

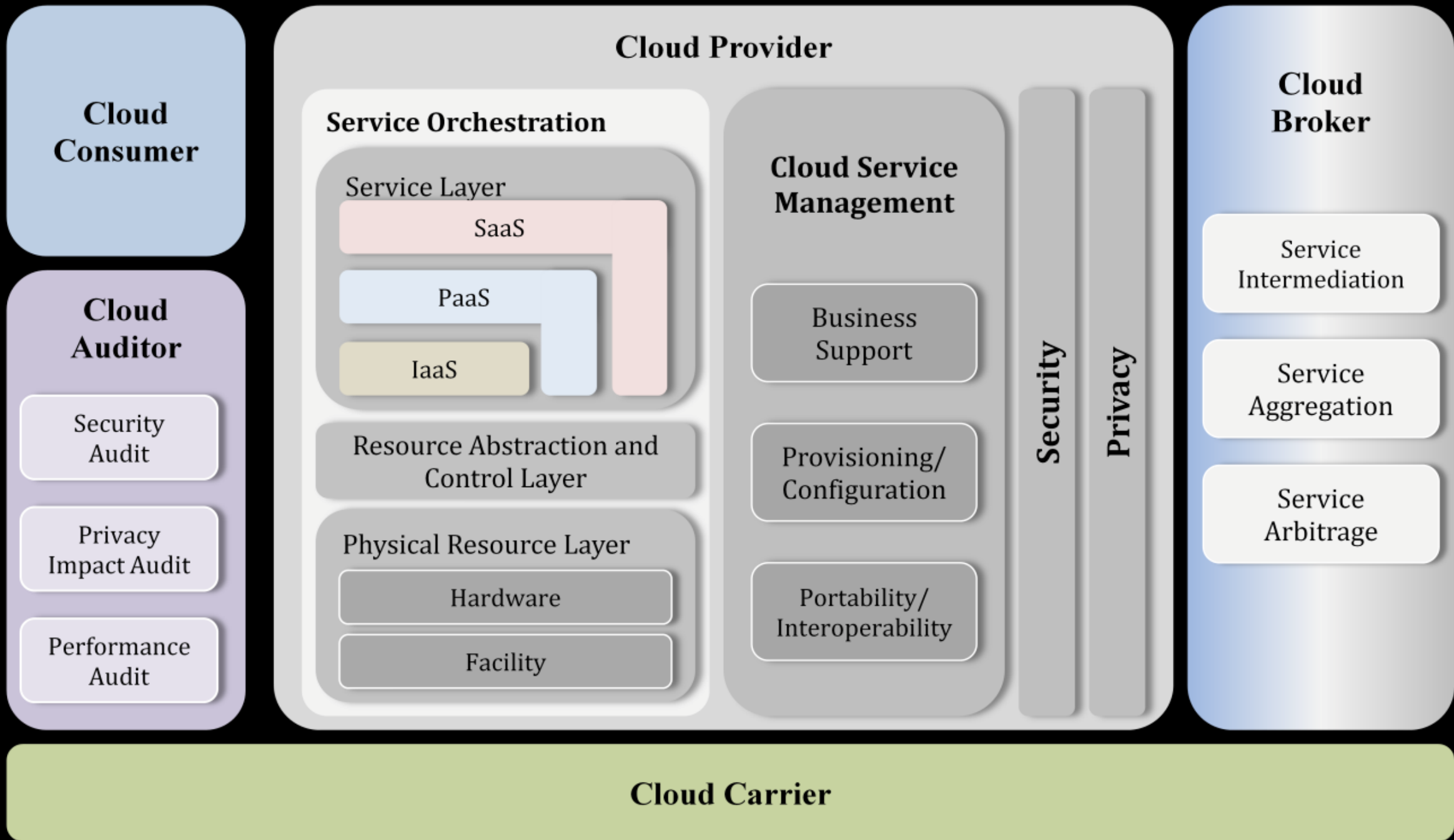
Cloud Computing Concepts

CS 3132

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NIIT University

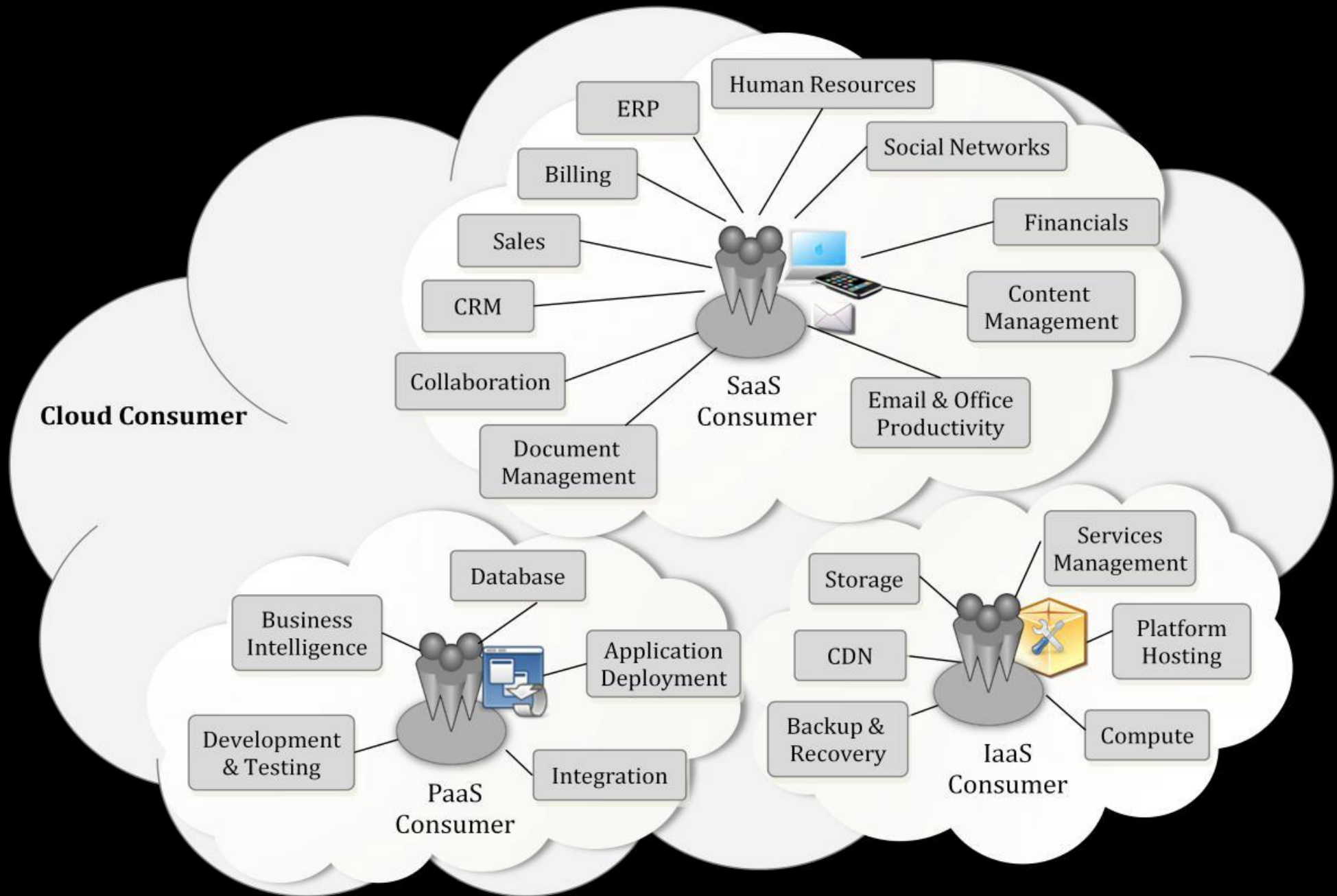
Cloud Computing Reference Architecture



Cloud Computing



- **Cloud Consumer** - A person or organization
 - maintains a business relationship with Cloud Providers
 - uses service from, Cloud Providers



On-Premises

Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking

You Manage

Infrastructure as a Service

Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking

Platform as a Service

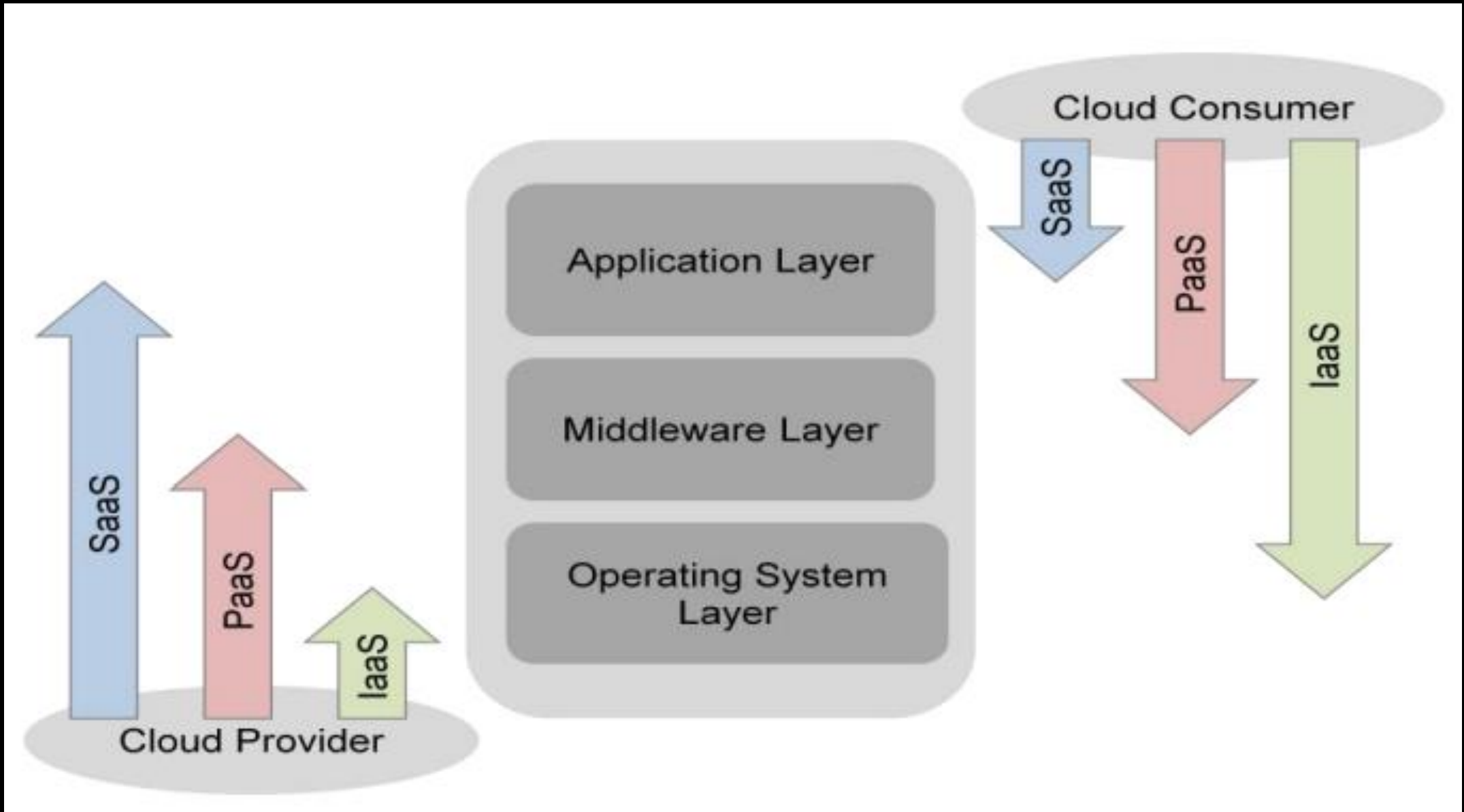
Applications
Data
Runtime
Middleware
O/S
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Other Manages

Software as a Service

Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking

Scope of Control between Provider and Consumer



Scope of Control between Provider and Consumer

- **The application layer** includes software applications targeted at end users or programs
 - The applications are used by SaaS consumers, or installed/managed/maintained by PaaS consumers, IaaS consumers, and SaaS providers
- **The middleware layer** provides software building blocks (e.g., libraries, database, and Java virtual machine) for developing application software in the cloud
 - The middleware is used by PaaS consumers, installed/managed/maintained by IaaS consumers or PaaS providers, and hidden from SaaS consumers.

