

Chapter 7

Architecture in Cloud

Cloud computing

- High performance networks and advanced development of internet is the basis for cloud computing .
- Cloud computing has started taking shape incorporating virtualization and on demand deployment and internet delivery of services.
- **Cloud computing** is a model for enabling ubiquitous ,convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

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- **Cloud is a pool of virtualized computer networked resources, which can:**
 - Host a variety of workloads.
 - Batch-style back-end jobs.
 - Interactive user-facing applications.
 - Workloads can be deployed and scaled out quickly through the rapid provisioning of virtual machines or physical machines.
 - Support redundant, self recovering, highly scalable programming models that allow workloads to recover from many unavoidable hardware / software failures.
 - Monitor resource use in real time to enable rebalancing of allocations when needed

Conventional computing vs. Cloud computing

Conventional

- Manually Provisioned
- Dedicated Hardware
- Fixed Capacity
- Pay for Capacity
- Capital & Operational Expenses

Cloud

- Self-provisioned
- Shared Hardware
- Elastic Capacity
- Pay for Use
- Operational Expenses

Five Key Cloud Attributes

- Shared / pooled resources (Resource pooling)
- Broad network access
- On-demand self-service
- Scalable and elastic
- Metered by use (Measured service)

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Shared / Pooled Resources:

- Resources are drawn from a common pool
- Common resources build economies of scale
- Common infrastructure runs at high efficiency

Broad Network Access:

- Open standards and APIs
- Almost always IP, HTTP, and REST
- Available from anywhere with an internet connection

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On-Demand Self-Service:

- Completely automated
- Users abstracted from the implementation
- Near real-time delivery (seconds or minutes)
- Services accessed through a self-serve web interface

Scalable and Elastic:

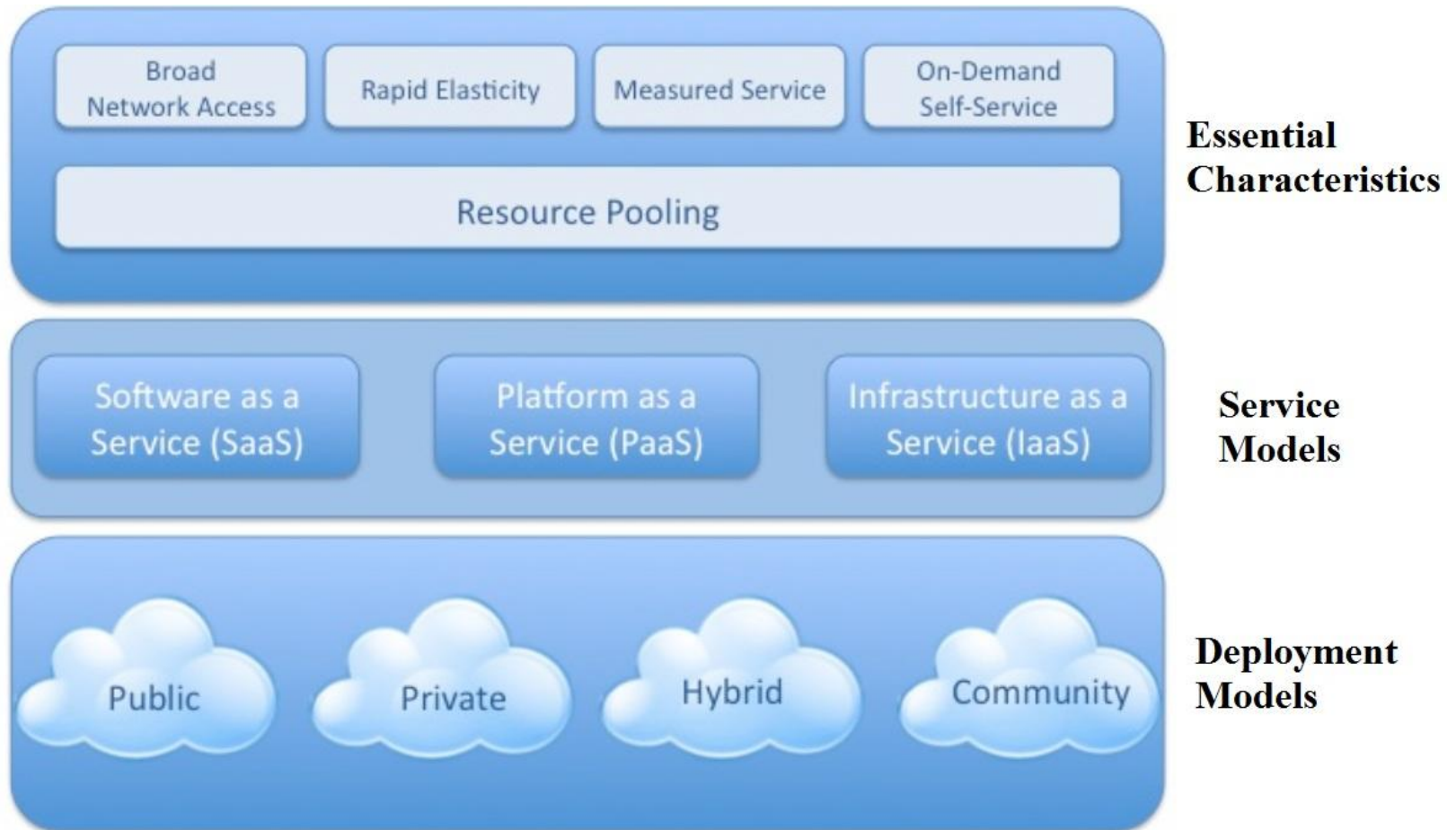
- Resources dynamically-allocated between users
- Additional resources dynamically-released when needed
- Fully automated

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Metered by Use:

- Services are metered, like a utility
- Users **pay only for services used**
- Services can be cancelled at any time

