به نام خدا

Cloud Computing Essentials

دکتر محمد کاظم اکبری

مرتضی سرگلزایی جوان

ITU-T Y3500 (ISO/IEC 17788): Cloud Definition

- "Paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on-demand"

Examples of resources

- Servers
- Operating systems
- Networks
- Software
- Applications
- Storage

Characteristics

- Broad network access
- Measured Service
- Multi-tenancy
- On-demand self-service
- Rapid elasticity and scalability
- Resource pooling

Broad network access

- Users can access physical and virtual resources from wherever they need to work, as long as it is network accessible, using a wide variety of clients including devices such as mobile phones, tablets, laptops, and workstations.

Measured service

- Usage can be monitored, controlled, reported, and billed. This is an important feature needed to optimize and validate the delivered cloud service. The customer may only pay for the resources that they use.

Multi-tenancy

- Within the context of multi-tenancy, the group of cloud service users that form a tenant will all belong to the same cloud service customer organization. Multiple tenants and their computations and data are isolated from and inaccessible to one another.

On-demand self-service

- Feature where a cloud service customer can provision computing capabilities, as needed, automatically or with minimal interaction with the cloud service provider

Rapid elasticity and scalability

- A feature where physical or virtual resources can be rapidly and elastically adjusted, in some cases automatically, to quickly increase or decrease resources.

Resource pooling

- Physical or virtual resources can be aggregated in order to serve one or more cloud service customers; to support multi-tenancy while at the same time using abstraction to mask the complexity of the process from the customer. This offloads some of the customer's original workload, such as maintenance requirements, to the provider.

Deployment models

- Public
- Private
- Hybrid
- Mobile
- Community
- Federated
- P2P

Many Cloud services categories

- **Software as a Service: SaaS**
- **Platform as a Service: PaaS**
- **Infrastructure as a Service: IaaS**
- **Compute as a Service:CompaaS**
- **Data Storage as a Service: DSaaS**
- **Network as a Service: NaaS**
- **Communications as a Service: CaaS**

Cloud service categories	Cloud capabilities types		
	Infrastructure	Platform	Application
Compute as a Service	X		
Communications as a Service		X	X
Data Storage as a Service	X	X	X
Infrastructure as a Service	X		
Network as a Service	X	X	X
Platform as a Service		X	
Software as a Service			X

- **Database as a Service**: *installation and maintenance of the databases are performed by the cloud service provider.*
- **Desktop as a Servic:** Service: *ability to build, configure, manage, store, execute, and deliver users' desktop functions remotely.*
- **Email as a Service:** *complete email service including related support services such as storage, receipt, transmission, backup, and recovery.*
- **Identity as a Service: Service:** *Identity and Access Management that can be extended and centralized into existing operating environments.*
- **Management as a Service:** *including application management, asset and change management, capacity management, problem management (service desk), project portfolio management, service catalog, and service level management.*
- **Security as a Service:** *integration of a suite of security services with the existing operating environment by the cloud service provider. This may include authentication, anti-virus, anti-malware/spyware, intrusion detection, and security event management, among others.*

3 Data categories

- Customer Data: Class of data objects under the control, by legal or other reasons, of the cloud service customer that were input to the cloud service, or resulted from exercising the capabilities of the cloud service.
- Provider Data: Class of data objects, specific to the operation of the cloud service, under the control of the cloud service provider .
- Derived Data: Class of data objects under cloud service provider control that are derived as a result of interaction with the cloud service by the cloud service customer (e.g. log data, configuration or customization data, …)

