# Table of Contents

What Is Amazon WorkSpaces? ................................................................. 1
  Features .......................................................................................... 1
  Architecture .................................................................................. 1
  Accessing Your WorkSpace ............................................................ 2
  Pricing ............................................................................................ 3
  How to Get Started ........................................................................ 3
Get Started: Quick Setup ........................................................................ 4
  Before You Begin .......................................................................... 4
  Step 1: Launch the WorkSpace ....................................................... 4
  Step 2: Connect to the WorkSpace ................................................. 6
  Step 3: Clean Up (Optional) ............................................................ 8
Networking, Access, and Security ......................................................... 9
  VPC Requirements ......................................................................... 9
    Step 1: Allocate an Elastic IP Address ......................................... 10
    Step 2: Create a VPC ................................................................. 11
    Step 3: Add a Second Private Subnet .......................................... 11
    Step 4: Verify and Name the Route Tables .................................. 12
  Port Requirements ......................................................................... 12
    Ports for Client Applications ..................................................... 12
    Ports for Web Access .................................................................. 13
    Whitelisted Domains and Ports .................................................. 13
    PCoIP Gateway and Health Check Servers .................................. 18
    Network Interfaces ..................................................................... 19
  Network Requirements ................................................................... 21
  Control Access ............................................................................. 22
    Specifying Amazon WorkSpaces Resources in an IAM Policy .. 24
  Trusted Devices ............................................................................. 26
    Step 1: Create the Certificates ................................................... 27
    Step 2: Deploy Client Certificates to the Trusted Devices ........ 27
    Step 3: Configure the Restriction .............................................. 27
  Internet Access ............................................................................. 28
    Manually Assign IP Addresses .................................................... 29
  Security Groups ............................................................................. 29
  IP Access Control Groups ............................................................ 30
    Create an IP Access Control Group .......................................... 30
    Associate an IP Access Control Group with a Directory .......... 30
    Copy an IP Access Control Group ............................................. 31
    Delete an IP Access Control Group .......................................... 31
  PCoIP Zero Client ......................................................................... 31
Directories ....................................................................................... 32
  Register a Directory ................................................................. 32
  Update Directory Details ............................................................ 33
    Select an Organizational Unit ................................................... 33
    Configure Automatic IP Addresses ......................................... 34
    Control Device Access .............................................................. 35
    Manage Local Administrator Permissions .................................. 35
    Update the AD Connector Account (AD Connector) ............... 35
    Multi-factor Authentication (AD Connector) .............................. 36
  Delete a Directory ......................................................................... 36
  Set Up Directory Administration .................................................. 36
  Manage Your Windows WorkSpaces ............................................ 38
    Install the Group Policy Administrative Template .................. 38
    Enable or Disable Local Printer Support for Windows WorkSpaces 39
    Enable or Disable Clipboard Redirection for Windows WorkSpaces 39
Upgrade Windows 10 BYOL WorkSpaces ................................................................. 68
Known Limitations ................................................................................................................. 70
Troubleshooting ..................................................................................................................... 70
Update Your WorkSpace Registry Using a PowerShell Script ............................................... 70
Required Configuration Elements and Service Components for WorkSpaces ..................... 71
  Required Routing Table Configuration ................................................................................. 71
  Required Service Components ............................................................................................ 71
Bundles and Images ................................................................................................................ 73
  Create a Custom Bundle ....................................................................................................... 73
  Update a Custom Bundle ..................................................................................................... 76
  Delete a Custom Bundle ...................................................................................................... 77
Bring Your Own Windows Desktop Images ............................................................................. 77
  Requirements ...................................................................................................................... 78
  Windows Versions That Are Supported for BYOL .......................................................... 79
Step 1: Enable BYOL for Your Account by Using the Amazon WorkSpaces Console ............ 79
Step 2: Run the BYOL Checker PowerShell Script on a Windows VM .................................. 79
Step 3: Export the VM from Your Virtualization Environment ............................................ 81
Step 4: Import the VM as an Image into EC2 ...................................................................... 81
Step 5: Create a BYOL Image by Using the Amazon WorkSpaces Console ......................... 81
Step 6: Create a Custom Bundle From the BYOL Image ...................................................... 82
Step 7: Register a Directory for Dedicated WorkSpaces ....................................................... 82
Step 8: Launch Your BYOL WorkSpaces .............................................................................. 83
Monitor Your WorkSpaces ...................................................................................................... 84
  Monitor Using CloudWatch Metrics ................................................................................... 84
  Amazon WorkSpaces Metrics ............................................................................................. 84
  Dimensions for Amazon WorkSpaces Metrics .................................................................... 86
  Monitoring Example ............................................................................................................ 86
  Monitor Using CloudWatch Events .................................................................................... 87
  WorkSpaces Events ............................................................................................................ 88
  Create a Rule to Handle WorkSpaces Events ..................................................................... 89
Enabling Advanced Logging ................................................................................................ 90
Troubleshooting .................................................................................................................... 90
  I can't create an Amazon Linux WorkSpace because there are invalid characters in the user name .................................................................................................................. 90
  Launching WorkSpaces in my connected directory often fails ............................................ 91
  Launching WorkSpaces fails with an internal error ............................................................. 91
  My users can't connect to a Windows WorkSpace with an interactive logon banner ............ 91
  My users are having issues when they try to log on to BYOL WorkSpaces from WorkSpaces Web Access .................................................................................................................. 91
  No WorkSpaces in my directory can connect to the internet .............................................. 92
  I receive a "DNS unavailable" error when I try to connect to my on-premises directory ....... 92
  I receive a "Connectivity issues detected" error when I try to connect to my on-premises directory ......................................................................................................................... 92
  I receive an "SRV record" error when I try to connect to my on-premises directory ............ 93
  My Windows WorkSpace goes to sleep when it's left idle ................................................. 93
  One of my WorkSpaces has a state of "Unhealthy" .......................................................... 93
Limits ........................................................................................................................................ 70
Document History ................................................................................................................ 96
Earlier Updates ...................................................................................................................... 97
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 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 uses port 4172 for pixel streaming to the WorkSpace and for network health checks. For more information, see Ports for Client Applications (p. 12).

Each WorkSpace has two elastic network interfaces (ENI) associated with it: an ENI for management and streaming (eth0) and a primary ENI (eth1). The primary ENI 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
ENI. For more information, see Network Interfaces (p. 19).

The following diagram shows the architecture of Amazon WorkSpaces.

![Amazon WorkSpaces Architectural Diagram](image)

**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
- Mac computers
- Chromebooks
- iPads
- Android tablets
- Fire tablets
- Zero client devices

On Windows, macOS, and Linux PCs, you can use the following web browsers to connect to Windows
WorkSpaces:
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. 43)
- Launch a WorkSpace Using Simple AD (p. 46)
- Launch a WorkSpace Using AD Connector (p. 49)
- Launch a WorkSpace Using a Trusted Domain (p. 51)
Get Started with Amazon WorkSpaces Quick Setup

In this tutorial, you'll 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. 43).

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

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

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. 8)

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 username 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.
3. On the Get Started with Amazon WorkSpaces page, next to Quick Setup, choose Launch.

```
Get Started with Amazon WorkSpaces
Choose an option below to set up your WorkSpaces.

Quick Setup
Quickly launch WorkSpaces for an individual or small group of cloud-based users in less than 20 minutes.
Launch

Advanced Setup
Launch WorkSpaces using advanced options—including using your on-premises directory and existing Amazon VPC.
Launch
```

4. For Bundles, select a bundle for the user.

```
<table>
<thead>
<tr>
<th>Bundle</th>
<th>CPU</th>
<th>Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value with Amazon Linux 2</td>
<td>1 vCPU</td>
<td>2 GiB</td>
</tr>
<tr>
<td>Standard with Amazon Linux 2</td>
<td>2 vCPU</td>
<td>4 GiB</td>
</tr>
<tr>
<td>Performance with Amazon Linux 2</td>
<td>2 vCPU</td>
<td>7.5 GiB</td>
</tr>
<tr>
<td>Power with Amazon Linux 2</td>
<td>4 vCPU</td>
<td>16 GiB</td>
</tr>
<tr>
<td>Standard with Windows 7</td>
<td>2 vCPU</td>
<td>4 GiB</td>
</tr>
<tr>
<td>Standard with Windows 10</td>
<td>2 vCPU</td>
<td>4 GiB</td>
</tr>
<tr>
<td>Standard with Windows 7 and Office 2010</td>
<td>2 vCPU</td>
<td>4 GiB</td>
</tr>
<tr>
<td>Standard with Windows 7 and Office 2013</td>
<td>2 vCPU</td>
<td>4 GiB</td>
</tr>
</tbody>
</table>
```

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

```
<table>
<thead>
<tr>
<th>Username</th>
<th>First Name</th>
<th>Last Name</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>johnd</td>
<td>John</td>
<td>Doe</td>
<td><a href="mailto:johnd@example.com">johnd@example.com</a></td>
</tr>
</tbody>
</table>
```

6. Choose Launch WorkSpaces.
7. On the confirmation page, choose View the WorkSpaces Console. 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. 56).
- Sends invitation emails to the specified users.

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.

**Note**

When you are connected to your WorkSpace from a Windows or MacOS client, you can toggle the fullscreen display by using following command shortcuts:

- Windows client: Ctrl+Alt+Enter
- MacOS client: Control+Option+Return

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 that 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. When prompted, download one of the client applications or launch Web Access. For more information about the requirements for each client, see Amazon WorkSpaces Clients in the Amazon WorkSpaces User Guide.

If you aren't prompted and you haven't installed a client application already, open https://clients.amazonworkspaces.com and follow the directions.