Architecture Overview



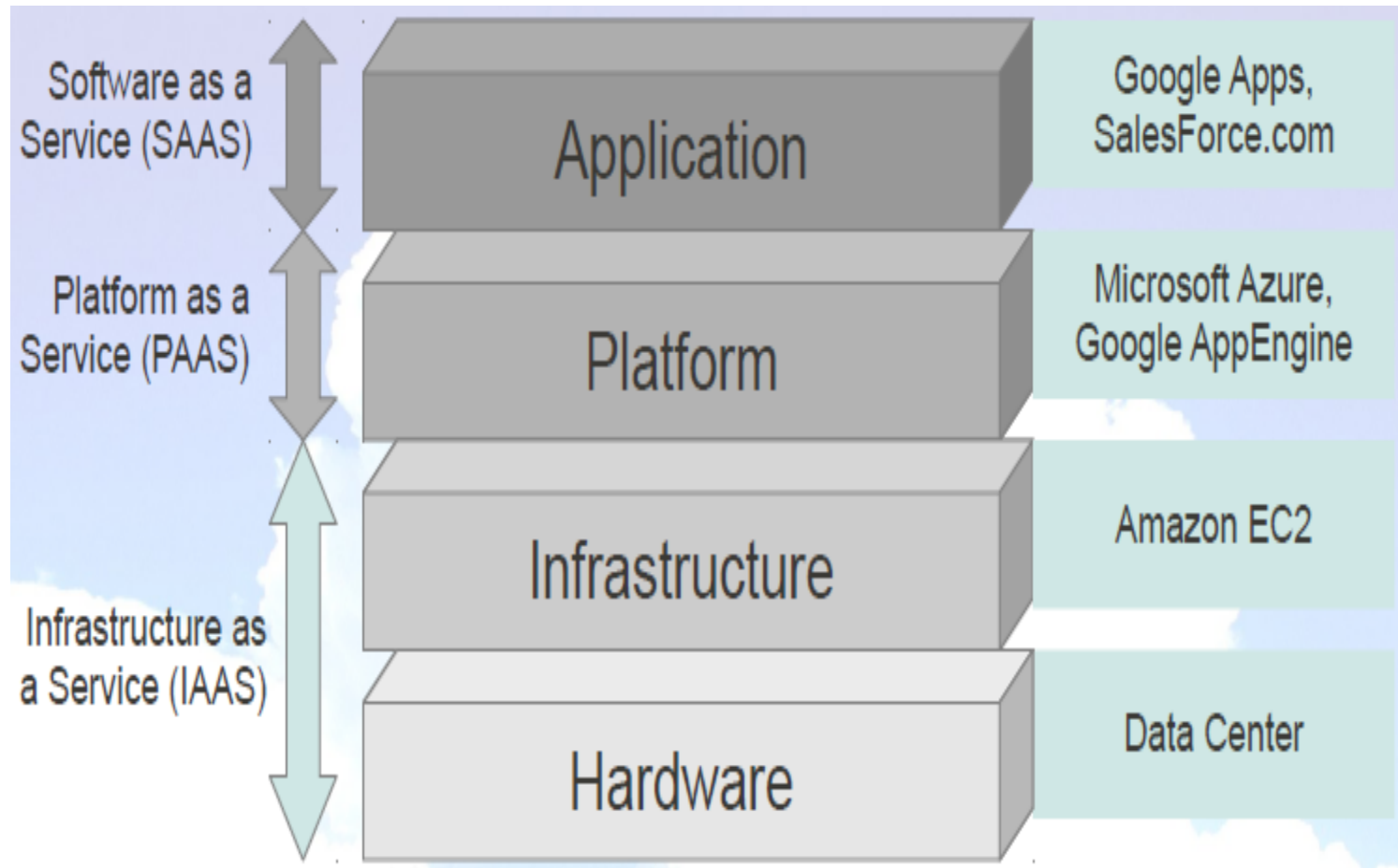
Architectural layers of cloud Computing

In the cloud computing stack, there are three basic layers that together create cloud environment. They are:



