

**CS 4037**  
**Introduction to Cloud**  
**Computing**  
**Lecture 7**

**Danyal Farhat**  
**FAST School of Computing**  
**NUCES Lahore**

# **Cloud Infrastructure Mechanisms**

# Lecture's Agenda

- **Logical Network Perimeter**
- Virtual Server
- Cloud Storage Device
- Cloud Usage Monitor
- Ready-Made Environment



# Logical Network Perimeter

- Defined as the isolation of a network environment from the rest of a communications network, the logical network perimeter establishes a **virtual network boundary** that can encompass and isolate a group of related cloud-based IT resources that may be physically distributed.



**Figure 7.1.** The dashed line notation used to indicate the boundary of a logical network perimeter.

# Logical Network Perimeter (Cont.)

Logical Network Perimeter mechanism can be **implemented** to:

- Isolate IT resources in a cloud from **non-authorized users**
- Isolate IT resources in a cloud from **non-users**
- Isolate IT resources in a cloud from **cloud consumers**
- Control the **bandwidth** that is available to isolated IT resources

# Logical Network Perimeter (Cont.)

Logical network perimeters are **established** via network devices that supply and control the connectivity of a data center and are commonly deployed as virtualized IT environments that include:

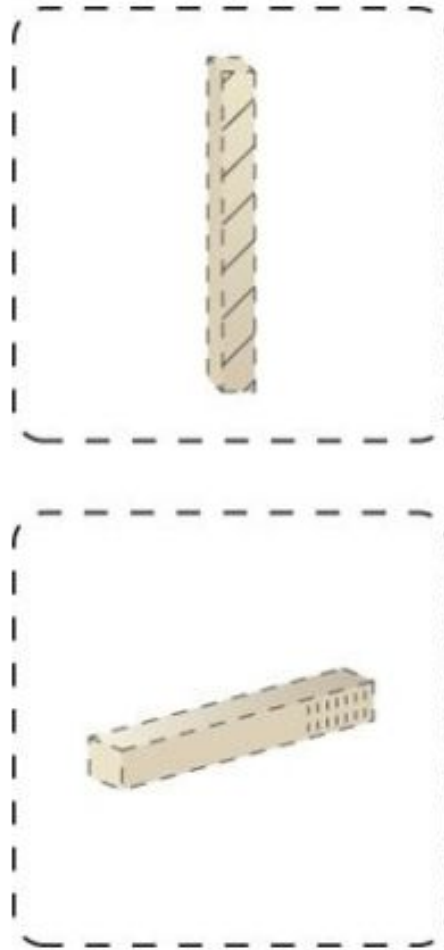
## Virtual Firewall:

- An IT resource that **actively filters network traffic** to and from the isolated network while controlling its interactions with the Internet.

## Virtual Network:

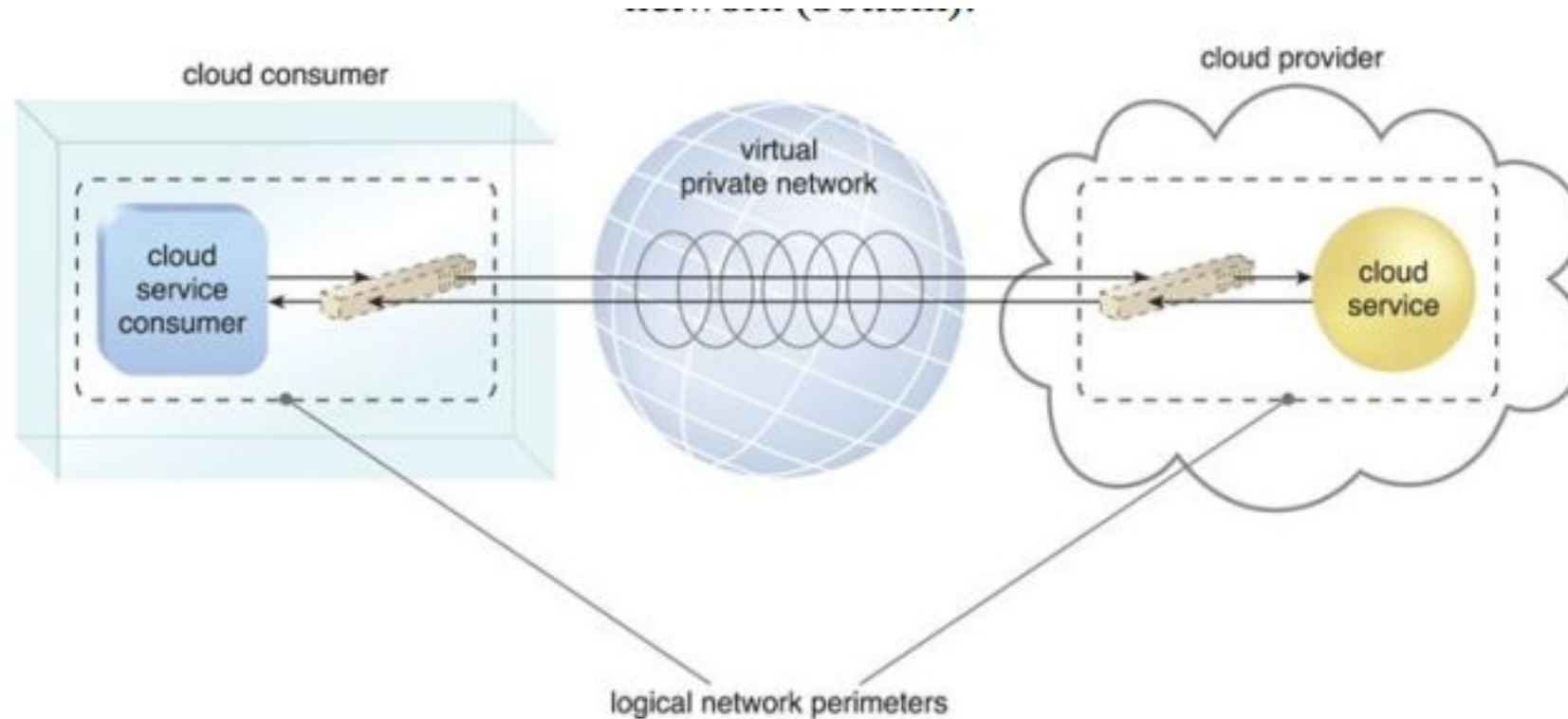
- Usually **acquired through VLANs**, this IT resource isolates the network environment within the data center infrastructure.