3. Start the client, enter the registration code from the invitation email, and choose Register.

4. When prompted to sign in, type the username and password, and then choose Sign In.
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.
Networking, Access, and Security for Amazon WorkSpaces

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

Contents
- Configure a VPC for Amazon WorkSpaces (p. 9)
- Port Requirements for Amazon WorkSpaces (p. 12)
- Amazon WorkSpaces Client Network Requirements (p. 21)
- Control Access to Amazon WorkSpaces Resources (p. 22)
- Restrict WorkSpaces Access to Trusted Devices (p. 26)
- Provide Internet Access from Your WorkSpace (p. 28)
- Security Groups for Your WorkSpaces (p. 29)
- IP Access Control Groups for Your WorkSpaces (p. 30)
- Set Up PCoIP Zero Client for WorkSpaces (p. 31)

Configure a VPC for Amazon WorkSpaces

Amazon WorkSpaces launches your WorkSpaces in a virtual private cloud (VPC). 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.

Note that 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 launch WorkSpaces using the Performance or Graphics bundles. By default, this setting is disabled. To check this setting, open the Amazon VPC console, select your subnet, and choose **Subnet Actions, Modify auto-assign IP settings.**

To provide internet access to WorkSpaces in a private subnet, configure a NAT gateway in the public subnet. For alternative methods of providing internet access for your WorkSpaces, see **Provide Internet Access from Your WorkSpace (p. 28).** Note that Windows WorkSpaces require an internet connection to receive applications through Amazon WAM.
To configure your VPC for use with Amazon WorkSpaces, complete the following tasks. For more information about Amazon VPC, see the Amazon VPC User Guide.

Tasks
- Step 1: Allocate an Elastic IP Address (p. 10)
- Step 2: Create a VPC (p. 11)
- Step 3: Add a Second Private Subnet (p. 11)
- Step 4: Verify and Name the Route Tables (p. 12)

**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, choose Allocate and 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 set up a VPC

1. Open the Amazon VPC console at https://console.aws.amazon.com/vpc/.
2. In the navigation pane, choose VPC Dashboard.
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, type 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 VPC name, type a name for the VPC.
6. Configure the public subnet as follows:
   a. For IPv4 CIDR block, type the CIDR block for the subnet.
   b. For Availability Zone, keep No Preference.
   c. For Public subnet name, type 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, type the CIDR block for the subnet.
   b. For Availability Zone, select the first one in the list (for example, us-west-2a).
   c. For Private subnet name, type 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.
9. Choose Create VPC. Note that it takes several minutes to set up your VPC. After the VPC is created, choose OK.

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 subnet

1. In the navigation pane, choose Subnets.
2. Choose Create Subnet.
3. For Name tag, type a name for the private subnet (for example, WorkSpaces Private Subnet 2).
4. For VPC, select the VPC that you created.
5. For Availability Zone, select the second one in the list (for example, us-west-2b).
6. For IPv4 CIDR block, type the CIDR block for the subnet.
7. Choose Yes, Create.
Step 4: Verify and Name the Route Tables

You can verify and name the route tables that you created.

To verify the route tables

1. In the navigation pane, choose Subnets, and select the public subnet that you created.
2. On the Route Table tab, choose the ID of the route table (for example, rtb-12345678).
3. Select the route table. Type a name (for example, workspaces-public-routetable) and choose the check mark to save the name.
4. 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.
5. In the navigation pane, choose Subnets, and select the first private subnet that you created (for example, WorkSpaces Private Subnet 1).
6. On the Route Table tab, choose the ID of the route table.
7. Select the route table. Type a name (for example, workspaces-private-routetable) and choose the check mark to save the name.
8. On the Routes tab, verify that there is one route for local traffic and another route that sends all other traffic to the NAT gateway.
9. In the navigation pane, choose Subnets, and select the second private subnet that you created (for example, WorkSpaces Private Subnet 2).
10. On the Routes tab, verify that the route table is the private route table (for example, workspaces-private-routetable). If the route table is different, choose Edit and select this route table.

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.

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, select Use Proxy Server, specify the address and port of the proxy server, and choose Save.

This port must be open to the following IP address ranges:
- The AMAZON subset in the GLOBAL region.
- 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.
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 http://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 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 as follows:

- Amazon WorkSpaces Web Access will work on Chrome and Firefox even if all UDP ports are blocked except 53, 80, and 443, 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.

**Whitelisted domains and ports**

<table>
<thead>
<tr>
<th>Category</th>
<th>Whitelisted</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPTCHA</td>
<td><a href="https://opfaptcha-prod.s3.amazonaws.com/">https://opfaptcha-prod.s3.amazonaws.com/</a></td>
</tr>
<tr>
<td>Client Auto-update</td>
<td>• <a href="https://d2td7dqidi7hjx7.cloudfront.net/">https://d2td7dqidi7hjx7.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• In the AWS GovCloud (US-West) Region:</td>
</tr>
<tr>
<td></td>
<td><a href="https://s3.amazonaws.com/workspaces-client-updates/prod/pdt/windows/">https://s3.amazonaws.com/workspaces-client-updates/prod/pdt/windows/</a></td>
</tr>
<tr>
<td></td>
<td>WorkSpacesAppCast.xml</td>
</tr>
<tr>
<td>Connectivity Check</td>
<td><a href="https://connectivity.amazonworkspaces.com/">https://connectivity.amazonworkspaces.com/</a></td>
</tr>
<tr>
<td>Category</td>
<td>Whitelisted</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Device Metrics</td>
<td><a href="https://device-metrics-us-2.amazon.com/">https://device-metrics-us-2.amazon.com/</a></td>
</tr>
</tbody>
</table>
### Whitelisted Domains and Ports

<table>
<thead>
<tr>
<th>Category</th>
<th>Whitelisted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directory Settings</td>
<td>Authentication from the client to the customer directory before login to the WorkSpace:</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://d32i4gd7pg4909.cloudfront.net/prod/">https://d32i4gd7pg4909.cloudfront.net/prod/</a>&lt;region&gt;/&lt;directory ID&gt;</td>
</tr>
<tr>
<td></td>
<td>Connections from MacOS clients:</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://d32i4gd7pg4909.cloudfront.net/">https://d32i4gd7pg4909.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>Customer directory settings:</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://d21ui22avrxoh6.cloudfront.net/prod/">https://d21ui22avrxoh6.cloudfront.net/prod/</a>&lt;region&gt;/&lt;directory ID&gt;</td>
</tr>
<tr>
<td></td>
<td>Login page graphics for customer directory level co-branding:</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://d1cbg795sa4g1u.cloudfront.net/prod/">https://d1cbg795sa4g1u.cloudfront.net/prod/</a>&lt;region&gt;/&lt;directory ID&gt;</td>
</tr>
<tr>
<td></td>
<td>CSS file to style the login pages:</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://d3s98kk2h6f4oh.cloudfront.net/">https://d3s98kk2h6f4oh.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• <a href="https://dyqsoz7pkju4e.cloudfront.net/">https://dyqsoz7pkju4e.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>JavaScript file for the login pages:</td>
</tr>
<tr>
<td></td>
<td>• US East (N. Virginia) — <a href="https://d32i4gd7pg4909.cloudfront.net/">https://d32i4gd7pg4909.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• US West (Oregon) — <a href="https://d18af777lo7lp.cloudfront.net/">https://d18af777lo7lp.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• Asia Pacific (Seoul) — <a href="https://dtyv4uwohon7ynt.cloudfront.net/">https://dtyv4uwohon7ynt.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• Asia Pacific (Singapore) — <a href="https://d3qzmdy7y07pzoi.cloudfront.net/">https://d3qzmdy7y07pzoi.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• Asia Pacific (Sydney) — <a href="https://dwcpoxuuza83q.cloudfront.net/">https://dwcpoxuuza83q.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• Asia Pacific (Tokyo) — <a href="https://d2c2t8moxjihq5z1.cloudfront.net/">https://d2c2t8moxjihq5z1.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• Canada (Central) — <a href="https://d2wfbspmqmog.cloudfront.net/">https://d2wfbspmqmog.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• EU (Frankfurt) — <a href="https://d1whcm49570jwj.cloudfront.net/">https://d1whcm49570jwj.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• EU (Ireland) — <a href="https://d3pgfbbf39h4k4.cloudfront.net/">https://d3pgfbbf39h4k4.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• EU (London) — <a href="https://d16q6638mhd01s7.cloudfront.net/">https://d16q6638mhd01s7.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>• South America (São Paulo) — <a href="https://d2lh2qc5bd0q4b.cloudfront.net/">https://d2lh2qc5bd0q4b.cloudfront.net/</a></td>
</tr>
<tr>
<td>Category</td>
<td>Whitelisted</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>In the AWS GovCloud (US-West) Region:</td>
</tr>
<tr>
<td></td>
<td>• Customer directory settings:</td>
</tr>
<tr>
<td></td>
<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>
</tr>
<tr>
<td></td>
<td>• Login page graphics for customer directory level co-branding:</td>
</tr>
<tr>
<td></td>
<td><a href="https://s3.amazonaws.com/workspaces-client-assets/prod/pdt/">https://s3.amazonaws.com/workspaces-client-assets/prod/pdt/</a>&lt;directory ID&gt;</td>
</tr>
<tr>
<td></td>
<td>• CSS file to style the login pages:</td>
</tr>
<tr>
<td></td>
<td><a href="https://s3.amazonaws.com/workspaces-client-css/workspaces_v2.css">https://s3.amazonaws.com/workspaces-client-css/workspaces_v2.css</a></td>
</tr>
<tr>
<td></td>
<td>• JavaScript file for the login pages:</td>
</tr>
<tr>
<td></td>
<td>Not applicable</td>
</tr>
<tr>
<td>Forrester Log Service</td>
<td><a href="https://fls-na.amazon.com/">https://fls-na.amazon.com/</a></td>
</tr>
<tr>
<td>PCoIP Healthcheck (DRP)</td>
<td>TCP:4172 and UDP:4172 on these domains:</td>
</tr>
<tr>
<td></td>
<td>• US East (N. Virginia) — drp-iad.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• US West (Oregon) — drp-pdx.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• Asia Pacific (Seoul) — drp-icn.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• Asia Pacific (Singapore) — drp-sin.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• Asia Pacific (Sydney) — drp-syd.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• Asia Pacific (Tokyo) — drp-nrt.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• Canada (Central) — drp-yul.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• EU (Frankfurt) — drp-fra.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• EU (Ireland) — drp-dub.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• EU (London) — drp-lhr.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• South America (São Paulo) — drp-gru.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>• AWS GovCloud (US-West) — drp-pdt.amazonworkspaces.com</td>
</tr>
<tr>
<td>PCoIP Session Gateway (PSG)</td>
<td>PCoIP Gateway and Health Check Servers (p. 18)</td>
</tr>
<tr>
<td>Registration Dependency</td>
<td><a href="https://s3.amazonaws.com">https://s3.amazonaws.com</a></td>
</tr>
</tbody>
</table>
### Whitelisted Domains and Ports

