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Comprehensive challenges on Cloud Service Broker architecture for efficient Cloud Service selection for secured data transmission

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Abstract

With the advent of Cloud Computing being used for the delivery of hosted services over the internet, there is a remarkable demand for the Internet of Things (IoT). Even in spite of advanced technologies in cloud computing, there are various security concerns occurring, when transmitting data through the Cloud. The cloud service brokers come to the rescue of the Cloud users or the Cloud Consumers. However, there are different challenges in the services provided by the Service Broker Agents (SBA). This paper explains a detailed survey conducted on the role of the cloud service broker and their inability to protect data during transmission between the Cloud Provider and the Cloud User and analyses few policies for secured data transmission. It also provides clarity and idea to the Cloud Consumers to take decision on selecting the type of the Cloud broker, who in terms selects the appropriate cloud service based on the consumers requirement. This paper guides the Cloud Consumer and gives clear idea about the various Cloud broker

architectures to select the appropriate cloud selection services for their requirements.

***Index Terms*:**Cloud service broker, Business Broker, Cloud Aggregator, Cloud Computing, Bcloud-tree, Trusted advisor, SbSBP, CSP.

1 INTRODUCTION

With cloud-based products are widely growing at a massive rate, the organizations using cloud need to take intelligent decisions to face more challenges in selecting best cloud options. The decision lies in selecting the cloud capabilities that would suit the best fit for the organizations short and long term strategic goals. The idea lies in selecting the best cloud broker. The intense knowledge is essential to know about the cloud broker. Cloud broker is a third party individual or business that acts as an intermediary between the purchaser of a cloud computing service and the sellers of that service. Cloud brokers help clients to translate business and technology needs into cloud by providing solutions. The other terms for cloud broker include trusted advisor, business cloud broker [1], [2]. The main role of the cloud broker as trusted advisor is to evaluate service providers, options and emerged platforms in the cloud. The role of business broker is at the advisory level to manage the vendor contract relationships and the payment considerations from the technical point of view. Using a cloud broker agent also add complexity, in adapting to the security requirements through the entire transmission. A list of obstacles such as the specific adaptation at the application level to scale the on demand traffic, services being bound to a single cloud provider due to lack of interoperable standards, traffic overloading with increased waiting time. Even though, the service broker agents provide optimal allocation of user requests to appropriate Data centers, the security is a major concern during information transmission [3]. The cloud aggregator is a type of cloud broker that packages and integrates multiple cloud computing services into one or more composite services [4].

This paper focuses and analyses the various challenges and flaws faced by the Broker Agent especially during the transmission between the cloud provider and cloud user or cloud consumer. It also further analyses the solutions provided to overcome the challenges.

The paper also highlights the drawbacks of using a cloud broker, wherein few cloud brokers fail to continuously update on new cloud technologies, options and offers to the organization they provide services.

2 RELATED KNOWLEDGE AND RESEARCH STATUS

In section 3, the paper made a detailed study on the obstacles faced by the excessive adoption of cloud computing. The top two obstacles are analyzed. The first one being the adaptation of specific resources provided at the application level to manage the services during the more traffic demand. It also deals with the SOS Cloud project [1] that provided the solutions for the deployment of services and the provisioning of various resources in the cloud infrastructure environment. The problem centered on the four actors in the SOS Cloud project being the cloud provider, service provider, cloud broker and the clients.

In section 4, the paper elaborates the cloud brokerage architecture that guides the clients to select efficient cloud service. It further analyses the selection process by a new indexing structure called the Bcloud-tree. The use of the efficient query algorithm supporting the generic type of service selection queries based on multiple properties is discussed. It guides how the cloud broker should efficiently manage numerous cloud service providers information that is up-to-date.

