# Amazon WorkSpaces Administration Guide

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What Is Amazon WorkSpaces?

Amazon WorkSpaces enables you to provision virtual, cloud-based Microsoft Windows or Amazon Linux desktops for your users, known as WorkSpaces. Amazon WorkSpaces eliminates the need to procure and deploy hardware or install complex software. You can quickly add or remove users as your needs change. Users can access their virtual desktops from multiple devices or web browsers.

For more information, see Amazon WorkSpaces.

Features

- Choose your operating system (Windows or Amazon Linux) and select from a range of hardware configurations, software configurations, and AWS Regions. For more information, see Amazon WorkSpaces Bundles.
- Connect to your WorkSpace and pick up from right where you left off. Amazon WorkSpaces provides a persistent desktop experience.
- Amazon WorkSpaces provides the flexibility of either monthly or hourly billing for WorkSpaces. For more information, see Amazon WorkSpaces Pricing.
- Deploy and manage applications for your Windows WorkSpaces by using Amazon WorkSpaces Application Manager (Amazon WAM).
- For Windows desktops, you can bring your own licenses and applications, or purchase them from the AWS Marketplace for Desktop Apps.
- Create a standalone managed directory for your users, or connect your WorkSpaces to your on-premises directory so that your users can use their existing credentials to obtain seamless access to corporate resources.
- Use the same tools to manage WorkSpaces that you use to manage on-premises desktops.
- Use multi-factor authentication (MFA) for additional security.
- Use AWS Key Management Service (AWS KMS) to encrypt data at rest, disk I/O, and volume snapshots.
- Control the IP addresses from which users are allowed to access their WorkSpaces.

Architecture

For both Windows and Amazon Linux WorkSpaces, each WorkSpace is associated with a virtual private cloud (VPC), and a directory to store and manage information for your WorkSpaces and users. Directories are managed through the AWS Directory Service, which offers the following options: Simple AD, AD Connector, or AWS Directory Service for Microsoft Active Directory, also known as AWS Managed Microsoft AD. For more information, see the AWS Directory Service Administration Guide.

Amazon WorkSpaces uses a directory, either AWS Directory Service or AWS Managed Microsoft AD, to authenticate users. Users access their WorkSpaces by using a client application from a supported device or, for Windows WorkSpaces, a web browser, and they log in by using their directory credentials. The login information is sent to an authentication gateway, which forwards the traffic to the directory for the WorkSpace. After the user is authenticated, streaming traffic is initiated through the streaming gateway.

Client applications use HTTPS over port 443 for all authentication and session-related information. Client applications use port 4172 for pixel streaming to the WorkSpace and for network health checks. For more information, see Ports for Client Applications (p. 15).
Each WorkSpace has two elastic network interfaces associated with it: a network interface for management and streaming (eth0) and a primary network interface (eth1). The primary network interface has an IP address provided by your VPC, from the same subnets used by the directory. This ensures that traffic from your WorkSpace can easily reach the directory. Access to resources in the VPC is controlled by the security groups assigned to the primary network interface. For more information, see Network Interfaces (p. 25).

The following diagram shows the architecture of Amazon WorkSpaces.

For additional architecture diagrams, see the "Best Practices for Deploying Amazon WorkSpaces" whitepaper.

Accessing Your WorkSpace

You can connect to your WorkSpaces by using the client application for a supported device or, for Windows WorkSpaces, by using a supported web browser on a supported operating system.

**Note**
You cannot use a web browser to connect to Amazon Linux WorkSpaces.

There are client applications for the following devices:

- Windows computers
- macOS computers
- Ubuntu Linux 18.04 computers
- Chromebooks
- iPads
- Android devices
- Fire tablets
- Zero client devices
On Windows, macOS, and Linux PCs, you can use the following web browsers to connect to Windows WorkSpaces:

- Chrome 53 and later (Windows and macOS only)
- Firefox 49 and later

For more information, see Amazon WorkSpaces Clients in the Amazon WorkSpaces User Guide.

Pricing

After you sign up for AWS, you can get started with Amazon WorkSpaces for free using the Amazon WorkSpaces free tier offer. For more information, see Amazon WorkSpaces Pricing.

With Amazon WorkSpaces, you pay only for what you use. You are charged based on the bundle and the number of WorkSpaces that you launch. The pricing for Amazon WorkSpaces includes the use of Simple AD and AD Connector but not the use of AWS Managed Microsoft AD.

Amazon WorkSpaces provides monthly or hourly billing for WorkSpaces. With monthly billing, you pay a fixed fee for unlimited usage, which is best for users who use their WorkSpaces full time. With hourly billing, you pay a small fixed monthly fee per WorkSpace, plus a low hourly rate for each hour the WorkSpace is running. For more information, see Amazon WorkSpaces Pricing.

How to Get Started

To create a WorkSpace, try one of the following tutorials:

- Get Started with Amazon WorkSpaces Quick Setup (p. 4)
- Launch a WorkSpace Using AWS Managed Microsoft AD (p. 65)
- Launch a WorkSpace Using Simple AD (p. 67)
- Launch a WorkSpace Using AD Connector (p. 70)
- Launch a WorkSpace Using a Trusted Domain (p. 73)
Get Started with Amazon WorkSpaces Quick Setup

In this tutorial, you learn how to provision a virtual, cloud-based Microsoft Windows or Amazon Linux desktop, known as a WorkSpace, by using Amazon WorkSpaces and AWS Directory Service.

This tutorial uses the Quick Setup option to launch your WorkSpace. This option is available only if you have never launched a WorkSpace. Alternatively, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 64).

Note
Quick Setup is supported only in the following AWS Regions:

- US East (N. Virginia)
- US West (Oregon)
- Europe (Ireland)
- Asia Pacific (Singapore)
- Asia Pacific (Sydney)
- Asia Pacific (Tokyo)

To change your Region, see Choosing a Region.

Tasks
- Before You Begin (p. 4)
- Step 1: Launch the WorkSpace (p. 4)
- Step 2: Connect to the WorkSpace (p. 6)
- Step 3: Clean Up (Optional) (p. 7)
- Next Steps (p. 7)

Before You Begin

- You must have an AWS account to create or administer a WorkSpace. Users do not need an AWS account to connect to and use their WorkSpaces.
- When you launch a WorkSpace, you must select a WorkSpace bundle. For more information, see Amazon WorkSpaces Bundles.
- When you launch a WorkSpace, you must specify profile information for the user, including a user name and email address. Users complete their profiles by specifying a password. Information about WorkSpaces and users is stored in a directory.
- Amazon WorkSpaces is not available in every Region. Verify the supported Regions and select a Region for your WorkSpaces. For more information about the supported Regions, see Amazon WorkSpaces Pricing by AWS Region.

Step 1: Launch the WorkSpace

Using Quick Setup, you can launch your first WorkSpace in minutes.
To launch a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. Choose Get Started Now. If you don’t see this button, either you have already launched a WorkSpace in this Region, or you aren’t using one of the Regions that support Quick Setup (p. 4). In this case, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 64).
3. On the Get Started with Amazon WorkSpaces page, next to Quick Setup, choose Launch.

4. For Bundles, select a bundle (hardware and software) for the user. For more information about the various public bundles available for Amazon WorkSpaces, see Amazon WorkSpaces Bundles.

5. For Enter User Details, complete Username, First Name, Last Name, and Email.

6. Choose Launch WorkSpaces.

7. On the confirmation page, choose View the WorkSpaces Console. It takes approximately 20 minutes for your WorkSpace to be launched. To monitor the progress, go to the left navigation pane and choose Directories. You will see a directory being created with an initial status of REQUESTED and then CREATING.
After the directory has been created and has a status of **ACTIVE**, you can choose **WorkSpaces** in the left navigation pane to monitor the progress of the WorkSpace launch process. The initial status of the WorkSpace is **PENDING**. When the launch is complete, the status is **AVAILABLE** and an invitation is sent to the email address that you specified for the user.

**Quick Setup**

Quick Setup completes the following tasks on your behalf:

- Creates an IAM role to allow the Amazon WorkSpaces service to create elastic network interfaces and list your Amazon WorkSpaces directories. This role has the name `workspaces_DefaultRole`.
- Creates a virtual private cloud (VPC).
- Sets up a Simple AD directory in the VPC that is used to store user and WorkSpace information. The directory has an administrator account and it is enabled for Amazon WorkDocs.
- Creates the specified user accounts and adds them to the directory.
- Creates WorkSpace instances. Each WorkSpace receives a public IP address to provide internet access. The running mode is AlwaysOn. For more information, see Manage the WorkSpace Running Mode (p. 81).
- Sends invitation emails to the specified users.

**Note**
The first user account created by Quick Setup is your Admin user account. You can't update this user account from the Amazon WorkSpaces Console. Don't share the information for this Admin account with anyone else. If you want to invite other users to use this WorkSpace, create new user accounts for them.

**Step 2: Connect to the WorkSpace**

After you receive the invitation email, you can connect to the WorkSpace using the client of your choice. After you sign in, the client displays the WorkSpace desktop.

**To connect to the WorkSpace**

1. If you haven't set up credentials for the user already, open the link in the invitation email and follow the directions. Remember the password that you specify as you will need it to connect to your WorkSpace.

   **Note**
   Passwords are case-sensitive and must be between 8 and 64 characters in length, inclusive. Passwords must contain at least one character from three of the following categories: lowercase letters (a-z), uppercase letters (A-Z), numbers (0-9), and the set \~!@#$%^&*_+-`\["]\{|\}\(|\)|\[\]::"<>?,./.

2. Review Amazon WorkSpaces Clients in the Amazon WorkSpaces User Guide for more information about the requirements for each client, and then do one of the following:

   - When prompted, download one of the client applications or launch Web Access.
   - If you aren't prompted and you haven't installed a client application already, open https://clients.amazonworkspaces.com/ and download one of the client applications or launch Web Access.

   **Note**
   You cannot use a web browser (Web Access) to connect to Amazon Linux WorkSpaces.
3. Start the client, enter the registration code from the invitation email, and choose Register.
4. When prompted to sign in, enter the user name and password, and then choose Sign In.
5. (Optional) When prompted to save your credentials, choose Yes.

Step 3: Clean Up (Optional)

If you are finished with the WorkSpace that you created for this tutorial, you can delete it.

To delete the WorkSpace
1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select your WorkSpace and choose Actions, Remove WorkSpaces.
4. When prompted for confirmation, choose Remove WorkSpaces.
5. (Optional) If you are not using the directory with another application, such as Amazon WorkDocs, Amazon WorkMail, or Amazon Chime, you can delete it as follows:
   a. In the navigation pane, choose Directories.
   b. Select your directory and choose Actions, Deregister.
   c. Select your directory again and choose Actions, Delete.
   d. When prompted for confirmation, choose Delete.

Next Steps

To create additional WorkSpaces, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 64).
Networking and Access for Amazon WorkSpaces

As a WorkSpace administrator, you must understand the following about Amazon WorkSpaces networking and access.

Contents
- Configure a VPC for Amazon WorkSpaces (p. 8)
- Availability Zones for Amazon WorkSpaces (p. 14)
- IP Address and Port Requirements for Amazon WorkSpaces (p. 15)
- Amazon WorkSpaces Client Network Requirements (p. 27)
- Restrict WorkSpaces Access to Trusted Devices (p. 29)
- Provide Internet Access from Your WorkSpace (p. 30)
- Security Groups for Your WorkSpaces (p. 31)
- IP Access Control Groups for Your WorkSpaces (p. 32)
- Set Up PColP Zero Client for WorkSpaces (p. 34)
- Set Up Android for Chromebooks (p. 34)
- Enable and Configure Amazon WorkSpaces Web Access (p. 35)
- Set Up Amazon WorkSpaces for FedRAMP Authorization or DoD SRG Compliance (p. 37)
- Enable SSH Connections for Your Linux WorkSpaces (p. 38)
- Required Configuration and Service Components for WorkSpaces (p. 42)

Configure a VPC for Amazon WorkSpaces

Amazon WorkSpaces launches your WorkSpaces in a virtual private cloud (VPC). Your WorkSpaces must have access to the internet so that you can install updates to the operating system and deploy applications using Amazon WorkSpaces Application Manager (Amazon WAM).

You can create a VPC with two private subnets for your WorkSpaces and a NAT gateway in a public subnet. Alternatively, you can create a VPC with two public subnets for your WorkSpaces and associate an Elastic IP address with each WorkSpace.

VPC Requirements

Your VPC’s subnets must reside in different Availability Zones in the Region where you’re launching WorkSpaces. Availability Zones are distinct locations that are engineered to be isolated from failures in other Availability Zones. By launching instances in separate Availability Zones, you can protect your applications from the failure of a single location. Each subnet must reside entirely within one Availability Zone and cannot span zones.

Note
Amazon WorkSpaces is available in a subset of the Availability Zones in each supported Region. To determine which Availability Zones you can use for the subnets of the VPC that you’re using for WorkSpaces, see Availability Zones for Amazon WorkSpaces (p. 14).

Options
- Configure a VPC with Private Subnets and a NAT Gateway (p. 9)
- Configure a VPC with Public Subnets (p. 12)
Configure a VPC with Private Subnets and a NAT Gateway

If you use AWS Directory Service to create an AWS Managed Microsoft or a Simple AD, we recommend that you configure the VPC with one public subnet and two private subnets. Configure your directory to launch your WorkSpaces in the private subnets. To provide internet access to WorkSpaces in a private subnet, configure a NAT gateway in the public subnet.

Prerequisites

If you aren't already familiar with working with VPCs and subnets, we recommend reading VPC and Subnet Sizing for IPv4 in the Amazon VPC User Guide before performing the following tasks.

Tasks

- Step 1: Allocate an Elastic IP Address (p. 9)
- Step 2: Create a VPC (p. 10)
- Step 3: Add a Second Private Subnet (p. 11)
- Step 4: Verify and Name the Route Tables (p. 11)

Step 1: Allocate an Elastic IP Address

Allocate an Elastic IP address for your NAT gateway as follows. Note that if you are using an alternative method of providing internet access, you can skip this step.
To allocate an Elastic IP address
1. Open the Amazon VPC console at https://console.aws.amazon.com/vpc/.
2. In the navigation pane, choose Elastic IPs.
3. Choose Allocate new address.
4. On the Allocate new address page, for IPv4 address pool, choose Amazon pool or Owned by me, and then choose Allocate.
5. Make a note of the Elastic IP address, then choose Close.

Step 2: Create a VPC

Create a VPC with one public subnet and two private subnets as follows.

To create the VPC
1. Open the Amazon VPC console at https://console.aws.amazon.com/vpc/.
2. In the navigation pane, choose VPC Dashboard in the upper-left corner.
3. Choose Launch VPC Wizard.
4. Choose VPC with Public and Private Subnets and then choose Select.
5. Configure the VPC as follows:
   a. For IPv4 CIDR block, enter the CIDR block for the VPC. We recommend that you use a CIDR block from the private (non-publicly routable) IP address ranges specified in RFC 1918. For example, 10.0.0.0/16. For more information, see VPC and Subnet Sizing for IPv4 in the Amazon VPC User Guide.
   b. For IPv6 CIDR Block, keep No IPv6 CIDR Block.
   c. For VPC name, enter a name for the VPC.
6. Configure the public subnet as follows:
   a. For IPv4 CIDR block, enter the CIDR block for the subnet. For more information, see VPC and Subnet Sizing for IPv4 in the Amazon VPC User Guide.
   b. For Availability Zone, keep No Preference.
   c. For Public subnet name, enter a name for the subnet (for example, WorkSpaces Public Subnet).
7. Configure the first private subnet as follows:
   a. For Private subnet's IPv4 CIDR, enter the CIDR block for the subnet.
   b. To make an appropriate selection for Availability Zone, see Availability Zones for Amazon WorkSpaces (p. 14).
   c. For Private subnet name, enter a name for the subnet (for example, WorkSpaces Private Subnet 1).
8. For Elastic IP Allocation ID, choose the Elastic IP address that you created. Note that if you are using an alternative method of providing internet access, you can skip this step.
10. For Enable DNS hostnames, keep Yes.
11. For Hardware tenancy, keep Default.
12. Choose Create VPC. Note that it takes several minutes to set up your VPC. After the VPC is created, choose OK.
**Note**
You can associate an IPv6 CIDR block with your VPC and subnets. However, if you configure your subnets to automatically assign IPv6 addresses to instances launched in the subnet, then you cannot use Graphics bundles. (You can use GraphicsPro bundles, however.) This restriction arises from a hardware limitation of previous-generation instance types that do not support IPv6. To work around this issue, you can temporarily disable the auto-assign IPv6 addresses setting on the WorkSpaces subnets before launching Graphics bundles, and then reenable this setting (if needed) after launching Graphics bundles so that any other bundles receive the desired IP addresses.

By default, the auto-assign IPv6 addresses setting is disabled. To check this setting from the Amazon VPC console, in the navigation pane, choose Subnets. Select the subnet, and choose Actions, Modify auto-assign IP settings.

For more information about working with IPv6 addresses, see IP Addressing in Your VPC in the Amazon VPC User Guide.

**Step 3: Add a Second Private Subnet**

In the previous step, you created a VPC with one public subnet and one private subnet. Use the following procedure to add a second private subnet.

**To add a private subnet**
1. In the navigation pane, choose Subnets.
2. Choose Create Subnet.
3. For Name tag, enter a name for the private subnet (for example, WorkSpaces Private Subnet 2).
4. For VPC, select the VPC that you created.
5. To make an appropriate selection for Availability Zone, see Availability Zones for Amazon WorkSpaces (p. 14). Make sure you select a different Availability Zone from the one you selected for Step 7 (p. 10) earlier.
6. For IPv4 CIDR block, enter the CIDR block for the subnet.
7. Choose Create.

**Step 4: Verify and Name the Route Tables**

You can verify and name the route tables for each subnet.

**To verify and name the route tables**
1. In the navigation pane, choose Subnets, and select the public subnet that you created.
   a. On the Route Table tab, choose the ID of the route table (for example, rtb-12345678).
   b. Select the route table. Under Name, choose the edit icon (the pencil), and enter a name (for example, workspaces-public-routetable), and then choose the check mark to save the name.
   c. On the Routes tab, verify that there is one route for local traffic and another route that sends all other traffic to the internet gateway for the VPC.
2. In the navigation pane, choose Subnets, and select the first private subnet that you created (for example, WorkSpaces Private Subnet 1).
   a. On the Route Table tab, choose the ID of the route table.
   b. Select the route table. Under Name, choose the edit icon (the pencil), and enter a name (for example, workspaces-private-routetable), and then choose the check mark to save the name.
Configure a VPC with Public Subnets

If you prefer, you can create a VPC with two public subnets. To provide internet access to WorkSpaces in public subnets, configure the directory to assign Elastic IP addresses automatically or manually assign an Elastic IP address to each WorkSpace.

Prerequisites

If you aren't already familiar with working with VPCs and subnets, we recommend reading VPC and Subnet Sizing for IPv4 in the Amazon VPC User Guide before performing the following tasks.

Tasks

- Step 1: Create a VPC (p. 12)
- Step 2: Add a Second Public Subnet (p. 13)
- Step 3: Assign the Elastic IP Address (p. 13)

Step 1: Create a VPC

Create a VPC with one public subnet as follows.

To create the VPC

1. Open the Amazon VPC console at https://console.aws.amazon.com/vpc/.
2. In the navigation pane, choose VPC Dashboard in the upper-left corner.
3. Choose Launch VPC Wizard.
4. Choose VPC with a Single Public Subnet and then choose Select.
5. For IPv4 CIDR block, enter the CIDR block for the VPC. We recommend that you use a CIDR block from the private (non-publicly routable) IP address ranges specified in RFC 1918. For example, 10.0.0.0/16. For more information, see VPC and Subnet Sizing for IPv4 in the Amazon VPC User Guide.
6. For IPv6 CIDR block, keep No IPv6 CIDR Block.
7. For VPC name, enter a name for the VPC.
8. For Public subnet's IPv4 CIDR, enter the CIDR block for the subnet. For more information, see VPC and Subnet Sizing for IPv4 in the Amazon VPC User Guide.
9. To make an appropriate selection for Availability Zone, see Availability Zones for Amazon WorkSpaces (p. 14).
10. (Optional) For Subnet name, enter a name for the subnet.
11. For Service endpoints, do nothing.
12. For Enable DNS hostnames, keep Yes.
13. For Hardware tenancy, keep Default.
14. Choose Create VPC. After the VPC is created, choose OK.
Note
You can associate an IPv6 CIDR block with your VPC and subnets. However, if you configure your
subnets to automatically assign IPv6 addresses to instances launched in the subnet, then you
cannot use Graphics bundles. (You can use GraphicsPro bundles, however.) This restriction arises
from a hardware limitation of previous-generation instance types that do not support IPv6.
To work around this issue, you can temporarily disable the auto-assign IPv6 addresses setting
on the WorkSpaces subnets before launching Graphics bundles, and then reenable this setting
(if needed) after launching Graphics bundles so that any other bundles receive the desired IP
addresses.
By default, the auto-assign IPv6 addresses setting is disabled. To check this setting from the
Amazon VPC console, in the navigation pane, choose Subnets. Select the subnet, and choose
Actions, Modify auto-assign IP settings.
For more information about working with IPv6 addresses, see IP Addressing in Your VPC in the
Amazon VPC User Guide.

Step 2: Add a Second Public Subnet

In the previous step, you created a VPC with one public subnet. Use the following procedure to add a
second public subnet and associate it with the route table for the first public subnet, which has a route to
the internet gateway for the VPC.

To add a public subnet

1. In the navigation pane, choose Subnets.
2. Choose Create Subnet.
3. For Name tag, enter a name for the subnet.
4. For VPC, select the VPC that you created.
5. To make an appropriate selection for Availability Zone, see Availability Zones for Amazon
   WorkSpaces (p. 14). Make sure you select a different Availability Zone from the one you selected
   for Step 9 (p. 12) earlier.
6. For IPv4 CIDR block, enter the CIDR block for the subnet.
7. Choose Create. After the subnet is created, choose Close.
8. Associate the new public subnet with the route table created for the first subnet as follows:
   a. In the navigation pane, choose Subnets.
   b. Select the first subnet.
   c. On the Route Table tab, choose the ID of the route table.
   d. On the Subnet Associations tab, choose Edit subnet associations.
   e. Select the check box for the second subnet (the public subnet you just created) and choose
      Save.

Step 3: Assign the Elastic IP Address

You can assign Elastic IP addresses (static public IP addresses) to your WorkSpaces automatically or
manually. To use automatic assignment, see Configure Automatic IP Addresses (p. 46). To assign
Elastic IP addresses manually, use the following procedure.

For a video tutorial about how to assign an Elastic IP address to a WorkSpace, see How do I associate an
Elastic IP Address with a WorkSpace? on the AWS Knowledge Center.

Warning
We recommend that you not modify the elastic network interface of the WorkSpace after
it is launched. If you have enabled automatic assignment of Elastic IP addresses at the
directory level, an Elastic IP address (from the Amazon-provided pool) is assigned to your
WorkSpace when it is launched. However, if you associate an Elastic IP address that you own to a WorkSpace, and then you later disassociate that Elastic IP address from the WorkSpace, the WorkSpace loses its public IP address, and it doesn't automatically get a new one from the Amazon-provided pool.

To associate a new public IP address from the Amazon-provided pool with the WorkSpace, you must rebuild the WorkSpace (p. 90). If you don’t want to rebuild the WorkSpace, you must associate another Elastic IP address that you own to the WorkSpace.

To assign an Elastic IP address to a WorkSpace manually

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Expand the row (choose the arrow icon) for the WorkSpace and note the value of WorkSpace IP. This is the primary private IP address of the WorkSpace.
4. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
5. In the navigation pane, choose Elastic IPs. If you do not have an available Elastic IP address, choose Allocate new address and choose Amazon pool or Owned by me, and then choose Allocate. Make note of the new IP address.
6. In the navigation pane, choose Network Interfaces.
7. Select the network interface for your WorkSpace. Note that the value of VPC ID matches the ID of your WorkSpaces VPC and the value of Primary private IPv4 IP matches the primary private IP address of the WorkSpace that you noted earlier.
8. Choose Actions, Manage IP Addresses. Choose Assign new IP, and then choose Yes, Update. Make note of the new IP address.
9. Choose Actions, Associate Address.
10. On the Associate Elastic IP Address page, choose an Elastic IP address from Address. For Associate to private IP address, specify the new private IP address, and then choose Associate Address.

Availability Zones for Amazon WorkSpaces

When you are creating a virtual private cloud (VPC) for use with Amazon WorkSpaces, your VPC’s subnets must reside in different Availability Zones in the Region where you’re launching WorkSpaces. Availability Zones are distinct locations that are engineered to be isolated from failures in other Availability Zones. By launching instances in separate Availability Zones, you can protect your applications from the failure of a single location. Each subnet must reside entirely within one Availability Zone and cannot span zones.

An Availability Zone is represented by a Region code followed by a letter identifier; for example, us-east-1a. To ensure that resources are distributed across the Availability Zones for a Region, we independently map Availability Zones to names for each AWS account. For example, the Availability Zone us-east-1a for your AWS account might not be the same location as us-east-1a for another AWS account.

To coordinate Availability Zones across accounts, you must use the AZ ID, which is a unique and consistent identifier for an Availability Zone. For example, use1-az2 is an AZ ID for the us-east-1 Region and it has the same location in every AWS account.

Viewing AZ IDs enables you to determine the location of resources in one account relative to the resources in another account. For example, if you share a subnet in the Availability Zone with the AZ ID use1-az2 with another account, this subnet is available to that account in the Availability Zone whose AZ ID is also use1-az2. The AZ ID for each VPC and subnet is displayed in the Amazon VPC console.

Amazon WorkSpaces is available in a subset of the Availability Zones for each supported Region. The following table lists the AZ IDs that you can use for each Region. To see the mapping of AZ IDs to Availability Zones in your account, see AZ IDs for Your Resources in the AWS RAM User Guide.
### IP Address and Port Requirements for Amazon WorkSpaces

To connect to your WorkSpaces, the network that your Amazon WorkSpaces clients are connected to must have certain ports open to the IP address ranges for the various AWS services (grouped in subsets). These address ranges vary by AWS Region. These same ports must also be open on any firewall running on the client. For more information about the AWS IP address ranges for different Regions, see [AWS IP Address Ranges in the Amazon Web Services General Reference](https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/using-ip-addresses.html).

For an architecture diagram, see [WorkSpaces Architecture](https://docs.aws.amazon.com_workspaces/latest/adg/whatsnew.html). For additional architecture diagrams, see the "Best Practices for Deploying Amazon WorkSpaces" whitepaper.

#### Ports for Client Applications

The Amazon WorkSpaces client application requires outbound access on the following ports:

**Port 443 (TCP)**

This port is used for client application updates, registration, and authentication. The desktop client applications support the use of a proxy server for port 443 (HTTPS) traffic. To enable the use of a proxy server, open the client application, choose [Advanced Settings](https://docs.aws.amazon.com_workspaces/latest/adg/whatsnew.html), select [Use Proxy Server](https://docs.aws.amazon.com_workspaces/latest/adg/whatsnew.html), specify the address and port of the proxy server, and choose [Save](https://docs.aws.amazon.com_workspaces/latest/adg/whatsnew.html).

This port must be open to the following IP address ranges:

---

<table>
<thead>
<tr>
<th>Region name</th>
<th>Region code</th>
<th>Supported AZ IDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>US East (N. Virginia)</td>
<td>us-east-1</td>
<td>use1-az2, use1-az4, use1-az6</td>
</tr>
<tr>
<td>US West (Oregon)</td>
<td>us-west-2</td>
<td>usw2-az1, usw2-az2, usw2-az3</td>
</tr>
<tr>
<td>Asia Pacific (Seoul)</td>
<td>ap-northeast-2</td>
<td>apne2-az1, apne2-az3</td>
</tr>
<tr>
<td>Asia Pacific (Singapore)</td>
<td>ap-southeast-1</td>
<td>apse1-az1, apse1-az2</td>
</tr>
<tr>
<td>Asia Pacific (Sydney)</td>
<td>ap-southeast-2</td>
<td>apse2-az1, apse2-az3</td>
</tr>
<tr>
<td>Asia Pacific (Tokyo)</td>
<td>ap-northeast-1</td>
<td>apne1-az1, apne1-az4</td>
</tr>
<tr>
<td>Canada (Central)</td>
<td>ca-central-1</td>
<td>cac1-az1, cac1-az2</td>
</tr>
<tr>
<td>Europe (Frankfurt)</td>
<td>eu-central-1</td>
<td>euc1-az2, euc1-az3</td>
</tr>
<tr>
<td>Europe (Ireland)</td>
<td>eu-west-1</td>
<td>euw1-az1, euw1-az2, euw1-az3</td>
</tr>
<tr>
<td>Europe (London)</td>
<td>eu-west-2</td>
<td>euw2-az2, euw2-az3</td>
</tr>
<tr>
<td>South America (São Paulo)</td>
<td>sa-east-1</td>
<td>sae1-az1, sae1-az3</td>
</tr>
</tbody>
</table>
• The AMAZON subset in the Region that the WorkSpace is in.
• The AMAZON subset in the us-east-1 Region.
• The AMAZON subset in the us-west-2 Region.
• The S3 subset in the us-west-2 Region.

Port 4172 (UDP and TCP)

This port is used for streaming the WorkSpace desktop and health checks. The desktop client applications do not support the use of a proxy server for port 4172 traffic; they require a direct connection to port 4172. This port must be open to the PCoIP Gateway IP address ranges and health check servers in the Region that the WorkSpace is in. For more information, see PCoIP Health Check Servers (p. 22) and PCoIP Gateway (p. 24).

Note
If your firewall uses stateful filtering, ephemeral (also known as dynamic) ports are automatically opened to allow return communication. If your firewall uses stateless filtering, you must open ephemeral ports explicitly to allow return communication. The required ephemeral port range that you must open will vary depending on your configuration.

Ports for Web Access

Amazon WorkSpaces Web Access requires inbound and outbound access for the following ports:

Port 53 (UDP)

This port is used to access DNS servers. It must be open to your DNS server IP addresses so that the client can resolve public domain names. This port requirement is optional if you are not using DNS servers for domain name resolution.

Port 80 (UDP and TCP)

This port is used for initial connections to https://clients.amazonworkspaces.com, which then switch to HTTPS. It must be open to all IP address ranges in the EC2 subset in the Region that the WorkSpace is in.

Port 443 (UDP and TCP)

This port is used for registration and authentication using HTTPS. It must be open to all IP address ranges in the EC2 subset in the Region that the WorkSpace is in.

Typically, the web browser randomly selects a source port in the high range to use for streaming traffic. Amazon WorkSpaces Web Access does not have control over the port that the browser selects. You must ensure that return traffic to this port is allowed.

Amazon WorkSpaces Web Access prefers UDP over TCP for desktop streams, but falls back to TCP if UDP is not available. If all UDP ports are blocked except 53, 80, and 443, Web Access will work on Chrome and Firefox using TCP connections.

Whitelisted Domains and Ports

For the Amazon WorkSpaces client application to be able to access the Amazon WorkSpaces service, the following domains and ports must be whitelisted on the network from which the client is trying to access the service.

<table>
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<tr>
<th>Category</th>
<th>Whitelisted</th>
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</thead>
<tbody>
<tr>
<td>CAPTCHA</td>
<td><a href="https://opfcaptcha-prod.s3.amazonaws.com/">https://opfcaptcha-prod.s3.amazonaws.com/</a></td>
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<td>Category</td>
<td>Whitelisted</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
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</tbody>
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| Client Auto-update | • https://d2td7dqidlhjx7.cloudfront.net/  
• In the AWS GovCloud (US-West) Region:  
| Connectivity Check | https://connectivity.amazonworkspaces.com/ |
| Device Metrics (for 1.0+ and 2.0+ WorkSpaces client applications) | https://device-metrics-us-2.amazon.com/ |
| Client Metrics (for 3.0+ WorkSpaces client applications) | Domains:  
• https://skylight-client-ds.us-east-1.amazonaws.com  
• https://skylight-client-ds.us-west-2.amazonaws.com  
• https://skylight-client-ds.ap-northeast-2.amazonaws.com  
• https://skylight-client-ds.ap-southeast-1.amazonaws.com  
• https://skylight-client-ds.ap-southeast-2.amazonaws.com  
• https://skylight-client-ds.ap-northeast-1.amazonaws.com  
• https://skylight-client-ds.ca-central-1.amazonaws.com  
• https://skylight-client-ds.eu-central-1.amazonaws.com  
• https://skylight-client-ds.eu-west-1.amazonaws.com  
• https://skylight-client-ds.eu-west-2.amazonaws.com  
• https://skylight-client-ds.sa-east-1.amazonaws.com  
• In the AWS GovCloud (US-West) Region:  
https://skylight-client-ds.us-gov-west-1.amazonaws.com |
Whitelisted Domains and Ports

### Directory Settings

**Authentication from the client to the customer directory before login to the WorkSpace:**

- https://d32i4gd7pg4909.cloudfront.net/prod/<region>/<directory ID>

**Connections from macOS clients:**

- https://d32i4gd7pg4909.cloudfront.net/

**Customer directory settings:**

- https://d21ui22avrxoh6.cloudfront.net/prod/<region>/<directory ID>

**Login page graphics for customer directory level co-branding:**

- https://d1cbg795sa4g1u.cloudfront.net/prod/<region>/<directory ID>

**CSS file to style the login pages:**

- https://d3s98kk2h6f4oh.cloudfront.net/
- https://dyqsoz7pkju4e.cloudfront.net/

**JavaScript file for the login pages:**

- US East (N. Virginia) — https://d32i4gd7pg4909.cloudfront.net/
- US West (Oregon) — https://d18af7771co7lp.cloudfront.net/
- Asia Pacific (Seoul) — https://dtyv4uwoh7ynt.cloudfront.net/
- Asia Pacific (Singapore) — https://d3qzmd7y07pz0i.cloudfront.net/
- Asia Pacific (Sydney) — https://dwcpoxuuza83q.cloudfront.net/
- Asia Pacific (Tokyo) — https://d2c2t8mixonq9z1.cloudfront.net/
- Canada (Central) — https://d2wfbyspmqjmqog.cloudfront.net/
- Europe (Frankfurt) — https://d1whcm49570ijw.cloudfront.net/
- Europe (Ireland) — https://d3pgffbf39h4k4.cloudfront.net/
- Europe (London) — https://d16q6638mh01s7.cloudfront.net/
- South America (São Paulo) — https://d2lh2qc5bdoq4b.cloudfront.net/
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<td>Amazon WorkSpaces Administration Guide</td>
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<td>• Customer directory settings:</td>
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<td><a href="https://s3.amazonaws.com/workspaces-client-properties/prod/pdt/">https://s3.amazonaws.com/workspaces-client-properties/prod/pdt/</a>&lt;directory ID&gt;</td>
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<td>PColIP Health Check (DRP)</td>
<td>PColIP Health Check Servers (p. 22)</td>
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<td>PColIP Session Gateway (PSG)</td>
<td>PColIP Gateway (p. 24)</td>
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<td>• <a href="https://skylight-cm-fips.us-east-1.amazonaws.com">https://skylight-cm-fips.us-east-1.amazonaws.com</a></td>
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<tr>
<td></td>
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<td>• <a href="https://skylight-cm-fips.us-west-2.amazonaws.com">https://skylight-cm-fips.us-west-2.amazonaws.com</a></td>
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<td><strong>User Login Pages</strong></td>
<td>https://&lt;directory id&gt;.awsapps.com/ (where &lt;directory id&gt; is the customer's domain)</td>
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<td><strong>Web Access TURN Servers</strong></td>
<td><strong>Servers:</strong></td>
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<tr>
<td></td>
<td>• turn:*-us-east-1.rdn.amazonaws.com</td>
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<td></td>
<td>• turn:*-us-west-2.rdn.amazonaws.com</td>
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<td></td>
<td>• turn:*-ap-northeast-2.rdn.amazonaws.com</td>
</tr>
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<td></td>
<td>• turn:*-ap-southeast-1.rdn.amazonaws.com</td>
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<tr>
<td></td>
<td>• turn:*-ap-southeast-2.rdn.amazonaws.com</td>
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<td>• turn:*-ap-northeast-1.rdn.amazonaws.com</td>
</tr>
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<td>• turn:*-ca-central-1.rdn.amazonaws.com</td>
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<td>• turn:*-eu-central-1.rdn.amazonaws.com</td>
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</table>
### PCoIP Health Check Servers

The Amazon WorkSpaces client applications perform PCoIP health checks over port 4172. These checks validate whether TCP or UDP traffic streams from the Amazon WorkSpaces servers to the client applications. For these checks to finish successfully, your firewall policies must allow outbound traffic to the IP addresses of the following Regional PCoIP health check servers.

<table>
<thead>
<tr>
<th>Region</th>
<th>Health check hostname</th>
<th>IP addresses</th>
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</thead>
<tbody>
<tr>
<td>US West (Oregon)</td>
<td>drp-pdx.amazonworkspaces.com</td>
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<tr>
<td>Region</td>
<td>Health check hostname</td>
<td>IP addresses</td>
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<td>Asia Pacific (Seoul)</td>
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<td>drp-sin.amazonworkspaces.com</td>
<td>3.0.212.144</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18.138.99.116</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18.140.252.123</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.74.175.118</td>
</tr>
<tr>
<td>Asia Pacific (Sydney)</td>
<td>drp-syd.amazonworkspaces.com</td>
<td>3.24.11.127</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.237.232.125</td>
</tr>
<tr>
<td>Asia Pacific (Tokyo)</td>
<td>drp-nrt.amazonworkspaces.com</td>
<td>18.178.102.247</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54.64.174.128</td>
</tr>
<tr>
<td>Canada (Central)</td>
<td>drp-yul.amazonworkspaces.com</td>
<td>52.60.69.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.60.80.237</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.60.173.117</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.60.201.0</td>
</tr>
<tr>
<td>Europe (Frankfurt)</td>
<td>drp-fra.amazonworkspaces.com</td>
<td>52.59.191.224</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.59.191.225</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.59.191.226</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.59.191.227</td>
</tr>
<tr>
<td>Europe (Ireland)</td>
<td>drp-dub.amazonworkspaces.com</td>
<td>18.200.177.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.48.86.38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54.76.137.224</td>
</tr>
</tbody>
</table>
Amazon WorkSpaces Administration Guide

PCoIP Gateway

<table>
<thead>
<tr>
<th>Region</th>
<th>Health check hostname</th>
<th>IP addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe (London)</td>
<td>drp-lhr.amazonworkspaces.com</td>
<td>35.176.62.54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35.177.255.44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.56.46.102</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.56.111.36</td>
</tr>
<tr>
<td>South America (São Paulo)</td>
<td>drp-gru.amazonworkspaces.com</td>
<td>18.231.0.105</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.67.55.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54.233.156.245</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54.233.216.234</td>
</tr>
<tr>
<td>AWS GovCloud (US-West)</td>
<td>drp-pdt.amazonworkspaces.com</td>
<td>52.61.60.65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.61.65.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.61.88.170</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.61.137.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.61.155.110</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.222.20.88</td>
</tr>
</tbody>
</table>

**PCoIP Gateway**

Amazon WorkSpaces uses PCoIP to stream the desktop session to clients over port 4172. For its PCoIP gateway servers, Amazon WorkSpaces uses a small range of Amazon EC2 public IPv4 addresses. This enables you to set more finely grained firewall policies for devices that access Amazon WorkSpaces. Note that the Amazon WorkSpaces clients do not support IPv6 addresses as a connectivity option at this time.