Cloud Deployment Models

Community Cloud

Mobile Cloud

Private Cloud

Hybrid Cloud

Cloud

Cloud

Cloud

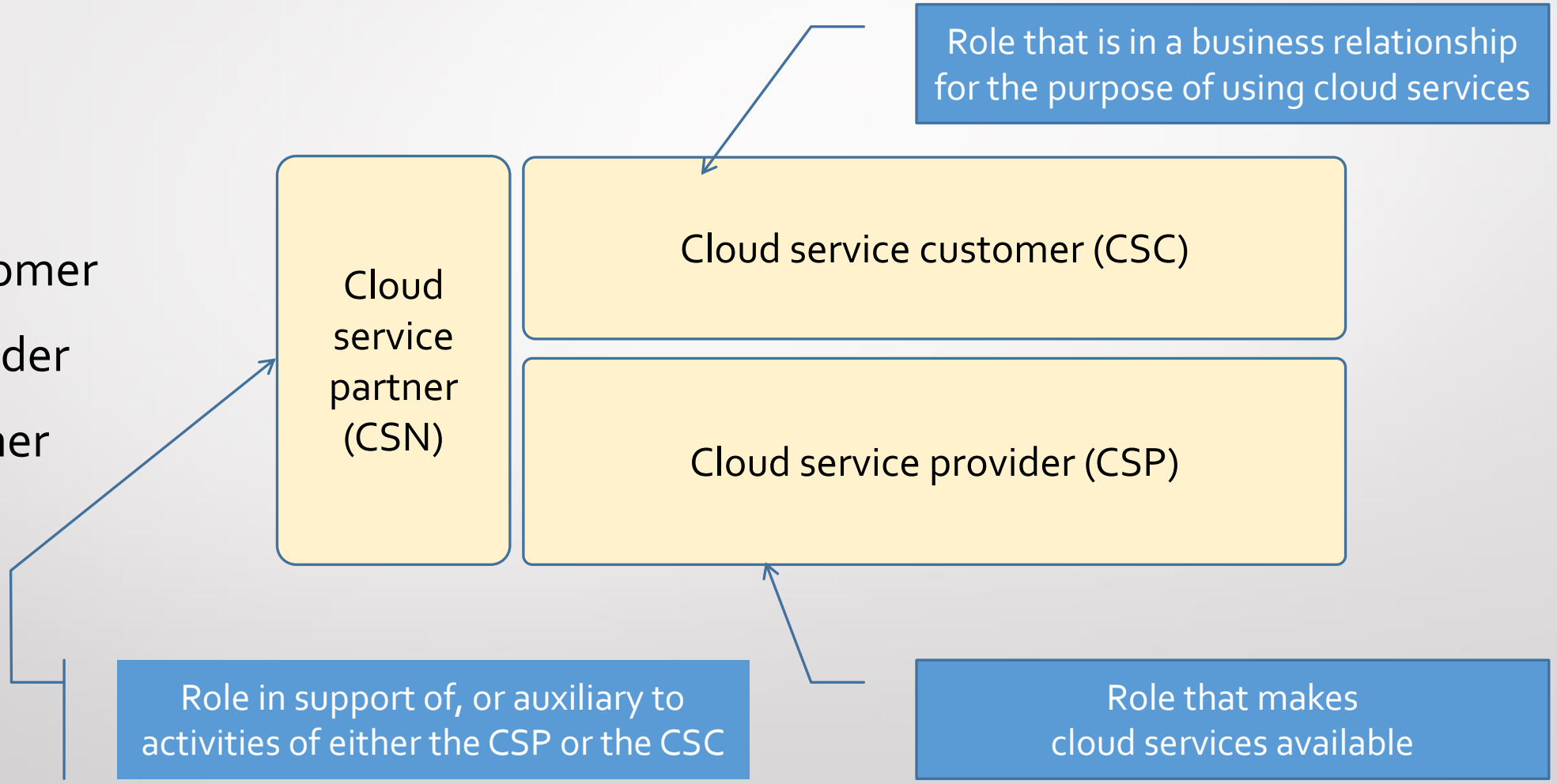
Public Cloud

Federated Cloud

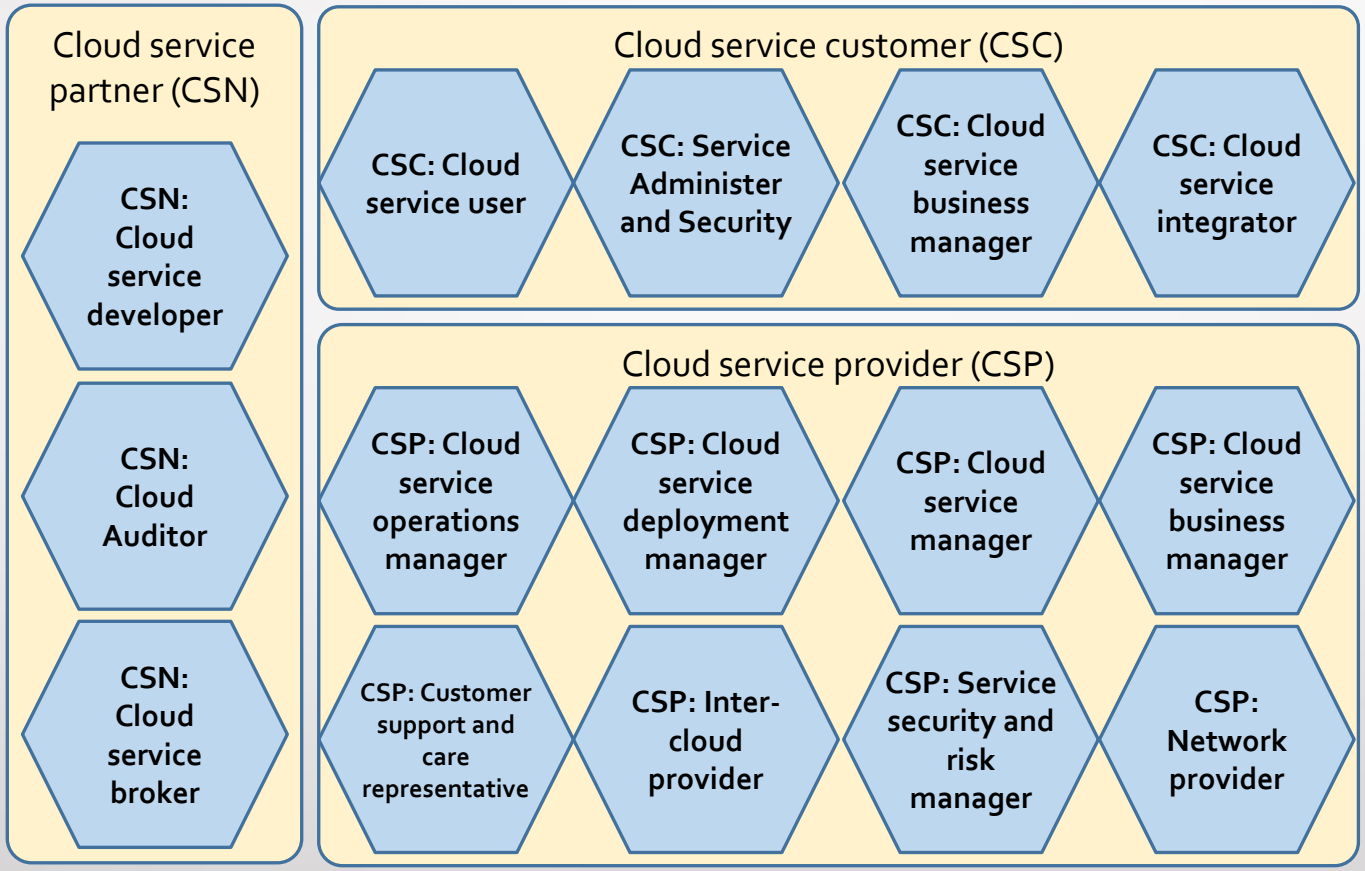
Mobile Cloud Computing

Main Cloud Computing Roles

- Customer
- Provider
- Partner

