Implementation Guide

Instance Scheduler on AWS

Instance Scheduler on AWS: Implementation Guide

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Automate starting and stopping AWS instances

The Instance Scheduler on AWS solution automates the starting and stopping of various AWS services including Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Relational Database Service (Amazon RDS) instances.

This solution helps reduce operational costs by stopping resources that are not in use and starting resources when their capacity is needed. For example, a company can use Instance Scheduler on AWS to automatically stop instances outside of business hours every day. If you leave all of your instances running at full utilization, this solution can result in up to 70% cost savings for those instances that are only necessary during regular business hours (weekly utilization reduced from 168 hours to 50 hours).

Instance Scheduler on AWS leverages Amazon Web Services (AWS) resource tags and AWS Lambda to automatically stop and restart instances across multiple AWS Regions and accounts on a customer-defined schedule. This solution also allows you to use hibernation for stopped EC2 instances.

This implementation guide provides an overview of the Instance Scheduler on AWS solution, its reference architecture and components, considerations for planning the deployment, and configuration steps for deploying the solution to the AWS Cloud.

This guide is intended for IT infrastructure architects, administrators, and DevOps professionals who want to implement Instance Scheduler on AWS in their environment.

Use this navigation table to quickly find answers to these questions:

If you want to . . .	Read . . .
Know the cost for running this solution. The estimated cost for running this solution in the US East (N. Virginia) Region is USD $13.15 per month.	Cost
Understand the security considerations for this solution.	AWS Well-Architected Security, Security
Configure schedules.	Scheduler configuration table

If you want to . . .	Read . . .
Know which AWS Regions are supported for this solution.	Supported AWS Regions
View or download the AWS CloudFormation template included in this solution to automatically deploy the infrastructure resources (the "stack") for this solution.	AWS CloudFormation templates
Access the source code and optionally use the AWS Cloud Development Kit (AWS CDK) to deploy the solution.	GitHub repository

Features and benefits

The Instance Schedule on AWS solution provides the following features:

Cross-account instance scheduling

This solution includes a template that creates the AWS Identity and Access Management (IAM) roles necessary to start and stop instances in secondary accounts. For more information, refer to the Cross-account instance scheduling section.

Automated tagging

Instance Scheduler on AWS can automatically add tags to all instances that it starts or stops. The solution also includes macros that allow you to add variable information to the tags.

Configure schedules or periods using Scheduler CLI

This solution includes a command line interface (CLI) that provides commands for configuring schedules and periods. The CLI allows customers to estimate cost savings for a given schedule. For more information, refer to the Scheduler CLI.

Manage schedules using Infrastructure as Code (IaC)

This solution provides an AWS CloudFormation Custom Resource that you can use to manage schedules using Infrastructure as Code (IaC). For more information, refer to Manage Schedules Using Infrastructure as Code.

Integration with Systems Manager Maintenance Windows

For Amazon EC2 instances, Instance Scheduler on AWS can integrate with AWS Systems Manager maintenance windows, defined in the same Region as those instances, to start and stop them in accordance with the maintenance window.

Use cases

Running instances only during working hours

If you leave all of your instances running at full utilization, this solution can result in up to 76% cost savings for those instances that are only necessary during regular business hours (weekly utilization reduced from 168 hours to 40 hours). For more information, see the Sample schedule.

Stopping instances after working hours

If you want to make sure that development instances are off after hours and until needed again, you can use this solution to set an end period without a start period. For more information, see the Sample schedule.

Concepts and definitions

This section describes key concepts and defines terminology specific to this solution:

schedule

Group of one or more periods that an instance is bound by.

period

Running period(s) defined by a start and stop time.

instance

A supported resource that is able to be scheduled. For example, an Amazon EC2 instance or an Amazon RDS cluster Amazon EC2 and Amazon RDS.

regular business hours

9:00 to 17:00 (9 AM - 5 PM) ET on weekdays

For a general reference of AWS terms, see the AWS Glossary.

Cost

You are responsible for the cost of the AWS services used while running Instance Scheduler. Understanding how costs scale with your deployment size helps you plan and optimize your implementation.

Cost scaling factors

Instance Scheduler costs scale based on several factors:

Number of scheduling targets: The number of unique account-region-service combinations being managed. Each target requires a separate Lambda invocation per scheduling interval.

Resources per target: The number of resources (EC2 instances, RDS databases, etc.) within each target influences Lambda execution time and duration costs.

Operational metrics complexity: Optional CloudWatch metrics costs scale with the number of unique instance types and active schedules being tracked across your deployment.

Scheduling frequency: The solution runs based on your configured frequency (default: 5 minutes). More frequent checks increase Lambda invocations from 24 times daily (hourly) to 288 times daily (5-minute intervals).

Calculating scheduling targets

A scheduling target is a unique combination of account-region-service that contains at least one actively managed instance. Multiple instances within the same account-region-service combination count as a single scheduling target.

Example calculation:

- Account A, us-east-1, 5 EC2 instances = 1 scheduling target
- Account A, us-east-1, 3 RDS databases = 1 scheduling target
- Account A, us-east-1, 2 Auto Scaling groups = 1 scheduling target
- Account A, us-west-2, 2 EC2 instances = 1 scheduling target
- Account B, us-east-1, 10 EC2 instances = 1 scheduling target

Total: 5 scheduling targets

This means the solution will invoke 5 separate Lambda functions per scheduling interval to manage all resources across these account-region-service combinations.

> **Note**
>
> Targets can be in scope for scheduling but are not considered "active" for cost calculations until at least one resource is tagged for scheduling in that target.
> For cost optimization, Instance Scheduler groups all Amazon RDS-related services into a single invocation. Therefore Amazon RDS, Amazon Aurora, Amazon Neptune, and Amazon DocDB scheduling all count as one "RDS" service for cost calculations.

Cost optimization strategies

1. Deploy in a Region with lower Lambda pricing
2. Use the default 512 MB Lambda memory setting unless required to increase it by single-target scale limitations
3. Minimize the number of unique schedules and instance types in active use
4. Adjust scheduling frequency based on your requirements
5. Disable operational metrics dashboard if not planning to use it

See the pricing webpage for each AWS service in this solution.

We recommend creating a budget through AWS Cost Explorer to help manage costs. Prices are subject to change.

Reference pricing examples (monthly)

The following examples demonstrate how costs scale across different deployment sizes. Use these as reference points to estimate costs for your specific deployment.

> **Note**
>
> All reference pricing are rough estimations of cost for the primary services used by the solution.

Small deployment (~$9 monthly)

This example represents a typical development or small production deployment:

- 5 active targets
- 20 managed resources
- 3 active schedules
- 2 instance types
- 5-minute scheduling interval
- 512 MB Lambda function, 5-second average runtime

AWS service	Monthly Cost [USD]
AWS Lambda	~$2.00
AWS KMS	~$1.50
CloudWatch Logs	~$0.30
CloudWatch Metrics	~$5.30
Amazon DynamoDB	~$0.05
Total:	~$9.15

Medium deployment (~$161 monthly)

This example represents a mid-size enterprise deployment:

- 250 active targets
- 1000 managed resources
- 15 active schedules
- 15 instance types
- 5-minute scheduling interval
- 512 MB Lambda function, 5-second average runtime
- 5 EC2 Maintenance Windows

AWS service	Monthly Cost [USD]
AWS Lambda	~$95.00
Amazon DynamoDB	~$1.00
CloudWatch Logs	~$10.00
CloudWatch Metrics	~$40.00
AWS KMS	~$15.00
Total:	~$161.00

Large deployment (~$630 monthly)

This example represents a large enterprise deployment:

- 1000 active targets
- 5000 managed resources
- 500 active schedules
- 50 instance types
- 5-minute scheduling interval
- 512 MB Lambda function, 5-second average runtime
- 100 EC2 Maintenance Windows

AWS service	Monthly Cost [USD]
AWS Lambda	~$380.00
Amazon DynamoDB	~$5.00
CloudWatch Logs	~$50.00
CloudWatch Metrics	~$140.00
AWS KMS	~$55.00

AWS service	Monthly Cost [USD]
Total:	~$630.00

Cost estimation for your deployment

To estimate costs for your specific deployment:

1. Count your total managed resources (EC2 instances, RDS databases, etc.)
2. Determine the number of accounts and Regions you'll manage
3. Consider your required scheduling frequency
4. Decide whether you need operational metrics
5. Use the reference examples above to interpolate your expected costs

Quotas

Scaling limitations

Instance Scheduler scales on two primary axes to manage large enterprise deployments:

Vertical scaling (resources per target)

Vertical scaling is bounded by the number of resources that a single Scheduling Request Lambda function can efficiently process within a single scheduling target (account/region/service combination).

Instance Scheduler is designed to be able to handle 1000s of EC2s, 100s of ASGs, and 100s of RDS dbs/clusters in a single scheduling targets but may be limited by cross-region latency.

To ensure optimal performance, we recommend monitoring the execution time of the Scheduling Request Lambda (see Operational insights dashboard). We recommend keeping average runtime below 90 seconds with a maximum peak time no greater than 4 minutes.

Horizontal scaling (number of targets)

Horizontal scaling is limited by the number of active scheduling targets being managed. An active target is an account/region/service combination with at least one actively tagged resource.

Instance Scheduler can be deployed to many more accounts and regions, but only targets with actively tagged resources affect performance.

With the default Lambda concurrency quota of 1000, you can run 1000 active targets simultaneously. Lambda queues additional executions automatically, allowing you to scale beyond this limit. We recommend keeping cumulative delay below 3 minutes for optimal performance.

For example, with a 15-second average runtime and lambda concurrency limit of 1000, you can manage up to 12000 active targets while keeping cumulative delay under 3 minutes (3 minutes ÷ 15 seconds × 1000 = 12000 targets).

For larger deployments, you can request a Lambda concurrency quota increase from AWS Support.

Additional Considerations

AWS resource tags: AWS resources typically have a limit of 50 tags per resource. Instance Scheduler requires 6 informational and control tags for operating the solution. Ensure your resources have sufficient tag capacity to accommodate both Instance Scheduler tags and your existing tagging strategy.

Lambda execution limits: Each Scheduling Request Handler Lambda function has a 5-minute execution timeout.

DynamoDB scaling: The solution uses on-demand scaling for its Amazon DynamoDB tables, automatically adjusting capacity based on your workload.

API rate limits: AWS service API throttling may occur with very large deployments. The solution includes retry logic to handle temporary throttling, but excessive throttling may reduce the upper scaling limits of the solution.

AWS Service Quotas

Service quotas for AWS services

Service quotas, also referred to as limits, are the maximum number of service resources or operations for your AWS account. Make sure you have sufficient quota for each of the services implemented in this solution. For more information, see AWS service quotas.

AWS CloudFormation quotas

Your AWS account has AWS CloudFormation quotas that you should be aware of when launching the stack in this solution. By understanding these quotas, you can avoid limitation errors that

would prevent you from deploying this solution successfully. For more information, see AWS CloudFormation quotas in the *AWS CloudFormation User's Guide*.

AWS Lambda quotas

Your account has a default AWS Lambda Concurrent Execution quota of 1000. For larger deployments, we recommend deploying Instance Scheduler to a dedicated account to avoid competing with other workloads for Lambda concurrency. This value is adjustable. For more information, refer to AWS Lambda Getting started guide.

Supported AWS Regions

You can deploy Instance Scheduler in any AWS Region, including AWS GovCloud (US) Regions and some opt-in Regions (Regions that are disabled by default). After you deploy the solution, you can configure it to apply the appropriate start or stop actions to tagged EC2 and RDS DB instances in any Region(s) of your account. If you use cross-account instance scheduling, the solution applies actions to instances in all configured Regions in all accounts.

Important

Instance Scheduler on AWS actions affect appropriately tagged instances in all AWS Regions of your account, even though the Lambda function is running in a single Region.

You can use multiple deployments of the solution to schedule a large number of instances, or instances in many accounts and Regions. When you deploy multiple schedulers, use a different tag name for each stack, and configure a set of non-overlapping Regions for each deployment.

Each deployment checks every instance in every configured Region in an account for the tag key that identifies resources it should schedule. If the Regions for multiple deployments overlap, each instance will be checked by multiple deployments.

Note

Instance Scheduler on AWS can target instances within any opt-in region for scheduling, even when the solution stacks are deployed in standard AWS regions.

Cross-account instance scheduling using account IDs or AWS Organization ID

This solution includes a template (instance-scheduler-on-aws-remote.template) that creates the AWS Identity and Access Management (IAM) roles and other necessary resources to enable the solution to start scheduling in the secondary accounts. You can review and modify permissions in the remote template before you launch the stack.

Enabling cross account scheduling using Account IDs

To apply automated start-stop schedules to resources in secondary accounts:

1. Sign in to the AWS Management Console and select the button to launch the instance-scheduler-on-aws AWS CloudFormation template in the primary account.
2. Launch the remote template (instance-scheduler-on-aws-remote) in each applicable secondary account. When each remote stack is launched, it creates a cross-account role Amazon Resource Name (ARN).
3. Update the primary solution stack with the Account ID in the **Provide Organization ID** or **List of Remote Account IDs** parameters to allow the solution to perform start and stop actions on instances in the secondary accounts.

Enabling cross account scheduling using AWS Organization ID

To apply automated start-stop schedules to resources in secondary accounts:

1. Sign in to the AWS Management Console and select the button to launch the instance-scheduler-on-aws AWS CloudFormation template in the primary account.
2. Set the CloudFormation parameter **Using AWS Organizations?** as Yes,and provide the organization ID in the **Provide Organization ID** OR **List of Remote Account IDs** CloudFormation parameters.
3. After deploying the stack in the primary account, launch the remote template (`instance-scheduler-on-aws-remote`) in each applicable secondary account in the same Region as the solution in the primary account. When each remote stack is launched successfully, the primary solution account will be updated with the account id without any further changes in the primary account.

Managing Account IDs with AWS Systems Manager Parameter Store

Use AWS Systems Manager Parameter Store to store remote account IDs. You can store remote Account IDs as a list parameter where every item is an account ID, or as a string parameter that contains a comma-delimited list of remote account IDs. The parameter has the format {param:_name_} where the name is the name of the parameter in Parameter Store.

To leverage this feature, you must launch the Instance Scheduler on AWS hub stack in the same account as your parameter store.

Services supported for scheduling

Instance Scheduler on AWS currently supports scheduling of the following services:

- Amazon EC2
- Amazon EC2 Auto Scaling groups
- Amazon RDS
- Amazon Aurora clusters
- Amazon DocumentDB
- Amazon Neptune

Instance shutdown behavior

Amazon EC2

This solution is designed to automatically stop EC2 instances and assumes that instance *shutdown behavior* is set to Stop, not Terminate. Note that you cannot restart an Amazon EC2 instance after it is terminated.

By default, EC2 instances are configured to stop, not terminate, when shut down, but you can modify this behavior. Therefore, make sure that the instances you control using the Instance Scheduler on AWS are configured with a Stop shutdown behavior; otherwise, they will be terminated.

Amazon RDS, Amazon Neptune, and Amazon DocumentDB

This solution is designed to automatically stop, not delete, RDS, Neptune, and DocDB instances. You can use the **Create RDS Instance Snapshot** AWS CloudFormation template parameter to create snapshots of RDS DB instances before the solution stops the instances. Snapshots are kept until the next time the instance is stopped and a new snapshot is created.