1. Infrastructure as a Service(IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)

SaaS
PaaS
IaaS

Service Models

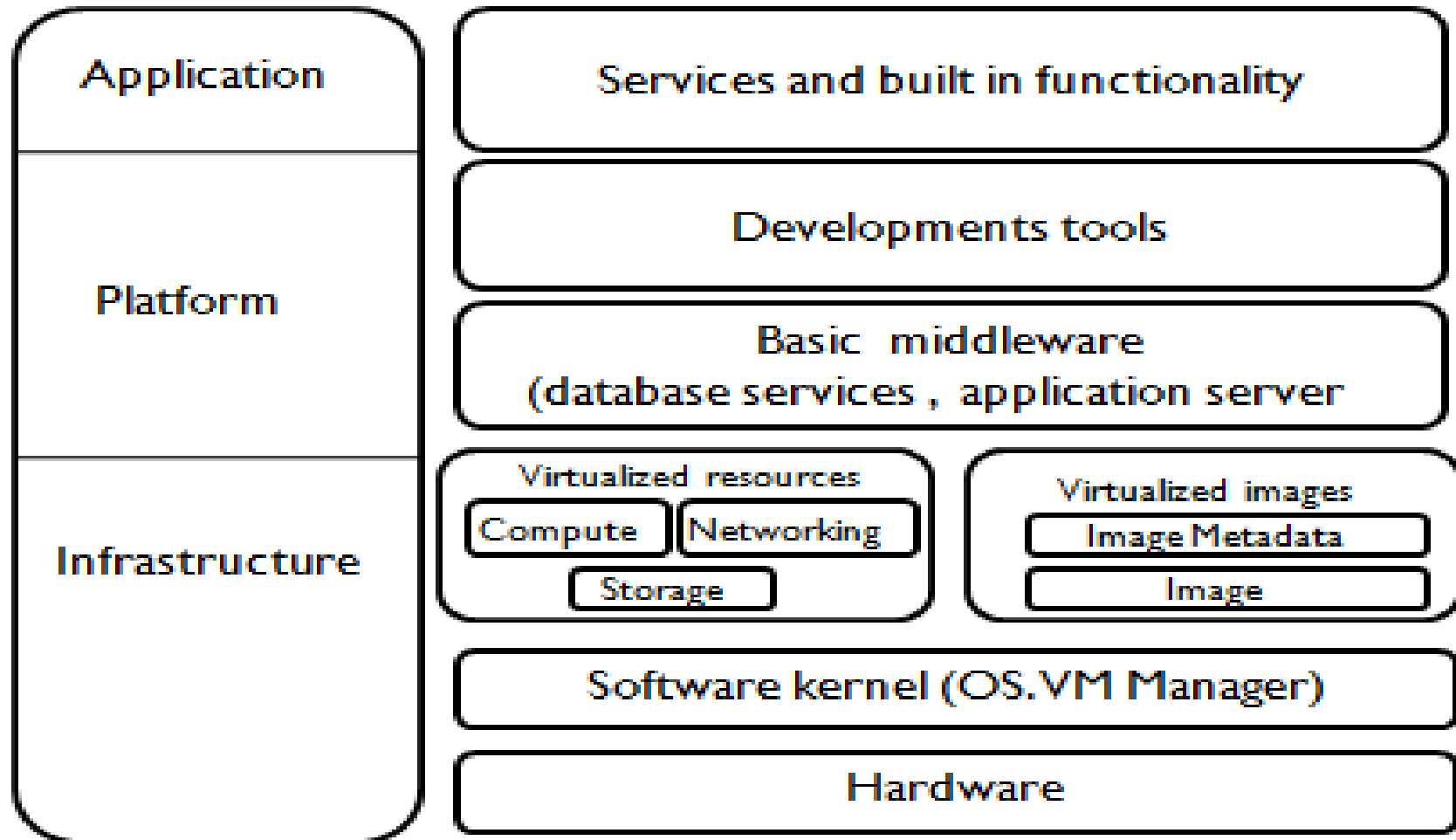


Service Delivery Model Examples

	Amazon	Google	Microsoft	Salesforce
SaaS				
PaaS				
IaaS				

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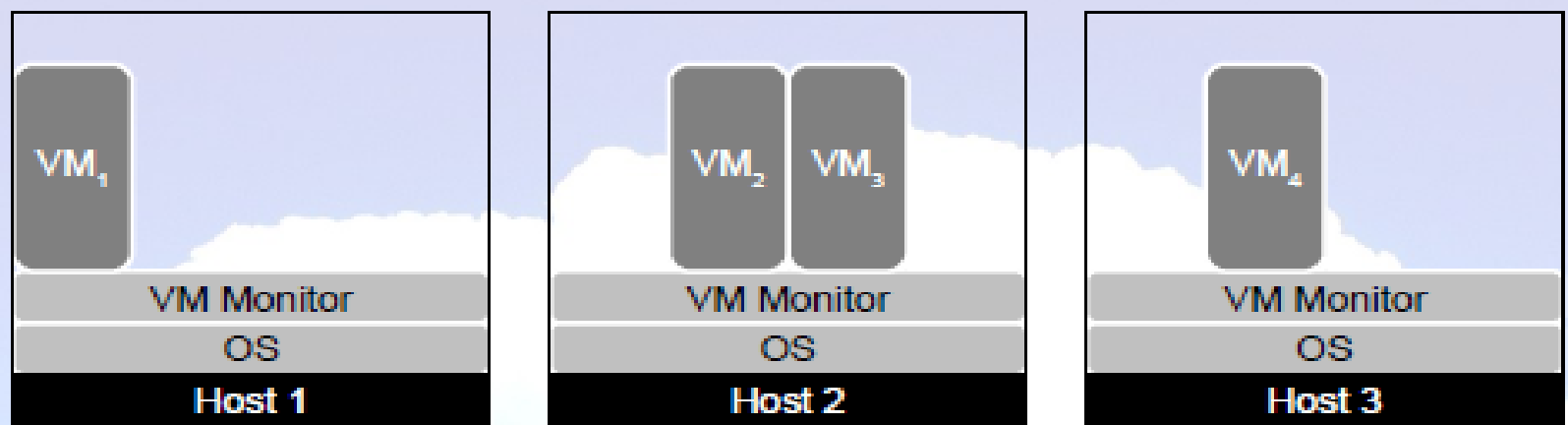
Framework of cloud computing



