A Model for Accomplishing and Managing Dynamic Cloud Federations

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Cloud federation

Definition of federation (from a common dictionary):

Act of joining states or other groups with an agreement in common affairs they will be governed under one central authority.

Terminology

According with the NIST definitions

Cloud Service Providers (CSPs)	• provision the physical processing, storage, networking, and other fundamental computing resources
Service Providers (SPs)	• deploy, configure, maintain, and update the operation of the software applications on a cloud infrastructure at PaaS and SaaS levels.
Cloud Brokers (CBs)	• manages the use, performance, and delivery of cloud services, as well as negotiates relationships between CSPs and SPs.
Cloud Consumers (CCs)	• exploiting CSPs can accomplish services for both PaaS and SaaS layers.

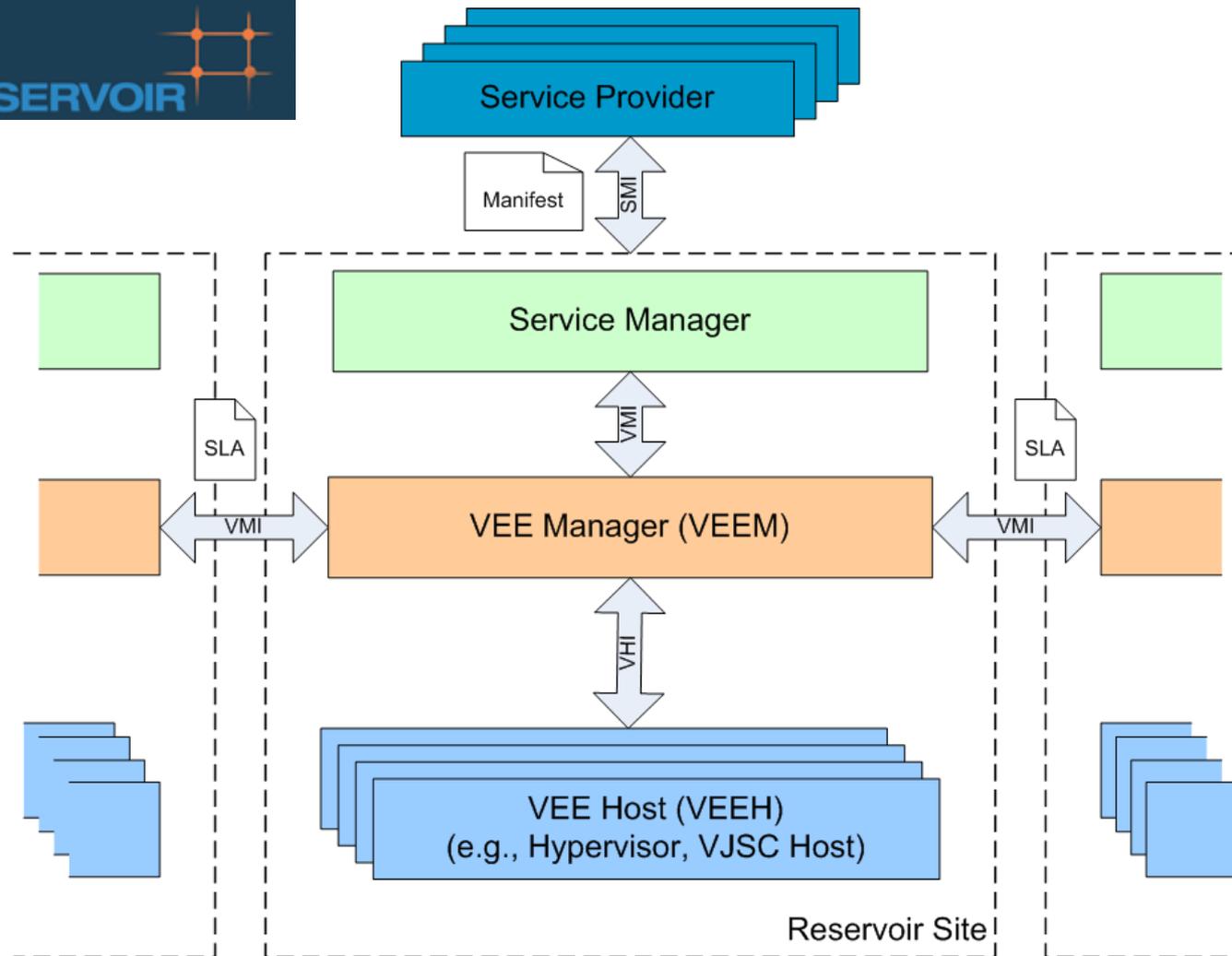# Survey on cloud federation model

Reservoir architecture:

Service Manager: the highest level of abstraction, interacts with the service providers to receive their Service Manifests, negotiate pricing, and handle billing. Two tasks:

1. deploying and provisioning **virtual execution environments (VEEs)** based on the Service Manifest,
2. monitoring and enforcing SLA compliance by throttling a service application's capacity.

