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An Proficient Algorithm for the Abounding of Service-Based uses in Hybrid Clouds

M. Vasavi
Associate Prof., Department of CSE TKRCET,
Hyderabad, India

Syed Samreen Sultana
PG Scholar in Department of CSE
Hyderabad, India

Abstract: Cloud computing, the imminent need of computing as a finest utility, has the latent to take a enormous leap in the IT industry, is structured and put to optimal use with regard to the current tendency. In the present era, organizations are more and more using cloud environments to deploy and run applications. In this view, it is needed to provide and manage software and hardware resources within the organization and acquiring additional resources, those are externally provided by public clouds as and when they need the resources. Later in advancement to this feature, some components are placed in private cloud and some in public cloud. With this NP-Hard problem has given rise and in order to overcome this, an approximation approach based on communication and hosting costs and for service based applications are efficiently modeled by using efficient algorithms presented in the paper.

Keywords: SBA, BPMN, URI, ATOM,

I. INTRODUCTION

The term cloud computing refers to the delivery of scalable IT resources over the Internet, as opposed to hosting and operating those resources locally, such as on a college or university network. There are four different deployment models of cloud computing. They are Public cloud, Community cloud, Hybrid cloud and Private cloud.

A. Public Cloud:

A public cloud, or external cloud, is the most common form of cloud computing, in which services are made available to the general public in a pay-as-you-go manner [10]. The public cloud model is widely accepted and adopted by many enterprises because ,the leading public cloud vendors as Amazon, Microsoft and Google, have equipped their infrastructure with a vast amount of data centres, enabling users to freely scale and shrink their rented resources with low cost and little management burden.

B. Private Cloud:

A Private Cloud, or internal cloud, is used when the cloud infrastructure, proprietary network or data centre, is operated solely for a business or organization, and serves customers within the business fire-wall [10].

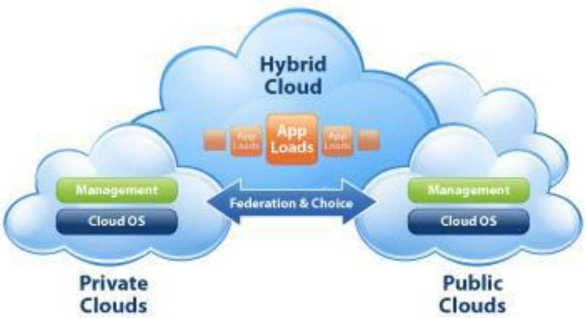

Fig1: Types of Cloud

C. Hybrid Cloud:

A composition of the two types (private and public) is called a Hybrid Cloud, where a private cloud is able to maintain high services availability by scaling up their system with externally provisioned resources from a public cloud when there are rapid workload fluctuations or hardware failures [10].

D. Community Cloud:

The idea of a Community Cloud is derived from the Grid Computing and Volunteer Computing paradigms. In a community cloud, several enterprises with similar requirement can share their infrastructures, thus increasing their scale while sharing the cost [10]. The benefits of cloud computing for an enterprise include, increased flexibility and market agility as the quick deployment model of cloud computing increases the ability to re-provision rapidly as required.

In cloud environments, the diversity of requirements for hosting services in the Cloud makes the management of Cloud applications and resources a challenging task. In this paper, we are interested in application division across clouds and particularly the division of service-based applications (SBAs) in hybrid clouds. The advantage of such a hybrid cloud deployment is that an organization only pays for extra compute resources when they are needed. Cloud Bursting is an application model where organizations can utilize the compute resources of one cloud and burst in to another cloud when the demand for computer resources exceeds the limit allowed in the current cloud.

Cloud Bursting Scenarios:

(i) Cloud Bursting from a private cloud in to a public cloud.
(ii) Cloud bursting from one private cloud in to another private cloud.
(iii) Cloud bursting from one public cloud in to another public cloud.

