UNIT - 4
Multi-Cloud Architecture

Multi-Cloud Architecture

In this chapter, we’re going to cover the following main topics

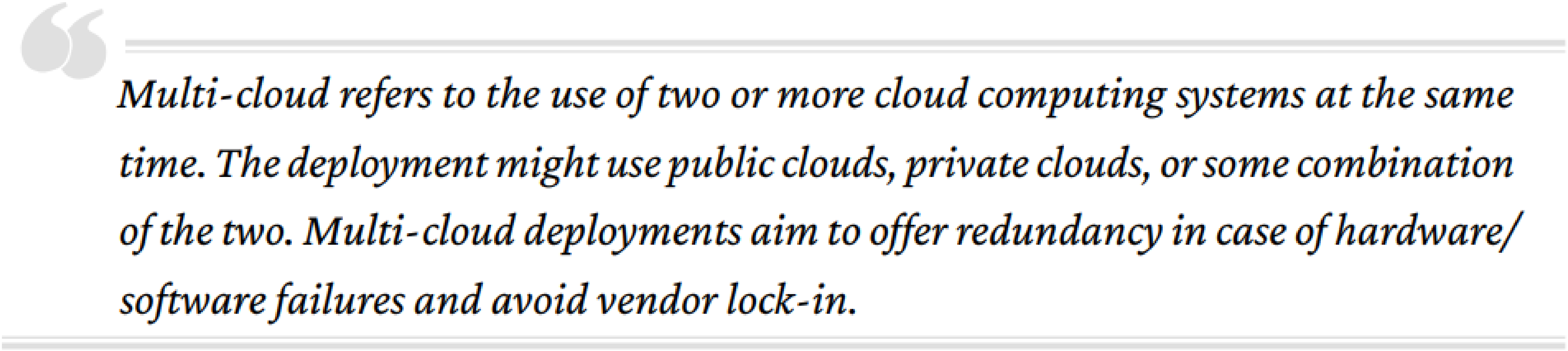
- Understanding multi-cloud concepts
- Multi-cloud—more than just public and private
- Setting out a real strategy for multi-cloud
- Introducing the main players in the field
- Evaluating cloud service models
- Gathering requirements for multi-cloud
- Understanding the business challenges of multi-cloud

Multi-Cloud Architecture

If my organization deploys IT systems on various cloud platforms, how do I keep control?

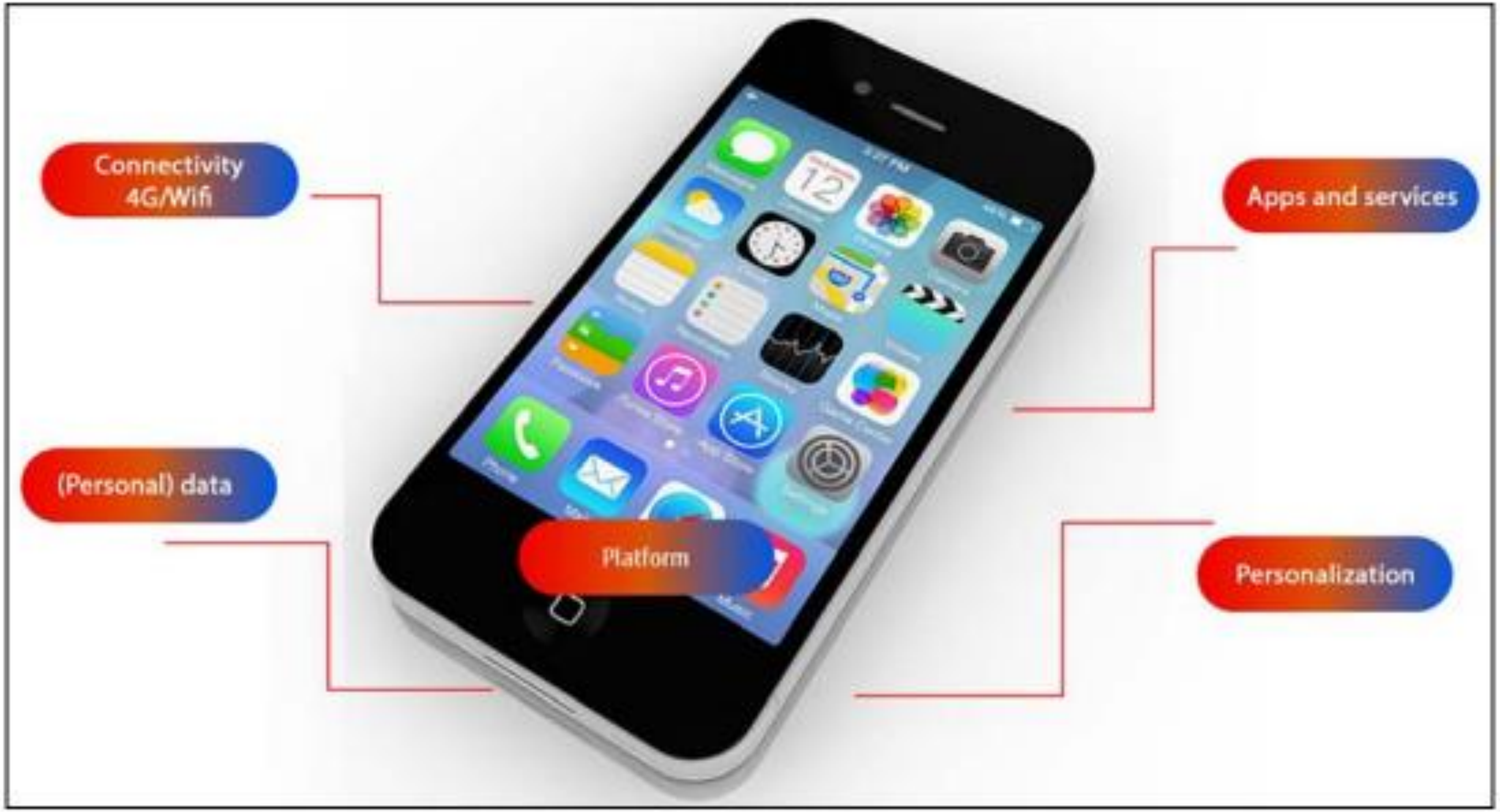
Multi-Cloud Architecture

What is Multi Cloud?