**Note**

We are regularly updating our IP address ranges in the `AWS IP Address Ranges ip-ranges.json` file. To ingest the most up-to-date IP address ranges for Amazon WorkSpaces, look for entries in the `ip-ranges.json` file where service: "WORKSPACES_GATEWAYS".

<table>
<thead>
<tr>
<th>Region</th>
<th>Public IP Address Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>US East (N. Virginia)</td>
<td>3.217.228.0 - 3.217.231.255</td>
</tr>
<tr>
<td></td>
<td>3.235.112.0 - 3.235.119.255</td>
</tr>
<tr>
<td></td>
<td>52.23.61.0 - 52.23.62.255</td>
</tr>
<tr>
<td>US West (Oregon)</td>
<td>44.234.54.0 - 44.234.55.255</td>
</tr>
<tr>
<td></td>
<td>54.244.46.0 - 54.244.47.255</td>
</tr>
<tr>
<td>Asia Pacific (Seoul)</td>
<td>3.34.37.0 - 3.34.37.255</td>
</tr>
<tr>
<td></td>
<td>3.34.38.0 - 3.34.39.255</td>
</tr>
</tbody>
</table>
## Network Interfaces

Each WorkSpace has the following network interfaces:

- The primary network interface (eth1) provides connectivity to the resources within your VPC and on the internet, and is used to join the WorkSpace to the directory.
- The management network interface (eth0) is connected to a secure Amazon WorkSpaces management network. It is used for interactive streaming of the WorkSpace desktop to Amazon WorkSpaces clients, and to allow Amazon WorkSpaces to manage the WorkSpace.

<table>
<thead>
<tr>
<th>Region</th>
<th>Public IP Address Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia Pacific (Singapore)</td>
<td>18.141.152.0 - 18.141.152.255</td>
</tr>
<tr>
<td></td>
<td>18.141.154.0 - 18.141.155.255</td>
</tr>
<tr>
<td></td>
<td>52.76.127.0 - 52.76.127.255</td>
</tr>
<tr>
<td>Asia Pacific (Sydney)</td>
<td>3.25.43.0 - 3.25.43.255</td>
</tr>
<tr>
<td></td>
<td>3.25.44.0 - 3.25.45.255</td>
</tr>
<tr>
<td></td>
<td>54.153.254.0 - 54.153.254.255</td>
</tr>
<tr>
<td>Asia Pacific (Tokyo)</td>
<td>18.180.178.0 - 18.180.178.255</td>
</tr>
<tr>
<td></td>
<td>54.250.251.0 - 54.250.251.255</td>
</tr>
<tr>
<td>Canada (Central)</td>
<td>15.223.100.0 - 15.223.100.255</td>
</tr>
<tr>
<td></td>
<td>15.223.102.0 - 15.223.103.255</td>
</tr>
<tr>
<td></td>
<td>35.183.255.0 - 35.183.255.255</td>
</tr>
<tr>
<td>Europe (Frankfurt)</td>
<td>18.156.52.0 - 18.156.52.255</td>
</tr>
<tr>
<td></td>
<td>18.156.54.0 - 18.156.55.255</td>
</tr>
<tr>
<td></td>
<td>52.59.127.0 - 52.59.127.255</td>
</tr>
<tr>
<td>Europe (Ireland)</td>
<td>3.249.28.0 - 3.249.29.255</td>
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<tr>
<td></td>
<td>52.19.124.0 - 52.19.125.255</td>
</tr>
<tr>
<td>Europe (London)</td>
<td>18.132.21.0 - 18.132.21.255</td>
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<tr>
<td></td>
<td>18.132.22.0 - 18.132.23.255</td>
</tr>
<tr>
<td></td>
<td>35.176.32.0 - 35.176.32.255</td>
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<tr>
<td>South America (São Paulo)</td>
<td>18.230.103.0 - 18.230.103.255</td>
</tr>
<tr>
<td></td>
<td>18.230.104.0 - 18.230.105.255</td>
</tr>
<tr>
<td></td>
<td>54.233.204.0 - 54.233.204.255</td>
</tr>
<tr>
<td>AWS GovCloud (US-West)</td>
<td>52.61.193.0 - 52.61.193.255</td>
</tr>
</tbody>
</table>
Amazon WorkSpaces selects the IP address for the management network interface from various address ranges, depending on the Region that the WorkSpaces are created in. When a directory is registered, Amazon WorkSpaces tests the VPC CIDR and the route tables in your VPC to determine if these address ranges create a conflict. If a conflict is found in all available address ranges in the Region, an error message is displayed and the directory is not registered. If you change the route tables in your VPC after the directory is registered, you might cause a conflict.

**Warning**
Do not modify or delete any of the network interfaces that are attached to a WorkSpace. Doing so might cause the WorkSpace to become unreachable or lose internet access. For example, if you have enabled automatic assignment of Elastic IP addresses (p. 46) at the directory level, an Elastic IP address (from the Amazon-provided pool) is assigned to your WorkSpace when it is launched. However, if you associate an Elastic IP address that you own to a WorkSpace, and then you later disassociate that Elastic IP address from the WorkSpace, the WorkSpace loses its public IP address, and it doesn't automatically get a new one from the Amazon-provided pool. To associate a new public IP address from the Amazon-provided pool with the WorkSpace, you must rebuild the WorkSpace (p. 90). If you don't want to rebuild the WorkSpace, you must associate another Elastic IP address that you own to the WorkSpace.

### Management Interface IP Ranges
The following table lists the IP address ranges used for the management network interface.

<table>
<thead>
<tr>
<th>Region</th>
<th>IP Address Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>US East (N. Virginia)</td>
<td>172.31.0.0/16, 192.168.0.0/16, 198.19.0.0/16</td>
</tr>
<tr>
<td>US West (Oregon)</td>
<td>172.31.0.0/16, 192.168.0.0/16, and 198.19.0.0/16</td>
</tr>
<tr>
<td>Asia Pacific (Seoul)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>Asia Pacific (Singapore)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>Asia Pacific (Sydney)</td>
<td>172.31.0.0/16, 192.168.0.0/16, and 198.19.0.0/16</td>
</tr>
<tr>
<td>Asia Pacific (Tokyo)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>Canada (Central)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>Europe (Frankfurt)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>Europe (Ireland)</td>
<td>172.31.0.0/16, 192.168.0.0/16, and 198.19.0.0/16</td>
</tr>
<tr>
<td>Europe (London)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>South America (São Paulo)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>AWS GovCloud (US-West)</td>
<td>198.19.0.0/16</td>
</tr>
</tbody>
</table>

### Management Interface Ports
The following ports must be open on the management network interface of all WorkSpaces:

- Inbound TCP on port 4172. This is used for establishment of the streaming connection.
- Inbound UDP on port 4172. This is used for streaming user input.
• Inbound TCP on port 4489. This is for access using the web client.
• Inbound TCP on port 8200. This is used for management and configuration of the WorkSpace.
• Outbound TCP on ports 8443 and 9997. This is used for access using the web client.
• Outbound UDP on ports 3478 and 4172. This is used for access using the web client.
• Outbound UDP on ports 50002 and 55002. This is used for PCoIP streaming. If your firewall uses stateful filtering, the ephemeral ports 50002 and 55002 are automatically opened to allow return communication. If your firewall uses stateless filtering, you must open ephemeral ports 49152 - 65535 to allow return communication.
• Outbound TCP on port 80 to IP address 169.254.169.254 for access to the EC2 metadata service. Any HTTP proxy assigned to your WorkSpaces must also exclude 169.254.169.254.
• Outbound TCP on port 1688 to IP addresses 169.254.169.250 and 169.254.169.251 to allow access to Microsoft KMS for Windows and Office activation.

Under normal circumstances, the Amazon WorkSpaces service configures these ports for your WorkSpaces. If any security or firewall software is installed on a WorkSpace that blocks any of these ports, the WorkSpace may not function correctly or may be unreachable.

Primary Interface Ports

No matter which type of directory you have, the following ports must be open on the primary network interface of all WorkSpaces:

• For internet connectivity, the following ports must be open outbound to all destinations and inbound from the WorkSpaces VPC. You need to add these manually to the security group for your WorkSpaces if you want them to have internet access.
  • TCP 80 (HTTP)
  • TCP 443 (HTTPS)
• To communicate with the directory controllers, the following ports must be open between your WorkSpaces VPC and your directory controllers. For a Simple AD directory, the security group created by AWS Directory Service will have these ports configured correctly. For an AD Connector directory, you might need to adjust the default security group for the VPC to open these ports.
  • TCP/UDP 53 - DNS
  • TCP/UDP 88 - Kerberos authentication
  • UDP 123 - NTP
  • TCP 135 - RPC
  • UDP 137-138 - Netlogon
  • TCP 139 - Netlogon
  • TCP/UDP 389 - LDAP
  • TCP/UDP 445 - SMB
  • TCP 1024-65535 - Dynamic ports for RPC

If any security or firewall software is installed on a WorkSpace that blocks any of these ports, the WorkSpace may not function correctly or may be unreachable.

Amazon WorkSpaces Client Network Requirements

Your Amazon WorkSpaces users can connect to their WorkSpaces by using the client application for a supported device. Alternatively, they can use a web browser to connect to WorkSpaces that support this form of access. For a list of WorkSpaces that support web browser access, see "Which Amazon WorkSpaces bundles support web access?" in Client Access, Web Access, and User Experience.
Note
A web browser cannot be used to connect to Amazon Linux WorkSpaces.

Important
Beginning October 1, 2020, customers will no longer be able to use the Amazon WorkSpaces Web Access client to connect to Windows 7 custom WorkSpaces or to Windows 7 Bring Your Own License (BYOL) WorkSpaces.

To provide your users with a good experience with their WorkSpaces, verify that their client devices meet the following network requirements:

- The client device must have a broadband internet connection. We recommend planning for a minimum of 1 Mbps per simultaneous user watching a 480p video window. Depending on your user-quality requirements for video resolution, more bandwidth might be required.
- The network that the client device is connected to, and any firewall on the client device, must have certain ports open to the IP address ranges for various AWS services. For more information, see IP Address and Port Requirements for Amazon WorkSpaces (p. 15).
- The round trip time (RTT) from the client's network to the Region that the WorkSpaces are in should be less than 100ms. If the RTT is between 100ms and 250ms, the user can access the WorkSpace but performance is degraded.
- If users will access their WorkSpaces through a virtual private network (VPN), the connection must support a maximum transmission unit (MTU) of at least 1200 bytes.

Note
You cannot access WorkSpaces through a VPN connected to your virtual private cloud (VPC). To access WorkSpaces using a VPN, internet connectivity (through the VPN's public IP addresses) is required, as described in IP Address and Port Requirements for Amazon WorkSpaces (p. 15).

- The clients require HTTPS access to Amazon WorkSpaces resources hosted by the service and Amazon Simple Storage Service (Amazon S3). The clients do not support proxy redirection at the application level. HTTPS access is required so that users can successfully complete registration and access their WorkSpaces.
- To allow access from PCoIP zero client devices, you must launch and configure an EC2 instance with PCoIP Connection Manager for Amazon WorkSpaces. For more information, see Deploying the PCoIP Connection Manager for Amazon WorkSpaces in the PCoIP Connection Manager User Guide. You must also enable Network Time Protocol (NTP) in Teradici. For more information, see Set Up PCoIP Zero Client for WorkSpaces (p. 34).
- For 3.0+ clients, if you are using single sign-on (SSO) for Amazon WorkDocs, you must follow the instructions in Single Sign-On in the AWS Directory Service Administration Guide.

You can verify that a client device meets the networking requirements as follows.

**To verify networking requirements for 3.0+ clients**

1. Open your Amazon WorkSpaces client. If this is the first time you have opened the client, you are prompted to enter the registration code that you received in the invitation email.
2. Depending on which client you're using, do one of the following.

<table>
<thead>
<tr>
<th>If you're using...</th>
<th>Do this</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows or Linux clients</td>
<td>In the upper-right corner of the client application, select the Network icon.</td>
</tr>
<tr>
<td>macOS client</td>
<td>Choose Connections, Network.</td>
</tr>
</tbody>
</table>
The client application tests the network connection, ports, and round-trip time, and reports the results of these tests.

3. Close the **Network** dialog box to return to the sign-in page.

To verify networking requirements for 1.0+ and 2.0+ clients

1. Open your Amazon WorkSpaces client. If this is the first time you have opened the client, you are prompted to enter the registration code that you received in the invitation email.
2. Choose **Network** in the lower-right corner of the client application. The client application tests the network connection, ports, and round-trip time, and reports the results of these tests.
3. Choose **Dismiss** to return to the sign-in page.

Restrict WorkSpaces Access to Trusted Devices

By default, users can access their WorkSpaces from any supported device that is connected to the internet. If your company limits corporate data access to trusted devices (also known as managed devices), you can restrict WorkSpaces access to trusted devices with valid certificates.

When you enable this feature, Amazon WorkSpaces uses certificate-based authentication to determine whether a device is trusted. If the WorkSpaces client application can’t verify that a device is trusted, it blocks attempts to log in or reconnect from the device.

For each directory, you can import up to two root certificates. If you import two root certificates, Amazon WorkSpaces presents them both to the client and the client finds the first valid matching certificate that chains up to either of the root certificates.

**Important**

This feature applies only to the Amazon WorkSpaces Windows and macOS clients. This feature does not apply to the Amazon WorkSpaces Web Access client or any third-party clients, including but not limited to Teradici PCoIP Software and Mobile Clients, Teradici PCoIP Zero Clients, RDP clients, and remote desktop applications.

Step 1: Create the Certificates

This feature requires two types of certificates: root certificates generated by an internal Certificate Authority (CA) and client certificates that chain up to a root certificate.

**Requirements**

- Certificates must be Base64-encoded certificate files in CRT, CERT, or PEM format.
- Certificates must include a Common Name.
- The maximum length of certificate chain supported is 4.
- Amazon WorkSpaces does not currently support device revocation mechanisms, such as certificate revocation lists (CRL) or Online Certificate Status Protocol (OCSP), for client certificates.
- Use a strong encryption algorithm. We recommend SHA256 with RSA, SHA256 with ECDSA, SHA381 with ECDSA, or SHA512 with ECDSA.
- Make sure "key usage: Digital signature" is present on the public key, or device authentication will fail even if the public and private keys are present on the machine and in the WorkSpaces console.
- For macOS, if the device certificate is in the system keychain, we recommend that you authorize the WorkSpaces client application to access those certificates. Otherwise, users must enter keychain credentials when they log in or reconnect.
Step 2: Deploy Client Certificates to the Trusted Devices

You must install client certificates on the trusted devices for your users. You can use your preferred solution to install certificates to your fleet of client devices; for example, System Center Configuration Manager (SCCM) or mobile device management (MDM). Note that SCCM and MDM can optionally perform a security posture assessment to determine whether the devices meet your corporate policies to access WorkSpaces.

On Windows, the WorkSpaces client application searches for client certificates in both the user and root certificate stores. On macOS, the WorkSpaces client application searches for client certificates in the entire keychain.

Step 3: Configure the Restriction

After you have deployed the client certificates on the trusted devices, you can enable restricted access at the directory level. This requires the WorkSpaces client application to validate the certificate on a device before allowing a user to log in to a WorkSpace.

To configure the restriction

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Select the directory and then choose Actions, Update Details.
4. Expand Access Control Options.
6. [macOS] Choose Only Allow Trusted macOS Devices to Access WorkSpaces.
7. Import up to two root certificates. For each root certificate, do the following:
   a. Choose Import.
   b. Copy the body of the certificate to the form.
   c. Choose Import.
8. (Optional) Specify whether other types of devices have access to WorkSpaces.
   a. Scroll down to the Other Platforms section. By default, WorkSpaces Web Access and Linux clients are disabled, and users can access their WorkSpaces from their iOS devices, Android devices, Chromebooks, and PCoIP zero client devices.
   b. Select the device types to enable and clear the device types to disable.
   c. To block access from all selected device types, choose Block.
9. Choose Update and Exit.

Provide Internet Access from Your WorkSpace

Your WorkSpaces must have access to the internet so that you can install updates to the operating system and deploy applications. You can use one of the following options to allow your WorkSpaces in a virtual private cloud (VPC) to access the internet.

Options

- Launch your WorkSpaces in private subnets and configure a NAT gateway in a public subnet in your VPC.
• Launch your WorkSpaces in public subnets and configure automatic assignment of public IP addresses.
• Launch your WorkSpaces in public subnets and manually assign public IP addresses to your WorkSpaces.

For more information, see Configure a VPC for Amazon WorkSpaces (p. 8).

With any of these options, you must ensure that the security group for your WorkSpaces allows outbound traffic on ports 80 (HTTP) and 443 (HTTPS) to all destinations (0.0.0.0/0).

**Amazon WAM**

If you are using Amazon WorkSpaces Application Manager (Amazon WAM) to deploy applications to your WorkSpaces, your WorkSpaces must have access to the internet.

**Amazon Linux Extras Library**

If you are using the Amazon Linux repository, your Amazon Linux WorkSpaces must either have internet access or you must configure VPC endpoints to this repository and to the main Amazon Linux repository. For more information, see the Example: Enabling Access to the Amazon Linux AMI Repositories section in Endpoints for Amazon S3. The Amazon Linux AMI repositories are Amazon S3 buckets in each Region. If you want instances in your VPC to access the repositories through an endpoint, create an endpoint policy that enables access to these buckets. The following policy allows access to the Amazon Linux repositories.

```
{
  "Statement": [
    {
      "Sid": "AmazonLinux2AMIREpositoryAccess",
      "Principal": "*",
      "Action": ["s3:GetObject"],
      "Effect": "Allow",
      "Resource": ["arn:aws:s3:::amazonlinux.*.amazonaws.com/*"]
    }
  ]
}
```

**Security Groups for Your WorkSpaces**

When you register a directory with Amazon WorkSpaces, it creates two security groups, one for directory controllers and another for WorkSpaces in the directory. The security group for directory controllers has a name that consists of the directory identifier followed by _controllers (for example, d-12345678e1_controllers). The security group for WorkSpaces has a name that consists of the directory identifier followed by _workspacesMembers (for example, d-123456fc11_workspacesMembers).

**Warning**

Do not delete the _workspacesMembers security group. If you delete this security group, your WorkSpaces won’t function correctly, and you won’t be able to recreate this group and add it back.

You can add a default WorkSpaces security group to a directory. After you associate a new security group with a WorkSpaces directory, new WorkSpaces that you launch or existing WorkSpaces that you rebuild will have the new security group. You can also add this new default security group to existing WorkSpaces without rebuilding them (p. 32), as explained later in this topic.
When you associate multiple security groups with a WorkSpaces directory, the rules from each security group are effectively aggregated to create one set of rules. We recommend condensing your security group rules as much as possible.

For more information about security groups, see Security Groups for Your VPC in the Amazon VPC User Guide.

**To add a security group to a WorkSpaces directory**

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Select the directory and choose Actions, Update Details.
4. Expand Security Group and select a security group.
5. Choose Update and Exit.

To add a security group to an existing WorkSpace without rebuilding it, you assign the new security group to the elastic network interface (ENI) of the WorkSpace.

**To add a security group to an existing WorkSpace**

1. Find the IP address for each WorkSpace that needs to be updated.
   a. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
   b. Expand each WorkSpace and record its WorkSpace IP address.
2. Find the ENI for each WorkSpace and update its security group assignment.
   a. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
   c. Search for the first IP address that you recorded in Step 1.
   d. Select the ENI associated with the IP address, choose Actions, and then choose Change Security Groups.
   e. Select the new security group, and choose Save.
   f. Repeat this process as needed for any other WorkSpaces.

**IP Access Control Groups for Your WorkSpaces**

An IP access control group acts as a virtual firewall that controls the IP addresses from which users are allowed to access their WorkSpaces. You can associate each IP access control group with one or more directories. You can create up to 100 IP access control groups per AWS account. However, you can only associate up to 25 IP access control groups with a single directory.

There is a default IP access control group associated with each directory. The default group allows all traffic. If you associate an IP access control group with a directory, the default IP access control group is disassociated.

To specify the public IP addresses and ranges of IP addresses for your trusted networks, add rules to your IP access control groups. If your users access their WorkSpaces through a NAT gateway or VPN, you must create rules that allow traffic from the public IP addresses for the NAT gateway or VPN.

**Note**

IP access control groups do not allow the use of dynamic IP addresses for NATs. If you're using a NAT, configure it to use a static IP address instead of a dynamic IP address. Make sure the NAT
routes all the UDP traffic through the same static IP address for the duration of the WorkSpaces session.

You can use this feature with Web Access and the client applications for macOS, iPad, Windows, Chromebook, and Android. To use this feature with a PCoIP zero client, you cannot use PCoIP Connection Manager.

Create an IP Access Control Group

You can create an IP access control group as follows. Each IP access control group can contain up to 10 rules.

To create an IP access control group

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose IP Access Controls.
3. Choose Create IP Group.
4. In the Create IP Group dialog box, enter a name and description for the group and choose Create.
5. Select the group and choose Edit.
6. For each IP address, choose Add Rule. For Source, enter the IP address or IP address range. For Description, enter a description. When you are done adding rules, choose Save.

Associate an IP Access Control Group with a Directory

You can associate an IP access control group with a directory to ensure that WorkSpaces are accessed only from trusted networks.

If you associate an IP access control group that has no rules with a directory, this blocks all access to all WorkSpaces.

To associate an IP access control group with a directory

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Select the directory and choose Actions, Update Details.
4. Expand IP Access Control Groups and select one or more IP access control groups.
5. Choose Update and Exit.

Copy an IP Access Control Group

You can use an existing IP access control group as a base for creating a new IP access control group.

To create an IP access control group from an existing one

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose IP Access Controls.
3. Select the group and choose Actions, Copy to New.
4. In the Copy IP Group dialog box, enter a name and description for the new group and choose Copy Group.
Delete an IP Access Control Group

You can delete a rule from an IP access control group at any time. If you remove a rule that was used to allow a connection to a WorkSpace, the user is disconnected from the WorkSpace.

Before you can delete an IP access control group, you must disassociate it from any directories.

To delete an IP access control group

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. For each directory that is associated with the IP access control group, select the directory and choose Actions, Update Details. Expand IP Access Control Groups, clear the check box for the IP access control group, and choose Update and Exit.
4. In the navigation pane, choose IP Access Controls.
5. Select the group and choose Actions, Delete IP Group.

Set Up PCoIP Zero Client for WorkSpaces

If your zero client device has firmware version 6.0.0 or later, your users can connect to their WorkSpaces directly. Otherwise, if the firmware is between 4.6.0 and 6.0.0, you must set up Teradici PCoIP Connection Manager for Amazon WorkSpaces and provide your users with server URLs to connect to their WorkSpaces through Teradici PCoIP Connection Manager for Amazon WorkSpaces.

To set up PCoIP Connection Manager for Amazon WorkSpaces on an EC2 instance, go to AWS Marketplace and find an Amazon Machine Image (AMI) that you can use to launch an instance with PCoIP Connection Manager. For more information, see Deploying the PCoIP Connection Manager for Amazon WorkSpaces in the PCoIP Connection Manager User Guide.

Note
In the Teradici PCoIP Administrative Web Interface (AWI) or the Teradici PCoIP Management Console (MC), make sure you enable Network Time Protocol (NTP). For the NTP host DNS name, use pool.ntp.org, and set the NTP host port to 123. If NTP isn't enabled, your PCoIP zero client users might receive certificate failure errors, such as "The supplied certificate is invalid due to timestamp."

For information about setting up and connecting with a PCoIP zero client device, see PCoIP Zero Client in the Amazon WorkSpaces User Guide. For a list of approved PCoIP zero client devices, see PCoIP Zero Clients on the Teradici website.

Thin clients aren't supported for use with Amazon WorkSpaces.

Set Up Android for Chromebooks

Version 2.4.13 is the final release of the Amazon WorkSpaces Chromebook client application. Because Google is phasing out support for Chrome Apps, there will be no further updates to the WorkSpaces Chromebook client application, and its use is unsupported.

For Chromebooks that support installing Android applications, we recommend using the Amazon WorkSpaces Android client application instead.
Some Chromebooks launched before 2019 must be enabled to install Android apps before users can install the Amazon WorkSpaces Android client application. For more information, see Chrome OS Systems Supporting Android Apps.

To remotely manage enabling your users' Chromebooks to install Android apps, see Set up Android on Chrome devices.

Enable and Configure Amazon WorkSpaces Web Access

Most WorkSpaces bundles support Amazon WorkSpaces Web Access through Chrome or Firefox browsers. For a list of WorkSpaces that support web browser access, see "Which Amazon WorkSpaces bundles support Web Access?" in Client Access, Web Access, and User Experience.

Note
A web browser cannot be used to connect to Amazon Linux WorkSpaces.

Important
Beginning October 1, 2020, customers will no longer be able to use the Amazon WorkSpaces Web Access client to connect to Windows 7 custom WorkSpaces or to Windows 7 Bring Your Own License (BYOL) WorkSpaces.

Step 1: Enable Web Access to Your WorkSpaces

You control Web Access to your WorkSpaces at the directory level. For each directory containing WorkSpaces that you want to allow users to access through the Web Access client, do the following steps.

To enable Web Access to your WorkSpaces
1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Choose the appropriate directory, and then choose Actions, Update Details.
4. Expand Access Control Options and find the Other Platforms section.
6. Choose Update and Exit.

Step 2: Configure Inbound and Outbound Access to Ports for Web Access

Amazon WorkSpaces Web Access requires inbound and outbound access for certain ports. For more information, see Ports for Web Access (p. 16).

Step 3: Configure Group Policy and Security Policy Settings to Enable Users to Log On

Amazon WorkSpaces relies on a specific logon screen configuration to enable users to successfully log on from their Web Access client.
To enable Web Access users to log on to their WorkSpaces, you must configure a Group Policy setting and three Security Policy settings. If these settings are not correctly configured, users might experience long logon times or black screens when they try to log on to their WorkSpaces. To configure these settings, use the following procedures.

You can use Group Policy Objects (GPOs) to apply settings to manage Windows WorkSpaces or users that are part of your Windows WorkSpaces directory. We recommend that you create an organizational unit for your WorkSpaces Computer Objects and an organizational unit for your WorkSpaces User Objects.

For information about using the Active Directory administration tools to work with GPOs, see Installing the Active Directory Administration Tools in the AWS Directory Service Administration Guide.

**To enable the WorkSpaces logon agent to switch users**

In most cases, when a user attempts to log on to a WorkSpace, the user name field is prepopulated with the name of that user. However, if an administrator has established an RDP connection to the WorkSpace to perform maintenance tasks, the user name field is populated with the name of the administrator instead.

To avoid this issue, disable the Hide entry points for Fast User Switching Group Policy setting. When you disable this setting, the WorkSpaces logon agent can use the Switch User button to populate the user name field with the correct name.

1. Open the Group Policy Management tool (gpmg.msc) and navigate to and select a GPO at the domain or domain controller level of the directory that you use for your WorkSpaces. (If you have the Amazon WorkSpaces Group Policy administrative template installed in your domain, you can use the WorkSpaces GPO for your WorkSpaces machine accounts.)
2. Choose Action, Edit in the main menu.
4. Open the Hide entry points for Fast User Switching setting.
5. In the Hide entry points for Fast User Switching dialog box, choose Disabled, and then choose OK.

**To hide the last logged on user name**

By default, the list of last logged on users is displayed instead of the Switch User button. Depending on the configuration of the WorkSpace, the list might not display the Other User tile. When this situation occurs, if the prepopulated user name isn't correct, the WorkSpaces logon agent can't populate the field with the correct name.

To avoid this issue, enable the Security Policy setting Interactive logon: Don't display last signed-in or Interactive logon: Do not display last user name (depending on which version of Windows you're using).

1. Open the Group Policy Management tool (gpmg.msc) and navigate to and select a GPO at the domain or domain controller level of the directory that you use for your WorkSpaces. (If you have the Amazon WorkSpaces Group Policy administrative template installed in your domain, you can use the WorkSpaces GPO for your WorkSpaces machine accounts.)
2. Choose Action, Edit in the main menu.
4. Open one of the following settings:
   - For Windows 7 — Interactive logon: Don't display last signed-in
   - For Windows 10 — Interactive logon: Do not display last user name
5. In the Properties dialog box for the setting, choose Enabled, and then choose OK.
To require pressing CTRL+ALT+DEL before users can log on

For WorkSpaces Web Access, you need to require that users press CTRL+ALT+DEL before they can log on. Requiring users to press CTRL+ALT+DEL before they log on ensures that users are using a trusted path when they’re entering their passwords.

1. Open the Group Policy Management tool (gpmc.msc) and navigate to and select a GPO at the domain or domain controller level of the directory that you use for your WorkSpaces. (If you have the Amazon WorkSpaces Group Policy administrative template (p. 57) installed in your domain, you can use the WorkSpaces GPO for your WorkSpaces machine accounts.)
2. Choose Action, Edit in the main menu.
4. Open the Interactive logon: Do not require CTRL+ALT+DEL setting.
5. On the Local Security Setting tab, choose Disabled, and then choose OK.

To display the domain and user information when the session is locked

The WorkSpaces logon agent looks for the user’s name and domain. After this setting is configured, the lock screen will display the user’s full name (if it is specified in Active Directory), their domain name, and their user name.

1. Open the Group Policy Management tool (gpmc.msc) and navigate to and select a GPO at the domain or domain controller level of the directory that you use for your WorkSpaces. (If you have the Amazon WorkSpaces Group Policy administrative template (p. 57) installed in your domain, you can use the WorkSpaces GPO for your WorkSpaces machine accounts.)
2. Choose Action, Edit in the main menu.
4. Open the Interactive logon: Display user information when the session is locked setting.
5. On the Local Security Setting tab, choose User display name, domain and user names, and then choose OK.

To apply the Group Policy and Security Policy settings changes

Group Policy and Security Policy settings changes take effect after the next Group Policy update for the WorkSpace and after the WorkSpace session is restarted. To apply the Group Policy and Security Policy changes in the prior procedures, do one of the following:

- Reboot the WorkSpace (in the Amazon WorkSpaces console, select the WorkSpace, then choose Actions, Reboot WorkSpaces).
- From an administrative command prompt, enter `gpupdate /force`.

Set Up Amazon WorkSpaces for FedRAMP Authorization or DoD SRG Compliance

To comply with the Federal Risk and Authorization Management Program (FedRAMP) or the Department of Defense (DoD) Cloud Computing Security Requirements Guide (SRG), you must configure Amazon WorkSpaces to use Federal Information Processing Standards (FIPS) endpoint encryption at the directory level. You must also use a US AWS Region that has FedRAMP authorization or is DoD SRG compliant.
The level of FedRAMP authorization (Moderate or High) or DoD SRG Impact Level (2, 4, or 5) depends on the US AWS Region in which Amazon WorkSpaces is being used. For the levels of FedRAMP authorization and DoD SRG compliance that apply to each Region, see AWS Services in Scope by Compliance Program.

Requirements

- You must create your WorkSpaces in a US AWS Region that has FedRAMP authorization or is DoD SRG-compliant.
- The WorkSpaces directory must be configured to use **FIPS 140-2 Validated Mode** for endpoint encryption.

  **Note**
  To use the **FIPS 140-2 Validated Mode** setting, the WorkSpaces directory must either be new, or all existing WorkSpaces in the directory must be using **FIPS 140-2 Validated Mode** for endpoint encryption. Otherwise, you cannot use this setting, and therefore the WorkSpaces that you create will not comply with FedRAMP or DoD security requirements.

- Users must access their WorkSpaces from one of the following WorkSpaces client applications:
  - Windows: 2.4.3 or later
  - macOS: 2.4.3 or later
  - Linux: 3.0.0 or later
  - iOS: 2.4.1 or later
  - Android: 2.4.1 or later
  - Fire Tablet: 2.4.1 or later
  - ChromeOS: 2.4.1 or later

To use FIPS endpoint encryption

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose **Directories**.
3. Verify that the directory where you want to create FedRAMP-authorized and DoD SRG-compliant WorkSpaces does not have any existing WorkSpaces associated with it. If there are WorkSpaces associated with the directory and the directory is not already enabled to use FIPS 140-2 Validated Mode, either terminate the WorkSpaces or create a new directory.
4. Choose the directory that meets the above criteria, and then choose **Actions, Update Details**.
5. On the **Update Directory Details** page, choose the arrow to expand the **Access Control Options** section.
6. For **Endpoint Encryption**, choose **FIPS 140-2 Validated Mode** instead of **TLS Encryption Mode (Standard)**.
7. Choose **Update and Exit**.
8. You can now create WorkSpaces from this directory that are FedRAMP authorized and DoD SRG compliant. To access these WorkSpaces, users must use one of the WorkSpaces client applications listed earlier in the Requirements (p. 38) section.

Enable SSH Connections for Your Linux WorkSpaces

If you or your users want to connect to your Amazon Linux WorkSpaces by using the command line, you can enable SSH connections. You can enable SSH connections to all WorkSpaces in a directory or to individual WorkSpaces in a directory.
To enable SSH connections, you create a new security group or update an existing security group and add a rule to allow inbound traffic for this purpose. Security groups act as a firewall for associated instances, controlling both inbound and outbound traffic at the instance level. After you create or update your security group, your users and others can use PuTTY or other terminals to connect from their devices to your Amazon Linux WorkSpaces.

For a video tutorial, see How can I connect to my Linux Amazon WorkSpaces using SSH? on the AWS Knowledge Center.

Contents
- Prerequisites for SSH Connections to Amazon Linux WorkSpaces (p. 39)
- Enable SSH Connections to All Amazon Linux WorkSpaces in a Directory (p. 40)
- Enable SSH Connections to a Specific Amazon Linux WorkSpace (p. 40)
- Connect to an Amazon Linux WorkSpace by Using Linux or PuTTY (p. 41)

Prerequisites for SSH Connections to Amazon Linux WorkSpaces

- Enabling inbound SSH traffic to a WorkSpace — To add a rule to allow inbound SSH traffic to one or more Amazon Linux WorkSpaces, make sure that you have the public or private IP addresses of the devices that require SSH connections to your WorkSpaces. For example, you can specify the public IP addresses of devices outside your virtual private cloud (VPC) or the private IP address of another EC2 instance in the same VPC as your WorkSpace.

If you plan to connect to a WorkSpace from your local device, you can use the search phrase "what is my IP address" in an internet browser or use the following service: Check IP.

- Connecting to a WorkSpace — The following information is required to initiate an SSH connection from a device to an Amazon Linux WorkSpace.
  - The NetBIOS name of the Active Directory domain that you are connected to.
  - Your WorkSpace user name.
  - The public or private IP address of the WorkSpace that you want to connect to.

  Private: If your VPC is attached to a corporate network and you have access to that network, you can specify the private IP address of the WorkSpace.

  Public: If your WorkSpace has a public IP address, you can use the WorkSpaces console to find the public IP address, as described in the following procedure.

To find the IP addresses for the Amazon Linux WorkSpace you want to connect to and your user name

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. In the list of WorkSpaces, choose the WorkSpace that you want to enable SSH connections to.
4. In the Running mode column, confirm that the WorkSpace status is Available.
5. Click the arrow to the left of the WorkSpace name to display the inline summary, and note the following information:
   - The WorkSpace IP. This is the private IP address of the WorkSpace.
The private IP address is required for obtaining the elastic network interface associated with the WorkSpace. The network interface is required to retrieve information such as the security group or public IP address associated with the WorkSpace.

- The WorkSpace Username. This is the user name that you specify to connect to the WorkSpace.

6. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
7. In the navigation pane, choose Network Interfaces.
8. In the search box, type the WorkSpace IP that you noted in Step 5.
9. Select the network interface associated with the WorkSpace IP.
10. If your WorkSpace has a public IP address, it is displayed in the IPv4 Public IP column. Make a note of this address, if applicable.

To find the NetBIOS name of the Active Directory domain that you are connected to

2. In the list of directories, click the Directory ID link of the directory for the WorkSpace.

Enable SSH Connections to All Amazon Linux WorkSpaces in a Directory

To enable SSH connections to all Amazon Linux WorkSpaces in a directory, do the following.

To create a security group with a rule to allow inbound SSH traffic to all Amazon Linux WorkSpaces in a directory

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the navigation pane, choose Security Groups.
4. Type a name and optionally, a description for your security group.
5. For VPC, choose the VPC that contains the WorkSpaces that you want to enable SSH connections to.
6. On the Inbound tab, choose Add Rule, and do the following:
   - For Type, choose SSH.
   - For Protocol, TCP is automatically specified when you choose SSH.
   - For Port Range, 22 is automatically specified when you choose SSH.
   - For Source, choose My IP or Custom, and specify a single IP address or an IP address range in CIDR notation. For example, if your IPv4 address is 203.0.113.25, specify 203.0.113.25/32 to list this single IPv4 address in CIDR notation. If your company allocates addresses from a range, specify the entire range, such as 203.0.113.0/24.
   - For Description (optional), type a description for the rule.
7. Choose Create.

Enable SSH Connections to a Specific Amazon Linux WorkSpace

To enable SSH connections to a specific Amazon Linux WorkSpace, do the following.
To add a rule to an existing security group to allow inbound SSH traffic to a specific Amazon Linux WorkSpace

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the navigation pane, under Network & Security, choose Network Interfaces.
3. In the search bar, type the private IP address of the WorkSpace that you want to enable SSH connections to.
4. In the Security groups column, click the link for the security group.
5. On the Inbound tab, choose Edit.
6. Choose Add Rule, and then do the following:
   - For Type, choose SSH.
   - For Protocol, TCP is automatically specified when you choose SSH.
   - For Port Range, 22 is automatically specified when you choose SSH.
   - For Source, choose My IP or Custom, and specify a single IP address or an IP address range in CIDR notation. For example, if your IPv4 address is 203.0.113.25, specify 203.0.113.25/32 to list this single IPv4 address in CIDR notation. If your company allocates addresses from a range, specify the entire range, such as 203.0.113.0/24.
   - For Description (optional), type a description for the rule.
7. Choose Save.

