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What Is Amazon WorkSpaces?

Amazon WorkSpaces enables you to provision virtual, cloud-based Microsoft Windows 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

- 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 using Amazon WorkSpaces Application Manager (Amazon WAM).
- 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.

Architecture

Each WorkSpace is associated with the 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 (Enterprise Edition), also known as Microsoft AD. For more information, see the AWS Directory Service Administration Guide.

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

Client applications use HTTPS over port 443 for all authentication and session-related information. Client applications use port 4172 for pixel streaming to the WorkSpace and for network health checks. For more information, see Ports for Client Applications (p. 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. 16).

The following diagram shows the architecture of Amazon WorkSpaces.

Accessing Your WorkSpace

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

There are client applications for the following devices:

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

The following web browsers are supported on Windows, macOS, and Linux:

- Chrome 53 and later
- Firefox 49 and later

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

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

With Amazon WorkSpaces, you pay only for what you use. You are charged based on the bundle and the number of WorkSpaces that you launch. The pricing for Amazon WorkSpaces includes the use of Simple AD and AD Connector but not the use of 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 Microsoft AD (p. 35)
- Launch a WorkSpace Using Simple AD (p. 37)
- Launch a WorkSpace Using AD Connector (p. 40)
- Launch a WorkSpace Using a Trusted Domain (p. 42)
Get Started with Amazon WorkSpaces Quick Setup

In this tutorial, you'll learn how to provision a virtual, cloud-based Microsoft Windows desktop, known as a WorkSpace, 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.

Note
Quick Setup is not supported in the EU (Frankfurt) region.

Alternatively, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 35).

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. The user completes their profile 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.

Advanced Setup

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

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

<table>
<thead>
<tr>
<th>Bundle</th>
<th>CPU</th>
<th>Memory</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard with Windows 7</td>
<td>2 vCPU</td>
<td>4 GiB</td>
<td>50 GB</td>
</tr>
<tr>
<td>Standard with Windows 10</td>
<td>2 vCPU</td>
<td>4 GiB</td>
<td>50 GB</td>
</tr>
<tr>
<td>Standard with Windows 7 and Office 2010</td>
<td>2 vCPU</td>
<td>4 GiB</td>
<td>50 GB</td>
</tr>
<tr>
<td>Standard with Windows 7 and Office 2013</td>
<td>2 vCPU</td>
<td>4 GiB</td>
<td>50 GB</td>
</tr>
<tr>
<td>Standard with Windows 10 and Office 2016</td>
<td>2 vCPU</td>
<td>4 GiB</td>
<td>50 GB</td>
</tr>
<tr>
<td>Performance with Windows 7</td>
<td>2 vCPU</td>
<td>7.5 GiB</td>
<td>100 GB</td>
</tr>
<tr>
<td>Performance with Windows 10</td>
<td>2 vCPU</td>
<td>7.5 GiB</td>
<td>100 GB</td>
</tr>
<tr>
<td>Performance with Windows 7 and Office 2010</td>
<td>2 vCPU</td>
<td>7.5 GiB</td>
<td>100 GB</td>
</tr>
</tbody>
</table>

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

Enter User Details

<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@mycompany.com">johnd@mycompany.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:
Step 2: Connect to the WorkSpace

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

To connect to the WorkSpace

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

   ![Password entry screen]

   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**.

5. (Optional) When prompted to save your credentials, choose **Yes**.
Step 3: Clean Up (Optional)

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

To delete the WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Select your WorkSpace and choose Actions, Remove WorkSpaces.
4. When prompted for confirmation, choose Remove WorkSpaces.
5. (Optional) If you are not using the directory with another application, such as Amazon WorkDocs, Amazon WorkMail, or Amazon Chime, you can delete it as follows:
   a. In the navigation pane, choose Directories.
   b. Select your directory and choose Actions, Deregister.
   c. Select your directory again and choose Actions, Delete.
   d. When prompted for confirmation, choose Delete.
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. 17)
- Control Access to Amazon WorkSpaces Resources (p. 18)
- Restrict WorkSpaces Access to Trusted Devices (p. 22)
- Provide Internet Access from Your WorkSpace (p. 23)
- Security Groups for Your WorkSpaces (p. 24)
- Set Up PCoIP Zero Client for WorkSpaces (p. 24)

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 a Microsoft AD 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. 23). Note that WorkSpaces require an Internet connection to receive applications through Amazon WAM.
To allocate an EIP

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.
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. On the VPC Dashboard, choose Start VPC Wizard.
3. Choose VPC with Public and Private Subnets and then choose Select.
4. Configure the VPC as follows:
   a. For IPv4 CIDR block, type the CIDR block for the VPC.
   b. For VPC name, type a name for the VPC.
5. 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.
6. 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.
7. 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.
8. 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 Subnet

The VPC wizard 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 subnet.
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 the Route Tables

You can verify the route tables that the VPC Wizard created.

To verify the route tables

1. In the navigation pane, choose Subnets.
2. Select the public subnet.
3. On the Route Table tab, choose the ID of the route table (for example, rtb-12345678).
4. Select the route table. Type a name (for example, workspaces-public) and choose the save icon. 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. Clear the search filter and select the other route table for the VPC, which is listed as the main route table for the VPC. Type a name (for example, workspaces-private) and choose the save icon. 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.

