



# Module 9: Cloud Architecture

# Module overview

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## Topics

- AWS Well-Architected Framework
- Reliability and high availability
- AWS Trusted Advisor



**Knowledge  
check**

# Module objectives

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After completing this module, you should be able to:

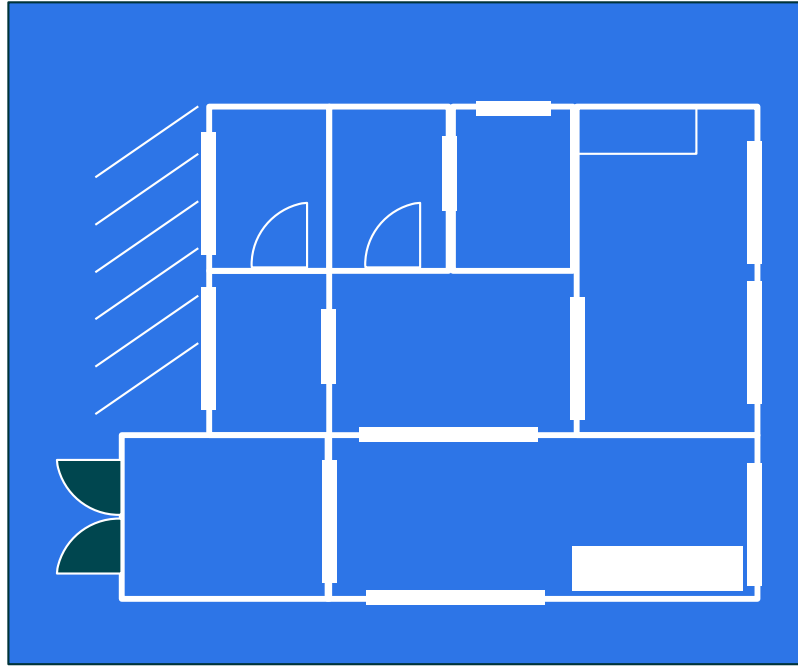
- Describe the AWS Well-Architected Framework, including the six pillars
- Identify the design principles of the AWS Well-Architected Framework
- Explain the importance of reliability and high availability
- Identify how AWS Trusted Advisor helps customers
- Interpret AWS Trusted Advisor recommendations

# Section 1: AWS Well-Architected Framework

## Module 9: Cloud Architecture

# Architecture: designing and building

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Structure  
design



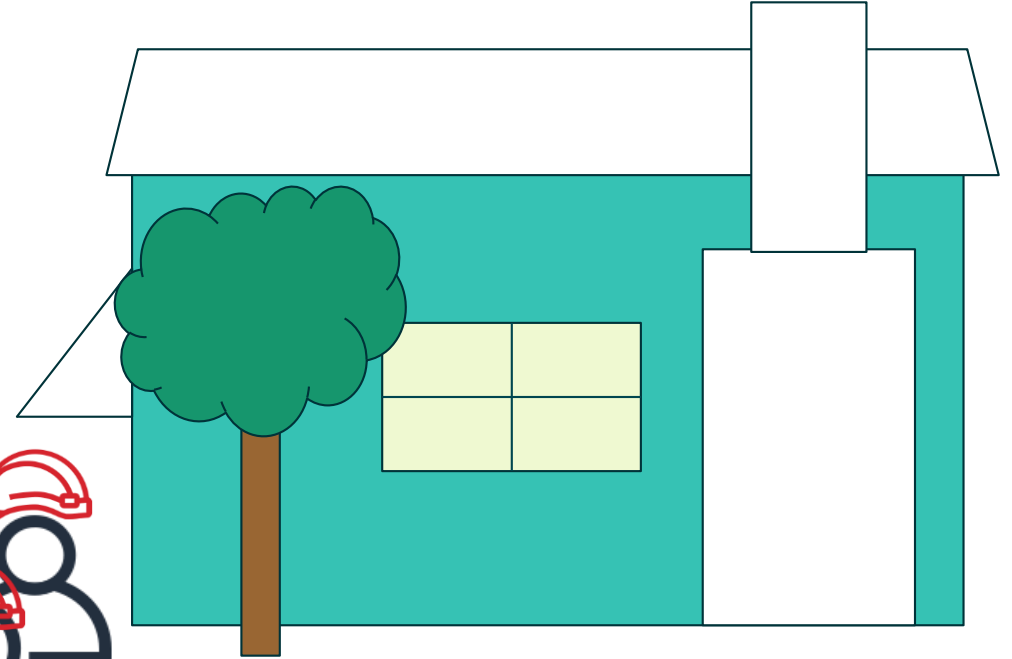
Customer  
(Decision  
maker)