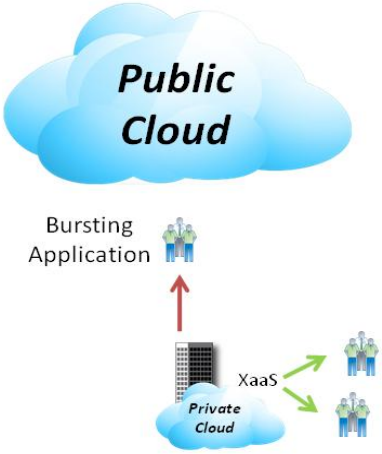

Fig 2: Cloud Bursting

The placement of resources at different levels are not considered for communication between services of hybrid cloud. Formulation of the bursting of services within a hybrid cloud results in NP-Hard problem. To overcome this problem, an algorithm has proposed to produce optimal placement solution. The algorithm proposed in this paper, is efficient for the bursting of behavior-based compositions and also for architecture-based compositions of services.

II. PROBLEM STATEMENT

The problem of placement of resources in cloud environments has been tackled from IaaS, PaaS and SaaS views, while considering private, public and hybrid clouds) from different criteria.Earlier many authors has presented algorithms to allocateplatform resources for service placement,approach for optimizingthe placement of virtual resources at the level ofinfrastructure across multiple clouds, a penalty-based geneticalgorithm for the placement of components and data(used by these components) that optimize the SaaSperformance.All these approaches are suitable for the placementin public or private clouds but not for hybrid clouds. Hybrid cloud communication costs betweenservices depend on the placement of services wherepublic and private communications should be differentiated. The placement of applications inpublic/private clouds is a matter of placement of avirtual network ona physical network that represents the cloud nodes and links. In the present scenario, the work is carried out on its formulation and its cost function and are specified that they are different from those of the approaches referencedabove.

Approaches that optimize bursting of resources in hybrid clouds: A scheduling model for optimizing virtual cluster Placements across available cloud offers was proposedin [15] and in [16]. In [17], the authors present an approach that triesto minimize the cost of provisioning workload in hybridIaaS clouds which consists in outsourcing partial

Workloads from private to public clouds. In [18], [19], [20], the authors propose several approachesfor placement of virtual machines acrossmultiple clouds.

There are three cases in view of applications that should be deployed in its private cloud as long as the neededresources can be provided by the private cloud:

(*)Already deployed applications request more resourcesthe private cloud could not provide.

(*)Already deployed applications release resourcesso that a re-deployment can be envisaged torelease allocated resources in the public cloud.

(*)New deployment requests to be fulfilled can notbe satisfied by the private cloud.

Here, we consider that almost all the private resources that are consumed and they have to be supported in any case.

So we have to decide about services that are to be deployed in the publiccloud is equivalent to minimize costs of hosting in thepublic cloud and communications between the privateand the public cloud and in the public cloud. Butthis minimization problem is subject to a constraint.Indeed, the hosting quantity of deployed services inthe public cloud is to be greeter or equal to HQ.

III. PROBLEM FORMULATION

The deployment of a SBA modeled as SBA graph as it is described above can be formulated as aprogramming problem as follows.

Minimize: $H + PC + HC$

Subject to:

$\sum_{i=1}^{n} h(s_i) \times l(s_i) \geq HQ$

Where:

$H = \sum_{i=1}^{n} \alpha \times h(s_i) \times l(s_i)$

$PC = \sum_{e=\langle s_i, s_j \rangle \in E} \beta_2 \times c(e) \times l(s_i) \times l(s_j)$

$HC = \sum_{i=1}^{n} \sum_{j \text{ s.t. } e=\langle s_i, s_j \rangle \in E} \beta_1 \times c(e) \times l(s_i) \times (1 - l(s_j))$

H is the sum of hosting costs of services deployedin the public cloud.PC is the sum of public communications (communicationsbetween services deployed in the publiccloud).HC is the sum of hybrid communications (communicationsbetween services deployed in the publiccloud and those deployed in the private cloud).

