Cloud computing mechanisms

Cloud infrastructure mechanisms

Cloud Infrastructure Mechanisms

- Foundational building blocks of cloud environments, which comprises
  - Logical Network Perimeter
  - Virtual Server
  - Cloud Storage Device
  - Cloud Usage Monitor
  - Resource Replication
  - Read-Made Environment

Logical Network Perimeter

- An isolation of network environment establishing a virtual network boundary.
- Purposes?
  - 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, and
  - control the bandwidth that is available to isolated IT resources.

Logical Network Perimeter (2)

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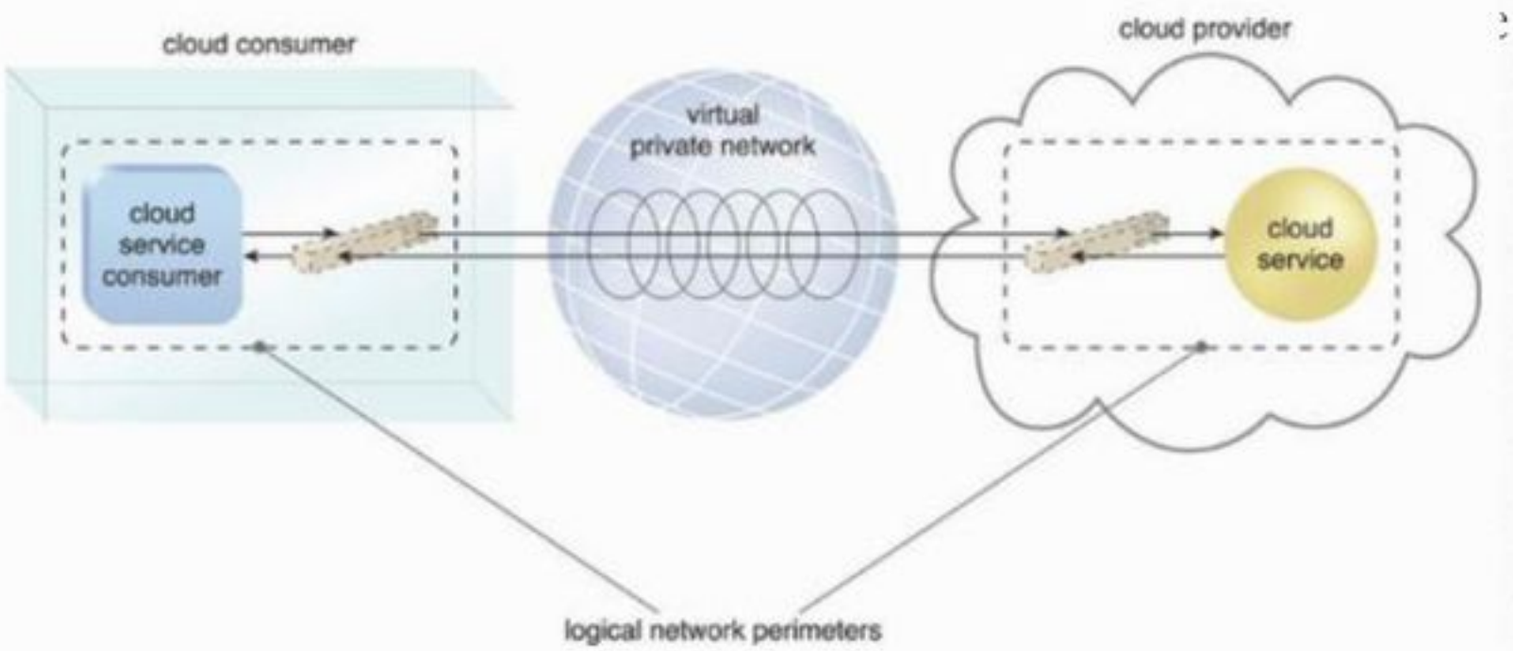
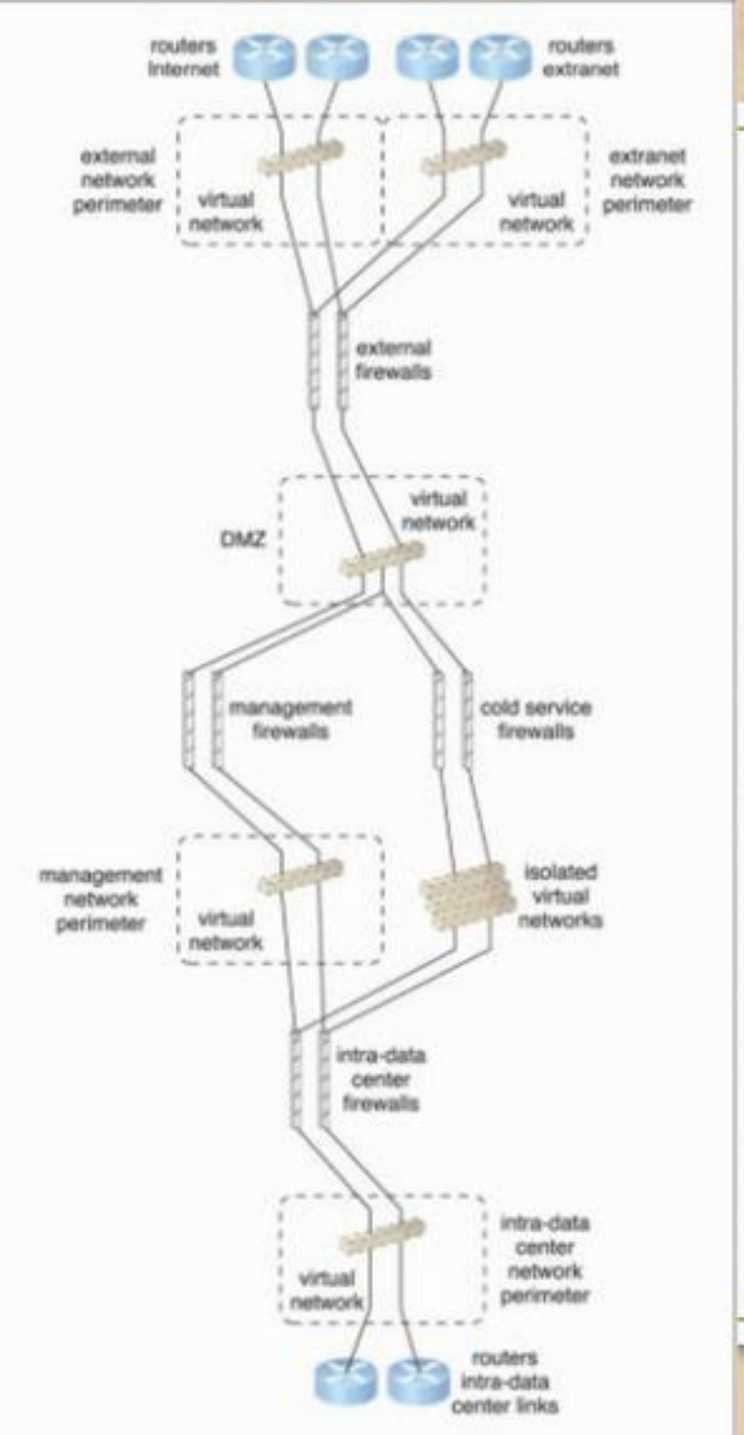


Case Study (DTGOV)

- Routers – connect the Internet and the extranet.
- DMZ zone – virtual network hosting the proxy servers.
- Management firewalls – isolate the management perimeter, providing management services.
- Cold service firewalls – isolate traffic to cloud-based IT resources.
- Intra-data center firewalls – filter network traffic to and from other data centers via routers.