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.

Port 4172 (UDP and TCP)

This port is used for streaming the WorkSpace desktop and health checks. It must be open to the PCoIP Gateway IP address ranges and health check servers in the region that the WorkSpace is in. For more information, see PCoIP Gateway and Health Check Servers (p. 15).

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 even if all UDP ports are blocked except 53, 80, and 443, using TCP connections.
- Amazon WorkSpaces Web Access will not work on Firefox if all UDP ports are blocked except 53, 80, and 443. Additional UDP ports must be open to enable streaming.

### Whitelisted Domains and Ports

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

<table>
<thead>
<tr>
<th>Category</th>
<th>Whitelisted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session Broker (PCM)</td>
<td>Domains:</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://skylight-cm.us-east-1.amazonaws.com">https://skylight-cm.us-east-1.amazonaws.com</a></td>
</tr>
<tr>
<td></td>
<td>• <a href="https://skylight-cm.us-west-2.amazonaws.com">https://skylight-cm.us-west-2.amazonaws.com</a></td>
</tr>
<tr>
<td></td>
<td>• <a href="https://skylight-cm.eu-west-1.amazonaws.com">https://skylight-cm.eu-west-1.amazonaws.com</a></td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>• <a href="https://skylight-cm.eu-west-2.amazonaws.com">https://skylight-cm.eu-west-2.amazonaws.com</a></td>
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</tr>
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<td></td>
<td>• <a href="https://skylight-cm.sa-east-1.amazonaws.com">https://skylight-cm.sa-east-1.amazonaws.com</a></td>
</tr>
<tr>
<td>PCoIP Session Gateway (PSG)</td>
<td>PCoIP Gateway and Health Check Servers (p. 15)</td>
</tr>
<tr>
<td>PCoIP Healthcheck (DRP)</td>
<td>TCP:4172 and UDP:4172 on these domains:</td>
</tr>
<tr>
<td></td>
<td>• drp-iad.amazonworkspaces.com</td>
</tr>
<tr>
<td>Category</td>
<td>Whitelisted</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>• drp-pdx.amazonworkspaces.com</td>
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<tr>
<td></td>
<td>• drp-dub.amazonworkspaces.com</td>
</tr>
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<td>• drp-fra.amazonworkspaces.com</td>
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<td></td>
<td>• drp-syd.amazonworkspaces.com</td>
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<td></td>
<td>• drp-nrt.amazonworkspaces.com</td>
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<tr>
<td></td>
<td>• drp-gru.amazonworkspaces.com</td>
</tr>
<tr>
<td></td>
<td>Device Metrics</td>
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<tr>
<td></td>
<td>• <a href="https://device-metrics-us-2.amazon.com/">https://device-metrics-us-2.amazon.com/</a></td>
</tr>
<tr>
<td></td>
<td>Forrester Log Service</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://fls-na.amazon.com/">https://fls-na.amazon.com/</a></td>
</tr>
<tr>
<td></td>
<td>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 name&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 name&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>JavaScript file for the login pages:</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://d1whcm49570jjw.cloudfront.net/">https://d1whcm49570jjw.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>CAPTCHA</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://opfcaptcha-prod.s3.amazonaws.com/">https://opfcaptcha-prod.s3.amazonaws.com/</a></td>
</tr>
<tr>
<td></td>
<td>Client Auto-update</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://d2td7dqidljx7.cloudfront.net/">https://d2td7dqidljx7.cloudfront.net/</a></td>
</tr>
<tr>
<td></td>
<td>Registration Dependency</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://s3.amazonaws.com">https://s3.amazonaws.com</a></td>
</tr>
<tr>
<td></td>
<td>Connectivity Check</td>
</tr>
<tr>
<td></td>
<td>• <a href="https://connectivity.amazonworkspaces.com/">https://connectivity.amazonworkspaces.com/</a></td>
</tr>
<tr>
<td></td>
<td>User Login Pages</td>
</tr>
<tr>
<td></td>
<td>• https://&lt;directory id&gt;.awsapps.com/ (where &lt;directory id&gt; is the customer's domain)</td>
</tr>
<tr>
<td></td>
<td>Web client</td>
</tr>
<tr>
<td></td>
<td>Outbound security group rules:</td>
</tr>
<tr>
<td></td>
<td>• TCP:8443</td>
</tr>
<tr>
<td></td>
<td>• TCP:9997</td>
</tr>
<tr>
<td></td>
<td>• UDP:4172</td>
</tr>
<tr>
<td></td>
<td>• UDP:3478</td>
</tr>
<tr>
<td></td>
<td>Inbound security group rules:</td>
</tr>
<tr>
<td></td>
<td>• TCP:4489</td>
</tr>
</tbody>
</table>
**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>EU (Ireland)</td>
<td>52.19.124.0 – 52.19.125.255</td>
</tr>
<tr>
<td>EU (Frankfurt)</td>
<td>52.59.127.0 - 52.59.127.255</td>
</tr>
<tr>
<td>EU (London)</td>
<td>35.176.32.0 - 35.176.32.255</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>South America (São Paulo)</td>
<td>54.233.204.0 - 54.233.204.255</td>
</tr>
</tbody>
</table>

The Amazon WorkSpaces client application performs PCoIP health checks over port 4172. This validates whether TCP or UDP traffic streams from the Amazon WorkSpaces servers to the client applications. To do this successfully, your firewall policies must take into account the following regional PCoIP health check servers.

