Cloud Computing Reference Architecture(CCRA)-NIST

Unit objectives

After completing this unit, you should be able to:

- Understand the concept of NIST's Cloud Computing Reference Architecture (CCRA)
- Learn about the conceptual reference model
- Gain knowledge on architectural components in CCRA

NIST Cloud Computing Reference Architecture (CCRA)

- The NIST CCRA doesn't focus on how to design solution and implementation, but mainly focuses on the requirements of what the cloud services should provide.

- To facilitate the understanding of the operational difficulties or complexities in cloud computing the reference architecture is designed.

- NIST CCRA is a tool for developing, discussing and describing a system specific architecture by using a common framework of reference.

- NIST CCRA doesn't represent the system architecture of a particular cloud computing system.

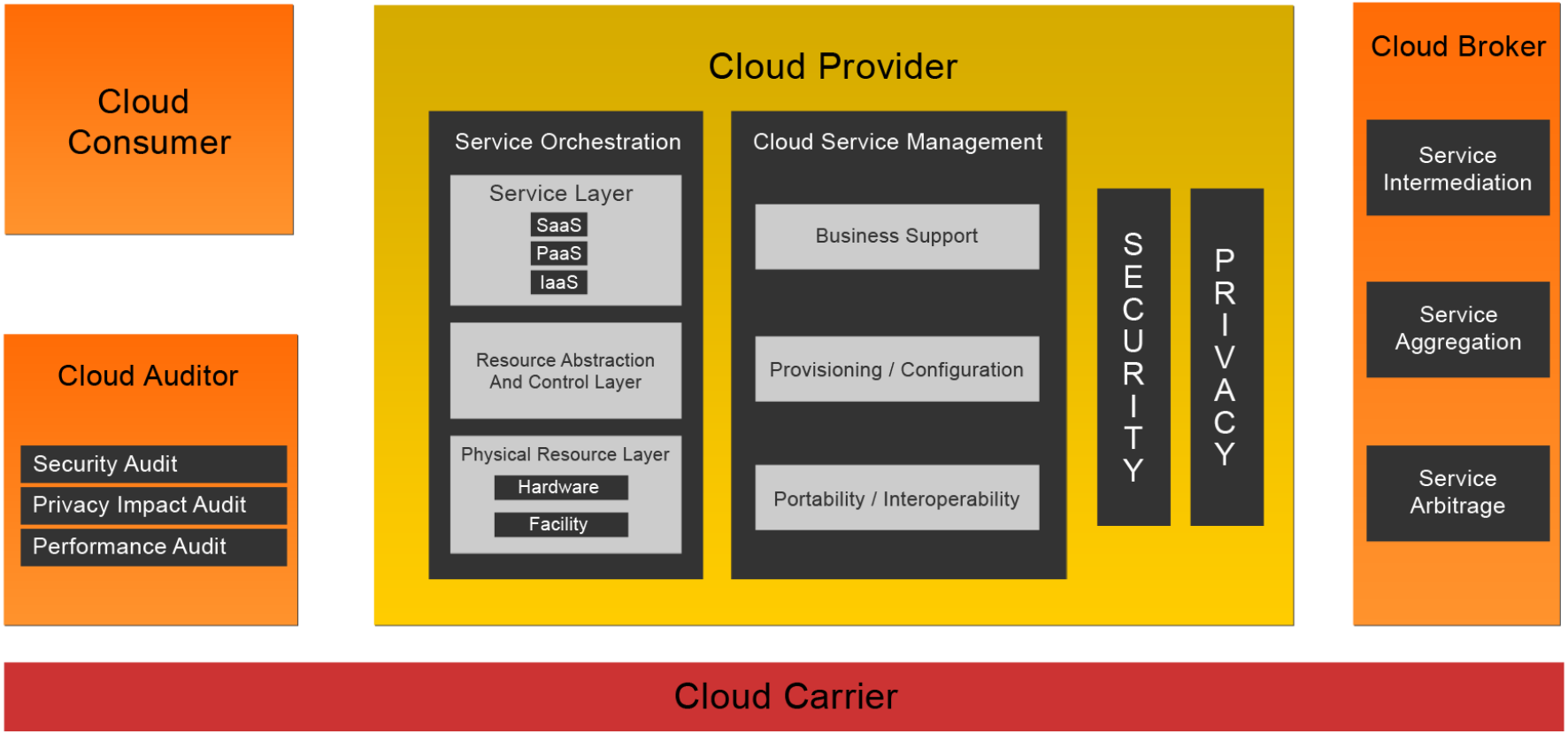
Objectives of NIST

- In the context of an overall cloud computing conceptual model the NIST CCRA is to understand and illustrate the various cloud services.

- In order to understand, compare, discuss and categorize the cloud services, the NIST CCRA is meant to provide a technical reference to USG agencies and to other consumers.

- The NIST CCRA is meant to facilitate the analysis of candidate standards for interoperability, portability, security and reference implementations.