Scope of Control between Provider and Consumer

- **The OS layer** includes operating system and drivers, and is hidden from SaaS consumers and PaaS consumers.
 - An IaaS cloud allows one or multiple guest OS's to run virtualized on a single physical host
 - Generally, consumers have broad freedom to choose which OS to be hosted among all the OS's that could be supported by the cloud provider
 - The IaaS consumers should assume full responsibility for the guest OSs, while the IaaS provider controls the host OS

Cloud Computing

- **Cloud Carrier** - An intermediary that **provides**
 - **connectivity** and
 - **transport of cloud services**
 - from Cloud Providers to Cloud Consumers



Cloud Carrier

Cloud Computing - Cloud Carrier

- Cloud carriers provide access to consumers through network, telecommunication and other access devices
- For example, cloud consumers can obtain cloud services through network access devices, such as computers, laptops, mobile phones, mobile Internet devices (MIDs), etc
- The distribution of cloud services is normally provided by
 - **network and telecommunication carriers or a transport agent**
 - transport agent refers to a business organization that provides physical transport of storage media such as high-capacity hard drives

Cloud Computing

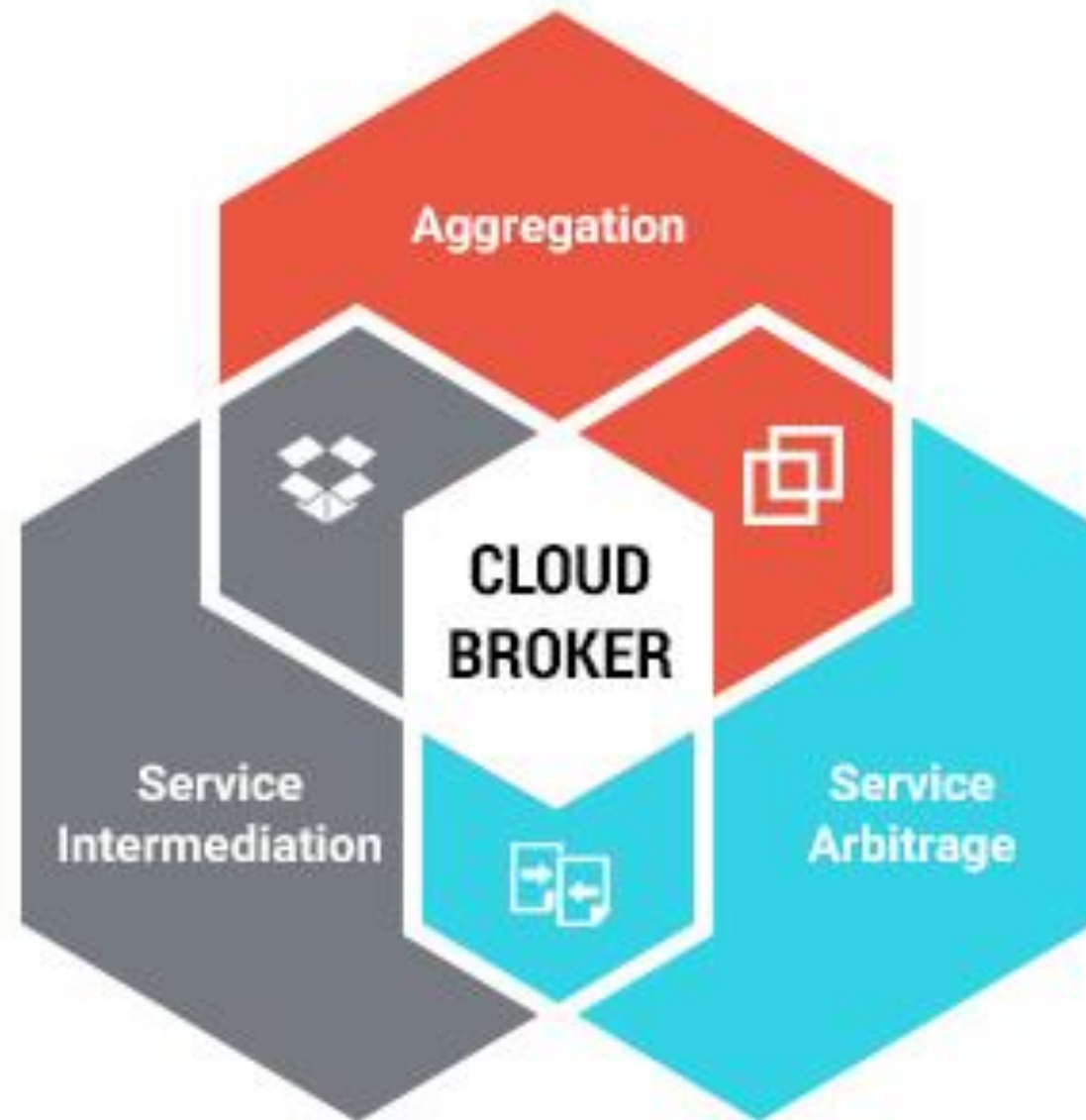
- **Cloud Auditor** - A party
 - conduct independent assessment of cloud services,
 - information system operations,
 - performance, security and privacy impact of the cloud implementation
- Auditing is especially important for federal agencies
- Ensuring that the correct policies are applied



