

Table of Contents

| | |
|--|----|
| What is Amazon EC2? | 1 |
| Features of Amazon EC2 | 1 |
| How to get started with Amazon EC2 | 1 |
| Related services | 2 |
| Accessing Amazon EC2 | 3 |
| Pricing for Amazon EC2 | 3 |
| PCI DSS compliance | 4 |
| Instances and AMIs | 4 |
| Instances | 5 |
| AMIs | 6 |
| Regions and Zones | 6 |
| Regions | 7 |
| Availability Zones | 12 |
| Local Zones | 14 |
| Wavelength Zones | 16 |
| AWS Outposts | 18 |
| Root device volume | 19 |
| Root device storage concepts | 20 |
| Choosing an AMI by root device type | 21 |
| Determining the root device type of your instance | 22 |
| Changing the root volume to persist | 22 |
| Setting up | 26 |
| Sign up for AWS | 26 |
| Create a key pair | 26 |
| Create a security group | 27 |
| Getting started tutorial | 30 |
| Overview | 30 |
| Prerequisites | 31 |
| Step 1: Launch an instance | 31 |
| Step 2: Connect to your instance | 32 |
| Step 3: Clean up your instance | 32 |
| Next steps | 32 |
| Best practices | 34 |
| Tutorials | 36 |
| Install a LAMP Server (Amazon Linux 2) | 36 |
| Step 1: Prepare the LAMP Server | 36 |
| Step 2: Test Your LAMP Server | 40 |
| Step 3: Secure the Database Server | 41 |
| Step 4: (Optional) Install phpMyAdmin | 42 |
| Troubleshooting | 45 |
| Related Topics | 45 |
| Install a LAMP Server (Amazon Linux AMI) | 46 |
| Step 1: Prepare the LAMP Server | 46 |
| Step 2: Test Your Lamp Server | 50 |
| Step 3: Secure the Database Server | 51 |
| Step 4: (Optional) Install phpMyAdmin | 52 |
| Troubleshooting | 55 |
| Related Topics | 56 |
| Tutorial: Hosting a WordPress Blog | 56 |
| Prerequisites | 57 |
| Install WordPress | 57 |
| Next Steps | 63 |
| Help! My Public DNS Name Changed and now my Blog is Broken | 64 |
| Tutorial: Configure SSL/TLS on Amazon Linux 2 | 65 |

| | |
|--|-----|
| Prerequisites | 66 |
| Step 1: Enable TLS on the Server | 66 |
| Step 2: Obtain a CA-signed Certificate | 68 |
| Step 3: Test and Harden the Security Configuration | 73 |
| Troubleshooting | 75 |
| Certificate Automation: Let's Encrypt with Certbot on Amazon Linux 2 | 76 |
| Tutorial: Configure SSL/TLS on Amazon Linux | 80 |
| Prerequisites | 80 |
| Step 1: Enable TLS on the Server | 81 |
| Step 2: Obtain a CA-signed Certificate | 82 |
| Step 3: Test and Harden the Security Configuration | 87 |
| Troubleshooting | 89 |
| Certificate Automation: Let's Encrypt with Certbot on Amazon Linux | 89 |
| Tutorial: Increase the Availability of Your Application | 92 |
| Prerequisites | 93 |
| Scale and Load Balance Your Application | 94 |
| Test Your Load Balancer | 95 |
| Amazon Machine Images | 97 |
| Using an AMI | 97 |
| Creating your own AMI | 97 |
| Buying, sharing, and selling AMIs | 98 |
| Deregistering your AMI | 98 |
| Amazon Linux 2 and Amazon Linux AMI | 98 |
| AMI types | 98 |
| Launch permissions | 99 |
| Storage for the root device | 99 |
| Virtualization types | 101 |
| Finding a Linux AMI | 104 |
| Finding a Linux AMI using the Amazon EC2 console | 104 |
| Finding an AMI using the AWS CLI | 105 |
| Finding the latest Amazon Linux AMI using Systems Manager | 105 |
| Using a Systems Manager parameter to find an AMI | 106 |
| Finding a Quick Start AMI | 108 |
| Shared AMIs | 109 |
| Finding shared AMIs | 110 |
| Making an AMI public | 112 |
| Sharing an AMI with specific AWS accounts | 113 |
| Using bookmarks | 115 |
| Guidelines for shared Linux AMIs | 115 |
| Paid AMIs | 119 |
| Selling your AMI | 120 |
| Finding a paid AMI | 120 |
| Purchasing a paid AMI | 121 |
| Getting the product code for your instance | 121 |
| Using paid support | 122 |
| Bills for paid and supported AMIs | 122 |
| Managing your AWS Marketplace subscriptions | 122 |
| Creating an Amazon EBS-backed Linux AMI | 123 |
| Overview of creating Amazon EBS-backed AMIs | 123 |
| Creating a Linux AMI from an instance | 124 |
| Creating a Linux AMI from a snapshot | 126 |
| Creating an instance store-backed Linux AMI | 126 |
| Overview of the creation process for instance store-backed AMIs | 127 |
| Prerequisites | 127 |
| Setting up the AMI tools | 128 |
| Creating an AMI from an instance store-backed instance | 130 |
| Converting to an Amazon EBS-Backed AMI | 138 |