> **Note**
>
> Snapshots are not available for Amazon Aurora clusters. You can use the **Schedule Aurora Clusters** template parameter to start and stop RDS DB instances that are part of an Aurora cluster or that manage Aurora databases. You must tag the cluster (not the individual instances) with the tag key you defined during initial configuration and the schedule name as the tag value to schedule that cluster.

For more information about limitations to starting and stopping an RDS DB instance, refer to Stopping an Amazon RDS DB instance temporarily in the *Amazon RDS User Guide*.

When an RDS DB instance is stopped, the cache is cleared, which might lead to slower performance when the instance is restarted.

Amazon RDS maintenance window

Every RDS DB instance has a weekly maintenance window during which any system changes are applied. During the maintenance window, Amazon RDS will automatically start instances that have been stopped for more than seven days to apply maintenance. Amazon RDS will not stop the instance once the maintenance event is complete.

The solution allows you to specify whether to add the preferred maintenance window of an RDS DB instance as a running period to its schedule. The solution will start the instance at the beginning of the maintenance window and stop the instance at the end of the maintenance window if no other running period specifies that the instance should run, and if the maintenance event is completed.

If the maintenance event is not completed by the end of the maintenance window, the instance will run until the scheduling interval after the maintenance event is completed. For more information about the Amazon RDS maintenance window, refer to Maintaining a DB instance in the *Amazon RDS User Guide*.

Amazon EC2 Auto Scaling groups

We designed this solution to automatically stop Amazon EC2 Auto Scaling groups by using scheduled scaling actions. You can use the solution to configure scheduled scaling actions on the Auto Scaling group (ASG). When an ASG is stopped by a scheduled scaling action, its minimum, desired, and maximum capacities will be set to `0` until the ASG is automatically started again. This will return the minimum, desired, and maximum capacities to their original values.

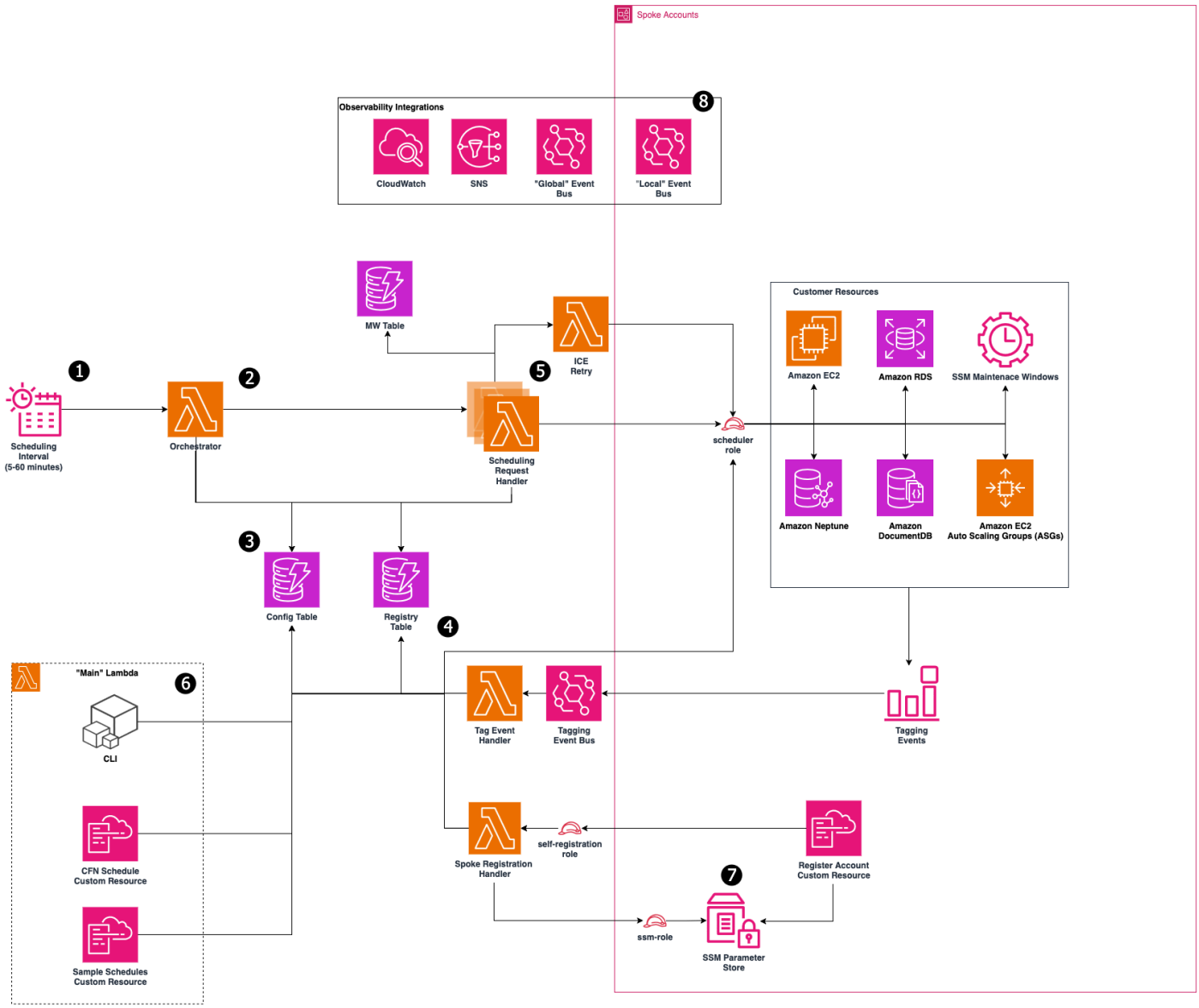
Architecture

This section provides a reference implementation architecture diagram, AWS Well-Architected design considerations, security components, scheduler configurations, and AWS services used in this solution.

Architecture diagram

Deploying this solution deploys the following components in your AWS account.

Instance Scheduler on the AWS Cloud



1. An Amazon EventBridge Rule triggers the orchestration Lambda function at configurable intervals (default: every 5 minutes).
2. The EventBridge rule invokes an AWS Lambda orchestration function that queries the DynamoDB configuration table to identify active scheduling targets. The orchestrator then invokes parallel scheduling Lambda functions for each active target.
3. Schedule definitions and periods are stored in an Amazon DynamoDB configuration table. You can define any number of schedules and periods in this table to control when your instances start and stop.
4. A DynamoDB registry table automatically tracks all managed resources. When resources are tagged for scheduling, they are registered in this table in response to AWS tagging events.
5. Each scheduling Lambda function describes tagged resources, evaluates their schedules against the current time, and executes the appropriate start or stop actions.
    a. For EC2 instances, if a start operation fails due to insufficient capacity, the solution can be configured to attempt to resize the instance to alternate instance types before retrying the start operation.
6. Schedule management is available through the DynamoDB console, scheduler CLI tool, or AWS CloudFormation Custom resources. The solution deploys with several example schedules pre-configured.
7. Cross-account deployments use a hub-spoke architecture where spoke accounts automatically self-register with the hub account. Spoke stacks must be deployed in the same region as the hub stack and must be either pre-approved by the hub stack or members of the same AWS Organization.
8. The solution publishes scheduling and registration events to EventBridge buses in the hub account (global events) and spoke accounts (local events per region).

> **Note**
>
> AWS CloudFormation resources are created from (AWS CDK) constructs.

All Lambda functions used by this solution leverage AWS IAM for permission requirements for your resources, and AWS KMS for encryption of the Amazon Simple Notification Service (Amazon SNS topic) and DynamoDB tables.

Each time the solution performs a scheduling interval, it checks the current state of each appropriately tagged instance against the targeted state (defined by one or more periods in a schedule in the instance tag) in the associated schedule. The schedule interval then applies the appropriate start or stop action, as necessary.

For example, if the Lambda function is invoked on a Friday at 9 AM (ET) and it identifies a stopped EC2 or RDS DB instance with a Schedule=office-hours tag, it will check Amazon DynamoDB for the office-hours schedule configuration details. If the office-hours schedule contains a period that indicates that the instance should run Monday through Friday from 9 AM ET to 5 PM ET, the Lambda function will start that instance.

The Lambda function also records information about your resources and displays them in an optional Amazon CloudWatch Custom dashboard. Information recorded includes the number of instances tagged for each schedule, the sizes of those instances, and whether or not those instances are currently in a running or stopped state. For more information on this custom dashboard, refer to Operational insights dashboard.

> **Note**
>
> *Stopping* an Amazon EC2 instance is different from *terminating* an Amazon EC2 instance. By default, Amazon EC2 instances are configured to stop, not terminate, when shut down, but you can modify this behavior. Before using this solution, verify that instances are set to stop or terminate as appropriate.

AWS Well-Architected design considerations

We designed this solution with best practices from the AWS Well-Architected Framework which helps customers design and operate reliable, secure, efficient, and cost-effective workloads in the cloud.

This section describes how the design principles and best practices of the Well-Architected Framework were applied when building this solution.

Operational excellence

This section describes how we architected this solution using the principles and best practices of the operational excellence pillar.

- The solution pushes metrics to Amazon CloudWatch to provide observability into its components (such as its infrastructure and Lambda functions).
- AWS X-Ray traces Lambda functions.
- Uses Amazon SNS for error reporting.

Security

This section describes how we architected this solution using the principles and best practices of the security pillar.

- All inter-service communications use IAM roles.
- All multi-account communications use IAM roles.
- All roles used by the solution follow least-privilege access. In other words, they only contain minimum permissions required so that the service can function properly.
- All data storage including DynamoDB tables have encryption at rest.

Reliability

This section describes how we architected this solution using the principles and best practices of the reliability pillar.

- The solution uses serverless AWS services wherever possible (such as Lambda and DynamoDB) to ensure high availability and recovery from service failure.
- Data processing uses Lambda functions. The solution stores data in DynamoDB, so it persists in multiple Availability Zones by default.

Performance efficiency

This section describes how we architected this solution using the principles and best practices of the performance efficiency pillar.

- The solution uses serverless architecture.
- You can launch the solution in any AWS Region that supports the AWS services used in this solution (such as Lambda and DynamoDB). For details, refer to Supported AWS Regions.

- The solution is automatically tested and deployed every day. Our solution architects and subject matter experts review the solution for areas to experiment and improve.

Cost optimization

This section describes how we architected this solution using the principles and best practices of the cost optimization pillar.

- The solution uses serverless architecture, and customers pay only for what they use.
- The compute layer defaults to Lambda, which uses a pay-per-use model.

Sustainability

This section describes how we architected this solution using the principles and best practices of the sustainability pillar.

- The solution uses managed and serverless services to minimize the environmental impact of the backend services.
- The solution's serverless design is aimed at reducing carbon footprint compared to the footprint of continually operating on-premises servers.

Scheduler configuration table

When deployed, Instance Scheduler on AWS creates an Amazon DynamoDB table that contains global configuration settings.

Global configuration items contain a type attribute with a value of **config** in the configuration table. Schedules and periods contain type attributes with values of **schedule** and **period**, respectively. You can add, update, or remove schedules and periods from the configuration table using the DynamoDB console or the solution's command line interface. However, you don't edit any items with a type of **config** because these items are managed by the solution.

Scheduler CLI

The solution includes a CLI that provides commands for configuring schedules and periods. The CLI allows you to estimate cost savings for a given schedule. The cost estimates provided by the

schedule CLI are for approximation purposes only. For more information about configuring and using the scheduler CLI, refer to Scheduler CLI.

AWS services used in this solution

AWS service	Description
AWS Lambda	**Core**. Solution deploys a Lambda function that contains all the logic to schedule the instances and to manage updates to the CloudForm ation stack using a custom resource feature.
Amazon DynamoDB	**Core.** Solution creates DynamoDB tables to store schedule configuration, state informati on, last actions performed of the instances , and a table to store Systems Manager maintenance window for scheduling purpose.
Amazon CloudWatch	**Core.** Solution stores debugging and informati on logs.
AWS IAM	**Core.** Solution uses IAM to get permissions for scheduling instances.
Amazon SNS	**Core.** Solution creates an SNS topic to send error messages for the users to subscribe to and troubleshoot in case of any errors.
AWS KMS	**Core.** Solution creates an AWS KMS key to encrypt the SNS topic.
Amazon EventBridge	**Core.** Solution creates an EventBridge Solution creates EventBridge scheduled rules that invoke AWS lambda on a consistent interval"

AWS service	Description
AWS Systems Manager	**Supporting.** Provides application-level resource monitoring and visualization of resource operations and cost data.
Amazon EC2	**Scheduled.** Solution is used to start and stop EC2 instances. The instances are identified by specific tags key/values which are configured in the solution.
Amazon RDS	**Scheduled.** Solution is used to change RDS DB instances status to Available or Stopped. The instances are identified by specific tags key/values which are configured in the solution.
Amazon Aurora	**Scheduled.** Solution is used to change Aurora clusters status to Available or Stopped. The clusters are identified by specific tags key/values which are configured in the solution.
Amazon Neptune	**Scheduled.** Solution is used to change Neptune instances status to Available or Stopped. The instances are identified by specific tags key/values which are configured in the solution.
Amazon DocumentDB	**Scheduled.** Solution is used to change DocumentDB instances status to Available or Stopped. The instances are identified by specific tags key/values which are configured in the solution.

AWS service	Description
Amazon EC2 Auto Scaling groups	**Scheduled.** Solution is used to manage scheduled scaling rules for EC2 Auto Scaling groups. These rules will start/stop Auto Scaling groups in accordance with an associate d schedule. Groups are identified by specific tags key/values which are configured in the solution.

Security

When you build systems on AWS infrastructure, security responsibilities are shared between you and AWS. This shared responsibility model reduces your operational burden because AWS operates, manages, and controls the components including the host operating system, the virtualization layer, and the physical security of the facilities in which the services operate. For more information about AWS security, visit AWS Cloud Security.

AWS KMS

The solution creates an AWS managed Customer managed key, which is used to configure server-side encryption for the SNS topic and the DynamoDB tables.

Amazon IAM

The solution's Lambda functions require permissions to access hub account resources and access to get/put Systems Manager parameters, access to CloudWatch log groups, AWS KMS key encryption/decryption, and publish messages to SNS. In addition, Instance Scheduler will also create Scheduling Roles in all managed accounts that will provide access to start/stop EC2, RDS, Autoscaling resurces, DB instances, modify instance attributes, and update tags for those resources. All the necessary permissions are provided by the solution to Lambda service role created as part of the solution template.

On deployment Instance Scheduler will deploy scoped down IAM roles for each of its Lambda functions along with Scheduler Roles that can be assumed only by specific scheduling Lambdas in the deployed hub template. These schedule roles will have names following the pattern `{namespace}-Scheduler-Role`, and `{namespace}-ASG-Scheduling-Role`.

