Beyond the Cloud: Federated and Multi Clouds

Tessema Mengistu (Ph.D.)

mengistu@cs.vt.edu

Outline

- Interclouds
- Federation of Clouds
- Overview of Multi-cloud

Interclouds

- Cloud computing is shifting from being a technology disruptor to becoming a necessary component for maintaining competitiveness for enterprises
- Worldwide end-user spending on public cloud services is forecast to exceed $1 trillion in 2027
- Over 70% of enterprises will use industry cloud platforms by 2027
  - Up from less than 15% in 2023
- Growing complexity and diversity of cloud computing tasks
  - A single cloud environment is highly likely inadequate

Source: Gartner Inc, Forecast: Public Cloud Services, Worldwide, 2021-2027, 3Q23 Update

Interclouds

- Solution?
  - Interclouds
- Intercloud can be basically viewed as a cloud of clouds
- Multiple cloud providers join hands to serve the customers
- Intercloud can take any of the two forms:
  - Federation of clouds
  - Multi-cloud

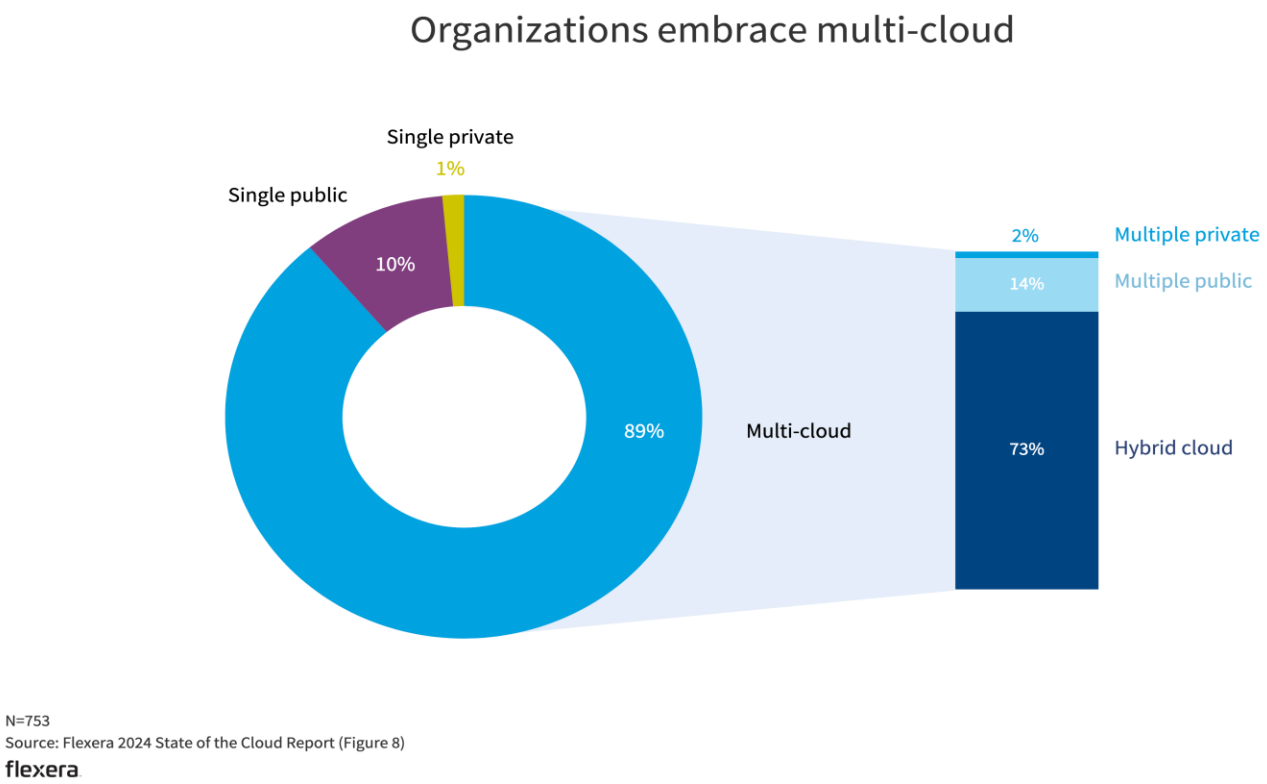
Interclouds

- Intercloud provides customers with a wide range of benefits such as the following:
  - Diverse geographical locations
  - Better application resilience
  - Avoidance of vendor lock-in
  - Flexibility
- Challenges in intercloud:
  - Interoperability:
    - Diversity of resources, management and rules and regulations of cloud providers, diverse SLAs, differences in security characteristics at various CSPs etc.

Overview of Multi-cloud

- Multi-cloud
  - When an organization uses cloud computing services from at least two cloud providers to run their applications
    - Typically include a combination of two or more public clouds, two or more private clouds, or some combination of both
    - It can be:
      - Distribution of Cloud assets (such as data, application, etc.) to different cloud service providers
      - A single workload balanced on different cloud service providers
      - Amalgamate multiple services to get the best of different providers
      - Shadow IT
      - Etc.