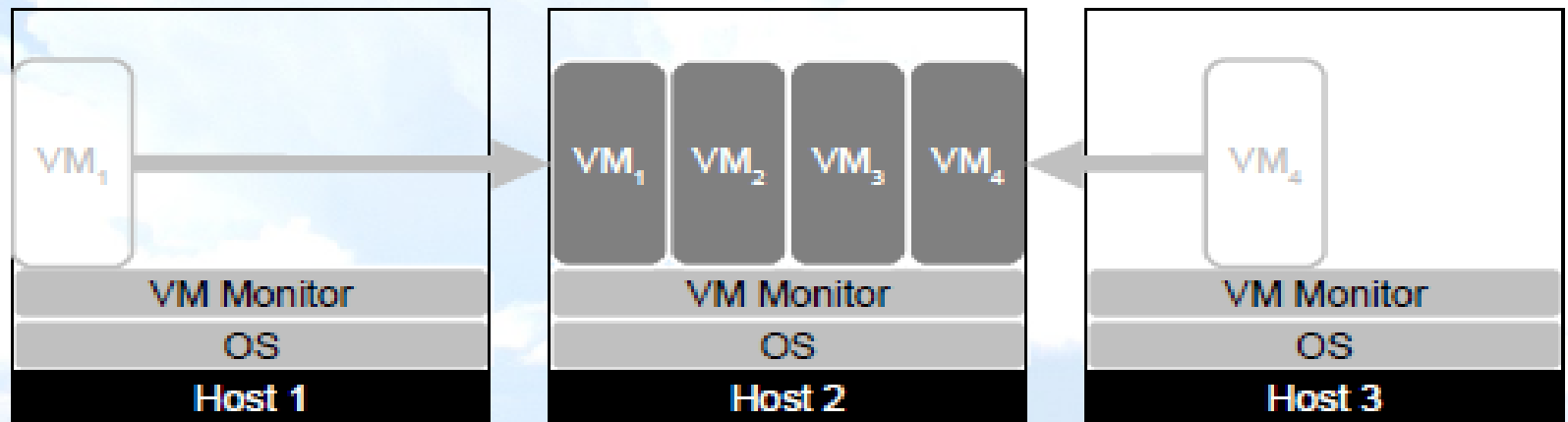
Virtualization

- Main feature of a Cloud system:
 - Dynamic scalability (pay-as-you-go economic model)
 - Virtualization of resources
- Assumptions:
 - Physical resources (servers) are multi-core/multi-processor machines; each server can support up to C VM instances
 - Users request Virtual Machine (VM) instances
 - Users release instances when no longer needed
 - The VM monitor supports live migration of VMs
- Goal:
 - Minimize energy consumption by consolidating VMs

VM Consolidation



(a) Before consolidation

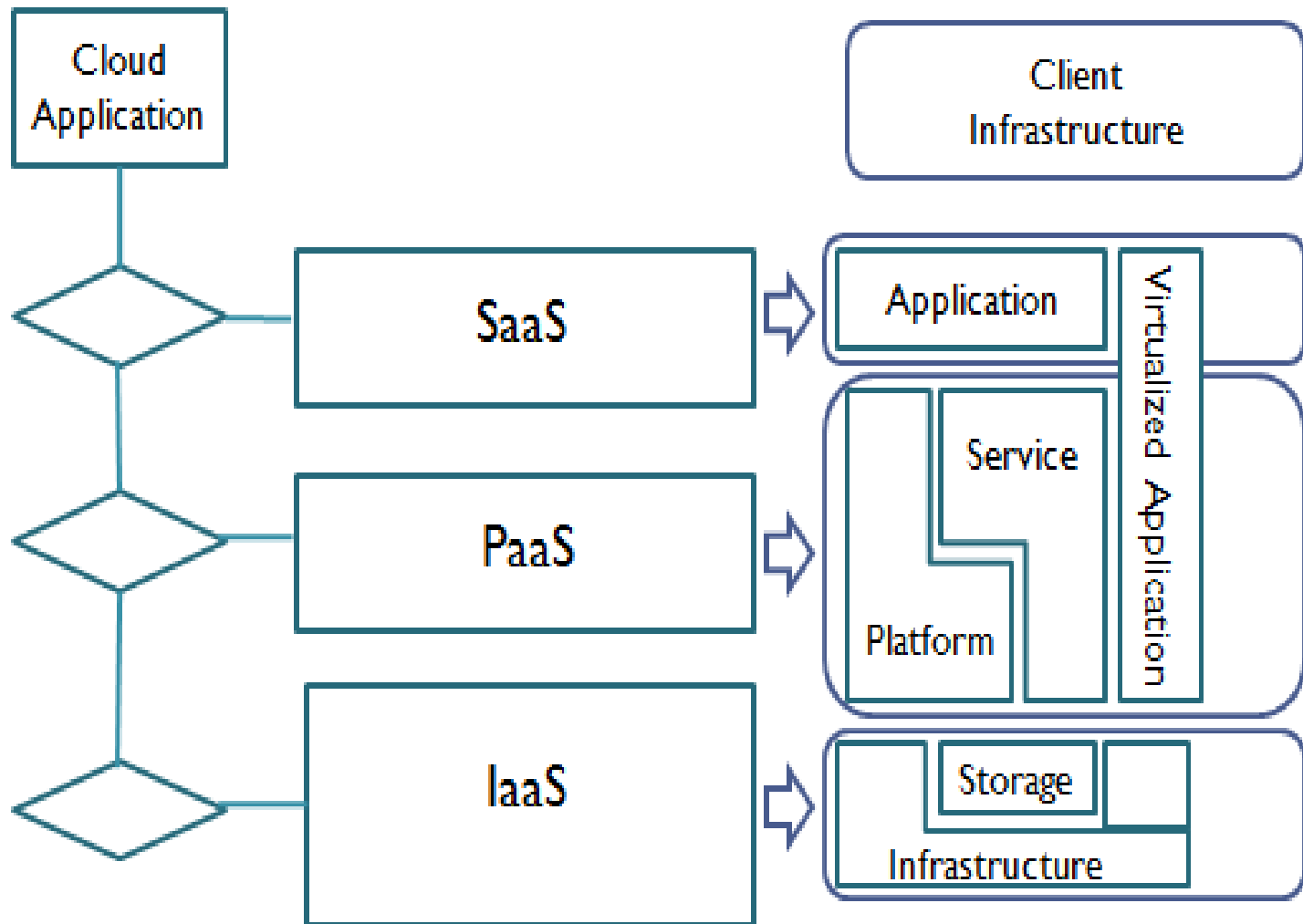


(b) After consolidation of VM₁ and VM₄ to host 2

Virtual infrastructure management and Cloud Computing

- For building the cloud environment a variety of requirements must be met to provide a uniform and homogeneous view of the virtualized resources.
- Virtual Infrastructure Management is the key component to build the cloud environment which does the dynamic orchestration of virtual machines on a pool of physical resources.
- Virtual infrastructure management provide primitives to schedule and manage VMs across multiple physical hosts.
- Cloud management provide remote and secure interface for creating controlling and monitoring virtualized resources on IaaS.

