

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.

Integration with Service Catalog AppRegistry and Application Manager, a capability of AWS Systems Manager

This solution includes a [Service Catalog AppRegistry](#) resource to register the solution's CloudFormation template and its underlying resources as an application in both Service Catalog AppRegistry and [Application Manager](#). With this integration, you can centrally manage the solution's resources.

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 on AWS. As of the latest revision, the cost for running this solution a small deployment in two accounts and two Regions is approximately **\$13.15 per month**. See the following sample cost tables for a more detailed breakdown.

Instance Scheduler on AWS is designed to invoke AWS Lambda functions multiple times per run cycle. For example, if you use the solution to manage both Amazon EC2 and Amazon RDS instances in one Region for two accounts (one account where the solution is deployed and the other account is a cross account), the solution runs five Lambda function invocations:

- One to handle the initial Orchestration Request from Event Bridge, which is invoked based on the selected frequency (default: five minutes).
- An additional Lambda invocation for each service, account, and Region.
- If [Auto Scaling Group scheduling](#) is enabled, another orchestration invocation runs for all accounts/regions every hour.

Custom Operational Metrics add additional costs based on the number of schedules and instance types (such as m2.medium, t3.large) being scheduled by the solution. If you don't want to track these metrics, you can turn off this feature to save costs. Refer to [Operational insights dashboard](#) for more details on these metrics and their associated costs.

This solution uses on-demand scaling for its [Amazon DynamoDB](#) tables to provide sufficient read and write capacity.

See the pricing webpage for each [AWS service in this solution](#).

The cost of the solution per run depends on the number of instances being tagged and managed by the solution. As the number of EC2 and RDS DB instances increases, the Lambda run time also increases proportionately.

We recommend creating a [budget](#) through AWS Cost Explorer to help manage costs. Prices are subject to change.

Note

For cost optimization purposes, Instance Scheduler groups all Amazon RDS-related services into a single invocation. So even if you enable Amazon RDS, [Amazon Aurora](#), [Amazon Neptune](#), and [Amazon DocDB scheduling](#); this will still be considered just "RDS" for the purpose of cost calculations.

Pricing examples (monthly)

Small deployment

This pricing example is based on these assumptions:

- Two accounts, two Regions, scheduling all possible services
- 3 schedules in active use
- 20 instances of 3 different sizes
- Scheduling interval: 5 minutes
- Lambda function size: 128 MB
- Average Lambda function runtime: 8 seconds

AWS service	Dimensions	Monthly Cost [USD]
AWS Lambda	288 + 24 scheduling runs per day	~\$1.50
	1+8 Lambda functions per run	
	8 second average Lambda runtime	
	(\$0.0000021/second)	

AWS service	Dimensions	Monthly Cost [USD]
	(\$0.00000002/Lambda function call)	
Operational Metrics (optional)	CloudWatch dashboard (\$3/month) 3 per-instance-type metrics (\$0.90/month) 3 per-schedule metrics * 2 services (\$0.60/month) ~80,000 PutMetric calls/month (\$0.01/1000)	~\$10.00
Amazon DynamoDB	~75,000 WRU/month (\$1.25 per million) ~100,000 RRU/month (\$0.5 per million) negligible storage costs (< \$0.01)	~\$0.15
AWS KMS	1 AWS KMS key (\$1/month) ~140,000 API requests/month (\$0.30/10000)	~\$1.50
Total:		~\$13.15

Medium deployment

This pricing example is based on these assumptions:

- 50 accounts, 4 Regions, scheduling all supported services

- 10 schedules in active use
- 200 instances of 10 different sizes
- Scheduling interval: 5 minutes
- Lambda function size: 128 MB
- Average Lambda runtime: 8 seconds
- 5 EC2 Maintenance Windows

AWS service	Dimensions	Monthly Cost [USD]
AWS Lambda	288 + 24 scheduling runs per day 1+400 Lambda functions per run 8 second average Lambda runtime (\$0.0000021/second) (\$0.0000002/Lambda function call)	~\$64.00
Operational Metrics (optional)	CloudWatch dashboard (\$3/month) 10 per-instance-type metrics (\$0.90/month) 10 per-schedule metrics * 2 services (\$0.60/month) ~3.5m PutMetric calls/month (\$0.01/1000)	~\$60.00

AWS service	Dimensions	Monthly Cost [USD]
Amazon DynamoDB	~7m WRU/month (\$1.25 per million) ~8m RRU/month (\$0.5 per million) Storage costs (<\$0.01)	~\$12.00
AWS KMS	1 AWS KMS key (\$1/month) ~7m API requests/month (\$0.30/10000)	~\$22.00
Total:		~\$158.00

Large deployment

This pricing example is based on these assumptions:

- 120 accounts, 6 Regions, scheduling both Amazon EC2 and Amazon RDS
- 100 schedules in active use
- 2000 instances of 50 different sizes
- 100 EC2 Maintenance Windows
- Scheduling interval: 5 minutes
- Lambda function size: 128 MB
- Average Lambda function runtime: 8 seconds

AWS service	Dimensions	Monthly Cost [USD]
AWS Lambda	288 + 24 scheduling runs per day 1+1440 Lambda functions per run	~\$230.00

AWS service	Dimensions	Monthly Cost [USD]
	8 second average Lambda function runtime (\$0.0000021/second) (\$0.0000002/Lambda call)	
Operational Metrics (optional)	CloudWatch dashboard (\$3/month) 50 per-instance-type metrics (\$0.90/month) 100 per-schedule metrics * 2 services (\$0.60/month) ~3.5m PutMetric calls/month (\$0.01/1000)	~\$300.00
Amazon DynamoDB	~26m WRU/month (\$1.25 per million) ~26m RRU/month (\$0.5 per million) Storage costs (<\$0.01)	~\$40.00
AWS KMS	1 KMS key (\$1/month) ~25m API requests/month (\$0.30/10000)	~\$80.00
Total:		~\$650.00

To efficiently configured the solution, consider the following:

1. Deploy the solution in a Region where the cost of the Lambda function is lowest.

2. Do not change the memory of the Lambda function (CloudFormation parameter **Memory** unless absolutely required). This will increase the cost of the solution significantly.
3. Remove unused schedules from the solution configurations.
4. Select a frequency that reduces the number of Lambda function runs per day. For example, if the schedules are hours apart, set the frequency (**Frequency** CloudFormation parameter) to one-hour increments. By default, the solution is set to five minutes which means the Lambda function will be invoked 288 times a day, whereas a one-hour frequency will run 24 times a day.

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

For opt-in Regions, Instance Scheduler on AWS can target instances within any opt-in Region for scheduling, but the CloudFormation stacks themselves are currently only available for deployment in the following opt-in 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.

