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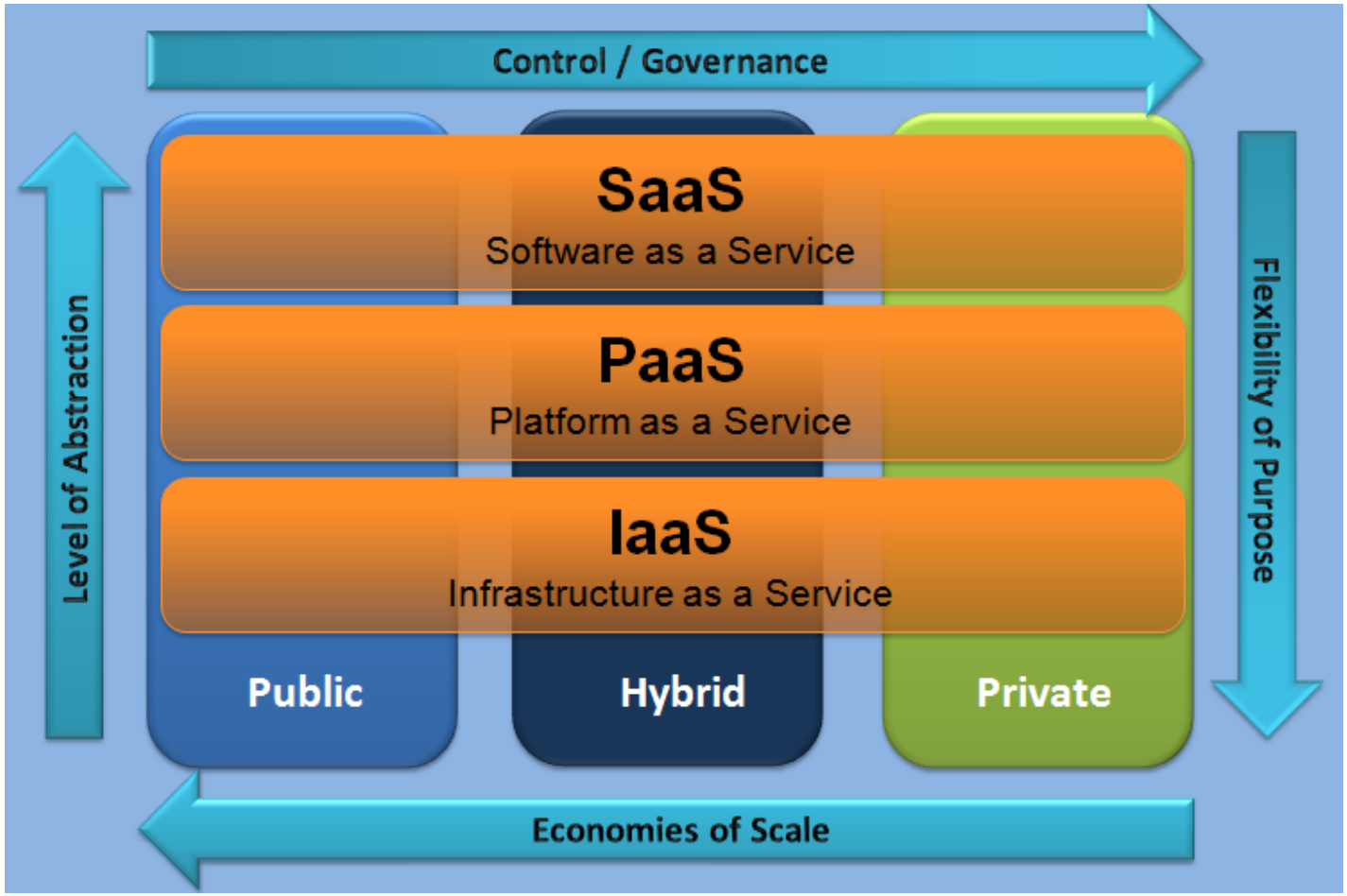
Service Models
IaaS

CCS3341 Cloud Computing

Dr S. Veloudis

Cloud Service Models



source: edu-infoo.org

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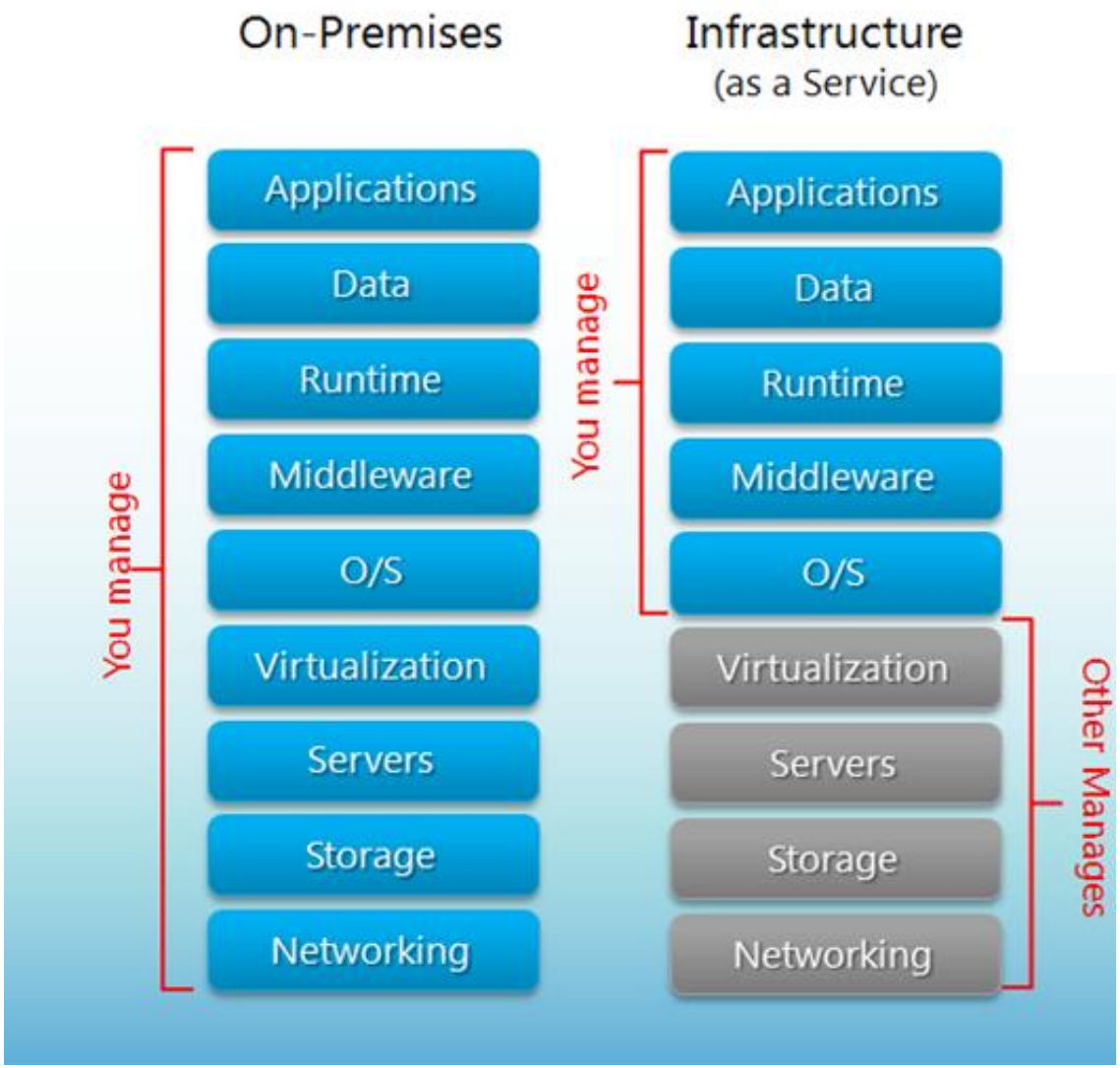
IaaS