#### Category

<table>
<thead>
<tr>
<th>Whitelisted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session Broker (PCM)</strong></td>
</tr>
<tr>
<td><strong>Domains:</strong></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.us-east-1.amazonaws.com">https://skylight-cm.us-east-1.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.us-west-2.amazonaws.com">https://skylight-cm.us-west-2.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.ap-northeast-2.amazonaws.com">https://skylight-cm.ap-northeast-2.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.ap-southeast-1.amazonaws.com">https://skylight-cm.ap-southeast-1.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.ap-southeast-2.amazonaws.com">https://skylight-cm.ap-southeast-2.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.ap-northeast-1.amazonaws.com">https://skylight-cm.ap-northeast-1.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.ca-central-1.amazonaws.com">https://skylight-cm.ca-central-1.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.eu-central-1.amazonaws.com">https://skylight-cm.eu-central-1.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.eu-west-1.amazonaws.com">https://skylight-cm.eu-west-1.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.eu-west-2.amazonaws.com">https://skylight-cm.eu-west-2.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.sa-east-1.amazonaws.com">https://skylight-cm.sa-east-1.amazonaws.com</a></td>
</tr>
<tr>
<td>- <a href="https://skylight-cm.us-gov-west-1.amazonaws.com">https://skylight-cm.us-gov-west-1.amazonaws.com</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>User Login Pages</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>https://&lt;directory id&gt;.awsapps.com/ (where &lt;directory id&gt; is the customer's domain)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Web Access TURN Servers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Servers:</strong></td>
</tr>
<tr>
<td>- turn:*-us-east-1.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-us-west-2.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-ap-northeast-2.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-ap-southeast-1.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-ap-southeast-2.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-ap-northeast-1.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-ca-central-1.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-eu-central-1.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-eu-west-1.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-eu-west-2.rdn.amazonaws.com</td>
</tr>
<tr>
<td>- turn:*-sa-east-1.rdn.amazonaws.com</td>
</tr>
</tbody>
</table>
**WS Broker**

**Domains:**
- https://ws-broker-service.us-east-1.amazonaws.com
- https://ws-broker-service.us-west-2.amazonaws.com
- https://ws-broker-service.ap-northeast-2.amazonaws.com
- https://ws-broker-service.ap-southeast-1.amazonaws.com
- https://ws-broker-service.ap-southeast-2.amazonaws.com
- https://ws-broker-service.ap-northeast-1.amazonaws.com
- https://ws-broker-service.ca-central-1.amazonaws.com
- https://ws-broker-service.eu-central-1.amazonaws.com
- https://ws-broker-service.eu-west-1.amazonaws.com
- https://ws-broker-service.eu-west-2.amazonaws.com
- https://ws-broker-service.sa-east-1.amazonaws.com
- https://ws-broker-service.us-gov-west-1.amazonaws.com

**PCoIP Gateway and Health Check Servers**

Amazon WorkSpaces uses PCoIP to stream the desktop session to clients over port 4172. Amazon WorkSpaces uses a small range of Amazon EC2 public IP addresses for its PCoIP gateway servers. This enables you to set more finely grained firewall policies for devices that access Amazon WorkSpaces.

<table>
<thead>
<tr>
<th>Region</th>
<th>Public IP Address Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>US East (N. Virginia)</td>
<td>52.23.61.0 - 52.23.62.255</td>
</tr>
<tr>
<td>US West (Oregon)</td>
<td>54.244.46.0 - 54.244.47.255</td>
</tr>
<tr>
<td>Asia Pacific (Seoul)</td>
<td>13.124.247.0 - 13.124.247.255</td>
</tr>
<tr>
<td>Asia Pacific (Singapore)</td>
<td>52.76.127.0 - 52.76.127.255</td>
</tr>
<tr>
<td>Asia Pacific (Sydney)</td>
<td>54.153.254.0 - 54.153.254.255</td>
</tr>
<tr>
<td>Asia Pacific (Tokyo)</td>
<td>54.250.251.0 - 54.250.251.255</td>
</tr>
<tr>
<td>Canada (Central)</td>
<td>35.183.255.0 - 35.183.255.255</td>
</tr>
<tr>
<td>EU (Frankfurt)</td>
<td>52.59.127.0 - 52.59.127.255</td>
</tr>
<tr>
<td>EU (Ireland)</td>
<td>52.19.124.0 - 52.19.125.255</td>
</tr>
</tbody>
</table>
Network Interfaces

Each WorkSpace has the following network interfaces:

- The primary network interface provides connectivity to the resources within your VPC as well as the Internet, and is used to join the WorkSpace to the directory.
- The management network 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.

Amazon WorkSpaces selects the IP address for the management network interface from various address ranges, depending on the region 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.
Do not modify or delete any of the network interfaces attached to a WorkSpace. Doing so might cause the WorkSpace to become unreachable.

**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, and 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>EU (Frankfurt)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>EU (Ireland)</td>
<td>172.31.0.0/16, 192.168.0.0/16, and 198.19.0.0/16</td>
</tr>
<tr>
<td>EU (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 port 3478 and 4172. This is used for access using the web client.
- Outbound UDP on port 55002. This is used for PCoIP streaming. If your firewall uses stateful filtering, the ephemeral port 55002 is automatically opened to allow return communication. If your firewall uses stateless filtering, you need to 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 may 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.

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.
- 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 Port Requirements for Amazon WorkSpaces (p. 12).
- 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.
• 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 can verify that a client device meets the networking requirements as follows.

**To verify client networking requirements**

1. Open the Amazon WorkSpaces client. If this is the first time you have opened the client, you are prompted to type 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.

---

**Control Access to Amazon WorkSpaces Resources**

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 Permissions and Policies in the IAM User Guide guide.

Amazon WorkSpaces also creates an IAM role to allow the Amazon WorkSpaces service access to required resources.

For more information about IAM, see Identity and Access Management (IAM) and the IAM User Guide.

**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, as well as running 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.

```json
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "workspaces:*",
                "ds:*",
                "iam:PassRole",
                "iam:GetRole",
                "iam:CreateRole",
                "iam:PutRolePolicy",
                "kms:ListAliases",
                "kms:ListKeys",
                "ec2:CreateVpc",
                "ec2:CreateSubnet",
                "ec2:CreateNetworkInterface",
                "ec2:CreateInternetGateway",
                "ecs:*",
                "s3:*"
            ],
            "Resource": "*"
        }
    ]
}
```
"ec2:CreateRouteTable",
"ec2:CreateRoute",
"ec2:CreateTags",
"ec2:CreateSecurityGroup",
"ec2:DescribeInternetGateways",
"ec2:DescribeRouteTables",
"ec2:DescribeVpcs",
"ec2:DescribeSubnets",
"ec2:DescribeNetworkInterfaces",
"ec2:DescribeAvailabilityZones",
"ec2:AttachInternetGateway",
"ec2:AssociateRouteTable",
"ec2:AuthorizeSecurityGroupEgress",
"ec2:AuthorizeSecurityGroupIngress",
"ec2:DeleteSecurityGroup",
"ec2:DeleteNetworkInterface",
"ec2:RevokeSecurityGroupEgress",
"ec2:RevokeSecurityGroupIngress",
"workdocs:RegisterDirectory",
"workdocs:DeregisterDirectory",
"workdocs:AddUserToGroup",
"workdocs:RemoveUserFromGroup"
]

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.

```
{
"Version": "2012-10-17",
"Statement": [
  {
"Effect": "Allow",
"Action": [
"workspaces:*",
"ds:*",
"iam:PutRolePolicy"
  ],
"Resource": "*"
  }
]
}
```

To also grant the user the ability to enable Amazon WorkDocs for users within Amazon WorkSpaces, add the `workdocs` operations shown here:

```
{
"Version": "2012-10-17",
"Statement": [
  {
"Effect": "Allow",
"Action": [
"workspaces:*",
"ds:*",
"workdocs:AddUserToGroup",
"workdocs:RemoveUserFromGroup"
  ],
"Resource": "*"
  }
]
}
```
Specifying Amazon WorkSpaces Resources in an IAM Policy

To specify an Amazon WorkSpaces resource in the Resource element of the policy statement, you need to 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 following syntax:

```
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 following syntax:

```
```

- **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 following syntax:

```
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 following syntax:

```
arn:aws:workspaces:region:account_id:directory/directory_identifier
```

You can use the * wildcard to specify all directories that belong to a specific account in a specific region.
The region that the WorkSpace is in (for example, us-east-2).

The ID of the AWS account, with no hyphens (for example, 123456789012).