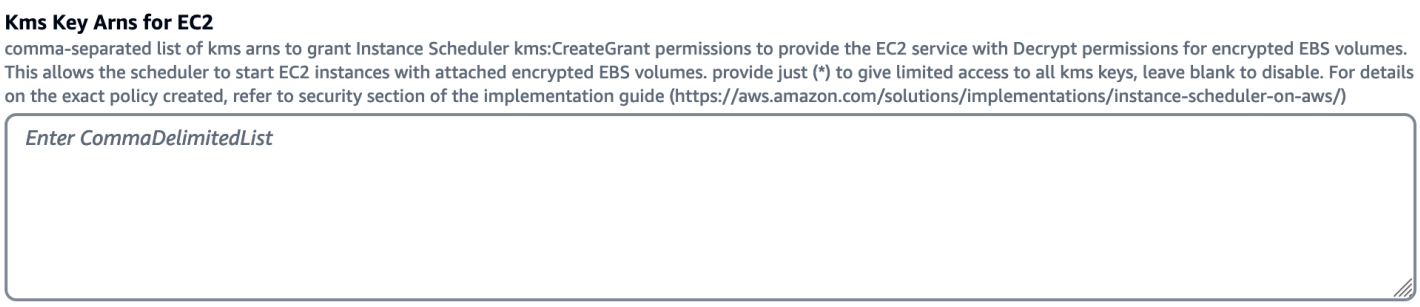
For detailed information about the permission provided to each service role, refer to the CloudFormation templates.

Encrypted EC2 EBS Volumes

When scheduling EC2 instances attached to EBS volumes encrypted by AWS KMS, you must grant Instance Scheduler permission to use the associated AWS KMS key(s). This allows Amazon EC2 to decrypt the attached EBS volumes during the started function. This permission must be granted to the scheduling role in the same account as the EC2 instance(s) using the key.

To grant permission to use an AWS KMS key with Instance Scheduler, add the AWS KMS key's ARN to the Instance Scheduler stack (hub or spoke) in the same account as the EC2 instance(s) using the key(s):

KMS Key Arns for EC2



This will automatically generate the following policy and add it to the scheduling role for that account:

```
{

  "Version": "2012-10-17",
  "Statement": [
     {
       "Condition": {
           "StringLike": {
              "kms:ViaService": "ec2.*.amazonaws.com"
        },
       "Null": {
             "kms:EncryptionContextKeys": "false",
             "kms:GrantOperations": "false"
        },
       "ForAllValues:StringEquals": {
```

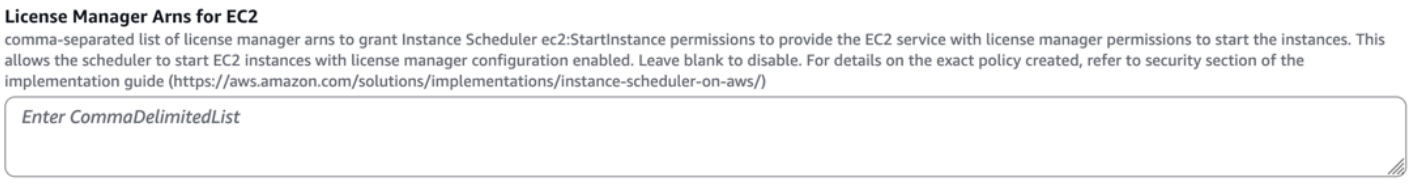
```
            "kms:EncryptionContextKeys": [
                "aws:ebs:id"
              ],
              "kms:GrantOperations": [
                 "Decrypt"
              ]
        },
        "Bool": {
                 "kms:GrantIsForAWSResource": "true"
              }
        },
        "Action": "kms:CreateGrant",
        "Resource": [
             "Your-KMS-ARNs-Here"
        ],
        "Effect": "Allow"
      }
   ]
}
```

EC2 License Manager

When scheduling EC2 instances that are managed in AWS License Manager, you must grant Instance Scheduler permission to use the associated license configurations. This allows the solution to properly start and stop instances while maintaining license compliance. This permission must be granted to the scheduling role in the same account as the EC2 instance(s) using License Manager.

To grant permission to use AWS License Manager with Instance Scheduler, add the License Manager configuration ARNs to the Instance Scheduler stack (hub or spoke) in the same account as the EC2 instance(s) using License Manager:

License Manager Configuration ARNs for EC2



This will automatically generate the following policy and add it to the scheduling role for that account:

```
{
```

```
  "Version": "2012-10-17",
  "Statement": [
     {
       "Action": "ec2:StartInstances",
       "Resource": [
            "Your-License-Manager-ARNs-Here"
       ],
       "Effect": "Allow"
     }
  ]
}
```

For more information about License Manager permissions, refer to Identity and access management for AWS License Manager in the *AWS License Manager User Guide*.

Getting started

This guide contains a brief overview and instructions to deploy the solution quickly. This solution uses AWS CloudFormation templates and stacks to automate its deployment. The CloudFormation templates specify the AWS resources included in this solution and their properties. The CloudFormation stack provisions the resources that are described in the templates.

Deployment process overview

> **Important**
>
> This solution includes an option to send anonymized operational metrics to AWS. We use this data to better understand how customers use this solution and related services and products. AWS owns the data gathered though this survey. Data collection is subject to the Privacy notice.

To opt out of this feature, download the template, modify the AWS CloudFormation mapping section, and then use the AWS CloudFormation console to upload your updated template and deploy the solution.

Follow the step-by-step instructions in this section to configure and deploy the solution into your account.

Time to deploy: Approximately 5-10 minutes (not including configuration).

Step 1: Launch the instance scheduler stack

1. Launch the AWS CloudFormation template in your AWS account.
2. Enter values for the required parameters.
3. Review the other template parameters, and adjust if necessary.

Step 2 (Optional): Launch the remote stack in secondary accounts

1. Launch the AWS CloudFormation template in your AWS account.
2. Enter values for the required parameters.

AWS CloudFormation templates

This solution uses AWS CloudFormation templates and stacks to automate its deployment. The CloudFormation templates specify the AWS resources included in this solution and their properties. The CloudFormation stack provisions the resources that are described in the templates.

You can download the CloudFormation templates for this solution before deploying it.

View template

instance-scheduler-on-aws.template - Use this template to launch the solution and all associated components. The default configuration deploys an AWS Lambda function, an Amazon DynamoDB table, an Amazon CloudWatch event, and CloudWatch custom metrics, but you can also customize the template based on your specific needs.

View template

instance-scheduler-on-aws-remote.template - Use this template to launch the cross-account role used by the solution to schedule instances in spoke accounts. For deployments using AWS Organizations, deploying the template also registers the spoke account with the hub, requiring no manual configuration.

> **Note**
>
> If you previously deployed this solution, see Update the solution for update instructions.

Step 1: Launch the instance scheduler hub stack

Follow the step-by-step instructions in this section to deploy the solution into your account.

Time to deploy: Approximately five minutes

Launch solution

1. Sign in to the AWS Management Console and select the button to launch the* instance-scheduler-on-aws.template* AWS CloudFormation template.

2. The template launches in the US East (N. Virginia) Region by default. To launch the solution in a different AWS Region, use the Region selector in the console navigation bar.
3. On the **Create stack** page, verify that the correct template URL is in the **Amazon S3 URL** text box and choose **Next**.
4. On the **Specify stack details** page, assign a name to your solution stack. For information about naming character limitations, see IAM and AWS STS quotas in the *AWS Identity and Access Management User Guide*.
5. Under **Parameters**, review the parameters for this solution template and modify them as necessary. This solution uses the following default values.

Parameter	Default	Description
	Infrastructure	
Namespace	`default`	Provide a unique identifier to differentiate between multiple solution deployments (no spaces). Example: Dev.
Use AWS Organizations	No	Use AWS Organizations to automate spoke account registration.
Organization ID/Remote Account IDs	*<Optional Input>*	*If you're using AWS Organizations this field is required.* Provide the Organization ID, for example, `o-xxxxyyy`. Otherwise, provide a comma separated list of trusted spoke Account IDs that can register themselves for scheduling (maximum 40), such as `1111111111,2222222222`
Schedule tag key	`Schedule`	The tag key that the solution reads to determine the

Parameter	Default	Description
		schedule for a resource. The value on a resource specifies the name of the schedule. If you choose to modify the default value, assign a name that is easy to apply consistently and correctly across all necessary instances . **Note**: The tag key is case sensitive.
Retain data and logs	`Enabled`	Enable deletion protection for DynamoDB tables used by the solution. This causes the tables to be retained when deleting this stack. To delete the tables when deleting this stack, first disable this parameter.
	Global Settings	
Enable scheduling	`Yes`	Set to `No` to suspend all scheduling operations.
Default time zone	`UTC`	Default IANA (International assigned Numbers Authority) time zone identifier for schedules that do not specify a time zone. For a list of valid time zone identifiers, refer to the **TZ identifier** column of the List of tz database time zones.

Parameter	Default	Description
Scheduling interval (minutes)	5	Interval in minutes between scheduler runs. Shorter intervals increase accuracy and responsiveness but also increase costs. Productio n deployments require a minimum of 5 minutes for stable operation; shorter values are for small-scale testing only.
Enable EC2 SSM maintenan ce windows	No	Allow schedules to specify one or more Systems Manger maintenance window na mes. Instance Scheduler on AWS will then ensure that instances tagged with that schedule are started at least ten minutes before associate d maintenance windows.
Create RDS instance snapshots on stop	No	Choose whether to create a snapshot before stopping RDS DB instances. **Note:** Snapshots are not available for Amazon Aurora clusters.
ASG action name prefix	`IS-`	The prefix that the solution uses when naming Scheduled Scaling actions for Auto Scaling groups. Actions with this prefix will be added and removed by the solution as needed.

Parameter	Default	Description
ASG scheduled tag key	`scheduled`	Deprecated. This parameter exists for migration purposes only and should not be edited.
	Hub-Account Scheduling	
Region(s)	*<Optional Input>*	List of Regions where instances will be scheduled . For example, `us-east-1 ,us-west-1` . NOTE: If you leave this parameter blank, the solution will use the current Region.
KMS Key ARNs for EC2	*<Optional Input>*	Comma-separated list of KMS ARNs to grant Instance Scheduler on AWS kms:CreateGrant permissions to provide the EC2 service with decrypt permissions for encrypted EBS volumes. This allows the scheduler to start EC2 instances with attached encrypted EBS volumes. Provide (*) to give limited access to all KMS keys; leave blank to disable. For details on the created policy, refer to Encrypted EC2 EBS Volumes.

Parameter	Default	Description
License Manager ARNs for EC2	*<Optional Input>*	Comma-separated list of License Manager configuration ARNs to grant Instance Scheduler permissions to start EC2 instances managed by License Manager. Leave blank to disable. For details, refer to EC2 License Manager.
Monitoring		
Enable informational tagging	`Yes`	When enabled, Instance Scheduler writes informational tags to managed resources indicating the last scheduling action taken and any errors encountered. For more information, refer to Informational tags.
Enable CloudWatch Debug Logs	`No`	Enable debug-level logging in CloudWatch logs.
Log retention period (days)	`30`	The log retention period for CloudWatch logs in days.
Operational Monitoring	`Enabled`	Deploy an operational insights dashboard to CloudWatch and gather custom metric data on the solution's operation. The dashboard can be disabled to reduce associated costs if desired.

Parameter	Default	Description
	Other	
SchedulingRequestHandler Memory size (MB)	512	The memory size of the AWS Lambda function that schedules resources. Increase if you are experiencing high memory usage or timeouts.
Orchestrator Memory size (MB)	512	The memory size of the orchestrator Lambda function. Increase if you are experiencing high memory usage or timeouts.

6. Choose **Next**.
7. On the **Configure stack options** page, choose **Next**.
8. On the **Review and create** page, review and confirm the settings. Check the box acknowledging that the template will create IAM resources.
9. Choose **Submit** to deploy the stack.

You can view the status of the stack in the AWS CloudFormation console in the **Status** column. You should receive a CREATE_COMPLETE status in approximately five minutes.

Step 2 (Optional): Launch the remote stack in secondary accounts

> **Important**
>
> The remote stack must be deployed in the same Region as the hub stack.

This automated AWS CloudFormation template configures secondary account permissions that will allow the hub stack to schedule instances in other accounts. Install the remote template only after the primary/hub stack has been successfully installed in the Hub account.

Launch solution

1. Sign in to the AWS Management Console of the applicable secondary account and select the button to launch the instance-scheduler-on-aws-remote AWS CloudFormation template.
2. The template launches in the US East (N. Virginia) Region by default. To launch the solution in a different AWS Region, use the Region selector in the console navigation bar. If the hub stack is configured to use AWS Organizations, then deploy the remote template in the same region as the hub stack.
3. On the **Create stack** page, verify that the correct template URL is in the **Amazon S3 URL** text box and choose **Next**.
4. On the **Specify Details** page, assign a name to your remote stack.
5. Under **Parameters**, review the parameter for the template, and modify it.
6. If the AWS Organizations option is enabled and the hub stack is similarly configured, there are no further changes required in the main stack to start the scheduling.
7. If the AWS Organization option is set to No, then the hub stack should be updated with the new Account ID.

Parameter	Default	Description
	Infrastructure	
Namespace	`default`	Unique identifier used to differentiate between multiple solution deployments. Must be set to the same value as the hub stack.
Use AWS Organizations	No	Use AWS Organizations to automate spoke account registration. Must be set to the same value as the hub stack.
Hub Account ID	*<Requires Input>*	Account ID of the Instance Scheduler on AWS hub stack

Parameter	Default	Description
		that will schedule resources in this account.
Schedule tag key	`Schedule`	The tag key that the solution reads to determine the schedule for a resource. Must be set to the same value as the hub stack.
	Member-Account Scheduling	
Region(s)	*<Optional Input>*	List of Regions where instances will be scheduled . For example, `us-east-1 ,us-west-1` . (this does not have to be the same region list as the hub). If you leave this parameter blank, the solution will use the current Region.
KMS Key ARNs for EC2	*<Optional Input>*	Comma-separated list of KMS ARNs to grant the solution kms:CreateGrant permissions to provide the EC2 service with decrypt permissions for encrypted EBS volumes. This allows the scheduler to start EC2 instances with attached encrypted EBS volumes. Provide (*) to give limited access to all KMS keys; leave blank to disable. For details, refer to Encrypted EC2 EBS Volumes.

Parameter	Default	Description
License Manager ARNs for EC2	*<Optional Input>*	Comma-separated list of License Manager configuration ARNs to grant Instance Scheduler permissions to start EC2 instances managed by License Manager. Leave blank to disable. For details, refer to EC2 License Manager.

1. Choose **Next**.
2. On the **Options** page, choose **Next**.
3. On the **Review and create** page, review and confirm the settings. Be sure to check the box acknowledging that the template will create IAM resources.
4. Choose **Submit** to deploy the stack.

You can view the status of the stack in the AWS CloudFormation Console in the **Status** column. You should see a status of `CREATE_COMPLETE` in approximately five minutes.

Configure the solution

Now that the solution has been deployed, you can begin configuring schedules and tagging instances for scheduler. To learn more about how to do these things, refer to Configure schedules and Tag instances for scheduling.

Operator guide

This guide is intended for users and operators of this solution and contains details on how to configure schedules and monitor the solution.