Cloud Computing

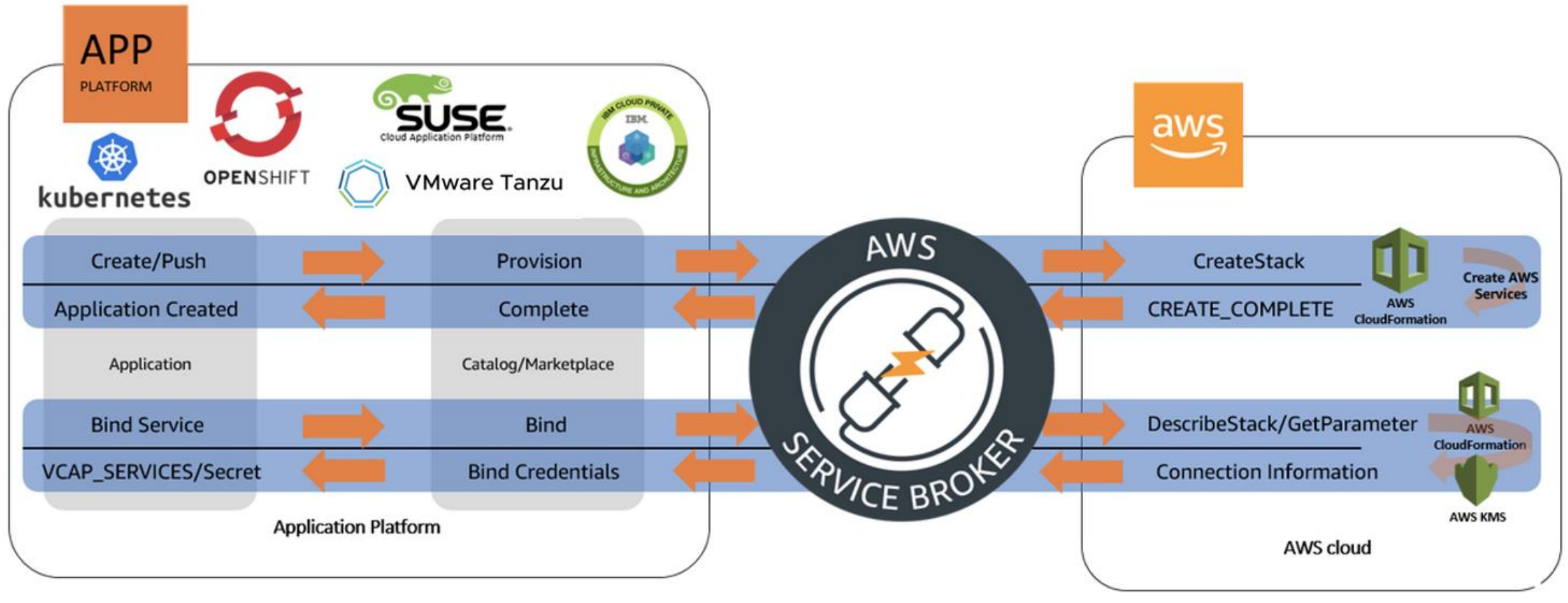
- **Cloud Broker** - An entity that manages
 - use, performance and delivery of cloud services, and
 - negotiates relationships between Cloud Providers and Cloud Consumers
- Services in 3 Categories:
 - Service Intermediation
 - Service Aggregation
 - Service Arbitrage





Cloud Computing - Cloud Broker – AWS Service Broker

Provision and Bind



Benefits of Cloud Service Brokerage

- CSB has significantly
 - reduced processing costs,
 - increase flexibility and
 - reduced downtimeas global offices, suppliers and other partners in the production chain can share information at real time with each other.
- **Integrated service management:**
 - provides key services, such as backup and recovery, resiliency, and security. These services ensure that your system is running all year round.
- **Access to IT resources anytime, anywhere:**
 - Cloud services remove your data from their physical silos and makes them readily available for use whenever and wherever you need them.

Benefits of Cloud Service Brokerage

- **Flexible scaling of resources:**
 - with advancing years and changes in business, so also there is a change in your data needs. There are plans in place to help scale your data solution investments with your current needs for maximum resource optimization.
- **Lowers total cost of ownership (TCO):**
 - Expedite delivery of your complex data projects helps reduce capital expenditures.
- **Automated self-service delivery:**
 - automation simplifies and speeds up the integration and deployment of services. Cloud service brokerage provides options to automate your services and the possibility of designing the automation as your needs require.

Jamcracker Cloud Brokerage Platform

- Providing services catalogue as a centralized resource for all users' needs, including private and public cloud services.
- Unifying security, auditing, and policy enforcement for internal and external cloud providers.
- Consolidating enterprise-wide license management and internal usage monitoring.
- Providing multi-level cloud service usage and show-back reporting.
- Centralizing service and user lifecycle management across disparate services.
- Integrating provider offerings into a standardized catalogue for automated provisioning across providers, consolidated billing, and SLA governance.
- Providing services marketplaces that include complementary third-party offerings.
- Merging third-party services with your core offerings.
- Providing a unified usage experience across the user/services lifecycle.
- Enabling existing and new services channels.