Virtual Execution Environment Manager (VEEM): responsible for the optimal placement of VEEs into VEE hosts subject to constraints determined by the Service Manager.

Virtual Execution Environment Host (VEEH): responsible for the basic control and monitoring of VEEs and their resources (e.g., creating a VEE, allocating additional resources to a VEE, monitoring a VEE, migrating a VEE, creating a virtual network and storage pool, etc.)

Survey on cloud federation model

In the Reservoir model the architecture is "invasive", so it is hard to make it coexists with the already existing Cloud Managers.

RESERVOIR leads up to FI-Ware, a recent EU initiative, and to XI-FI Federation, a federated framework based on FI-Ware. XI-FI federates homogeneous FI-Ware systems based on OpenStack

Cross-Cloud Federation Manager is an architectural design for federation, a software in charge of:
- Discovery
- Match-making
- Auhentication

Openstack is focusing on Identity & Access Management federation

Reference scenario
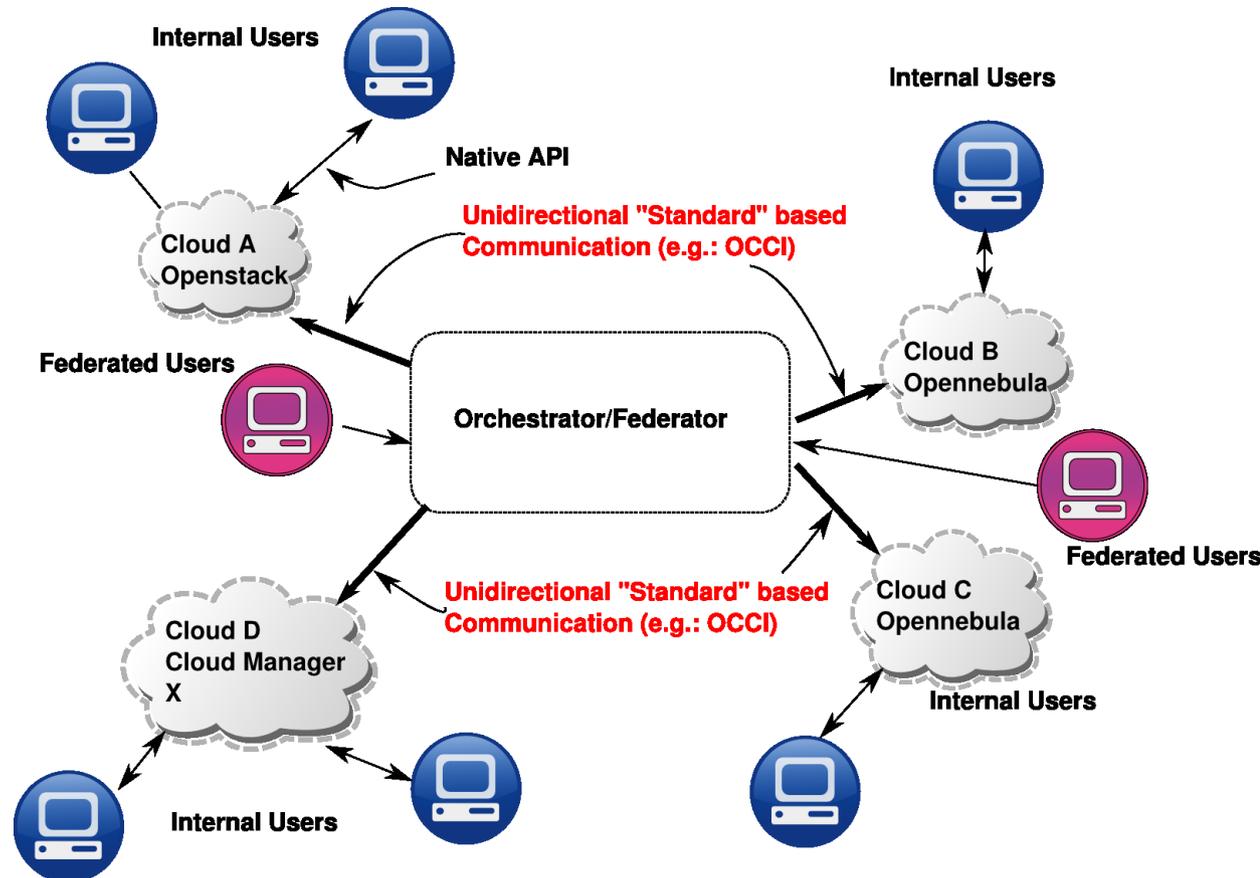## Orchestrator

Focus on cloud interoperability:
- Mainly focused on protocols needed to access clouds based on different software systems (OpenStack, OpenNebula, EC2, …)
- Main effort to design communication protocols and resources dissemination policies

Approach focused on interoperability:
1. CC willing to access the federated cloud resources
2. Centralized entity receiving requests from CC
3. translates them into requests to external CSPs.

