

BUS5001 – Cloud Platforms and Analytics



Week 01 – Introduction to the Cloud

Centre for Data Analytics and Cognition

La Trobe University, Australia

Centre for Data Analytics and Cognition (CDAC)

A world-class research centre working on the advancement of Artificial Intelligence, Data Analytics and Automation for the digital transformation of industries, organisations and society through the development of intelligent tools, technologies and platforms.

- **Artificial Intelligence** – a world class track record in peer reviewed research
- **Technology Platforms** – research innovations into practical value
- **Digital Transformation** – consultancy, internships, commercialisation
- **Tertiary Education** – QS world ranking, top 2 in Australia
- **Workforce** – 84% Master's and 100% PhD employability (first six months)
- **Executive Education** – bespoke courses and micro-credentials
- **Community** – digital health, energy AI, social equality
- **Industry Engagement** – across all of the above



http



LinkedIn



g Scholar



Subject Coordinator / Lecturer – Nishan

- “Industry engagement” is central to all Analytics PG subjects and courses
- Technical Architect with over 15 years of experience in enterprise, public, private and NFP sectors
- At CDAC, leads a team of ten in the design and development of the Net Zero emission technology platform (full stack, AI, viz)
- Bunji – a smartphone based privacy-preserving mental health chatbot (check it out on the App Store)
- Certified Scrum Master
- Certified Measurement & Verification Professional
- AI / Analytics industry engagement with Armitage, AFAC, Cancer Council Victoria, C4Net, LaTrobe Sustainability & I&O

Tutor – Dilantha

- CDAC PhD Candidate advancing the theory and practice of machine comprehension, leveraging linguistics, heuristics, language models (BERT, GPTx) and deep learning
- Unsupervised learning with vector symbolic architectures
- PV energy forecasting, simulation and analytics
- Five years of experience in Analytics and AI applications
- Leads the design and development of solar forecasting and near casting for community climate action

Aims of BUS5001

- Acquire and exhibit technical knowledge and analytical awareness of components, configurations, capabilities and security features of state-of-the-art cloud platforms
- Review, assess and determine a functional and agile cloud platform setting that addresses the organisational needs of data, analytics, computation and IT security.
- Analyse and articulate IT security strategies and techniques, ethics and governance for organisational cloud solutions
- Discuss, design and create infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS) strategies and solutions, such as a data lakehouse for open data management architecture
- Create and evaluate an end-to-end analytics and artificial intelligence applications by leveraging cloud platform capabilities, such as chatbots and federated search, with cloud IT security management functionality.

Weekly Schedule

- Weeks 1-2: The Rationale for the Cloud and Business Architectures in the Cloud
- Week 3: Virtualisation and Containerisation
- Week 4: Data Storage and Movement in the Cloud
- Week 5: Governance, Security and Ethics in the Cloud
- Break
- Week 6: DevOps – Provisioning and Configuration Management of Cloud Platforms
- Weeks 7 – 8: RPA
- Weeks 9 – 10: Chatbot Design
- Week 10 – 11: Analytics and AI

Learning Management System

- All resources – announcements, lecture slides, tutorials, solutions, readings, discussion forum, assignments, grades
- Communication with the Subject Coordinator should be via your La Trobe email address
 - Please check your student email account regularly.
 - And the “announcements” section on LMS.

Assessments

- There will be 3 individual assessments and no written examinations
- 20% Assignment 01 – Individual
 - Creating and critically evaluating a business solution architecture
- 40% Assignment 02 – Individual
 - Construct, synthesise and use a cloud solution in providing a solution for a business case
- 40% Assignment 03 – Individual
 - Adapt, use and evaluate a cloud computing environment for machine learning and big data

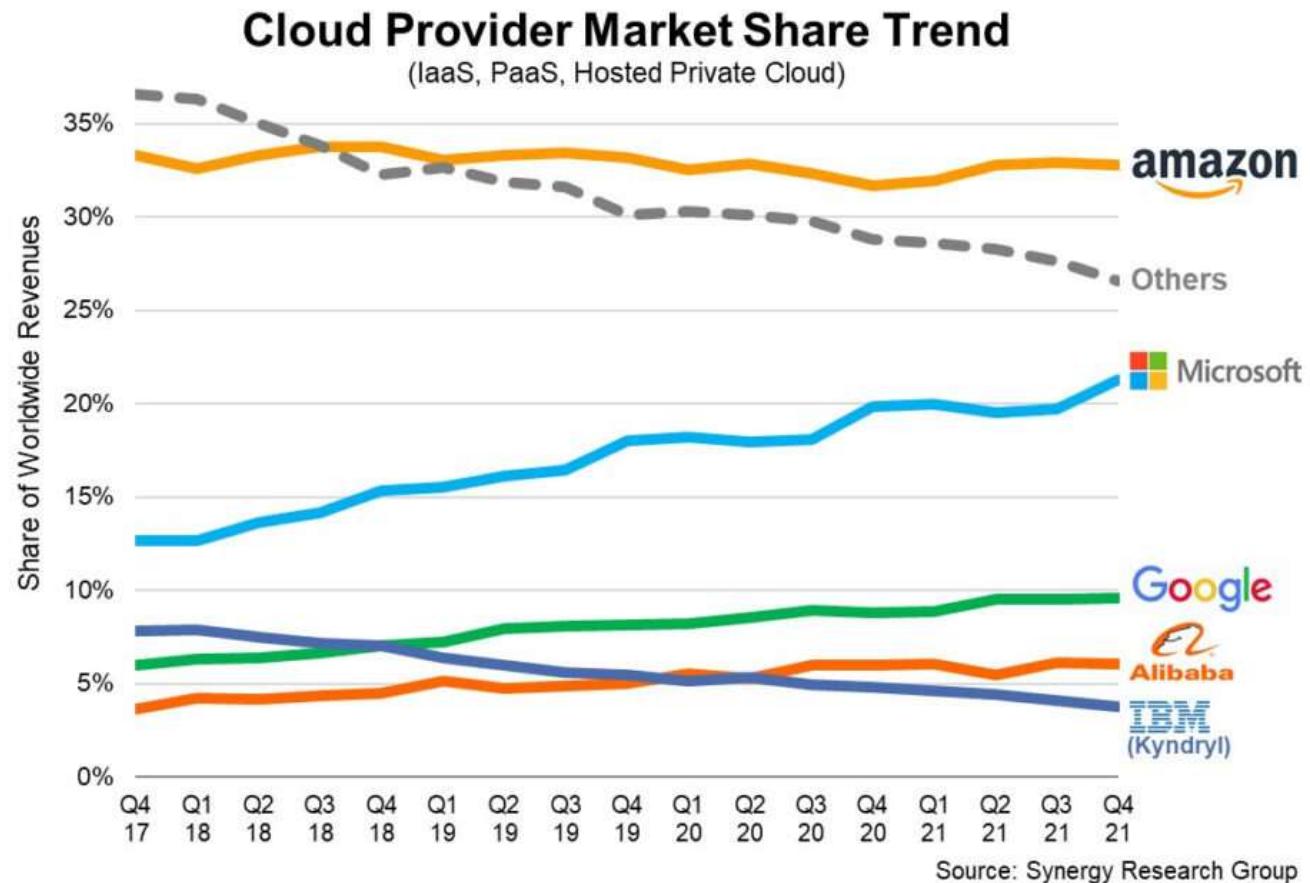
Introduction

- Today the word Cloud is synonymous with technology
- It symbolises a large rapidly growing market
- The power of Cloud is that computational / storage power which was once only available to large enterprises is now available to small businesses and individuals
- The Cloud make this computational / storage power available at affordable rates using the economics of pay as you go
- Emerging technology enablers such as Artificial Intelligence, the Internet of Things, Data Analytics, all require to work with large amounts of data which need large volumes of storage capacity and computational power
- The Cloud is possibly the only viable platform to enable the use of these enablers democratically

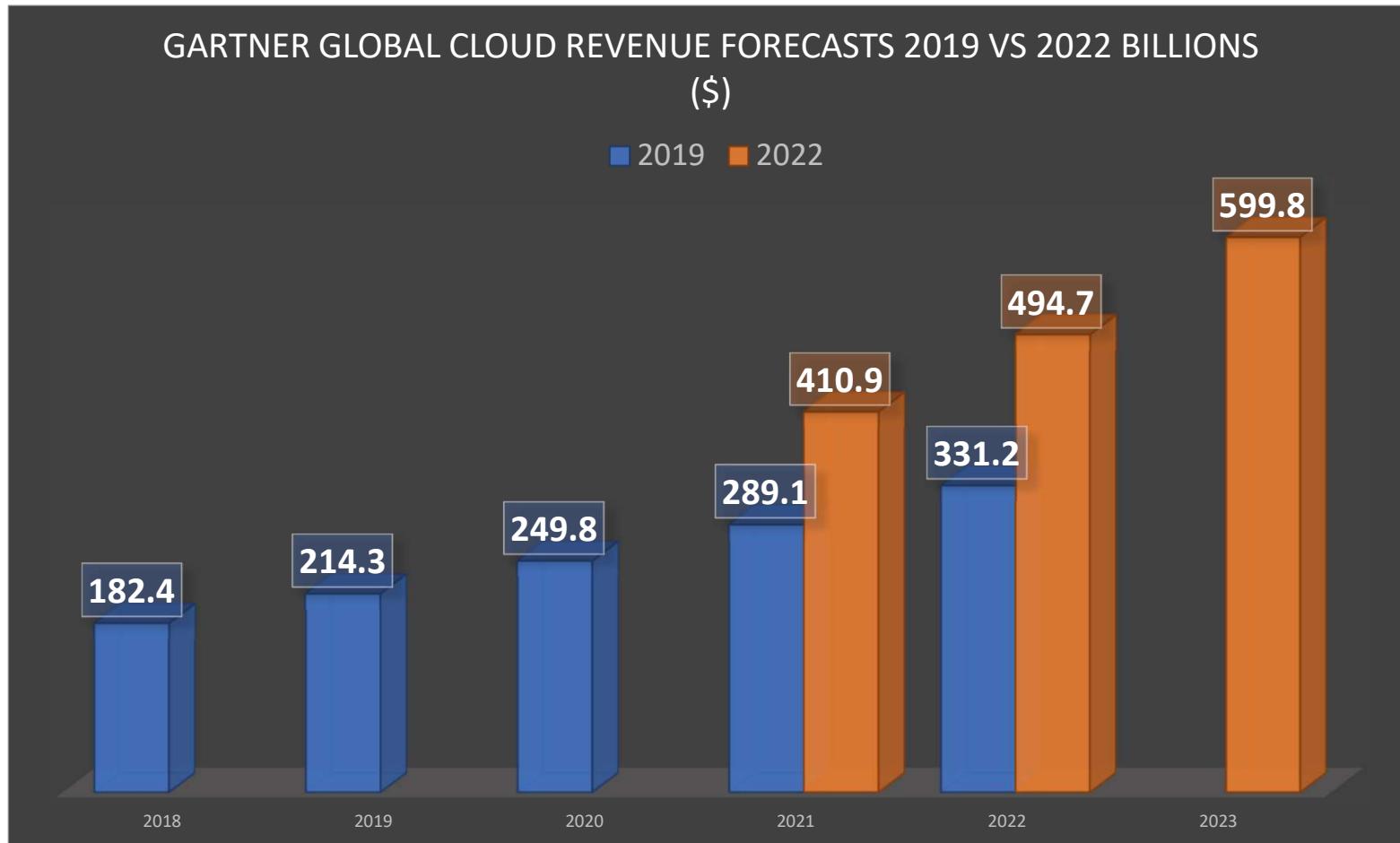
Major Cloud Players



Cloud provider by market share



Gartner 2022 public cloud service revenue forecasts



Source: Gartner

What is the Cloud?