source: blogs.technet.microsoft.com

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IaaS – AWS

- Main concepts:
  - EC2 instance
    - A virtual server running a guest OS based on the machine image from which the instance was cloned
  - AMI (Amazon Machine Image)
    - A clean copy of a server that can be used to launch any number of instances
    - It has a core OS and common preinstalled tools

- Availability zone
  - Roughly analogous to a data centre
  - Any two availability zones are guaranteed not to share any common infrastructure

Note: A machine image is the prototype from which virtual servers are created. It as a copy of the server's hard drive that gets cloned onto a new server's virtual hard drive just before the server is launched.

IaaS – Computation as a Service

- Supplies virtual machine images (CPU and RAM) of different OS flavours
- These images can be tailored by the user to run any custom or packaged application
- The user can bring online and use instances of these virtual machine images on an as-needed basis and with a high degree of flexibility
  - The user is operating with the least amount of pre-packaged functionality
- The use of virtual machine images is typically metered and charged in granular hour-long increments
- There is also the possibility to rent dedicated servers
  - Frees from the disadvantages of IaaS-level multi-tenancy (of course at a hefty extra cost…)

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IaaS – Computation as a Service

- Other consumable IaaS commodities include:
  - Storage
  - Network connections – essentially IP endpoints
  - Bandwidth
  - VPN connections
  - Elastic load balancing