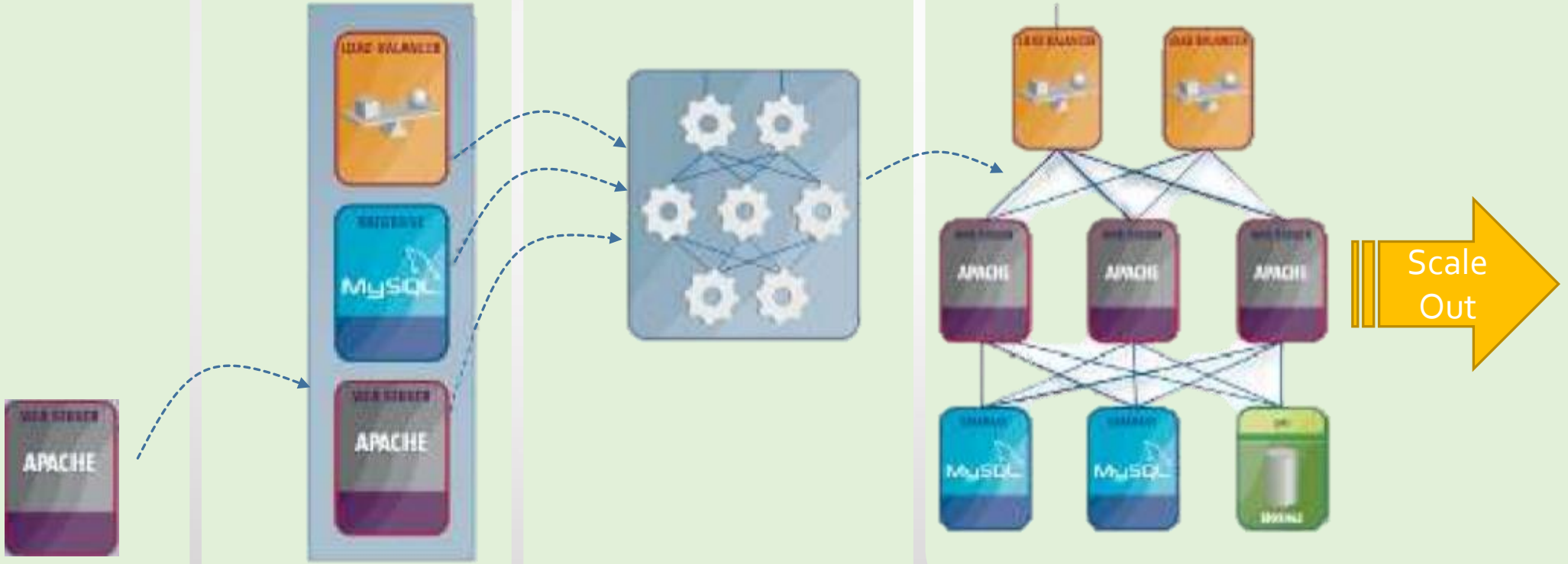


Main Cloud Computing Roles & Sub-Roles



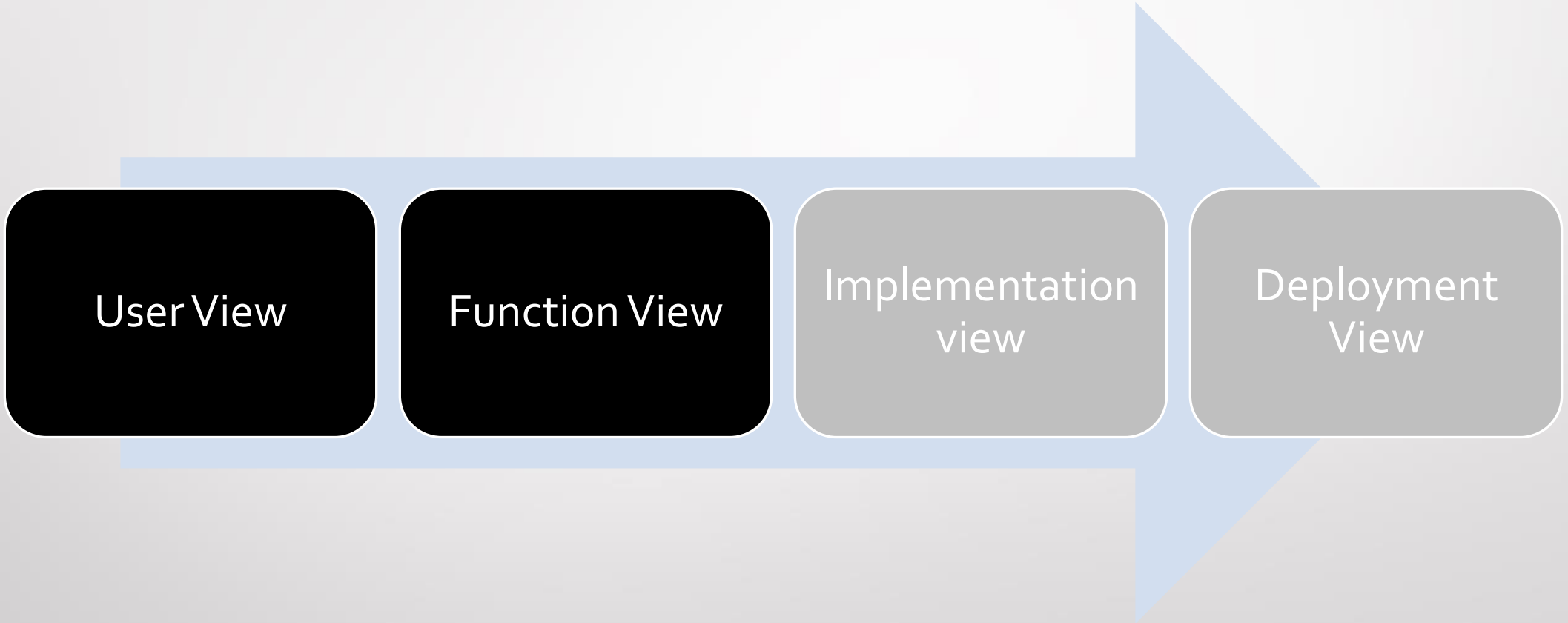
Sub-Roles Example

ISO/IEC 17789: 2014

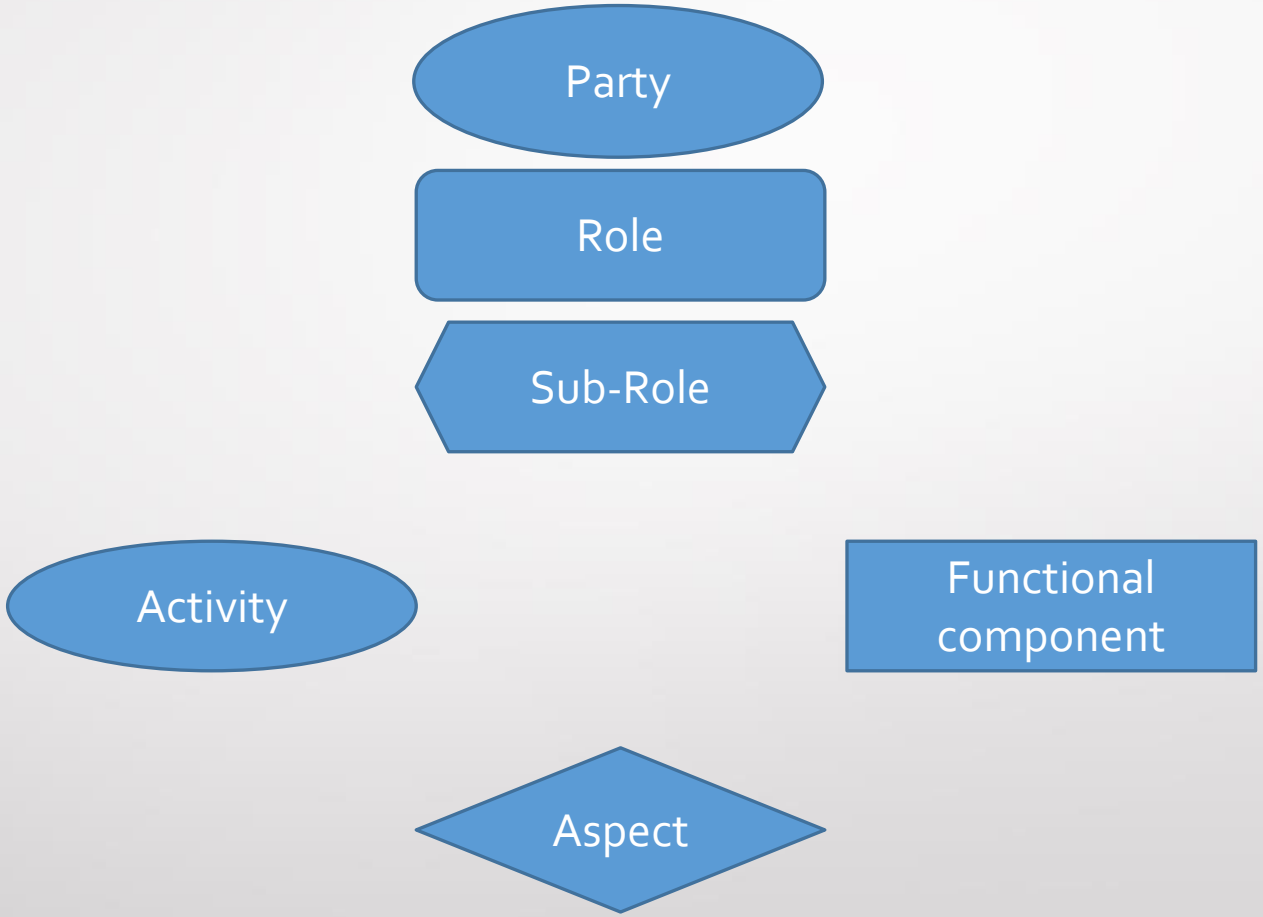


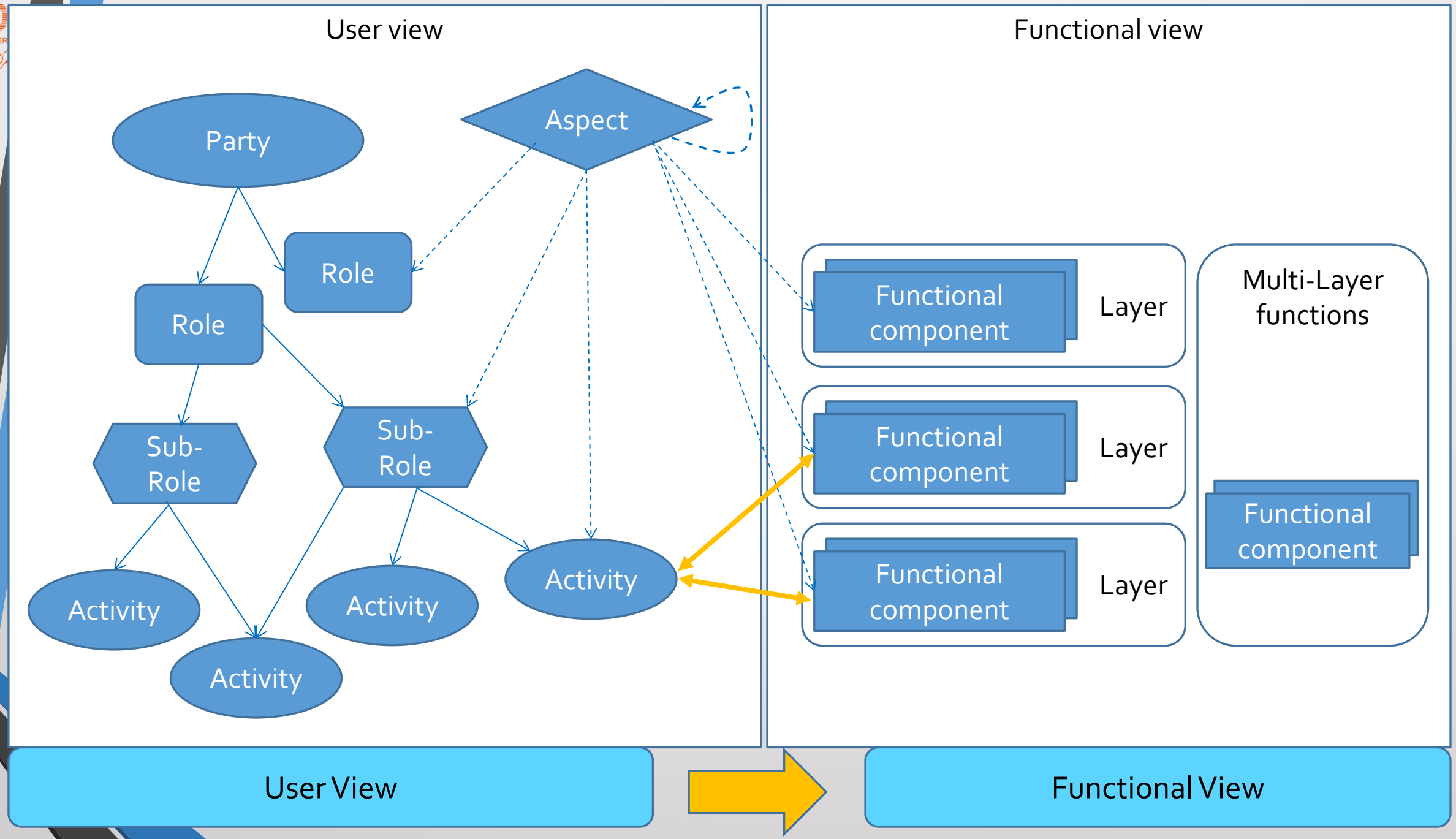
CSN: Service Developer	CSP: Deployment Manager	CSP: Service Manager	CSP: Operations Manager