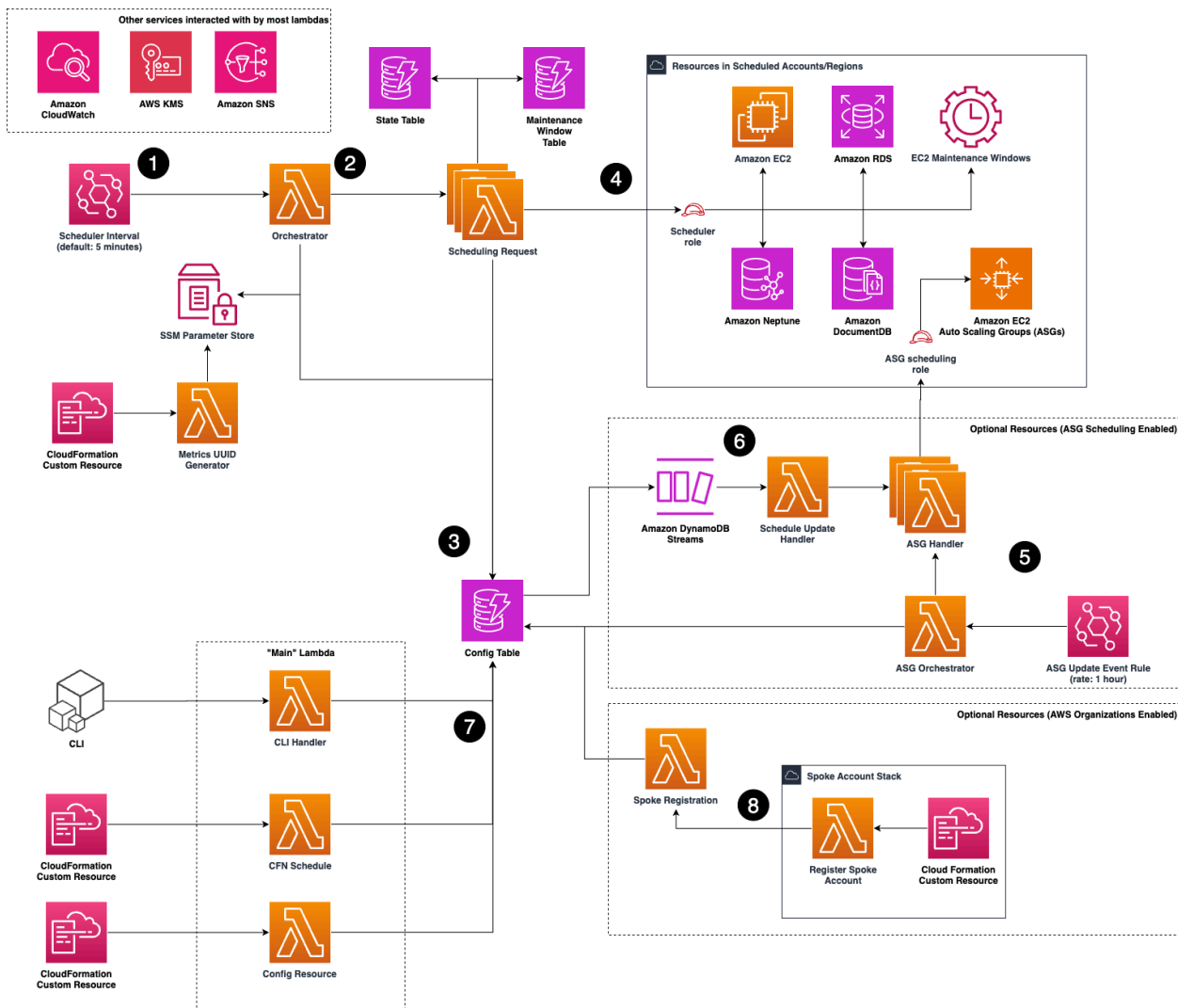
Architecture

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. The solution deploys an [Amazon EventBridge Rule](#) with a configurable scheduling interval. This scheduling interval defines how frequently the solution runs and takes action to schedule your instances.
2. Each scheduling interval invokes an [AWS Lambda](#) Orchestration function. This will determine the list of AWS accounts, Regions, and services that need to be scheduled. The scheduling interval will then invoke multiple scheduling request Lambda functions in parallel to perform scheduling activities.
3. A collection of schedules and periods are stored in an [Amazon DynamoDB](#) configuration table to control the scheduling behavior of the solution. You can configure any number of schedules/periods in this table and the solution will schedule instances accordingly.
4. Each scheduling request inspects resources in its particular target (account/Region/service) to find resources that have been tagged for scheduling by using schedules defined in the solution's configuration table. The scheduling request handler then inspect the configured schedules and performs required scheduling actions.
5. If ASG scheduling is enabled, Instance Scheduler on AWS deploys an hourly [Amazon EventBridge rule](#) and associated orchestration and handler resources to manage [Scheduled Scaling Actions](#) for [Amazon EC2 Auto Scaling groups](#) that have been tagged for scheduling by the solution.
6. In addition to the hourly scan, the solution also tracks updates to schedules in the configuration table. When a schedule is updated, a secondary orchestration Lambda function is invoked to ensure that ASG scheduled scaling actions are kept up to date with the most recent schedule configuration.
7. The solution provides multiple ways to create/update schedules in the solution's configuration table, along with several example schedules to use as a starting point. Configuration methods include: The DynamoDB console, a scheduler CLI, and an [AWS CloudFormation Custom resource](#).
8. If AWS Orgs Mode is enabled and a valid Org ID is provided when the solution is deployed, Instance Scheduler on AWS automatically registers newly deployed spoke stacks with the solution hub stack. The hub and spoke stacks must be deployed in the same Region and in accounts that are members of the same [AWS Organization](#).

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 CloudFormation stack using a custom resource feature.
Amazon DynamoDB	Core. Solution creates DynamoDB tables to store schedule configuration, state information, 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 information 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

AWS service	Description
	that invoke AWS lambda on a consistent interval"
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 associated 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 on AWS will also create Scheduling Roles in all managed accounts that will provide access to start/stop EC2, RDS, Autoscaling resources, 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 on AWS 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 on AWS 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 on AWS, add the AWS KMS key's ARN to the Instance Scheduler on AWS stack (hub or spoke) in the same account as the EC2 instance(s) using the key(s):

KMS Key Arns for EC2

Kms Key Arns for EC2

comma-separated list of kms arns to grant Instance Scheduler 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 just (*) to give limited access to all kms keys, leave blank to disable. For details on the exact policy created, refer to security section of the implementation guide (<https://aws.amazon.com/solutions/implementations/instance-scheduler-on-aws/>)