Configure schedules

Important

Misconfigured schedules can result in instances running continuously and incurring unexpected costs. Before applying schedules to your resources, verify the following:

- The schedule name in the resource tag exactly matches a schedule defined in the configuration table. Misspelled or nonexistent schedule names will result in an `UnknownSchedule` error and the instance will not be stopped by the scheduler. Check for the `IS-Error` tag on your resources to identify this condition.
- If `stop_new_instances` is set to `false`, instances that are running outside of a scheduled period when first tagged will not be stopped until the next scheduled stop transition. This can result in instances running longer than expected.
- If `retain_running` is set to `true`, instances that are manually started before a running period begins will not be stopped at the end of that period. This is by design, but can lead to instances running indefinitely if not monitored.
- When using `enforced: false` (the default), the scheduler will not restart instances that are manually stopped during a running period, and will not stop instances that are manually started outside of a running period after the initial stop transition.

We recommend enabling informational tagging (enabled by default) and periodically reviewing the `IS-Error` and `IS-LastAction` tags on your resources to confirm that scheduling is operating as expected.

Once the solution has been successfully deployed, you can begin to configure schedules. Instance Scheduler on AWS supports two methods of managing schedules as described below.

Note

The solution can support any number of schedules, each of which can contain one or more periods that define when instances controlled by that schedule should be running. For more information, refer to Schedules and Periods.

Using Infrastructure as Code (recommended)

Instance Scheduler on AWS provides an AWS CloudFormation CustomResource that you can use to manage your schedules and periods using Infrastructure as Code (IaC).

For information on how to manage schedules using IaC, please refer to Manage Schedules Using Infrastructure as Code (IaC).

Using the Amazon DynamoDB Console and Instance Scheduler on AWS CLI

Important

If you used the custom resource to manage any schedules using IaC, you must not use the DynamoDB console or scheduler CLI to delete or modify those schedules or their periods. If you do, you will create a conflict between the stored parameters in CloudFormation and the values in the table. Also, do not use periods managed by CloudFormation in schedules created using the DynamoDB console or the scheduler CLI.

When deploying the Instance Scheduler on AWS hub stack, the solution created an Amazon DynamoDB table containing several sample periods and schedules that you can use as a reference to create your own custom periods and schedules. To create a schedule in DynamoDB, modify one of the schedules in the configuration table (ConfigTable) or create a new one. To create a schedule using the CLI, first Install the Scheduler CLI and then use the Available commands.

Note

For examples of how to create several sample schedules using IaC, DynamoDB, and the InstanceScheduler CLI, please refer to Sample schedules.

This section provides instruction and reference on how to use, monitor and update the solution as well as troubleshooting and support information.

Tag instances for scheduling

When you deployed the AWS CloudFormation template, you defined the name (tag key) for the solution's *custom tag*. For Instance Scheduler on AWS to recognize an Amazon EC2 or Amazon RDS instance, the tag key on that instance must match this custom tag key. Therefore, it is important that you apply tags consistently and correctly to all applicable instances. You can continue to use existing tagging best practices for your instances while using this solution. For more information, refer to Tag your Amazon EC2 resources and Tagging Amazon RDS resources.

On the AWS Management Console, use the Tag Editor to apply or modify tags for multiple resources at a time. You can also apply and modify tags manually in the console.

Shortly after tagging a resource, an IS-ManagedBy tag will be applied to the resource by Instance Scheduler to indicate that the resource is now being managed by the scheduler. You can look for this tag to confirm that the resource has been correctly registered for scheduling.

Setting the tag value

When you apply a tag to an instance, use the tag key you defined during initial configuration (by default the tag key is Schedule) and set the tag value to the name of the schedule that should apply to the instance. If you would like to change the tag key, you can do so by updating the solution parameters.

> **Note**
>
> For Amazon RDS instances, the tag value can be from 1 to 256 Unicode characters in length and cannot be prefixed with aws:. The string can contain only the set of Unicode letters, digits, white-space, '_', '.', '/', '=', '', '-' (Java regex: "^([\\p{L}\\p{Z}\\p{N}_.:/=\\-]*)$"). For more information, refer to Tagging Amazon RDS resources.

EC2 instances with encrypted EBS volumes

If your EC2 DB instances have EBS volumes encrypted with customer-managed KMS keys, you must give the Instance Scheduler role the KMS:CreateGrant permission to be able to start those instances. For more information, refer to Encrypted EC2 EBS Volumes.

EC2 instances managed in License Manager

If your EC2 instances are managed in AWS License Manager, you must give the Instance Scheduler role the appropriate License Manager permissions to be able to start and stop those instances. For more information, refer to EC2 License Manager.

Schedule reference

Schedules specify when instances tagged with that schedule should run. Each schedule must have a unique name, which is used as the tag *value* that identifies the schedule you want to apply to the tagged resource.

Periods

Each schedule must contain at least one period that defines the time(s) the instance should run. A schedule can contain more than one period. When more than one period is used in a schedule, Instance Scheduler on AWS will apply the appropriate start action when at least one of the periods is true. For more information, refer to Period reference.

Time zone

You can also specify a time zone for the schedule. If you do not specify a time zone, the schedule will use the default time zone you specify when you launch the solution. For a list of acceptable time zone values, refer to the **TZ** column of the List of TZ database time zones.

Stop new instances field

The stop_new_instances field controls whether Instance Scheduler should stop an instance the first time it is tagged for scheduling if it is currently running outside of a running period. By default, this field is set to true.

When set to true, if you tag a running instance that is outside its scheduled running period, Instance Scheduler will immediately stop the instance. When set to false, Instance Scheduler will leave the instance running until the next scheduled stop time.

Hibernate field

The hibernate field allows you to use hibernation for stopped Amazon EC2 instances. If this field is set to true, your EC2 instances must use an Amazon Machine Image (AMI) that supports

hibernation. For more information, refer to Supported Linux AMIs in the *Amazon EC2 User Guide*. Hibernation saves the contents from the instance memory (RAM) to your Amazon Elastic Block Store (Amazon EBS) root volume. If this field is set to true, instances are hibernated instead of stopped when the solution stops them.

If you set the solution to use hibernation, but your instances are not configured for hibernation or they do not meet the hibernation prerequisites, the solution logs a warning and the instances are stopped without hibernation. For more information, refer to Hibernate your On-Demand Instance or Spot Instance in the *Amazon EC2 User Guide*.

Enforced field

Schedules contain an enforced field that allows you to prevent an instance from being manually started outside of a running period, or manually stopped during a running period. If this field is set to true and a user manually starts an instance outside of a running period, the solution will stop the instance. If this field is set to true, it also restarts an instance if it is manually stopped during a running period.

Retain running field

The retain_running field prevents the solution from stopping an instance at the end of a running period if the instance was manually started before the beginning of the period. For example, if an instance with a period that runs from 9 AM to 5 PM is manually started before 9 AM, the solution will not stop the instance at 5 PM.

Systems Manager maintenance window field (only applies to EC2 instances)

The ssm-maintenance-window field allows you to automatically add AWS Systems Manager maintenance windows as a running periods to a schedule. When you specify the name of a maintenance window that exists in the same account and AWS Region as your Amazon EC2 instances, the solution will start the instance at least 10 minutes before the start of the maintenance window and stop the instance at the end of the maintenance window if no other running period specifies that the instance should run.

Once the SSM Maintenance window is created and the schedule is configured with the name of the SSM maintenance window, the changes are picked up at the next scheduled run of the Lambda. For example, if you selected a frequency of 5 minutes for the scheduler Lambda to run, the maintenance window changes will be picked up by the Lambda on the next 5-minute interval.

Instance Scheduler on AWS will ensure that your instances are started at least 10 minutes before the maintenance window begins. Depending on the value you set for the **Scheduling Interval** AWS CloudFormation parameter, this may result in your instance being started 10+interval minutes before the beginning of the maintenance window in order to guarantee that the instance starts at least 10 minutes early. For example, if you set the Scheduling Interval to 30 minutes, the scheduler will start the instance between 10-40 minutes before the beginning of the maintenance window.

> **Note**
>
> In order to use this feature, the Enable EC2 SSM Maintenance Windows CloudFormation parameter in the solution hub stack must be set to `yes`.

For more information, refer to AWS Systems Manager Maintenance Windows in the *AWS Systems Manager user guide*.

Instance type

For Amazon EC2 instances only, a schedule allows you to specify an optional desired instance type for each period in a schedule. When you specify an instance type in the period, the solution will automatically resize EC2 instances to match the requested instance type.

To specify an instance type, use the syntax *<period-name>@<instance-type>*. For example, `weekends@t2.nano`. Note that if you specify an instance type for a period that schedules Amazon EC2 instances and Amazon RDS instances, the instance type will be ignored for Amazon RDS instances.

If the instance type of a running instance is different than the instance type specified for the period, the solution will stop the running instance and restart the instance with the specified instance type. For more information, refer to Change the instance type in the *Amazon EC2 User Guide for Linux Instances*.

Schedule definitions

The Instance Scheduler on AWS configuration table in Amazon DynamoDB contains schedule definitions. A schedule definition can contain the following fields:

Field	Description
`description`	An optional description of the schedule.
`hibernate`	Choose whether to hibernate Amazon EC2 instances running Amazon Linux. When this field is set to true, the scheduler will hibernate instances when it stops them. Note that your instances must turn on hibernation and must meet the hibernation prerequisites.
`enforced`	Choose whether to enforce the schedule. When this field is set to true, the scheduler will stop a running instance if it is manually started outside of the running period or it will start an instance if it is stopped manually during the running period.
`name`	The name used to identify the schedule. This name must be unique and include only alpha-numerics, hyphens (-), and underscores (_).
`periods`	The name of the periods that are used in this schedule. Enter the name(s) exactly as it appears in the period name field. You can also specify an instance type for the period using the syntax *<period-name>@<instance-type>*. For example, `weekdays@t2.large` .
`retain_running`	Choose whether to prevent the solution from stopping an instance at the end of a running period if the instance was manually started before the beginning of the period.
`use_maintenance_window`	Choose whether to include Amazon RDS maintenance window as a running period to

Field	Description
	an Amazon RDS instance schedule, or an AWS Systems Manager maintenance window as a running period to an Amazon EC2 instance schedule. This field is enabled by default and can be disabled by setting its value to "false"
`ssm_maintenance_window`	Choose whether to add AWS Systems Manager maintenance window(s) as additional running period for this schedule. Accepts a StringSet of maintenance window names that will be matched against the names of windows in the same account/region as scheduled EC2 instances. **Note:** This feature only applies to EC2 instances.
`stop_new_instances`	Choose whether to stop an instance the first time it is tagged if it is running outside of the running period. By default, this field is set to true.
`timezone`	The time zone the schedule will use. If no time zone is specified, the default time zone (UTC) is used. For a list of acceptable time zone values, refer to the **TZ** column of the List of tz database time zones.
`use_metrics`	Choose whether to turn on CloudWatch metrics at the schedule level. This field overwrites the CloudWatch metrics setting you specified at deployment. **Note:** Enabling this feature will incur charges of $0.90/month per schedule or scheduled service.

Period reference

Periods contain conditions that allow you to set the specific hours, days, and months an instance will run. A period can contain multiple conditions, but all conditions must be true for the Instance Scheduler on AWS to apply the appropriate start or stop action.

Start and stop times

The `begintime` and `endtime` fields define when the Instance Scheduler on AWS will start and stop instances. If you specify a start time only, the instance must be stopped manually. Note that if you specify a value in the weekdays field, the solution uses that value to determine when to stop the instance. For example, if you specify a `begintime` of 9 AM with no `endtime` and a weekdays value of Monday through Friday, the instance will be stopped at 11:59 PM on Friday unless you have scheduled an adjacent period.

Similarly, if you only specify a stop time, the instance must be started manually. If you don't specify either time, this solution uses the days of the week, days of the month, or months rules to start and stop instances at the beginning/end of each day as appropriate.

The `begintime` and `endtime` values for your period must be in the time zone specified in the schedule. If you do not specify a time zone in the schedule, the solution will use the time zone specified when you launch the solution.

If your schedule contains multiple periods, we recommend that you always specify both a `begintime` and `endtime` in your periods.

If you start an instance before the specified start time, the instance will run until the end of the running period. For example, a user might define a period that starts an instance daily at 9 AM and stops that instance at 5 PM.

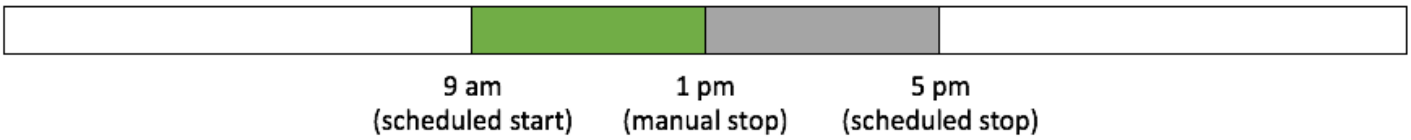
9-5 scheduled start and stop

If you manually start that instance at 5 AM, the solution will stop the instance at 5 PM. If you use the retain running field, the solution will not stop the instance at 5 PM.

5 AM scheduled stop

If you stop an instance before the specified stop time, the instance will not run until the beginning of the next running period. Continuing from the previous example, if the user stops the instance at 1 PM on Wednesday, the solution will not start the instance until 9 AM on Thursday.

Timeline showing scheduled start at 9 am, manual stop at 1 pm, and scheduled stop at 5 pm.



Adjacent periods

The solution will not stop running instances if the schedule contains two adjacent running periods. For example, if you have a schedule with one period with an `endtime` of 11:59 PM and another period with a `begintime` of midnight the following day, the solution will not stop running instances, if there are no `weekdays`, `monthdays`, or `months` rules that stop the instances.

To implement a schedule that runs instances from 9 AM Monday to 5 PM Friday, the solution requires three periods. The first period runs applicable instances from 9 AM to 11:59 PM Monday. The second period runs the instances from midnight Tuesday to 11:59 PM Thursday. The third period runs the instances from midnight Friday to 5 PM Friday. For more information, refer to Sample schedules.

Days of the week

The `weekdays` field defines which days during the week an instance will run. You can specify a list of days, a range of days, the n^th^ occurrence of that day in a month, or the last occurrence of that day in a month. The solution supports abbreviated day names (Mon) and numbers (0).

Days of the month

The `monthdays`, field defines which days during the month an instance will run. You can specify a list of days, a range of days, every n^th^ day of the month, the last day of the month, or the nearest weekday to a specific date.

Months

The `months` field defines which months an instance will run. You can specify a list of months, a range of months, or every n^th^ month. The solution supports abbreviated month names (Jan) and numbers (1).

Period definitions

The Instance Scheduler on AWS configuration table in Amazon DynamoDB contains period definitions. A period definition can contain the following fields. Note that some fields support Cron non-standard characters.

> **Important**
>
> You must specify at least one of the following items: begintime, endtime, weekdays, months, or monthdays.