routers Internet
routers extranet
external network perimeter
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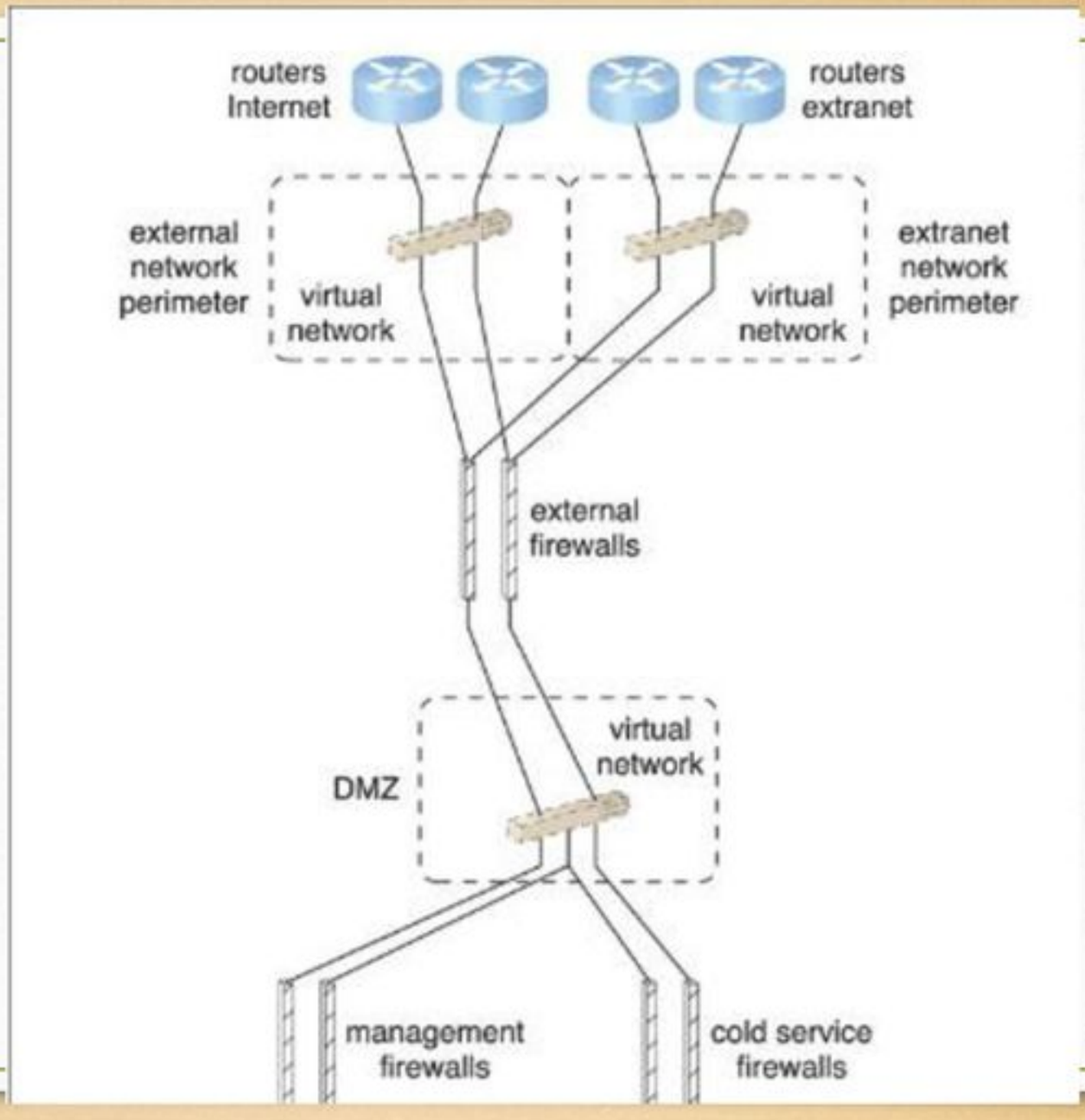
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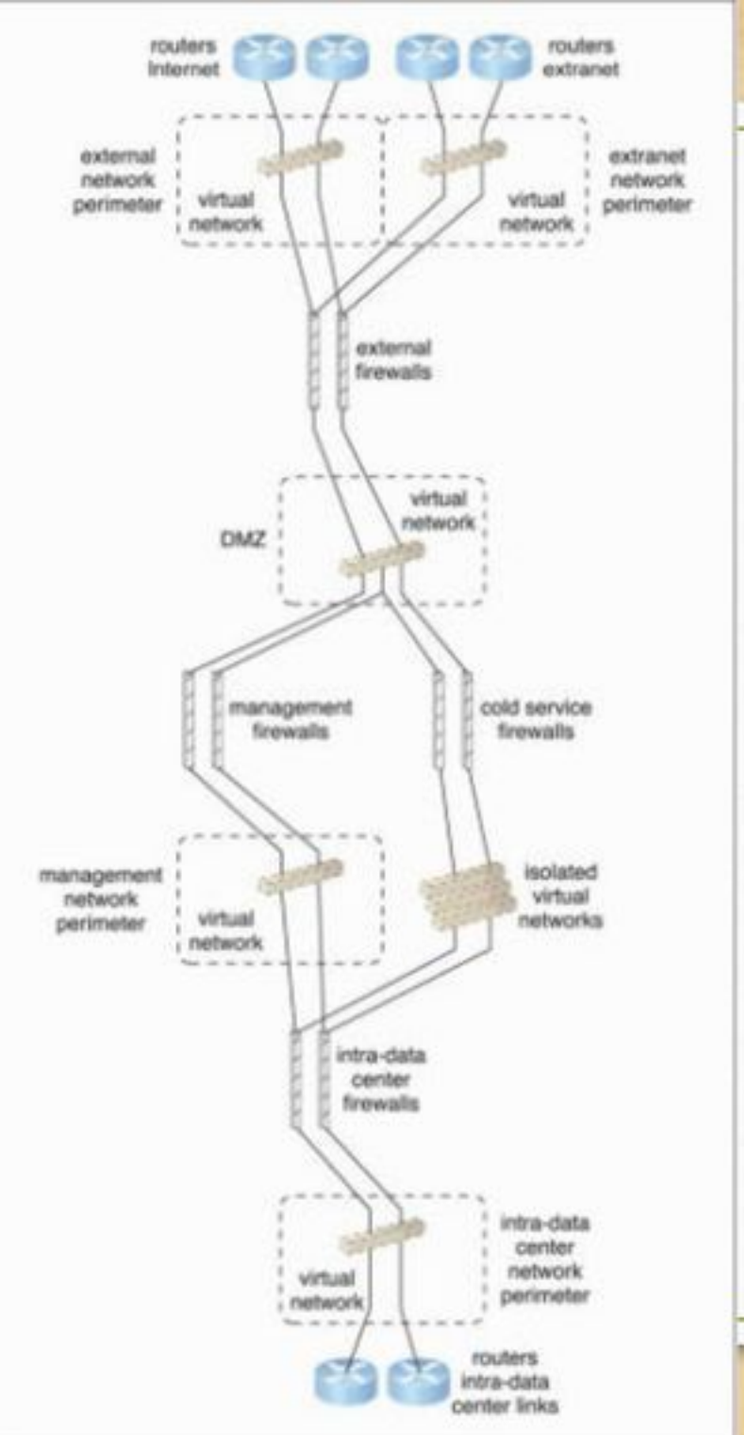
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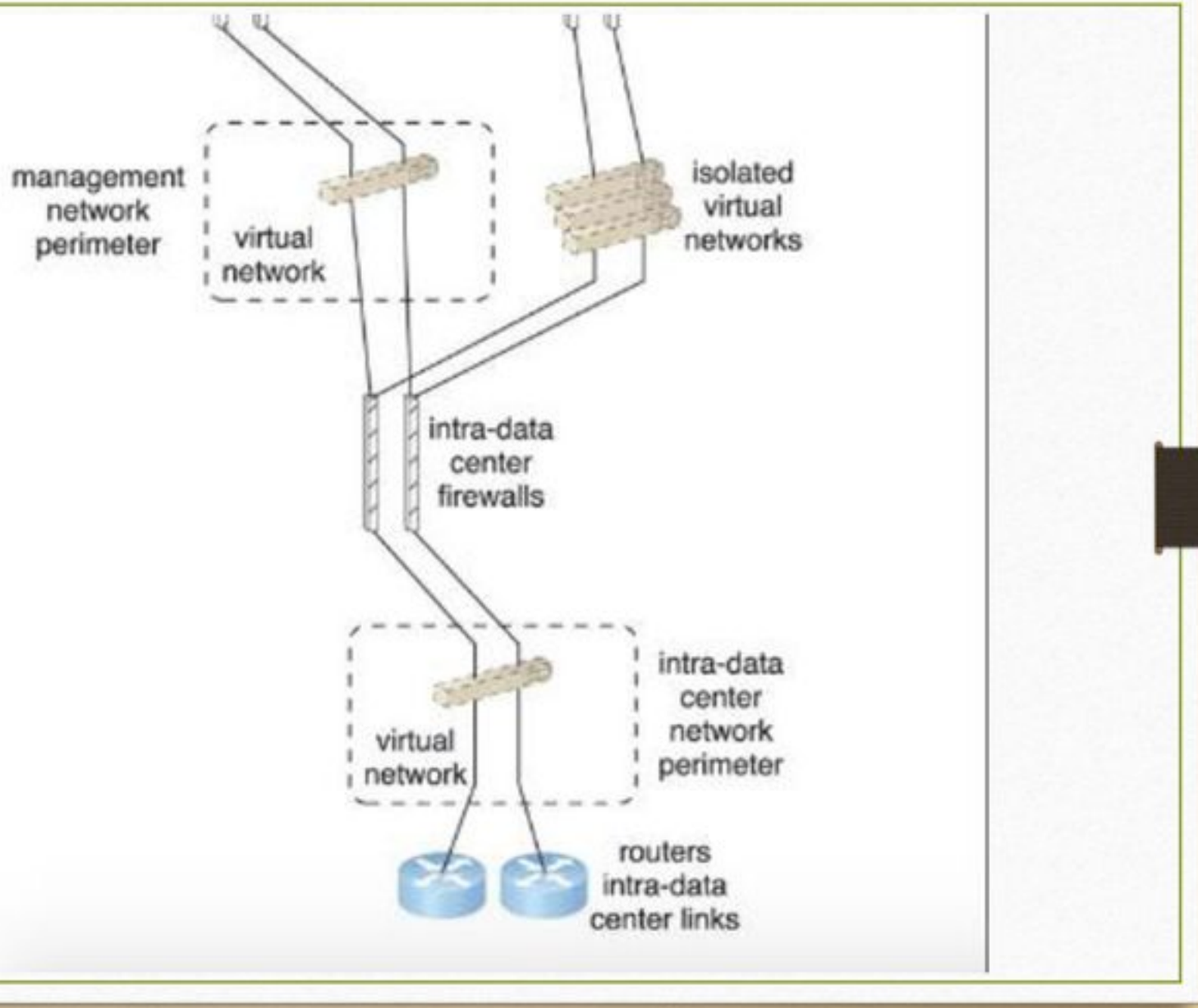
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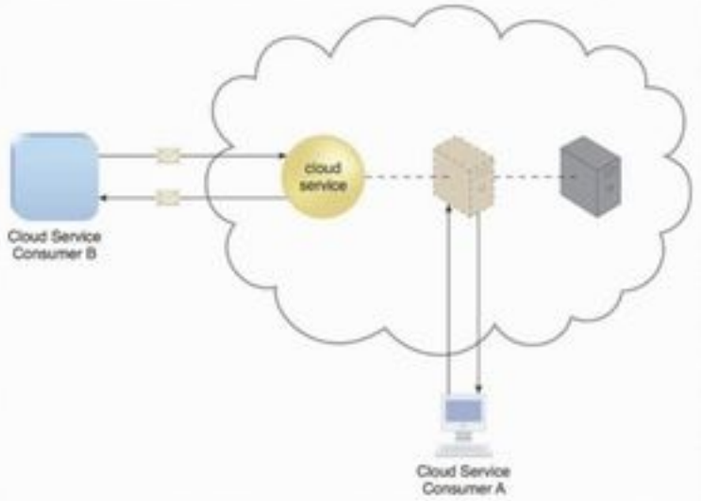
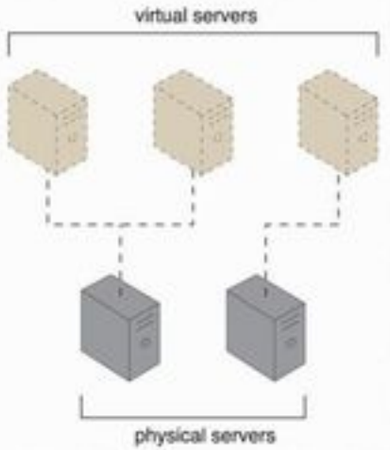
Virtual Servers