This model, following the introductory definition, is not a cloud federation:
- Users (CCs) are aware of the different CSPs
- There is not cooperation among CSPs

Reference scenario
Orchestrator

Different software interfaces to access either their own internal resources or the external ones ("federated").
Users are divided in:

- **Internal users** that access cloud services through native APIs,
- **Federated users** that interact with the central entity through federation specific APIs.

Some issues that can be critical in specific scenarios.

- Internal users cannot extend their cloud resources by taking advantage of federated CSPs, because they need another external software system that, in turn, will access resources not related to their own cloud.
- Additionally, internal users may have applications developed on cloud manager specific APIs thus, in order to exploit the federated resources, such applications have to be rebuilt.

Nevertheless, each cloud may provide <u>different services or interfaces</u> (e.g. event notification or monitoring service), which cannot be available on the federation system.
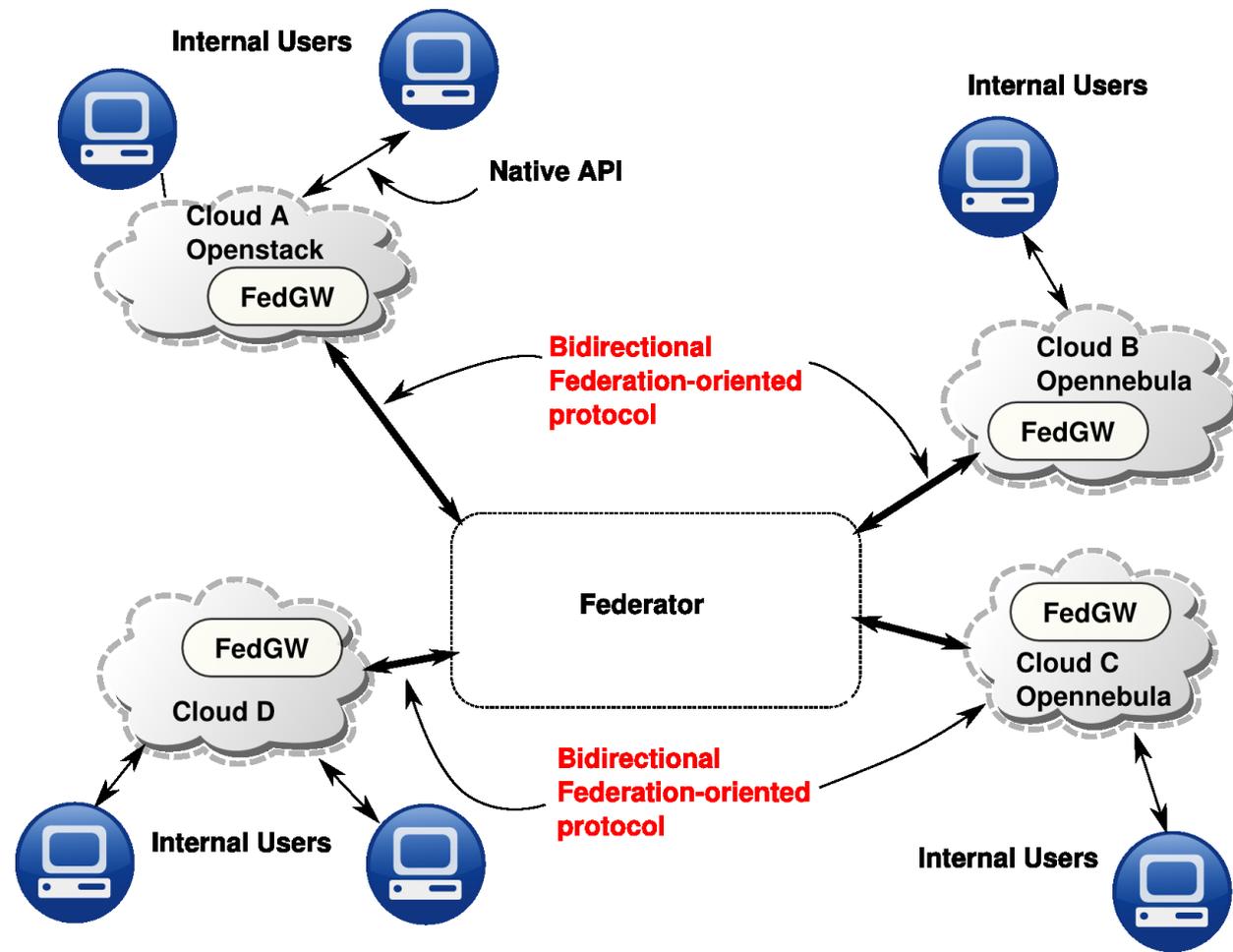
Reference scenario
Federator

Focus based on definition allows to design a system able to transparently extend each cloud including external resources.