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 following resource statement:

```
"Resource": "*"
```

**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 is supported for Windows computers and Mac computers.

### 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.
- 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/](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**.
5. [Windows] Choose **Only Allow Trusted Windows Devices to Access WorkSpaces**.
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. Choose **Update and Exit**.

Provide Internet Access from Your WorkSpace

We recommend that you launch your WorkSpaces in private subnets in your virtual private cloud (VPC) and use one of the following options to allow your WorkSpaces to access the internet:

**Options**

- Configure a NAT gateway in your VPC. For more information, see Configure a VPC for Amazon WorkSpaces (p. 9).
- Configure automatic assignment of public IP addresses. For more information, see Configure Automatic IP Addresses (p. 34).
- Manually assign public IP addresses to your WorkSpaces. For more information, see Manually Assign IP Addresses (p. 29).

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.

```json
{
  "Statement": [
    {
      "Sid": "AmazonLinux2AMIRepositoryAccess",
      "Principal": "",
      "Action": [
        "s3:GetObject"
      ],
      "Effect": "Allow",
      "Resource": [
        "arn:aws:s3:::amazonlinux..amazonaws.com/*"
      ]
    }
  ]
}
```
Manually Assign IP Addresses

You can manually assign an Elastic IP address to a WorkSpace.

Prerequisites

- Your VPC must have an attached internet gateway. For more information, see Attaching an Internet Gateway in the Amazon VPC User Guide.
- The route table for the WorkSpaces subnets must have one route for local traffic and another route that sends all other traffic to the internet gateway.

To assign an Elastic IP address to a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Expand the row 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 follow the directions.
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, Associate Address.
9. On the Associate Elastic IP Address page, choose an Elastic IP address from Address and then choose Associate Address.

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-92673056e8_controllers) and the security group for WorkSpaces has a name that consists of the directory identifier followed by _workspacesMembers (for example, d-926720fc18_workspacesMembers).

Important
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 have an additional security group for WorkSpaces. After you add the security group to the directory, it is associated with new WorkSpaces that you launch or existing WorkSpaces that you rebuild.

To add a security group to 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 **Security Group** and select a security group.
5. Choose **Update and Exit**.

### 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 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 IP addresses for the NAT gateway or VPN.

You can use this feature with Web Access and the client applications for Mac OS X, iPad, Windows, Android, and Chromebook. 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, type 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**, type the IP address or IP address range. For **Description**, type 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/](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, type a name and description for the new group and choose **Copy Group**.
5. (Optional) To modify the rules copied from the original group, select the new group and choose **Edit**. Add, update, or remove rules as needed. Choose **Save**.

**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/](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 checkbox 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 URIs 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**.

For information about setting up and connecting with a PCoIP zero client device, see **PCoIP Zero Client** in the **Amazon WorkSpaces User Guide**.
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 only displayed if Amazon WorkDocs is available in the region.
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 have any Amazon WAM applications assigned to your users, you must remove those assignments before you can delete a directory. For more information, see Removing Application Assignments in the *Amazon WAM Administration Guide*.

**To deregister 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, 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. 33)
- Configure Automatic IP Addresses (p. 34)
- Control Device Access (p. 35)
- Manage Local Administrator Permissions (p. 35)
- Update the AD Connector Account (AD Connector) (p. 35)
- Multi-factor Authentication (AD Connector) (p. 36)

**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 connected directory, or specify an OU in a separate target domain. Note that you can select only one OU per directory.

After you select a new OU, the machine accounts for all WorkSpaces that are created or rebuilt are placed in the newly selected OU.
To select an organizational unit

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 Target Domain and Organizational Unit.
5. To find an OU, you can type all or part of the OU name and choose Search OU. Alternatively, you can choose List all OU to list all OUs.
6. Select the OU and choose Update and Exit.
7. (Optional) Rebuild the existing WorkSpaces to update the OU. For more information, see Rebuild a WorkSpace (p. 62).

To specify a target domain and organizational unit

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 Target Domain and Organizational Unit.
5. For Selected OU, type the full LDAP distinguished name for the target domain and OU and then choose Update and Exit. For example, OU=WorkSpaces_machines,DC=machines,DC=example,DC=com.
6. (Optional) Rebuild the existing WorkSpaces to update the OU. For more information, see Rebuild a WorkSpace (p. 62).

Configure Automatic IP Addresses

After you enable automatic assignment of public IP addresses, each WorkSpace that you launch is assigned a public IP address. This allows the WorkSpaces to access the Internet. WorkSpaces that exist at the time you enable automatic assignment do not receive a public IP address until you rebuild them.

Note that you do not need to enable automatic assignment of public IP access if you configured your VPC with a NAT gateway. For more information, see Configure a VPC for Amazon WorkSpaces (p. 9).

Prerequisites

- Your VPC must have an attached Internet gateway. For more information, see Attaching an Internet Gateway in the Amazon VPC User Guide.
- The route table for the WorkSpaces subnets must have one route for local traffic and another route that sends all other traffic to the Internet gateway.

To configure public IP addresses

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

You can specify the types of devices that have access to WorkSpaces. In addition, you 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 Control Options and find the Other Platforms section. By default, WorkSpaces Web Access is disabled and users can access their WorkSpaces from their iOS devices, Android devices, Chromebooks, and PCoIP zero client devices.
5. Select the device types to enable and clear the device types to disable. To block access from all selected device types, choose Block.
6. (Optional) You can restrict access to trusted devices. For more information, see Restrict WorkSpaces Access to Trusted Devices (p. 26).
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 username 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/.
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.

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 applications such as Amazon WorkDocs, Amazon WorkMail, or Amazon Chime. Note that you must deregister a directory before you can delete it.

To delete 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, Deregister**.
4. When prompted for confirmation, choose **Deregister**.
5. Select the directory again and choose **Actions, Delete**.
6. When prompted for confirmation, choose **Delete**.

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. 32).
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**

1. Open the Active Directory Users and Computers tool.
2. Navigate to the *Users* folder under your domain and select the user to promote.
3. Choose *Action, Properties*.
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 use whichever Active Directory tools you are familiar with to manage user objects. Note that before you can remove a user, you must delete the WorkSpace assigned to that user. For more information, see *Delete a WorkSpace (p. 63)*.

**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.
Manage Your Windows WorkSpaces Using Group Policy

You can use Group Policy objects 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. 41).

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

Group Policy settings can affect a WorkSpace user’s experience as follows:

- Some Group Policy settings force a user to log off when they are disconnected from a session. Any applications that a user has open on the WorkSpace are closed.
- Implementing an interactive logon message to display a logon banner prevents users from being able to access their WorkSpace. The interactive logon message Group Policy setting is not currently supported by Amazon WorkSpaces.
- Group Policy can be used to restrict drive access. If you configure Group Policy to restrict access to Drive C or to Drive D, users can’t access their WorkSpace. To prevent this issue from occurring, make sure that your users can access Drive C and Drive D.

Contents
- Install the Group Policy Administrative Template (p. 38)
- Enable or Disable Local Printer Support for Windows WorkSpaces (p. 39)
- Enable or Disable Clipboard Redirection for Windows WorkSpaces (p. 39)
- Set the Session Resume Timeout for Windows WorkSpaces (p. 40)

Install the Group Policy Administrative Template

To use the Group Policy settings that are specific to Amazon WorkSpaces, you need to install the Group Policy administrative template. Perform the following procedure on a directory administration WorkSpace or Amazon EC2 instance that is joined to your 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. Open the Group Policy Management tool 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 Group Policy object, 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 Group Policy object 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.
Enable or Disable Local Printer Support for Windows WorkSpaces

By default, Amazon WorkSpaces disables local printer redirection. For Windows WorkSpaces, you can use Group Policy settings to enable this feature if needed.

**Note**
Local printer support is not available for Amazon Linux Workspaces.

The Group Policy setting change takes effect after the WorkSpace's next Group Policy settings update and the session is restarted.

**To enable or disable local printer support**

1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 38) is installed in your domain.
2. Open the Group Policy Management tool and navigate to and select the WorkSpaces Group Policy object 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 Administration Defaults.
4. Open the Configure remote printing setting.
5. In the Configure remote printing dialog box, choose Enabled or Disabled, and then choose one of the following settings:

   - 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.

**To enable local printer auto-redirection**

1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 38) is installed in your domain.
2. Open the Group Policy Management tool and navigate to and select the WorkSpaces Group Policy object 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 Administration Defaults.
4. Open the Configure remote printing setting.
5. In the Configure remote printing dialog box, choose Enabled, set or clear Automatically set default printer, and then choose OK.

Enable or Disable Clipboard Redirection for Windows WorkSpaces

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

The Group Policy setting change takes effect after the WorkSpace's next Group Policy settings update and the session is restarted.
To enable or disable clipboard redirection for Windows WorkSpaces

1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 38) is installed in your domain.
2. Open the Group Policy Management tool and navigate to and select the WorkSpaces Group Policy object 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 Administration 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

Known Limitation

With clipboard redirection enabled on the WorkSpace, if you copy content that is larger than 890KB 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 X 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.

The Group Policy setting change takes effect after the WorkSpace's next Group Policy settings update and the session is restarted.

To set the automatic session resume timeout value

1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 38) is installed in your domain.
2. Open the Group Policy Management tool and navigate to and select the WorkSpaces Group Policy object 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 Administration Defaults; otherwise, choose Not Overridable Administration 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.
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, and to 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 such as AWS Opsworks for Chef Automate, AWS OpsWorks for Puppet Enterprise, or Ansible to distribute and enforce policy.

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.

The Group Policy setting change takes effect after the WorkSpace's next Group Policy settings update and the session is restarted.

To enable or disable clipboard redirection for Amazon Linux WorkSpaces

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

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

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

   ```
   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:

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

2. Add the following line:

   ```bash
   %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.