Architect



Building crew  
(Delivery  
team)



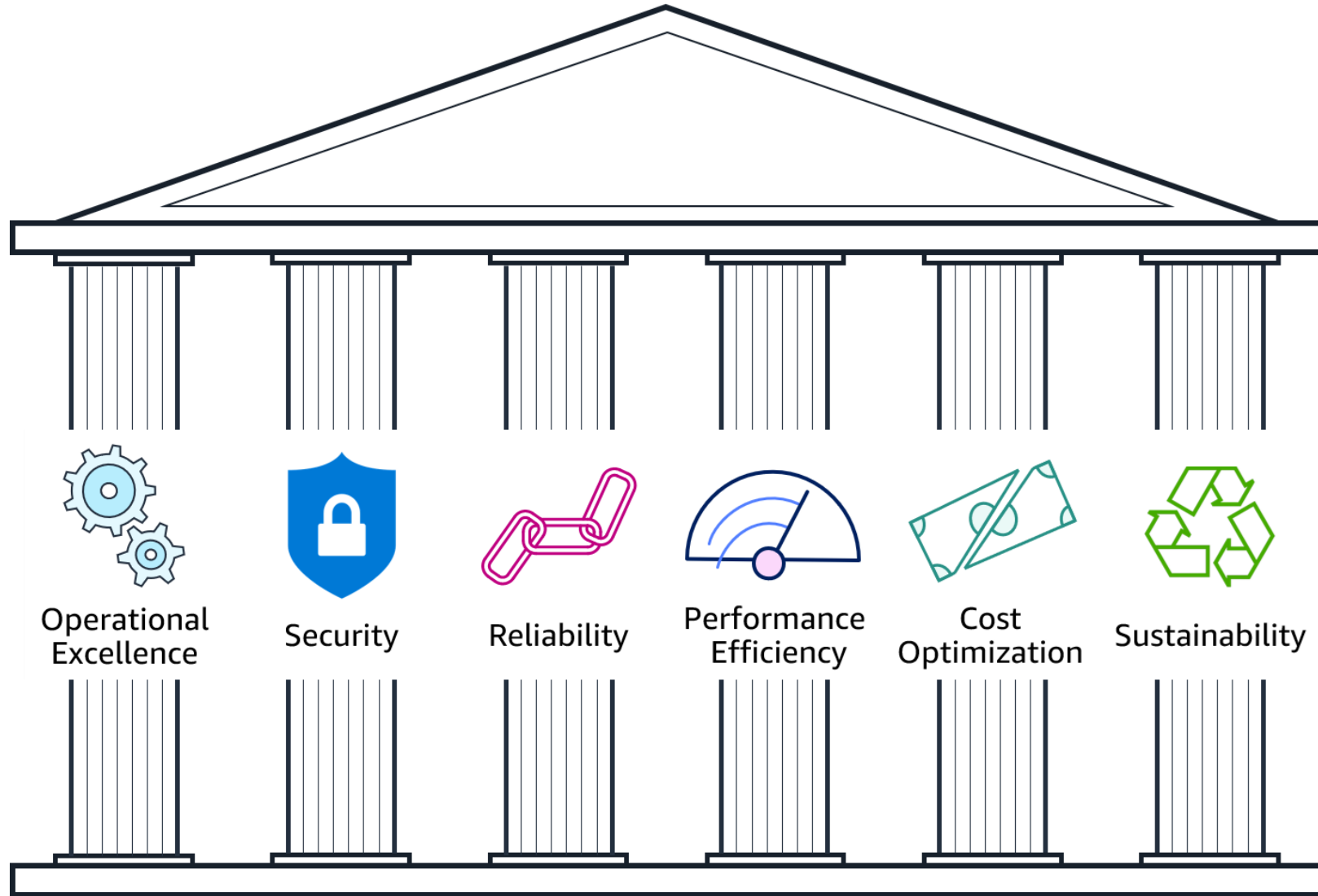
Completed structure

# What is the AWS Well-Architected Framework?

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- A guide for designing infrastructures that are:
  - ✓ Secure
  - ✓ High-performing
  - ✓ Resilient
  - ✓ Efficient
- A consistent approach to evaluating and implementing cloud architectures
- A way to provide best practices that were developed through lessons learned by reviewing customer architectures