ISO/IEC 17789: Cloud Reference Architecture

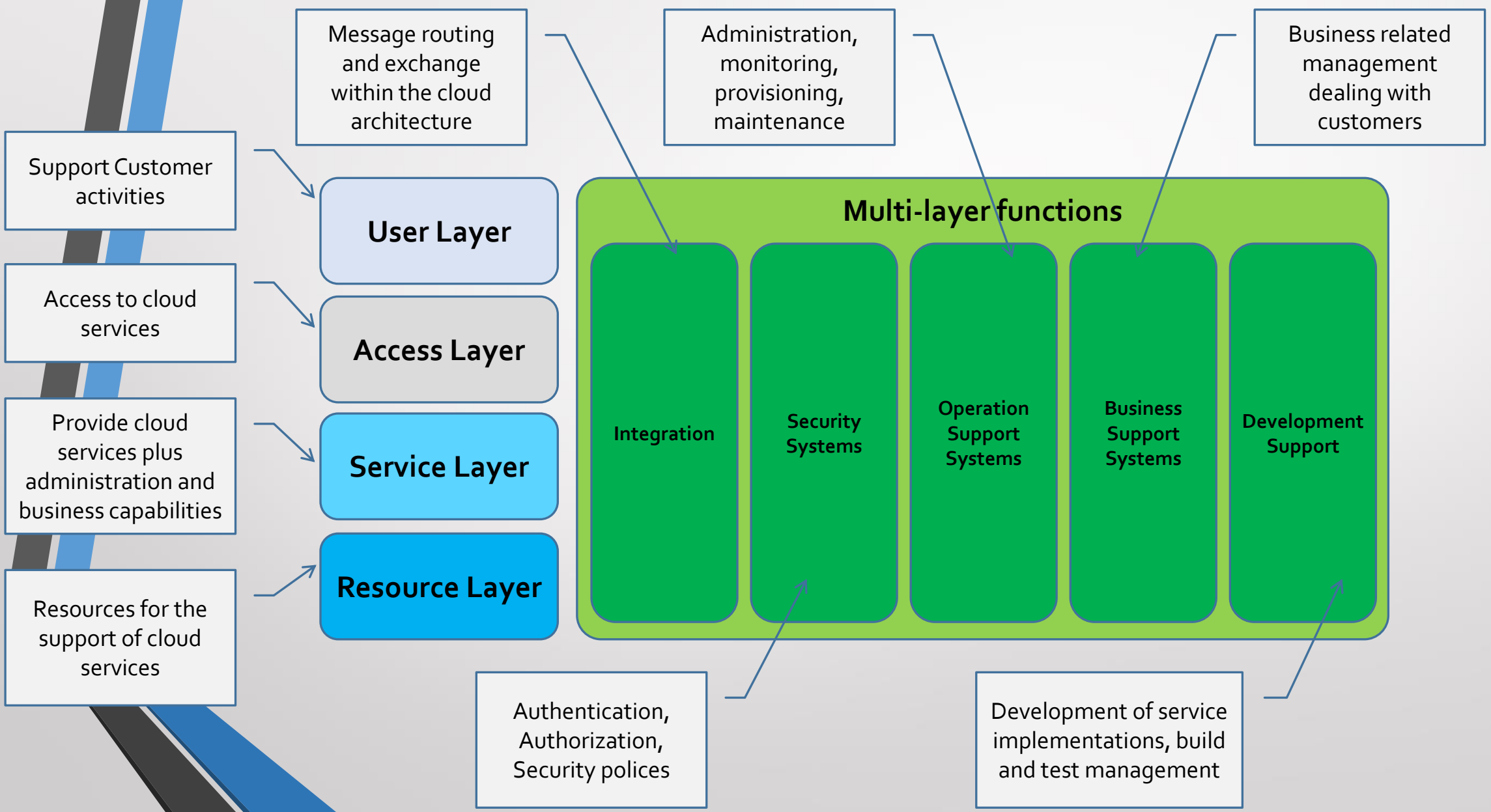


Legend

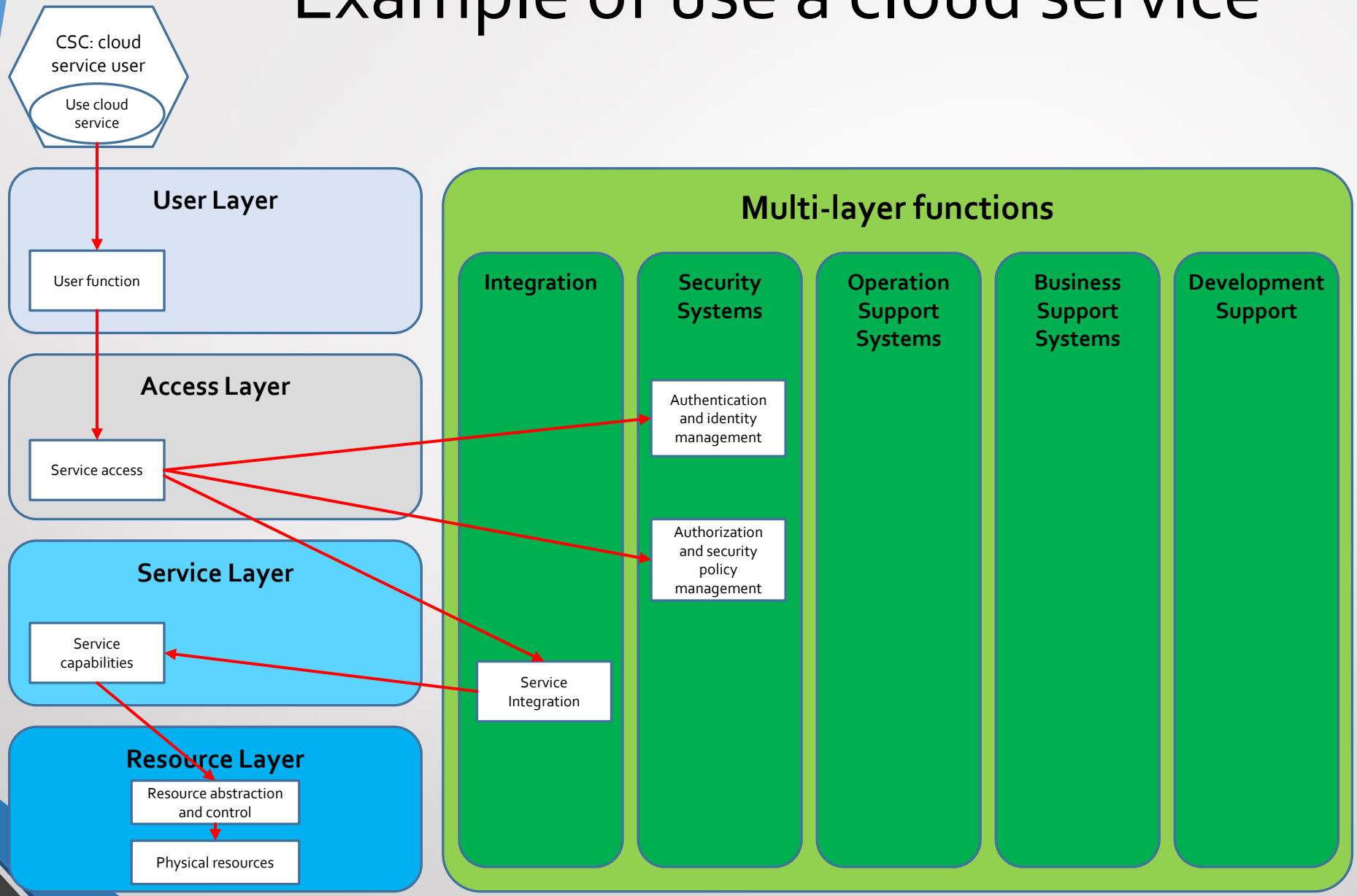



User view
Functional view
Party
Aspect
Role
Role
Role
Sub-Role
Sub-Role
Activity
Activity
Activity
Activity
Functional component
Layer
Functional component
Layer
Functional component
Layer
Multi-Layer functions
Functional component
User View
Functional View