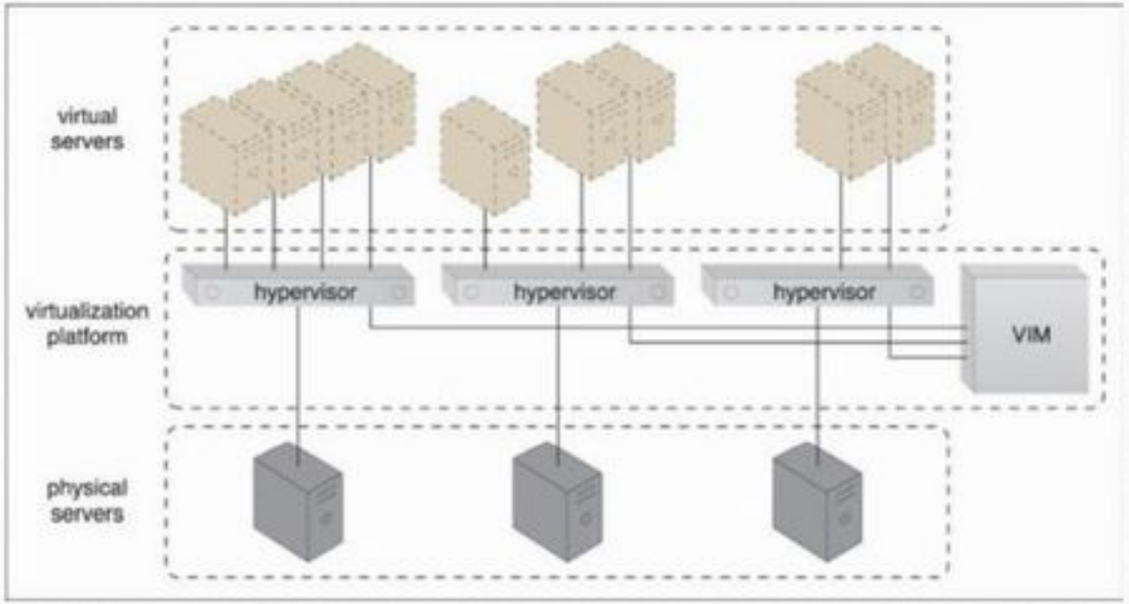
- A form of virtualization software that emulates a physical server.
- Used by a cloud provider for resources sharing.
- Virtual server = virtual machine





Case Study (DTGOV) Continued.

- DTGOV offers several types of pre-made VM images for its customers.
- VM images = virtual disk images used by a hypervisor to boot virtual servers.
- Template virtual servers.



Case Study (DTGOV) Continued

- Template Virtual Servers (may include pre-installed software/applications) examples:
- **Small Virtual Server Instance** – 1 virtual processor core, 4 GB of virtual RAM, 20 GB of storage space in the root file system
- **Medium Virtual Server Instance** – 2 virtual processor cores, 8 GB of virtual RAM, 20 GB of storage space in the root file system
- **Large Virtual Server Instance** – 8 virtual processor cores, 16 GB of virtual RAM, 20 GB of storage space in the root file system
- **Memory Large Virtual Server Instance** – 8 virtual processor cores, 64 GB of virtual RAM, 20 GB of storage space in the root file system
- **Processor Large Virtual Server Instance** – 32 virtual processor cores, 16 GB of virtual RAM, 20 GB of storage space in the root file system
- **Ultra-Large Virtual Server Instance** – 128 virtual processor cores, 512 GB of virtual RAM, 40 GB of storage space in the root file system

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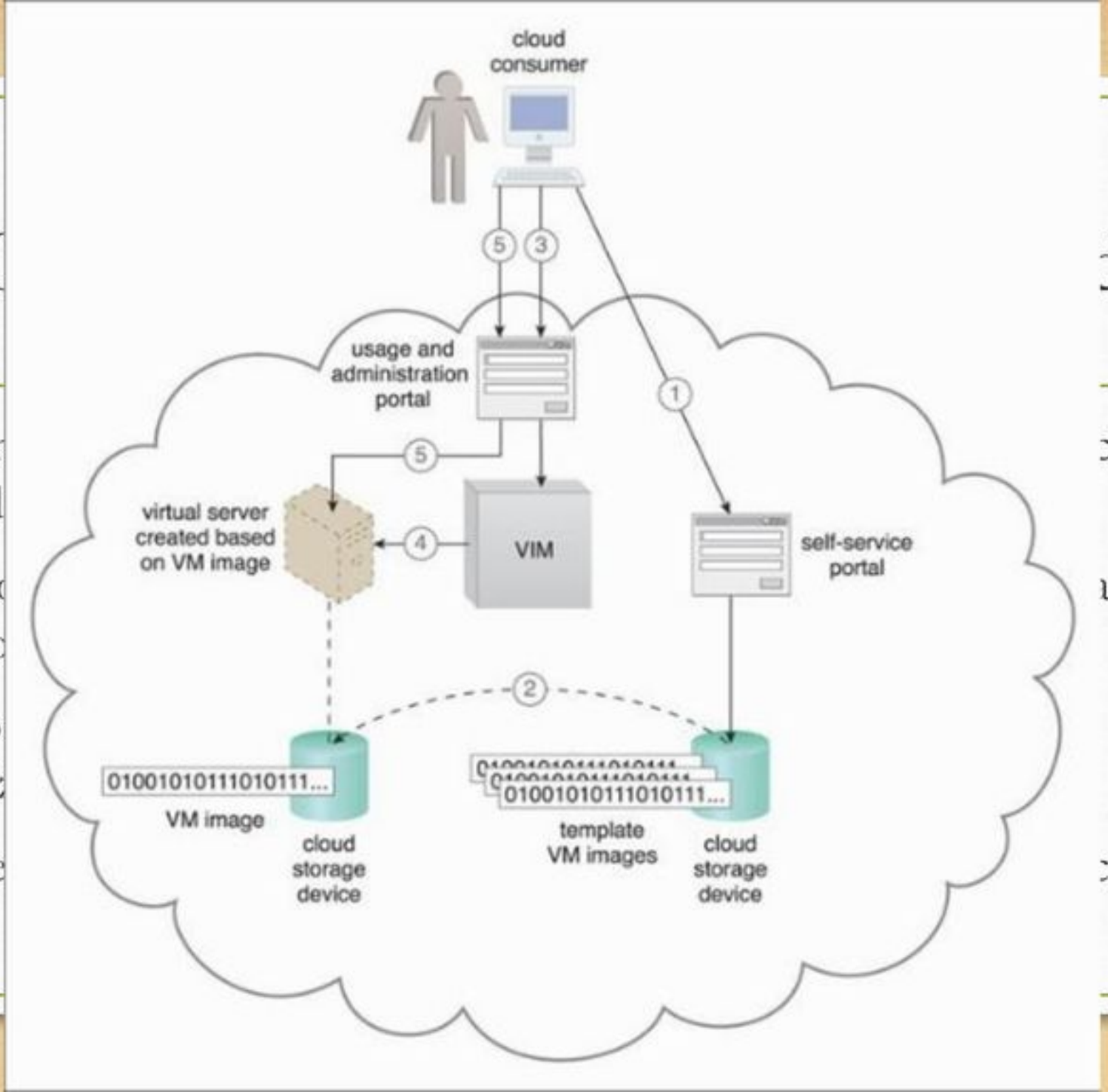

Cloud Storage Devices Mechanism

- Storage devices designed specifically for cloud-based environment.
- Instances of these storage could be virtualized.
- Able to provide fix-increment capacity allocation in support of pay-per-use mechanism.
- Primary concern - CIA

