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# Amazon WorkSpaces Cost Optimizer Implementation Guide



## **Amazon WorkSpaces Cost Optimizer: Implementation Guide**

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# Amazon WorkSpaces Cost Optimizer

## **AWS Implementation Guide**

*AWS Solutions Builder Team*

*January 2017 (last update (p. 15): April 2020)*

This implementation guide discusses architectural considerations and configuration steps for deploying the Amazon WorkSpaces Cost Optimizer on the Amazon Web Services Cloud. It includes links to [AWS CloudFormation](#) templates that launch, configure, and run the AWS compute, management, storage, and other services required to deploy this solution on AWS, using AWS best practices for security and availability.

The guide is intended for IT infrastructure architects, administrators, and DevOps professionals who have a working knowledge of Amazon WorkSpaces and architecting on the AWS Cloud.

# Overview

Amazon WorkSpaces, a fully managed, secure Desktop-as-a-Service (DaaS) solution that runs on AWS, eliminates the need for customers to procure, deploy, and manage complex virtual desktop environments. Amazon WorkSpaces provides a complete cloud-based virtual desktop service, including compute, persistent storage, and applications.

Amazon WorkSpaces offers the flexibility to pay hourly or monthly without any up-front commitment. With hourly billing, you pay a small fixed monthly fee per Workspace and a low hourly rate for each hour the Workspace is used during the month. With monthly billing, you pay a fixed monthly fee for unlimited usage during the month. This is initially set up when you launch the Workspace and can be changed at any time.

To help customers monitor their Workspace usage and optimize costs, AWS offers the Amazon WorkSpaces Cost Optimizer, a solution that analyzes all of your Amazon WorkSpaces usage data and automatically converts the Workspace to the most cost-effective billing option (hourly or monthly) depending on a user's individual usage. This solution is easy to deploy and uses AWS CloudFormation to automatically provision and configure the necessary AWS services to convert individual WorkSpaces.

This guide assumes basic knowledge of virtual desktops and Amazon WorkSpaces. It is also helpful to have working knowledge of Amazon Simple Storage Service (Amazon S3), AWS Lambda, Amazon CloudWatch, and AWS Fargate.

## Cost

You are responsible for the cost of the AWS services used while running this solution. The total cost for running this solution depends on the number of WorkSpaces this solution monitors. As of the date of publication, the cost for running this solution with default settings in the US East (N. Virginia) Region is approximately **\$0.005 per day** for a deployment with 25 WorkSpaces. This does not include the cost of the individual WorkSpaces. This reflects AWS Lambda, Amazon CloudWatch, and AWS Fargate charges. You will also incur variable charges from Amazon S3.

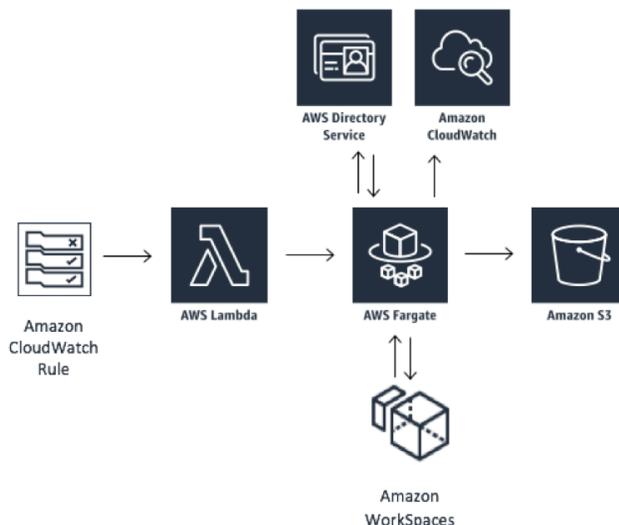
### Note

The default values provided in the Amazon WorkSpaces Cost Optimizer for each of the WorkSpaces bundle type should be considered a guidance value only. Review [Amazon WorkSpaces pricing](#) for the AWS Region where you deployed the solution to determine the value for your location. Pricing differences between AWS Regions can mean a different billing break-even point between AutoStop and AlwaysOn instances.

Prices are subject to change. For full details, see the pricing webpage for each AWS service you will be using in this solution.

