# Building Blocks of Multi Cloud Computing Systems

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***Abstract*—Multi Cloud Computing Systems access simultaneously multiple clouds, interacts with each cloud service providers, process data and collection of results are required. Many organizations shifting towards multi cloud environment to improve performance, faster data access rate and to reduce cost. Multi cloud computing systems includes the geographically distributed clouds assimilation in a large open system to manage all the issues regarding collaboration of the Clouds entirely detached from vendors and providers. So, there is a need of automatic load coordination. The proposed architecture supports automatic load scaling with the vital elements of architecture like cloud exchange, cloud broker and cloud coordinator.**

***Keywords*—Multi Cloud Computing System, Cloud Exchange, Cloud Broker, Cloud Coordinator.**

## I. INTRODUCTION

Multi Cloud [1] is a scenario where an enterprise implements multiple different platforms, services and applications into its cloud architecture. Rather than implementing a hybrid cloud, a public cloud, or a private cloud, the business merges several different clouds into one complete platform. Most of the enterprises are looking for multi cloud strategies for their both short and long term dimensions to gain benefits of business intelligence, latest backup and recovery techniques, project tracking and management tools etc.

Deploying an application in multi cloud architecture reduces the dependency on a single cloud provider. This helps the organizations to negotiate more favourable service level agreements or pricing or both. At the same time an enterprise prevents being locked into any one cloud vendor's exclusive infrastructure requirements.

Multi Cloud solutions facilitates decision criteria of an enterprise like performance, cost control and cost optimization in mind, enables the enterprise to choose for keeping some applications on-premises even as organizations migrate others to one or more public clouds.

Accelerated by the needs of business organizations to permit the interoperability [2] of existing corporate datacenters with their own public infrastructure, cloud providers are facilitating the upload and download of entire virtual machines, so that copying organizations virtual machines from one provider to another is easier than ever.

Various cloud providers provides different solutions and suggest continually evolving arrays of features and capabilities. Few offerings will not be supported by any other cloud provider. Multi Cloud supports the organizations the ability to select favourite data services from any provider to create a customized solution that best fits the organization's needs.

For small businesses by employing multi cloud strategy has ability to grow exponentially and spikes in infrastructure demand across geographic. Thus multi cloud scenarios provide both cost and agility benefits that make the organisations for cloud stronger.

## II. STRUCTURE OF MULTI CLOUD COMPUTING SYSTEM

Multi Cloud architecture [3] instantiates utility oriented integration of clouds, enables cross domain application coupling and deploys advanced virtualization mechanisms. Multi cloud architecture consists of three building blocks as in Fig 1 [4]:

- Cloud Exchange
- Cloud Broker
- Cloud Coordinator

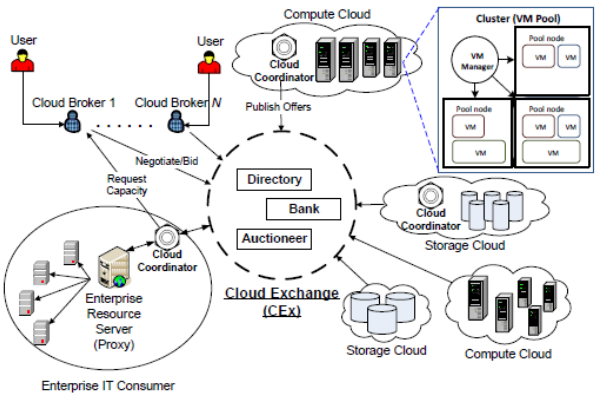


Fig 1: Building Blocks of Multi cloud Architecture

## III. CLOUD EXCHANGE

The Cloud Exchange [5] collaborates cloud service providers and cloud consumers. It provides integration of on demand infrastructure needs of application brokers to match

against currently available supply of cloud coordinator. Thus it plays an vital role and arbitrator between cloud broker and cloud coordinator. Every cloud user in the multi cloud environment needs to instantiate a Cloud Brokering service [6] that can dynamically establish service contracts with Cloud Coordinators through the trading functions exposed by the Cloud Exchange.

