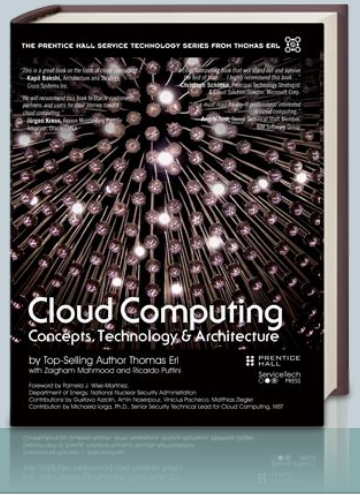
Cloud Computing

Concept, Technology & Architecture

Chapter 07
Cloud Computing Mechanisms

Taken from textbook "Cloud Computing - Concepts, Technology and Architecture"



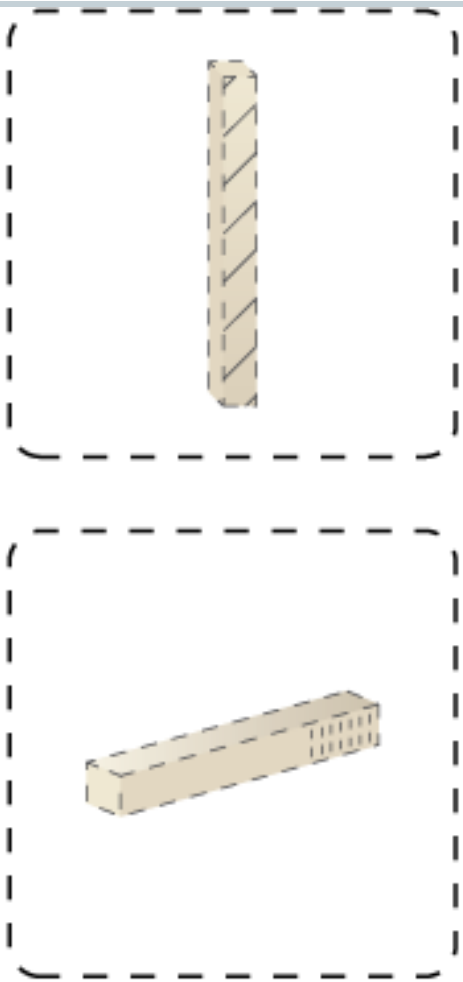
Contents

- Technology mechanisms foundational to cloud platforms are covered, including:
  - **7.1 Logical Network Perimeter**
  - **7.2 Virtual Server**
  - **7.3 Cloud Storage Device**
  - **7.4 Cloud Usage Monitor**
  - **7.5 Resource Replication**
  - **7.6 Ready-Made Environment**

7.1 Logical Network Perimeter

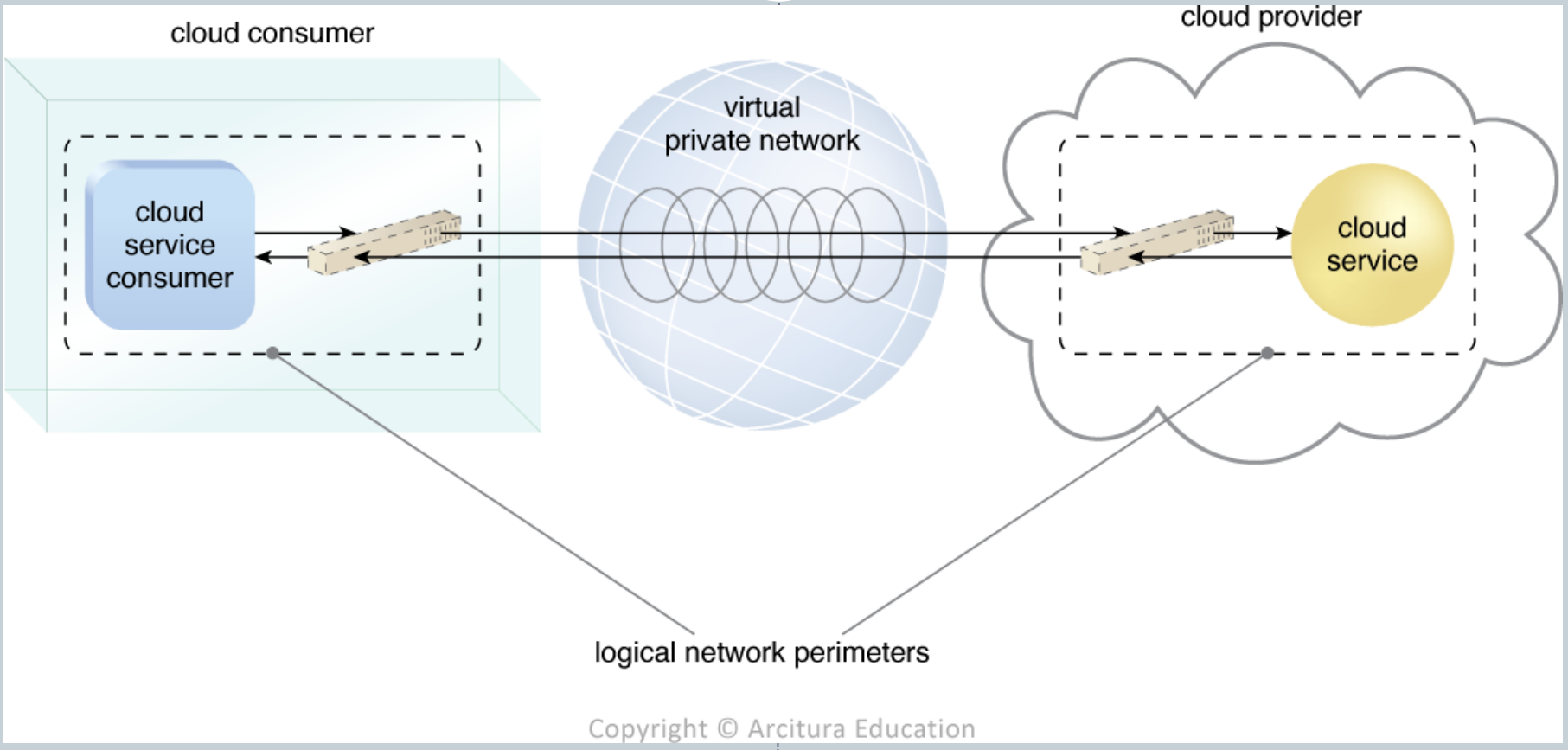
- The isolation of a network environment from the rest of communications network, the logical network perimeter establishes a virtual network boundary that can encompass and isolate a group of related cloud-based IT resources that may be physically distributed.
- Logical network perimeter can be implement to isolate IT resources in a cloud from cloud users and control the bandwidth via network devices by deploying virtual firewall and virtual network.

Figure 7.2



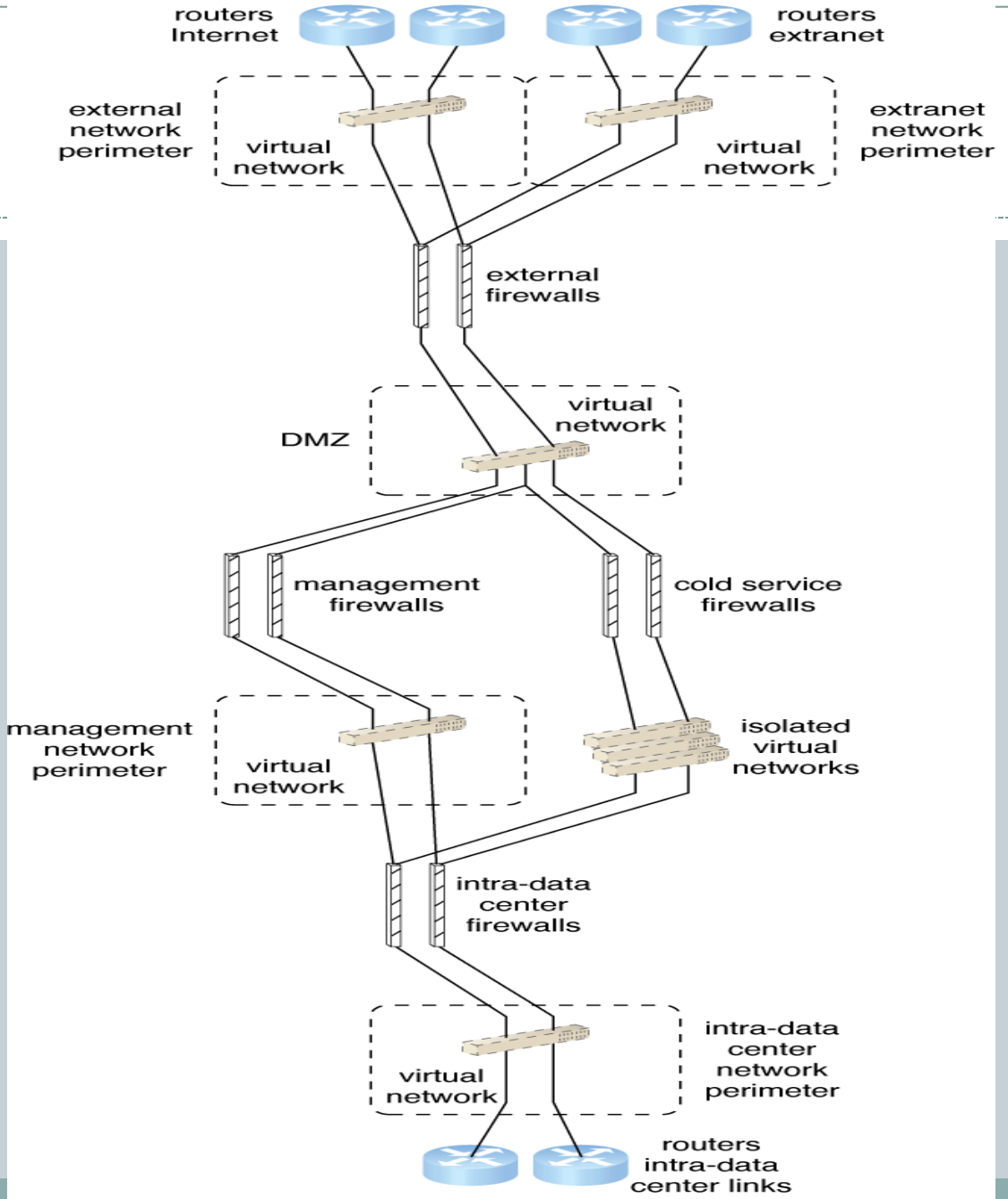
- *Figure 7.2 Virtual firewall (top) and virtual network. (bottom)*

Figure 7.3



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

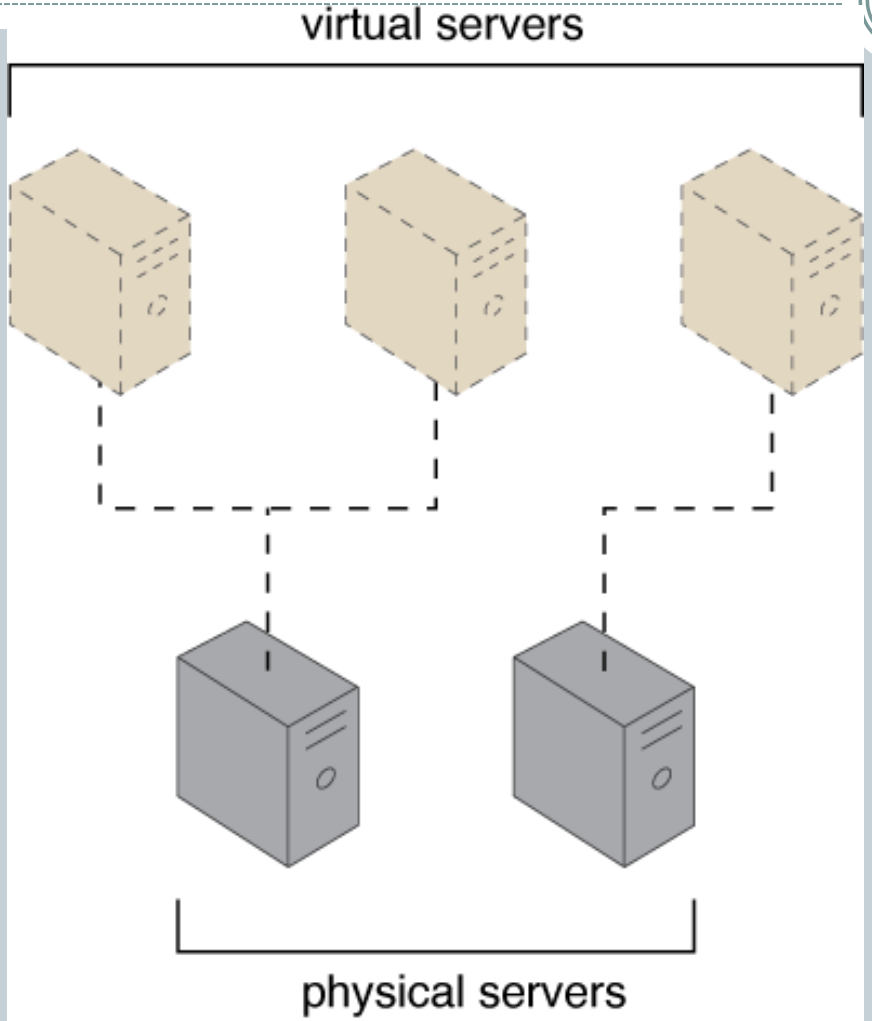
- *Figure 7.4 - A logical network layout is established through a set of logical network perimeters using various firewalls and virtual networks.*



