Amazon Web Services: Overview of Security Processes

June 2014

(Please consult **http://aws.amazon.com/security/** for the latest version of this paper)

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Amazon Web Services (AWS) delivers a scalable cloud computing platform with high availability and dependability, offering the flexibility to enable customers to build a wide range of applications. Helping to protect the confidentiality, integrity, and availability of our customers' systems and data is of the utmost importance to AWS, as is maintaining customer trust and confidence. This document is intended to answer questions such as, "How does AWS help me protect my data?" Specifically, AWS physical and operational security processes are described for network and server infrastructure under AWS's management, as well as service-specific security implementations.

Shared Responsibility Environment

Moving IT infrastructure to AWS creates a shared responsibility model between the customer and AWS. This shared model can reduce your operational burden as AWS operates, manages, and controls the components from the host operating system and virtualization layer down to the physical security of the facilities in which the services operate. In turn, you assume responsibility and management of the guest operating system (including updates and security patches), other associated application software, as well as the configuration of the AWS-provided security group firewall. You should carefully consider the services you choose as your responsibilities vary depending on the services you use, the integration of those services into your IT environment, and applicable laws and regulations. It is possible for you to enhance security and/or meet more stringent compliance requirements by leveraging technology such as host-based firewalls, host-based intrusion detection/prevention, and encryption.

AWS Infrastructure Security

AWS operates the cloud infrastructure that you use to provision a variety of basic computing resources such as processing and storage. The AWS infrastructure includes the facilities, network, and hardware as well as some operational software (e.g., host OS, virtualization software, etc.) that support the provisioning and use of these resources. The AWS infrastructure is designed and managed according to security best practices as well as a variety of security compliance standards. As an AWS customer, you can be assured that you're building web architectures on top of some of the most secure computing infrastructure in the world.

AWS Compliance Program

The AWS Compliance Program enables customers to understand the robust security in place and then helps them streamline their compliance with industry and government requirements for security and data protection. The IT infrastructure that AWS provides to its customers is designed and managed in alignment with best security practices and a variety of IT security standards, including:

- SOC 1/SSAE 16/ISAE 3402 (formerly SAS 70 Type II)
- SOC 2
- SOC 3
- FISMA, DIACAP, and FedRAMP
- PCI DSS Level 1
- ISO 27001
- ITAR
- FIPS 140-2

In addition, the flexibility and control that the AWS platform provides allows customers to deploy solutions that meet several industry-specific standards, including:

- HIPAA
- Cloud Security Alliance (CSA)
- Motion Picture Association of America (MPAA)

AWS provides a wide range of information regarding its IT control environment to customers through white papers, reports, certifications, accreditations, and other third-party attestations. More information is available in the Risk and Compliance whitepaper available on the website: http://aws.amazon.com/security.

Physical and Environmental Security

AWS's data centers are state of the art, utilizing innovative architectural and engineering approaches. Amazon has many years of experience in designing, constructing, and operating large-scale data centers. This experience has been applied to the AWS platform and infrastructure. AWS data centers are housed in nondescript facilities. Physical access is strictly controlled both at the perimeter and at building ingress points by professional security staff utilizing video surveillance, intrusion detection systems, and other electronic means. Authorized staff must pass two-factor authentication a minimum of two times to access data center floors. All visitors and contractors are required to present identification and are signed in and continually escorted by authorized staff.

AWS only provides data center access and information to employees and contractors who have a legitimate business need for such privileges. When an employee no longer has a business need for these privileges, his or her access is immediately revoked, even if they continue to be an employee of Amazon or Amazon Web Services. All physical access to data centers by AWS employees is logged and audited routinely.

Fire Detection and Suppression

Automatic fire detection and suppression equipment has been installed to reduce risk. The fire detection system utilizes smoke detection sensors in all data center environments, mechanical and electrical infrastructure spaces, chiller rooms and generator equipment rooms. These areas are protected by either wet-pipe, double-interlocked pre-action, or gaseous sprinkler systems.

Power

The data center electrical power systems are designed to be fully redundant and maintainable without impact to operations, 24 hours a day, and seven days a week. Uninterruptible Power Supply (UPS) units provide back-up power in the event of an electrical failure for critical and essential loads in the facility. Data centers use generators to provide back-up power for the entire facility.

Climate and Temperature

Climate control is required to maintain a constant operating temperature for servers and other hardware, which prevents overheating and reduces the possibility of service outages. Data centers are conditioned to maintain atmospheric conditions at optimal levels. Personnel and systems monitor and control temperature and humidity at appropriate levels.

Management

AWS monitors electrical, mechanical, and life support systems and equipment so that any issues are immediately identified. Preventative maintenance is performed to maintain the continued operability of equipment.

Storage Device Decommissioning

When a storage device has reached the end of its useful life, AWS procedures include a decommissioning process that is designed to prevent customer data from being exposed to unauthorized individuals. AWS uses the techniques detailed in DoD 5220.22-M ("National Industrial Security Program Operating Manual ") or NIST 800-88 ("Guidelines for Media Sanitization") to destroy data as part of the decommissioning process. All decommissioned magnetic storage devices are degaussed and physically destroyed in accordance with industry-standard practices.

Business Continuity Management

Amazon's infrastructure has a high level of availability and provides customers the features to deploy a resilient IT architecture. AWS has designed its systems to tolerate system or hardware failures with minimal customer impact. Data center Business Continuity Management at AWS is under the direction of the Amazon Infrastructure Group.

Availability

Data centers are built in clusters in various global regions. All data centers are online and serving customers; no data center is "cold." In case of failure, automated processes move customer data traffic away from the affected area. Core applications are deployed in an N+1 configuration, so that in the event of a data center failure, there is sufficient capacity to enable traffic to be load-balanced to the remaining sites.

AWS provides you with the flexibility to place instances and store data within multiple geographic regions as well as across multiple availability zones within each region. Each availability zone is designed as an independent failure zone. This means that availability zones are physically separated within a typical metropolitan region and are located in lower risk flood plains (specific flood zone categorization varies by Region). In addition to discrete uninterruptable power supply (UPS) and onsite backup generation facilities, they are each fed via different grids from independent utilities to further reduce single points of failure. Availability zones are all redundantly connected to multiple tier-1 transit providers.

You should architect your AWS usage to take advantage of multiple regions and availability zones. Distributing applications across multiple availability zones provides the ability to remain resilient in the face of most failure modes, including natural disasters or system failures.

Incident Response

The Amazon Incident Management team employs industry-standard diagnostic procedures to drive resolution during business-impacting events. Staff operators provide 24x7x365 coverage to detect incidents and to manage the impact and resolution.

Company-Wide Executive Review

Amazon's Internal Audit group has recently reviewed the AWS services resiliency plans, which are also periodically reviewed by members of the Senior Executive management team and the Audit Committee of the Board of Directors.

Communication

AWS has implemented various methods of internal communication at a global level to help employees understand their individual roles and responsibilities and to communicate significant events in a timely manner. These methods include orientation and training programs for newly hired employees; regular management meetings for updates on business performance and other matters; and electronics means such as video conferencing, electronic mail messages, and the posting of information via the Amazon intranet.

AWS has also implemented various methods of external communication to support its customer base and the community. Mechanisms are in place to allow the customer support team to be notified of operational issues that impact the customer experience. A "Service Health Dashboard" is available and maintained by the customer support team to alert customers to any issues that may be of broad impact. A "Security and Compliance Center" is available to provide you with a single location to obtain security and compliance details about AWS. You can also subscribe to AWS Support offerings that include direct communication with the customer support team and proactive alerts to any customer impacting issues.

Network Security

The AWS network has been architected to permit you to select the level of security and resiliency appropriate for your workload. To enable you to build geographically dispersed, fault-tolerant web architectures with cloud resources, AWS has implemented a world-class network infrastructure that is carefully monitored and managed.

Secure Network Architecture

Network devices, including firewall and other boundary devices, are in place to monitor and control communications at the external boundary of the network and at key internal boundaries within the network. These boundary devices employ rule sets, access control lists (ACL), and configurations to enforce the flow of information to specific information system services.

ACLs, or traffic flow policies, are established on each managed interface, which manage and enforce the flow of traffic. ACL policies are approved by Amazon Information Security. These policies are automatically pushed using AWS's ACL-Manage tool, to help ensure these managed interfaces enforce the most up-to-date ACLs.

Secure Access Points

AWS has strategically placed a limited number of access points to the cloud to allow for a more comprehensive monitoring of inbound and outbound communications and network traffic. These customer access points are called API endpoints, and they allow secure HTTP access (HTTPS), which allows you to establish a secure communication session with your storage or compute instances within AWS. To support customers with FIPS 140-2 requirements, the Amazon Virtual Private Cloud VPN endpoints and SSL-terminating load balancers in AWS GovCloud (US) operate using FIPS 140-2 level 2-validated hardware.