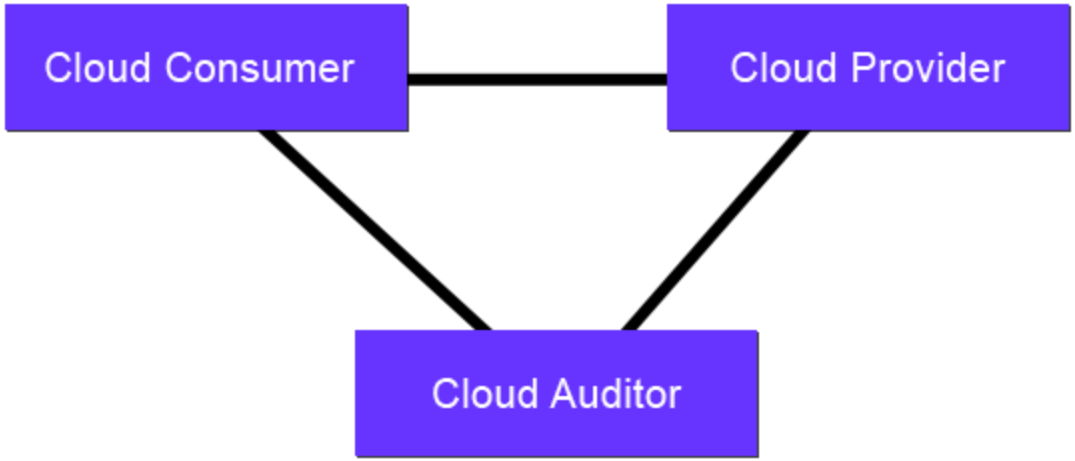
The conceptual reference model



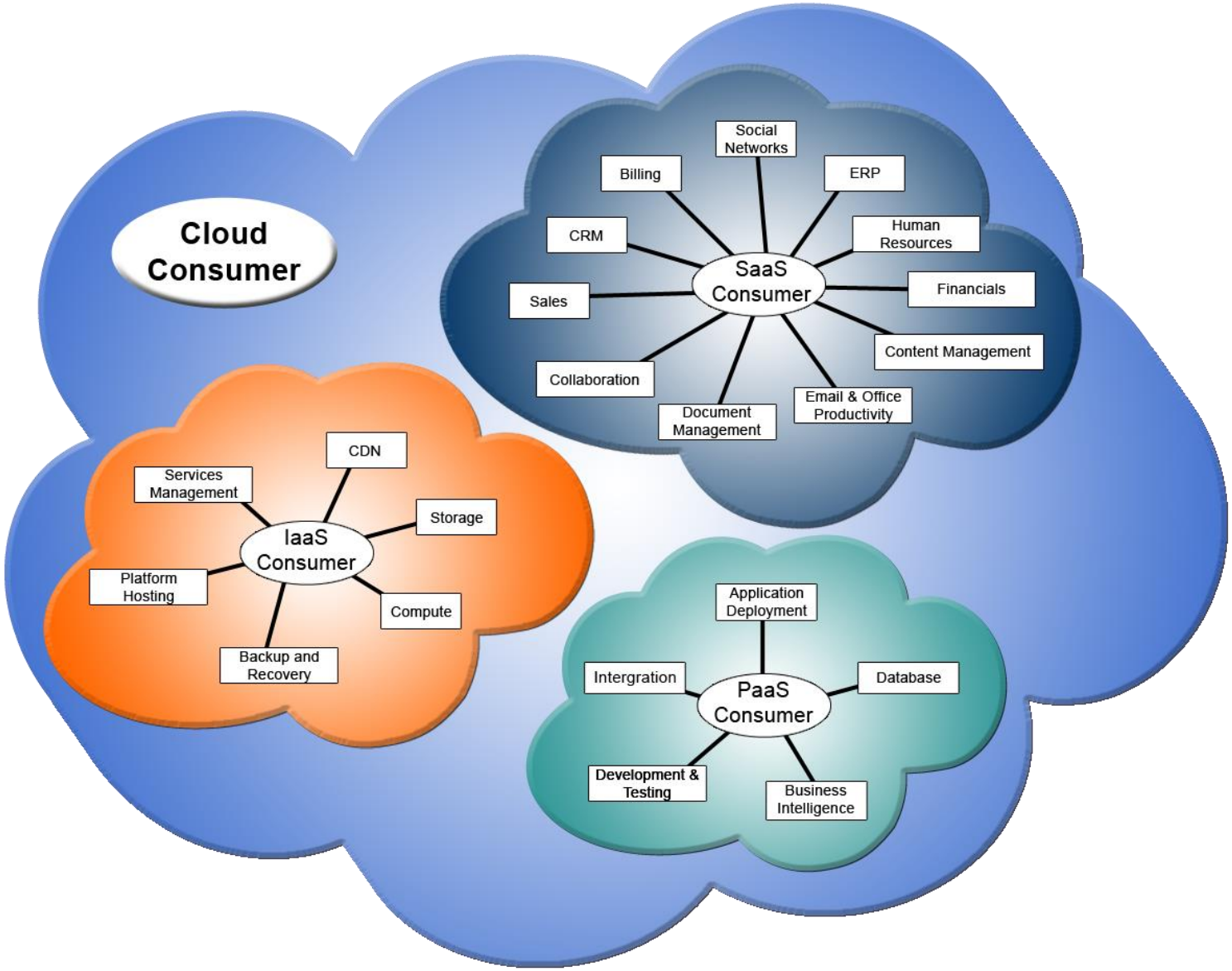
Example: Usage scenario 1

Example: Usage scenario 2

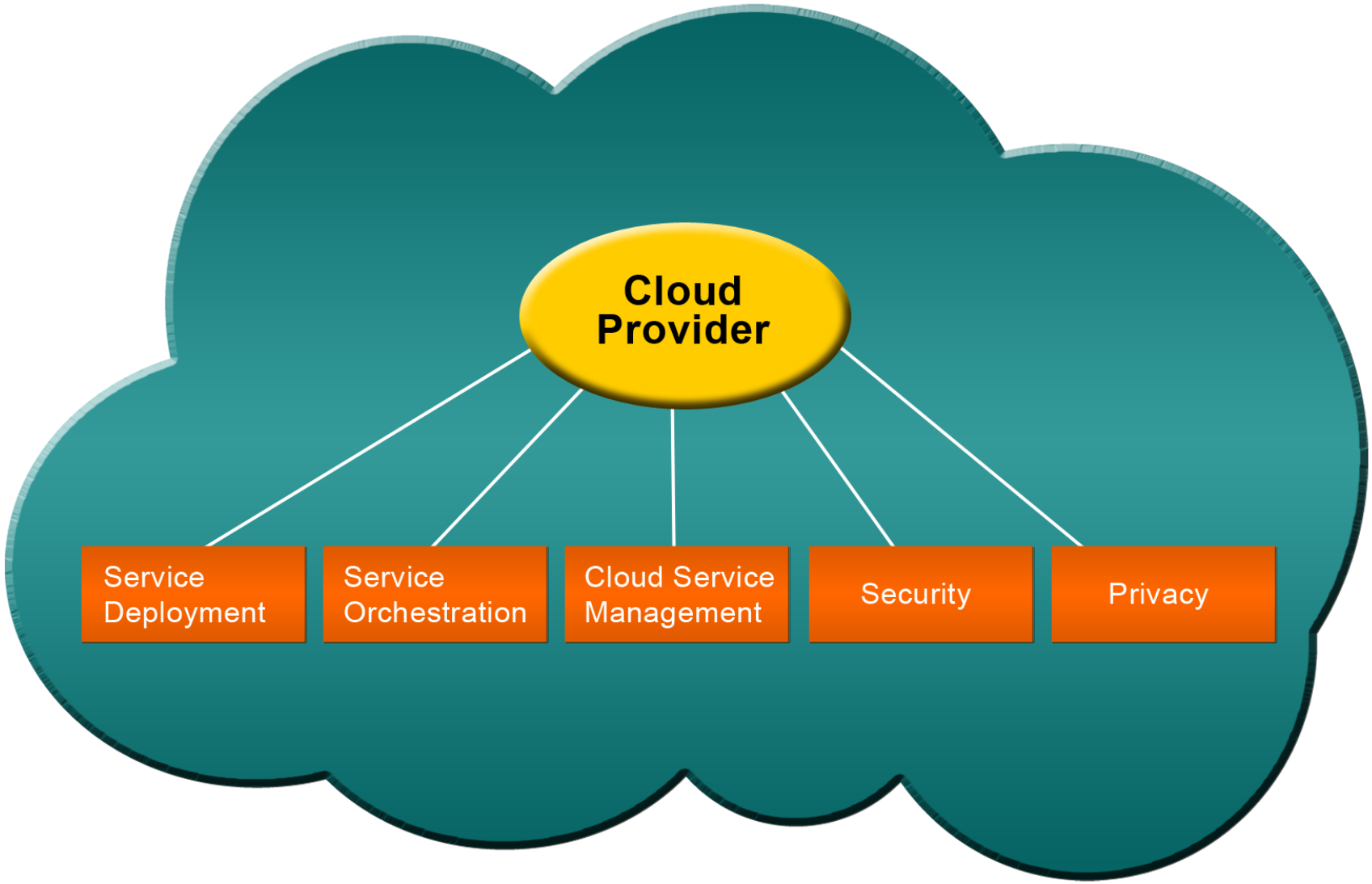
Example: Usage scenario 3



Cloud consumer



Cloud provider



Cloud auditor

- A cloud auditor is a team that can perform an independent examination of cloud service controls, with the intent to express an opinion there on.

- Audits are performed to verify conformance to standards through review of objective evidence.

- A cloud auditor can gauge the services provided by a cloud provider in terms of security controls, privacy impact, performance, etc.

Cloud broker

- A cloud broker as an entity that manages the use, performance and delivery of cloud services and negotiates relationships between cloud providers and cloud consumers.