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

2. Add the following line:

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

**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. 28).
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.

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. 43)
- Launch a WorkSpace Using Simple AD (p. 46)
- Launch a WorkSpace Using AD Connector (p. 49)
- Launch a WorkSpace Using a Trusted Domain (p. 51)

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. 43).

Tasks
- Before You Begin (p. 44)
- Step 1: Create an AWS Managed Microsoft AD Directory (p. 44)
- Step 2: Create a WorkSpace (p. 44)
- Step 3: Connect to the WorkSpace (p. 45)
- Next Steps (p. 46)
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. 9).

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, type 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 alphanumeric characters and hyphens (-), and begin or end with a character other than a hyphen.
   b. For Directory DNS, type the fully-qualified name for the directory (for example, workspaces.demo.com).
   c. For NetBIOS name, type a short name for the directory (for example, workspaces).
   d. For Admin password and Confirm password, type a password for the directory administrator account. For more information about the password requirements, see Create Your AWS Managed Microsoft AD Directory in the AWS Directory Service Administration Guide.
   e. (Optional) For Description, type a description for the directory.
   f. For VPC, select the VPC that you created.
   g. For Subnets, select the two private subnets (with the CIDR blocks 10.0.1.0/24 and 10.0.2.0/24).
   h. Choose Next Step.
5. Choose Create Microsoft AD.
6. Choose Done. The initial status of the directory is Creating. When directory creation is complete, the status is Active.

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个工作spaces/.
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.

Note
When you are connected to your WorkSpace from a Windows or MacOS client, you can toggle the fullscreen display by using following command shortcuts:

- Windows client: Ctrl+Alt+Enter
- MacOS client: Control+Option+Return

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. When prompted, download one of the client applications or, for Windows WorkSpaces, launch Web Access.
   
   Note
   You cannot use a web browser to connect to Amazon Linux WorkSpaces.

   If you aren't prompted and you haven't installed a client application already, open http://clients.amazonworkspaces.com/ and follow the directions.

3. Start the client, enter the registration code from the invitation email, and choose Register.
4. When prompted to sign in, type 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 Bundle (p. 73)
- Administer Your WorkSpaces (p. 54)
- Manage Directories for Amazon WorkSpaces (p. 32)
- Delete a WorkSpace (p. 63)

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. 43).

Tasks

- Before You Begin (p. 46)
- Step 1: Create a Simple AD Directory (p. 47)
- Step 2: Create a WorkSpace (p. 47)
- Step 3: Connect to the WorkSpace (p. 48)
- Next Steps (p. 49)

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, see the Simple AD table under 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. 9).
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**, type 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**, type the fully-qualified name for the directory (for example, example.com).
   c. For **NetBIOS name**, type a short name for the directory (for example, example).
   d. For **Admin password** and **Confirm password**, type 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**, type 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**.
5. Choose **Create Simple AD**.
6. Choose **Done**. The initial status of the directory is **Requested** and then **Creating**. When directory creation is complete, the status is **Active**.

**Directory Creation**

Amazon WorkSpaces 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`.
- Sets up a Simple AD directory in the VPC that is used to store user and WorkSpace information. The directory has an administrator account with the user name Administrator and the specified password.
- Creates two security groups, one for directory controllers and another for WorkSpaces in the directory.

### 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.

**Note**
When you are connected to your WorkSpace from a Windows or MacOS client, you can toggle the fullscreen display by using following command shortcuts:

- Windows client: Ctrl+Alt+Enter
- MacOS client: Control+Option+Return

**To connect to the WorkSpace**

1. Open the link in the invitation email. When prompted, type 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. 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 http://clients.amazonworkspaces.com/ and follow the directions.
3. Start the client, enter the registration code from the invitation email, and choose Register.
4. When prompted to sign in, type the username 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 Bundle (p. 73)
- Administer Your WorkSpaces (p. 54)
- Manage Directories for Amazon WorkSpaces (p. 32)
- Delete a WorkSpace (p. 63)

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. 43).

Tasks
- Before You Begin (p. 49)
- Step 1: Create an AD Connector (p. 49)
- Step 2: Create a WorkSpace (p. 50)
- Step 3: Connect to the WorkSpace (p. 51)
- Next Steps (p. 51)

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. 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. 28).

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, type 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, type the fully-qualified name of your on-premises directory (for example, example.com).
6. For Connected directory NetBIOS name, type the short name of your on-premises directory (for example, example).
7. For Connector account username, type 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, type the password for the on-premises user account.
9. For DNS address, type the IP address of at least one DNS server in your on-premises directory.
10. (Optional) For Description, type 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 type 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. 56)*.

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. For more information, see *Send an Invitation Email (p. 55)*.

**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.

**Note**

When you are connected to your WorkSpace from a Windows or MacOS client, you can toggle the fullscreen display by using following command shortcuts:

- Windows client: Ctrl+Alt+Enter
- MacOS client: Control+Option+Return

**To connect to the WorkSpace**

1. Open the link in the invitation email.
2. 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 [http://clients.amazonworkspaces.com/](http://clients.amazonworkspaces.com/) and follow the directions.
3. Start the client, enter the registration code from the invitation email, and choose **Register**.
4. When prompted to sign in, type the username 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 Bundle (p. 73)**
- **Administer Your WorkSpaces (p. 54)**
- **Manage Directories for Amazon WorkSpaces (p. 32)**
- **Delete a WorkSpace (p. 63)**

**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. 43).

Tasks
- Before You Begin (p. 52)
- Step 1: Establish a Trust Relationship (p. 52)
- Step 2: Create a WorkSpace (p. 52)
- Step 3: Connect to the WorkSpace (p. 53)
- Next Steps (p. 53)

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.

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:
   - For Select trust from forest, select the trust relationship that you created.
   - 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. 55).

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).

**Note**
When you are connected to your WorkSpace from a Windows or MacOS client, you can toggle the fullscreen display by using following command shortcuts:

- Windows client: Ctrl+Alt+Enter
- MacOS client: Control+Option+Return

To connect to the WorkSpace

1. Open the link in the invitation email. When prompted, type 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. 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 http://clients.amazonworkspaces.com/ and follow the directions.

3. Start the client, enter the registration code from the invitation email, and choose Register.

4. When prompted to sign in, type the username 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 Bundle (p. 73)
- Administer Your WorkSpaces (p. 54)
- Manage Directories for Amazon WorkSpaces (p. 32)
- Delete a WorkSpace (p. 63)
Administer Your WorkSpaces

You can administer your WorkSpaces using the Amazon WorkSpaces console.

Amazon WorkSpaces schedules maintenance for your WorkSpaces. During the maintenance window, the Windows operating system downloads and installs important updates. For AlwaysOn WorkSpaces, the maintenance window is each Sunday morning, from 00:00 to 04:00 in the time zone of the AWS region for the WorkSpace. During this time, your WorkSpaces might be unavailable. For AutoStop WorkSpaces, you can enable maintenance mode or install updates manually. For more information, see Set Maintenance Mode (p. 57).

Contents

• Manage WorkSpaces Users (p. 54)
• Customize How Users Log in to their WorkSpaces (p. 55)
• Manage the WorkSpace Running Mode (p. 56)
• Modify a WorkSpace (p. 58)
• Tag WorkSpaces Resources (p. 58)
• Launch an Encrypted WorkSpace (p. 59)
• Restart a WorkSpace (p. 62)
• Rebuild a WorkSpace (p. 62)
• Delete a WorkSpace (p. 63)
• Enable Self-Service WorkSpace Management Capabilities for Your Users (p. 63)
• Connect to Amazon Linux WorkSpaces by Using SSH (p. 65)
• Upgrade Windows 10 BYOL WorkSpaces (p. 68)
• Required Configuration Elements and Service Components for WorkSpaces (p. 71)

Manage WorkSpaces Users

Each WorkSpace is assigned to a single user and cannot be shared by multiple users. Whenever you launch a WorkSpace, you must assign it to a user that does not already have a WorkSpace.

As an administrator for Amazon WorkSpaces, you can use the Amazon WorkSpaces console to 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 Microsoft AD or Simple AD. If you use Microsoft Active Directory through AD Connector or a trust relationship, you can manage users and groups using Active Directory Users and Computers.

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**.

## Send an Invitation Email

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

### 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. Select the user to send the invitation to and choose **Actions, Invite User**.
4. 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.

## 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, automatically generate login URIs that registers 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.
- Their user names and multifactor authentication (MFA) code are automatically entered on their client login page, if MFA is used in your organization.

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

- Windows computers
- macOS computers
- iPads
- Android tablets

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 also supported on the Firefox and Chrome browsers on Windows and macOS computers, and on Windows computers, the Internet Explorer and Microsoft Edge browsers. For more information about WorkSpaces clients, see **Amazon WorkSpaces Clients** in the **Amazon WorkSpaces User Guide**.

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.</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>
<tr>
<td>workspaces://username@registrationcode</td>
<td>Registers a user by using their WorkSpaces registration code. Also automatically enters the user name in the <code>username</code> field on the client login page.</td>
</tr>
<tr>
<td>workspaces://username@registrationcode?mfacode=mfa</td>
<td>Registers a user by using their WorkSpaces registration code. Also automatically enters the user name in the <code>username</code> field and the multifactor authentication (MFA) code in the <code>MFA code</code> field on the client login page.</td>
</tr>
<tr>
<td>workspaces://@registrationcode?mfacode=mfa</td>
<td>Registers a user by using their WorkSpaces registration code. Also automatically enters the multifactor authentication (MFA) code in the <code>MFA code</code> field on the client login page.</td>
</tr>
</tbody>
</table>

**Note**

If users open a URI link when they are already connected to a WorkSpace from a Windows client, a new WorkSpaces session opens and their original WorkSpaces session remains open. If users open a URI link when they are connected to a WorkSpace from a macOS, iPad, or Android client, no new session opens; only their original WorkSpaces session remains open.