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Cloud Computing - Cloud Broker – Service Intermediation

- Provision of value-added services or basically improving a capability without actually providing any of the cloud services itself
- A cloud broker enhances a given service by improving some specific capability and providing value-added services to cloud consumers
 - Managing access to cloud services
 - Identity management
 - Performance reporting
 - Enhanced security

Cloud Computing - Cloud Broker – Service Aggregation

- combining and integrating multiple services,
 - data integration, safeguarding process integrity and ensuring data portability between the cloud customer and the various cloud services providers
- A cloud broker combines and integrates multiple services into one or more new services
- Data integration
 - Ensures the secure data movement between the cloud consumer and **multiple cloud providers**

Cloud Computing - Cloud Broker – Service Arbitrage

- Similar to service aggregation
 - except that the services being aggregated are not fixed
- Service arbitrage means a broker has the flexibility to choose services from multiple agencies
- The cloud broker, for example, can use a credit-scoring service to measure and select an agency with the best score

Service Arbitrage

- The difference between service arbitrage and service aggregation is that the services being aggregated aren't fixed.
- Indeed the goal of arbitrage is to provide **flexibility and opportunistic choices** for the service aggregator, e.g.,
 - providing multiple email services through one service provider or providing a credit-scoring service that checks multiple scoring agencies and selects the best score

Service Arbitrage

- Some cloud broker services providers are not directly involved in cloud customer contact, but rather enable other cloud broker services providers to provide their brokerage services.
- Examples of these cloud brokerage enablers are providers of cloud aggregation platforms or other (software) technology that enable aggregation providers to combine various cloud services into one or more aggregated cloud services to the cloud customer

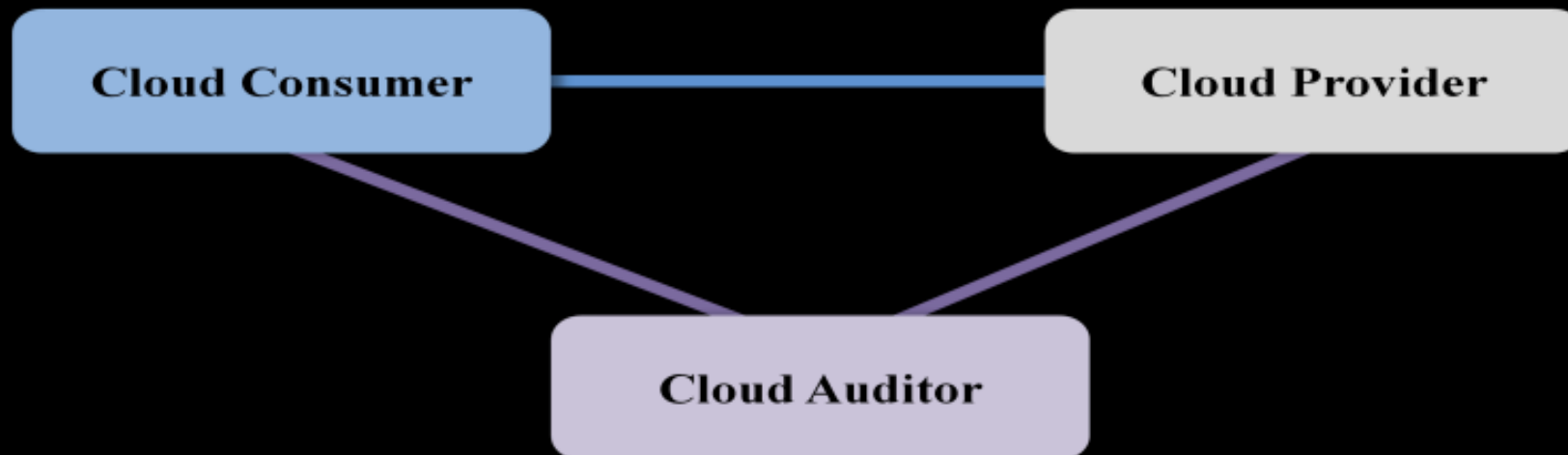
Cloud Computing - Cloud Actors - Example Usage Scenario 1

- A cloud consumer may request service from a cloud broker instead of contacting a cloud provider directly
- The cloud broker may create a new service by combining multiple services or by enhancing an existing service



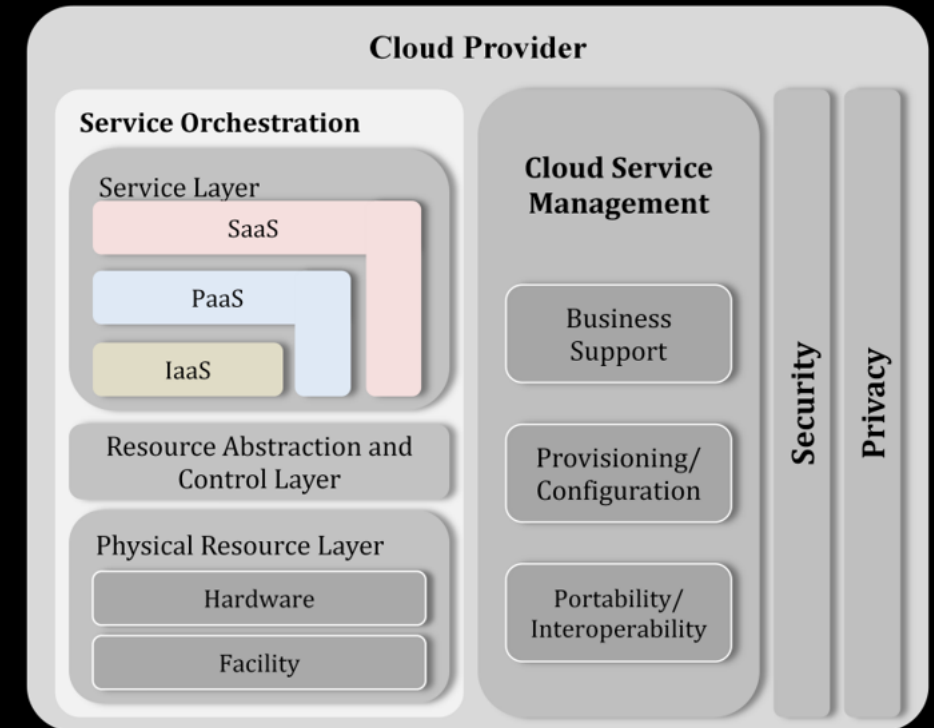
Cloud Computing - Cloud Actors - Example Usage Scenario 2