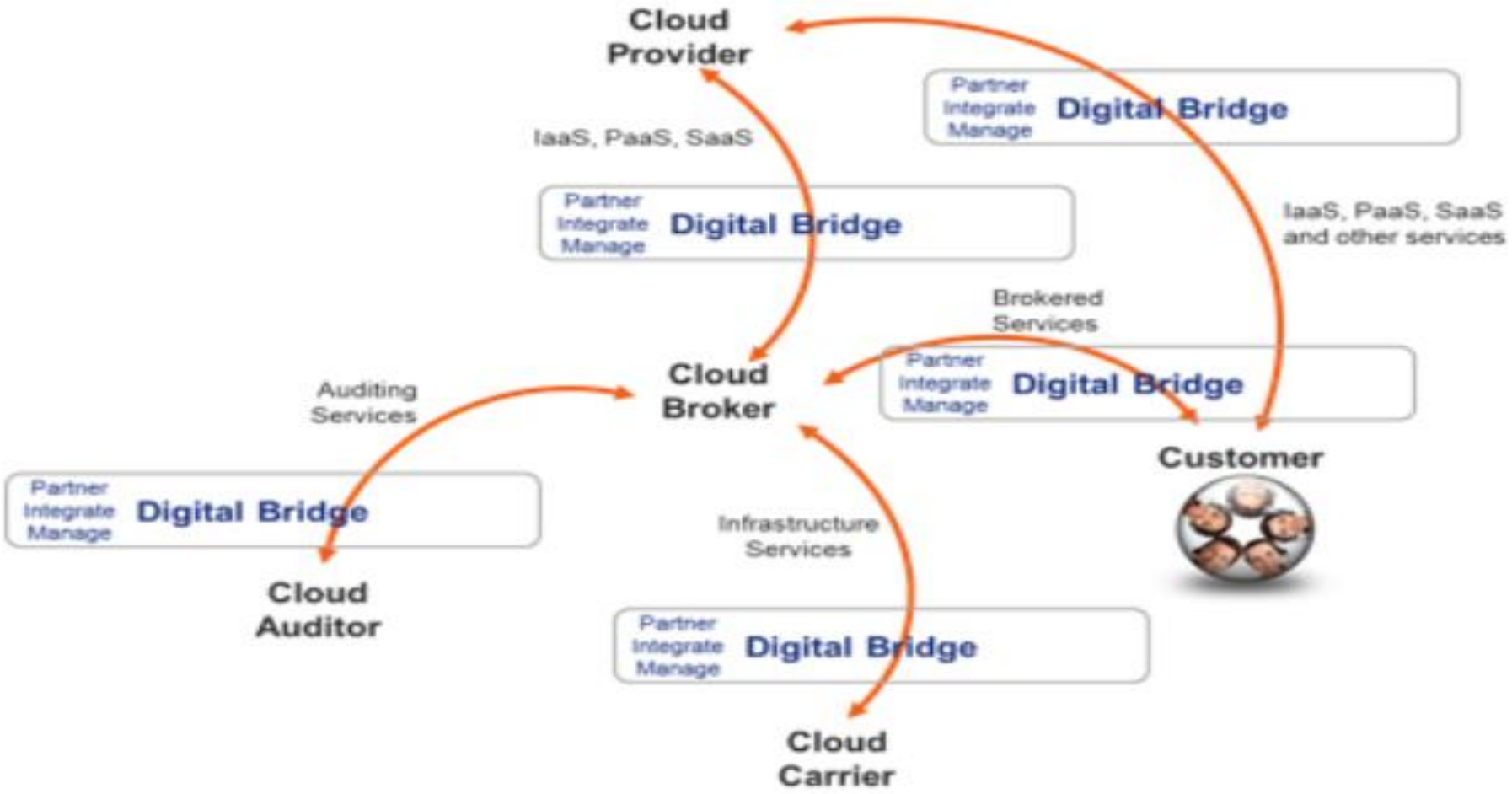


Figure: Cloud broker

Source: https://www.google.com/url?sa=i&source=images&cd=&ved=2ahUKEwjtqsC

Cloud carrier

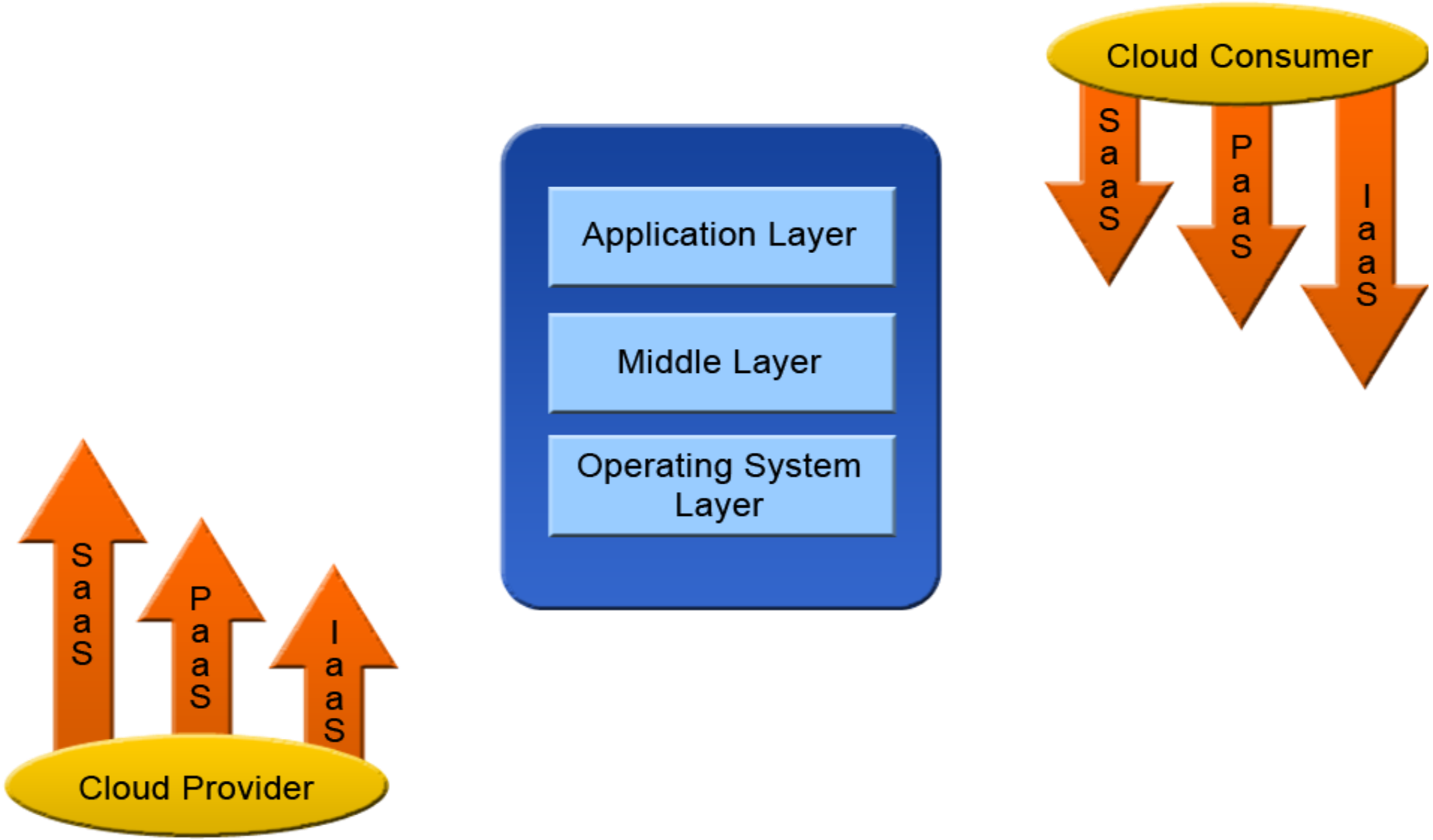
- A cloud carrier acts as a mediator which provides connectivity and transport of cloud services between cloud consumers and cloud providers.

- Cloud carriers provide access to consumers through network, telecommunication and other access devices.

Figure: Cloud carrier

Source:https://www.google.com/url?sa=i&source=images&cd=&ved=2ahUKEwim8uzoxcrjAhUU2o8