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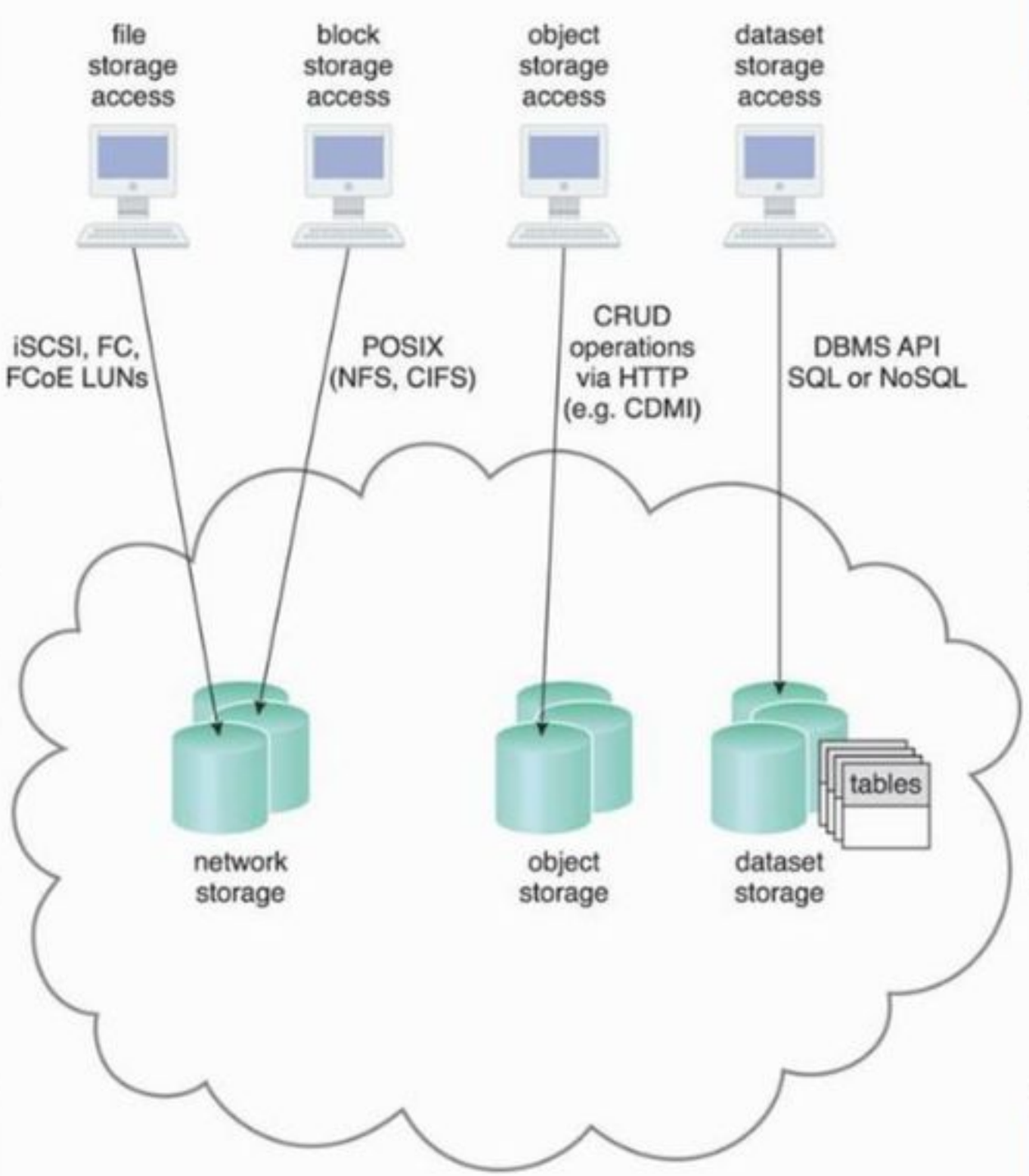
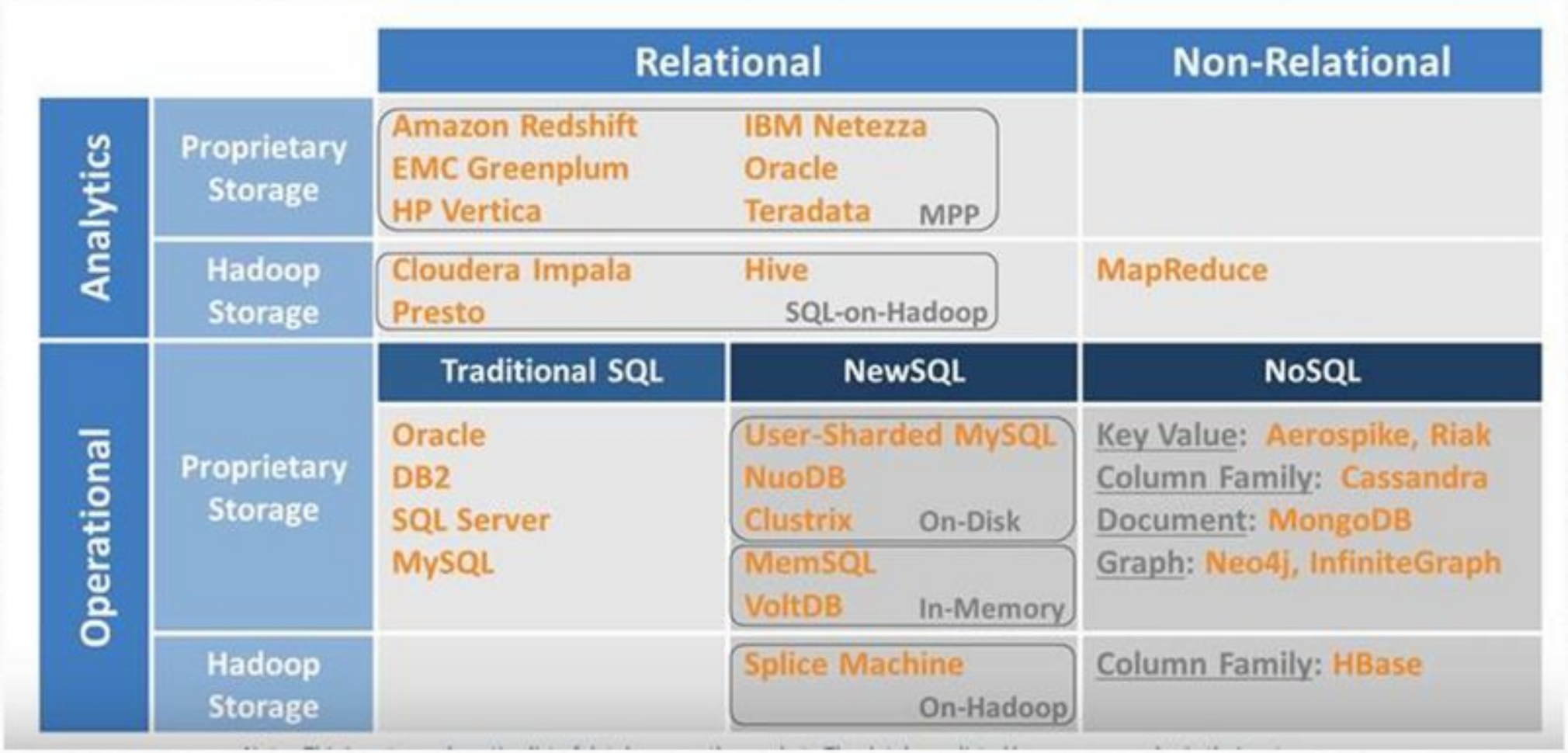


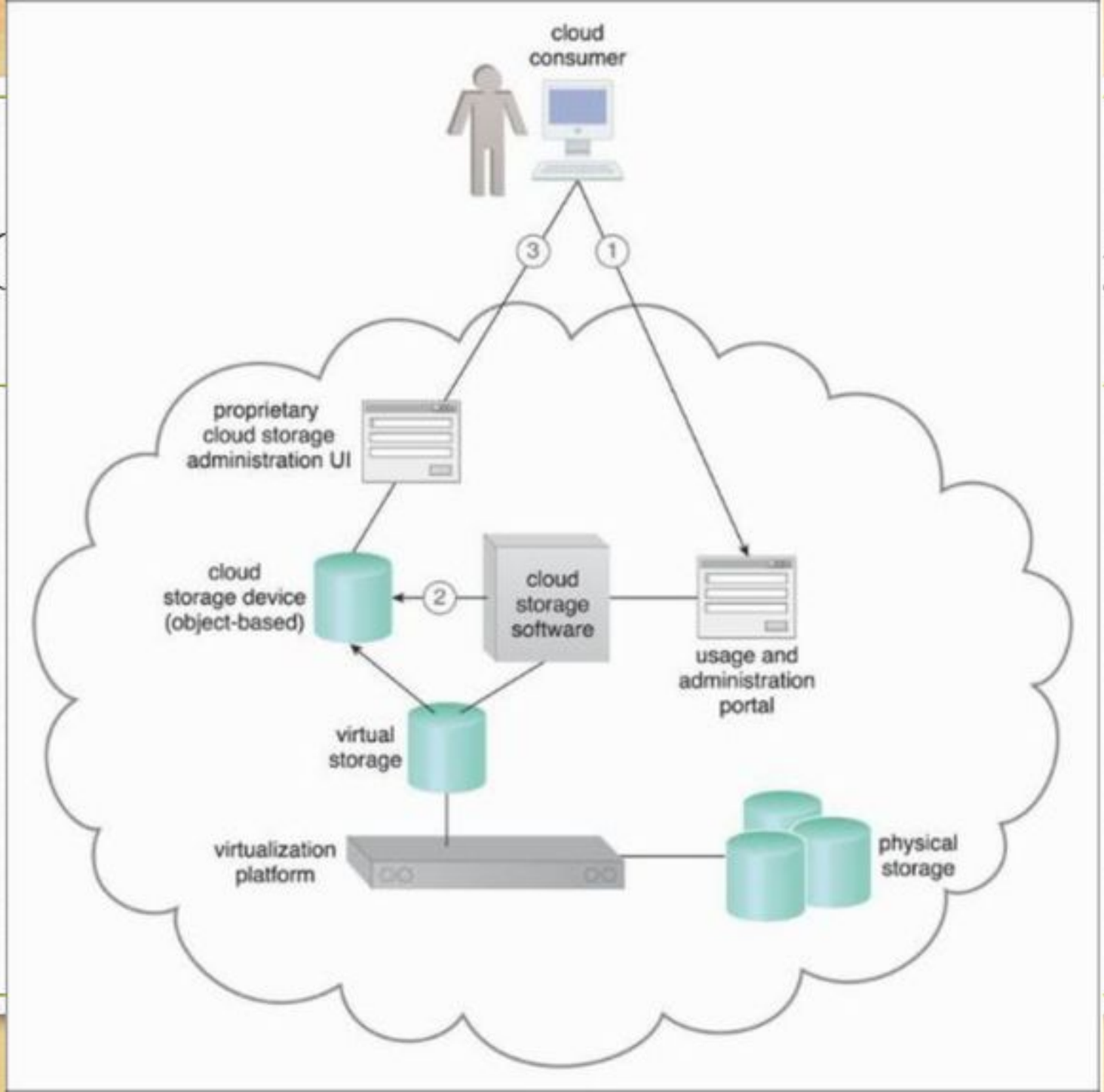
Technical Interfaces to Storage

- Network Storage Interfaces – Most legacy network storage falls under this category, e.g., SCSI for storage blocks, NFS for network storage.
  - Storage processing levels and thresholds for file allocation are usually determined by the file system itself (tend to be suboptimal)
- Object Storage Interfaces - Various types of data can be referenced and stored as Web resources. This is referred to as object storage.
  - REST protocol, Web service-based cloud services as examples