<table>
<thead>
<tr>
<th>Region</th>
<th>Health check server</th>
</tr>
</thead>
<tbody>
<tr>
<td>US East (N. Virginia)</td>
<td>drp-iad.amazonworkspaces.com</td>
</tr>
<tr>
<td>US West (Oregon)</td>
<td>drp-pdx.amazonworkspaces.com</td>
</tr>
<tr>
<td>EU (Ireland)</td>
<td>drp-dub.amazonworkspaces.com</td>
</tr>
<tr>
<td>EU (Frankfurt)</td>
<td>drp-fra.amazonworkspaces.com</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 and 192.168.0.0/16</td>
</tr>
<tr>
<td>EU (Ireland)</td>
<td>172.31.0.0/16 and 192.168.0.0/16</td>
</tr>
<tr>
<td>EU (Frankfurt)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>EU (London)</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 and 192.168.0.0/16</td>
</tr>
<tr>
<td>Asia Pacific (Tokyo)</td>
<td>198.19.0.0/16</td>
</tr>
<tr>
<td>South America (São Paulo)</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 8200. This is used for management and configuration of the WorkSpace.
- 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.

Under normal circumstances, the Amazon WorkSpaces service properly 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.

- All WorkSpaces require that port 80 (HTTP) be open to IP address 169.254.169.254 to allow access to the EC2 metadata service. Any HTTP proxy assigned to your WorkSpaces must exclude 169.254.169.254.

Amazon WorkSpaces Client Network Requirements

Your Amazon WorkSpaces users access their WorkSpaces using the client application for a supported device or a web browser. To provide your users with a good experience with their WorkSpaces, verify that their client devices meet the following network requirements:
Control Access

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 client 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": [
```
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. The user can perform some tasks on the WorkSpaces directory, such as enabling or disabling the settings for Internet access, local administrator access, and maintenance mode.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "workspaces:*",
        "ds:*"
      ],
      "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:*",
        "iam:PassRole",
        "iam:GetRole",
        "iam:CreateRole",
        "iam:PutRolePolicy",
        "kms:ListAliases",
        "kms:ListKeys",
        "ec2:CreateVpc",
        "ec2:CreateSubnet",
        "ec2:CreateNetworkInterface",
        "ec2:CreateInternetGateway",
        "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"
      ],
      "Resource": "*"
    }
  ]
}
```
To also grant the user the ability to use the Launch WorkSpaces wizard, add the kms operations shown here:

```json
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "workspaces:*",
        "ds:*",
        "workdocs:AddUserToGroup",
        "workdocs:RemoveUserFromGroup"
      ],
      "Resource": "*"
    }
  ]
}
```