Scope of control between provider and consumer

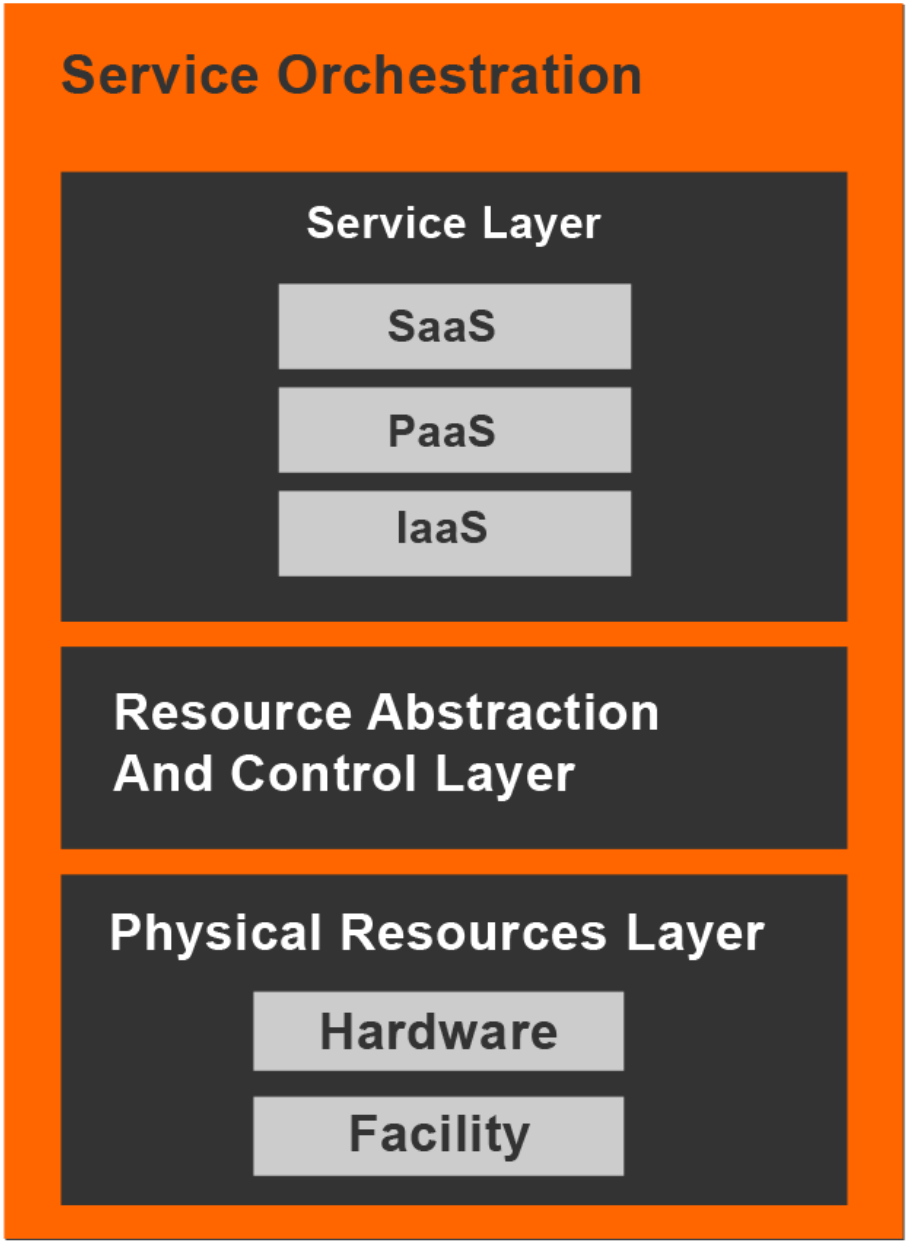


CCRA: Architectural components

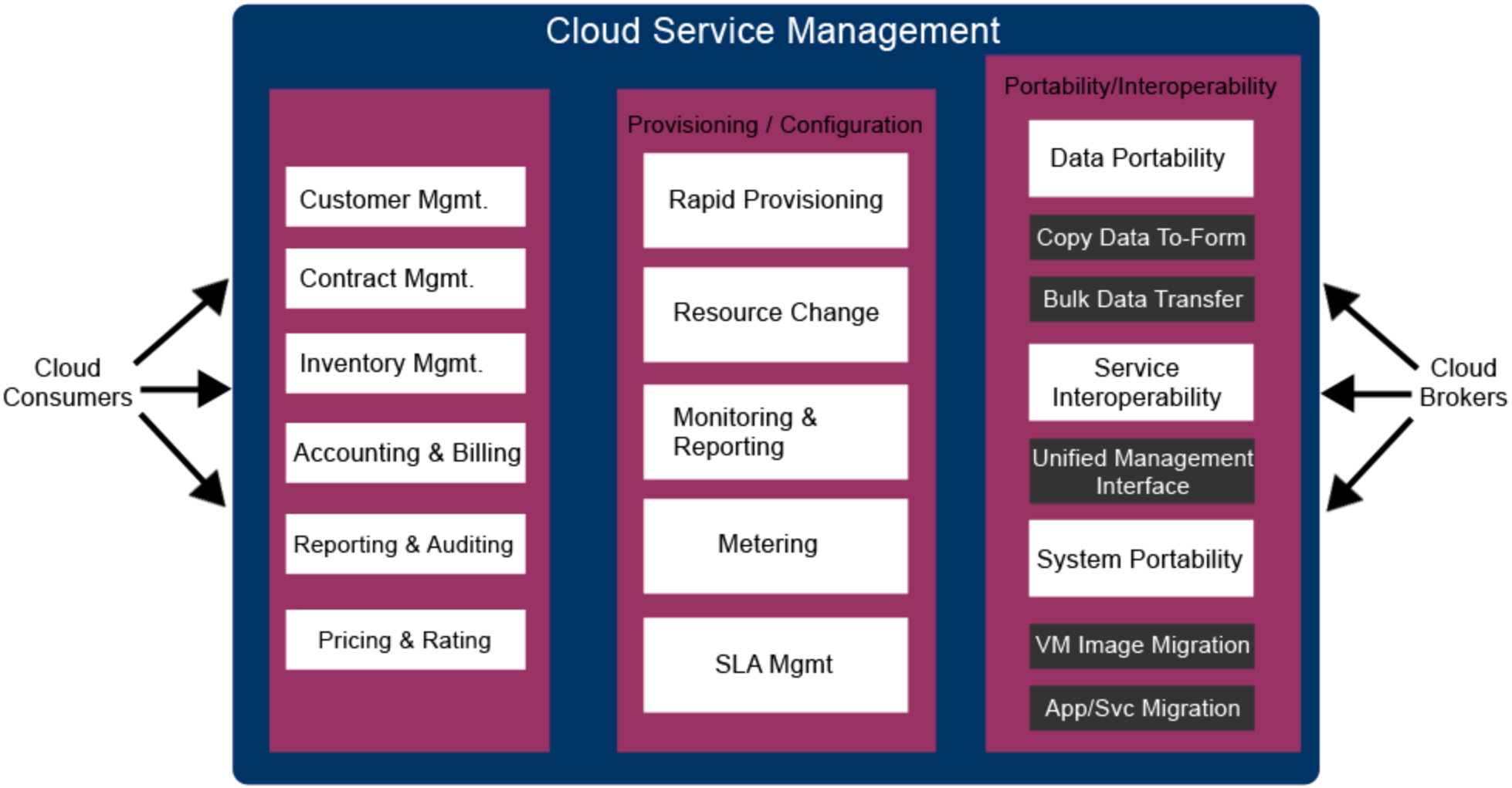
- According to NIST's cloud computing definition, a cloud infrastructure can be operated in one of the following implementation models:
  - Private cloud.

