Module 4. Cloud Architecture Design Principles

This module covers the following subjects:

- **The Well-Architected Framework**: AWS does not just hope you can architect a brilliant design on their cloud; they provide detailed guidance on how to do so. "The AWS Well-Architected Framework" is a thorough document introduced in this section of the module.
- **Fault Tolerance and High Availability**: This section discusses the relative ease of achieving a fault-tolerant and highly available architecture in AWS.
- **Web Hosting**: This section of the module describes how AWS can assist dramatically in the hosting of various web application content.

There are proven techniques for using AWS established by many companies all over the world. In this module, you benefit from all this experimentation and learn some of the fundamental design principles that can guide you throughout your AWS experiences.

FOUNDATION TOPICS

THE WELL-ARCHITECTED FRAMEWORK

You might think that at Amazon, engineers sat down to pen "The Well-Architected Framework" based on their experience with cloud design. However, they based the document on the experiences of AWS users. To provide you with a document as critical as "The Well-Architected Framework," these engineers and architects analysed the actual implementations of successful designs by some of their most significant and successful customers. This research gave rise to the framework that we cover here.

What are some of the goals of "The Well-Architected Framework"? Well, they are pretty lofty. They include designing for security, performance, resiliency, and efficiency. The framework also provides you with the valuable opportunity to evaluate a proposed design against the tried and true principles contained in the document. This makes it an even more useful tool.

Amazon had many goals when they created this framework. Here are the most important:

- Build and deploy solutions faster than ever before.
- Lower and mitigate the risks associated with a move to the cloud.
- Make informed decisions about how to implement solutions in the cloud.
- Learn the most potent best-practice approaches to using AWS services and tools.

To help organize the framework and make it more valuable, Amazon focused the framework around the following five pillars:

- Operational excellence
- Security
- Reliability
- Performance efficiency
- Cost optimisation
- Sustainability

We should examine each of these pillars and the important design concepts in each.

The AWS Well-Architected Framework provides a set of best practices and guidelines to help cloud architects build secure, high-performing, resilient, efficient, and sustainable infrastructures for their applications. The framework is organised into six pillars, each representing a key area of focus to ensure a robust cloud architecture:

1. Operational Excellence

- **Focus:** This pillar emphasises running and monitoring systems to deliver business value and continuously improving processes and procedures.
- **Key Practices:**
  - Define and manage your operations as code.
  - Make frequent, small, reversible changes.
  - Anticipate failure and learn from all operational events.
  - Refine operations procedures frequently, ensuring teams have a shared understanding of your environment and workflows.

2. Security

- **Focus:** This pillar protects information, systems, and assets while delivering business value through risk assessments and mitigation strategies.
- **Key Practices:**
  - Implement a strong identity foundation with the principle of least privilege.
  - Enable traceability with comprehensive logging and monitoring.
  - Apply security at all layers, including network, data, and application security.
  - Automate security best practices to respond quickly to security incidents.
  - Protect data both at rest and in transit, and ensure systems and software are up-to-date.

3. Reliability

- **Focus:** This pillar ensures that a workload performs its intended function correctly and consistently when expected.
- **Key Practices:**
  - Design systems to recover from failures automatically.
  - Scale horizontally to increase availability and handle workload demands.
  - Test recovery procedures regularly and define recovery objectives, such as RTO (Recovery Time Objective) and RPO (Recovery Point Objective).
  - Automate recovery and ensure the ability to detect and respond to failure.

4. Performance Efficiency

- **Focus:** This pillar focuses on efficiently using IT and computing resources to meet system requirements and maintain performance as demand changes and technologies evolve.
- **Key Practices:**
  - Select the suitable AWS resource types and sizes based on workload requirements.
  - Continuously monitor performance and optimize using data-driven decisions.
  - Automate processes to reduce manual intervention and enable experimentation.
  - Utilize a global footprint by taking advantage of AWS's global infrastructure.

5. Cost Optimization

- **Focus:** This pillar is about managing costs to maximize the value delivered while avoiding unnecessary expenditure.
- **Key Practices:**
  - Implement cloud financial management practices to understand and control costs.
  - Use the most cost-effective resources, such as reserved instances or Savings Plans.
  - Continuously monitor usage, shut down unused resources, and right-size services.
  - Optimize over time by adopting newer, more efficient resources and solutions.