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IaaS – AWS

- Connecting to an instance
  - Can connect through the AWS site
  - Or through a tool such as PuTTY – an open source terminal emulator that allows secure connection via SSH
  - SSH ensures security through asymmetric encryption, i.e. through the use of a public and a private key pair
    - Everything encrypted with the private key can only be decrypted with the public key and vice-versa
  - AWS provides a key pair (in case the user does not have one)

```
Encryption: none
Comment: imported-openssh-key
Public-Lines: 6
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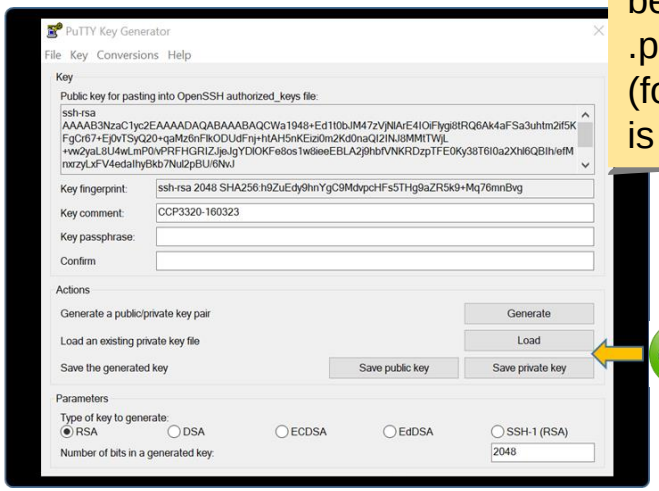

Note: A key pair may be downloaded in .pem or .ppk format (for PuTTY, the latter is needed)

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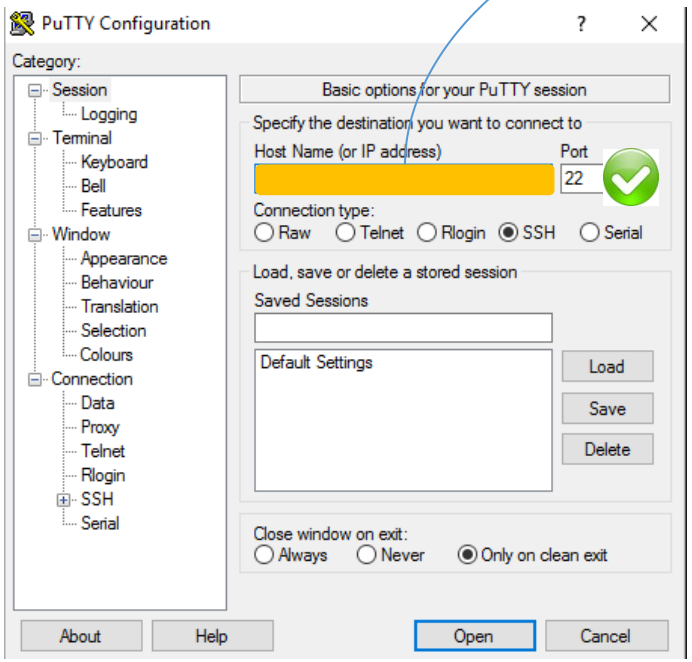
IaaS – AWS

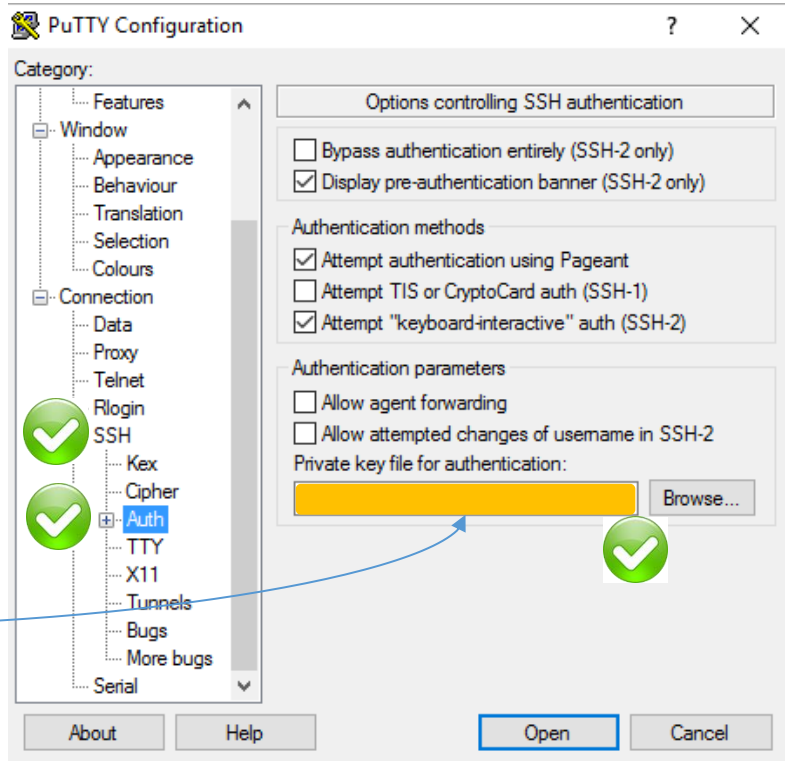
- Start PuTTY

username@public_DNS

the public DNS of the instance

standard name provided by EC2, e.g. `ec2-user`, `ubuntu`





.ppk private key created previously

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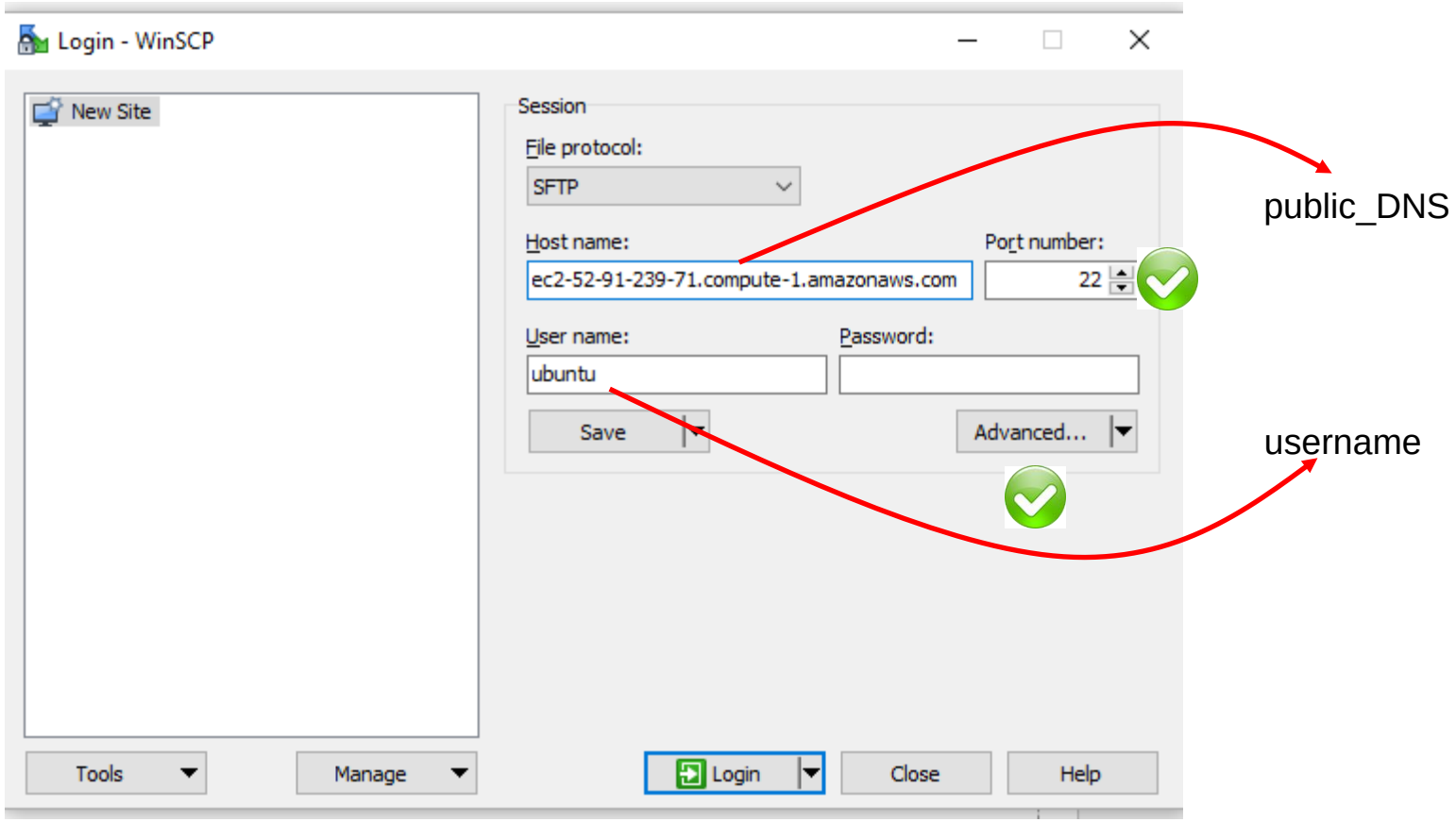
IaaS – AWS

- To transfer files from the local host to the running instance is WinSCP