> *Multi-cloud refers to the use of two or more cloud computing systems at the same time. The deployment might use public clouds, private clouds, or some combination of the two. Multi-cloud deployments aim to offer redundancy in case of hardware/ software failures and avoid vendor lock-in.*

Multi-Cloud Architecture



Multi-Cloud Architecture

Multi-cloud—more than just public and private

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Hybrid platforms are homogeneous and multi-cloud platforms are heterogeneous.

Homogeneous here means that the cloud solutions belong to one stack, for instance, the Azure public cloud with Azure Stack on-premises.

Is multi cloud is Hybrid IT?

Heterogeneous, then, would mean combining Azure and AWS, for instance.

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Recap

- **Hybrid:** Combines on-premises and cloud.
- **Multi-cloud:** Two or more cloud providers.
- **Private:** Resources dedicated to one company or user.
- **Public:** Resources are shared (note, this doesn’t mean anyone has access to your data. In the public cloud, we will have separate tenants, but these tenants will share resources, for instance, in networking).

Multi-Cloud Architecture

Setting out a real strategy for multi-cloud

A cloud strategy emerges from the business and the business goals. Business goals.

for example, could include the following:

- Creating more brand awareness
- Releasing products to the market faster
- Improving profit margins

Honestly

The strategy should focus on how to generate and increase revenue

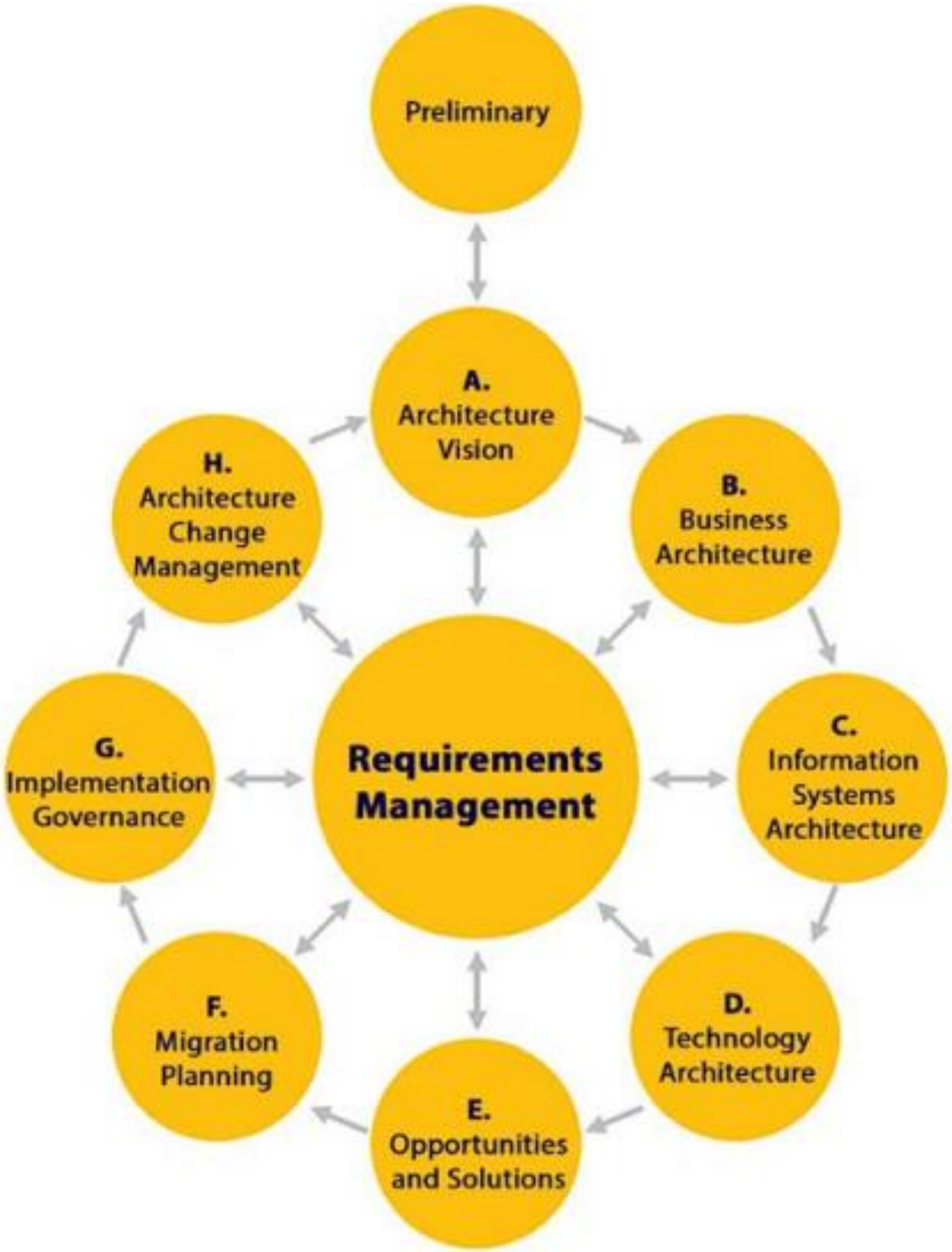
The most used framework for enterprise architecture is TOGAF (The Open Group Architecture Framework)

Multi-Cloud Architecture

Setting out a real strategy for multi-cloud

The core of TOGAF is the ADM cycle, short for Architecture Development Method. Also, in architecting multi-cloud environments, ADM is applicable.