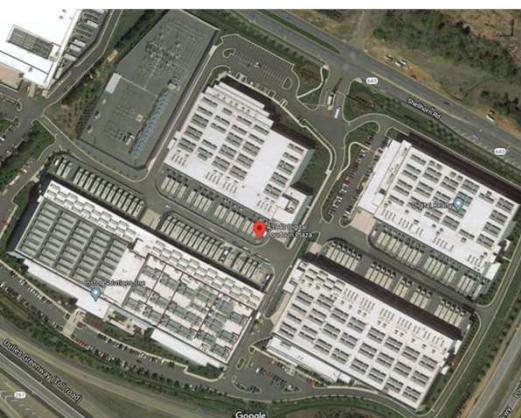
- Computing as a service over the internet
- Cloud computing, also referred to as the “cloud”, is the delivery of on-demand compute resources over the internet on a pay-per-use basis.
 - Resources include
 - Services
 - Applications
 - Data Centre
- Some Features of the Cloud
 - Elastic resources — Scale up or down quickly and easily to meet demands
 - Metered services so that you only pay for what you are using
 - Self service — All accessible from just a web portal

What does the Cloud look like from the outside?

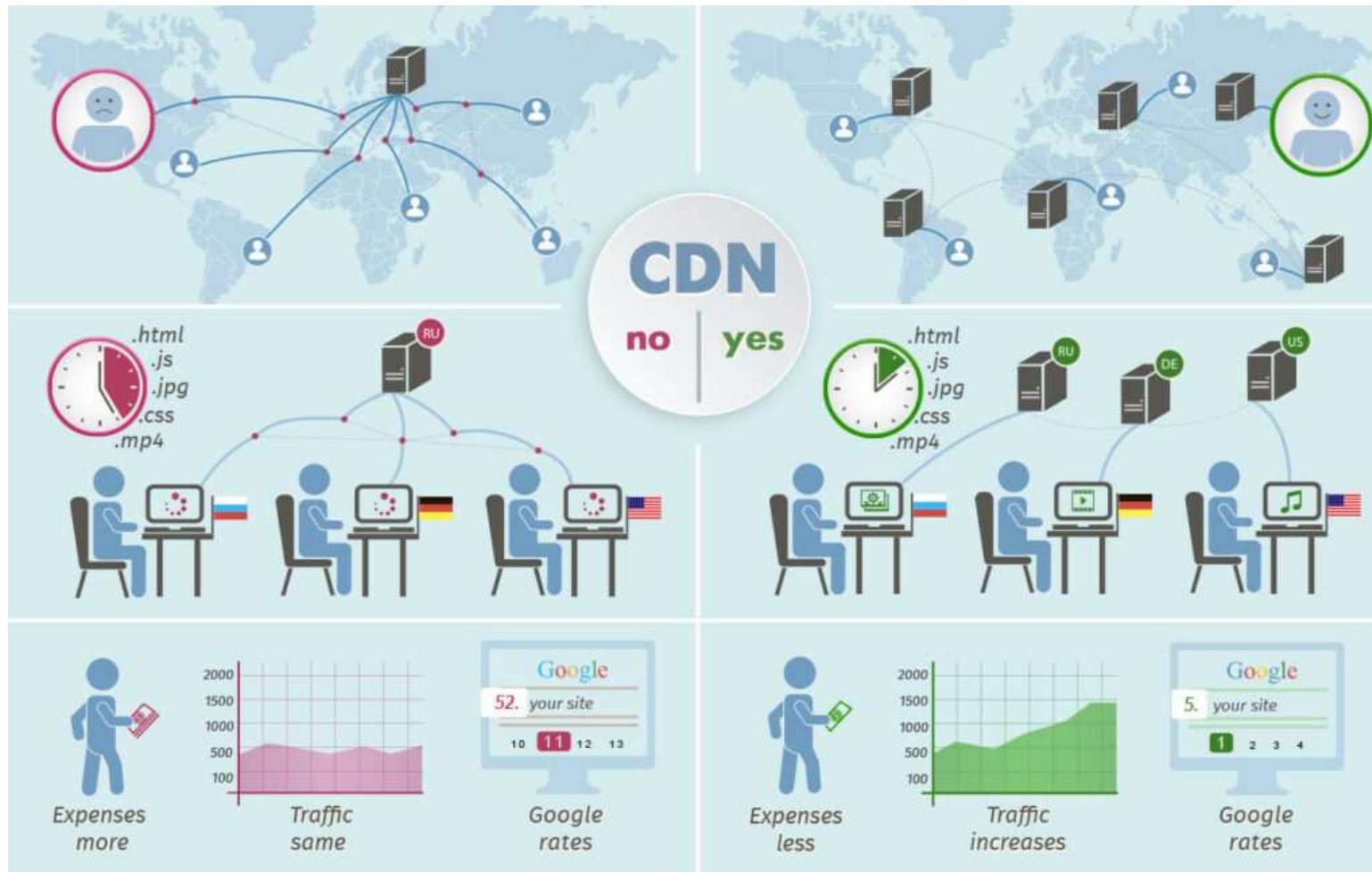


Behind the Scenes

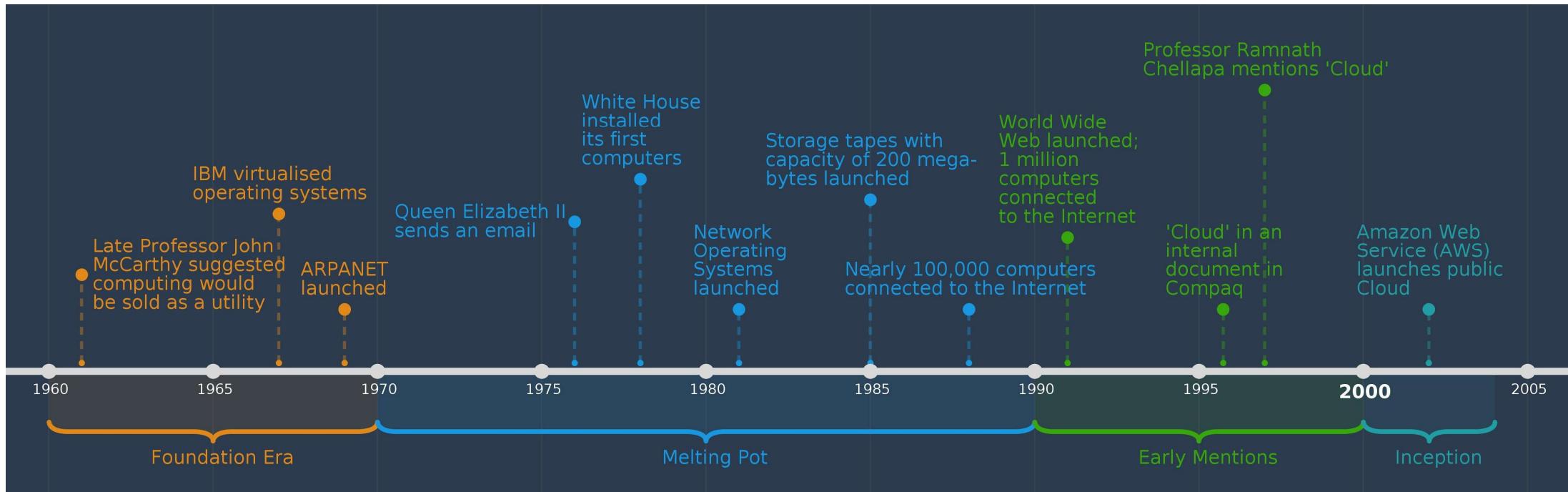
- Cloud infrastructure spending will surpass \$599 billion in 2018
- Two of the Largest Data Centres in the World are not even owned by Google / AWS or Microsoft.
 - a) The Citadel – Tahoe Reno, Nevada | 7.2 Million Square Feet
 - b) Range International Information Group – Langfang, China | 6.3 Million Square Feet
- <https://www.infrastructure.aws/> - Gives AWS infrastructure across the world have a look when you have some time. There was also a WikiLeaks document that gave a lot of classified information out on the locations.



Cloud (Edge) in Action – Content Delivery Network (CDN)



A brief timeline of the Cloud



The National Institute of Standards and Technology (NIST)

- Cloud computing is a model for enabling **ubiquitous, convenient, on-demand network access** to a **shared pool of configurable** computing resources (e.g., networks, servers, storage, applications, and services) that can be **rapidly provisioned** and released with **minimal management effort or service provider interaction**.

Five Essential Characteristics of the Cloud (NIST) 1 – 3

On-Demand Self-service

- The consumer gets access to cloud resources such as the processing power, storage, and network they need, using an interface, with no interaction required with the service provider.

Ubiquitous Access

- The consumer accessed the services via the network through standard mechanisms and platforms such as mobile phones, tablets, laptops, and workstations. Generally tailored to the needs of different cloud consumers.

Multitenancy (and Resource Pooling)

- Gives providers economies of scale, making cloud cost-efficient. Using a multi-tenant model, computing resources are pooled to serve multiple consumers; cloud resources are dynamically assigned and reassigned, according to demand, without customers needing to concern themselves with the physical location of these resources.

Five Essential Characteristics of the Cloud (NIST) 4 – 5

Elasticity

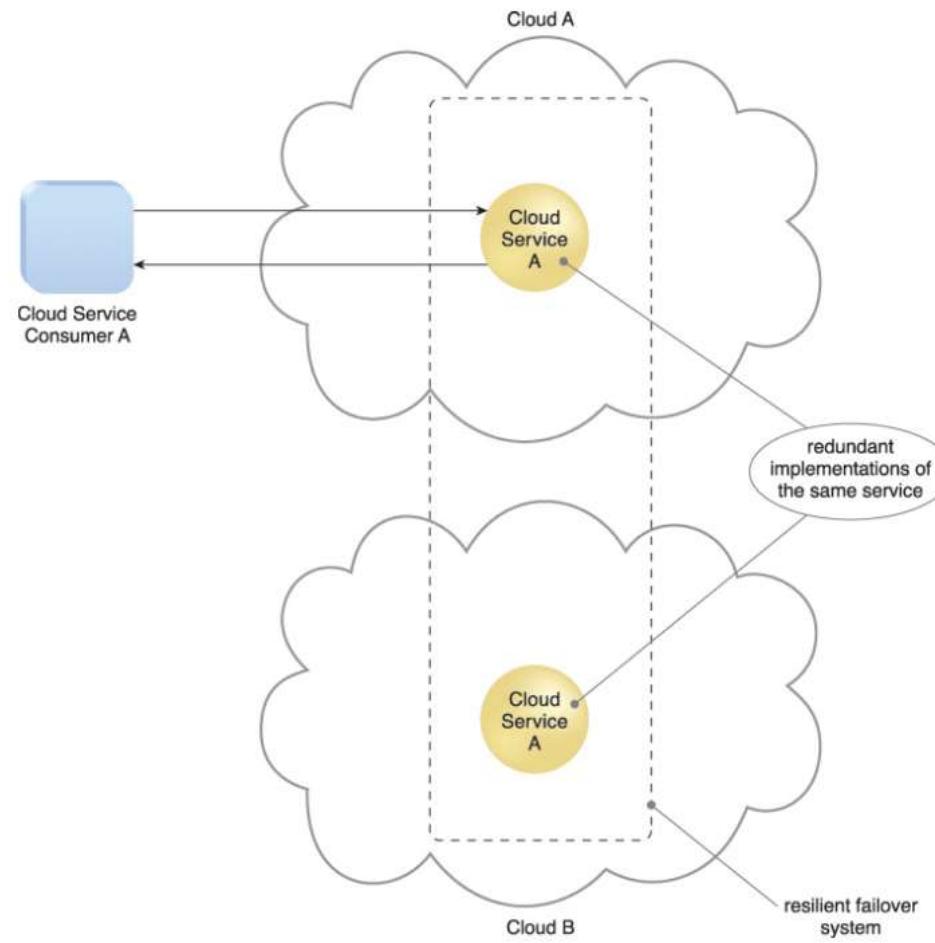
- The consumers ability to access more resources when you need them, and scale back when you don't, and the provider's ability to facilitate this giving rise to the concept of Elasticity.