# Logical Network Perimeter (Cont.)



**Figure 7.2.** The symbols used to represent a virtual firewall (top) and a virtual network (bottom).

# Logical Network Perimeter (Cont.)



**Figure 7.3.** Two logical network perimeters surround the cloud consumer and cloud provider environments.



# Lecture's Agenda

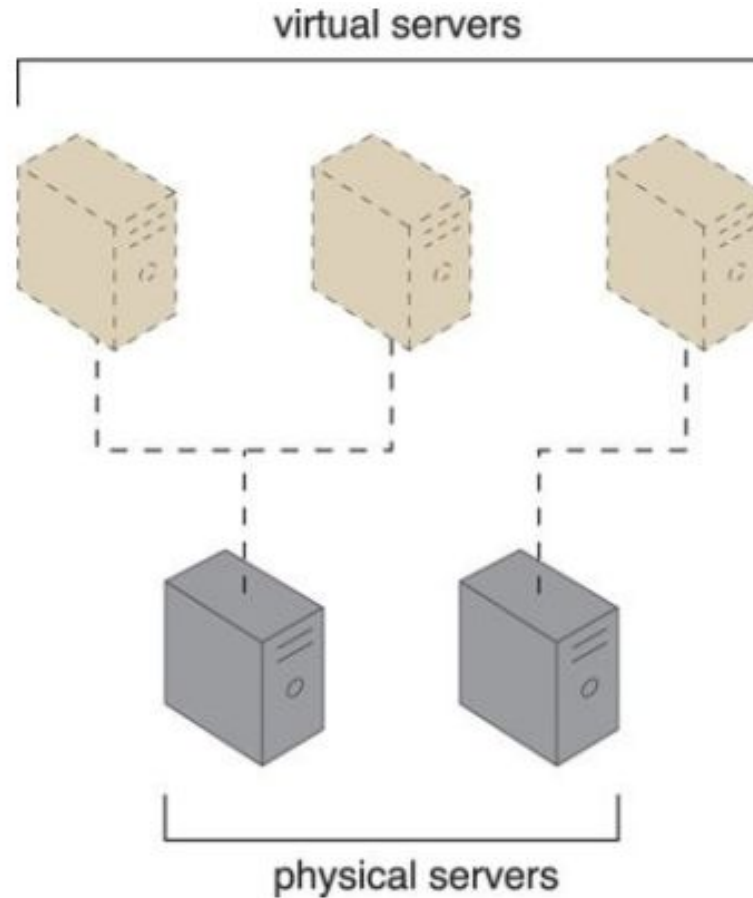
- Logical Network Perimeter
- **Virtual Server**
- Cloud Storage Device
- Cloud Usage Monitor
- Ready-Made Environment



# Virtual Server

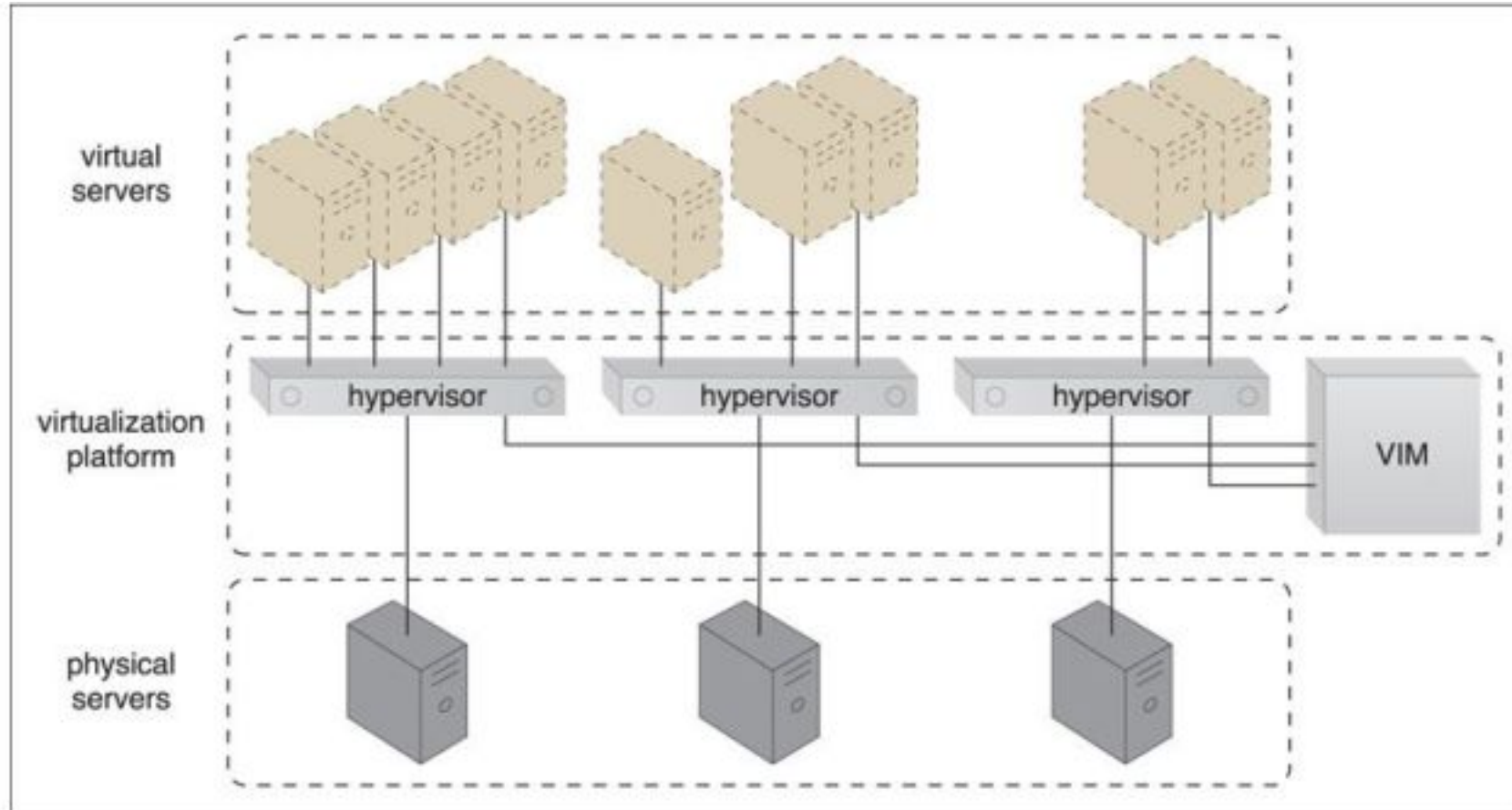
- A virtual server is a form of virtualization software that **emulates** a physical server.
- Virtual servers are **used by cloud providers** to share the same physical server with multiple cloud consumers by providing cloud consumers with individual virtual server instances.