# Pillars of the AWS Well-Architected Framework



# Pillar organization

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## Best practice area Identity and Access Management

### Question text

### SEC 1: How do you manage credentials and authentication?

### Question context

Credential and authentication mechanisms include passwords, tokens, and keys that grant access directly or indirectly in your workload. Protect credentials with appropriate mechanisms to help reduce the risk of accidental or malicious use.

### Best practices

#### Best practices:

- Define requirements for identity and access management
- Secure AWS account root user
- Enforce use of multi-factor authentication
- Automate enforcement of access controls
- Integrate with centralized federation provider
- Enforce password requirements
- Rotate credentials regularly
- Audit credentials periodically

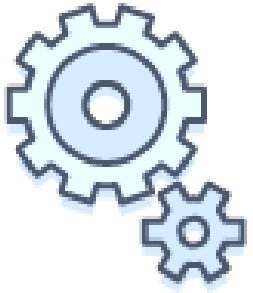


# Operational Excellence pillar

# Operational Excellence pillar – deliver business value

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## Operational Excellence pillar



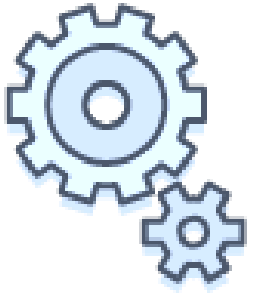
Deliver  
business  
value

- **Focus**
  - Run and monitor systems to deliver business value, and to continually improve supporting processes and procedures.
- **Key topics**
  - Automating changes
  - Responding to events
  - Defining standards to manage daily operations

# Operational excellence design principles

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## **Operational Excellence pillar**



Deliver  
business  
value

- Perform operations as code
- Make frequent, small, reversible changes
- Refine operations procedures frequently
- Anticipate failure
- Learn from all operational events and failures

# Operational excellence questions

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## Organization

- How do you determine what your priorities are?
- How do you structure your organization to support your business outcomes?
- How does your organizational culture support your business outcomes?

## Prepare

- How do you design your workload so that you can understand its state?
- How do you reduce defects, ease remediation, and improve flow into production?
- How do you mitigate deployment risks?
- How do you know that you are ready to support a workload?

## Operate

- How do you understand the health of your workload?
- How do you understand the health of your operations?
- How do you manage workload and operations events?

## Evolve

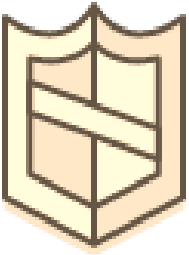
- How do you evolve operations?

# Security pillar

# Security pillar – protect and monitor systems

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## Security pillar



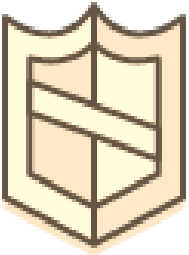
Protect and  
monitor  
systems

- **Focus**
  - Protect information, systems, and assets while delivering business value through risk assessments and mitigation strategies.
- **Key topics**
  - Protecting confidentiality and integrity of data
  - Identifying and managing who can do what
  - Protecting systems
  - Establishing controls to detect security events

# Security design principles

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## Security pillar



Protect and  
monitor  
systems

- Implement a strong identity foundation
- Enable traceability
- Apply security at all layers
- Automate security best practices
- Protect data in transit and at rest
- Keep people away from data
- Prepare for security events

# Security questions

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## Security

- How do you securely operate your workload?

## Identity and access management

- How do you manage identities for people and machines?
- How do you manage permissions for people and machines?

## Detection

- How do you detect and investigate security events?

## Infrastructure protection

- How do you protect your network resources?
- How do you protect your compute resources?

## Data protection

- How do you classify your data?
- How do you protect your data at rest?
- How do you protect your data in transit?