6. Sustainability

- **Focus:** The Sustainability pillar aims to minimise the environmental impact of cloud workloads by optimising architecture to reduce energy consumption and carbon footprint.
- **Key Practices:**
    - Understand the environmental impact of your workloads, including the entire lifecycle of cloud services.
    - Set measurable sustainability goals to reduce energy consumption and carbon emissions.
    - Optimize workload design, increase efficiency, and select energy-efficient AWS Regions.
    - Maximize utilisation, reduce waste, and automate scaling to shut down idle resources.
    - Continuously measure, monitor, and improve the sustainability impact of your architecture using AWS tools and best practices.
    - Leverage AWS innovations, such as AWS's commitment to renewable energy and efficient infrastructure.

By following the six pillars of the AWS Well-Architected Framework, organisations can build secure, resilient, high-performing, cost-efficient, and sustainable cloud infrastructures, aligning their architecture with business objectives and environmental responsibilities. This holistic approach ensures that workloads are optimised for current demands and prepared for future growth and evolving sustainability needs.

FAULT TOLERANCE AND HIGH AVAILABILITY

Let's begin by ensuring you understand these two critical concepts. Fault tolerance (FT) is the ability of a system to sustain the loss of a component without incurring downtime. High availability (HA) refers to the ability of your entire architecture to maintain an increased level of availability. You should note that fault tolerance is a subcomponent of high availability.

There are two critical considerations for high availability with AWS. First, HA should be achievable at a small fraction of the cost of attaining HA in a traditional data centre on your premises. Second, HA should be

achievable with a minimum of human intervention. Most consider HA to mean there is *no* human intervention.

Understand that implementing HA on-premises using traditional IT technology tends to be very expensive and protects only the most mission-critical resources. In contrast, HA in AWS tends to be much more cost-effective and comprehensive for the entire architecture.

What are some of AWS's key services and tools that make incredible levels of HA possible?

- Elastic Load Balancers
- Elastic IP Addresses
- Route 53
- Auto Scaling
- CloudWatch

What about the tools that exist in AWS specifically for the fault tolerance aspect of HA?

- Simple Queue Service (SQS)
- Simple Storage Service (S3)
- Simple DB

WEB HOSTING

Web hosting is a trend that began decades ago and shows no sign of slowing down. Web servers host more and more applications. Web servers might play a crucial part in your organisation for the following reasons:

- Hosting your company website
- Web-based Content Management Systems
- Social media applications
- Internal SharePoint sites
- Web services such as API endpoints

No matter your specific need for web hosting with AWS, you should be able to achieve the following compelling benefits:

- **Cost-effectiveness**: Simple on-demand provisioning is needed as more web server scalability is required.
- **On-demand resources**: This capability promotes the use of test fleets, staging servers, and simulated user traffic.

Architecturally, there are many positive effects, such as the following:

- An elimination of reliance on strict physical appliances.
- Firewalling can be done everywhere in the architecture.
- Multiple data centres can be located across the globe with ease.
- Hosts can be considered entirely transient and dynamic.

You can also take advantage of many AWS services and tools that can aid you in your transition to the cloud. These include the following:

- VPC
- Route 53
- CloudFront
- Elastic Load Balancing
- Web Application Firewall (WAF)
- AWS Shield
- Auto Scaling
- EC2
- ElastiCache
- RDS
- DynamoDB

EXAM PREPARATION TASKS

- **REVIEW ALL TOPICS**
- **DEFINE ALL KEY TERMS AND CHECK ANSWERS IN THE GLOSSARY.**
- **DO THE QUIZ – REPEAT UNTIL YOU PASS IT (100% PASSMARK).**

DEFINE KEY TERMS

Define the following key terms from this module and check your answers in the Glossary:

HA

FT

Q&A ASSIGNMENT

1. Name the five pillars in "The Well-Architected Framework" of AWS.

2. What is often considered a subcomponent of HA?

3. What service is often used to build the web server itself in AWS, especially if this web server is to host complex, dynamic content?