In Section 5, the paper details the service broker policy and its security that could be extended from the cloud environment to the fog environment. It discusses the Security-based Service Broker Policy, SbSBP for the fog environment. It further discusses about the main types of service brokers implemented by the Cloud Analyst based on the various broker routing policies like: (i) Proximity-based, (ii) Performance-based and (iii) Dynamic reconfiguration-based. This bridged the routing policies of the service brokers from the cloud environment to the fog environment. The discussion from the earliest cloud brokers CloudSwitch [5], Equinix [6] and RightScale [7], the services they offer and the challenges faced during the deployment of services are dealt.

In Section 6, we discuss the cloud brokerage model with three entities Cloud consumers (users), cloud users and cloud service providers (CSPs). Once the consumer submits the required specifications to the cloud broker, the architecture elaborates how the cloud broker searches the database and offers the best cloud services to the user. The brokerage architecture also explains the key challenges faced, when offering services.

In Section 7, we conclude highlighting the challenges faced and the solutions provided. We finally state the advantages and disadvantages of each architecture for the cloud brokers to consider their service based on their existing scenario.

3 CLOUD BROKER IN SOS CLOUD PROJECT

The cloud broker provides Service Optimization as a Service (SOaaS) to cloud service providers. The paper addressed the solutions to cloud broker connected to only one cloud service provider. The figure 1, below provides a scenario of the SOS Cloud project.

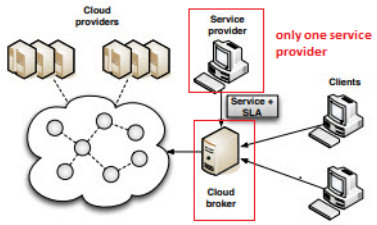

Fig. 1.SOS Cloud project with only one service provider

The cloud broker targets services with high request rates. The systems or the nodes consisted of more number of similar identical components that dynamically self-organized based on situations. The broker maintained autonomous system with large number of homogeneous nodes. Hence, each node is provided with an autonomic layer, which handles in executing three important decentralized mechanisms service optimization, overlays management and request routing. The service optimization being the key important part, uses a feedback loop that handles four key activities: monitoring, analysis, decision, and execution. The performance data is

stored by the autonomic layer of the present node and its neighbours that are in service and system overlays as shown in Fig.2. The management tables are maintained to maintain the overlays topology and store performance data of nearby nodes. The gossip protocol is used to assess the updations of the management tables.

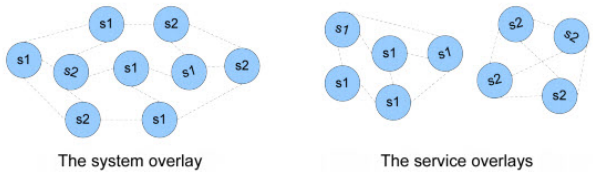

Fig. 2. System and service overlays

The project aimed in achieving by minimizing the number of rejected requests and by minimizing the number of nodes. It also analyzed the efficient use of hardware resources on each node that reduces the requirement of nodes. The prediction algorithm is used to predict the utility rate of the node resources whether heavily utilized or not. The algorithm also analyses by assuming the desired load a node could handle. If the demand goes beyond the desired load, the node will be removed in handling the traffic and new node will handle the traffic by providing the desired services. The final analysis through a custom simulator was implemented in Java. The result revealed that during heavy traffic burst, the utility of the node drops initially and then rapidly recovers after the allocation of new nodes. Elasticity is achieved by allocating new resources and deallocating the other resources by respecting the contractual SLAs of the cloud brokers.

4 ROLE OF CLOUD BROKER IN EFFICIENT CLOUD SERVICE SELECTION

The option of choosing best cloud computing service with best pricing option relies on the cloud broker. But the challenge of searching for the best based cloud service in a huge pool of service providers

is a tough task for the cloud broker. A brokerage-based architecture has been developed to provide the responsibility of the cloud broker to select the efficient service for the cloud consumers. The architecture comes along with an efficient indexing structure called B^{cloud}-tree for maintaining information of huge count of cloud service providers. The survey started with a single broker registered with more than 500 registered cloud providers and a single cloud provider providing more than 70 types of cloud services turned to be more tie consuming task. This paved way for developing the cloud service selection process with generic cloud brokerage architecture that also handles efficient indexing structure with a powerful query engine. The analysis also surveyed other cloud service selection approaches, such as MCDM (Multi-Criteria Decision Making), Optimization-based and Logic-based approaches. The overall cloud brokerage model is illustrated below.