Connect to an Amazon Linux WorkSpace by Using Linux or PuTTY

After you create or update your security group and add the required rule, your users and others can use Linux or PuTTY to connect from their devices to your WorkSpaces.

Note
Before completing either of the following procedures, make sure that you have the following:

- The NetBIOS name of the Active Directory domain that you are connected to.
- The username that you use to connect to the WorkSpace.
- The public or private IP address of the WorkSpace that you want to connect to.

For instructions on how to obtain this information, see "Prerequisites for SSH Connections to Amazon Linux WorkSpaces" earlier in this topic.

To connect to an Amazon Linux WorkSpace by using Linux

1. Open the command prompt as an administrator and enter the following command. For NetBIOS name, Username, and WorkSpace IP, enter the applicable values.

   \ssh "NetBIOS_NAME\Username"@WorkSpaceIP

The following is an example of the SSH command where:

- The NetBIOS_NAME is anycompany
- The Username is janedoe
- The WorkSpace IP is 203.0.113.25
To connect to an Amazon Linux WorkSpace by using PuTTY

1. Open PuTTY.
2. In the PuTTY Configuration dialog box, do the following:
   • For Host Name (or IP address), enter the following command. Replace the values with the NetBIOS name of the Active Directory domain that you are connected to, the user name that you use to connect to the WorkSpace, and the IP address of the WorkSpace that you want to connect to.
   
   NetBIOS_NAME\Username@WorkSpaceIP
   
   • For Port, enter 22.
   • For Connection type, choose SSH.
   
   For an example of the SSH command, see step 1 in the previous procedure.
3. Choose Open.
4. When prompted, enter the same password that you use when authenticating with the WorkSpaces client (your Active Directory password).

Required Configuration and Service Components for WorkSpaces

As a WorkSpace administrator, you must understand the following about required configuration and service components.

Required Routing Table Configuration

We recommend that you not modify the operating system-level routing table for a WorkSpace. The WorkSpaces service requires the preconfigured routes in this table to monitor the system state and update system components. If routing table changes are required for your organization, contact AWS Support or your AWS account team before applying any changes.

Required Service Components

On Windows WorkSpaces, the service components are installed in the following locations. Do not delete, change, block, or quarantine these objects. If you do so, the WorkSpace will not function correctly.

Note
   If antivirus software is installed on the WorkSpace, exclude the following locations.

• C:\Program Files\Amazon
• C:\Program Files (x86)\Teradici
• C:\ProgramData\Amazon
• C:\ProgramData\Teradici

On Amazon Linux WorkSpaces, the service components are installed in the following locations. Do not delete, change, block, or quarantine these objects. If you do so, the WorkSpace will not function correctly.

• /etc/dhcp/dhclient.conf
• /etc/os-release
• /etc/pam.d/pcoip
• /etc/pam.d/pcoip-session
• /etc/profile.d/system-restart-check.sh
• /etc/X11/default-display-manager
• /etc/yum/pluginconf.d/halt_os_update_check.conf
• /usr/lib/pcoip-agent
• /usr/lib/skylight
• /usr/lib/systemd/system/pcoip.service
• /usr/lib/systemd/system/pcoip.service.d/
• /usr/lib/systemd/system/skylight-agent.service
• /usr/lib/yum-plugins/halt_os_update_check.py
• /var/lib/pcoip-agent
• /var/lib/skylight
• /var/log/pcoip-agent
• /var/log/skylight
Manage Directories for Amazon WorkSpaces

Amazon WorkSpaces uses a directory to store and manage information for your WorkSpaces and users. You can use one of the following options:

- **AD Connector** — Use your existing on-premises Microsoft Active Directory. Users can sign into their WorkSpaces using their on-premises credentials and access on-premises resources from their WorkSpaces.
- **Microsoft AD** — Create a Microsoft Active Directory hosted on AWS.
- **Simple AD** — Create a directory that is compatible with Microsoft Active Directory, powered by Samba 4, and hosted on AWS.
- **Cross trust** — Create a trust relationship between your Microsoft AD directory and your on-premises domain.

For tutorials that demonstrate how to set up these directories and launch WorkSpaces, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 64).

After you create a directory, you'll perform most directory administration tasks using tools such as the Active Directory Administration Tools. You can perform some directory administration tasks using the Amazon WorkSpaces console and other tasks using Group Policy. For more information about managing users and groups, see Manage WorkSpaces Users (p. 76) and Set Up Active Directory Administration Tools for Amazon WorkSpaces (p. 54).

**Note**
Shared directories are not currently supported with WorkSpaces.

Contents
- Register a Directory with Amazon WorkSpaces (p. 44)
- Update Directory Details for Your WorkSpaces (p. 45)
- Update DNS Servers for Amazon WorkSpaces (p. 48)
- Delete the Directory for Your WorkSpaces (p. 53)
- Enable Amazon WorkDocs for Microsoft Active Directory (p. 54)
- Set Up Active Directory Administration Tools for Amazon WorkSpaces (p. 54)
- Manage Your Windows WorkSpaces Using Group Policy (p. 56)
- Manage Your Amazon Linux WorkSpaces (p. 61)

Register a Directory with Amazon WorkSpaces

To allow Amazon WorkSpaces to use an existing AWS Directory Service directory, you must register it with Amazon WorkSpaces. After you register a directory, you can launch WorkSpaces in the directory.

**To register a directory**

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose **Directories**.
3. Select the directory.
4. Choose **Actions**, **Register**.
5. Select two subnets that are not from the same Availability Zone.
6. For **Enable Self Service Permissions**, choose **Yes** to enable your users to rebuild their WorkSpaces, change volume size, compute type and running mode. Enabling may impact how much you pay for Amazon WorkSpaces. Choose **No** otherwise.
7. For **Enable Amazon WorkDocs**, choose **Yes** to register the directory for use with Amazon WorkDocs or **No** otherwise.

   **Note**
   This option is displayed only if Amazon WorkDocs is available in the Region and if you're not using Microsoft Active Directory (AD). If you’re using Microsoft AD, finish registering your directory, and then see Enable Amazon WorkDocs for Microsoft Active Directory (p. 54).
8. Choose **Register**. Initially the value of **Registered** is **REGISTERING**. After registration is complete, the value is **Yes**.

When you are finished using the directory with Amazon WorkSpaces, you can deregister it. Note that you must deregister a directory before you can delete it. If you want to deregister and delete a directory, you must first find and remove all the applications and services that are registered to the directory. For more information, see Delete Your Directory in the **AWS Directory Service Administration Guide**.

**To deregister a directory**
1. Open the Amazon WorkSpaces console at [https://console.aws.amazon.com/workspaces/](https://console.aws.amazon.com/workspaces/).
2. In the navigation pane, choose **Directories**.
3. Select the directory.
4. Choose **Actions**, **Deregister**.
5. When prompted for confirmation, choose **Deregister**. After deregistration is complete, the value of **Registered** is **No**.

**Update Directory Details for Your WorkSpaces**

You can complete the following directory management tasks using the Amazon WorkSpaces console.

**Tasks**
- Select an Organizational Unit (p. 45)
- Configure Automatic IP Addresses (p. 46)
- Control Device Access (p. 47)
- Manage Local Administrator Permissions (p. 47)
- Update the AD Connector Account (AD Connector) (p. 47)
- Multi-factor Authentication (AD Connector) (p. 48)

**Select an Organizational Unit**

WorkSpace machine accounts are placed in the default organizational unit (OU) for the WorkSpaces directory. Initially, the machine accounts are placed in the Computers OU of your directory or the directory that your AD Connector is connected to. You can select a different OU from your directory or
Configure Automatic IP Addresses

After you enable automatic assignment of Elastic IP addresses, each WorkSpace that you launch is assigned an Elastic IP address (a static public IP address) from the Amazon-provided pool of Elastic IP addresses. These Elastic IP addresses allow WorkSpaces in public subnets to access the internet. WorkSpaces that already exist before you enable automatic assignment do not receive an Elastic IP address until you rebuild them.

Note that you do not need to enable automatic assignment of Elastic IP addresses if your WorkSpaces are in private subnets and you configured a NAT gateway for the virtual private cloud (VPC), or if your WorkSpaces are in public subnets and you manually assigned Elastic IP addresses. For more information, see Configure a VPC for Amazon WorkSpaces (p. 8).

Warning
If you associate an Elastic IP address that you own to a WorkSpace, and then you later disassociate that Elastic IP address from the WorkSpace, the WorkSpace loses its public IP address, and it doesn't automatically get a new one from the Amazon-provided pool. To associate a new public IP address from the Amazon-provided pool with the WorkSpace, you must rebuild the WorkSpace (p. 90). If you don't want to rebuild the WorkSpace, you must associate another Elastic IP address that you own to the WorkSpace.

To configure Elastic IP addresses
1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.

Configure Automatic IP Addresses

After you enable automatic assignment of Elastic IP addresses, each WorkSpace that you launch is assigned an Elastic IP address (a static public IP address) from the Amazon-provided pool of Elastic IP addresses. These Elastic IP addresses allow WorkSpaces in public subnets to access the internet. WorkSpaces that already exist before you enable automatic assignment do not receive an Elastic IP address until you rebuild them.

Note that you do not need to enable automatic assignment of Elastic IP addresses if your WorkSpaces are in private subnets and you configured a NAT gateway for the virtual private cloud (VPC), or if your WorkSpaces are in public subnets and you manually assigned Elastic IP addresses. For more information, see Configure a VPC for Amazon WorkSpaces (p. 8).

Warning
If you associate an Elastic IP address that you own to a WorkSpace, and then you later disassociate that Elastic IP address from the WorkSpace, the WorkSpace loses its public IP address, and it doesn't automatically get a new one from the Amazon-provided pool. To associate a new public IP address from the Amazon-provided pool with the WorkSpace, you must rebuild the WorkSpace (p. 90). If you don't want to rebuild the WorkSpace, you must associate another Elastic IP address that you own to the WorkSpace.

To configure Elastic IP addresses
1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
Control Device Access

You can specify the types of devices that have access to WorkSpaces. In addition, you can restrict access to WorkSpaces to trusted devices (also known as managed devices).

To control device access to WorkSpaces

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Select the directory and then choose Actions, Update Details.
4. Expand Access to Internet and select Enable or Disable.
5. Choose Update.

6. (Optional) You can also restrict access to trusted devices only. For more information, see Restrict WorkSpaces Access to Trusted Devices (p. 29).

7. Choose Update and Exit.

Manage Local Administrator Permissions

You can specify whether users are local administrators on their WorkSpaces, which enables them to install application and modify settings on their WorkSpaces. Users are local administrators by default. If you modify this setting, the change applies to all new WorkSpaces that you create and any WorkSpaces that you rebuild.

To modify local administrator permissions

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Select your directory and then choose Actions, Update Details.
4. Expand Local Administrator Setting.
5. To ensure that users are local administrators, choose Enable. Otherwise, choose Disable.
6. Choose Update and Exit.

Update the AD Connector Account (AD Connector)

You can update the AD Connector account that is used to read users and groups and join Amazon WorkSpaces machine accounts to your AD Connector directory.

To update the AD Connector account

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose **Directories**.
3. Select your directory and then choose **Actions, Update Details**.
4. Expand **Update AD Connector Account**.
5. Type the user name and password for the new account.
6. Choose **Update and Exit**.

## Multi-factor Authentication (AD Connector)

You can enable multi-factor authentication for your AD Connector directory.

**To enable multi-factor authentication**

1. Open the Amazon WorkSpaces console at [https://console.aws.amazon.com/workspaces/](https://console.aws.amazon.com/workspaces/).
2. In the navigation pane, choose **Directories**.
3. Select your directory and then choose **Actions, Update Details**.
4. Expand **Multi-Factor Authentication** and then select **Enable Multi-Factor Authentication**.
5. For **RADIUS server IP address(es)**, type the IP addresses of your RADIUS server endpoints separated by commas, or type the IP address of your RADIUS server load balancer.
6. For **Port**, type the port that your RADIUS server is using for communications. Your on-premises network must allow inbound traffic over the default RADIUS server port (1812) from AD Connector.
7. For **Shared secret code** and **Confirm shared secret code**, type the shared secret code for your RADIUS server.
8. For **Protocol**, choose the protocol for your RADIUS server.
9. For **Server timeout**, type the time, in seconds, to wait for the RADIUS server to respond. This value must be between 1 and 20.
10. For **Max retries**, type the number of times to attempt communication with the RADIUS server. This value must be between 0 and 10.
11. Choose **Update and Exit**.

Multi-factor authentication is available when **RADIUS status** is **Enabled**. While multi-factor authentication is being set up, users cannot log in to their WorkSpaces.

## Update DNS Servers for Amazon WorkSpaces

If you need to update the DNS server IP addresses for your Active Directory after launching your WorkSpaces, you must also update your WorkSpaces with the new DNS server settings.

You can update your WorkSpaces with the new DNS settings in one of the following ways:

- Update the DNS settings on the WorkSpaces **before** you update the DNS settings for Active Directory.
- Rebuild the WorkSpaces **after** you update the DNS settings for Active Directory.

We recommend updating the DNS settings on the WorkSpaces before updating the DNS settings in Active Directory (as explained in Step 1 (p. 49) of the following procedure).

If you want to rebuild the WorkSpaces instead, update one of the DNS server IP addresses in your Active Directory (Step 2 (p. 51)), and then follow the procedure in Rebuild a Workspace (p. 90) to rebuild your WorkSpaces. After you've rebuilt your WorkSpaces, follow the procedure in Step 3 (p. 51) to test
your DNS server updates. After completing that step, update the IP address of your second DNS server in Active Directory, and then rebuild your WorkSpaces again. Be sure to follow the procedure in Step 3 (p. 51) to test your second DNS server update. As noted in the Best Practices (p. 49) section, we recommend updating your DNS server IP addresses one at a time.

Best Practices

When you're updating your DNS server settings, we recommend the following best practices:

- To avoid disconnections and inaccessibility of domain resources, we strongly recommend performing DNS server updates during off-peak hours or during a planned maintenance period.
- Don't launch any new WorkSpaces during the 15 minutes before and the 15 minutes after changing your DNS server settings.
- When updating your DNS server settings, change one DNS server IP address at a time. Verify that the first update is correct before updating the second IP address. We recommend performing the following procedure (Step 1 (p. 49), Step 2 (p. 51), and Step 3 (p. 51)) twice to update the IP addresses one at a time.

Step 1: Update the DNS Server Settings on Your WorkSpaces

In the following procedure, the current and new DNS server IP address values are referred to as follows:

- Current DNS IP addresses: OldIP1, OldIP2
- New DNS IP addresses: NewIP1, NewIP2

Note

If this is the second time you're performing this procedure, replace OldIP1 with OldIP2 and NewIP1 with NewIP2.

Update the DNS Server Settings for Windows WorkSpaces

If you have multiple WorkSpaces, you can deploy the following registry update to the WorkSpaces by applying a Group Policy Object (GPO) on the Active Directory OU for your WorkSpaces. For more information about working with GPOs, see Manage Your Windows WorkSpaces Using Group Policy (p. 56).

You can make these updates either by using the Registry Editor or by using Windows PowerShell. Both procedures are described in this section.

To update the DNS registry settings using the Registry Editor

1. On your Windows WorkSpace, open the Windows search box, and enter registry editor to open the Registry Editor (regedit.exe).
2. When asked "Do you want to allow this app to make changes to your device?", choose Yes.
3. In the Registry Editor, navigate to the following registry entry:

   HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\SkyLight

4. Open the DomainJoinDns registry key. Update OldIP1 with NewIP1, and then choose OK.
5. Close the Registry Editor.
6. Reboot the WorkSpace, or restart the service SkyLightWorkspaceConfigService.
7. Proceed to Step 2 (p. 51), and update your DNS server settings in Active Directory to replace \textit{OldIP1} with \textit{NewIP1}.

To update the DNS registry settings using PowerShell

The following procedure uses PowerShell commands to update your registry and restart the service SkyLightWorkspaceConfigService.

1. On your Windows WorkSpace, open the Windows search box, and enter \texttt{powershell}. Choose \texttt{Run as Administrator}.
2. When asked “Do you want to allow this app to make changes to your device?”, choose \texttt{Yes}.
3. In the PowerShell window, run the following command to retrieve the current DNS server IP addresses.

   \begin{verbatim}
   Get-ItemProperty -Path HKLM:\SOFTWARE\Amazon\SkyLight -Name DomainJoinDNS
   \end{verbatim}

   You should receive the following output.

   \begin{verbatim}
   DomainJoinDns : OldIP1,OldIP2
   PSPath        : Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\SkyLight
   ParentPath    : Microsoft.PowerShell.Core\Registry::HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\SkyLight
   PSChildName   : SkyLight
   PSDrive       : HKLM
   PSProvider    : Microsoft.PowerShell.Core\Registry
   \end{verbatim}

4. In the PowerShell window, run the following command to change \textit{OldIP1} to \textit{NewIP1}. Be sure to leave \textit{OldIP2} as is for now.

   \begin{verbatim}
   Set-ItemProperty -Path HKLM:\SOFTWARE\Amazon\SkyLight -Name DomainJoinDNS -Value "NewIP1, OldIP2"
   \end{verbatim}

5. Run the following command to restart the service SkyLightWorkspaceConfigService.

   \begin{verbatim}
   restart-service -Name SkyLightWorkspaceConfigService
   \end{verbatim}

6. Proceed to Step 2 (p. 51), and update your DNS server settings in Active Directory to replace \textit{OldIP1} with \textit{NewIP1}.

Update the DNS Server Settings for Linux WorkSpaces

If you have more than one Linux WorkSpace, we recommend that you use a configuration management solution to distribute and enforce policy. For example, you can use AWS Opsworks for Chef Automate, AWS OpsWorks for Puppet Enterprise, or Ansible.

To update the DNS server settings on a Linux WorkSpace

1. On your Linux WorkSpace, open a Terminal window (\texttt{Applications > System Tools > MATE Terminal}).
2. Use the following Linux command to edit the \texttt{/etc/dhcp/dhclient.conf} file. You must have root user privileges to edit this file. Either become root by using the \texttt{sudo -i} command, or execute all commands with \texttt{sudo} as shown.

   \begin{verbatim}
   sudo vi /etc/dhcp/dhclient.conf
   \end{verbatim}
In the `/etc/dhcp/dhclient.conf` file, you will see the following `prepend` command, where `OldIP1` and `OldIP2` are the IP addresses of your DNS servers.

```
prepend domain-name-servers OldIP1, OldIP2; # skylight
```

3. Replace `OldIP1` with `NewIP1`, and leave `OldIP2` as is for now.
4. Save your changes to `/etc/dhcp/dhclient.conf`.
5. Reboot the WorkSpace.
6. Proceed to Step 2 (p. 51), and update your DNS server settings in Active Directory to replace `OldIP1` with `NewIP1`.

**Step 2: Update the DNS Server Settings for Active Directory**

In this step, you update your DNS server settings for Active Directory. As noted in the Best Practices (p. 49) section, we recommend updating your DNS server IP addresses one at a time.

To update your DNS server settings for Active Directory, see the following documentation in the AWS Directory Service Administration Guide:

- AD Connector: Update the DNS Address for Your AD Connector
- AWS Managed Microsoft AD: Configure DNS Conditional Forwarders for Your On-premises Domain
- Simple AD: Configure DNS

After updating your DNS server settings, proceed to Step 3 (p. 51).

**Step 3: Test the Updated DNS Server Settings**

After completing Step 1 (p. 49) and Step 2 (p. 51), use the following procedure to verify that your updated DNS server settings are working as expected.

In the following procedure, the current and new DNS server IP address values are referred to as follows:

- Current DNS IP addresses: `OldIP1, OldIP2`
- New DNS IP addresses: `NewIP1, NewIP2`

**Note**

If this is the second time you're performing this procedure, replace `OldIP1` with `OldIP2` and `NewIP1` with `NewIP2`.

**Test the Updated DNS Server Settings for Windows WorkSpaces**

1. Shut down the `OldIP1` DNS server.
2. Log in to a Windows WorkSpace.
4. Run the following command, where `AD_Name` is the name of your Active Directory (for example, corp.example.com).

```
nslookup AD_Name
```
Step 3: Test the Updated DNS Server Settings

The `nslookup` command should return the following output. (If this is the second time you're performing this procedure, you should see `NewIP2` in place of `OldIP2`.)

| Server: | Full_AD_Name |
| Address: | NewIP1 |
| Name: | AD_Name |
| Addresses: | OldIP2
| | NewIP1 |

5. If the output is not what you were expecting or if you receive any errors, repeat Step 1 (p. 49).

6. Wait for an hour and confirm that no user issues have been reported. Verify that `NewIP1` is getting DNS queries and responding with answers.

7. After you've verified that the first DNS server is working properly, repeat Step 1 (p. 49) to update the second DNS server, this time replacing `OldIP2` with `NewIP2`. Then repeat Step 2 and Step 3.

Test the Updated DNS Server Settings for Linux WorkSpaces

1. Shut down the `OldIP1` DNS server.
2. Log in to a Linux WorkSpace.
3. On your Linux WorkSpace, open a Terminal window (Applications > System Tools > MATE Terminal).
4. The DNS server IP addresses returned in the DHCP response are written to the local `/etc/resolv.conf` file on the WorkSpace. Run the following command to view the contents of the `/etc/resolv.conf` file.

```
cat /etc/resolv.conf
```

You should see the following output. (If this is the second time you're performing this procedure, you should see `NewIP2` in place of `OldIP2`.)

```
; This file is generated by Amazon WorkSpaces
; Modifying it can make your WorkSpace inaccessible until reboot
options timeout:2 attempts:5
; generated by /usr/sbin/dhclient-script
search region.compute.internal
nameserver NewIP1
nameserver OldIP2
nameserver WorkSpaceIP
```

Note

If you make manual modifications to the `/etc/resolv.conf` file, those changes are lost when the WorkSpace is restarted.

5. If the output is not what you were expecting or if you receive any errors, repeat Step 1 (p. 49).

6. The actual DNS server IP addresses are stored in the `/etc/dhcp/dhclient.conf` file. To see the contents of this file, run the following command.

```
sudo cat /etc/dhcp/dhclient.conf
```

You should see the following output. (If this is the second time you're performing this procedure, you should see `NewIP2` in place of `OldIP2`.)

```
# This file is generated by Amazon WorkSpaces
```
# Modifying it can make your WorkSpace inaccessible until rebuild
prepend domain-name-servers NewIP1, OldIP2; # skylight

7. Wait for an hour and confirm that no user issues have been reported. Verify that NewIP1 is getting DNS queries and responding with answers.

8. After you've verified that the first DNS server is working properly, repeat Step 1 (p. 49) to update the second DNS server, this time replacing OldIP2 with NewIP2. Then repeat Step 2 and Step 3.

Delete the Directory for Your WorkSpaces

You can delete the directory for your WorkSpaces if it is no longer in use by other WorkSpaces or other applications, such as Amazon WorkDocs, Amazon WorkMail, or Amazon Chime. Note that you must deregister a directory before you can delete it.

What Happens When a Directory Is Deleted

When a Simple AD or AWS Directory Service for Microsoft Active Directory directory is deleted, all of the directory data and snapshots are deleted and cannot be recovered. After the directory is deleted, all instances that are joined to the directory remain intact. You cannot, however, use your directory credentials to log in to these instances. You need to log in to these instances with a user account that is local to the instance.

When an AD Connector directory is deleted, your on-premises directory remains intact. All instances that are joined to the directory also remain intact and remain joined to your on-premises directory. You can still use your directory credentials to log in to these instances.

To delete a directory

1. Delete all WorkSpaces in the directory. For more information, see Delete a WorkSpace (p. 101).
2. Find and remove all of the applications and services that are registered to the directory. For more information, see Delete Your Directory in the AWS Directory Service Administration Guide.
3. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
4. In the navigation pane, choose Directories.
5. Select the directory and choose Actions, Deregister.
6. When prompted for confirmation, choose Deregister.
7. Select the directory again and choose Actions, Delete.
8. When prompted for confirmation, choose Delete.

Note
Removing application assignments can sometimes take more time than expected. If you receive the following error message, verify that you've removed all application assignments, and then wait 30 to 60 minutes before trying again to delete the directory:

An Error Has Occurred
Cannot delete the directory because it still has authorized applications.
Additional directory details can be viewed at the Directory Service console.

9. (Optional) After you delete all resources in the virtual private cloud (VPC) for your directory, you can delete the VPC and release the Elastic IP address used for the NAT gateway. For more information, see Deleting your VPC and Working with Elastic IP addresses in the Amazon VPC User Guide.
10. (Optional) To delete any custom bundles and images that you are finished with, see Delete a Custom WorkSpaces Bundle or Image (p. 115).
Enable Amazon WorkDocs for Microsoft Active Directory

If you're using Microsoft Active Directory (AD) with Amazon WorkSpaces, you can enable Amazon WorkDocs for your directory through either the Amazon WorkDocs console or the AWS Directory Service console.

To enable WorkDocs through the Amazon WorkDocs console

1. Open the Amazon WorkDocs console at https://console.aws.amazon.com/zocalo/.
2. Choose Create a New WorkDocs Site.
4. Select the directory and create your site name.
5. Specify the user who will administer the WorkDocs site. You can use the admin or any user created in the directory.

For more information, see Getting Started with AWS Managed Microsoft AD in the Amazon WorkDocs Administration Guide.

To enable WorkDocs through the AWS Directory Service console

2. In the navigation pane, choose Directories.
3. On the Directories page, choose your directory.
5. In the Application access URL section, if an access URL has not been assigned to the directory, the Create button is displayed. Enter a directory alias and choose Create. For more information, see Creating an Access URL in the AWS Directory Service Administration Guide.
6. In the Application access URL section, choose Enable to enable single sign-on for Amazon WorkDocs. For more information, see Single Sign-On in the AWS Directory Service Administration Guide.

Set Up Active Directory Administration Tools for Amazon WorkSpaces

You'll perform most administrative tasks for your WorkSpaces directory using directory management tools, such as the Active Directory Administration Tools. However, you'll use Amazon WorkSpaces console to perform some directory-related tasks. For more information, see Manage Directories for Amazon WorkSpaces (p. 44).

If you create a directory with Microsoft AD or Simple AD that includes five or more WorkSpaces, we recommend that you centralize administration on an Amazon EC2 instance. Although you can install the directory management tools on a WorkSpace, using an Amazon EC2 instance is a more robust solution.

To set up the Active Directory Administration Tools

1. Launch a Windows instance and join it to your WorkSpaces directory.
You can join an Amazon EC2 Windows instance to your directory domain when you launch the instance. For more information, see Joining a Windows Instance to an AWS Directory Service Domain in the Amazon EC2 User Guide for Windows Instances.

Alternatively, you can join the instance to your directory manually. For more information, see Manually Add a Windows Instance (Simple AD and Microsoft AD) in the AWS Directory Service Administration Guide.

2. Install the Active Directory Administration Tools on the instance. For more information, see Installing the Active Directory Administration Tools in the AWS Directory Service Administration Guide.

3. Run the tools as a directory administrator as follows:
   a. Open the Administrative Tools.
   b. Hold down the Shift key, right-click the tool shortcut, and choose Run as different user.
   c. Type the username and password for the administrator. With Simple AD, the username is Administrator and with Microsoft AD, the administrator is Admin.

You can now perform directory administration tasks using the Active Directory tools that you are familiar with. For example, you can use the Active Directory Users and Computers Tool to add users, remove users, promote a user to directory administrator, or reset a user password. Note that you must be logged into your Windows instance as a user that has permissions to manage users in the directory.

To promote a user to a directory administrator

**Note**
This procedure applies only to directories created with Simple AD, not AWS Managed AD. For directories created with AWS Managed AD, see Manage Users and Groups in AWS Managed Microsoft AD in the AWS Directory Service Administration Guide.

1. Open the Active Directory Users and Computers tool.
2. Navigate to the Users folder under your domain and select the user to promote.
4. In the user properties dialog box, choose Member of.
5. Add the user to the following groups and choose OK.
   - Administrators
   - Domain Admins
   - Enterprise Admins
   - Group Policy Creator Owners
   - Schema Admins

To add or remove users

You can create new users from the Amazon WorkSpaces console only during the process of launching a WorkSpace, and you cannot delete users through the Amazon WorkSpaces console. Most user management tasks, including managing user groups, must be performed through your directory.

**Important**
Before you can remove a user, you must delete the WorkSpace assigned to that user. For more information, see Delete a WorkSpace (p. 101).

The process you use for managing users and groups depends on which type of directory you're using.

- If you're using AWS Managed Microsoft AD, see Manage Users and Groups in AWS Managed Microsoft AD in the AWS Directory Service Administration Guide.
• If you're using Simple AD, see Manage Users and Groups in Simple AD in the AWS Directory Service Administration Guide.

• If you use Microsoft Active Directory through AD Connector or a trust relationship, you can manage users and groups by using Active Directory.

To reset a user password

When you reset the password for an existing user, do not set User must change password at next logon. Otherwise, the users cannot connect to their WorkSpaces. Instead, assign a secure temporary password to each user and then ask the users to manually change their passwords from within the WorkSpace the next time they log on.

   Note
   If you're using AD Connector, your users won't be able to reset their own passwords. (The Forgot password? option on the WorkSpaces client application login screen won't be available.)

Manage Your Windows WorkSpaces Using Group Policy

You can use Group Policy Objects (GPOs) to apply settings to manage Windows WorkSpaces or users that are part of your Windows WorkSpaces directory.

   Note
   Linux instances do not adhere to Group Policy. For information about managing Amazon Linux WorkSpaces, see Manage Your Amazon Linux WorkSpaces (p. 61).

We recommend that you create an organizational unit for your WorkSpaces Computer Objects and an organizational unit for your WorkSpaces User Objects.

   Warning
   Group Policy settings can affect the experience of your WorkSpace users as follows:

   • Some Group Policy settings force users to log off when they are disconnected from a session. Any applications that users have open on their WorkSpaces are closed.
   • Implementing an interactive logon message to display a logon banner prevents users from being able to access their WorkSpaces. The interactive logon message Group Policy setting is not currently supported by Amazon WorkSpaces.
   • Disabling removable storage through Group Policy settings causes a login failure that results in users being logged in to temporary user profiles with no access to drive D.
   • Group Policy settings can be used to restrict drive access. If you configure Group Policy settings to restrict access to drive C or to drive D, users can't access their WorkSpaces. To prevent this issue from occurring, make sure that your users can access drive C and drive D.

For information about using the Active Directory administration tools to work with GPOs, see Set Up Active Directory Administration Tools for Amazon WorkSpaces (p. 54).

Contents

• Install the Group Policy Administrative Template (p. 57)
• Configure Printer Support for Windows WorkSpaces (p. 57)
• Enable or Disable Clipboard Redirection for Windows WorkSpaces (p. 58)
• Set the Session Resume Timeout for Windows WorkSpaces (p. 59)
• Disable Time Zone Redirection for Windows WorkSpaces (p. 60)
Install the Group Policy Administrative Template

To use the Group Policy settings that are specific to Amazon WorkSpaces, you must install the Group Policy administrative template. Perform the following procedure on a directory administration WorkSpace or Amazon EC2 instance that is joined to your WorkSpaces directory.

To install the Group Policy administrative template

1. From a running Windows WorkSpace, make a copy of the pcoip.adm file in the C:\Program Files (x86)\Teradici\PCoIP Agent\configuration directory.
2. On a directory administration WorkSpace or Amazon EC2 instance that is joined to your WorkSpaces directory, open the Group Policy Management tool (gpmc.msc) and navigate to the organizational unit in your domain that contains your WorkSpaces machine accounts.
3. Open the context (right-click) menu for the machine account organizational unit and choose Create a GPO in this domain, and link it here.
4. In the New GPO dialog box, enter a descriptive name for the GPO, such as WorkSpaces Machine Policies, and leave Source Starter GPO set to (none). Choose OK.
5. Open the context (right-click) menu for the new GPO and choose Edit.
6. In the Group Policy Management Editor, choose Computer Configuration, Policies, and Administrative Templates. Choose Action, Add/Remove Templates from the main menu.
7. In the Add/Remove Templates dialog box, choose Add, select the pcoip.adm file copied previously, and then choose Open, Close.
8. Close the Group Policy Management Editor. You can now use this GPO to modify the Group Policy settings that are specific to Amazon WorkSpaces.

Configure Printer Support for Windows WorkSpaces

By default, Amazon WorkSpaces enables Basic remote printing, which offers limited printing capabilities because it uses a generic printer driver on the host side to ensure compatible printing.

Advanced remote printing for Windows clients lets you use specific features of your printer, such as double-sided printing, but it requires installation of the matching printer driver on the host side.

Remote printing is implemented as a virtual channel. If virtual channels are disabled, remote printing does not function.

For Windows WorkSpaces, you can use Group Policy settings to configure printer support as needed.

To configure printer support

1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 57) is installed in your domain.
2. On a directory administration WorkSpace or Amazon EC2 instance that is joined to your WorkSpaces directory, open the Group Policy Management tool (gpmc.msc) and navigate to and select the WorkSpaces GPO for your WorkSpaces machine accounts. Choose Action, Edit in the main menu.
3. In the Group Policy Management Editor, choose Computer Configuration, Policies, Administrative Templates, Classic Administrative Templates, PCoIP Session Variables, and Overridable Administrator Defaults.
4. Open the Configure remote printing setting.
5. In the Configure remote printing dialog box, do one of the following:
To enable Advanced remote printing, choose **Enabled**, and then under **Options, Configure remote printing**, choose **Basic and Advanced printing for Windows clients**. To automatically use the client computer's current default printer, select **Automatically set default printer**.

To disable printing, choose **Enabled**, and then under **Options, Configure remote printing**, choose **Printing disabled**.

6. Choose **OK**.
7. The Group Policy setting change takes effect after the next Group Policy update for the WorkSpace and after the WorkSpace session is restarted. To apply the Group Policy changes, do one of the following:

   • Reboot the WorkSpace (in the Amazon WorkSpaces console, select the WorkSpace, then choose **Actions, Reboot WorkSpaces**).
   • From an administrative command prompt, type `gpupdate /force`.

By default, local printer auto-redirection is disabled. You can use Group Policy settings to enable this feature so that your local printer is set as the default printer every time you connect to your WorkSpace.

**Note**
Local printer redirection is not available for Amazon Linux WorkSpaces.

### To enable local printer auto-redirection

1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 57) is installed in your domain.
2. On a directory administration WorkSpace or Amazon EC2 instance that is joined to your WorkSpaces directory, open the Group Policy Management tool (**gpmc.msc**) and navigate to and select the WorkSpaces GPO for your WorkSpaces machine accounts. Choose **Action, Edit** in the main menu.
3. In the Group Policy Management Editor, choose **Computer Configuration, Policies, Administrative Templates, Classic Administrative Templates, PCoIP Session Variables, and Overridable Administrator Defaults**.
4. Open the **Configure remote printing** setting.
5. Choose **Enabled**, and then under **Options, Configure remote printing**, choose either **Basic and Advanced printing for Windows clients** or choose **Basic printing**, select **Automatically set default printer**, and then choose **OK**.
6. The Group Policy setting change takes effect after the next Group Policy update for the WorkSpace and after the WorkSpace session is restarted. To apply the Group Policy changes, do one of the following:

   • Reboot the WorkSpace (in the Amazon WorkSpaces console, select the WorkSpace, then choose **Actions, Reboot WorkSpaces**).
   • From an administrative command prompt, type `gpupdate /force`.

**Enable or Disable Clipboard Redirection for Windows WorkSpaces**

By default, Amazon WorkSpaces supports clipboard redirection. If needed for Windows WorkSpaces, you can use Group Policy settings to disable this feature.

### To enable or disable clipboard redirection

1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 57) is installed in your domain.
2. On a directory administration WorkSpace or Amazon EC2 instance that is joined to your WorkSpaces directory, open the Group Policy Management tool (gpmc.msc) and navigate to and select the WorkSpaces GPO for your WorkSpaces machine accounts. Choose Action, Edit in the main menu.

3. In the Group Policy Management Editor, choose Computer Configuration, Policies, Administrative Templates, Classic Administrative Templates, PCoIP Session Variables, and Overridable Administrator Defaults.

4. Open the Configure clipboard redirection setting.

5. In the Configure clipboard redirection dialog box, choose Enabled and then choose one of the following settings to determine the direction in which clipboard redirection is allowed. When you’re done, choose OK.

   - Disabled in both directions
   - Enabled agent to client only (WorkSpace to local computer)
   - Enabled client to agent only (local computer to WorkSpace)
   - Enabled in both directions

6. The Group Policy setting change takes effect after the next Group Policy update for the WorkSpace and after the WorkSpace session is restarted. To apply the Group Policy changes, do one of the following:

   - Reboot the WorkSpace (in the Amazon WorkSpaces console, select the WorkSpace, then choose Actions, Reboot WorkSpaces).
   - From an administrative command prompt, type gpupdate /force.

Known Limitation

With clipboard redirection enabled on the WorkSpace, if you copy content that is larger than 890 KB from a Microsoft Office application, the application might become slow or unresponsive for up to 5 seconds.

Set the Session Resume Timeout for Windows WorkSpaces

When using the Amazon WorkSpaces client applications, an interruption of network connectivity causes an active session to be disconnected. This can be caused by events such as closing the laptop lid, or the loss of your wireless network connection. The Amazon WorkSpaces client applications for Windows and macOS attempt to reconnect the session automatically if network connectivity is regained within a certain amount of time. The default session resume timeout is 20 minutes, but you can modify that value for WorkSpaces that are controlled by your domain's Group Policy settings.

To set the automatic session resume timeout value

1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 57) is installed in your domain.

2. On a directory administration WorkSpace or Amazon EC2 instance that is joined to your WorkSpaces directory, open the Group Policy Management tool (gpmc.msc) and navigate to and select the WorkSpaces GPO for your WorkSpaces machine accounts. Choose Action, Edit in the main menu.

3. In the Group Policy Management Editor, choose Computer Configuration, Policies, Administrative Templates, Classic Administrative Templates, and PCoIP Session Variables.

   To allow the user to override your setting, choose Overridable Administrator Defaults; otherwise, choose Not Overridable Administrator Defaults.