In addition, AWS has implemented network devices that are dedicated to managing interfacing communications with Internet service providers (ISPs). AWS employs a redundant connection to more than one communication service at each Internet-facing edge of the AWS network. These connections each have dedicated network devices.

Transmission Protection

You can connect to an AWS access point via HTTP or HTTPS using Secure Sockets Layer (SSL), a cryptographic protocol that is designed to protect against eavesdropping, tampering, and message forgery.

For customers who require additional layers of network security, AWS offers the Amazon Virtual Private Cloud (VPC), which provides a private subnet within the AWS cloud, and the ability to use an IPsec Virtual Private Network (VPN) device to provide an encrypted tunnel between the Amazon VPC and your data center. For more information about VPC configuration options, refer to the Amazon Virtual Private Cloud (Amazon VPC) Security section below.

Amazon Corporate Segregation

Logically, the AWS Production network is segregated from the Amazon Corporate network by means of a complex set of network security / segregation devices. AWS developers and administrators on the corporate network who need to access AWS cloud components in order to maintain them must explicitly request access through the AWS ticketing system. All requests are reviewed and approved by the applicable service owner.

Approved AWS personnel then connect to the AWS network through a bastion host that restricts access to network devices and other cloud components, logging all activity for security review. Access to bastion hosts require SSH public-key authentication for all user accounts on the host. For more information on AWS developer and administrator logical access, see *AWS Access* below.

Fault-Tolerant Design

Amazon's infrastructure has a high level of availability and provides you with the capability to deploy a resilient IT architecture. AWS has designed its systems to tolerate system or hardware failures with minimal customer impact.

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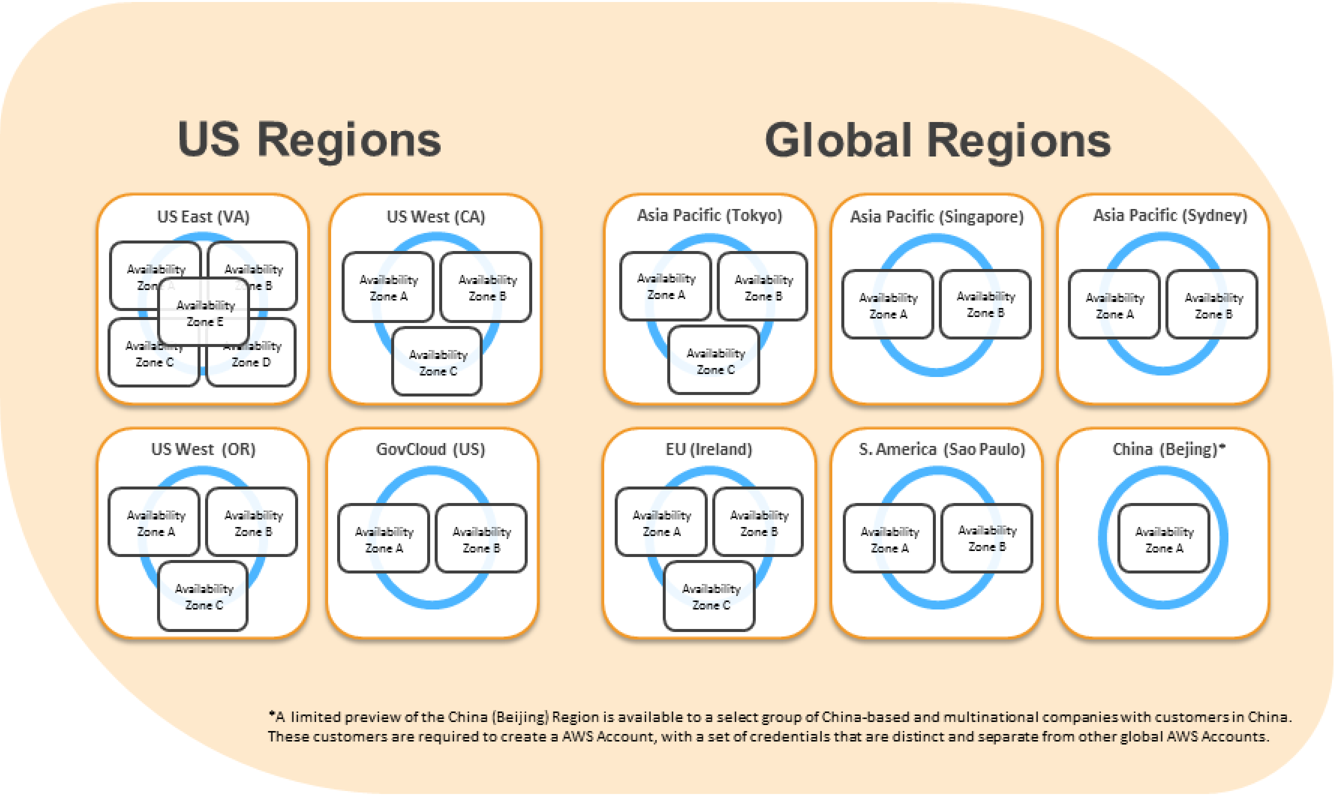
You should architect your AWS usage to take advantage of multiple regions and availability zones. Distributing applications across multiple availability zones provides the ability to remain resilient in the face of most failure scenarios, including natural disasters or system failures. However, you should be aware of location-dependent privacy and compliance requirements, such as the EU Data Privacy Directive. Data is not replicated between regions unless proactively done so by the customer, thus allowing customers with these types of data placement and privacy requirements the ability to establish compliant environments. It should be noted that all communications between regions is across public Internet infrastructure; therefore, appropriate encryption methods should be used to protect sensitive data.

As of this writing, there are ten regions: US East (Northern Virginia), US West (Oregon), US West (Northern California), AWS GovCloud (US), EU (Ireland), Asia Pacific (Singapore), Asia Pacific (Tokyo), Asia Pacific (Sydney), South America (Sao Paulo), and China (Bejing).



*A limited preview of the China (Beijing) Region is available to a select group of China-based and multinational companies with customers in China. These customers are required to create a AWS Account, with a set of credentials that are distinct and separate from other global AWS Accounts.

Figure 1: Regions and Availability Zones

Note that the number of Availability Zones may change.

AWS GovCloud (US) is an isolated AWS Region designed to allow US government agencies and customers to move workloads into the cloud by helping them meet certain regulatory and compliance requirements. The AWS GovCloud (US) framework allows US government agencies and their contractors to comply with U.S. International Traffic in Arms Regulations (ITAR) regulations as well as the Federal Risk and Authorization Management Program (FedRAMP) requirements. AWS GovCloud (US) has received an Agency Authorization to Operate (ATO) from the US Department of Health and Human Services (HHS) utilizing a FedRAMP accredited Third Party Assessment Organization (3PAO) for several AWS services.

The AWS GovCloud (US) Region provides the same fault-tolerant design as other regions, with two Availability Zones. In addition, the AWS GovCloud (US) region is a mandatory AWS Virtual Private Cloud (VPC) service by default to create an isolated portion of the AWS cloud and launch Amazon EC2 instances that have private (RFC 1918) addresses. More information about GovCloud is available on the AWS website: http://aws.amazon.com/govcloud-us/

Network Monitoring and Protection

AWS utilizes a wide variety of automated monitoring systems to provide a high level of service performance and availability. AWS monitoring tools are designed to detect unusual or unauthorized activities and conditions at ingress and egress communication points. These tools monitor server and network usage, port scanning activities, application usage, and unauthorized intrusion attempts. The tools have the ability to set custom performance metrics thresholds for unusual activity.

Systems within AWS are extensively instrumented to monitor key operational metrics. Alarms are configured to automatically notify operations and management personnel when early warning thresholds are crossed on key operational metrics. An on-call schedule is used so personnel are always available to respond to operational issues. This includes a pager system so alarms are quickly and reliably communicated to operations personnel.

Documentation is maintained to aid and inform operations personnel in handling incidents or issues. If the resolution of an issue requires collaboration, a conferencing system is used which supports communication and logging capabilities. Trained call leaders facilitate communication and progress during the handling of operational issues that require collaboration. Post-mortems are convened after any significant operational issue, regardless of external impact, and Cause of Error (COE) documents are drafted so the root cause is captured and preventative actions are taken in the future. Implementation of the preventative measures is tracked during weekly operations meetings.