7.2 Virtual Server

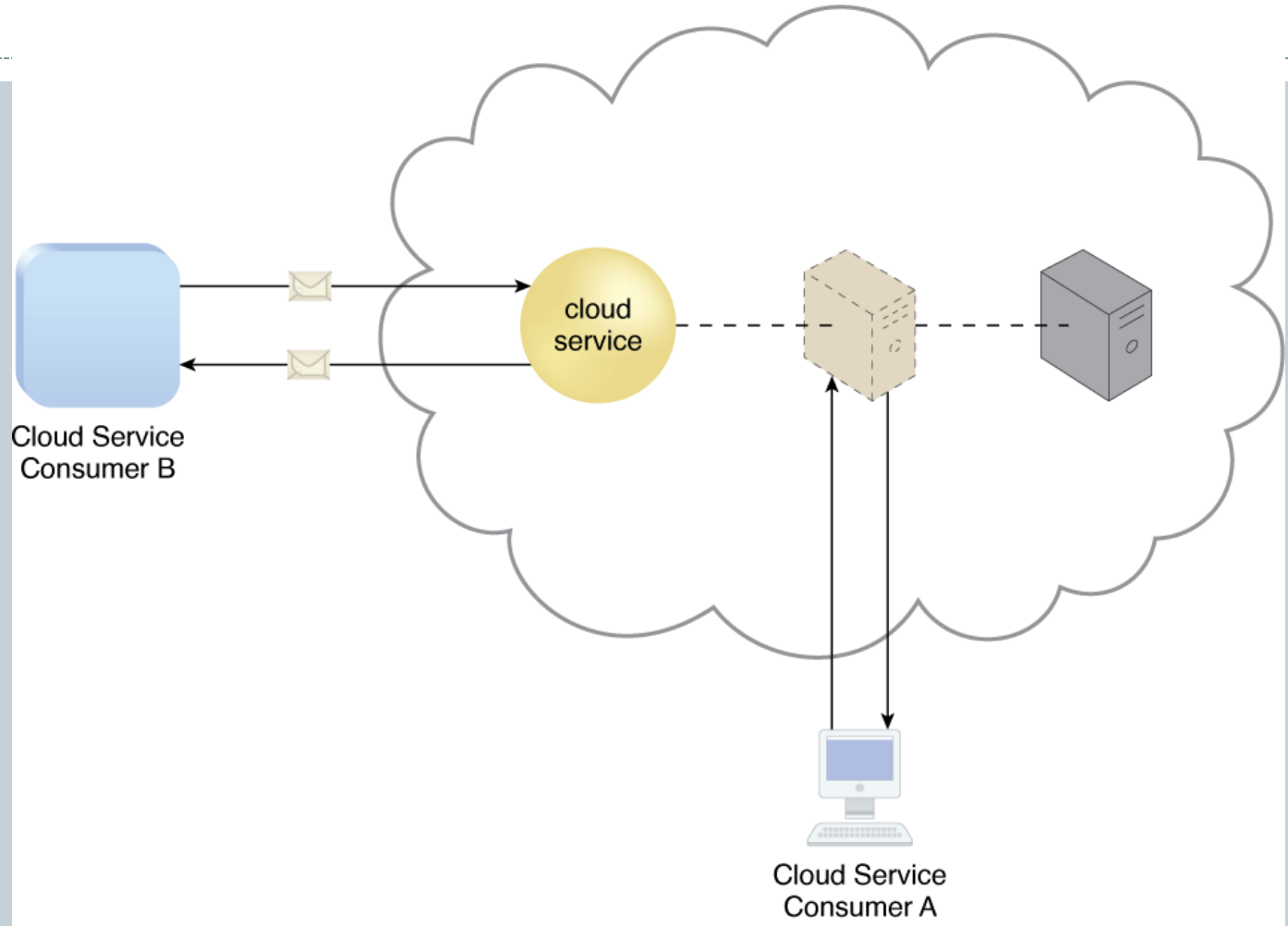
- A virtual server is a form of virtualization software that emulates a physical service.
- The virtual server represents the mode fundamental building block of cloud environment. The instantiation of virtual servers from image files is a resource allocation process that can be completed rapidly and on-demand.
- Cloud customers that install or lease virtual servers can customize their environments independently from other customers.

Figure 7.5



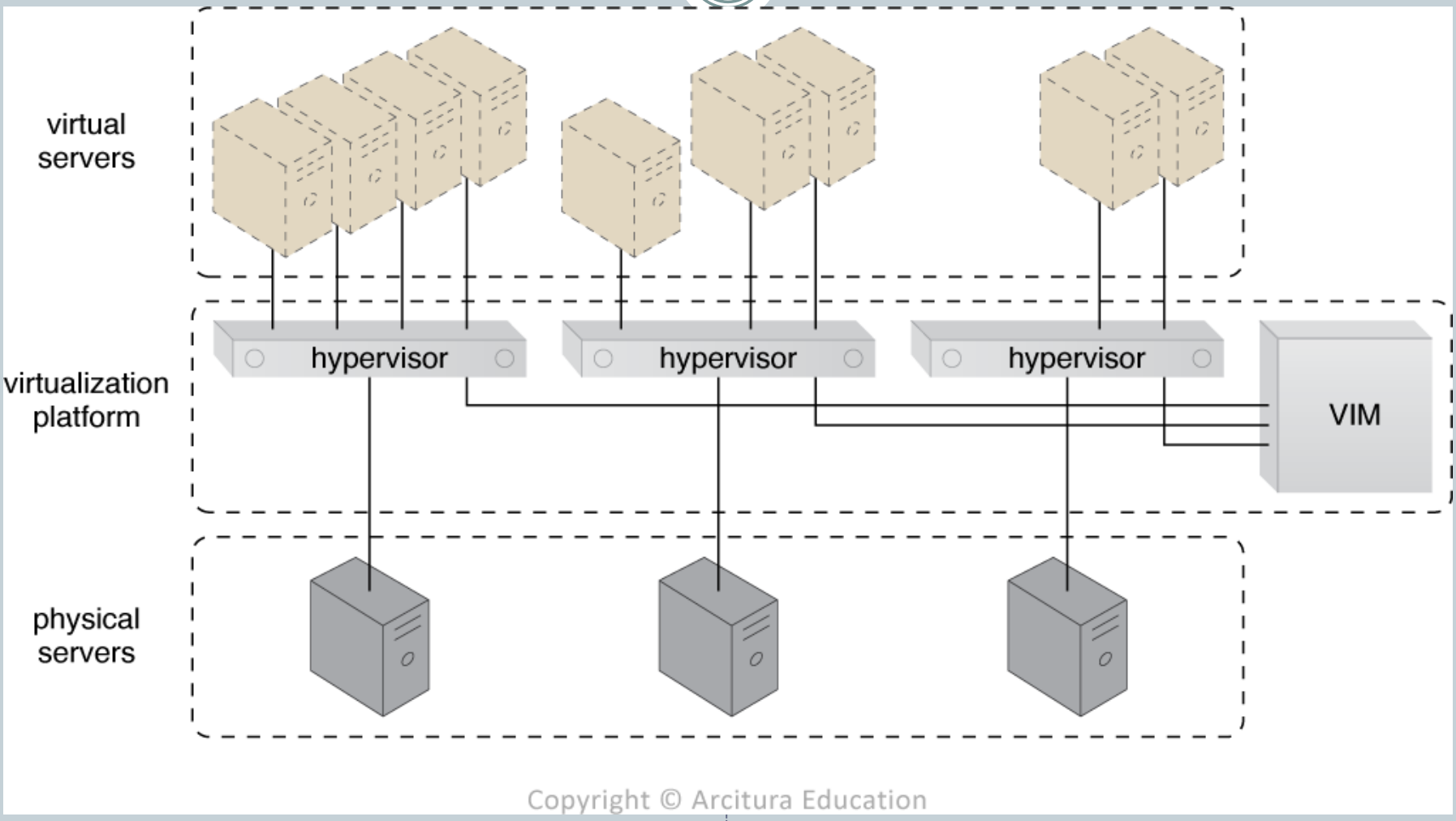
- *Figure 7.5 - The first physical server hosts two virtual servers, while the second physical server hosts one virtual server.*

Figure 7.6



- *Figure 7.6 - A virtual server hosts an active cloud service and is further accessed by a cloud consumer for administrative purposes.*

Figure 7.7



- *Figure 7.7 - Virtual servers are created via the hypervisor and VIM.*

7.3 Cloud Storage Device (1/3)

- 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.
- The primary concern related to cloud storage is the security, integrity, and confidentiality.

7.3 Cloud Storage Device (2/3)

- There are several levels in providing common logical units of data storage:
  - files – located in a folder
  - Blocks – lowest level of storage closest to the HW
  - Datasets – table-based, delimited, or record collection
  - Objects – web-based resources

7.3 Cloud Storage Device (3/3)

- According to different storage levels, there are three kinds of interfaces implemented:
  - Network storage interfaces – files or blocks
  - Object storage interfaces – web resources
  - Databasre storage interfaces – relational or non-relational (NoSQL)