4. Open the Configure Session Automatic Reconnection Policy setting.
5. In the Configure Session Automatic Reconnection Policy dialog box, choose Enabled, set the Configure Session Automatic Reconnection Policy option to the desired timeout, in minutes, and choose OK.

6. The Group Policy setting change takes effect after the next Group Policy update for the WorkSpace and after the WorkSpace session is restarted. To apply the Group Policy changes, do one of the following:

   • Reboot the WorkSpace (in the Amazon WorkSpaces console, select the WorkSpace, then choose Actions, Reboot WorkSpaces).
   • From an administrative command prompt, type gpupdate /force.

Disable Time Zone Redirection for Windows WorkSpaces

By default, the time within a Workspace is set to mirror the time zone of the client that is being used to connect to the WorkSpace. This behavior is controlled through time zone redirection. You might want to turn off time zone direction for various reasons:

• Your company wants all employees to work in a certain time zone (even if some employees are in other time zones).
• You have scheduled tasks in a WorkSpace that are meant to run at a certain time in a specific time zone.
• Your users who travel a lot want to keep their WorkSpaces in one time zone for consistency and personal preference.

If needed for Windows WorkSpaces, you can use Group Policy settings to disable this feature.

To disable time zone redirection

1. On a directory administration WorkSpace or Amazon EC2 instance that is joined to your WorkSpaces directory, open the Group Policy Management tool (gpmc.msc) and navigate to and select a GPO at the domain or domain controller level of the directory you use for your WorkSpaces. (If you have the Amazon WorkSpaces Group Policy administrative template (p. 57) installed in your domain, you can use the WorkSpaces GPO for your WorkSpaces machine accounts.)

2. Choose Action, Edit in the main menu.


4. Open the Allow time zone redirection setting.

5. In the Allow time zone redirection dialog box, choose Disabled, and choose OK.

6. The Group Policy setting change takes effect after the next Group Policy update for the WorkSpace and after the WorkSpace session is restarted. To apply the Group Policy changes, do one of the following:

   • Reboot the WorkSpace (in the Amazon WorkSpaces console, select the WorkSpace, then choose Actions, Reboot WorkSpaces).
   • From an administrative command prompt, type gpupdate /force.

7. Set the time zone for the WorkSpaces to the desired time zone.

The time zone of the WorkSpaces is now static and no longer mirrors the time zone of the client machines.
Set the Maximum Lifetime for a Kerberos Ticket

If you have not disabled the Remember Me feature of your Windows WorkSpaces, your WorkSpace users can use the Remember Me check box in their WorkSpaces client application to save their credentials. This feature allows users to easily connect to their WorkSpaces while the client application remains running. Their credentials are securely cached up to the maximum lifetime of their Kerberos tickets.

If your WorkSpace uses an AD Connector directory, you can modify the maximum lifetime of the Kerberos tickets for your WorkSpaces users through Group Policy by following the steps in Maximum Lifetime for a User Ticket in the Microsoft Windows documentation.

To enable or disable the Remember Me feature, see Enable Self-Service WorkSpace Management Capabilities for Your Users (p. 79).

Manage Your Amazon Linux WorkSpaces

As with Windows WorkSpaces, Amazon Linux WorkSpaces are domain joined, so you can use Active Directory Users and Groups to:

- Administer your Amazon Linux WorkSpaces
- Provide access to those WorkSpaces for users

Because Linux instances do not adhere to Group Policy, we recommend that you use a configuration management solution to distribute and enforce policy. For example, you can use AWS Opsworks for Chef Automate, AWS OpsWorks for Puppet Enterprise, or Ansible.

Control PCoIP Agent Behavior on Amazon Linux WorkSpaces

The behavior of the PCoIP Agent is controlled by configuration settings in the pcoip-agent.conf file, which is located in the /etc/pcoip-agent/ directory. To deploy and enforce changes to the policy, use a configuration management solution that supports Amazon Linux. Any changes take effect when the agent starts up. Restarting the agent ends any open connections and restarts the window manager. For a full listing of the available settings, run man pcoip-agent.conf from the terminal on any Amazon Linux WorkSpace.

Enable or Disable Clipboard Redirection for Amazon Linux WorkSpaces

By default, Amazon WorkSpaces supports clipboard redirection. Use the PCoIP Agent conf to disable this feature, if needed.

To enable or disable clipboard redirection for Amazon Linux WorkSpaces

1. Open the pcoip-agent.conf file in an editor with elevated rights by using the following command.

```bash
[domain\username@workspace-id -]# sudo vi /etc/pcoip-agent/pcoip-agent.conf
```

2. Add the following line to the end of the file.

```bash
pcoip.server_clipboard_state = x
```
Where the possible values for $x$ are:

0 — Disabled in both directions
1 — Enabled in both directions
2 — Enabled client to agent only
3 — Enabled agent to client only

Grant SSH Access to Amazon Linux WorkSpaces Administrators

By default, only assigned users and accounts in the Domain Admins group can connect to Amazon Linux WorkSpaces by using SSH.

We recommend that you create a dedicated administrators group for your Amazon Linux WorkSpaces administrators in Active Directory.

To enable sudo access for members of the Linux_Workspaces_Admins Active Directory group

1. Edit the sudoers file by using visudo, as shown in the following example.

   ```
   [example\username@workspace-id ~]$ sudo visudo
   ```

2. Add the following line.

   ```
   %example.com\Linux_WorkSpaces_Admins ALL=(ALL) ALL
   ```

After you create the dedicated administrators group, follow these steps to enable login for members of the group.

To enable login for members of the Linux_Workspaces_Admins Active Directory group

1. Edit `/etc/security/access.conf` with elevated rights.

   ```
   [example\username@workspace-id ~]$ sudo vi /etc/security/access.conf
   ```

2. Add the following line.

   ```
   +:(example\Linux_WorkSpaces_Admins):ALL
   ```

For more information about enabling SSH connections, see Enable SSH Connections for Your Linux WorkSpaces (p. 38).

Override the Default Shell for Amazon Linux WorkSpaces

To override the default shell for Linux WorkSpaces, we recommend that you edit the user's `~/.bashrc` file. For example, to use Z shell instead of Bash shell, add the following lines to `/home/username/.bashrc`. 
Protect Custom Repositories from Unauthorized Access

To control access to your custom repositories, we recommend using the security features built into Amazon Virtual Private Cloud (Amazon VPC) rather than using passwords. For example, use network access control lists (ACLs) and security groups. For more information about these features, see Security in the Amazon VPC User Guide.

If you must use passwords to protect your repositories, be sure to create your yum repository definition files as shown in Repository Definition Files in the Fedora documentation.

Use the Amazon Linux Extras Library Repository

With Amazon Linux, you can use the Extras Library to install application and software updates on your instances. For information about using the Extras Library, see Extras Library (Amazon Linux) in the Amazon EC2 User Guide for Linux Instances.

Note
If you are using the Amazon Linux repository, your Amazon Linux WorkSpaces must have internet access, or you must configure virtual private cloud (VPC) endpoints to this repository and to the main Amazon Linux repository. For more information, see Provide Internet Access from Your WorkSpace (p. 30).
Launch a Virtual Desktop Using Amazon WorkSpaces

With Amazon WorkSpaces, you can provision virtual, cloud-based Microsoft Windows or Amazon Linux desktops for your users, known as WorkSpaces.

**Note**
The **Computer Name** value shown for a WorkSpace in the Amazon WorkSpaces console varies, depending on which type of WorkSpace you've launched (Linux or Windows). The computer name for a WorkSpace can be in one of these formats:

- **Linux**: A-1xxxxxxxxxxxx
- **Windows**: IP-Cxxxxxx or WSAMZN-xxxxxxx or EC2AMAZ-xxxxxxx

For Windows WorkSpaces, the computer name format is determined by the bundle type, and in the case of WorkSpaces created from public bundles or from custom bundles based on public images, by when the public images were created. Starting June 22, 2020, Windows WorkSpaces launched from public bundles have the WSAMZN-xxxxxxx format for their computer names instead of the IP-Cxxxxxx format. For custom bundles based on a public image, if the public image was created before June 22, 2020, the computer names are in the EC2AMAZ-xxxxxxx format. If the public image was created on or after June 22, 2020, the computer names are in the WSAMZN-xxxxxxx format. For Bring Your Own License (BYOL) bundles, the EC2AMAZ-xxxxxxx format is used for the computer names by default.

If you've specified a custom format for the computer names in your custom or BYOL bundles, your custom format overrides these defaults.

Amazon WorkSpaces uses a directory to store and manage information for your WorkSpaces and users. You can do any of the following:

- Create a Simple AD directory.
- Create an AWS Directory Service for Microsoft Active Directory, also known as AWS Managed Microsoft AD.
- Connect to an existing Microsoft Active Directory by using Active Directory Connector.
- Create a trust relationship between your AWS Managed Microsoft AD directory and your on-premises domain.

The following tutorials show you how to launch a WorkSpace by using the supported directory service options.

**Tutorials**
- Launch a WorkSpace Using AWS Managed Microsoft AD (p. 65)
- Launch a WorkSpace Using Simple AD (p. 67)
- Launch a WorkSpace Using AD Connector (p. 70)
- Launch a WorkSpace Using a Trusted Domain (p. 73)
Amazon WorkSpaces Administration Guide
Launch Using AWS Managed Microsoft AD

Launch a WorkSpace Using AWS Managed Microsoft AD

Amazon WorkSpaces enables you to provision virtual, cloud-based Windows desktops for your users, known as WorkSpaces.

Amazon WorkSpaces uses directories to store and manage information for your WorkSpaces and users. For your directory, you can choose from Simple AD, AD Connector, or AWS Directory Service for Microsoft Active Directory, also known as AWS Managed Microsoft AD. In addition, you can establish a trust relationship between your AWS Managed Microsoft AD directory and your on-premises domain.

In this tutorial, we launch a WorkSpace that uses AWS Managed Microsoft AD. For tutorials that use the other options, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 64).

Tasks
• Before You Begin (p. 65)
• Step 1: Create an AWS Managed Microsoft AD Directory (p. 65)
• Step 2: Create a WorkSpace (p. 66)
• Step 3: Connect to the WorkSpace (p. 66)
• Next Steps (p. 67)

Before You Begin
• Amazon WorkSpaces is not available in every Region. Verify the supported Regions and select a Region for your WorkSpaces. For more information about the supported Regions, see Amazon WorkSpaces Pricing by AWS Region.
• When you launch a WorkSpace, you must select a WorkSpace bundle. A bundle is a combination of an operating system, and storage, compute, and software resources. For more information, see Amazon WorkSpaces Bundles.
• When you create a directory using AWS Directory Service or launch a WorkSpace, you must create or select a virtual private cloud configured with a public subnet and two private subnets. For more information, see Configure a VPC for Amazon WorkSpaces (p. 8).

Step 1: Create an AWS Managed Microsoft AD Directory

First, create an AWS Managed Microsoft AD directory. AWS Directory Service creates two directory servers, one in each of the private subnets of your VPC. Note that there are no users in the directory initially. You will add a user in the next step when you launch the WorkSpace.

To create an AWS Managed Microsoft AD directory
1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Choose Set up Directory, Create Microsoft AD.
4. Configure the directory as follows:
   a. For Organization name, enter a unique organization name for your directory (for example, my-demo-directory). This name must be at least four characters in length, consist of only
Step 2: Create a WorkSpace

Now that you have created an AWS Managed Microsoft AD directory, you are ready to create a WorkSpace.

To create a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Choose Launch WorkSpaces.
4. On the Select a Directory page, choose the directory that you created, and then choose Next Step. Amazon WorkSpaces registers your directory.
5. On the Identify Users page, add a new user to your directory as follows:
   a. Complete Username, First Name, Last Name, and Email. Use an email address that you have access to.
   b. Choose Create Users.
   c. Choose Next Step.
6. On the Select Bundle page, select a bundle and then choose Next Step.
7. On the WorkSpaces Configuration page, choose a running mode and then choose Next Step.
8. On the Review & Launch WorkSpaces page, choose Launch WorkSpaces. The initial status of the WorkSpace is PENDING. When the launch is complete, the status is AVAILABLE and an invitation is sent to the email address that you specified for the user.

Step 3: Connect to the WorkSpace

After you receive the invitation email, you can connect to your WorkSpace using the client of your choice. After you sign in, the client displays the WorkSpace desktop.
To connect to the WorkSpace

1. Open the link in the invitation email. When prompted, specify a password and activate the user. Remember this password as you will need it to sign in to your WorkSpace.

   **Note**
   Passwords are case-sensitive and must be between 8 and 64 characters in length, inclusive. Passwords must contain at least one character from three of the following categories: lowercase letters (a-z), uppercase letters (A-Z), numbers (0-9), and ~!@#$%^&*_-+=`|{}[]:;"'<>,.?/

2. Review Amazon WorkSpaces Clients in the Amazon WorkSpaces User Guide for more information about the requirements for each client, and then do one of the following:

   - When prompted, download one of the client applications or launch Web Access.
   - If you aren't prompted and you haven't installed a client application already, open https://clients.amazonworkspaces.com/ and download one of the client applications or launch Web Access.

   **Note**
   You cannot use a web browser (Web Access) to connect to Amazon Linux WorkSpaces.

3. Start the client, enter the registration code from the invitation email, and choose **Register**.
4. When prompted to sign in, enter the user name and password for the user, and then choose **Sign In**.
5. (Optional) When prompted to save your credentials, choose **Yes**.

Next Steps

You can continue to customize the WorkSpace that you just created. For example, you can install software and then create a custom bundle from your WorkSpace. If you are finished with your WorkSpace, you can delete it. For more information, see the following documentation.

- Create a Custom WorkSpaces Image and Bundle (p. 103)
- Administer Your WorkSpaces (p. 81)
- Manage Directories for Amazon WorkSpaces (p. 44)
- Delete a WorkSpace (p. 101)

Launch a WorkSpace Using Simple AD

Amazon WorkSpaces enables you to provision virtual, cloud-based Microsoft Windows desktops for your users, known as WorkSpaces.

Amazon WorkSpaces uses directories to store and manage information for your WorkSpaces and users. For your directory, you can choose from Simple AD, AD Connector, or AWS Directory Service for Microsoft Active Directory, also known as AWS Managed Microsoft AD. In addition, you can establish a trust relationship between your AWS Managed Microsoft AD directory and your on-premises domain.

In this tutorial, we launch a WorkSpace that uses Simple AD. For tutorials that use the other options, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 64).

Tasks

- Before You Begin (p. 68)
- Step 1: Create a Simple AD Directory (p. 68)
- Step 2: Create a WorkSpace (p. 69)
Before You Begin

- Simple AD is not available in every Region. Verify the supported Regions and select a Region for your Simple AD directory. For more information about the supported Regions for Simple AD, see Region Availability for AWS Directory Service.
- Amazon WorkSpaces is not available in every Region. Verify the supported Regions and select a Region for your WorkSpaces. For more information about the supported Regions, see Amazon WorkSpaces Pricing by AWS Region.
- When you launch a WorkSpace, you must select a WorkSpace bundle. A bundle is a combination of an operating system, and storage, compute, and software resources. For more information, see Amazon WorkSpaces Bundles.
- When you create a directory using AWS Directory Service or launch a WorkSpace, you must create or select a virtual private cloud configured with a public subnet and two private subnets. For more information, see Configure a VPC for Amazon WorkSpaces (p. 8).

Step 1: Create a Simple AD Directory

Create a Simple AD directory. AWS Directory Service creates two directory servers, one in each of the private subnets of your VPC. Note that there are no users in the directory initially. You will add a user in the next step when you create the WorkSpace.

To create a Simple AD directory

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Choose Set up Directory, Create Simple AD.
4. Configure the directory as follows:
   a. For Organization name, enter a unique organization name for your directory (for example, my-example-directory). This name must be at least four characters in length, consist of only alphanumeric characters and hyphens (-), and begin or end with a character other than a hyphen.
   b. For Directory DNS, enter the fully-qualified name for the directory (for example, example.com).
      Important
      If you need to update your DNS server after launching your WorkSpaces, follow the procedure in Update DNS Servers for Amazon WorkSpaces (p. 48) to ensure that your WorkSpaces get properly updated.
   c. For NetBIOS name, enter a short name for the directory (for example, example).
   d. For Admin password and Confirm password, enter a password for the directory administrator account. For more information about the password requirements, see How to Create a Microsoft AD Directory in the AWS Directory Service Administration Guide.
   e. (Optional) For Description, enter a description for the directory.
   f. Keep Directory size as Small.
   g. For VPC, select the VPC that you created.
   h. For Subnets, select the two private subnets (with the CIDR blocks 10.0.1.0/24 and 10.0.2.0/24).
   i. Choose Next Step.
Step 2: Create a WorkSpace

Now you are ready to launch the WorkSpace.

To create a WorkSpace for a user

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Choose Launch WorkSpaces.
4. On the Select a Directory page, do the following:
   a. For Directory, choose the directory that you created.
   b. For Enable Amazon WorkDocs, choose Yes.
   Note
      This option is available only if Amazon WorkDocs is available in the selected Region.
   c. Choose Next. Amazon WorkSpaces registers your Simple AD directory.
5. On the Identify Users page, add a new user to your directory as follows:
   a. Complete Username, First Name, Last Name, and Email. Use an email address that you have access to.
   b. Choose Create Users.
   c. Choose Next Step.
6. On the Select Bundle page, select a bundle and then choose Next Step.
7. On the WorkSpaces Configuration page, choose a running mode and then choose Next Step.
8. On the Review & Launch WorkSpaces page, choose Launch WorkSpaces. The initial status of the WorkSpace is PENDING. When the launch is complete, the status is AVAILABLE and an invitation is sent to the email address that you specified for the user.

Step 3: Connect to the WorkSpace

After you receive the invitation email, you can connect to your WorkSpace using the client of your choice. After you sign in, the client displays the WorkSpace desktop.

To connect to the WorkSpace

1. Open the link in the invitation email. When prompted, enter a password and activate the user. Remember this password as you will need it to sign in to your WorkSpace.
Note
Passwords are case-sensitive and must be between 8 and 64 characters in length, inclusive. Passwords must contain at least one character from four of the following categories: lowercase letters (a-z), uppercase letters (A-Z), numbers (0-9), and ~!@#$%^&*_-+=`|}{[]:;"'<>,.?/.

2. Review Amazon WorkSpaces Clients in the Amazon WorkSpaces User Guide for more information about the requirements for each client, and then do one of the following:

- When prompted, download one of the client applications or launch Web Access.
- If you aren't prompted and you haven't installed a client application already, open https://clients.amazonworkspaces.com/ and download one of the client applications or launch Web Access.

Note
You cannot use a web browser (Web Access) to connect to Amazon Linux WorkSpaces.

3. Start the client, enter the registration code from the invitation email, and choose Register.
4. When prompted to sign in, enter the user name and password for the user, and then choose Sign In.
5. (Optional) When prompted to save your credentials, choose Yes.

Next Steps
You can continue to customize the WorkSpace that you just created. For example, you can install software and then create a custom bundle from your WorkSpace. If you are finished with your WorkSpace, you can delete it. For more information, see the following documentation.

- Create a Custom WorkSpaces Image and Bundle (p. 103)
- Administer Your WorkSpaces (p. 81)
- Manage Directories for Amazon WorkSpaces (p. 44)
- Delete a WorkSpace (p. 101)

Launch a WorkSpace Using AD Connector

Amazon WorkSpaces enables you to provision virtual, cloud-based Microsoft Windows desktops for your users, known as WorkSpaces.

Amazon WorkSpaces uses directories to store and manage information for your WorkSpaces and users. For your directory, you can choose from Simple AD, AD Connector, or AWS Directory Service for Microsoft Active Directory, also known as AWS Managed Microsoft AD. In addition, you can establish a trust relationship between your AWS Managed Microsoft AD directory and your on-premises domain.

In this tutorial, we launch a WorkSpace that uses AD Connector. For tutorials that use the other options, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 64).

Tasks
- Before You Begin (p. 71)
- Step 1: Create an AD Connector (p. 71)
- Step 2: Create a WorkSpace (p. 72)
- Step 3: Connect to the WorkSpace (p. 72)
- Next Steps (p. 73)
Before You Begin

- Amazon WorkSpaces is not available in every Region. Verify the supported Regions and select a Region for your WorkSpaces. For more information about the supported Regions, see Amazon WorkSpaces Pricing by AWS Region.

- When you launch a WorkSpace, you must select a WorkSpace bundle. A bundle is a combination of an operating system, and storage, compute, and software resources. For more information, see Amazon WorkSpaces Bundles.

- Create a virtual private cloud with at least two private subnets. For more information, see Configure a VPC for Amazon WorkSpaces (p. 8). The VPC must be connected to your on-premises network through a virtual private network (VPN) connection or AWS Direct Connect. For more information, see AD Connector Prerequisites in the AWS Directory Service Administration Guide.

- Provide access to the internet from the WorkSpace. For more information, see Provide Internet Access from Your WorkSpace (p. 30).

Step 1: Create an AD Connector

To create an AD Connector

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Choose Set up Directory, Create AD Connector.
4. For Organization name, enter a unique organization name for your directory (for example, my-example-directory). This name must be at least four characters in length, consist of only alphanumeric characters and hyphens (-), and begin or end with a character other than a hyphen.
5. For Connected directory DNS, enter the fully-qualified name of your on-premises directory (for example, example.com).
6. For Connected directory NetBIOS name, enter the short name of your on-premises directory (for example, example).
7. For Connector account username, enter the user name of a user in your on-premises directory. The user must have permissions to read users and groups, create computer objects, and join computers to the domain.
8. For Connector account password and Confirm password, enter the password for the on-premises user account.
9. For DNS address, enter the IP address of at least one DNS server in your on-premises directory.
   
   Important
   If you need to update your DNS server IP address after launching your WorkSpaces, follow the procedure in Update DNS Servers for Amazon WorkSpaces (p. 48) to ensure that your WorkSpaces get properly updated.
10. (Optional) For Description, enter a description for the directory.
11. Keep Size as Small.
12. For VPC, select your VPC.
13. For Subnets, select your subnets. The DNS servers that you specified must be accessible from each subnet.
15. Choose Create AD Connector. It takes several minutes for your directory to be connected. The initial status of the directory is Requested and then Creating. When directory creation is complete, the status is Active.
Step 2: Create a WorkSpace

Now you are ready to launch WorkSpaces for one or more users in your on-premises directory.

To launch a WorkSpace for an existing user

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Choose Launch WorkSpaces.
4. For Directory, choose the directory that you created.
5. (Optional) If this is the first time you have launched a WorkSpace in this directory, and Amazon WorkDocs is supported in the Region, you can enable or disable Amazon WorkDocs for all users in the directory. For more information, see Amazon WorkDocs Sync Client Help in the Amazon WorkDocs Administration Guide.
6. Choose Next. Amazon WorkSpaces registers your AD Connector.
7. Select one or more existing users from your on-premises directory. Do not add new users to an on-premises directory through the Amazon WorkSpaces console.

To find users to select, you can enter all or part of the user's name and choose Search or choose Show All Users. Note that you cannot select a user that does not have an email address.

After you select the users, choose Add Selected and then choose Next Step.
8. Under Select Bundle, choose the default WorkSpace bundle to be used for the WorkSpaces. Under Assign WorkSpace Bundles, you can choose a different the bundle for an individual WorkSpace if needed. When you have finished, choose Next Step.
9. Choose a running mode for your WorkSpaces and then choose Next Step. For more information, see Manage the WorkSpace Running Mode (p. 81).
10. Choose Launch WorkSpaces. The initial status of the WorkSpace is PENDING. When the launch is complete, the status is AVAILABLE.
11. Send invitations to the email address for each user. (These invitations aren't sent automatically if you're using AD Connector.) For more information, see Send an Invitation Email (p. 77).

Step 3: Connect to the WorkSpace

You can connect to your WorkSpace using the client of your choice. After you sign in, the client displays the WorkSpace desktop.

To connect to the WorkSpace

1. Open the link in the invitation email.
2. Review Amazon WorkSpaces Clients in the Amazon WorkSpaces User Guide for more information about the requirements for each client, and then do one of the following:
   - When prompted, download one of the client applications or launch Web Access.
   - If you aren't prompted and you haven't installed a client application already, open https://clients.amazonworkspaces.com/ and download one of the client applications or launch Web Access.
   
   **Note**

   You cannot use a web browser (Web Access) to connect to Amazon Linux WorkSpaces.
3. Start the client, enter the registration code from the invitation email, and choose Register.
4. When prompted to sign in, enter the user name and password for the user, and then choose Sign In.
5. (Optional) When prompted to save your credentials, choose Yes.

Note
Because you’re using AD Connector, your users won’t be able to reset their own passwords. (The Forgot password? option on the WorkSpaces client application login screen won’t be available.) For information about how to reset user passwords, see Set Up Active Directory Administration Tools for Amazon WorkSpaces (p. 54).

Next Steps
You can continue to customize the WorkSpace that you just created. For example, you can install software and then create a custom bundle from your WorkSpace. If you are finished with your WorkSpace, you can delete it. For more information, see the following documentation.

- Create a Custom WorkSpaces Image and Bundle (p. 103)
- Administer Your WorkSpaces (p. 81)
- Manage Directories for Amazon WorkSpaces (p. 44)
- Delete a WorkSpace (p. 101)

Launch a WorkSpace Using a Trusted Domain

Amazon WorkSpaces enables you to provision virtual, cloud-based Microsoft Windows desktops for your users, known as WorkSpaces.

Amazon WorkSpaces uses directories to store and manage information for your WorkSpaces and users. For your directory, you can choose from Simple AD, AD Connector, or AWS Directory Service for Microsoft Active Directory, also known as AWS Managed Microsoft AD. In addition, you can establish a trust relationship between your AWS Managed Microsoft AD directory and your on-premises domain.

In this tutorial, we launch a WorkSpace that uses a trust relationship. For tutorials that use the other options, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 64).

Tasks
- Before You Begin (p. 73)
- Step 1: Establish a Trust Relationship (p. 74)
- Step 2: Create a WorkSpace (p. 74)
- Step 3: Connect to the WorkSpace (p. 74)
- Next Steps (p. 75)

Before You Begin

- Amazon WorkSpaces is not available in every Region. Verify the supported Regions and select a Region for your WorkSpaces. For more information about the supported Regions, see Amazon WorkSpaces Pricing by AWS Region.
- When you launch a WorkSpace, you must select a WorkSpace bundle. A bundle is a combination of storage, compute, and software resources. For more information, see Amazon WorkSpaces Bundles.
- When you create a directory using AWS Directory Service or launch a WorkSpace, you must create or select a virtual private cloud configured with a public subnet and two private subnets. For more information, see Configure a VPC for Amazon WorkSpaces (p. 8).
Step 1: Establish a Trust Relationship

To set up the trust relationship

1. Set up AWS Managed Microsoft AD in your virtual private cloud (VPC). For more information, see Create Your AWS Managed Microsoft AD directory in the AWS Directory Service Administration Guide.
2. Create a trust relationship between your AWS Managed Microsoft AD and your on-premises domain. Ensure that the trust is configured as a two-way trust. For more information, see Tutorial: Create a Trust Relationship Between Your AWS Managed Microsoft AD and Your On-Premises Domain in the AWS Directory Service Administration Guide.

A two-way trust is required so that on-premises credentials can be used to manage and authenticate with WorkSpaces, and so that WorkSpaces can be provisioned to on-premises users and groups.

Step 2: Create a WorkSpace

After you establish a trust relationship between your AWS Managed Microsoft AD and your on-premises Microsoft Active Directory domain, you can provision WorkSpaces for users in the on-premises domain.

Note that you must ensure that GPO settings are replicated across domains before you can apply them to Amazon WorkSpaces.

To launch workspaces for users in a trusted on-premises domain

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Choose Launch WorkSpaces.
4. On the Select a Directory page, choose the directory that you just registered and then choose Next Step.
5. On the Identify Users page, do the following:
   a. For Select trust from forest, select the trust relationship that you created.
   b. Select the users from the on-premises domain and then choose Add Selected.
   c. Choose Next Step.
6. Select the bundle to be used for the WorkSpaces and then choose Next Step.
7. Choose the running mode, choose the encryption settings, and configure any tags. When you are finished, choose Next Step.
8. Choose Launch WorkSpaces. Note that it can take up to 20 minutes for the WorkSpaces to become available, and up to 40 minutes if encryption is enabled. The initial status of the WorkSpace is PENDING. When the launch is complete, the status is AVAILABLE.
9. Send invitations to the email address for each user. For more information, see Send an Invitation Email (p. 77).

Step 3: Connect to the WorkSpace

After you receive the invitation email, you can connect to your WorkSpace. Users can enter their user names as username, corp\username, or corp.example.com\username).

To connect to the WorkSpace

1. Open the link in the invitation email. When prompted, enter a password and activate the user. Remember this password as you will need it to sign in to your WorkSpace.
Note
Passwords are case-sensitive and must be between 8 and 64 characters in length, inclusive. Passwords must contain at least one character from three of the following categories: lowercase letters (a-z), uppercase letters (A-Z), numbers (0-9), and ~!@#$%^&*_-+=`|{}[]:;"'<>,.?/. 

2. Review Amazon WorkSpaces Clients in the Amazon WorkSpaces User Guide for more information about the requirements for each client, and then do one of the following:
   • When prompted, download one of the client applications or launch Web Access.
   • If you aren't prompted and you haven't installed a client application already, open https://clients.amazonworkspaces.com/ and download one of the client applications or launch Web Access.

Note
You cannot use a web browser (Web Access) to connect to Amazon Linux WorkSpaces.

3. Start the client, enter the registration code from the invitation email, and choose Register.
4. When prompted to sign in, enter the user name and password for the user, and then choose Sign In.
5. (Optional) When prompted to save your credentials, choose Yes.

Next Steps
You can continue to customize the WorkSpace that you just created. For example, you can install software and then create a custom bundle from your WorkSpace. If you are finished with your WorkSpace, you can delete it. For more information, see the following documentation.

- Create a Custom WorkSpaces Image and Bundle (p. 103)
- Administer Your WorkSpaces (p. 81)
- Manage Directories for Amazon WorkSpaces (p. 44)
- Delete a WorkSpace (p. 101)
Administer WorkSpace Users

Each WorkSpace is assigned to a single user and cannot be shared by multiple users. By default, only one WorkSpace per user per directory is allowed.

Contents

- Manage WorkSpaces Users (p. 76)
- Create Multiple WorkSpaces for a User (p. 77)
- Customize How Users Log In to Their WorkSpaces (p. 78)
- Enable Self-Service WorkSpace Management Capabilities for Your Users (p. 79)

Manage WorkSpaces Users

As an administrator for Amazon WorkSpaces, you can perform the following tasks to manage WorkSpaces users.

Edit User Information

You can use the Amazon WorkSpaces console to edit the user information for a WorkSpace.

**Note**
This feature is available only if you use AWS Managed Microsoft AD or Simple AD. If you use Microsoft Active Directory through AD Connector or a trust relationship, you can manage users and groups by using Active Directory.

To edit user information

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select a user and choose Actions, Edit User.
4. Update First Name, Last Name, and Email as needed.
5. Choose Update.

Add or Delete Users

You can create new users from the Amazon WorkSpaces console only during the process of launching a WorkSpace, and you cannot delete users through the Amazon WorkSpaces console. Most user management tasks, including managing user groups, must be performed through your directory.

To add or delete users and groups

To add, delete, or otherwise manage users and groups, you must do this through your directory. You'll perform most administrative tasks for your WorkSpaces directory using directory management tools, such as the Active Directory Administration Tools. For more information, see Set Up Active Directory Administration Tools for Amazon WorkSpaces (p. 54).
Important
Before you can remove a user, you must delete the WorkSpace assigned to that user. For more information, see Delete a WorkSpace (p. 101).

The process you use for managing users and groups depends on which type of directory you’re using.

- If you’re using AWS Managed Microsoft AD, see Manage Users and Groups in AWS Managed Microsoft AD in the AWS Directory Service Administration Guide.
- If you’re using Simple AD, see Manage Users and Groups in Simple AD in the AWS Directory Service Administration Guide.
- If you use Microsoft Active Directory through AD Connector or a trust relationship, you can manage users and groups by using Active Directory.

Send an Invitation Email

You can send an invitation email to a user manually if needed.

Note
If you’re using AD Connector, welcome emails aren’t automatically sent to your users, so you must send them manually.

To resend an invitation email

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. On the WorkSpaces page, use the search box to search for the user you want to send an invitation to, and then select the corresponding WorkSpace from the search results. You can select only one WorkSpace at a time.
5. Copy the email body text and paste it into an email to the user using your own email application. You can modify the body text if desired. When the invitation email is ready, send it to the user.

Create Multiple WorkSpaces for a User

By default, you can create only one WorkSpace per user per directory. However, if needed, you can create more than one WorkSpace for a user, depending on your directory setup.

- If you have only one directory for your WorkSpaces, create multiple user names for the user. For example, a user named Mary Major can have mmajor1, mmajor2, and so on as user names. Each user name will be associated with a different WorkSpace in the same directory, but the WorkSpaces will have the same registration code.
- If you have multiple directories for your WorkSpaces, create the WorkSpaces for the user in separate directories. You can use the same user name in the directories, or you can use different user names in the directories. The WorkSpaces will have different registration codes.

Tip
You might want to use the same email address with each user name so that you can easily locate all the WorkSpaces that you’ve created for a user.

To switch between the WorkSpaces, the user logs in with the user name and registration code associated with a particular Workspace. If the user is using a 3.0+ version of the WorkSpaces client applications for
Customize How Users Log In to Their WorkSpaces

Customize your users' access to WorkSpaces by using uniform resource identifiers (URIs) to provide a simplified login experience that integrates with existing workflows in your organization. For example, you can automatically generate login URIs that register your users by using their WorkSpaces registration code. As a result:

- Users can bypass the manual registration process.
- Their user names are automatically entered on their WorkSpaces client login page.
- If multi-factor authentication (MFA) is used in your organization, their user names and MFA codes are automatically entered on their client login page.

You can configure URI access to WorkSpaces for client applications on the following supported devices:

- Windows computers
- macOS computers
- Ubuntu Linux 18.04 computers
- iPads
- Android devices

To use URIs to access their WorkSpaces, users must first install the client application for their device by opening https://clients.amazonworkspaces.com/ and following the directions.

URI access is supported on the Firefox and Chrome browsers on Windows and macOS computers, on the Firefox browser on Ubuntu Linux 18.04 computers, and on the Internet Explorer and Microsoft Edge browsers on Windows computers. For more information about WorkSpaces clients, see Amazon WorkSpaces Clients in the Amazon WorkSpaces User Guide.

Note

On Android devices, URI access works only with the Firefox browser, not with the Google Chrome browser.

To configure URI access to WorkSpaces, use any of the URI formats described in the following table.

Note

If the data component of your URI includes any of the following reserved characters, we recommend that you use percent-encoding in the data component to avoid ambiguity:

@ : / ? & =

For example, if you have user names that include any of these characters, you should percent-encode those user names in your URI. For more information, see Uniform Resource Identifier (URI): Generic Syntax.

<table>
<thead>
<tr>
<th>Supported Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>workspaces://</td>
<td>Opens the WorkSpaces client application. (Note: Using workspaces:// by itself is not currently supported in the Linux client application.)</td>
</tr>
<tr>
<td>workspaces://@registrationcode</td>
<td>Registers a user by using their WorkSpaces registration code. Also displays the client login page.</td>
</tr>
</tbody>
</table>
Enable Self-Service WorkSpace Management Capabilities for Your Users

In Amazon WorkSpaces, you can enable self-service WorkSpace management capabilities for your users to provide them with more control over their experience. It can also reduce your IT support staff workload for Amazon WorkSpaces. When you enable self-service capabilities, you can allow users to perform one or more of the following tasks directly from their Windows, macOS, or Linux client for Amazon WorkSpaces:

- Cache their credentials on their client. This lets them reconnect to their WorkSpace without re-entering their credentials.
- Restart their WorkSpace.
- Increase the size of the root and user volumes on their WorkSpace.
- Change the compute type (bundle) for their WorkSpace.
- Switch the running mode of their WorkSpace.
- Rebuild their WorkSpace.

To enable one or more of these capabilities for your users, perform the following steps.

To enable self-service management capabilities for your users

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Select your directory, and choose Actions, Update Details.
4. Expand User Self-Service Permissions. Enable or disable the following options as required to determine the WorkSpace management tasks that users can perform from their client:

   - Remember me — Users can choose whether to cache their credentials on their client by selecting the Remember Me or Keep me logged in check box on the login screen. The credentials are cached in RAM only. When users choose to cache their credentials, they can reconnect to their
WorkSpaces without re-entering their credentials. To control how long users can cache their credentials, see Set the Maximum Lifetime for a Kerberos Ticket (p. 61).

- **Restart WorkSpace from client**— Users can restart their WorkSpace. Restarting disconnects the user from their WorkSpace, shuts it down, and restarts it. The user data, operating system, and system settings are not affected.

- **Increase volume size**— Users can expand the root and user volumes on their WorkSpace to a specified size without contacting IT support. Users can increase the size of the root volume (for Windows, the C: drive; for Linux, /) up to 175 GB, and the size of the user volume (for Windows, the D: drive; for Linux, /home) up to 100 GB. WorkSpace root and user volumes come in set groups that can't be changed. The available groups are [Root(GB), User(GB)]: [80, 10], [80, 50], [80, 100], [175 to 2000, 100 to 2000]. For more information, see Modify a WorkSpace (p. 82).

For a newly created WorkSpace, users must wait 6 hours before they can increase the size of these drives. After that, they can do so only once in a 6-hour period. While a volume size increase is in progress, users can perform most tasks on their WorkSpace. The tasks that they can't perform are: changing their WorkSpace compute type, switching their WorkSpace running mode, restarting their WorkSpace, or rebuilding their WorkSpace. When the process is finished, the WorkSpace must be rebooted for the changes to take effect. This process might take up to an hour.

**Note**

If users increase the volume size on their WorkSpace, this will increase the billing rate for their WorkSpace.

- **Change compute type**— Users can switch their WorkSpace between compute types (bundles). For a newly created WorkSpace, users must wait 6 hours before they can switch to a different bundle. After that, they can switch to a larger bundle only once in a 6-hour period, or to a smaller bundle once in a 30-day period. When a WorkSpace compute type change is in progress, users are disconnected from their WorkSpace, and they can't use or change the WorkSpace. The WorkSpace is automatically rebooted during the compute type change process. This process might take up to an hour.