Field	Description
`begintime`	The time, in **HH:MM** format, that the instance will start.
`description`	An optional description of the period.
`endtime`	The time, in **HH:MM** format, that the instance will stop.
`months`	Enter a comma-delimited list of months, or a hyphenated range of months, during which the instance will run. For example, enter `jan, feb, mar` or `1, 2, 3` to run an instance during those months. Or, you can enter `jan-mar` or `1-3`. You can also schedule an instance to run every n^th^ month or every n^th^ month in a range. For example, enter `Jan/3` or `1/3` to run an

Field	Description
	instance every third month starting in January. Enter `Jan-Jul/2` to run every other month from January to July.
`monthdays`	Enter a comma-delimited list of days of the month, or a hyphenated range of days, during which the instance will run. For example, enter `1, 2, 3` or `1-3` to run an instance during the first three days of the month. You can also enter multiple ranges. For example, enter `1-3, 7-9` to run an instance from the 1^st^ to the 3^rd^ and the 7^th^ through the 9^th^. You can also schedule an instance to run every n^th^ day of the month or every n^th^ day of the month in a range. For example, enter `1/7` to run an instance every seventh day starting on the 1^st^. Enter `1-15/2` to run an instance every other day from the 1^st^ to the 15^th^. Enter `L` to run an instance on the last day of the month. Enter a date and `W` to run an instance on the nearest weekday to the specified date. For example, enter `15W` to run an instance on the nearest weekday to the 15^th^.
`name`	The name used to identify the period. This name must be unique and include only alpha-numerics, hyphens (-), and underscores (_).

Field	Description
`weekdays`	Enter a comma-delimited list of days of the week, or a range of days of the week, during which the instance will run. For example, enter `0, 1, 2` or `0-2` to run an instance Monday through Wednesday. You can also enter multiple ranges. For example, enter `0-2, 4-6` to run an instance every day except Thursday. You can also schedule an instance to run every n^th^ occurrence of a weekday in the month. For example, enter `Mon#1` or `0#1` to run an instance the first Monday of the month. Enter a day and L to run an instance on the last occurrence of that weekday in the month. For example, enter `friL` or `4L` to run an instance on the last Friday of the month.

When a period contains multiple conditions, note that all conditions must be true for Instance Scheduler on AWS to apply the appropriate action. For example, a period that contains a `weekdays` field with a value of `Mon#1` and a months field with a value of `Jan/3` will apply the action on the first Monday of the quarter.

Sample schedules

Instance Scheduler on AWS allows you to automatically start and stop Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Relational Database Service (Amazon RDS) instances. The following section provides some example schedules that can be adapted to many common use cases.

Standard 9-5 working hours

This schedule shows how to run instances on weekdays from 9 AM to 5 PM in London.

Periods

This period will start instances at 9 AM and stop instances at 5 PM on weekdays (Mon-Fri).

Field	Type	Value
`begintime`	`String`	`09:00`
`endtime`	`String`	`16:59`
`name`	`String`	`weekdays-9-5`
`weekdays`	`StringSet`	`mon-fri`

Schedule

The schedule name provides the tag value that must be applied to instances and the timezone that will be used.

Field	Type	Value
`name`	`String`	`london-working-hours`
`periods`	`StringSet`	`weekdays-9-5`
`timezone`	`String`	`Europe/London`

Instance tag

To apply this schedule to instances, you must add the `Schedule=london-working-hours` tag to the instances. If you change the default tag name in the AWS CloudFormation **Instance Scheduler tag name** parameter, your tag will be different. For example, if you entered `Sked` as your tag name, your tag will be `Sked=london-working-hours`. For more information, refer to Tag your resources in the *Amazon Elastic Compute Cloud User Guide*.

Scheduler CLI

To configure the above schedule using the Instance Scheduler CLI use the following commands:

```
scheduler-cli create-period --stack <stackname> --name weekdays-9-5 --weekdays mon-fri
 --begintime 9:00 --endtime 16:59

scheduler-cli create-schedule --stack <stackname> --name london-working-hours --periods
 weekdays-9-5 --timezone Europe/London

Europe/London
```

Custom resource

The following CloudFormation template will create the above schedule using the schedule custom resource.

To deploy this template, you will need to provide the **ServiceInstanceScheduleServiceToken** ARN that can be found in the AWS CloudFormation console by selecting the previously deployed Instance Scheduler Hub Stack and then select **Outputs**.

```
AWSTemplateFormatVersion: 2010-09-09
Parameters:
  ServiceInstanceScheduleServiceTokenARN:
    Type: String
    Description: (Required) service token arn taken from InstanceScheduler outputs
Metadata:
  'AWS::CloudFormation::Designer': {}
Resources:
  LondonWorkingWeek:
    Type: 'Custom::ServiceInstanceSchedule'
    Properties:
      NoStackPrefix: 'True'
      Name: london-working-hours
      Description: run instances from 9am to 5pm in London on weekdays
      ServiceToken: !Ref ServiceInstanceScheduleServiceTokenARN
      Timezone: Europe/London
      Periods:
     - Description: 9am to 5pm on weekdays
        BeginTime: '09:00'
        EndTime: '16:59'
        WeekDays: mon-fri
```

Stop instances after 5 PM

Instances can be started freely at any time during the day and this schedule will ensure that a stop command is automatically sent to them at 5 PM ET every day.

Periods

This period will stop instances at 5 PM every day.

Field	Type	Value
`endtime`	`String`	`16:59`
`name`	`String`	`stop-at-5`

Schedule

The schedule name provides the tag value that must be applied to instances and the timezone that will be used.

Field		Value
`name`	`String`	`stop-at-5-new-york`
`periods`	`StringSet`	`stop-at-5`
`timezone`	`String`	`America/New York`

Instance tag

To apply this schedule to instances, you must add the `Schedule=stop-at-5-new-york` tag to the instances. If you changed the default tag name in the AWS CloudFormation **Instance Scheduler tag name** parameter, your tag will be different. For example, if you entered `Sked` as your tag name, your tag will be `Sked=stop-at-5-new-york` . For more information, refer to Tag your resources in the *Amazon Elastic Compute Cloud User Guide*.

Scheduler CLI

To configure the above schedule using the Instance Scheduler CLI, use the following commands:

```
scheduler-cli create-period --stack <stackname> --name stop-at-5 --endtime 16:59

scheduler-cli create-schedule --stack <stackname> --name stop-at-5-new-york --periods
 stop-at-5 --timezone America/New_York
```

Custom resource

The following CloudFormation template will create the above schedule using the schedule custom resource.

To deploy this template, you will need to provide the **ServiceInstanceScheduleServiceToken** ARN that can be found in the AWS CloudFormation console by clicking on the previously deployed Instance Scheduler Hub Stack and selecting **Outputs**.

```
AWSTemplateFormatVersion: 2010-09-09
Parameters:
  ServiceInstanceScheduleServiceTokenARN:
    Type: String
    Description: (Required) service token arn taken from InstanceScheduler outputs
Metadata:
  'AWS::CloudFormation::Designer': {}
Resources:
  StopAfter5:
    Type: 'Custom::ServiceInstanceSchedule'
    Properties:
      NoStackPrefix: 'True'
      Name: stop-at-5-new-york
      Description: stop instances at 5pm ET every day
      ServiceToken: !Ref ServiceInstanceScheduleServiceTokenARN
      Timezone: America/New_York
      Periods:
      - Description: stop at 5pm
        EndTime: '16:59'
```

Stop instances over the weekend

This schedule shows how to run instances from Monday 9 AM ET to Friday 5 PM ET. Since Monday and Friday are not full days, this schedule includes three periods to accommodate: Monday, Tuesday-Thursday, and Friday.

Periods

The first period starts tagged instances at 9 AM Monday and stops at midnight. This period includes the following fields and values.

Field	Type	Value
begintime	String	09:00
endtime	String	23:59
name	String	mon-start-9am
weekdays	StringSet	mon

The second period runs tagged instances all day Tuesday through Thursday. This period includes the following fields and values.

Field		Value
name	String	tue-thu-full-day
weekdays	StringSet	tue-thu

The third period stops tagged instances at 5 PM on Friday. This period includes the following fields and values.

Field		Value
begintime	String	00:00
endtime	String	16:59
name	String	fri-stop-5pm
weekdays	StringSet	fri

Schedule

The schedule combines the three periods into the schedule for tagged instances. The schedule includes the following fields and values.

Field		Value
`name`	`String`	mon-9am-fri-5pm
`periods`	`StringSet`	mon-start-9am,tue-thu-full-day,fri-stop-5pm
`timezone`	`String`	America/New_York

Instance tag

To apply this schedule to instances, you must add the `Schedule=mon-9am-fri-5pm` tag to the instances. Note that if you changed the default tag name in the AWS CloudFormation **Instance Scheduler tag name** parameter, your tag will be different. For example, if you entered Sked as your tag name, your tag will be `Sked=mon-9am-fri-5pm`. For more information, refer to Tag your resources in the *Amazon Elastic Compute Cloud User Guide*.

Scheduler CLI

To configure the above schedule using the Instance Scheduler CLI, use the following commands:

```
scheduler-cli create-period --stack <stackname> --name
mon-start-9am --weekdays mon --begintime 9:00 --endtime 23:59
scheduler-cli create-period --stack <stackname> --name
tue-thu-full-day --weekdays tue-thu
scheduler-cli create-period --stack <stackname> --namefri-stop-5pm --weekdays fri --
begintime 0:00 --endtime 17:00

scheduler-cli create-schedule --stack <stackname> --name
mon-9am-fri-5pm --periods
mon-start-9am,tue-thu-full-day,fri-stop-5pm -timezone
America/New_York
```

Custom resource

The following CloudFormation template will create the above schedule using the schedule custom resource.

To deploy this template, you will need to provide the **ServiceInstanceScheduleServiceToken** ARN that can be found in the AWS CloudFormation console by selecting the previously deployed Instance Scheduler Hub Stack and then select **Outputs**.

```
AWSTemplateFormatVersion: 2010-09-09
Parameters:
  ServiceInstanceScheduleServiceTokenARN:
    Type: String
    Description: (Required) service token arn taken from InstanceScheduler outputs
Metadata:
  'AWS::CloudFormation::Designer': {}
Resources:
  StopOnWeekends:
    Type: 'Custom::ServiceInstanceSchedule'
    Properties:
      NoStackPrefix: 'True'
      Name: mon-9am-fri-5pm
      Description: start instances at 9am on monday and stop them at 5pm on friday
      ServiceToken: !Ref ServiceInstanceScheduleServiceTokenARN
      Timezone: America/New_York
      Periods:
      - Description: 9am monday start
        BeginTime: '09:00'
        EndTime: '23:59'
        WeekDays: mon
      - Description: all day tuesday-thursday
        WeekDays: tue-thu
      - Description: 5pm friday stop
        BeginTime: '00:00'
        EndTime: '16:59'
        WeekDays: fri
```

Solution resources

The following resources are created as part of the Instance Scheduler on AWS stack.

Resource name	Type	Description
Main	`AWS::Lambda::Function`	Instance Scheduler on AWS Lambda function.
Scheduler Config Helper	`Custom::ServiceSetup`	Stores global configuration settings in Amazon DynamoDB.
Scheduler Invoke Permission	`AWS::Lambda::Permission`	Allows the Amazon CloudWatch event to invoke the Instance Scheduler's AWS Lambda function.
Scheduler Logs	`AWS::Logs::LogGroup`	CloudWatch Log Group for Instance Scheduler.
Scheduler Policy	`AWS::IAM::Policy`	Policy that allows scheduler to perform start and stop actions, change Amazon EC2 instance attributes, set tags, and access scheduler resources.
Scheduler Rule	`AWS::Events::Rule`	Amazon EventBridge event rule that invokes the scheduler's Lambda function.
Configuration Metrics Event Rule	`AWS::Events::Rule`	Amazon EventBridge event rule that periodically invokes the configuration description anonymized metrics function. Disabled when anonymized metrics are disabled.
State Table	`AWS::DynamamoDB::Table`	DynamoDB table that stores last desired state of instances.

Resource name	Type	Description
Config Table	`AWS::DynamamoDB::Table`	DynamoDB table that stores global configuration, schedule, and period data.
Instance Scheduler SNS Topic	`AWS::SNS::Topic`	Sends warning and error messages to subscribed email addresses.

Scheduler CLI

The Instance Scheduler on AWS command line interface (CLI) allows you to configure schedules and periods, and estimate cost savings for a given schedule.

Prerequisites

The CLI in this solution requires Python 3.8+ and the latest version of boto3.

Credentials

To use the scheduler CLI, you must have credentials for the AWS CLI. For more information, refer to Configuration and credential file settings in the *AWS CLI User Guide*.

Your credentials must have the following permissions:

- `lambda:InvokeFunction` - To invoke the InstanceSchedulerMain function in the scheduler stack, and to update the schedule and period information in the scheduler configuration database from the command line
- `cloudformation:DescribeStackResource` - To retrieve the physical resource ID of the AWS Lambda function from the stack to handle the CLI request

Requests made by the scheduler CLI and responses are logged in the `AdminCliRequestHandler-yyyymmdd` log stream.

> **Note**
>
> If you specify a profile using the profile-name argument, the profile you specify must have these permissions. For more information about the profile-name argument, refer to Common Arguments.

Install the Scheduler CLI

1. Download the scheduler CLI package ***(instance_scheduler_cli.zip)*** and place it in a directory on your computer.

   > **Important**
   >
   > The installation will fail if you don't place the files into their own directory, and then install them from that directory.

2. Unzip the zip archive into its own directory (instance_scheduler_cli).
3. From the same directory in which you placed the unzipped CLI package, install the scheduler-cli to your environment:

   > **Note**
   >
   > Scheduler-CLI requires Python 3.8 or above and the latest versions of pip and boto3. If you do not have all of these installed on your local machine, please refer to pip's official documentation for installation instructions before attempting to install the Scheduler-CLI.

   ```
   pip install --no-index --find-links=instance_scheduler_cli instance_scheduler_cli
   ```

4. Verify the installation succeeded with:

   ```
   scheduler-cli --help
   ```

Note

If preferred, an sdist of the CLI and can be installed using the same process as above.

Command structure

The scheduler CLI uses a multipart structure on the command line. The next part specifies the scheduler CLI python script. The scheduler CLI has commands that specify the operations to perform on periods and schedules. The specific arguments for an operation can be specified on the command line in any order.

```
scheduler-cli <command> <arguments>
```

Common arguments

The scheduler CLI supports the following arguments that all commands can use:

Argument	Description
`--stack [replaceable]<stackname>`	The name of the scheduler stack. **Important:** This argument is required for all commands.
`--region [replaceable]<regionname>`	The name of the region where the scheduler stack is deployed. **Note:** You must use this argument when the default configuration and credential files are not installed in the same region as the solution stack.
`--profile-name [replaceable] <profilename>`	The name of the profile to use to run commands. If no profile name is specified, the default profile is used.
`--query`	A JMESPath expression that controls the command output. For more information

Argument	Description
	on controlling output, refer to Controlling Command Output from the AWS Command Line Interface in the *AWS CLI User Guide*.
`--help`	Shows valid commands and arguments for the scheduler CLI. When used with a specific command, it shows valid subcommands and arguments for that command.
`--version`	Shows the version number of the scheduler CLI.

Available commands

- create-period
- create-schedule
- delete-period
- delete-schedule
- describe-periods
- describe-schedules
- describe-schedule-usage
- update-period
- update-schedule
- help

create-period

Description

Creates a period. A period must contain at least one of the following items: `begintime`, `endtime`, `weekdays`, `months`, or `monthdays`.