Figure 7.9

- *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.)*

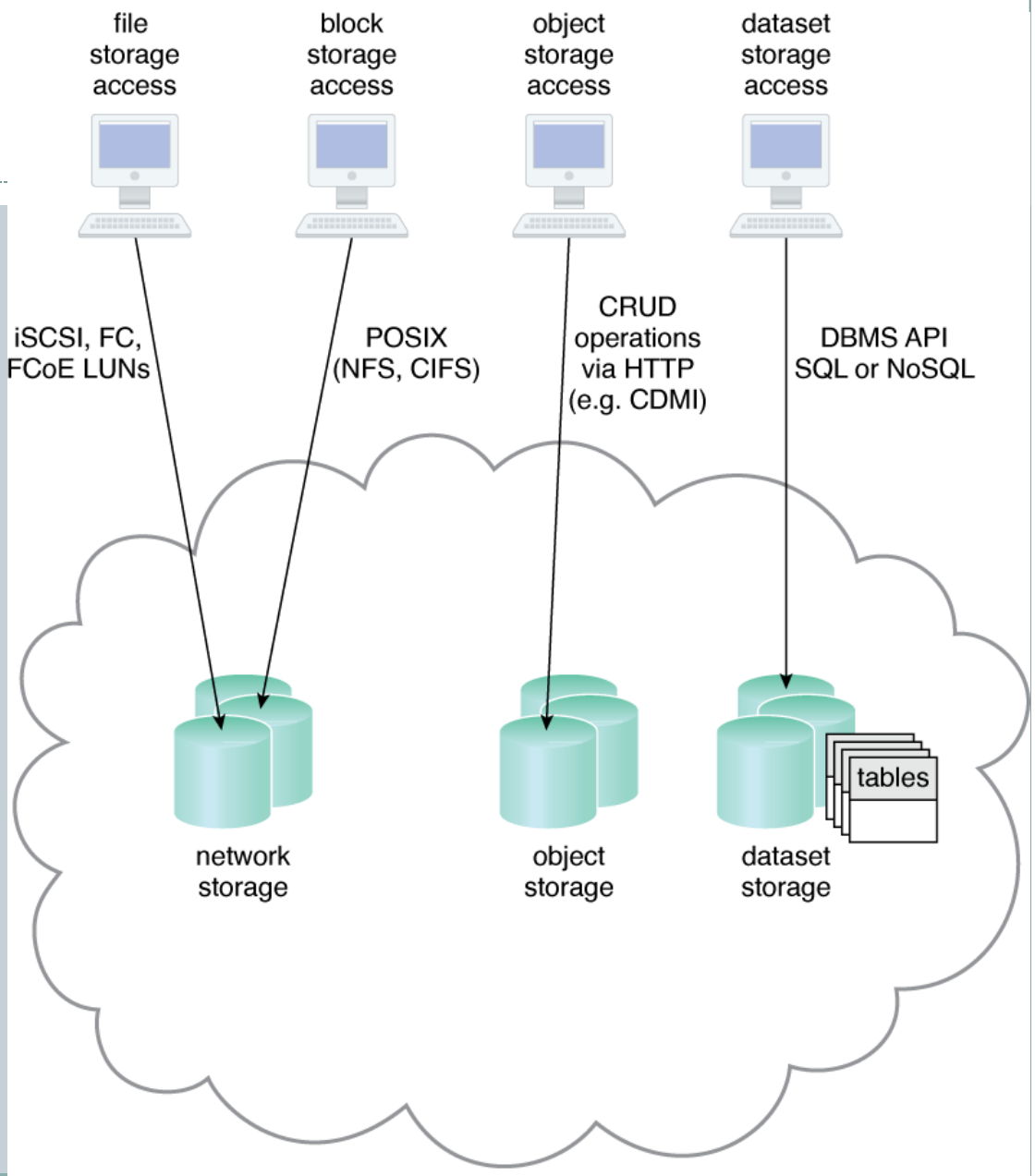
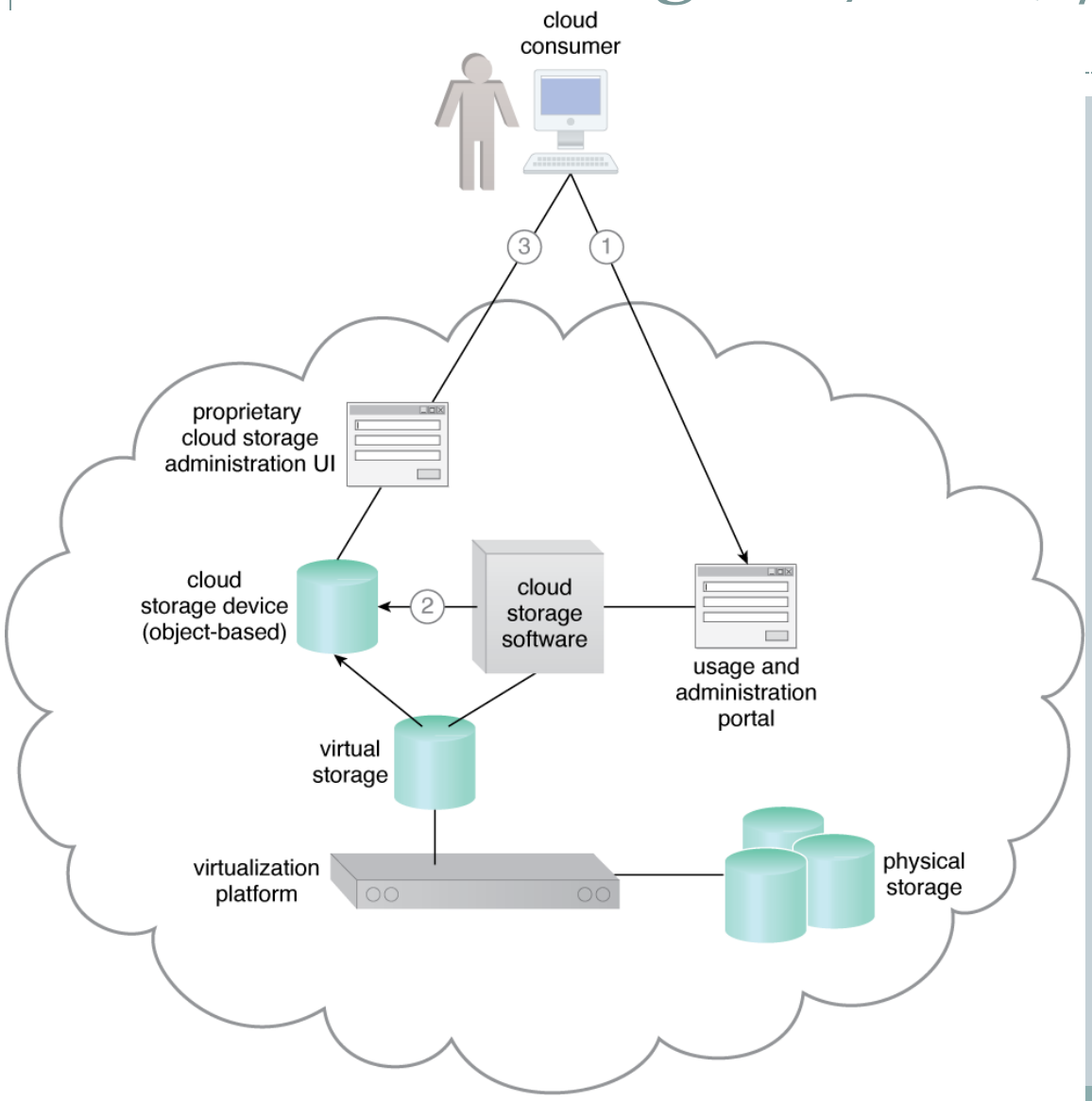
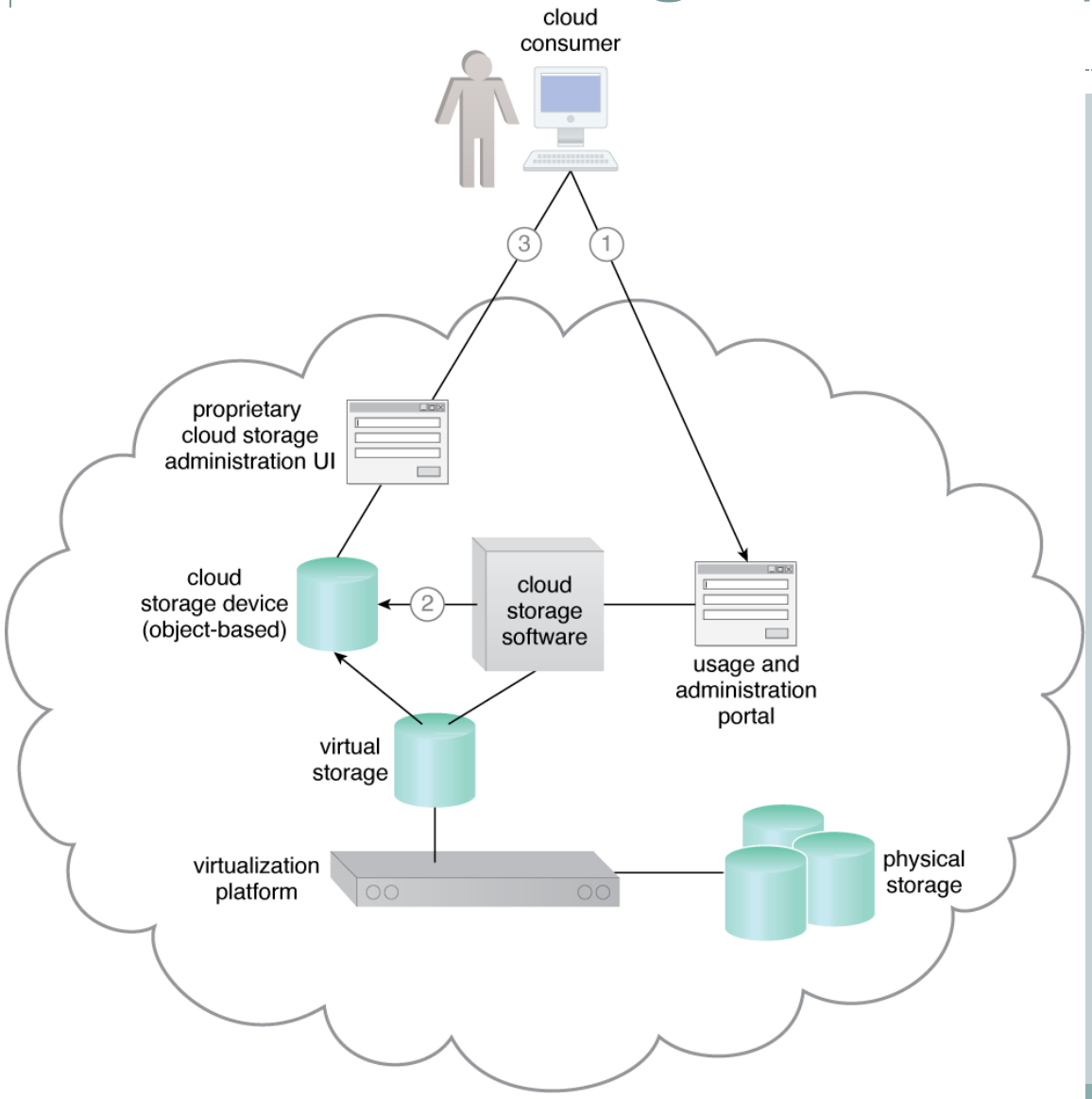


Figure 7.10 (1/3)



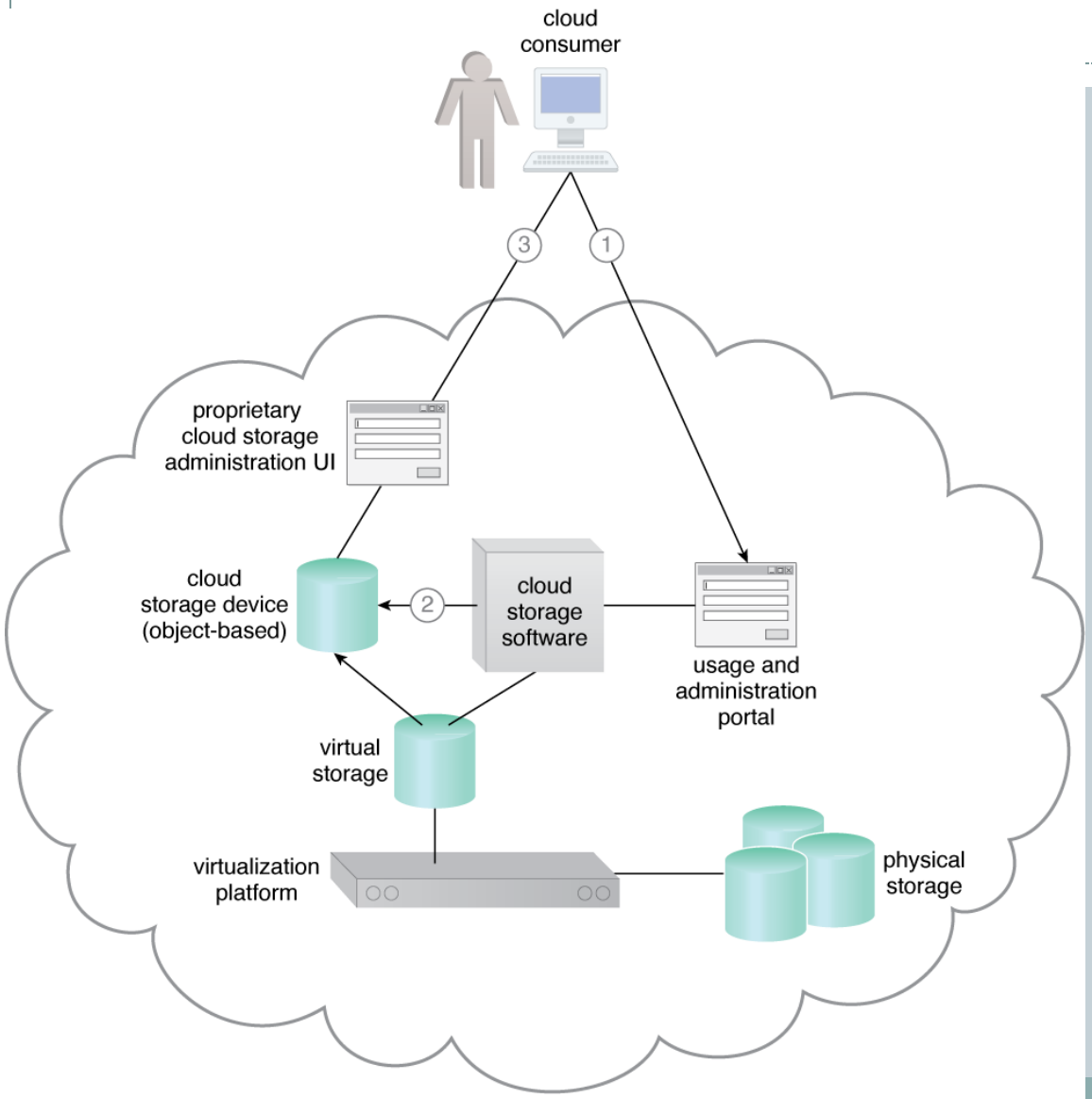
- *The cloud service consumer interacts with management tools to create the cloud storage device and define appropriated access control policies for each data object (1).*

Figure 7.10 (2/3)



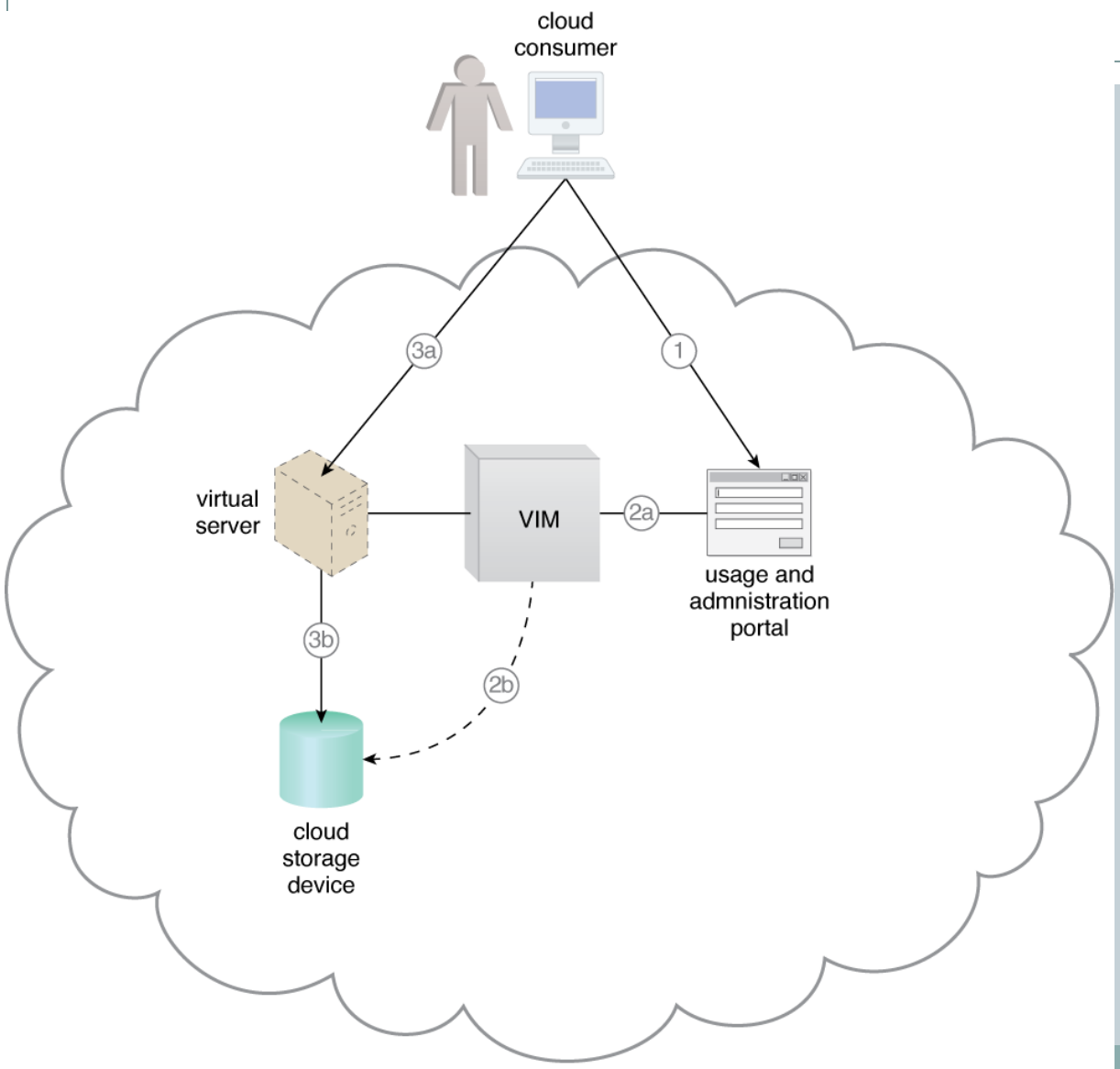
- *The management tools interact with the cloud storage software to create a cloud storage device instance and apply the required access policy to its data objects (2).*

