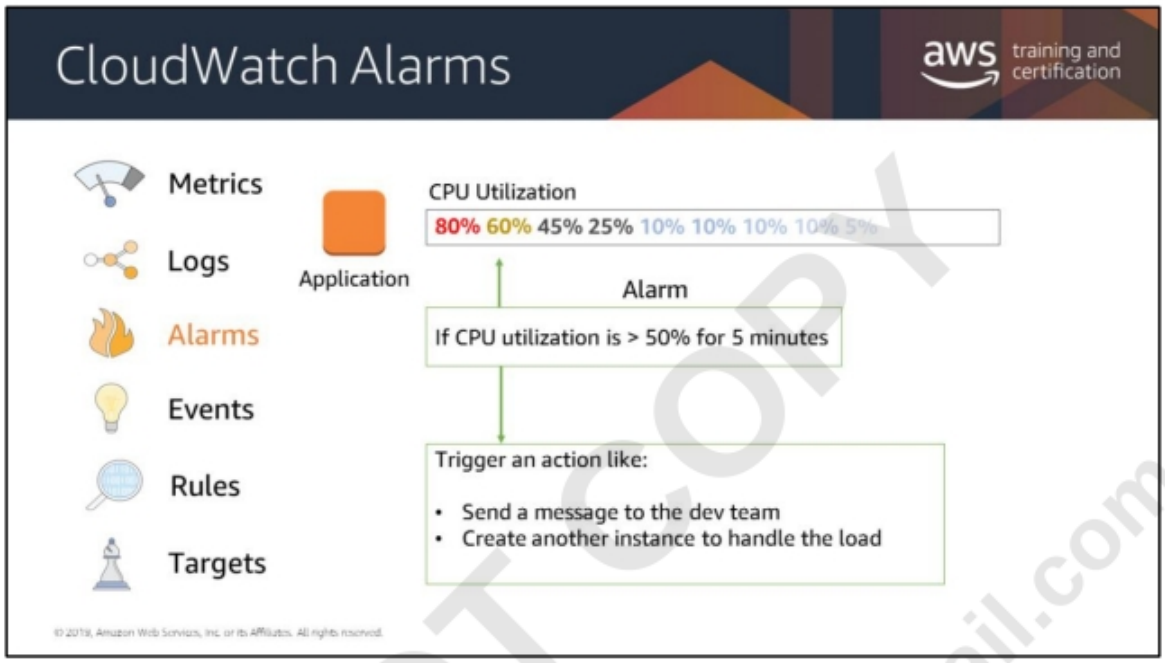
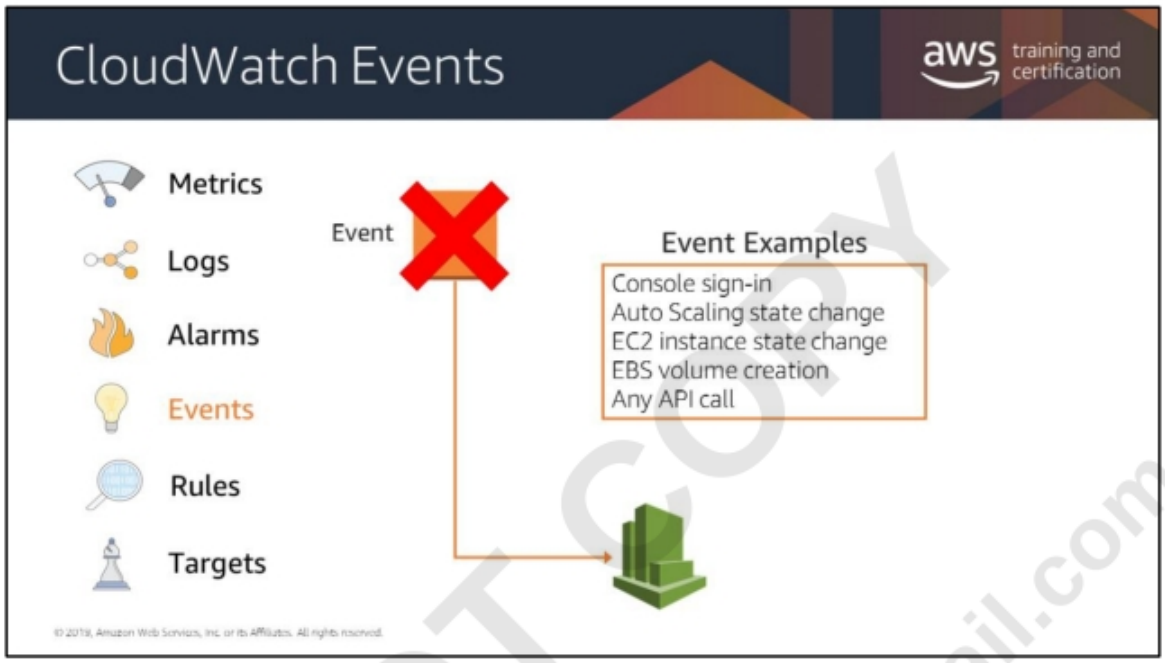


You can use an alarm to automatically initiate actions on your behalf. An *alarm* watches a single metric over a specified time period, and performs one or more specified actions, based on the value of the metric relative to a threshold over time. The action is a notification sent to an Amazon SNS topic or an Auto Scaling policy. You can also add alarms to dashboards.

Alarms invoke actions for sustained state changes only. CloudWatch alarms do not invoke actions simply because they are in a particular state. The state must have changed and been maintained for a specified number of periods.

With these examples, the triggering of the alarm would start some other action, such as executing an Auto Scaling policy, sending a notification (to an Ops team, for instance), etc.

Actions can also be executed when an alarm is *not* triggered.



Amazon CloudWatch Events delivers a near real-time stream of system events that describe changes in AWS resources.

AWS resources can generate events when their state changes. For example, Amazon EC2 generates an event when the state of an EC2 instance changes from *pending* to *running*, and Amazon EC2 Auto Scaling generates events when it launches or terminates instances.

Using simple rules that you can quickly set up, you can match events and route them to one or more target functions or streams.

CloudWatch Events becomes aware of operational changes as they occur. CloudWatch Events responds to these operational changes and takes corrective action as necessary, by sending messages to respond to the environment, activating functions, making changes, and capturing state information.

You can also use CloudWatch Events to schedule automated actions that self-trigger at certain times using cron or rate expressions.

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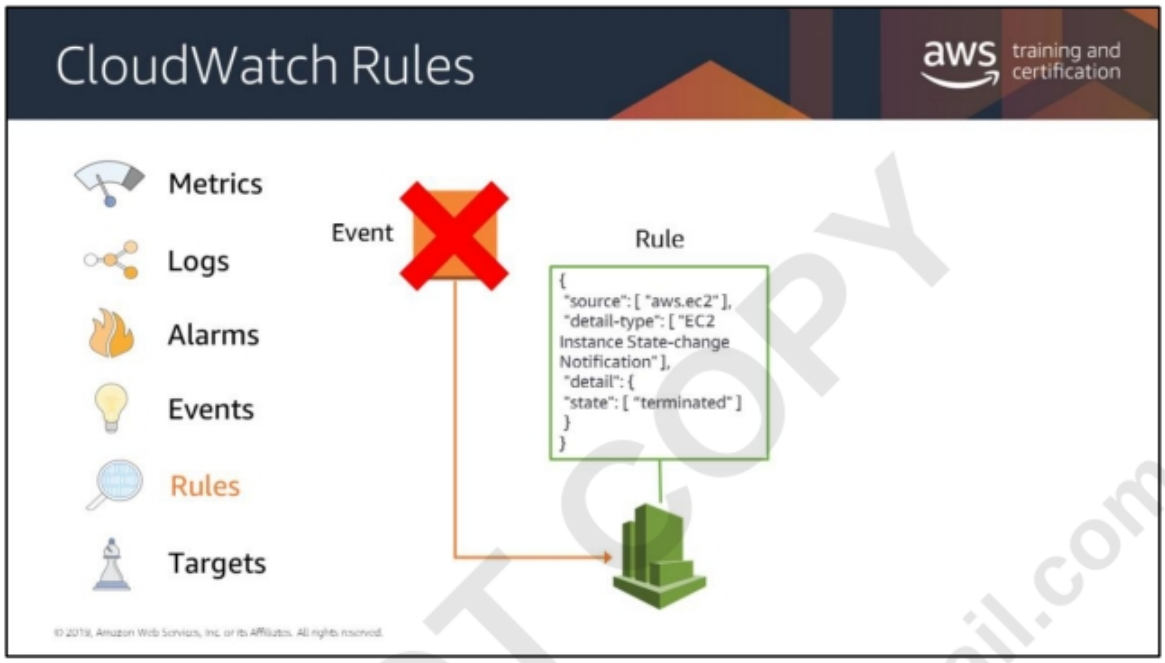
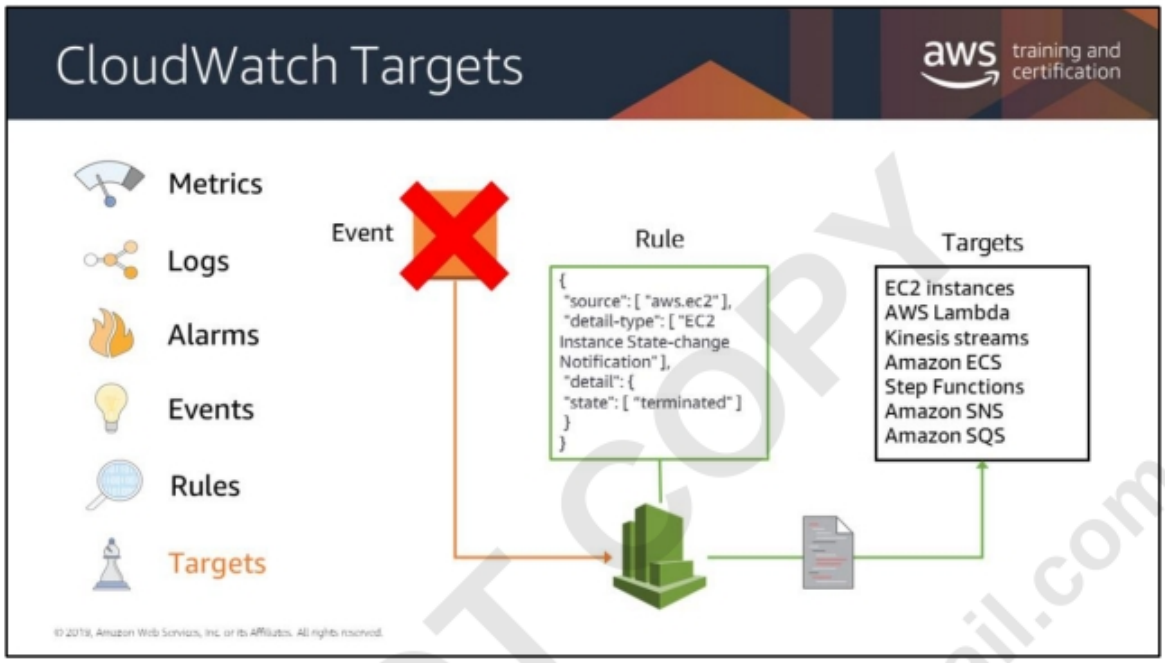


A *rule* matches incoming events and routes them to targets for processing. A single rule can route to multiple targets, all of which are processed in parallel. Rules are not processed in a particular order. This enables different parts of an organization to look for and process the events that are of interest to them. A rule can customize the JSON sent to the target, by passing only certain parts or by overwriting it with a constant.



A *target* processes events. Targets can include Amazon EC2 instances, AWS Lambda functions, Kinesis streams, Amazon ECS tasks, Step Functions state machines, Amazon SNS topics, Amazon SQS queues, and built-in targets. A target receives events in JSON format.

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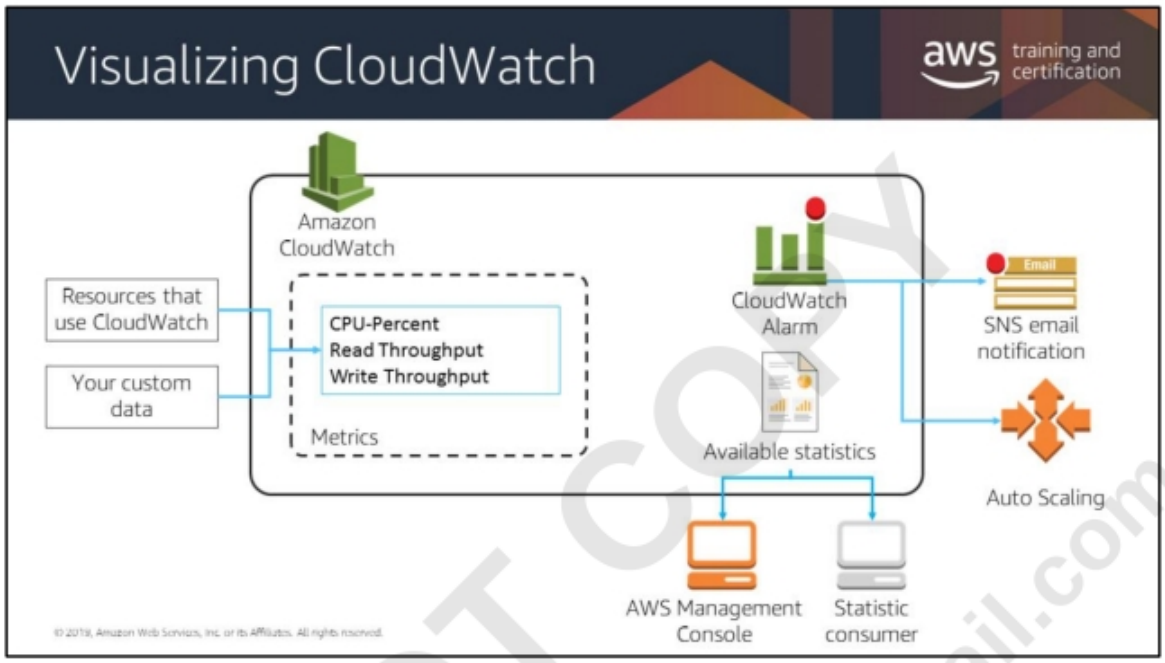

Amazon CloudWatch is basically a metrics repository. An AWS service—such as Amazon EC2—puts metrics into the repository, and you retrieve statistics based on those metrics. If you put your own custom metrics into the repository, you can retrieve statistics on these metrics as well.