# Virtual Server (Cont.)



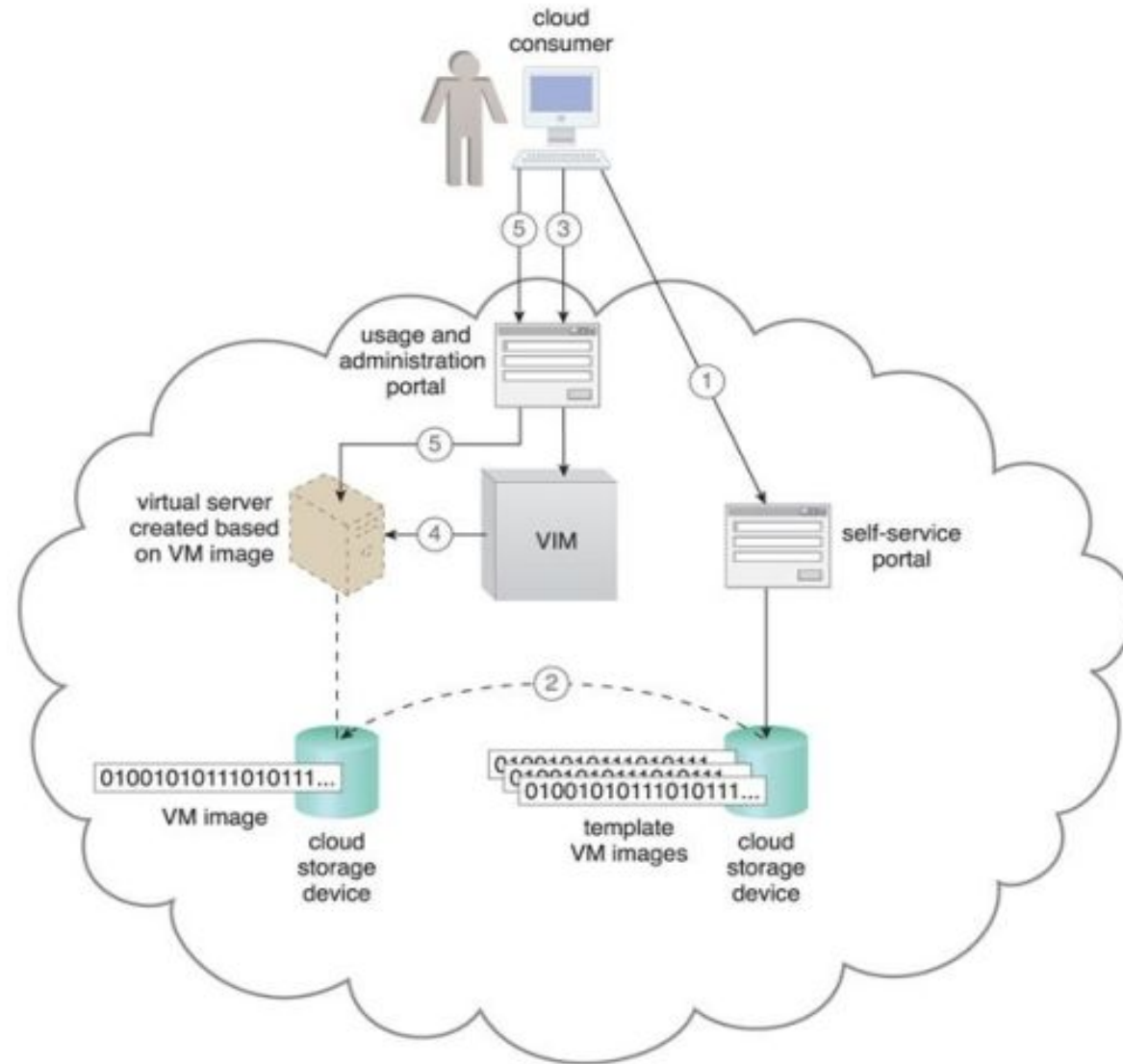
**Figure 7.5.** The first physical server hosts two virtual servers, while the second physical server hosts one virtual server.

# Virtual Server (Cont.)



**Figure 7.7.** Virtual servers are created via the physical servers' hypervisors and a central VIM.

# Virtual Server – Case Study Example



# Virtual Server – Case Study Example (Cont.)

- The cloud consumer uses the **self-service portal** to select a template virtual server for creation (1).
- A copy of the corresponding **VM image** is created in a cloud consumer-controlled cloud storage device (2).
- The cloud consumer initiates the **virtual server** using the usage and administration portal (3).
- Usage and administration portal **interacts with the VIM** to create the virtual server instance via the underlying hardware (4).
- The cloud consumer is able to **use and customize the virtual server** via other features on the usage and administration portal (5).



# Lecture's Agenda

- Logical Network Perimeter
- Virtual Server
- **Cloud Storage Device**
- Cloud Usage Monitor
- Ready-Made Environment



# Cloud Storage Device

- The cloud storage device mechanism represents **storage devices** that are designed specifically for cloud-based provisioning.
- Cloud storage devices are commonly able to provide **fixed-increment capacity allocation** in support of the pay-per-use mechanism.



# Cloud Storage Levels

## Files:

- Collections of data are **grouped into files** that are located in folders.

## Blocks:

- The lowest level of storage and the closest to the hardware, a block is the **smallest unit of data** that is still individually accessible.