IV. OUR APPROACH: SERVICE-BASED APPLICATIONS IN HYBRID CLOUD

SBAs consist in assembling of a set of services usingappropriate service composition specifications thatcan be architecture-based like Service Component Architecture(SCA [5]) and UML component diagram [6]or behavior-based like Business Process ExecutionLanguage (BPEL [7]) and Business Process Model andNotation (BPMN [8]). The two types of compositions are given below withexamples.

a) Behavior-based compositions
b) Architecture-based compositions

4.1 Behavior-based compositions:

A SBA composed using a behavior-based specificationcan be described as a structured process whichconsists of a set of process nodes and transitionsbetween them. A process node can be service, Or-Join, Or-Split, And-Split or And-Join. And-Joins andOr-Joins should have at least two ingoing transitionsand at least one outgoing transition. And-Splits andOr-Splits should have at least one outgoing transition

And at least two ingoing transitions. Non-initial andnon-final services have one ingoing transition and oneoutgoing transition.

Definition 1 (Structured process): A structured processis inductively defined in [23] as follows:

As an example of a structured process, we considera business process of an online shopping purchaseorder of a clothing store called Cloth Store (fictitiousname). Cloth Store offers products to its customers,interacts with two suppliers and a shipper for processingorders. It holds certain products in stock, andorders others from suppliers in case of product lack.The second supplier is contacted only if the first onehasn't the required quantity or articles.The structured process of Cloth Store is illustrated inthe BPMN diagram shown in Figure 1. The customersends a purchase order request with details aboutthe required products and the needed quantity. Uponreceipt of customer order, the seller checks productavailability. If some of the products are not in stock,the alternative branch ordering from suppliers is executed.When all products are available, the choiceof a shipper and the calculation of the initial price ofthe order are launched. Afterwards, the shipping priceand the retouch price are computed simultaneously.

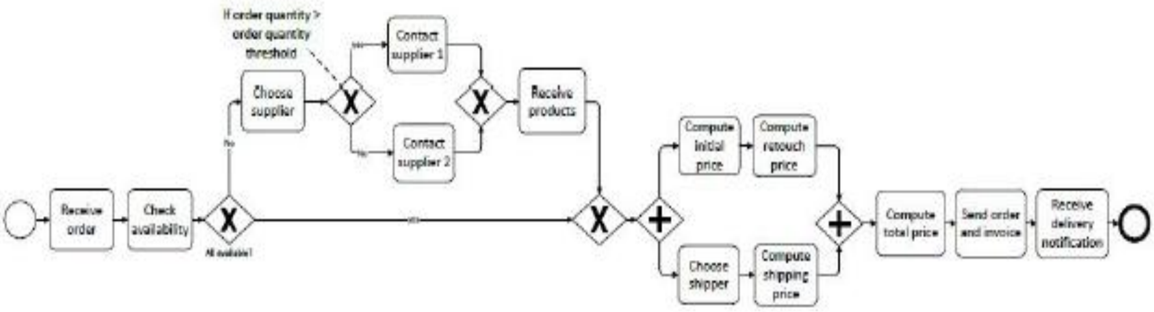

Fig 3: Example of an SBA application

The total price is then computed in order to sendinvoice and deliver the order. Finally, a notificationis received from the shipper assuring that the order isalready delivered.

4.2 Architecture-based compositions:

A SBA composed using an architecture-based compositioncan be described as a set of linked components.A component provides one or more services. It mayconsume one or several references, which are servicesprovided by other components. Connection of onereference and one service is realized by a wire. We consider the on-linestore example using a UMLcomponent diagram [6]. This diagram illustrates variouscomponents and services they offer to form aSBA.

It shows how components reference servicesoffered by other components. Offered services aredefined through interfaces. These interfaces representthe contract between components.