Enter CommaDelimitedList

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"  
}  
]  
}
```

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 through 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
Schedule tag key	Schedule	<p>The tag key that the solution reads to determine the schedule for a resource. The value on a resource specifies the name of the schedule.</p> <p>If you choose to modify the default value, assign a name that is easy to apply consistently and correctly across all necessary instances .</p> <p>Note: The tag key is case sensitive.</p> <p>For example, if the value for this parameter is left as the default of Schedule, Instance Scheduler on AWS will schedule all EC2 instances tagged with the key Schedule and the value my-office-hours-schedule</p>

Parameter	Default	Description
		according to the schedule with the name my-office-hours-schedule .
Scheduling interval (minutes)	5	<p>Interval in minutes between scheduler initiates for Amazon EC2 and Amazon RDS.</p> <p>A longer scheduling interval reduces the running costs of the solution but also make scheduling less accurate. With a scheduling interval of 5 minutes, instances are started/stopped within 5 minutes of requested start/stop times.</p>
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 .
Scheduling enabled	Yes	Select No to disable scheduling for all services.
Enable xxx Scheduling	Enabled	Enable/disable scheduling for each service supported by the solution (multiple parameters).

Parameter	Default	Description
Start tags	InstanceScheduler- LastAction=Started By {scheduler} {year}/{month}/{day} {hour}:{minute}{timezone},>	Comma separated list of tag keys and values of the format key=value, key=value,... that are set on started instances. This value can be removed to disable the feature entirely.
Stop tags	InstanceScheduler- LastAction=Stopped By {scheduler} {year}/{month}/{day} {hour}:{minute}{timezone},>	Comma separated list of tag keys and values of the format key=value, key=value,... that are set on stopped instances. This value can be removed to disable the feature entirely.
Enable EC2 SSM maintenance windows	No	Allow schedules to specify one or more Systems Manager maintenance window names. Instance Scheduler on AWS will then ensure that instances tagged with that schedule are started at least ten minutes before associated maintenance windows.

Parameter	Default	Description
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 .
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 scheduled tag key	scheduled	A tag that this solution applies to Amazon EC2 Auto Scaling groups to track necessary scheduling information for the solution.

Parameter	Default	Description
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.
Use AWS Organizations	No	Use AWS Organizations to automate spoke account registration.
Namespace	default	<p>Provide a unique identifier to differentiate between multiple solution deployments (no spaces). Example: Dev.</p> <p>This parameter is required to be a non-empty value for deployments using AWS Organizations.</p>
Organization ID/Remote Account IDs	<Optional Input>	<p><i>If you're using AWS Organizations this field is required.</i></p> <p>Provide the Organization ID, for example, o-xxxxyyy.</p> <p>Otherwise, provide a comma separated list of spoke Account IDs to schedule, such as 1111111111, 2222222222 or {param: ssm-param-name} to load a list of accounts from 1 or more SSM parameters.</p>

Parameter	Default	Description
Region(s)	<i><Optional Input></i>	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.
Enabled hub account scheduling	Yes	Enable scheduling of instances within the hub account.
Log retention period (days)	30	The log retention period for CloudWatch logs in days.
Enable CloudWatch Debug Logs	No	Enable debug-level logging in CloudWatch logs.
Operational Monitoring	Enabled	Deploy an operational insights dashboard to CloudWatch and gather custom metric data on the solution's operation . IMPORTANT: Enabling this feature will incur additional charges for custom CloudWatch metrics and dashboard.
Memory Size	128	The memory size of the AWS Lambda function that schedules Amazon EC2 and Amazon RDS resources. Increase if you are experiencing high memory usage or timeouts.

Parameter	Default	Description
Protect DynamoDB Tables	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.

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
Hub Account ID	<i><Requires Input></i>	Account ID of the Instance Scheduler on AWS hub stack that will schedule resources in this account.
Use AWS Organizations	No	Use AWS Organizations to automate spoke account registration. Must be set to the same value as the hub stack.
Namespace	default	Unique identifier used to differentiate between multiple solution deployments. Must be set to the same value as the hub stack.
Kms Key ARNs for EC2	<i><Optional Input></i>	Comma-separated list of KMS ARNs to grant the solution

Parameter	Default	Description
		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 exact policy created, refer to Encrypted EC2 EBS Volumes

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](#), [monitor the solution](#), [update the solution](#).

Configure schedules

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.

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](#).

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](#).