Only cloud users:
- No distinction between internal and federated users
- Can access the resources offered by both their own CSP and external federated ones through cloud native interfaces

Most of the harmonization work among the federated CSPs is performed by **FedGW**, a software running on each site.
The entity **Federator** will carry out operations like resource discovery, marketplace of image templates, and so on.

Reference scenario

A, **B** & **C** are small CPSs
D & **E** CSPs big enough to internally address any request.
CSP **D** is distributed around the world and its internal interconnection is depicted as a link between **D** and **D'.**

Cloud brokers act as third part intermediary agents, that make their business selecting the best solution satisfying both the CSPs and SPs' requirements.

Our interest is to provide clouds **A**, **B** and **C** the same type of business opportunities as for clouds **D** and **E**, in which neither brokers nor SPs might be aware of the capabilities each cloud operator supply with
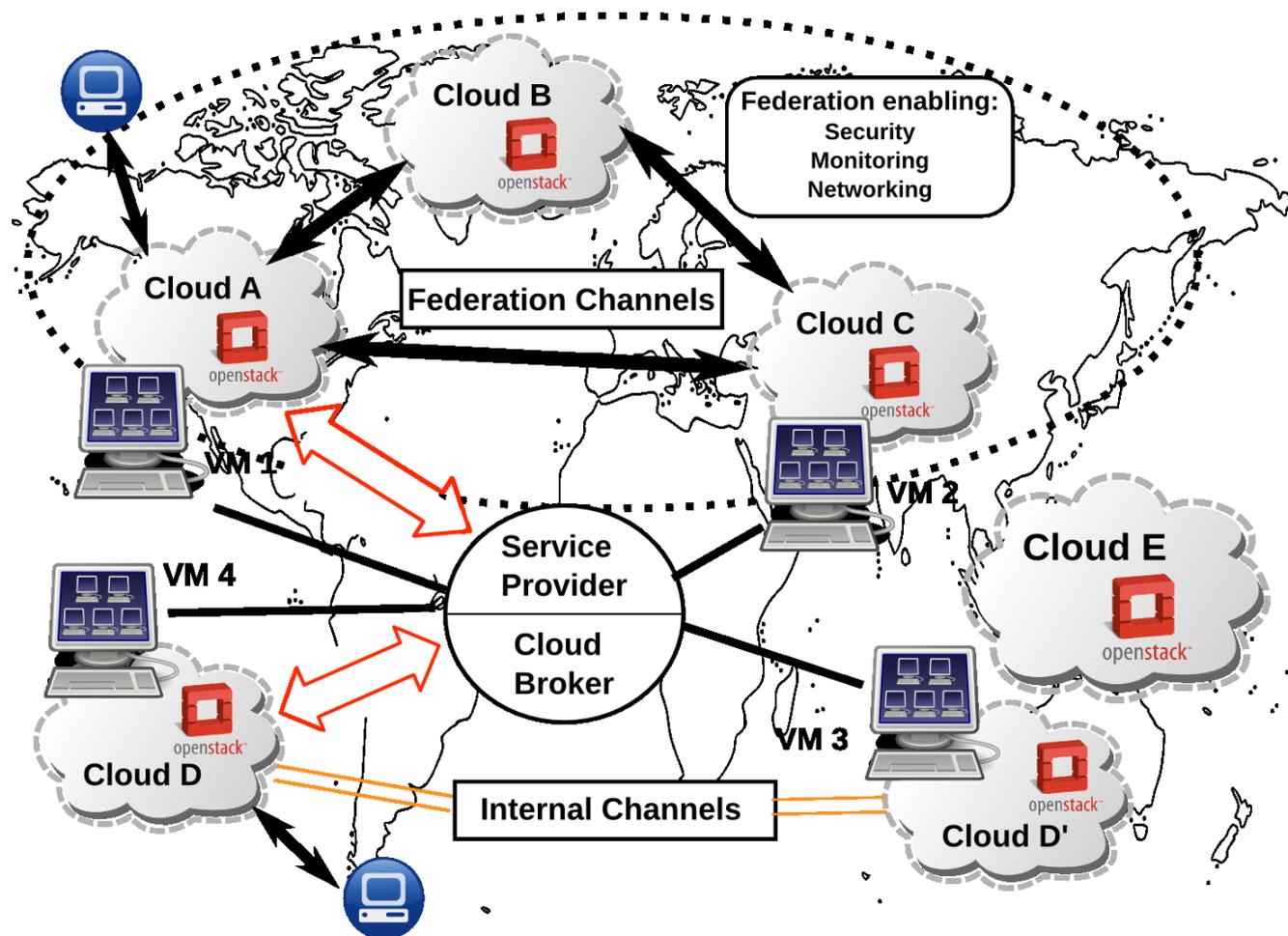
Proposed cloud federation model