Technical Interfaces to Storage (2)

- Database Storage Interfaces – support a query language in addition to basic storage operations.
  - Relational Data Storage – relies on table to organize similar data into rows and columns. Use of the industry standard Structured Query Language (SQL). Examples include IBM DB2, Oracle database, Microsoft SQL and MySQL.
    - Complex relational database designs can imposes higher processing overhead and latency
  - Non-relational Data Storage – aims at reducing processing overhead of relational databases.
    - Drawback – tend to not support relational database functions such as transactions or joins.


Relational
Non-Relational
Analytics
Proprietary Storage
Amazon Redshift
EMC Greenplum
HP Vertica
IBM Netezza
Oracle
Teradata
MPP
Hadoop Storage
Cloudera Impala
Presto
Hive
SQL-on-Hadoop
MapReduce
Operational
Proprietary Storage
Traditional SQL
NewSQL
NoSQL
Oracle
DB2
SQL Server
MySQL
User-Sharded MySQL
NuoDB
Clustrix
On-Disk
MemSQL
VoltDB
In-Memory
Key Value: Aerospike, Riak
Column Family: Cassandra
Document: MongoDB
Graph: Neo4j, InfiniteGraph
Hadoop Storage
Splice Machine
On-Hadoop
Column Family: HBase


cloud
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cloud storage
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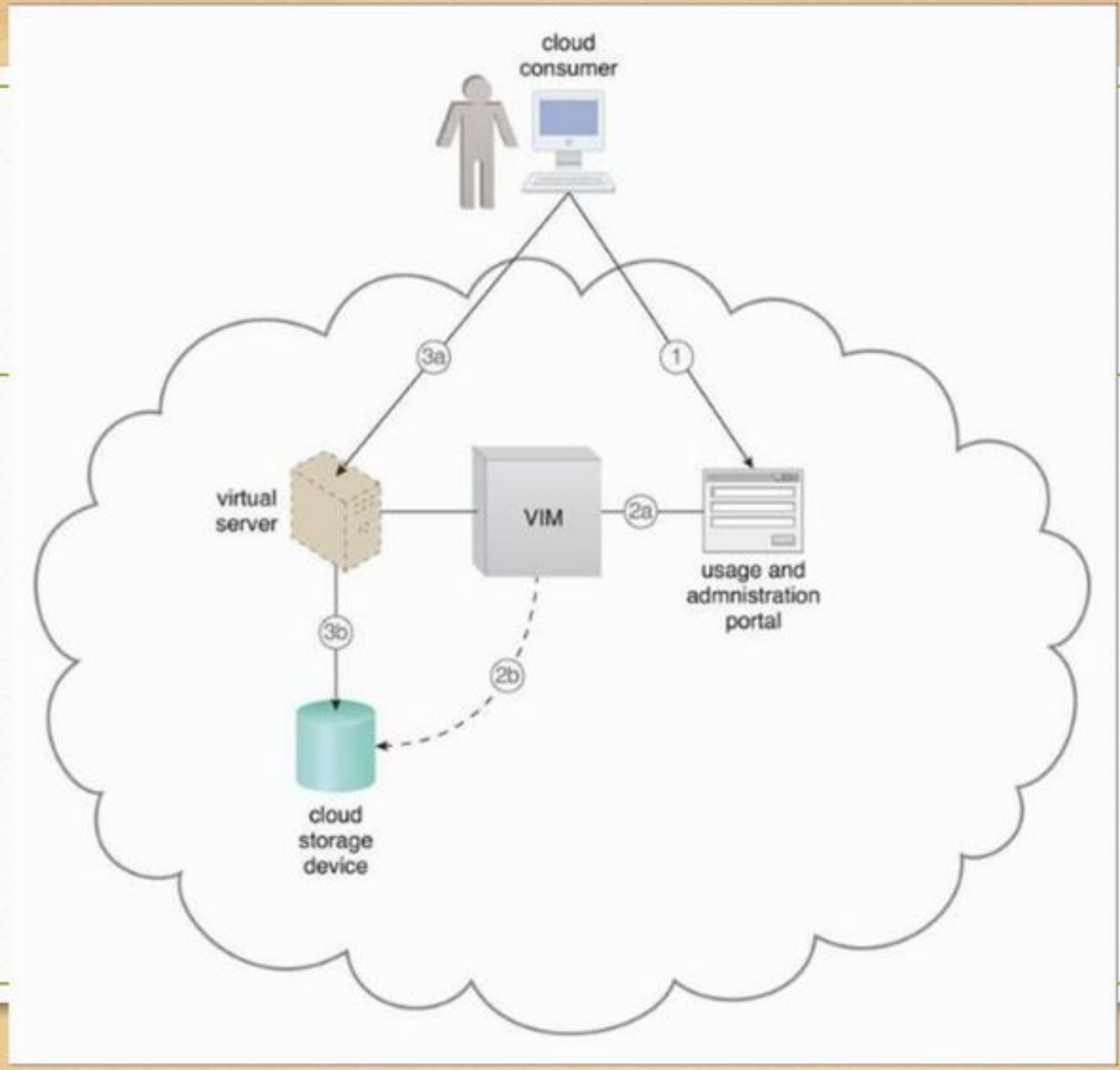
virtual
storage
virtualization
platform
physical
storage


cloud
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Cloud Usage Monitor Mechanism

- A lightweight and autonomous software program responsible for collecting and processing IT resource usage data.
- Metrics – amount of data, number of transactions, usage time, etc.
- Three common agent-based implementation formats:
  - Monitoring agent
  - Resource agent
  - Polling agent

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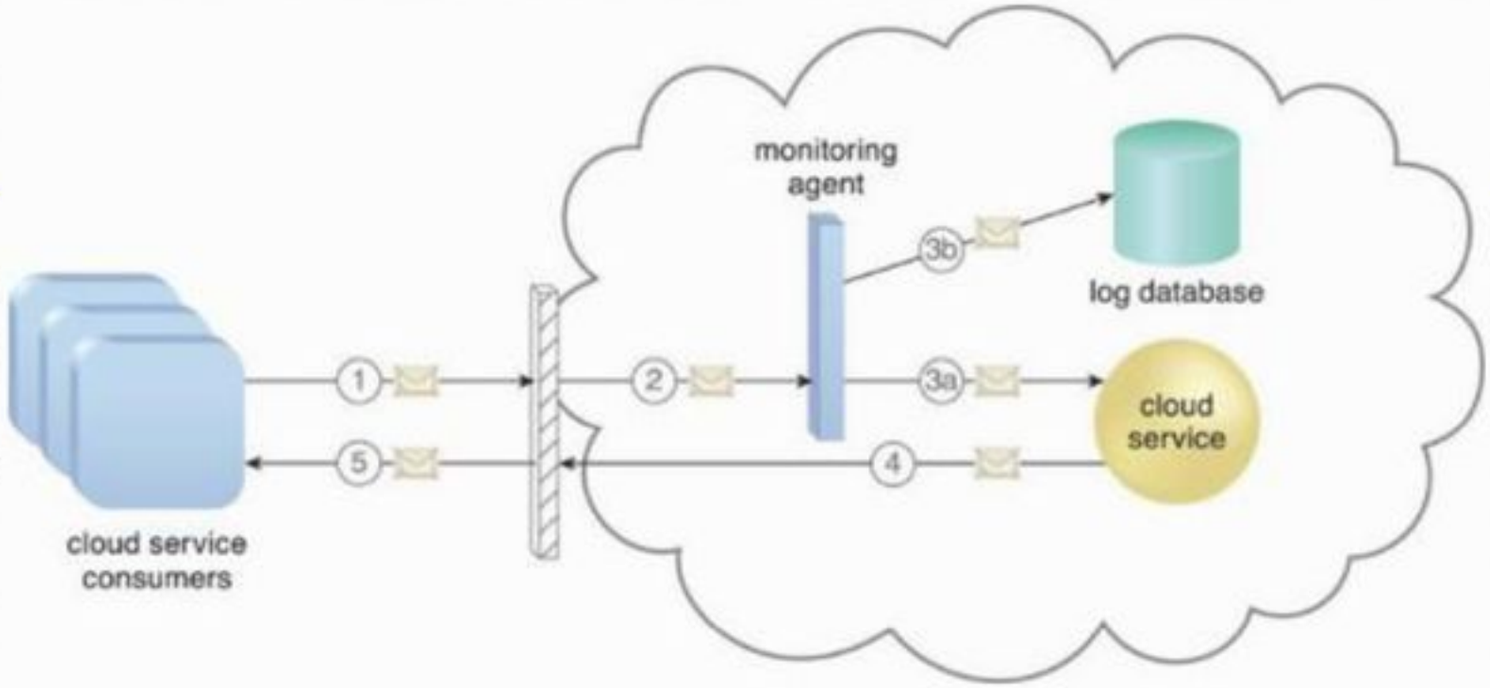

