. For example, companies increasingly engage in open-innovation networks that require secure sharing of data and

computing resources. Other companies may require sophisticated supply chain integration or the sharing data and domain-specific, proprietary software under highly specific policy and regulatory regimes [7]. Companies in a region that has high bandwidth within then region might form a SOBE because they cannot depend on global connectivity. Or, noncompeting companies may wish to pool resources so that the net cost of additional resources (as might happen in cloud bursting) is very low. Tai et al. [7] illustrate the value of SOBEs using the pharmaceutical discovery process.

This position paper discusses SOBEs that have agreed to share IT resources with appropriate constraints and Service Level Agreements (SLAs). However, this type of inter-enterprise or inter-agency cooperation has problems as well as benefits. The key benefits over and above the public cloud are that it leverages current assets and continues many of the roles and responsibilities of the current enterprise IT organization. Within a SOBE, trust among providers and consumers can be expected to be higher than in the public marketplace of cloud services, however trust must still be sustained though appropriate incentives and heuristics such as those found in [7]. Many additional problems present themselves in an ecosystem of interlocking internal clouds. Although collaborating companies want to increase IT utilization when they are not using these resources, yet they also want to ensure that they have the resources they need for critical business processes and for their peak usage. Many of the concepts developed for Peer-to-Peer (P2P) Grids are applicable here [1], except that they reformulated within a SOBE cloud with strong privacy guarantees, membership services, etc. Unlike [2], the ecosystem that we explore requires a brokering system; the incentives are not necessarily maximizing profits by providing more services within the SOBE to other SOBE members, but may also include the equitable sharing of resources to maximize profits from customers outside of the commerce-community. Hence, commerce-community members are exchanging services with one another, but are also selling services outside of the commerce-community.

Our position paper presents a conceptual brokering approach to c-commerce, where the system enables and facilitates new ad-hoc possibilities for providing and consuming IT services. Participating in the c-commerce arena, service providers may offer services opportunistically, as they become available. These services are not part of their core business, but shared among businesses within the c-commerce consortia on an opportunistic basis. For example,

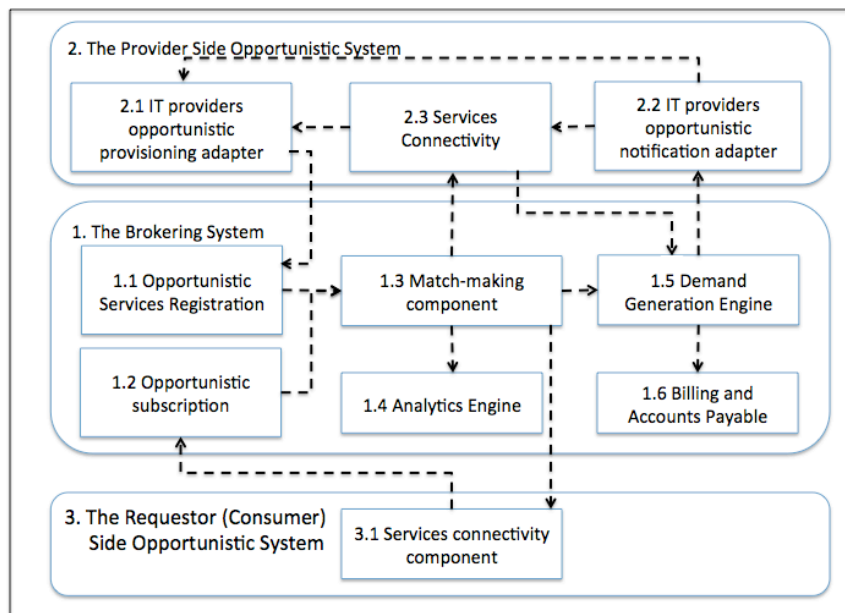


Figure 1: Conceptual architecture of a community-commerce brokering system

one company within a commerce-community might provide a payroll service they have developed, but consume the risk assessment service of another commerce-community member. To motivate future research in this area, this paper first describes a conceptual model for supporting c-commerce brokering, then discusses a prototypical usage pattern. This is followed by an examination of the advantages of the proposed system, and concludes with a discussion of the community-commerce concept and future research directions.