Cloud federation life cycle comprises of two distinct moments:

- **join/exit**
  - related to the activities performed by a CSP to create or destroy the environment needed by the federation members to communicate each others
- **resources access**
  - related to the discovery, negotiation and usage of federated resources.
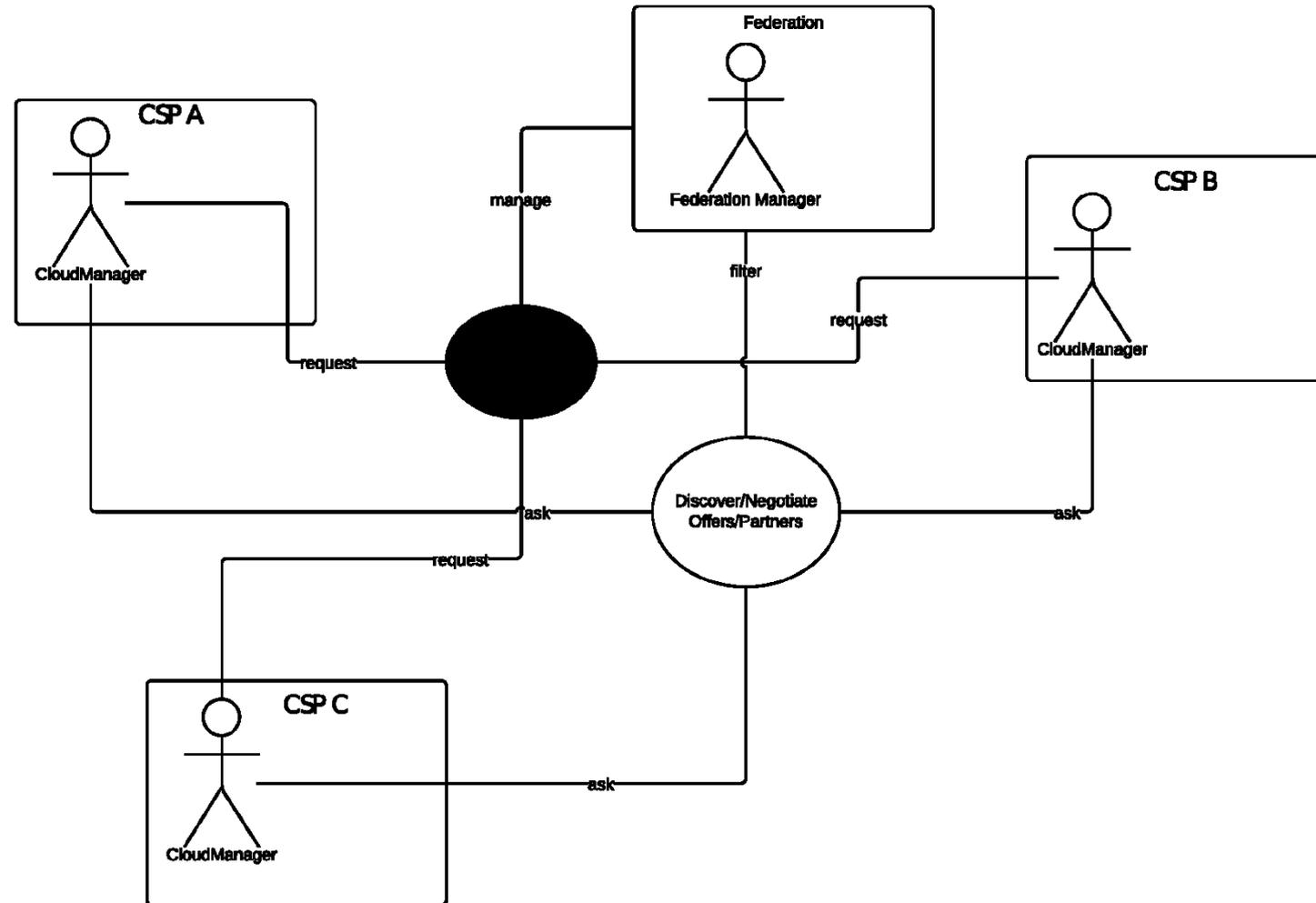
Proposed cloud federation model
Join/exit