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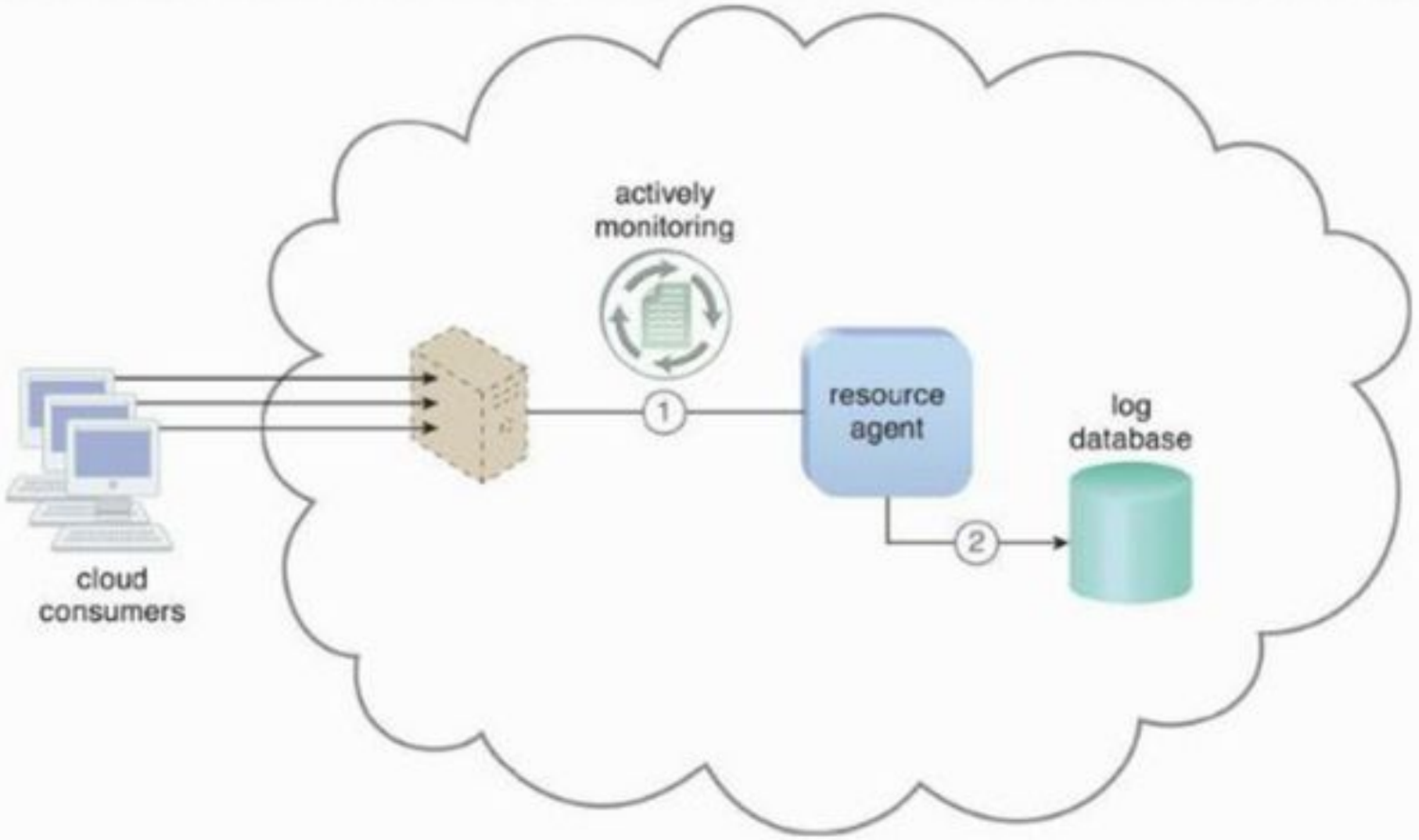

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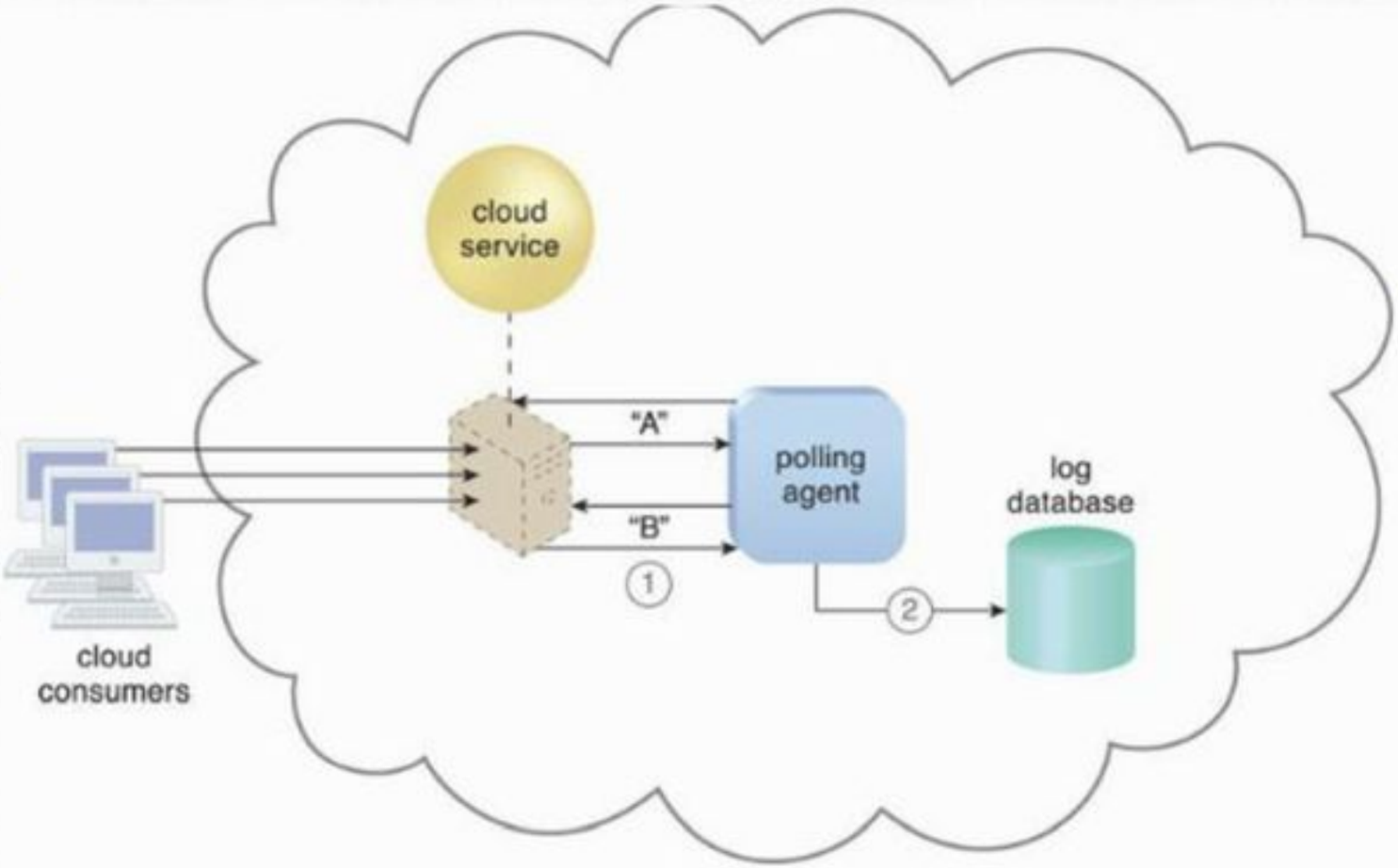

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Case Study (DTGOV) Continued

- Needs to define a model that allows virtual servers of varying performance levels to be leased and billed hourly.
- Each resource usage event that is generated by VIM contains the following data:
  - Event Type (starting, started, scaled, stopping, stopped), VM Type – pre-defined VM configurations, VM ID, Cloud Consumer ID, Timestamp.
  - Usage measurements – for every VM, a measurement period (in a scale of minute usage).
  - VM can be started, scaled and stopped multiple times (e.g., started and scaled, or scaled and scaled).