AWS security monitoring tools help identify several types of denial of service (DoS) attacks, including distributed, flooding, and software/logic attacks. When DoS attacks are identified, the AWS incident response process is initiated. In addition to the DoS prevention tools, redundant telecommunication providers at each region as well as additional capacity protect against the possibility of DoS attacks.

The AWS network provides significant protection against traditional network security issues, and you can implement further protection. The following are a few examples:

- **Distributed Denial Of Service (DDoS) Attacks.** AWS API endpoints are hosted on large, Internet-scale, world-class infrastructure that benefits from the same engineering expertise that has built Amazon into the world's largest online retailer. Proprietary DDoS mitigation techniques are used. Additionally, AWS's networks are multi-homed across a number of providers to achieve Internet access diversity.
- **Man in the Middle (MITM) Attacks.** All of the AWS APIs are available via SSL-protected endpoints which provide server authentication. Amazon EC2 AMIs automatically generate new SSH host certificates on first boot and log them to the instance's console. You can then use the secure APIs to call the console and access the host certificates before logging into the instance for the first time. We encourage you to use SSL for all of your interactions with AWS.
- **IP Spoofing.** Amazon EC2 instances cannot send spoofed network traffic. The AWS-controlled, host-based firewall infrastructure will not permit an instance to send traffic with a source IP or MAC address other than its own.
- **Port Scanning**. Unauthorized port scans by Amazon EC2 customers are a violation of the AWS Acceptable Use Policy. Violations of the AWS Acceptable Use Policy are taken seriously, and every reported violation is investigated. Customers can report suspected abuse via the contacts available on our website at: http://aws.amazon.com/contact-us/report-abuse/. When unauthorized port scanning is detected by AWS, it is stopped and blocked. Port scans of Amazon EC2 instances are generally ineffective because, by default, all inbound ports on Amazon EC2 instances are closed and are only opened by you. Your strict management of security groups can further mitigate the threat of port scans. If you configure the security group to allow traffic from any source to a specific port, then that specific port will be vulnerable to a port scan. In these cases, you must use appropriate security measures to protect listening services that may be essential to their application from being discovered by an unauthorized port scan. For example, a web server must clearly have port 80 (HTTP) open to the world, and the administrator of this server is responsible for the security of the HTTP server software, such as Apache. You may request permission to conduct vulnerability scans as required to meet your specific compliance requirements. These scans must be limited to your own instances and must not violate the AWS Acceptable Use Policy. Advanced approval for these types of scans can be initiated by submitting a request via the website at: https://aws-portal.amazon.com/gp/aws/html-forms-controller/contactus/AWSSecurityPenTestRequest

- **Packet sniffing by other tenants.** It is not possible for a virtual instance running in promiscuous mode to receive or "sniff" traffic that is intended for a different virtual instance. While you can place your interfaces into promiscuous mode, the hypervisor will not deliver any traffic to them that is not addressed to them. Even two virtual instances that are owned by the same customer located on the same physical host cannot listen to each other's traffic. Attacks such as ARP cache poisoning do not work within Amazon EC2 and Amazon VPC. While Amazon EC2 does provide ample protection against one customer inadvertently or maliciously attempting to view another's data, as a standard practice you should encrypt sensitive traffic.

In addition to monitoring, regular vulnerability scans are performed on the host operating system, web application, and databases in the AWS environment using a variety of tools. Also, AWS Security teams subscribe to newsfeeds for applicable vendor flaws and proactively monitor vendors' websites and other relevant outlets for new patches. AWS customers also have the ability to report issues to AWS via the AWS Vulnerability Reporting website at: http://aws.amazon.com/security/vulnerability-reporting/

AWS Access

The AWS Production network is segregated from the Amazon Corporate network and requires a separate set of credentials for logical access. The Amazon Corporate network relies on user IDs, passwords, and Kerberos, while the AWS Production network requires SSH public-key authentication through a bastion host.

AWS developers and administrators on the Amazon Corporate network who need to access AWS cloud components must explicitly request access through the AWS access management system. All requests are reviewed and approved by the appropriate owner or manager.

Account Review and Audit

Accounts are reviewed every 90 days; explicit re-approval is required or access to the resource is automatically revoked. Access is also automatically revoked when an employee's record is terminated in Amazon's Human Resources system. Windows and UNIX accounts are disabled and Amazon's permission management system removes the user from all systems.

Requests for changes in access are captured in the Amazon permissions management tool audit log. When changes in an employee's job function occur, continued access must be explicitly approved to the resource or it will be automatically revoked.

Background Checks

AWS has established formal policies and procedures to delineate the minimum standards for logical access to AWS platform and infrastructure hosts. AWS conducts criminal background checks, as permitted by law, as part of pre-employment screening practices for employees and commensurate with the employee's position and level of access. The policies also identify functional responsibilities for the administration of logical access and security.

Credentials Policy

AWS Security has established a credentials policy with required configurations and expiration intervals. Passwords must be complex and are forced to be changed every 90 days.

Secure Design Principles

AWS's development process follows secure software development best practices, which include formal design reviews by the AWS Security Team, threat modeling, and completion of a risk assessment. Static code analysis tools are run as a part of the standard build process, and all deployed software undergoes recurring penetration testing performed by carefully selected industry experts. Our security risk assessment reviews begin during the design phase and the engagement lasts through launch to ongoing operations.

Change Management

Routine, emergency, and configuration changes to existing AWS infrastructure are authorized, logged, tested, approved, and documented in accordance with industry norms for similar systems. Updates to AWS's infrastructure are done to minimize any impact on the customer and their use of the services. AWS will communicate with customers, either via email, or through the AWS Service Health Dashboard (http://status.aws.amazon.com/) when service use is likely to be adversely affected.

Software

AWS applies a systematic approach to managing change so that changes to customer-impacting services are thoroughly reviewed, tested, approved, and well-communicated. The AWS change management process is designed to avoid unintended service disruptions and to maintain the integrity of service to the customer. Changes deployed into production environments are:

- Reviewed: Peer reviews of the technical aspects of a change are required.
- Tested: Changes being applied are tested to help ensure they will behave as expected and not adversely impact performance.
- Approved: All changes must be authorized in order to provide appropriate oversight and understanding of business impact.

Changes are typically pushed into production in a phased deployment starting with lowest impact areas. Deployments are tested on a single system and closely monitored so impacts can be evaluated. Service owners have a number of configurable metrics that measure the health of the service's upstream dependencies. These metrics are closely monitored with thresholds and alarming in place. Rollback procedures are documented in the Change Management (CM) ticket.

When possible, changes are scheduled during regular change windows. Emergency changes to production systems that require deviations from standard change management procedures are associated with an incident and are logged and approved as appropriate.

Periodically, AWS performs self-audits of changes to key services to monitor quality, maintain high standards, and facilitate continuous improvement of the change management process. Any exceptions are analyzed to determine the root cause, and appropriate actions are taken to bring the change into compliance or roll back the change if necessary. Actions are then taken to address and remediate the process or people issue.

Infrastructure

Amazon's Corporate Applications team develops and manages software to automate IT processes for UNIX/Linux hosts in the areas of third-party software delivery, internally developed software, and configuration management. The Infrastructure team maintains and operates a UNIX/Linux configuration management framework to address hardware scalability, availability, auditing, and security management. By centrally managing hosts through the use of automated processes that manage change, Amazon is able to achieve its goals of high availability, repeatability, scalability, security, and disaster recovery. Systems and network engineers monitor the status of these automated tools on a continuous basis, reviewing reports to respond to hosts that fail to obtain or update their configuration and software.

Internally developed configuration management software is installed when new hardware is provisioned. These tools are run on all UNIX hosts to validate that they are configured and that software is installed in compliance with standards determined by the role assigned to the host. This configuration management software also helps to regularly update packages that are already installed on the host. Only approved personnel enabled through the permissions service may log in to the central configuration management servers.

AWS Account Security Features

AWS provides a number of ways for you to identify yourself and securely access your AWS Account. A complete list of credentials supported by AWS can be found on the Security Credentials page under Your Account. AWS also provides additional security options that enable you to further protect your AWS Account and control access: AWS Identity and Access Management (AWS IAM), key management and rotation, temporary security credentials, and multi-factor authentication (MFA).

AWS Identity and Access Management (AWS IAM)

AWS IAM allows you to create multiple users and manage the permissions for each of these users within your AWS Account. A user is an identity (within an AWS Account) with unique security credentials that can be used to access AWS Services. AWS IAM eliminates the need to share passwords or keys, and makes it easy to enable or disable a user’s access as appropriate.

AWS IAM enables you to implement security best practices, such as least privilege, by granting unique credentials to every user within your AWS Account and only granting permission to access the AWS services and resources required for the users to perform their jobs. AWS IAM is secure by default; new users have no access to AWS until permissions are explicitly granted.