**Manage the WorkSpace Running Mode**

The *running mode* of a WorkSpaces 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/.
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 saved for the next time a user logs in to the WorkSpace.

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 WorkSpaces 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 associated with AutoStop WorkSpaces, remove the WorkSpace from your account. For more information, see Delete a WorkSpace (p. 63).

Set Maintenance Mode

If you enable maintenance mode for your AutoStop WorkSpaces, they are started automatically one time a month in order to download and install important service, security, and Windows updates. Unless the updates are delayed, the maintenance window is typically between 00:00 and 05:00 every day, starting on the third Monday of the month. The maintenance window might take up to two weeks. A WorkSpace can be maintained on any day in the maintenance window.

After you enable maintenance mode, ensure that your WorkSpaces are in the stopped state between 00:00 and 02:00 of the maintenance window. Otherwise, they are not maintained automatically.

If you manage updates to your WorkSpaces on a regular basis, you can disable maintenance mode.

To set maintenance mode
1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
Modify a WorkSpace

You can increase the size of the root and user volumes for a WorkSpace, up to 2000 GB each. You can expand these volumes whether they are encrypted or unencrypted. You can request a volume expansion once in a 6-hour period. To ensure that your data is preserved, you cannot decrease the size of the root or user volumes after you launch a WorkSpace.

Note
When you expand a volume for a WorkSpace, Amazon WorkSpaces automatically extends the volume's partition within Windows. However, for this change to take effect, you must restart the WorkSpace.

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 6-hour period or a smaller bundle once in 30 days. For a newly launched WorkSpace, you must wait 6 hours before requesting a larger bundle.

To modify the configuration 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 type the new values.

Note
You can only resize SSD volumes.
5. To change the bundle, choose Change Compute Type and select the new bundle type.
6. 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 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 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 value 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:
   a. To update a tag, edit the values of Key and Value.
   b. To add a tag, choose Add Tag and then edit the values of Key and Value.
   c. 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.

Launch an Encrypted WorkSpace

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 (CMK). 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 you launch a WorkSpace from the Amazon WorkSpaces console in a region, a default CMK is created for you automatically. You can select this key to encrypt the user and root volumes of your WorkSpace.

Alternately, you can select a CMK that you created using AWS KMS. For more information about creating keys, see Creating Keys in the AWS Key Management Service Developer Guide. For more information
about creating keys 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 key must be enabled.
- You must have the correct permissions and policies associated with the key. For more information, see IAM Permissions and Roles for Encryption (p. 60).

Limits

- 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.

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, choose your AWS KMS CMK.
   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

Amazon WorkSpaces encryption privileges require limited AWS KMS access on a given key for the IAM user who launches encrypted WorkSpaces. The following is a sample key policy that can be used. This policy enables you to separate the principals that can manage the AWS KMS CMK from those that can use it. The account ID and IAM user name must be modified to match your account.

The first statement matches the default AWS KMS key policy. 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 condition uses a context key that is set only for AWS KMS calls made by AWS services on behalf of the customers.
The IAM policy for a user or role that is encrypting a WorkSpace should include usage permissions on the CMK, as well as access to WorkSpaces. The following is a sample policy that can be attached to an IAM user to grant them WorkSpaces privileges.

```json
{
    "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:Put***",
                "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": "*
        },
        {
            "Effect": "Allow",
            "Principal": {"AWS": "arn:aws:iam::123456789012:user/Alice"},
            "Action": [
                "ds:*",
                "ds:DescribeDirectories",
                "ds:CreateDirectories",
                "ds:DeleteDirectories",
                "ds:TagDirectory",
                "ds:DescribeDirectories",
                "ds:TagResources"
            ],
            "Resource": "*
        }
    ]
}
```
Restart a WorkSpace

Occasionally, you might need to restart a WorkSpace manually. Restarting a WorkSpace performs a shutdown and restart of the WorkSpace. The user data, operating system, and system settings are not affected.

**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 the operating system of a WorkSpace to its original state. Rebuilding a WorkSpace causes the following to occur:

- The system is restored to the most recent image of the bundle that the WorkSpace is created from. Any applications that have been installed, or system settings that have been made after the WorkSpace was created are lost.
- The data drive (for Microsoft Windows, the D: drive; for Linux, /home) is recreated from the last automatic snapshot taken of the data drive. The current contents of the data drive is overwritten.
Automatic snapshots of the data drive are taken every 12 hours, so the snapshot can be as much as 12 hours old.

• The primary elastic network interface (ENI) is recreated. The WorkSpace receives a new private IP address.

To rebuild 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 rebuilt and choose Actions, Rebuild WorkSpace.
4. When prompted for confirmation, choose Rebuild WorkSpace.

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 (p. 77).
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. 36).
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.

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 client or OS X 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 volume size of the C: drive and D: drive 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:

   • Record me — Users can choose whether to cache their credentials on their client. 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.
   • Restart WorkSpace from client — Users can restart their WorkSpace. Restarting disconnects users 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 (C: drive) up to 175 GB, and the size of the user volume (D: drive) 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 1000, 100 to 1000].

      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. When 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.

      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. This process may take up to an hour.

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

   • Switch running mode — Users can switch their WorkSpace between the Always on and AutoStop running modes. For more information, see Manage the WorkSpace Running Mode (p. 56).

      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 may 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.
WorkSpace, and they can't use or make changes to their WorkSpace. This process may take up to an hour.

5. Choose **Update** or **Update and Exit**.

---

### Connect to Amazon Linux WorkSpaces by Using SSH

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.

---

### 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/.
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/](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:
   - **Type**: Choose **SSH**.
   - **Protocol**: TCP is automatically specified when you choose SSH.
   - **Port Range**: 22 is automatically specified when you choose SSH.
   - **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`.
   - **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 type the following command. For **NetBIOS name**, **Username**, and **WorkSpace IP**, type the applicable values.

```bash
ssh "NetBIOS_NAME\Username"@WorkSpaceIP
```

The following is an example of the SSH command where:
Upgrade Windows 10 BYOL WorkSpaces

On your Windows 10 BYOL WorkSpaces, you can upgrade your Windows 10 WorkSpace to a newer version of Windows 10 using in-place upgrade. Follow the instructions in this topic to do so.

This guidance applies only to Windows 10 BYOL WorkSpaces. WorkSpaces with the Windows 10 desktop experience are based on Windows Server 2016 and do not need regular OS release upgrades from Microsoft.

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

Prerequisites

- If you have deferred or paused Windows 10 upgrades 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. 56). To leave them set to AutoStop, change the AutoStop time to three hours or more while the upgrades take place.

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), type 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.
   - For Port, type 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, type the same password that you use when authenticating with the WorkSpaces client (your Active Directory password).

Upgrade Windows 10 BYOL WorkSpaces

On your Windows 10 BYOL WorkSpaces, you can upgrade your Windows 10 WorkSpace to a newer version of Windows 10 using in-place upgrade. Follow the instructions in this topic to do so.

This guidance applies only to Windows 10 BYOL WorkSpaces. WorkSpaces with the Windows 10 desktop experience are based on Windows Server 2016 and do not need regular OS release upgrades from Microsoft.

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

Prerequisites

- If you have deferred or paused Windows 10 upgrades 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. 56). To leave them set to AutoStop, change the AutoStop time to three hours or more while the upgrades take place.
• The in-place upgrade process re-creates the user profile by making a copy of a special profile named Default User (C:\Users\Default). To preserve custom Windows preferences and application settings stored in the Windows registry, modify C:\Users\Default\NTUSER.DAT on the WorkSpace before you perform the in-place upgrades.

To perform an in-place upgrade of Windows 10

1. Check the version of Windows 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 the in-place upgrade for the WorkSpace.

   You can do this manually. If you have multiple WorkSpaces to update, you can use Group Policy or SCCM to push a PowerShell script (p. 70).

   • 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.

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

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

   [Optional check]: Confirm that the value data for 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

4. 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 can take 40-120 minutes.

5. After the update completes, 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 check]: To confirm that the update scripts were successfully executed, verify that the value data for the following key value is set to 1.

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

After in-place upgrades, the NTUSER.DAT file of the user is regenerated and placed onto the C drive, so that you do not have to go through the above steps again for future Windows 10 in-place upgrades. WorkSpaces redirects the following shell folders to the D drive:

• D:\Users\%USERNAME%\Downloads
• D:\Users\%USERNAME%\AppData\Roaming
• D:\Users\%USERNAME%\Desktop
• D:\Users\%USERNAME%\Favorites
• D:\Users\%USERNAME%\Music
• D:\Users\%USERNAME%\Pictures
• D:\Users\%USERNAME%\Videos
• D:\Users\%USERNAME%\Documents

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

**Known Limitations**

The NTUSER.DAT location change does not happen during WorkSpaces rebuilds. If you perform an in-place upgrade on a Windows 10 BYOL WorkSpace, and then rebuild it, the new WorkSpace uses the NTUSER.DAT on the D drive. Also, if your default bundle contains the image that is based on an earlier release of Windows 10, you need to perform the in-place upgrade again after the WorkSpace is rebuilt.