## Architecture Overview

Deploying this solution builds the following environment in the AWS Cloud.



**Figure 1: Amazon WorkSpaces Cost Optimizer architecture**

The AWS CloudFormation template creates an Amazon CloudWatch rule that invokes the Amazon WorkSpaces Cost Optimizer AWS Lambda function every 24 hours. The Lambda function leverages Amazon Elastic Container Service (Amazon ECS) to create an AWS Fargate task definition to poll the AWS Directory Service to gather a list of all directories registered for Amazon WorkSpaces in a specific AWS Region.

The task then checks the total usage for each Workspace that is on an hourly billing model. If the monthly usage threshold has been met, the solution will convert the individual Workspace to monthly billing.

**Note**

If a Workspace starts in monthly billing or the solution converts a Workspace from hourly to monthly billing, the solution will not convert the Workspace to hourly billing until the beginning of the next month, if usage was below the threshold. However, you can manually change the billing model at any time using the Amazon WorkSpaces console. Also, you can change the threshold for when each Workspace converts from hourly to monthly billing. For more information, see [Billing Model Conversion \(p. 4\)](#).

The solution also features a dry run mode that enables you to gain insight into how the recommended changes will affect your costs. For more information, see [Dry Run Mode \(p. 4\)](#).

At the end of the month, the solution checks the total usage for each Workspace that is on a monthly billing model. If the monthly usage threshold has not been met, the solution will convert the individual Workspace from monthly to hourly billing at the start of the next month.

The AWS CloudFormation template also creates an Amazon S3 bucket to log the conversions at the end of each execution.

**Note**

Check your Amazon S3 bucket frequently to track the optimizer's activity, and to view logs with error messages. Runtime information is logged in Amazon CloudWatch and Workspace metadata is stored in Amazon S3.

# Implementation Considerations

## Dry Run Mode

We recommend that you run this solution in the dry run mode for a few months, review the daily and monthly reports, and manually implement any desired changes. This provides insight into how the recommended changes may affect your WorkSpaces costs and allows you to evaluate and analyze solution's recommendations. When you are comfortable with the recommendations provided by the solution and would like these recommendations to be automatically implemented, change the template parameter **Dry Run Mode** to `No`. The solution will then begin to automatically implement future changes based on the recommendations provided in its daily and monthly reports.

## Billing Model Conversion

### Hourly to Monthly

This solution will calculate the hourly WorkSpace usage for each WorkSpace once per day, just before midnight GMT. Note that the calculation includes that day's usage. When the **Dry Run Mode** parameter is set to `No`, the solution will automatically convert individual WorkSpaces from an hourly billing model to a monthly billing model, if the WorkSpace exceeds an hourly usage threshold for that particular WorkSpace type.

By default, the threshold is set close to the hourly and monthly billing break-even point. But, you can use the solution's AWS CloudFormation template parameters to change the threshold for when each WorkSpace converts from hourly to monthly billing.

Because the solution cannot convert WorkSpaces before the calculation at midnight, the default configuration may result in some WorkSpaces exceeding the threshold for up to 24 hours. For example, the default threshold for a Standard instance is set to 85. If, at midnight on Monday, your usage is 84, the WorkSpace will not be converted to monthly billing. If usage exceeds 85 after midnight on Monday, the WorkSpace will not be converted until the calculation at midnight on Tuesday.

We recommend carefully monitoring your usage using dry run mode and adjusting the threshold to meet your needs. If several of your WorkSpaces consistently exceed the threshold before being converted, consider lowering the threshold. If several of your WorkSpaces are prematurely converted before exceeding the threshold, consider raising the threshold.

Once the solution converts a WorkSpace from hourly billing to monthly billing, the solution will not convert the WorkSpace back to hourly billing until the beginning of the next month, if usage was below the monthly usage threshold. However, you can manually change the billing model at any time using the AWS Management Console.