AWS IAM is also integrated with the AWS Marketplace, so that you can control who in your organization can subscribe to the software and services offered in the Marketplace. Since subscribing to certain software in the Marketplace launches an EC2 instance to run the software, this is an important access control feature. Using AWS IAM to control access to the AWS Marketplace also enables AWS Account owners to have fine-grained control over usage and software costs.

AWS IAM enables you to minimize the use of your AWS Account credentials. Once you create AWS IAM user accounts, all interactions with AWS Services and resources should occur with AWS IAM user security credentials. More information about AWS IAM is available on the AWS website: http://aws.amazon.com/iam/

Roles

An IAM *roles* uses temporary security credentials to allow you to delegate access to users or services that normally don't have access to your AWS resources. A role is a set of permissions to access specific AWS resources, but these permissions are not tied to a specific IAM user or group. An authorized entity (e.g., mobile user, EC2 instance) assumes a role and receives temporary security credentials for authenticating to the resources defined in the role. Temporary security credentials provide enhanced security due to their short life-span (the default expiration is 12 hours) and the fact that they cannot be reused after they expire. This can be particularly useful in providing limited, controlled access in certain situations:

- **Federated (non-AWS) User Access.** Federated users are users (or applications) who do not have AWS Accounts. With roles, you can give them access to your AWS resources for a limited amount of time. This is useful if you have non-AWS users that you can authenticate with an external service, such as Microsoft Active Directory, LDAP, or Kerberos. The temporary AWS credentials used with the roles provide identity federation between AWS and your non-AWS users in your corporate identity and authorization system.

If your organization supports SAML 2.0 (Security Assertion Markup Language 2.0), you can create trust between your organization as an identity provider (IdP) and other organizations as service providers. In AWS, you can configure AWS as the service provider and use SAML to provide your users with federated single-sign on (SSO) to the AWS Management Console or to get federated access to call AWS APIs.

Roles are also useful if you create a mobile or web-based application that accesses AWS resources. AWS resources require security credentials for programmatic requests; however, you shouldn't embed long-term security credentials in your application because they are accessible to the application's users and can be difficult to rotate. Instead, you can let users sign in to your application using Login with Amazon, Facebook, or Google, and then use their authentication information to assume a role and get temporary security credentials.

- **Cross-Account Access**. For organizations who use multiple AWS Accounts to manage their resources, you can set up roles to provide users who have permissions in one account to access resources under another account. For organizations who have personnel who only rarely need access to resources under another account, using roles helps ensures that credentials are provided temporarily, only as needed.
- **Applications Running on EC2 Instances that Need to Access AWS Resources.** If an application runs on an Amazon EC2 instance and needs to make requests for AWS resources such as Amazon S3 buckets or an DynamoDB table, it must have security credentials. Using roles instead of creating individual IAM accounts for each application on each instance can save significant time for customers who manage a large number of instances or an elastically scaling fleet using AWS Auto Scaling.

The temporary credentials include a security token, an Access Key ID, and a Secret Access Key. To give a user access to certain resources, you distribute the temporary security credentials to the user you are granting temporary access to. When the user makes calls to your resources, the user passes in the token and Access Key ID, and signs the request with the Secret Access Key. The token will not work with different access keys. How the user passes in the token depends on the API and version of the AWS product the user is making calls to. More information about temporary security credentials is available on the AWS website: http://docs.amazonwebservices.com/STS

The use of temporary credentials means additional protection for you because you don't have to manage or distribute long-term credentials to temporary users. In addition, the temporary credentials get automatically loaded to the target instance so you don't have to embed them somewhere unsafe like your code. Temporary credentials are automatically rotated or changed multiple times a day without any action on your part, and are stored securely by default.

More information about using IAM roles to auto-provision keys on EC2 instances is available in the *Using IAM* guide on the AWS website: http://docs.amazonwebservices.com/IAM

AWS Multi-Factor Authentication (AWS MFA)

AWS Multi-Factor Authentication (AWS MFA) is an additional layer of security for accessing AWS services. When you enable this optional feature, you will need to provide a six-digit single-use code in addition to your standard user name and password credentials before access is granted to your AWS Account settings or AWS services and resources. You get this single-use code from an authentication device that you keep in your physical possession. This is called multi-factor authentication because more than one authentication factor is checked before access is granted: a password (something you know) and the precise code from your authentication device (something you have). You can enable MFA devices for your AWS Account as well as for the users you have created under your AWS Account with AWS IAM. In addition, you add MFA protection for access across AWS Accounts, for when you want to allow a user you've created under one AWS Account to use an IAM role to access resources under another AWS Account. You can require the user to use MFA before assuming the role as an additional layer of security.

AWS MFA supports the use of both hardware tokens and virtual MFA devices. Virtual MFA devices use the same protocols as the physical MFA devices, but can run on any mobile hardware device, including a smartphone. A virtual MFA device uses a software application that generates six-digit authentication codes that are compatible with the Time-Based One-Time Password (TOTP) standard, as described in RFC 6238. Most virtual MFA applications allow you to host more than one virtual MFA device, which makes them more convenient than hardware MFA devices. However, you should be aware that because a virtual MFA might be run on a less secure device such as a smartphone, a virtual MFA might not provide the same level of security as a hardware MFA device.

You can also enforce MFA authentication for AWS service APIs in order to provide an extra layer of protection over powerful or privileged actions such as terminating Amazon EC2 instances or reading sensitive data stored in Amazon S3. You do this by adding an MFA-authentication requirement to an IAM access policy. You can attach these access policies to IAM users, IAM groups, or resources that support Access Control Lists (ACLs) like Amazon S3 buckets, SQS queues, and SNS topics.

It is easy to obtain hardware tokens from a participating third-party provider or virtual MFA applications from an AppStore and to set it up for use via the AWS website. More information about AWS MFA is available on the AWS website: http://aws.amazon.com/mfa/

Key Management and Rotation

For the same reasons why it is important to change passwords frequently, AWS recommends that you rotate your access keys and certificates on a regular basis. To let you do this without potential impact to your application's availability, AWS supports multiple concurrent access keys and certificates. With this feature, you can rotate keys and certificates into and out of operation on a regular basis without any downtime to your application. This can help to mitigate risk from lost or compromised access keys or certificates. The AWS IAM API enables you to rotate the access keys of your AWS Account as well as for users created under their AWS Account using AWS IAM.

AWS Trusted Advisor Security Checks

The AWS Trusted Advisor customer support service not only monitors for cloud performance and resiliency, but also cloud security. Trusted Advisor inspects your AWS environment and makes recommendations when opportunities may exist to save money, improve system performance, or close security gaps. It provides alerts on several of the most common security misconfigurations that can occur, including leaving certain ports open that make you vulnerable to hacking and unauthorized access, neglecting to create IAM accounts for your internal users, allowing public access to S3 buckets, or not using MFA on your root AWS Account. The AWS Trusted Advisor service is available to AWS customers who have signed up for the Business or Enterprise levels of AWS Support.

AWS Service-Specific Security

Not only is security built into every layer of the AWS infrastructure, but also into each of the services available on that infrastructure. AWS services are architected to work efficiently and securely with all AWS networks and platforms. Each service provides extensive security features to enable you to protect sensitive data and applications.

Amazon Elastic Compute Cloud (Amazon EC2) Security

Amazon Elastic Compute Cloud (EC2) is a key component in Amazon's Infrastructure as a Service (IaaS), providing resizable computing capacity using server instances in AWS's data centers. Amazon EC2 is designed to make web-scale computing easier by enabling you to obtain and configure capacity with minimal friction. You create and launch *instances*, which are collections of platform hardware and software.

Multiple Levels of Security

Security within Amazon EC2 is provided on multiple levels: the operating system (OS) of the host platform, the virtual instance OS or guest OS, a firewall, and signed API calls. Each of these items builds on the capabilities of the others. The goal is to prevent data contained within Amazon EC2 from being intercepted by unauthorized systems or users and to provide Amazon EC2 instances themselves that are as secure as possible without sacrificing the flexibility in configuration that customers demand.

The Hypervisor

Amazon EC2 currently utilizes a highly customized version of the Xen hypervisor, taking advantage of paravirtualization (in the case of Linux guests). Because paravirtualized guests rely on the hypervisor to provide support for operations that normally require privileged access, the guest OS has no elevated access to the CPU. The CPU provides four separate privilege modes: 0-3, called *rings.* Ring 0 is the most privileged and 3 the least. The host OS executes in Ring 0. However, rather than executing in Ring 0 as most operating systems do, the guest OS runs in a lesser-privileged Ring 1 and applications in the least privileged Ring 3. This explicit virtualization of the physical resources leads to a clear separation between guest and hypervisor, resulting in additional security separation between the two.

