Cloud Computing

Fundamentals

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Cloud Computing
Agenda

- What is cloud computing?

- Why cloud computing?

- Example of applications hosted on the cloud

- Cloud service Models

- Deployment Models

- Summary

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Cloud Computing
Agenda

- # Hammam Abdelwahab

- Bachelors: Electrical & Electronics Engineer (University of Khartoum)

- MSc. Autonomous Systems (Bonn-Rhein-Sieg University of Applied Science)

- Research Scientist at Fraunhofer IAIS (Germany)

- Senior AI Engineer (Germany)

LinkedIn

Cloud Computing

What is Cloud Computing?
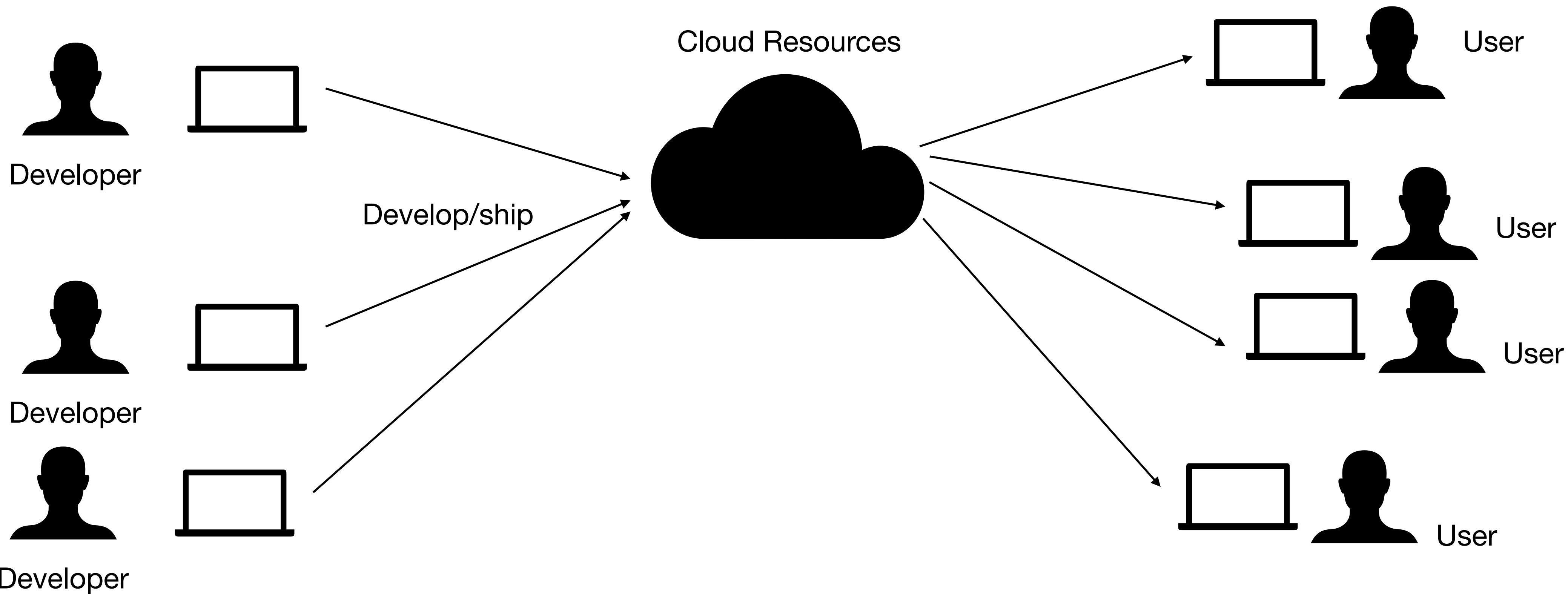
- The U.S National Institute for Standards and Technology (NIST) defines cloud computing as:

A model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.

- Key points:

  - On Demand

  - Network access

  - Minimal management offer/ service provider interaction

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Cloud Computing
What is Cloud Computing?