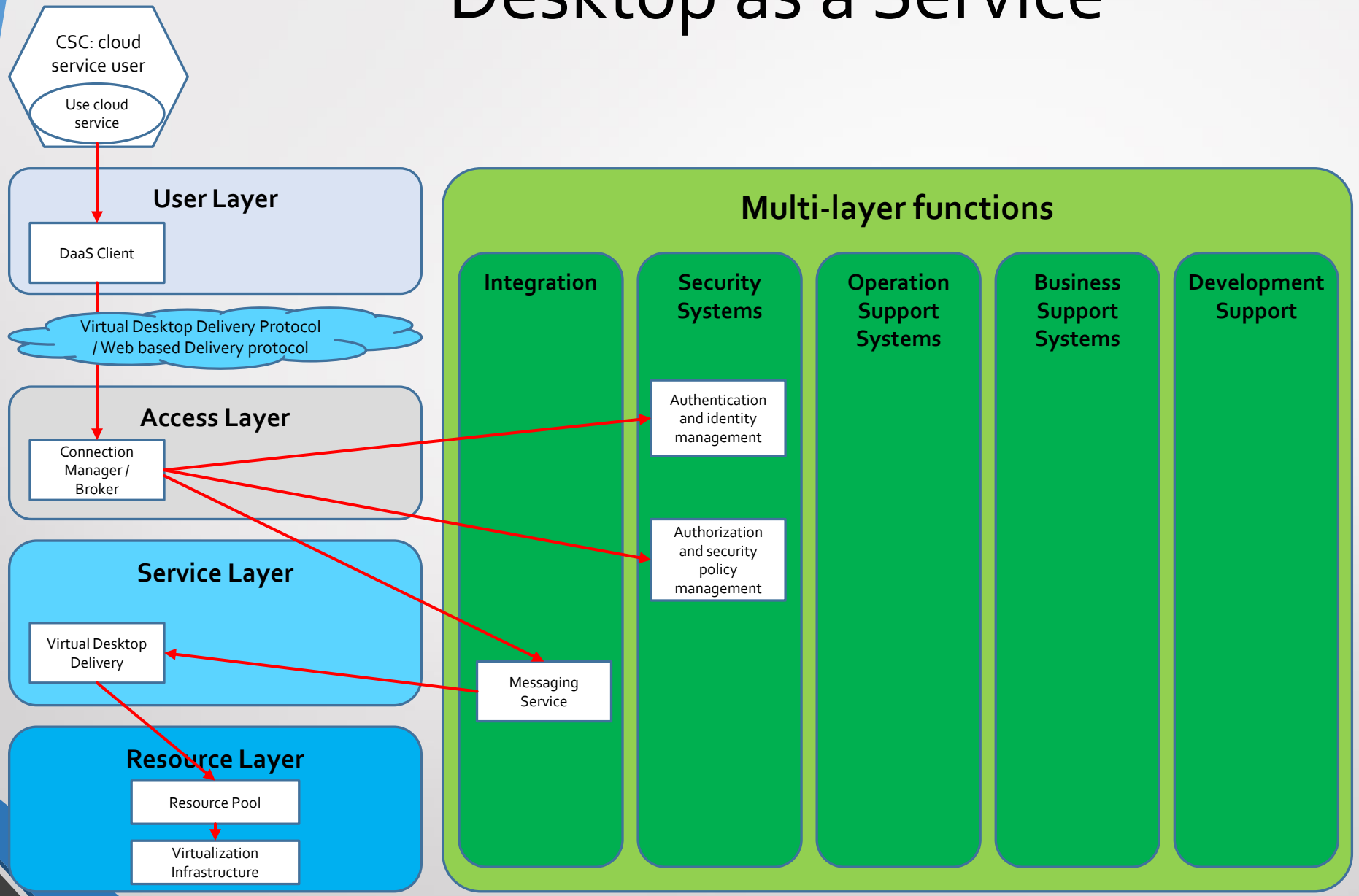
Functional Architecture



Example of use a cloud service



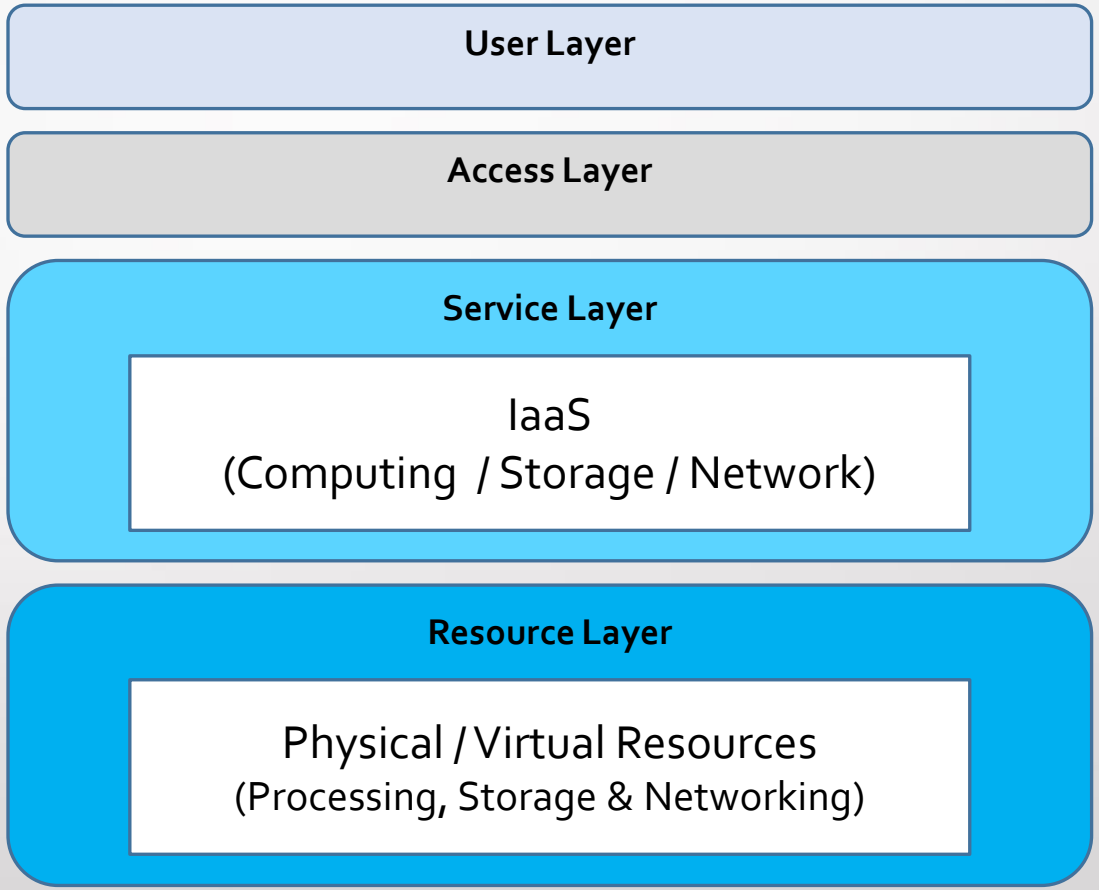
Desktop as a Service



Example: Infrastructure as a Service

Computing service functions allow CSC to provision and use processing resources.