**Note**

If users change their WorkSpace compute type, this will change the billing rate for their WorkSpace.

- **Switch running mode**— Users can switch their WorkSpace between the **AlwaysOn** and **AutoStop** running modes. For more information, see Manage the WorkSpace Running Mode (p. 81).

**Note**

If users switch the running mode of their WorkSpace, this will change the billing rate for their WorkSpace.

- **Rebuild WorkSpace from client**— Users can rebuild the operating system of a WorkSpace to its original state. When a WorkSpace is rebuilt, the user volume (D: drive) is recreated from the latest backup. Because backups are completed every 12 hours, users' data might be up to 12 hours old. For a newly created WorkSpace, users must wait 12 hours before they can rebuild their WorkSpace. When a WorkSpace rebuild is in progress, users are disconnected from their WorkSpace, and they can't use or make changes to their WorkSpace. This process might take up to an hour.

5. Choose **Update** or **Update and Exit**.
Administer Your WorkSpaces

You can administer your WorkSpaces using the Amazon WorkSpaces console.

Contents

• Manage the WorkSpace Running Mode (p. 81)
• Modify a WorkSpace (p. 82)
• Tag WorkSpaces Resources (p. 84)
• WorkSpace Maintenance (p. 85)
• Encrypted WorkSpaces (p. 87)
• Restart a WorkSpace (p. 90)
• Rebuild a WorkSpace (p. 90)
• Restore a WorkSpace (p. 91)
• Upgrade Windows 10 BYOL WorkSpaces (p. 92)
• Migrate a WorkSpace (p. 98)
• Delete a WorkSpace (p. 101)

Manage the WorkSpace Running Mode

The running mode of a WorkSpace determines its immediate availability and how you pay for it. You can choose between the following running modes when you create the WorkSpace:

• **AlwaysOn** — Use when paying a fixed monthly fee for unlimited usage of your WorkSpaces. This mode is best for users who use their WorkSpace full time as their primary desktop.

• **AutoStop** — Use when paying for your WorkSpaces by the hour. With this mode, your WorkSpaces stop after a specified period of inactivity, and the state of apps and data is saved. To set the automatic stop time, use **AutoStop Time (hours)**.

When possible, the state of the desktop is saved to the root volume of the WorkSpace. The WorkSpace resumes when a user logs in, and all open documents and running programs return to their saved state.

For more information, see Amazon WorkSpaces Pricing.

Modify the Running Mode

You can switch between running modes at any time.

To modify the running mode of a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select the WorkSpace to modify and choose Actions, Modify Running Mode Properties.
4. Select the new running mode, AlwaysOn or AutoStop, and then choose Modify.
Stop and Start an AutoStop WorkSpace

When your AutoStop WorkSpaces are not in use, they are automatically stopped after a specified period of inactivity, and hourly metering is suspended. To further optimize costs, you can suspend the hourly charges associated with AutoStop WorkSpaces. The WorkSpace is stopped and all apps and data are saved for the next time a user logs in to the WorkSpace.

**Note**

Amazon WorkSpaces can detect inactivity only when users are using Amazon WorkSpaces clients. If users are using third-party clients, Amazon WorkSpaces might not be able to detect inactivity, and therefore the WorkSpace might not automatically stop and metering might not be suspended.

When a user reconnects to a stopped WorkSpace, it resumes from where it left off, typically in under 90 seconds.

You can restart AutoStop WorkSpaces that are available or in an error state.

**To stop an AutoStop WorkSpace**

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose **WorkSpaces**.
3. Select the WorkSpace to be stopped and choose **Actions, Stop WorkSpaces**.
4. When prompted for confirmation, choose **Stop**.

**To start an AutoStop WorkSpace**

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose **WorkSpaces**.
3. Select the WorkSpaces to be started and choose **Actions, Start WorkSpaces**.
4. When prompted for confirmation, choose **Start**.

To remove the fixed infrastructure costs that are associated with AutoStop WorkSpaces, remove the WorkSpace from your account. For more information, see [Delete a WorkSpace](p. 101).

Modify a WorkSpace

After you launch a WorkSpace, you can modify its configuration in two ways:

- You can change the size of its root volume (for Windows, drive C; for Linux, /) and its user volume (for Windows, drive D; for Linux /home).
- You can change its compute type to select a new bundle.

The current modification state of a WorkSpace is displayed in the **State** setting in the Amazon WorkSpaces console. The possible values for **State** are **Modifying Compute, Modifying Storage**, and **None**.

If you want to modify a WorkSpace, it must have a status of **AVAILABLE** or **STOPPED**. When you are modifying the volume size, you can't change the compute type at the same time, and vice versa.

Changing the volume size or compute type of a WorkSpace will change the billing rate for the WorkSpace.
To allow your users to modify their volumes and compute types themselves, see Enable Self-Service WorkSpace Management Capabilities for Your Users (p. 79).

### Changing Volume Sizes

You can increase the size of the root and user volumes for a WorkSpace, up to 2000 GB each. WorkSpace root and user volumes come in set groups that can't be changed. The available groups are:

<table>
<thead>
<tr>
<th>[Root (GB), User (GB)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[80, 10]</td>
</tr>
<tr>
<td>[80, 50]</td>
</tr>
<tr>
<td>[80, 100]</td>
</tr>
<tr>
<td>[175 to 2000, 100 to 2000]</td>
</tr>
</tbody>
</table>

You can expand the root and user volumes whether they are encrypted or unencrypted, and you can expand both volumes once in a 6-hour period. However, you can't increase the size of the root and user volumes at the same time. For more information, see Limitations for Increasing Volumes (p. 83).

**Note**

When you expand a volume for a WorkSpace, Amazon WorkSpaces automatically extends the volume's partition within Windows or Linux. When the process is finished, you must reboot the WorkSpace for the changes to take effect.

To ensure that your data is preserved, you cannot decrease the size of the root or user volumes after you launch a WorkSpace. Instead, make sure that you specify the minimum sizes for these volumes when launching a WorkSpace. You can launch a Value, Standard, Performance, Power, or PowerPro WorkSpace with a minimum of 80 GB for the root volume and 10 GB for the user volume. You can launch a Graphics or GraphicsPro WorkSpace with a minimum of 100 GB for the root volume and 100 GB for the user volume.

While a WorkSpace disk size increase is in progress, users can perform most tasks on their WorkSpace. However, they can't change their WorkSpace compute type, switch the WorkSpace running mode, rebuild their WorkSpace, or restart their WorkSpace.

The disk size increase process might take up to an hour.

### Limitations for Increasing Volumes

- You can resize only SSD volumes.
- When you launch a WorkSpace, you must wait 6 hours before you can modify the sizes of its volumes.
- You cannot increase the size of the root and user volumes at the same time. To increase the root volume, you must first change the user volume to 100 GB. After that change is made, you can then update the root volume to any value between 175 and 2000 GB. After the root volume has been changed to any value between 175 and 2000 GB, you can then update the user volume further, to any value between 100 and 2000 GB.
  
  **Note**
  
  If you want to increase both volumes, you must wait 20-30 minutes for the first operation to finish before you can start the second operation.

- Unless the WorkSpace is a Graphics or GraphicsPro WorkSpace, the root volume cannot be less than 175 GB when the user volume is 100 GB. Graphics and GraphicsPro WorkSpaces can have the root and user volumes both set to 100 GB minimum.
- If the user volume is 50 GB, you cannot update the root volume to anything other than 80 GB. If the root volume is 80 GB, the user volume can only be 10, 50, or 100 GB.
To change the volume sizes of a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select the WorkSpace and choose Actions, Modify WorkSpace.
4. To increase the size of the root volume or user volume, choose Modify Volume Sizes and enter the new value.
5. Choose Modify.
6. When the disk size increase is finished, you must restart the WorkSpace (p. 90) for the changes to take effect. To avoid data loss, make sure the user saves any open files before you restart the WorkSpace.

Changing Bundle Types

You can switch a WorkSpace between the Value, Standard, Performance, Power, and PowerPro bundles. When you request a bundle change, Amazon WorkSpaces restarts the WorkSpace using the new bundle. Amazon WorkSpaces preserves the operating system, applications, data, and storage settings for the WorkSpace.

You can request a larger bundle once in a 1-hour period or a smaller bundle once every 30 days. For a newly launched WorkSpace, you must wait 1 hour before requesting a larger bundle.

When a WorkSpace compute type change is in progress, users are disconnected from their WorkSpace, and they can't use or change the WorkSpace. The WorkSpace is automatically rebooted during the compute type change process.

**Important**

To avoid data loss, make sure users save any open documents and other application files before you change the WorkSpace compute type.

The compute type change process might take up to an hour.

To change the bundle type of a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select the WorkSpace and choose Actions, Modify WorkSpace.
4. To change the bundle, choose Change Compute Type and select the new bundle type.
5. Choose Modify.

Tag WorkSpaces Resources

You can organize and manage the resources for your WorkSpaces by assigning your own metadata to each resource in the form of tags. You specify a key and a value for each tag. A key can be a general category, such as "project," "owner," or "environment," with specific associated values. Using tags is a simple yet powerful way to manage AWS resources and to organize data, including billing data.

Tags added to an existing resource appear in your cost allocation report on the first of the following month for WorkSpaces renewed in that month. For more information, see Using Cost Allocation Tags in the AWS Billing and Cost Management User Guide.

Resources That You Can Tag

- You can add tags to the following resources when you create them—WorkSpaces, imported images, and IP access control groups.
• You can add tags to existing resources of the following types—WorkSpaces, registered directories, custom bundles, images, and IP access control groups.

Tag Restrictions
• Maximum number of tags per resource—50
• Maximum key length—127 Unicode characters
• Maximum value length—255 Unicode characters
• Tag keys and values are case-sensitive. Allowed characters are letters, spaces, and numbers representable in UTF-8, plus the following special characters: + - = _ : / @. Do not use leading or trailing spaces.
• Do not use the "aws:" or "aws:workspaces:" prefixes in your tag names or values because they are reserved for AWS use. You can’t edit or delete tag names or values with these prefixes.

To update the tags for an existing resource using the console
1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose one of the following resource types: Directories, WorkSpaces, Bundles, Images, or IP Access Controls.
3. Select the resource and choose Actions, Manage Tags.
4. Do one or more of the following:
   • To update a tag, edit the values of Key and Value.
   • To add a tag, choose Add Tag and then edit the values of Key and Value.
   • To delete a tag, choose the delete icon (X) next to the tag.
5. When you are finished updating tags, choose Save.

To update the tags for an existing resource using the AWS CLI
Use the create-tags and delete-tags commands.

WorkSpace Maintenance

We recommend that you maintain your WorkSpaces on a regular basis. Amazon WorkSpaces schedules default maintenance windows for your WorkSpaces. During the maintenance window, the WorkSpace installs important updates from Amazon WorkSpaces and reboots as necessary. If available, operating system updates are also installed from the OS update server that the WorkSpace is configured to use. During maintenance, your WorkSpaces might be unavailable.

Note
By default, your Windows WorkSpaces are configured to receive updates from Windows Update. To configure your own automatic update mechanisms for Windows, see the documentation for Windows Server Update Services (WSUS) and Configuration Manager.

Maintenance Windows for AlwaysOn WorkSpaces

For AlwaysOn WorkSpaces, the maintenance window is determined by operating system settings. The default is a four-hour period from 00h00 to 04h00, in the time zone of the WorkSpace, each Sunday morning. By default, the time zone of an AlwaysOn WorkSpace is the time zone of the AWS Region for the WorkSpace. However, if you connect from another Region and time zone redirection is enabled, and
then you disconnect, the time zone of the WorkSpace is updated to the time zone of the Region that you connected from.

You can disable time zone redirection for Windows WorkSpaces (p. 60) using Group Policy. You cannot disable time zone redirection for Linux WorkSpaces.

For Windows WorkSpaces, you can configure the maintenance window using Group Policy; see Configure Group Policy Settings for Automatic Updates. You cannot configure the maintenance window for Linux WorkSpaces.

### Maintenance Windows for AutoStop WorkSpaces

AutoStop WorkSpaces are started automatically once a month in order to install important updates. Beginning on the third Monday of the month, and for up to two weeks, the maintenance window is open each day from about 00h00 to 05h00, in the time zone of the AWS Region for the WorkSpace. The WorkSpace can be maintained on any one day in the maintenance window.

During the time period when the WorkSpace is undergoing maintenance, the state of the WorkSpace is set to **MAINTENANCE**.

Although you cannot modify the time zone that is used for maintaining AutoStop WorkSpaces, you can disable the maintenance window for your AutoStop WorkSpaces as follows. If you disable maintenance mode, your WorkSpaces are not rebooted and do not enter the **MAINTENANCE** state.

#### To disable maintenance mode

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose **Directories**.
3. Select your directory, and choose **Actions, Update Details**.
4. Expand **Maintenance Mode**.
5. To enable automatic updates, choose **Enabled**. If you prefer to manage updates manually, choose **Disabled**.
6. Choose **Update and Exit**.

### Manual Maintenance

If you prefer, you can maintain your WorkSpaces on your own schedule. When you perform maintenance tasks, we recommend that you change the state of the WorkSpace to **ADMIN_MAINTENANCE**. When you are finished, change the state of the WorkSpace to **AVAILABLE**.

When a WorkSpace is in **ADMIN_MAINTENANCE** mode, the following behaviors occur:

- The WorkSpace does not respond to requests to reboot, stop, start, or rebuild.
- Users cannot log in to the WorkSpace.
- An AutoStop WorkSpace is not hibernated.

#### To change the state of the WorkSpace using the console

**Note**

To change the state of a WorkSpace, the WorkSpace must have a status of **AVAILABLE**. The **Modify State** setting is not available when a WorkSpace has a status of **STOPPED**.

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose **WorkSpaces**.
3. Select your WorkSpace, and choose Actions, Modify WorkSpace.
4. Choose Modify State. For Intended State, select ADMIN_MAINTENANCE or AVAILABLE.
5. Choose Modify.

To change the state of the WorkSpace using the AWS CLI

Use the modify-workspace-state command.

Encrypted WorkSpaces

Amazon WorkSpaces is integrated with the AWS Key Management Service (AWS KMS). This enables you to encrypt storage volumes of WorkSpaces using customer master keys (CMKs). When you launch a WorkSpace, you can encrypt the root volume (for Microsoft Windows, the C drive; for Linux, /) and the user volume (for Windows, the D drive; for Linux, /home). Doing so ensures that the data stored at rest, disk I/O to the volume, and snapshots created from the volumes are all encrypted.

Prerequisites

You need an AWS KMS CMK before you can begin the encryption process.

The first time that you launch an unencrypted WorkSpace from the Amazon WorkSpaces console in a Region, Amazon WorkSpaces automatically creates an AWS managed CMK (aws/workspaces) in your account. You can select this AWS managed CMK to encrypt the user and root volumes of your WorkSpace. For details, see How Amazon WorkSpaces uses AWS KMS in the AWS Key Management Service Developer Guide.

You can view this AWS managed CMK, including its policies and grants, and can track its use in AWS CloudTrail logs, but you cannot use or manage this CMK. Amazon WorkSpaces creates and manages this CMK. Only Amazon WorkSpaces can use this CMK, and it can use it only to encrypt WorkSpaces resources in your account. AWS managed CMKs, including the one that Amazon WorkSpaces supports, are rotated every three years. For details, see Rotating Keys in the AWS Key Management Service Developer Guide.

Alternatively, you can select a symmetric customer managed CMK that you created using AWS KMS. You can view, use, and manage this CMK, including setting its policies. For more information about creating CMKs, see Creating Keys in the AWS Key Management Service Developer Guide. For more information about creating CMKs using the AWS KMS API, see Working with Keys in the AWS Key Management Service Developer Guide.

You must meet the following requirements to use an AWS KMS CMK to encrypt your WorkSpaces:

- The CMK must be symmetric. Amazon WorkSpaces does not support asymmetric CMKs. For information about distinguishing between symmetric and asymmetric CMKs, see Identifying Symmetric and Asymmetric CMKs in the AWS Key Management Service Developer Guide.
- The CMK must be enabled. To determine whether a CMK is enabled, see Displaying CMK Details in the AWS Key Management Service Developer Guide.
- You must have the correct permissions and policies associated with the key. For more information, see IAM Permissions and Roles for Encryption (p. 88).

Important

There is a limit of 500 WorkSpaces per CMK. This limit is due to the Grants per grantee principal quota in AWS KMS. For more information about this quota, see Grants per grantee principal in the AWS Key Management Service Developer Guide.

When you are encrypting WorkSpaces, create a CMK for every 500 WorkSpaces. For example, if you are encrypting 850 WorkSpaces, create two CMKs.
If you are trying to launch encrypted WorkSpaces and you receive the error message "The specified key is not available. Please provide a valid key for encryption," the Grants per grantee principal quota for the existing CMK has been reached.

Limits

- You can't encrypt an existing WorkSpace. You must encrypt a WorkSpace when you launch it.
- Creating a custom image from an encrypted WorkSpace is not supported.
- Disabling encryption for an encrypted WorkSpace is not currently supported.
- WorkSpaces launched with root volume encryption enabled might take up to an hour to provision.
- To reboot or rebuild an encrypted WorkSpace, first make sure that the AWS KMS CMK is enabled; otherwise, the WorkSpace becomes unusable. To determine whether a CMK is enabled, see Displaying CMK Details in the AWS Key Management Service Developer Guide.

Encrypting WorkSpaces

To encrypt a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. Choose Launch WorkSpaces and complete the first three steps.
3. For the WorkSpaces Configuration step, do the following:
   a. Select the volumes to encrypt: Root Volume, User Volume, or both volumes.
   b. For Encryption Key, select an AWS KMS CMK, either the AWS managed CMK created by Amazon WorkSpaces or a CMK that you created. The CMK that you select must be symmetric. Amazon WorkSpaces does not support asymmetric CMKs.
   c. Choose Next Step.

Viewing Encrypted WorkSpaces

To see which WorkSpaces and volumes have been encrypted from the Amazon WorkSpaces console, choose WorkSpaces from the navigation bar on the left. The Volume Encryption column shows whether each WorkSpace has encryption enabled or disabled. To see which specific volumes have been encrypted, expand the WorkSpace entry to see the Encrypted Volumes field.

IAM Permissions and Roles for Encryption

If you select a customer managed CMK to use for encryption, you must establish policies that allow Amazon WorkSpaces to use the CMK on behalf of an IAM user in your account who launches encrypted WorkSpaces. That user also needs permission to use Amazon WorkSpaces.

Amazon WorkSpaces encryption requires limited access to the CMK. The following is a sample key policy that you can use. This policy separates the principals who can manage the AWS KMS CMK from those who can use it. Before you use this sample key policy, replace the example account ID and IAM user name with actual values from your account.

The first statement matches the default AWS KMS key policy. It gives your account permission to use IAM policies to control access to the CMK. The second and third statements define which AWS principals can manage and use the key, respectively. The fourth statement enables AWS services that are integrated with AWS KMS to use the key on behalf of the specified principal. This statement enables AWS services
to create and manage grants. The statement uses a condition element that limits grants on the CMK to those made by AWS services on behalf of users in your account.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {"AWS": "arn:aws:iam::123456789012:root"},
      "Action": "kms:*",
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Principal": {"AWS": "arn:aws:iam::123456789012:user/Alice"},
      "Action": [
        "kms:Create*",
        "kms:Describe*",
        "kms:Enable*",
        "kms:List*",
        "kms:Get*",
        "kms:Update*",
        "kms:Revoke*",
        "kms:Disable",
        "kms:Get",
        "kms:Delete*"
      ],
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Principal": {"AWS": "arn:aws:iam::123456789012:user/Alice"},
      "Action": [
        "kms:Encrypt",
        "kms:Decrypt",
        "kms:ReEncrypt",
        "kms:GenerateDataKey*",
        "kms:DescribeKey"
      ],
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Principal": {"AWS": "arn:aws:iam::123456789012:user/Alice"},
      "Action": [
        "kms:CreateGrant",
        "kms:ListGrants",
        "kms:RevokeGrant"
      ],
      "Resource": "*",
      "Condition": {"Bool": {"kms:GrantIsForAWSResource": "true"}}
    }
  ]
}
```

The IAM policy for a user or role that is encrypting a WorkSpace must include usage permissions on the customer managed CMK, as well as access to WorkSpaces. To give an IAM user or role WorkSpaces permissions, you can attach the following sample policy to the IAM user or role.

```
{
  "Version": "2012-10-17",
  "Statement": [
  
    "Effect": "Allow",
    "Principal": {"AWS": "arn:aws:iam::123456789012:user/Alice"},
    "Action": [
      "workspaces:CreateWorkspace",
      "workspaces:DescribeWorkspaces",
      "workspaces:StartWorkspaceSession",
      "workspaces:StopWorkspaceSession",
      "workspaces:DescribeWorkspaceSessions",
      "workspaces:EncryptWorkspace",
      "workspaces:DecryptWorkspace",
      "workspaces:ReEncryptWorkspace"
    ],
    "Resource": "*"
  ]
}
```
Restart a WorkSpace

Occasionally, you might need to restart a WorkSpace manually. Restarting a WorkSpace performs a shutdown and reboot of the WorkSpace. To avoid data loss, make sure users save any open documents and other application files before you restart the WorkSpace. The user data, operating system, and system settings are not affected.

**Warning**

To reboot an encrypted WorkSpace, first make sure that the AWS KMS CMK is enabled; otherwise, the WorkSpace becomes unusable. To determine whether a CMK is enabled, see Displaying CMK Details in the AWS Key Management Service Developer Guide.

**To restart a WorkSpace**

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select the WorkSpaces to be restarted and choose Actions, Reboot WorkSpaces.
4. When prompted for confirmation, choose Reboot WorkSpaces.

Rebuild a WorkSpace

If needed, you can rebuild a WorkSpace. This recreates both the root volume and the user volume.
You cannot rebuild a WorkSpace unless its state is AVAILABLE, ERROR, UNHEALTHY, STOPPED, or REBOOTING.

**Important**

- To rebuild a WorkSpace in the REBOOTING state, you must use the RebuildWorkspaces API operation or the rebuild-workspaces AWS Command Line Interface (CLI) command.
- After January 14, 2020, WorkSpaces created from a public Windows 7 bundle can no longer be rebuilt. You might want to consider migrating your Windows 7 WorkSpaces to Windows 10. For more information, see Migrate a WorkSpace (p. 98).

Rebuilding a WorkSpace causes the following to occur:

- The system is refreshed with the most recent image of the bundle that the WorkSpace was created from. Any applications that were installed, or system settings that were changed after the WorkSpace was created, are lost.
- The user volume (for Microsoft Windows, the D drive; for Linux, /home) is recreated from the most recent snapshot. The current contents of the user volume are overwritten.

Automatic snapshots for use when rebuilding a WorkSpace are scheduled every 12 hours. If the WorkSpace is healthy, a snapshot of the user volume is created. If the WorkSpace is unhealthy, the snapshot is not created.

- The primary elastic network interface is recreated. The WorkSpace receives a new private IP address.

**To rebuild a WorkSpace**

**Warning**
To rebuild an encrypted WorkSpace, first make sure that the AWS KMS CMK is enabled; otherwise, the WorkSpace becomes unusable. To determine whether a CMK is enabled, see Displaying CMK Details in the AWS Key Management Service Developer Guide.

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select the WorkSpace to be rebuilt and choose Actions, Rebuild / Restore WorkSpace.
4. When prompted for confirmation, choose Rebuild WorkSpace.

**Note**
If you rebuild a WorkSpace after changing the user's sAMAccountName user naming attribute in Active Directory, you might receive the following error message:

```
"ErrorCode": "InvalidUserConfiguration.Workspace"
"ErrorMessage": "The user was either not found or is misconfigured."
```

To work around this issue, either revert to the original user naming attribute and then reinitiate the rebuild, or create a new WorkSpace for that user.

**Restore a WorkSpace**

Automatic snapshots for use when restoring a WorkSpace are scheduled every 12 hours. If the WorkSpace is healthy, snapshots of both the root volume and user volume are created around the same time. If the WorkSpace is unhealthy, these snapshots are not created.
If needed, you can restore a WorkSpace to its last known healthy state. This recreates both the root volume and user volume, based on the most recent snapshots of these volumes that were created when the WorkSpace was healthy.

You cannot restore a WorkSpace unless its state is **AVAILABLE**, **ERROR**, **UNHEALTHY**, or **STOPPED**.

Restoring a WorkSpace causes the following to occur:

- The system is restored to the most recent snapshot of the root volume. Any applications that were installed, or system settings that were changed after the most recent snapshot was created, are lost.
- The user volume (for Microsoft Windows, the D drive; for Linux, /home) is recreated from the most recent snapshot. The current contents of the user volume are overwritten.

**To restore a WorkSpace**

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose **WorkSpaces**.
3. Select the WorkSpace to be restored and choose **Actions, Rebuild / Restore WorkSpace**.
4. Choose **Restore WorkSpace**.

---

**Upgrade Windows 10 BYOL WorkSpaces**

On your Windows 10 Bring Your Own License (BYOL) WorkSpaces, you can upgrade to a newer version of Windows 10 by using the in-place upgrade process. Follow the instructions in this topic to do so.

The in-place upgrade process applies only to Windows 10 BYOL WorkSpaces.

**Important**

Do not run Sysprep on an upgraded WorkSpace. If you do so, an error that prevents Sysprep from finishing might occur. If you plan to run Sysprep, do so only on a WorkSpace that hasn't been upgraded.

**Contents**

- Prerequisites (p. 92)
- Important Considerations (p. 93)
- Known Limitations (p. 93)
- Summary of Registry Key Settings (p. 93)
- Steps to Perform an In-place Upgrade (p. 94)
- Troubleshooting (p. 96)
- Update Your WorkSpace Registry Using a PowerShell Script (p. 97)

**Prerequisites**

- If you have deferred or paused Windows 10 upgrades by using Group Policy or System Center Configuration Manager (SCCM), enable operating system upgrades for your Windows 10 WorkSpaces.
- If the WorkSpace is an AutoStop WorkSpace, change it to an AlwaysOn WorkSpace before the in-place upgrade process so that it won't be stopped automatically while updates are being applied. For more information, see Modify the Running Mode (p. 81). If you prefer to keep the WorkSpace set to AutoStop, change the AutoStop time to three hours or more while the upgrade takes place.
The in-place upgrade process recreates the user profile by making a copy of a special profile named Default User (C:\Users\Default). Do not use this default user profile to make customizations. We recommend making any customizations to the user profile through Group Policy Objects (GPOs) instead. Customizations made through GPOs can be easily modified or rolled back and are less prone to error.

Important Considerations

The in-place upgrade process uses two registry scripts (enable-inplace-upgrade.ps1 and update-pvdrivers.ps1) to make the necessary changes to your WorkSpaces that enable the Windows Update process to run. These changes involve creating a (temporary) user profile on drive C instead of drive D. If a user profile already exists on drive D, the data in that original user profile remains on drive D.

By default, WorkSpaces creates the user profile in D:\Users\%USERNAME%. The enable-inplace-upgrade.ps1 script configures Windows to create a new user profile in C:\Users\%USERNAME% and redirects the user shell folders to D:\Users\%USERNAME%. This new user profile is created when a user logs on the first time.

After the in-place upgrade, you have the choice of leaving your user profiles on drive C to allow your users to use the Windows Update process to upgrade their machines in the future. However, be aware that WorkSpaces with profiles stored on drive C can't be rebuilt or migrated without losing all of the data in the user's profile unless you back up and restore that data yourself. If you decide to leave the profiles on drive C, you can use the UserShellFoldersRedirection registry key to redirect the user shell folders to drive D, as explained later in this topic.

To ensure that you can rebuild or migrate your WorkSpaces and to avoid any potential problems with user shell folder redirection, we recommend that you choose to restore your user profiles to drive D after the in-place upgrade. You can do so by using the PostUpgradeRestoreProfileOnD registry key, as explained later in this topic.

Known Limitations

- The user profile location change from drive D to drive C does not happen during WorkSpace rebuilds or migrations. If you perform an in-place upgrade on a Windows 10 BYOL WorkSpace and then rebuild or migrate it, the new WorkSpace will have the user profile on drive D.

  **Warning**
  
  If you leave the user profile on drive C after the in-place upgrade, the user profile data stored on drive C will be lost during rebuilds or migrations unless you manually back up the user profile data prior to rebuilding or migrating, and then manually restore the user profile data after running the rebuild or migration process.

- If your default BYOL bundle contains an image that is based on an earlier release of Windows 10, you must perform the in-place upgrade again after the WorkSpace is rebuilt or migrated.

Summary of Registry Key Settings

To enable the in-place upgrade process and to specify where you would like the user profile to be located after the upgrade, you must set a number of registry keys.

**Registry path: HKLM:\Software\Amazon\WorkSpacesConfig\enable-inplace-upgrade.ps1**

<table>
<thead>
<tr>
<th>Registry key</th>
<th>Type</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabled</td>
<td>DWORD</td>
<td>0 – (Default) Disables in-place upgrade</td>
</tr>
</tbody>
</table>
Steps to Perform an In-place Upgrade

To enable in-place Windows upgrades on your BYOL WorkSpaces, you must set certain registry keys, as described in the following procedure. You must also set certain registry keys to indicate the drive (C or D) where you want the user profiles to be located after the in-place upgrades are finished.

You can make these registry changes manually. If you have multiple WorkSpaces to update, you can use Group Policy or SCCM to push a PowerShell script. For a sample PowerShell script, see Update Your WorkSpace Registry Using a PowerShell Script (p. 97).

To perform an in-place upgrade of Windows 10

1. Make note of which version of Windows is currently running on the Windows 10 BYOL WorkSpaces that you are updating, and then reboot them.
2. Update the following Windows system registry keys to change the value data for Enabled from 0 to 1. These registry changes enable in-place upgrades for the WorkSpace.
Steps to Perform an In-place Upgrade

- HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\WorkSpacesConfig\enable-inplace-upgrade.ps1
- HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\WorkSpacesConfig\update-pvdrivers.ps1

**Note**
If these keys do not exist, reboot the WorkSpace. The keys should be added when the system is rebooted.

(Optional) If you are using a managed workflow such as SCCM Task Sequences to perform the upgrade, set the following key value to 1 to prevent the computer from rebooting:

HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\WorkSpacesConfig\enable-inplace-upgrade.ps1\NoReboot

3. Decide which drive you want user profiles to be located on after the in-place upgrade process (for more information, see Important Considerations (p. 93)), and set the registry keys as follows:

- Settings if you want the user profile on drive C after the upgrade:

  HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\WorkSpacesConfig\enable-inplace-upgrade.ps1
  
  Key name: PostUpgradeRestoreProfileOnD
  
  Key value: 0

  Key name: UserShellFoldersRedirection
  
  Key value: 1

- Settings if you want the user profile on drive D after the upgrade:

  HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\WorkSpacesConfig\enable-inplace-upgrade.ps1
  
  Key name: PostUpgradeRestoreProfileOnD
  
  Key value: 1

  Key name: UserShellFoldersRedirection
  
  Key value: 0

4. After saving the changes to the registry, reboot the WorkSpace again so that the changes are applied.

  **Note**
  After the reboot, logging in to the WorkSpace creates a new user profile. You might see placeholder icons in the Start menu. This behavior is automatically resolved after the in-place upgrade is complete.

(Optional) Confirm that the following key value is set to 1, which unblocks the WorkSpace for updating:

HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\WorkSpacesConfig\enable-inplace-upgrade.ps1\profileImagePathDeleted

5. Perform the in-place upgrade. You can use whichever method you like, such as SCCM, ISO, or Windows Update (WU). Depending on your original Windows 10 version and how many apps were installed, this process can take from 40 to 120 minutes.

6. After the update process is finished, confirm that the Windows version has been updated.
**Note**
If the in-place upgrade fails, Windows automatically rolls back to use the Windows 10 version that was in place before you started the upgrade. For more information about troubleshooting, see the Microsoft documentation.

(Optional) To confirm that the update scripts were successfully executed, verify that the following key value is set to 1:

```
HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\WorkSpacesConfig\enable-inplace-upgrade.ps1\scriptExecutionComplete
```

7. If you modified the running mode of the Workspace by setting it to AlwaysOn or by changing the AutoStop time period so that the in-place upgrade process could run without interruption, set the running mode back to your original settings. For more information, see Modify the Running Mode (p. 81).

If you haven’t set the `PostUpgradeRestoreProfileOnD` registry key to 1, the user profile is regenerated by Windows and placed in `C:\Users\%USERNAME%\` after the in-place upgrade, so that you do not have to go through the above steps again for future Windows 10 in-place upgrades. By default, the `enable-inplace-upgrade.ps1` script redirects the following shell folders to drive D:

- `D:\Users\%USERNAME%\Downloads`
- `D:\Users\%USERNAME%\Desktop`
- `D:\Users\%USERNAME%\Favorites`
- `D:\Users\%USERNAME%\Music`
- `D:\Users\%USERNAME%\Pictures`
- `D:\Users\%USERNAME%\Videos`
- `D:\Users\%USERNAME%\Documents`
- `D:\Users\%USERNAME%\AppData\Roaming\Microsoft\Windows\Network Shortcuts`
- `D:\Users\%USERNAME%\AppData\Roaming\Microsoft\Windows\Printer Shortcuts`
- `D:\Users\%USERNAME%\AppData\Roaming\Microsoft\Windows\Start Menu\Programs`
- `D:\Users\%USERNAME%\AppData\Roaming\Microsoft\Windows\Recent`
- `D:\Users\%USERNAME%\AppData\Roaming\Microsoft\Windows\SendTo`
- `D:\Users\%USERNAME%\AppData\Roaming\Microsoft\Windows\Start Menu\Programs\Startup`
- `D:\Users\%USERNAME%\AppData\Roaming\Microsoft\Windows\Templates`

If you redirect the shell folders to other locations on your WorkSpaces, perform the necessary operations on the WorkSpaces after the in-place upgrades.

**Troubleshooting**

If you encounter any issues with the update, you can check the following items to assist with troubleshooting:

- Windows Logs, which are located, by default, in the following locations:
  
  C:\Program Files\Amazon\WorkSpacesConfig\Logs\*
  
  C:\Program Files\Amazon\WorkSpacesConfig\Logs\TRANSMITTED
- Windows Event Viewer
Windows Logs > Application > Source: Amazon WorkSpaces

**Tip**
During the in-place upgrade process, if you see that some icon shortcuts on the desktop no longer work, it's because WorkSpaces moves any user profiles located on drive D to drive C to prepare for the upgrade. After the upgrade is completed, the shortcuts will work as expected.

**Update Your WorkSpace Registry Using a PowerShell Script**

You can use the following sample PowerShell script to update the registry on your WorkSpaces to enable in-place upgrades. Follow the Steps to Perform an In-place Upgrade (p. 94), but use this script to update the registry on each WorkSpace.

```powershell
# AWS WorkSpaces 1.28.20
# Enable In-Place Update Sample Scripts
# These registry keys and values will enable scripts to execute on the next reboot of the WorkSpace.