Arguments

`--name`

- The name of the period

  Type: String

  Required: Yes

`--description`

- A description of the period

  Type: String

  Required: No

`--begintime`

- The time when the running period starts. If `begintime` and `endtime` are not specified, the running period is 00:00 - 23:59.

  Type: String

  Constraints: `H:MM` or `HH:MM` format

  Required: No

`--endtime`

- The time when the running period stops. If `begintime` and `endtime` are not specified, the running period is 00:00 - 23:59.

  Type: String

  Constraints: `H:MM` or `HH:MM` format

  Required: No

`--weekdays`

- The days of the week for the period

  Type: String

  Constraints: Comma-delimited list of abbreviated day names (mon) or numbers (0). Use - to specify a range. Use / to specify every n^th^ day of the week.

Required: No

`--months`

- The months of the period

  Type: String

  Constraints: Comma-delimited list of abbreviated months names (jan) or numbers (1). Use - to specify a range. Use / to specify every n^th^ month.

  Required: No

`--monthdays`

- The days of the month for the period

  Type: String

  Constraints: Comma-delimited list of abbreviated months names (jan) or numbers (1). Use - to specify a range. Use / to specify every n^th^ day of the month.

  Required: No

Example

```
$ scheduler-cli create-period --name "weekdays" --begintime 09:00 --endtime 18:00 --
weekdays mon-fri --stack Scheduler
{
   "Period": {
      "Name": "weekdays",
      "Endtime": "18:00",
      "Type": "period",
      "Begintime": "09:00",
      "Weekdays": [
         "mon-fri"
      ]
   }
    }
```

create-schedule

Description

Creates a schedule.

Arguments

`--name`

- The name of the schedule

  Type: String

  Required: Yes

`--description`

- A description of the schedule

  Type: String

  Required: No

`--enforced`

- Enforces the scheduled state for the instance

  Required: No

`--use-metrics`

- Collect Amazon CloudWatch metrics

  Required: No

`--periods`

- A list of running periods for the schedule. If multiple periods are specified, the solution will start an instance if one of the periods evaluates to `true`.

  Type: String

  Constraints: Comma-delimited list of periods. Use `<period-name>@[replaceable]<instance type>` to specify an instance type for a period. For example, `weekdays@t2.large`.

  Required: Yes

`--retain-running`

- Prevents an instance from being stopped by the solution at the end of a running period, if the instance was manually started before the beginning of the period.

  Required: No

`--ssm-maintenance-window`

- Adds an AWS Systems Manager maintenance window as a running period to an Amazon EC2 instance schedule.

  Type: String

  Required: No

`--do-not-stop-new-instances`

- Do not stop an instance the first time it is tagged if it is running outside of a running period

  Required: No

`--timezone`

- The time zone the schedule will use

  Type: Array of strings

  Required: No (If this argument is not used, the default time zone from main solution stack is used.)

`--use-maintenance-window`

- Adds an Amazon RDS maintenance window as a running period to an Amazon RDS instance schedule, or an AWS Systems Manager maintenance window as a running period to an Amazon EC2 instance schedule

  Type: true/false

  Required: No (default true)

Example

```
$ scheduler-cli create-schedule --name LondonOfficeHours --periods weekdays,weekends --
timezone Europe/London --stack Scheduler
{
```

```
   "Schedule": {
      "Enforced": false,
      "Name": "LondonOfficeHours",
      "StopNewInstances": true,
      "Periods": [
         "weekends",
         "weekdays"
      ],
      "Timezone": "Europe/London",
      "Type": "schedule"
   }
}
```

delete-period

`--name`

- The name of the applicable period

  Type: String

  Required: Yes

> **Important**
>
> If the period is used in existing schedules, you must remove it from those schedules *before* you delete it.

Example

```
$ scheduler-cli delete-period --name weekdays --stack Scheduler
{
   "Period": "weekdays"
}
```

delete-schedule

Description

Deletes an existing schedule

Arguments

`--name`

- The name of the applicable schedule

  Type: String

  Required: Yes

Example

```
$ scheduler-cli delete-schedule --name LondonOfficeHours --stack Scheduler
{
   "Schedule": "LondonOfficeHours"
}
```

describe-periods

Description

Lists the configured periods for the Instance Scheduler stack

Arguments

`--name`

- The name of a specific period you want described

  Type: String

  Required: No

Example

```
$ scheduler-cli describe-periods --stack Scheduler
{
   "Periods": [
      {
         "Name": "first-monday-in-quarter",
         "Months": [
            "jan/3"
```

```
         ],
         "Type": "period",
         "Weekdays": [
            "mon#1"
         ],
         "Description": "Every first Monday of each quarter"
      },
      {
         "Description": "Office hours",
         "Weekdays": [
            "mon-fri"
         ],
         "Begintime": "09:00",
         "Endtime": "17:00",
         "Type": "period",
         "Name": "office-hours"
      },

      {
         "Name": "weekdays",
         "Endtime": "18:00",
         "Type": "period",
         "Weekdays": [
            "mon-fri"
         ],
         "Begintime": "09:00"
      },
      {
         "Name": "weekends",
         "Type": "period",
         "Weekdays": [
            "sat-sun"
         ],
         "Description": "Days in weekend"
      }
   ]
}
```

describe-schedules

Description

Lists the configured schedules for the Instance Scheduler stack.

Arguments

`--name`

- The name of a specific schedule you want described

  Type: String

  Required: No

Example

```
$ scheduler-cli describe-schedules --stack Scheduler

{
   "Schedules": [
      {
         "OverrideStatus": "running",
         "Type": "schedule",
         "Name": "Running",
         "UseMetrics": false
      },
      {
         "Timezone": "UTC",
         "Type": "schedule",
         "Periods": [
            "working-days@t2.micro",
            "weekends@t2.nano"
         ],
         "Name": "scale-up-down"
      },
      {
         "Timezone": "US/Pacific",
         "Type": "schedule",
         "Periods": [
            "office-hours"
         ],
         "Name": "seattle-office-hours"
      },
      {
         "OverrideStatus": "stopped",
         "Type": "schedule",
         "Name": "stopped",
```

```
        "UseMetrics": true
      }
   ]
}
```

describe-schedule-usage

Description

Lists all the periods running within a schedule and calculates the billing hours for instances. Use this command to simulate a schedule to calculate potential savings, and running periods after creating or updating a schedule.

Arguments

`--name`

- The name of the applicable schedule

  Type: String

  Required: Yes

`--startdate`

- The start date of the period used for calculation. The default date is the current date.

  Type: String

  Required: No

`--enddate`

- The end date of the period used for calculation. The default date is the current date.

  Type: String

  Required: No

Example

```
$ scheduler-cli describe-schedule-usage --stack InstanceScheduler --name seattle-
office-hours
{
```

```
   "Usage": {
      "2017-12-04": {
         "BillingHours": 8,
         "RunningPeriods": {
            "Office-hours": {
               "Begin": "12/04/17 09:00:00",
               "End": "12/04/17 17:00:00",
               "BillingHours": 8,
               "BillingSeconds": 28800
            }
         },
         "BillingSeconds": 28800
      }
   },
   "Schedule": "seattle-office-hours"
```

update-period

Description

Updates an existing period

Arguments

The `update-period` command supports the same arguments as the `create-period` command. For more information on the arguments, refer to the create period command.

> **Important**
>
> If you do not specify an argument, that argument will be removed from the period.

update-schedule

Description

Updates an existing schedule

Arguments

The `update-schedule` command supports the same arguments as the `create-schedule` command. For more information on the arguments, refer to the create schedule command.

Important

If you do not specify an argument, that argument will be removed from the schedule.

help

Description

Displays a list of valid commands and arguments for the scheduler CLI.

Example

```
$ scheduler-cli --help
usage: scheduler-cli [-h] [--version]
                     {create-period,create-schedule,delete-period,delete-
schedule,describe-periods,describe-schedule-usage,describe-schedules,update-
period,update-schedule}
                     ...

optional arguments:
  -h, --help            show this help message and exit
  --version             show program's version number and exit

subcommands:
  Valid subcommands

  {create-period,create-schedule,delete-period,delete-schedule,describe-
periods,describe-schedule-usage,describe-schedules,update-period,update-schedule}
                        Commands help
    create-period       Creates a period
    create-schedule     Creates a schedule
    delete-period       Deletes a period
    delete-schedule     Deletes a schedule
    describe-periods    Describes configured periods
    describe-schedule-usage
                        Calculates periods and billing hours in which
                        instances are running
    describe-schedules  Described configured schedules
    update-period       Updates a period
    update-schedule     Updates a schedule
```

When used with a specific command, the `--help` argument shows valid subcommands and arguments for that command.

Specific command example

```
$ scheduler-cli describe-schedules --help
usage: scheduler-cli describe-schedules [-h] [--name NAME] [--query QUERY]
                                        [--region REGION] --stack STACK

optional arguments:
  -h, --help         show this help message and exit
  --name NAME        Name of the schedule
  --query QUERY      JMESPath query to transform or filter the result
  --region REGION    Region in which the Instance Scheduler stack is
                        deployed
  --stack STACK, -s STACK
                     Name of the Instance Scheduler stack
```

Update global configuration settings

When you first deployed Instance Scheduler's Hub template in AWS CloudFormation, a number of global configuration settings were selected as parameter inputs. These global configuration parameters can be updated at any time within the CloudFormation console.

To update the global configuration of Instance Scheduler, log into the account/region containing your hub deployment and go to the AWS CloudFormation console. Find the Instance Scheduler Hub Stack and select ***Update # Use Existing Template*** . Update any global configuration parameters you would like to change, and then select ***next # next # submit*** to perform a CloudFormation update of the relevant solution resources.

Manage schedules using Infrastructure as Code (IaC)

> **Important**
>
> Deploy schedules using a separate template after the hub stack deployment is complete.

Instance Scheduler on AWS provides a custom resource (`ServiceInstanceSchedule`) that you can use to configure and manage schedules through AWS CloudFormation. The custom

resource uses PascalCase keys for the same data as the Instance Scheduler config table in Amazon DynamoDB (see template below for examples). For more information on the fields for schedules, refer to Schedule Definitions. For more information on the fields for periods, refer to Period Definitions.

When you use the custom resource to create a schedule, the name of that schedule is the logical resource name of the custom resource by default. To specify a different name, use the Name property of the custom resource. The solution also adds the stack name to the schedule name as a prefix by default. If you do not want to add the stack name as a prefix, use the `NoStackPrefix` property.

When you use the Name and `NoStackPrefix` properties, make sure you choose unique schedule names. If a schedule with the same name already exists, the resource will not be created or updated.

To get started managing schedules using IaC, copy and paste the following sample template and customize as many or as few schedules as you like. Save the file as a .template file (for example: `my-schedules.template`), and then deploy your new template using AWS CloudFormation. For examples of completed schedule templates, refer to Sample Schedules.

```
AWSTemplateFormatVersion: 2010-09-09
Parameters:
  ServiceInstanceScheduleServiceTokenARN:
    Type: String
    Description: (Required) service token arn taken from InstanceScheduler outputs
Metadata:
  'AWS::CloudFormation::Designer': {}
Resources:
  SampleSchedule1:
    Type: 'Custom::ServiceInstanceSchedule'
    Properties:
      ServiceToken: !Ref ServiceInstanceScheduleServiceTokenARN #do not edit this line
      NoStackPrefix: 'False'
      Name: my-renamed-sample-schedule
      Description: a full sample template for creating cfn schedules showing all
 possible values
      Timezone: America/New_York
      Enforced: 'True'
      Hibernate: 'True'
      RetainRunning: 'True'
      StopNewInstances: 'True'
```

```
      UseMaintenanceWindow: 'True'
      SsmMaintenanceWindow: 'my_window_name'
      Periods:
      - Description: run from 9-5 on the first 3 days of March
        BeginTime: '9:00'
        EndTime: '17:00'
        InstanceType: 't2.micro'
        MonthDays: '1-3'
        Months: '3'
      - Description: run from 2pm-5pm on the weekends
        BeginTime: '14:00'
        EndTime: '17:00'
        InstanceType: 't2.micro'
        WeekDays: 'Sat-Sun'

  SampleSchedule2:
    Type: 'Custom::ServiceInstanceSchedule'
    Properties:
      ServiceToken: !Ref ServiceInstanceScheduleServiceTokenARN #do not edit this line
      NoStackPrefix: 'True'
      Description: a sample template for creating simple cfn schedules
      Timezone: Europe/Amsterdam
      Periods:
      - Description: stop at 5pm every day
        EndTime: '17:00'
```

When deploying the template, you must provide ServiceTokenARN for your deployment of Instance Scheduler on AWS. This ARN can be found within CloudFormation by navigating to your deployed Instance Scheduler stack, selecting **Outputs**, and looking for `ServiceInstanceScheduleServiceToken`.

Important

Do not use the DynamoDB console or scheduler CLI to delete or modify schedules and periods that were configured using the custom resource. If you do, you will create a conflict between the stored parameters in the stack and the values in the table. Also, do not use periods configured using the custom resource in schedules created using the DynamoDB console or the scheduler CLI.

Before you delete the main Instance Scheduler stack, you must delete all additional stacks that contain schedules and periods created using the custom resource because the custom resource stacks contain dependencies on the main stack's DynamoDB table.

In the configuration DynamoDB table, schedules and periods that were configured with the custom resource can be identified by the **configured_in_stack** attribute. The attribute contains the Amazon Resource Name of the stack that was used to create the item.

Handling EC2 Insufficient Capacity Errors

When Instance Scheduler fails to start an instance due to insufficient capacity, its default behavior is to issue a start-failed event (see EventBridge Events) and try again on the next scheduling interval. Alternatively, Instance Scheduler can be configured to resize your instance to alternative instance types before retrying the start operation. This feature helps improve instance availability in capacity constrained environments.

Configuration

To enable alternate instance types for an EC2 instance, add the `IS-PreferredInstanceTypes` tag to the instance with a comma-separated list of instance types in order of preference (most preferred first):

```
IS-PreferredInstanceTypes: t3.medium,t3.large,m5.large
```

How it works

The alternate instance types list is provided in order of preference, with the first type being the most preferred. When Instance Scheduler attempts to start an EC2 instance:

1. If the instance is not currently the most preferred size, attempts to resize it to the most preferred size before starting
2. If the start operation succeeds, no further alternates are attempted
3. If the start operation fails due to insufficient capacity:
   a. Attempts to resize to the next alternate instance type in the list
   b. Retries the start operation
   c. If still unsuccessful, tries the next alternate type
   d. Continues until successful or all alternates are exhausted

Requirements and limitations

Instance compatibility: Alternate instance types must be compatible with the instance's current configuration (AMI, subnet, security groups, etc.). For more information, refer to Change the instance type in the *Amazon EC2 User Guide*.

Tag format: The `IS-PreferredInstanceTypes` tag value must be a comma-separated list of valid EC2 instance types.

Example

For an instance originally configured as `t3.small`, you might configure:

```
Schedule: office-hours
IS-PreferredInstanceTypes: t3.small,t3.medium,t3.large,m5.large
```

If the `t3.small` instance fails to start due to capacity issues, Instance Scheduler will attempt to resize and start the instance as `t3.medium`, then `t3.large`, then `m5.large` until successful or all options are exhausted.