$$U_{\text{total\_VM\_type\_j}} = \sum_{t_{start}}^{t_{end}} T_{cycle_i}$$

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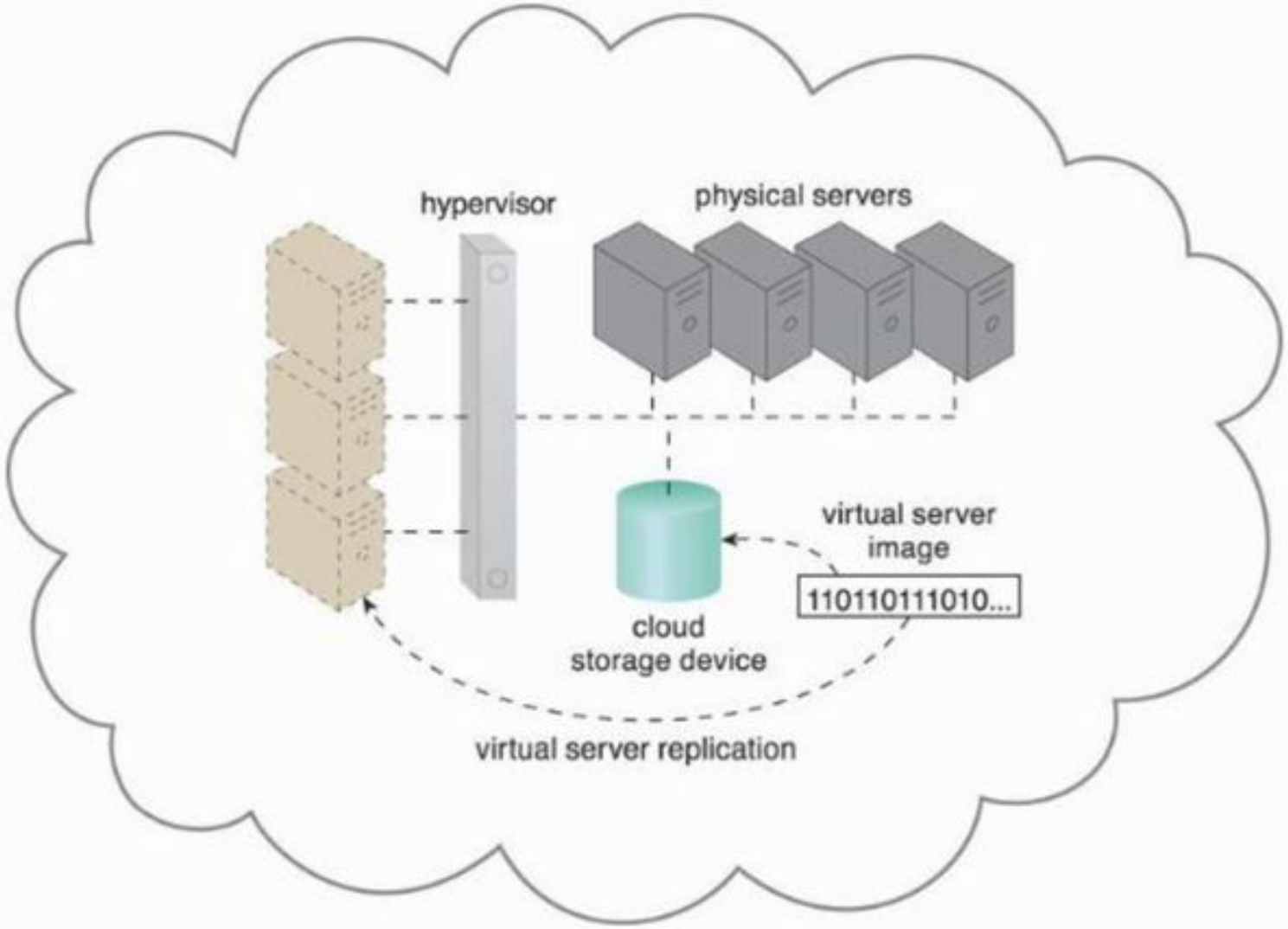
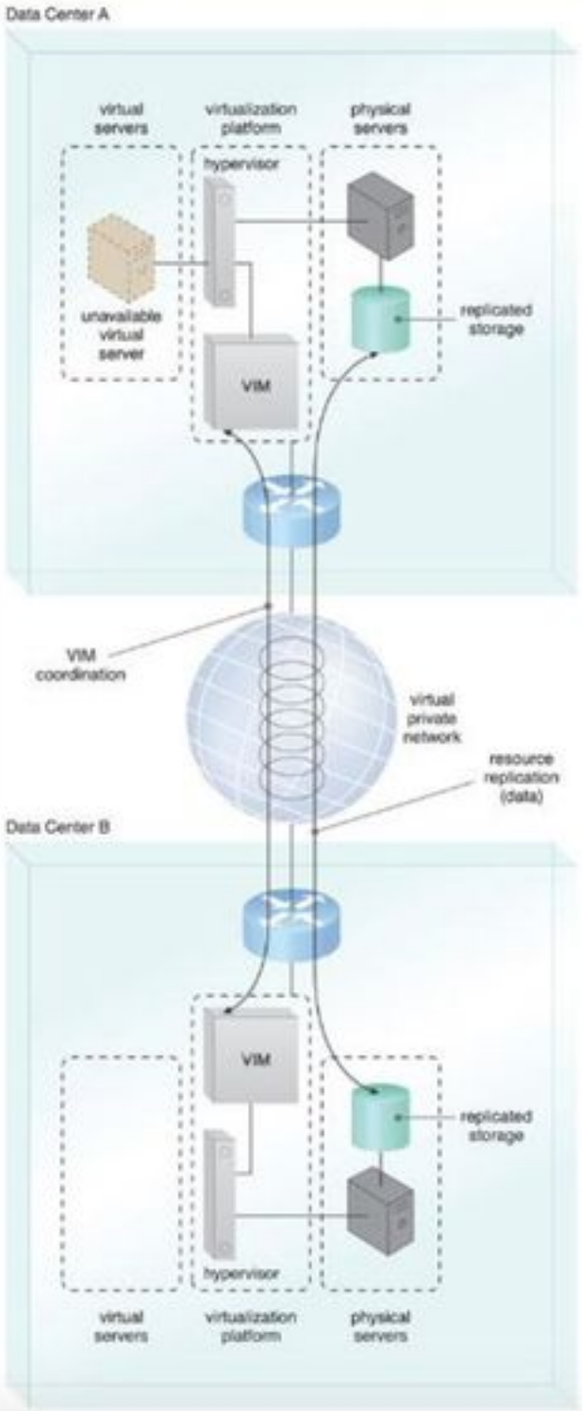
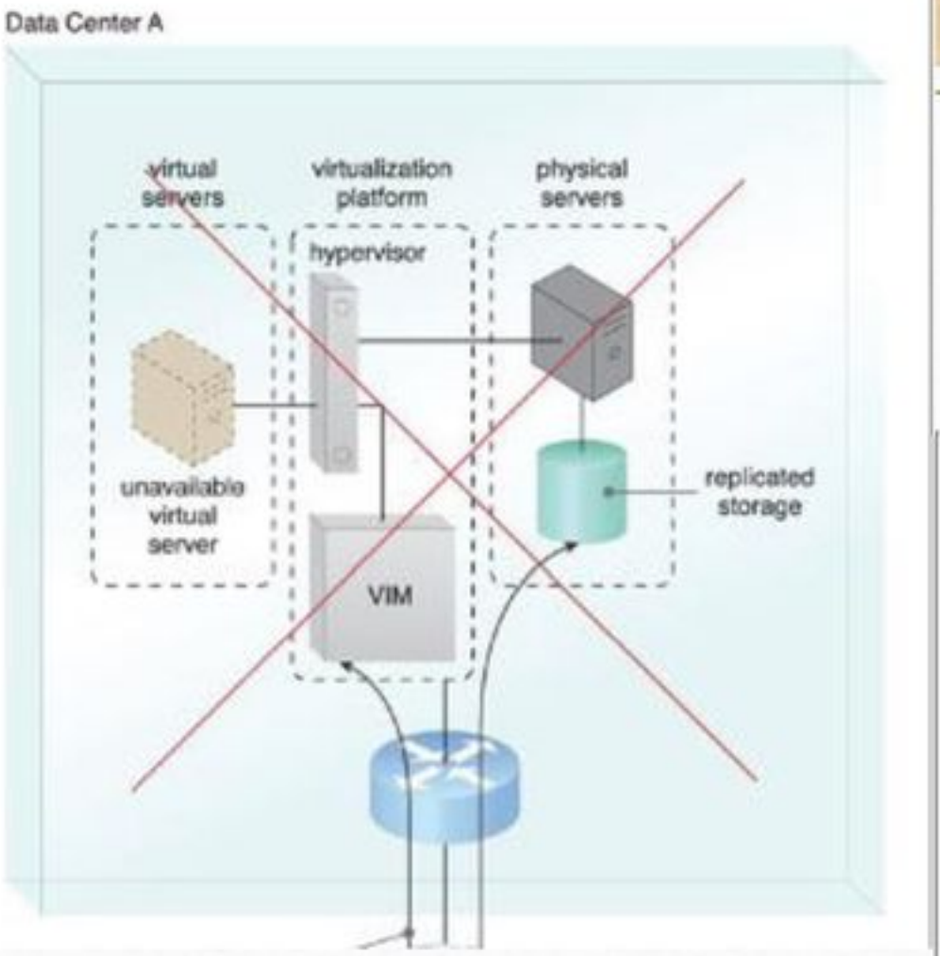
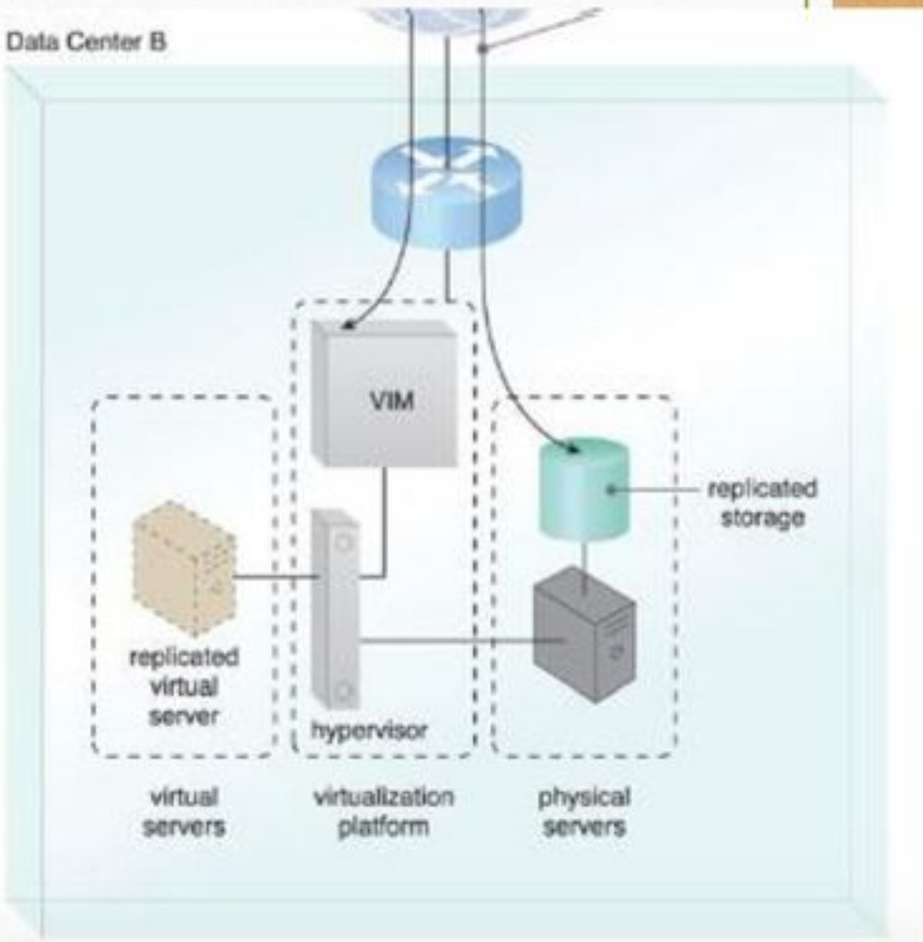