Measured Service

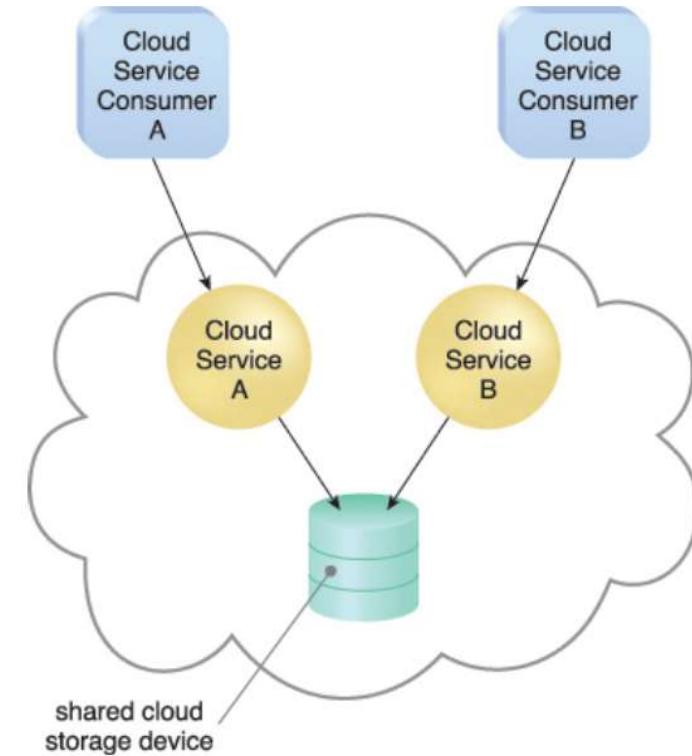
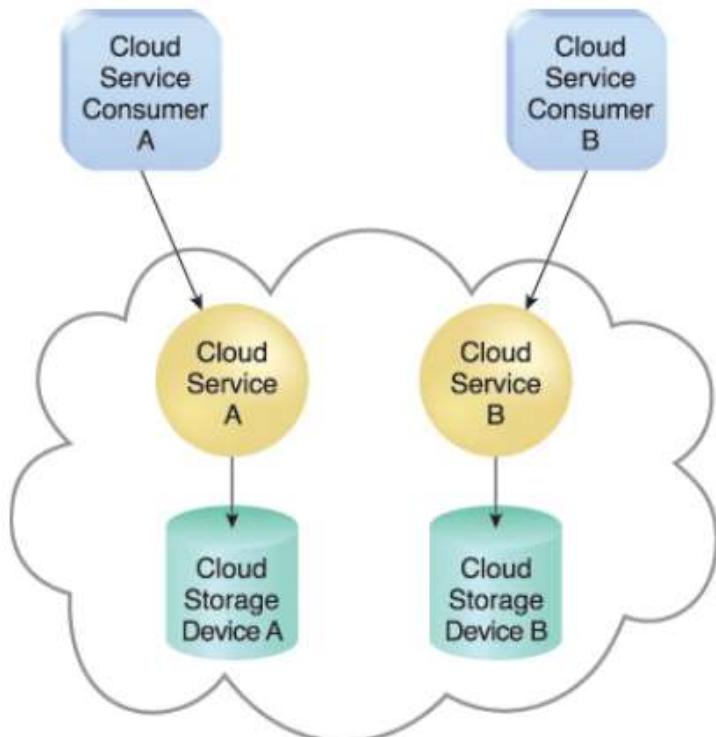
- Consumer only pays for what you use or reserve as you go. Resource usage is monitored, measured, and reported transparently based on utilization.

A 6th Characteristic (Not in the NIST Spec)

- Resiliency



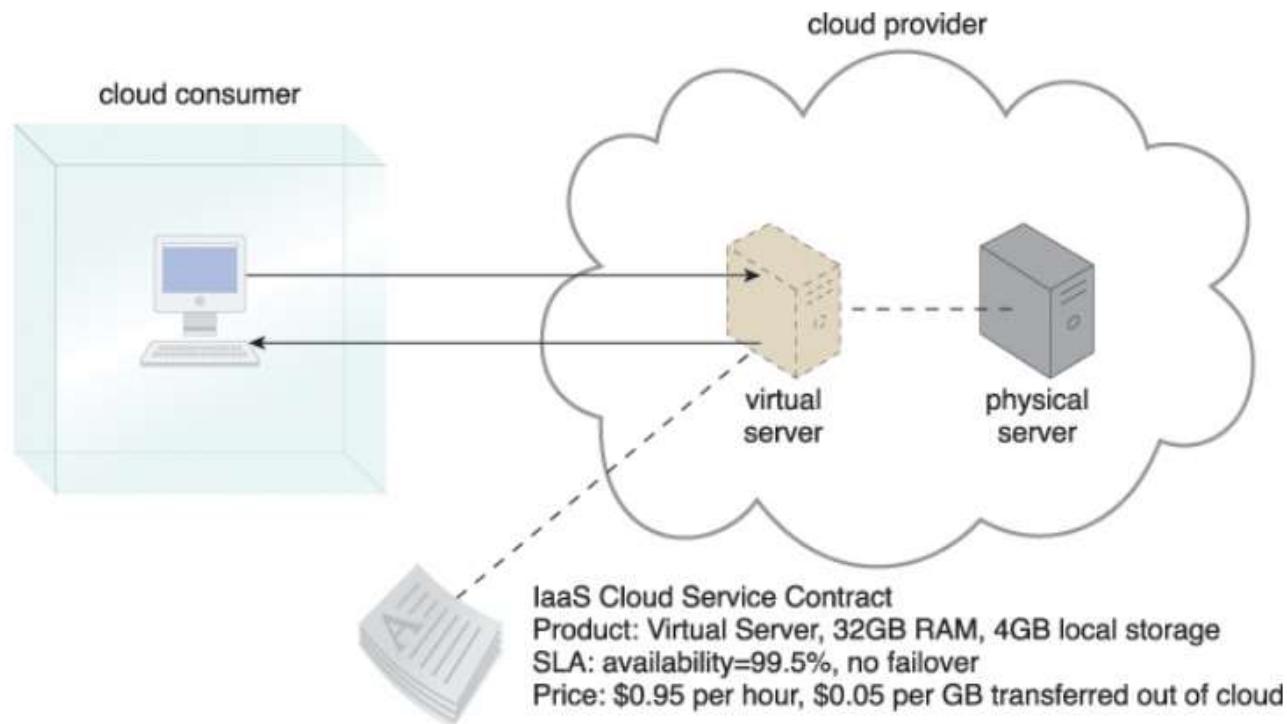
Single Tenancy vs. Multi Tenancy



Cloud Delivery Models – Infrastructure as a service (IaaS)

- Provides companies with computing resources including;
 - Servers
 - Networking
 - Storage
 - Data center space on a pay-per-use basis.
- Benefits
 - No need to invest in your own hardware
 - Infrastructure scales on demand to support dynamic workloads
 - Flexible, innovative services available on demand

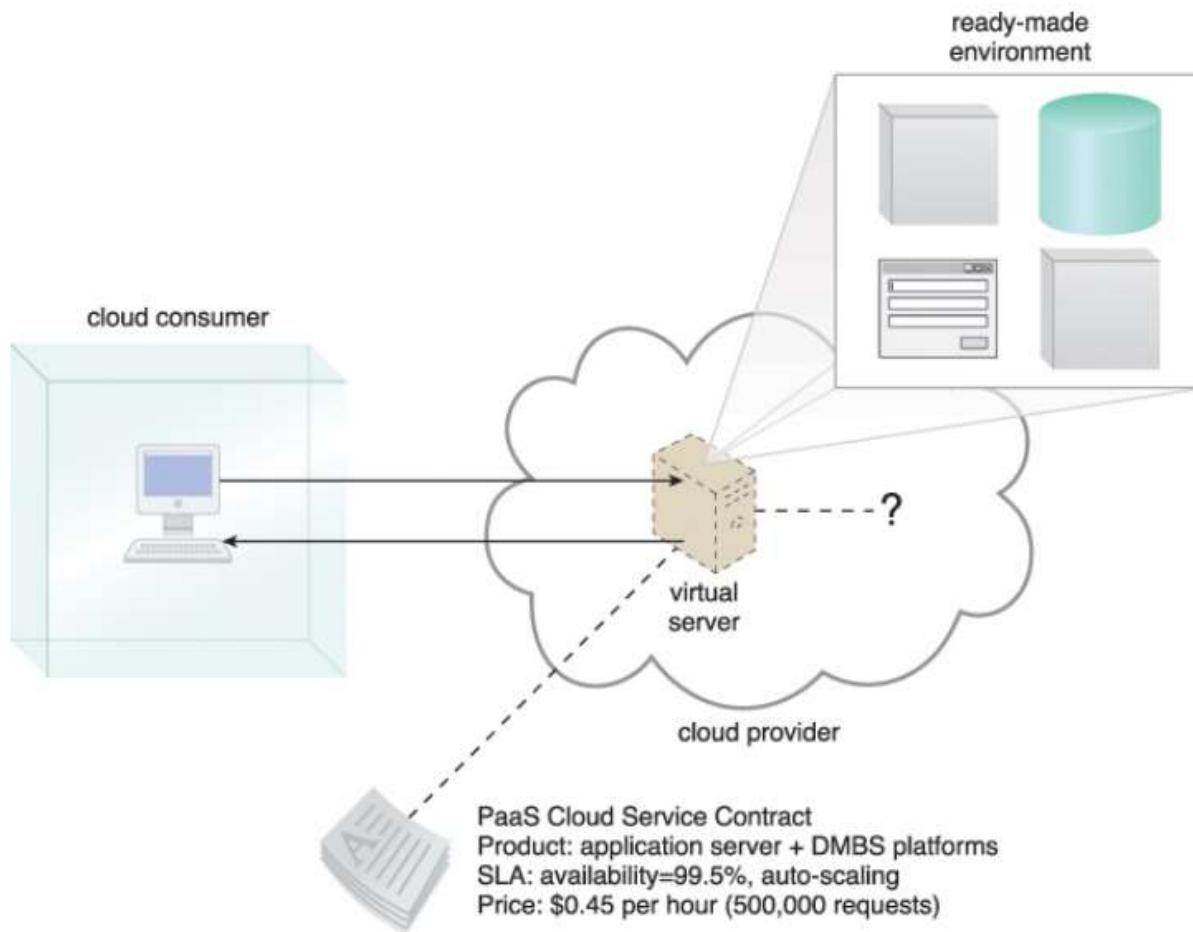
Depiction of IaaS



Delivery Models– Platform as a service (PaaS)

- Provides a cloud-based environment with everything required to support the complete lifecycle of building and delivering web-based (cloud) applications
- Without the cost and complexity of buying and managing the underlying hardware, software, provisioning, and hosting.
- The benefits of PaaS
 - Develop applications and get to market faster
 - Deploy new web applications to the cloud in minutes
 - Reduce complexity with middleware as a service