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	Description
	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-numeric, 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 <i><period-name>@<instance-type></i> . 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.

Field	Description
use_maintenance_window	Choose whether to include 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. This field is enabled by default and can be disabled by setting its value to "false"
ssm_maintenance_window	<p>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.</p> <p>Note: This feature only applies to EC2 instances.</p>
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 .

Field	Description
<code>use_metrics</code>	<p>Choose whether to turn on CloudWatch metrics at the schedule level. This field overwrites the CloudWatch metrics setting you specified at deployment.</p> <p>Note: Enabling this feature will incur charges of \$0.90/month per schedule or scheduled service.</p>

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



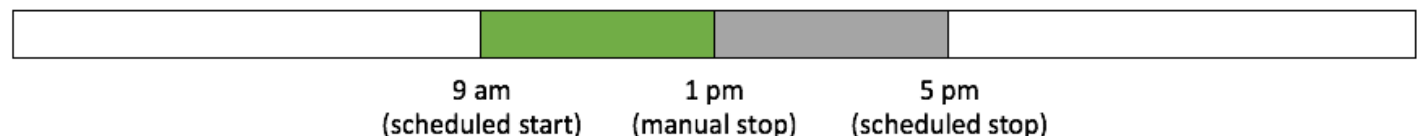
If you manually start that instance at 5 AM, the solution will stop the instance at 5 PM. If you use the [retain running field](#), the solution will not stop the instance at 5 PM.

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 schedule](#).

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
<code>begintime</code>	The time, in HH:MM format, that the instance will start.
<code>description</code>	An optional description of the period.

Field	Description
endtime	The time, in HH:MM format, that the instance will stop.
months	<p>Enter a comma-delimited list of months, or a hyphenated range of months, during which the instance will run. For example, enter <code>jan</code>, <code>feb</code>, <code>mar</code> or <code>1</code>, <code>2</code>, <code>3</code> to run an instance during those months. Or, you can enter <code>jan-mar</code> or <code>1-3</code>.</p> <p>You can also schedule an instance to run every n^{th} month or every n^{th} month in a range. For example, enter <code>Jan/3</code> or <code>1/3</code> to run an instance every third month starting in January. Enter <code>Jan-Jul/2</code> to run every other month from January to July.</p>

Field	Description
monthdays	<p>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 1st to the 3rd and the 7th through the 9th.</p> <p>You can also schedule an instance to run every nth day of the month or every nth day of the month in a range. For example, enter 1/7 to run an instance every seventh day starting on the 1st. Enter 1-15/2 to run an instance every other day from the 1st to the 15th.</p> <p>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 15th.</p>
name	<p>The name used to identify the period. This name must be unique and include only alpha-numeric, hyphens (-), and underscores (_).</p>

Field	Description
weekdays	<p>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 <code>0, 1, 2</code> or <code>0-2</code> to run an instance Monday through Wednesday. You can also enter multiple ranges. For example, enter <code>0-2, 4-6</code> to run an instance every day except Thursday.</p> <p>You can also schedule an instance to run every n^{th} occurrence of a weekday in the month. For example, enter <code>Mon#1</code> or <code>0#1</code> to run an instance the first Monday of the month.</p> <p>Enter a day and <code>L</code> to run an instance on the last occurrence of that weekday in the month. For example, enter <code>friL</code> or <code>4L</code> to run an instance on the last Friday of the month.</p>

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.

Automated tagging

The Instance Scheduler on AWS can automatically add tags to all instances it starts or stops. You can specify a list of tag names or `tagname=tagvalue` pairs in the **Started tags** and **Stopped tags** parameters. The solution also includes macros that allow you to add variable information to the tags:

- `{scheduler}`: The name of the scheduler stack
- `{year}`: The year (four digits)
- `{month}`: The month (two digits)
- `{day}`: The day (two digits)

- `{hour}`: The hour (two digits, 24-hour format)
- `{minute}`: The minute (two digits)
- `{timezone}`: The time zone

The following table gives examples of different inputs and the resulting tags.

Example parameter input	Instance Scheduler tag
<code>ScheduleMessage=Started by scheduler {scheduler}</code>	<code>ScheduleMessage=Started by scheduler MyScheduler</code>
<code>ScheduleMessage=Started on {year}/{month}/{day}</code>	<code>`ScheduleMessage=Started on 2017/07/06 `</code>
<code>ScheduleMessage=Started on {year}/{month}/{day} at {hour}:{minute}</code>	<code>ScheduleMessage=Started on 2017/07/06 at 09:00</code>
<code>ScheduleMessage=Started on {year}/{month}/{day} at {hour}:{minute} {timezone}</code>	<code>ScheduleMessage=Started on 2017/07/06 at 09:00 UTC</code>

When you use the **Started tags** parameter, the tags are automatically deleted when the scheduler stops the instance. When you use the **Stopped tags** parameter, the tags are automatically deleted when the instance is started.

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	Type	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	Type	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	Type	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::DynamoDB::Table	DynamoDB table that stores last desired state of instances.