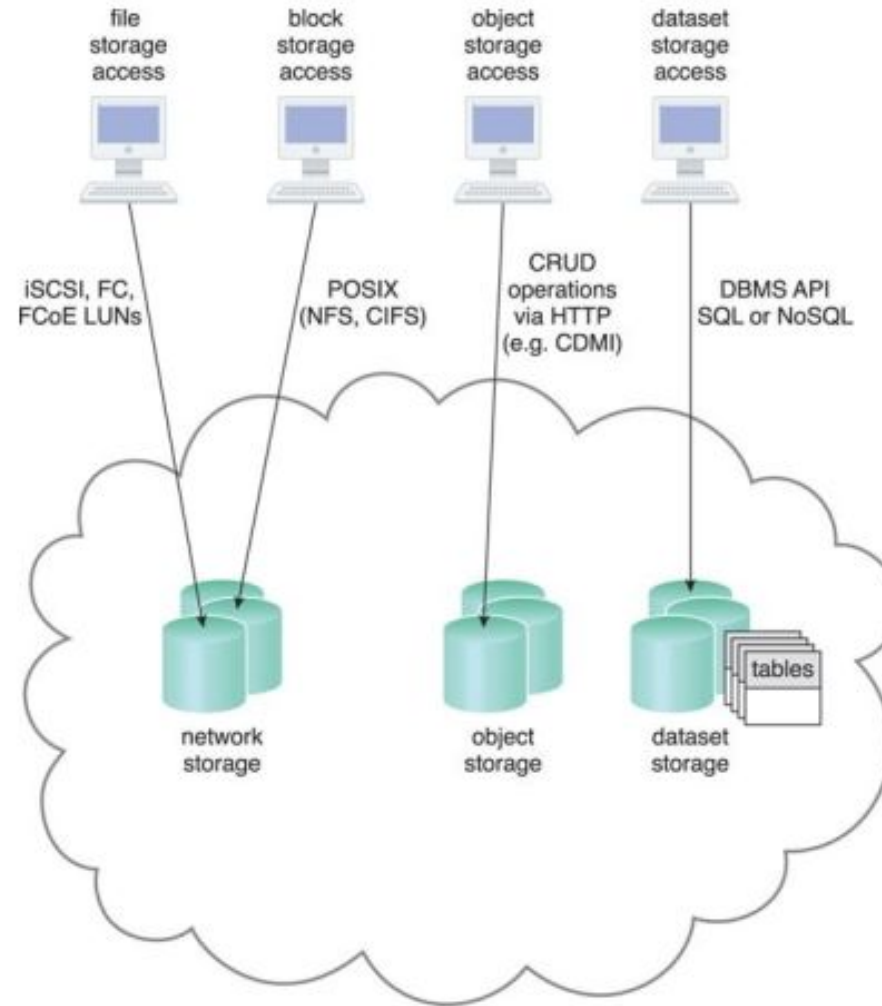
## Datasets:

- Sets of data are organized into a **table-based**, delimited, or record format.

## Objects:

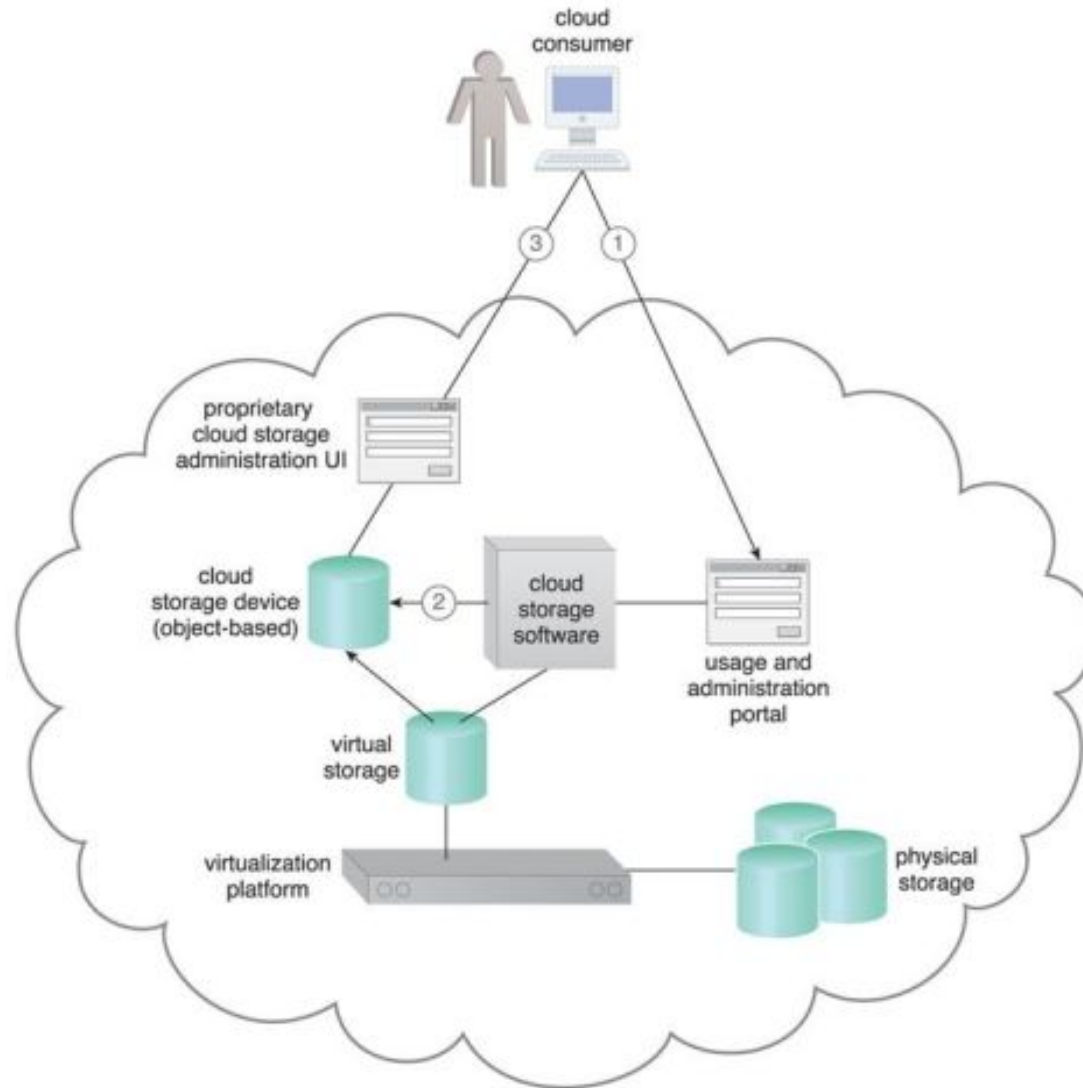
- Data and its associated metadata are organized as **Web-based resources**.

# Cloud Storage Levels (Cont.)



**Figure 7.9.** Different cloud service consumers utilize different technologies to interface with virtualized cloud storage devices. (Adapted from the CDMI Cloud Storage Reference Model.)

# Cloud Storage Device – Case Study Example



# Cloud Storage Device – Case Study Example

- The cloud consumer interacts with the usage and administration portal to **create a cloud storage device** and define access control policies (1).
- The usage and administration portal interact with the cloud storage software to **create the cloud storage device instance** and apply the required access policy to its data objects (2).
- Each data object is assigned to a cloud storage device and all of the data objects are stored in the same virtual storage volume. The cloud consumer **uses the proprietary cloud storage device UI** to interact directly with the data objects (3).