For more information, see https://docs.aws.amazon.com/AmazonCloudWatch/latest/monitoring/cloudwatch_architecture.html

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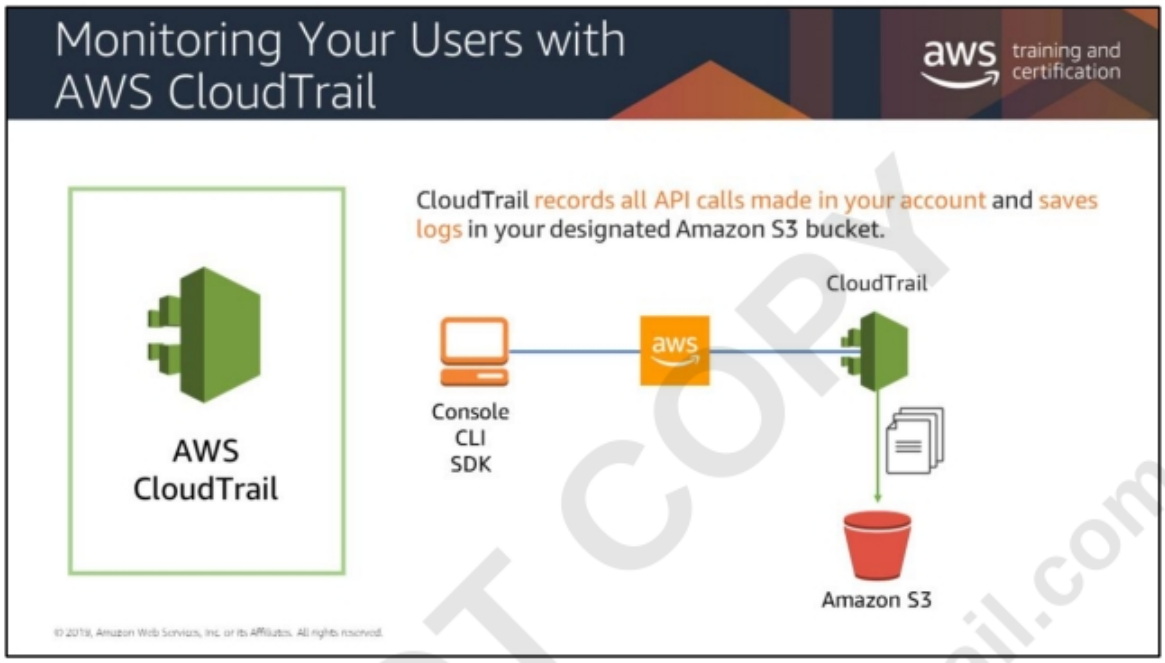

AWS CloudTrail is a web service that records AWS API calls for your account and delivers log files to you. The recorded information includes the identity of the API caller, the time of the API call, the source IP address of the API caller, the request parameters, and the response elements returned by the AWS service.

With CloudTrail, you can get a history of AWS API calls for your account, including API calls made via the AWS Management Console, AWS SDKs, command line tools, and higher-level AWS services (such as AWS CloudFormation). The AWS API call history produced by CloudTrail enables security analysis, resource change tracking, and compliance auditing.

You turn on CloudTrail on a per-region basis. If you use multiple regions, you can choose where log files are delivered for each region. For example, you can have a separate Amazon S3 bucket for each region, or you can aggregate log files from all regions in a single Amazon S3 bucket.

For a list of AWS services supported by CloudTrail, see http://docs.aws.amazon.com/awscloudtrail/latest/userguide/cloudtrail-supported-services.html.

For more information about CloudTrail APN partners, see:
- Splunk: http://aws.amazon.com/cloudtrail/partners/splunk/
- AlertLogic: https://aws.amazon.com/cloudtrail/partners/alert-logic/
- SumoLogic: https://aws.amazon.com/cloudtrail/partners/sumo-logic/

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VPC Flow Logs is a feature that enables you to capture information about the IP traffic going to and from network interfaces in your VPC. Flow log data is stored using Amazon CloudWatch Logs. After you've created a flow log, you can view and retrieve its data in Amazon CloudWatch Logs.

Flow logs can help you with a number of tasks—like troubleshooting why specific traffic is not reaching an instance, which in turn helps you diagnose security group rules that are overly restrictive. You can also use flow logs as a security tool to monitor the traffic that is reaching your instance.

Use cases:

- Troubleshoot connectivity issues
- Test network access rules
- Monitor traffic
- Detect and investigate security incidents

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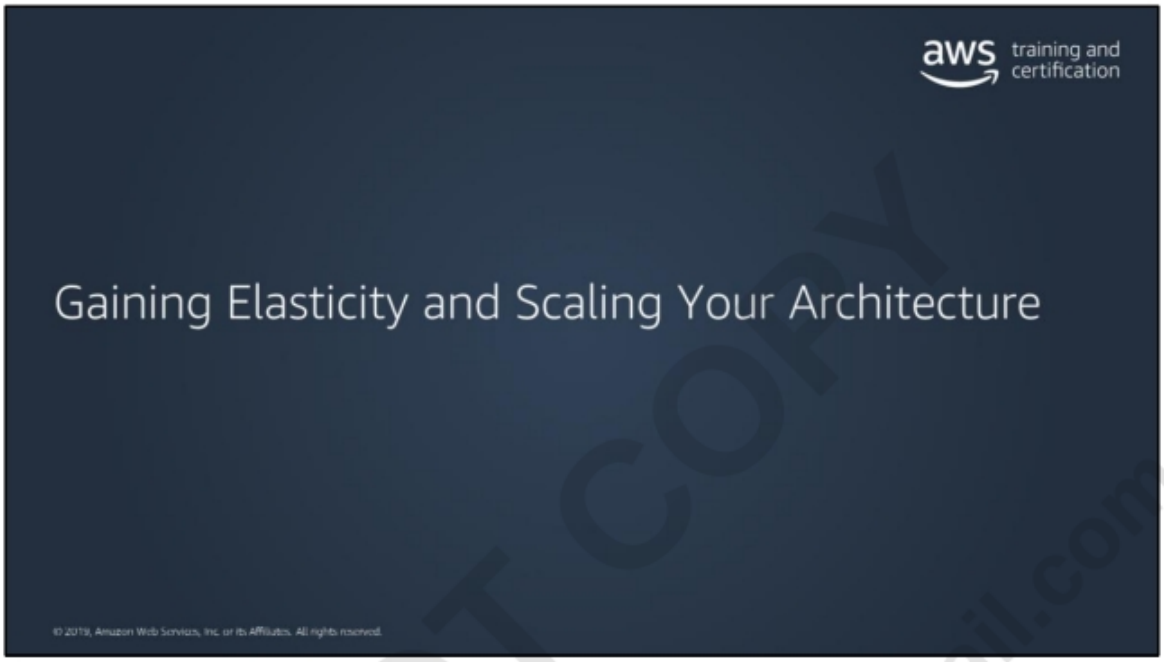

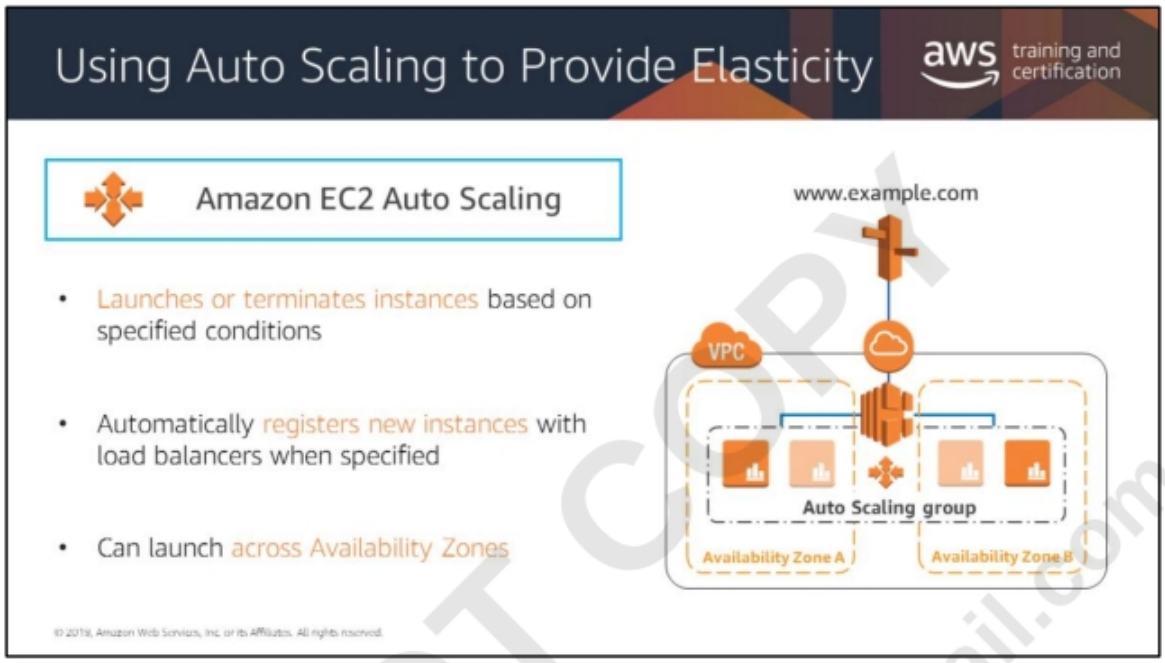

If you specify scaling policies, then Auto Scaling can launch or terminate instances as demand on your application increases or decreases. Auto Scaling integrates with ELB to enable you to attach one or more load balancers to an existing Auto Scaling group. After you attach the load balancer, it automatically registers the instances in the group and distributes incoming traffic across the instances.

When one Availability Zone becomes unhealthy or unavailable, Auto Scaling launches new instances in an unaffected Availability Zone. When the unhealthy Availability Zone returns to a healthy state, Auto Scaling automatically redistributes the application instances evenly across all of the Availability Zones for your Auto Scaling group. Auto Scaling does this by attempting to launch new instances in the Availability Zone with the fewest instances. If the attempt fails, however, Auto Scaling attempts to launch in other Availability Zones until it succeeds.