To grant the user the ability to perform WorkSpaces-specific tasks except for certificate tasks, add a statement to deny the certificate operations:

```json
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "workspaces:*",
        "ds:*"
      ],
      "Resource": "*"
    },
    {
      "Effect": "Deny",
      "Action": [
        "workspaces:DeleteCertificate",
        "workspaces:ImportCertificate",
        "workspaces:DescribeCertificates"
      ],
      "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 and bundles.

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.

### 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 CEDSA, SHA381 with CEDSA, or SHA512 with CEDSA.
- For macOS, if the device certificate is in the system keychain, we recommend that you authorize the WorkSpaces client application to access those certificates. Otherwise, users must enter keychain credentials when they log in or reconnect.

### Step 2: Deploy Client Certificates to the Trusted Devices

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

On Windows, the WorkSpaces client application searches for client certificates in both the user and root certificate stores. On macOS, the WorkSpaces client application searches for client certificates in the entire keychain.
Step 3: Configure the Restriction

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

To configure the restriction

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose Directories.
3. Select the directory and then choose Actions, Update Details.
4. Expand Access Control Options.
6. [macOS] Choose Only Allow Trusted macOS Devices to Access WorkSpaces.
7. Import up to two root certificates. For each root certificate, do the following:
   a. Choose Import.
   b. Copy the body of the certificate to the form.
   c. Choose Import.
8. 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. 28).
- Manually assign public IP addresses to your WorkSpaces. For more information, see Manually Assign IP Addresses (p. 23).

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.

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 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).

You have the option to 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.

Set Up PCoIP Zero Client for WorkSpaces

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

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

For information about setting up and connecting with a PCoIP zero client device, see PCoIP Zero Client in the Amazon WorkSpaces User Guide.
Amazon WorkSpaces uses a directory to store and manage information for your WorkSpaces and users. You can use one of the following options:

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

For tutorials that demonstrate how to set up these directories and launch WorkSpaces, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 35).

After you create a directory, you'll perform most directory administration tasks using tools such as the Active Directory Administration Tools. You can perform some directory administration tasks using the Amazon WorkSpaces console and other tasks using Group Policy.

**Contents**
- Register a Directory with Amazon WorkSpaces (p. 26)
- Update Directory Details for Your WorkSpaces (p. 27)
- Delete the Directory for Your WorkSpaces (p. 30)
- Set Up Active Directory Administration Tools for Amazon WorkSpaces (p. 30)
- Manage Your WorkSpaces Using Group Policy (p. 31)

## 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. 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.
6. 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. 27)
- Configure Automatic IP Addresses (p. 28)
- Control Device Access (p. 28)
- Manage Local Administrator Permissions (p. 29)
- Update the AD Connector Account (AD Connector) (p. 29)
- Multi-factor Authentication (AD Connector) (p. 29)

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. 51).

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. 51).

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. 22).

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. 26).

If you create a Microsoft AD or Simple AD with five or more WorkSpaces, we recommend that you centralize administration on an Amazon EC2 instance. Although it is possible to install the directory management tools on a WorkSpace, there are limitations, and using an 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.
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. 52).

**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 WorkSpaces Using Group Policy**

You can apply Group Policy settings to the WorkSpaces or users that are part of your WorkSpaces directory.
We recommend that you create an organizational unit for your WorkSpaces machine accounts and an organizational unit for your WorkSpaces user accounts.

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

- Depending on the number of custom Group Policy settings applied to a WorkSpace, a user's first login to their WorkSpace after it is launched or rebooted can take several minutes.
- Changes to Group Policy settings can cause an active session to be closed when a user is not connected to the WorkSpace.
- 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.

Contents
- Install the Group Policy Administrative Template (p. 32)
- Local Printer Support (p. 32)
- Clipboard Redirection (p. 33)
- Setting the Session Resume Timeout (p. 33)

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 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.
8. Close the Group Policy Management Editor. You can now use this Group Policy object to modify the Group Policy settings that are specific to Amazon WorkSpaces.

Local Printer Support

By default, Amazon WorkSpaces supports local printer redirection. You can use Group Policy settings 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 local printer support
1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 32) 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 and set the Configure remote printing option to the desired setting, enabled or disabled, and choose OK.

Clipboard Redirection
By default, Amazon WorkSpaces supports clipboard redirection. You can use Group Policy settings 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
1. Make sure that the most recent Amazon WorkSpaces Group Policy administrative template (p. 32) 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 set the Configure clipboard redirection option to the desired setting, enabled or disabled, and choose OK.

Setting the Session Resume Timeout
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 OS 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. 32) 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.
Launch a Virtual Desktop Using Amazon WorkSpaces

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

Amazon WorkSpaces uses a directory to store and manage information for your WorkSpaces and users. You can create a Simple AD directory or a Microsoft AD directory, connect to an existing Microsoft Active Directory using Active Directory Connector, or create a trust relationship between your Microsoft AD directory and your on-premises domain.

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

Tutorials
- Launch a WorkSpace Using Microsoft AD (p. 35)
- Launch a WorkSpace Using Simple AD (p. 37)
- Launch a WorkSpace Using AD Connector (p. 40)
- Launch a WorkSpace Using a Trusted Domain (p. 42)

Launch a WorkSpace Using Microsoft 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 (Enterprise Edition), also known as Microsoft AD. In addition, you can establish a trust relationship between your Microsoft AD directory and your on-premises domain.

In this tutorial, we launch a WorkSpace that uses Microsoft AD. For tutorials that use the other options, see Launch a Virtual Desktop Using Amazon WorkSpaces (p. 35).

Tasks
- Before You Begin (p. 35)
- Step 1: Create a Microsoft AD Directory (p. 36)
- Step 2: Create a WorkSpace (p. 36)
- Step 3: Connect to the WorkSpace (p. 37)
- Next Steps (p. 37)

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: Create a Microsoft AD Directory

Create a 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 a 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 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. 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 a Microsoft AD directory, you are ready to create a WorkSpace.