# Lecture's Agenda

- Logical Network Perimeter
- Virtual Server
- Cloud Storage Device
- **Cloud Usage Monitor**
- Ready-Made Environment



# Cloud Usage Monitor

- The cloud usage monitor mechanism is a lightweight and autonomous software program responsible for **collecting** and processing IT resource usage data.

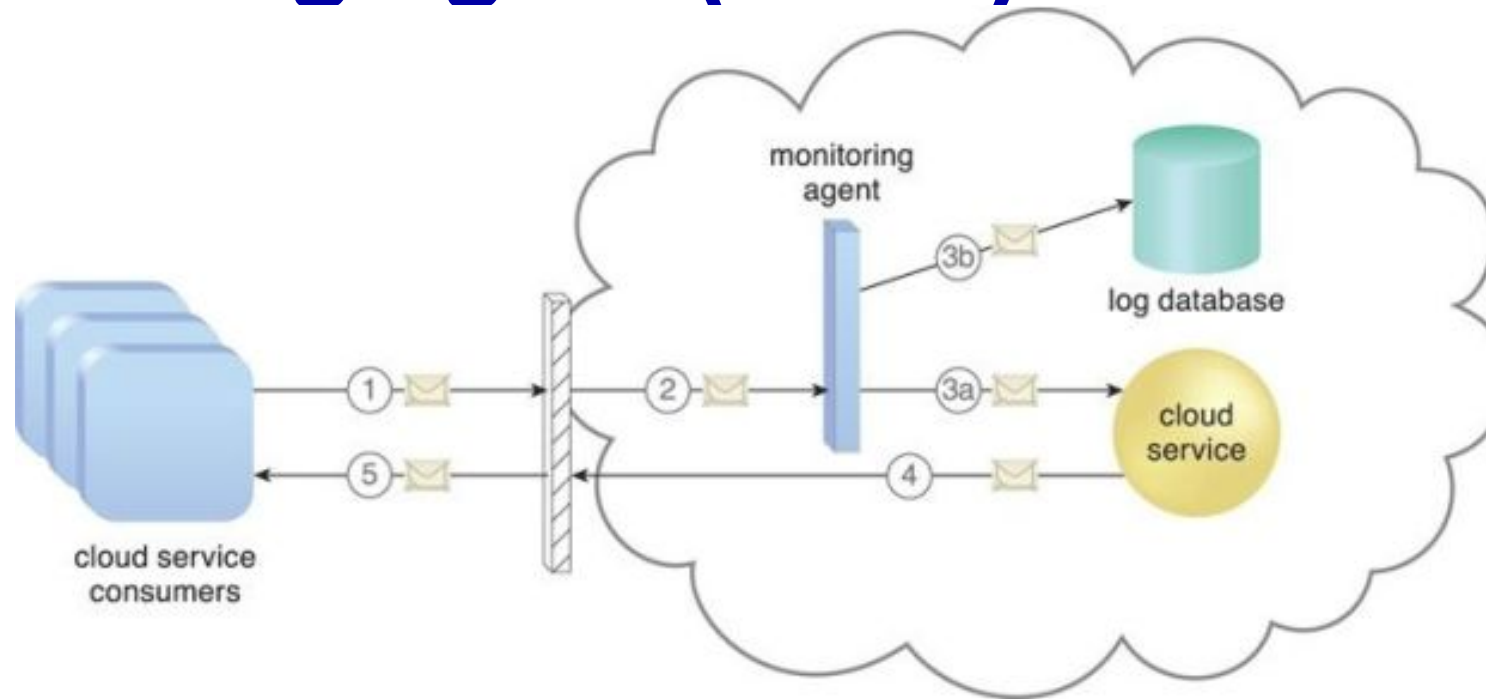
## Components of Cloud Usage Monitor:

- Monitoring Agent
- Resource Agent
- Polling Agent

# Monitoring Agent

- A monitoring agent is an intermediary, event-driven program that exists as a service agent and resides along existing communication paths to transparently **monitor and analyze dataflows**.
- Mainly used to **measure network traffic** and message metrics.

# Monitoring Agent (Cont.)



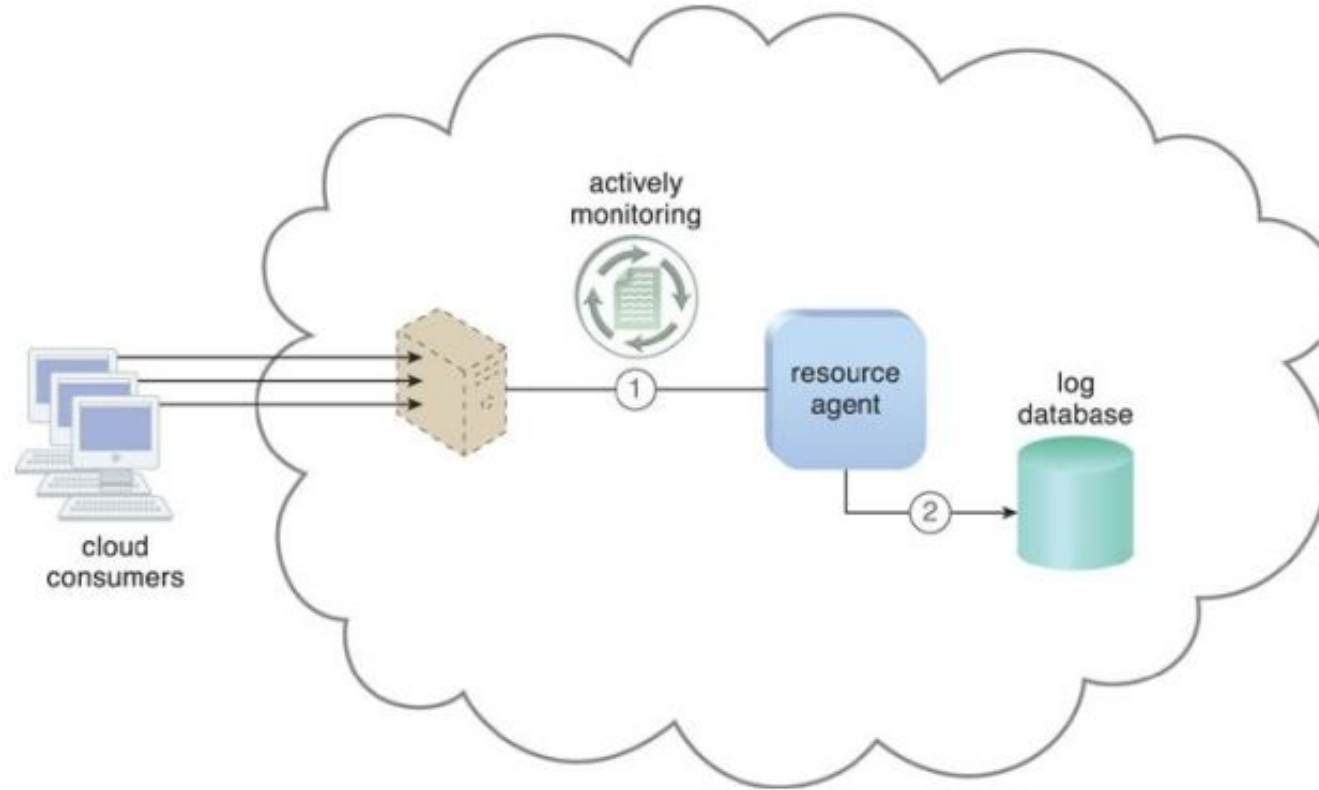
**Figure 7.12.** A cloud service consumer sends a request message to a cloud service (1). The monitoring agent intercepts the message to collect relevant usage data (2) before allowing it to continue to the cloud service (3a). The monitoring agent stores the collected usage data in a log database (3b). The cloud service replies with a response message (4) that is sent back to the cloud service consumer without being intercepted by the monitoring agent (5).