**Troubleshooting**

If you encounter any issues with the update, you can check the following to troubleshoot:

- Windows Logs, which are located, by default, in the following locations:
  
  C:\Program Files\Amazon\WorkSpacesConfig\Logs\n
  C:\Program Files\Amazon\WorkSpacesConfig\Logs\TRANSMITTED

- Windows Event Viewer

  Windows Logs > Application > Source: Amazon WorkSpaces

- If, during the process, you see that some icon short-cuts on the desktop no longer work, it is because WorkSpaces moves any user profiles located on drive D to drive C to prepare for the upgrade. After the upgrade is completed, the short-cuts 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 upgrade. Follow the steps in the previous section, but use this script to update the registry on each WorkSpace.

```powershell
# AWS WorkSpaces 2.13.18
# Enable In-Place Update Sample Scripts
# These registry keys and values will enable scripts to execute on next reboot of the WorkSpace.

$scriptlist = ("update-pvdrivers.ps1","enable-inplace-upgrade.ps1")
$wsConfigRegistryRoot="HKLM:\Software\Amazon\WorkSpacesConfig"
$Enabled = 1

foreach ($scriptName in $scriptlist) {
    $scriptRegKey = "$wsConfigRegistryRoot\$scriptName"
    if (-not(Test-Path $scriptRegKey)) {
        Set-ItemProperty $scriptRegKey -Property "Enabled" -Value $Enabled
    }
}
```
Required Configuration Elements 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.

- /var/lib/skylight
- /var/lib/pcoip-agent
- /var/log/skylight
- /var/log/pcoip-agent
- /etc/pam.d/pcoip
- /etc/pam.d/pcoip-session
- /etc/X11/default-display-manager
- /etc/os-release
- /etc/profile.d/system-restart-check.sh
- /etc/yum/pluginconf.d/halt_os_update_check.conf
- /usr/lib/skylight
- /usr/lib/pcoip-agent
- /usr/lib/system.d/system/pcoip.service.d/
- /usr/lib/system.d/system/pcoip.service
- /usr/lib/system.d/system/skylight-agent.service
- /usr/lib/yum-plugins/halt_os_update_check.p
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. For more information, see Amazon WorkSpaces Bundles.

You can create an image from a Windows or Amazon Linux WorkSpace that you've customized, create a custom WorkSpace bundle from the image, and launch WorkSpaces from your custom bundle. By creating a custom bundle, you can ensure that the WorkSpaces for your users have everything that they need already installed. If you need to perform software updates or install additional software on your WorkSpaces, you can update your custom bundle and rebuild your WorkSpaces.

Contents
- Create a Custom WorkSpaces Bundle (p. 73)
- Update a Custom WorkSpaces Bundle (p. 76)
- Delete a Custom WorkSpaces Bundle (p. 77)
- Bring Your Own Windows Desktop Images (p. 77)

Create a Custom WorkSpaces Bundle

After you've launched a Windows or Amazon Linux WorkSpace and customized it, you can create an image from the WorkSpace and then create a custom bundle from the image. You can specify this bundle when you launch new WorkSpaces to ensure that they have the same configuration and software as the WorkSpace you used to create the bundle.

Important
If you plan to create an image from a Windows 10 WorkSpace, do so from one that hasn't been upgraded. 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.

Requirements to create Windows custom images
- All applications to be included in the image must be installed on the C: drive, or the user profile in D:\Users\username. They must also be compatible with Microsoft Sysprep.
  
  Note
  If you are preparing a bring your own Microsoft Windows License (BYOL) Windows 10 image, place the user profile in C:\Users\Default.
- The user profile must exist and its total size (files and data) must be less than 10 GB.
- The C: drive must have enough available space for the contents of the user profile, plus an additional 2 GB.
- 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 following components are required in an image; otherwise, the WorkSpaces you launch from the image will not function correctly:
  - PowerShell
  - Remote Desktop Services
  - AWS PV drivers
Amazon WorkSpaces Administration Guide
Create a Custom Bundle

- EC2Config or EC2Launch (Windows Server 2016)
- [EC2Launch 1.2.0 or earlier] 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

- All applications to be included in the image must be installed outside of the /home directory (or user volume).
- The root volume (/) should be less than 97% full.
- The following components are required in an image; otherwise, the WorkSpaces 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:

- Install all operating system and application updates on the WorkSpace.
- 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.

To create a 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, to update your WorkSpaces software to the latest version necessary.
   Restart your WorkSpace if needed by closing the message and following the steps in Restart a WorkSpace (p. 62). When you're done, repeat the previous step, and choose Next when this message appears.
6. Type 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 changes to Available.
8. Select the image and choose Actions, Create Bundle.
9. Type a bundle name and a description, and then do the following:
   - For Bundle Type, choose the hardware from which your WorkSpace is launched.
• For **Root Volume Size**, leave the default value or type a new value that is equal or greater than the current size. Then, type a value for **User Volume Size**.

The 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

Alternatively, you can expand the root and user volumes up to 1000 GB each.

10. Choose **Create Bundle**.

**Image Creation for Windows WorkSpaces**

When you create an image from a Windows WorkSpace, the entire contents of the C:\ drive are included. 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
Image Creation for Amazon Linux WorkSpaces

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 based on the bundle, creating an image from the WorkSpace, and updating the bundle with the new image. You can launch new WorkSpaces using the updated bundle. To update existing WorkSpaces that are based on the bundle, rebuild the WorkSpace.

To update a bundle

1. Connect to a WorkSpace that is based on the bundle and make any changes. For example, you can apply the latest operating system and application patches and install additional applications.
Alternatively, you can create a WorkSpace with the same base software package (Plus or Standard) as the image used to create the bundle and make changes.

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. Type an image name and a description, and then choose Create Image. The WorkSpace is unavailable while the image is being created.
6. In the navigation pane, choose Bundles.
7. Select the bundle and choose Actions, Update Bundle.
8. For Update WorkSpace Bundle, select the image that you created and choose Update Bundle.
9. (Optional) Rebuild the existing WorkSpaces based on the bundle. For more information, see Rebuild a WorkSpace (p. 62).

Delete a Custom WorkSpaces Bundle

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 based on the bundle have been deleted.

To delete a bundle

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Bundles.
3. Select the bundle and choose Actions, Delete Bundle.
4. When prompted for confirmation, choose Delete Bundle.

After you delete a custom bundle, you can delete the image you used to create or update the bundle.

To delete 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, Delete Image.
4. When prompted for confirmation, choose Delete Image.

Bring Your Own Windows Desktop Images

If your licensing agreement with Microsoft allows it, you can use your Windows 7, Windows 10 Enterprise, or Windows 10 Pro desktop images for your WorkSpaces. To do this, you must bring your own Windows License (BYOL) and provide a Windows 7 or Windows 10 image that meets the following requirements. To stay compliant with Microsoft licensing terms, run your Amazon 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.
To get started, open the Amazon WorkSpaces console and choose **Account Settings** to enable your account for BYOL.

**Contents**
- Requirements (p. 78)
- Windows Versions That Are Supported for BYOL (p. 79)
- Step 1: Enable BYOL for Your Account by Using the Amazon WorkSpaces Console (p. 79)
- Step 2: Run the BYOL Checker PowerShell Script on a Windows VM (p. 79)
- Step 3: Export the VM from Your Virtualization Environment (p. 81)
- Step 4: Import the VM as an Image into EC2 (p. 81)
- Step 5: Create a BYOL Image by Using the Amazon WorkSpaces Console (p. 81)
- Step 6: Create a Custom Bundle From the BYOL Image (p. 82)
- Step 7: Register a Directory for Dedicated WorkSpaces (p. 82)
- Step 8: Launch Your BYOL WorkSpaces (p. 83)

**Requirements**

Before you begin, verify the following:

- Your Microsoft licensing agreement allows Windows to be run in a virtual hosted environment.
- You will use a minimum of 200 Amazon WorkSpaces. This 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.

If you plan to use GPU-enabled (Graphics and Graphics Pro) 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. 19). At least one of the following IP address ranges must be available 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
- You have a virtual machine (VM) that runs a supported 64-bit version of Windows 7 or Windows 10. For a list of supported versions, see the next section in this topic, Windows Versions That Are Supported for BYOL (p. 79). 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 7 or Windows 10 can be installed on the VM. You can add additional software, such as an antivirus solution, when you later create a custom image.
  - If the VM is running Windows 10, the user profile must be placed in C:\Users\Default.
  - We recommend that you create a **WorkSpaces_BYOL** account with local administrator access before you share the image. The password for this account may be required later.
  - Your VM must also run PowerShell version 4 or later.
Windows Versions That Are Supported for BYOL

Your VM must run one of the following Windows versions:

- Windows 7 Service Pack 1
- Windows 10 Version 1607 (Anniversary Update)
- Windows 10 Version 1703 (Creators Update)
- Windows 10 Version 1709 (Fall Creators Update)
- Windows 10 Version 1803 (April 2018 Update)
- Windows 10 Version 1809 (October 2018 Update)

**Note**
Graphics and GraphicsPro bundles currently do not support Windows 10 Version 1809 (October 2018 Update) with BYOL.

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 CIDR blocks, within the range that you specify. If you require a specific IP address range, you can edit the search range.

   **Note**
   Specify an IP address range that is outside your internal range.
4. Choose the CIDR block that you want from the list of results, and then choose **Enable BYOL**.

   **Note**
   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. Open the following URL to download the BYOL Checker script.zip file: https://d2zdcak60k1ljz.cloudfront.net/BYOLChecker.zip.
2. When prompted, right-click the Download link and choose Save target as.
3. In the Save as dialog box, navigate to the location where you want to save the script file, and choose Save. We recommend that you create a folder in the Windows Temp folder for this purpose. For example, C:\Windows\Temp\byol.
4. When a message notifies you that the BYOL Checker script .zip file has finished downloading, choose OK to close the message.
5. Windows Explorer opens in the location where you saved the .zip file. Right-click the file, and choose Extract All.
6. In the Select a Destination and Extract Files dialog box, navigate to the location where you want to extract the script (for example, C:\Windows\Temp\byol\), and choose Extract.
7. If you created a folder for the BYOL script, you can copy the extracted files to the root of the folder.
8. Delete the original .zip files so that only the extracted files remain. Close any open applications and windows (for example, close Windows Explorer and your browser, if they are open).