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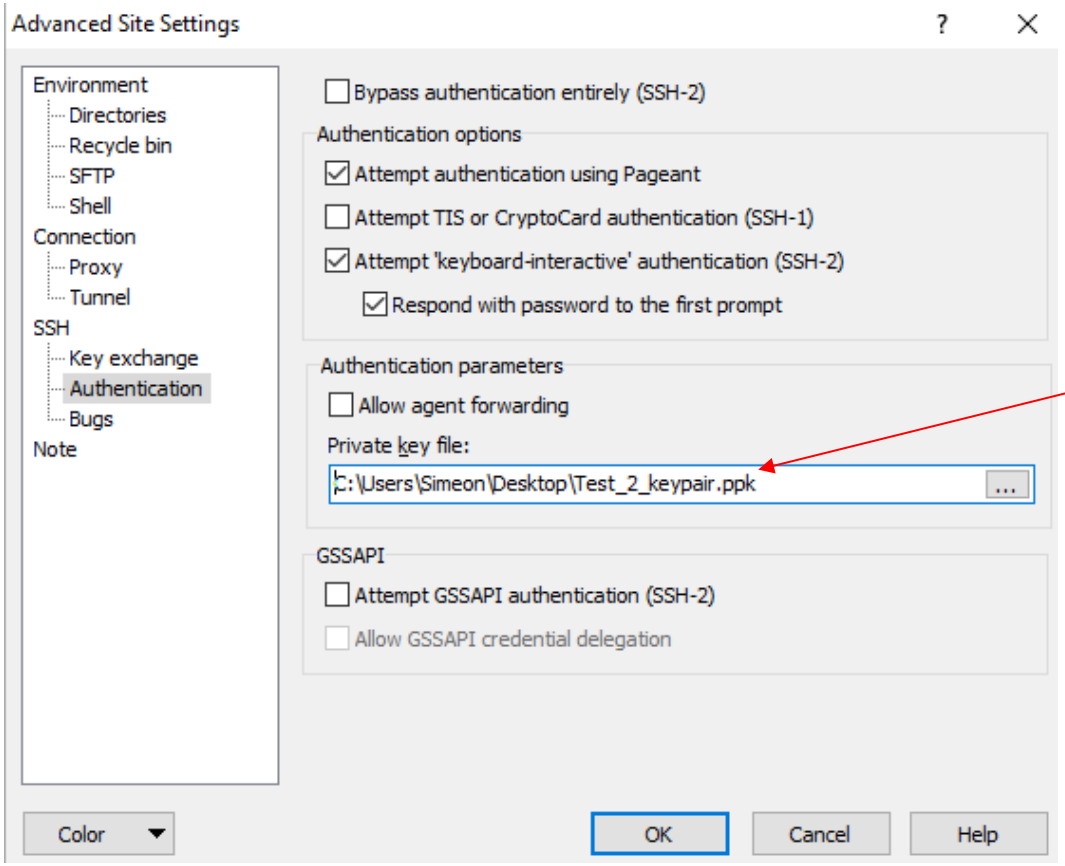
IaaS – AWS

- WinSCP (contd.)



.ppk private key created previously

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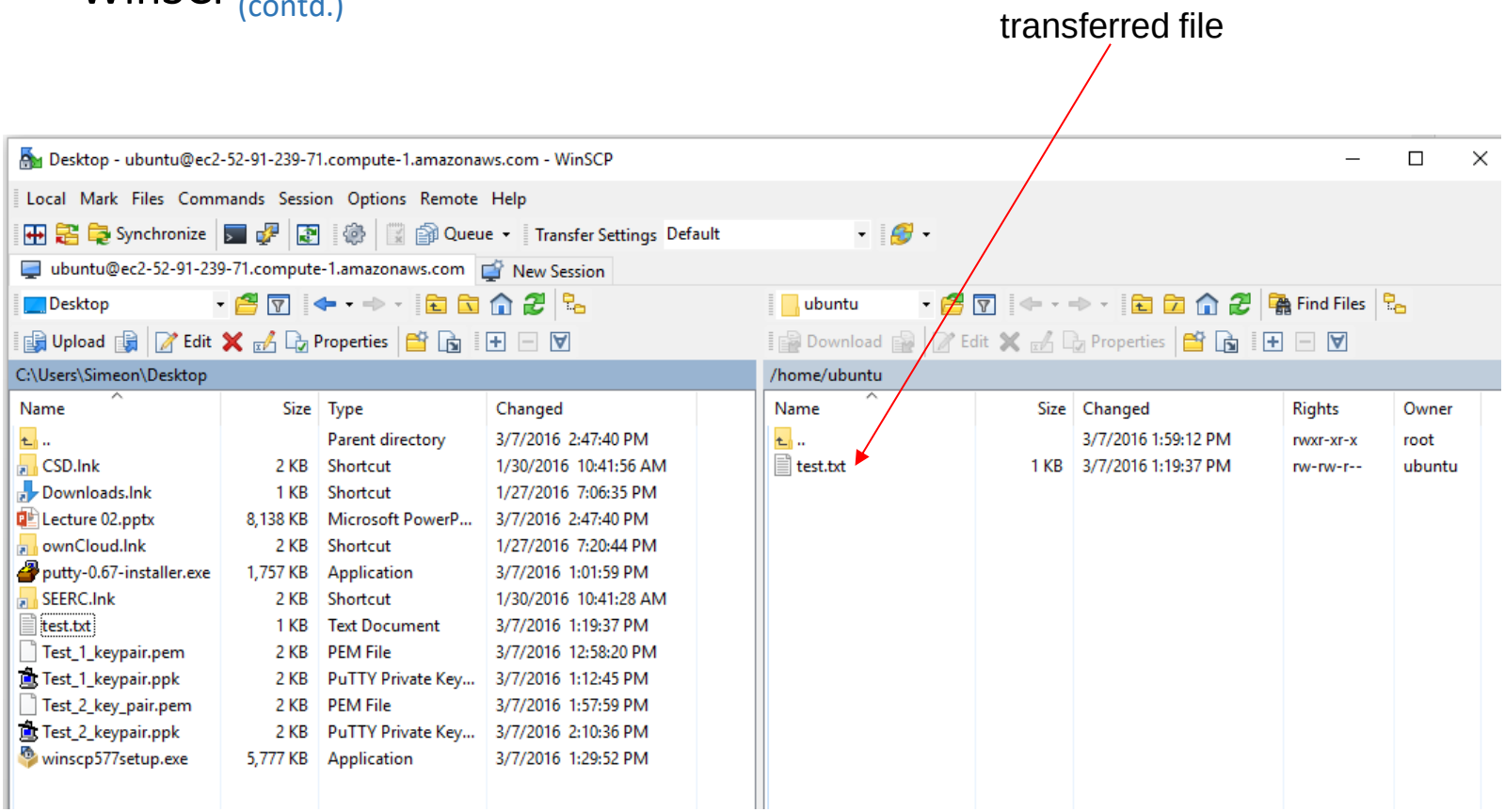
IaaS – AWS

contd.

- WinSCP (contd.)



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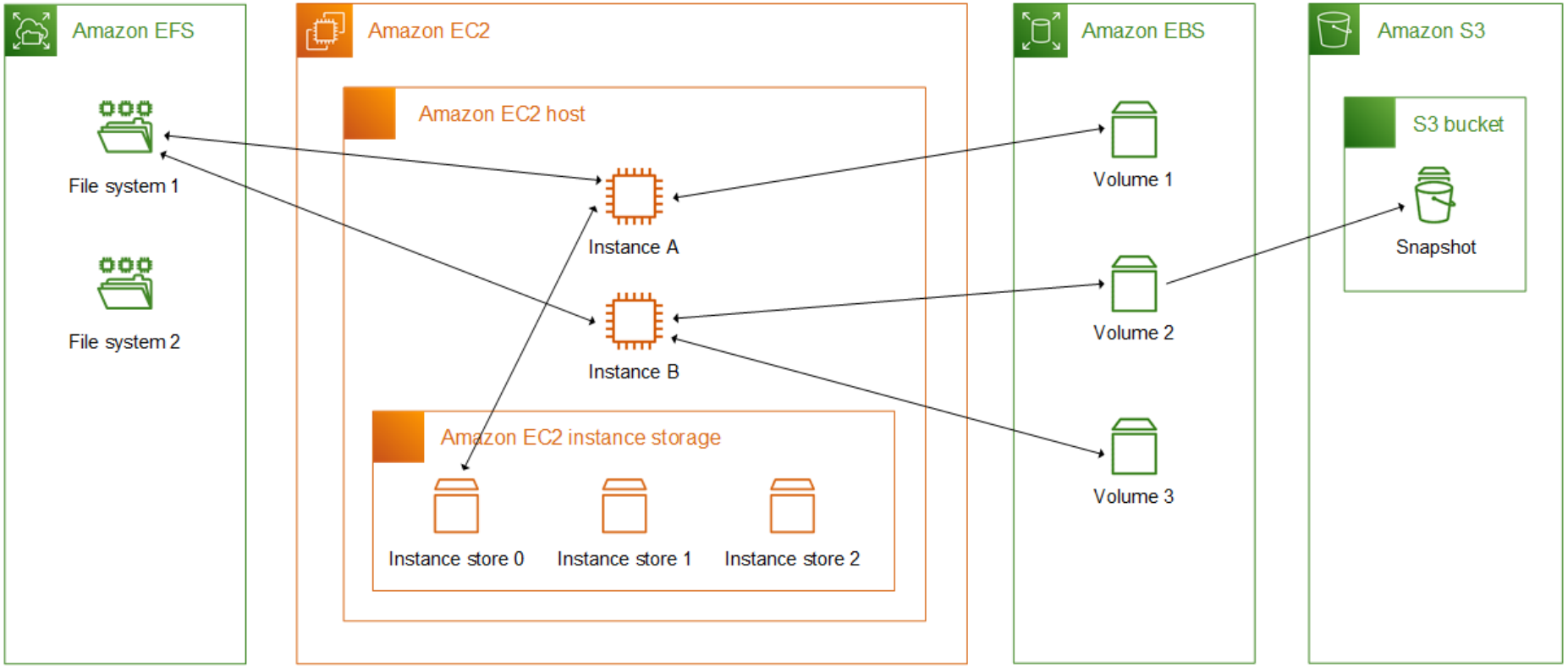
IaaS – AWS: Storage



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IaaS – AWS: Storage

- Stores data directly into fixed-size blocks
- Random access
- High performance

Elastic Block Storage (EBS)

- EBS provides **block**-level **network** storage that can be attached to Amazon EC2 (Elastic Compute Cloud) instances
- Offers high performance, low-latency access, and durability
- Typically used for hosting databases and disk images
- Not shareable between multiple instances

Flavours:
- General Purpose (SSD)
- Provisioned IOPS (SSD)
- Magnetic (HDD)

Elastic File Storage (EFS)

- Fully managed, **sharable**, **scalable**, and **network** file storage service
- Well-suited for scenarios where multiple EC2 instances need shared concurrent access to files

Instance Storage

- Physically connected to the underlying host aware (local storage)
- Can only be attached to an instance once (initially)