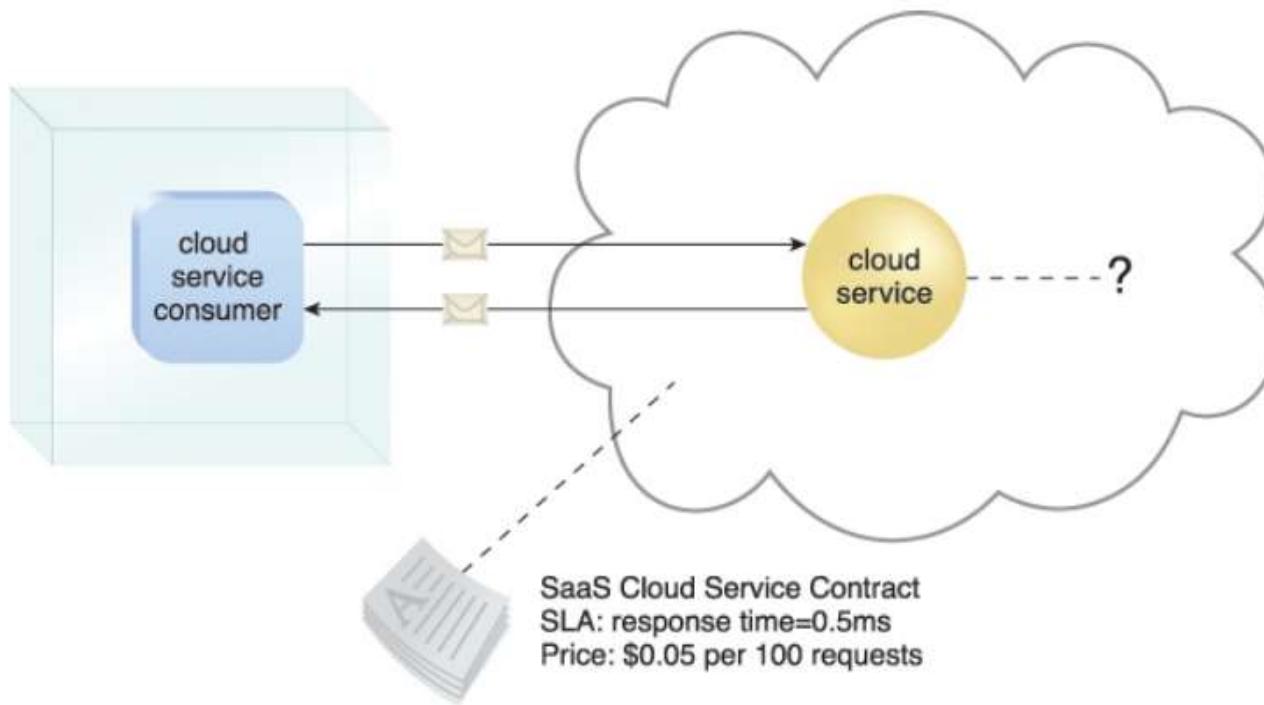
Depiction of PaaS



Delivery Models– Software as a service (SaaS)

- Software as a service (SaaS)
- Cloud-based applications — or software as a service — run on distant computers “in the cloud” that are owned and operated by others and that connect to users’ computers via the internet and, usually, a web browser.
- The benefits of SaaS
 - You can sign up and rapidly start using innovative business apps
 - Apps and data are accessible from any connected computer
 - No data is lost if your computer breaks, as data is in the cloud
 - The service is able to dynamically scale to usage needs

Depiction of SaaS



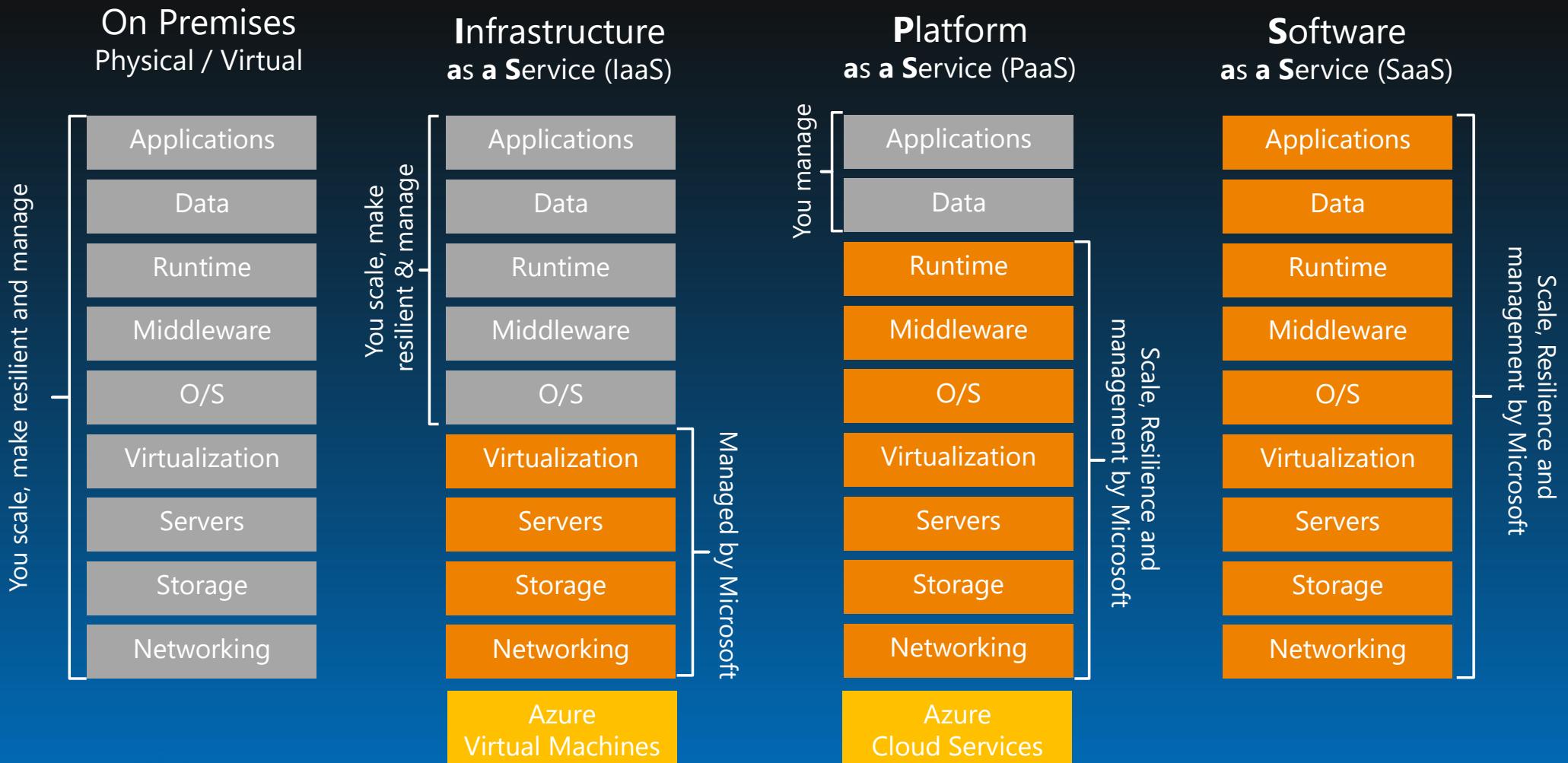
Comparison of Delivery Models in terms of Control

Cloud Delivery Model	Typical Level of Control Granted to Cloud Consumer	Typical Functionality Made Available to Cloud Consumer
SaaS	usage and usage-related configuration	access to front-end user-interface
PaaS	limited administrative	moderate level of administrative control over IT resources relevant to cloud consumer's usage of platform
IaaS	full administrative	full access to virtualized infrastructure-related IT resources and, possibly, to underlying physical IT resources

Comparison of Delivery Models in terms of Activities

Cloud Delivery Model	Common Cloud Consumer Activities	Common Cloud Provider Activities
SaaS	uses and configures cloud service	implements, manages, and maintains cloud service monitors usage by cloud consumers
PaaS	develops, tests, deploys, and manages cloud services and cloud-based solutions	pre-configures platform and provisions underlying infrastructure, middleware, and other needed IT resources, as necessary monitors usage by cloud consumers
IaaS	sets up and configures bare infrastructure, and installs, manages, and monitors any needed software	provisions and manages the physical processing, storage, networking, and hosting required monitors usage by cloud consumers