Figure 7.10 (3/3)



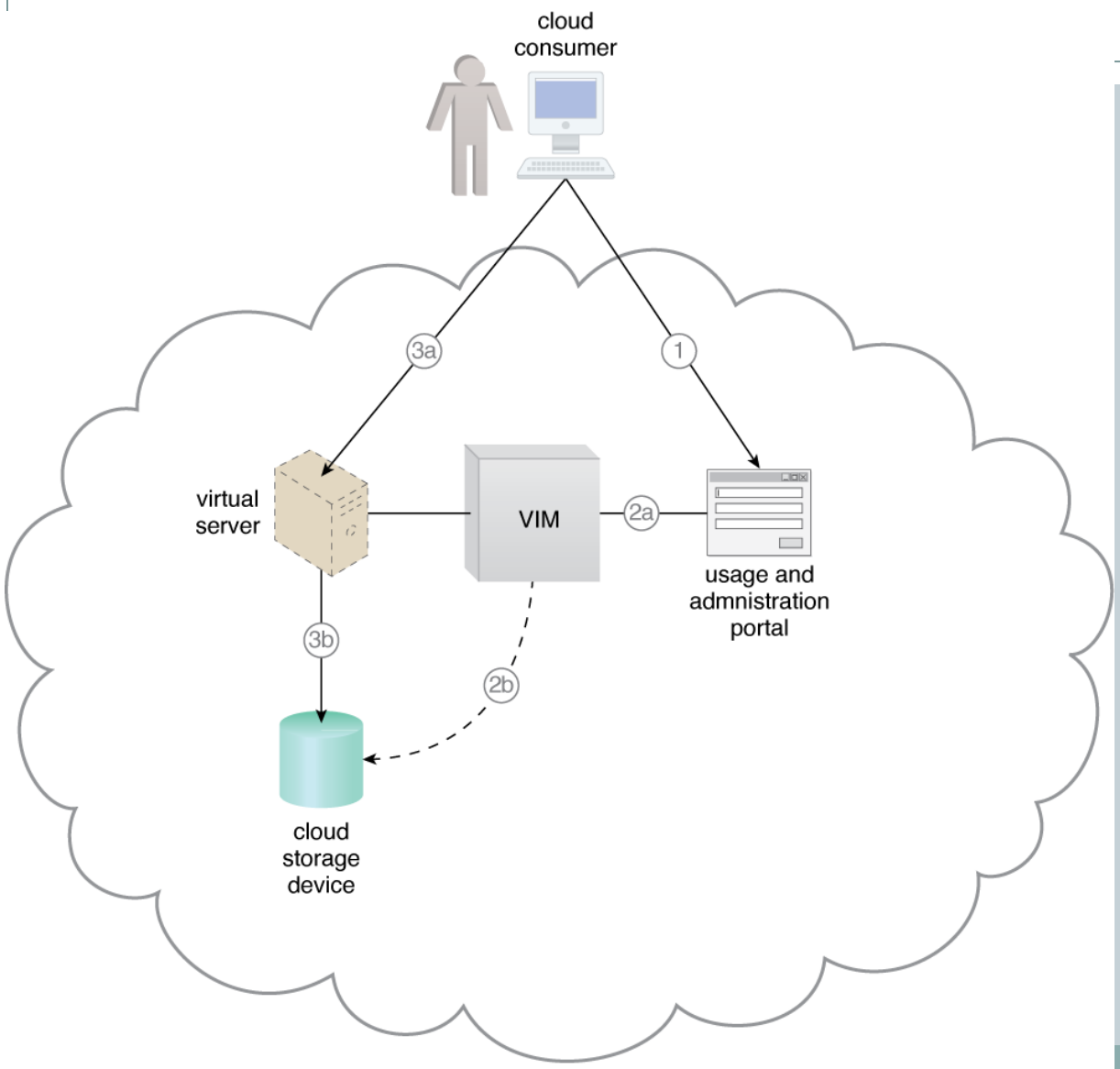
- *Each data object is assigned to a cloud storage device and all of the data objects are stored in the same virtual storage volume. The cloud service consumer uses the cloud storage device interface to access data objects (3).*

Figure 7.11 (1/3)



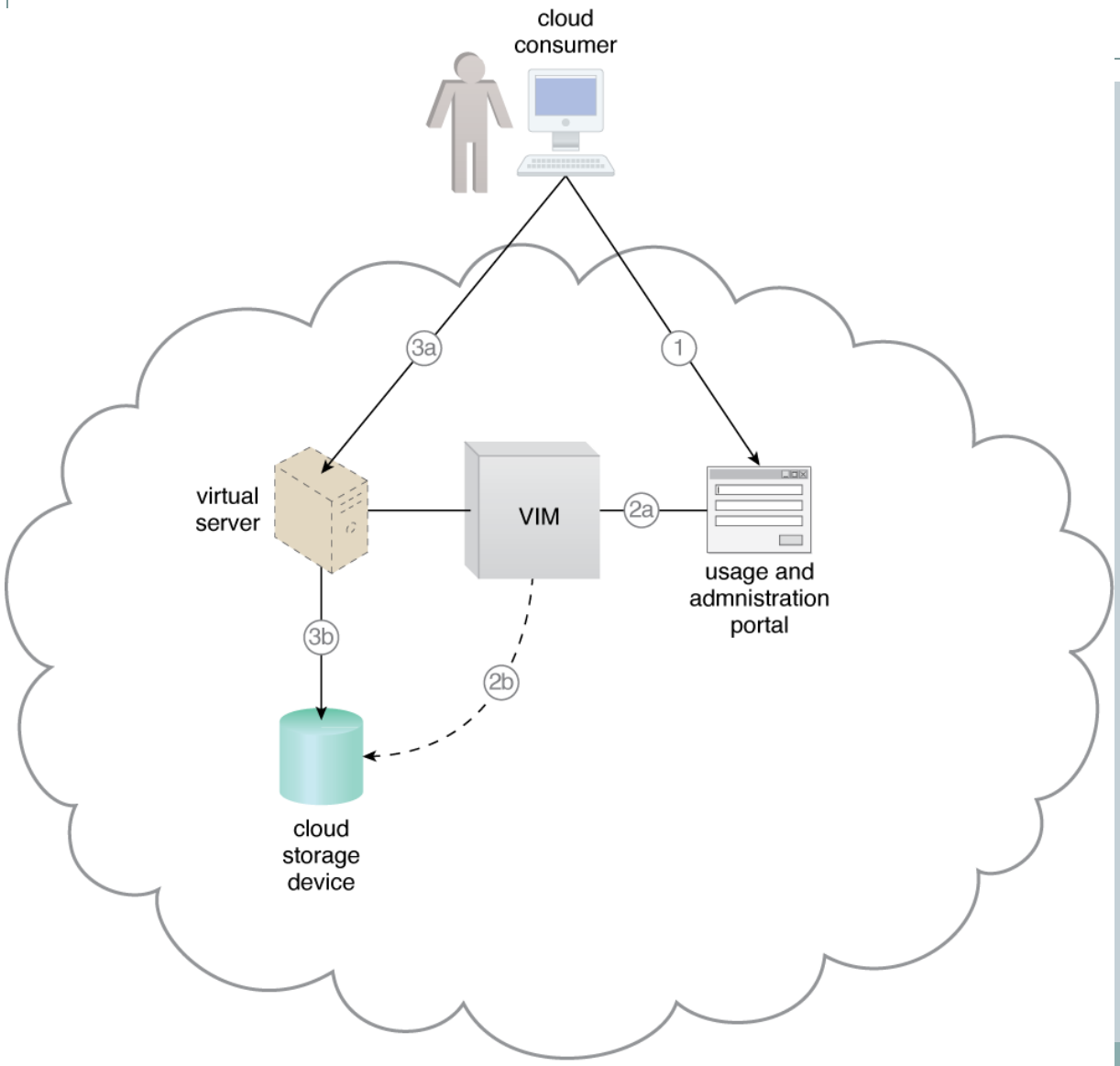
- *The cloud service consumer uses management tools to create and assign a cloud storage device to an existing virtual server (1).*

Figure 7.11 (2/3)



- *The management tools interact with the VIM software (2a), which creates and configures the appropriate LUN (2b).*

Figure 7.11 (3/3)



- *Each cloud storage device uses a separate LUN controlled by the virtualization platform. The cloud service consumer uses the virtual server (3a) to access the cloud storage device (3b).*

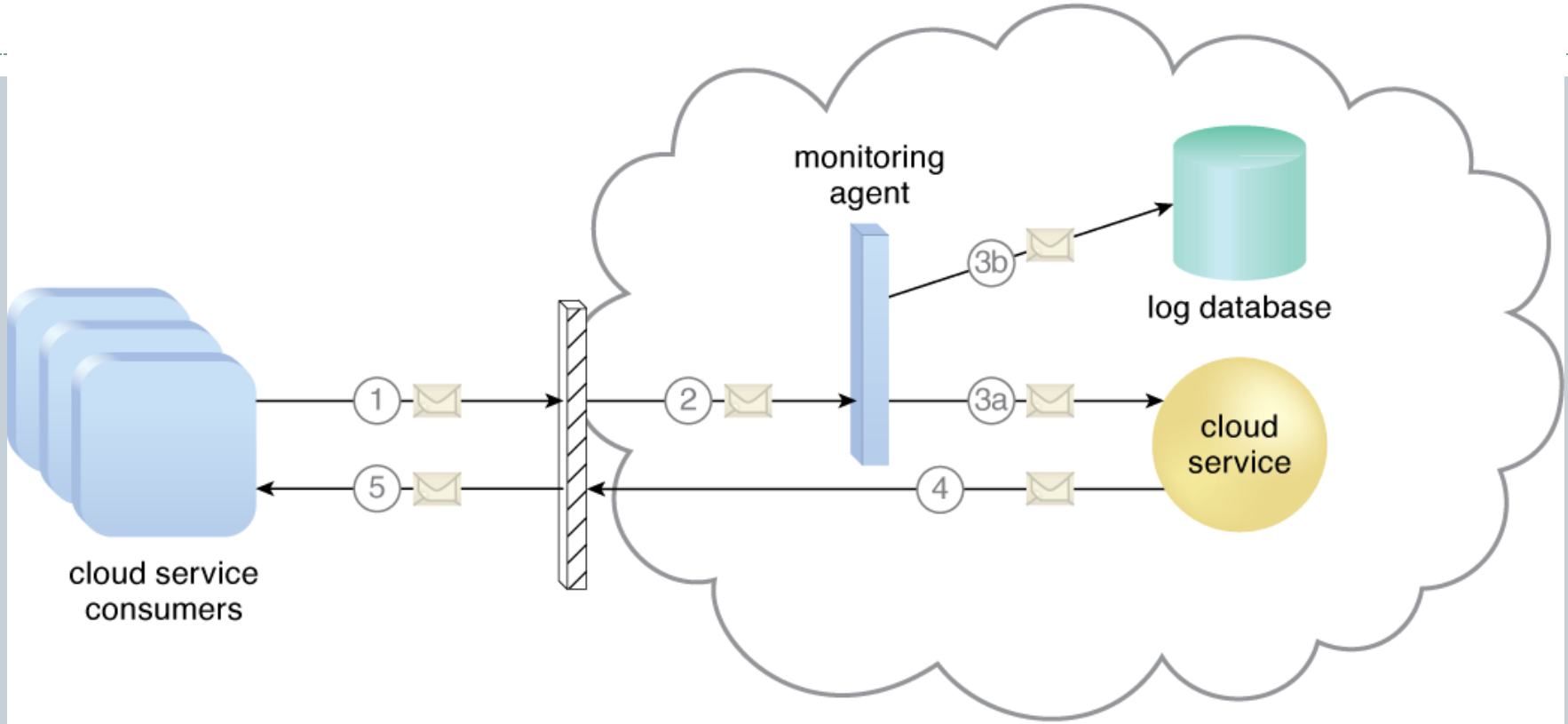
7.4 Cloud Usage Monitor (1/2)

- The cloud usage monitor mechanism is a lightweight and autonomous software program responsible for collecting and processing IT resource usage.
- Three common agent-based implementation formats:
  - monitoring agent
  - Resource agent
  - Polling agent