View of Cloud Deployment



Software as a Service

- ❖ It is a Deployment/Delivery model
 - Hosted and managed by vendor
 - Delivered across the internet
- ❖ It is a Business Model : usage-based pricing(vs. perpetual license model of on-premise software). Examples:
 - Per user per month
 - Per transaction
 - Per GB of storage per month

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Architectural

- Multi-tenancy
- Scalability
- Security
- Performance

Functional

- Provisioning
- Billing
- Metering
- Monitoring

Multi-tenancy

- **Multi-tenancy** is an architectural pattern
- A single instance of the software is run on the service provider's infrastructure
- Multiple tenants access the **same instance**.
- In contrast to the multi-user model, multi-tenancy requires customizing the single instance according to the multi-faceted requirements of many tenants.

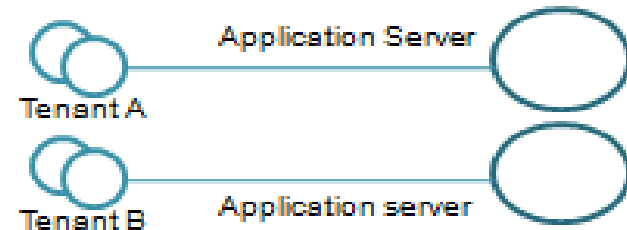
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- A Multi-tenants application lets customers (tenants) share the same hardware resources, by offering them one shared application and database instance ,while allowing them to configure the application to fit there needs as if it runs on dedicated environment.
- These definition focus on what we believe to be the key aspects of multi tenancy:
 1. The ability of the application to share hardware resources.
 2. The offering of a high degree of configurability of the software.
 3. The architectural approach in which the tenants make use of a single application and database instance.

Multi-tenants Deployment Modes for Application Server

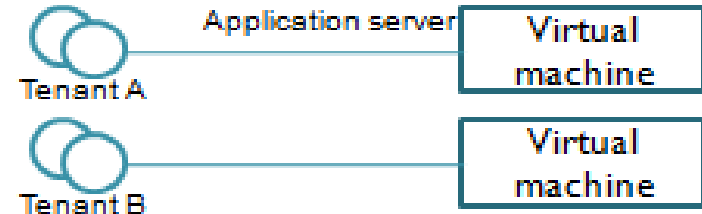
Fully isolated Application server

Each tenant accesses an application server running on a dedicated servers.



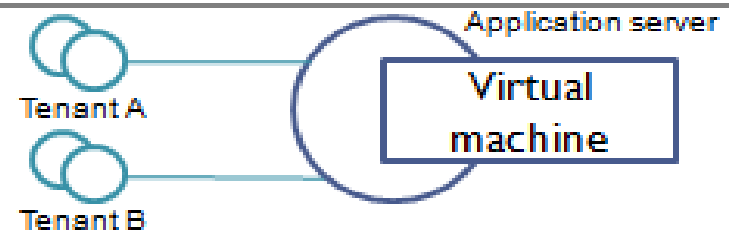
Virtualized Application Server

Each tenant accesses a dedicated application running on a separate virtual machine.



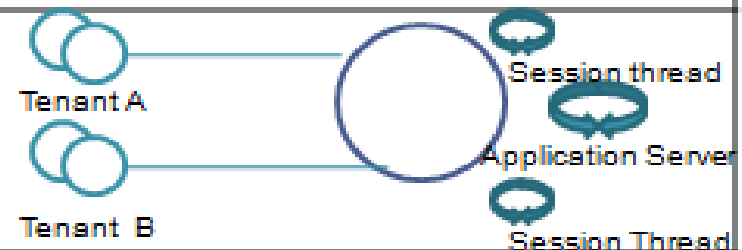
Shared Virtual Server

Each tenant accesses a dedicated application server running on a shared virtual machine.


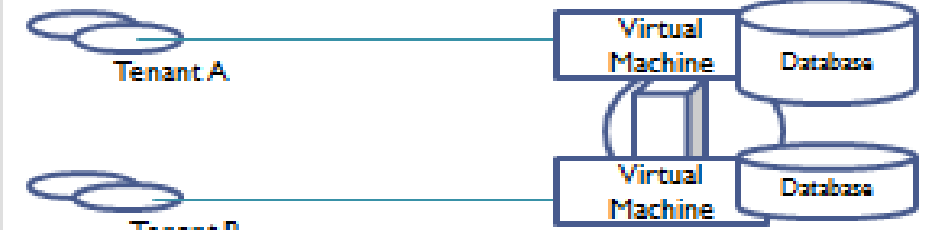

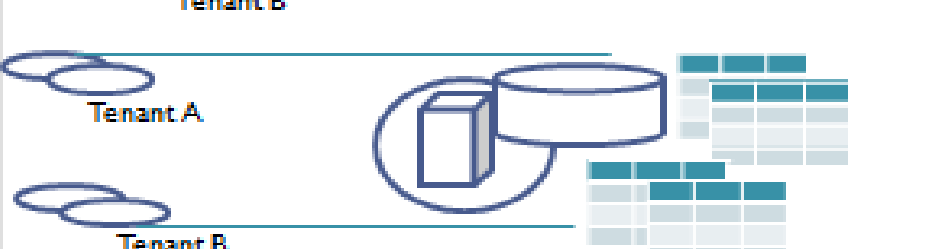
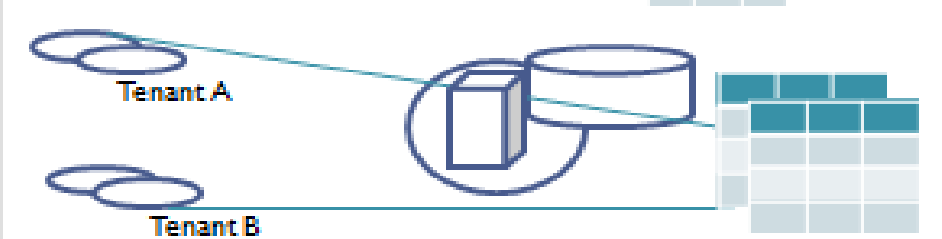