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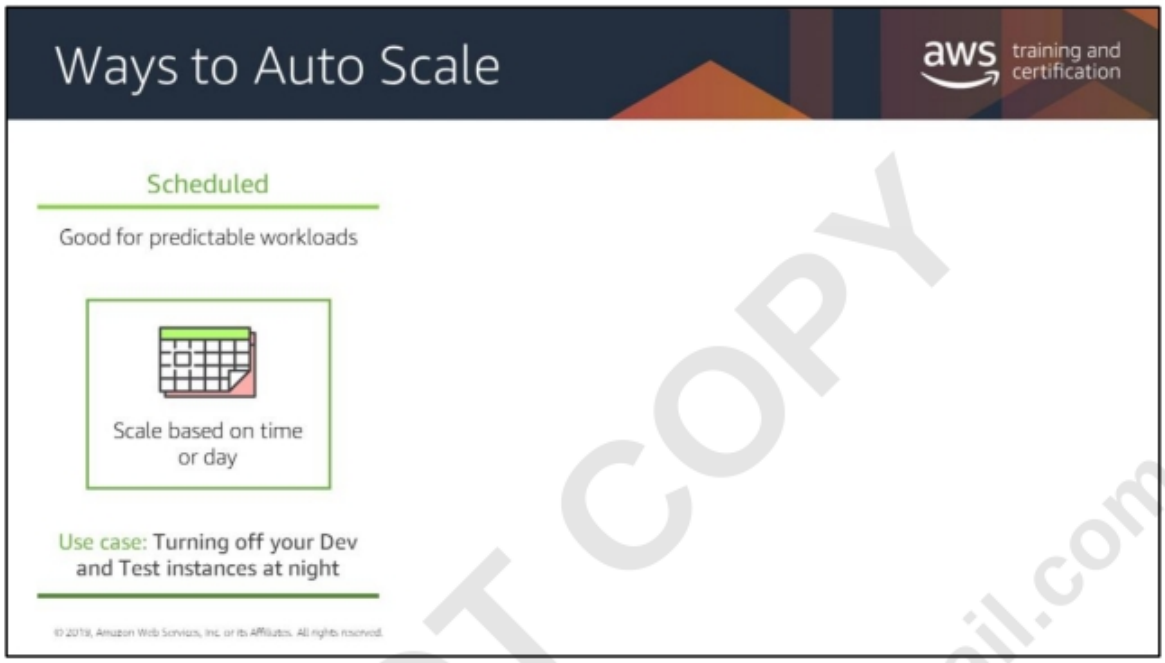
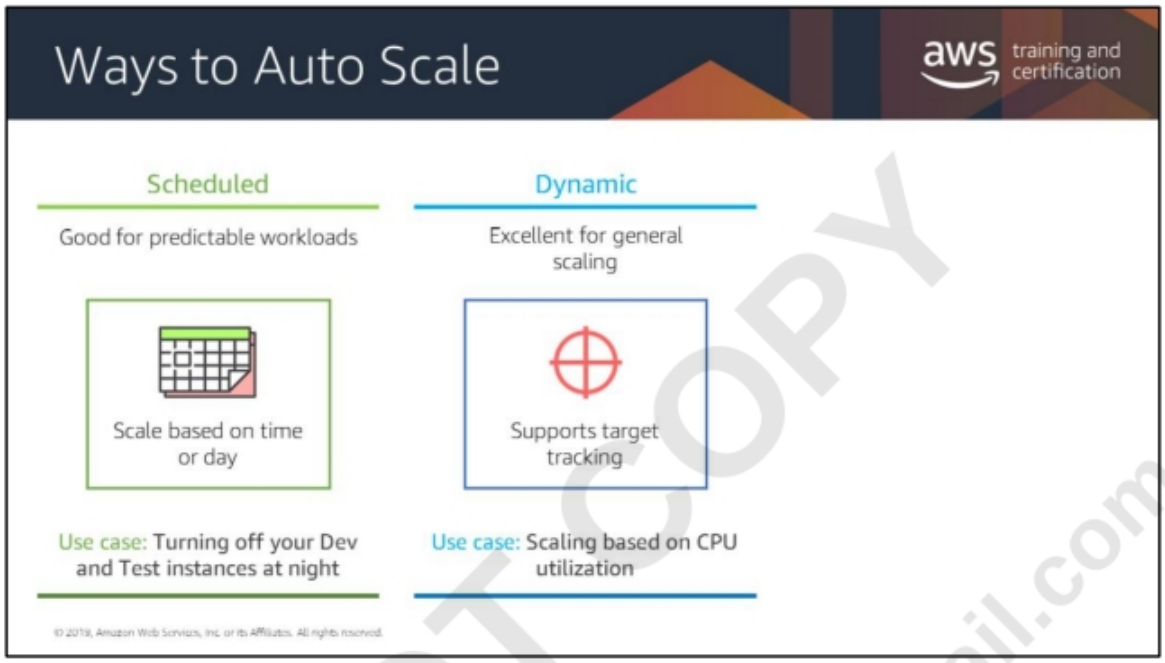
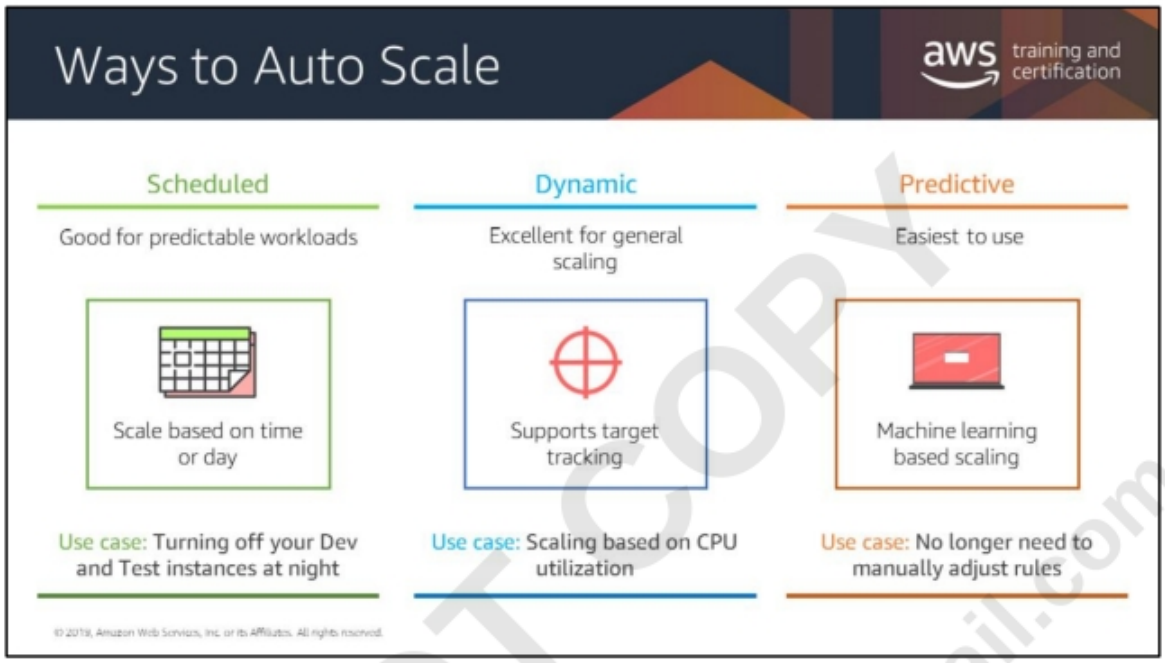
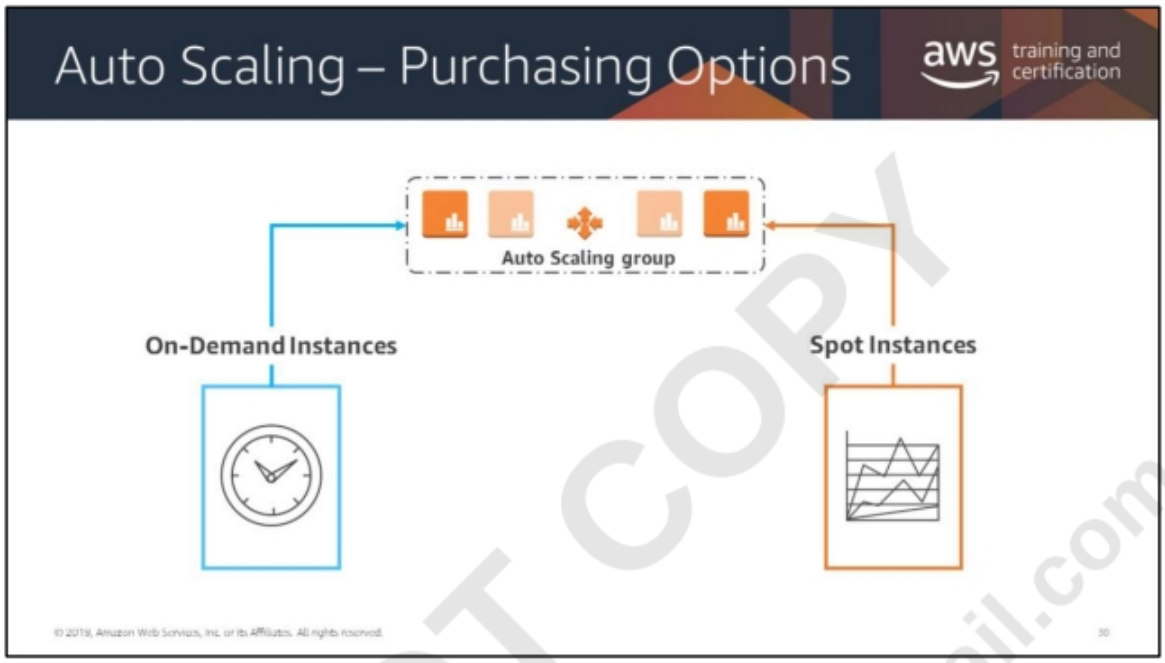


Scaling based on a schedule allows you to scale your application ahead of known load changes. For example, every week the traffic to your web application starts to increase on Wednesday, remains high on Thursday, and starts to decrease on Friday. You can plan your scaling activities based on the known traffic patterns of your web application.







Amazon EC2 Auto Scaling supports multiple purchasing options within the same Auto Scaling group (ASG). You can include Spot, On-Demand, and Reserved Instances (RIs) (which are on-demand instances until after the bill is processed) within a single ASG, allowing you to save up to 90% on compute costs.

Using Amazon EC2 Fleet, you can define a combination of EC2 instance types to make up the desired capacity of your ASG. This is defined as a percentage of each type of purchasing option. EC2 Auto Scaling will maintain the desired cost optimization as your ASG scales in or out. ASGs made up of mixed fleets still support the same lifecycle hooks, instance health checks, and scheduled scaling as a single-fleet ASG.

The following options can be configured when defining an ASG using combined purchasing models and instance types:
Maximum Spot Price: Sets the maximum Spot price for instances in the ASG.

Spot Allocation Strategy: Configure the per-Availability Zone diversity. This is especially helpful when particular instance types are in high demand in a single Availability Zone.

(Optional) On-Demand Base: Configure the initial capacity to be made up of On-Demand Instances. This is independent of the percentage of On-Demand Instances making up the total capacity.

On-Demand Percentage Above Base: Controls the percentage of On-Demand Instances to add on to the initial group.

A mixed-fleet configuration can be combined with different EC2 instance types with varying amounts of RAM and vCPU capacity. EC2 Auto Scaling will automatically provision the lowest price combination to meet the desired capacity.

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Auto Scaling Minimum Capacity

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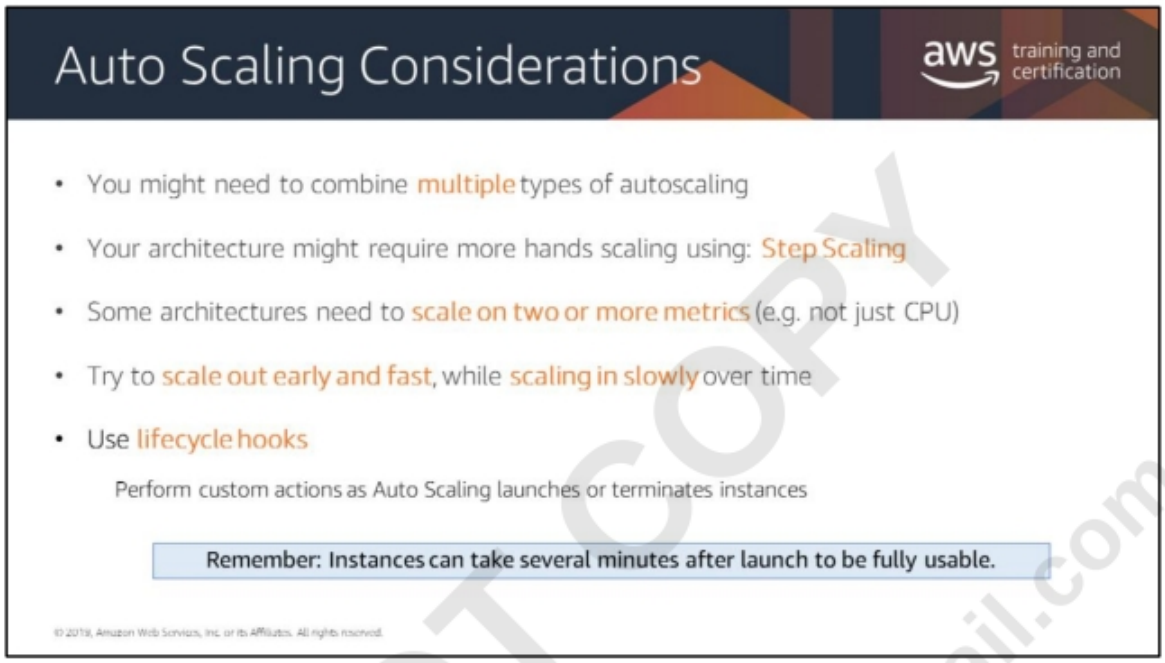
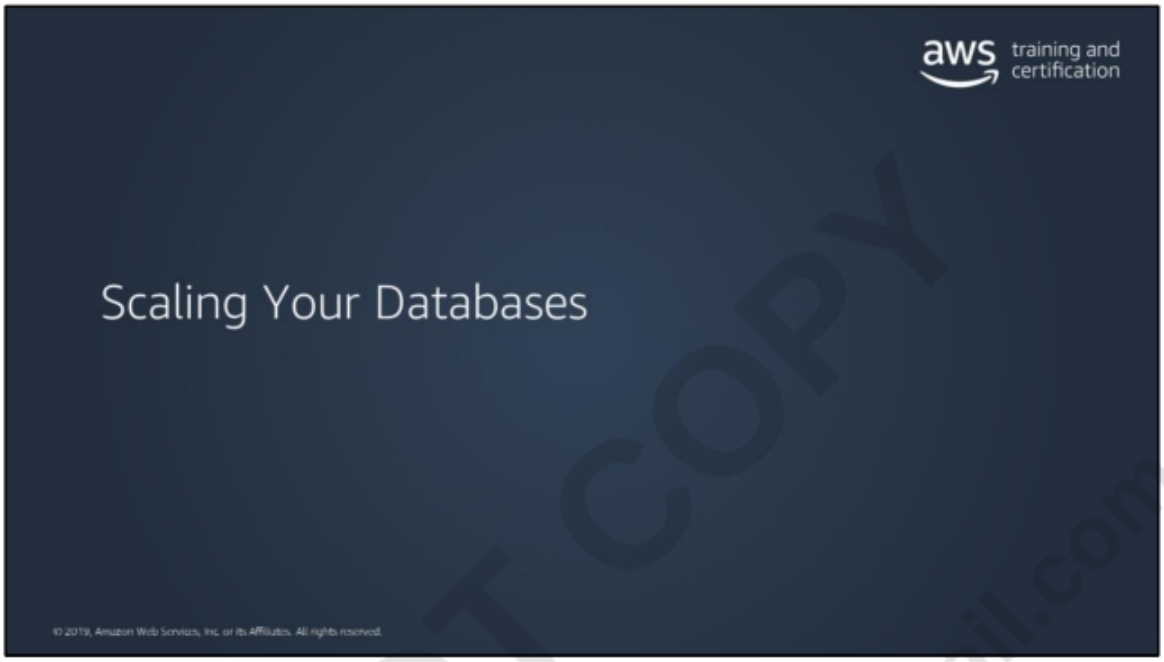
Auto Scaling group defines:

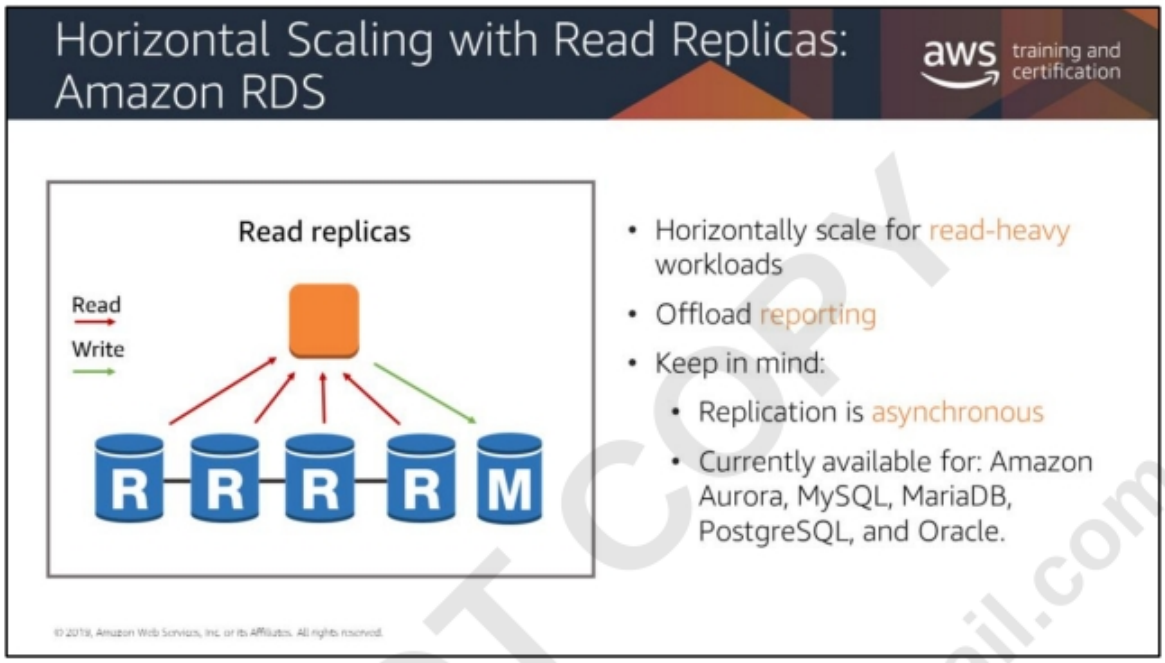
- Desired capacity
- Minimum capacity
- Maximum capacity

What would be a good **minimum** capacity to set it to?