$scriptlist = ("update-pvdrivers.ps1","enable-inplace-upgrade.ps1")
$wsConfigRegistryRoot="HKLM:\Software\Amazon\WorkSpacesConfig"
$Enabled = 1
$script:ErrorActionPreference = "Stop"
foreach ($scriptName in $scriptlist)
{
    $scriptRegKey = "$wsConfigRegistryRoot\$scriptName"
    try
    {
        if (~not(Test-Path $scriptRegKey))
        {
            Write-Host "Registry key not found. Creating registry key '$scriptRegKey' with 'Update' enabled."
            New-Item -Path $wsConfigRegistryRoot -Name $scriptName | Out-Null
            New-ItemProperty -Path $scriptRegKey -Name Enabled -PropertyType DWord -Value $Enabled | Out-Null
            Write-Host "Value created. '$scriptRegKey' Enabled='"$((Get-ItemProperty -Path $scriptRegKey).Enabled)'"
        }
        else
        {
            Write-Host "Registry key is already present with value '$scriptRegKey' Enabled='"$((Get-ItemProperty -Path $scriptRegKey).Enabled)'"
            if((Get-ItemProperty -Path $scriptRegKey).Enabled -ne $Enabled)
            {
                Set-ItemProperty -Path $scriptRegKey -Name Enabled -Value $Enabled
                Write-Host "Value updated. '$scriptRegKey' Enabled='"$((Get-ItemProperty -Path $scriptRegKey).Enabled)'"
            }
        }
    }
    catch
    {
        write-host "Stopping script, the following error was encountered:" `r
        ForegroundColor Red
        break
    }
}
```

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Migrate a WorkSpace

You can migrate a WorkSpace from one bundle to another, while retaining the data on the user volume. You can use this feature to migrate WorkSpaces from the Windows 7 desktop experience to the Windows 10 desktop experience. You can also use this feature to migrate WorkSpaces from one public or custom bundle to another. For example, you can migrate from GPU-enabled (Graphics and GraphicsPro) bundles to non-GPU-enabled bundles, and vice versa. For more information about Amazon WorkSpaces bundles, see WorkSpace Bundles and Images (p. 103).

The migration process recreates the WorkSpace by using a new root volume from the target bundle image and the user volume from the last available snapshot of the original WorkSpace. A new user profile is generated during migration for better compatibility. The old user profile is renamed, and then certain files in the old user profile are moved to the new user profile. (For details about what gets moved, see What Happens During Migration (p. 99).)

The migration process takes up to one hour per WorkSpace. When you initiate the migration process, a new WorkSpace is created. If an error occurs that prevents successful migration, the original WorkSpace is recovered and returned to its original state, and the new WorkSpace is terminated.

Contents
- Migration Limits (p. 98)
- Available Migration Scenarios (p. 99)
- What Happens During Migration (p. 99)
- Best Practices (p. 100)
- Troubleshooting (p. 100)
- How Billing Is Affected (p. 100)
- Migrating a WorkSpace (p. 101)

Migration Limits

- You cannot migrate to a public or custom Windows 7 desktop experience bundle. You also cannot migrate to Bring Your Own License (BYOL) Windows 7 bundles.
- You can migrate BYOL WorkSpaces only to other BYOL bundles.
- You cannot migrate a WorkSpace created from public or custom bundles to a BYOL bundle.
- You cannot migrate between Plus bundles (those that include Microsoft Office) and non-Plus bundles. You can migrate from a Plus bundle to another Plus bundle, or between a non-Plus bundle and another non-Plus bundle.
- Migrating Linux WorkSpaces is not currently supported.
- In AWS Regions that support more than one language, you can migrate WorkSpaces between language bundles.
- The source and target bundles must be different. (However, in Regions that support more than one language, you can migrate to the same Windows 10 bundle as long as the languages differ.) If you want to refresh your WorkSpace using the same bundle, rebuild the WorkSpace (p. 90) instead.
- You cannot migrate WorkSpaces across Regions.
- In some cases, if migration is unable to finish successfully, you might not receive an error message, and it might appear that the migration process did not start. If the WorkSpace bundle remains the same one hour after attempting migration, the migration is unsuccessful. Contact the AWS Support Center for assistance.
Available Migration Scenarios

The following table shows which migration scenarios are available:

<table>
<thead>
<tr>
<th>Source OS</th>
<th>Target OS</th>
<th>Available?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public or custom bundle Windows 7</td>
<td>Public or custom bundle Windows 10</td>
<td>Yes</td>
</tr>
<tr>
<td>Custom bundle Windows 7</td>
<td>Public bundle Windows 7</td>
<td>No</td>
</tr>
<tr>
<td>Custom bundle Windows 7</td>
<td>Custom bundle Windows 7</td>
<td>No</td>
</tr>
<tr>
<td>Public bundle Windows 7</td>
<td>Custom bundle Windows 7</td>
<td>No</td>
</tr>
<tr>
<td>Public or custom bundle Windows 10</td>
<td>Public or custom bundle Windows 7</td>
<td>No</td>
</tr>
<tr>
<td>Custom bundle Windows 10</td>
<td>Public bundle Windows 10</td>
<td>No</td>
</tr>
<tr>
<td>Public or custom bundle Windows 10</td>
<td>Custom bundle Windows 10</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows 7 BYOL bundle</td>
<td>Windows 7 BYOL bundle</td>
<td>No</td>
</tr>
<tr>
<td>Windows 7 BYOL bundle</td>
<td>Windows 10 BYOL bundle</td>
<td>Yes</td>
</tr>
<tr>
<td>Windows 10 BYOL bundle</td>
<td>Windows 7 BYOL bundle</td>
<td>No</td>
</tr>
<tr>
<td>Windows 10 BYOL bundle</td>
<td>Windows 10 BYOL bundle</td>
<td>Yes</td>
</tr>
</tbody>
</table>

What Happens During Migration

During migration, the data on the user volume (drive D) is preserved, but all of the data on the root volume (drive C) is lost. This means that none of the installed applications, settings, and changes to the registry are preserved. The old user profile folder is renamed with the .NotMigrated suffix, and a new user profile is created.

The migration process recreates drive D based on the last snapshot of the original user volume. During the new WorkSpace's first boot, the migration process moves the original D:\Users\%USERNAME% folder to a folder named D:\Users\%USERNAME%MMddyyTHHmss%.NotMigrated. A new D:\Users\%USERNAME% folder is generated by the new OS.

After the new user profile is created, the files in the following user shell folders are moved from the old .NotMigrated profile to the new profile:

- D:\Users\%USERNAME%\Desktop
- D:\Users\%USERNAME%\Documents
- D:\Users\%USERNAME%\Downloads
- D:\Users\%USERNAME%\Favorites
- D:\Users\%USERNAME%\Music
- D:\Users\%USERNAME%\Pictures
- D:\Users\%USERNAME%\Videos
Important
The migration process attempts to move the files from the old user profile to the new profile. Any files that weren't moved during migration remain in the D:\Users\%USERNAME%MMddyyTHHmmss%.NotMigrated folder. If the migration is successful, you can see which files got moved in C:\Program Files\Amazon\WorkspacesConfig\Logs\MigrationLogs. You can manually move any files that didn't get moved automatically.

Any tags assigned to the original WorkSpace are carried over during migration, and the running mode of the WorkSpace is preserved. However, the new WorkSpace gets a new WorkSpace ID, computer name, and IP address.

Best Practices
Before you migrate a WorkSpace, do the following:

• Back up any important data on drive C to another location. All data on drive C is erased during migration.
• Make sure that the WorkSpace being migrated is at least 12 hours old, to ensure that a snapshot of the user volume has been created. On the Migrate WorkSpaces page in the Amazon WorkSpaces console, you can see the time of the last snapshot. Any data created after the last snapshot is lost during migration.
• To avoid potential data loss, make sure that your users log out of their WorkSpaces and don't log back in until after the migration process is finished. Note that WorkSpaces cannot be migrated when they are in ADMIN_MAINTENANCE mode.
• Make sure that the WorkSpaces you want to migrate have a status of AVAILABLE, STOPPED, or ERROR.
• Make sure that you have enough IP addresses for the WorkSpaces you are migrating. During migration, new IP addresses will be allocated for the WorkSpaces.
• If you are using scripts to migrate WorkSpaces, migrate them in batches of no more than 25 WorkSpaces at a time.

Troubleshooting

• If your users report missing files after migration, check to see if their user profile files did not get moved during the migration process. You can see which files got moved in C:\Program Files\Amazon\WorkspacesConfig\Logs\MigrationLogs. The files that didn't get moved will be located in the D:\Users\%USERNAME%MMddyyTHHmmss%.NotMigrated folder. You can manually move any files that didn't get moved automatically.
• If you are using the API to migrate WorkSpaces and the migration does not succeed, the target WorkSpace ID returned by the API will not be used, and the WorkSpace will still have the original WorkSpace ID.
• If a migration does not successfully finish, check the Active Directory to see if it was cleaned up accordingly. You might need to manually remove WorkSpaces that you no longer need.

How Billing Is Affected

During the month in which migration occurs, you are charged prorated amounts for both the new and the original WorkSpaces. For example, if you migrate WorkSpace A to WorkSpace B on May 10, you will be charged for WorkSpace A from May 1 to May 10, and you will be charged for WorkSpace B from May 11 to May 30.

Note
If you are migrating a WorkSpace to a different bundle type (for example, from Performance to Power, or Value to Standard), the size of the root volume (drive C) and the user volume
Migrating a WorkSpace

You can migrate WorkSpaces through the Amazon WorkSpaces console, the AWS command line interface (CLI), or the Amazon WorkSpaces API.

To migrate a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select your WorkSpace and choose Actions, Migrate WorkSpaces.
4. Under Select Target Bundle, select the bundle that you'd like to migrate your WorkSpace to.
5. Under Assign WorkSpace Bundle, choose the target bundle for each WorkSpace user.
   Warning
   For each WorkSpace, take note of the listed snapshot time. Any changes made to the user volume after the listed snapshot time are discarded during the migration process.
6. Choose Migrate WorkSpaces.

   A new WorkSpace with a status of PENDING appears in the Amazon WorkSpaces console. When the migration is finished, the original WorkSpace is terminated, and the status of the new WorkSpace is set to AVAILABLE.
7. (Optional) To delete any custom bundles and images that you no longer need, see Delete a Custom WorkSpaces Bundle or Image (p. 115).

To migrate WorkSpaces through the AWS CLI, use the migrate-workspace command. To migrate WorkSpaces through the Amazon WorkSpaces API, see MigrateWorkSpace in the Amazon WorkSpaces API Reference.

Delete a WorkSpace

When you are finished with a WorkSpace, you can delete it. You can also delete related resources.

Warning
   This is a permanent action and cannot be undone. The WorkSpace user's data does not persist and is destroyed. For help with backing up user data, contact AWS Support.

To delete a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select your WorkSpace and choose Actions, Remove WorkSpaces.
4. When prompted for confirmation, choose Remove WorkSpaces. The status of the WorkSpace is set to TERMINATING. When the termination is complete, the status is set to TERMINATED.
5. (Optional) To delete any custom bundles and images that you are finished with, see Delete a Custom WorkSpaces Bundle or Image (p. 115).
6. (Optional) After you delete all WorkSpaces in a directory, you can delete the directory. For more information, see Delete the Directory for Your WorkSpaces (p. 53).

7. (Optional) After you delete all resources in the virtual private cloud (VPC) for your directory, you can delete the VPC and release the Elastic IP address used for the NAT gateway. For more information, see Deleting your VPC and Working with Elastic IP addresses in the Amazon VPC User Guide.
WorkSpace Bundles and Images

A *WorkSpace bundle* is a combination of an operating system, and storage, compute, and software resources. When you launch a WorkSpace, you select the bundle that meets your needs. The default bundles available for WorkSpaces are called *public bundles*. For more information about the various public bundles available for Amazon WorkSpaces, see Amazon WorkSpaces Bundles.

If you've launched a Windows or Amazon Linux WorkSpace and have customized it, you can create a custom image from that WorkSpace.

A *custom image* contains only the OS, software, and settings for the WorkSpace. A *custom bundle* is a combination of both that custom image and the hardware from which a WorkSpace can be launched.

After you create a custom image, you can build a custom bundle that combines the custom WorkSpace image and the underlying compute and storage configuration that you select. You can then specify this custom bundle when you launch new WorkSpaces to ensure that the new WorkSpaces have the same consistent configuration (hardware and software).

If you need to perform software updates or to install additional software on your WorkSpaces, you can update your custom bundle and use it to rebuild your WorkSpaces.

**Contents**

- Create a Custom WorkSpaces Image and Bundle (p. 103)
- Update a Custom WorkSpaces Bundle (p. 114)
- Copy a Custom WorkSpaces Image (p. 115)
- Delete a Custom WorkSpaces Bundle or Image (p. 115)
- Bring Your Own Windows Desktop Licenses (p. 116)

Create a Custom WorkSpaces Image and Bundle

If you've launched a Windows or Amazon Linux WorkSpace and have customized it, you can create a custom image and custom bundles from that WorkSpace.

A *custom image* contains only the OS, software, and settings for the WorkSpace. A *custom bundle* is a combination of both that custom image and the hardware from which a WorkSpace can be launched.

After you create a custom image, you can build a custom bundle that combines the custom image and the underlying compute and storage configuration that you select. You can then specify this custom bundle when you launch new WorkSpaces to ensure that the new WorkSpaces have the same consistent configuration (hardware and software).

You can use the same custom image to create various custom bundles by selecting different compute and storage options for each bundle.

**Important**

- If you plan to create an image from a Windows 10 WorkSpace, note that image creation is not supported on Windows 10 systems that have been upgraded from one version of Windows 10 to a newer version of Windows 10 (a Windows feature/version upgrade). However, Windows cumulative or security updates are supported by the WorkSpaces image-creation process.
• After January 14, 2020, images cannot be created from public Windows 7 bundles. You might want to consider migrating your Windows 7 WorkSpaces to Windows 10. For more information, see Migrate a WorkSpace (p. 98).

Custom bundles cost as same as the public bundles they are created from. For more information about pricing, see Amazon WorkSpaces Pricing.

Contents
• Requirements to Create Windows Custom Images (p. 104)
• Requirements to Create Amazon Linux Custom Images (p. 104)
• Best Practices (p. 105)
• Step 1: Run the Image Checker (p. 105)
• Step 2: Create a Custom Image and Custom Bundle (p. 112)
• What's Included with Windows WorkSpaces Custom Images (p. 113)
• What's Included with Amazon Linux WorkSpace Custom Images (p. 114)

Requirements to Create Windows Custom Images

• The status of the WorkSpace must be Available and its modification state must be None.
• All applications and user profiles on WorkSpaces images must be compatible with Microsoft Sysprep.
• All applications to be included in the image must be installed on the C drive.
• The user profile must exist, must be located at D:\Users\username, and its total size (files and data) must be less than 10 GB.
• The C drive must have at least 12 GB of available space.
• All application services running on the WorkSpace must use a local system account instead of domain user credentials. For example, you cannot have a Microsoft SQL Server Express installation running with a domain user's credentials.
• The WorkSpace must not be encrypted. Image creation from an encrypted WorkSpace is not currently supported.
• The following components are required in an image. Without these components, the WorkSpaces that you launch from the image will not function correctly:
  • Windows PowerShell version 3.0 or later
  • Remote Desktop Services
  • AWS PV drivers
  • Windows Remote Management (WinRM)
  • Teradici PCoIP agents and drivers
  • STXHD agents and drivers
  • AWS and WorkSpaces certificates
  • Skylight agent

Requirements to Create Amazon Linux Custom Images

• The status of the WorkSpace must be Available and its modification state must be None.
• All applications to be included in the image must be installed outside of the user volume (the /home directory).
• The root volume (/) should be less than 97% full.
• The WorkSpace must not be encrypted. Image creation from an encrypted WorkSpace is not currently supported.
• The following components are required in an image. Without these components, the WorkSpaces that you launch from the image will not function correctly:
  • Cloud-init
  • Teradici PCoIP agents and drivers
  • Skylight agent

Best Practices

Before you create an image from a WorkSpace, do the following:

• Use a separate VPC that is not connected to your production environment.
• Deploy the WorkSpace in a private subnet and use a NAT instance for outbound traffic.
• Use a small Simple AD directory.
• Use the smallest volume size for the source WorkSpace, and then adjust the volume size as needed when creating the custom bundle.
• Install all operating system updates (except Windows feature/version updates) and all application updates on the WorkSpace. For more information, see the Important note (p. 103) at the start of this topic.
• Delete cached data from the WorkSpace that shouldn't be included in the bundle (for example, browser history, cached files, and browser cookies).
• Delete configuration settings from the WorkSpace that shouldn't be included in the bundle (for example, email profiles).
• Switch to dynamic IP address settings using DHCP.
• Make sure that you haven't exceeded your quota for WorkSpace images allowed in a Region. By default, you're allowed 20 WorkSpace images per Region. If you've reached this quota, new attempts to create an image will fail. To request a quota increase, use the Amazon WorkSpaces Limits form.
• Make sure that you aren't trying to create an image from an encrypted WorkSpace. Image creation from an encrypted WorkSpace is not currently supported.
• If you're running any antivirus software on the WorkSpace, disable it while you're attempting to create an image.
• If you have a firewall enabled on your WorkSpace, make sure that it isn't blocking any necessary ports. For more information, see IP Address and Port Requirements for Amazon WorkSpaces (p. 15).
• For Windows WorkSpaces, don't configure any Group Policy Objects (GPOs) before image creation.
• For Windows WorkSpaces, do not customize the default user profile (C:\Users\Default) before creating an image. We recommend making any customizations to the user profile through GPOs, and applying them after image creation. GPOs can be easily modified or rolled back, and are therefore less prone to error than customizations made to the default user profile.
• For Linux WorkSpaces, see also the "Best Practices to Prepare Your Amazon WorkSpaces for Linux Images" whitepaper.

Step 1: Run the Image Checker

Note
The Image Checker is available only for Windows WorkSpaces. If you are creating an image from a Linux WorkSpace, skip to Step 2: Create a Custom Image and Custom Bundle (p. 112).

To confirm that your Windows WorkSpace meets the requirements for image creation, we recommend running the Image Checker. The Image Checker performs a series of tests on the WorkSpace that you want to use to create your image, and provides guidance on how to resolve any issues it finds.
Important

- The WorkSpace must pass all of the tests run by the Image Checker before you can use it for image creation.
- Before you run the Image Checker, verify that the latest Windows security and cumulative updates are installed on your WorkSpace.

To get the Image Checker, do one of the following:

- Reboot your WorkSpace. The Image Checker is downloaded automatically during the reboot and installed at C:\Program Files\Amazon\ImageChecker.exe.
- Download the Amazon WorkSpaces Image Checker from https://tools.amazonworkspaces.com/ImageChecker.zip and extract the ImageChecker.exe file. Copy this file to C:\Program Files\Amazon.

To run the Image Checker

1. On the Windows Start menu, choose Windows System, then choose Command Prompt.
2. In the Command Prompt window, enter the following commands, one at a time, and press Enter after each command.

   ```
   C:\
   cd C:\Program Files\Amazon
   ImageChecker.exe
   ```

3. When asked "Do you want to allow this app to make changes to your device?" choose Yes.
4. In the Amazon WorkSpaces Image Checker dialog box, choose Run.
5. After each test is completed, you can view the status of the test.

   For any test with a status of FAILED, choose Info to display information about how to resolve the issue that caused the failure. For more information about how to resolve these issues, see Tips for Resolving Issues Detected by the Image Checker (p. 106).

   If any tests display a status of WARNING, choose the Fix All Warnings button.

   The tool generates an output log file in the same directory where the Image Checker is located. By default, this file is located at C:\Program Files\Amazon\ImageChecker_yyyyMMddhhmmss.log.

   Tip
   Do not delete this log file. If an issue occurs, this log file might be helpful in troubleshooting.

6. If applicable, resolve any issues that cause test failures and warnings, and repeat the process of running the Image Checker until the WorkSpace passes all tests. All failures and warnings must be resolved before you can create an image.
7. After your WorkSpace passes all tests, you see a Validation Successful message. You are now ready to create a custom bundle.

Tips for Resolving Issues Detected by the Image Checker

In addition to consulting the following tips for resolving issues that are detected by the Image Checker, be sure to review the Image Checker log file at C:\Program Files\Amazon\ImageChecker_yyyyMMddhhmmss.log.
PowerShell version 3.0 or later must be installed

Install the latest version of Microsoft Windows PowerShell.

Important
The PowerShell execution policy for a WorkSpace must be set to allow RemoteSigned scripts. To check the execution policy, run the Get-ExecutionPolicy PowerShell command. If the execution policy is not set to Unrestricted or RemoteSigned, run the Set-ExecutionPolicy –ExecutionPolicy RemoteSigned command to change the value of the execution policy. The RemoteSigned setting allows the execution of scripts on Amazon WorkSpaces, which is required to create an image.

Only the C and D drives can be present

Only the C and D drives can be present on a WorkSpace that’s used for imaging. Remove all other drives, including virtual drives.

No pending reboot due to Windows Updates can be detected

• The Create Image process can’t be run until Windows has been rebooted to finish installing security or cumulative updates. Reboot Windows to apply these updates, and make sure that no other pending Windows security or cumulative updates need to be installed.
• Image creation is not supported on Windows 10 systems that have been upgraded from one version of Windows 10 to a newer version of Windows 10 (a Windows feature/version upgrade). However, Windows cumulative or security updates are supported by the WorkSpaces image-creation process.

The Sysprep file must exist and can’t be blank

If there are problems with your Sysprep file, contact the AWS Support Center to get your EC2Config or EC2Launch repaired.

The user profile size must be less than 10 GB

The user profile (D: \ Users \ username) must be less than 10 GB total. Remove files as needed to reduce the size of the user profile.

Drive C must have enough free space

You must have at least 12 GB of free space on drive C. Remove files as needed to free up space on drive C.

No services can be running under a domain account

To run the Create Image process, no services on the WorkSpace can be running under a domain account. All services must be running under a local account.

To run services under a local account

1. Open C:\ Program Files \ Amazon \ ImageChecker_yyyyMMddhhmmss.log and find the list of services that are running under a domain account.
2. In the Windows search box, enter services.msc to open the Windows Services Manager.
3. Under Log On As, look for the services that are running under domain accounts. (Services running as Local System, Local Service, or Network Service do not interfere with image creation.)
4. Select a service that is running under a domain account, and then choose Action, Properties.
5. Open the Log On tab. Under Log on as, choose Local System account.
6. Choose OK.
Amazon WorkSpaces Application Manager (Amazon WAM) must be installed

If you have used Amazon WAM to assign applications to your users, you must set up the Amazon WAM installer on your WorkSpace. When you are finished, the Amazon WAM shortcut will appear on your WorkSpace desktop.

The WorkSpace must be configured to use DHCP

You must configure all network adapters on the WorkSpace to use DHCP instead of static IP addresses.

To set all network adapters to use DHCP

1. In the Windows search box, enter control panel to open the Control Panel.
2. Choose Network and Internet.
3. Choose Network and Sharing Center.
4. Choose Change adapter settings, and select an adapter.
5. Choose Change settings of this connection.
6. On the Networking tab, select Internet Protocol Version 4 (TCP/IPv4), and then choose Properties.
8. Choose OK.
9. Repeat this process for all network adapters on the WorkSpace.

Remote Desktop Services must be enabled

The Create Image process requires Remote Desktop Services to be enabled.

To enable Remote Desktop Services

1. In the Windows search box, enter services.msc to open the Windows Services Manager.
2. In the Name column, find Remote Desktop Services.
3. Select Remote Desktop Services, and then choose Action, Properties.
4. On the General tab, for Startup type, choose Manual or Automatic.
5. Choose OK.

A user profile must exist

The WorkSpace that you’re using to create images must have a user profile (D:\Users\username). If this test fails, contact the AWS Support Center for assistance.

The environment variable path must be properly configured

The environment variable path for the local machine is missing entries for System32 and for Windows PowerShell. These entries are required for Create Image to run.

To configure your environment variable path

1. In the Windows search box, enter environment variables and then choose Edit the system environment variables.
2. In the System Properties dialog box, open the Advanced tab, and choose Environment Variables.
3. In the Environment Variables dialog box, under System variables, select the Path entry and then choose Edit.
4. Choose **New**, and add the following path:
   
   C:\Windows\System32

5. Choose **New** again, and add the following path:
   
   C:\Windows\System32\WindowsPowerShell\v1.0\

6. Choose **OK**.

7. Restart the WorkSpace.

   **Tip**
   
   The order in which items appear in the environment variable path matters. To determine the correct order, you might want to compare the environment variable path of your WorkSpace with one from a newly created WorkSpace or a new Windows instance.

---

**Windows Modules Installer must be enabled**

The Create Image process requires the Windows Modules Installer service to be enabled.

**To enable the Windows Modules Installer service**

1. In the Windows search box, enter `services.msc` to open the Windows Services Manager.
2. In the **Name** column, find **Windows Modules Installer**.
3. Select **Windows Modules Installer**, and then choose **Action**, **Properties**.
4. On the **General** tab, for **Startup type**, choose **Manual** or **Automatic**.
5. Choose **OK**.

**Amazon SSM Agent must be disabled**

The Create Image process requires the Amazon SSM Agent service to be disabled.

**To disable the Amazon SSM Agent service**

1. In the Windows search box, enter `services.msc` to open the Windows Services Manager.
2. In the **Name** column, find **Amazon SSM Agent**.
3. Select **Amazon SSM Agent**, and then choose **Action**, **Properties**.
4. On the **General** tab, for **Startup type**, choose **Disabled**.
5. Choose **OK**.

**SSL3 and TLS version 1.2 must be enabled**

To configure SSL/TLS for Windows, see [How to Enable TLS 1.2](#) in the Microsoft Windows documentation.

**Only one user profile can exist on the WorkSpace**

There can be only one WorkSpaces user profile (`D:\Users\username`) on the WorkSpace that you're using to create images. Delete any user profiles that don't belong to the intended user of the WorkSpace.

For image creation to work, your WorkSpace can have only three user profiles on it:

- The user profile of the intended user of the WorkSpace (`D:\Users\username`)
- The default user profile (also known as Default Profile)
• The Administrator user profile

If there are additional user profiles, you can delete them through the advanced system properties in the Windows Control Panel.

To delete a user profile

1. To access the advanced system properties, do one of the following:
   - Press the Windows key+Pause Break, and then choose Advanced system settings in the left pane of the Control Panel > System and Security > System dialog box.
   - In the Windows search box, enter control panel. In the Control Panel, choose System and Security, then choose System, and then choose Advanced system settings in the left pane of the Control Panel > System and Security > System dialog box.
2. In the System Properties dialog box, on the Advanced tab, choose Settings under User Profiles.
3. If any profile is listed other than the Administrator profile, the Default Profile, and the profile of the intended WorkSpaces user, select that additional profile and choose Delete.
4. When asked if you want to delete the profile, choose Yes.
5. If necessary, repeat Steps 3 and 4 to remove any other profiles that don't belong on the WorkSpace.
6. Choose OK twice and close the Control Panel.
7. Restart the WorkSpace.

No AppX packages can be in a staged state

One or more AppX packages are in a staged state. This might cause a Sysprep error during image creation.

To remove all staged AppX packages

1. In the Windows search box, enter powershell. Choose Run as Administrator.
2. When asked “Do you want to allow this app to make changes to your device?”, choose Yes.
3. In the Windows PowerShell window, enter the following commands to list all staged AppX packages, and press Enter after each one.

```
$workSpaceUserName = $env:username

$allAppxPackages = Get-AppxPackage -AllUsers

$packages = $allAppxPackages | Where-Object { `n  ($_.PackageUserInformation -like "*S-1-5-18*" -and ! `n    ($_.PackageUserInformation -like "*$workSpaceUserName*")) -and `n  ($_.PackageUserInformation -like "*Staged*" -or `n    ($_.PackageUserInformation -like "*Installed*")) -or `n  ((!($_.PackageUserInformation -like "*S-1-5-18*")) -and `n    ($_.PackageUserInformation -like "$workSpaceUserName") -and `n    ($_.PackageUserInformation -like "*Staged*"))
```

4. Enter the following command to remove all staged AppX packages, and press Enter.