Shared Application Server

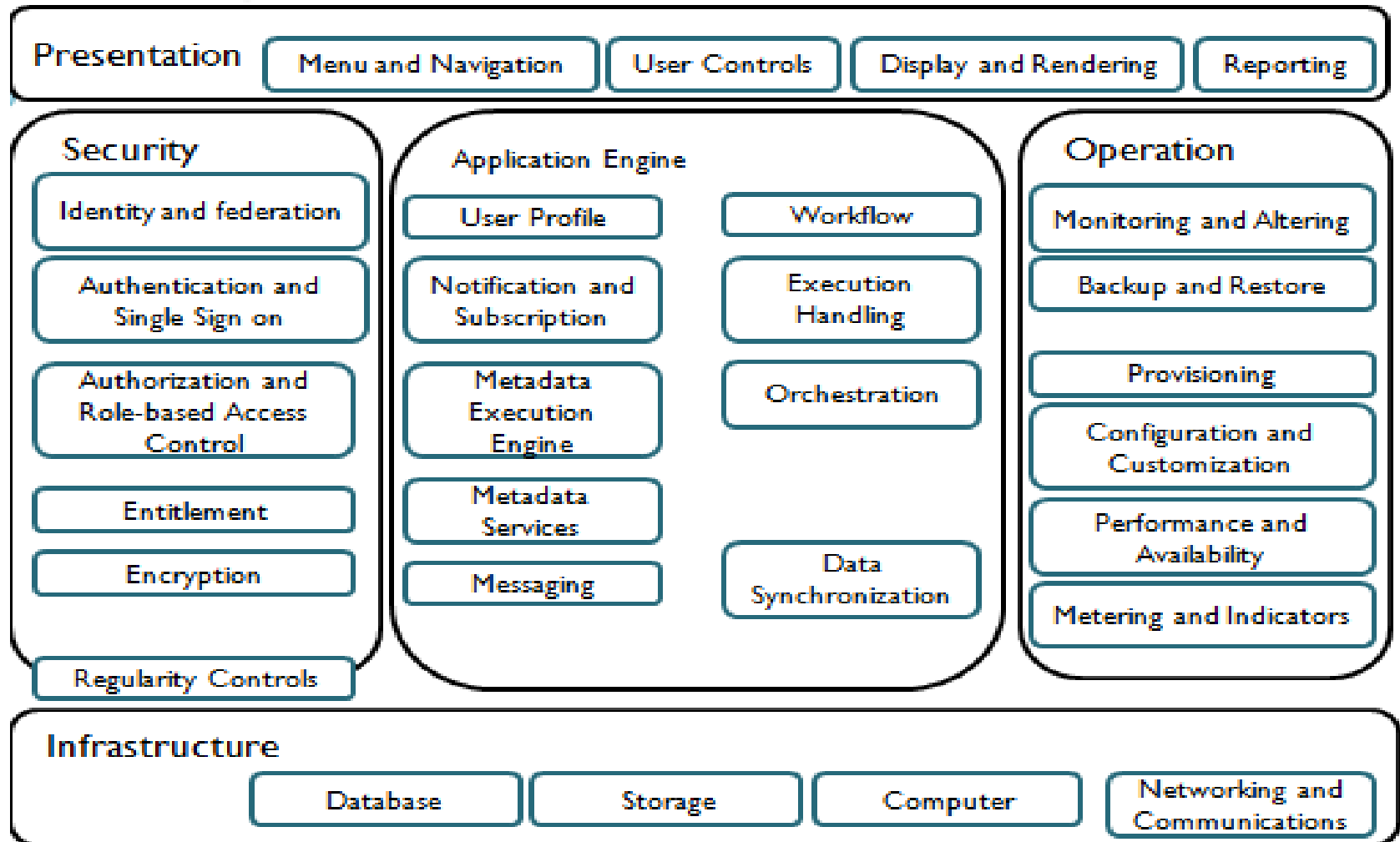
The tenant shared the application server and access application resources through separate session or threads.



Multi-tenants Deployment Modes in Data Centers

<p>Fully isolated data center The tenants do not share any data center resources</p>	
<p>Virtualized servers The tenants share the same host but access different databases running on separate virtual machines</p>	
<p>Shared Server The tenants share the same server (Hostname or IP) but access different databases</p>	
<p>Shared Database The tenants share the same server and database (shared or different ports) but access different schema(tables)</p>	
<p>Shared Schema The tenants share the same server, database and schema (tables). The irrespective data is segregated by key and rows.</p>	