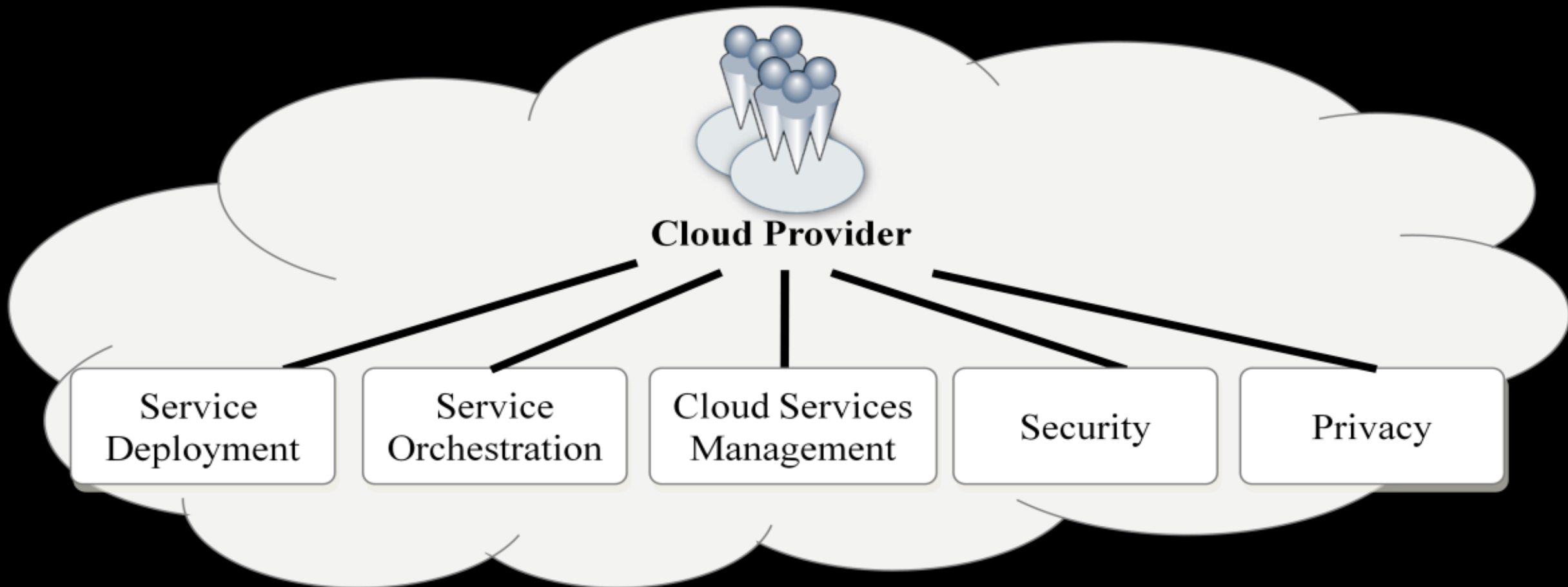
- For a cloud service, a cloud auditor conducts independent assessments of the operation and security of the cloud service implementation
- The audit may involve interactions with both the Cloud Consumer and the Cloud Provider



Cloud Computing

- **Cloud Provider** - A person, organization, or entity
 - responsible for making a service available to interested parties





Cloud Provider - Activities

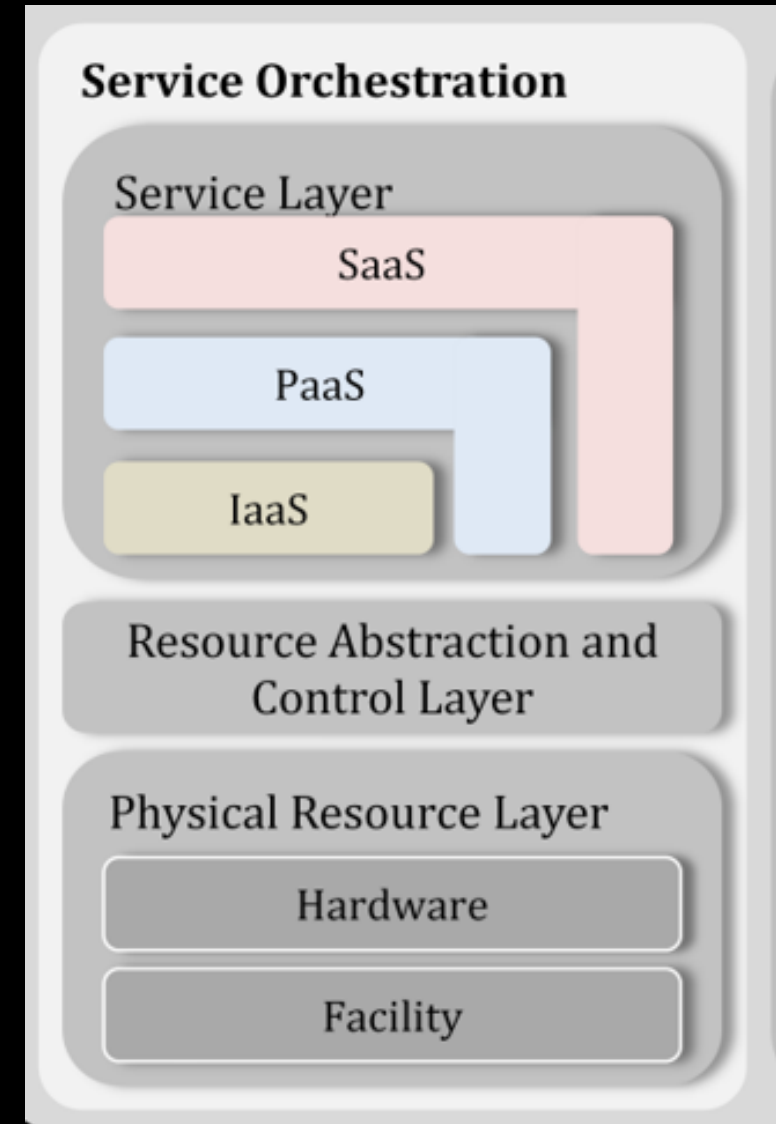
- Service deployment
- Service orchestration
- Cloud service management
- Security
- Privacy