EC2 Auto Scaling Group Scheduling

Instance Scheduler on AWS supports scheduling of EC2 Auto Scaling groups (ASGs) using Scheduled Scaling Actions. This differs from the implementation of EC2/RDS scheduling and will be further explained in this section

Refer to Scheduled scaling for Amazon EC2 Auto Scaling for more information on Scheduled Scaling Actions.

ASG scheduling overview

ASGs can be scheduled by applying a schedule tag as described in Tagging instances for scheduling

Definition of Running/Stopped for ASGs

When an Auto Scaling Group is configured, a user specifies a minimum, desired, and maximum capacity for that ASG. Instance Scheduler refers to these values as the min-desired-max or MDM of an ASG.

The ***running state*** of an ASG is defined using the `IS-MinDesiredMax` control tag. This tag should contain the desired MDM values in the format `min,desired,max` (for example: `1,3,5`).

If the `IS-MinDesiredMax` tag is not provided when the ASG is first tagged for scheduling, it will be automatically generated from the current size of the ASG at the time of tagging.

For all ASGs the ***stopped state*** is defined as an MDM of 0-0-0.

ASG Start/Stop Behavior

When Instance Scheduler starts or stops an ASG, it modifies the ASG's capacity settings:

Starting an ASG: Sets the minimum, desired, and maximum capacity to the values defined in the `IS-MinDesiredMax` tag (or the automatically generated values from when the ASG was first tagged).

Stopping an ASG: Sets the minimum, desired, and maximum capacity to 0-0-0, which causes all instances in the ASG to be terminated.

Limitations

ASG scheduling is performed by converting Instance Scheduler on AWS schedules into scheduled scaling rules compatible with the ASG service. This translation works best for simple single-period schedules that do not use complex cron expressions.

The following schedule features are not supported for ASG scheduling:

- Advanced schedule flags such as *enforced* and *retain running.*
- N-th weekday, nearest weekday, and last weekday expressions in periods.
- Multi-period schedules with immediately adjacent or overlapping periods.
  - When configuring scheduled scaling actions for multi-period schedules, Instance Scheduler on AWS directly translate the beginning/end of periods to start/stop actions for the ASG even when another overlapping or adjacent period would normally cause that action to be skipped.

Monitor the solution

Logging and notifications

Instance Scheduler uses structured logging optimized for CloudWatch Logs Insights queries. This solution logs processing information for each tagged instance, the results of the period evaluation

for the instance, the desired state of the instance during that period, the applied action, and debugging messages.

Logs are written to Amazon CloudWatch Logs in two log groups:

`{stackName}-{namespace}-administrative-logs`

Logs for resource registration and deregistration, custom resource operations, CLI requests, and other administrative activities.

`{stackName}-{namespace}-scheduling-logs`

Logs for scheduling operations including orchestration and request handler execution.

Warning and error logs are also forwarded to a solution-created Amazon SNS topic, which can be configured to send messages to a subscribed email address. You can find the name of the Amazon SNS topic in the **Outputs** tab of the solution stack.

Informational tags

When informational tagging is enabled (the default), Instance Scheduler writes tags directly to managed resources to provide at-a-glance visibility into the solution's scheduling activity. These tags are applied using the AWS Resource Groups Tagging API and are updated each time the scheduler processes a resource.

You can enable or disable this feature using the **Enable informational tagging** parameter on the hub stack. For more information, refer to Update global configuration settings.

Informational tag keys

The following tags are written to managed resources:

Tag key	Description
`IS-ManagedBy`	The ARN of the Instance Scheduler hub stack managing this resource. Applied when a resource is first registered for scheduling and on each subsequent scheduling action.
`IS-LastAction`	The last scheduling action taken on the resource, along with a UTC timestamp. For example: `Started 2025-06-15 09:00:00 UTC` or `Stopped 2025-06-15 17:00:00 UTC .`

Tag key	Description
	This tag is only updated when the scheduler actively starts or stops a resource (not when it evaluates a resource and determines no action is needed).
`IS-Error`	If the scheduler encounters an error while processing a resource, this tag contains the error code and a UTC timestamp . For example: `StartFailed 2025-06-15 09:00:05` UTC. This tag is automatically cleared on the next successful scheduling action.
`IS-ErrorMessage`	A human-readable description of the error. This tag is only present when `IS-Error` is also present and is cleared alongside it.

Error codes

The following error codes may appear in the `IS-Error` tag:

Error code	Description
`UnknownSchedule`	The schedule name specified in the resource's schedule tag does not match any schedule defined in the configuration table.
`UnsupportedResource`	The resource type is not supported for scheduling (for example, a read replica of another RDS instance).
`IncompatibleSchedule`	The schedule assigned to the resource is not compatible with the resource type (for example, an ASG schedule that uses unsupported cron expressions).
`StartFailed`	The scheduler attempted to start the resource but the operation failed.
`StopFailed`	The scheduler attempted to stop the resource but the operation failed.

Error code	Description
`ConfigurationFailed`	The scheduler attempted to configure scheduled scaling rules on an Auto Scaling group but the operation failed.
`UnknownError`	An unexpected error occurred while processing the resource.

Tag behavior

- When a resource is first registered for scheduling, the `IS-ManagedBy` tag is applied immediately.
- When a resource is deregistered (the schedule tag is removed), all informational tags (`IS-ManagedBy`, `IS-LastAction`, `IS-Error`, `IS-ErrorMessage`) are removed from the resource.
- Error tags are not re-written on each scheduling interval if the same error persists and the existing tag is still present on the resource. They are only updated when the error code changes.
- All tag values are truncated to 256 characters to comply with AWS tagging limits.

Tag governance considerations

Important

Instance Scheduler creates and updates the tags listed above on managed resources as part of normal operation. If your organization enforces tag governance through AWS Config rules, tag policies, service control policies, or automated remediation, ensure that your change management controls are configured to allow the following tag keys:

- `IS-ManagedBy`
- `IS-LastAction`
- `IS-Error`
- `IS-ErrorMessage`
- `IS-PreferredInstanceTypes` (if using alternate instance types)
- `IS-MinDesiredMax` (if scheduling Auto Scaling groups)

If you cannot accommodate these tags in your governance policies, disable informational tagging by setting the **Enable informational tagging** parameter to `No` on the hub stack.

Note that this will also disable the `IS-ManagedBy` tag that is used to confirm resource registration.

Control tags

In addition to informational tags, Instance Scheduler uses the following control tags for specific features:

Tag key	Description
`IS-PreferredInstanceTypes`	A comma-separated list of alternate EC2 instance types to try when starting an instance fails due to insufficient capacity. For more information, refer to Handling EC2 Insufficient Capacity Errors.
`IS-MinDesiredMax`	The minimum, desired, and maximum capacity values for an Auto Scaling group in the format `min,desired,max` . For more information, refer to EC2 Auto Scaling Group Scheduling.

Tag capacity

Important

AWS resources typically have a limit of 50 tags per resource. Instance Scheduler may use up to 6 tags on a resource (4 informational tags plus up to 2 control tags). Ensure your resources have sufficient tag capacity to accommodate Instance Scheduler tags alongside your existing tagging strategy.

If a resource is at or near the 50-tag limit, informational tag writes may fail. The scheduler logs these failures but continues scheduling operations. Check CloudWatch Logs if you suspect tagging issues.

CloudWatch Logs Insights queries

Instance Scheduler's structured logging format enables efficient querying using CloudWatch Logs Insights. You can use Logs Insights to search, analyze, and visualize log data to troubleshoot operational issues and monitor scheduling activity.

Instance Scheduler provides pre-formatted log queries that you can access from the Saved Queries section in the CloudWatch Logs console:

`SchedulingHistory`

Query scheduling actions performed on resources, including start and stop operations.

`RegistrationEvents`

Query resource registration and deregistration events.

`Errors`

Query error logs to troubleshoot issues with the solution.

For more information about CloudWatch Logs Insights, refer to Analyzing log data with CloudWatch Logs Insights in the *Amazon CloudWatch Logs User Guide*.

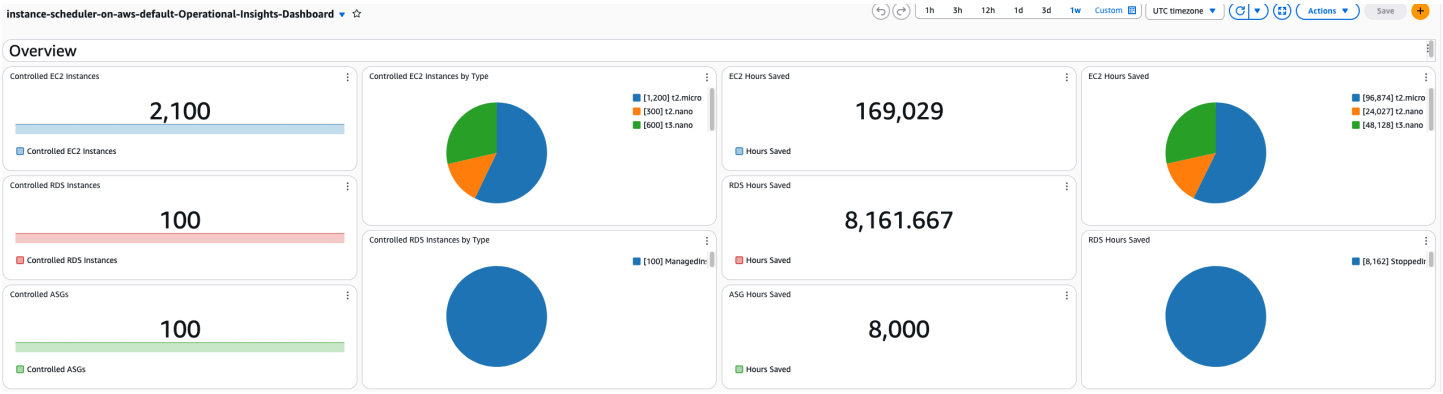
Operational insights dashboard

The Operational Insights dashboard provides visibility into solution performance and cost savings from scheduled instance management.

To access the dashboard, ensure **Operational Monitoring** is set to "enabled" in the hub stack parameters. Navigate to CloudWatch and select "Dashboards" from the navigation menu. The dashboard name is **{stack-name}-Operational-Insights-Dashboard**.

The dashboard displays managed instance counts, running hours saved, and Lambda function performance metrics.

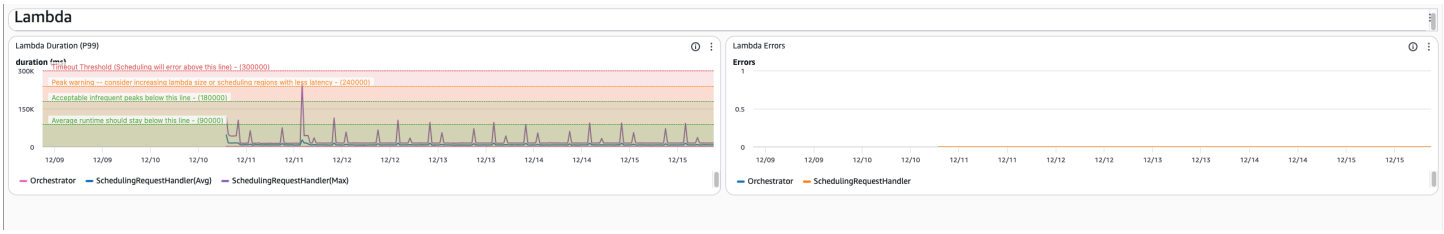
Operational insights dashboard overview



> **Note**
>
> The information in these graphs is dependent upon the scheduling interval configured on the solution hub stack. When updating the solution's scheduling interval, the dashboard will only display scheduling metrics from after the most recent update to the scheduling interval.

Monitor Lambda execution times to ensure optimal performance (see Quotas). If execution times consistently approach the timeout threshold, consider increasing the Lambda size property or deploying Instance Scheduler to a region with lower latency to your managed regions.

Lambda metrics showing duration and error counts



Additional costs associated with this feature

This operational dashboard is powered by custom CloudWatch metrics collected by the solution that will incur additional cost. This feature can be turned off by disabling "Operational Monitoring" on the solution hub stack. This feature costs an additional $3.00/month plus additional scaling costs based on the size of your deployment. The costs are as follows:

Custom CloudWatch Dashboard	**$3**
Per-instance-type metrics	$0.90 per instance type*
API usage	~$0.10 per active target**

These costs are tracked per service category (EC2/RDS) and only for instance types actually used for scheduling.

*

Monitoring EventBridge Events

Instance Scheduler publishes scheduling and registration events to EventBridge event buses to provide visibility into solution operations and enable integration with other AWS services.

Event types

The solution publishes two main categories of events:

Scheduling events: Published when Instance Scheduler takes action to start, stop, or configure managed resources. These events include details about the instance, schedule, and action taken. start, stop, or configure managed resources. These events include details about the instance, schedule, and action taken.

Registration events: Published when resources are registered or unregistered for scheduling based on tagging operations.

Event destinations

IS-LocalEvents event buses: An `IS-LocalEvents` event bus is deployed in each managed region of each member account (including the hub account). Each bus receives events for scheduling actions and resource registrations within that region.

IS-GlobalEvents event bus: The `IS-GlobalEvents` event bus in the hub account receives a copy of each event sent to any `IS-LocalEvents` event bus, providing centralized monitoring across all accounts and regions.

Using EventBridge events

You can create EventBridge rules to:

- Monitor scheduling operations across your infrastructure
- Trigger notifications when instances are started or stopped
- Integrate with other AWS services for automated workflows
- Implement compliance monitoring and alerting

Event structure

All events use the standard EventBridge format. The following examples show the structure for each event type:

Scheduling event:

```
{
  "Source": "instance-scheduler",
  "DetailType": "Scheduling Action",
  "Resources": ["arn:aws:ec2:us-east-1:123456789012:instance/i-1234567890abcdef0"],
  "Detail": {
    "account": "123456789012",
    "region": "us-east-1",
    "service": "ec2",
    "resource_id": "i-1234567890abcdef0",
    "requested_action": "Start",
    "action_taken": "Started",
    "schedule": "office-hours"
  }
}
```

Registration event:

```
{
  "Source": "instance-scheduler",
  "DetailType": "Resource Registered",
  "Resources": ["arn:aws:ec2:us-east-1:123456789012:instance/i-1234567890abcdef0"],
  "Detail": {
    "account": "123456789012",
    "region": "us-east-1",
    "service": "ec2",
    "resource_id": "i-1234567890abcdef0",
    "schedule": "office-hours"
  }
```

```
}
```

Each event contains these key fields:

- `Source` - Identifies the event source as "instance-scheduler"
- `DetailType` - Specifies the event category: "Scheduling Action" for instance operations or "Resource Registered" for tagging events
- `Resources` - Array containing the ARNs of affected AWS resources
- `Detail` - Contains the event payload with account ID, region, service type (ec2/rds), resource ID, schedule name, and for scheduling events, both the requested action and actual result

Possible `requested_action` values for scheduling events:

- `Start`: Scheduler intended to start the instance
- `Stop`: Scheduler intended to stop the instance
- `Configure`: Scheduler intended to configure the instance

Possible `action_taken` values for scheduling events:

- `Started`: Instance was started
- `Stopped`: Instance was stopped
- `Hibernated`: Instance was hibernated
- `Configured`: Instance configuration was modified
- `Error`: An error occurred during the scheduling operation

Creating EventBridge rules

To monitor Instance Scheduler events:

1. Navigate to the EventBridge console in your AWS account
2. Create a new rule targeting either the `IS-GlobalEvents` event bus (for centralized monitoring) or `IS-LocalEvents` event bus (for local monitoring)
3. Define event patterns to match Instance Scheduler events
4. Configure targets such as SNS topics, Lambda functions, or CloudWatch Logs

For more information about EventBridge, refer to What is Amazon EventBridge? in the *Amazon EventBridge User Guide*.