| | |
|--|-----|
| AMI tools reference | 140 |
| Using encryption with EBS-backed AMIs | 157 |
| Instance-launching scenarios | 158 |
| Image-copying scenarios | 161 |
| Copying an AMI | 163 |
| Permissions for copying an instance store-backed AMI | 164 |
| Cross-Region copying | 164 |
| Cross-account copying | 165 |
| Encryption and copying | 166 |
| Copying an AMI | 167 |
| Stopping a pending AMI copy operation | 168 |
| Obtaining billing information | 168 |
| AMI billing information fields | 169 |
| Platform details and usage operation values | 169 |
| Viewing platform details and usage operation values | 170 |
| Confirm billing information on your bill | 171 |
| Deregistering your Linux AMI | 171 |
| Cleaning up your Amazon EBS-backed AMI | 172 |
| Cleaning up your instance store-backed AMI | 174 |
| Amazon Linux | 175 |
| Amazon Linux availability | 175 |
| Connecting to an Amazon Linux instance | 176 |
| Identifying Amazon Linux images | 176 |
| AWS command line tools | 177 |
| Package repository | 178 |
| Extras library (Amazon Linux 2) | 180 |
| Accessing source packages for reference | 181 |
| cloud-init | 181 |
| Subscribing to Amazon Linux notifications | 183 |
| Running Amazon Linux 2 as a virtual machine onpremises | 184 |
| Kernel Live Patching on Amazon Linux 2 | 188 |
| User provided kernels | 193 |
| HVM AMIs (GRUB) | 193 |
| Paravirtual AMIs (PV-GRUB) | 194 |
| Using the MATE desktop environment | 199 |
| Instances | 200 |
| Instance types | 200 |
| Available instance types | 201 |
| Hardware specifications | 204 |
| AMI virtualization types | 204 |
| Instances built on the Nitro System | 205 |
| Networking and storage features | 205 |
| Instance limits | 208 |
| General purpose | 208 |
| Compute optimized | 253 |
| Memory optimized | 259 |
| Storage optimized | 271 |
| Accelerated computing | 277 |
| Finding an instance type | 292 |
| Changing the instance type | 293 |
| Getting recommendations | 297 |
| Instance purchasing options | 299 |
| Determining the instance lifecycle | 300 |
| On-Demand Instances | 301 |
| Reserved Instances | 304 |
| Scheduled Instances | 342 |
| Spot Instances | 346 |