Cloud Provider - Activities – Service Deployment

- Public cloud - general public
- Private cloud - a single Cloud Consumer's organization
- Community cloud - a group of Cloud Consumers (shared concerns)
- Hybrid cloud - a composition of two or more clouds

Cloud Provider - Activities – Service Orchestration

- Service Layer
- Resource abstraction and control layer
- Physical resource layer
- Arrangement
- Coordination and
- Management of computing resources
- To provide cloud services to Cloud Consumers



Cloud Provider – Service Orchestration - Service layer

- Cloud Providers define **interfaces** for Cloud Consumers
 - To access the computing services
- SaaS applications can be built on top of PaaS components
 - A SaaS application can be implemented and hosted on VMs from an IaaS cloud or
 - It can be implemented directly on top of cloud resources without using IaaS VMs.
- PaaS components can be built on top of IaaS components
- **Each of the service component can stand by itself**

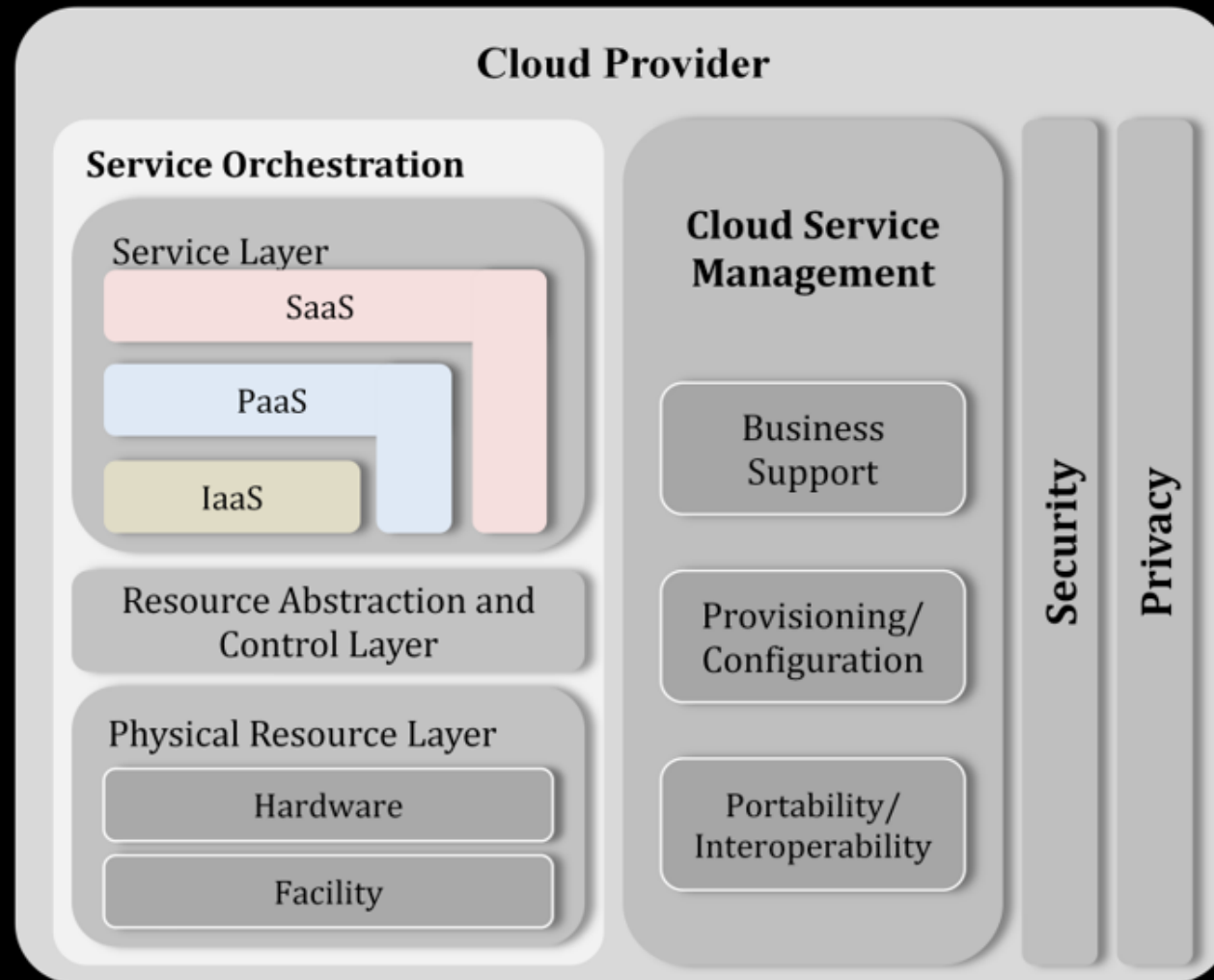
Cloud Provider - Service orchestration - Physical resource layer

- Hardware resources
 - computers (CPU and memory),
 - networks (routers, firewalls, switches, network links and interfaces),
 - storage components (hard disks)
- Facility resources
 - heating, ventilation and air conditioning (HVAC)
 - power, communications, and other aspects of the physical plant

Cloud Provider - Service orchestration - Resource abstraction and control layer

- Cloud Providers use **to provide and manage access** to the physical computing resources through software abstraction
- **Software elements** such as hypervisors, VMs, virtual data storage, etc.
- **Control aspect** - resource allocation, access control, and usage monitoring
- Resource pooling, dynamic allocation
- Various open source and proprietary cloud software

Cloud Provider - Cloud Service Management



Cloud Provider - Security

- Security requirements such as
 - Authentication
 - Authorization
 - Availability
 - Confidentiality
 - Identity management
 - Integrity, audit, security monitoring, incident response, and security policy management