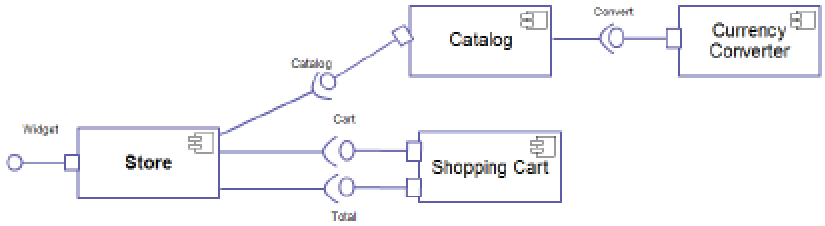

Fig 4: Example of an Online store

The example is a composition of four services. TheStore service provides the interface of the on-linestore. The Catalog service which the Store service canask for catalog items provides the item prices. TheCurrencyConverter service does the currency conversionfor the Catalog service. The ShoppingCart serviceis used to include items chosen from the Catalogservice.

4.3 SBA Graphs:

Based on the above considerations, we can model a SBA like the one presented as a graph.Services, Or-Join, Or-Split, And-Split and And-Joinnodes will be represented by graph nodes and connections/transitions between services will be representedby edges. Nodes are identified by an ID (a URI ora number) and characterised by an amount of unitsof hosting resources. Edges are characterized by anamount of communications units which refers to theamount of traffic that is transferred on the considerededge.

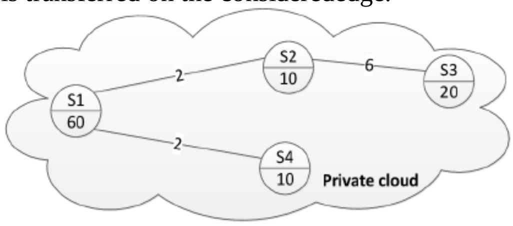

Fig 5: SBA graph of Online Store

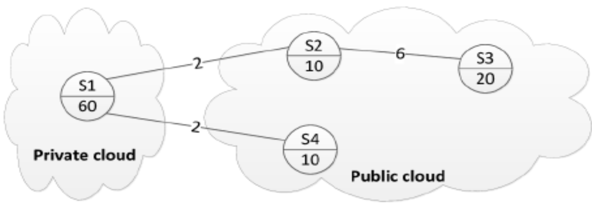

Fig 6: Online store deployed on a hybrid cloud.

4.4 Services in SBAs:

Services that compose SBAs can be identified by URIs and characterized by their interfaces, bindings and implementations. Services may be implemented with several programming languages (C++, Java, etc.), support several communication protocols (RMI, SOAP/HTTP, etc.) and/or run on several hosting frameworks (POJO, .NET framework, component based platform, etc.). A service implementation requires specific platform resources for its deployment such as a container with specific sizing. A connection between two services is characterized by the amount of data flow to be communicated between services. For example, the Catalog service is bound using the JSONRPC binding, and the Shopping Cart service is bound using the ATOM binding. The Store service is implemented in HTML and JavaScript and the Catalog service is implemented in Java.

V. IMPLEMENTATION: ALGORITHMS FOR AN EFFICIENT BURSTING

The two algorithms forthe bursting of service-based applications in hybridclouds are based on three procedurescalled Forward, Backward and Refinement. We present after the first algorithm basedon the Forward and Backward procedures. The second algorithm we propose here is based onthree combinations of the Forward, Backward andRefinement procedures.

5.1 Forward-Backward (FB) algorithm:

The Forward-Backward algorithm (FB algorithmfor short) is a first approximate bursting algorithmthat calls first the Forward procedure and then theBackward procedure[10].