Instance Isolation

Different instances running on the same physical machine are isolated from each other via the Xen hypervisor. Amazon is active in the Xen community, which provides awareness of the latest developments. In addition, the AWS firewall resides within the hypervisor layer, between the physical network interface and the instance's virtual interface. All packets must pass through this layer, thus an instance’s neighbors have no more access to that instance than any other host on the Internet and can be treated as if they are on separate physical hosts. The physical RAM is separated using similar mechanisms.

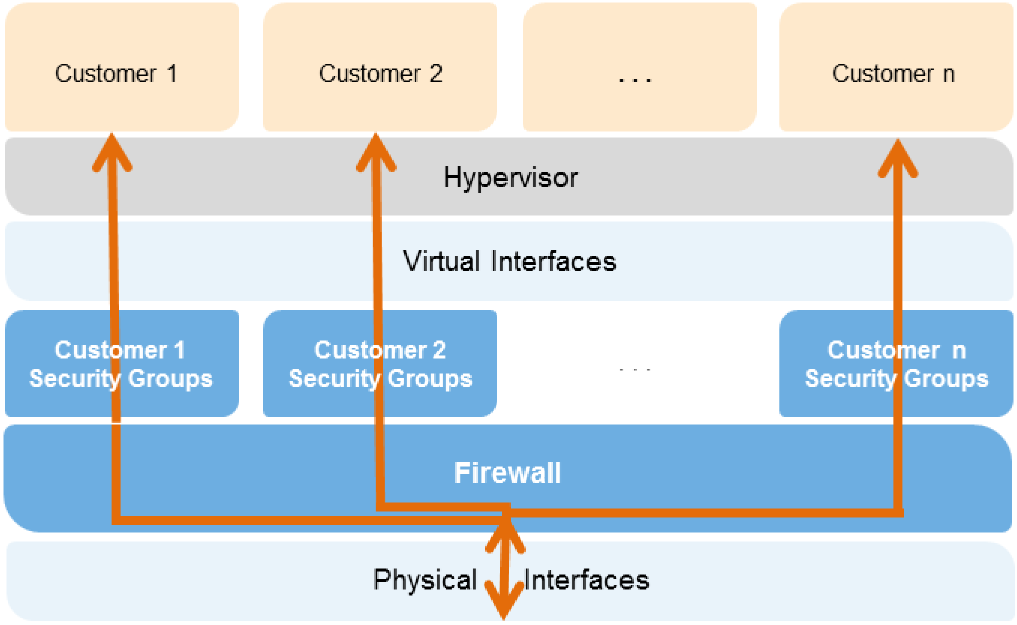


Figure 2: Amazon EC2 Multiple Layers of Security

Customer instances have no access to raw disk devices, but instead are presented with virtualized disks. The AWS proprietary disk virtualization layer automatically resets every block of storage used by the customer, so that one customer’s data is never unintentionally exposed to another. In addition, memory allocated to guests is scrubbed (set to zero) by the hypervisor when it is unallocated to a guest. The memory is not returned to the pool of free memory available for new allocations until the memory scrubbing is complete.

AWS recommends customers further protect their data using appropriate means. One common solution is to run an encrypted file system on top of the virtualized disk device.

Host Operating System: Administrators with a business need to access the management plane are required to use multi-factor authentication to gain access to purpose-built administration hosts. These administrative hosts are systems that are specifically designed, built, configured, and hardened to protect the management plane of the cloud. All such access is logged and audited. When an employee no longer has a business need to access the management plane, the privileges and access to these hosts and relevant systems can be revoked.

Guest Operating System: Virtual instances are completely controlled by you, the customer. You have full root access or administrative control over accounts, services, and applications. AWS does not have any access rights to your instances or the guest OS. AWS recommends a base set of security best practices to include disabling password-only access to your guests, and utilizing some form of multi-factor authentication to gain access to your instances (or at a minimum certificate-based SSH Version 2 access). Additionally, you should employ a privilege escalation mechanism with logging on a per-user basis. For example, if the guest OS is Linux, after hardening your instance you should utilize certificate-based SSHv2 to access the virtual instance, disable remote root login, use command-line logging, and use 'sudo' for privilege escalation. You should generate your own key pairs in order to guarantee that they are unique, and not shared with other customers or with AWS.

AWS also supports the use of the Secure Shell (SSH) network protocol to enable you to log in securely to your UNIX/Linux EC2 instances. Authentication for SSH used with AWS is via a public/private key pair to reduce the risk of unauthorized access to your instance. You can also connect remotely to your Windows instances using Remote Desktop Protocol (RDP) by utilizing an RDP certificate generated for your instance.

You also control the updating and patching of your guest OS, including security updates. Amazon-provided Windows and Linux-based AMIs are updated regularly with the latest patches, so if you do not need to preserve data or customizations on your running Amazon AMI instances, you can simply relaunch new instances with the latest updated AMI. In addition, updates are provided for the Amazon Linux AMI via the Amazon Linux yum repositories.

Firewall: Amazon EC2 provides a complete firewall solution; this mandatory inbound firewall is configured in a default deny-all mode and Amazon EC2 customers must explicitly open the ports needed to allow inbound traffic. The traffic may be restricted by protocol, by service port, as well as by source IP address (individual IP or Classless Inter-Domain Routing (CIDR) block).

The firewall can be configured in groups permitting different classes of instances to have different rules. Consider, for example, the case of a traditional three-tiered web application. The group for the web servers would have port 80 (HTTP) and/or port 443 (HTTPS) open to the Internet. The group for the application servers would have port 8000 (application specific) accessible only to the web server group. The group for the database servers would have port 3306 (MySQL) open only to the application server group. All three groups would permit administrative access on port 22 (SSH), but only from the customer's corporate network. Highly secure applications can be deployed using this expressive mechanism. See diagram below:

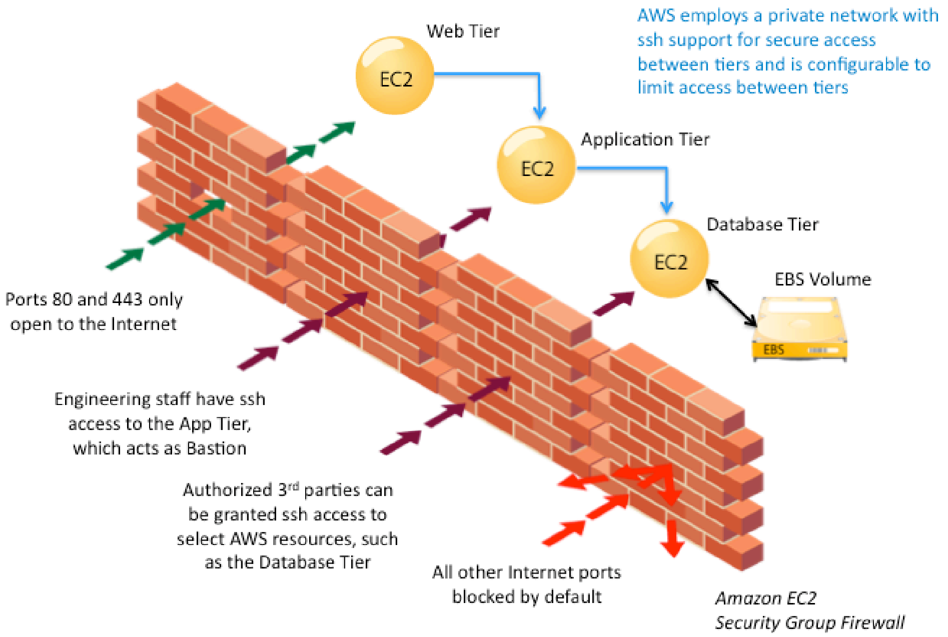

Web Tier
EC2
AWS employs a private network with ssh support for secure access between tiers and is configurable to limit access between tiers
Application Tier
EC2
Database Tier
EC2
EBS Volume
EBS
Ports 80 and 443 only open to the Internet
Engineering staff have ssh access to the App Tier, which acts as Bastion
Authorized 3rd parties can be granted ssh access to select AWS resources, such as the Database Tier
All other Internet ports blocked by default
Amazon EC2 Security Group Firewall

Figure 3: Amazon EC2 Security Group Firewall

The firewall isn't controlled through the guest OS; rather it requires your X.509 certificate and key to authorize changes, thus adding an extra layer of security. AWS supports the ability to grant granular access to different administrative functions on the instances and the firewall, therefore enabling you to implement additional security through separation of duties. The level of security afforded by the firewall is a function of which ports you open, and for what duration and purpose. The default state is to deny all incoming traffic, and you should plan carefully what you will open when building and securing your applications. Well-informed traffic management and security design are still required on a per-instance basis. AWS further encourages you to apply additional per-instance filters with host-based firewalls such as IPtables or the Windows Firewall and VPNs. This can restrict both inbound and outbound traffic.