IaaS vs PaaS vs SaaS



Cloud Delivery Models

Infrastructure as a Service

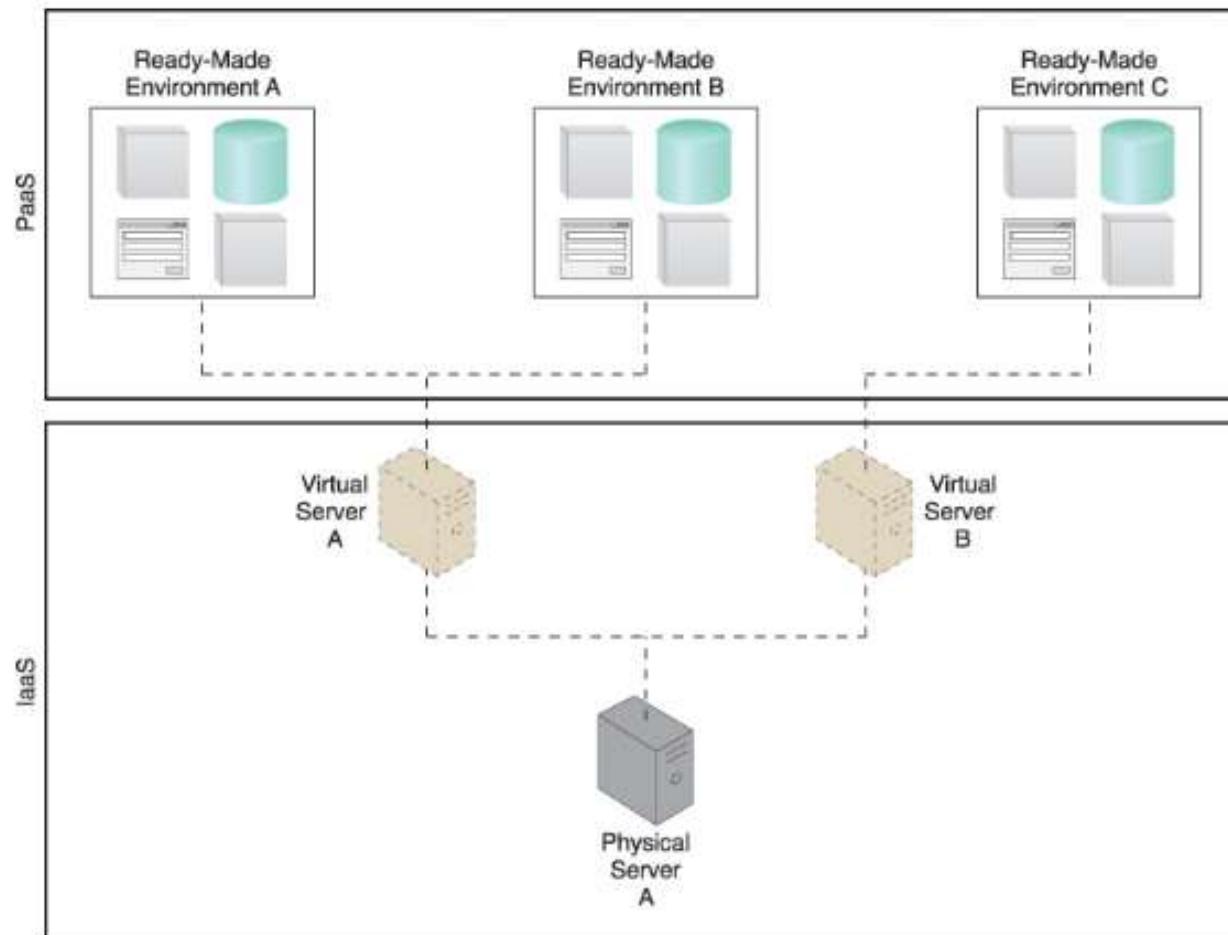
Platform as a Service

Software as a Service

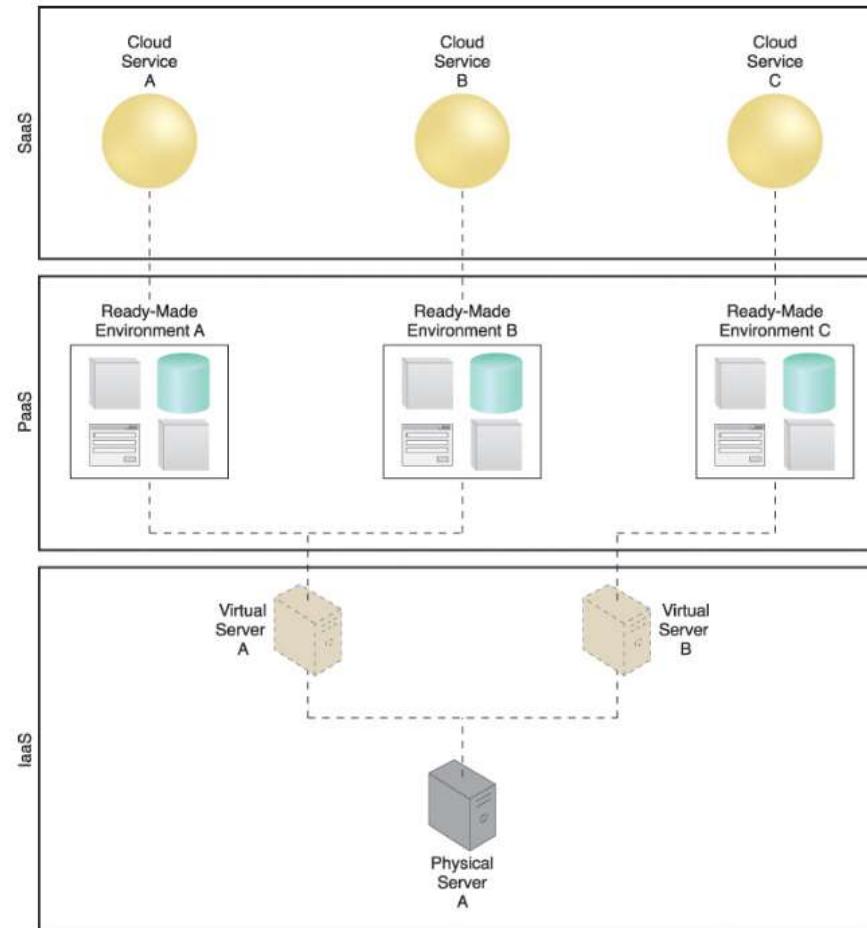
Other as a Services

- Storage
- Database
- Security
- Communication
- Testing

Combining the Delivery Modes in an Architecture



Combining IaaS / PaaS / SaaS



Some Examples IaaS

- Backup and Recovery: Services for backup and recovery of file systems and raw data stores on servers and desktop systems.
- Compute: Server resources for running cloud-based systems that can be dynamically provisioned and configured as needed.
- Content Delivery Networks (CDNs): CDNs store content and files to improve the performance and cost of delivering content for web-based systems.
- Services Management: Services that manage cloud infrastructure platforms. These tools often provide features that cloud providers do not provide or specialize in managing certain application technologies.
- Storage: Massively scalable storage capacity that can be used for applications, backups, archival, and file storage.

Examples PaaS

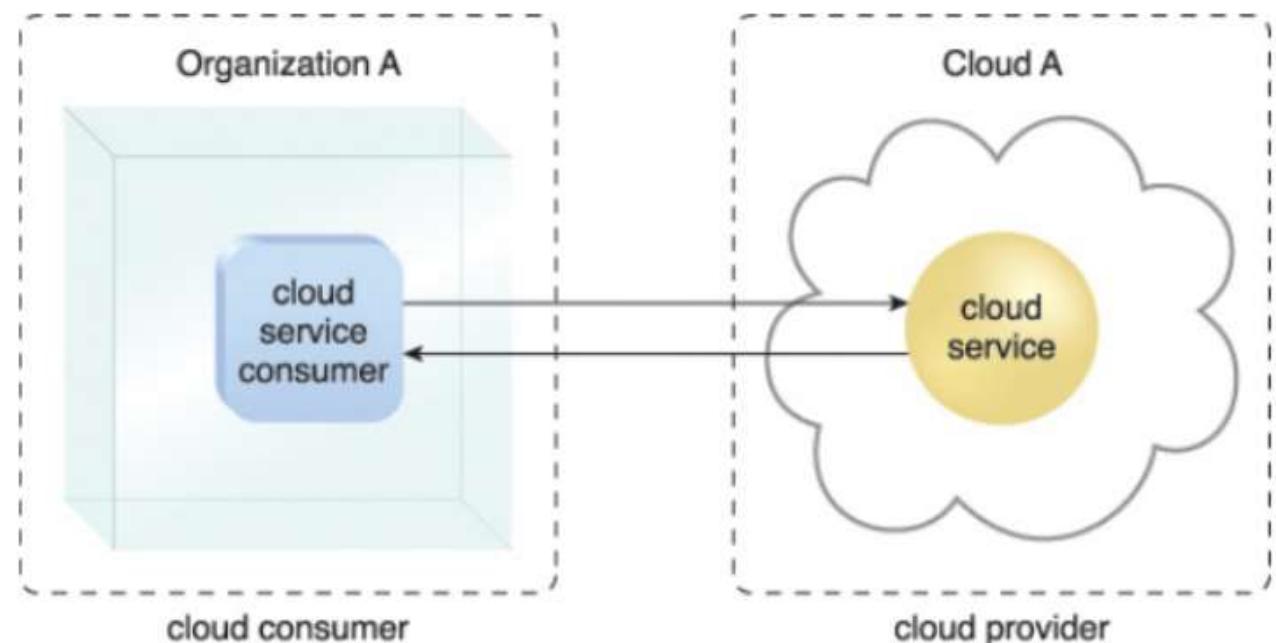
- Business Intelligence: Platforms for the creation of applications such as dashboards, reporting systems, and data analysis.
- Database: Services offering scalable relational database solutions or scalable non-SQL datastores.
- Development and Testing: Platforms for the development and testing cycles of application development, which expand and contract as needed.
- Integration: Development platforms for building integration applications in the cloud and within the enterprise.
- Application Deployment: Platforms suited for general purpose application development. These services provide databases, web application runtime environments, etc.

Examples SaaS

- Email and Office Productivity: Applications for email, word processing, spreadsheets, presentations, etc.
- Billing: Application services to manage customer billing based on usage and subscriptions to products and services.
- Customer Relationship Management (CRM): CRM applications that range from call center applications to sales force automation.
- Collaboration: Tools that allow users to collaborate in workgroups, within enterprises, and across enterprises.
- Content Management: Services for managing the production of and access to content for web-based applications.
- Document Management: Applications for managing documents, enforcing document production workflows, and providing workspaces for groups or enterprises to find and access documents.
- Financials: Applications for managing financial processes ranging from expense processing and invoicing to tax management.
- Human Resources: Software for managing human resources functions within companies.
- Sales: Applications that are specifically designed for sales functions such as pricing, commission tracking, etc.
- Social Networks: Social software that establishes and maintains a connection among users that are tied in one or more specific types of interdependency.
- Enterprise Resource Planning (ERP): Integrated computer-based system used to manage internal and external resources, including tangible assets, financial resources, materials, and human resources.

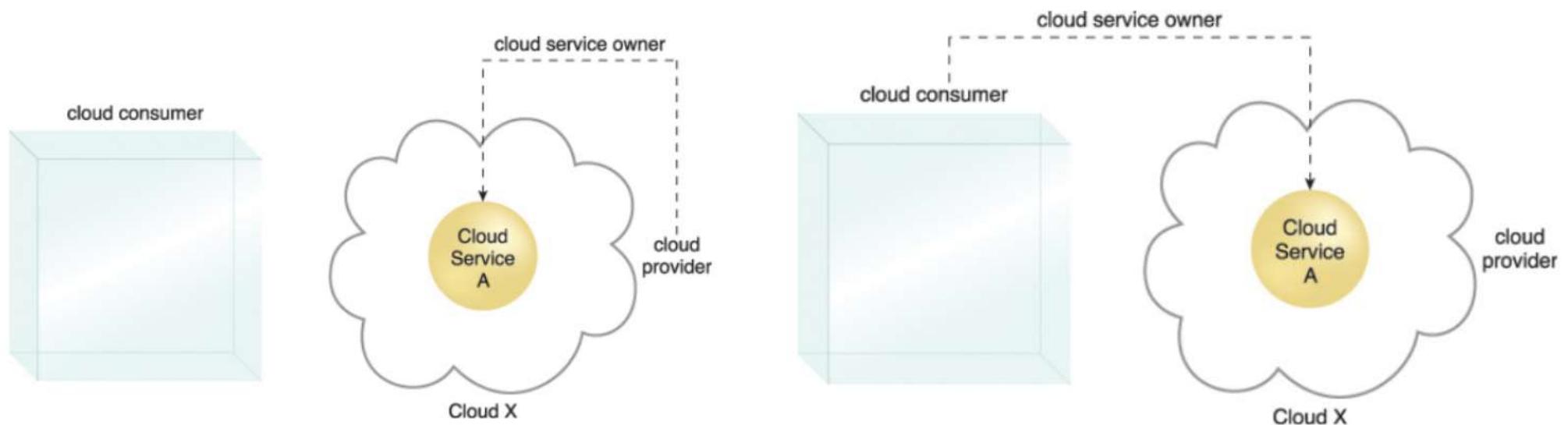
Roles in the Cloud – Provider / Consumer

- Cloud Provider
 - An organisation that provides cloud based resources
- Cloud Consumer
 - An organisation that has a formal contract with a cloud provider to use resources



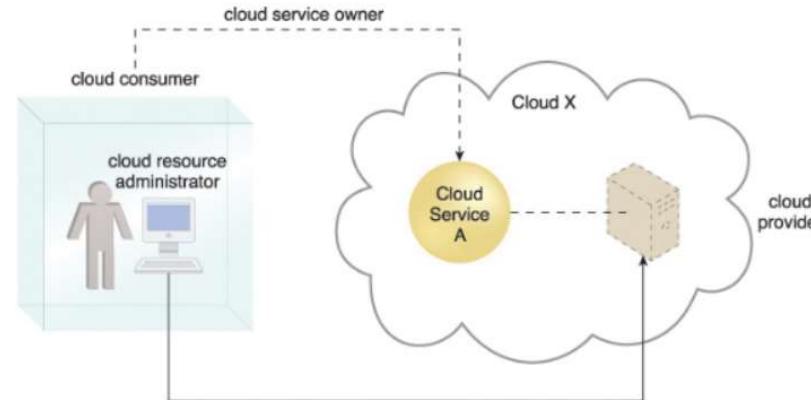
Roles in the Cloud – Cloud Service Owner

- Cloud Service Owner
 - The organisation that legally owns the cloud service.
- Provider or Consumer can be Service Owners

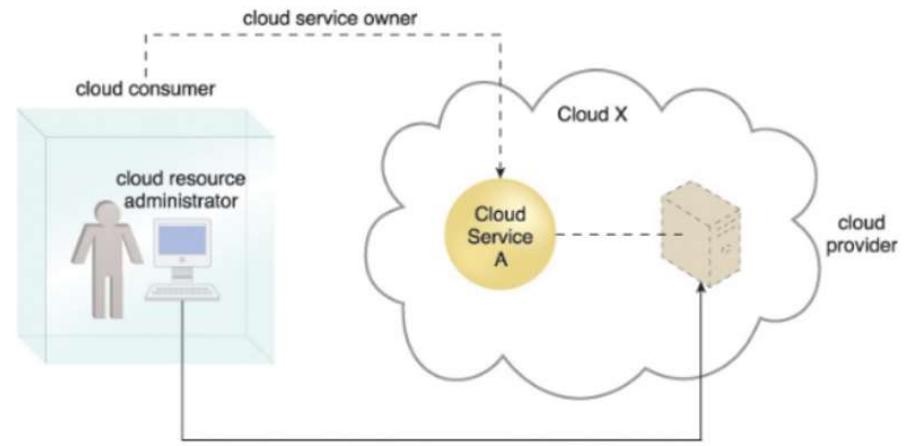


Roles in the Cloud – Cloud Service Owner

- Cloud Resource Administrator
 - Organisation responsible for administrating the cloud resource
 - Can be contracted by Service Owner



the cloud consumer's cloud resource administrator remotely accesses the virtual server hosting Cloud Service A (which is owned by the cloud consumer)



the cloud consumer's cloud resource administrator remotely accesses the virtual server hosting Cloud Service A (which is owned by the cloud consumer)