The ground principle of ADM is B-D-A-T: the cycle of **business**, **data**, **applications**, and **technology**.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F. Migration Planning
G. Implementation Governance
H. Architecture Change Management
Requirements Management

Multi-Cloud Architecture

Analyzing the enterprise strategy for the cloud

Every business should have the goal of generating revenue and earning money.

That’s not really a strategy. The strategy is defined by how it generates money with the products the business makes or the services that it delivers.

A good strategy comprises a well-thought-out balance between timing, access to and use of data, and something that has to do with braveness—daring to make decisions at a certain point in time. That decision has to be based on—you guessed it—proper timing, planning, and the right interpretation of data that you have access to.

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Analyzing the enterprise strategy for the cloud

The overall strategy should be translated into use cases.

Use cases can be:

- Delivering products in new business models, such as SaaS
- Achieving more resilience in business, for instance, by implementing disaster recovery using the cloud
- Faster time to market in product development through the quick deployment of development environments
- Analysis of big data using data lakes in the cloud

What are the drivers for business strategy? Typically, these are categorized into four areas:

- Financial objectives
- Customer objectives
- Product objectives
- Internal objectives

Analyzing the enterprise strategy for the cloud

The following are the one that helps to build good strategy in Enterprise

Quality Function Deployment (QFD)

House of Quality (HOQ)

Voice of the Customer (VOC)

Multi-Cloud Architecture

Introducing the scaffold for multi-cloud environments

The meaning of scaffold is a structure that supports the construction and maintenance of buildings;

the term was adopted by Microsoft to support, build, and manage environments that are deployed in Azure

Working with Well-Architected Frameworks

Well-Architected Frameworks were invented to help customers build environments in public clouds by providing them with best practices.

The frameworks typically contain pillars or scaffolds.

- Operational excellence
- Security
- Cost optimization
- Reliability
- Performance efficiency
- Sustainability (at the time of writing, only included by AWS)

Multi-Cloud Architecture

Identity and Access Management (IAM)

- Specific access rules need to be set for these identities; they need to be authorized to execute tasks.
- The most important thing to bear in mind is that virtually everything in the cloud is an identity
- Resources, functions, APIs, machines, workloads, and databases that are allowed to perform certain actions
- All these resources need to be uniquely identified to authenticate them in your environment.

Security

- Security remains the responsibility of the business itself. Cloud platforms will provide you with the tools to secure your environment.
- **Center for Internet Security (CIS)** CIS baseline is extensive and covers a lot of ground in terms of hardening resources in the cloud.

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Cost management

- Businesses have a tendency not to fully calculate all related costs to workloads that are hosted on on-premises systems. Very often, things such as power, cooling, but also labor (especially involved in changes) are not taken into consideration.
- Businesses use the public cloud like they use on-premises systems, but without the functionality that clouds offer in terms of flexibility. Not all workloads need to be operational 24/7/365.

Monitoring

- Cloud providers offer native monitoring platforms: Azure Monitor, AWS CloudWatch, Google Cloud Monitoring
- All these monitoring suites can operate within the cloud itself, but also have APIs to major IT Service Management (ITSM) systems such as ServiceNow, where the latter will then provide a single pane of glass over different platforms in the IT environment.

Automation

- Most large outages are caused by **human error** that could have been avoided by **automation**. However, automation only works when it's tested thoroughly. And you still need good developers to write the initial code and the automation scripts
- Automation is not only about tools and technology It's also about processes; methodologies such as **Site Reliability Engineering (SRE**)—invented by Google—are gaining a lot of ground.

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Understanding identities and roles in the cloud

- Everything in the cloud has an identity.
- There are two things that we need to do with identities: **authenticate** and **authorize**
- For authentication, we need an identity store. Most enterprises will use **Active Directory (AD**) for that, where AD becomes the **central place** to store the **identities** of **persons** and **computers**

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Understanding identities and roles in the cloud