Developer

Developer

Developer

Develop/ship

Cloud Resources

User

User

User

User

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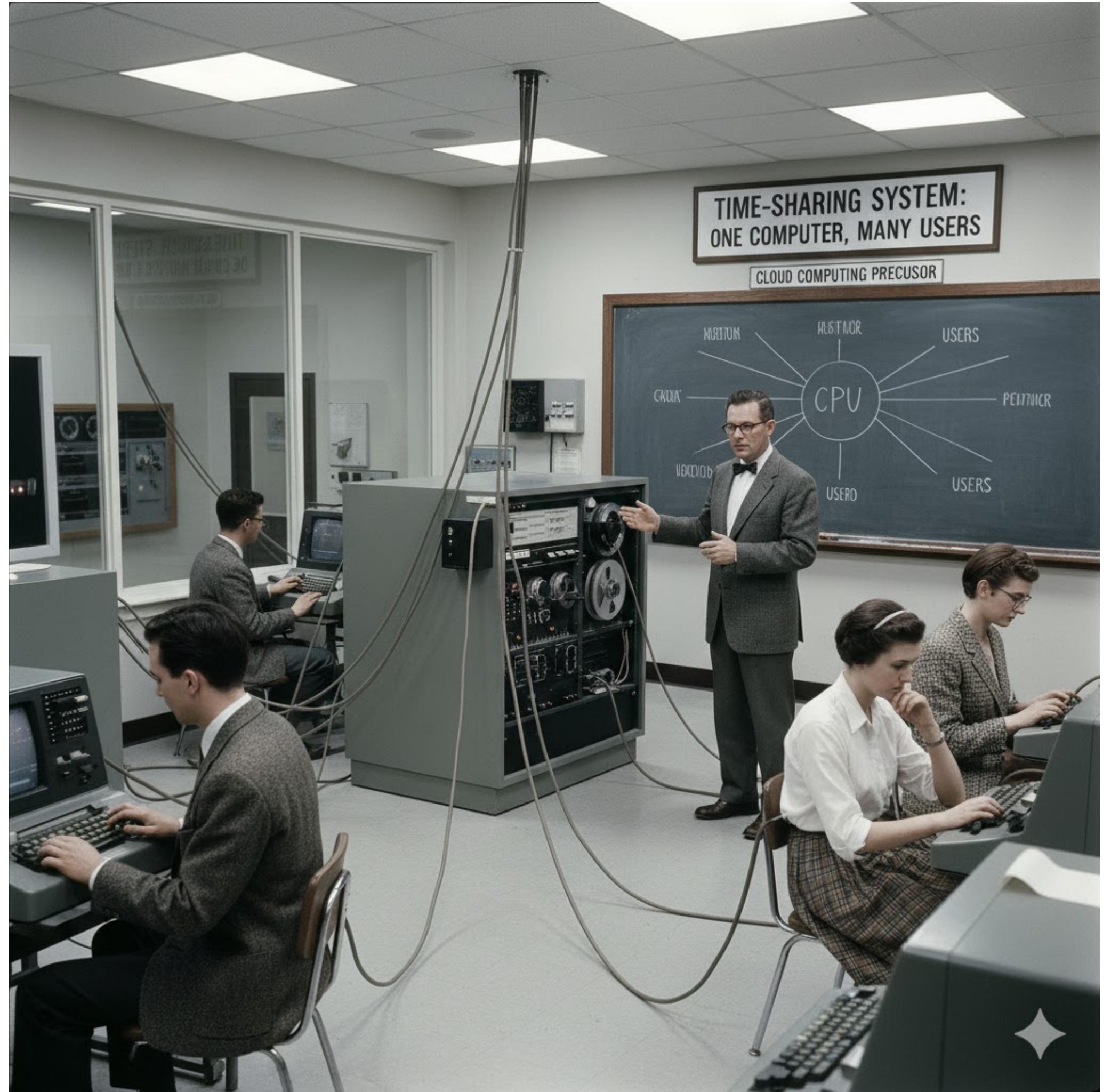
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What is Cloud Computing?
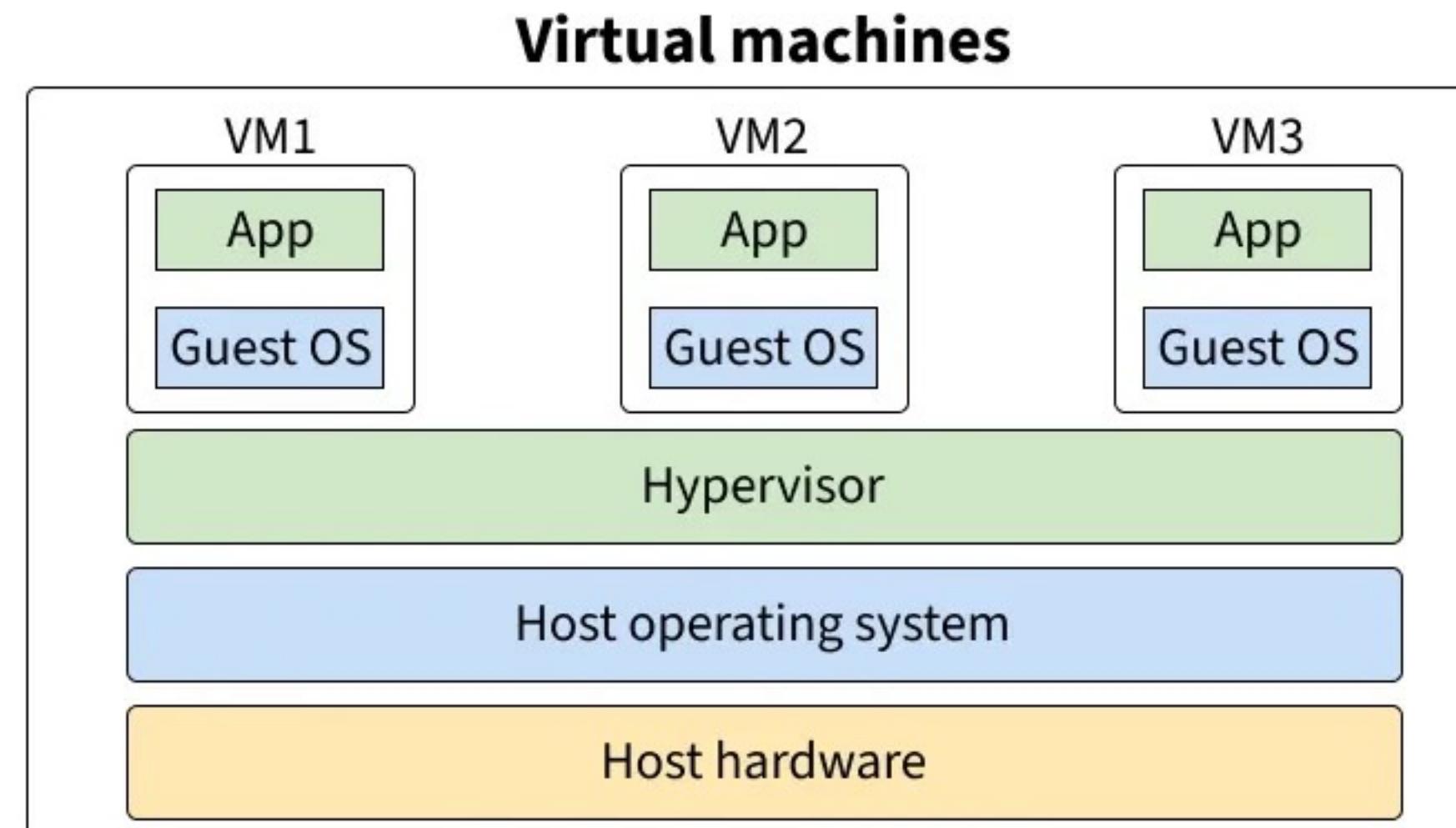
- History and Evolution:

  - Dates back to 1950's

  - Time-sharing method

  - Goal: maximize the use and efficiency

Image generated with AI for education purposes

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Cloud Computing
What is Cloud Computing?