To create a WorkSpace

1. Open the Amazon WorkSpaces console at https://console.aws.amazon.com/workspaces/.
2. In the navigation pane, choose WorkSpaces.
3. Choose Launch WorkSpaces.
4. On the Select a Directory page, choose the directory that you created, and then choose Next Step. Amazon WorkSpaces registers your directory.
5. On the Identify Users page, add a new user to your directory as follows:
   a. Complete Username, First Name, Last Name, and Email. Use an email address that you have access to.
Step 3: Connect to the WorkSpace

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

To connect to the WorkSpace

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

2. 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. 53)
- Administer Your WorkSpaces (p. 45)
- Manage Directories for Amazon WorkSpaces (p. 26)
- Delete a WorkSpace (p. 52)

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 (Enterprise Edition), also known as Microsoft AD. In addition, you can establish a trust relationship between your 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. 35).

Tasks
- Before You Begin (p. 38)
- Step 1: Create a Simple AD Directory (p. 38)
- Step 2: Create a WorkSpace (p. 39)
- Step 3: Connect to the WorkSpace (p. 39)
- Next Steps (p. 40)

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

**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. 53)
- Administer Your WorkSpaces (p. 45)
- Manage Directories for Amazon WorkSpaces (p. 26)
- Delete a WorkSpace (p. 52)

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 (Enterprise Edition), also known as Microsoft AD. In addition, you can establish a trust
relationship between your 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. 35).

Tasks
- Before You Begin (p. 40)
- Step 1: Create an AD Connector (p. 41)
- Step 2: Create a WorkSpace (p. 41)
- Step 3: Connect to the WorkSpace (p. 42)
- Next Steps (p. 42)

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.
• 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. 23).

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 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. 46).

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. 45).

Step 3: Connect to the WorkSpace

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

To connect to the WorkSpace

1. Open the link in the invitation email.
2. 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. 53)
- Administer Your WorkSpaces (p. 45)
- Manage Directories for Amazon WorkSpaces (p. 26)
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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 (Enterprise Edition), also known as Microsoft AD. In addition, you can establish a trust relationship between your 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. 35).

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- Step 1: Establish a Trust Relationship (p. 43)
- Step 2: Create a WorkSpace (p. 43)
- Step 3: Connect to the WorkSpace (p. 44)
- Next Steps (p. 44)

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 Microsoft AD in your virtual private cloud (VPC). For more information, see How to Create a Microsoft AD directory in the AWS Directory Service Administration Guide.
2. Create a trust relationship between your 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 Microsoft AD and Your On-Premises Domain in the AWS Directory Service Administration Guide.

Step 2: Create a WorkSpace

After you establish a trust relationship between your AWS 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:
Step 3: Connect to the WorkSpace

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

**To connect to the WorkSpace**

1. Open the link in the invitation email. When prompted, 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/](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.

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- Delete a WorkSpace (p. 52)
Administer Your WorkSpaces

You can administer your WorkSpaces using the Amazon WorkSpaces console.

Amazon WorkSpaces schedules maintenance for your WorkSpaces. During the maintenance window, we download and install 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. 47).

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- Manage WorkSpaces Users (p. 45)
- Manage the WorkSpace Running Mode (p. 46)
- Modify a WorkSpace (p. 47)
- Tag a WorkSpace (p. 48)
- Encrypt a WorkSpace (p. 48)
- Reboot a WorkSpace (p. 51)
- Rebuild a WorkSpace (p. 51)
- Delete a WorkSpace (p. 52)

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.

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; all open documents and running programs return to their saved state.

For more information, see Amazon WorkSpaces Pricing.

Modify the Running Mode

You can switch between running modes at any time.

**To modify the running mode of a WorkSpace**

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

Stop and Start an AutoStop WorkSpace

When your AutoStop WorkSpaces are not in use, they are automatically stopped after a specified period of inactivity, and hourly metering is suspended. To further optimize costs, you can suspend the hourly charges associated with AutoStop WorkSpaces. The WorkSpace is stopped and all apps and data 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. 52).

Set Maintenance Mode

If you enable maintenance mode for your AutoStop WorkSpaces, they are started automatically once a month in order to download and install important service, security, and Windows updates. Unless the updates are delayed, we schedule the maintenance window for the third Monday of the month from 00:00 to 05:00 in the time zone of the region for the WorkSpace.

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 will not be 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.
3. Select your directory, and choose Actions, Update Details.
4. Expand Maintenance Mode.
5. To enable automatic updates, choose Enabled. If you manage updates manually, choose Disabled.
6. Choose Update and Exit.

Modify a WorkSpace

You can increase the size of the root and user volumes for a WorkSpace, up to 1000 GB each. You can expand these volumes whether they are encrypted or unencrypted. You can request a volume expansion once in a 24-hour period.

You can switch a WorkSpace between Value, Standard, Performance, and Power bundles. When you request a bundle change, Amazon WorkSpaces reboots 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 24-hour period or a smaller bundle once in 30 days.

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.
5. To change the bundle, choose Change Compute Type and select the new bundle type.
Tag a WorkSpace

You can organize and manage your WorkSpaces by assigning your own metadata to each WorkSpace 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.

You can apply tags to a WorkSpace when you launch it or apply them to the WorkSpace later on. Each tag automatically applies to all WAM applications and WAM related service charges for the WorkSpace. Note that tags added to existing WorkSpaces appear in your cost allocation report on the first of the following month for WorkSpaces renewed in that month. For more information, see Setting Up Your Monthly Cost Allocation Report.

Tag Restrictions

- The maximum number of tags per WorkSpace is 50.
- The maximum key length is 127 characters.
- The maximum value length is 255 characters.
- Tag keys and values are both case-sensitive.
- Tags with a prefix of "aws:" or "aws:workspaces:" cannot be used. These prefixes are reserved for AWS and WorkSpaces, respectively. Tags with these prefixes cannot be edited or deleted.

To update the tags for an existing 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, 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.

Encrypt a 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 have the option to encrypt the root volume (C: drive) and the user volume (D: drive). This 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 a 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 a 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. 49).

**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:user/Alice"
      },
      "Action": [
        "ds:*",
        "ds:DescribeDirectories"
      ],
      "Resource": "*"
    }
  ]
}
```
Reboot a WorkSpace