## Incident response

- How do you anticipate, respond to, and recover from incidents?

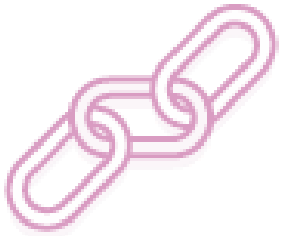


# Reliability pillar

# Reliability pillar – recover from failure and mitigate disruption

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## Reliability pillar



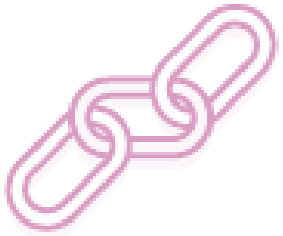
Recover  
from failure  
and mitigate  
disruption.

- **Focus**
  - Ensure a workload performs its intended function correctly and consistently when it's expected to.
- **Key topics**
  - Designing distributed systems
  - Recovery planning
  - Handling change

# Reliability design principles

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## Reliability pillar



Recover  
from failure  
and mitigate  
disruption.

- Automatically recover from failure
- Test recovery procedures
- Scale horizontally to increase aggregate workload availability
- Stop guessing capacity
- Manage change in automation

# Reliability questions

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## Foundations

- How do you manage service quotas and constraints?
- How do you plan your network topology?

## Workload architecture

- How do you design your workload service architecture?
- How do you design interactions in a distributed system to prevent failure?
- How do you design interactions in a distributed system to mitigate or withstand failures?

## Change management

- How do you monitor workload resources?
- How do you design your workload to adapt to changes in demand?
- How do you implement change?

## Failure management

- How do you back up data?
- How do you use fault isolation to protect your workload?
- How do you design your workload to withstand component failures?
- How do you test reliability?
- How do you plan for disaster recovery?

# Performance Efficiency pillar

# Performance Efficiency pillar – use resources sparingly

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## Performance Efficiency pillar



Use  
resources  
sparingly.

- **Focus**
  - Use IT and computing resources efficiently to meet system requirements and to maintain that efficiency as demand changes and technologies evolve.
- **Key topics**
  - Selecting the right resource types and sizes based on workload requirements
  - Monitoring performance
  - Making informed decisions to maintain efficiency as business needs evolve

# Performance efficiency design principles

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## Performance Efficiency pillar



Use  
resources  
sparingly.

- Democratize advanced technologies
- Go global in minutes
- Use serverless architectures
- Experiment more often
- Consider mechanical sympathy

# Performance efficiency questions

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## Selection

- How do you select the best performing architecture?
- How do you select your compute solution?
- How do you select your storage solution?
- How do you select your database solution?
- How do you configure your networking solution?

## Review

- How do you evolve your workload to take advantage of new releases?

## Monitoring

- How do you monitor your resources to ensure they are performing?

## Tradeoffs

- How do you use tradeoffs to improve performance?

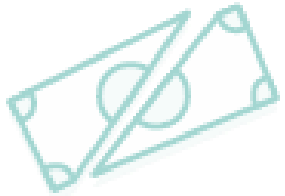


# Cost Optimization pillar

# Cost Optimization pillar – eliminate unneeded expense

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## Cost Optimization pillar



Eliminate unneeded expense.

- **Focus**
  - Avoid unnecessary costs.
- **Key topics**
  - Understanding and controlling where money is being spent
  - Selecting the most appropriate and right number of resource types
  - Analyzing spend over time
  - Scaling to meeting business needs without overspending

# Cost optimization design principles

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## **Cost Optimization pillar**



Eliminate  
unnecessary  
expense.

- Implement Cloud Financial Management
- Adopt a consumption model
- Measure overall efficiency
- Stop spending money on undifferentiated heavy lifting
- Analyze and attribute expenditure

# Cost optimization questions

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## Practice cloud financial management

- How do you implement cloud financial management?

## Expenditure and usage awareness

- How do you govern usage?
- How do you monitor usage and cost?
- How do you decommission resources?

## Cost-effective resources

- How do you evaluate cost when you select services?
- How do you meet cost targets when you select resource type, size, and number?
- How do you use pricing models to reduce cost?
- How do you plan for data transfer changes?