# Resource Agent

- A resource agent is a processing module that **collects usage data** by having event-driven interactions with specialized resource software.
- This module is used to monitor usage metrics based on pre-defined, observable events at the **resource software level**, such as initiating, suspending, resuming, and vertical scaling.

# Resource Agent (Cont.)

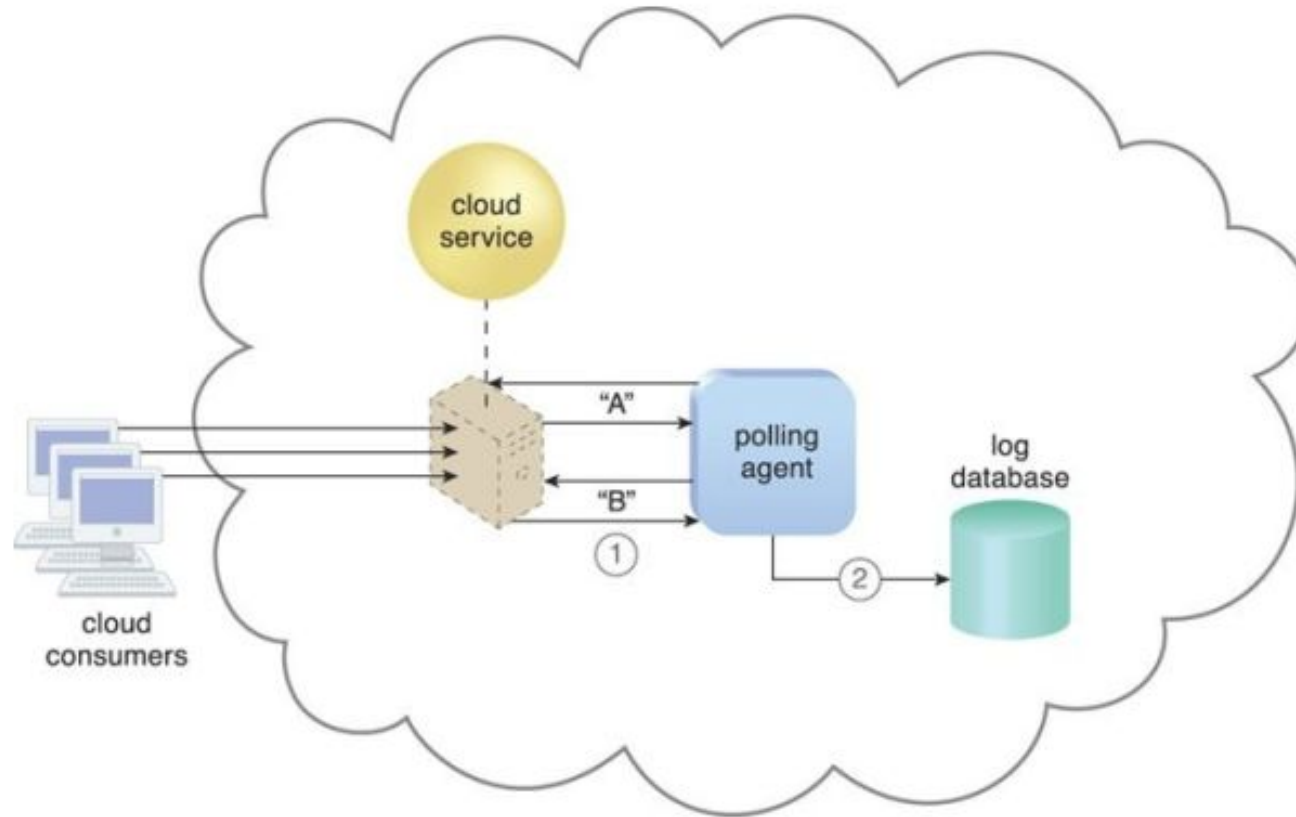


**Figure 7.13.** The resource agent is actively monitoring a virtual server and detects an increase in usage (1). The resource agent receives a notification from the underlying resource management program that the virtual server is being scaled up and stores the collected usage data in a log database, as per its monitoring metrics (2).

# Polling Agent

- A polling agent is a processing module that collects cloud service usage data by **polling IT resources**.
- This type of cloud service monitor is used to **periodically monitor IT resource** status, such as uptime and downtime.