Occasionally, you may find it necessary to reboot a WorkSpace manually. Rebooting a WorkSpace performs a shutdown and restart of the WorkSpace. The user data, operating system, and system settings are not affected.

To reboot 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 rebooted 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 (D drive) 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.
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 will be destroyed. If you need guidance on 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. 55).
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. 30).
7. (Optional) After you delete all resources in the virtual private cloud (VPC) for your directory service, you can delete the VPC and release the Elastic IP address used for the NAT gateway.
WorkSpace Bundles and Images

A WorkSpace bundle specifies the hardware and software for your WorkSpace. 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 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.

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- Update a Custom WorkSpaces Bundle (p. 55)
- Delete a Custom WorkSpaces Bundle (p. 55)
- Bring Your Own Windows Desktop Images (p. 56)

Create a Custom WorkSpaces Bundle

After you've launched a 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.

Requirements
- 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.
- 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
  - 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
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).

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. Type an image name and a description that will help you identify the image, and then choose Create Image. The WorkSpace is unavailable while the image is being created.
6. In the navigation pane, choose Images. The image is complete when the status changes to Available.
7. Select the image and choose Actions, Create Bundle.
8. Type a bundle name and a description, select a hardware type, and choose Create Bundle.

Image Creation

When you create an image, 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\n- appdata\roaming\apple computer\logs\n- appdata\roaming\apple computer\itunes\iphone software updates\n- appdata\roaming\macromedia\flash player\macromedia.com\support\flashplayer\sys\n- appdata\roaming\macromedia\flash player\#sharedobjects\n- appdata\roaming\adobe\flash player\assetcache\n- appdata\roaming\microsoft\windows\recent\n- appdata\roaming\microsoft\office\recent\n- appdata\roaming\microsoft office\live meeting
- appdata\roaming\microsoft shared\livemeeting shared\
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. 51).

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 or Windows 10 Enterprise or Professional desktop images for your WorkSpaces. To do this, you must bring your own Microsoft Windows License (BYOL) and provide a Windows 7 or Windows 10 image that meets the requirements listed below. To stay compliant with Microsoft licensing terms, you must run your Amazon WorkSpaces on hardware that is dedicated to you on the AWS cloud. By bringing your own license, you can save money and provide a consistent experience for your users. For more information, see Amazon WorkSpaces Pricing.

**Requirements**

Before you begin, do the following:

- Review the prerequisites and limitations for importing Windows operating systems from a VM. For more information, see Importing a VM as an Image.
- Verify that your Microsoft licensing agreement allows Windows to be run in a virtual hosted environment.
- Verify that your Windows operating system is 64-bit and activated against your key management servers.
- Verify that your Windows operating system has "English (United States)" as the primary language.
- Verify that your base image contains no additional software beyond what comes with Windows 7 or Windows 10. You can add additional software, like an anti-virus solution, and create a custom image later on.
- Run Sysprep to prepare the image.
- Create the following account with local administrator access before you share the image: WorkSpaces_BYOL. The password for this account will be requested at a later time.
- Verify that the image that you are importing is on a single volume that is smaller than 80 GB, and the format of the image is OVA.
- Amazon WorkSpaces uses a management interface. It's 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. 16). Confirm that Amazon WorkSpaces can use a /16 range for the management interface in at least one of the following IP ranges:
  - 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 must use a minimum of 200 Amazon WorkSpaces in order to run your Amazon WorkSpaces on dedicated hardware. Running your Amazon WorkSpaces on dedicated hardware is necessary to comply with Microsoft licensing requirements.

Getting Started

To get started, contact your AWS account manager or Sales representative, or create a Technical Support case for Amazon WorkSpaces. Your contact will verify whether you have enough dedicated capacity allocated to your account and guide you through BYOL setup.
Monitoring Amazon WorkSpaces

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).

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- Monitoring Example (p. 60)

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>Available¹</td>
<td>The number of WorkSpaces that returned a healthy status.</td>
<td>DirectoryId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WorkspaceId</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unhealthy¹</td>
<td>The number of WorkSpaces that returned an unhealthy status.</td>
<td>DirectoryId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WorkspaceId</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ConnectionAttempt²</td>
<td>The number of connection attempts.</td>
<td>DirectoryId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WorkspaceId</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ConnectionSuccess²</td>
<td>The number of successful connections.</td>
<td>DirectoryId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WorkspaceId</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ConnectionFailure²</td>
<td>The number of failed connections.</td>
<td>DirectoryId</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WorkspaceId</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SessionLaunchTime²</td>
<td>The amount of time it takes to initiate a</td>
<td>DirectoryId</td>
<td>Average, Sum, Maximum,</td>
<td>Second (time)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WorkspaceID</td>
<td>Minimum, Data Samples</td>
<td></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>InSessionLatency²</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>SessionDisconnect²</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>UserConnected³</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>Maintenance⁴</td>
<td>The number of WorkSpaces that are under maintenance.</td>
<td>DirectoryID, WorkspaceID</td>
<td>Average, Sum, Maximum, Minimum, Data Samples</td>
<td>Count</td>
</tr>
</tbody>
</table>

¹ Amazon WorkSpaces periodically sends status requests to a WorkSpace. A WorkSpace is marked Available when it responds to these requests, and Unhealthy when it fails to respond to these requests. These metrics are available at a per-WorkSpace granularity, and also aggregated for all WorkSpaces in an organization.

² Amazon WorkSpaces records metrics on connections made to each WorkSpace. These metrics are emitted after a user has successfully authenticated via the WorkSpaces client and the client then initiates a session. The metrics are available at a per-WorkSpace granularity, and also aggregated for all WorkSpaces in a directory.