What would be a good **maximum** capacity to set it to?







Read replicas with PostgreSQL have specific requirements. For more information, see: http://docs.aws.amazon.com/AmazonRDS/latest/UserGuide/USER_ReadRepl.html#USER_ReadRepl.PostgreSQL

Oracle supports read replicas with Dataguard. For more information see: https://aws.amazon.com/about-aws/whats-new/2019/03/Amazon-RDS-for-Oracle-Now-Supports-In-region-Read-Replicas-with-Active-Data-Guard-for-Read-Scalability-and-Availability/

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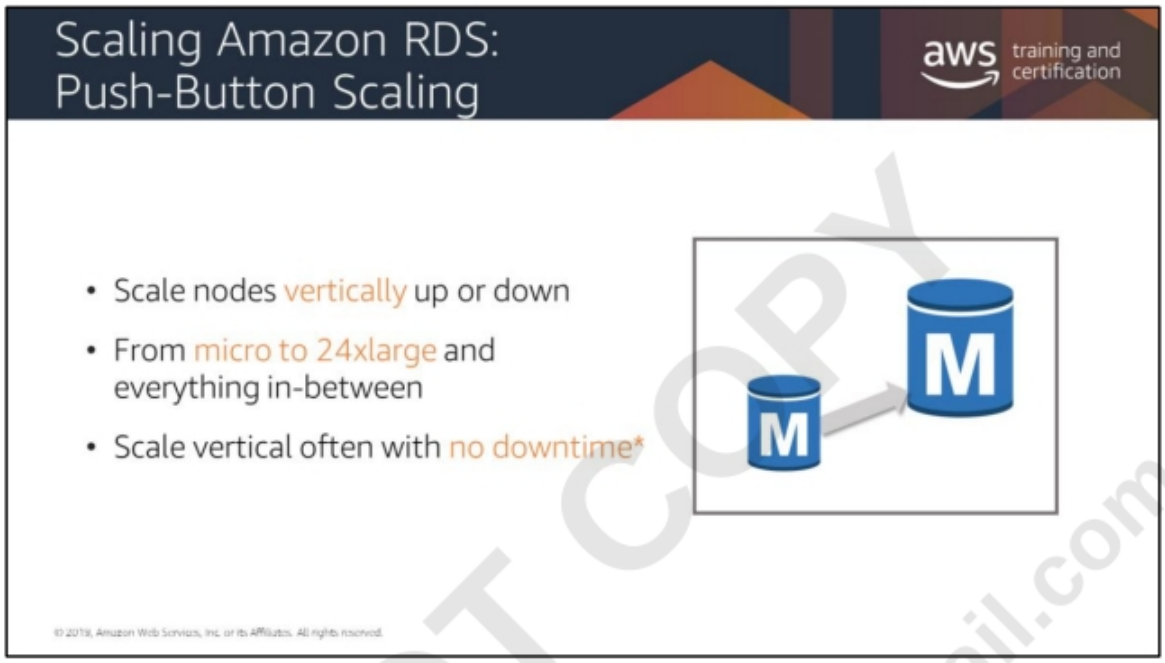

Using the Amazon RDS APIs or a few clicks of the console, you can scale the compute and memory resources powering your deployment up or down. Scaling operations typically finish within a few minutes. *Note that normal RDS requires a short downtime of 1-2 minutes when scaled, but aurora serverless can scale without any downtime.

As your storage requirements grow, you can provision additional storage on-the-fly with zero downtime. If you are using RDS PIOPS (with the exception of Amazon RDS with SQL Server), you can also scale the throughput of your DB instance by specifying the IOPS rate from 1,000 IOPS to 30,000 IOPS in 1,000 IOPS increments and storage from 100GB and 6TB.

Storage can be increased with no downtime. However, changing instance type requires downtime. Refer to https://aws.amazon.com/blogs/database/scaling-your-amazon-rds-instance-vertically-and-horizontally

Amazon RDS for SQL Server does not currently support increasing storage or IOPS of an existing SQL Server DB instance.

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There is minimal downtime when you are scaling up on a multi-Availability Zone environment because the standby database gets upgraded first, then a failover will occur to the newly sized database. A single-Availability Zone instance will be unavailable during the scale operation. To see a table that describes what DB instance changes will cause downtime, see http://docs.aws.amazon.com/AmazonRDS/latest/UserGuide/Overview.DBInstance.Modifying.html#USER_ModifyInstance.Settings.

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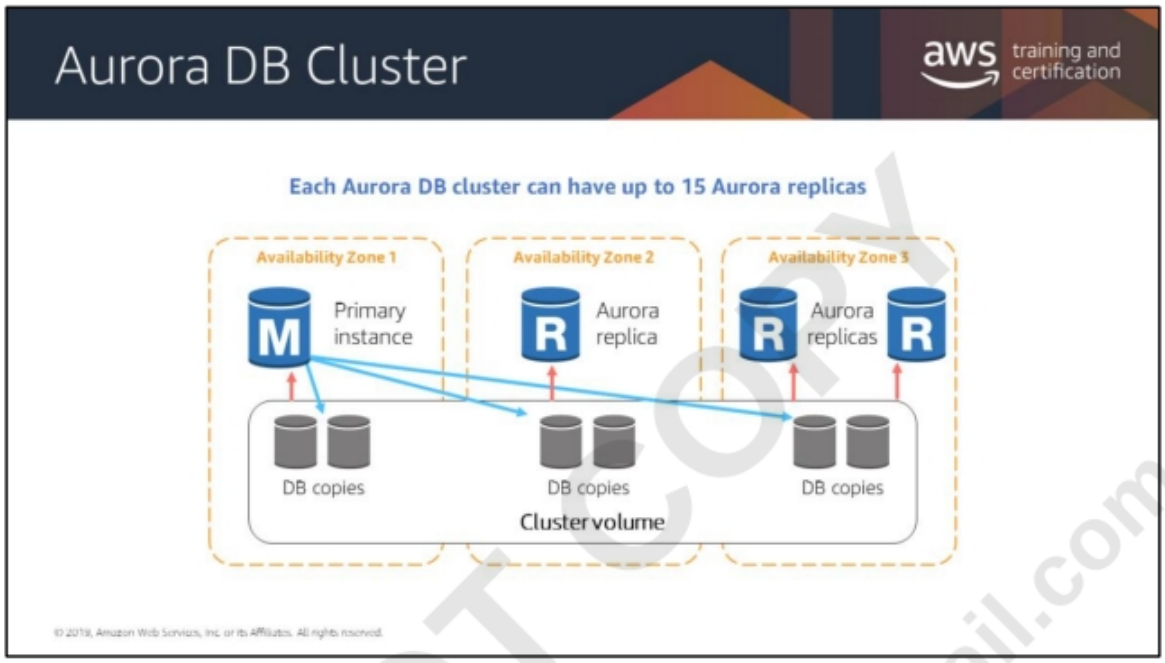

Primary instance – Supports read and write operations, and performs all of the data modifications to the cluster volume. Each Aurora DB cluster has one primary instance.

Aurora replica – Supports only read operations. Each Aurora DB cluster can have up to 15 Aurora replicas in addition to the primary instance. Multiple Aurora replicas distribute the read workload, and by locating Aurora replicas in separate Availability Zones, you can also increase database availability.

Note that you can have a read replica in the same region as the master.

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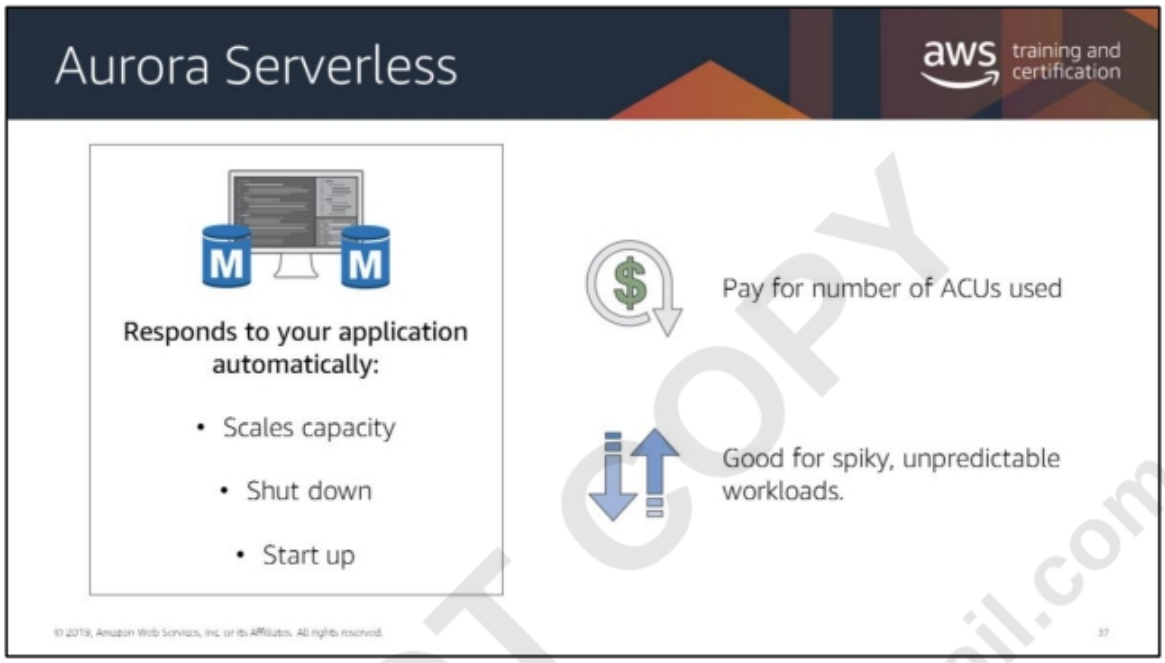
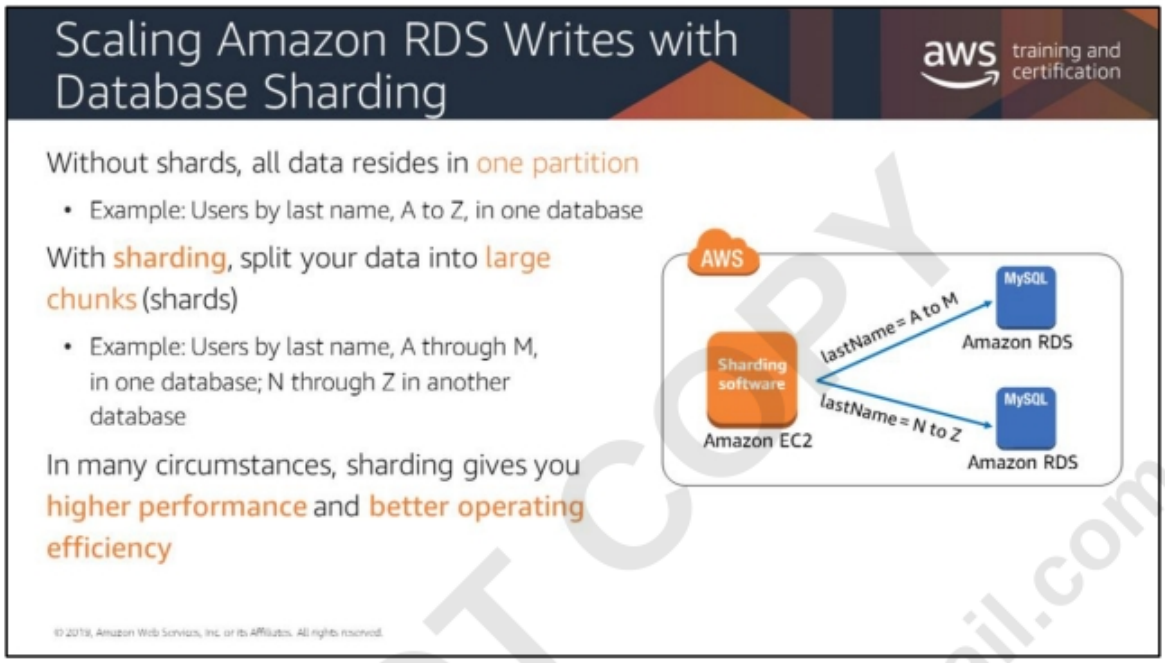


Amazon Aurora Serverless is an on-demand, auto scaling configuration for Amazon Aurora as a relational database. An Aurora Serverless DB cluster is a DB cluster that automatically starts up, shuts down, and scales up or down capacity based on your application's needs without the need for managing database server infrastructure.