# Polling Agent (Cont.)

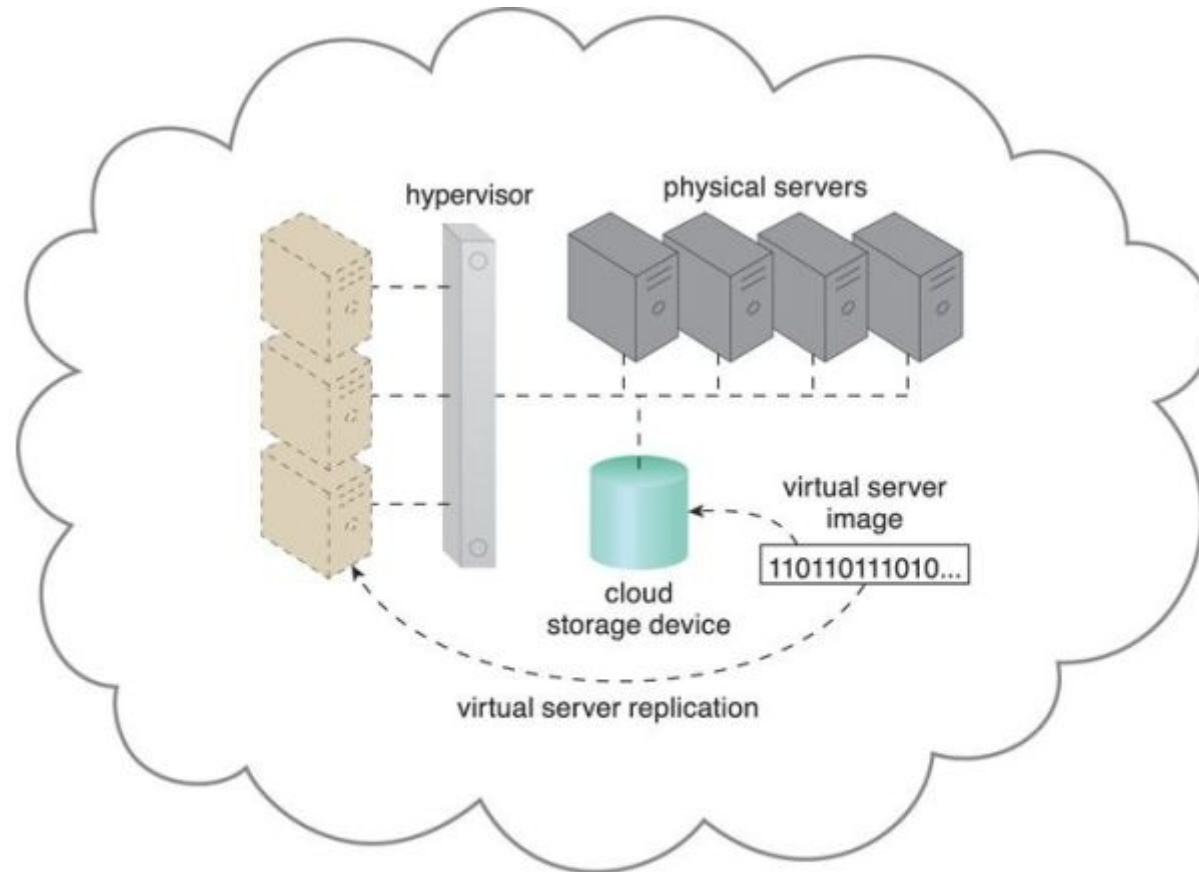


**Figure 7.14.** A polling agent monitors the status of a cloud service hosted by a virtual server by sending periodic polling request messages and receiving polling response messages that report usage status “A” after a number of polling cycles, until it receives a usage status of “B” (1), upon which the polling agent records the new usage status in the log database (2).

# Resource Replication

- Defined as the **creation of multiple instances** of the same IT resource, replication is performed when an IT resource's availability and performance need to be enhanced.
- Virtualization technology is **used** to implement the resource replication mechanism to replicate cloud-based IT resources.

# Resource Replication (Cont.)



**Figure 7.16.** The hypervisor replicates several instances of a virtual server, using a stored virtual server image.

# Lecture's Agenda

- Logical Network Perimeter
- Virtual Server
- Cloud Storage Device
- Cloud Usage Monitor
- **Ready-Made Environment**