- History and Evolution:

  - Virtual Machines (VM) in 1970's

  - Hypervisor divides physical compute resources to multiple VMs

Virtual machines

VM1	VM2	VM3
App	App	App
Guest OS	Guest OS	Guest OS

Hypervisor

Host operating system

Host hardware

Hammam Abdelwahab   Source: https://www.geeksforgeeks.org/operating-systems/virtual-machines-in-operating-system/

Cloud Computing
What is Cloud Computing?

- History and Evolution:

  - Internet!

  - Hypervisor for compute resources accessible via internet

  - Operation Expenditure (Opex Model) & pay-as-you-go got cheaper

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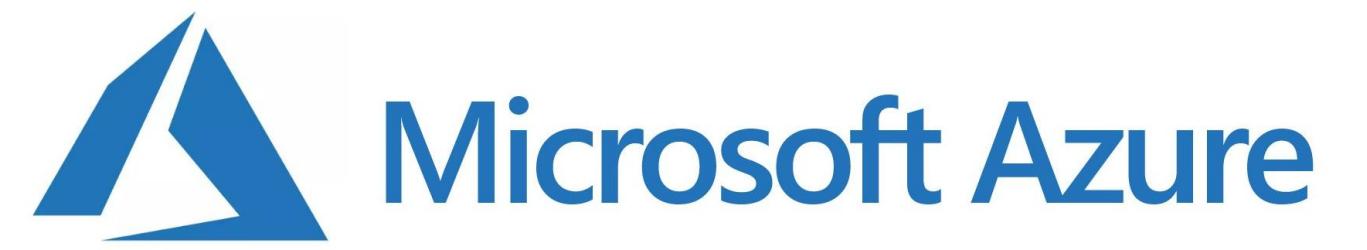
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Why Cloud Computing?

- Cost saving (pay-as-you-go)

- No cost for establishing data-centres or maintenance/upgrades

- Competitiveness

- Agility

- Flexibility

- Scalability

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Example of Cloud Applications

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Cloud Computing
Example of Cloud Applications

SOME TOP COMPANIES THAT USE AWS

https://deftsoft.com/what-is-aws-amazon-web-services-and-how-does-it-work/

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Example of Cloud Applications

- Web Hosting and Content Delivery

- Data Analytics (e.g stocks, weather)

- Collaboration Software: Microsoft 365, Google Workspace

- Internet of Things (IoT): Sensor data streaming, IoT Devices management

- Backup & Disaster Recovery: Automated and secured storage and backups

- AI: Chatgpt, Gemini, DeepSeek

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Cloud Service Models

- Infrastructure as a Service (IaaS)

- Platform as a Service (PaaS)

- Software as a Service (SaaS)