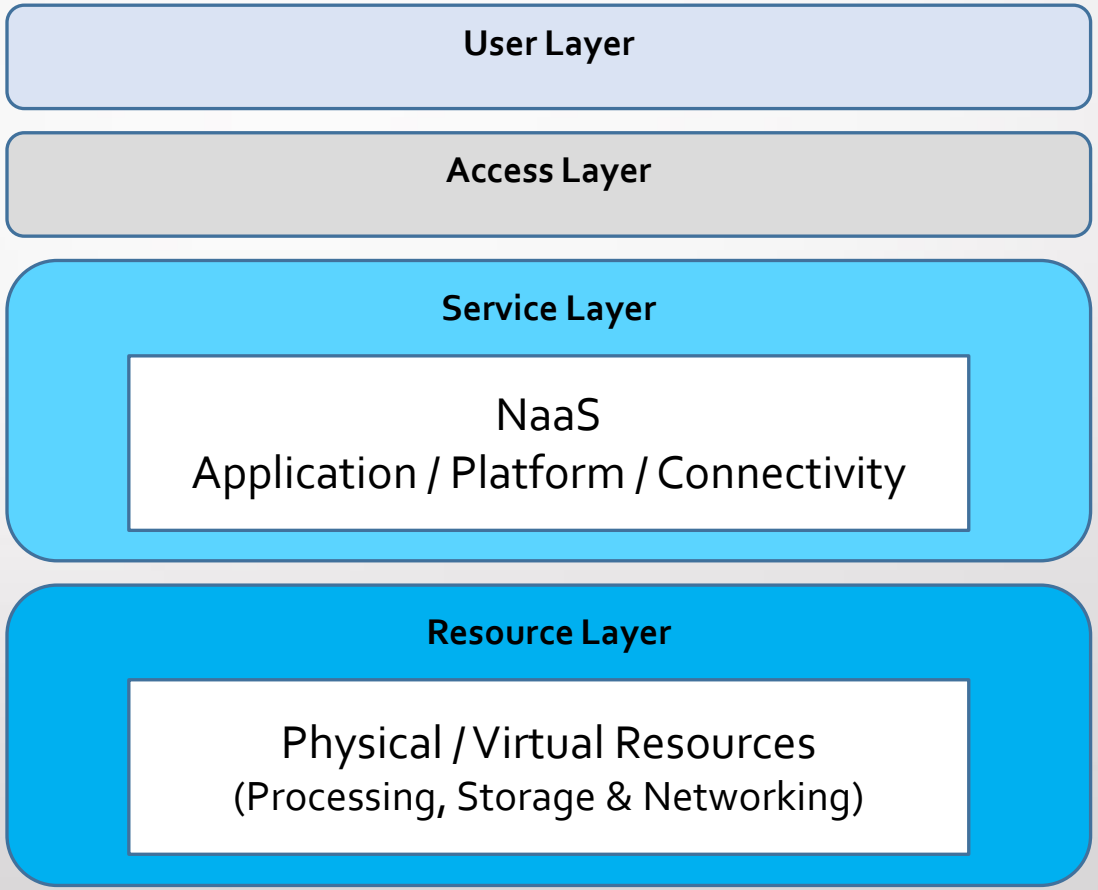
- storage service functions allow CSC to use storage resources.
- network service functions allow CSC to use networking resources.



Example: Network as a Service

NaaS concept is based on
3 capabilities types of service:

- NaaS Application (VNF)
- NaaS Platform
- NaaS Connectivity (SDN)



Cloud Cross Cutting aspects

Cross Cutting: behaviors which need to be coordinated across roles and implemented consistently in a cloud computing system:

- Auditability
- Availability
- Governance
- Interoperability
- Maintenance and versioning
- Performance
- Portability
- Privacy
- Regulatory
- Resiliency
- Reversibility
- Security
- Service levels and service level agreement

Auditability

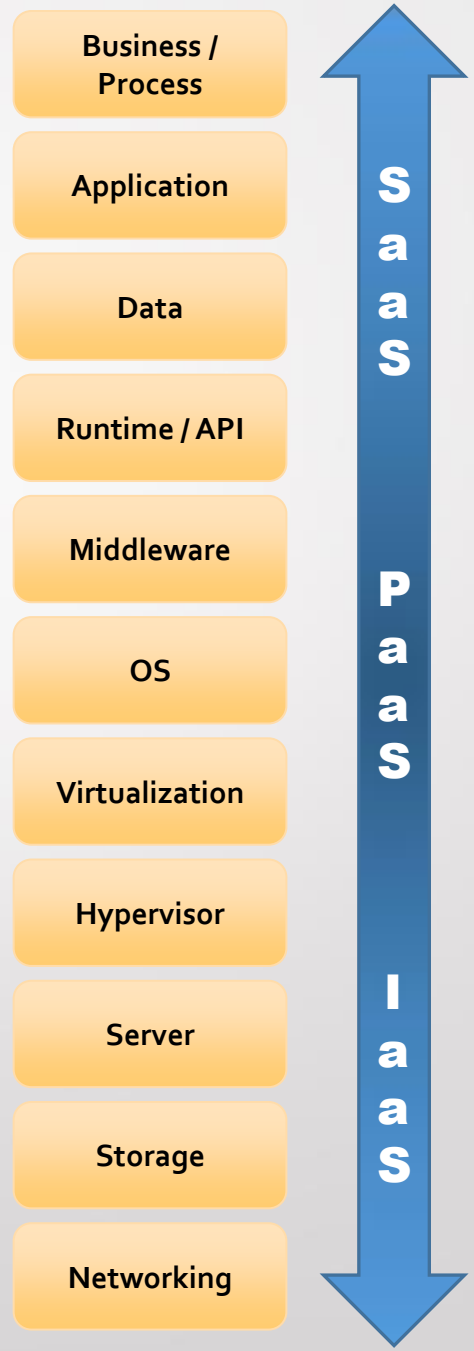
- The capability of collecting and making available necessary evidential information related to the operation and use of a cloud service, for the purpose of conducting an audit;

Availability

- The property of being accessible and usable upon demand by an authorized entity. The "authorized entity" is typically a cloud service customer;

Governance

- The system by which the provision and use of cloud services are directed and controlled.
  - **Internal cloud governance**: Ensure that cloud computing based solutions are designed and implemented, and cloud computing based services are delivered, according to specified expectations.
  - **External cloud governance:** Some form of agreement between the cloud service customer and the cloud service provider concerning the use of cloud services by the cloud service customer;



Interoperability

- Ability of a cloud service customer to interact with a cloud service and exchange information according to a prescribed method and obtain predictable results;

Maintenance and versioning

- Maintenance refers to changes to a cloud service or the resources it uses in order to fix faults or in order to upgrade or extend capabilities for business reasons. Versioning implies the appropriate labelling of a service so that it is clear to the cloud service customer that a particular version is in use;

Performance

- A set of behaviours relating to the operation of a cloud service, and having metrics defined in a SLA;

Portability

- Ability of cloud service customers to move their data or their applications between multiple cloud service providers at low cost and with minimal disruption. The amount of cost and disruption that is acceptable may vary based upon the type of cloud service that is being used;

Protection of PII

- Protect the assured, proper, and consistent collection, processing, communication, use and disposal of Personally Identifiable Information (PII) in relation to cloud services;

Regulatory

- … vary by market sector and jurisdiction, and they can change the responsibilities of both cloud service customers and cloud service providers. Compliance with such requirements is often related to governance and risk management activities;

Resiliency

- Ability of a system to provide and maintain an acceptable level of service in the face of faults (unintentional, intentional, or naturally caused) affecting normal operation;

Reversibility

- A process for the cloud service customer to retrieve their cloud service customer data and application artefacts and for the cloud service provider to delete all cloud service customer data as well as contractually specified cloud service derived data after an agreed period;