Federated resources:
- Are an upper bounds of the resources available, not exclusively for the federation members
- Its real usage depends on the actual request during federation life cycle.
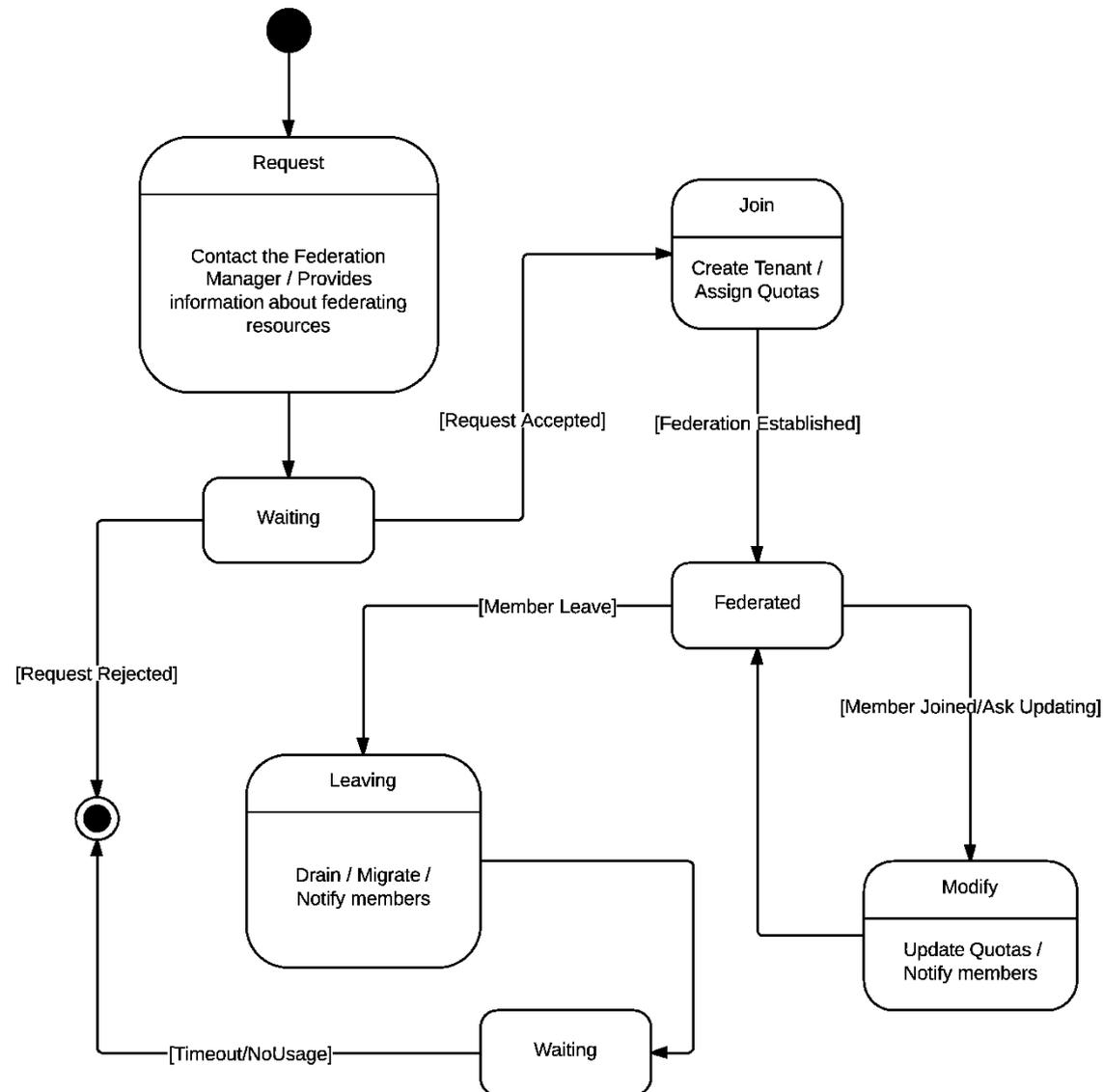
Federation manager:
- Receives join request reception by the CSP
- checks whether the information provided about resources and policies matches with the federation rules

If yes the CSP can be considered as being federated and ready to fulfill requests from/to others federation members.

CSP can:
- Modify the amount of resources committed to the federation and the policy in any moment but the changes must be notified in advance to the federation manager, who will propagate the information to all members.
- Be rejected because it does not comply any more with the rules
- Leave the federation, either for its or the federation manager decision

Request

Contact the Federation Manager / Provides information about federating resources

Join

Create Tenant / Assign Quotas

[Request Accepted]

[Federation Established]

Waiting

[Request Rejected]

[Member Leave]

Federated

[Member Joined/Ask Updating]

Leaving

Drain / Migrate / Notify members

Modify

Update Quotas / Notify members

[Timeout/NoUsage]

Waiting

Proposed cloud federation model
Discovery & Negotiate

The federation defines the technical aspects in order to access remote resources and maintains a list of CSPs providing resources with both qualitative and quantitative information. Nevertheless, in order to access member resources a new negotiation is requested between the two members, acting one as CC and the other as CSP, with the supervision of the federation manager acting as CFA.