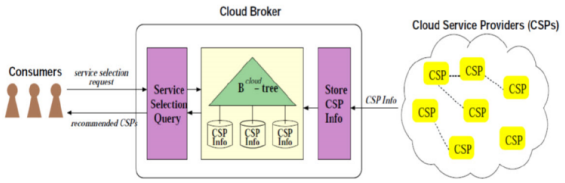

Fig. 3.Overview of the Cloud Brokerage Model

The cloud broker in this model handles the service selection request through a service selection query, sends the request to the B^{cloud}-tree which searches for the efficient cloud service provider, selects the best cloud service provider among the other connected ones, gathers and collects the stored information of the CSPs and then responds to the cloud consumer with the recommended CSP information.

This brokerage model faced the challenge of maintaining the CSP information up-to-date, for which the efficient query algorithms are proposed. The next challenge is to respond fast to a users request based on the users requirements. The properties of various types of cloud services were identified with Service type, Security, Quality of Service (QoS), Measurement and Pricing units, Instance sizes, Operating system, Sensitivity of the pricing and Subcontractors. The types of user requests were analyzed based on the

properties and the corresponding query will selected. The two types of queries, such as, exact query and interval query are used for service selection. Studies found that the broker after evaluating the exact query, gets the best match. The cloud broker for the interval query provides related different cloud services.

The biggest advantage of the B^{cloud} tree can easily integrate to existing systems, where the information of the CSPs are stored based on their IDs. A simple example ofB^{cloud} tree is illustrated.

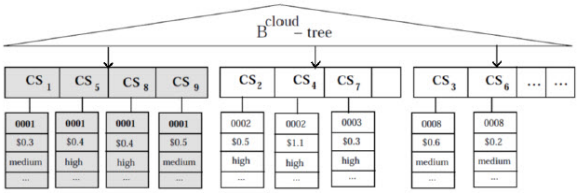

Fig. 4.Example B^{cloud}-tree

The searches are conducted based on the IDs of the CSP to retrieve their information. The main challenge is the generation of the indexing key, by which the storage order is maintained for cloud services. The index keys are generated based on the encoded properties of the respective cloud services. The broker plays an important role converting each encoding into a binary representation. The results yielded significant improvement in terms of both efficiency and accuracy.

5 SECURITY-BASED SERVICE BROKER POLICY

The extensive use of cloud computing has led to the evolution of computing from the personal computers to the Internet of Things (IoTs) services. Even though, various services were offered in both cloud and fog, the security remains the main challenge. The cloud broker acts as a service broker in this environment. It acts as an interface between the users and the data centers, taking into consideration the load balancing factor during heavy peak traffic periods. This architecture proposed a Security-based Service Broker Policy,

SbSBP in a fog environment. The service requests are selected based on the security strength of the data centers. The existing service broker policies relied on the basis of the present load on the data centers. But with the SbSBP, the dynamic reconfiguration is provided to the data centers based on the VM cost, cost of data transfer cost, security properties, load balancing properties, etc.