### Monthly to Hourly

The solution converts a WorkSpace to monthly or hourly billing model at the end of the month, depending on the WorkSpace utilization for the given month. If WorkSpace utilization exceeds the usage threshold, the billing model changes to monthly. If WorkSpace utilization was lesser than or equal to usage threshold, the model changes to hourly. To prevent Amazon WorkSpaces from being converted multiple times in a month, usage for monthly WorkSpaces is calculated at the end of the month. For

customers who want to convert WorkSpaces from monthly billing to hourly billing immediately, the solution's AWS CloudFormation template includes a parameter (**Simulate End of Month**) that will execute these conversions at the time of deployment.

## Opting Out with Tags

To prevent the solution from converting a WorkSpace between billing models, you can apply a resource tag to the WorkSpace using the tag key **skip\_convert** and any tag value. This solution will log tagged WorkSpaces, but it will not convert the tagged WorkSpaces. Remove the tag at any time to resume automatic conversion for that WorkSpace.

## Regional Deployment

You must launch the Amazon WorkSpaces Cost Optimizer solution in an AWS Region that supports AWS Lambda, Amazon WorkSpaces, and AWS Fargate services. However, once deployed, the solution will monitor the WorkSpaces in any AWS Region. Also, you must launch this solution in the same account as the WorkSpaces you want to monitor. For the most current AWS Lambda availability by region, see [AWS service offerings by region](#).

# AWS CloudFormation Template

This solution uses AWS CloudFormation to automate the deployment of Amazon WorkSpaces Cost Optimizer on the AWS Cloud. It includes the following AWS CloudFormation template, which you can download before deployment:

[View  
Template](#)

**workspaces-cost-optimizer.template:** Use this template to launch the Amazon WorkSpaces Cost Optimizer and all associated components. The default configuration deploys an AWS Lambda functions, an Amazon ECS task definition, an Amazon CloudWatch event, and an Amazon S3 bucket, but you can also customize the template based on your specific needs.

# Automated Deployment

Before you launch the automated deployment, please review the architecture, configuration, and other considerations discussed in this guide. Follow the step-by-step instructions in this section to configure and deploy Amazon WorkSpaces Cost Optimizer into your account.

**Time to deploy:** Approximately five minutes

## Launch the Stack

This automated AWS CloudFormation template deploys the Amazon WorkSpaces Cost Optimizer on the AWS Cloud.

### Note

You are responsible for the cost of the AWS services used while running this solution. See the [Cost \(p. 2\)](#) section for more details. For full details, see the pricing webpage for each AWS service you will be using in this solution.

1. Sign in to the AWS Management Console and choose the button below to launch the `workspaces-cost-optimizer` AWS CloudFormation template.



You can also [download the template](#) as a starting point for your own implementation.

2. The template is launched in the US East (N. Virginia) Region by default. To launch the Amazon WorkSpaces Cost Optimizer in a different AWS Region, use the region selector in the console navigation bar.

### Note

This solution uses AWS Lambda, AWS Fargate, and Amazon WorkSpaces, which are currently available in specific AWS Regions only. However, once deployed, the solution will monitor the Workspaces in any AWS Region. Also, you must launch this solution in the same account as the WorkSpaces you want to monitor. For the most current availability by region, see [AWS service offerings by region](#).

3. On the **Select Template** page, verify that you selected the correct template and choose **Next**.
4. Under **Parameters**, review the parameters for the template and modify them as necessary. This solution uses the following default values.

Parameter	Default	Description
<b>Launch in Dry Run Mode?</b>	Yes	Generates a change log, but does not execute any changes. For more information, see <a href="#">Dry Run Mode (p. 4)</a>
<b>Simulate End of Month</b>	No	Overrides date and forces the solution to run as if it is the end of the month

Parameter	Default	Description
<b>Log Level</b>	INFO	Sets the log level for the Lambda function logs in CloudWatch
<b>Value Limit</b>	81	The number of hours a Value instance can run in a month before being converted to ALWAYS_ON
<b>Standard Limit</b>	85	The number of hours a Standard instance can run in a month before being converted to ALWAYS_ON
<b>Performance Limit</b>	83	The number of hours a Performance instance can run in a month before being converted to ALWAYS_ON
<b>Power Limit</b>	83	The number of hours a Power instance can run in a month before being converted to ALWAYS_ON
<b>Graphics Limit</b>	217	The number of hours a Graphics instance can run in a month before being converted to ALWAYS_ON
<b>PowerPro Limit</b>	80	The number of hours a PowerPro instance can run in a month before being converted to ALWAYS_ON
<b>GraphicsPro Limit</b>	80	The number of hours a GraphicsPro instance can run in a month before being converted to ALWAYS_ON
<b>VPC CIDR</b>	10.215.0.0/16	The default VPC CIDR used to deploy the AWS Fargate container dynamically when the solution runs
<b>Subnet1 CIDR</b>	10.215.10.0/24	One of two subnets in different AZs where the AWS Fargate container is deployed
<b>Subnet2 CIDR</b>	10.215.20.0/24	The second of two subnets in different AZs where the AWS Fargate container is deployed