7.4 Cloud Usage Monitor (2/2)

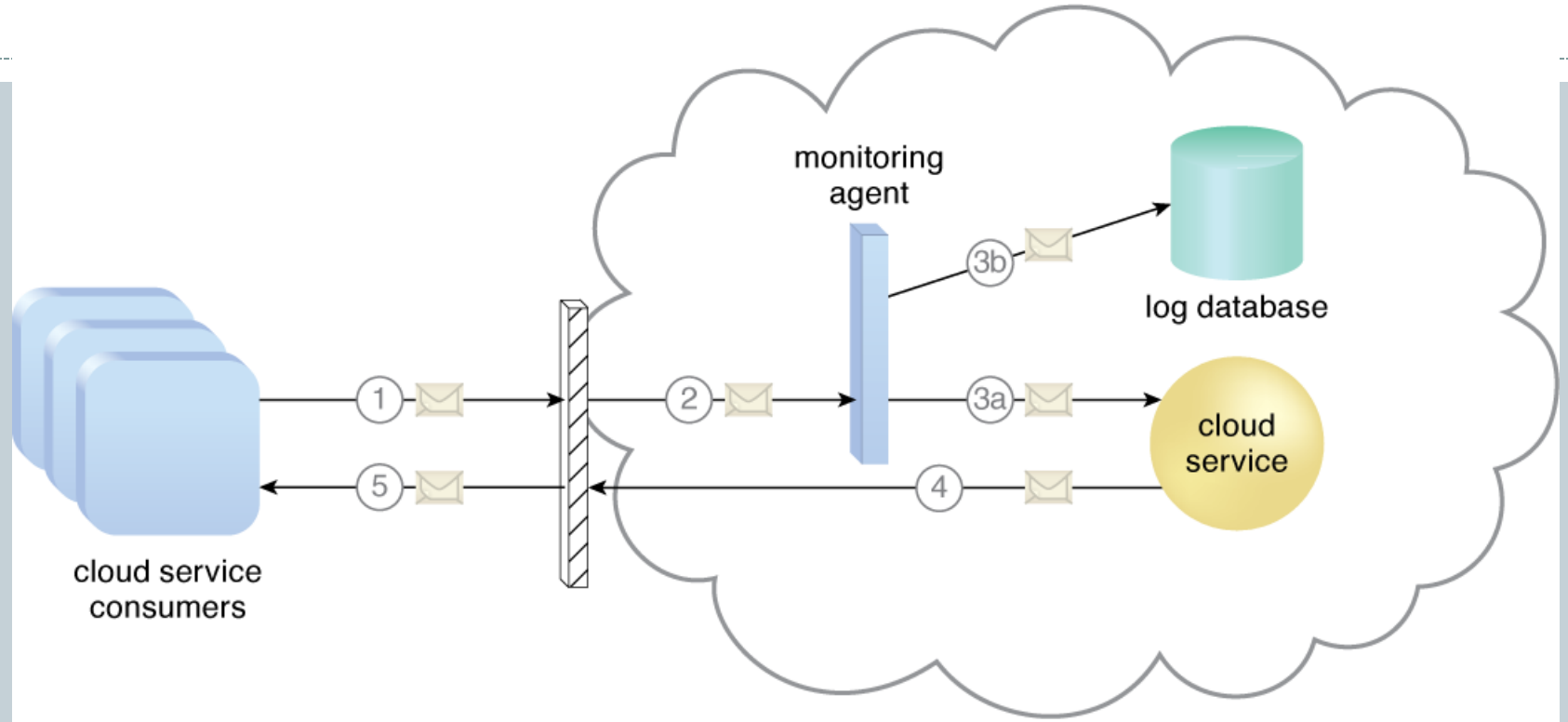
- Each monitor agent can be designed to forward collected usage data to a log database for post-processing and reporting purposes.
- monitoring agent is usually an event-driven program to network traffic and message metrics.
- resource agent monitors usage metrics based on pre-defined, observable events at the resource software level, such as initiating, suspending, resuming, and vertical scaling.
- polling agent polls IT resources to periodically monitor IT resource status, eg. up or down time.

Figure 7.12 (1/2)



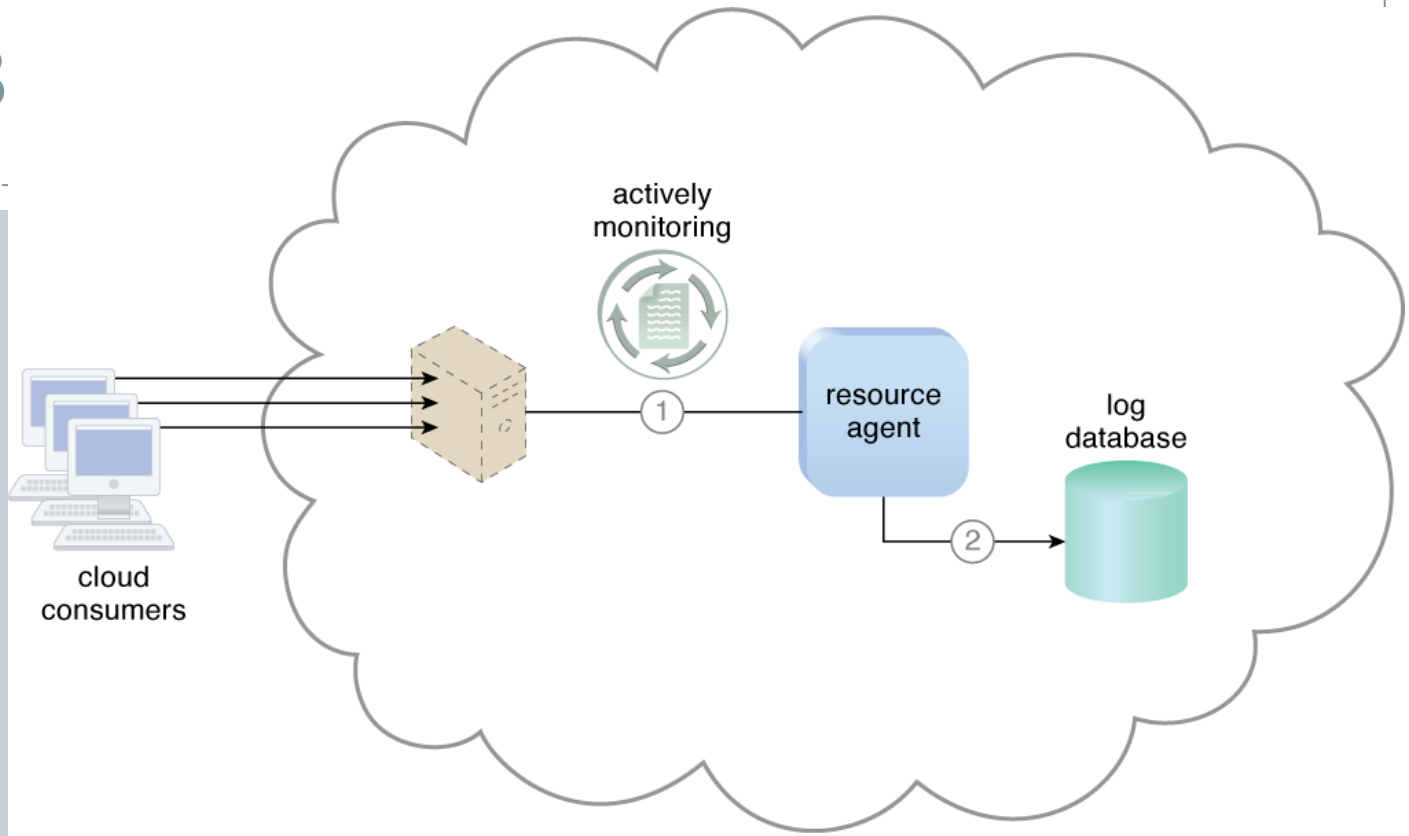
- *A cloud service consumer send a request message to a cloud service (1).*
- *The monitoring agent intercepts the message to collect relevant usage data (2) before allowing it to continue to the cloud service (3a).*

Figure 7.12 (2/2)



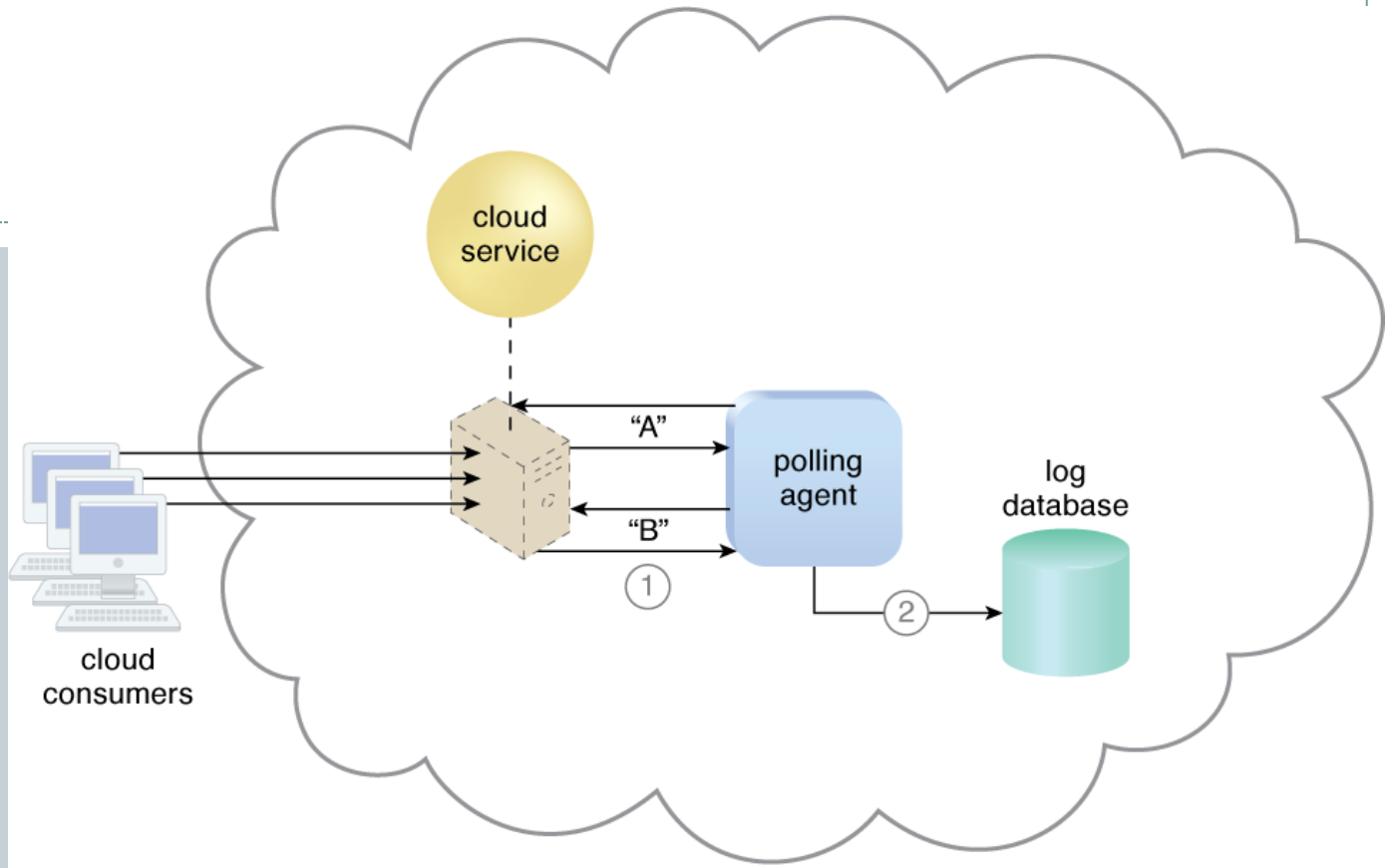
- *The monitoring agent stores the collected usage data in a log database (3b).*
- *The cloud service replies with a response message (4) that is sent back to the cloud service consumer without being intercepted by the monitoring agent (5).*

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).*

Figure 7.14



- *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).*

Figure 7.15 (1/3)

- *The cloud service consumer (CS_ID = CS1) requests the creation of a virtual server (VM_ID = VM1) of configuration size type 1 (VM_TYPE = type1) (1).*
- *The VIM creates the virtual server (2a).*
- *The VIM's event-driven API generates a resource usage event with timestamp = t1, which the usage monitor software agent captures and records in the resource usage event log database (2b).*

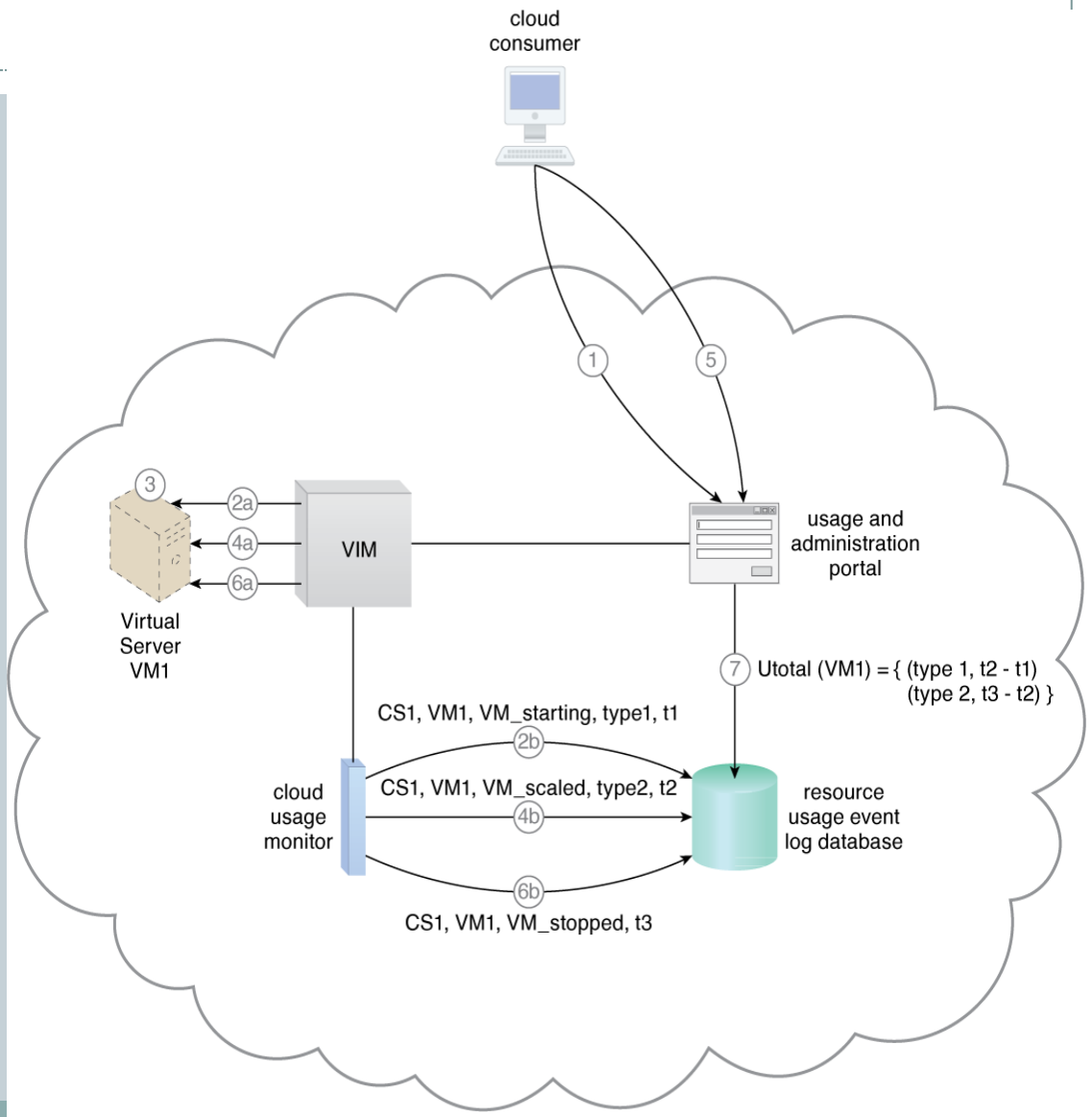


Figure 7.15 (2/3)