³ Amazon WorkSpaces periodically sends connection status requests to a WorkSpace. Users are reported as connected when they are actively using their sessions. This metric is available at a per-WorkSpace granularity, and is also aggregated for all WorkSpaces in an organization.

⁴ This metric applies to WorkSpaces that are configured with an AutoStop running mode. If you have maintenance enabled for your WorkSpaces, this metric captures the number of WorkSpaces that are currently under maintenance. This metric is available at a per-WorkSpace granularity, which describes when a WorkSpace went into maintenance and when it was removed.

**Dimensions for Amazon WorkSpaces Metrics**

Amazon WorkSpaces metrics are available for the following dimensions.
Monitoring Example

The following example demonstrates how you can use the AWS CLI to respond to a CloudWatch alarm and determine which WorkSpaces in a directory have experienced connection failures.

To respond to a CloudWatch alarm

1. Determine which directory the alarm applies to using the `describe-alarms` command.

   ```bash
   aws cloudwatch describe-alarms --state-value "ALARM"
   {
   "MetricAlarms": [
   {
   ...,
   "Dimensions": [
   {
   "Name": "DirectoryId",
   "Value": "directory_id"
   },
   ...,
   }
   ]
   }
   }
   ```

2. Get the list of WorkSpaces in the specified directory using the `describe-workspaces` command.

   ```bash
   aws workspaces describe-workspaces --directory-id directory_id
   {
   "Workspaces": [
   {
   ...,
   "WorkspaceId": "workspace1_id",
   ...,
   }
   {
   ...,
   "WorkspaceId": "workspace2_id",
   ...,
   }
   {
   ...,
   "WorkspaceId": "workspace3_id",
   ...,
   }
   ]
   }
   ```
3. Get the CloudWatch metrics for each WorkSpace in the directory using the `get-metric-statistics` command.

```bash
aws cloudwatch get-metric-statistics \
  --namespace AWS/WorkSpaces \
  --metric-name ConnectionFailure \
  --start-time 2015-04-27T00:00:00Z \
  --end-time 2015-04-28T00:00:00Z \
  --period 3600 \
  --statistics Sum \
  --dimensions "Name=WorkspaceId,Value=workspace_id"

{
  "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"
}
```
Troubleshooting Amazon WorkSpaces Issues

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

Issues

- Launching WorkSpaces in my connected directory often fails (p. 62)
- Launching WorkSpaces fails with an internal error (p. 62)
- Can't connect to a WorkSpace with an interactive logon banner (p. 62)
- No WorkSpaces in my directory can connect to the Internet (p. 63)
- I receive a "DNS unavailable" error when I try to connect to my on-premises directory (p. 63)
- I receive a "Connectivity issues detected" error when I try to connect to my on-premises directory (p. 63)
- I receive an "SRV record" error when I try to connect to my on-premises directory (p. 63)
- One of my WorkSpaces has a state of "Unhealthy" (p. 64)
- The state of my apps was not saved when my WorkSpace was stopped (p. 64)

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.

Can't connect to a WorkSpace with an interactive logon banner

Implementing an interactive logon message to display a logon banner prevents users from being able to access their WorkSpaces. The interactive logon message Group Policy setting is not currently supported by Amazon WorkSpaces.
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. 23).

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:

\[
\text{DNS unavailable (TCP port 53) for IP: dns-ip-address}
\]

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:

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

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)
- 389 (LDAP)

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:

\[
\text{SRV record for LDAP does not exist for IP: dns-ip-address}
\text{SRV record for Kerberos does not exist for IP: dns-ip-address}
\]

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.

One of my WorkSpaces has a state of "Unhealthy"

The Amazon WorkSpaces service periodically sends status requests to a WorkSpace. A WorkSpace is marked Unhealthy when it fails to respond to these requests. Common causes for this problem are:

- An application on the WorkSpace is blocking network ports which prevents the WorkSpace from responding to the status request.
- High CPU utilization is preventing the WorkSpace from responding to the status request in a timely manner.
- The computer name of the WorkSpace has been changed. This prevents a secure channel from being established between Amazon WorkSpaces and the WorkSpace.

You can attempt to correct the situation using the following methods:

- Reboot the WorkSpace from the Amazon WorkSpaces console.
- Connect to the unhealthy WorkSpace using the following procedure, which should be used only for troubleshooting purposes:
  1. Connect to an operational WorkSpace in the same directory as the unhealthy WorkSpace.
  2. From the operational WorkSpace, use Remote Desktop Protocol (RDP) to connect to the unhealthy WorkSpace using the IP address of the unhealthy WorkSpace. Depending on the extent of the problem, you might not be able to connect to the unhealthy WorkSpace.
  3. On the unhealthy WorkSpace, confirm that the minimum port requirements 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.

The state of my apps was not saved when my WorkSpace was stopped

To save the state of your apps, you must have enough free space on the root volume of your WorkSpace to store the total memory offered on the WorkSpace bundle. For example, a Standard Workspace has 4 GB of memory, so you must have 4 GB of free space on the root volume of the WorkSpace.