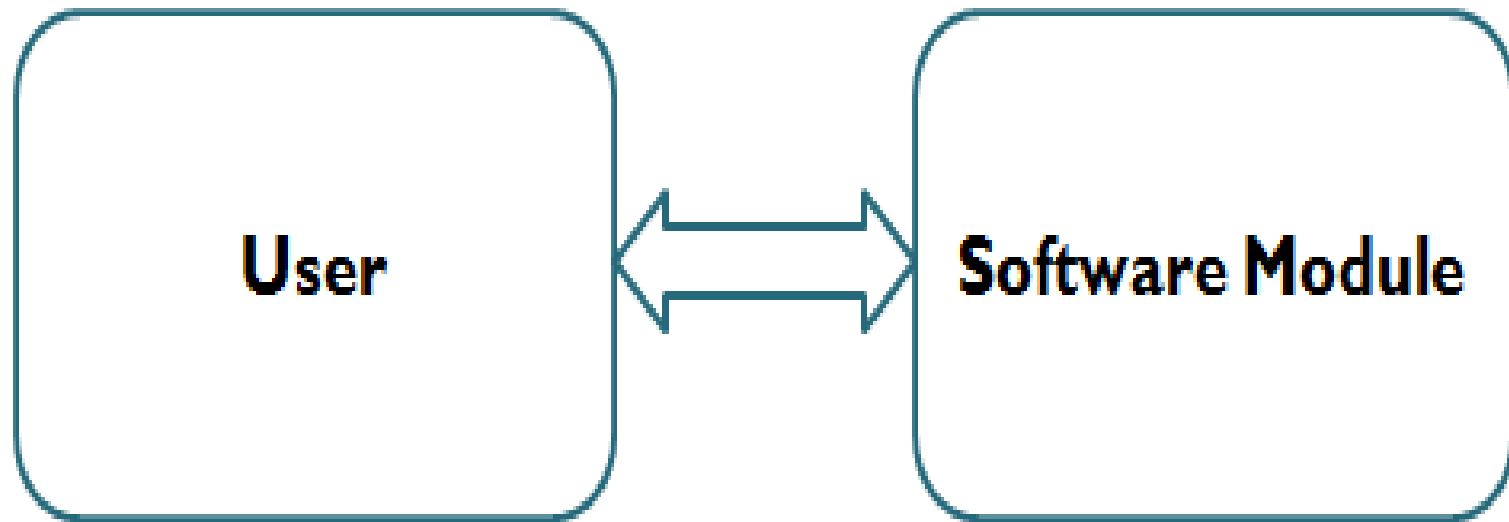
Conceptual framework of Software as a Service



Migrating to Cloud Environment

- The Software can be redeployed in cloud environment as Software as a Service (SaaS).
- The main sections of the software can be mapped to the SaaS architecture.
- **Payroll Processing in Cloud Computing:**
- Many State Government departments are utilizing standardized set up of payroll packages which are deployed at user locations and it is amounting huge investment on procurement of hardware and software and maintenance for various locations of the organization.
- Payroll Software Installed at more than 300 locations

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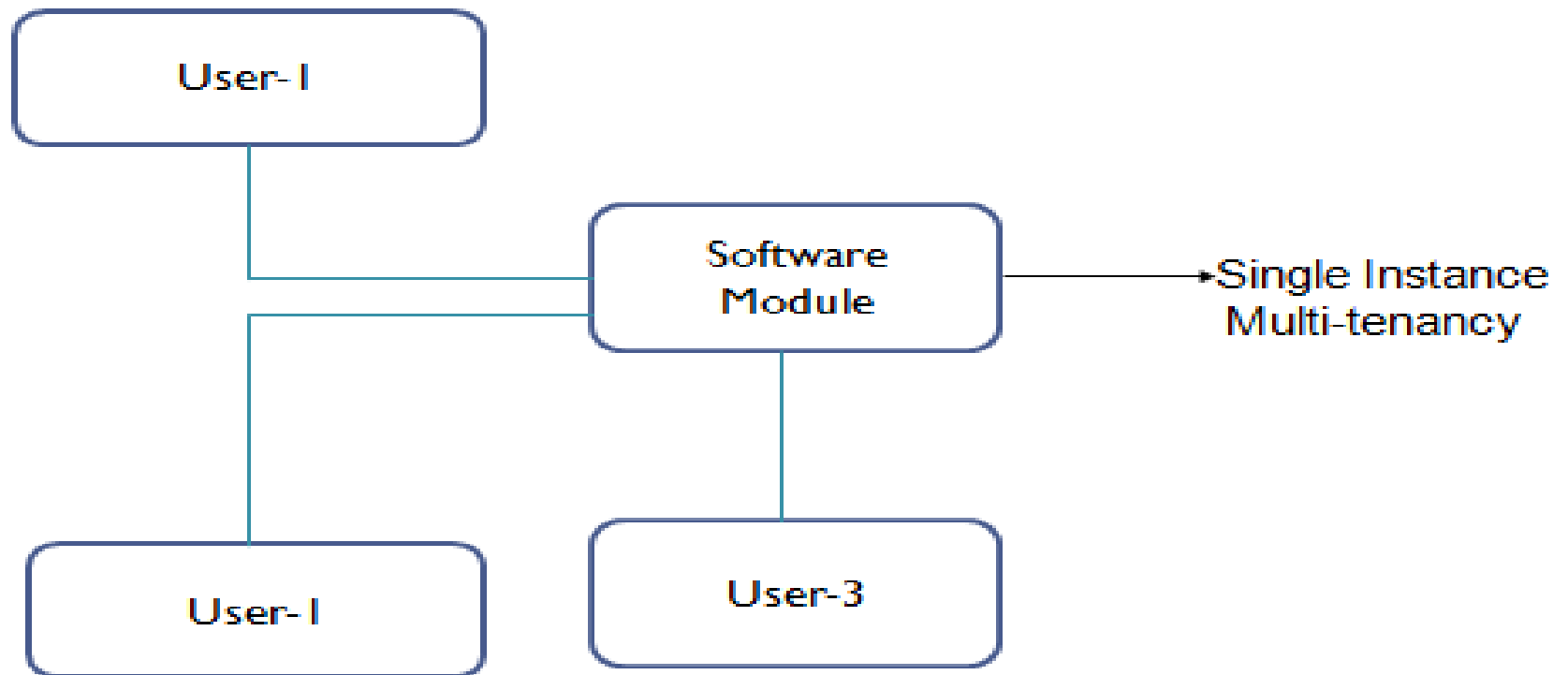
Standalone Loaded on PC