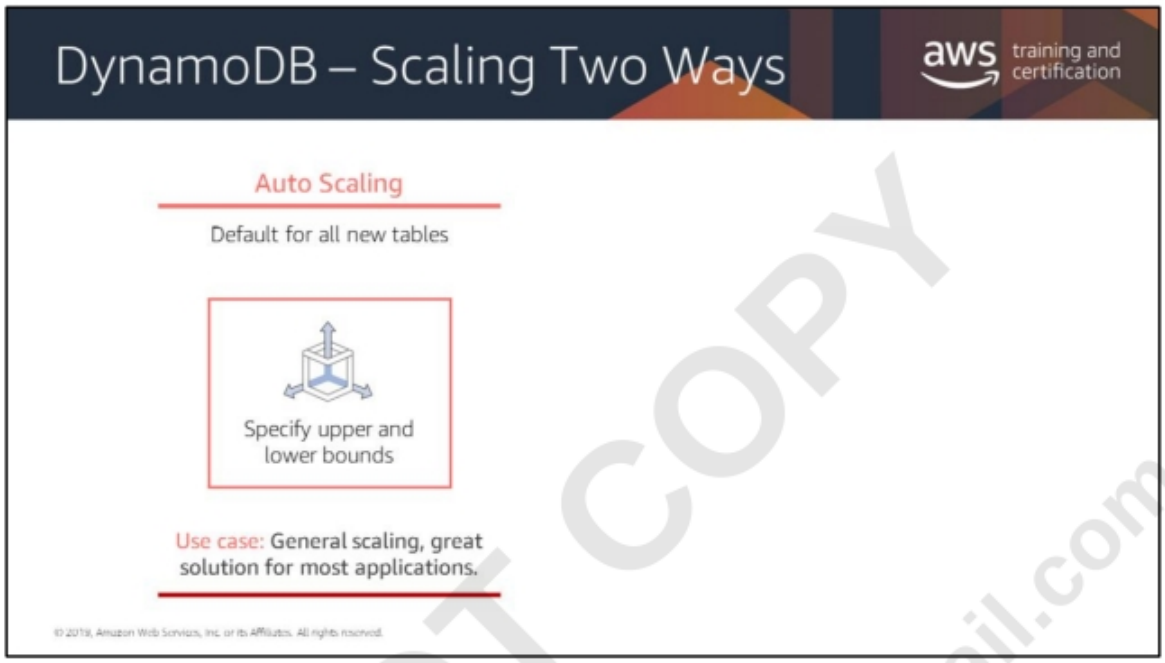
Aurora Serverless provides a relatively simple, cost-effective option for infrequent, intermittent, or unpredictable workloads. It can provide this because it automatically starts up, scales capacity to match your application's usage, and shuts down when it's not in use. You define a maximum and minimum Aurora Capacity Units (ACU) and pay for the number of ACUs used.



Sharding is a technique for improving the performance of writing with multiple database servers. Fundamentally, databases with identical structures are prepared and divided using appropriate table columns as keys, to distribute the writing processes. The use of the RDBMS service provided in the AWS Cloud lets you perform this sharding to achieve an increase in availability and operating efficiency.

You can use Amazon RDS in sharding backend databases. Install sharding software such as MySQL server combined with a Spider Storage Engine on an Amazon EC2 instance. Prepare multiple RDSs and use them as the sharding backend databases. You can distribute the RDSs to multiple regions.

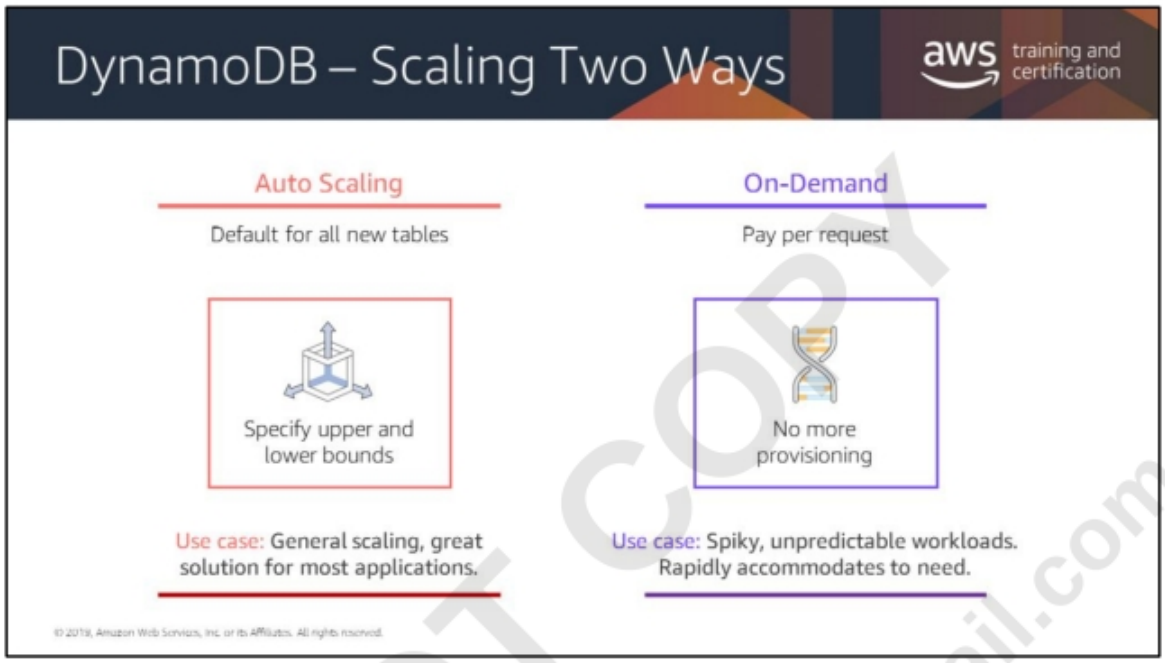
For more information, see http://en.clouddesignpattern.org/index.php/CDP:Sharding_Write_Pattern.



When you create a new DynamoDB table using the console, the table will have Auto Scaling enabled by default. DynamoDB Auto Scaling automatically adjusts read and write throughput capacity in response to dynamically changing request volumes, with zero downtime. With DynamoDB Auto Scaling, you simply set your desired throughput utilization target, minimum and maximum limits, and Auto Scaling takes care of the rest.

DynamoDB Auto Scaling works with Amazon CloudWatch to continuously monitor actual throughput consumption, and scales capacity up or down automatically, when actual utilization deviates from your target. Auto Scaling can be enabled for new and existing tables, and global secondary indexes. You can enable Auto Scaling with just a few clicks in the console, where you'll also have full visibility into scaling activities. You can also manage DynamoDB Auto Scaling programmatically, using the AWS Command Line Interface and the AWS Software Development Kits.

There is no additional cost to use DynamoDB Auto Scaling, beyond what you already pay for DynamoDB and CloudWatch alarms. DynamoDB Auto Scaling is available in all AWS regions, effective immediately.



Amazon DynamoDB On-Demand is a flexible billing option for DynamoDB capable of serving thousands of requests per second without capacity planning. It moves to a pay-per-request pricing, instead of a provisioned pricing model. DynamoDB On-Demand can observe any increase or scale of traffic level. If the level of traffic hits a new peak, DynamoDB adapts rapidly to accommodate the workload. This is useful if your workload is difficult to predict, or has large spikes over a short duration. You can change a table from provisioned capacity to on-demand once per day. You can go from on-demand capacity to provisioned as often as you want.

https://aws.amazon.com/blogs/aws/amazon-dynamodb-on-demand-no-capacity-planning-and-pay-per-request-pricing/

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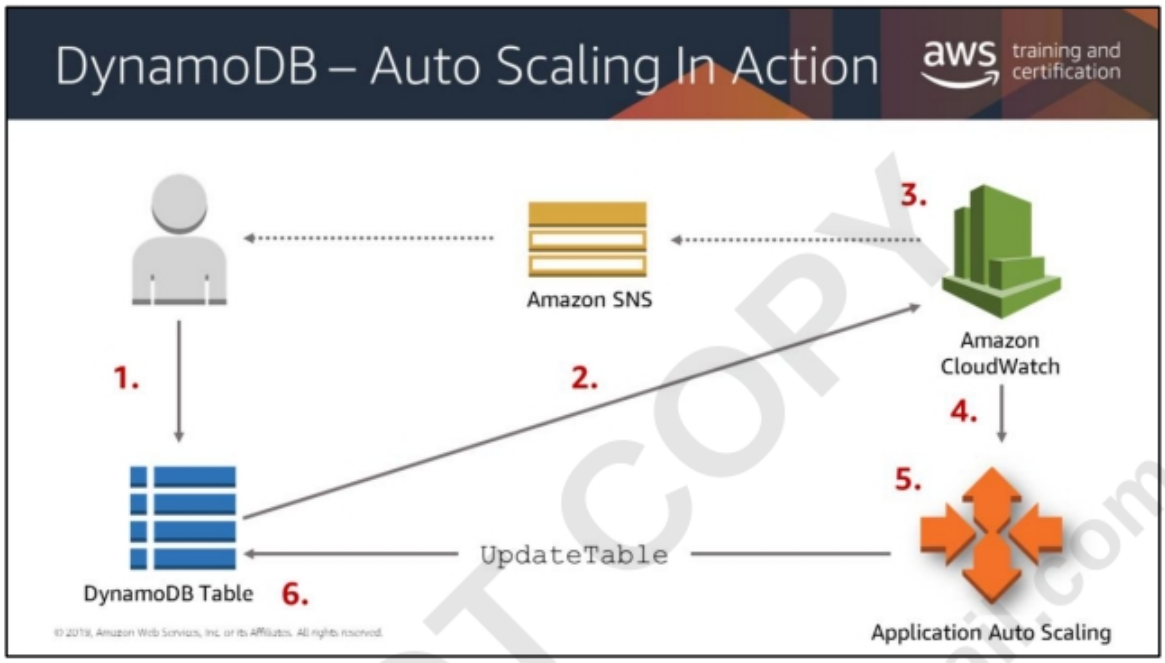
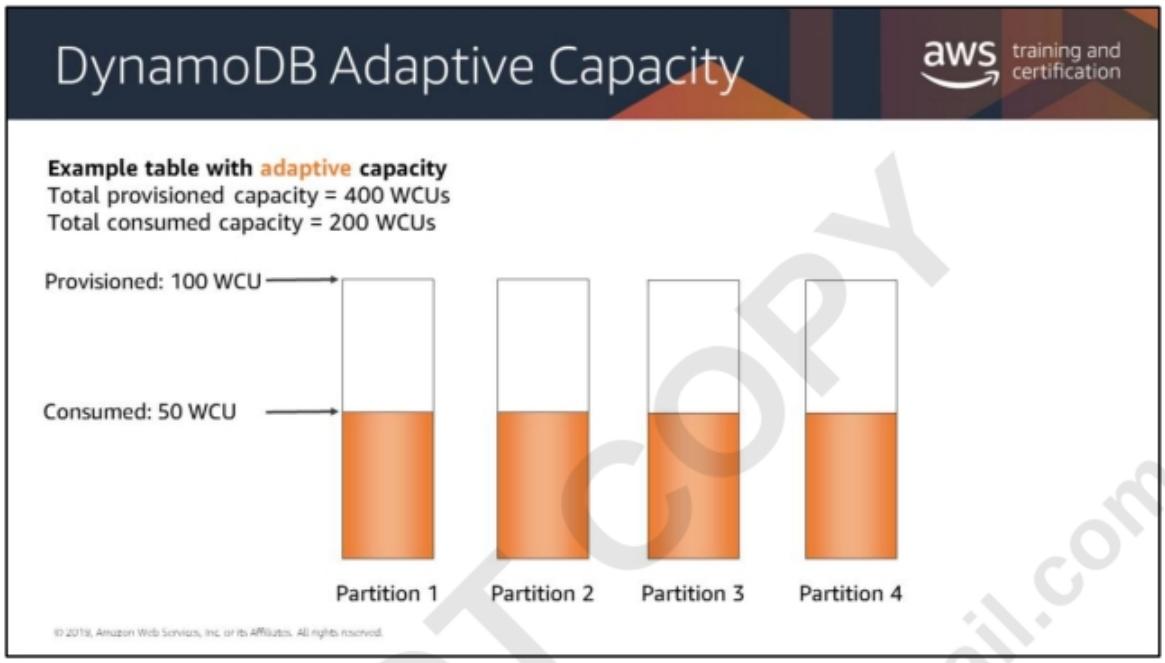


1. Create an Application Auto Scaling policy for your DynamoDB table.
2. DynamoDB publishes consumed capacity metrics to Amazon CloudWatch.
3. If the table's consumed capacity exceeds your target utilization (or falls below the target) for a specific length of time, Amazon CloudWatch triggers an alarm. You can view the alarm on the console and receive notifications using Amazon SNS.
4. The CloudWatch alarm invokes Application Auto Scaling to evaluate your scaling policy.
5. Application Auto Scaling issues an UpdateTable request to adjust your table's provisioned throughput.
6. DynamoDB processes the UpdateTable request, dynamically increasing (or decreasing) the table's provisioned throughput capacity so that it approaches your target utilization.



It's not always possible to distribute read and write activity evenly all the time. When data access is imbalanced, a "hot" partition can receive such a higher volume of read and write traffic compared to other partitions. In extreme cases, throttling can occur if a single partition receives more than 3,000 RCUs or 1,000 WCUs.