- **Ephemeral** – data does not persist if instance is stopped, terminated, or hibernated (but survives instance reboots)
- High I/O performance

Simple Storage Service (S3)

- **Object storage**
- High durability and redundancy (data replication across different availability zones)
- Features versioning, security (encryption), and data bucket rules
- Used for data analytics

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IaaS – AWS: EBS

General Purpose SSD

- Suitable for a wide range of workloads, including boot volumes, small to medium-sized databases, and development/test environments
- Burst performance is based on credits earned during low-usage periods

Provisioned IOPS SSD (io1)

- I/O-intensive workloads, such as large databases, NoSQL databases, and critical business applications
- Volume size and IOPS configured upon volume creation
- Optimised for low latency access

Throughput Optimized HDD (st1)

- Cost-effective for large, sequential workloads, such as big data processing, data warehousing, and log processing
- Optimised for throughput rather than low latency – suitable for sequential accesses

Cold HDD (sc1)

- Cold HDD volumes are designed for less frequently accessed data, such as archival storage and backups
- Low cost

IaaS – AWS: EFS

Standard storage classes

EFS Standard and **EFS Standard–Infrequent Access** (**Standard–IA**), which offer Multi-AZ resilience and the highest levels of durability and availability

One Zone storage classes

EFS One Zone and EFS One Zone–Infrequent Access (**EFS One Zone–IA**), offers additional savings by choosing to persist data in a single Availability Zone

IaaS – AWS

- Amazon's Simple Storage Service (S3)
  - A web service offered by AWS for persistent cloud storage
    - Exposes REST and SOAP interfaces
  - Advocates an object storage architecture
    - Data objects are stored in buckets
    - Each object cannot be larger than 5TB and is accompanied by up to 2KB of metadata
    - Buckets do not present a hierarchical structure – i.e. no 'sub-buckets'
    - Data objects can be computer files or folders
    - CRUD operations on buckets and objects are usually performed through a RESTful interface (though a SOAP interface is supported as well)
      - Buckets and objects are identified by URIs
  - S3 does provide a browser-based UI for creating and manipulating buckets
    - Bucket manipulation can also be done by using an appropriate (external) tool or programmatically

Note: Amazon does not make details of S3's design public.

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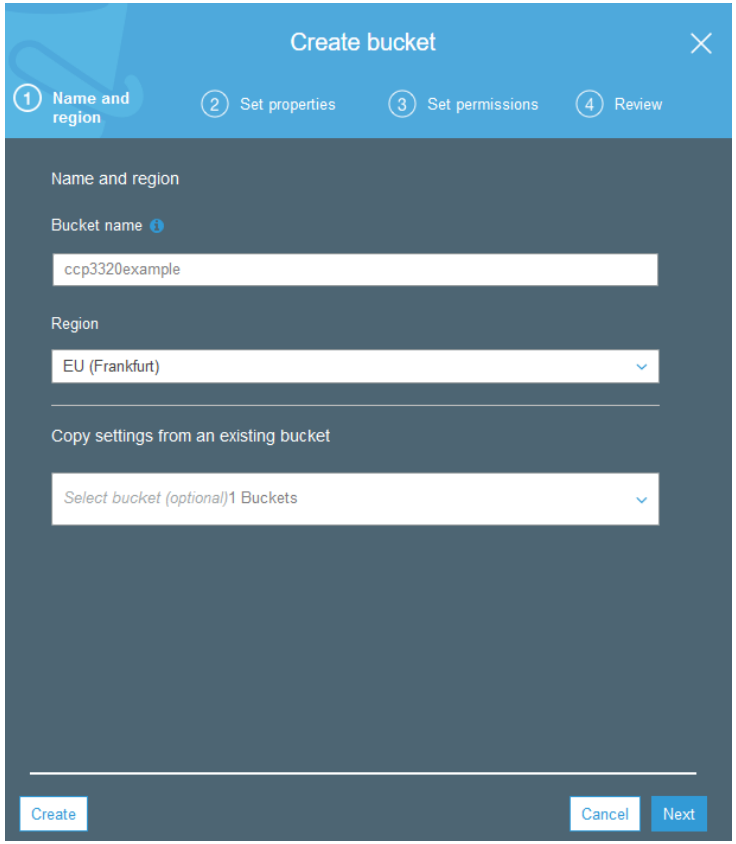
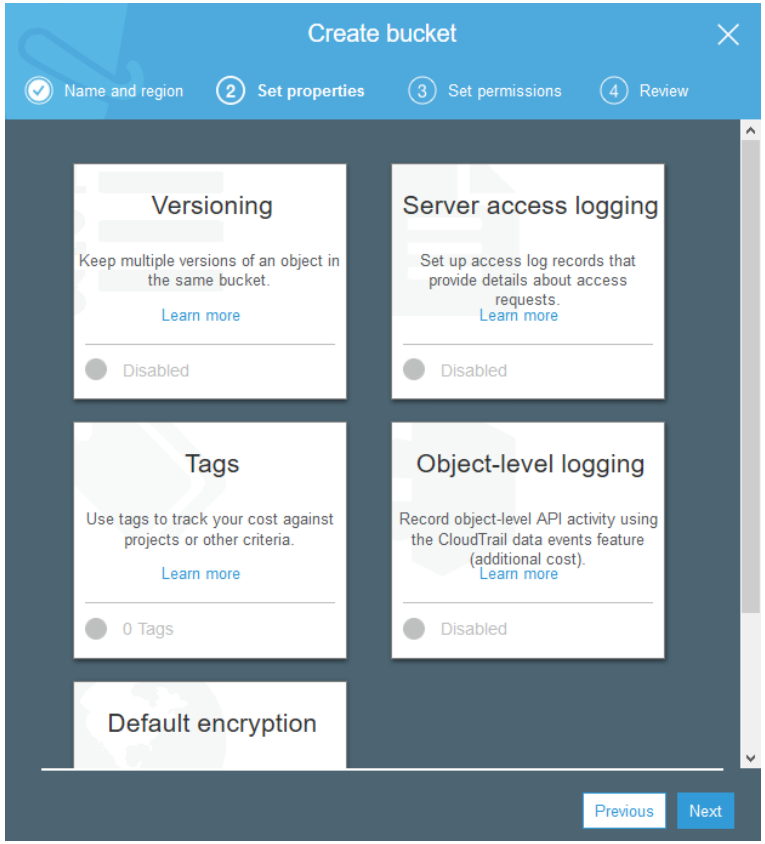