Overview of Multi-cloud



Source: https://info.flexera.com/CM-REPORT-State-of-the-Cloud

Overview of Multi-cloud

- Advantages of multi-cloud
  - Best of multiple clouds
  - Avoid vendor lock-in
  - Increased reliability and redundancy
  - Innovative technology
  - Cost efficiency???

Overview of Multi-cloud

- Challenges of multi-cloud
  - Increased operational complexity
  - Maintaining consistent security and compliance
  - Integrating software environments
  - Difficulty with achieving consistent performance and reliability across clouds
  - Cost

Overview of Multi-cloud

- Multi-Cloud Services
  - Standardizes one or more functional areas across clouds with a consistent API, object model, identity management and other core functions
  - Abstracts functionality into one platform and reduces complexity compared to individually consuming the equivalent native services from multiple clouds
  - It has one or more of the following characteristics:
    - Runs on a single cloud but supports interactions with at least two different clouds
    - Runs on multiple clouds and supports interactions with at least two different clouds
    - Runs on a cloud or edge of a user's choosing, even in disconnected mode, and basic operations are fully automated

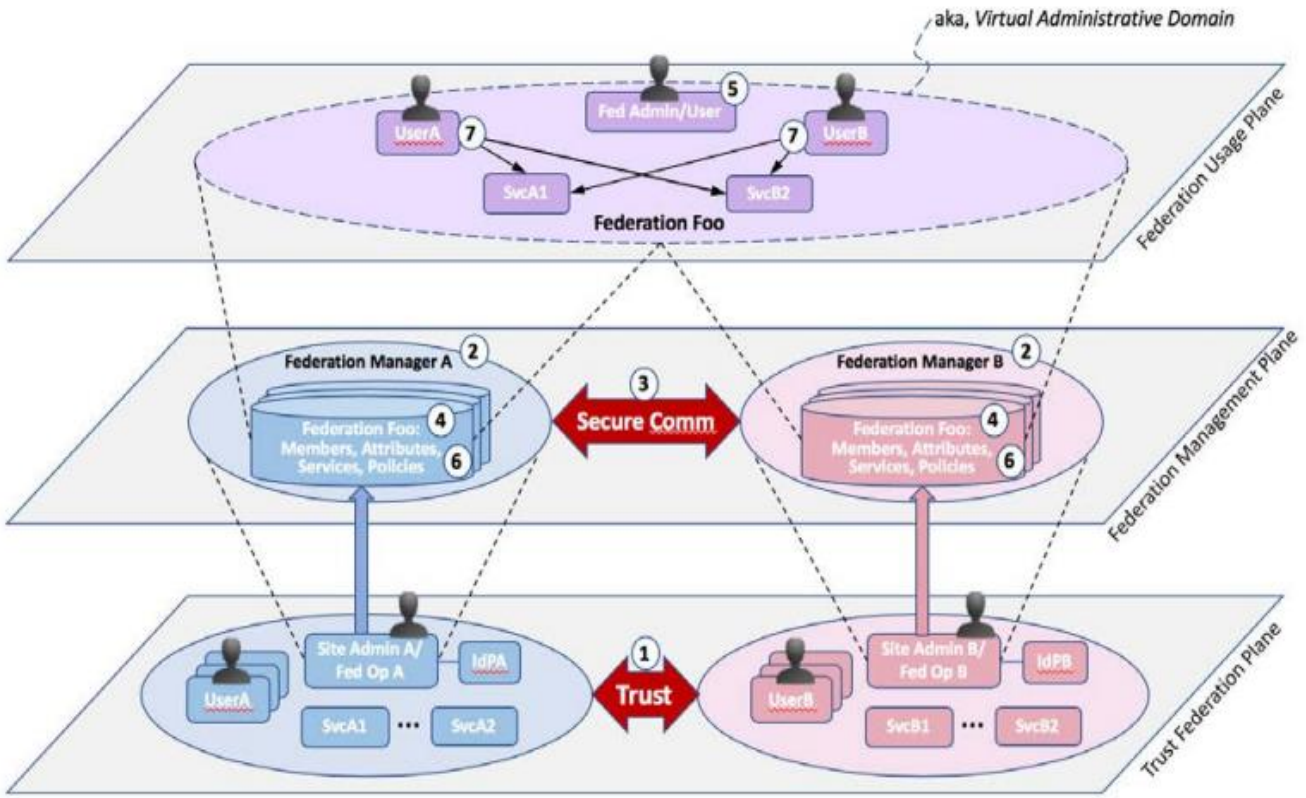
Overview of Multi-cloud

- GCP
  - Anthos - a unified fully managed platform to manage multi-cloud infrastructure
- Microsoft
  - Azure arc
- AWS
  - ECS and EKS Anywhere
- Red Hat
  - OpenShift