- *Virtual server usage increases and reaches the auto-scaling threshold (3).*
- *The VIM scales up Virtual Server (VM1) (4a) from configuration type 1 to type 2 (VM_TYPE = type2).*
- *The VIM's event-driven API generates a resource usage event with timestamp = t2, which is captured and recorded at the resource usage event log database by the usage monitor software agent (4b).*
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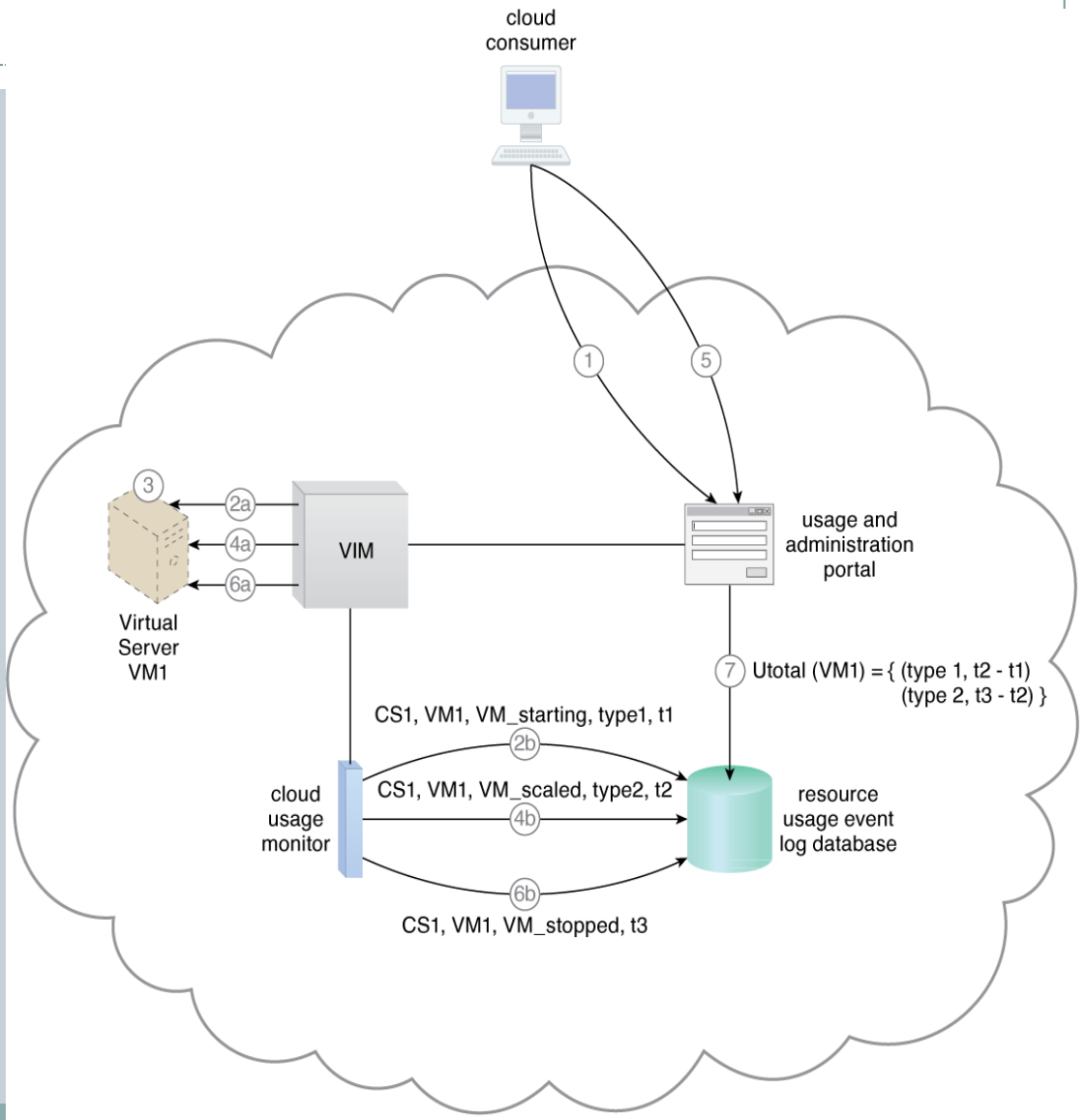
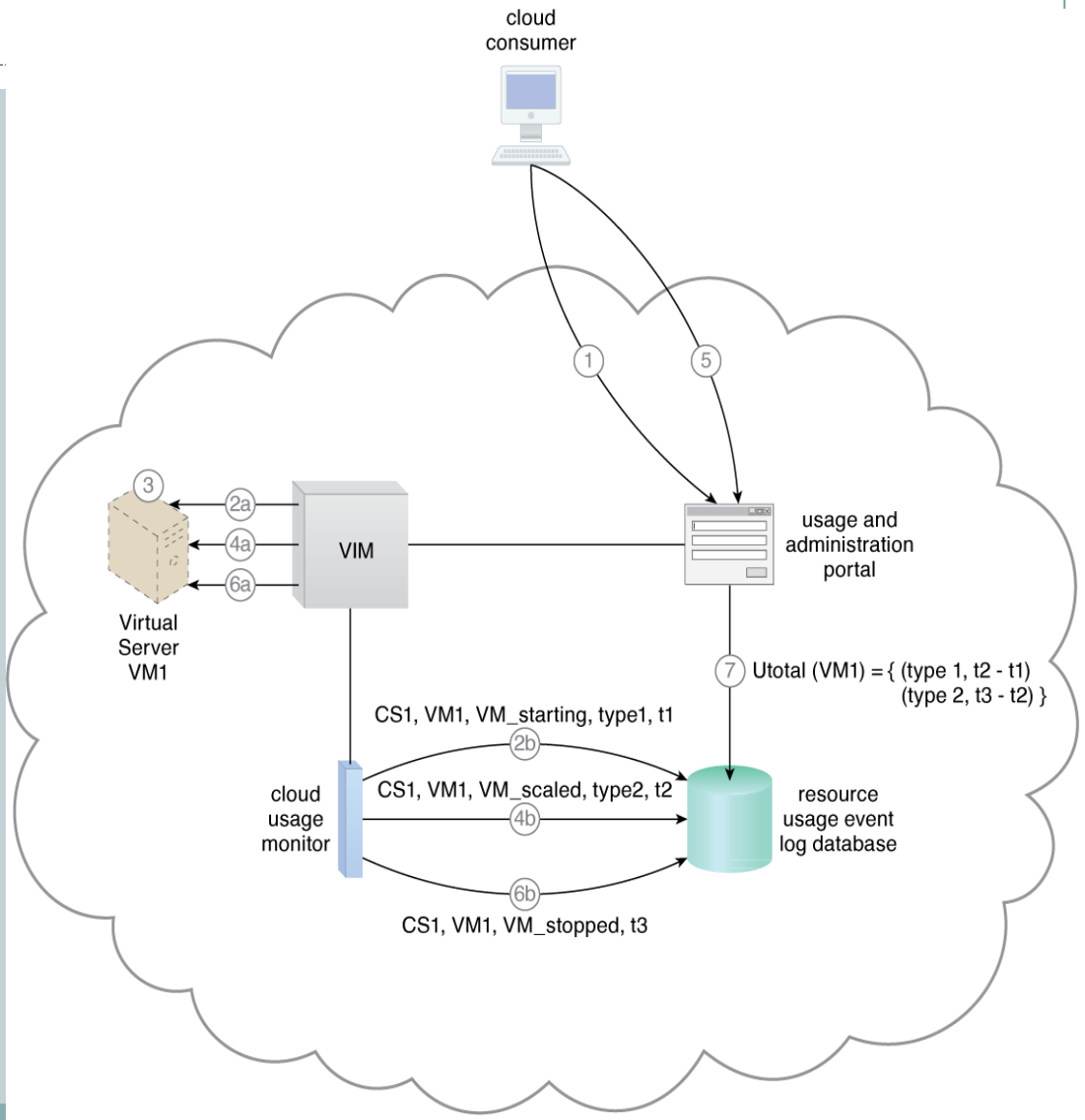


Figure 7.15 (3/3)

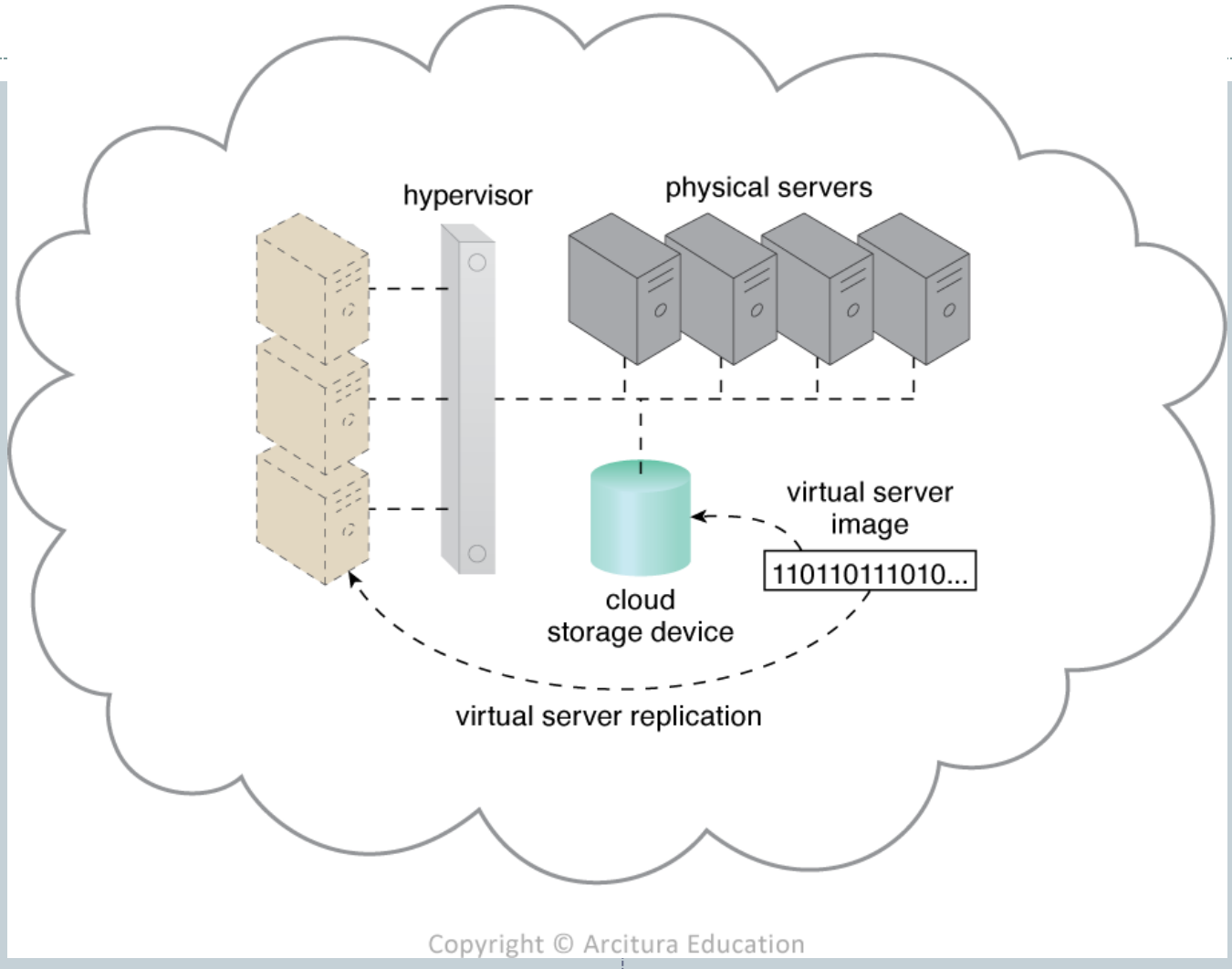
- *The cloud service consumer shuts down the virtual server (5).*
- *The VIM stops Virtual Server (VM1) (6a) and its event-driven API generates a resource usage event with timestamp = t3, which the usage monitor software agent captures and records at the log database (6b).*
- *Management tools access the log database and calculate the total usage for Virtual Server Utotal (VM1) (7).*



7.5 Resource Replication

- Replication is usually performed when resource's availability and performance need to be enhanced.
- Resource replication mechanism usually uses virtualization technology to replicate cloud-based IT resources.