## Manage demand and supply resources

- How do you manage demand and supply resources?

## Optimize over time

- How do you evaluate new services?

# The AWS Well-Architected Tool

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- Helps you review the state of your workloads and compares them to the latest AWS architectural best practices
- Gives you access to knowledge and best practices used by AWS architects, whenever you need it
- Delivers an action plan with step-by-step guidance on how to build better workloads for the cloud
- Provides a consistent process for you to review and measure your cloud architectures

# Section 1 key takeaways



- The AWS Well-Architected Framework provides a **consistent approach** to evaluate cloud architectures and **guidance** to help implement designs.
- The AWS Well-Architected Framework documents a **set of design principles** and **best practices** that enable you to understand if a specific architecture aligns well with cloud best practices.
- The AWS Well-Architected Framework is organized into **six pillars**.
- Each pillar includes its own set of **design principles** and **best practices**.

# Section 2: Reliability and availability

Module 9: Cloud Architecture

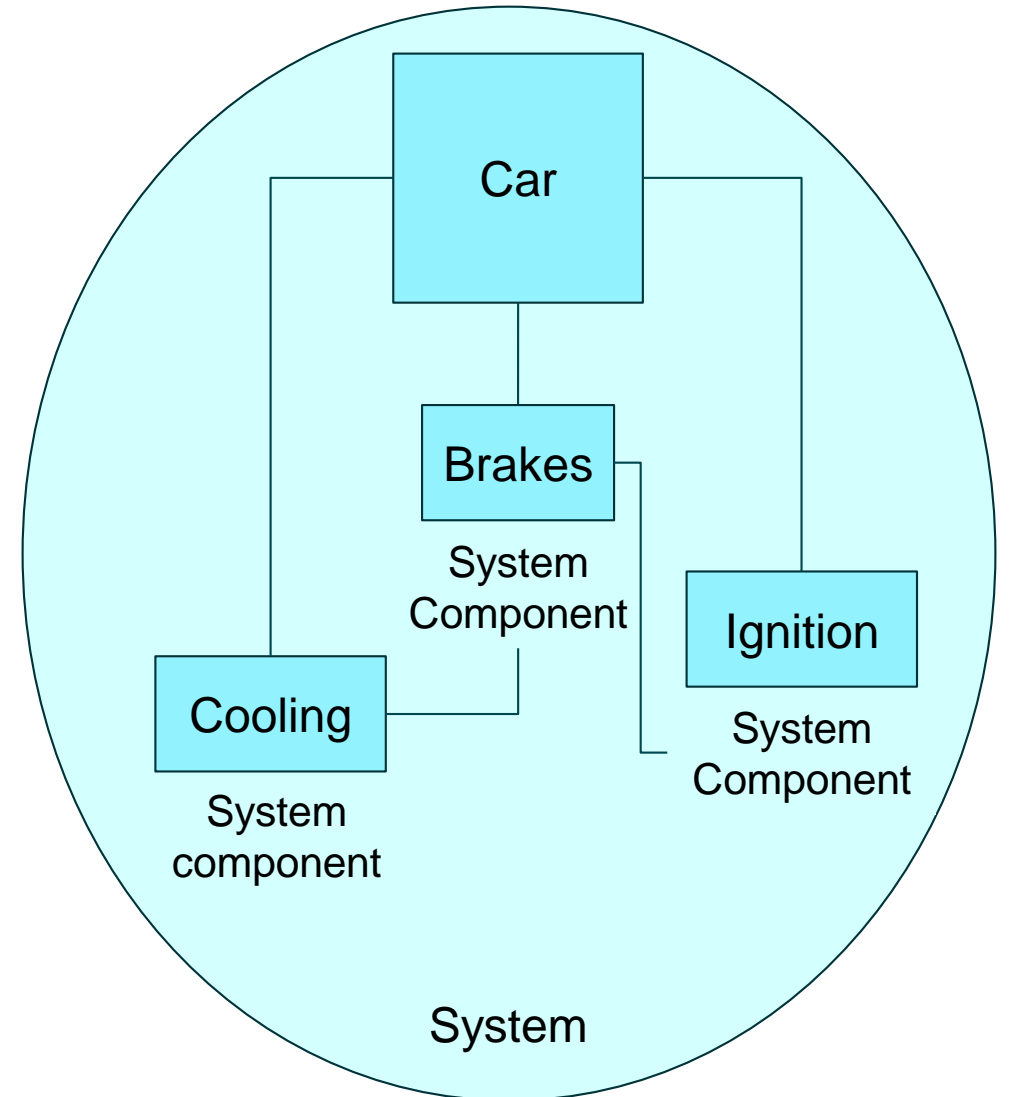
***“Everything fails, all the time.”***

Werner Vogels, CTO, Amazon.com

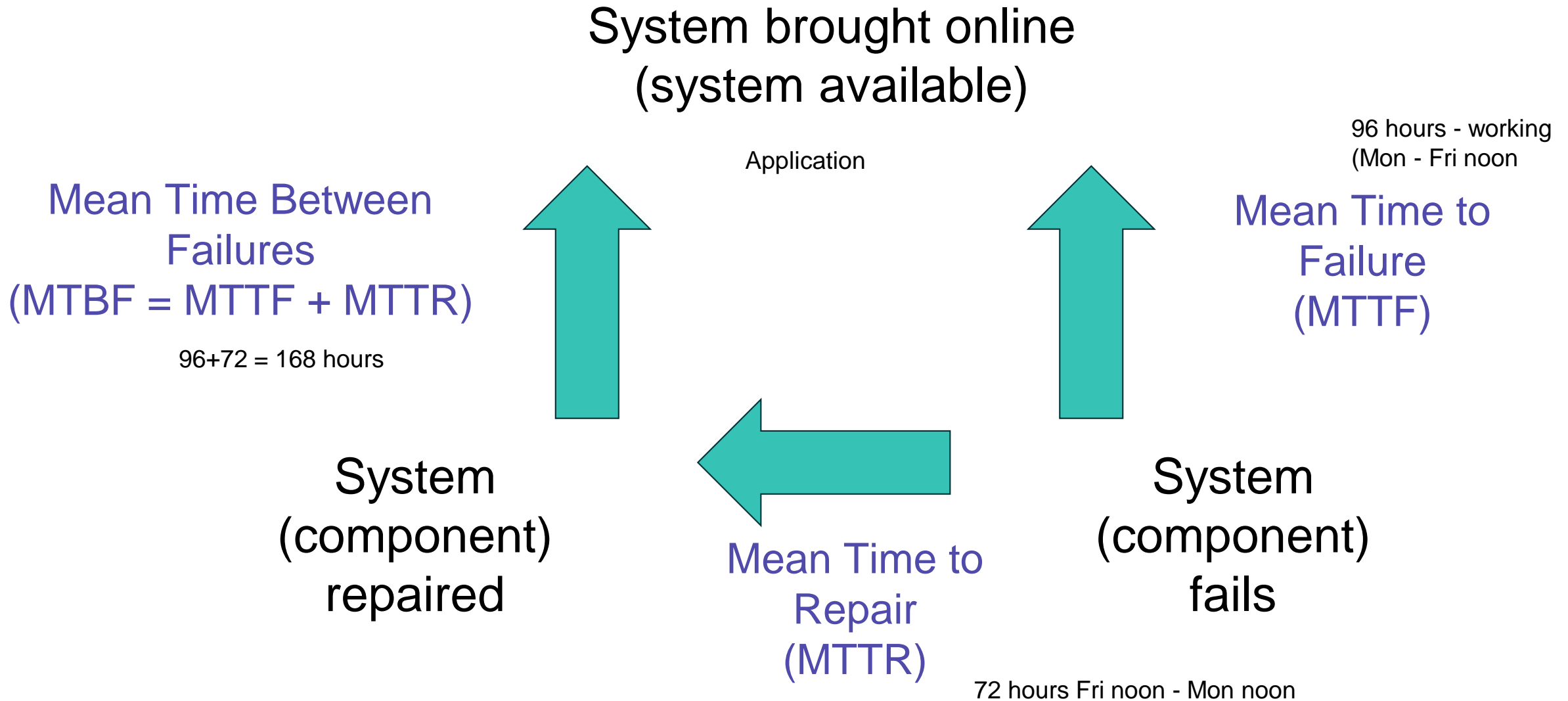


# Reliability

- A measure of your system's **ability to provide functionality** when desired by the user.
- **System** includes all system components: hardware, firmware, and software.
- **Probability** that your entire system will function as intended for a specified period.
- **Mean time between failures (MTBF)** = total time in service/number of failures



# Understanding reliability metrics



# Availability

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- Normal operation time / total time
- A percentage of uptime (for example, 99.9 percent) over time (for example, 1 year)
- Number of 9s – Five 9s means 99.999 percent availability

# High availability

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- System can withstand some measure of degradation while still remaining available.
- Downtime is minimized.
- Minimal human intervention is required.