The cloud exchange provides database repository that facilitates cloud service providers to declare their offered supply of possessions and services and their existing prices. Loud users can search for most suitable cloud service providers based on cost or quality of service and can submit their request about the cloud service. Cloud service providers and users can retrieve the information from the database repository through standard interfaces. The third party controllers called dealers regulates, controls and updates the policies of cloud exchanger. Banking system is a part of cloud exchange tracks the financial transactions between the participants of cloud exchange by offering online payment management systems.

## IV. CLOUD COORDINATOR

The cloud coordinator monitors and maintains the business goals specific enterprise clouds and their membership and facilitates exporting of cloud services. The components of cloud coordinator are shown in Fig 2 [7] and are:

- Scheduling and Allocation
- Market and Policy Engine
- Application Composition Engine
- Sensor
- Discovery and Monitoring

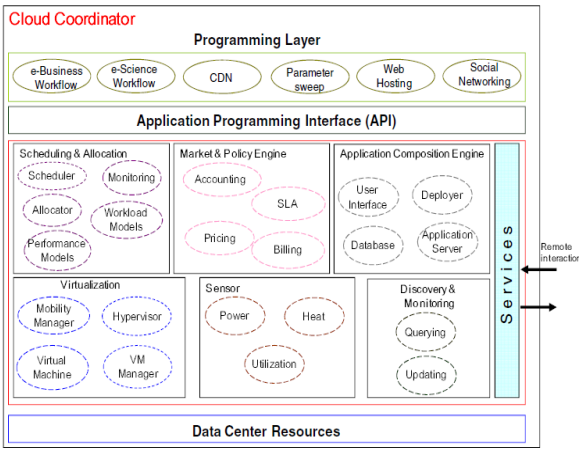


Fig 2: Components of Cloud Coordinator

*4.1 Scheduling and Allocation:*

Coordinator specifies the assemblage of components into virtual networks and tiers that from the service application. After deploying application successfully, feedback [8] is sends to the remote node by using sensor component and can monitor remote node until execution of task is completed.

*4.2 Market and Policy Engine:*

Stores and manages Quality of Service [9] parameters, SLA agreements [10] and resources information of each cloud service provider, develops a pricing model based on this information. The Accounting module contains the actual resource usage information which helps in the calculation of total resource usage cost of each user. The Billing module then charges the usage costs to users accordingly.

*4.3 Application Composition Engine:*

This component provides the environment to facilitate application developer to develop and implement applications by using backend databases like Internet Information Server (IIS) of ASP.Net, SQL data services provided by MS Azure etc.

*4.4 Sensor:*

Cloud Coordinator utilizes this component to collect data regarding virtualization [11], migration of cloud and scheduling components. Through this component the coordinator monitors heat dissipation, power consumption and resource consumption by remote clients.

*4.5 Discovering and Monitoring:*

This component monitors status of load, power consumption, SLA and allocation of resource by collaborating with other components.

## V. CLOUD BROKER

Cloud Brokers is an entry point to handle multiple cloud services for an enterprise, provides standard interface for multiple cloud service providers, facilitates interoperability, portability and clear visibility regarding services provided by the cloud service providers. Cloud Broker negotiates a contract with cloud coordinator by analyzing the SLAs, facilities and resource list of multiple cloud providers in cloud exchange. Cloud broker supports value added services to cloud users. Cloud broker consists of three parts

- User Interface
- Core service
- Execution interface

User interface enables the cloud user to access cloud application and acts as a mediator between cloud application and cloud broker. Cloud user submits the tasks to be executed to cloud broker which in turn access necessary service to user. Major functionality of cloud broker is provided by the core service. The services provided by the core service include task scheduling, service negotiations, monitoring and management of cloud services. Execution interface encapsulates and dispatches the user application to remote cloud for execution.

## 6. CONCLUSION

Multi cloud architecture supports customers the flexibility and capability they require for their applications but increased backend complexity. To meet more critical business requirements, organizations across industries are adopting multi cloud computing systems. Application architects must practice architectural discipline to prevent cloud driven applications from being tied to a cloud provider's service. This paper provides guidance on framework for building portable cloud applications as part of a multi cloud strategy that avoids vendor lock-in.

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