5. Choose **Next**.
6. On the **Options** page, choose **Next**.
7. On the **Review** page, review and confirm the settings. Be sure to check the box acknowledging that the template will create AWS Identity and Access Management (IAM) resources.
8. Choose **Create** 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.

**Note**

In addition to the `CostOptimizerCreateTask` AWS Lambda function, this solution includes the `solution-helper` Lambda function, which runs only during initial configuration or when resources are updated or deleted.

When running this solution, you will see all AWS Lambda functions in the AWS console, but only the `CostOptimizerCreateTask` function is regularly active. However, do not delete the `solution-helper` function as it is necessary to manage associated resources.

# Security

When you build systems on AWS infrastructure, security responsibilities are shared between you and AWS. This shared model can reduce your operational burden as AWS operates, manages, and controls the components from the host operating system and virtualization layer down to the physical security of the facilities in which the services operate. For more information about security on AWS, visit the [AWS Security Center](#).

## IAM Roles

This solution creates AWS Identity and Access Management (IAM) roles to control and isolate permissions for the AWS Lambda function and AWS Fargate Container, following the best practice of least privilege. The services are granted the following permissions:

`CostOptimizerCreateTask` function:

- Create and Run Amazon ECS tasks
- Execute permissions to AWS Lambda

ECS Container:

- Read-only permissions to AWS Directory Service
- Write permissions to Amazon CloudWatch Logs
- Write permissions to Amazon S3
- Read/Write permissions to Amazon WorkSpaces

# Additional Resources

## **AWS services**

- [Amazon WorkSpaces](#)
- [AWS CloudFormation](#)
- [AWS Lambda](#)
- [Amazon CloudWatch](#)
- [AWS Fargate](#)

# Appendix: Collection of Operational Metrics

This solution includes an option to send anonymous operational metrics to AWS. We use this data to better understand how customers use this solution and related services and products. When enabled, the following information is collected and sent to AWS:

- **Solution ID:** The AWS solution identifier
- **Unique ID (UUID):** Randomly generated, unique identifier for each Amazon WorkSpaces Cost Optimizer deployment
- **Timestamp:** Data-collection timestamp
- **WorkSpaces Data:** The number and billing model of WorkSpaces that the Amazon WorkSpaces Cost Optimizer manages in each AWS Region

Example data:

```
{
  noChange: 103
  error: 0
  toHourly: 0
  toMonthly: 17
}
```

Note that AWS will own the data gathered via this survey. Data collection will be subject to the [AWS Privacy Policy](#). To opt out of this feature, modify the AWS CloudFormation template mapping section as follows:

```
Mappings:
  Solution:
    Data:
      SendAnonymousUsageData: True
```

to

```
Mappings:
  Solution:
    Data:
      SendAnonymousUsageData: False
```

# Source Code

Visit our [GitHub repository](#) to download the templates and scripts for this solution, and to share your customizations with others.

# Contributors

The following individuals contributed to this document:

- Matt Juairé
- Joseph Seeley
- Michael Ortwein

# Document Revisions

Date	Change
January 2017	Initial release
March 2017	Added a function to the child AWS Lambda function and updated the parameters
February 2018	Added a Power instance parameter and updated the anonymous data collection configuration
May 2018	Updated for clarity on the Dry Run Mode provided by the solution
December 2018	Added clarification on billing conversion
February 2019	Converted parent and child AWS Lambda functions to AWS Fargate container solution
December 2019	Added information on support for Node.js update
April 2020	Bug fixes

# Notices

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