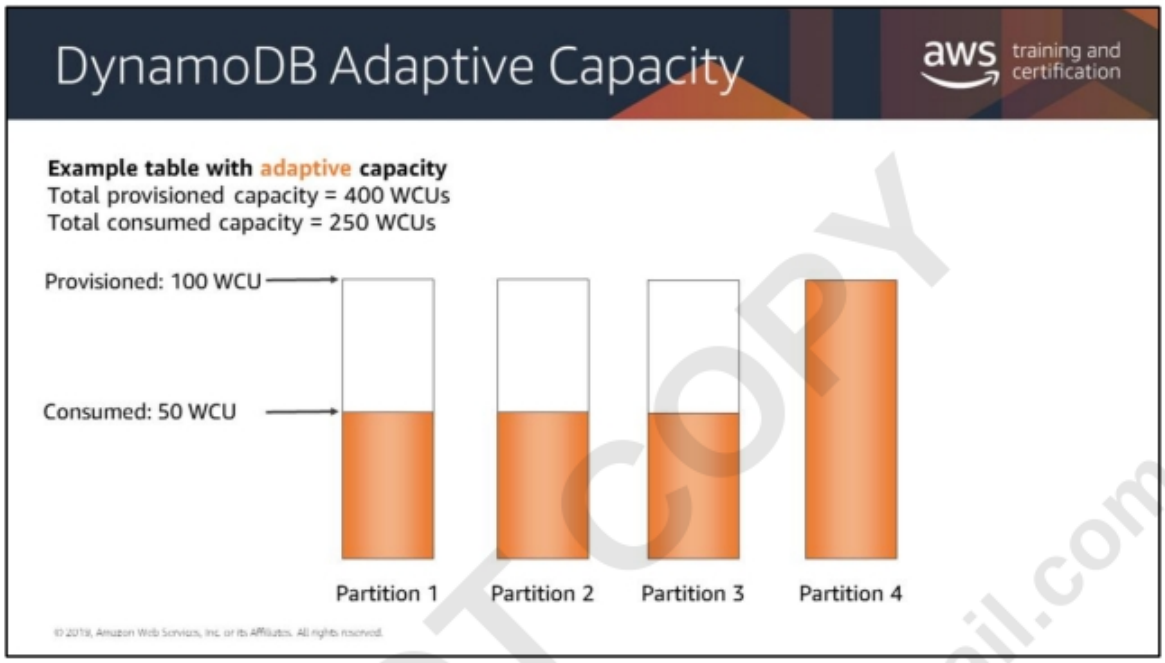
To better accommodate uneven access patterns, DynamoDB adaptive capacity enables your application to continue reading and writing to hot partitions without being throttled, provided that traffic does not exceed your table's total provisioned capacity or the partition maximum capacity. Adaptive capacity works by automatically increasing throughput capacity for partitions that receive more traffic.

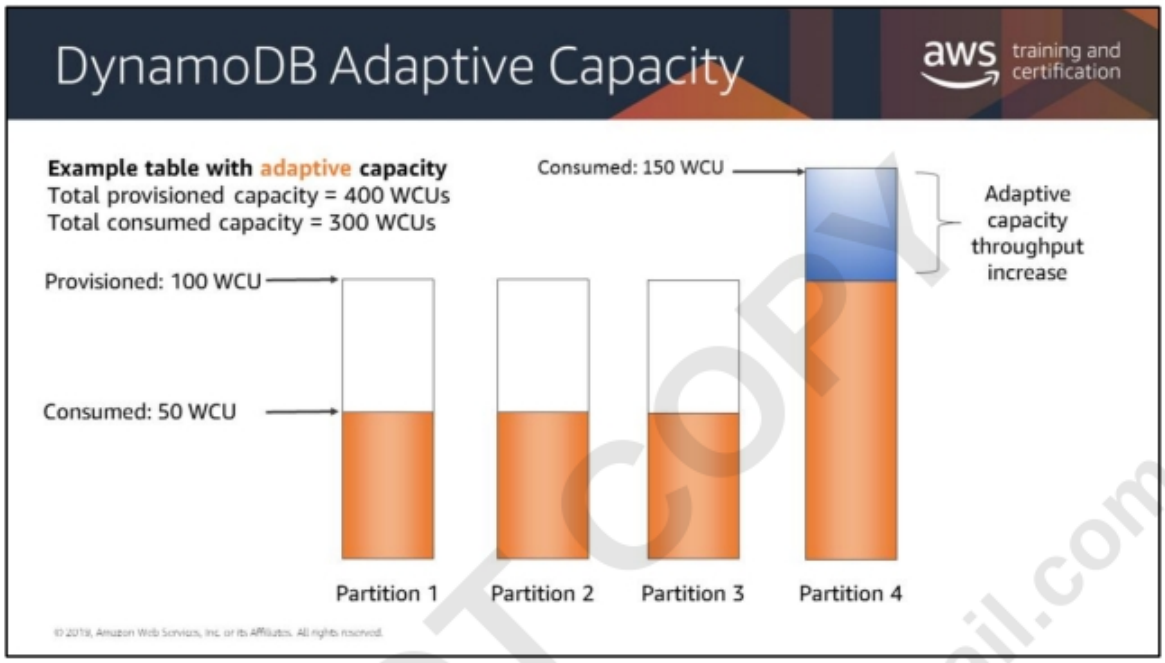
Adaptive capacity is enabled automatically for every DynamoDB table, so you don't need to explicitly enable or disable it.

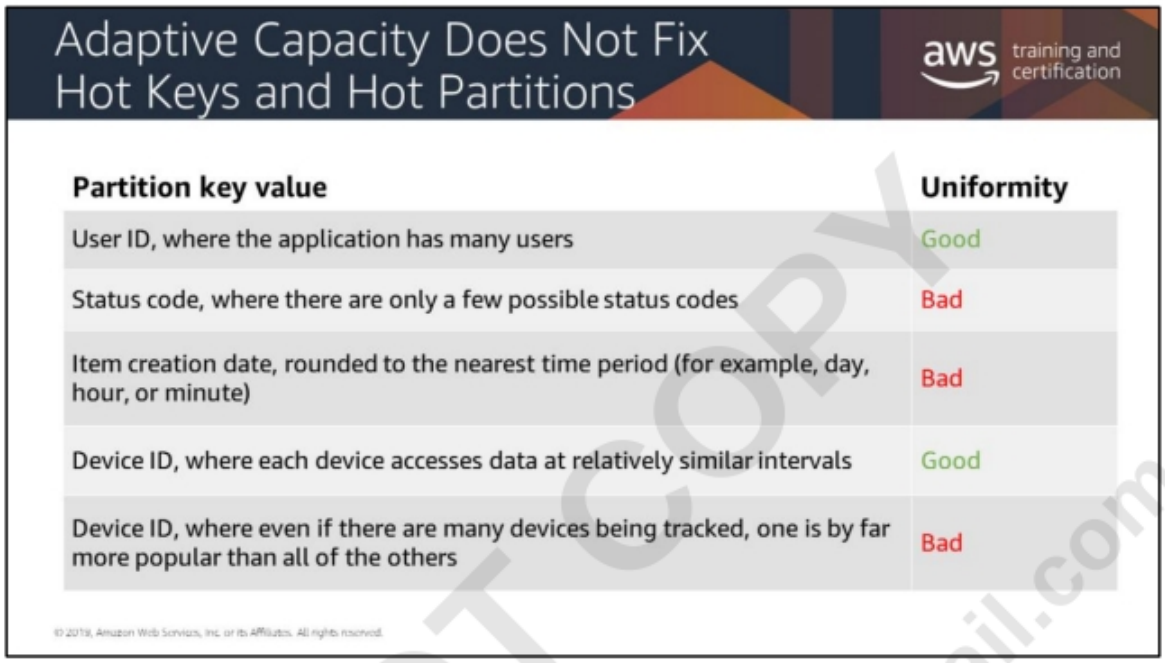
The following diagram illustrates how adaptive capacity works. The example table is provisioned with 400 write-capacity units (WCUs) evenly shared across four partitions, allowing each partition to sustain up to 100 WCUs per second. Partitions 1, 2, and 3 each receive write traffic of 50 WCU/sec. Partition 4 receives 150 WCU/sec. This hot partition can accept write traffic while it still has unused burst capacity, but eventually it will throttle traffic that exceeds 100 WCU/sec.

DynamoDB adaptive capacity responds by increasing partition 4's capacity so that it can sustain the higher workload of 150 WCU/sec without being throttled.

For more information, see https://docs.aws.amazon.com/amazondynamodb/latest/developerguide/bp-partition-key-design.html.



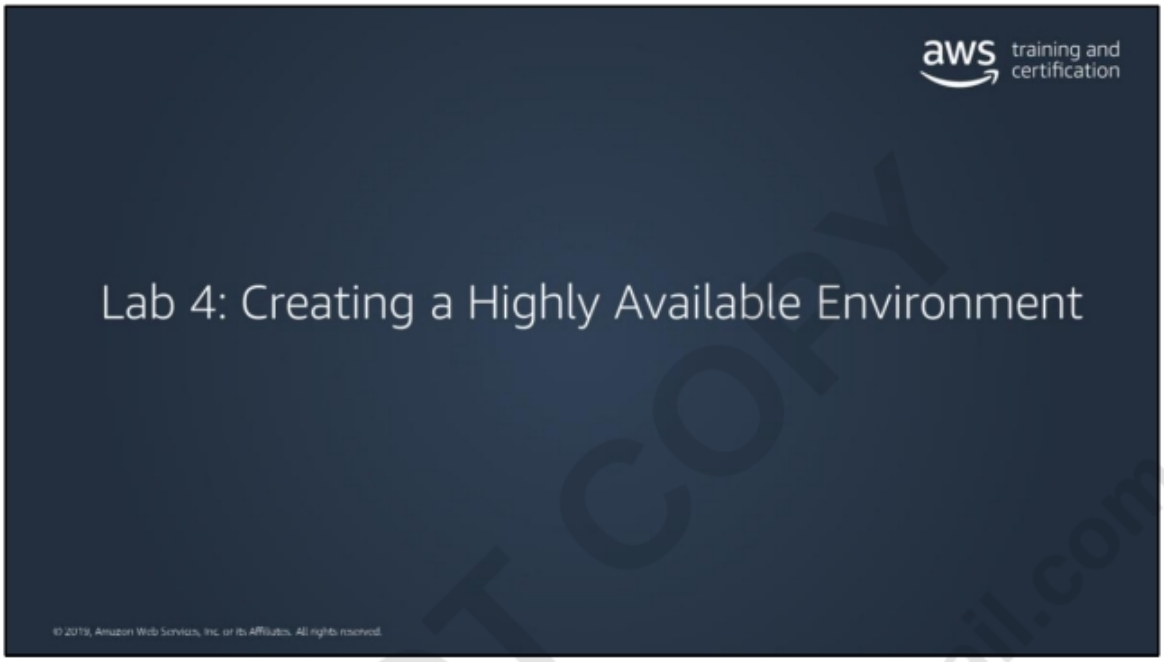


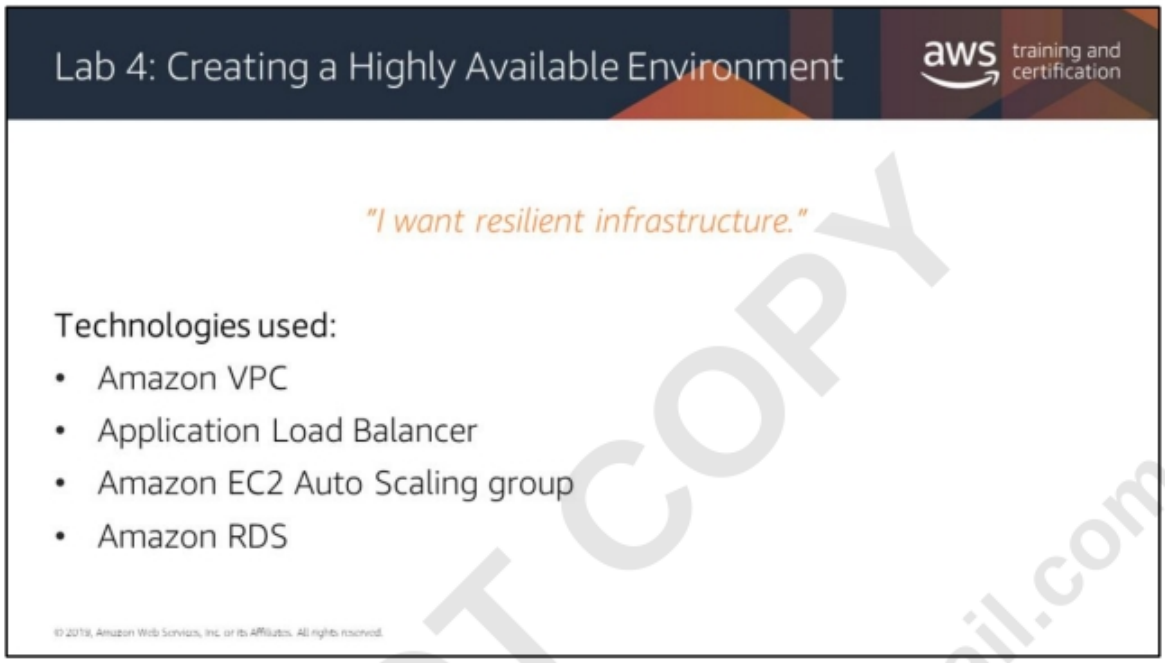


The partition key portion of a table's primary key determines the logical partitions in which a table's data is stored. This in turn affects the underlying physical partitions. Provisioned I/O capacity for the table is divided evenly among these physical partitions. Therefore a partition key design that doesn't distribute I/O requests evenly can create "hot" partitions that result in throttling and use your provisioned I/O capacity inefficiently.

The optimal usage of a table's provisioned throughput depends not only on the workload patterns of individual items, but also on the partition-key design. This doesn't mean that you must access all partition key values to achieve an efficient throughput level, or even that the percentage of accessed partition key values must be high. It *does* mean that the more distinct partition key values that your workload accesses, the more those requests will be spread across the partitioned space. In general, you will use your provisioned throughput more efficiently as the ratio of partition key values accessed to the total number of partition key values increases.