Cloud manager to access federated resources:

1. Send a request to the federation manager
2. Federation Manager search for the required resources
   1. Cloud manager can reject offer and send a new request
3. In case of acceptance:
   1. Establish agreement and sign it
   2. Notify the Federation Manager
   3. Federation Manager can update resources usage
4. CC can start to use new resources
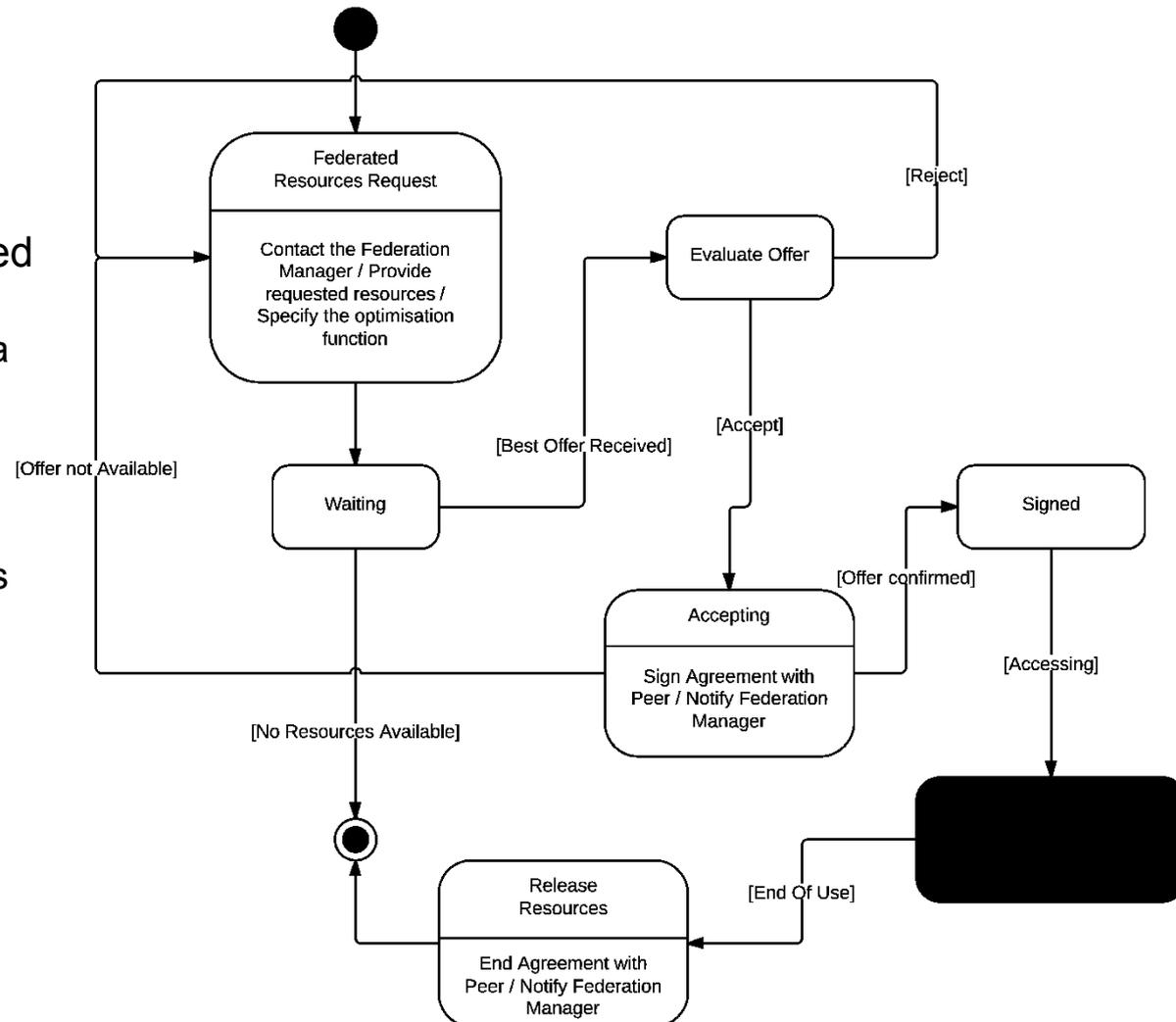
Proposed cloud federation model
Request & Access