II. CONCEPTUAL ARCHITECTURE OF THE SYSTEM

The conceptual brokering system displayed in Figure 1, conducts matchmaking between potential service providers and requestors, and facilitates the negotiations between the sides. The central system has several conceptual components:

An **Opportunistic Services Registration component** enables IT service providers to offer active or dormant services, as well as acknowledge the provisioning of a specific service to a specific consumer. The registration component can block consumers that do not act according to agreed-upon commitments, e.g., not paying fees on time.

An **Opportunistic Subscription Component** allows consumers to view existing active services and inactive ones, as well as their underlying specifications and details. The component enables the requestors to register for the services, and even register for several alternative services according to preference and a set of subscription rules, such as time of day, signaling bandwidth, distance, etc. The subscription component can block providers who routinely fail to meet SLAs and other agreed upon commitments.

A **Match-making Component** balances the offered services and requests (requirements), and notifies providers about potential consumers (while collecting match-making fee).

The **Analytics Engine** generates historical demand and offerings lists, and identifies, according to classifications, trends in potential services that the broker is involved with.

The **Demand Generation Engine** is used in case the match-making component cannot accommodate a match according to the consumer's criteria. This component notifies the providers of a need (new requirements that may be addressed with other services that they offer)

The **Billing and Account Payable Component** bills both the providers and consumers, with the overall charges or revenue, in a monthly account. The costs of the services are collected by the broker, and transferred on a periodic basis from overall consumers to overall providers. If the provider is a consumer of other services as well, the broker will pay or collect the net difference. The payment schedule is determined by the contractual agreements between the broker and the subscribers (net-consumers or net-providers). Notably, a single broker may handle payment arrangements for many different consortia.

In addition to the main brokering system, there are interaction modules for service providers and requestors:

One interaction module is the **Provider Side Opportunistic system** that contains the **IT provider's Opportunistic Provisioning Adapter**. This adapter enables the IT provider to publish the potential services offerings (what), as well as their provisioning date (when) to potential consumers. When a potential service is not publically available (even for a limited time), it is denoted as dormant (or inactive) service and can be published without any

availability options. When a dormant service is allocated for a consumer, the provider will send a token that will indicate the identity of the requested service, its duration, its availability time, and the consumer's identity.

IT providers Opportunistic Notification Adapter enables the IT providers to be notified that a request may match a potential offering that is not "Active". When the requestor of a service acknowledges the offering of a dormant service (tailored just for this specific consumer), the approval and handshake of the negotiated service is sent via this adapter as well.

A second interaction module is the **Requestor (Consumer) Side opportunistic** system. This system enables the requestor of services to subscribe to services registered in the brokering system. The requestors can define criteria for the services, and the component presents an acceptance approval for offered potential alternatives for final selections, if exists.

The **Services connectivity component** is identical for both service providers and consumers. It provides activation codes to service requestors that indicate billing, or provides activation codes to providers that indicate payments.

A. Prototypical usage pattern

The service provider offers an active service (description, availability time, and cost, etc.), or offers a dormant one, and publishes the offering to the brokering system. The brokering system registers the offering in the match-making component.

A requestor (potential consumer) browses the offered services in the *Match-Making* component (active or dormant), and subscribes to the services via the *Opportunistic subscription* component, including an order of prioritization (in case several similar services are available).

The brokering *Match-Making* system locates a potential existing (active) offering, assigns an activation code, and informs the service provider and requestor via their respective connectivity components. The activities of the *Match-Making* component are logged in the *Analytics* component for trends analysis.