For more information, see
https://docs.aws.amazon.com/amazondynamodb/latest/developerguide/bp-partition-key-uniform-load.html





Lab 4: Creating a Highly Available Environment

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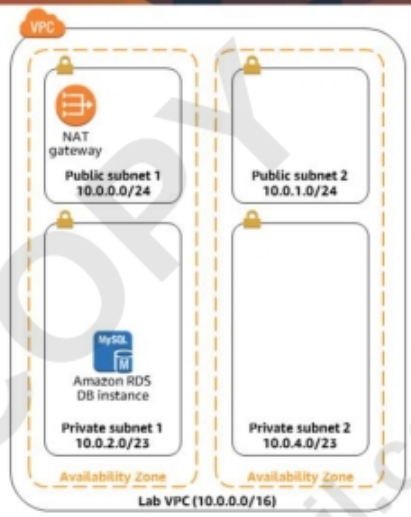
Provided at start of lab:

- VPC across two Availability Zones
- 2 x public subnets
- 2 x private subnets
- 1 x NAT gateway
- Amazon RDS DB instance

You will make this highly available!

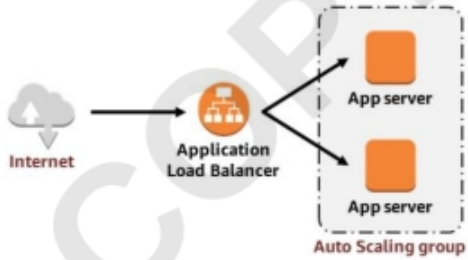


Lab 4: Creating a Highly Available Environment

aws training and certification

To distribute requests across multiple servers, use:

- Amazon EC2 Auto Scaling group
- Load Balancer

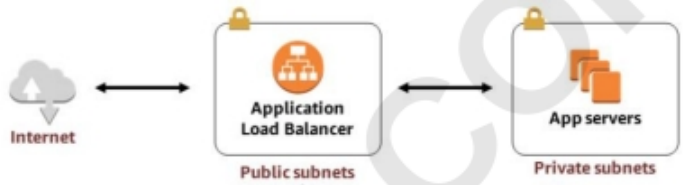


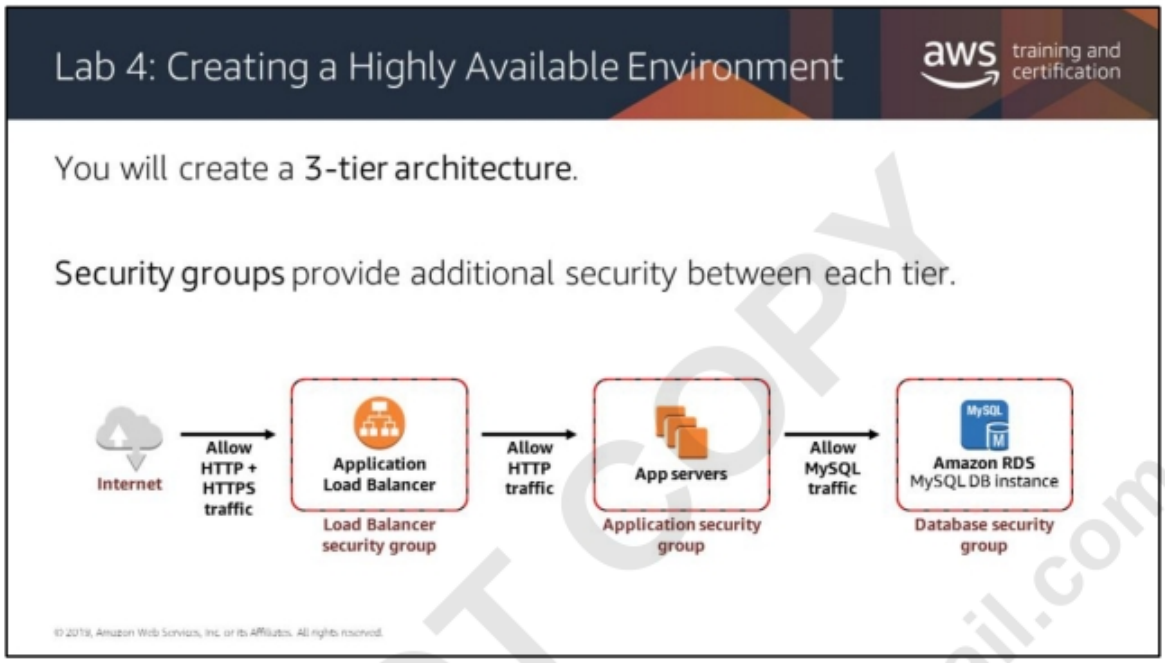
Lab 4: Creating a Highly Available Environment

aws training and certification

The Load Balancer is distributed across the **public subnets**.

The application servers are in the **private subnets**.





Lab 4: Creating a Highly Available Environment

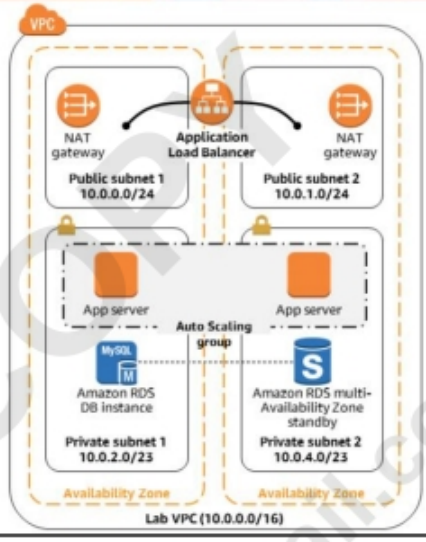
aws training and certification

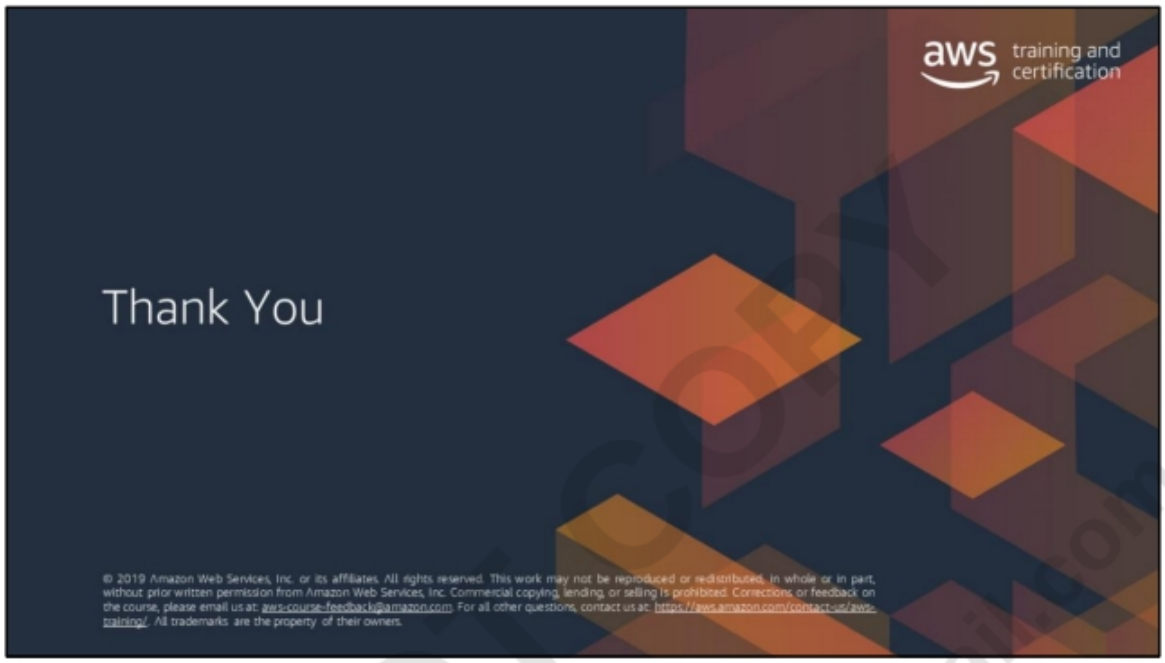
Final configuration:

- Load balancer
- Multiple application servers
- Multi-Availability Zone database
- NAT gateway in each Availability Zone

Scalable, reliable, highly available!

Duration: 40m





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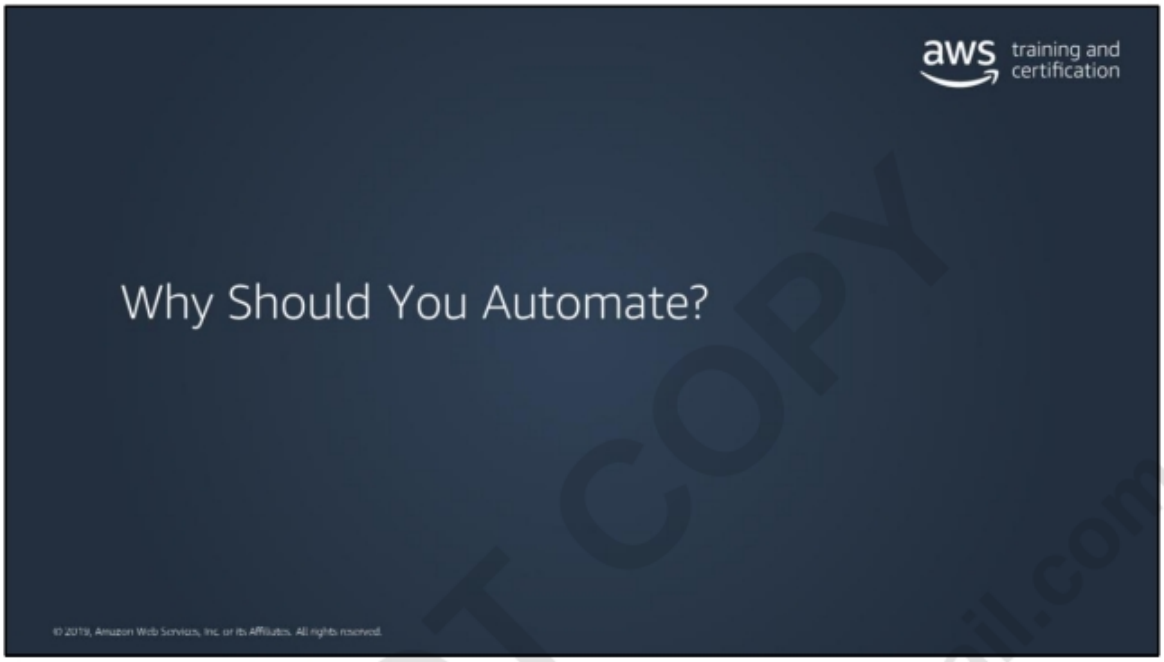

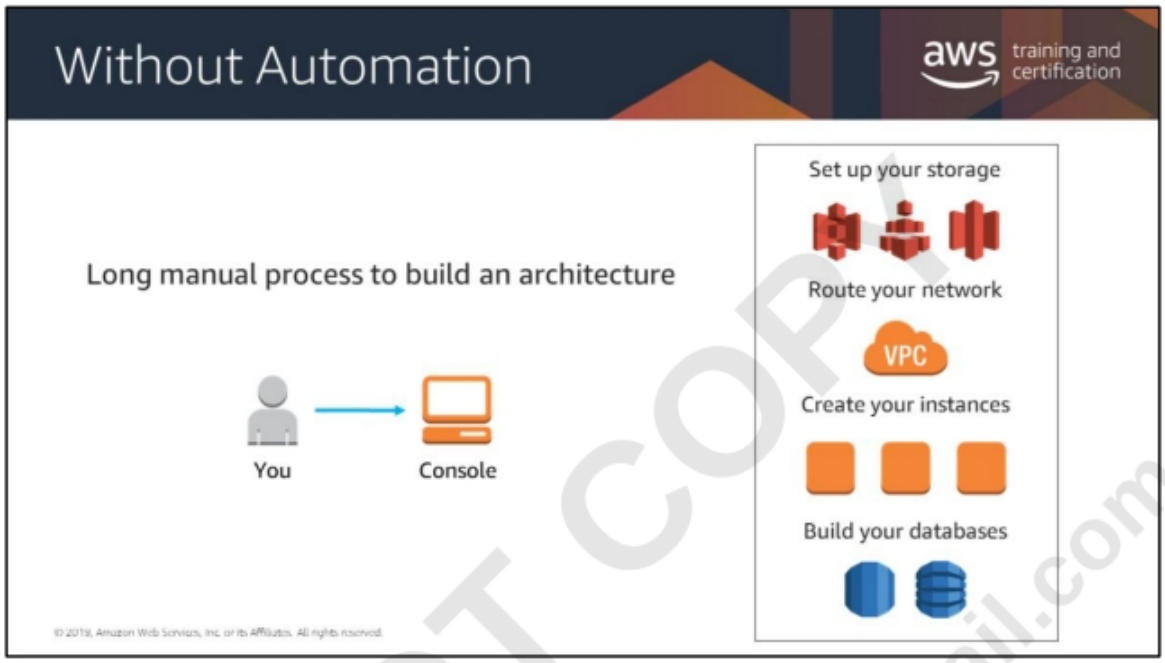

It takes significant time and energy to build a large-scale computing environment. Here are some questions to consider:

- Where do you want to put your efforts: the design or the implementation? And what are the risks of manual implementations?
- How do you update production servers? How are you going to roll out deployments across multiple geographic regions? When things break, and they will, how do you manage the rollback?
- What about debugging deployments? How do you find what's wrong and then fix it so that it says fixed?
- How will you manage dependencies on the various systems and subsystems in your organization?
- Finally, can you do all of this by hand?