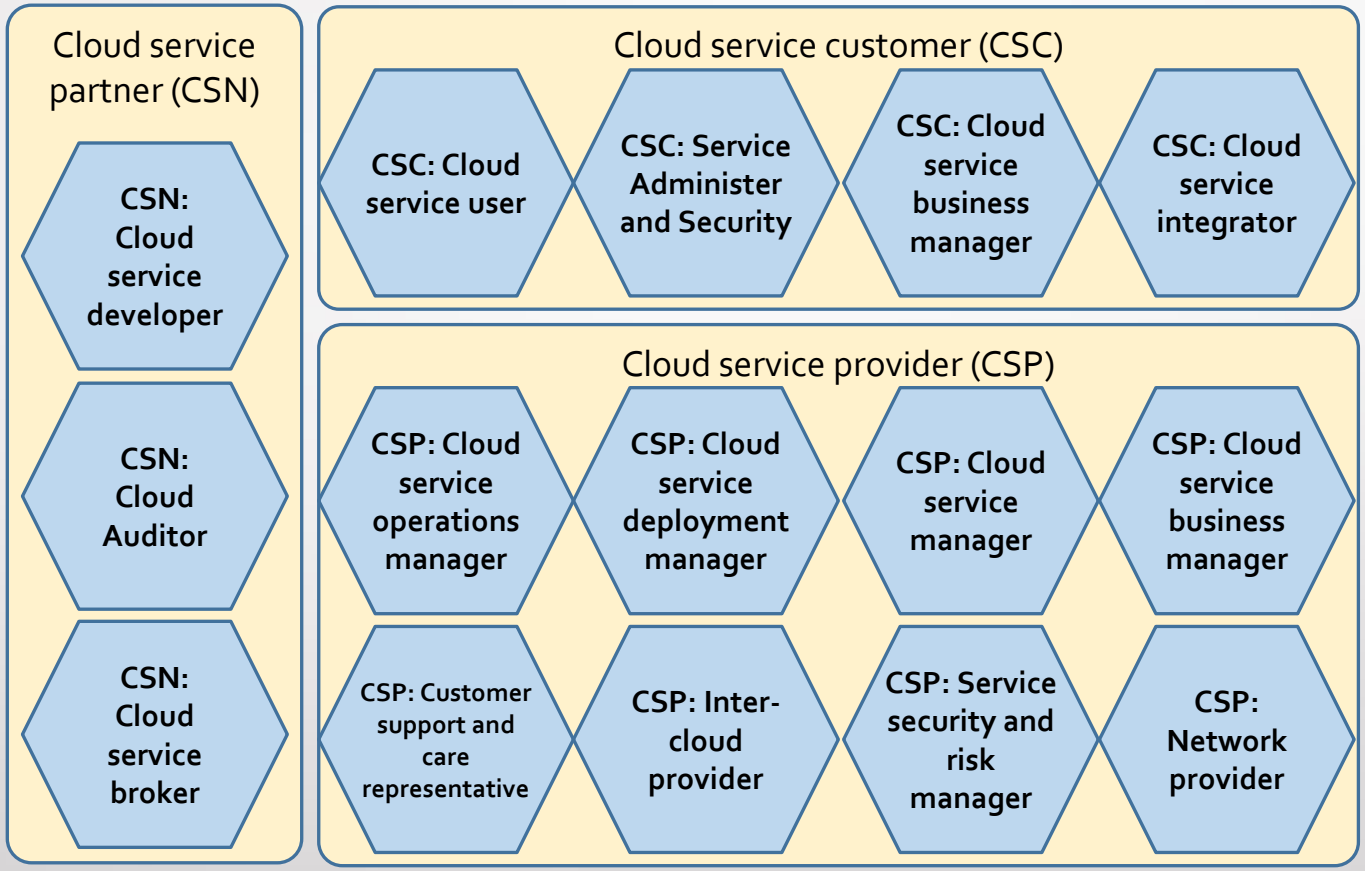
Security

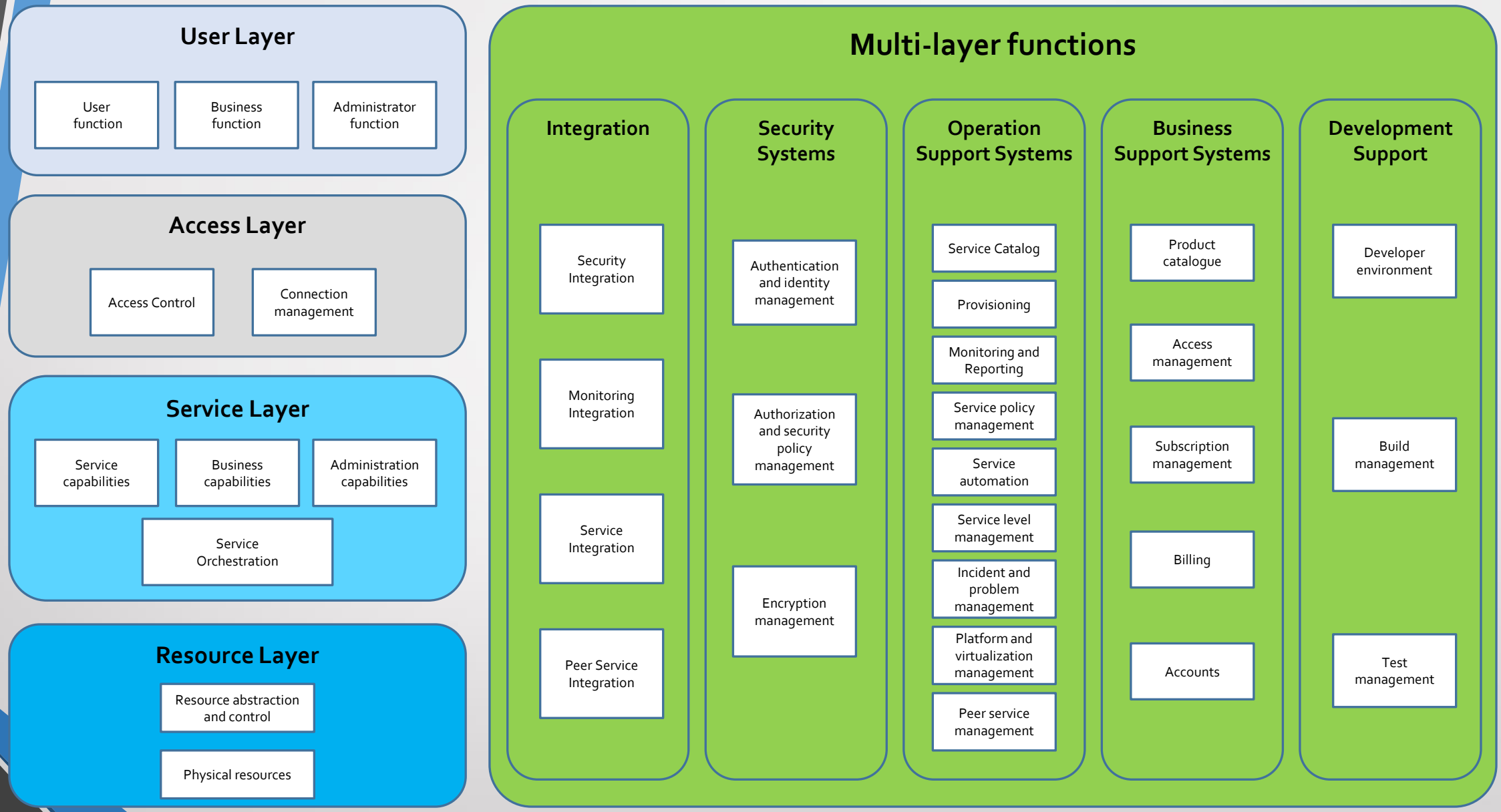
- Ranges from physical security to application security, and includes requirements such as authentication, authorization, availability, confidentiality, identity management, integrity, non-repudiation, audit, security monitoring, incident response, and security policy management;

Service levels and service level agreement

- It characterizes quality of the cloud services delivered in terms of:
  - 1) a set of measurable properties specific to cloud computing (business and technical) and
  - 2) a given set of cloud computing roles (cloud service customer and cloud service provider and related sub-roles).