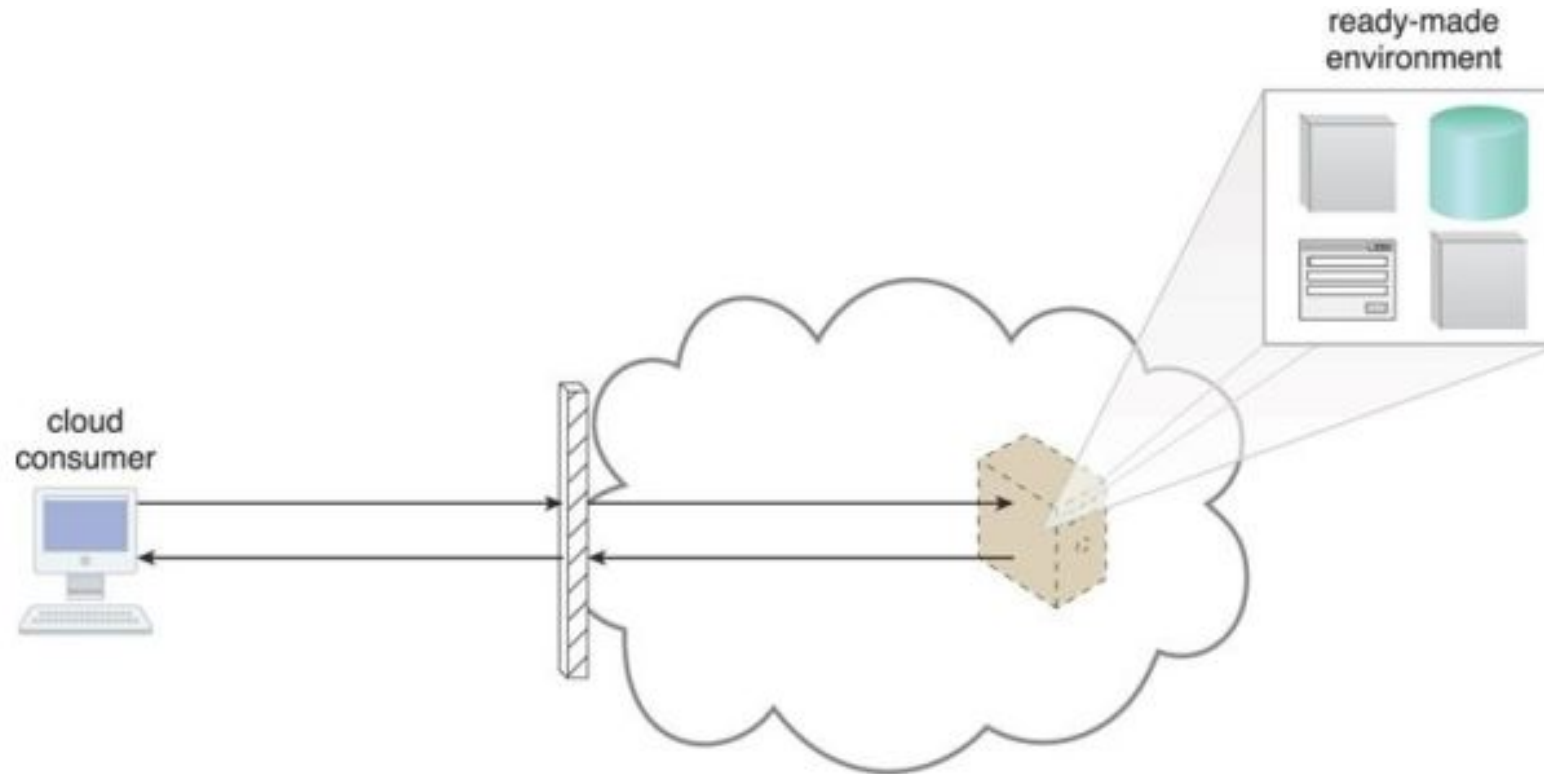


# Ready-Made Environment

- The ready-made environment mechanism is a **defining component** of the PaaS cloud delivery model that represents a **pre-defined**, cloud-based platform comprised of a set of already installed IT resources, ready to be used and customized by a cloud consumer.
- Typical ready-made environments include pre-installed IT resources, such as databases, **middleware**, development tools, and governance tools.
- These environments are utilized by cloud consumers to remotely develop and deploy **their own services and applications** within a cloud.

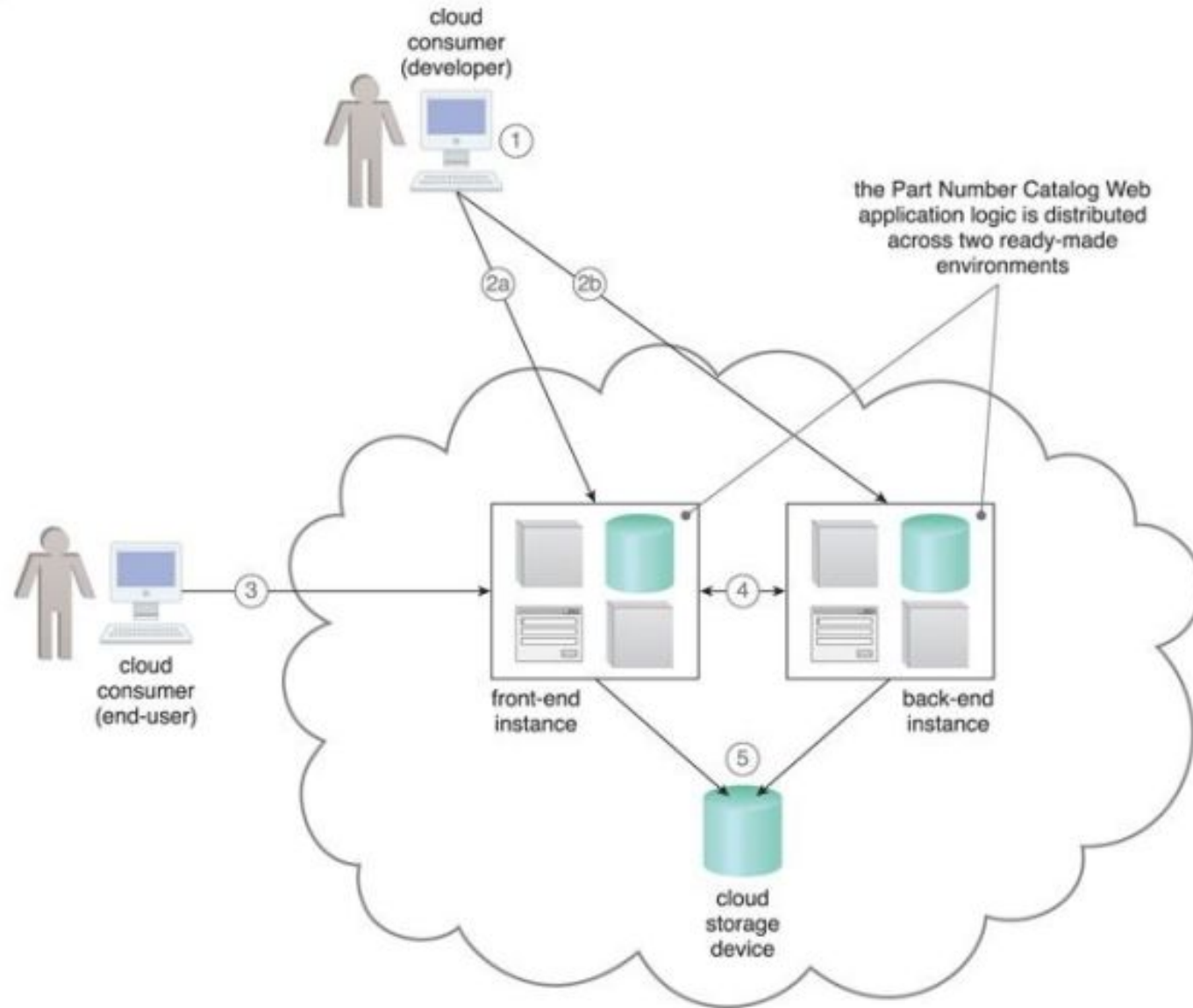


# Ready-Made Environment (Cont.)



**Figure 7.20.** A cloud consumer accesses a ready-made environment hosted on a virtual server.

# Ready-Made Environment – Case Study Example



# Ready-Made Environment – Case Study Example (Cont.)

- The developer **uses the provided SDK** to develop the Part Number Catalog Web application (1).
- The application software is deployed on a Web platform that was established by **two ready-made environments** called the frontend instance (2a) and the back-end instance (2b).
- The application is made **available** for usage and one end-user accesses its front-end instance (3).

# Ready-Made Environment – Case Study Example (Cont.)

- The software running in the front-end instance **invokes a long-running task** at the back-end instance that corresponds to the processing required by the end-user (4).
- The application software deployed at both the front-end and back-end instances is **backed by a cloud storage device** that provides persistent storage of the application data (5).

# Additional Resources

- **Cloud Computing – Concepts, Technology, and Architecture** by Thomas Erl, Zaigham Mahmood, and Ricardo Puttini

□ Chapter 7: Cloud Infrastructure Mechanisms

**Questions?**