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 PowerShell to make changes to your device, choose Yes.
2. At the PowerShell command prompt, type the commands required to change to the directory where the BYOL Checker script is located. For example, if the script is located in the BYOL directory, type the following commands. After each command, press Enter:

```
cd/

cd C:\Windows\Temp\byol
```

3. Type 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, type A to specify Yes for all.
5. Type 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 steps 7 and 8 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, BYOLPrevalidationlogYYYYMMDDT 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 may be helpful in troubleshooting.

11. After your VM passes all test, 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. Choose Run Sysprep. If Sysprep is successful, your VM shuts down. Otherwise, review the Sysprep logs, resolve the reported issues, and run the BYOL Checker script again.

   The most common reason that Sysprep fails is that the Modern Appx Packages are not installed for all users. Use the Remove-AppxPackage cmdlet to remove the Appx Packages.

---

**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 that is at least 10 GB and smaller than 80 GB. 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 EC2**

After you export your VM, review the VM Import/Export Requirements for importing Windows operating systems from a VM. You can use the AWS Command Line Interface (AWS CLI) import-image command or the ImportImage API operation to import your VM into Amazon EC2 as an Amazon Machine Image (AMI). 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 permissions to:
   
   - Call Amazon WorkSpaces ImportWorkspaceImage.
   - Call EC2 DescribeImages on the EC2 image that you want to use to create the BYOL image.
   - Call EC2 ModifyImageAttribute on the 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 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.
4. In the Create BYOL Image dialog box, do the following:
   - For AMI ID, click the EC2 Console link, and choose the EC2 image that you imported as described in the previous section (Step 4: Import the VM as an Image into EC2). The image name must begin with ami- and be followed by the identifier for the AMI (for example, ami-5731123e).
   - For BYOL image name, type a unique name for the image.
   - For Image description, type a description to help you quickly identify the image.
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 Bundle (p. 73).

### 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 AWS Directory Service for Microsoft Active Directory or an AD Connector directory for WorkSpaces that does not run on dedicated hardware, you can set up a new Microsoft Active 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. 43).
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. 84).

**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. 87).

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 Port Requirements for Amazon WorkSpaces (p. 12).

**Contents**

- Amazon WorkSpaces Metrics (p. 84)
- Dimensions for Amazon WorkSpaces Metrics (p. 86)
- Monitoring Example (p. 86)

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>Available²</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>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>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>Maintenance&lt;sup&gt;4&lt;/sup&gt;</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>
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.

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.

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.

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-xxxxxxxxxx.</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"
   ```

   ```json
   {  
     "MetricAlarms": [  
       {  
         "Dimensions": [  
           {  
             "Name": "DirectoryId",  
             "Value": "directory_id"
           },  
           ...  
         ]  
       },  
       ..
     ]
   }
   ```
2. Get the list of WorkSpaces in the specified directory using the `describe-workspaces` command.

```
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.

```
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. These WorkSpaces login events can be stored or archived as logs for future reference, analyzed to look for patterns, and actions can be taken on those patterns. With more visibility into where users are logged in from using the WAN IP address, you can
use policies to only allow access to files or data from WorkSpaces meeting access criteria found in the CloudWatch Event type of ‘WorkSpaces Access’. You can also analyze this data, which is available in near real-time, and perform automated actions using AWS Lambda and have policy controls to block access to files and applications from unauthorized IP addresses with policy controls.

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": "2018-07-01T17:52:51.595Z",
    "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.

- **workspacesClientProductName**
  
  - WorkSpaces Desktop client — Windows and Mac OS X clients
  - Amazon WorkSpaces Mobile client — iOS client
  - WorkSpaces Mobile client — Android clients
  - WorkSpaces Chrome client — Chromebook client
  - WorkSpaces Web client — Web Access client
  - Teradici PCoIP Zero Client, Teradici PCoIP Desktop Client, or Dell Wyse PCoIP Client — Zero Client

- **loginTime**
  
  The time at which the user logged in to the WorkSpace.

- **clientPlatform**
  
  - Android
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, type a name and description.
7. Choose Create rule.
Troubleshooting Amazon WorkSpaces Issues

The following information can help you troubleshoot issues with your WorkSpaces.

Enabling Advanced Logging

You can enable advanced logging on any WorkSpaces client to help troubleshoot issues that your users may experience when they use the client. To enable advanced logging, open the WorkSpaces client, choose the gear icon in the upper right corner of the client application, choose Advanced Settings, select the Enable Advanced Logging check box, and then choose Save. 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. These 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.

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 invalid characters in the user name (p. 90)
- Launching WorkSpaces in my connected directory often fails (p. 91)
- Launching WorkSpaces fails with an internal error (p. 91)
- My users can't connect to a Windows WorkSpace with an interactive logon banner (p. 91)
- My users are having issues when they try to log on to BYOL WorkSpaces from WorkSpaces Web Access (p. 91)
- No WorkSpaces in my directory can connect to the internet (p. 92)
- I receive a "DNS unavailable" error when I try to connect to my on-premises directory (p. 92)
- I receive a "Connectivity issues detected" error when I try to connect to my on-premises directory (p. 92)
- I receive an "SRV record" error when I try to connect to my on-premises directory (p. 93)
- My Windows WorkSpace goes to sleep when it's left idle (p. 93)
- One of my WorkSpaces has a state of "Unhealthy" (p. 93)

I can't create an Amazon Linux WorkSpace because there are invalid characters in the user name

For Amazon Linux WorkSpaces, user names can contain only 20 letters, spaces, and numbers representable in UTF-8, plus the following special characters:
Additionally, you can't use 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.

### 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 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

Implementing an interactive logon message to display a logon banner prevents users from being able to access their Windows WorkSpaces. The interactive logon message Group Policy setting is not currently supported by Amazon WorkSpaces.

### My users are having issues when they try to log on to BYOL WorkSpaces from WorkSpaces Web Access

BYOL WorkSpaces rely 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 BYOL WorkSpaces, you must configure a Group Policy setting and a Local Security Policy setting. If these two settings are not correctly configured, users may experience long logon times or black screens when they try to log on to their BYOL WorkSpaces. To configure the settings, follow these steps.

**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 establishes an RDP connection to the WorkSpace to perform maintenance tasks, the user name field is populated with the name of the administrator instead. To resolve this issue, disable the **Hide entry points for Fast User Switching** Group Policy setting. When you do so, the WorkSpaces logon agent can use the **Switch User** button to populate the user name field with the correct name.

1. Open Local Group Policy Editor by opening the command prompt as an administrator, typing `gpedit.msc`, and then pressing ENTER.
2. In the console tree, choose **Local Computer Policy**, **Computer Configuration**, **Administrative Templates**, **System**, and **Logon**.
3. Open the **Hide entry points for Fast User Switching** setting.
4. In the **Hide entry points for Fast User Switching** dialog box, choose **Disabled**, and then choose **OK**.

### To configure Local Security Policy Editor to hide the last logged on user name

By default, the list of last logged on users displays, rather than the **Switch User** button. Depending on the configuration of the WorkSpace, the list may not display the **Other User** tile. When this occurs, if the prepopulated user name isn't correct, the WorkSpaces logon agent can't populate the field with the correct name. To resolve this issue, enable the **Interactive logon: Don't display last signed-in** Local Security Policy setting.

1. Open Local Security Policy Editor by opening the command prompt as an administrator, typing `secpol.msc`, and then pressing ENTER.
2. In the console tree, choose **Security Settings**, **Local Policies**, and **Security Options**.
3. Open one of the following settings:  
   - For Windows 7 — **Interactive logon: Do not display last user name**  
   - For Windows 10 — **Interactive logon: Don’t display last signed-in**
4. In the **Properties** dialog box for the setting, choose **Enabled**, and then choose **OK**.

### 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. 28).

#### 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:

```
Connectivity issues detected: LDAP unavailable (TCP port 389) for IP: ip-address  
Kerberos/authentication unavailable (TCP port 88) for IP: ip-address  
Please ensure that the listed ports are available and retry the operation.
```

AD Connector must be able to communicate with your on-premises domain controllers via TCP and UDP over the following ports. Verify that your security groups and on-premises firewalls allow TCP and UDP communication over these ports:

- 88 (Kerberos)
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 will 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 contains 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.
One of my WorkSpaces has a state of "Unhealthy"

- 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 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.
Amazon WorkSpaces Limits

The following are the limits for Amazon WorkSpaces for your AWS account. To request a limit increase, use the Amazon WorkSpaces Limits form.

WorkSpace and Image Limits

- WorkSpaces per Region: 1
- Graphics WorkSpaces per Region: 0
- GraphicsPro WorkSpaces per Region: 0
- Images per Region: 5

IP Access Control Limits

- 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>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 Windows 7 and Windows 10 desktop images for your WorkSpaces.</td>
<td>November 16, 2018</td>
</tr>
<tr>
<td>PowerPro and Graphics Pro 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, as well as Windows 7.</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>
<tr>
<td>Amazon Linux WorkSpaces</td>
<td>You can provision Amazon Linux WorkSpaces for your users.</td>
<td>June 26, 2018</td>
</tr>
<tr>
<td>IP access control groups</td>
<td>You can control the IP addresses from which users can access their WorkSpaces.</td>
<td>April 30, 2018</td>
</tr>
<tr>
<td>In-place upgrades</td>
<td>You can upgrade your Windows 10 BYOL WorkSpaces to a newer version of Windows 10.</td>
<td>March 9, 2018</td>
</tr>
</tbody>
</table>
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 easier to switch between WorkSpaces in different directories or regions.</td>
<td>January 28, 2016</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>Change</td>
<td>Description</td>
<td>Date</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------</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 EU (Ireland)</td>
<td>Amazon WorkSpaces is available in the EU (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>