Algorithm : FB procedure
Require: Graph : <S,E, h, c, l> SBA graph
Ensure: Public: set of application nodes in the publiccloud
Ensure: Private: set of application nodes in the privatecloud
1: Public, Private ←Forward(Graph)
2: Public, Private ←Backward(Graph, Public, Private)

5.2 Forward-Backward-Refinement (FBR) algorithm:

Require: Graph : <S,E, h, c, l> SBA graph
Ensure: Public: set of application nodes in the publiccloud
Ensure: Private: set of application nodes in the privatecloud
1: Public, Private ←Forward(G)

2: Public1, Private1 ←Backward(G, Public, Private)
3: Public1, Private1 ←Refinement(G, Public1,Private1)
4: Public2, Private2 ←Refinement(G, Public, Private)
5: Public2, Private2 ←Backward(G, Public2, Private2)
6: Private3 ←Ø;
7: Public3 ←Graph:S
8: Public3, Private3 ←Backward(G, Public3, Private3)
9: Public3, Private3 ←Refinement(G, Public3,Private3)
10: choose i s.t.cost(Publici; Privatei) <=cost(Publicj ; Privatej); j = 1; 2; 3
11: Public ←Publici
12: Private ←Privatei

VI. EMPIRICAL EVALUATION

To evaluate our proposed algorithms for the placementof services in hybrid clouds, we compared itsquality of responses against an algorithm that calculatesfor each graph all possible partitions (Public,Private) and evaluate them to choose an optimal solutionthat satisfies the quadratic programming problem. We considered in all our experiments that the costof a communication unit between the public and theprivate clouds is greater than the cost of a communicationunit inside the public Cloud. The distance between the optimal and our approximatesolutions can be qualified by the percentageof loss that is equal to (CAS - COS)X100/COS, whereCOS is the cost of an optimal solution and CAS is thecost of the approximate solution.

Table 1: Characteristics of generated graphs

Graphs	Nodes	Edges	Hosting needed	Density
G1	15	14	573	13%
G2	14	18	581	20%
G3	11	17	433	30%
G4	17	54	791	40%
G5	18	77	880	50%
G6	13	47	589	60%
G7	15	74	652	70%
G8	17	109	737	80%
G9	12	59	428	90%
G10	16	120	687	100%

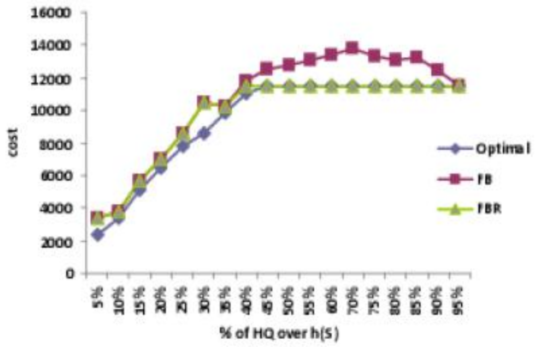

Fig 7: varying HQ

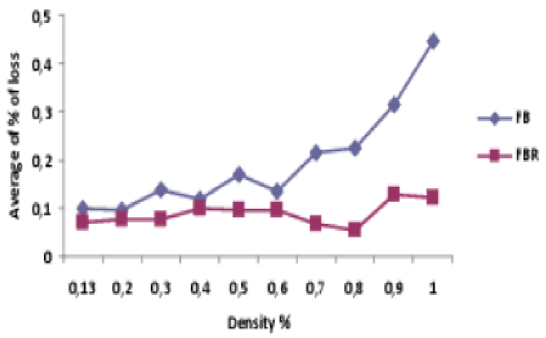

Fig 8: Varying Hosting costs

VII. CONCLUSION AND FUTURE SCOPE

In this paper, weconsidered hosting and communications costs as criteriafor service bursting of SBAs in hybrid clouds. We tackled in this paper a NP-hard problem relatedto the bursting of a service-based applications to bedeployed in hybrid clouds. This consists in determininga partition of the set of services composingthe application while minimizing the hosting andcommunication costs. The partition is composed oftwo subsets: Private and Public. Services in Privateare to be deployed locally in the private cloud andservices in Public are to be deployed in the publiccloud. FRB algorithm has a good behaviornot only for architecture-based compositionsbut also for those based on behavior. In ourfuture work, we will consider additional parameterssuch as security and privacy.

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