Roles in the Cloud - Additional

- Cloud Auditor
 - Conducts independent assessments of cloud environments
 - Provides an unbiased assessment of a cloud environment to help strengthen the trust relationship between cloud consumers and cloud providers.
 - Responsibilities evaluation
 - Security controls,
 - Privacy impacts,
 - and Performance
- Examples of Compliance
 - <https://learn.microsoft.com/en-us/azure/compliance/>
 - <https://aws.amazon.com/compliance/programs/>
- PwC, Delloitte, EY, KPMG

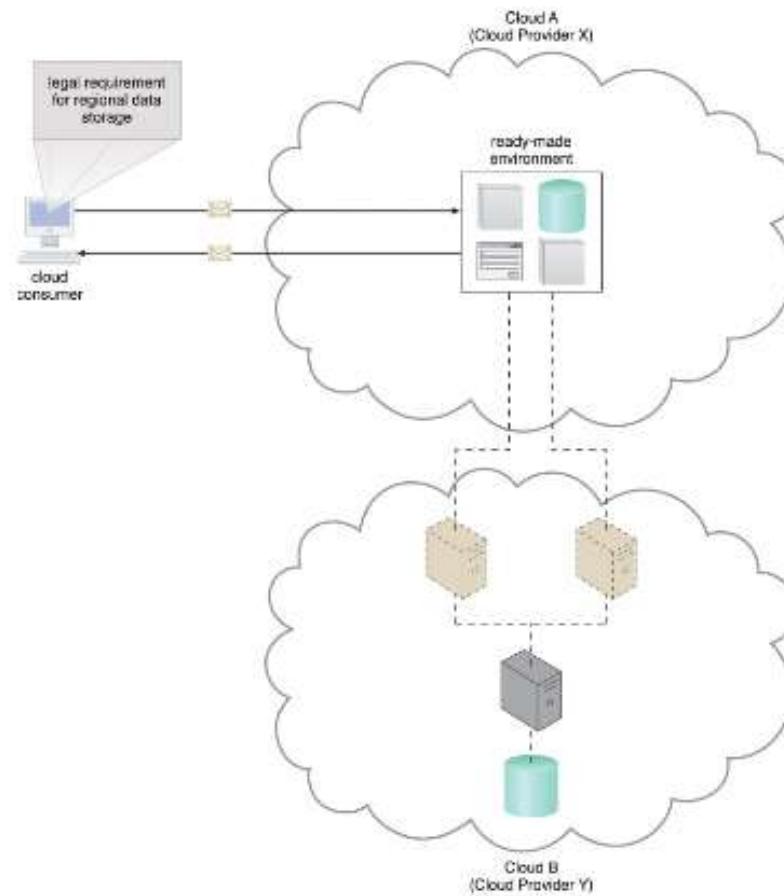
A sample of a Cloud Audit



Roles in the Cloud - Additional

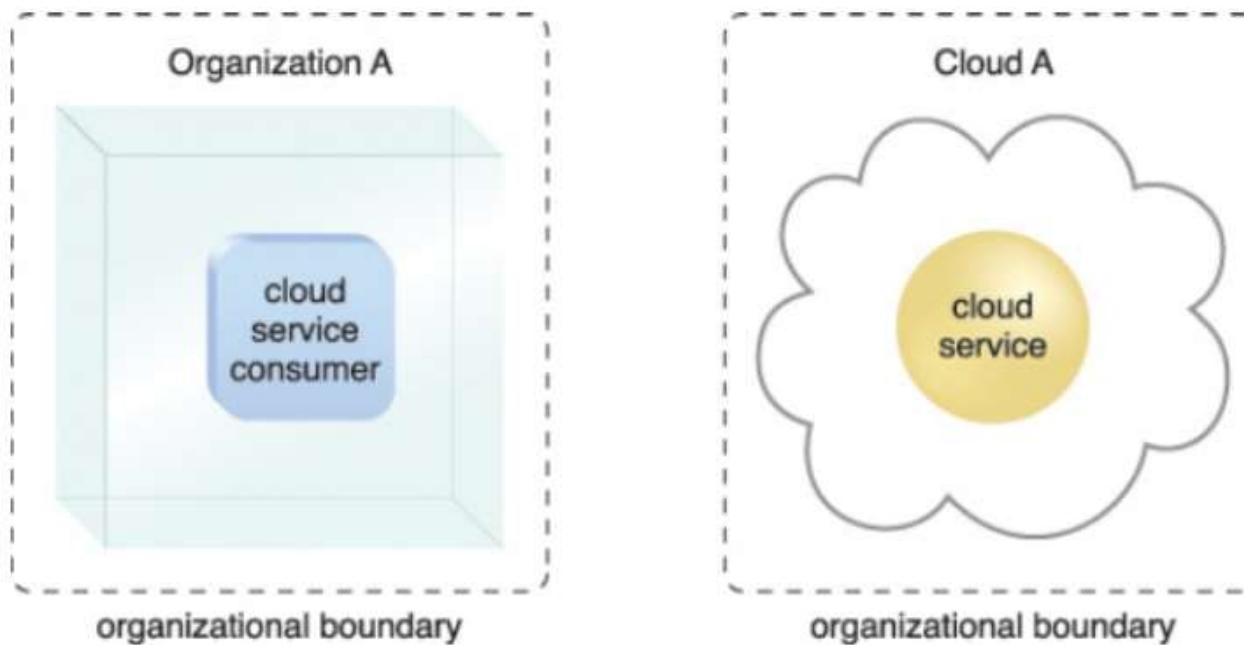
- Cloud Broker
 - Manage and negotiating the usage of cloud services between cloud consumers and cloud providers.
 - Mediation services include;
 - Service intermediation
 - Aggregation, and arbitrage.
 - Accenture Cloud First, IBM Cloud Brokerage Services
- Cloud Carrier
 - Responsible for providing the wire-level connectivity between cloud consumers and cloud providers assumes the role of the cloud carrier. This role is often assumed by network and telecommunication providers.

Mixing different Providers



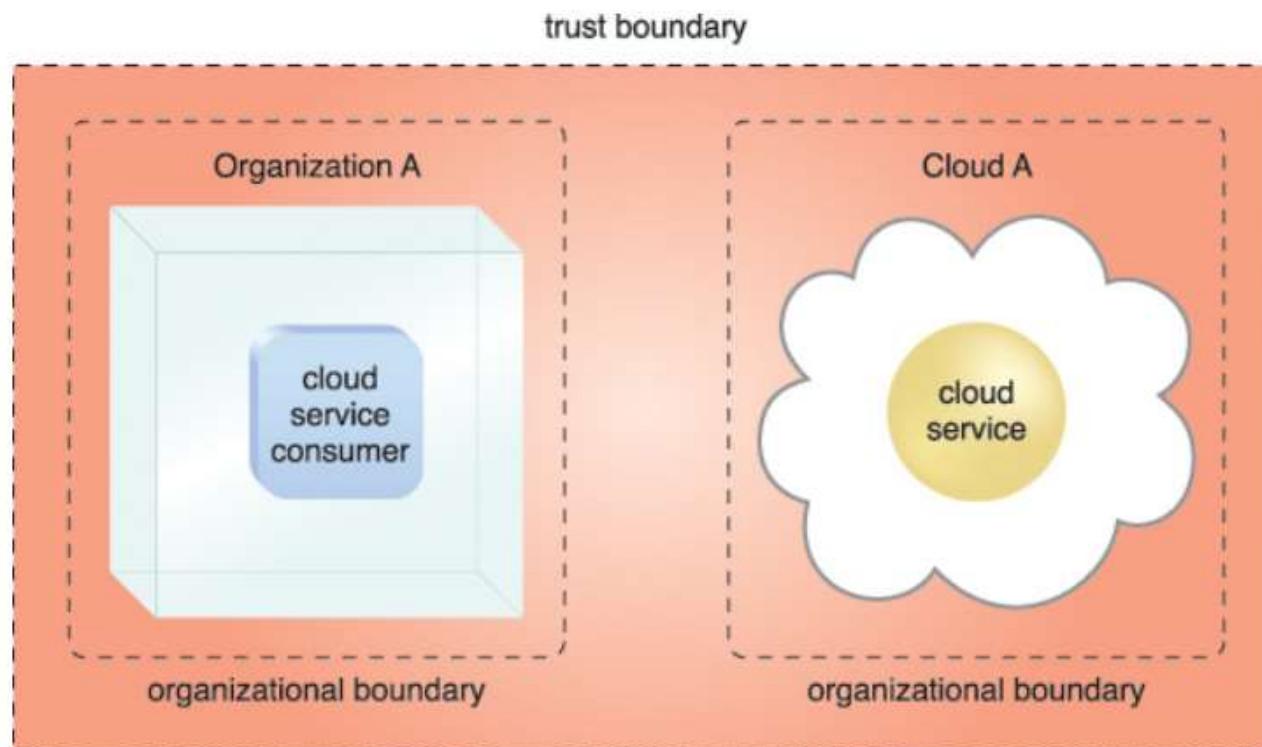
Boundaries - Organisational

- Organisational Boundary
 - Physical perimeter that surrounds a set of resources owned by an Organisation



Boundaries – Extending Trust

- Trust Boundary
 - Logical perimeter that would span beyond the physical boundaries to what is represent resources that are trusted in the organisation