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Cloud Service Models
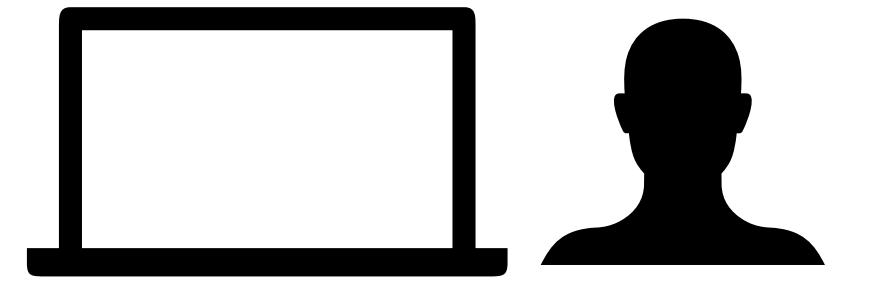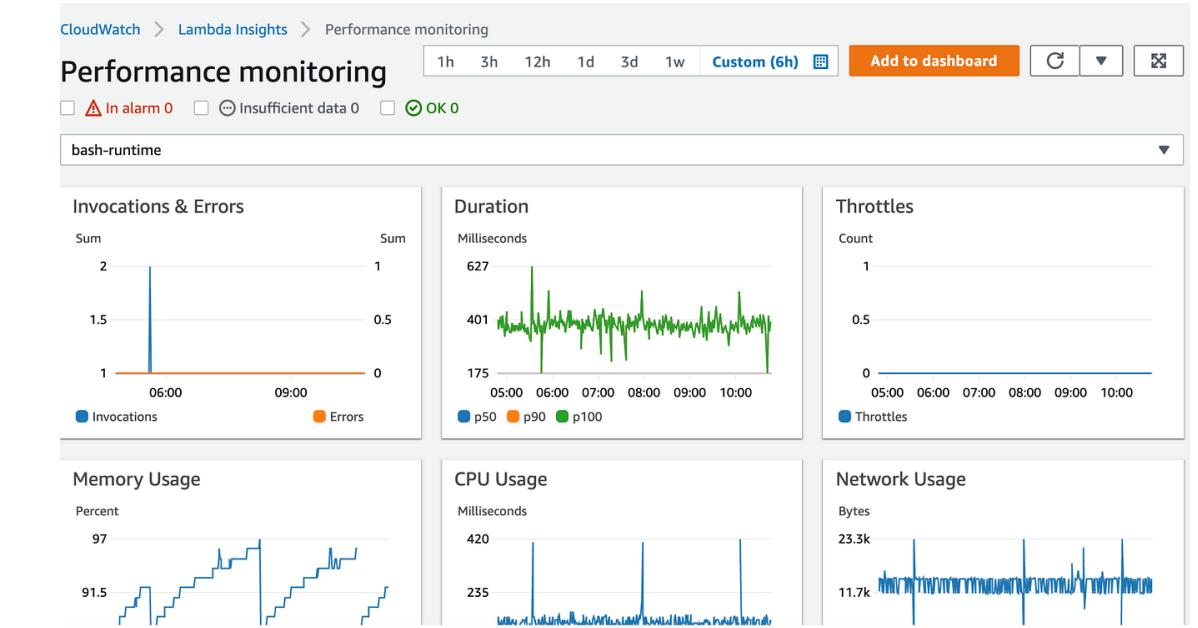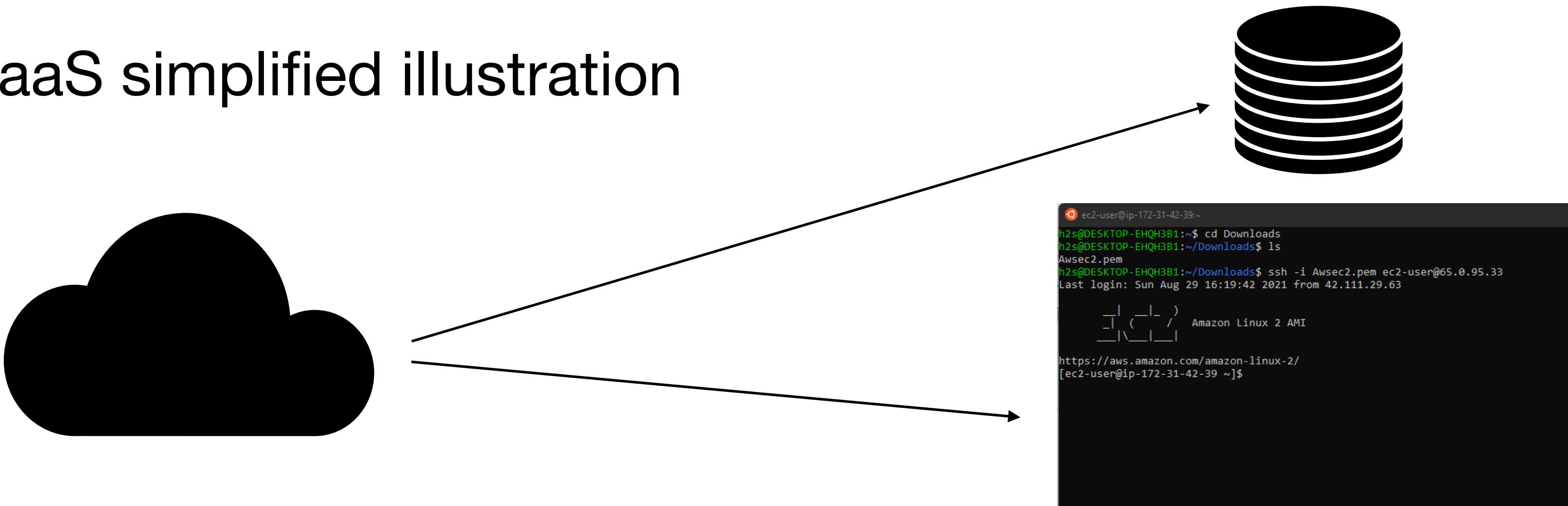
- Infrastructure as a Service (IaaS)