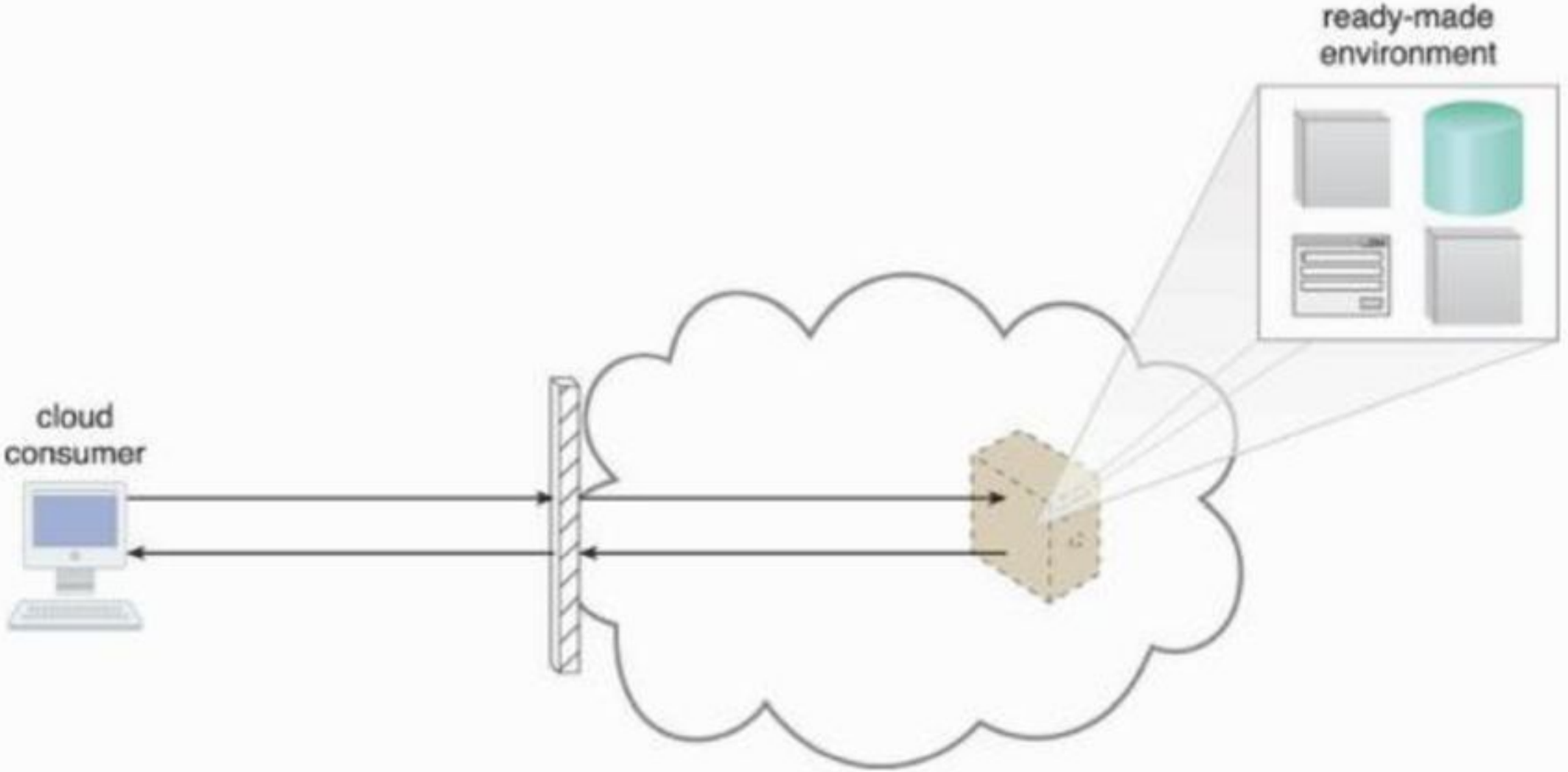
Case Study (DTGOV) Continued.

- A set of high-availability virtual servers that can be automatically relocated to physical servers running in different data centers in response to severe failure conditions.


Data Center A
virtual servers
virtualization platform
physical servers
hypervisor
unavailable virtual server
VIM
replicated storage
VIM coordination
virtual private network
resource replication (data)
Data Center B
VIM
replicated storage
hypervisor
virtual servers
virtualization platform
physical servers


Data Center A
virtual servers
virtualization platform
physical servers
hypervisor
unavailable virtual server
VIM
replicated storage


Data Center B
VIM
replicated storage
replicated virtual server
hypervisor
virtual servers
virtualization platform
physical servers


ready-made
environment
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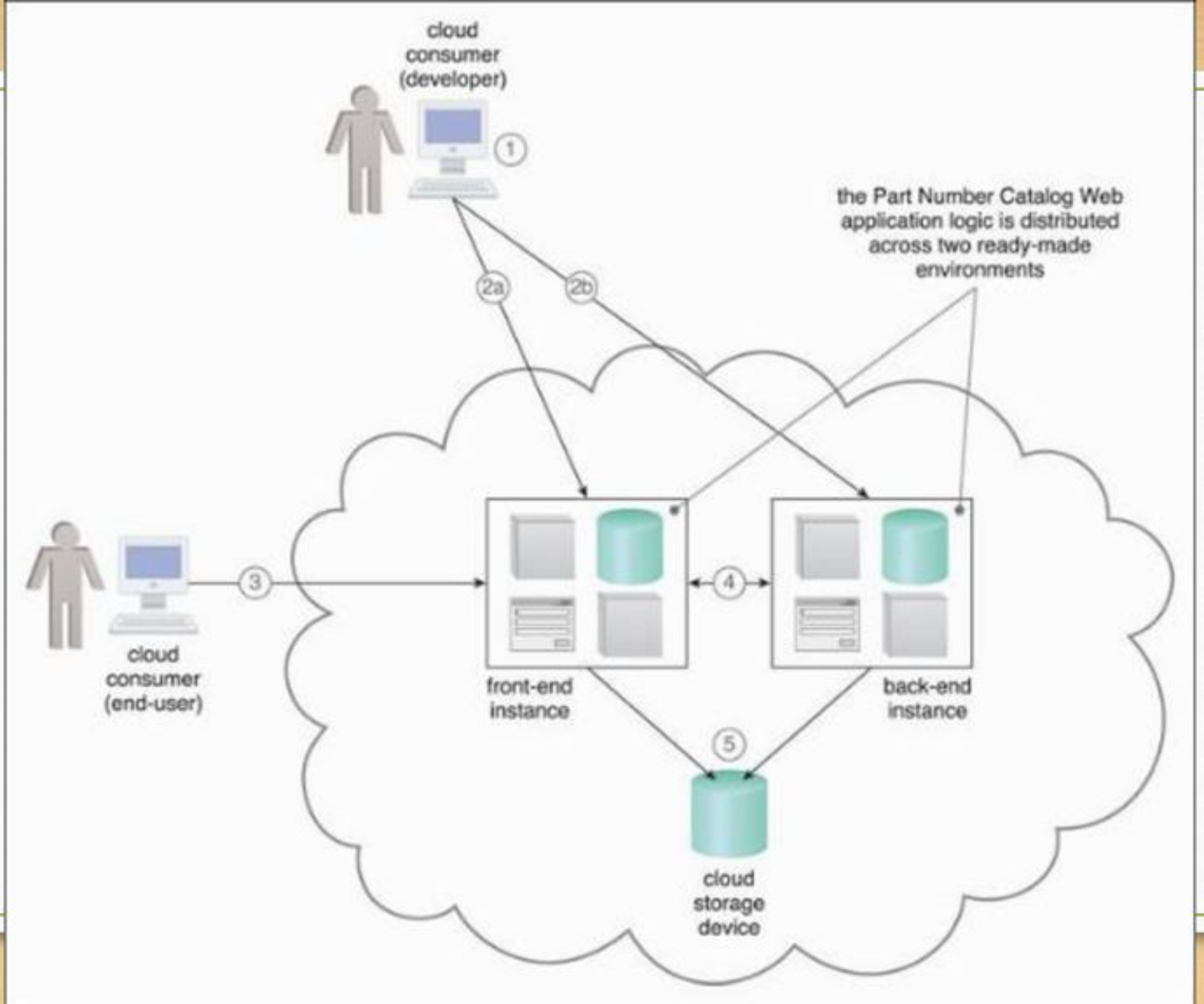
cloud
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cloud
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