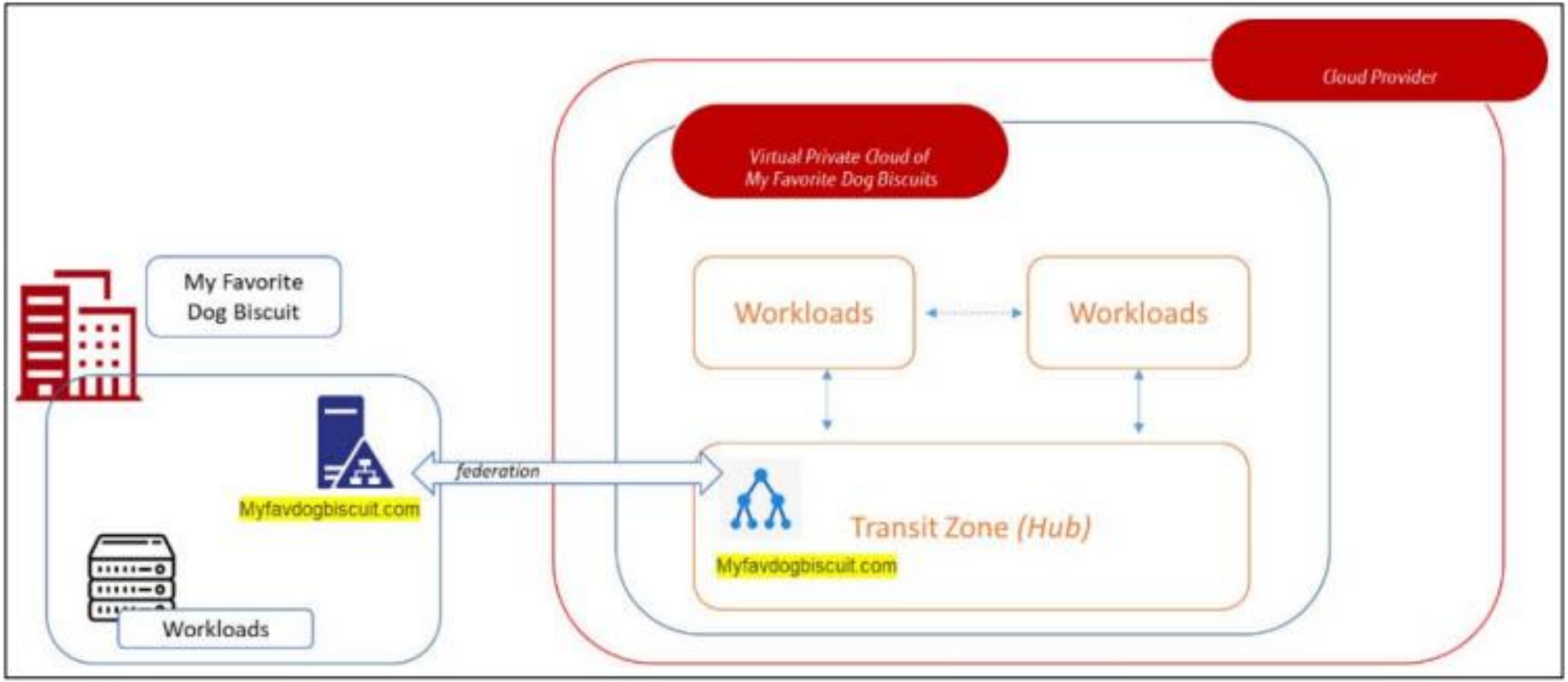


Figure: Active Directory Federation

Understanding identities and roles in the cloud

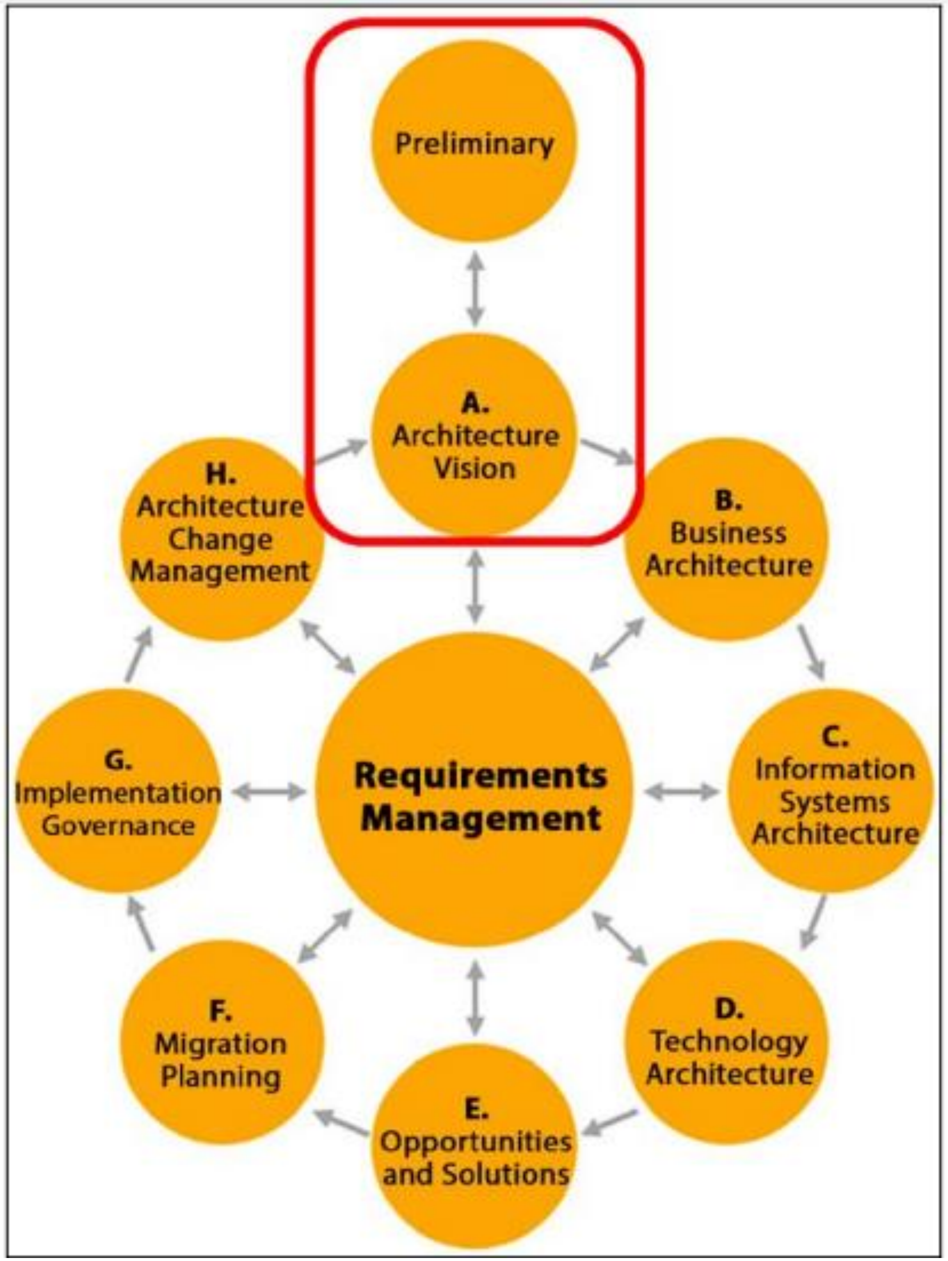
For Example: I have a company with the name **myfavdogbiscuit.com**. On Azure, we can specify a domain with **myfavdogbiscuit.onmicrosoft.com.**