Also, if the Amazon WorkSpaces service could not communicate with the WorkSpace when a stop request is issued, it will force shut down the operating system and the state of the apps will not be saved.
Amazon WorkSpaces Limits

The following are the limits for Amazon WorkSpaces, per region. To request a limit increase, use the Amazon WorkSpaces Limits form.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>WorkSpaces</td>
<td>1</td>
</tr>
<tr>
<td>Graphics WorkSpaces</td>
<td>0</td>
</tr>
<tr>
<td>Images</td>
<td>5</td>
</tr>
</tbody>
</table>
# Document History

The following table describes important additions to the Amazon WorkSpaces service and its documentation set. We also update the documentation frequently to address the feedback that you send us.

<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. For more information, see Modify a WorkSpace (p. 47).</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. For more information, see Modify a WorkSpace (p. 47).</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). For more information, see Control Device Access (p. 28).</td>
<td>June 19, 2017</td>
</tr>
<tr>
<td>Inter-forest trusts</td>
<td>You can establish a trust relationship between your AWS Microsoft AD and your on-premises Microsoft Active Directory domain and then provision WorkSpaces for users in the on-premises domain. For more information, see Launch a WorkSpace Using a Trusted Domain (p. 42).</td>
<td>February 9, 2017</td>
</tr>
<tr>
<td>Hourly WorkSpaces</td>
<td>You can configure your WorkSpaces so that users are billed by the hour. For more information, see Manage the WorkSpace Running Mode (p. 46).</td>
<td>August 18, 2016</td>
</tr>
<tr>
<td>Tagging support</td>
<td>You can now use tags to manage and track your WorkSpaces. For more information, see Tag a WorkSpace (p. 48).</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</td>
<td>Bring your Windows 7 Desktop License to Amazon WorkSpaces (BYOL).</td>
<td>October 1, 2015</td>
</tr>
<tr>
<td>Chromebook client</td>
<td>Use the Chromebook client.</td>
<td></td>
</tr>
<tr>
<td>WorkSpace encryption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>Description</td>
<td>Date</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Change</td>
<td>Use WorkSpace encryption (see Encrypt a WorkSpace (p. 48)).</td>
<td></td>
</tr>
<tr>
<td>CloudWatch monitoring</td>
<td>Added information about CloudWatch monitoring. For more information, see Monitoring Amazon WorkSpaces (p. 58).</td>
<td>April 28th, 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 31st, 2015</td>
</tr>
<tr>
<td>Public IP addresses</td>
<td>Added support for automatically assigning a public IP address to your WorkSpaces. For more information, see Configure Automatic IP Addresses (p. 28).</td>
<td>January 23rd, 2015</td>
</tr>
<tr>
<td>Amazon WorkSpaces launched in Asia Pacific (Singapore)</td>
<td>Amazon WorkSpaces is now available in the Asia Pacific (Singapore) region.</td>
<td>January 15th, 2015</td>
</tr>
<tr>
<td>Value bundle added</td>
<td>The Value bundle is now available.</td>
<td>November 6th, 2014</td>
</tr>
<tr>
<td>Standard bundle updates</td>
<td>The Standard bundle hardware has been upgraded.</td>
<td></td>
</tr>
<tr>
<td>Office 2013 added</td>
<td>Microsoft Office 2013 is now available in Plus packages.</td>
<td></td>
</tr>
<tr>
<td>Image and bundle support</td>
<td>Added support for images and custom bundles. For more information, see WorkSpace Bundles and Images (p. 53).</td>
<td>October 28th, 2014</td>
</tr>
<tr>
<td>PCoIP zero client support</td>
<td>You can now access Amazon WorkSpaces PCoIP zero client devices.</td>
<td>October 15th, 2014</td>
</tr>
<tr>
<td>Amazon WorkSpaces launched in Asia Pacific (Tokyo)</td>
<td>Amazon WorkSpaces is now available in the Asia Pacific (Tokyo) region.</td>
<td>August 26th, 2014</td>
</tr>
<tr>
<td>Local printer support</td>
<td>Added support for local printers.</td>
<td>August 26th, 2014</td>
</tr>
<tr>
<td>Multi-factor authentication</td>
<td>Added support for multi-factor authentication in connected directories.</td>
<td>August 11th, 2014</td>
</tr>
<tr>
<td>Default OU support</td>
<td>You can now select a default Organizational Unit (OU) where your WorkSpace machine accounts are placed.</td>
<td>July 7th, 2014</td>
</tr>
<tr>
<td>Target domain support</td>
<td>You can now select a separate domain where your WorkSpace machine accounts are created.</td>
<td>July 7th, 2014</td>
</tr>
<tr>
<td>Add security group</td>
<td>The ability to add a security group to your WorkSpaces. For more information, see Security Groups for Your WorkSpaces (p. 24).</td>
<td>July 7th, 2014</td>
</tr>
<tr>
<td>Amazon WorkSpaces launched in Asia Pacific (Sydney)</td>
<td>Amazon WorkSpaces is now available in the Asia Pacific (Sydney) region.</td>
<td>May 15th, 2014</td>
</tr>
<tr>
<td>Amazon WorkSpaces launched in EU (Ireland)</td>
<td>Amazon WorkSpaces is now available in the EU (Ireland) region.</td>
<td>May 5th, 2014</td>
</tr>
<tr>
<td>Public beta</td>
<td>Amazon WorkSpaces is now available as a public beta.</td>
<td>March 25th, 2014</td>
</tr>
</tbody>
</table>