# Availability tiers

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Availability	Max Disruption (per year)	Application Category
99%	3 days 15 hours	Batch processing, data extraction, transfer, and load jobs
99.9%	8 hours 45 minutes	Internal tools like knowledge management, project tracking
99.95%	4 hours 22 minutes	Online commerce, point of sale
99.99%	52 minutes	Video delivery, broadcast systems
99.999%	5 minutes	ATM transactions, telecommunications systems

# Factors that influence availability

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## Fault tolerance

- The **built-in redundancy** of an application's components and its **ability to remain operational**.

## Scalability

- The ability of an application to **accommodate increases in capacity needs** without changing design.

## Recoverability

- The process, policies, and procedures that are related to **restoring service** after a catastrophic event.

# Section 2 key takeaways



- **Reliability** is a measure of your system's ability to provide functionality when desired by the user, and it can be measured in terms of MTBF.
- **Availability** is the percentage of time that a system is operating normally or correctly performing the operations expected of it (or normal operation time over total time).
- Three factors that influence the availability of your applications are **fault tolerance**, **scalability**, and **recoverability**.
- You can design your workloads and applications to be **highly available**, but there is a cost tradeoff to consider.

# Section 3: AWS Trusted Advisor

## Module 9: Cloud Architecture



# AWS Trusted Advisor



AWS Trusted  
Advisor

- Online tool that provides real-time guidance to help you provision your resources following AWS best practices.
- Looks at your **entire AWS environment** and gives you real-time recommendations in five categories.

Cost Optimization



0 ✓ 9 ⚠ 0 !

\$7,516.85

Potential monthly savings

Performance



3 ✓ 7 ⚠ 0 !

Security



2 ✓ 4 ⚠ 11 !

Fault Tolerance



0 ✓ 15 ⚠ 5 !

Service Limits



37 ✓ 0 ⚠ 1 !

# Activity: Interpret AWS Trusted Advisor recommendations

## Trusted Advisor Dashboard

### Cost Optimization



9  0  0 

\$0.00

Potential monthly savings

### Performance



9  1  0 

### Security



13  2  2 

### Fault Tolerance



14  2  1 

### Service Limits



48  0  0 

# Activity: Recommendation #1

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## MFA on Root Account

**Description:** Checks the root account and warns if multi-factor authentication (MFA) is not enabled. For increased security, we recommend that you protect your account by using MFA, which requires a user to enter a unique authentication code from their MFA hardware or virtual device when interacting with the AWS console and associated websites.

**Alert Criteria:** MFA is not enabled on the root account.

**Recommended Action:** Log in to your root account and activate an MFA device.

# Activity: Recommendation #2

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## IAM Password Policy

**Description:** Checks the password policy for your account and warns when a password policy is not enabled, or if password content requirements have not been enabled. Password content requirements increase the overall security of your AWS environment by enforcing the creation of strong user passwords. When you create or change a password policy, the change is enforced immediately for new users but does not require existing users to change their passwords.

**Alert Criteria:** A password policy is enabled, but at least one content requirement is not enabled.

**Recommended Action:** If some content requirements are not enabled, consider enabling them. If no password policy is enabled, create and configure one. See [Setting an Account Password Policy for IAM Users](#).

# Activity: Recommendation #3

## Security Groups – Unrestricted Access

**Description:** Checks security groups for rules that allow unrestricted access to a resource. Unrestricted access increases opportunities for malicious activity (hacking, denial-of-service attacks, loss of data).