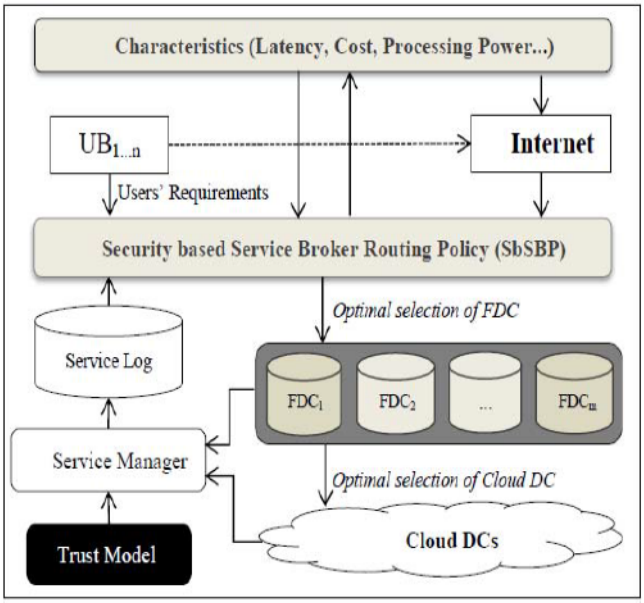

Fig. 5.SbSBP system model in a Fog environment

The SbSBP model of architecture contains five key steps, such as, requirement elicitation, assigning security indices, assigning optimal indices, selecting optimal DC and dynamic reconfiguration. The Cloud Analyst simulation tool has been used for performance analysis through implementation of this policy. The Fog-Cloud interaction is also established, in a similar manner like the user-Fog interaction by considering the users to be Fog data centers and the service providers to be Cloud datacenters. The results were compared with the DSBP (Dynamic Service Broker Policy) based on the parameters like: loading pattern of data center, cost, response time and the processing time of data center. A comparative study has been conducted with data center processing time for different

cases. The new service broker policy is implemented in the Fog computing environment by way of selecting an optimal data center that can be provided to the users based on their requests and requirements, considering the response time and cost, and the data centers current load. The concept of dynamic reconfiguration has been dealt to adapt the changes in the data center characteristics. This policy model enables the security based service broker policy in order to strengthen the security of IoT devices. But the main concerns lies on the privacy issues, cost the fog equipment, trust authentication concerns and wireless network security concerns.

6 STRUCTURE OF CLOUD BROKER ARCHITECTURE

This paper classifies the cloud broker based on the dimensions of broker application, dimensions of generic platform and dimensions of Broker platform.The basic ontology of the cloud broker architecture is given below:

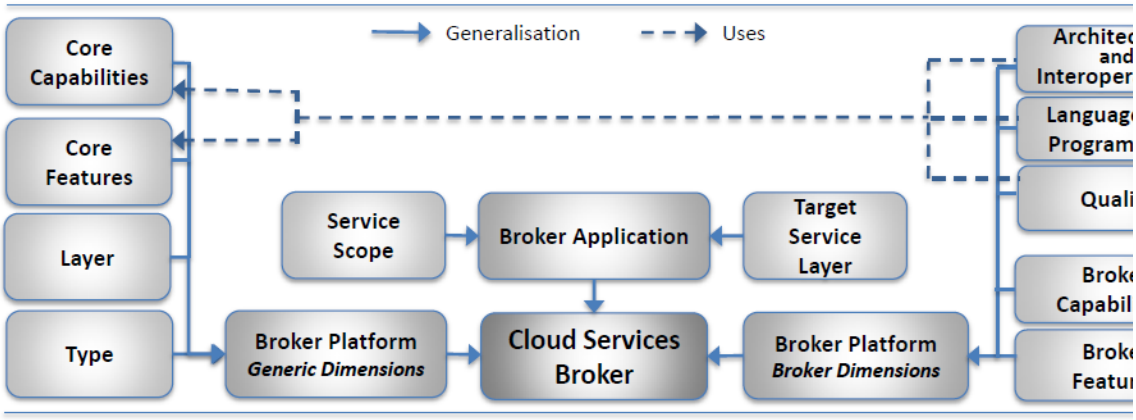

Fig. 6.Basic ontology of Cloud Broker architecture

The dimensions of Broker application is dealt on cloud delivery model categories, construction of the broker and broker scope as given in Fig. 6 [4]. The dimensions of generic platforms are dealt on

the basic cloud platform classification. Further, on the dimensions of broker platforms. In this architecture, the ontology uses a combination of descriptive and categorical elements. Fig. 7 explains the structure of describing the hierarchy of generic and broker-specific features and capabilities depending on the platforms.