| | |
|--|-----|
| Dedicated Hosts | 430 |
| Dedicated Instances | 460 |
| On-Demand Capacity Reservations | 466 |
| Instance lifecycle | 483 |
| Instance launch | 485 |
| Instance stop and start (Amazon EBS-backed instances only) | 485 |
| Instance hibernate (Amazon EBS-backed instances only) | 486 |
| Instance reboot | 486 |
| Instance retirement | 486 |
| Instance termination | 487 |
| Differences between reboot, stop, hibernate, and terminate | 487 |
| Launch | 488 |
| Connect | 554 |
| Stop and start | 577 |
| Hibernate | 580 |
| Reboot | 591 |
| Retire | 592 |
| Terminate | 595 |
| Recover | 601 |
| Configure instances | 602 |
| Common configuration scenarios | 602 |
| Managing software | 603 |
| Managing users | 608 |
| Processor state control | 610 |
| Setting the Time | 616 |
| Optimizing CPU options | 620 |
| Changing the hostname | 636 |
| Setting up dynamic DNS | 639 |
| Running commands at launch | 640 |
| Instance metadata and user data | 646 |
| Elastic Inference | 677 |
| Identify Instances | 678 |
| Inspecting the Instance Identity Document | 678 |
| Inspecting the System UUID | 678 |
| Monitoring | 680 |
| Automated and manual monitoring | 681 |
| Automated monitoring tools | 681 |
| Manual monitoring tools | 682 |
| Best practices for monitoring | 682 |
| Monitoring the status of your instances | 683 |
| Instance status checks | 683 |
| Scheduled events | 688 |
| Monitoring your instances using CloudWatch | 699 |
| Enable detailed monitoring | 699 |
| List available metrics | 701 |
| Get statistics for metrics | 711 |
| Graph metrics | 719 |
| Create an alarm | 719 |
| Create alarms that stop, terminate, reboot, or recover an instance | 720 |
| Automating Amazon EC2 with CloudWatch Events | 729 |
| Monitoring memory and disk metrics | 729 |
| CloudWatch agent | 730 |
| CloudWatch monitoring scripts | 730 |
| Logging API calls with AWS CloudTrail | 737 |
| Amazon EC2 and Amazon EBS information in CloudTrail | 737 |
| Understanding Amazon EC2 and Amazon EBS log file entries | 738 |
| Auditing users that connect via EC2 Instance Connect | 739 |

| | |
|---|-----|
| Networking | 741 |
| Instance IP addressing | 741 |
| Private IPv4 addresses and internal DNS hostnames | 741 |
| Public IPv4 addresses and external DNS hostnames | 742 |
| Elastic IP addresses (IPv4) | 743 |
| Amazon DNS server | 743 |
| IPv6 addresses | 743 |
| Working with IP addresses for your instance | 744 |
| Multiple IP addresses | 748 |
| Bring your own IP addresses | 756 |
| Requirements | 756 |
| Prepare to bring your address range to your AWS account | 757 |
| Provision the address range for use with AWS | 759 |
| Advertise the address range through AWS | 760 |
| Work with your address range | 760 |
| Deprovision the address range | 761 |
| Elastic IP addresses | 762 |
| Elastic IP address basics | 762 |
| Working with Elastic IP addresses | 763 |
| Using reverse DNS for email applications | 768 |
| Elastic IP address limit | 769 |
| Network interfaces | 769 |
| Network interface basics | 770 |
| IP addresses per network interface per instance type | 771 |
| Scenarios for network interfaces | 782 |
| Best practices for configuring network interfaces | 784 |
| Working with network interfaces | 785 |
| Requester-managed network interfaces | 794 |
| Enhanced networking | 795 |
| Enhanced networking types | 795 |
| Enabling enhanced networking on your instance | 796 |
| Enhanced networking: ENA | 796 |
| Enhanced networking: Intel 82599 VF | 808 |
| Troubleshooting ENA | 814 |
| Elastic Fabric Adapter | 820 |
| EFA basics | 821 |
| Supported interfaces and libraries | 822 |
| Supported instance types | 822 |
| Supported AMIs | 822 |
| EFA limitations | 823 |
| Getting started with EFA and MPI | 823 |
| Getting started with EFA and NCCL | 831 |
| Working with EFA | 846 |
| Monitoring an EFA | 849 |
| Verifying the EFA installer using a checksum | 849 |
| Placement groups | 850 |
| Cluster placement groups | 851 |
| Partition placement groups | 852 |
| Spread placement groups | 853 |
| Placement group rules and limitations | 853 |
| Creating a placement group | 854 |
| Tagging a placement group | 855 |
| Launching instances in a placement group | 858 |
| Describing instances in a placement group | 859 |
| Changing the placement group for an instance | 860 |
| Deleting a placement group | 861 |
| Network MTU | 862 |