```
$packages | Remove-AppxPackage -ErrorAction SilentlyContinue
```

5. Run the Image Checker again. If this test still fails, enter the following commands to remove all AppX packages, and press Enter after each one.
Step 1: Run the Image Checker

Get-AppxProvisionedPackage -Online | Remove-AppxProvisionedPackage -ErrorAction SilentlyContinue

Get-AppxPackage -AllUsers | Remove-AppxPackage -ErrorAction SilentlyContinue

Windows must not have been upgraded from a previous version

Image creation is not supported on Windows systems that have been upgraded from one version of Windows 10 to a newer version of Windows 10 (a Windows feature/version upgrade).

To create images, use a WorkSpace that has not undergone a Windows feature/version upgrade.

The Windows rearm count must not be 0

The rearm feature allows you to extend the activation period for the trial version of Windows. The Create Image process requires that the rearm count be a value other than 0.

To check the Windows rearm count

1. On the Windows Start menu, choose Windows System, then choose Command Prompt.
2. In the Command Prompt window, enter the following command, and then press Enter.

   cscript C:\Windows\System32\slmgr.vbs /dlv

To reset the rearm count to a value other than 0, see Sysprep (Generalize) a Windows installation in the Microsoft Windows documentation.

Other Troubleshooting Tips

If your WorkSpace passes all of the tests run by the Image Checker, but you are still unable to create an image from the WorkSpace, check for the following issues:

- Make sure that the WorkSpace isn't assigned to a user within a Domain Guests group. To check if there are any domain accounts, run the following PowerShell command.

  Get-WmiObject -Class Win32_Service | Where-Object { $_.StartName -like "*\$env:USERDOMAIN*" }

- For Windows 7 WorkSpaces only: If problems occur while the user profile is being copied during image creation, check for the following issues:
  - Long profile paths can cause image creation errors. Make sure that the paths of all folders within the user profile are less than 261 characters.
  - Make sure to grant full permissions on the profile folder to the system and all application packages.
  - If any files in the user profile are locked by a process or are in use during image creation, copying the profile might fail.
  - Some Group Policy Objects (GPOs) restrict access to the RDP certificate thumbprint when it is requested by the EC2Config service or the EC2Launch scripts during Windows instance configuration. Before you try to create an image, move the WorkSpace to a new organizational unit (OU) with blocked inheritance and no GPOs applied.
  - Make sure that the Windows Remote Management (WinRM) service is configured to start automatically. Do the following:
    1. In the Windows search box, enter services.msc to open the Windows Services Manager.
Step 2: Create a Custom Image and Custom Bundle

After you have validated your WorkSpace image, you can proceed with creating your custom image and custom bundle.

To create a custom image and custom bundle

1. If you are still connected to the WorkSpace, disconnect.
2. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
3. In the navigation pane, choose WorkSpaces.
4. Select the WorkSpace and choose Actions, Create Image.
5. A message displays, prompting you to restart your WorkSpace before continuing. Restarting your WorkSpace updates your Amazon WorkSpaces software to the latest version.

   Restart your WorkSpace by closing the message and following the steps in Restart a WorkSpace (p. 90). When you're done, repeat Step 4 (p. 112) of this procedure, but this time choose Next when the restart message appears. To create an image, the status of the WorkSpace must be Available and its modification state must be None.
6. Enter an image name and a description that will help you identify the image, and then choose Create Image. While the image is being created, the status of the WorkSpace is Suspended and the WorkSpace is unavailable.
7. In the navigation pane, choose Images. The image is complete when the status of the WorkSpace changes to Available.
8. Select the image and choose Actions, Create Bundle.
9. Enter a bundle name and a description, and then do the following:
   - For Bundle Type, choose the hardware to use when launching WorkSpaces from this custom bundle.
   - For Root Volume Size, leave the default value or enter a new value that is equal to or greater than the current size. Then, enter a value for User Volume Size.

   The default available sizes for the root volume (for Microsoft Windows, the C drive, for Linux, /) and the user volume (for Windows, the D drive; for Linux, /home) are as follows:
   - Root: 80 GB, User: 10 GB, 50 GB, or 100 GB
   - Root: 175 GB, User: 100 GB

   For Graphics and GraphicsPro WorkSpaces only: Root: 100 GB, User: 100 GB

   Alternatively, you can expand the root and user volumes up to 2000 GB each.

   Note
   To ensure that your data is preserved, you cannot decrease the size of the root or user volumes after you launch a WorkSpace. Instead, make sure that you specify the minimum sizes for these volumes when launching a WorkSpace. You can launch a Value, Standard, Performance, Power, or PowerPro WorkSpace with a minimum of 80 GB for the root volume and 10 GB for the user volume. You can launch a Graphics or GraphicsPro WorkSpace with a minimum of 100 GB for the root volume and 100 GB for the user volume.
10. Choose Create Bundle.
What's Included with Windows WorkSpaces Custom Images

When you create an image from a Windows 7 or 10 WorkSpace, the entire contents of the C drive are included.

For Windows 10 WorkSpaces, the user profile in D:\Users\username is not included in the custom image.

For Windows 7 WorkSpaces, the entire contents of the user profile in D:\Users\username are included, except for the following:

- Contacts
- Downloads
- Music
- Pictures
- Saved games
- Videos
- Podcasts
- Virtual machines
- .virtualbox
- Tracing
- appdata\local\temp
- appdata\roaming\apple computer\mobilesync
- appdata\roaming\apple computer\logs
- appdata\roaming\apple computer\itunes\iphone software updates
- appdata\roaming\macromedia\flash player\macromedia.com\support\flashplayer\sys
- appdata\roaming\macromedia\flash player\#sharedobjects
- appdata\roaming\adobe\flash player\assetcache
- appdata\roaming\microsoft\windows\recent
- appdata\roaming\microsoft\office\recent
- appdata\roaming\microsoft office\live meeting
- appdata\roaming\microsoft shared\livemeeting shared
- appdata\roaming\mozilla\firefox\crash reports
- appdata\roaming\mcafee\common framework
- appdata\local\microsoft\feeds cache
- appdata\local\microsoft\windows\temporary internet files
- appdata\local\microsoft\windows\history
- appdata\local\microsoft\internet explorer\domstore
- appdata\local\microsoft\internet explorer\imagestore
- appdata\local\microsoft\internet explorer\iconcache
- appdata\local\microsoft\internet explorer\domstore
- appdata\local\microsoft\internet explorer\imagestore
- appdata\local\microsoft\internet explorer\recovery
- appdata\local\mozilla\firefox\profiles
What's Included with Amazon Linux WorkSpace Custom Images

When you create an image from an Amazon Linux WorkSpace, the entire contents of the user volume (/home) are removed. The contents of the root volume (/) are included, except the following folders and keys, which are removed:

- /tmp
- /var/spool/mail
- /var/tmp
- /var/lib/dhcp
- /var/lib/cloud
- /var/cache
- /var/backups
- /etc/sudoers.d
- /etc/udev/rules.d/70-persistent-net.rules
- /etc/network/interfaces.d/50-cloud-init.cfg
- /etc/security/access.conf
- /var/log/amazon/ssm
- /var/log/pcoip-agent
- /var/log/skylight
- /var/lock/.skylight.domain-join.lock
- /var/lib/skylight/domain-join-status
- /var/lib/skylight/configuration-data
- /var/lib/skylight/config-data.json
- /home

The following keys are shredded during custom image creation:

- /etc/ssh/ssh_host_*_key
- /etc/ssh/ssh_host_*_key.pub
- /var/lib/skylight/tls.*
- /var/lib/skylight/private.key
- /var/lib/skylight/public.key

Update a Custom WorkSpaces Bundle

You can update an existing custom WorkSpaces bundle by modifying a WorkSpace that is based on the bundle, creating an image from the WorkSpace, and updating the bundle with the new image. You can then launch new WorkSpaces using the updated bundle.

Important
Existing WorkSpaces aren't automatically updated when you update the bundle that they're based on. To update existing WorkSpaces that are based on a bundle that you've updated, you must either rebuild the WorkSpaces or delete and recreate them.
To update a bundle

1. Connect to a WorkSpace that is based on the bundle and make the changes that you want. For example, you can apply the latest operating system and application patches and install additional applications.

   Alternatively, you can create a new WorkSpace with the same base software package (Plus or Standard) as the image used to create the bundle, and make changes.

2. If you are still connected to the WorkSpace, disconnect.

3. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.

4. In the navigation pane, choose WorkSpaces.

5. Select the WorkSpace and choose Actions, Create Image.

6. Enter an image name and a description, and then choose Create Image. The WorkSpace is unavailable while the image is being created.

7. In the navigation pane, choose Bundles.

8. Select the bundle and choose Actions, Update Bundle.

9. For Update WorkSpace Bundle, select the image that you created and choose Update Bundle.

10. As needed, update any existing WorkSpaces that are based on the bundle by rebuilding the WorkSpaces or deleting and recreating them. For more information, see Rebuild a WorkSpace (p. 90).

Copy a Custom WorkSpaces Image

You can copy a custom WorkSpaces image within or across AWS Regions. Copying an image results in the creation of an identical image with its own unique identifier.

You can copy a Bring Your Own License (BYOL) image to another Region as long as the destination Region is enabled for BYOL.

There are no additional charges for copying an image across Regions. However, the quota for the number of images in the destination Region applies.

You can copy images one by one using the console. To bulk copy images, use the CopyWorkspaces API operation or the copy-workspace-image command in the AWS command line interface (CLI). For more information, see CopyWorkspaceImage in the Amazon WorkSpaces API Reference or see copy-workspace-image in the AWS CLI Command Reference.

To copy an image

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.

2. In the navigation pane, choose Images.

3. Select the image and choose Actions, Copy Image.

4. Provide a name, description and Region for the copied image, and then choose Copy Image.

Delete a Custom WorkSpaces Bundle or Image

You can delete unused custom bundles as needed. If you delete a bundle that is being used by a WorkSpace, the bundle is placed in a delete queue and will be deleted after all WorkSpaces that are based on the bundle have been deleted.

To delete a bundle

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
Bring Your Own Windows Desktop Licenses

If your licensing agreement with Microsoft allows it, you can use your Windows 10 Enterprise or Windows 10 Pro desktop licenses for your WorkSpaces. To do this, you must Bring Your Own License (BYOL) and provide a Windows 10 license that meets the following requirements. To stay compliant with Microsoft licensing terms, AWS runs your BYOL WorkSpaces on hardware that is dedicated to you in the AWS Cloud. By bringing your own license, you can provide a consistent experience for your users. For more information, see Amazon WorkSpaces Pricing.

Important
Image creation is not supported on Windows 10 systems that have been upgraded from one version of Windows 10 to a newer version of Windows 10 (a Windows feature/version upgrade). However, Windows cumulative or security updates are supported by the WorkSpaces image-creation process.

To get started, open the Amazon WorkSpaces console and choose Account Settings to enable your account for BYOL.

Requirements
Before you begin, verify the following:

Contents
- Requirements (p. 116)
- Windows Versions That Are Supported for BYOL (p. 117)
- Step 1: Enable BYOL for Your Account by Using the Amazon WorkSpaces Console (p. 118)
- Step 2: Run the BYOL Checker PowerShell Script on a Windows VM (p. 118)
- Step 3: Export the VM from Your Virtualization Environment (p. 120)
- Step 4: Import the VM as an Image into Amazon EC2 (p. 120)
- Step 5: Create a BYOL Image by Using the Amazon WorkSpaces Console (p. 120)
- Step 6: Create a Custom Bundle from the BYOL Image (p. 121)
- Step 7: Register a Directory for Dedicated WorkSpaces (p. 121)
- Step 8: Launch Your BYOL WorkSpaces (p. 122)
• Your Microsoft licensing agreement allows Windows to be run in a virtual hosted environment.

• If you will be using non-GPU-enabled bundles (bundles other than Graphics and GraphicsPro), verify that you will use a minimum of 200 Amazon WorkSpaces. These 200 WorkSpaces can be any mix of AlwaysOn and AutoStop WorkSpaces. Using a minimum of 200 WorkSpaces is a requirement for running your Amazon WorkSpaces on dedicated hardware. Running your Amazon WorkSpaces on dedicated hardware is necessary to comply with Microsoft licensing requirements. The dedicated hardware is provisioned on the AWS side, so your VPC can stay on default tenancy.

If you plan to use GPU-enabled (Graphics and GraphicsPro) bundles, verify that you will run a minimum of 4 AlwaysOn or 20 AutoStop GPU-enabled WorkSpaces in a Region per month on dedicated hardware.

• Amazon WorkSpaces can use a management interface in the /16 IP address range. The management interface is connected to a secure Amazon WorkSpaces management network used for interactive streaming. This allows Amazon WorkSpaces to manage your WorkSpaces. For more information, see Network Interfaces (p. 25). You must reserve a /16 netmask from at least one of the following IP address ranges for this purpose:
  • 10.0.0.0/8
  • 100.64.0.0/10
  • 172.16.0.0/12
  • 192.168.0.0/16
  • 198.18.0.0/15

  **Note**
  As you adopt the WorkSpaces service, the available management interface IP address ranges frequently change. To determine which ranges are currently available, run the `list-available-management-cidr-ranges` AWS Command Line Interface (AWS CLI) command.

• You have a virtual machine (VM) that runs a supported 64-bit version of Windows. For a list of supported versions, see the next section in this topic, Windows Versions That Are Supported for BYOL (p. 117). The VM must also meet these requirements:
  • The Windows operating system must be activated against your key management servers.
  • The Windows operating system must have **English (United States)** as the primary language.
  • No software beyond what is included with Windows can be installed on the VM. You can add additional software, such as an antivirus solution, when you later create a custom image.
  • Do not customize the default user profile (C:\Users\Default) or make other customizations before creating an image. All customizations should be made after image creation. We recommend making any customizations to the user profile through Group Policy Objects (GPOs) and applying them after image creation. This is because customizations done through GPOs can be easily modified or rolled back and are less prone to error than customizations made to the default user profile.
  • You must create a **WorkSpaces_BYOL** account with local administrator access before you share the image. The password for this account might be required later, so make note of it.
  • The VM must be on a single volume with a maximum size of 70 GB and at least 10 GB of free space.
  • Your VM must run Windows PowerShell version 4 or later.
  • Make sure that you have installed the latest Microsoft Windows patches before running the BYOL Checker PowerShell script in Step 2 (p. 118) later in this topic.

---

**Windows Versions That Are Supported for BYOL**

Your VM must run one of the following Windows versions:

• Windows 10 Version 1803 (April 2018 Update)
• Windows 10 Version 1809 (October 2018 Update)
Step 1: Enable BYOL for Your Account by Using the Amazon WorkSpaces Console

To enable BYOL for your account, you must specify a management network interface. This interface is connected to a secure Amazon WorkSpaces management network. It is used for interactive streaming of the WorkSpace desktop to Amazon WorkSpaces clients, and to allow Amazon WorkSpaces to manage the WorkSpace.

**Note**
The steps in this procedure for enabling BYOL for your account need to be performed only once per account, per Region.

**To enable BYOL for your account by using the Amazon WorkSpaces console**

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Account Settings. If your account is not currently eligible for BYOL, a message provides guidance for next steps.
3. Under Bring Your Own License (BYOL), in the Management network interface IP address range area, choose an IP address range, and then choose Display available CIDR blocks.

Amazon WorkSpaces searches for and displays available IP address ranges as IPv4 Classless Inter-Domain Routing (CIDR) blocks, within the range that you specify. If you require a specific IP address range, you can edit the search range.

**Important**
After you specify an IP address range, you cannot modify it. Make sure to specify an IP address range that doesn't conflict with the ranges used by your internal network. If you have any question about which range to specify, contact your AWS account manager or sales representative, or contact the AWS Support Center before proceeding.

4. Choose the CIDR block that you want from the list of results, and then choose Enable BYOL.

This process may take several hours. While Amazon WorkSpaces is enabling your account for BYOL, proceed to the next step.

Step 2: Run the BYOL Checker PowerShell Script on a Windows VM

After you enable BYOL for your account, you must confirm that your VM meets the requirements for BYOL. To do so, perform these steps to download and run the Amazon WorkSpaces BYOL Checker PowerShell script. The script performs a series of tests on the VM that you plan to use to create your image.

**Important**
The VM must pass all tests before you can use it for BYOL.
To download the BYOL Checker script

Before you download and run the BYOL Checker script, verify that the latest Windows security updates are installed on your VM. While this script runs, it disables the Windows Update service.

1. Download the BYOL Checker script.zip file from https://tools.amazonworkspaces.com/BYOLChecker.zip to your Downloads folder.
2. In your Downloads folder, create a BYOL folder.
3. Extract the files from BYOLChecker.zip and copy them to the Downloads\BYOL folder.
4. Delete the Downloads\BYOLChecker.zip folder so that only the extracted files remain.

Perform these steps to run the BYOL Checker script.

To run the BYOL Checker script

1. From the Windows desktop, open Windows PowerShell. Choose the Windows Start button, right-click Windows PowerShell, and choose Run as administrator. If you are prompted by User Account Control to choose whether you want PowerSheel to make changes to your device, choose Yes.
2. At the PowerShell command prompt, change to the directory where the BYOL Checker script is located. For example, if the script is located in the Downloads\BYOL directory, enter the following command and press Enter:
   ```
   cd C:\Users\username\Downloads\BYOL
   ```
3. Enter the following command to update the PowerShell execution policy on the computer. Doing so allows the BYOL Checker script to run:
   ```
   Set-ExecutionPolicy Unrestricted
   ```
4. When prompted to confirm whether to change the PowerShell execution policy, enter A to specify Yes to All.
5. Enter the following command to run the BYOL Checker script:
   ```
   \BYOLChecker.ps1
   ```
6. If a security notification appears, press the R key to Run Once.
7. In the Amazon WorkSpaces Image Validation dialog box, choose Begin Tests.
8. After each test is completed, you can view the status of the test. For any test with a status of FAILED, choose Info to display information about how to resolve the issue that caused the failure. If any tests display a status of WARNING, choose the Fix All Warnings button.
9. If applicable, resolve any issues that cause test failures and warnings, and repeat Step 7 (p. 119) and Step 8 (p. 119) until the VM passes all tests. All failures and warnings must be resolved before you export the VM.
10. The BYOL script checker generates two log files, BYOLPrevalidationlogYYYY-MM-DD_HHmmss.txt and ImageInfo.text. These files are located in the directory that contains the BYOL Checker script files.
   
   Tip
   Do not delete these files. If an issue occurs, they might be helpful in troubleshooting.
11. After your VM passes all tests, you get a Validation Successful message. Review the VM locale settings displayed in the tool. To update the locale settings, follow these instructions in the Microsoft documentation and run the BYOL Checker script again.
12. Shut down the VM and create a snapshot of it.
13. Start the VM again. Choose Run Sysprep. If Sysprep is successful, your VM that you exported after Step 12 (p. 119) can be imported into Amazon Elastic Compute Cloud (Amazon EC2). Otherwise, review the Sysprep logs, roll back to the snapshot taken at Step 12 (p. 119), resolve the reported issues, take a new snapshot, and run the BYOL Checker script again.
Step 3: Export the VM from Your Virtualization Environment

To create an image for BYOL, you must first export the VM from your virtualization environment. The VM must be on a single volume with a maximum size of 70 GB and at least 10 GB of free space. For more information, see the documentation for your virtualization environment and Export Your VM from its Virtualization Environment in the VM Import/Export User Guide.

Step 4: Import the VM as an Image into Amazon EC2

After you export your VM, review the requirements for importing Windows operating systems from a VM. Take action as needed. For more information, see VM Import/Export Requirements.

Note
Importing a VM with an encrypted disk is not supported. If you've opted in to default encryption for Amazon Elastic Block Store (Amazon EBS) volumes, you must deselect that option before importing your VM.

Import your VM into Amazon EC2 as an Amazon Machine Image (AMI). Use one of the following methods:

- Use the `import-image` command with the AWS CLI. For more information, see `import-image` in the AWS CLI Command Reference.
- Use the `ImportImage` API operation. For more information, see ImportImage in the Amazon EC2 API Reference.

For more information, see Importing a VM as an Image in the VM Import/Export User Guide.

Step 5: Create a BYOL Image by Using the Amazon WorkSpaces Console

Perform these steps to create an Amazon WorkSpaces BYOL image.

Note
To perform this procedure, verify that you have AWS Identity and Access Management (IAM) permissions to:

- Call Amazon WorkSpaces `ImportWorkspaceImage`.
- Call Amazon EC2 `DescribeImages` on the Amazon EC2 image that you want to use to create the BYOL image.
- Call Amazon EC2 `ModifyImageAttribute` on the Amazon EC2 image that you want to use to create the BYOL image.

For more information, see Changing Permissions for an IAM User in the IAM User Guide.
To create a Graphics or GraphicsPro bundle from your image, contact the AWS Support Center to get your account added to the allow list. After your account is on the allow list, you can use
the AWS CLI `import-workspace-image` command to ingest the Graphics or GraphicsPro image. For more information, see `import-workspace-image` in the *AWS CLI Command Reference*.

**To create an image from the Windows VM**

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose *Images*.
3. Choose *Actions, Create BYOL Image*.
4. In the *Create BYOL Image* dialog box, do the following:
   - For *AMI ID*, click the EC2 Console link, and choose the Amazon EC2 image that you imported as described in the previous section (Step 4: Import the VM as an Image into Amazon EC2). The image name must begin with `ami-` and be followed by the identifier for the AMI (for example, `ami-1234567e`).
   - For *BYOL image name*, enter a unique name for the image.
   - For *Image description*, enter a description to help you quickly identify the image.
   - For *Ingestion process*, choose the appropriate bundle type (either *Regular*, *Graphics*, or *GraphicsPro*). For non-GPU-enabled bundles (bundles other than Graphics or GraphicsPro), choose *Regular*.
5. Choose *Create*.

While your image is being created, the image status in the image registry of the console appears as *Pending*. If the image validation does not succeed, the console displays an error code. When the image creation is complete, the status changes to *Available*.

**Step 6: Create a Custom Bundle from the BYOL Image**

After your BYOL image is created, you can use the image to create a custom bundle. For information, see *Create a Custom WorkSpaces Image and Bundle* (p. 103).

**Step 7: Register a Directory for Dedicated WorkSpaces**

To use BYOL images for WorkSpaces, you must register a directory for this purpose. To do so, perform these steps.

**To register a directory for dedicated WorkSpaces**

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose *Directories*.
3. Select the directory and choose *Actions, Register*.
4. In the *Register directory* dialog box, for *Enable Dedicated WorkSpaces*, choose *Yes*.
5. Choose *Register*.

If you have already registered an AWS Managed Microsoft AD directory or an AD Connector directory for WorkSpaces that does not run on dedicated hardware, you can set up a new AWS Managed Microsoft AD directory or AD Connector directory for this purpose. You can also deregister the directory and then reregister it as a directory for dedicated WorkSpaces. To do so, perform these steps.
Note
You can only perform this procedure if no WorkSpaces are associated with the directory.

To deregister a directory and reregister it for dedicated WorkSpaces
1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. Terminate existing WorkSpaces.
3. In the navigation pane, choose Directories.
4. Select the directory and choose Actions, Deregister.
5. When prompted for confirmation, choose Deregister.
6. Select the directory again and choose Actions, Register.
7. In the Register directory dialog box, for Enable Dedicated WorkSpaces, choose Yes.
8. Choose Register.

Step 8: Launch Your BYOL WorkSpaces

After you register a directory for dedicated WorkSpaces, you can launch your BYOL WorkSpaces in this directory. For information about how to launch WorkSpaces, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 64).
Monitor Your WorkSpaces

You can use the following features to monitor your WorkSpaces.

**CloudWatch metrics**

Amazon WorkSpaces publishes data points to Amazon CloudWatch about your WorkSpaces. CloudWatch enables you to retrieve statistics about those data points as an ordered set of time-series data, known as metrics. You can use these metrics to verify that your WorkSpaces are performing as expected. For more information, see Monitor Your WorkSpaces Using CloudWatch Metrics (p. 123).

**CloudWatch Events**

Amazon WorkSpaces can submit events to Amazon CloudWatch Events when users log in to your WorkSpace. This enables you to respond when the event occurs. For more information, see Monitor Your WorkSpaces Using CloudWatch Events (p. 127).

**CloudTrail logs**

AWS CloudTrail provides a record of actions taken by a user, role, or an AWS service in Amazon WorkSpaces. Using the information collected by CloudTrail, you can determine the request that was made to Amazon WorkSpaces, the IP address from which the request was made, who made the request, when it was made, and additional details. For more information, see Logging Amazon WorkSpaces API Calls by Using CloudTrail.

Monitor Your WorkSpaces Using CloudWatch Metrics

Amazon WorkSpaces and Amazon CloudWatch are integrated, so you can gather and analyze performance metrics. You can monitor these metrics using the CloudWatch console, the CloudWatch command line interface, or programmatically using the CloudWatch API. CloudWatch also allows you to set alarms when you reach a specified threshold for a metric.

For more information about using CloudWatch and alarms, see the Amazon CloudWatch User Guide.

**Prerequisites**

To get CloudWatch metrics, enable access on port 443 on the AMAZON subset in the us-east-1 Region. For more information, see IP Address and Port Requirements for Amazon WorkSpaces (p. 15).

**Contents**

- Amazon WorkSpaces Metrics (p. 123)
- Dimensions for Amazon WorkSpaces Metrics (p. 125)
- Monitoring Example (p. 125)

Amazon WorkSpaces Metrics

The AWS/WorkSpaces namespace includes the following metrics.
<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
<th>Dimensions</th>
<th>Statistics Available</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available&lt;sup&gt;1&lt;/sup&gt;</td>
<td>The number of WorkSpaces that returned a healthy status.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td>Unhealthy&lt;sup&gt;1&lt;/sup&gt;</td>
<td>The number of WorkSpaces that returned an unhealthy status.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td>ConnectionAttempt&lt;sup&gt;2&lt;/sup&gt;</td>
<td>The number of connection attempts.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td>ConnectionSuccess&lt;sup&gt;2&lt;/sup&gt;</td>
<td>The number of successful connections.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td>ConnectionFailure&lt;sup&gt;2&lt;/sup&gt;</td>
<td>The number of failed connections.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td>SessionLaunchTime&lt;sup&gt;2&lt;/sup&gt;</td>
<td>The amount of time it takes to initiate a WorkSpaces session.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Second (time)</td>
</tr>
<tr>
<td>InSessionLatency&lt;sup&gt;2&lt;/sup&gt;</td>
<td>The round trip time between the WorkSpaces client and the WorkSpace.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Millisecond (time)</td>
</tr>
<tr>
<td>SessionDisconnect&lt;sup&gt;2&lt;/sup&gt;</td>
<td>The number of connections that were closed, including user-initiated and failed connections.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td>UserConnected&lt;sup&gt;3&lt;/sup&gt;</td>
<td>The number of WorkSpaces that have a user connected.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td>Stopped</td>
<td>The number of WorkSpaces that are stopped.</td>
<td>DirectoryId, WorkspaceId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td>Metric</td>
<td>Description</td>
<td>Dimensions</td>
<td>Statistics Available</td>
<td>Units</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------------------------------</td>
<td>---------------------</td>
<td>----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Maintenance⁴</td>
<td>The number of WorkSpaces that are under maintenance.</td>
<td>DirectoryID, WorkspaceID</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
</tbody>
</table>

¹ Amazon WorkSpaces periodically sends status requests to a WorkSpace. A WorkSpace is marked Available when it responds to these requests, and Unhealthy when it fails to respond to these requests. These metrics are available at a per-WorkSpace granularity, and also aggregated for all WorkSpaces in an organization.

² Amazon WorkSpaces records metrics on connections made to each WorkSpace. These metrics are emitted after a user has successfully authenticated via the WorkSpaces client and the client then initiates a session. The metrics are available at a per-WorkSpace granularity, and also aggregated for all WorkSpaces in a directory.

³ Amazon WorkSpaces periodically sends connection status requests to a WorkSpace. Users are reported as connected when they are actively using their sessions. This metric is available at a per-WorkSpace granularity, and is also aggregated for all WorkSpaces in an organization.

⁴ This metric applies to WorkSpaces that are configured with an AutoStop running mode. If you have maintenance enabled for your WorkSpaces, this metric captures the number of WorkSpaces that are currently under maintenance. This metric is available at a per-WorkSpace granularity, which describes when a WorkSpace went into maintenance and when it was removed.

### Dimensions for Amazon WorkSpaces Metrics

To filter the metric data, use the following dimensions.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DirectoryId</td>
<td>Filters the metric data to the WorkSpaces in the specified directory. The form of the directory ID is d-XXXXXXXXXX.</td>
</tr>
<tr>
<td>WorkspaceId</td>
<td>Filters the metric data to the specified WorkSpace. The form of the workspace ID is ws-XXXXXXXXX.</td>
</tr>
</tbody>
</table>

### Monitoring Example

The following example demonstrates how you can use the AWS CLI to respond to a CloudWatch alarm and determine which WorkSpaces in a directory have experienced connection failures.

**To respond to a CloudWatch alarm**

1. Determine which directory the alarm applies to using the `describe-alarms` command.

```bash
aws cloudwatch describe-alarms --state-value "ALARM"
```

```
{
  "MetricAlarms": [  
    
```
2. Get the list of WorkSpaces in the specified directory using the `describe-workspaces` command.

```bash
aws workspaces describe-workspaces --directory-id directory_id
```

```json
{
  "Workspaces": [
    ...,
    {
      ...
      "WorkspaceId": "workspace1_id",
      ...
    },
    {
      ...
      "WorkspaceId": "workspace2_id",
      ...
    },
    {
      ...
      "WorkspaceId": "workspace3_id",
      ...
    }
  ]
}
```

3. Get the CloudWatch metrics for each WorkSpace in the directory using the `get-metric-statistics` command.

```bash
aws cloudwatch get-metric-statistics \
--namespace AWS/WorkSpaces \
--metric-name ConnectionFailure \
--start-time 2015-04-27T00:00:00Z \
--end-time 2015-04-28T00:00:00Z \
--period 3600 \
--statistics Sum \
--dimensions "Name=WorkspaceId,Value=workspace_id"
```

```json
{
  "Datapoints": [
    {
      "Timestamp": "2015-04-27T00:18:00Z",
      "Sum": 1.0,
      "Unit": "Count"
    },
    {
      "Timestamp": "2014-04-27T01:18:00Z",
      "Sum": 0.0,
      "Unit": "Count"
    }
  ],
  "Label": "ConnectionFailure"
}
```
Monitor Your WorkSpaces Using CloudWatch Events

You can use events from Amazon CloudWatch Events to view, search, download, archive, analyze, and respond to successful logins to your WorkSpaces. For example, you can use events for the following purposes:

- Store or archive WorkSpaces login events as logs for future reference, analyze the logs to look for patterns, and take action based on those patterns.
- Use the WAN IP address to determine where users are logged in from, and then use policies to allow users access only to files or data from WorkSpaces that meet the access criteria found in the CloudWatch Event type of WorkSpaces Access.
- Analyze login data, which is available in near real-time, and perform automated actions by using AWS Lambda.
- Use policy controls to block access to files and applications from unauthorized IP addresses.

For more information about events, see the Amazon CloudWatch Events User Guide.

WorkSpaces Events

Amazon WorkSpaces client applications send WorkSpaces Access events to CloudWatch Events when a user successfully logs in to a WorkSpace. All Amazon WorkSpaces clients send these events.

Events are represented as JSON objects. The following is example data for a WorkSpaces Access event.

```json
{
    "version": "0",
    "id": "64ca0eda-9751-dc55-c41a-1bd50b4fc9b7",
    "detail-type": "WorkSpaces Access",
    "source": "aws.workspaces",
    "account": "123456789012",
    "time": "2018-07-01T17:53:06Z",
    "region": "us-east-2",
    "resources": [],
    "detail": {
        "clientIpAddress": "192.0.2.3",
        "actionType": "successfulLogin",
        "workspacesClientProductName": "WorkSpaces Desktop client",
        "loginTime": "2018-07-01T17:53:06.595Z",
        "clientPlatform": "Windows",
        "directoryId": "d-123456789",
        "workspaceId": "ws-xyskdga"
    }
}
```

Event-Specific Fields

**clientIpAddress**

The WAN IP address of the client application. For PCoIP zero clients, this is the IP address of the Teradici auth client.

**actionType**

This value is always successfulLogin.
Create a Rule to Handle WorkSpaces Events

Use the following procedure to create a CloudWatch Events rule to handle the WorkSpaces events.

To create a rule to handle WorkSpaces events

2. In the navigation pane, choose Events.  
3. Choose Create rule.  
4. For Event Source, do the following:
   a. Choose Event Pattern and Build event pattern to match events by service (the default).
   b. For Service Name, choose WorkSpaces.  
   c. For Event Type, choose WorkSpaces Access.  
5. For Targets, choose Add target, and then choose the service that is to act when a WorkSpaces event is detected. Provide any information required by this service.  
6. Choose Configure details. For Rule definition, enter a name and description.  
7. Choose Create rule.
Cloud security at AWS is the highest priority. As an AWS customer, you benefit from a data center and network architecture that is built to meet the requirements of the most security-sensitive organizations.

Security is a shared responsibility between AWS and you. The shared responsibility model describes this as security of the cloud and security in the cloud:

- **Security of the cloud** – AWS is responsible for protecting the infrastructure that runs AWS services in the AWS Cloud. AWS also provides you with services that you can use securely. Third-party auditors regularly test and verify the effectiveness of our security as part of the AWS Compliance Programs. To learn about the compliance programs that apply to Amazon WorkSpaces, see AWS Services in Scope by Compliance Program.
- **Security in the cloud** – Your responsibility is determined by the AWS service that you use. You are also responsible for other factors including the sensitivity of your data, your company’s requirements, and applicable laws and regulations.

This documentation helps you understand how to apply the shared responsibility model when using Amazon WorkSpaces. It shows you how to configure Amazon WorkSpaces to meet your security and compliance objectives. You also learn how to use other AWS services that help you to monitor and secure your Amazon WorkSpaces resources.

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- Identity and Access Management for Amazon WorkSpaces (p. 130)
- Compliance Validation for Amazon WorkSpaces (p. 136)
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- Infrastructure Security in Amazon WorkSpaces (p. 136)
- Update Management in Amazon WorkSpaces (p. 139)

**Data Protection in Amazon WorkSpaces**

Amazon WorkSpaces conforms to the AWS shared responsibility model, which includes regulations and guidelines for data protection. AWS is responsible for protecting the global infrastructure that runs all the AWS services. AWS maintains control over data hosted on this infrastructure, including the security configuration controls for handling customer content and personal data. AWS customers and APN partners, acting either as data controllers or data processors, are responsible for any personal data that they put in the AWS Cloud.

For data protection purposes, we recommend that you protect AWS account credentials and set up individual user accounts with AWS Identity and Access Management (IAM), so that each user is given only the permissions necessary to fulfill their job duties. We also recommend that you secure your data in the following ways:

- Use multi-factor authentication (MFA) with each account.
- Use TLS to communicate with AWS resources.
- Set up API and user activity logging with AWS CloudTrail.
- Use AWS encryption solutions, along with all default security controls within AWS services.
• Use advanced managed security services such as Amazon Macie, which assists in discovering and securing personal data that is stored in Amazon S3.

We strongly recommend that you never put sensitive identifying information, such as your customers' account numbers, into free-form fields or metadata, such as function names and tags. Any data that you enter into metadata might get picked up for inclusion in diagnostic logs. When you provide a URL to an external server, don't include credentials information in the URL to validate your request to that server.

For more information about data protection, see the AWS Shared Responsibility Model and GDPR blog post on the AWS Security Blog.

Encryption at Rest

You can encrypt the storage volumes for your WorkSpaces using customer master keys (CMK) from AWS Key Management Service. For more information, see Encrypted WorkSpaces (p. 87).

Encryption in Transit

Data in-transit is encrypted using TLS 1.2 encryption and SigV4 request signing. The PCOIP protocol uses encrypted UDP traffic, with AES encryption, for streaming pixels.

Identity and Access Management for Amazon WorkSpaces

By default, IAM users don't have permissions for Amazon WorkSpaces resources and operations. To allow IAM users to manage Amazon WorkSpaces resources, you must create an IAM policy that explicitly grants them permissions, and attach the policy to the IAM users or groups that require those permissions. For more information about IAM policies, see Policies and Permissions in the IAM User Guide guide.

Amazon WorkSpaces also creates an IAM role to allow the Amazon WorkSpaces service access to required resources.

Note
Amazon WorkSpaces doesn’t support the provisioning of IAM credentials into a WorkSpace (such as with an instance profile).

For more information about IAM, see Identity and Access Management (IAM) and the IAM User Guide. You can find the WorkSpaces-specific resources, actions, and condition context keys for use in IAM permission policies at Actions, Resources, and Condition Keys for Amazon WorkSpaces in the IAM User Guide.

For a tool that helps you create IAM policies, see the AWS Policy Generator. You can also use the IAM Policy Simulator to test whether a policy would allow or deny a specific request to AWS.

Example 1: Perform all Amazon WorkSpaces tasks

The following policy statement grants an IAM user permission to perform all Amazon WorkSpaces tasks, including creating and managing directories. It also grants permission to run the quick setup procedure.

Note that although Amazon WorkSpaces fully supports the Action and Resource elements when using the API and command line tools, you must set them both to "*" in order to use the Amazon WorkSpaces console successfully.
Example 2: Perform WorkSpace-specific tasks

The following policy statement grants an IAM user permission to perform WorkSpace-specific tasks, such as launching and removing WorkSpaces. In the policy statement, the `ds:*` action grants broad permissions — full control over all Directory Services objects in the account.
Creating the workspaces_DefaultRole Role

Before you can register a directory using the API, you must create the workspaces_DefaultRole role, if it doesn't already exist.

To create the workspaces_DefaultRole role

1. Sign in to the AWS Management Console and open the IAM console at https://console.aws.amazon.com/iam/.
2. In the navigation pane on the left, choose Roles.
3. Choose Create role.
4. Under Select type of trusted entity, choose Another AWS account.
5. For Account ID, enter your account ID with no hyphens or spaces.
6. For Options, do not specify multi-factor authentication (MFA).
7. Choose Next: Permissions.
8. On the Attach permissions policies page, select the AWS managed policies AmazonWorkSpacesServiceAccess and AmazonWorkSpacesSelfServiceAccess.
9. Under **Set permissions boundary**, we recommend that you not use a permissions boundary because of the potential for conflicts with the policies attached to the workspaces_DefaultRole role. Such conflicts could block certain necessary permissions for the role.

10. Choose **Next: Tags**.

11. On the **Add tags (optional)** page, add tags if needed.

12. Choose **Next: Review**.

13. On the **Review** page, for **Role name**, enter `workspaces_DefaultRole`.

14. (Optional) For **Role description**, enter a description.

15. Choose **Create Role**.

16. On the **Summary** page for the workspaces_DefaultRole role, choose the **Trust relationships** tab.

17. On the **Trust relationships** tab, choose **Edit trust relationship**.

18. On the **Edit Trust Relationship** page, replace the existing policy statement with the following statement.

   ```json
   {
     "Statement": [
       {
         "Effect": "Allow",
         "Principal": {
           "Service": "workspaces.amazonaws.com"
         },
         "Action": "sts:AssumeRole"
       }
     ]
   }
   ```

19. Choose **Update Trust Policy**.

---

### Specifying Amazon WorkSpaces Resources in an IAM Policy

To specify an Amazon WorkSpaces resource in the **Resource** element of the policy statement, use the Amazon Resource Name (ARN) of the resource. You control access to your Amazon WorkSpaces resources by either allowing or denying permissions to use the API actions specified in the **Action** element of your IAM policy statement. Amazon WorkSpaces defines ARNs for WorkSpaces, bundles, IP groups, and directories.

#### WorkSpace ARN

A WorkSpace ARN has the syntax shown in the following example.

```text
arn:aws:workspaces:region:account_id:workspace/workspace_identifier
```

- **region**
  - The Region that the WorkSpace is in (for example, `us-east-2`).
- **account_id**
  - The ID of the AWS account, with no hyphens (for example, `123456789012`).
- **workspace_identifier**
  - The ID of the WorkSpace (for example, `ws-0123456789`).
The following is the format of the Resource element of a policy statement that identifies a specific WorkSpace.

```
```

You can use the * wildcard to specify all WorkSpaces that belong to a specific account in a specific Region.

### Bundle ARN

A bundle ARN has the syntax shown in the following example.

```
```

- **region**
  - The Region that the WorkSpace is in (for example, us-east-2).
- **account_id**
  - The ID of the AWS account, with no hyphens (for example, 123456789012).
- **bundle_identifier**
  - The ID of the WorkSpace bundle (for example, wsb-0123456789).

The following is the format of the Resource element of a policy statement that identifies a specific bundle.

```
```

You can use the * wildcard to specify all bundles that belong to a specific account in a specific Region.

### IP Group ARN

An IP group ARN has the syntax shown in the following example.

```
arn:aws:workspaces:region:account_id:workspaceipgroup/ipgroup_identifier
```

- **region**
  - The Region that the WorkSpace is in (for example, us-east-2).
- **account_id**
  - The ID of the AWS account, with no hyphens (for example, 123456789012).
- **ipgroup_identifier**
  - The ID of the IP group (for example, wsipg-a1bcd2efg).

The following is the format of the Resource element of a policy statement that identifies a specific IP group.

```
```
You can use the * wildcard to specify all IP groups that belong to a specific account in a specific Region.

**Directory ARN**

A directory ARN has the syntax shown in the following example.

```
arn:aws:workspaces:region:account_id:directory/directory_identifier
```

- **region**
  
  The Region that the WorkSpace is in (for example, us-east-2).

- **account_id**
  
  The ID of the AWS account, with no hyphens (for example, 123456789012).

- **directory_identifier**
  
  The ID of the directory (for example, d-12345a67b8).

The following is the format of the `Resource` element of a policy statement that identifies a specific directory.

```
```

You can use the * wildcard to specify all directories that belong to a specific account in a specific Region.

**API Actions with No Support for Resource-Level Permissions**

You can't specify a resource ARN with the following API actions:

- AssociateIpGroups
- CreateIpGroup
- CreateTags
- DeleteTags
- DeleteWorkspaceImage
- DescribeAccount
- DescribeAccountModifications
- DescribeTags
- DescribeWorkspaceDirectories
- DescribeWorkspaceImages
- DescribeWorkspaces
- DescribeWorkspacesConnectionStatus
- DisassociateIpGroups
- ImportWorkspaceImage
- ListAvailableManagementCidrRanges
- ModifyAccount

For API actions that don't support resource-level permissions, you must specify the resource statement shown in the following example.

```
"Resource": "*
```
Compliance Validation for Amazon WorkSpaces

Third-party auditors assess the security and compliance of Amazon WorkSpaces as part of multiple AWS compliance programs. These include SOC, PCI, FedRAMP, HIPAA, and others.

For a list of AWS services in scope of specific compliance programs, see AWS Services in Scope by Compliance Program. For general information, see AWS Compliance Programs.

You can download third-party audit reports using AWS Artifact. For more information, see Downloading Reports in AWS Artifact.

For more information about Amazon WorkSpaces and FedRAMP, see Set Up Amazon WorkSpaces for FedRAMP Authorization or DoD SRG Compliance (p. 37).

Your compliance responsibility when using Amazon WorkSpaces is determined by the sensitivity of your data, your company's compliance objectives, and applicable laws and regulations. AWS provides the following resources to help with compliance:

- **Security and Compliance Quick Start Guides** – These deployment guides discuss architectural considerations and provide steps for deploying security- and compliance-focused baseline environments on AWS.
- **Architecting for HIPAA Security and Compliance Whitepaper** – This whitepaper describes how companies can use AWS to create HIPAA-compliant applications.
- **AWS Compliance Resources** – This collection of workbooks and guides might apply to your industry and location.
- **Evaluating Resources with Rules in the AWS Config Developer Guide** – AWS Config; assesses how well your resource configurations comply with internal practices, industry guidelines, and regulations.
- **AWS Security Hub** – This AWS service provides a comprehensive view of your security state within AWS that helps you check your compliance with security industry standards and best practices.

Resilience in Amazon WorkSpaces

The AWS global infrastructure is built around AWS Regions and Availability Zones. Regions provide multiple physically separated and isolated Availability Zones, which are connected through low-latency, high-throughput, and highly redundant networking. With Availability Zones, you can design and operate applications and databases that automatically fail over between zones without interruption. Availability Zones are more highly available, fault tolerant, and scalable than traditional single or multiple data center infrastructures.

For more information about AWS Regions and Availability Zones, see AWS Global Infrastructure.

Infrastructure Security in Amazon WorkSpaces

As a managed service, Amazon WorkSpaces is protected by the AWS global network security procedures that are described in the Amazon Web Services: Overview of Security Processes whitepaper.

You use AWS published API calls to access Amazon WorkSpaces through the network. Clients must support Transport Layer Security (TLS) 1.0 or later. We recommend TLS 1.2 or later. Clients must also support cipher suites with perfect forward secrecy (PFS) such as Ephemeral Diffie-Hellman (DHE) or Elliptic Curve Ephemeral Diffie-Hellman (ECDHE). Most modern systems such as Java 7 and later support these modes.
Additionally, requests must be signed using an access key ID and a secret access key that is associated with an IAM principal. Or you can use the AWS Security Token Service (AWS STS) to generate temporary security credentials to sign requests.

**Network Isolation**

A virtual private cloud (VPC) is a virtual network in your own logically isolated area in the AWS Cloud. You can deploy your WorkSpaces in a private subnet in your VPC. For more information, see Configure a VPC for Amazon WorkSpaces (p. 8).

To allow traffic only from specific address ranges (for example, from your corporate network), update the security group for your VPC or use an IP access control group (p. 32).

You can restrict WorkSpace access to trusted devices with valid certificates. For more information, see Restrict WorkSpaces Access to Trusted Devices (p. 29).

**Isolation on Physical Hosts**

Different WorkSpaces on the same physical host are isolated from each other through the hypervisor. It is as though they are on separate physical hosts. When a WorkSpace is deleted, the memory allocated to it is scrubbed (set to zero) by the hypervisor before it is allocated to a new WorkSpace.

**Authorization of Corporate Users**

With Amazon WorkSpaces, directories are managed through the AWS Directory Service. You can create a standalone, managed directory for users. Or you can integrate with your existing Active Directory environment so that your users can use their current credentials to obtain seamless access to corporate resources. For more information, see Manage Directories for Amazon WorkSpaces (p. 44).

To further control access to your WorkSpaces, use multi-factor authentication. For more information, see How to Enable Multi-Factor Authentication for AWS Services.

**Make Amazon WorkSpaces API Requests Through a VPC Interface Endpoint**

You can connect directly to Amazon WorkSpaces API endpoints through an interface endpoint in your virtual private cloud (VPC) instead of connecting over the internet. When you use a VPC interface endpoint, communication between your VPC and the Amazon WorkSpaces API endpoint is conducted entirely and securely within the AWS network.

**Note**

This feature can be used only for connecting to WorkSpaces API endpoints. To connect to WorkSpaces using the WorkSpaces clients, internet connectivity is required, as described in IP Address and Port Requirements for Amazon WorkSpaces (p. 15).

The Amazon WorkSpaces API endpoints support Amazon Virtual Private Cloud (Amazon VPC) interface endpoints that are powered by AWS PrivateLink. Each VPC endpoint is represented by one or more network interfaces (also known as elastic network interfaces, or ENIs) with private IP addresses in your VPC subnets.

The VPC interface endpoint connects your VPC directly to the Amazon WorkSpaces API endpoint without an internet gateway, NAT device, VPN connection, or AWS Direct Connect connection. The instances in your VPC don't need public IP addresses to communicate with the Amazon WorkSpaces API endpoint.

You can create an interface endpoint to connect to Amazon WorkSpaces with either the AWS console or AWS Command Line Interface (AWS CLI) commands. For instructions, see Creating an Interface Endpoint.
After you have created a VPC endpoint, you can use the following example CLI commands that use the endpoint-url parameter to specify interface endpoints to the Amazon WorkSpaces API endpoint:

```
aws workspaces copy-workspace-image --endpoint-url VPC_Endpoint_ID.workspaces.Region.vpce.amazonaws.com
aws workspaces delete-workspace-image --endpoint-url VPC_Endpoint_ID.api.workspaces.Region.vpce.amazonaws.com
aws workspaces describe-workspace-bundles --endpoint-url VPC_Endpoint_ID.workspaces.Region.vpce.amazonaws.com --endpoint-name Endpoint_Name --body "Endpoint_Body" --content-type "Content_Type" Output_File
```

If you enable private DNS hostnames for your VPC endpoint, you don't need to specify the endpoint URL. The Amazon WorkSpaces API DNS hostname that the CLI and Amazon WorkSpaces SDK use by default (https://api.workspaces.Region.amazonaws.com) resolves to your VPC endpoint.

The Amazon WorkSpaces API endpoint supports VPC endpoints in all AWS Regions where both Amazon VPC and Amazon WorkSpaces are available. Amazon WorkSpaces supports making calls to all of its public APIs inside your VPC.

To learn more about AWS PrivateLink, see the AWS PrivateLink documentation. For the price of VPC endpoints, see VPC Pricing. To learn more about VPC and endpoints, see Amazon VPC.

To see a list of Amazon WorkSpaces API endpoints by Region, see WorkSpaces API Endpoints (p. 22).

**Note**
Amazon WorkSpaces API endpoints with AWS PrivateLink are not supported for Federal Information Processing Standard (FIPS) Amazon WorkSpaces API endpoints.

### Create a VPC Endpoint Policy for Amazon WorkSpaces

You can create a policy for Amazon VPC endpoints for Amazon WorkSpaces to specify the following:

- The principal that can perform actions.
- The actions that can be performed.
- The resources on which actions can be performed.

For more information, see Controlling Access to Services with VPC Endpoints in the Amazon VPC User Guide.

**Note**
VPC endpoint policies aren't supported for Federal Information Processing Standard (FIPS) Amazon WorkSpaces endpoints.

The following example VPC endpoint policy specifies that all users who have access to the VPC interface endpoint are allowed to invoke the Amazon WorkSpaces hosted endpoint named ws-f9abcdefg.