- Example: Azure, GCP, AWS

- Provision of fundamental resources such as compute, network, and storage

- On demand, access via the internet, pay-as-you-go

- Freedom to manage and monitor resource utilisation and backups.

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Cloud Service Models

- IaaS simplified illustration

Developer

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Cloud Service Models
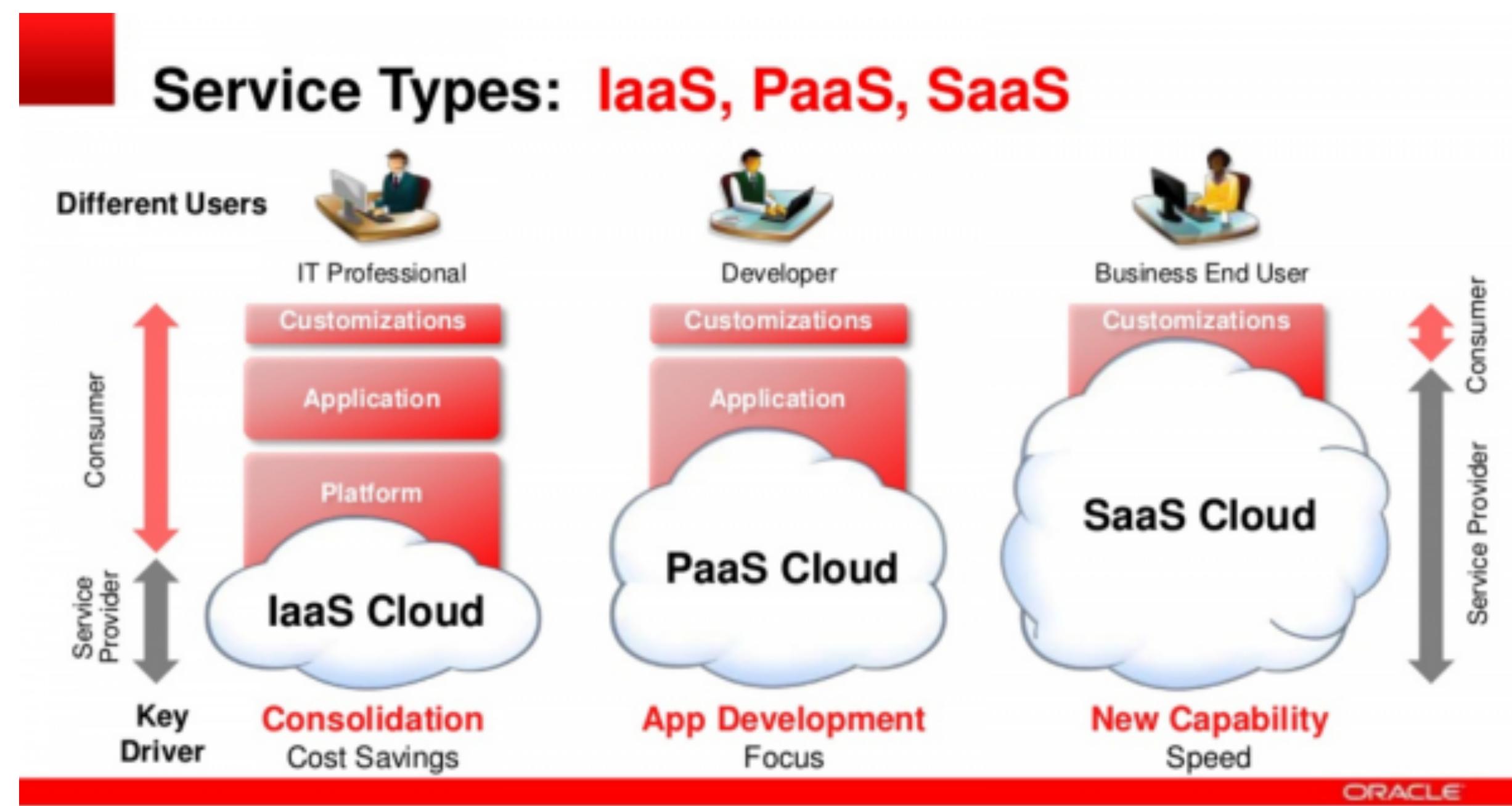
- Platform as a Service (PaaS)