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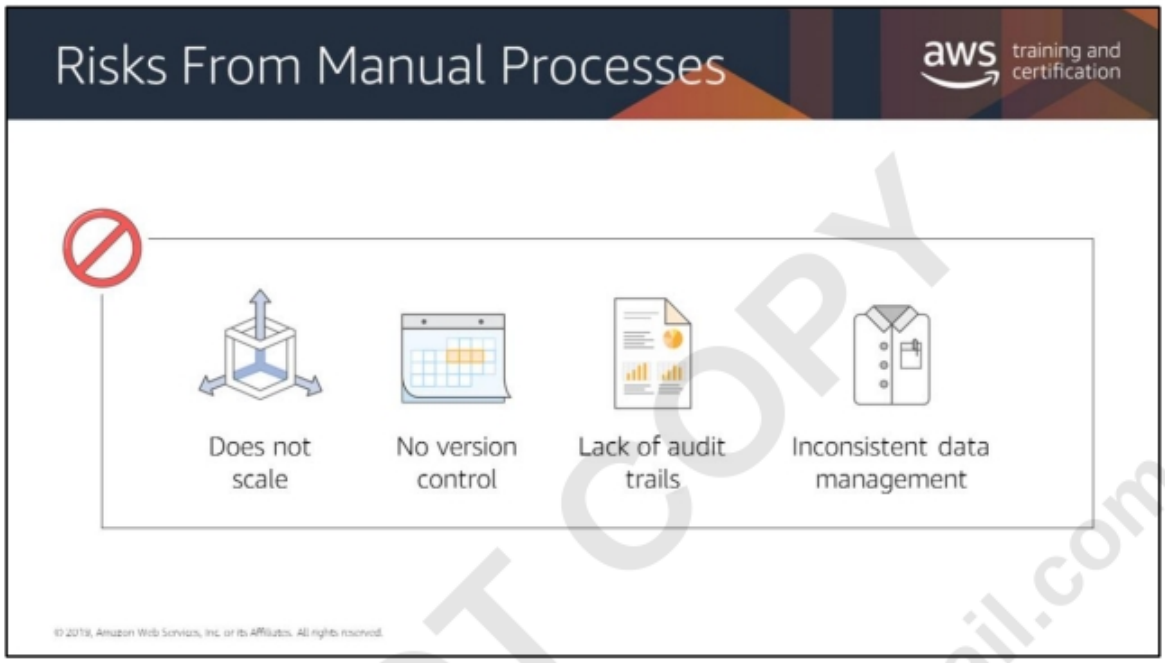

Having to manually create and add pieces to your environment does not scale. If you are responsible for a large corporate application, there are not enough people to manually sail the ship.

Creating architecture and applications by scratch doesn't have inherent version control. In case of emergency, it's helpful to roll back the production stack to a previous version—but that's not possible when you create your environment manually.

Having an audit trail is very important for many compliance and security situations. It's dangerous to allow people to manually control and edit your environment.

Finally, consistency is critical when minimizing risks. Automation allows you to maintain consistency.

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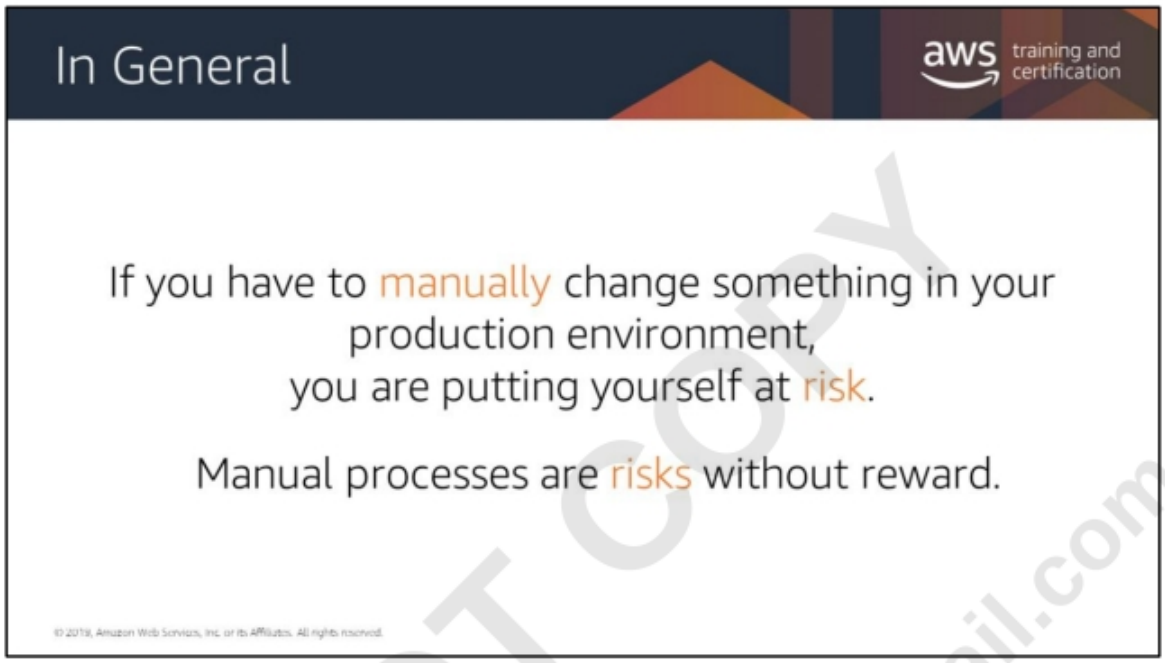
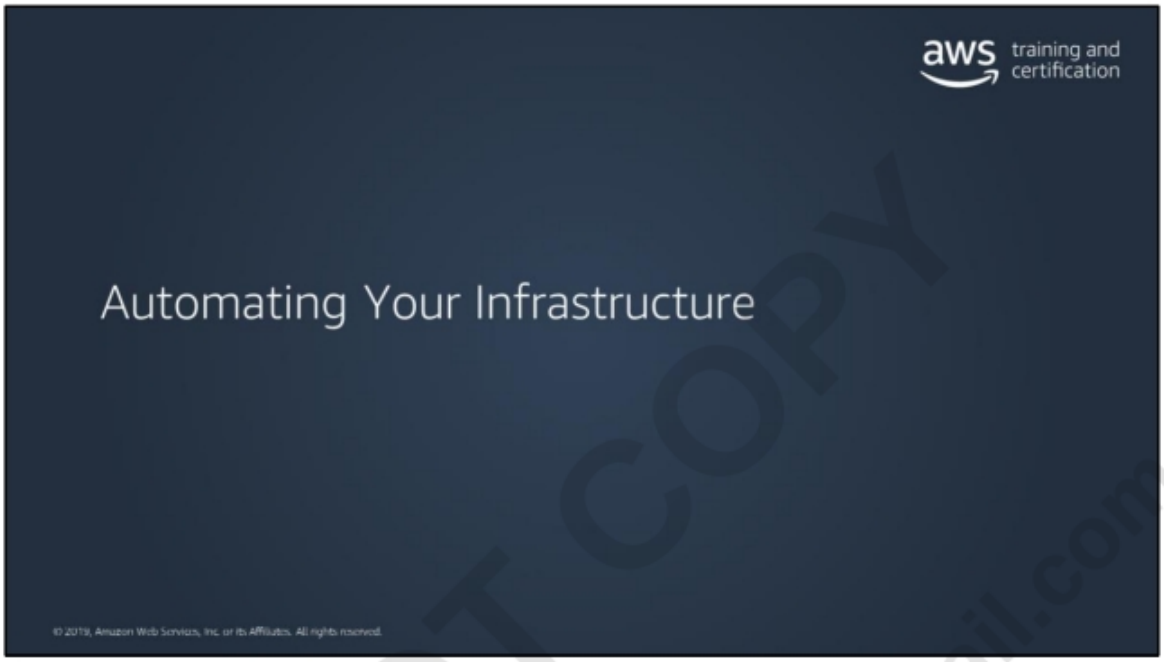
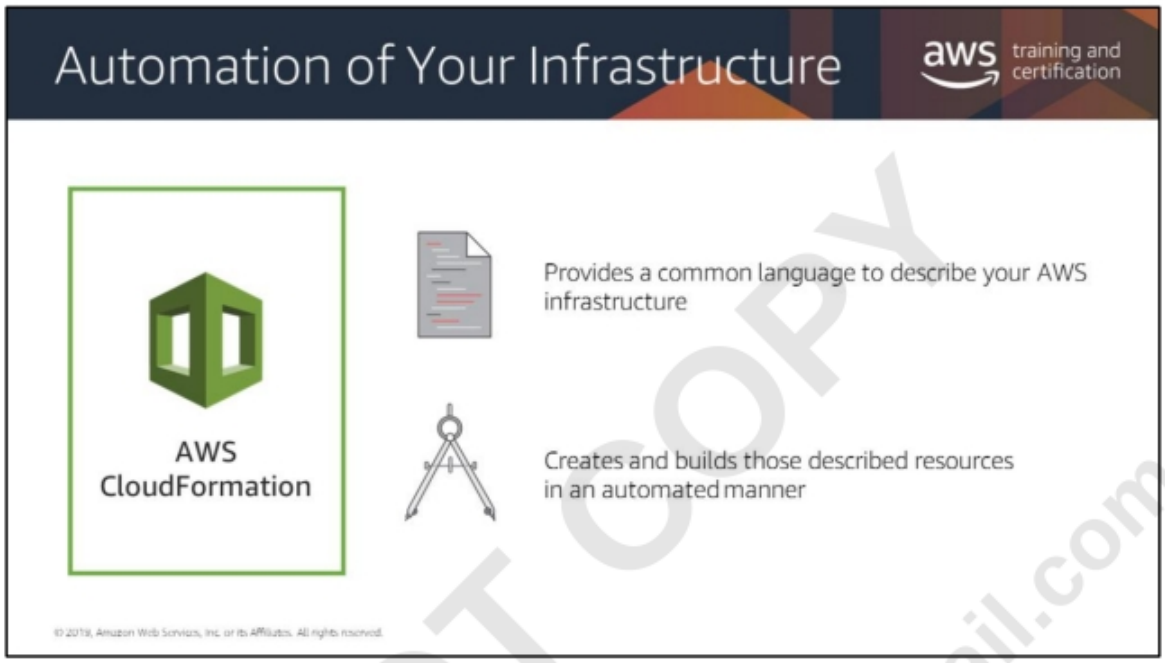
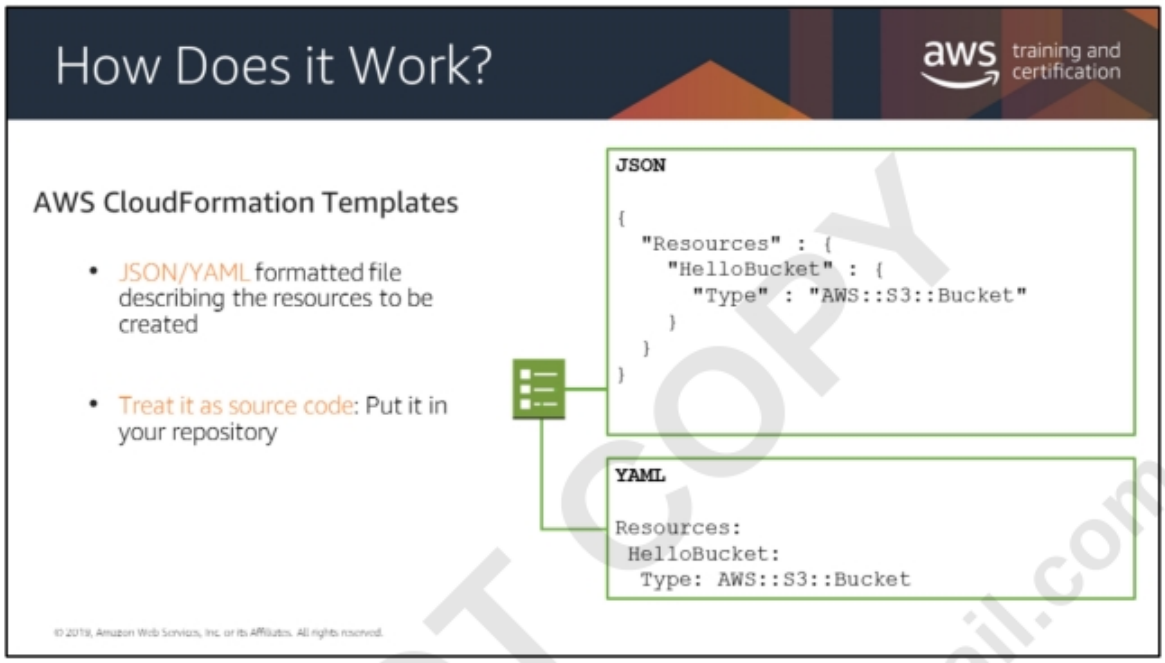






AWS CloudFormation provisions resources in a safe, repeatable manner, allowing you to build and rebuild your infrastructure and applications without having to perform manual actions or write custom scripts.

Using AWS CloudFormation allows you to treat your infrastructure as code. Author it with any code editor, check it into a version control system such as GitHub or AWS CodeCommit, and review files with team members before deploying into the appropriate environments.



Additional points for an AWS CloudFormation template:

- Treat it as code and manage it using your choice of version control (e.g., Git or SVN).
- Define an entire application stack (all resources required for your application) in a JSON template file.
- Define runtime parameters for a template (Amazon EC2 instance size, Amazon EC2 key pair, etc.).

You can now create YAML-formatted templates to describe your AWS resources and properties in AWS CloudFormation. Now, you have the option to use either YAML-formatted templates or JSON-formatted templates to model and describe your AWS infrastructure. YAML-formatted AWS CloudFormation templates follow the same anatomy as existing JSON-formatted templates and support all the same features.

You can also create cross stack references that let you share outputs from one stack with another stack. This lets you share things such as IAM roles, VPC information, and security groups. Previously, you needed to use AWS CloudFormation custom resources to accomplish this. Now, you can simply export values from one stack and import them to another stack using the new ImportValue intrinsic function.

Cross-stack references are useful for customers who separate their AWS infrastructure into logical components grouped by stack (e.g. a network stack, an application stack, etc.) and who need a way to loosely couple stacks together as an alternative to nested stacks.

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