Troubleshooting

This section provides troubleshooting instructions for deploying and using the solution.

Known issue resolution provides instructions to mitigate known errors. If these instructions don't address your issue, Contact Support provides instructions for opening an Support case for this solution.

Known issue resolution

Problem: Instances not being scheduled in a remote account (v1.4-v3.0)

If you notice instances are not being scheduled in a remote account.

Resolution

Update the hub stack with the secondary account ID or complete the following task:

1. In the primary account, navigate to the CloudWatch console
2. In the navigation pane, select **Logs** > **Log Groups**.
3. Select the log group named *<STACK_NAME>*-logs
4. Search for the log stream for the Account ID (remote account).
5. For example, If there is no log stream named with the account ID, go to the DynamoDB console and select the table named *<STACK_NAME>*-<ConfigTable>-<RANDOM>.
6. Select **Explore Items** and select **Run**.
7. Select the item type Config.
8. Check if the attribute remote_account_ids has the account ID.
9. Check if the Account ID is not visible in this attribute.
10. If the solution is configured to aws organizations, then uninstall and reinstall the remote template in the remote account.
11. If the solution is configured to use remote Account IDs, update the cloudformation parameter **Provide Organization Id OR List of Remote Account IDs** with the list of account IDs where the instances are to be scheduled and where the remote template is deployed.

Problem: Instances not being scheduled (v3.1+)

If you notice instances are not being scheduled.

Resolution

1. Verify the resource has an **IS-ManagedBy** tag applied.
2. If the tag is not present, delete and recreate the Schedule tag to retrigger registration.
3. If the tag is still not being applied, verify the region is enabled for scheduling:
   a. Check the hub/spoke stack configuration for the region, or
   b. Navigate to the EventBridge console in the same region as the resource and verify that the default event bus has event rules with the prefix **IS-Tagging**.
4. If the region is not enabled, update the Instance Scheduler stack to include the region in the regions CloudFormation parameter.
5. If the issue persists, review the solution administration logs for hub registration errors.
6. Confirm that your organization does not have policies in place that would prevent events from being forwarded from your account to the solution hub account.

Problem: Encrypted EC2 instances not starting

Instance Scheduler is reporting that EC2 instances with encrypted EBS volumes are being started, but they never actually start.

Resolution

Refer to Encrypted EC2 EBS Volumes for how to grant Instance Scheduler access to be able to schedule EC2 instances with encrypted EBS volumes

Problem: Unexpected API costs from informational tagging

Unexpectedly high costs from AWS Resource Groups Tagging API calls, AWS Config evaluations, or related remediation actions.

Resolution

Instance Scheduler writes informational tags to managed resources on each scheduling interval. If your environment enforces tag governance through AWS Config rules, tag policies, or automated

remediation, ensure that Instance Scheduler's tag keys are permitted. For the full list of tag keys and configuration guidance, refer to Tag governance considerations.

If you are unable to update your tag governance policies, disable informational tagging by setting the **Enable informational tagging** parameter to No on the hub stack.

Problem: RDS Instances not stopping when Create RDS Snapshots is Enabled

RDS Instances are not being stopped and the solution's scheduler logs are reporting (AccessDenied) errors when calling the `StopDBInstance` operation due to not having `rds:CreateDBSnapshot` permission.

Resolution

Update the solution to v3.0.5 or newer or alternatively add the `rds:CreateDBSnapshot` permission to the solution's scheduler role in each scheduled account.

Contact AWS Support

If you have AWS Business Support+, AWS Enterprise Support, or Unified Operations, you can use the AWS Support Center to get expert assistance with this solution. The following sections provide instructions.

Create case

1. Sign in to Support Center.
2. Choose **Create case**.

How can we help?

1. Choose **Technical**.
2. For **Service**, select **Solutions**.
3. For **Category**, select **Instance Scheduler on AWS (Linux or Windows)**.
4. For **Severity**, select the option that best matches your use case.

5. When you enter the **Service**, **Category**, and **Severity**, the interface populates links to common troubleshooting questions. If you can't resolve your question with these links, choose **Next step: Additional information**.

Additional information

1. For **Subject**, enter text summarizing your question or issue.
2. For **Description**, describe the issue in detail, including the name of this product and the version you are using, such as this example: `Instance Scheduler on AWS vX.Y.Z`.
3. Choose **Attach files**.
4. Attach the information that Support needs to process the request.

Help us resolve your case faster

1. Enter the requested information.
2. Choose **Next step: Solve now or contact us**.

Solve now or contact us

1. Review the **Solve now** solutions.
2. If you can't resolve your issue with these solutions, choose **Contact us**, enter the requested information, and choose **Submit**.

Update the solution

Instance Scheduler is designed to be safe to update in-place using AWS CloudFormation. The general procedure to do this is as follows:

1. Sign in to the AWS CloudFormation console, on the account/region where your Hub stack is installed,select `instance-scheduler-on-aws`, and select **Update stack**.
2. Select **Make a direct update**.
3. Select **Replace existing template**.
4. Under **Specify template**:
   - Select **Amazon S3 URL**.
   - Copy the link of the latest template.
   - Paste the link in the **Amazon S3 URL** box.
   - Verify that the correct template URL shows in the **Amazon S3 URL** text box, and choose **Next**. Choose **Next** again.
5. Under **Parameters**, review the parameters for the template and modify them as necessary (see list of breaking changes below for any required parameter updates).For details about each of the parameters For details about the parameters, see Step 1. Launch the instance scheduler stack.
6. Choose **Next**.
7. On the **Configure stack options** page, choose **Next**.
8. On the **Review** page, review and confirm the settings. Check the box acknowledging that the template will create AWS Identity and Access Management (IAM) resources.
9. Choose **View change set** and verify the changes.
10. Choose **Update stack** to deploy the stack.

You can view the status of the stack in the AWS CloudFormation console in the **Status** column. You should receive an **UPDATE_COMPLETE** status in a few minutes.

Repeat the above steps for the aws-instance-scheduler-remote stacks in each of your spoke accounts.

Breaking Changes in Specific Versions

When updating the solution, you can upgrade directly from any older version to any newer version without loss of critical data or interruption to scheduling. Please see below for a list of behavioral and breaking changes in each major version.

A full changelog can be viewed on the solution's GitHub page

v1.5.0

Version 1.5.0 replaces the need to provide a list of cross-account scheduling role ARNs with the ability to automatically manage them through your AWS Organization. If you don't want to use AWS Organizations, you can instead provide a list of Spoke Account IDs and Instance Scheduler will manage the scheduling roles for you.

When updating to v1.5.0 or newer, you must:

1. Update the hub template using the normal update instructions while updating the following parameters:
   a. Choose a unique namespace for the solution.
   b. Select whether you would like to **Use AWS Organizations** to manage spoke registration going forward.
      i. If you selected **Yes** replace **Organization ID/Remote Account IDs** with the ID of your AWS Organization.
      ii. If you selected **No** replace **OrganizationID/RemoteAccountIDs** with a comma-separated list of the Account IDs of your Spoke accounts.
2. Update all remote stacks using the normal update instructions while updating the following parameters :
   a. Namespace - same as you chose for the hub account.
   b. Use AWS Organizations - same as hub account.
   c. Hub Account ID - Account ID of the hub account (should be unchanged from before).

v3.0.0

v3.0.0 Adds support for EC2 autoscaling groups and breaks apart the solution's core lambda function into separate functions with dedicated responsibilities to provide better security

isolation for each individual function. This release also updates scheduling log behavior to include "SchedulingDecision" logs for better insight into scheduling operations.

V3.0.0 contains the following breaking changes compared to previous versions:

- "CloudWatch Metrics" feature in 1.5.x has been replaced with the Operational Insights Dashboard.
- Per-schedule metrics in CloudWatch have been moved from Schedule/Service/MetricName → Schedule/Service/SchedulingInterval/MetricName.
- All existing metrics will remain, but new metrics will now be gathered under the new namespace and will be made available in the solution dashboard.
- KMS key ARNs for use with encrypted EBS volumes on EC2 DB instances must now be provided to the hub/spoke CloudFormation stack in their respective accounts. (For more information, refer to Encrypted EC2 EBS Volumes.)
  - If you are scheduling EC2s with Encrypted EBS Volumes, you will need to copy the KMS key arns being used to your hub/spoke stack parameters.
- The CloudFormation parameter for scheduled services has been broken up into individual parameters for each supported service.
  - All services will be enabled by default and can be disabled individually.
- Instance Scheduler 3.0 is not backwards compatible with older versions of the Instance Scheduler CLI.
  - You will need to update to the latest version of the Instance Scheduler CLI to continue using CLI commands.

In addition to the above, the schema of the Maintenance Window table has been updated and will be replaced as part of the update. This will reset tracking for EC2 maintenance windows for the first few minutes after updating to v3.x and in rare cases may cause instances currently within a maintenance window to be stopped prematurely immediately following the update. After this data has been regenerated scheduling operations will continue as normal.

v3.1.0

v3.1.0 refactors the core infrastructure of the solution to use AWS tagging events to track when resources are tagged for scheduling. Please ensure that your organization's permissions will allow these tagging events to be sent from member accounts to your central hub account.

When updating to v3.1.0 or newer:

- Spoke accounts now declare scheduled regions independently of the hub account. Each spoke stack must specify which regions to schedule in that account using the **Region(s)** parameter.
- AWS Organizations mode is now required for deployments with more than 40 total accounts. If you have more than 40 accounts and are not using Organizations mode, you must enable it during the update.
- If you have EC2 instances managed in AWS License Manager that you want to schedule, add the License Manager configuration ARNs to the **License Manager Configuration ARNs** parameter in your hub/spoke CloudFormation stacks. For more information, refer to EC2 License Manager.
- The solution will automatically apply an IS-ManagedBy tag to resources after they are tagged for scheduling to indicate they are being managed by the scheduler.
- *(Restored in v3.2.0)* Scheduled instance resizing (defining `period-name@size` in a schedule) was temporarily removed in v3.1.0 but has been re-implemented in v3.2.0 and newer. Refer to Instance type.
- Listing member accounts via an SSM parameter (passing `{param: ssm-param-name}` to the accounts parameter on the hub stack) is no longer supported. All trusted accounts must be passed to the hub stack at deploy-time.
- Instance Scheduler will require up to 6 unique tags on resources during scheduling. Please ensure sufficient tagging capacity on resources when combined with the rest of your organization's tagging strategy.
- Per-schedule metrics have been removed from CloudWatch.
- Solution logs have been repackaged into separate administrative and scheduling log groups and optimized for querying with CloudWatch Log Insights. Please refer to Monitoring the Solution for more information.
- Start and stop tags are no longer configurable through CloudFormation parameters. The solution now uses fixed tag names with richer information for tracking scheduling actions.

Important

Instance Scheduler writes up to 6 unique tags to managed resources during normal operation. Ensure that your tag governance policies (such as AWS Config rules, tag policies, or automated remediation) are configured to allow these tags. For a full list of tags and important governance considerations, refer to Informational tags.

Uninstall the solution

Important

When uninstalling the solution, make sure to uninstall all custom schedule stacks before uninstalling the solution itself.

You can uninstall the Instance Scheduler on AWS solution from the AWS Management Console or by using the AWS Command Line Interface. To uninstall the solution, delete the hub stack in AWS Cloud Formation along with all installed remote stacks. You can then remove any scheduling tags that had been applied to instances for scheduling purposes.

Note

If **Protect DynamoDB Tables** is enabled on the solution's hub stack, CloudFormation will retain the solution's DynamoDB tables and KMS key rather than deleting them. If you wish to delete these resources, ensure that this property is set to **Disabled** before deleting the hub stack. Alternatively, you can delete them manually after the hub stack has already been deleted.

Using the AWS Management Console

1. Sign in to the AWS CloudFormation console.
2. On the **Stacks** page, select this solution's installation stack.
3. Choose **Delete**.

Using AWS Command Line Interface

Determine whether the AWS Command Line Interface (AWS CLI) is available in your environment. For installation instructions, refer to What Is the AWS Command Line Interface in the *AWS CLI User Guide*. After confirming that the AWS CLI is available, run the following command.

```
$ aws cloudformation delete-stack --stack-name
```

```
    <installation-stack-name>
```

Developer guide

This section provides the source code for the solution and list the sections added here and include links to each subtopic.

Source code

Visit our GitHub repository to download the source files for this solution and to share your customizations with others.

The Instance Scheduler on AWS templates are generated using the AWS CDK. See the link: README.md file for additional information.

Reference

This section includes information about data collection, pointers to related resources, and a list of builders who contributed to this solution.

Data collection

This solution sends operational metrics to AWS (the "Data") about the use of this solution. We use this Data to better understand how customers use this solution and related services and products. AWS's collection of this Data is subject to the AWS Privacy Notice.

Related resources

The Resource Scheduler is a similar to Instance Scheduler on AWS, but its implementation differs in the following ways:

Instance Scheduler on AWS uses a Lambda function to frequently evaluate the schedules stored in its configuration and checks if the instances are in the desired state. The Resource scheduler quicksetup uses start and stop times to perform start and stop actions using SSM runbooks. This occurs one time when the current time is equal to the start time or the current time is past the start time.

Instance Scheduler on AWS currently enables scheduling for EC2, RDS, and Aurora Clusters. Resource scheduler only schedules or starts and stops EC2 instances.

Use Resource scheduler to identify EC2 instances and start/stop them at specific times.

Use Instance Scheduler on AWS when the accounts have to regulary scanned to start/stop instances.

The table identifies which solution is better based on scenarios.

Scenario	Resource Scheduler	Instance Scheduler on AWS
Schedule Amazon Neptune instances	No	Yes

Scenario	Resource Scheduler	Instance Scheduler on AWS
Schedule Amazon DocumentDB instances	No	Yes
Schedule Auto Scaling group instances	No	Yes
Schedule EC2 instances	Yes	Yes
Schedule RDS instances	No	Yes
Schedule Aurora Clusters	No	Yes
Manage Schedules in a Single Account (hub account)	No	Yes
Manage Schedules in individual accounts	Yes	No
Change Calendar Integration	Yes	No
Start and Stop actions only	Yes	No
Monitor instances periodically and start and stop based on instance current state	No	Yes

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Revisions

Publication date: *October 2020*

Check the CHANGELOG.md file in the GitHub repository to see all notable changes and updates to the software. The changelog provides a clear record of improvements and fixes for each version.

Notices

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