The implementation and management of several internal and external cloud computing services to meet business demands is known as cloud federation, sometimes known as federated cloud. A global cloud system combines community, private, and public clouds into scalable computing platforms. By utilizing a common standard to link the cloud environments of several cloud providers, a federated cloud is built.

Levels of Cloud Federation

Cloud Federation stack

Each level of the cloud federation poses unique problems and functions at a different level of the IT stack. Then, several strategies and technologies are needed. The answers to the problems encountered at each of these levels when combined form a reference model for a cloud federation.

Conceptual Level

The difficulties in presenting a cloud federation as an advantageous option for using services rented from a single cloud provider are addressed at the conceptual level. At this level, it's crucial to define the new opportunities that a federated environment brings in comparison to a single-provider solution and to explicitly describe the benefits of joining a federation for service providers or service users.

At this level, the following factors need attention:

- The reasons that cloud providers would want to join a federation.
- Motivations for service users to use a federation.
- Benefits for service providers who rent their services to other service providers. Once a provider joins the federation, they have obligations.
- Agreements on trust between suppliers.
- Consumers versus transparency.

The incentives of service providers and customers joining a federation stand out among these factors as being the most important.

Logical and Operational Level

The obstacles in creating a framework that allows the aggregation of providers from various administrative domains within the context of a single overlay infrastructure, or cloud federation, are identified and addressed at the logical and operational level of a federated cloud.

Policies and guidelines for cooperation are established at this level. Additionally, this is the layer where choices are made regarding how and when to use a service from another provider that is being leased or

leveraged. The operational component characterizes and molds the dynamic behavior of the federation as a result of the decisions made by the individual providers, while the logical component specifies the context in which agreements among providers are made and services are negotiated.

At this level, MOCC is put into precise and becomes a reality. At this stage, it's crucial to deal with the following difficulties:

- How ought a federation should be portrayed?
- How should a cloud service, a cloud provider, or an agreement be modeled and represented?
- How should the regulations and standards that permit providers to join a federation be defined?
- What procedures are in place to resolve disputes between providers?
- What obligations does each supplier have to the other?
- When should consumers and providers utilize the federation?
- What categories of services are more likely to be rented than purchased?
- Which percentage of the resources should be leased, and how should we value the resources that are leased?

Both academia and industry have potential at the logical and operational levels.

Infrastructure Level

The technological difficulties in making it possible for various cloud computing systems to work together seamlessly are dealt with at the infrastructure level. It addresses the technical obstacles keeping distinct cloud computing systems from existing inside various administrative domains. These obstacles can be removed by using standardized protocols and interfaces.

The following concerns should be addressed at this level:

- What types of standards ought to be applied?
- How should interfaces and protocols be created to work together?
- Which technologies should be used for collaboration?
- How can we design platform components, software systems, and services that support interoperability?

Only open standards and interfaces allow for interoperability and composition amongst various cloud computing companies. Additionally, the Cloud Computing Reference Model has layers that each has significantly different interfaces and protocols.