| | |
|---|------|
| Jumbo frames (9001 MTU) | 862 |
| Path MTU Discovery | 863 |
| Check the path MTU between two hosts | 863 |
| Check and set the MTU on your Linux instance | 864 |
| Troubleshooting | 864 |
| Virtual private clouds | 865 |
| Amazon VPC documentation | 865 |
| EC2-Classic | 865 |
| Detecting supported platforms | 865 |
| Instance types available in EC2-Classic | 867 |
| Differences between instances in EC2-Classic and a VPC | 867 |
| Sharing and accessing resources between EC2-Classic and a VPC | 872 |
| ClassicLink | 873 |
| Migrating from EC2-Classic to a VPC | 885 |
| Security | 894 |
| Infrastructure security | 894 |
| Network isolation | 895 |
| Isolation on physical hosts | 895 |
| Controlling network traffic | 895 |
| Interface VPC endpoints | 896 |
| Create an interface VPC endpoint | 896 |
| Create an interface VPC endpoint policy | 896 |
| Resilience | 897 |
| Data protection | 897 |
| Encryption at rest | 898 |
| Encryption in transit | 898 |
| Identity and access management | 899 |
| Network access to your instance | 899 |
| Amazon EC2 permission attributes | 899 |
| IAM and Amazon EC2 | 899 |
| IAM policies | 901 |
| IAM roles | 954 |
| Network access | 962 |
| Key pairs | 964 |
| Creating or importing a key pair | 965 |
| Tagging a key pair | 968 |
| Retrieving the public key for your key pair | 970 |
| Retrieving the public key for your key pair through instance metadata | 970 |
| Locating the public key on an instance | 971 |
| Identifying the key pair that was specified at launch | 972 |
| (Optional) Verifying your key pair's fingerprint | 972 |
| Adding or replacing a key pair for your instance | 973 |
| Connecting to your Linux instance if you lose your private key | 973 |
| Deleting your key pair | 977 |
| Security groups | 978 |
| Security group rules | 979 |
| Default security groups | 982 |
| Custom security groups | 982 |
| Working with security groups | 982 |
| Security group rules reference | 990 |
| Update management | 995 |
| Compliance validation | 996 |
| Storage | 997 |
| Amazon EBS | 998 |
| Features of Amazon EBS | 999 |
| EBS volumes | 1000 |
| EBS snapshots | 1039 |

| | |
|---|------|
| EBS data services | 1087 |
| EBS volumes and NVMe | 1113 |
| EBS optimization | 1116 |
| EBS performance | 1133 |
| EBS CloudWatch metrics | 1148 |
| EBS CloudWatch events | 1154 |
| Instance store | 1164 |
| Instance store lifetime | 1165 |
| Instance store volumes | 1165 |
| Add instance store volumes | 1171 |
| SSD instance store volumes | 1174 |
| Instance store swap volumes | 1176 |
| Optimizing disk performance | 1178 |
| File Storage | 1179 |
| Amazon EFS | 1179 |
| Amazon FSx | 1182 |
| Amazon S3 | 1183 |
| Amazon S3 and Amazon EC2 | 1183 |
| Instance volume limits | 1184 |
| Nitro System volume limits | 1184 |
| Linux-specific volume limits | 1185 |
| Bandwidth versus capacity | 1185 |
| Device naming | 1185 |
| Available device names | 1186 |
| Device name considerations | 1186 |
| Block device mapping | 1187 |
| Block device mapping concepts | 1187 |
| AMI block device mapping | 1190 |
| Instance block device mapping | 1192 |
| Resources and tags | 1197 |
| Resource locations | 1197 |
| Resource IDs | 1198 |
| Working with longer IDs | 1199 |
| Controlling access to longer ID settings | 1202 |
| Listing and filtering your resources | 1203 |
| Advanced search | 1203 |
| Listing resources using the console | 1204 |
| Filtering resources using the console | 1205 |
| Listing and filtering using the CLI and API | 1206 |
| Tagging your resources | 1208 |
| Tag basics | 1208 |
| Tagging your resources | 1209 |
| Tag restrictions | 1212 |
| Tagging your resources for billing | 1213 |
| Working with tags using the console | 1213 |
| Working with tags using the CLI or API | 1216 |
| Service quotas | 1219 |
| Viewing your current limits | 1219 |
| Requesting a limit increase | 1221 |
| Limits on email sent using port 25 | 1221 |
| Usage Reports | 1221 |
| Troubleshooting | 1222 |
| Troubleshooting launch issues | 1222 |
| Instance limit exceeded | 1222 |
| Insufficient instance capacity | 1223 |
| Instance terminates immediately | 1223 |
| Connecting to your instance | 1224 |