- The differences between the implementation models mentioned depend on how exclusive the computing resources are available to a consumer in the cloud.
  - Public cloud.
  - Community cloud or hybrid cloud.

Service orchestration



Cloud service management



Business support

- Commercial support involves the set of services related to businesses that deal with customers and support processes. It includes the components used to execute commercial operations oriented to the client.
- Customer management.
- Contract management.
- Inventory management.
- Accounting and billing.
- Reporting and auditing.
- Pricing and rating.

Provisioning and configuration

- SLA management.
- Resource changing.
- Rapid provisioning.
- Metering.
- Monitoring and reporting.

Portability and interoperability

- Cloud providers should provide mechanisms to support data portability, service interoperability and system portability.
  - Data portability is the ability of cloud consumers to copy data objects in or out of a cloud or to use a disk for mass data transfer.

- Service interoperability is the ability of cloud consumers to use their data and services through multiple cloud providers with a unified management interface.

- System portability allows the migration of a fully stopped virtual machine instance or a machine image from one provider to another or migrating applications, services and their contents from one service provider to another.

Security

- Shared security responsibilities.
- Cloud service model perspectives.
- Implications of cloud deployment models.

Privacy

- Cloud providers should protect the assured, proper, consistent collection, processing, communication, use and disposition of Personal Information (PI) and Personally Identifiable Information (PII) in the cloud.

Figure: Cloud privacy

Source: https://www.information-age.com/disappointing-truth-about-data-privacy-and-security-123460241/