Resource name	Type	Description
Config Table	AWS::DynamoDB::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-yyyyymmdd` 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
<code>--stack [replaceable]<stackname></code>	The name of the scheduler stack. Important: This argument is required for all commands.
<code>--region [replaceable]<regionname></code>	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.
<code>--profile-name [replaceable]<profilename></code>	The name of the profile to use to run commands. If no profile name is specified, the default profile is used.
<code>--query</code>	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 <i>AWS CLI User Guide</i> .
--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}

  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.

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](#)

Scheduled scaling rules will then be managed for your ASG by two systems:

First, an ASG orchestrator Lambda function runs hourly and initiates an ASG handler function for each of your scheduled accounts/regions. This function will look for newly tagged ASGs or ASGs whose configured scheduled scaling actions have become stale. It will then reconfigure all scheduled scaling actions that start with the ASG action name prefix (specified at solution deployment) to match the associated schedule.

Second, when a schedule is modified in the scheduler configuration table, a DynamoDB stream triggers the Schedule Update Handler Lambda function. This function then creates ASG handler requests to update the scheduled scaling actions for all Auto Scaling Groups tagged with that schedule.

Note

After tagging an ASG with a schedule, it can take up to an hour before scheduled scaling actions are updated according to the new schedule.

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 of an ASG.

When Instance Scheduler first configures Scheduled Scaling Actions for an ASG, the currently configured min-desired-max values will be used to define the **running state** of the ASG. If the ASG is currently configured with a min-desired-max of 0-0-0, Instance Scheduler will report an error and will not configure any Scheduled Scaling Actions until a new min-desired-max has been configured that can be used to define a running state for the ASG.

When updating the Scheduled Scaling Actions for an ASG, Instance Scheduler will look at the current min-desired-max at the time of the update and use those values to define the new **running state** for the schedule. If the min-desired-max is currently 0-0-0 at the time of the update, the previous **running state** will be used.

For all ASGs the **stopped state** is defined as a min-desired-max of 0-0-0.

ASG Scheduled Tag

When an auto scaling group is scheduled by the solution, an auto scaling group scheduled tag is added to the auto scaling group. The tag contains the below information in JSON format:

Key	Value Type	Value
schedule	String	Schedule name aligned with the scheduler configuration table.
ttl	String	Until when the tag is valid.
min_size	Integer	Auto scaling group min size when scheduled.
max_size	Integer	Auto scaling group max size when scheduled.
desired_size	Integer	Auto scaling group desired capacity when scheduled.

The presence of a valid Scheduled Tag that has not yet expired its TTL indicates to Instance Scheduler that an ASG has been correctly configured for scheduling. This tag can be manually deleted to forcefully cause Instance Scheduler to reconfigure Scheduled Scaling Actions on an ASG during the next ASG scheduling run.

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*.
- Nth 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 on AWS leverages Amazon CloudWatch Logs for logging. 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. For more information, refer to [Solution resources](#).

Warning and error messages are also published to a solution-created Amazon SNS topic, which sends messages to a subscribed email address. For details, refer to What is Amazon SNS? in the *Amazon SNS Developer Guide*. You can find the name of the Amazon SNS topic in the **Outputs** tab of the solution stack.

Log files

The Instance Scheduler on AWS creates a log group that contains the default AWS Lambda log files and a log group that contains the following log files:

- `InstanceScheduler-yyyyymmdd`: Logs general scheduler messages
- `SchedulingOrchestratorHandler-yyyyymmdd`: Logs general orchestration information for when scheduling executions are started
- `SchedulerSetupHandler-yyyyymmdd`: Logs the output of configuration actions
- `Scheduler-<service>-<account>-<region>-yyyyymmdd`: Logs scheduling activity in each service, account, and region
- `CliHandler-yyyyymmdd`: Logs requests from the admin CLI
- `Eventbus_request_handler-yyyyymmdd`: Logs the calls to the EventBus resources, if the solution is deployed to AWS organizations.
- `CollectConfigurationDescription-yyyyymmdd`: Logs configuration description metric data that is sent periodically

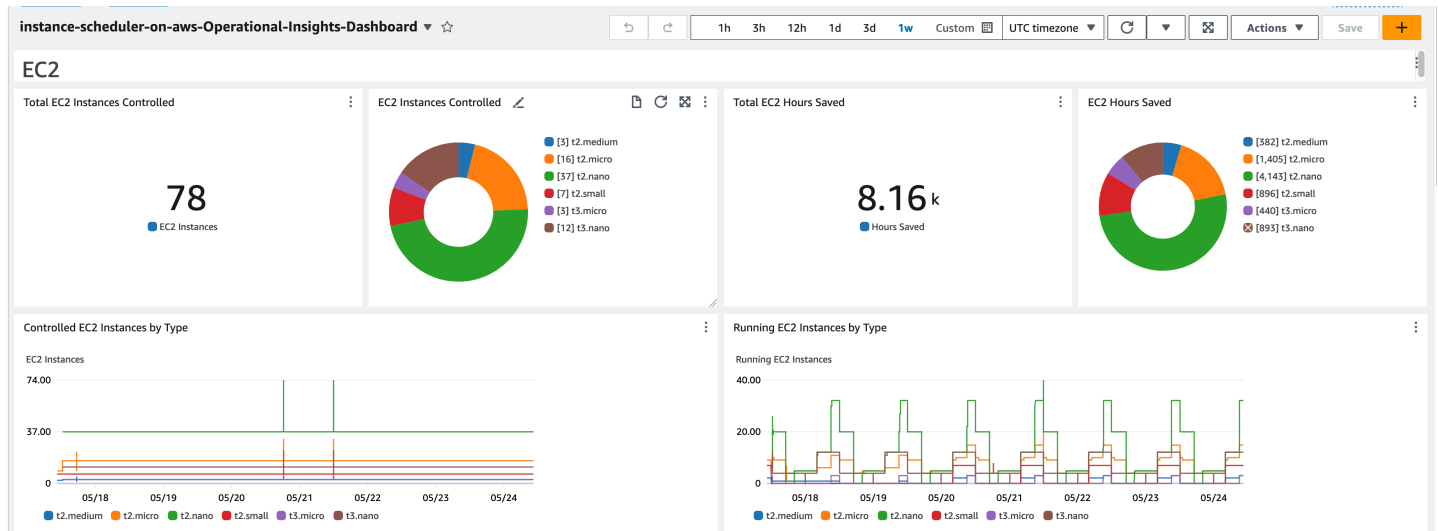
Operational insights dashboard

Instance Scheduler on AWS comes with an Operational Insights dashboard that allows you to monitor the operation of the solution and get insight into the running hours that have been saved by using this solution.