**Alert Criteria:** A security group rule has a source IP address with a /0 suffix for ports other than 25, 80, or 443.)

**Recommended Action:** Restrict access to only those IP addresses that require it. To restrict access to a specific IP address, set the suffix to /32 (for example, 192.0.2.10/32). Be sure to delete overly permissive rules after creating rules that are more restrictive.

Region	Security Group Name	Security Group ID	Protocol	Port	Status	IP Range
us-east-1	WebServerSG	sg-xxxxxxx1 (vpc-xxxxxxx1)	tcp	22	Red	0.0.0.0/0
us-west-2	DatabaseServerSG	sg-xxxxxxx2 (vpc-xxxxxxx2)	tcp	8080	Red	0.0.0.0/0

# Activity: Recommendation #4



## Amazon EBS Snapshots

**Description:** Checks the age of the snapshots for your Amazon Elastic Block Store (Amazon EBS) volumes (available or in-use). Even though Amazon EBS volumes are replicated, failures can occur. Snapshots are persisted to Amazon Simple Storage Service (Amazon S3) for durable storage and point-in-time recovery.

**Alert Criteria:**

Yellow: The most recent volume snapshot is between 7 and 30 days old.

Red: The most recent volume snapshot is more than 30 days old.

Red: The volume does not have a snapshot.

**Recommended Action:** Create weekly or monthly snapshots of your volumes

Region	Volume ID	Volume Name	Snapshot ID	Snapshot Name	Snapshot Age	Volume Attachment	Status	Reason
us-east-1	vol-xxxxxxx	My-EBS-Volume				/dev/...	Red	No snapshot

# Activity: Recommendation #5



## Amazon S3 Bucket Logging

**Description:** Checks the logging configuration of Amazon Simple Storage Service (Amazon S3) buckets. When server access logging is enabled, detailed access logs are delivered hourly to a bucket that you choose. An access log record contains details about each request, such as the request type, the resources specified in the request, and the time and date the request was processed. By default, bucket logging is not enabled; you should enable logging if you want to perform security audits or learn more about users and usage patterns.

**Alert Criteria:**

- Yellow: The bucket does not have server access logging enabled.
- Yellow: The target bucket permissions do not include the owner account. Trusted Advisor cannot check it.

**Recommended Action:**

Enable bucket logging for most buckets.  
If the target bucket permissions do not include the owner account and you want Trusted Advisor to check the logging status, add the owner account as a grantee.

Region	Bucket Name	Target Name	Target Exists	Same Owner	Write Enabled	Reason
us-east-2	my-hello-world-bucket		No	No	No	Logging not enabled

# Section 3 key takeaways



- **AWS Trusted Advisor** is an online tool that provides real-time guidance to help you provision your resources by following AWS best practices.
- AWS Trusted Advisor looks at your **entire AWS environment** and gives you real-time recommendations in five categories.
- You can use AWS Trusted Advisor to help you optimize your AWS environment as soon as you start implementing your architecture designs.



# Module wrap-up

## Module 9: Cloud Architecture

# Module summary

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In summary, in this module you learned how to:

- Describe the AWS Well-Architected Framework, including the six pillars
- Identify the design principles of the AWS Well-Architected Framework
- Explain the importance of reliability and high availability
- Identify how AWS Trusted Advisor helps customers
- Interpret AWS Trusted Advisor recommendations

# Complete the knowledge check



# Sample exam question

A SysOps engineer working at a company wants to protect their data in transit and at rest. What services could they use to protect their data?

Choice	Response
A	Elastic Load Balancing
B	Amazon Elastic Block Storage (Amazon EBS)
C	Amazon Simple Storage Service (Amazon S3)
D	All of the above

# Sample exam question answer

A SysOps engineer working at a company wants to protect their data in transit and at rest. What services could they use to protect their data?

The correct answer is D.

The keywords in the question are “protect their data in transit and at rest”.

# Additional resources

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- AWS Well-Architected website:  
<https://aws.amazon.com/architecture/well-architected/?wa-lens-whitepapers.sort-by=item.additionalFields.sortDate&wa-lens-whitepapers.sort-order=desc>
- AWS Well-Architected Labs: <https://wellarchitectedlabs.com/>
- AWS Trusted Advisor Best Practice Checks:  
<https://docs.aws.amazon.com/awssupport/latest/user/trusted-advisor-check-reference.html>

# Thank you



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