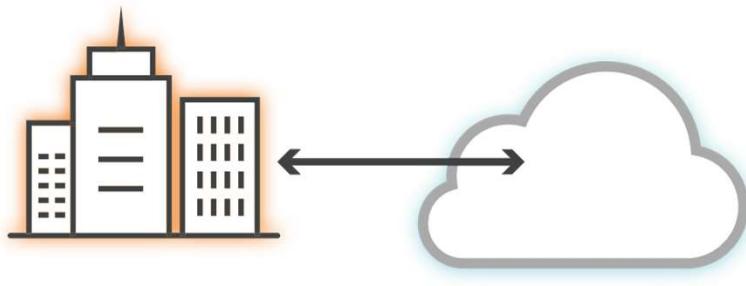


Cloud Deployment Models

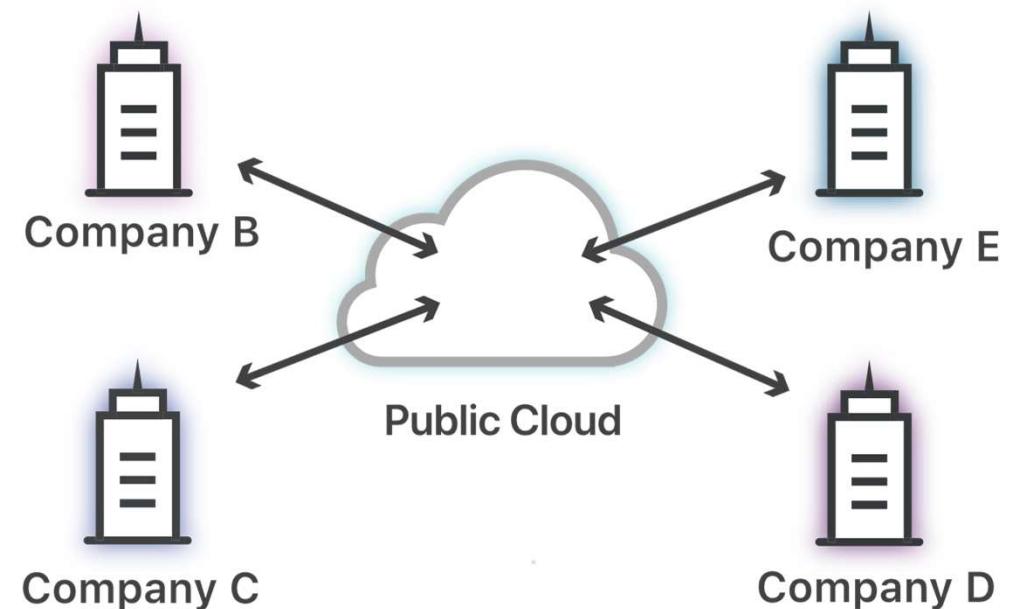


Private vs. Public

Private cloud

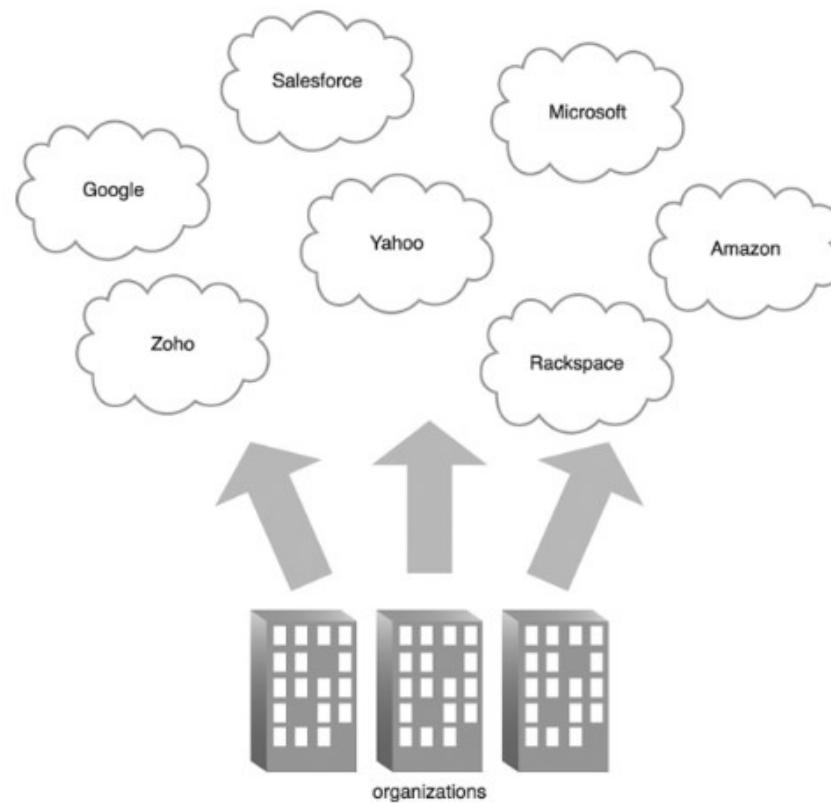


Public cloud shared by multiple companies



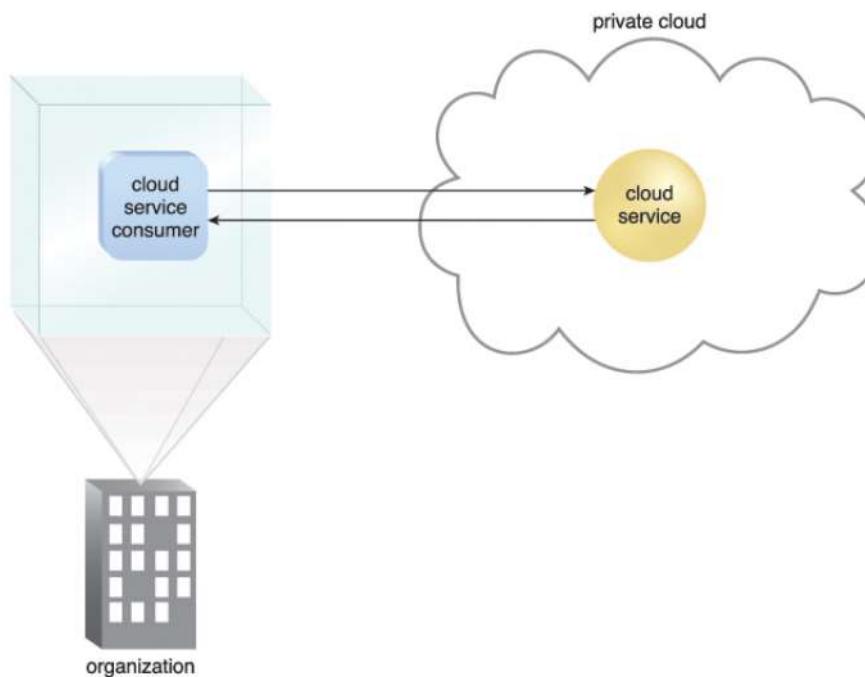
Public Cloud

- Most common way of deploying cloud computing
- Hardware, software, and other supporting infrastructure owned and managed by the third party cloud provider.
 - Bring your own software
- Targeted costs
- No maintenance
- Scalability
- Highly reliable

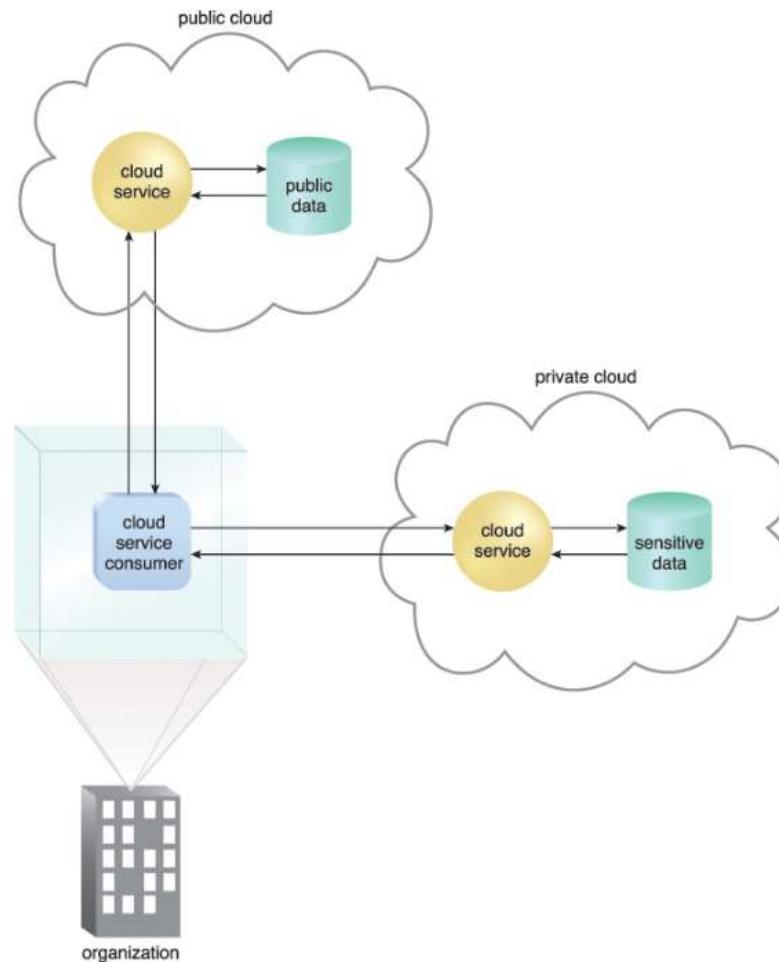


Private Cloud

- Computing resources used exclusively by one entity / organization
- Mid to large size organizations; government agencies, financial institutions
 - with business critical operations
 - want more control over their environment
- Flexible / Customisable
- Security
- Scalable



Hybrid Cloud



Other Deployment Models

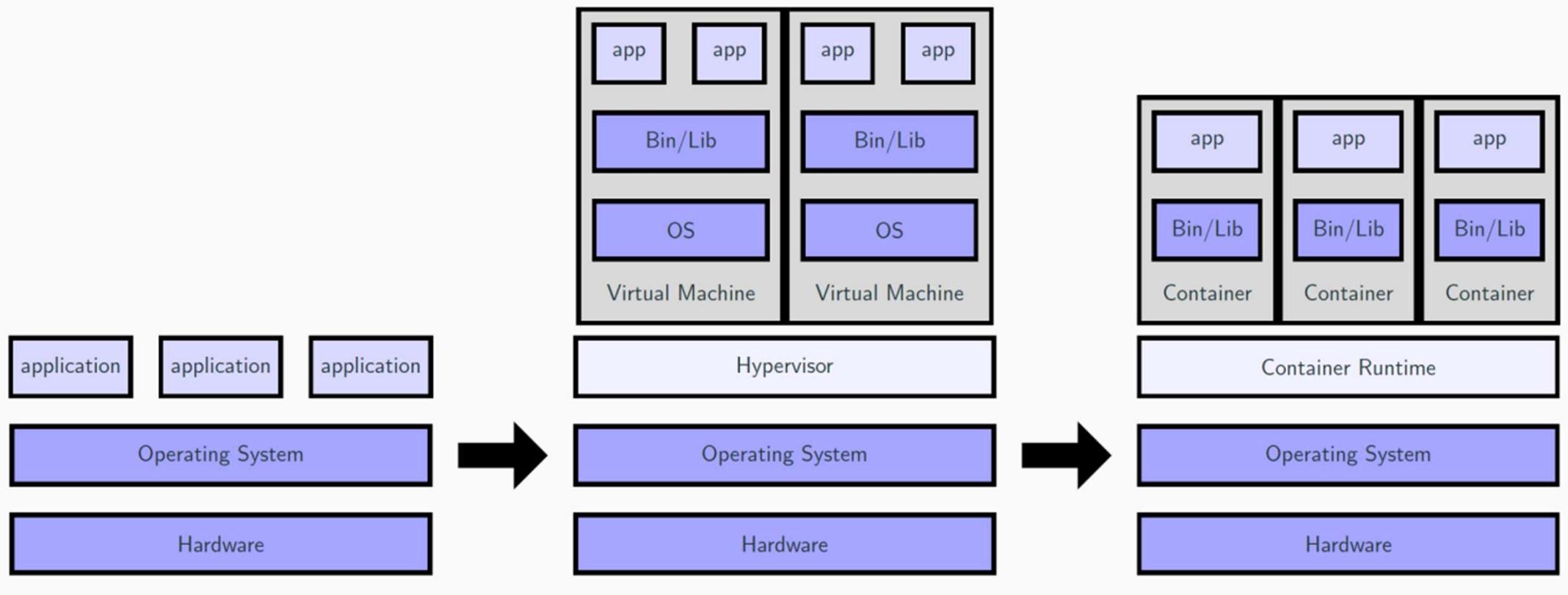
- Community Cloud

- Community cloud is a multitenant platform that is accessible only for a specific subset of customers. Example; U.S.-based dedicated IBM SoftLayer cloud for federal agencies. Only governmental entities sharing common characteristics like security, auditability and privacy concerns/requirements can use this platform