Cloud taxonomy

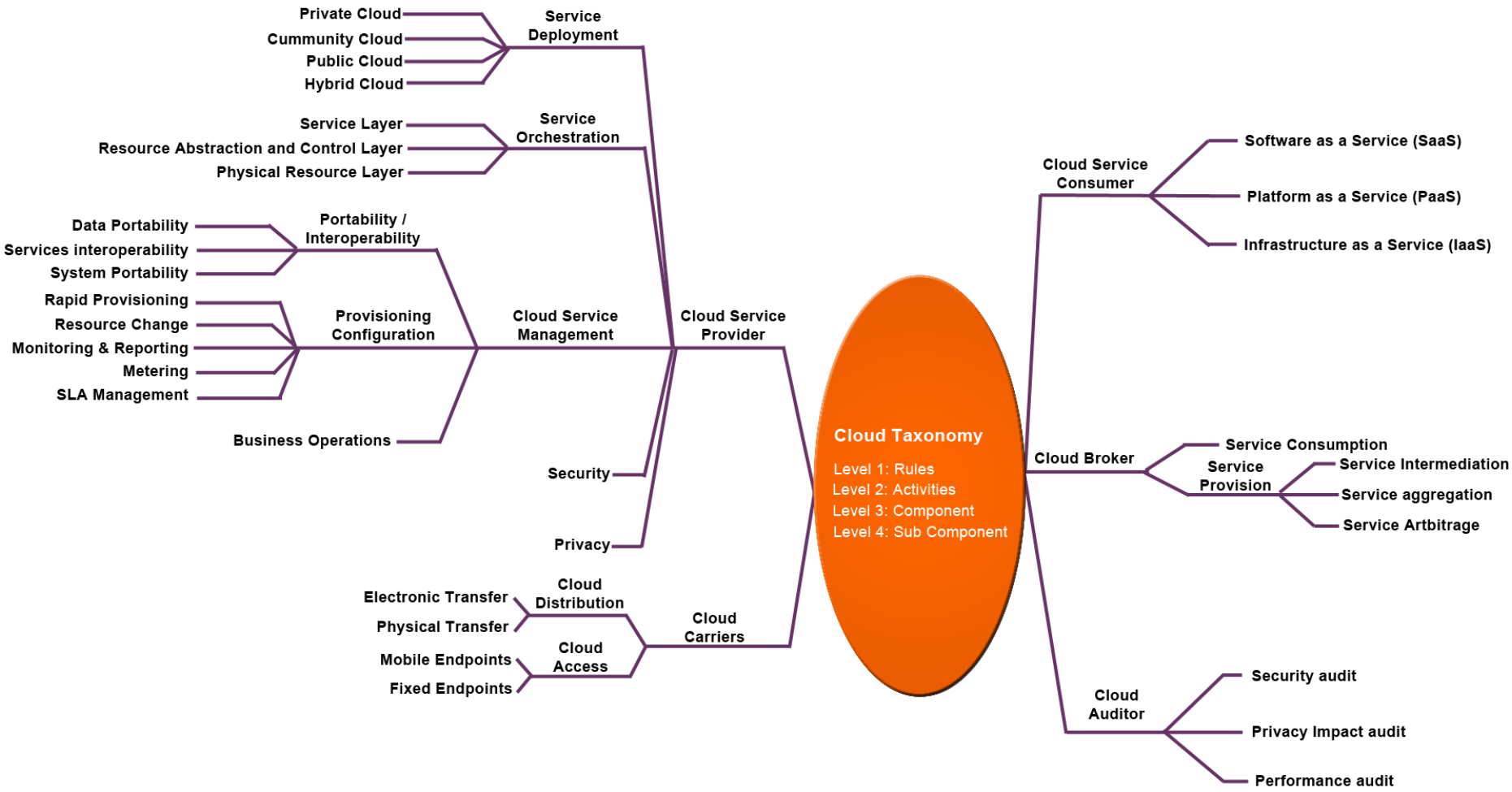


Figure: Cloud taxonomy

Checkpoint (1 of 2)

Multiple choice questions:

1. Aim of the NIST cloud computing program is to _____ the standard for cloud computing.
   a) Frame
   b) Discuss
   c) Create
   d) Prepare
2. Which layer comprises software applications that are targeted to end users or programs?
   a) The cloud layers
   b) The application layers
   c) The network layers
   d) None of the above
3. _____ are an intermediary which provides connectivity and transport of cloud services from cloud providers to cloud consumers.
   a) Computing carriers
   b) Cloud carriers
   c) Network carriers
   d) None of the above

Checkpoint solutions(1 of 2)

Multiple choice questions:

1. Aim of the NIST cloud computing program is to _____ the standard for cloud computing.
   - **a) Frame**
   - b) Discuss
   - c) Create
   - d) Prepare
2. Which layer comprises software applications that are targeted to end users or programs?
   - a) The cloud layers
   - **b) The application layers**
   - c) The network layers
   - d) None of the above
3. _____ are an intermediary which provides connectivity and transport of cloud services from cloud providers to cloud consumers.
   - a) Computing carriers
   - **b) Cloud carriers**
   - c) Network carriers
   - d) None of the above

Checkpoint (2 of 2)

Fill in the blanks:

1. _____have access to virtual computers, network accessible storage (NAS), network infrastructure components and other fundamental computing resources.
2. _____assumes most of the responsibilities in controlling and managing the infrastructure and the applications.
3. _____ arbitration of services is like the aggregation of services, only the difference is that the aggregate services are not fixed.
4. NIST's Cloud Computing Reference Architecture (CCRA) is a generic _____ conceptual model.

True or False:

1. The NIST CCRA does not focus on how to design solution and implementation, but mainly focuses on the requirements of what the cloud services should provide. True/False
2. The application layer includes the operating system and drivers. True/False
3. A person, organization or an entity responsible for making a service available to cloud consumer actor cloud provider. True/False

Checkpoint solutions (2 of 2)

Fill in the blanks:

1. **IaaS consumers** have access to virtual computers, network accessible storage (NAS), network infrastructure components and other fundamental computing resources.
2. **The SaaS providers** assumes most of the responsibilities in controlling and managing the infrastructure and the applications.
3. **Service arbitrage** arbitration of services is like the aggregation of services, only the difference is that the aggregate services are not fixed.
4. NIST's Cloud Computing Reference Architecture (CCRA) is a generic **high level** conceptual model.

True or False:

1. The NIST CCRA does not focus on how to design solution and implementation, but mainly focuses on the requirements of what the cloud services should provide. **True**
2. The application layer includes the operating system and drivers. **False**
3. A person, organization or an entity responsible for making a service available to Cloud Consumer actor cloud provider. **True**

Question bank

Two mark questions:

1. Define cloud provider.
2. Define cloud auditor.
3. Define cloud broker.
4. Define cloud carrier.

Four mark questions:

1. Describe the scope of control between provider and consumer.
2. Explain the service orchestration.
3. Describe the cloud service management.
4. Differentiate between provisioning and configuration.

Eight mark questions:

1. Explain the characteristics of NIST - CCRA.
2. Explain four level of cloud taxonomy.

Unit summary

Having completed this unit, you should be able to:

- Understand the concept of NIST's Cloud Computing Reference Architecture (CCRA)
- Learn about the conceptual reference model
- Gain knowledge on architectural components in CCRA