CC requires new resources to CSP

1. internal resources:
    request managed from
    CSP as usual

2. from the federation:
i.   cloud manager will become a
        federation
ii.   start the negotiation procedur
        internally managed by a feder
iii.   Upon agreement establishme
        resources made available
iv.   CC can access the services t
        resources managed by the cl
3. agreements could be defin
    before users request new i
4. Users might release reque
    before the actual expiration of the
    corresponding agreement
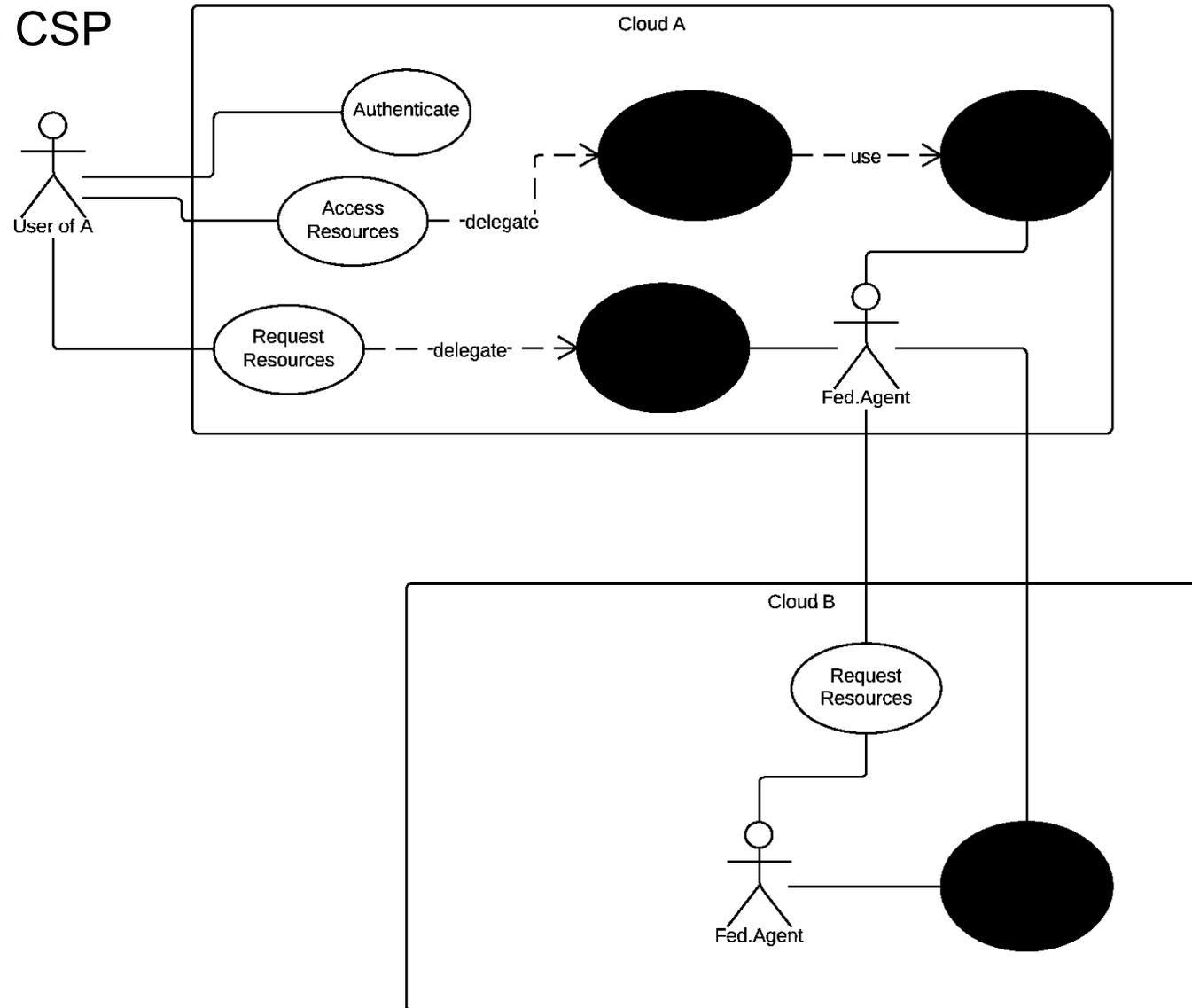
Conclusions and future work

The challenge: federation to overcome all the problems raising in merging clouds with heterogeneous administration domains.
Sensible argument in case of research institutions willing to cooperate sharing resources in a simple way for users.

E.g., INFN is owning distributed resources, managed differently from different cloud manager. In this way could be shared without the need to establish only one set of policies for all. Also this would be very useful in future collaborations with other institutions.

The high level model of cloud federation introduced is able to provide the scalability and flexibility needed by small clouds.

The added value: providing a high-level model not related to a specific technology which aims at federating different cloud infrastructures.

We are working on a concrete implementation:
- To test our model
- To provide new features
- To solve real problems that may occur in cloud federation accomplishments.

Thank you

Any question?