Main Cloud Computing Roles & Sub-Roles





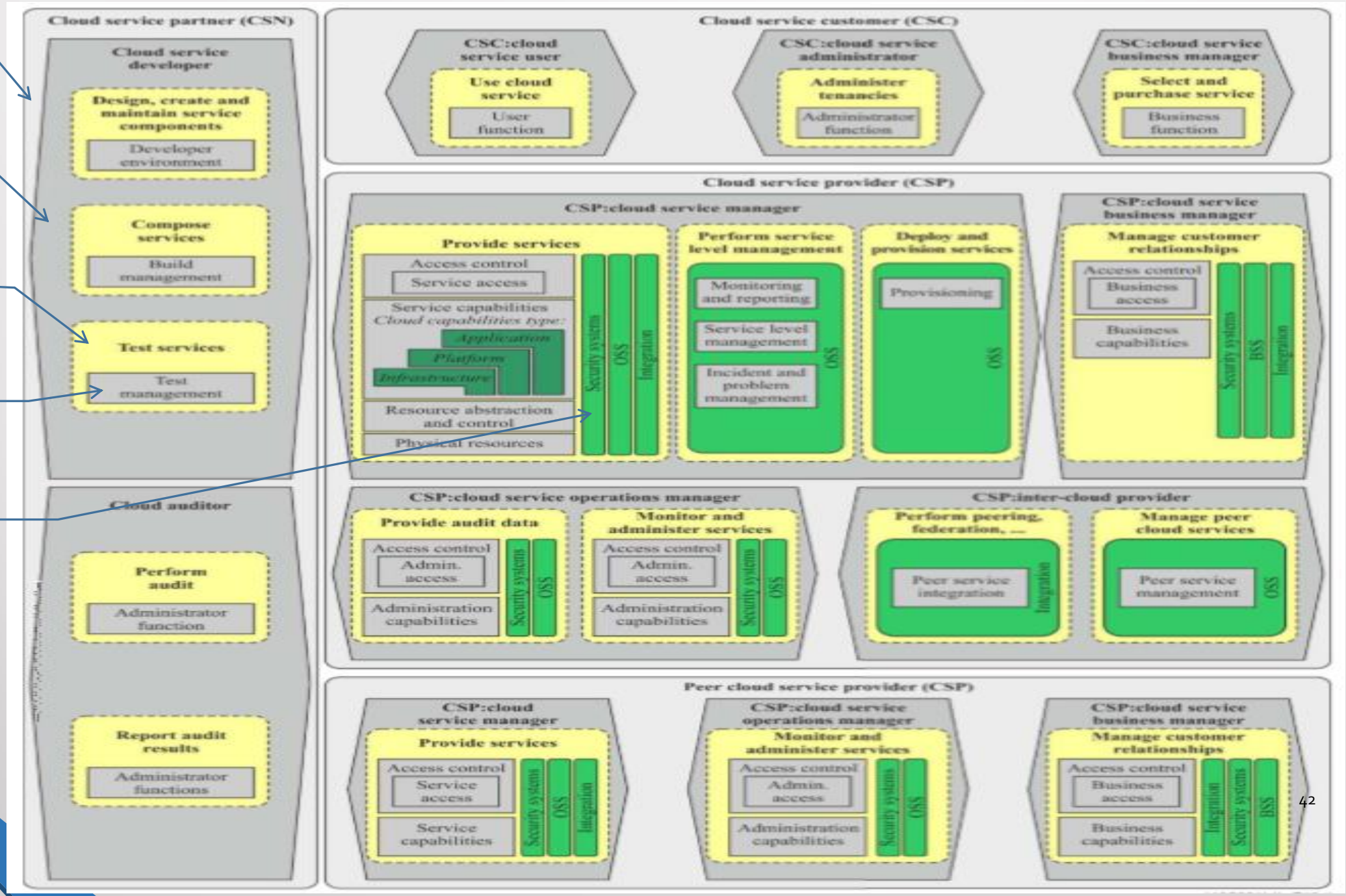
Role

Sub-Role

Activity

Single Layer Function

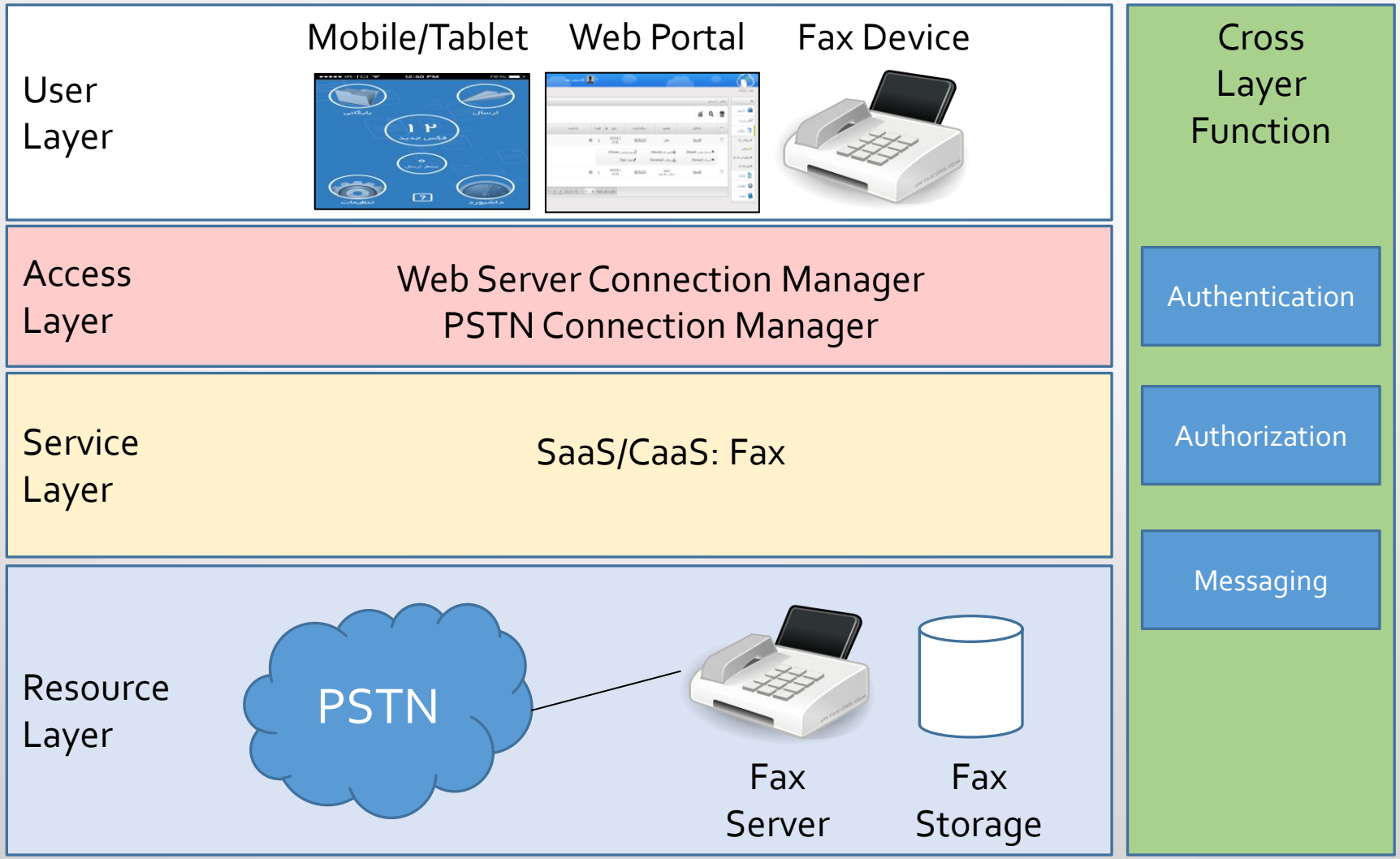
Multi Layer Function



Exercise 1.2

- Deep into one of Cloud Services in Exercise 1.1
  - Identify Service Characterization
  - Identify Service Category and Service Capabilities
  - Identify Cross Cutting Aspects
  - Draw Functional Architecture

Example


User Layer
Mobile/Tablet
Web Portal
Fax Device
Access Layer
Web Server Connection Manager
PSTN Connection Manager
Service Layer
SaaS/CaaS: Fax
Resource Layer
PSTN
Fax Server
Fax Storage
Cross Layer Function
Authentication
Authorization
Messaging