Figure 7.16



- *Figure 7.16 - The hypervisor replicates several instances of a virtual server.*

Figure 7.17

- *Figure 7.17 - A high availability virtual server is running in Data Center A. VIM instances, in Data Center A and Data Center B, are executing the coordination function that allows detection of failure conditions. Storage of VM images is replicated between data centers, as a consequence of the high availability configuration.*

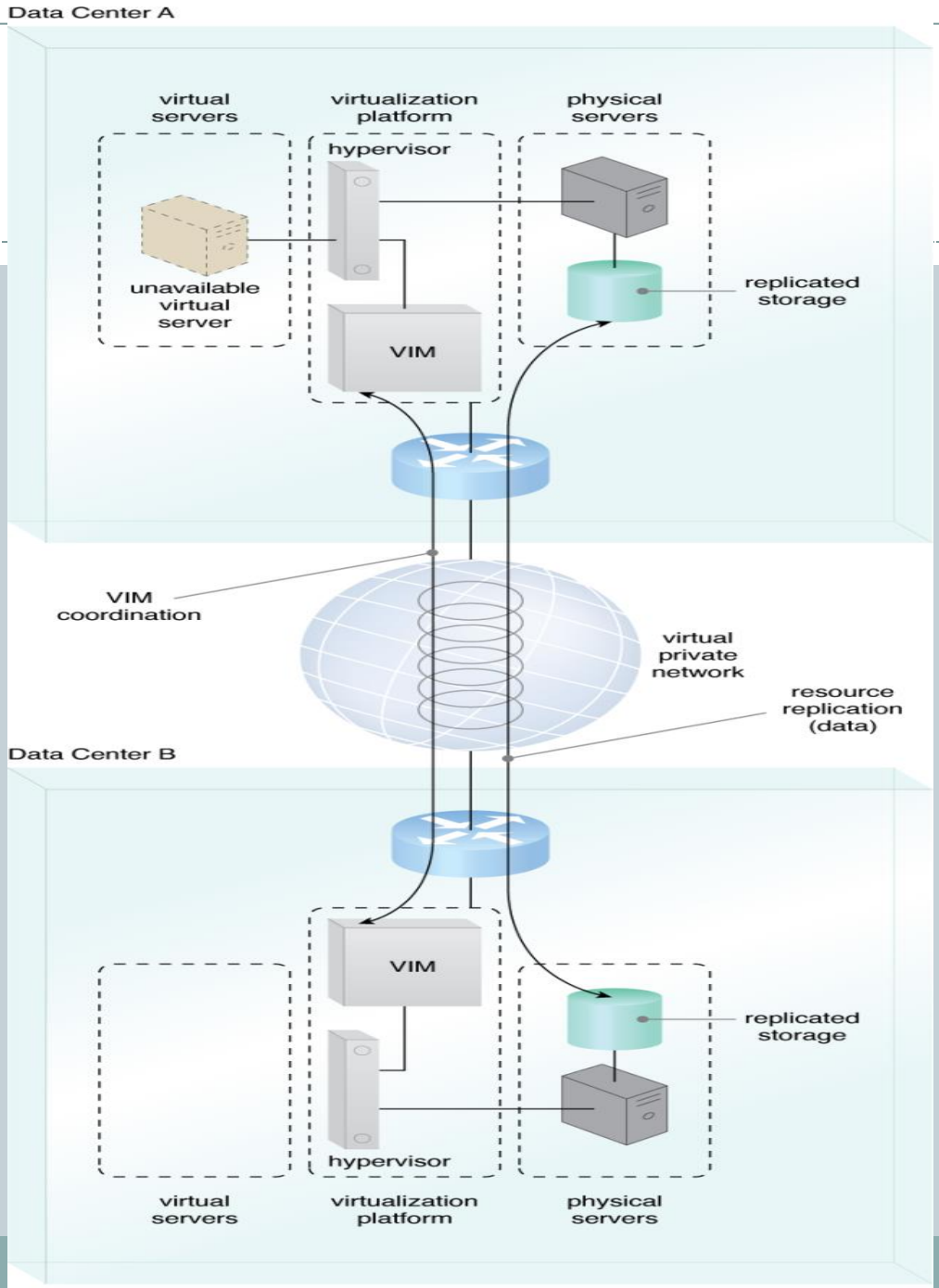


Figure 7.18

- *Figure 7.18 - The virtual server becomes unavailable in Data Center A. VIM in Data Center B detects the failure condition and starts to reallocate the high availability server from Data Center A into Data Center B.*

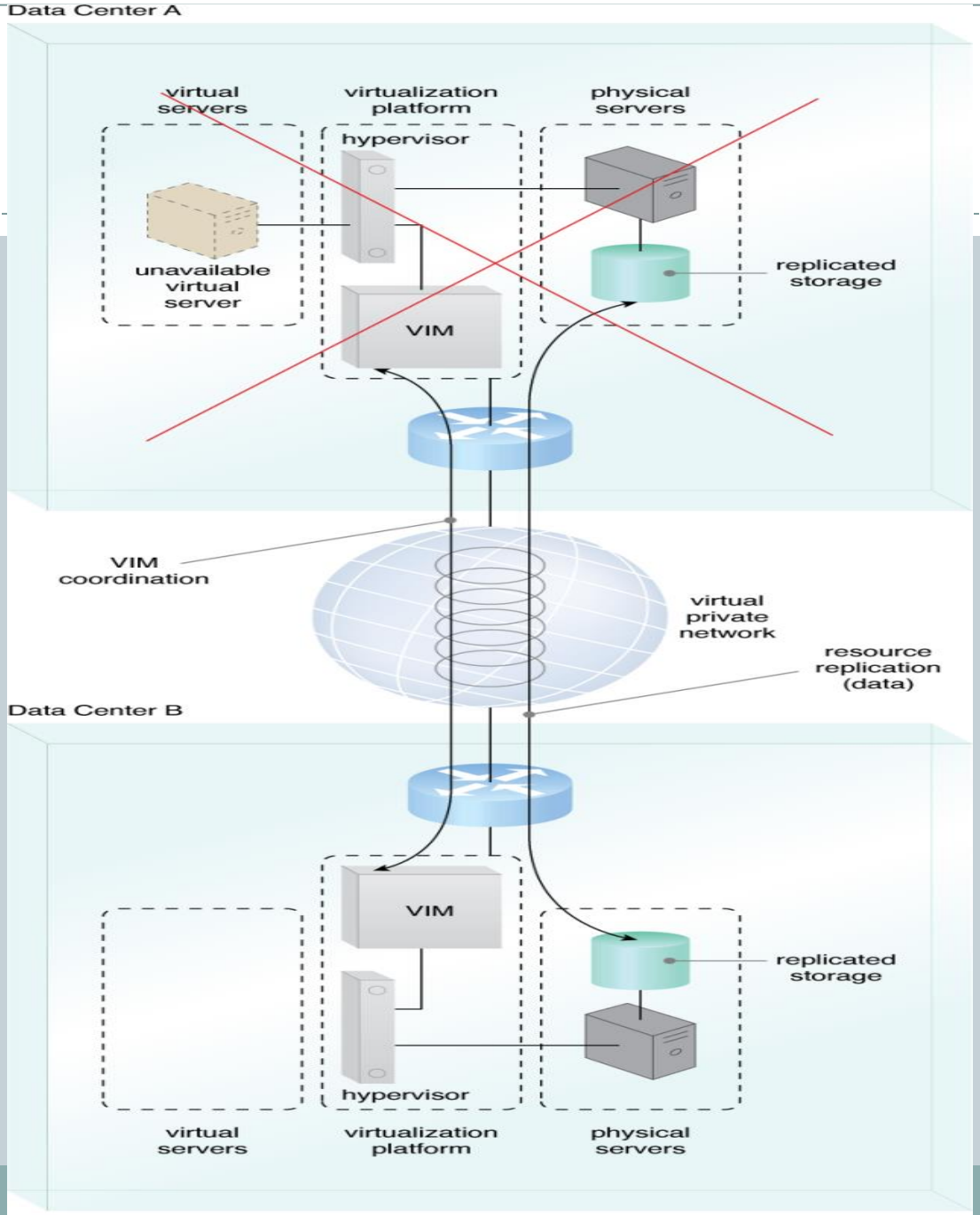
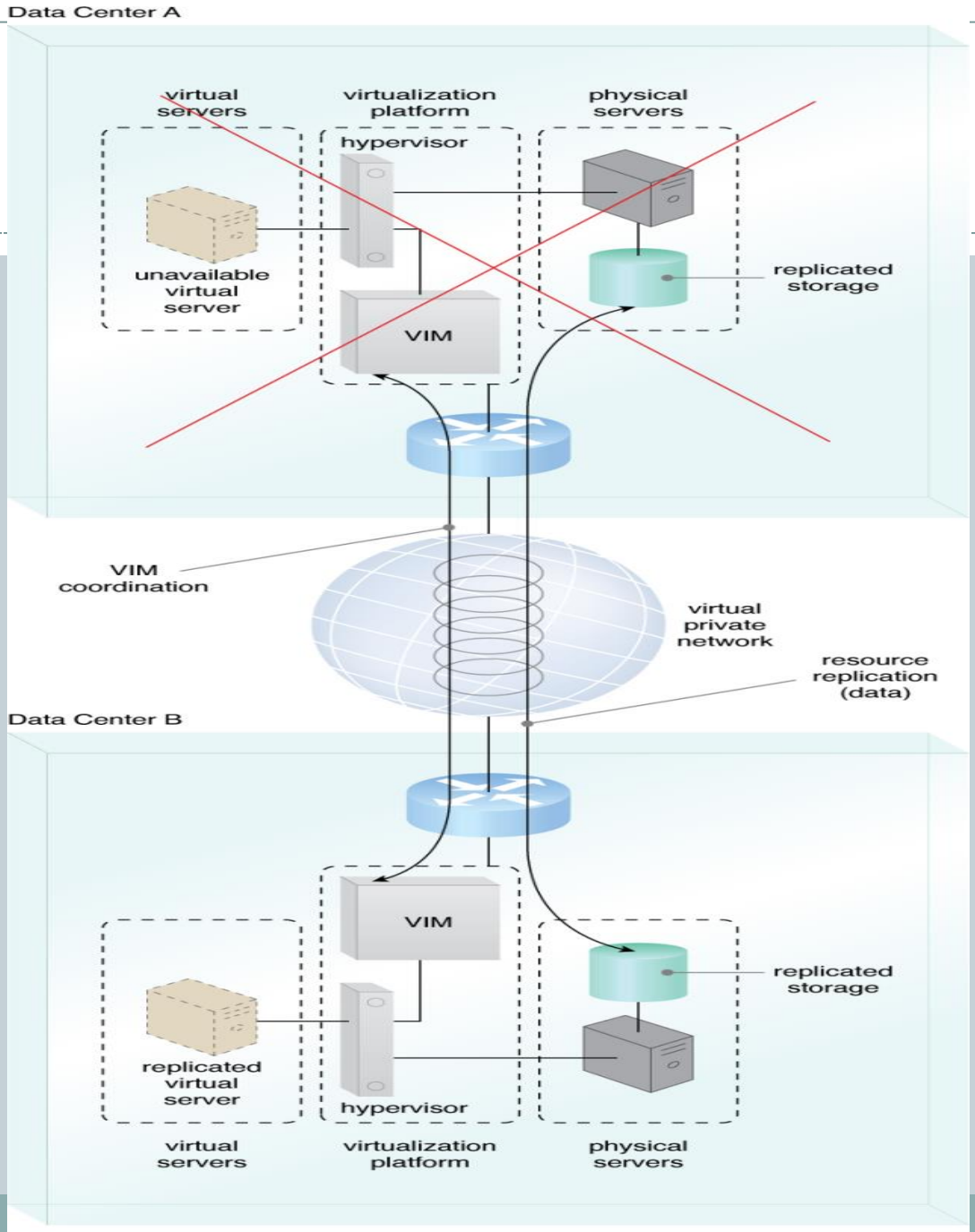


Figure 7.19

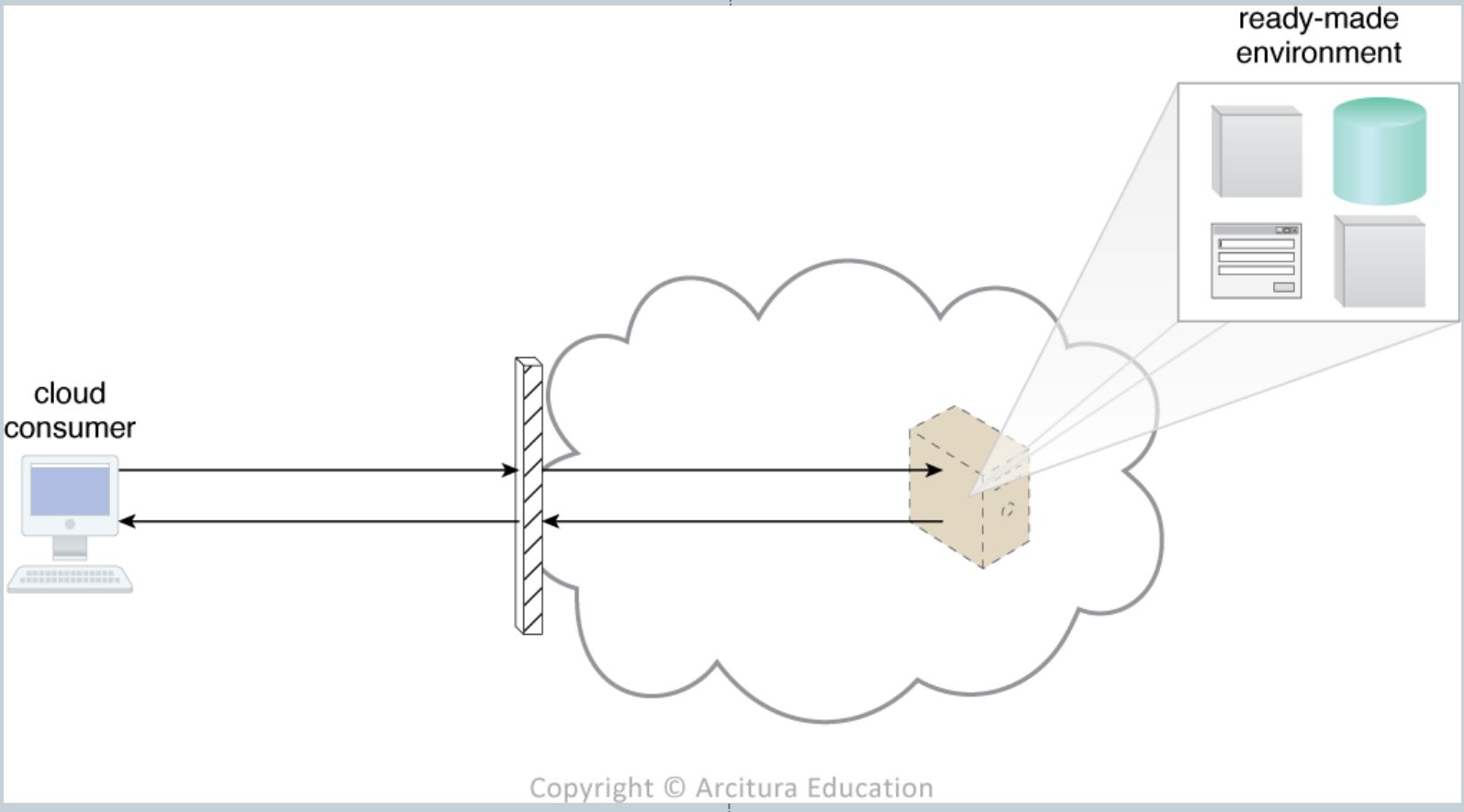
- *Figure 7.19 - A new instance of the virtual server is created in Data Center B and the service becomes available.*