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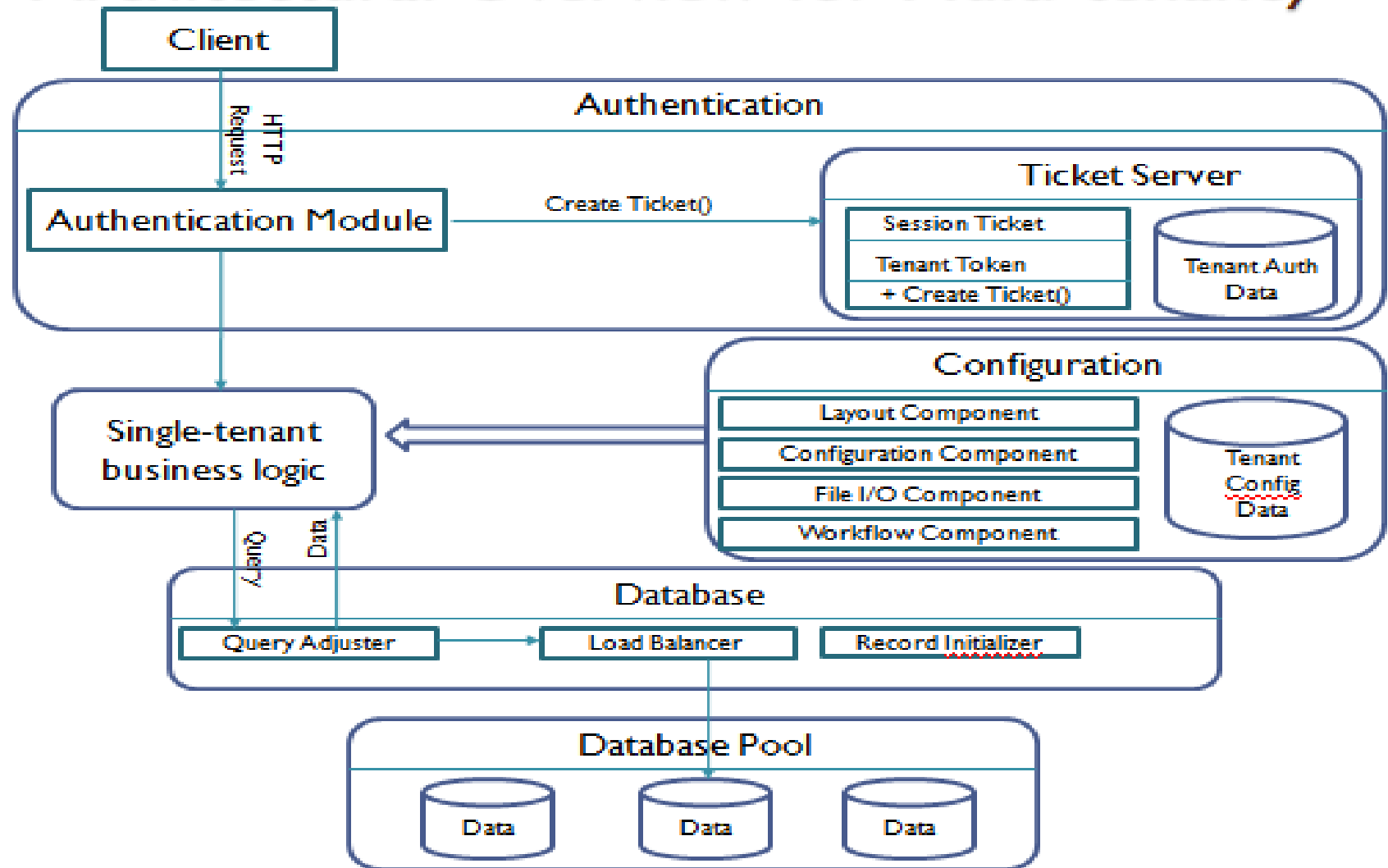
- Migrating the payroll package, to cloud environment can be worked **out without changing business logic.**

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IN CLOUD



Architectural Overview for Multi-tenancy



Provisioning for new tenants

- For Separate server model new machine is to be installed.
- For separate database model create a database start it on a server.
- For separate schema and shared schema models scripts / stored procedure could create new schema in one of the existing databases.

Background of the Application

- The existing application, which is implemented in state government departments, is having the following main sections:
 - Data admin
 - Master data entry
 - Month process
 - Token no. entry
 - Reports
 - Back up to system
- The existing package is deployed in the user premises and found difficult in regular software maintenance and overhead costs for the infrastructure requirements.

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- **The application is ideally suited to deploy in cloud environment with following features:**
 - The application can be taken up as a single instance and multi-tenant model
 - Configurability option in the software is required to be provided. Configurability in SaaS enables the flexibility to access the software by many tenants with the option of configuring each tenant for their application needs.
 - **The software will have configurability for the following :**
 1. User interface.
 2. Workflow.
 3. Data.
 4. Access control.

SaaS Applications

User requirements / Use cases	Type of environment in cloud	Impact
Payroll processing	IaaS (VM) Cloud storage and SaaS	1. Processing time will be reduced. 2. Hardware requirements will be reduced. 3. Number of users can be increased with scalability. 4. Maintenance cost will be reduced.
Project Management	PaaS and Cloud storage	1. Processing time can be reduced. 2. Project execution time and cost can be reduced. 3. Efficient way of utilization of skill sets and manpower can be attained.
e-Governance & Office automation	IaaS Cloud storage SaaS	1. Hardware cost can be reduced. 2. CPU processing time can be reduced. 3. Accountability can be maintained. 4. Maintenance cost can be reduced. 5. Reduces energy consumption.
e-Learning	Cloud storage IaaS PaaS SaaS	1. Hardware cost can be reduced. 2. CPU processing time can be reduced. 3. Accountability can be maintained. 4. Maintenance cost can be reduced.

SOA and Cloud Computing

- In cloud environment we adopt the bundling of resources into layers of
 - Saas
 - Paas
 - Iaas
- And further add a layer for business process management with the concept of **service oriented architecture(SOA)**.
- **SOA** is a base for further building of cloud environment for composite application with workflow concepts.