API Access: API calls to launch and terminate instances, change firewall parameters, and perform other functions are all signed by your Amazon Secret Access Key, which could be either the AWS Accounts Secret Access Key or the Secret Access key of a user created with AWS IAM. Without access to your Secret Access Key, Amazon EC2 API calls cannot be made on your behalf. In addition, API calls can be encrypted with SSL to maintain confidentiality. Amazon recommends always using SSL-protected API endpoints.

Permissions: AWS IAM also enables you to further control what APIs a user has permissions to call.

Elastic Block Storage (Amazon EBS) Security

Amazon Elastic Block Storage (EBS) allows you to create storage volumes from 1 GB to 1 TB that can be mounted as devices by Amazon EC2 instances. Storage volumes behave like raw, unformatted block devices, with user supplied device names and a block device interface. You can create a file system on top of Amazon EBS volumes, or use them in any other way you would use a block device (like a hard drive). Amazon EBS volume access is restricted to the AWS Account that created the volume, and to the users under the AWS Account created with AWS IAM if the user has been granted access to the EBS operations, thus denying all other AWS Accounts and users the permission to view or access the volume.

Data stored in Amazon EBS volumes is redundantly stored in multiple physical locations as part of normal operation of those services and at no additional charge. However, Amazon EBS replication is stored within the same availability zone, not across multiple zones; therefore, it is highly recommended that you conduct regular snapshots to Amazon S3 for long-term data durability. For customers who have architected complex transactional databases using EBS, it is recommended that backups to Amazon S3 be performed through the database management system so that distributed transactions and logs can be checkpointed. AWS does not perform backups of data that are maintained on virtual disks attached to running instances on Amazon EC2.

You can make Amazon EBS volume snapshots publicly available to other AWS Accounts to use as the basis for creating your own volumes. Sharing Amazon EBS volume snapshots does not provide other AWS Accounts with the permission to alter or delete the original snapshot, as that right is explicitly reserved for the AWS Account that created the volume. An EBS snapshot is a block-level view of an entire EBS volume. Note that data that is not visible through the file system on the volume, such as files that have been deleted, may be present in the EBS snapshot. If you want to create shared snapshots, you should do so carefully. If a volume has held sensitive data or has had files deleted from it, a new EBS volume should be created. The data to be contained in the shared snapshot should be copied to the new volume, and the snapshot created from the new volume.

Amazon EBS volumes are presented to you as raw unformatted block devices that have been wiped prior to being made available for use. Wiping occurs immediately before reuse so that you can be assured that the wipe process completed. If you have procedures requiring that all data be wiped via a specific method, such as those detailed in DoD 5220.22-M (“National Industrial Security Program Operating Manual “) or NIST 800-88 (“Guidelines for Media Sanitization”), you have the ability to do so on Amazon EBS. You should conduct a specialized wipe procedure prior to deleting the volume for compliance with your established requirements.

Encryption of sensitive data is generally a good security practice, and AWS provides the ability to encrypt EBS volumes and their snapshots with AES-256. The encryption occurs on the servers that host the EC2 instances, providing encryption of data as it moves between EC2 instances and EBS storage. In order to be able to do this efficiently and with low latency, the EBS encryption feature is only available on EC2's more powerful instance types (e.g., M3, C3, R3, G2).

Amazon Elastic Load Balancing Security

Amazon Elastic Load Balancing is used to manage traffic on a fleet of Amazon EC2 instances, distributing traffic to instances across all availability zones within a region. Elastic Load Balancing has all the advantages of an on-premises load balancer, plus several security benefits:

- Takes over the encryption and decryption work from the Amazon EC2 instances and manages it centrally on the load balancer
- Offers clients a single point of contact, and can also serve as the first line of defense against attacks on your network
- When used in an Amazon VPC, supports creation and management of security groups associated with your Elastic Load Balancing to provide additional networking and security options
- Supports end-to-end traffic encryption using TLS (previously SSL) on those networks that use secure HTTP (HTTPS) connections. When TLS is used, the TLS server certificate used to terminate client connections can be managed centrally on the load balancer, rather than on every individual instance.

HTTPS/TLS uses a long-term secret key to generate a short-term session key to be used between the server and the browser to create the ciphered (encrypted) message. Amazon Elastic Load Balancing configures your load balancer with a pre-defined cipher set that is used for TLS negotiation when a connection is established between a client and your load balancer. The pre-defined cipher set provides compatibility with a broad range of clients and uses strong cryptographic algorithms. However, some customers may have requirements for allowing only specific ciphers and protocols (such as PCI, SOX, etc.) from clients to ensure that standards are met. In these cases, Amazon Elastic Load Balancing provides options for selecting different configurations for TLS protocols and ciphers. You can choose to enable or disable the ciphers depending on your specific requirements.

To help ensure the use of newer and stronger cipher suites when establishing a secure connection, you can configure the load balancer to have the final say in the cipher suite selection during the client-server negotiation. When the Server Order Preference option is selected, the load balancer will select a cipher suite based on the server's prioritization of cipher suites rather than the client's. This gives you more control over the level of security that clients use to connect to your load balancer.

For even greater communication privacy, Amazon Elastic Load Balancer allows the use of Perfect Forward Secrecy, which uses session keys that are ephemeral and not stored anywhere. This prevents the decoding of captured data, even if the secret long-term key itself is compromised.

Amazon Elastic Load Balancing allows you to identify the originating IP address of a client connecting to your servers, whether you're using HTTPS or TCP load balancing. Typically, client connection information, such as IP address and port, is lost when requests are proxied through a load balancer. This is because the load balancer sends requests to the server on behalf of the client, making your load balancer appear as though it is the requesting client. Having the originating client IP address is useful if you need more information about visitors to your applications in order to gather connection statistics, analyze traffic logs, or manage whitelists of IP addresses.

Amazon Elastic Load Balancing access logs contain information about each HTTP and TCP request processed by your load balancer. This includes the IP address and port of the requesting client, the backend IP address of the instance that processed the request, the size of the request and response, and the actual request line from the client (for example, GET http://www.example.com: 80/HTTP/1.1). All requests sent to the load balancer are logged, including requests that never made it to back-end instances.

Auto Scaling Security

Auto Scaling allows you to automatically scale your Amazon EC2 capacity up or down according to conditions you define, so that the number of Amazon EC2 instances you are using scales up seamlessly during demand spikes to maintain performance, and scales down automatically during demand lulls to minimize costs.

Like all AWS services, Auto Scaling requires that every request made to its control API be authenticated so only authenticated users can access and manage Auto Scaling. Requests are signed with an HMAC-SHA1 signature calculated from the request and the user's private key. However, getting credentials out to new EC2 instances launched with Auto-Scaling can be challenging for large or elastically scaling fleets. To simplify this process, you can use *roles* within IAM, so that any new instances launched with a role will be given credentials automatically. When you launch an EC2 instance with an IAM role, temporary AWS security credentials with permissions specified by the role will be securely provisioned to the instance and will be made available to your application via the Amazon EC2 Instance Metadata Service. The Metadata Service will make new temporary security credentials available prior to the expiration of the current active credentials, so that valid credentials are always available on the instance. In addition, the temporary security credentials are automatically rotated multiple times per day, providing enhanced security. You can further control access to Auto Scaling by creating users under your AWS Account using AWS IAM, and controlling what Auto Scaling APIs these users have permission to call. More information about using roles when launching instances is available in the Amazon EC2 User Guide on the AWS website: http://docs.amazonwebservices.com/AWSEC2/latest/UserGuide/UsingIAM

Amazon Virtual Private Cloud (Amazon VPC) Security

Normally, each Amazon EC2 instance you launch is randomly assigned a public IP address in the Amazon EC2 address space. Amazon VPC enables you to create an isolated portion of the AWS cloud and launch Amazon EC2 instances that have private (RFC 1918) addresses in the range of your choice (e.g., 10.0.0.0/16). You can define subnets within your VPC, grouping similar kinds of instances based on IP address range, and then set up routing and security to control the flow of traffic in and out of the instances and subnets.