- Provision of a platform to facilitate development, deployment, management and running applications.

- Examples: Provision of Base images, services for API development, Platforms for IoT (ThingWorx, ThingsBoard, Azure IoT, AWS IoS Core)

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Cloud Service Models

- Platform as a Service (PaaS)
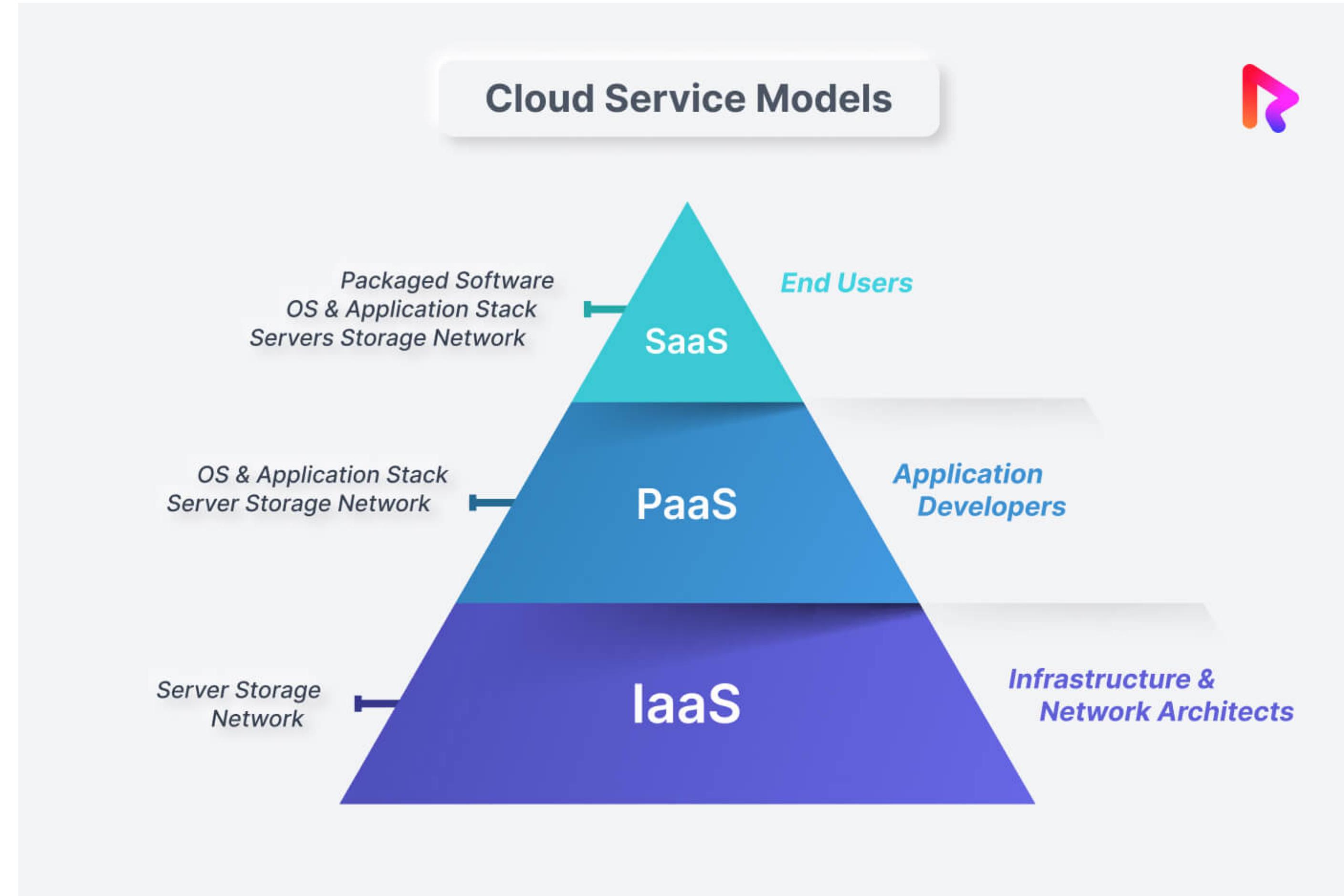
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Cloud Service Models

- Software as a Service (SaaS)

- Provision of software services to end users that they can directly use via browser or client.

- Example: Email tools, Customer Relation Management (CRM), Billing Systems.

- Subscription model

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Cloud Service Models

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Source: redswitch.com

Cloud Computing
Deployment Models

- Say you are in IT department, and would like to provide (deploy) cloud resources to developers in your company.

- When it comes to resources, there are multiple questions you need to ask. Including:

- Where the infrastructure resides?

- Who owns and manages it?

- How resources are made available to users?

- You can deploy resources either on public cloud, private cloud, or hybrid cloud

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Deployment Models

- Public Cloud:

  - infrastructure

  - management

  - Also security by provider

  - Multi-tenant

  - Pay-as-you-go

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Deployment Models

- Public Cloud Risks:

  - Data Sovereignty

  - Security

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Deployment Models

- Private Cloud:

    - Exclusive use by a single organisation

    - Could be on or off-premise

    - Preferred by large organisations for security and compliance

    - Requires Virtual Private Cloud (VPC)

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Deployment Models

- Hybrid Cloud:

  - Around 80% companies adopt this deployment model [1]

  - On-premise cloud + third party public cloud

  - Benefits: scalability, interoperability, compliance, cost saving

  - Challenges: maintenance, migrations, integrations and configurations

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[1] https://amnic.com/blogs/cloud-deployment-models

Cloud Computing
Summary

- What is cloud computing?

  - Provision of resources (compute, storage, network) on demand

- Why cloud computing?

  - Costs, scalability, agility , …

- Examples: Web Hosting, Sensor Streaming, IoT Device Management

- Cloud Service Models: IaaS, PaaS, SaaS

- Cloud Deployment Models: Public, Private, Hybrid

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Thank You!