IaaS – AWS

- Amazon S3 (contd.)
  - Browser-based bucket creation and property-setting





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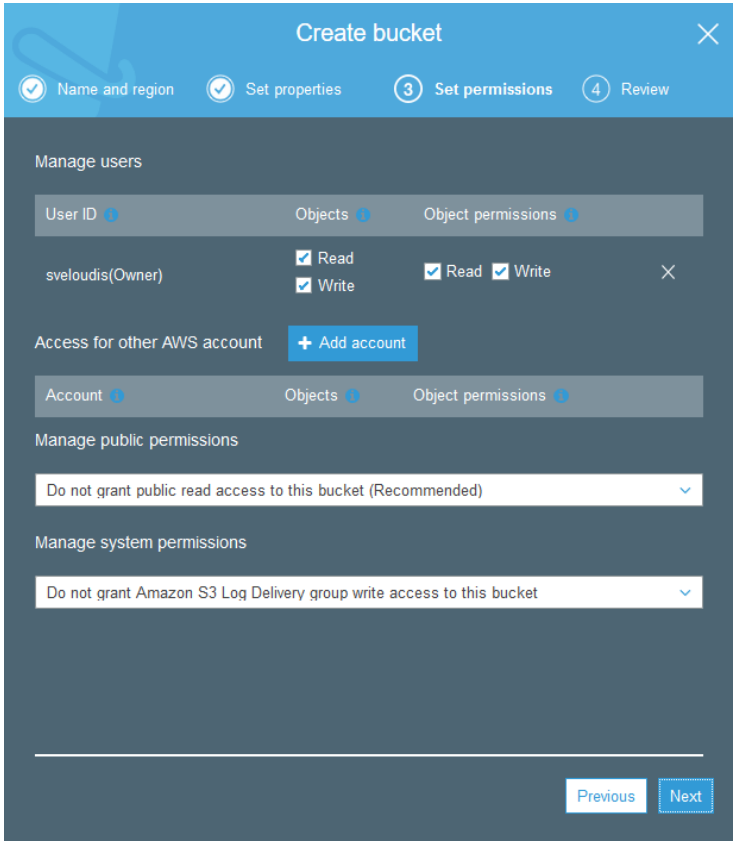
IaaS – AWS

- Amazon S3 (contd.)
  - Browser-based bucket permission-setting



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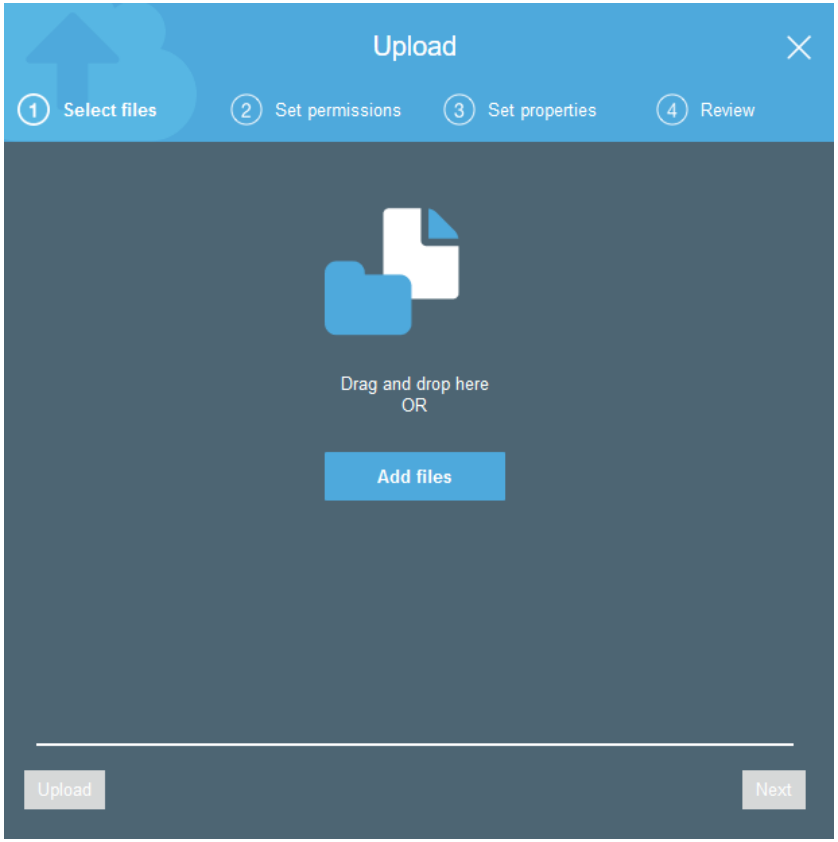
IaaS – AWS

- Amazon S3 (contd.)
  - Browser-based object upload



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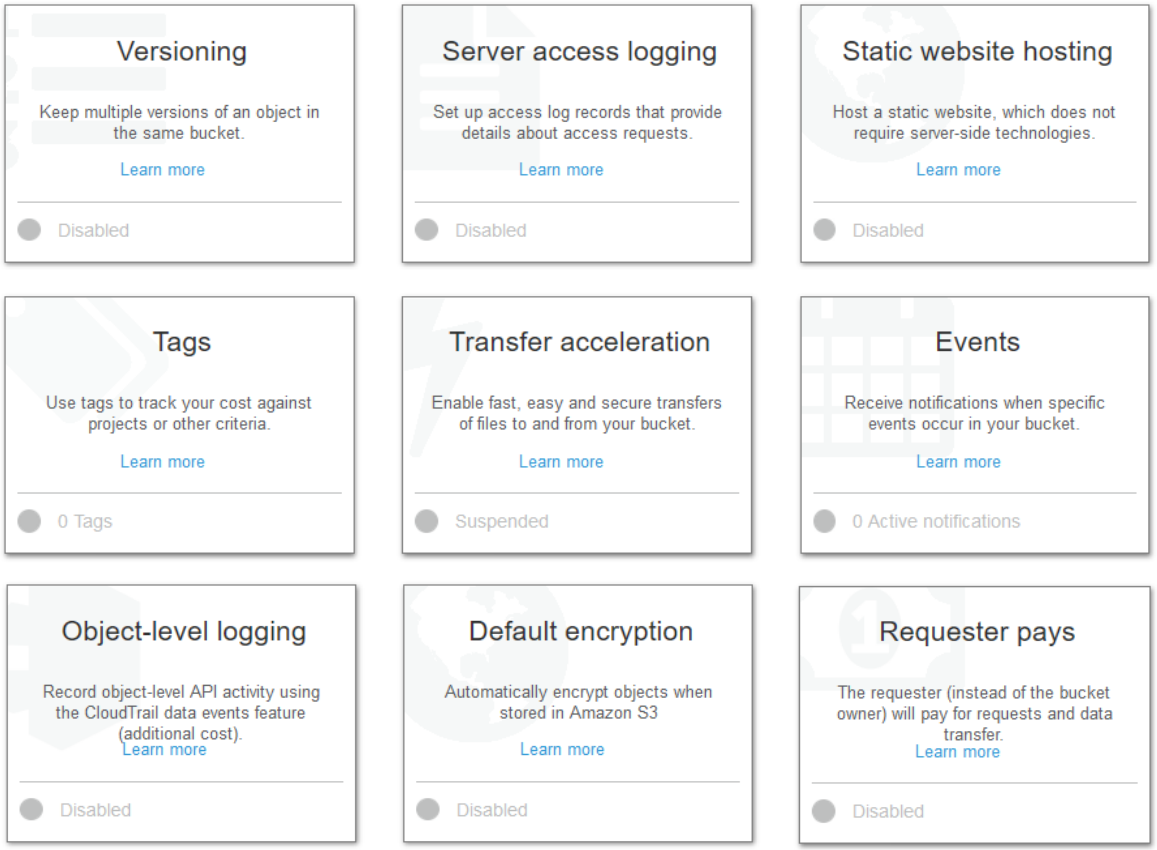
IaaS – AWS

- Amazon S3 (contd.)
  - Browser-based object property-setting



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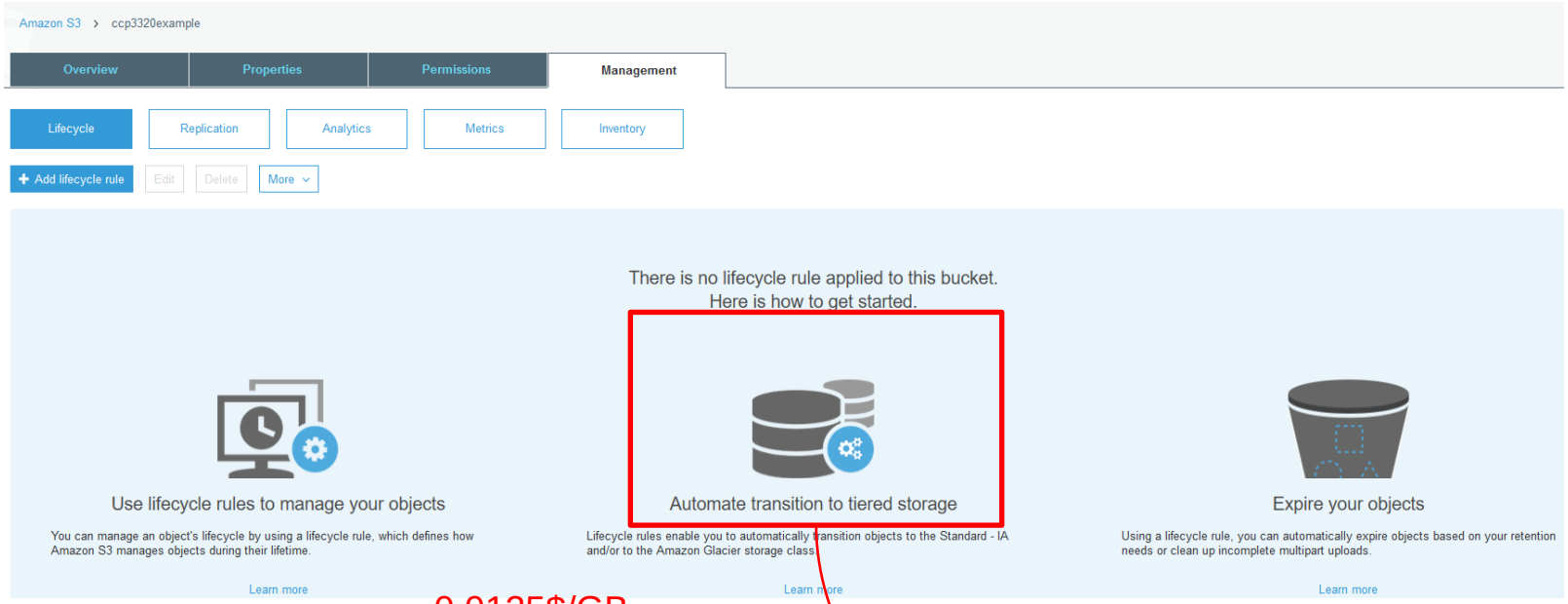
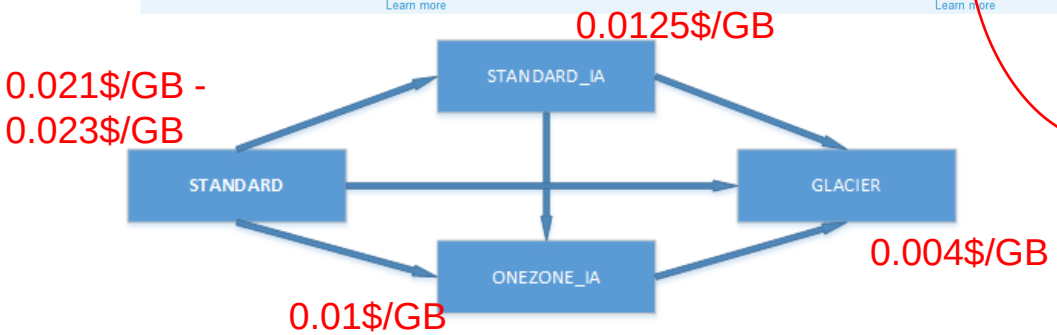
IaaS – AWS

- Object transition





Rules for automatic transition of objects into IA (infrequent access) – e.g. after x days of inactivity

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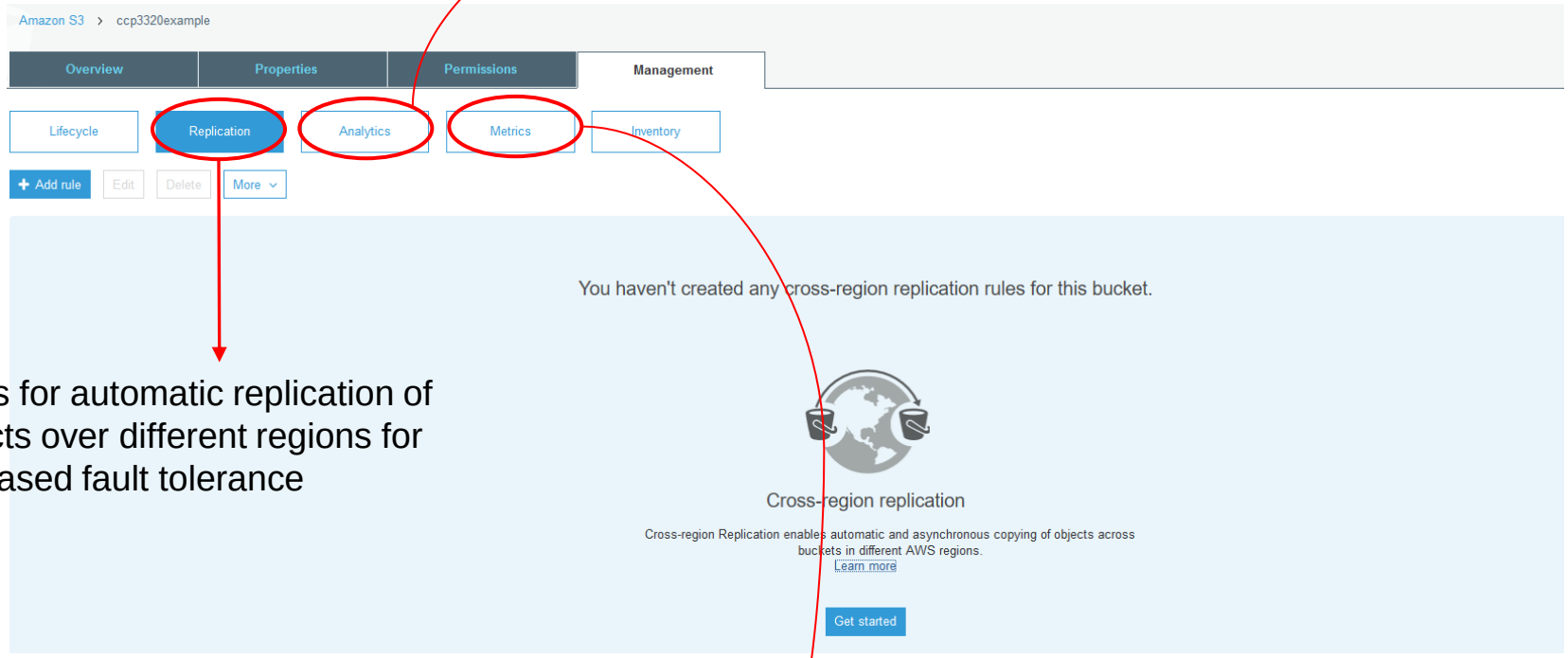
IaaS – AWS

- Object replication

S3 analyzes access patterns and suggests a candidate age to transition objects to Standard - IA for a lifecycle rule (paid feature)



Rules for automatic replication of objects over different regions for increased fault tolerance

Activates request metrics that enable fine-grained monitoring of object activity – can count GET, PUT, POST, DELETE, etc. requests to an object over a time interval

IaaS

- Benefits
  - Cost savings
    - Leveraging economies of scale allows lower infrastructure setting up, running and maintenance costs
    - The flexible pay-as-you-go model incurs lower costs as it allows usage to be monitored, measured, and billed transparently based on utilisation
  - Agility and increased productivity
    - No need to spend time and effort on planning and purchasing servers, networking equipment, etc.
    - Easy and cost-effective to quickly setup the infrastructure required for testing up new ideas
    - Faster time to market
    - Focus on business growth rather than on IT-related issues
    - Location independence
  - Performance and availability
    - Scalability to cope with increased demand loads

IaaS

contd.

- Benefits (contd.)
  - Reliability
    - Provides support for disaster recovery and business continuity
  - Power-efficient
    - Multi-tenancy and virtualisation permit less power consumption
- Criticisms
  - Security
  - Lock-in effect
    - Difficult (and costly) to move massive data from one IaaS provider to another
    - Difficult to re-architect the data around the services offered by the new IaaS provider (e.g. load balancing, auto-scaling, etc.)