A A A

Authentication, Authorization, Accounting

- **Authentication** - Process by which it can be identified that the **user**, which want to access the resources, **valid or not** by asking some credentials such as **username and password**
- **Authorization** - After the authentication is successful,
 - authorisation can be used to determine that **what resources is the user allowed to access** and the **operations** that can be performed
- **Accounting** - Monitoring and capturing the events done by the user while accessing the resources
 - Keeps track of a user's activity while attached to a system
 - How long the user has an access to the network
 - the amount of time attached, the resources accessed, and how much data transferred

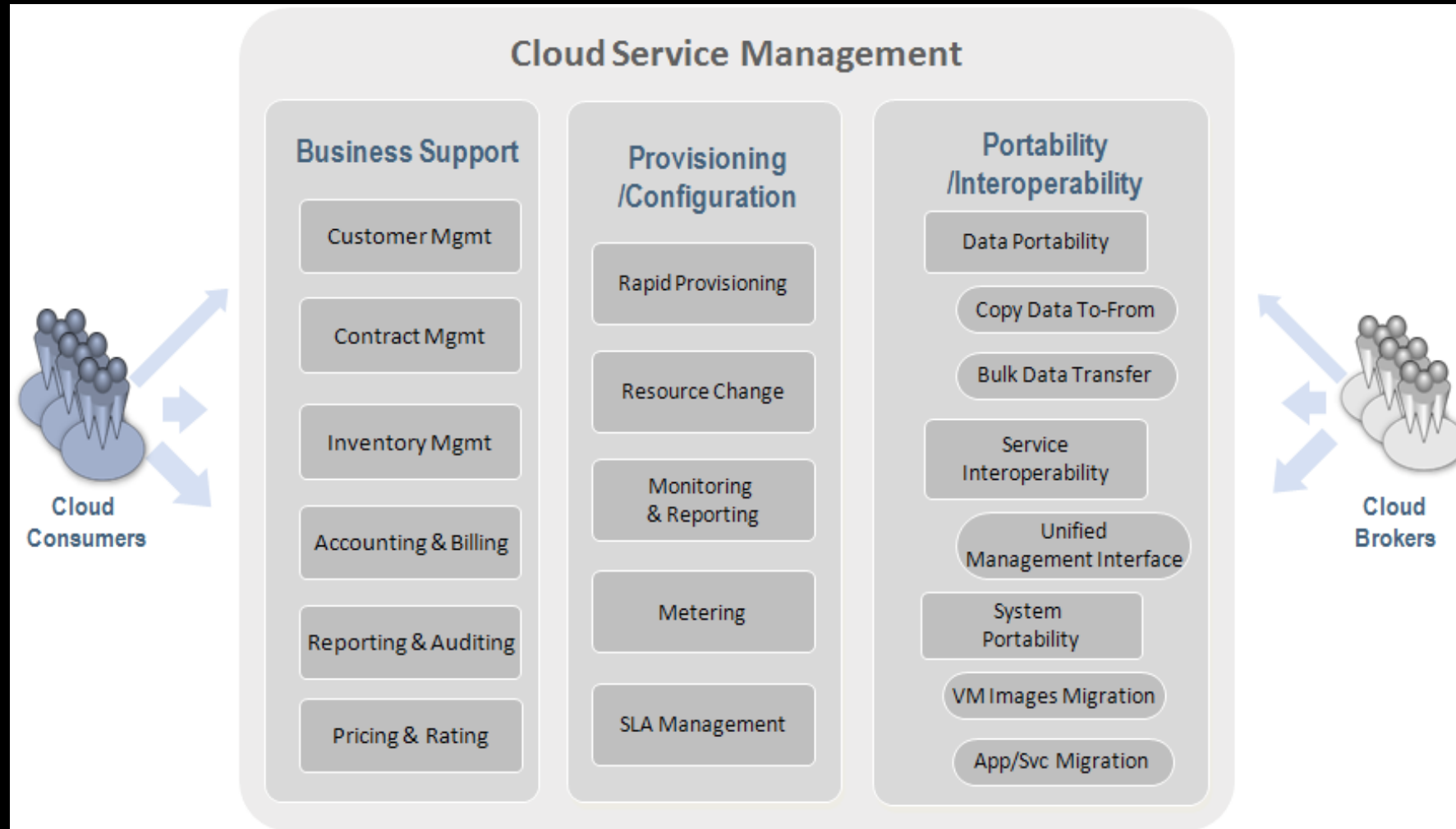
Cloud Provider - Privacy

- Cloud providers should protect -
 - personal information (PI)
 - personally identifiable information (PII)

PI and PII

- PI - Information relating to a person, directly or indirectly
- PII - Information that can be used to identify a person
 - This could be a single piece of data or multiple pieces of data that when compiled, or seen together, can **identify a person** or distinguish one person from another

Cloud Provider - Cloud Service Management



Cloud Provider - Cloud service management - Business support

- **Business-related services dealing with clients**
- **Customer management** - manage user profiles
- **Contract management** - service contract , negotiations
- **Inventory management** - service catalogs
- **Account and Billing** - customer billing info., payments
- **Reporting and Auditing** - monitoring user operations, reports
- **Pricing and Rating** - evaluate cloud services and determine prices

Cloud Provider - Cloud service management - Provisioning/Configuration

- **Rapid provisioning** - automatically deploying cloud systems
- **Resource changing** - adjusting configuration/resource assignment for repairs
 - **Upgrades and joining new nodes into the cloud**
- **Monitoring and Reporting** - monitoring virtual resources, cloud operations
- **Metering** - providing a metering capability
- **SLA management** - SLA contract definition

Cloud Provider - Cloud service management - Portability/Interoperability

- **Portability** - customers are interested to know
 - whether they can **move their data** or applications **across multiple cloud environments** at low cost and minimal disruption.
- **Interoperability** - customers are concerned about the
 - capability to **communicate between or among multiple clouds**