AWS offers a variety of VPC architecture templates with configurations that provide varying levels of public access:

- **VPC with a single public subnet only.** Your instances run in a private, isolated section of the AWS cloud with direct access to the Internet. Network ACLs and security groups can be used to provide strict control over inbound and outbound network traffic to your instances.
- **VPC with public and private subnets.** In addition to containing a public subnet, this configuration adds a private subnet whose instances are not addressable from the Internet. Instances in the private subnet can establish outbound connections to the Internet via the public subnet using Network Address Translation (NAT).
- **VPC with public and private subnets and hardware VPN access.** This configuration adds an IPsec VPN connection between your Amazon VPC and your data center, effectively extending your data center to the cloud while also providing direct access to the Internet for public subnet instances in your Amazon VPC. In this configuration, customers add a VPN appliance on their corporate data center side.
- **VPC with private subnet only and hardware VPN access.** Your instances run in a private, isolated section of the AWS cloud with a private subnet whose instances are not addressable from the Internet. You can connect this private subnet to your corporate data center via an IPsec VPN tunnel.

You can also connect two VPCs using a private IP address, which allows instances in the two VPCs to communicate with each other as if they are within the same network. You can create a VPC peering connection between your own VPCs, or with a VPC in another AWS account within a single region.

Security features within Amazon VPC include security groups, network ACLs, routing tables, and external gateways. Each of these items is complementary to providing a secure, isolated network that can be extended through selective enabling of direct Internet access or private connectivity to another network. Amazon EC2 instances running within an Amazon VPC inherit all of the benefits described below related to the host OS, guest OS, hypervisor, instance isolation, and protection against packet sniffing. Note, however, that you must create VPC security groups specifically for your Amazon VPC; any Amazon EC2 security groups you have created will not work inside your Amazon VPC. Also, Amazon VPC security groups have additional capabilities that Amazon EC2 security groups do not have, such as being able to change the security group after the instance is launched and being able to specify any protocol with a standard protocol number (as opposed to just TCP, UDP, or ICMP).

Each Amazon VPC is a distinct, isolated network within the cloud; network traffic within each Amazon VPC is isolated from all other Amazon VPCs. At creation time, you select an IP address range for each Amazon VPC. You may create and attach an Internet gateway, virtual private gateway, or both to establish external connectivity, subject to the controls below.

API Access: Calls to create and delete Amazon VPCs, change routing, security group, and network ACL parameters, and perform other functions are all signed by your Amazon Secret Access Key, which could be either the AWS Account's Secret Access Key or the Secret Access key of a user created with AWS IAM. Without access to your Secret Access Key, Amazon VPC API calls cannot be made on your behalf. In addition, API calls can be encrypted with SSL to maintain confidentiality. Amazon recommends always using SSL-protected API endpoints. AWS IAM also enables a customer to further control what APIs a newly created user has permissions to call.

Subnets and Route Tables: You create one or more subnets within each Amazon VPC; each instance launched in the Amazon VPC is connected to one subnet. Traditional Layer 2 security attacks, including MAC spoofing and ARP spoofing, are blocked.

Each subnet in an Amazon VPC is associated with a routing table, and all network traffic leaving the subnet is processed by the routing table to determine the destination.

Firewall (Security Groups): Like Amazon EC2, Amazon VPC supports a complete firewall solution enabling filtering on both ingress and egress traffic from an instance. The default group enables inbound communication from other members of the same group and outbound communication to any destination. Traffic can be restricted by any IP protocol, by service port, as well as source/destination IP address (individual IP or Classless Inter-Domain Routing (CIDR) block).

The firewall isn’t controlled through the guest OS; rather, it can be modified only through the invocation of Amazon VPC APIs. AWS supports the ability to grant granular access to different administrative functions on the instances and the firewall, therefore enabling you to implement additional security through separation of duties. The level of security afforded by the firewall is a function of which ports you open, and for what duration and purpose. Well-informed traffic management and security design are still required on a per-instance basis. AWS further encourages you to apply additional per-instance filters with host-based firewalls such as IPtables or the Windows Firewall.

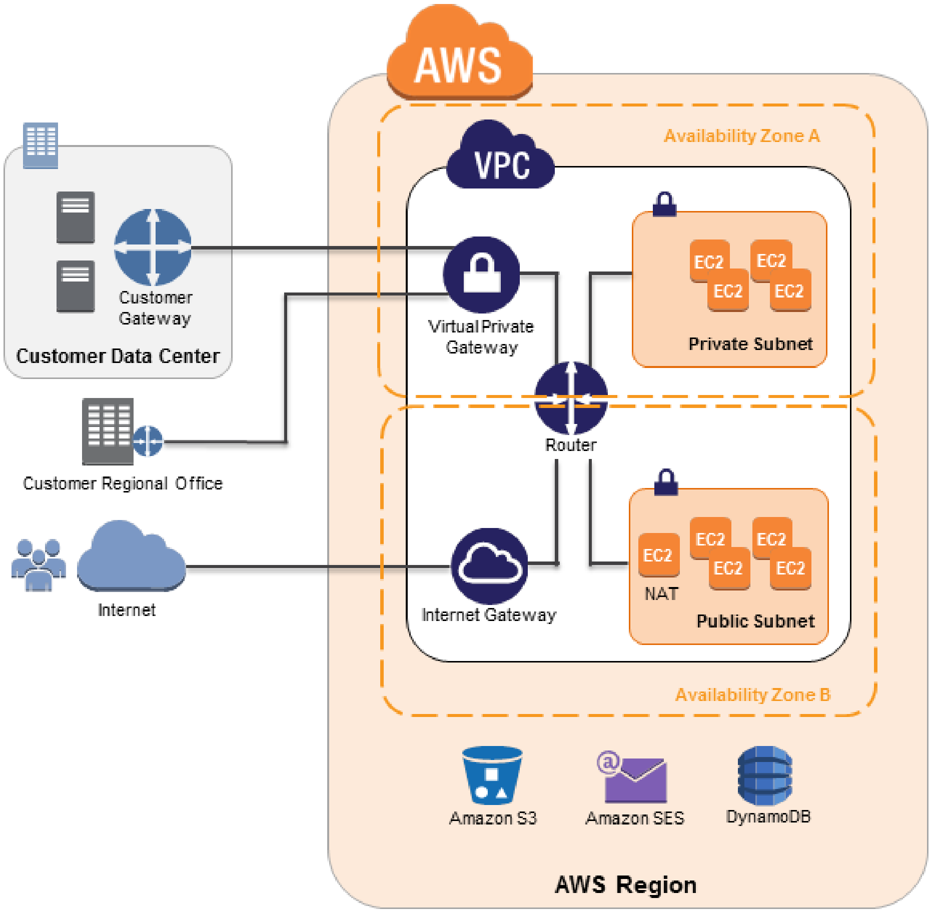


Figure 4: Amazon VPC Network Architecture

Network Access Control Lists: To add a further layer of security within Amazon VPC, you can configure network ACLs. These are stateless traffic filters that apply to all traffic inbound or outbound from a subnet within Amazon VPC. These ACLs can contain ordered rules to allow or deny traffic based upon IP protocol, by service port, as well as source/destination IP address.

Like security groups, network ACLs are managed through Amazon VPC APIs, adding an additional layer of protection and enabling additional security through separation of duties. The diagram below depicts how the security controls above inter-relate to enable flexible network topologies while providing complete control over network traffic flows.