```
{
  "Statement": [
    {
      "Action": "workspaces:*",
      "Effect": "Allow",
      "Principal": {
        "AWS": "[arns]
      }
    }
  }
```
"Principal": "*"
]
}

In this example, the following actions are denied:

- Invoking Amazon WorkSpaces hosted endpoints other than `ws-f9abcdefg`.
- Performing an action on any resource besides the one specified (WorkSpace ID: `ws-f9abcdefg`).

**Note**

In this example, users can still take other Amazon WorkSpaces API actions from outside the VPC. To restrict API calls to those from within the VPC, see [Identity and Access Management for Amazon WorkSpaces](p. 130) for information about using identity-based policies to control access to Amazon WorkSpaces API endpoints.

## Connect Your Private Network to Your VPC

To call the Amazon WorkSpaces API through your VPC, you have to connect from an instance that is inside the VPC, or connect your private network to your VPC by using an Amazon Virtual Private Network (VPN) or AWS Direct Connect. For information about Amazon VPN, see [VPN Connections](p. 130) in the *Amazon Virtual Private Cloud User Guide*. For information about AWS Direct Connect, see [Creating a Connection](p. 130) in the *AWS Direct Connect User Guide*.

## Update Management in Amazon WorkSpaces

We recommend that you regularly patch, update, and secure the operating system and applications on your WorkSpaces. You can configure your WorkSpaces to be updated by Amazon WorkSpaces during a regular maintenance window or you can update them yourself. For more information, see [WorkSpace Maintenance](p. 85).

For applications on your WorkSpaces, you can use any automatic update services provided or follow the recommendations for installing updates provided by the application vendor.

## Amazon WAM

Amazon WorkSpaces Application Manager (Amazon WAM) offers a fast, flexible, and secure way to deploy and manage applications for your Windows WorkSpaces. For more information, see the [Amazon WAM Administration Guide](p. 130).
Troubleshooting Amazon WorkSpaces Issues

The following information can help you troubleshoot issues with your WorkSpaces.

Enabling Advanced Logging

To help troubleshoot issues that your users might experience, you can enable advanced logging on any Amazon WorkSpaces client. Advanced logging is enabled for every subsequent client session until you disable it.

Advanced logging generates log files that contain diagnostic information and debugging-level details, including verbose performance data. For the 1.0+ and 2.0+ clients, these advanced logging files are automatically uploaded to a database in AWS.

**Note**
To have AWS review the log files that are generated by advanced logging and to receive technical support for issues with your WorkSpaces clients, contact AWS Support. For more information, see AWS Support Center.

To enable advanced logging for 3.0+ clients

The Windows client logs are stored in the following location:

%LOCALAPPDATA%\Amazon Web Services\Amazon WorkSpaces\logs

To enable advanced logging for Windows clients

1. Close the Amazon WorkSpaces client.
2. Open the Command Prompt app.
3. Launch the WorkSpaces client with the -l3 flag.
   ```
   c:\
   cd "C:\Program Files (x86)\Amazon Web Services, Inc\Amazon WorkSpaces"
   workspaces.exe -l3
   ```

The macOS client logs are stored in the following location:

-/Library/Application Support/"Amazon Web Services"/"Amazon WorkSpaces"/logs

To enable advanced logging for macOS clients

1. Close the Amazon WorkSpaces client.
2. Open Terminal.
3. Run the following command.

   ```bash
   open -a workspaces --args -l3
   ```

The Linux client logs are stored in the following location:

   `~/.local/share/Amazon Web Services/Amazon WorkSpaces/logs`

**To enable advanced logging for Linux clients**

1. Close the Amazon WorkSpaces client.
2. Open Terminal.
3. Run the following command.

   ```bash
   /opt/workspacesclient/workspacesclient -l3
   ```

**To enable advanced logging for 1.0+ and 2.0+ clients**

1. Open the WorkSpaces client.
2. Choose the gear icon in the upper-right corner of the client application.
3. Choose **Advanced Settings**.
4. Select the **Enable Advanced Logging** check box.
5. Choose **Save**.

The Windows client logs are stored in the following location:

   `%LOCALAPPDATA%\Amazon Web Services\Amazon WorkSpaces\1.0\Logs`

The macOS client logs are stored in the following location:

   `~/Library/Logs/Amazon Web Services/Amazon WorkSpaces/1.0`

**Troubleshooting for Specific Issues**

The following information can help you troubleshoot specific issues with your WorkSpaces.

**Issues**

- I can't create an Amazon Linux WorkSpace because there are non-valid characters in the user name (p. 142)
- I changed the shell for my Amazon Linux WorkSpace and now I can't provision a PCoIP session (p. 143)
- My Amazon Linux WorkSpaces won't start (p. 143)
- Launching WorkSpaces in my connected directory often fails (p. 144)
- Launching WorkSpaces fails with an internal error (p. 144)
- My users can't connect to a Windows WorkSpace with an interactive logon banner (p. 144)
- My users can't connect to a Windows WorkSpace (p. 144)
- My users are having issues when they try to log on to WorkSpaces from WorkSpaces Web Access (p. 145)
I can't create an Amazon Linux WorkSpace because there are non-valid characters in the user name

For Amazon Linux WorkSpaces, user names:

- Can contain a maximum of 20 characters
- Can contain letters, spaces, and numbers that are representable in UTF-8
- Can include the following special characters: _.-#
- Cannot begin with a dash symbol (-) as the first character of the user name

Note
These limitations do not apply to Windows WorkSpaces. Windows WorkSpaces support the @ and - symbols for all characters in the user name.
I changed the shell for my Amazon Linux WorkSpace and now I can't provision a PCoIP session

To override the default shell for Linux WorkSpaces, see Override the Default Shell for Amazon Linux WorkSpaces (p. 62).

My Amazon Linux WorkSpaces won't start

Starting July 20, 2020, Amazon Linux WorkSpaces will be using new license certificates. These new certificates are compatible only with versions 2.14.1.1, 2.14.7, and 2.14.9 of the PCoIP agent.

If you're using an unsupported version of the PCoIP agent, you must upgrade it to the latest version (2.14.9), which has the latest fixes and performance improvements that are compatible with the new certificates. If you don't make these upgrades by July 20, session provisioning for your Linux WorkSpaces will fail and your end users won't be able to connect to their WorkSpaces.

To upgrade your PCoIP agent to the latest version

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select your Linux WorkSpace, and reboot it by choosing Actions, Reboot WorkSpaces. If the WorkSpace status is STOPPED, you must choose Actions, Start WorkSpaces first and wait until its status is AVAILABLE before you can reboot it.
4. After your WorkSpace has rebooted and its status is AVAILABLE, we recommend that you change the status of the WorkSpace to ADMIN_MAINTENANCE while you are performing this upgrade. When you are finished, change the status of the WorkSpace to AVAILABLE. For more information about ADMIN_MAINTENANCE mode, see Manual Maintenance.

To change the status of a WorkSpace to ADMIN_MAINTENANCE, do the following:
   a. Select the WorkSpace and choose Actions, Modify WorkSpace.
   b. Choose Modify State.
   c. For Intended State, select ADMIN_MAINTENANCE.
   d. Choose Modify.
5. Connect to your Linux WorkSpace through SSH. For more information, see Enable SSH Connections for Your Linux WorkSpaces (p. 38).
6. To update the PCoIP agent, run the following command:

   ```bash
   sudo yum --enablerepo=pcoip-stable install pcoip-agent-standard-2.14.9
   ```
7. To verify the agent version and to confirm that the update succeeded, run the following command:

   ```bash
   rpm -q pcoip-agent-standard
   ```

   The verification command should produce following result:

   ```text
   pcoip-agent-standard-2.14.9-27877.el7.x86_64
   ```
8. Disconnect from the WorkSpace and reboot it again.
9. If you set the status of the WorkSpace to ADMIN_MAINTENANCE in Step 4 (p. 143), repeat Step 4 (p. 143) and set Intended State to AVAILABLE.
Launching WorkSpaces in my connected directory often fails

Verify that the two DNS servers or domain controllers in your on-premises directory are accessible from each of the subnets that you specified when you connected to your directory. You can verify this connectivity by launching an Amazon EC2 instance in each subnet and joining the instance to your directory using the IP addresses of the two DNS servers.

Launching WorkSpaces fails with an internal error

Check whether your subnets are configured to automatically assign IPv6 addresses to instances launched in the subnet. To check this setting, open the Amazon VPC console, select your subnet, and choose Subnet Actions, Modify auto-assign IP settings. If this setting is enabled, you cannot launch WorkSpaces using the Performance or Graphics bundles. Instead, disable this setting and specify IPv6 addresses manually when you launch your instances.

My users can't connect to a Windows WorkSpace with an interactive logon banner

If an interactive logon message has been implemented to display a logon banner, this prevents users from being able to access their Windows WorkSpaces. The interactive logon message Group Policy setting is not currently supported by Amazon WorkSpaces. Move the WorkSpaces to an organizational unit (OU) where the Interactive logon: Message text for users attempting to log on Group Policy isn’t applied.

My users can't connect to a Windows WorkSpace

My users receive the following error when they try to connect to their Windows WorkSpaces:

"An error occurred while launching your WorkSpace. Please try again."

This error often occurs when the WorkSpace can't load the Windows desktop using PCoIP. Check the following:

- This message appears if the PCoIP Standard Agent for Windows service is not running. Connect using RDP to verify that the service is running, that it's set to start automatically, and that it can communicate over the management interface (eth0).

- If the PCoIP agent was uninstalled, reboot the WorkSpace through the Amazon WorkSpaces console to reinstall it automatically.

- You might also receive this error on the Amazon WorkSpaces client after a long delay if the WorkSpaces security group (p. 31) was modified to restrict outbound traffic. Restricting outbound traffic prevents Windows from communicating with your directory controllers for login. Verify that your security groups allow your WorkSpaces to communicate with your directory controllers on all required ports (p. 15) over the primary network interface.

Another cause of this error is related to the User Rights Assignment Group Policy. If the following group policy is incorrectly configured, it prevents users from being able to access their Windows WorkSpaces:
My users are having issues when they try to log on to WorkSpaces from WorkSpaces Web Access

Amazon WorkSpaces relies on a specific logon screen configuration to enable users to successfully log on from their Web Access client.

To enable Web Access users to log on to their WorkSpaces, you must configure a Group Policy setting and three Security Policy settings. If these settings are not correctly configured, users might experience long logon times or black screens when they try to log on to their WorkSpaces. To configure these settings, see Enable and Configure Amazon WorkSpaces Web Access (p. 35).

Important
Beginning October 1, 2020, customers will no longer be able to use the Amazon WorkSpaces Web Access client to connect to Windows 7 custom WorkSpaces or to Windows 7 Bring Your Own License (BYOL) WorkSpaces.

The Amazon WorkSpaces client displays a gray "Loading..." screen for a while before returning to the login screen. No other error message appears.

This behavior usually indicates that the WorkSpaces client can authenticate over port 443, but can’t establish a streaming connection over port 4172. This situation can occur when network prerequisites (p. 15) aren’t met. Issues on the client side often cause the network check in the bottom-right corner of the client to fail. To see which health checks are failing, choose the network check icon (typically a red triangle with an exclamation point).

Note
The most common cause of this problem is a client-side firewall or proxy preventing access over port 4172 (TCP and UDP). If this health check fails, check your local firewall settings.

If the network check passes, there might be a problem with the network configuration of the WorkSpace. For example, a Windows Firewall rule might block port UDP 4172 on the management interface.
My users receive the message "WorkSpace Status: Unhealthy. We were unable to connect you to your WorkSpace. Please try again in a few minutes."

This error usually indicates the SkyLightWorkSpacesConfigService service isn't responding to health checks.

If you just rebooted or started your WorkSpace, wait a few minutes, and then try again.

If the WorkSpace has been running for some time and you still see this error, connect using RDP to verify that the SkyLightWorkSpacesConfigService service:

- Is running.
- Is set to start automatically.
- Can communicate over the management interface (eth0).
- Isn't blocked by any third-party antivirus software.

My users receive the message "This device is not authorized to access the WorkSpace. Please contact your administrator for assistance."

This error indicates that IP access control groups are configured on the WorkSpace directory, but the client IP address isn't whitelisted.

Check the settings on your directory. Confirm that the public IP address the user is connecting from allows access to the WorkSpace.

The WorkSpaces client gives my users a network error, but they are able to use other network-enabled apps on their devices

The WorkSpaces client applications rely on access to resources in the AWS Cloud, and require a connection that provides at least 1 Mbps download bandwidth. If a device has an intermittent connection to the network, the WorkSpaces client application might report an issue with the network.

Amazon WorkSpaces enforces the use of digital certificates issued by Amazon Trust Services, as of May 2018. Amazon Trust Services is already a trusted Root CA on the operating systems that are supported by Amazon WorkSpaces. If the Root CA list for the operating system is not up to date, the device cannot connect to WorkSpaces and the client gives a network error.

To recognize connection issues due to certificate failures

- PCoIP zero clients — The following error message is displayed.
The WorkSpaces client gives my users a network error, but they are able to use other network-enabled apps on their devices.

Failed to connect. The server provided a certificate that is invalid. See below for details:
- The supplied certificate is invalid due to timestamp
- The supplied certificate is not rooted in the devices local certificate store

- Other clients — The health checks fail with a red warning triangle for Internet.

To resolve certificate failures
- Windows Client Application (p. 147)
- PCoIP Zero Clients (p. 147)
- Other Client Applications (p. 148)

Windows Client Application

Use one of the following solutions for certificate failures.

Solution 1: Update the client application

Download and install the latest Windows client application from Amazon WorkSpaces Client Downloads. During installation, the client application ensures that your operating system trusts certificates issued by Amazon Trust Services.

Solution 2: Add Amazon Trust Services to the local Root CA list

2. Download the Starfield certificate in DER format (2b071c9a00a76b0eadb2bad23bad4580b69c3601b630c2eaf0613afa83f92).
3. Open the Microsoft Management Console. (From the Command Prompt, run mmc.)
5. On the Certificates snap-in page, select Computer account and choose Next. Keep the default, Local computer. Choose Finish. Choose OK.
6. Expand Certificates (Local Computer) and select Trusted Root Certification Authorities. Choose Action, All Tasks, Import.
7. Follow the wizard to import the certificate that you downloaded.
8. Exit and restart the WorkSpaces client application.

Solution 3: Deploy Amazon Trust Services as a trusted CA using Group Policy

Add the Starfield certificate to the trusted Root CAs for the domain using Group Policy. For more information, see Use Policy to Distribute Certificates.

PCoIP Zero Clients

To connect directly to a WorkSpace using firmware version 6.0 or later, download and install the certificate issued by Amazon Trust Services.

To add Amazon Trust Services as a trusted Root CA

1. Open https://certs.secureserver.net/repository/.
2. Download the certificate under Starfield Certificate Chain with the thumbprint 14 65 FA 20 53 97 B8 76 FA A6 F0 A9 95 8E 55 90 E4 0F CC 7F AA 4F B7 C2 C8 67 75 21 FB 5F B6 58.
3. Upload the certificate to the zero client. For more information, see Uploading Certificates in the Teradici documentation.

Other Client Applications

Add the Starfield certificate (2b071c59a0a0ae76b0eadb2bad23bad4580b69c3601b630c2eaf0613afa83f92) from Amazon Trust Services. For more information about how to add a Root CA, see the following documentation:

- Android: Add & remove certificates
- Chrome OS: Manage client certificates on Chrome devices
- macOS and iOS: Installing a CA's Root Certificate on Your Test Device

My WorkSpace users see the following error message: "Device can't connect to the registration service. Check your network settings."

When a registration service failure occurs, your WorkSpace users might see the following error message on the Connection Health Check page: "Your device is not able to connect to the WorkSpaces Registration service. You will not be able to register your device with WorkSpaces. Please check your network settings."

This error occurs when the WorkSpaces client application can't reach the registration service. Typically, this happens when the WorkSpaces directory has been deleted. To resolve this error, make sure that the registration code is valid and corresponds to a running directory in the AWS Cloud.

My PCoIP zero client users are receiving the error "The supplied certificate is invalid due to timestamp"

If Network Time Protocol (NTP) isn't enabled in Teradici, your PCoIP zero client users might receive certificate failure errors. To set up NTP, see Set Up PCoIP Zero Client for WorkSpaces (p. 34).

My users skipped updating their Windows or macOS client applications and aren't getting prompted to install the latest version

When users skip updates to the Amazon WorkSpaces Windows client application, the SkipThisVersion registry key gets set, and they are no longer prompted to update their clients when a new version of the client is released. To update to the latest version, you can edit the registry as described in Update the WorkSpaces Windows Client Application to a Newer Version in the Amazon WorkSpaces User Guide. You can also run the following PowerShell command:

```
Remove-ItemProperty -Path "HKCU:\Software\Amazon Web Services, LLC\Amazon WorkSpaces \WinSparkle" -Name "SkipThisVersion"
```

When users skip updates to the Amazon WorkSpaces macOS client application, the SUSkippedVersion preference gets set, and they are no longer prompted to update their clients when a new version of the client is released. To update to the latest version, you can reset this preference as described in Update the WorkSpaces macOS Client Application to a Newer Version in the Amazon WorkSpaces User Guide.
My users are unable to install the Android client application on their Chromebooks

Version 2.4.13 is the final release of the Amazon WorkSpaces Chromebook client application. Because Google is phasing out support for Chrome Apps, there will be no further updates to the WorkSpaces Chromebook client application, and its use is unsupported.

For Chromebooks that support installing Android applications, we recommend using the Amazon WorkSpaces Android client application instead.

In some cases, you might need to enable your users' Chromebooks to install Android applications. For more information, see Set Up Android for Chromebooks (p. 34).

My users aren't receiving invitation emails or password reset emails

Users do not automatically receive welcome or password reset emails for WorkSpaces that were created using AD Connector.

To manually send welcome emails to these users, see Send an Invitation Email (p. 77).

To reset user passwords, see Set Up Active Directory Administration Tools for Amazon WorkSpaces (p. 54).

My users don't see the Forgot password? option on the client login screen

If you're using AD Connector, your users won't be able to reset their own passwords. (The Forgot password? option on the WorkSpaces client application login screen won't be available.) For information about how to reset user passwords, see Set Up Active Directory Administration Tools for Amazon WorkSpaces (p. 54).

I receive the message "The system administrator has set policies to prevent this installation" when I try to install applications on a Windows WorkSpace

You can address this issue by modifying the Windows Installer Group Policy setting. To deploy this policy to multiple WorkSpaces in your directory, apply this setting to a Group Policy object that is linked to the WorkSpaces organizational unit (OU) from a domain-joined EC2 instance. If you are using AD Connector, you can make these changes from a domain controller. For more information about using the Active Directory administration tools to work with Group Policy objects, see Installing the Active Directory Administration Tools in the AWS Directory Service Administration Guide.

The following procedure shows how to configure the Windows Installer setting for the Amazon WorkSpaces Group Policy object.

1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 57) is installed in your domain.
2. Open the Group Policy Management tool on your Windows WorkSpace client and navigate to and select the WorkSpaces Group Policy object for your WorkSpaces machine accounts. From the main menu, choose Action, Edit.

4. Open the Turn Off Windows Installer setting.

5. In the Turn Off Windows Installer dialog box, change Not Configured to Enabled, and then set Disable Windows Installer to Never.

6. Choose OK.

7. To apply the group policy changes, do one of the following:
   - Reboot the WorkSpace (in the Amazon WorkSpaces console, select the WorkSpace, then choose Actions, Reboot WorkSpaces).
   - From an administrative command prompt, enter gpupdate /force.

---

**No WorkSpaces in my directory can connect to the internet**

WorkSpaces cannot communicate with the internet by default. You must explicitly provide internet access. For more information, see Provide Internet Access from Your WorkSpace (p. 30).

**My WorkSpace has lost its internet access**

If your WorkSpace has lost access to the internet and you can't connect to the WorkSpace by using RDP, this issue is probably caused by the loss of the public IP address for the WorkSpace. If you have enabled automatic assignment of Elastic IP addresses (p. 46) at the directory level, an Elastic IP address (from the Amazon-provided pool) is assigned to your WorkSpace when it is launched. However, if you associate an Elastic IP address that you own to a WorkSpace, and then you later disassociate that Elastic IP address from the WorkSpace, the WorkSpace loses its public IP address, and it doesn't automatically get a new one from the Amazon-provided pool.

To associate a new public IP address from the Amazon-provided pool with the WorkSpace, you must rebuild the WorkSpace (p. 90). If you don't want to rebuild the WorkSpace, you must associate another Elastic IP address that you own to the WorkSpace.

We recommend that you not modify the elastic network interface of a WorkSpace after the WorkSpace is launched. After an Elastic IP address has been assigned to a WorkSpace, the WorkSpace retains the same public IP address (unless the WorkSpace is rebuilt, in which case it gets a new public IP address).

**I receive a "DNS unavailable" error when I try to connect to my on-premises directory**

You receive an error message similar to the following when connecting to your on-premises directory.

```
DNS unavailable (TCP port 53) for IP: dns-ip-address
```

AD Connector must be able to communicate with your on-premises DNS servers via TCP and UDP over port 53. Verify that your security groups and on-premises firewalls allow TCP and UDP communication over this port.

**I receive a "Connectivity issues detected" error when I try to connect to my on-premises directory**

You receive an error message similar to the following when connecting to your on-premises directory.
I receive an "SRV record" error when I try to connect to my on-premises directory

You receive an error message similar to one or more of the following when connecting to your on-premises directory.

- SRV record for LDAP does not exist for IP: dns-ip-address
- SRV record for Kerberos does not exist for IP: dns-ip-address

AD Connector needs to obtain the _ldap._tcp.dns-domain-name and _kerberos._tcp.dns-domain-name SRV records when connecting to your directory. You get this error if the service cannot obtain these records from the DNS servers that you specified when connecting to your directory. Make sure that your DNS servers contain these SRV records. For more information, see SRV Resource Records on Microsoft TechNet.

My Windows WorkSpace goes to sleep when it's left idle

To resolve this issue, connect to the WorkSpace and change the power plan to High performance by using the following procedure:

1. From the WorkSpace, open Control Panel, then choose Hardware and Sound.
2. Under Power Options, choose Choose a power plan.
3. In the Choose or customize a power plan pane, choose the High performance power plan. If this plan isn't visible, choose the arrow to the right of Show additional plans to display it.

If the preceding steps do not solve the issue, do the following:

1. In the Choose or customize a power plan pane, choose the Change plan settings link to the right of the High performance power plan, then choose the Change advanced power settings link.
2. In the Power Options dialog box, in the list of settings, choose the plus sign to the left of Hard disk to display the relevant settings.
3. Verify that the Turn off hard disk after value for Plugged in is greater than the value for On battery (the default value is 20 minutes).
4. Choose the plus sign to the left of PCI Express, and do the same for Link State Power Management.
5. Verify that the Link State Power Management settings are Off.
6. Choose OK (or Apply if you changed any settings) to close the dialog box.
7. In the Change settings for the plan pane, if you changed any settings, choose Save changes.

One of my WorkSpaces has a state of "Unhealthy"

The Amazon WorkSpaces service periodically sends status requests to a WorkSpace. A WorkSpace is marked Unhealthy when it fails to respond to these requests. Common causes for this problem are:

- An application on the WorkSpace is blocking network ports, which prevents the WorkSpace from responding to the status request.
- High CPU utilization is preventing the WorkSpace from responding to the status request in a timely manner.
- The computer name of the WorkSpace has been changed. This prevents a secure channel from being established between Amazon WorkSpaces and the WorkSpace.

You can attempt to correct the situation using the following methods:

- Reboot the WorkSpace from the Amazon WorkSpaces console.
- Connect to the unhealthy WorkSpace using the following procedure, which should be used only for troubleshooting purposes:
  1. Connect to an operational WorkSpace in the same directory as the unhealthy WorkSpace.
  2. From the operational WorkSpace, use Remote Desktop Protocol (RDP) to connect to the unhealthy WorkSpace using the IP address of the unhealthy WorkSpace. Depending on the extent of the problem, you might not be able to connect to the unhealthy WorkSpace.
  3. On the unhealthy WorkSpace, confirm that the minimum port requirements (p. 15) are met.
- Rebuild the WorkSpace from the Amazon WorkSpaces console. Because rebuilding a WorkSpace can potentially cause a loss of data, this option should only be used if all other attempts to correct the problem have been unsuccessful.

My WorkSpace is unexpectedly crashing or rebooting

If your WorkSpace is repeatedly crashing or rebooting and your error logs or crash dumps are pointing to problems with spacedeskHookKmode.sys or spacedeskHookUmode.dll, or if you're receiving the following error messages, you might need to disable Web Access to the WorkSpace:

```
The kernel power manager has initiated a shutdown transition.
Shutdown reason: Kernel API
```

```
The computer has rebooted from a bugcheck.
```

**Note**

You should disable Web Access only if you aren't allowing your users to use Web Access.

To disable Web Access to the WorkSpace, you must set a group policy and modify two registry settings. For information about using the Active Directory administration tools to work with Group Policy Objects, see Installing the Active Directory Administration Tools in the AWS Directory Service Administration Guide.
Step 1: Set a Group Policy to disable Web Access at the directory level

You can make these changes either from the machine that you use to administer the domain, or from a domain controller.

1. Open the Group Policy Management Editor (gpmc.msc) and locate the Group Policy Object (GPO) policy at the domain controller level of your directory.
2. Choose Action, Edit.
3. Navigate to the following setting:
   Computer Configuration\Windows Settings\Security Settings\System Services\STXHD Hosted Application Service
4. In the STXHD Hosted Application Service Properties dialog box, on the Security Policy Setting tab, select the Define this policy setting check box.
5. Under Select Service Startup Mode, select Disabled.
6. Choose OK.
7. Prevent the machine from rebooting until you have finished editing the registry (Step 2).

Step 2: Edit the Registry to disable Web Access

We recommend that you push out these registry changes through GPO.

1. Set the following registry key value to 1 (enabled):

   KeyPath = HKEY_LOCAL_MACHINE\SOFTWARE\Amazon\WorkSpacesConfig\update-webaccess.ps1
   KeyName = RebootCount
   KeyType = DWORD
   KeyValue = 1

2. Set the following registry key value to 4 (disabled):

   KeyPath = HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\spacedeskHookKmode
   KeyName = Start
   KeyType = DWORD
   KeyValue = 4

3. Reboot the machine.

The same username has more than one WorkSpace, but the user can log in to only one of the WorkSpaces

If you delete a user in Active Directory (AD) without first deleting their WorkSpace and then you add the user back to Active Directory and create a new WorkSpace for that user, the same username will now have two WorkSpaces in the same directory. However, if the user tries to connect to their original WorkSpace, they will receive the following error:

"Unrecognized user. No WorkSpace found under your username. Contact your administrator to request one."
Additionally, searches for the username in the Amazon WorkSpaces console return only the new
WorkSpace, even though both WorkSpaces still exist. (You can find the original WorkSpace by searching
for the WorkSpace ID instead of the username.)

This behavior can also occur if you rename a user in Active Directory without first deleting their
WorkSpace. If you then change their username back to the original username and create a new
WorkSpace for the user, the same username will have two WorkSpaces in the directory.

This problem occurs because Active Directory uses the user's security identifier (SID), rather than the
username, to uniquely identify the user. When a user is deleted and recreated in Active Directory, the
user is assigned a new SID, even if their username remains the same. During searches for a username,
the Amazon WorkSpaces console uses the SID to search Active Directory for matches. The Amazon
WorkSpaces clients also use the SID to identify users when they are connecting to WorkSpaces.

To resolve this problem, do one of the following:

- If this problem occurred because the user was deleted and recreated in Active Directory, you might be
  able to restore the original deleted user object if you have enabled the Recycle Bin feature in Active
  Directory. If you’re able to restore the original user object, make sure the user can connect to their
  original WorkSpace. If they can, you can delete the new WorkSpace (p. 101) after manually backing up
  and transferring any user data from the new WorkSpace to the original WorkSpace (if needed).

- If you can’t restore the original user object, delete the user’s original WorkSpace (p. 101). The user
  should be able to connect to and use their new WorkSpace instead. Be sure to manually back up and
  transfer any user data from the original WorkSpace to the new WorkSpace.

  **Warning**
  Deleting a WorkSpace is a permanent action and cannot be undone. The WorkSpace user’s
data does not persist and is destroyed. For help with backing up user data, contact AWS
  Support.

I’m having trouble using Docker with Amazon
WorkSpaces

Nested virtualization (including the use of Docker) is not supported on Amazon WorkSpaces for Windows
or Linux. For more information, see the Docker documentation.

I receive ThrottlingException errors to some of my
API calls

The default allowed rate for Amazon WorkSpaces API calls is a constant rate of two API calls per second,
with a maximum allowed "burst" rate of five API calls per second. The following table shows how the
burst rate limit works for API requests.

<table>
<thead>
<tr>
<th>Second</th>
<th>Number of Requests Sent</th>
<th>Net Requests Allowed</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>5</td>
<td>During the first second (second 1), five requests are allowed, up to the burst rate maximum of five calls per second.</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>5</td>
<td>Because two or fewer calls were issued in second 1, the full burst capacity of five calls is still available.</td>
</tr>
</tbody>
</table>
I receive ThrottlingException errors to some of my API calls

<table>
<thead>
<tr>
<th>Second</th>
<th>Number of Requests Sent</th>
<th>Net Requests Allowed</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>5</td>
<td>5</td>
<td>Because only two calls were issued in second 2, the full burst capacity of five calls is still available.</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
<td>Because the full burst capacity was used in second 3, only the constant rate of two calls per second is available.</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>Because there is no remaining burst capacity, only two calls are allowed at this time. This means that one of the three API calls is throttled. The one throttled call will respond after a short delay.</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>1</td>
<td>Because one of the calls from second 5 is being retried in second 6, there is capacity for only one additional call in second 6 because of the constant rate limit of two calls per second.</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>3</td>
<td>Now that there are no longer any throttled API calls in the queue, the rate limit continues to increase, up to the burst rate limit of five calls.</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>5</td>
<td>Because no calls were issued in second 7, the maximum number of requests is allowed.</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>5</td>
<td>Even though no calls were issued in second 8, the rate limit does not increase above five.</td>
</tr>
</tbody>
</table>
Amazon WorkSpaces Quotas

The following are the quotas (also referred to as limits) for Amazon WorkSpaces for your AWS account. To request a quota increase, use the Amazon WorkSpaces Limits form.

WorkSpace and Image Quotas

- WorkSpaces per Region: 1
- Graphics WorkSpaces per Region: 0
- GraphicsPro WorkSpaces per Region: 0
- Images per Region: 20

IP Access Control Quotas

- IP access control groups per Region: 100
- Rules per IP access control group: 10
- IP access control groups per directory: 25
### Document History

The following table describes the important changes to the Amazon WorkSpaces service and to the *Amazon WorkSpaces Administration Guide* from January 1, 2018, onward. We also update the documentation frequently to address the feedback that you send us.

For notification about these updates, you can subscribe to the Amazon WorkSpaces RSS feed.

<table>
<thead>
<tr>
<th>update-history-change</th>
<th>update-history-description</th>
<th>update-history-date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BYOL Automation in China (Ningxia)</td>
<td>You can use Bring Your Own License (BYOL) automation to simplify the process of using your Windows 10 desktop licenses for your WorkSpaces in China (Ningxia).</td>
<td>April 2, 2020</td>
</tr>
<tr>
<td>Image Checker</td>
<td>The Image Checker tool helps you determine whether your Windows WorkSpace meets the requirements for image creation. The Image Checker performs a series of tests on the WorkSpace that you want to use to create your image, and provides guidance on how to resolve any issues it finds.</td>
<td>March 30, 2020</td>
</tr>
<tr>
<td>Migrate WorkSpaces</td>
<td>The Amazon WorkSpaces migrate feature enables you to migrate a WorkSpace from one bundle to another, while retaining the data on the user volume. You can use this feature to migrate WorkSpaces from the Windows 7 desktop experience to the Windows 10 desktop experience. You can also use this feature to migrate WorkSpaces from one public or custom bundle to another.</td>
<td>January 9, 2020</td>
</tr>
<tr>
<td>PrivateLink integration for Amazon WorkSpaces APIs</td>
<td>You can connect directly to Amazon WorkSpaces API endpoints through an interface endpoint in your Virtual Private Cloud (VPC) instead of connecting over the internet. When you use a VPC interface endpoint, communication between your VPC and the Amazon WorkSpaces API endpoint is conducted entirely and securely within the AWS network.</td>
<td>November 25, 2019</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
<td>Date</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Linux client for Amazon WorkSpaces</td>
<td>Users can now use the Linux client to access their WorkSpaces.</td>
<td>November 25, 2019</td>
</tr>
<tr>
<td>Amazon WorkSpaces launched in China (Ningxia)</td>
<td>Amazon WorkSpaces is available in the China (Ningxia) Region.</td>
<td>November 13, 2019</td>
</tr>
<tr>
<td>Restore WorkSpaces to last known healthy state</td>
<td>You can use the restore feature to roll back a WorkSpace to its last known healthy state.</td>
<td>September 18, 2019</td>
</tr>
<tr>
<td>FIPS endpoint encryption</td>
<td>To comply with the Federal Risk and Authorization Management Program (FedRAMP) or the Department of Defense (DoD) Cloud Computing Security Requirements Guide (SRG), you can configure Amazon WorkSpaces to use Federal Information Processing Standards (FIPS) endpoint encryption at the directory level.</td>
<td>September 12, 2019</td>
</tr>
<tr>
<td>Copy WorkSpace images</td>
<td>You can copy your images within the same Region or across Regions.</td>
<td>June 27, 2019</td>
</tr>
<tr>
<td>Self-Service WorkSpace Management Capabilities for Users</td>
<td>You can enable self-service WorkSpace management capabilities for your users to provide them with more control over their experience.</td>
<td>November 19, 2018</td>
</tr>
<tr>
<td>BYOL Automation</td>
<td>You can use Bring Your Own License (BYOL) automation to simplify the process of using your Windows 7 and Windows 10 desktop licenses for your WorkSpaces.</td>
<td>November 16, 2018</td>
</tr>
<tr>
<td>PowerPro and GraphicsPro bundles</td>
<td>The PowerPro and GraphicsPro bundles are now available for Amazon WorkSpaces.</td>
<td>October 18, 2018</td>
</tr>
<tr>
<td>Monitor successful WorkSpace logins</td>
<td>You can use events from Amazon CloudWatch Events to monitor and respond to successful WorkSpace logins.</td>
<td>September 17, 2018</td>
</tr>
<tr>
<td>Web Access for Windows 10 WorkSpaces</td>
<td>Users can now use the web access client to access a WorkSpace running the Windows 10 desktop experience.</td>
<td>August 24, 2018</td>
</tr>
<tr>
<td>URI login</td>
<td>You can use uniform resource identifiers (URIs) to provide users with access to their WorkSpaces.</td>
<td>July 31, 2018</td>
</tr>
</tbody>
</table>
Amazon WorkSpaces Administration Guide

Earlier Updates

Amazon Linux WorkSpaces
You can provision Amazon Linux WorkSpaces for your users.
June 26, 2018

IP access control groups
You can control the IP addresses from which users can access their WorkSpaces.
April 30, 2018

In-place upgrades
You can upgrade your Windows 10 BYOL WorkSpaces to a newer version of Windows 10.
March 9, 2018

Earlier Updates

The following table describes important additions to the Amazon WorkSpaces service and its documentation set before January 1, 2018.

<table>
<thead>
<tr>
<th>Change</th>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible compute options</td>
<td>You can switch your WorkSpaces between the Value, Standard, Performance, and Power bundles</td>
<td>December 22, 2017</td>
</tr>
<tr>
<td>Configurable storage</td>
<td>You can configure the size of the root and user volumes for your WorkSpaces when you launch them and increase the size of these volumes later on.</td>
<td>December 22, 2017</td>
</tr>
<tr>
<td>Control device access</td>
<td>You can specify the types of devices that have access to WorkSpaces. In addition, you can restrict access to WorkSpaces to trusted devices (also known as managed devices).</td>
<td>June 19, 2017</td>
</tr>
<tr>
<td>Inter-forest trusts</td>
<td>You can establish a trust relationship between your AWS Managed Microsoft AD and your on-premises Microsoft Active Directory domain and then provision WorkSpaces for users in the on-premises domain.</td>
<td>February 9, 2017</td>
</tr>
<tr>
<td>Windows Server 2016 bundles</td>
<td>Amazon WorkSpaces offers bundles that include a Windows 10 desktop experience, powered by Windows Server 2016.</td>
<td>November 29, 2016</td>
</tr>
<tr>
<td>Web Access</td>
<td>You can access your Windows WorkSpaces from a web browser using Amazon WorkSpaces Web Access.</td>
<td>November 18, 2016</td>
</tr>
<tr>
<td>Hourly WorkSpaces</td>
<td>You can configure your WorkSpaces so that users are billed by the hour.</td>
<td>August 18, 2016</td>
</tr>
<tr>
<td>Windows 10 BYOL</td>
<td>You can bring your Windows 10 Desktop License to Amazon WorkSpaces (BYOL).</td>
<td>July 21, 2016</td>
</tr>
<tr>
<td>Tagging support</td>
<td>You can use tags to manage and track your WorkSpaces.</td>
<td>May 17, 2016</td>
</tr>
<tr>
<td>Saved registrations</td>
<td>Every time you enter a new registration code, the WorkSpaces client stores it. This makes it</td>
<td>January 28, 2016</td>
</tr>
<tr>
<td>Change</td>
<td>Description</td>
<td>Date</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>easier to switch between WorkSpaces in different directories or Regions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows 7 BYOL, Chromebook client, WorkSpace encryption</td>
<td>You can bring your Windows 7 Desktop License to Amazon WorkSpaces (BYOL), use the Chromebook client, and use WorkSpace encryption.</td>
<td>October 1, 2015</td>
</tr>
<tr>
<td>CloudWatch monitoring</td>
<td>Added information about CloudWatch monitoring.</td>
<td>April 28, 2015</td>
</tr>
<tr>
<td>Automatic session reconnect</td>
<td>Added information about the auto session reconnect feature in the WorkSpaces desktop client applications.</td>
<td>March 31, 2015</td>
</tr>
<tr>
<td>Public IP addresses</td>
<td>You can automatically assign a public IP address to your WorkSpaces.</td>
<td>January 23, 2015</td>
</tr>
<tr>
<td>Amazon WorkSpaces launched in Asia Pacific (Singapore)</td>
<td>Amazon WorkSpaces is available in the Asia Pacific (Singapore) Region.</td>
<td>January 15, 2015</td>
</tr>
<tr>
<td>Value bundle added, Standard bundle updates, Office 2013 added</td>
<td>The Value bundle is available, the Standard bundle hardware has been upgraded, and Microsoft Office 2013 is available in Plus packages.</td>
<td>November 6, 2014</td>
</tr>
<tr>
<td>Image and bundle support</td>
<td>You can create an image from a WorkSpace that you’ve customized and a custom WorkSpace bundle from the image.</td>
<td>October 28, 2014</td>
</tr>
<tr>
<td>PCoIP zero client support</td>
<td>You can access Amazon WorkSpaces PCoIP zero client devices.</td>
<td>October 15, 2014</td>
</tr>
<tr>
<td>Amazon WorkSpaces launched in Asia Pacific (Tokyo)</td>
<td>Amazon WorkSpaces is available in the Asia Pacific (Tokyo) Region.</td>
<td>August 26, 2014</td>
</tr>
<tr>
<td>Local printer support</td>
<td>You can enable local printer support for your WorkSpaces.</td>
<td>August 26, 2014</td>
</tr>
<tr>
<td>Multi-factor authentication</td>
<td>You can use multi-factor authentication in connected directories.</td>
<td>August 11, 2014</td>
</tr>
<tr>
<td>Default OU support and target domain support</td>
<td>You can select a default Organizational Unit (OU) where your WorkSpace machine accounts are placed, and a separate domain where your WorkSpace machine accounts are created.</td>
<td>July 7, 2014</td>
</tr>
<tr>
<td>Add security groups</td>
<td>You can add a security group to your WorkSpaces.</td>
<td>July 7, 2014</td>
</tr>
<tr>
<td>Amazon WorkSpaces launched in Asia Pacific (Sydney)</td>
<td>Amazon WorkSpaces is available in the Asia Pacific (Sydney) Region.</td>
<td>May 15, 2014</td>
</tr>
<tr>
<td>Amazon WorkSpaces launched in Europe (Ireland)</td>
<td>Amazon WorkSpaces is available in the Europe (Ireland) Region.</td>
<td>May 5, 2014</td>
</tr>
<tr>
<td>Public beta</td>
<td>Amazon WorkSpaces is available as a public beta.</td>
<td>March 25, 2014</td>
</tr>
</tbody>
</table>