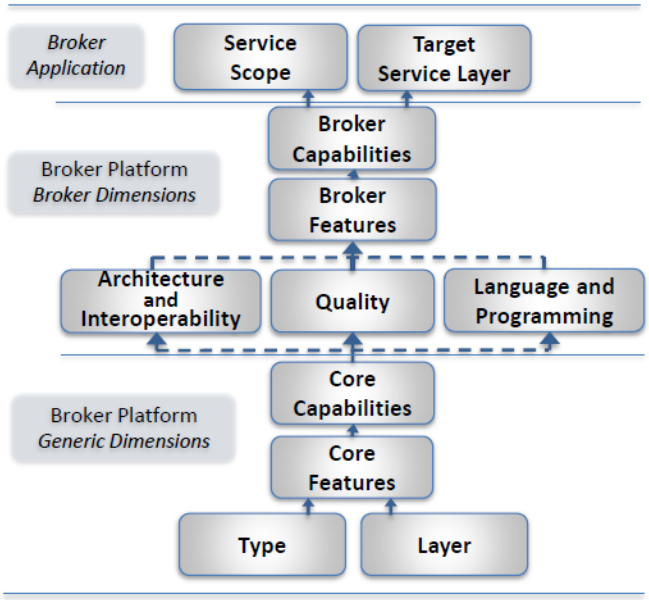

Fig. 7.Structure of Cloud Broker Architecture

In the above case, a cloud service application is a cloud-based software system which provides application service to CSPs and cloud consumers. The framework with number of cloud brokerage solutions were analyzed during the comparison. The foremost aim of this application is the evaluation done on the framework regarding two factors:

i) *Adequacy (for fit purpose):* to identify the strengths and drawbacks by identifying the presence or absence of common features.

ii) *Completeness:* Concern on the use of the tools being properly used.

To overcome the concerns, they have selected the open-source solutions and other research projects focusing the current trends. Some of the open-source solutions are IaaS (OpenStack), PaaS (OpenShift, CloudFoundry) to assist the cloud app developer. Google search engine was used to select solutions based on the keyword searches that were applied to cloud solutions. The discussions involved on the brokerage solutions, marketplace, commoditization and federation. The challenges were identified in the reference architectures, scope of control and federation and syndication.

7 CONCLUSION

In this paper, we have made a detailed analysis of the cloud broker being used on different environments at different stages and the levels. The survey study indicates that whenever a transmission of information is to take place in the cloud, the service of cloud broker plays an essential role. The brokers will act as first point of call. But this study determines the role of brokers and their connection to the cloud service providers and the type of services offered at various stages. The cloud consumer can choose the best cloud broker depending on the requirements, cost considerations and demand. The table below indicates the advantages and disadvantages of each cloud broker based on the requirements of the cloud consumer.

TABLE I.CSP architecture Concept with advantages and disadvantages

SNO	CSP Architecture	Concepts	Advantages	Disadvantages
1	SOaaS broker in SOS Cloud Project	Only one service provider	a) System remains stable at constant request rates. b) Adding a new node can be done by an existing node.	During traffic burst utility drops initially and recovers at a rapid rate.
2	Novel broker-based architecture	500 service providers with 70 types of services	a) Uses indexing B^{+}-tree b) Supports generic type of service selection queries	Occurrence of collision due to lack of promised immutable resources.
3	ShSBP Broker policy	CSPs in Fog environment	a) Allocation of optimal Datacenter to the users. b) Better performance than DSBP.	Lack of security in strength in IoT devices.
4	Ontology Cloud Broker architecture	Based on cloud delivery model, broker construction and broker scope	Provides open-source solutions are – IaaS (OpenStack), PaaS (OpenShift, CloudFoundry) to assist the cloud app developer.	Commoditization and federation deployment.

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