- Resources deployed in the cloud domains can now be domain-joined, if the domain on the cloud platform is connected to the business domain. That connection is provided by domain controllers.
- All cloud providers support AD, the underlying **Lightweight Directory Access Protocol** (LDAP) standard, and **Kerberos**.
- **Role-Based Access Control (RBAC).** RBAC in Azure, IAM in AWS, and Cloud Identity in GCP let you manage access to (parts of) the environment and what identities can do in that environment.

Multi-Cloud Architecture

Defining architecture principles for multi-cloud

- we have a preliminary phase where we set out the framework and the architecture principles.
- These feed into the very first step in the actual cycle, known as architecture vision.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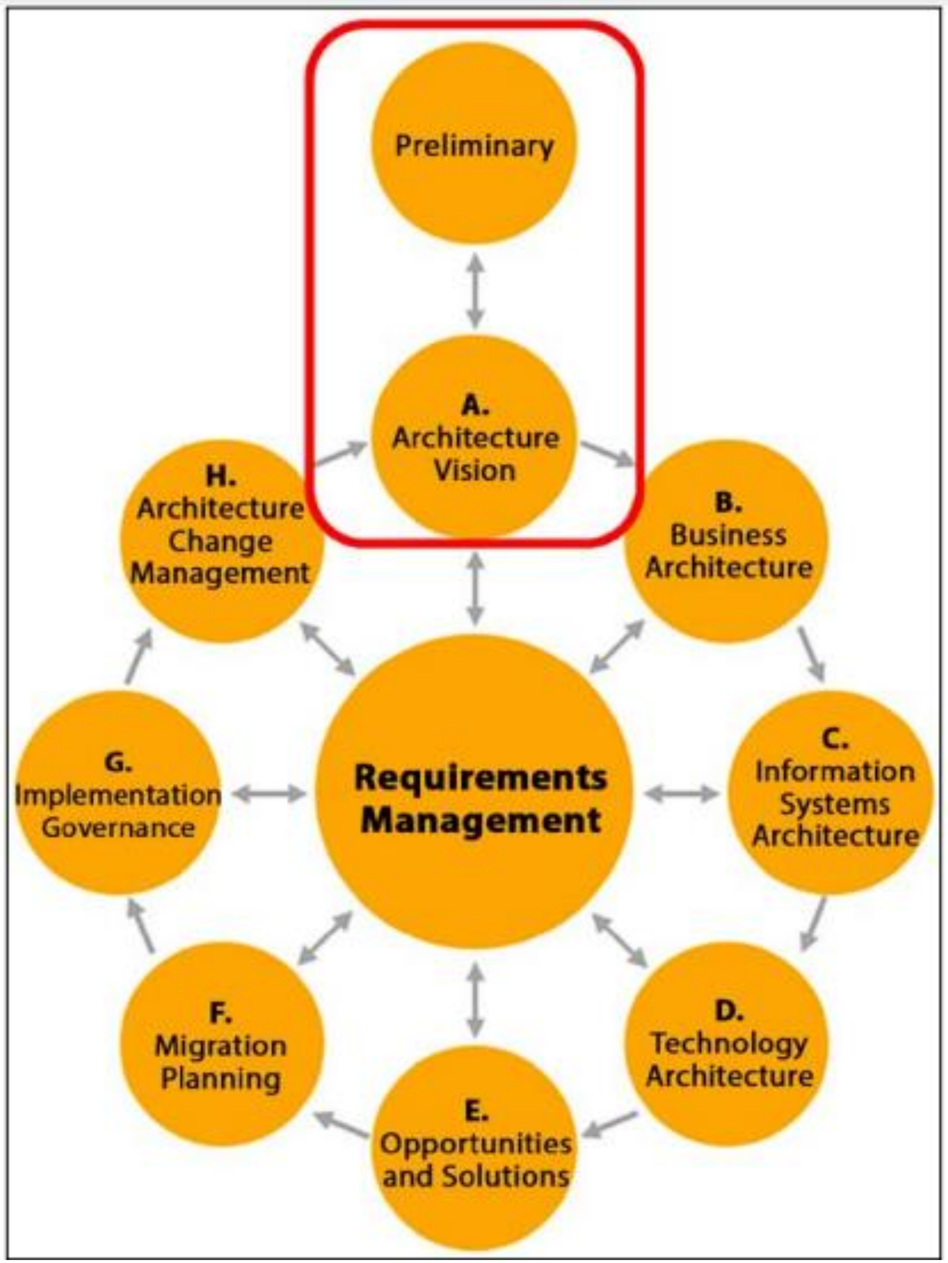
Multi-Cloud Architecture

Defining architecture principles for multi-cloud

- Does the principle support the business goals?
- Is the principle clear so that it can’t be subject to multiple interpretations?
- Is the principle leading toward a clearly defined solution?