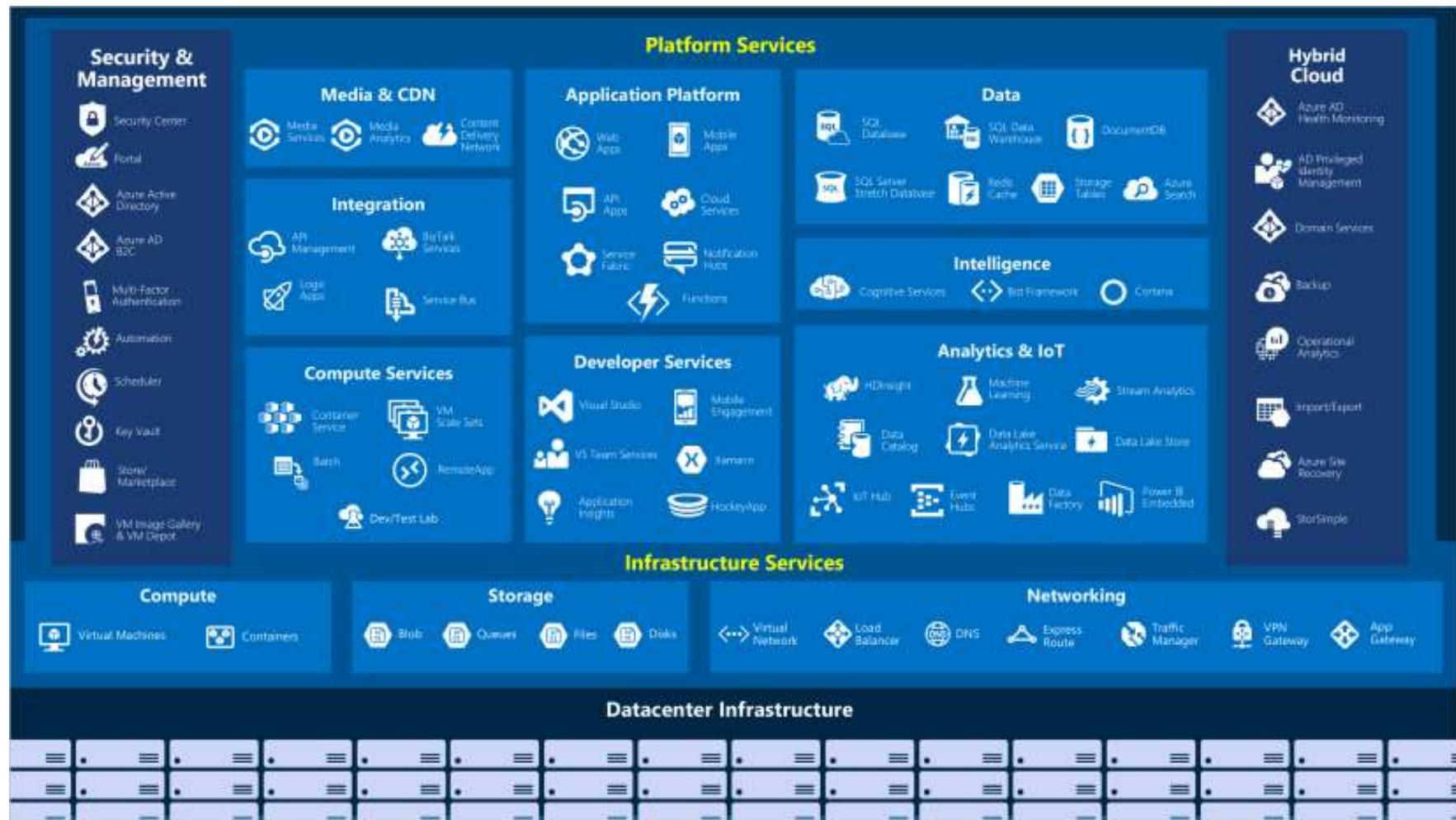
- Virtual Private Cloud

- Dedicated / hosted cloud, a public cloud provider hosts and provides a self contained environment for the Cloud Consumer

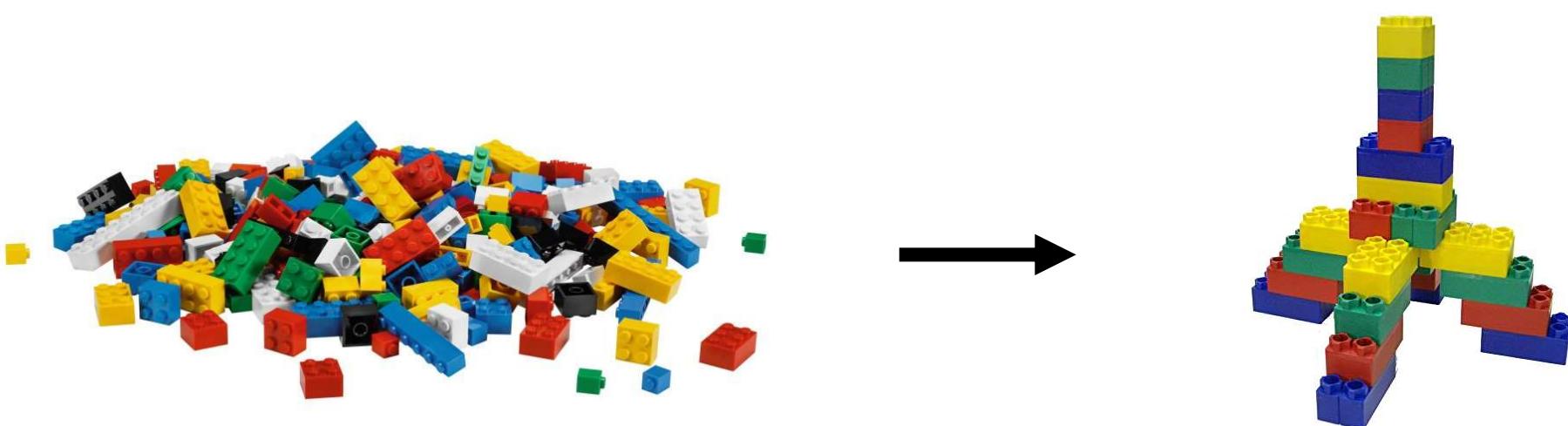
Traditional / Virtualisation / Containerisation



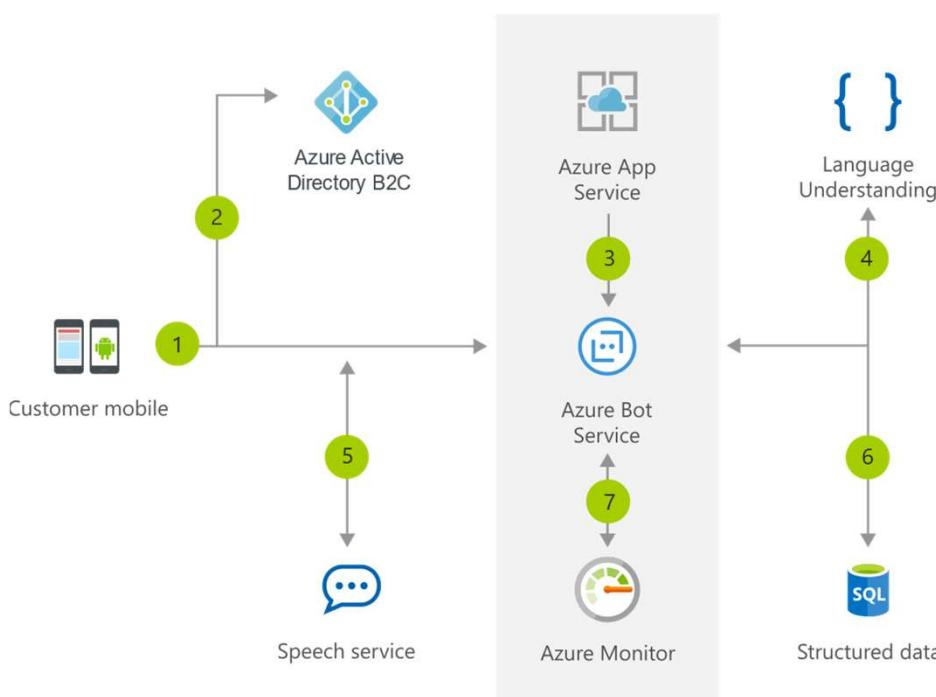
A subset of the Azure Service Landscape



We need to piece together these components for our solution



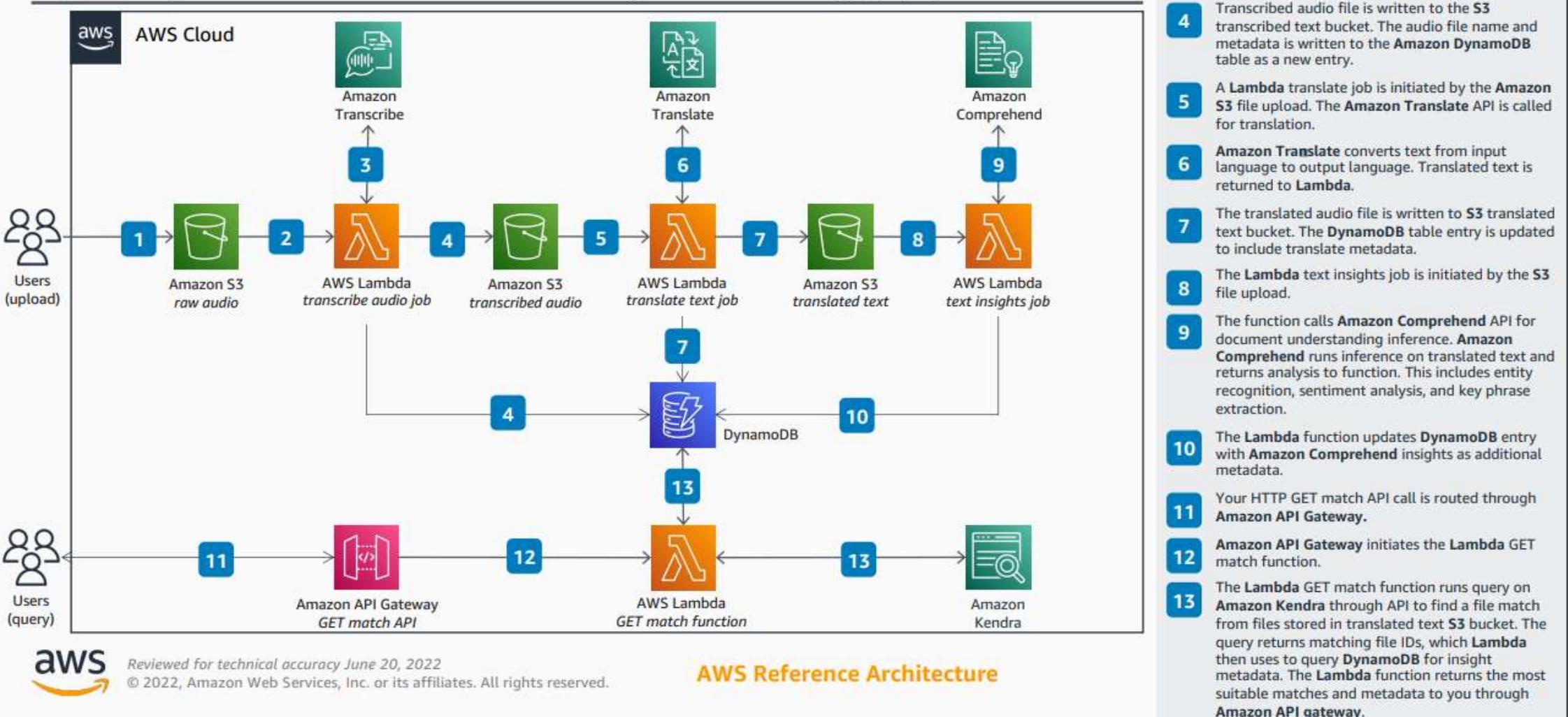
Example – Azure Chatbot for Customer Service (Reservations)



1. The customer uses your mobile app.
2. The customer authenticates by using Azure Active Directory B2C.
3. The customer requests information by using the custom application Bot.
4. Cognitive Services helps process the natural language request.
5. The response is reviewed by the customer, who can refine the question using natural language.
6. Once the customer is happy with the results, the Application Bot updates the reservation.
7. Application Insights monitors the live application to diagnose issues and help understand how to improve Bot performance and usability.

AI-Enabled Audio Insight Processing Pipeline

The following diagram shows how you can use API-driven artificial intelligence/machine learning (AI/ML) services such as Amazon Transcribe, Amazon Translate, and Amazon Comprehend to automatically process audio files via simple API integrations. The architecture shows you how to upload raw audio and create a pipeline for multi-language insights through a serverless architecture. The pipeline integrates with the Amazon Kendra smart search functionality to assist in a natural language query of audio content.



Reviewed for technical accuracy June 20, 2022
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AWS Reference Architecture

Thank you



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