Federation of Clouds

- Cloud Federation
  - A virtual collaboration and security framework among two or more cloud providers
  - An arrangement in which participants'' identities, data and other resources are managed as a unified, interoperable whole
  - Provides services that involve aggregation of capabilities from multiple cloud service providers(CSPs)
  - Federated services help a CSP to deal with unanticipated changes in resource requirements by acquiring the same resource from other CSPs
    - Usually in a dynamic manner

Federation of Clouds



Source: https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-332.pdf

Federation of Clouds

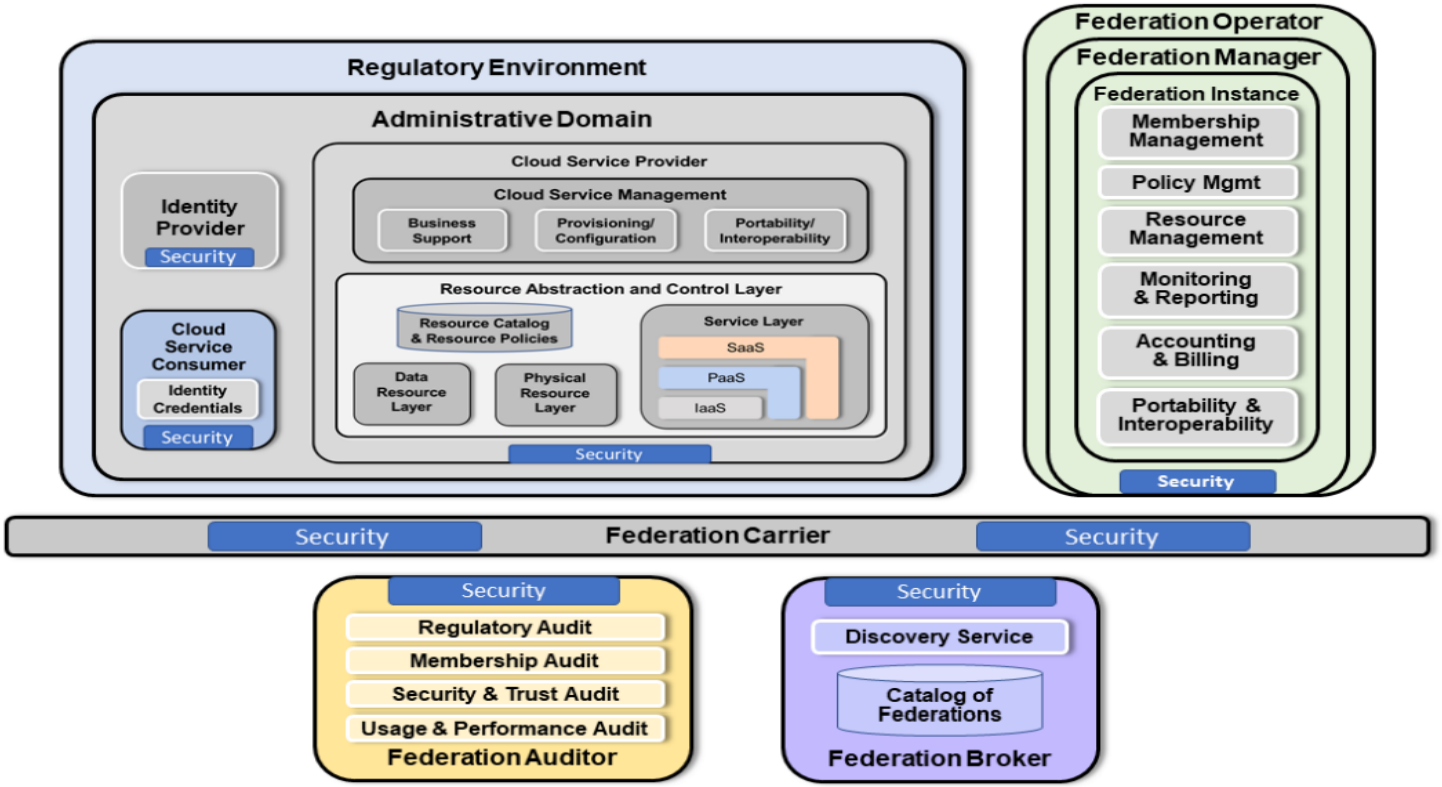
- Federation can be:
  - Cloud Infrastructure Federations
  - Platform Federations
  - Data Federations
- In federated clouds, a service level agreement(SLA) is signed between a user and its parent CSP

Federation of Clouds

- Federation Components:
  - Cloud Service Consumer
  - Cloud Service Provider
  - Federation Manager
  - Federation Operator
  - Federation Auditor
  - Federation Carrier
  - Federation Broker

Federation of Clouds

- The NIST Cloud Federation Reference Architecture Actors



References

- https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-332.pdf
- https://cloud.google.com/learn/what-is-multicloud
- Multi-cloud Cheat Sheet: Definition, Benefits & Use Cases