Some suggested groups for defining principles are as follows:

- Business
- Security and compliance
- Data principles
- Application principles
- Infrastructure and technology principles
- Usability
- Processes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Using quality attributes in architecture

- Quality attributes is a term that sprouts from a different framework, called Continuous Architecture.
- Cloud architectures tend to be fluid, meaning that they are very dynamic since they have to respond to changing customer demands fast and continuously.

This framework defines quality attributes to which architecture must comply:

1. Operability
2. Performance
3. Configurability
4. Discoverability
5. Security
6. Scalability
7. Robustness
8. Portability
9. Usability

Multi-Cloud Architecture

Defining principles from use cases

1. Business principles

This is phase A in TOGAF

Business principles start with business units setting out their goals and strategy.

These adhere to the business mission statement and, from there, describe what they want to achieve in the short and long term.

This can involve a wide variety of topics:

- Faster response to customers
- Faster deployment of new products (time to market)
- Improve the quality of services or products
- Engage more with employees
- Real digital goals such as releasing a new website or web shop
- Increase revenue and profit, while controlling costs

Multi-Cloud Architecture

Defining principles from use cases

Business principles Business principles start with business units setting out their goals and strategy.

These adhere to the business mission statement and, from there, describe what they want to achieve in the short and long term.

As with nearly everything, goals should be SMART, which is short for **specific**, **measurable**, **attainable**, **relevant**, and **timely**.

For example

A SMART-formulated goal could be “the release of the web shop for product X in the North America region on June 1.”

Multi-Cloud Architecture

Defining principles from use cases

2. Principles for security and compliance

This is phase B in TOGAF

Though security and compliance are major topics in any architecture, the principles in this domain can be fairly simple.

Security by design

Center for Internet Security (CIS)

Hardware Security Modules (HSMs)

General Data Protection Regulation (GDPR)

Defining principles from use cases

3. Data principles

The most often used data principles are related to data confidentiality and, from that, protecting data.

The five most important data principles are:

1. Accuracy
2. Relevance
3. Timeliness
4. Consistency
5. Privacy and security

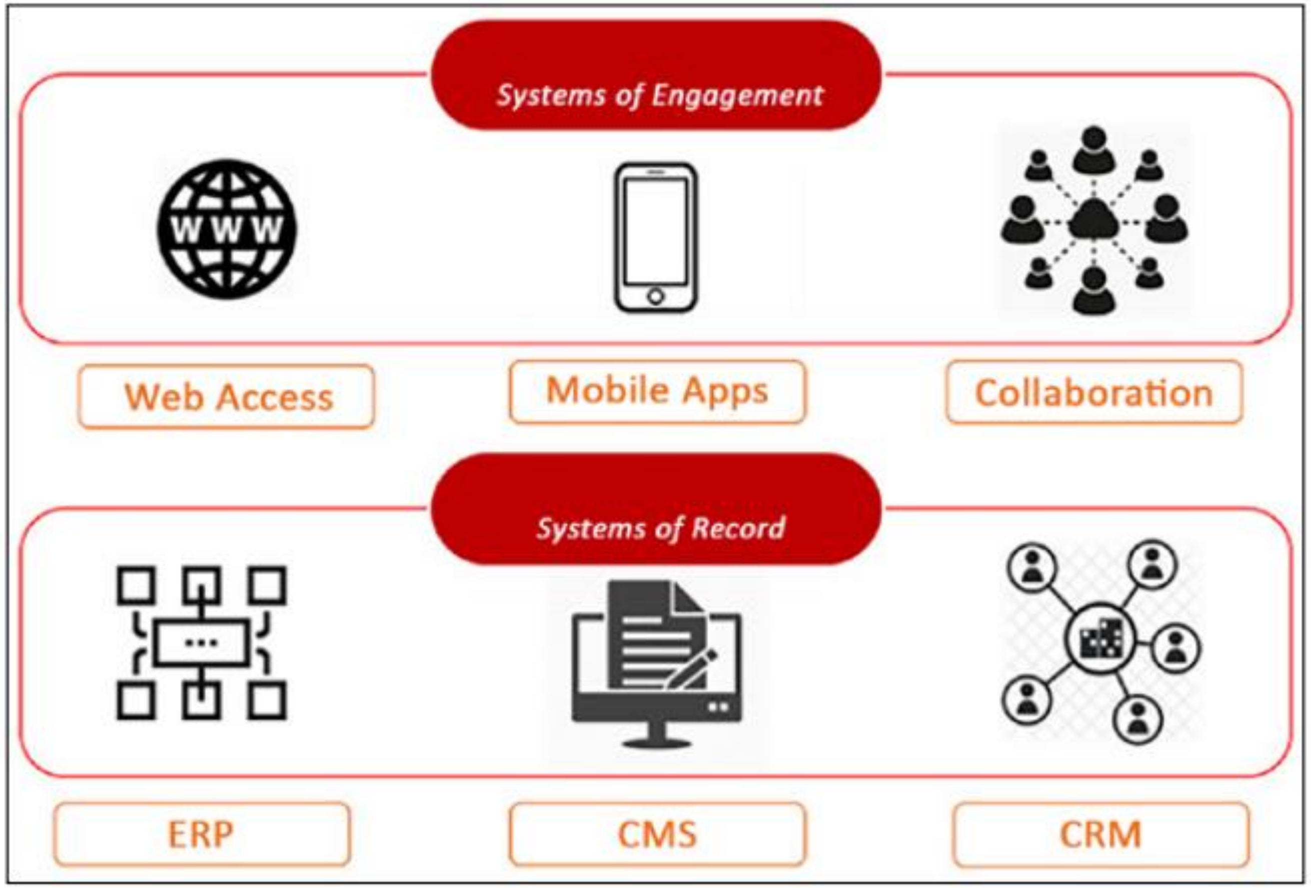
Defining principles from use cases

3. Data principles

Two important technology terms that have become quite common in cloud environments

1. Systems of record: Systems of record are data management or information storage systems; that is, systems that hold data.

2. Systems of engagement: Systems of engagement are systems that are used to collect or access data. This can include a variety of systems: think of email, collaboration platforms, and content management systems

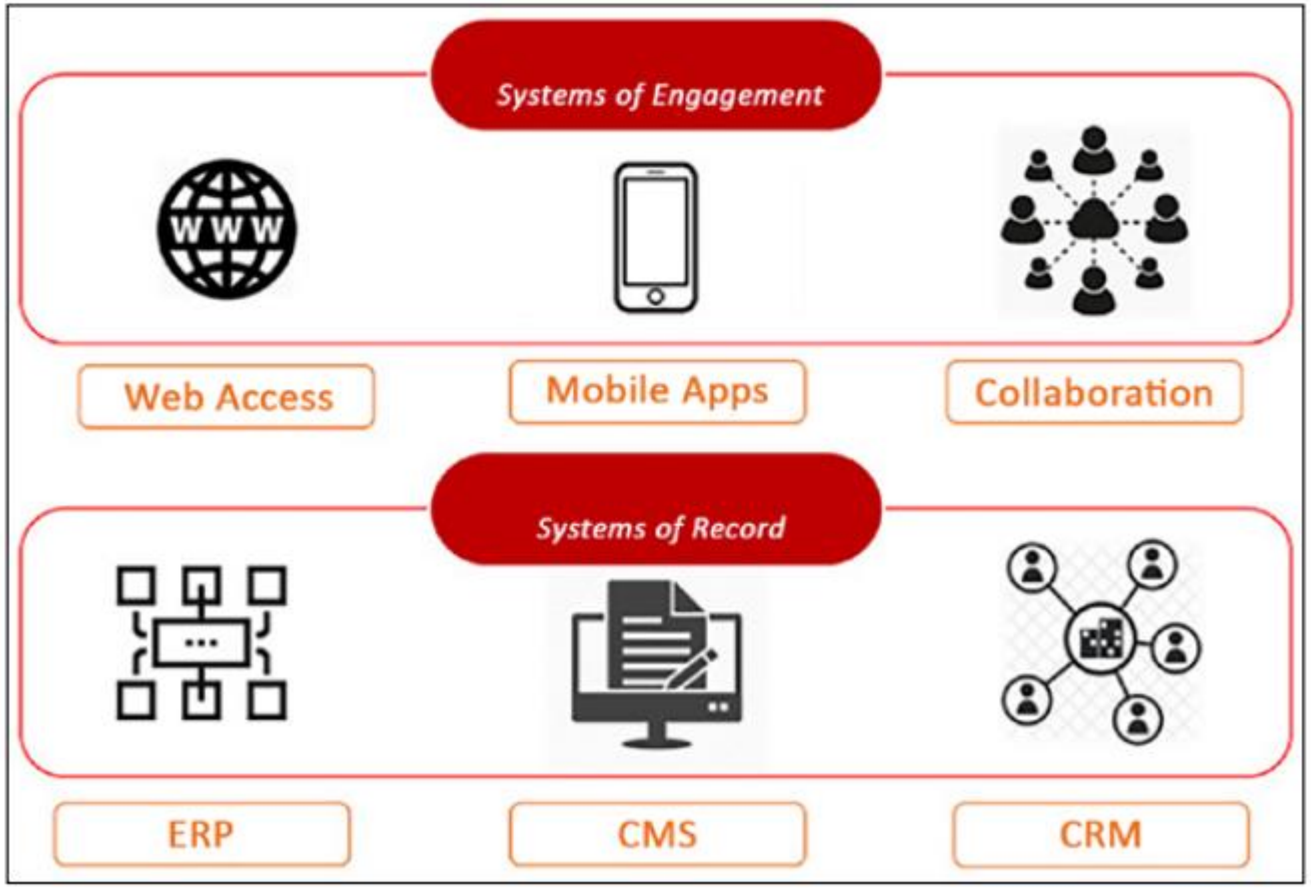


Multi-Cloud Architecture

Defining principles from use cases

3. Data principles

A high-level overview of the topology for holding systems of record and systems of engagement is shown in the following diagram, with **Enterprise Resource Planning (ERP), Content Management (CMS)**, and **Customer Relationship Management (CRM)** systems being used as examples of systems of record:



Multi-Cloud Architecture

Defining principles from use cases

3. Data principles

Big data and data analytics have become increasingly important for businesses in their journey to become data-driven: any activity or business decision,

A growing number of architects believe that there will be a new layer in the model. That layer will hold **"systems of intelligence"** using machine learning and artificial intelligence (AI).