| | |
|--|------|
| Common causes for connection issues | 1225 |
| Error connecting to your instance: Connection timed out | 1225 |
| Error: unable to load key ... Expecting: ANY PRIVATE KEY | 1227 |
| Error: User key not recognized by server | 1228 |
| Error: Permission denied or connection closed by [instance] port 22 | 1229 |
| Error: Unprotected private key file | 1230 |
| Error: Private key must begin with "-----BEGIN RSA PRIVATE KEY-----" and end with "-----END RSA PRIVATE KEY-----" | 1231 |
| Error: Server refused our key or No supported authentication methods available | 1231 |
| Cannot ping instance | 1231 |
| Error: Server unexpectedly closed network connection | 1232 |
| Stopping your instance | 1232 |
| Creating a replacement instance | 1232 |
| Terminating your instance | 1233 |
| Delayed instance termination | 1234 |
| Terminated instance still displayed | 1234 |
| Instances automatically launched or terminated | 1234 |
| Failed status checks | 1234 |
| Review status check information | 1235 |
| Retrieve the system logs | 1235 |
| Troubleshooting system log errors for Linux-based instances | 1236 |
| Out of memory: kill process | 1237 |
| ERROR: mmu_update failed (Memory management update failed) | 1238 |
| I/O error (block device failure) | 1238 |
| I/O ERROR: neither local nor remote disk (Broken distributed block device) | 1239 |
| request_module: runaway loop modprobe (Looping legacy kernel modprobe on older Linux versions) | 1240 |
| "FATAL: kernel too old" and "fsck: No such file or directory while trying to open /dev" (Kernel and AMI mismatch) | 1241 |
| "FATAL: Could not load /lib/modules" or "BusyBox" (Missing kernel modules) | 1241 |
| ERROR Invalid kernel (EC2 incompatible kernel) | 1243 |
| fsck: No such file or directory while trying to open... (File system not found) | 1244 |
| General error mounting filesystems (failed mount) | 1245 |
| VFS: Unable to mount root fs on unknown-block (Root filesystem mismatch) | 1247 |
| Error: Unable to determine major/minor number of root device... (Root file system/device mismatch) | 1248 |
| XENBUS: Device with no driver... | 1249 |
| ... days without being checked, check forced (File system check required) | 1249 |
| fsck died with exit status... (Missing device) | 1250 |
| GRUB prompt (grubdom>) | 1251 |
| Bringing up interface eth0: Device eth0 has different MAC address than expected, ignoring. (Hard-coded MAC address) | 1253 |
| Unable to load SELinux Policy. Machine is in enforcing mode. Halting now. (SELinux misconfiguration) | 1254 |
| XENBUS: Timeout connecting to devices (Xenbus timeout) | 1255 |
| Troubleshooting an unreachable instance | 1255 |
| Instance reboot | 1256 |
| Instance console output | 1256 |
| Capture a screenshot of an unreachable instance | 1256 |
| Instance recovery when a host computer fails | 1257 |
| Booting from the wrong volume | 1258 |
| EC2Rescue for Linux | 1259 |
| Installing EC2Rescue for Linux | 1259 |
| (Optional) Verify the Signature of EC2Rescue for Linux | 1260 |
| Working with EC2Rescue for Linux | 1263 |
| Developing EC2Rescue Modules | 1265 |
| Sending a diagnostic interrupt | 1269 |

| | |
|--------------------------------------|------|
| Supported instance types | 1269 |
| Prerequisites | 1270 |
| Sending a diagnostic interrupt | 1272 |
| Document history | 1273 |
| History for previous years | 1277 |