7.6 Ready-Made Environment

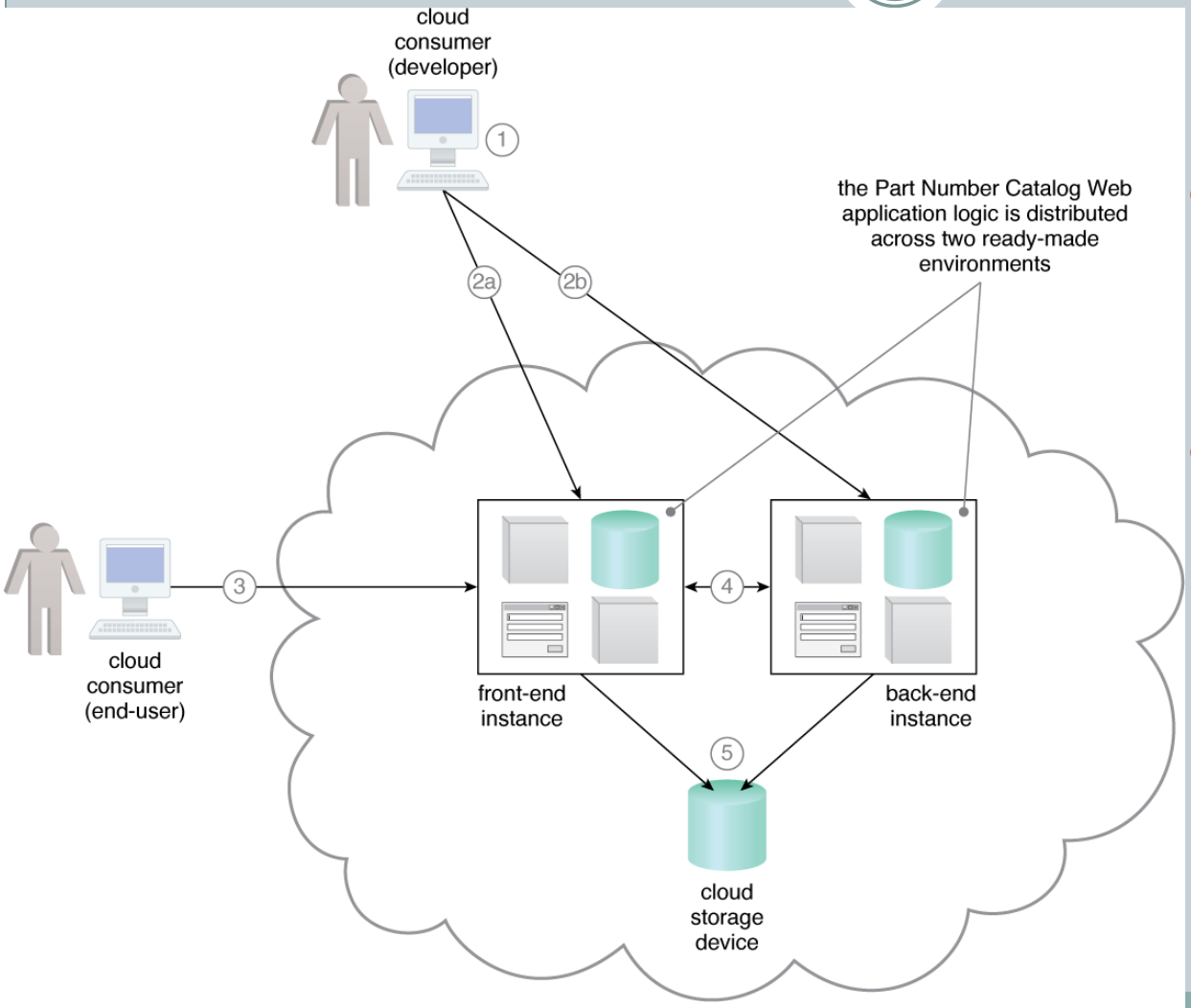
- The ready-made environment mechanism is a defining component of the PaaS cloud delivery model that represents a platform comprised of a set of already installed IT resources, ready to be used and customized by a cloud consumer.
- Ready-made environments are utilized by cloud consumers to remotely develop and deploy their own services and applications within a cloud by providing with a complete software development kit (SDK).
- Typical ready-made environments include pre-installed IT resources, eg. database, middleware, governance tools.

Figure 7.20



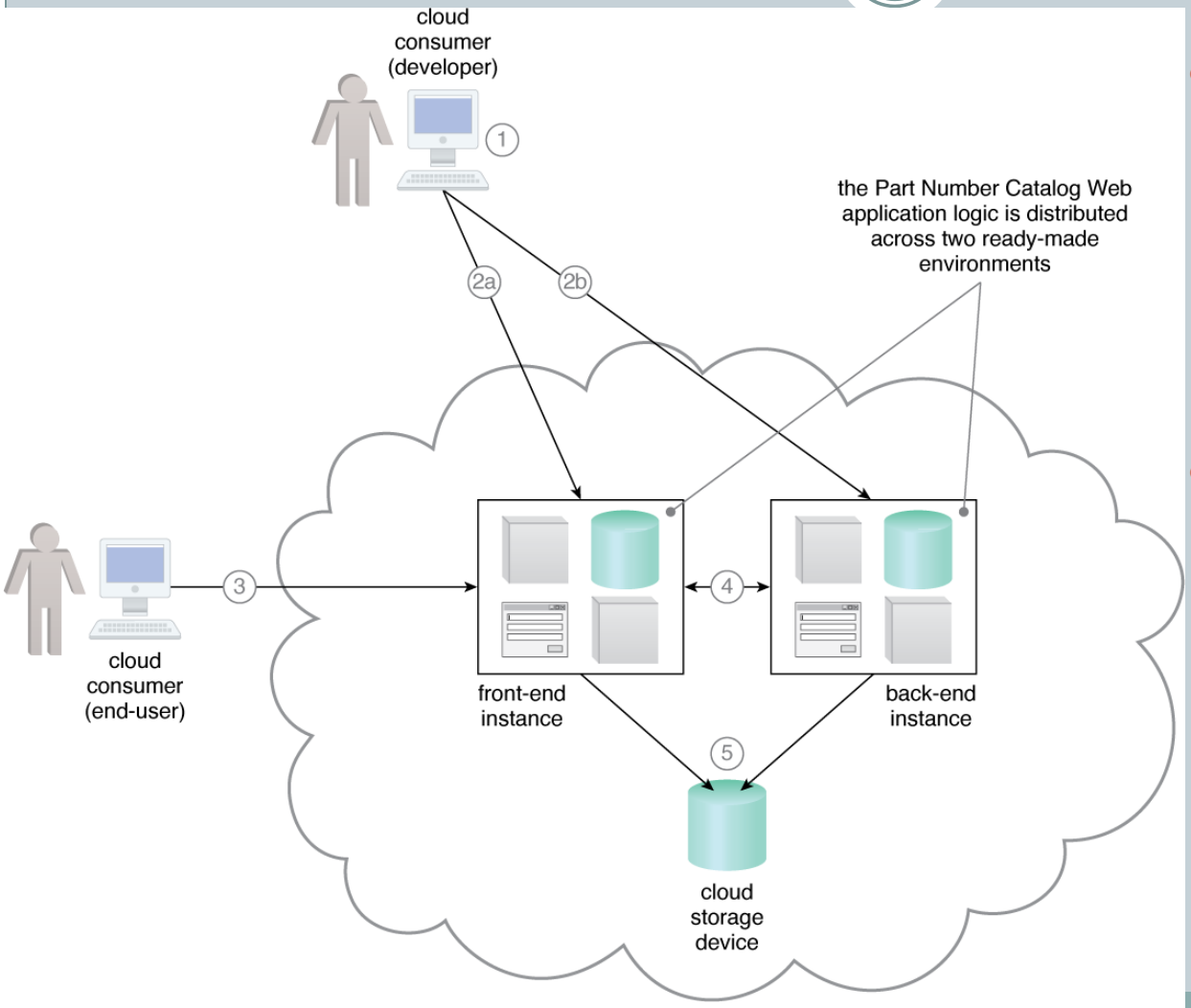
- *Figure 7.20 - A cloud consumer accesses a ready-made environment hosted on a virtual server.*

Figure 7.21 (1/3)



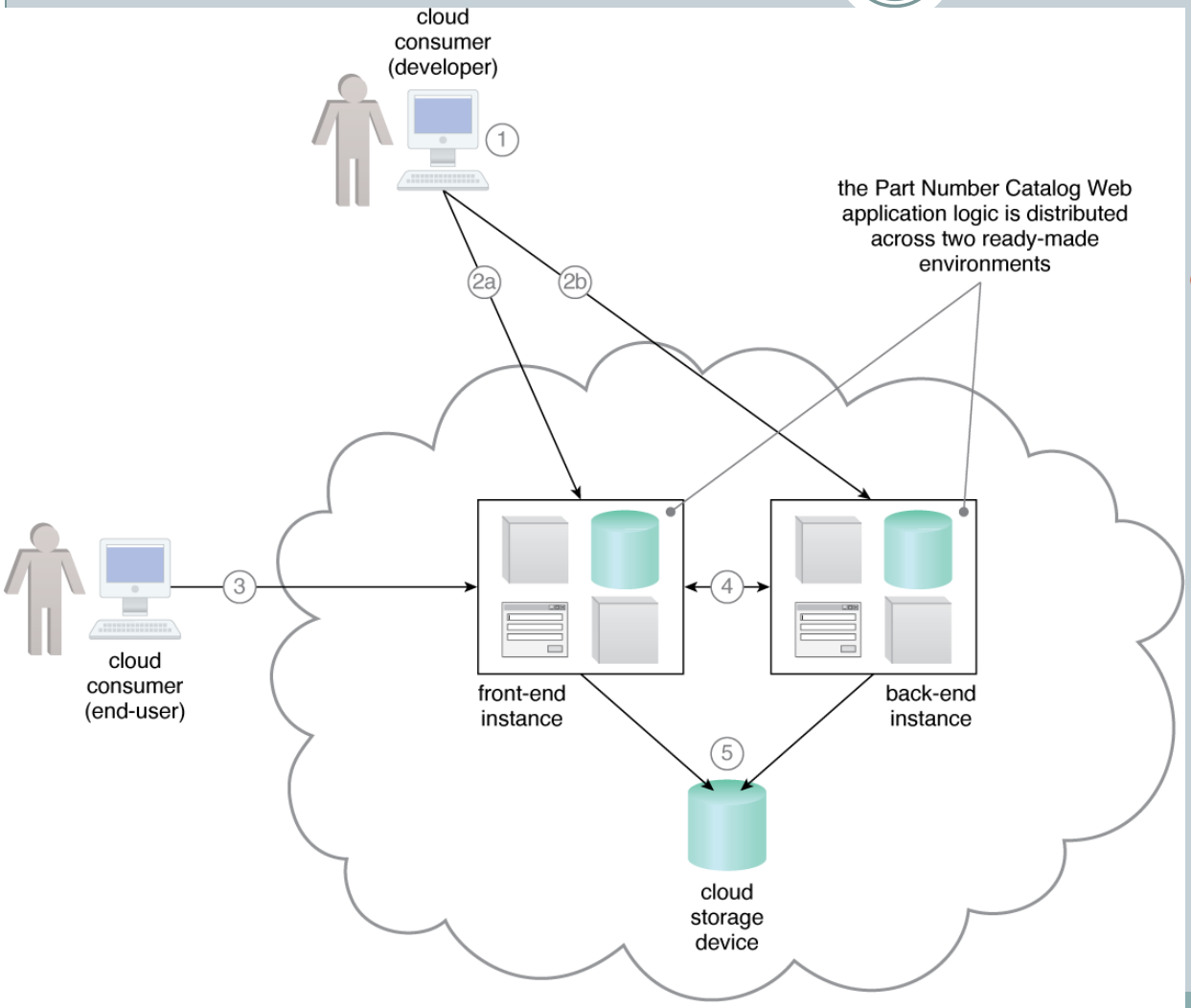
- *The cloud developer uses the provided SDK to develop the Web application (1).*
- *The application software is deployed on the Web platform that was established by the two ready-made environments called the frontend instance (2a) and the backend instance (2b).*

Figure 7.21 (2/3)



- *The application is made available for end-users and one accesses the application interface at the frontend instance (3).*
- *The software running in the frontend instance invokes a long-running task at the backend instance that corresponds to the processing required by the end-user (4).*

Figure 7.21 (3/3)



- *The application software deployed at both the frontend and backend instances is backed by a cloud storage device that implements persistent storage of the application data (5).*