In case no active service exists, the *Match-Making* component defers the request to the *Demand* engine that searches dormant services. When the *Demand* engine locates a potential offering, it connects to the provider's *IT providers opportunistic notification* adapter, and reports the request. If the provider can provision such a service, the *Demand Engine* gets a commitment from the *Services connectivity* component of the requestor, and immediately notifies the provider via the *IT providers opportunistic notification* adapter to provision the service with the specific token issued by the *Providers' IT providers opportunistic provisioning* adapter.

The *Demand Engine* delegates monitoring of the service once it is provisioned to the *Billing and Account Payable* component for further monitoring.

The *Billing* component reports to the *Analytics* engine for further analysis of trends.

III. ADVANTAGES OF THE PROPOSED SYSTEM

There are several advantages that are consequents of the conceptual brokering system, all parts of a cloud e-commerce arena.

Maximization of capacity utilization allows enterprise IT departments to offer excess of IT services on a transient base (limited duration). For example, such excess capability may be offered on a regular schedule (e.g., between 3 am and 6 am), or on an ad hoc basis.

Proactive revenue generation notifies potential enterprise IT departments of an external need for IT service. As a result, a service provider may balance internal capacity and job scheduling, optionally accommodating the requests for an external service.

Triggering negotiations and trade enables consumers to be engaged with potential IT service providers, request a service, and negotiate its availability date, timeframe, and associated costs.

Business offering expansion enables service providers to examine a potential service. The offering can be a primary service that varies in scale, used as an alternative to existing service, or deployed when testing a brand new offering.

Business opportunities detection enables a consumer of services to offer services as well, in an opportunistic way as well, whether or not they wrap services of other parties, composite services, or the consumer's original services.

Arbitrage transactions profit enables the brokering service to generate revenue based on advertisements of the providers, match-making fee, payment and billing processing fee, survey and analytics of trends of usage (requests), or trends of offerings (what is available). Because the providers of these services are also consumers of other services, the brokering service can create a single bill that takes into account all of the negative and positive charges.

Simplification of transactions complexity reduces the amount of funds and transactions transferred between providers or consumers, and facilitates trade-offs between providers and consumers, while reducing the brokering fee.

IV. DISCUSSION

This position paper presented a conceptual brokering arena, aimed at exploiting opportunistic service offerings within a Services-Oriented Business Ecosystem (SOBE). The presented paper triggers discussions around the applicability of such systems. Existing prototypical brokering and commerce arenas revolve around established service providers offerings, in which the broker acts as sophisticated IT service catalog. The notions presented in this paper are focusing on the interactions, registration, financial, and commerce potential aspects of such collaboration. In addition, the restriction based on competitive advantages is imperative, in which the provider can restrict several consumers, and deny service based on the end-users identify, all according to the provider internal business or compliance policy.

The game change is not "where can I buy/use a service", rather of "who do I want to sell my excess services to".

This approach may form business alliances, without financial transactions, aimed at temporary treaty between prototypical competitors, in order to block a third one.

Brokering may be extended to any type of intervention in the middle ground of C-commerce (service-commerce): permanent, transient, or opportunistic. Brokering and auditing may be operated through a third party or through a consortia of SOBE members. Notably the agreements would not be peer to peer, but between the SOBE member and the broker.

Such an approach for opportunistic brokering and marginal changes facilitates services demand and requests according to business changes, enabling consumers to become providers. Thus, the distinction between requestors and consumers is introduced, separating negotiating parties and contracted ones.

“Service leverage” is introduced, tilting the balance between market forces. The dynamic nature of the cloud is no longer the playground of the Managed Service Provider, but may also be influenced by Telco companies, large IT enterprises, and other large-scale commercial organizations.

Cloud brokering concepts are just emerging, and have largely been the domain of Managed Service Providers (MSPs). The present paper extends these brokering concepts to community cloud infrastructures. Future research directions may include expansions into financial combinations and chains of brokering arenas.

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