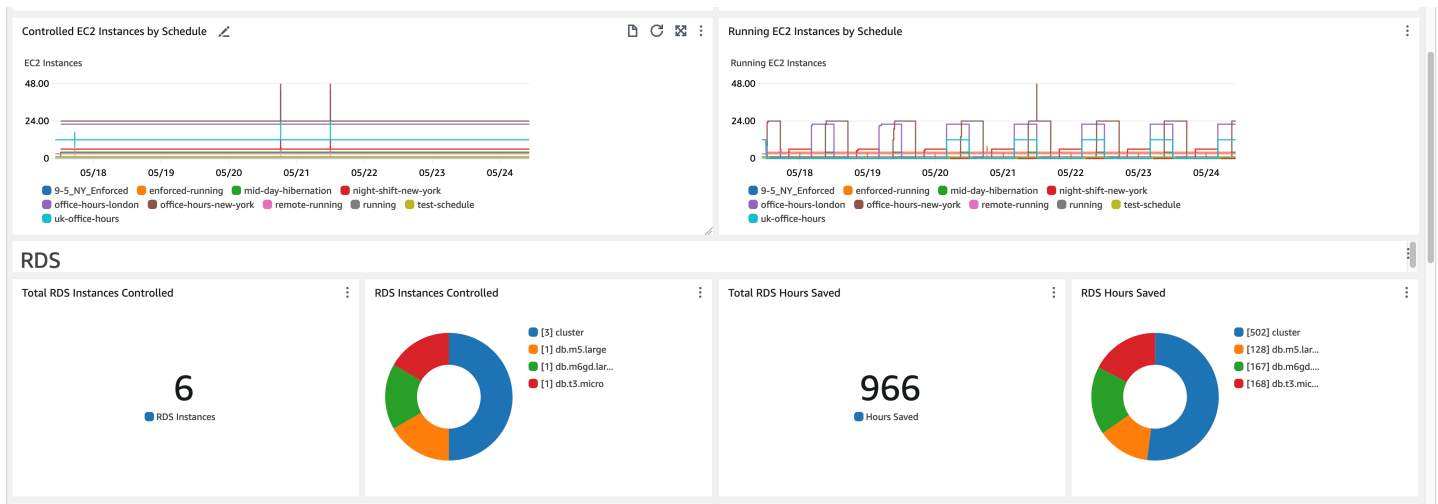
To use this dashboard, ensure that **Operational Monitoring** is set to "enabled" in the solution's hub stack parameters in AWS CloudFormation. Then go to AWS CloudWatch and select "Dashboards" from the navigation menu. The dashboards name will be **{stack-name}-Operational-Insights-Dashboard**

The dashboard will display various operational metrics about the operations of your solution including counts of how many instances are currently being managed by the solution, information on when and how many instances are running throughout the day, and an estimation of how many running hours have been saved by shutting instances down. Sample data below:

Dashboard showing EC2 instance metrics



EC2 instance schedules and RDS metrics showing controlled instances and hours saved

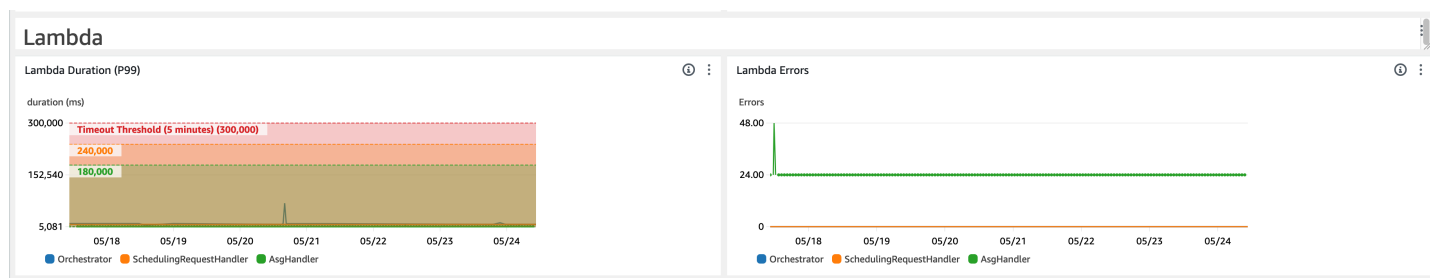


Note

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.

The dashboard also provides insight into the health of Lambda functions that are critical to the operation of the solution. If the average Lambda duration for any of the depicted Lambda functions begins to approach the yellow zone, it may be time to increase the Lambda size property on the solution hub stack.

Lambda duration graph showing timeout threshold and error count for multiple functions.



Depicted: AsgHandler is raising consistent errors over multiple days. This indicates a potential problem with ASG scheduling and should prompt further investigation into the logs for that Lambda

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-schedule metrics	\$0.60 per schedule*
Per-instance-type metrics	\$0.90 per instance type*
API usage	~\$0.10 per account/region

****These costs are tracked per service category (EC2/RDS) and only for schedules/instance types actually used for scheduling. For example, if you have 15 schedules configured, with three for RDS and five for EC2, the total cost will be \$0.60 or \$4.80/month. Inactive schedules will not be billed.***

Monitor the solution with Service Catalog AppRegistry

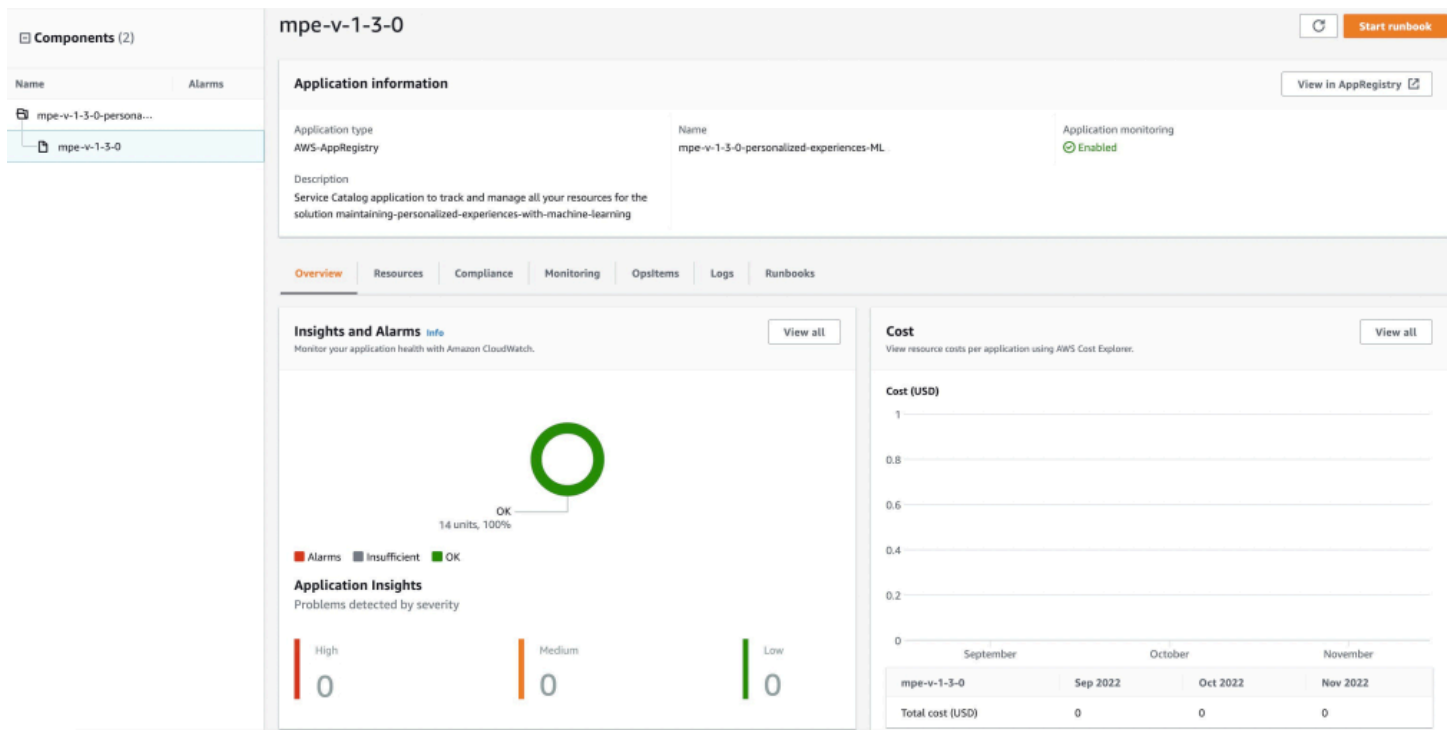
The solution includes a Service Catalog AppRegistry resource to register the CloudFormation template and underlying resources as an application in both [Service Catalog AppRegistry](#) and [AWS Systems Manager Application Manager](#).

AWS Systems Manager Application Manager gives you an application-level view into this solution and its resources so that you can:

- Monitor its resources, costs for the deployed resources across stacks and AWS accounts, and logs associated with this solution from a central location.
- View operations data for the resources of this solution in the context of an application, such as deployment status, CloudWatch alarms, resource configurations, and operational issues.

The following figure depicts an example of the application view for Instance Scheduler on AWS stack in Application Manager.

Instance Scheduler on AWS in Application Manager



Note: You must activate CloudWatch Application Insights, AWS Cost Explorer, and cost allocation tags associated with this solution. They are not activated by default.

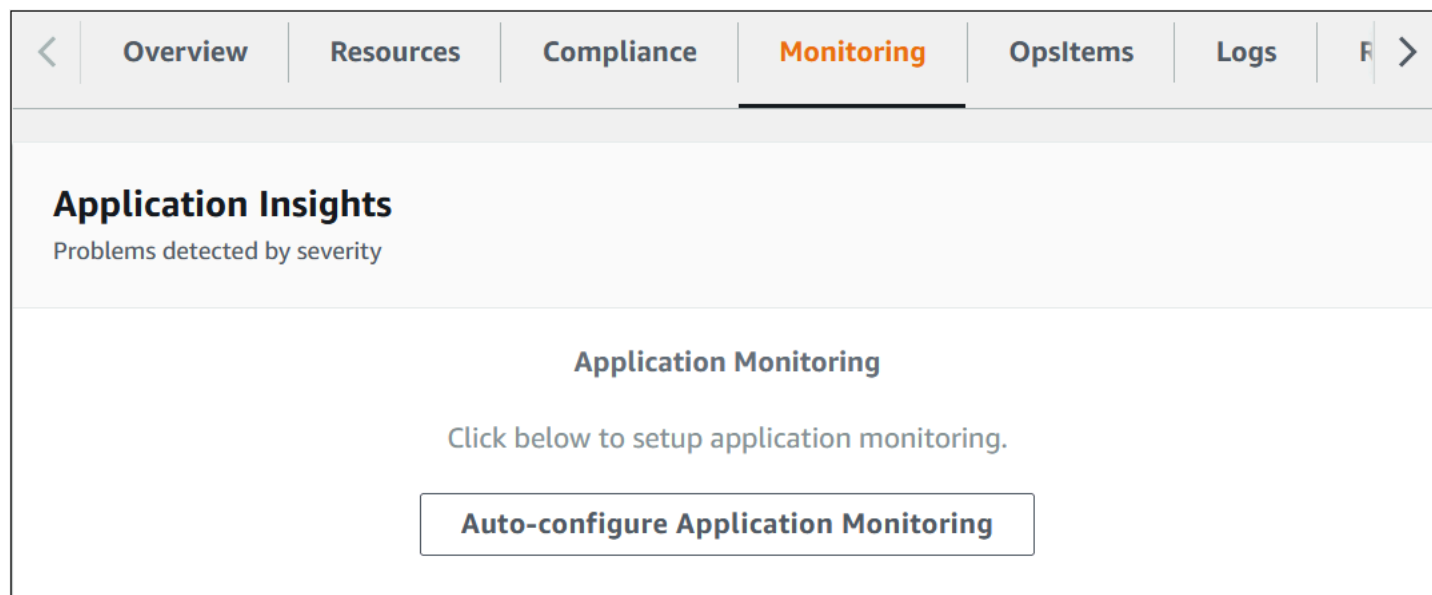
Activate CloudWatch Application Insights

1. Sign in to the [Systems Manager console](#).
2. In the navigation pane, choose **Application Manager**.
3. In **Applications**, search for the application name for this solution and select it.

The application name will have App Registry in the **Application Source** column, and will have a combination of the solution name, Region, account ID, or stack name.

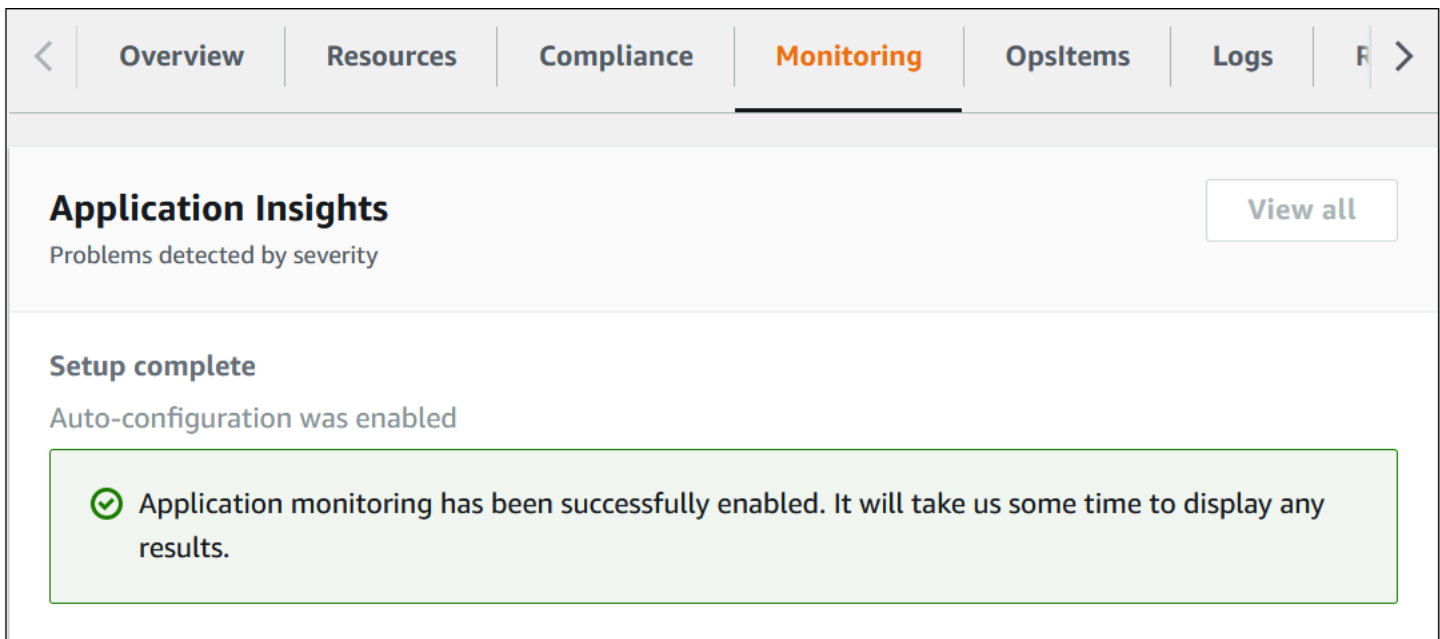
4. In the **Components** tree, choose the application stack you want to activate.
5. In the **Monitoring** tab, in **Application Insights**, select **Auto-configure Application Insights**.

Screenshot of Application Monitoring



Monitoring for your applications is now activated and the following status box appears:

Screenshot of Application Insights

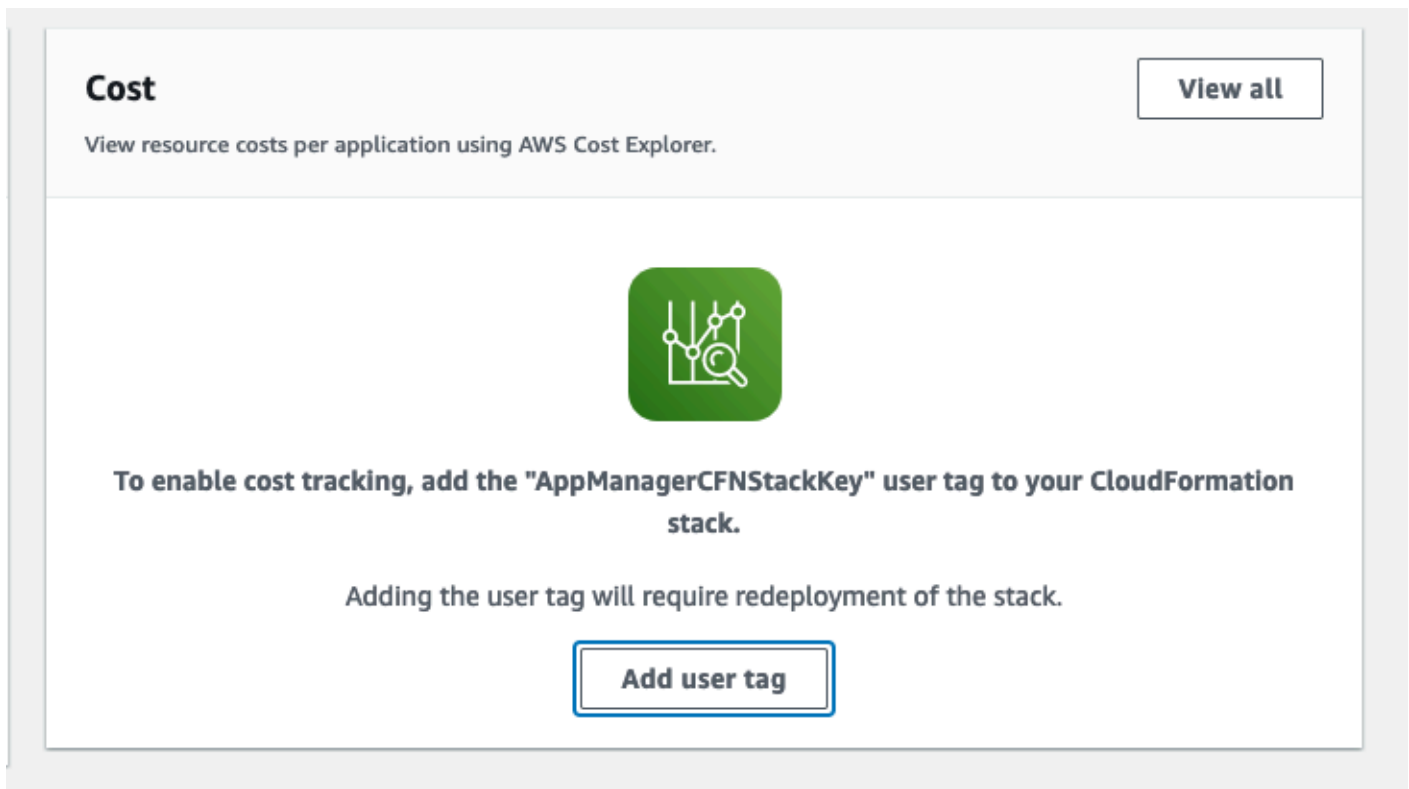


Confirm cost tags associated with the solution

After you activate cost allocation tags associated with the solution, you must confirm the cost allocation tags to see the costs for this solution. To confirm cost allocation tags:

1. Sign in to the [Systems Manager console](#).
2. In the navigation pane, choose **Application Manager**.
3. In **Applications**, choose the application name for this solution and select it.
4. In the **Overview** tab, in **Cost**, select **Add user tag**.

Cost tracking interface with green icon and instructions to add "AppManagerCFNStackKey" user tag.



5. On the **Add user tag** page, enter confirm, then select **Add user tag**.

The activation process can take up to 24 hours to complete and the tag data to appear.

Activate cost allocation tags associated with the solution

After you activate Cost Explorer, you must activate the cost allocation tags associated with this solution to see the costs for this solution. The cost allocation tags can only be activated from the management account for the organization. To activate cost allocation tags:

1. Sign in to the [AWS Billing and Cost Management and Cost Management console](#).
2. In the navigation pane, select **Cost Allocation Tags**.
3. On the **Cost allocation tags** page, filter for the AppManagerCFNStackKey tag, then select the tag from the results shown.