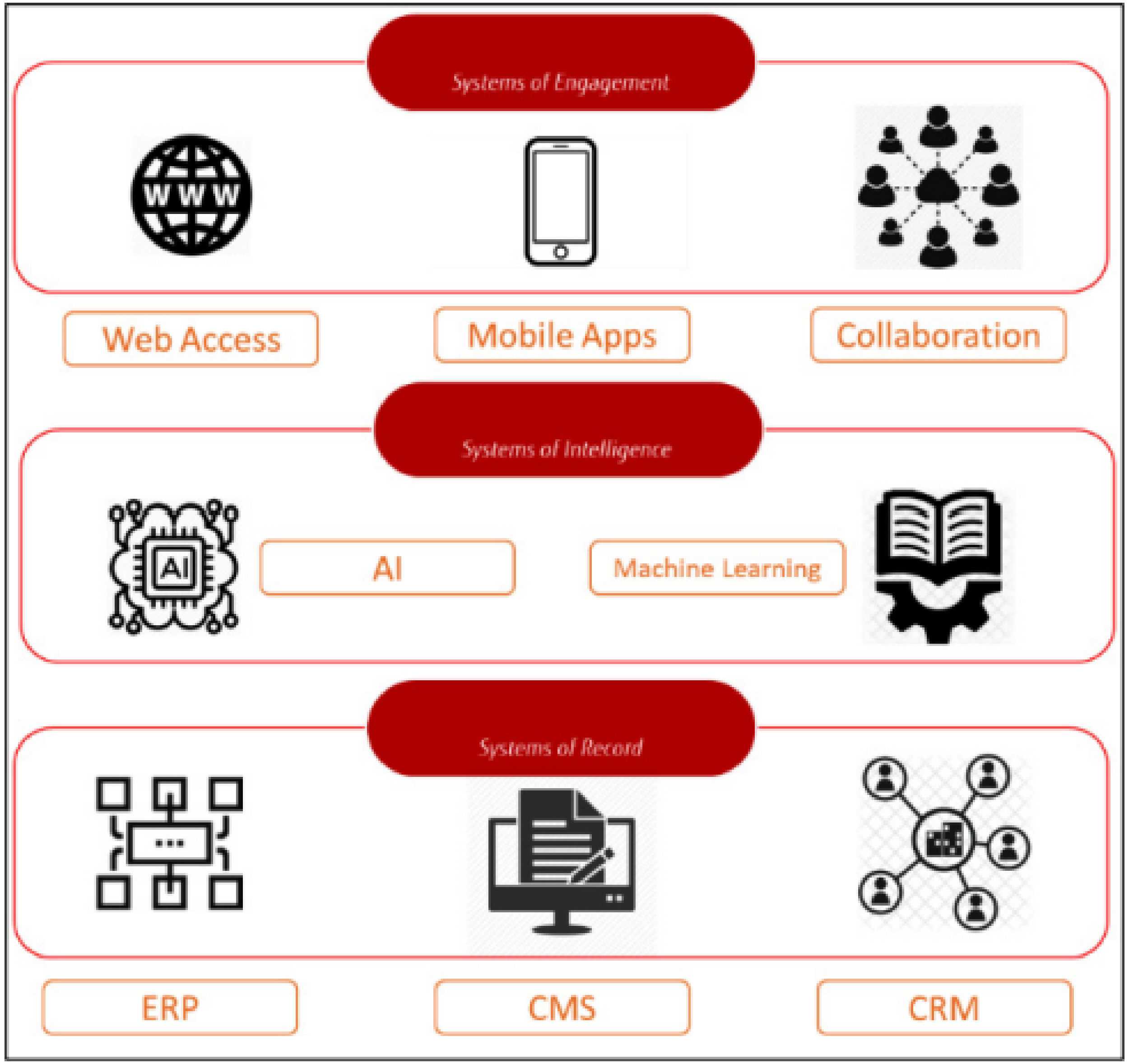


Figure 5.3: Simple representation of the systems of intelligence layer

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Defining principles from use cases

4 Application principles

If we look at TOGAF once more, we'll see that data and applications are grouped into one architectural phase, known as phase C.

- In modern applications, one of the main principles of applications is that they have a data-driven approach using **Enterprise Architecture Planning**
- In multi-cloud, the storage data changes, but also the format of applications. Modern applications are usually not monolithic or client-server-based these days, although enterprises can still have a large base of applications with legacy architectures.
- popular principles for applications are taking the specific characteristics of **cloud-native** technology into consideration. Modern apps should be enabled for mobility, be platform-independent using open standards.

Defining principles from use cases

5. Infrastructure and technology principles

This is phase D in TOGAF

- We get to the real technology: machines, wires, nuts, and bolts. Here, we're talking about virtual nuts and bolts. Since data is stored in many places in our multi-cloud environment and applications are built to be cloud-native.

The Twelve-Factor App sets the following three major requirements for infrastructure:

• The app is **portable** between different platforms, meaning that the app is **platform-agnostic** and does not rely on a specific server or system's settings.

• There's little to no difference between the development stage and the production stage of the app so continuous development and deployment are enabled. The platform that the app is deployed on should support this (meaning that everything is basically code-based).

Multi-Cloud Architecture

Defining principles from use cases

6. Principles for processes

- The last group of principles is concerned with processes.
- This is not about the IT System Management (ITSM) processes, but about the processes of deployment and automation in multi-cloud.
- If we have a code-only principle defined, then we can subsequently set a principle that states that we must work from the code base or master branch.
- Today, a lot of companies are devoted to agile and DevOps. (**Scaled Agile Framework (SAFe)**)