4. Choose **Activate**.

AWS Cost Explorer

You can see the overview of the costs associated with the application and application components within the Application Manager console through integration with AWS Cost Explorer which must be first activated. Cost Explorer helps you manage costs by providing a view of your AWS resource costs and usage over time. To activate Cost Explorer for the solution:

1. Sign in to the [AWS Cost Management console](#).
2. In the navigation pane, select **Cost Explorer** to view the solution's costs and usage over time.

Performance

If the solution's AWS Lambda function does not process all scheduled instances before its next invocation, the solution logs the error in Amazon CloudWatch Logs, and sends an Amazon Simple Notification Service (Amazon SNS) notification to the error SNS topic. To help ensure that all instances are processed before the next invocation, you can change the default interval at which the Lambda function runs or launch multiple deployments of the solution with different tag names.

If you increase the default interval, this might reduce the granularity of your schedules. For example, a Lambda function set to run on a 15-minute interval will only perform start and stop actions every 15 minutes.

To schedule a large number of instances, we recommend using an interval of at least five minutes and increasing the memory size of the Instance Scheduler's main AWS Lambda function using the **Memory Size** parameter.

Update the solution

Important

Instance Scheduler v1.5.0 has a known compatibility issue with AppRegistry that prevents it from being able to directly upgrade to newer versions of the solution.

If you are planning to update from v1.5.0 to any future AppRegistry enabled version, you must first update to the 1.5.0-u intermediary stack using the following templates:

Hub Stack: <https://solutions-reference.s3.amazonaws.com/aws-instance-scheduler/v1.5.0/aws-instance-scheduler-1.5.0-u.template>

Remote Stack: <https://solutions-reference.s3.amazonaws.com/aws-instance-scheduler-remote-v1.5.0-u.template/>

Installation of these stacks will disable AppRegistry integration on your deployment, allowing newer versions of the solution to recreate the association.

Example upgrade path: 1.5.0 → 1.5.0-u → 3.0.4

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**.
2. Select **Replace current template**.
3. 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.
4. 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](#).
5. Choose **Next**.
6. On the **Configure stack options** page, choose **Next**.
7. 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.
8. Choose **View change set** and verify the changes.
9. 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 data or interruption to scheduling operations except where explicitly called out below. When updating past certain versions, you may need to take certain actions for versions you are passing. For example, when updating from v1.4.1 to v3.0.2, follow the instructions for breaking changes in v1.5.0 and v3.0.0.

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 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.

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

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: Solution update from any version v1.3.x to v1.5.0

Lambda function is not working, for example, scheduling is not being performed.

Resolution

1. Ensure that the update to the CloudFormation stack has been completed.
2. Go to the CloudFormation console and select the solution stack .
3. Select the Resources tab.
4. Search for **Main** in the **Search Resources** filter.
5. Select the Lambda function in the **Physical ID** column.
6. In the Lambda console select **Configuration**.
7. Select the environment **Variables**.
8. Ensure the following environment variables are available.
 - ACCOUNT
 - CONFIG_TABLE
 - DDB_TABLE_NAME
 - ENABLE_SSM_MAINTENANCE_WINDOWS
 - ISSUES_TOPIC_ARN
 - LOG_GROUP
 - MAINTENANCE_WINDOW_TABLE
 - METRICS_URL
 - SCHEDULER_FREQUENCY
 - SEND_METRICS
 - SOLUTION_ID
 - STACK_ID
 - STACK_NAME
 - START_EC2_BATCH_SIZE
 - STATE_TABLE
 - TAG_NAME
 - TRACE
 - USER_AGENT

- USER_AGENT_EXTRA
- UUID_KEY

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: 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 Support

If you have [AWS Developer Support](#), [AWS Business Support](#), or [AWS Enterprise Support](#), you can use the 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.
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**.

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 an optional feature for collecting unique metrics for this solution, [quotas](#), pointers to [related resources](#), and a [list of builders](#) who contributed to this solution.

Anonymized data collection

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. When invoked, the following information is collected periodically and sent to AWS:

- **Solution ID** - The AWS Solution identifier.
- **Unique ID (UUID)** - Randomly generated, unique identifier for each Instance Scheduler on AWS deployment.
- **Timestamp** - Data-collection timestamp.
- **Scheduling Actions** - Count of how often instance scheduler takes certain actions against instances and how long it took to perform those actions.

Example data:

```
num_unique_schedules: 4
num_instances_scanned: 23
duration_seconds: 6.7
actions: [
  {
    action: Started
    instanceType: a1.medium
    instances: 8
    service: ec2
  },
  ...
]
```

- **Instance Count** - Count of the number of instances and schedules being processed in each Region.

Example data:

```
service: [ec2]
regions: [us-east-1]
num_instances: 35
num_schedules: 6
```

- ***Deployment Description *** An overview description of the deployment:

Example data:

```
services: [ec2, rds]
regions: [us-east-1, us-east-2]
num_accounts: 6
num_schedules: 12
num_cfn_schedules: 3
default_timezone: UTC
schedule_aurora_clusters: True,
create_rds_snapshots: False,
schedule_interval_minutes: 10,
memory_size_mb: 128,
using_organizations: False,
enable_ec2_ssm_maintenance_windows: True,
num_started_tags: 1,
num_stopped_tags: 0,
schedule_flag_counts: {
  stop_new_instances: 10,
  enforced: 3,
  retain_running: 0,
  hibernate: 0,
  override: 0,
  use_ssm_maintenance_window: 2,
  use_metrics: 0,
  non_default_timezone: 4,
},
```

- **CLI Usage** How often each feature of the Scheduler CLI is used.

Example data:

```
command_used: describe-schedule-usage
```


AWS owns the data gathered through this survey. Data collection is subject to the [AWS Privacy Policy](#). To opt out of this feature, complete the following steps before launching the CloudFormation template.

1. Download the `instance-scheduler-on-aws.template` [AWS CloudFormation template](#) to your local hard drive.
2. Open the CloudFormation template with a text editor.
3. Modify the CloudFormation template mapping section from:

```
"Send": {  
  "AnonymousUsage": {  
    "Data": "Yes"  
  }  
}
```

to

```
"Send": {  
  "AnonymousUsage": {  
    "Data": "No"  
  }  
}
```

4. Sign in to the [AWS CloudFormation console](#).
5. Select **Create stack**.
6. On the **Create stack** page, **Specify template** section, select **Upload a template file**.
7. Under **Upload a template file**, choose **Choose file** and select the edited template from your local drive.
8. Choose **Next** and follow the steps in the [Launch the stack](#) section of this guide.

Quotas

Service quotas, also referred to as limits, are the maximum number of service resources or operations for your AWS account.

Quotas for AWS services in this solution

Make sure you have sufficient quota for each of the [services implemented in this solution](#). For more information, see [AWS service quotas](#).

Use the following links to go to the page for that service. To view the service quotas for all AWS services in the documentation without switching pages, view the information in the [Service endpoints and quotas](#) page in the PDF instead.

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 AWS Lambda, Concurrent Execution quota of 1000, if the solution is used in an account where there are other workloads running and using Lambda then this Quota should be set to an appropriate value. This value is adjustable, for more information refer to [AWS Lambda Getting started guide](#).

Related resources

The [Resource Scheduler](#) is 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 regularly 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
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

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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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