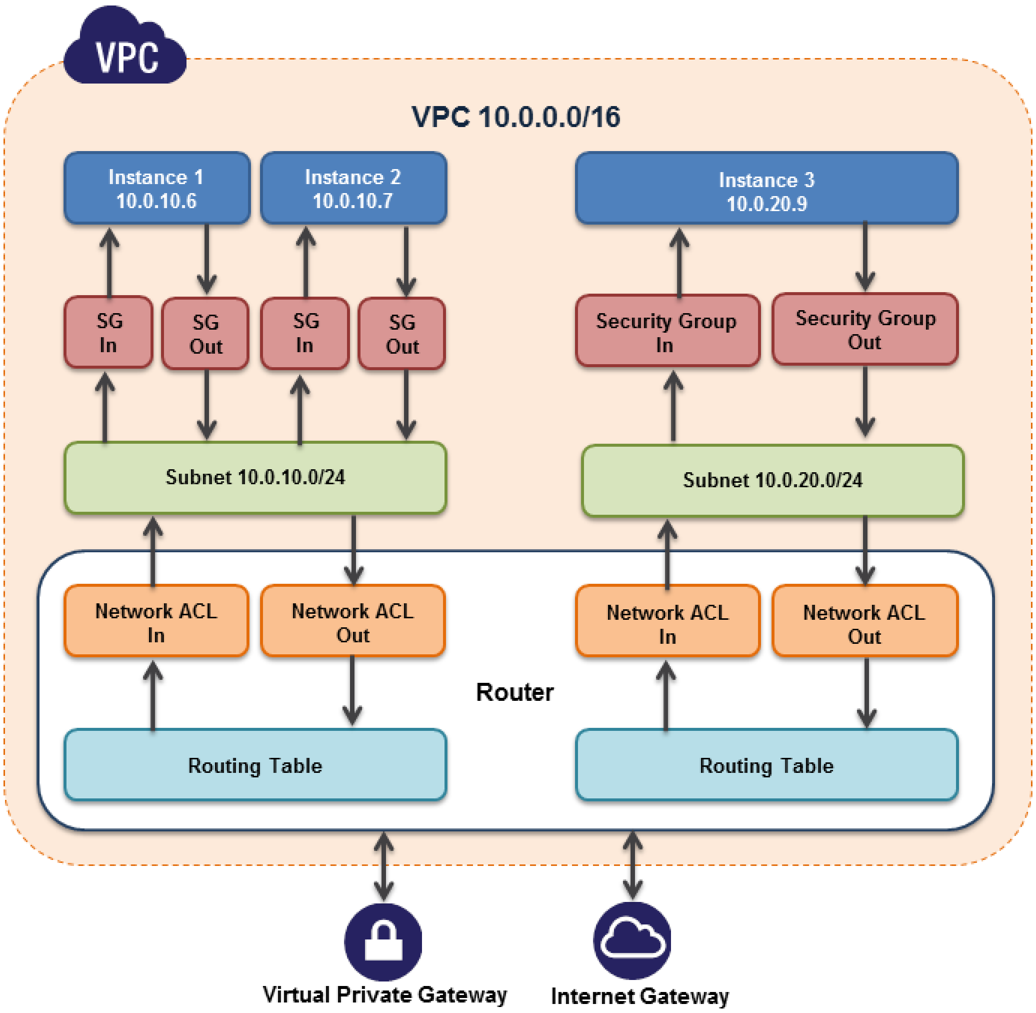


Figure 5: Flexible Network Topologies

Virtual Private Gateway: A virtual private gateway enables private connectivity between the Amazon VPC and another network. Network traffic within each virtual private gateway is isolated from network traffic within all other virtual private gateways. You can establish VPN connections to the virtual private gateway from gateway devices at your premises. Each connection is secured by a pre-shared key in conjunction with the IP address of the customer gateway device.

Internet Gateway: An Internet gateway may be attached to an Amazon VPC to enable direct connectivity to Amazon S3, other AWS services, and the Internet. Each instance desiring this access must either have an Elastic IP associated with it or route traffic through a NAT instance. Additionally, network routes are configured (see above) to direct traffic to the Internet gateway. AWS provides reference NAT AMIs that you can extend to perform network logging, deep packet inspection, application-layer filtering, or other security controls.

This access can only be modified through the invocation of Amazon VPC APIs. AWS supports the ability to grant granular access to different administrative functions on the instances and the Internet gateway, therefore enabling you to implement additional security through separation of duties.

Dedicated Instances: Within a VPC, you can launch Amazon EC2 instances that are physically isolated at the host hardware level (i.e., they will run on single-tenant hardware). An Amazon VPC can be created with 'dedicated' tenancy, so that all instances launched into the Amazon VPC will utilize this feature. Alternatively, an Amazon VPC may be created with 'default' tenancy, but you can specify dedicated tenancy for particular instances launched into it.

Elastic Network Interfaces: Each Amazon EC2 instance has a default network interface that is assigned a private IP address on your Amazon VPC network. You can create and attach an additional network interface, known as an elastic network interface (ENI), to any Amazon EC2 instance in your Amazon VPC for a total of two network interfaces per instance. Attaching more than one network interface to an instance is useful when you want to create a management network, use network and security appliances in your Amazon VPC, or create dual-homed instances with workloads/roles on distinct subnets. An ENI's attributes, including the private IP address, elastic IP addresses, and MAC address, will follow the ENI as it is attached or detached from an instance and reattached to another instance. More information about Amazon VPC is available on the AWS website: http://aws.amazon.com/vpc/

Additional Network Access Control with EC2-VPC

If you launch instances in a region where you did not have instances before AWS launched the new EC2-VPC feature (also called Default VPC), all instances are automatically provisioned in a ready-to-use default VPC. You can choose to create additional VPCs, or you can create VPCs for instances in regions where you already had instances before we launched EC2-VPC.

If you create a VPC later, using regular VPC, you specify a CIDR block, create subnets, enter the routing and security for those subnets, and provision an Internet gateway or NAT instance if you want one of your subnets to be able to reach the Internet. When you launch EC2 instances into an EC2-VPC, most of this work is automatically performed for you. When you launch an instance into a default VPC using EC2-VPC, we do the following to set it up for you:

- Create a default subnet in each Availability Zone
- Create an Internet gateway and connect it to your default VPC
- Create a main route table for your default VPC with a rule that sends all traffic destined for the Internet to the Internet gateway
- Create a default security group and associate it with your default VPC
- Create a default network access control list (ACL) and associate it with your default VPC
- Associate the default DHCP options set for your AWS account with your default VPC

In addition to the default VPC having its own private IP range, EC2 instances launched in a default VPC can also receive a public IP.

The following table summarizes the differences between instances launched into EC2-Classic, instances launched into a default VPC, and instances launched into a non-default VPC.

Characteristic	EC2-Classic	EC2-VPC (Default VPC)	Regular VPC
Public IP address	Your instance receives a public IP address.	Your instance launched in a default subnet receives a public IP address by default, unless you specify otherwise during launch.	Your instance doesn't receive a public IP address by default, unless you specify otherwise during launch.
Private IP address	Your instance receives a private IP address from the EC2-Classic	Your instance receives a static private IP address from the	Your instance receives a static private IP address from the

Characteristic	EC2-Classic	EC2-VPC (Default VPC)	Regular VPC
	range each time it's started.	address range of your default VPC.	address range of your VPC.
Multiple private IP addresses	We select a single IP address for your instance. Multiple IP addresses are not supported.	You can assign multiple private IP addresses to your instance.	You can assign multiple private IP addresses to your instance.
Elastic IP address	An EIP is disassociated from your instance when you stop it.	An EIP remains associated with your instance when you stop it.	An EIP remains associated with your instance when you stop it.
DNS hostnames	DNS hostnames are enabled by default.	DNS hostnames are enabled by default.	DNS hostnames are disabled by default.
Security group	A security group can reference security groups that belong to other AWS accounts.	A security group can reference security groups for your VPC only.	A security group can reference security groups for your VPC only.
Security group association	You must terminate your instance to change its security group.	You can change the security group of your running instance.	You can change the security group of your running instance.
Security group rules	You can add rules for inbound traffic only.	You can add rules for inbound and outbound traffic.	You can add rules for inbound and outbound traffic.
Tenancy	Your instance runs on shared hardware; you cannot run an instance on single-tenant hardware.	You can run your instance on shared hardware or single-tenant hardware.	You can run your instance on shared hardware or single-tenant hardware.

Note that security groups for instances in EC2-Classic are slightly different than security groups for instances in EC2-VPC. For example, you can add rules for inbound traffic for EC2-Classic, but you can add rules for both inbound and outbound traffic to EC2-VPC. In EC2-Classic, you can’t change the security groups assigned to an instance after it’s launched, but in EC2-VPC, you can change security groups assigned to an instance after it’s launched. In addition, you can't use the security groups that you've created for use with EC2-Classic with instances in your VPC. You must create security groups specifically for use with instances in your VPC. The rules you create for use with a security group for a VPC can't reference a security group for EC2-Classic, and vice versa.

AWS Direct Connect Security

With AWS Direct Connect, you can provision a direct link between your internal network and an AWS region using a high-throughput, dedicated connection. Doing this may help reduce your network costs, improve throughput, or provide a more consistent network experience. With this dedicated connection in place, you can then create virtual interfaces directly to the AWS cloud (for example, to Amazon EC2 and Amazon S3) and Amazon VPC.

With Direct Connect, you bypass Internet service providers in your network path. You can procure rack space within the facility housing the AWS Direct Connect location and deploy your equipment nearby. Once deployed, you can connect this equipment to AWS Direct Connect using a cross-connect. Each AWS Direct Connect location enables connectivity to the geographically nearest AWS region as well as access to other US regions. For example, you can provision a single connection to any AWS Direct Connect location in the US and use it to access public AWS services in all US Regions and AWS GovCloud (US).

Using industry standard 802.1q VLANs, the dedicated connection can be partitioned into multiple virtual interfaces. This allows you to use the same connection to access public resources such as objects stored in Amazon S3 using public IP address space, and private resources such as Amazon EC2 instances running within an Amazon VPC using private IP space, while maintaining network separation between the public and private environments.

Amazon Direct Connect requires the use of the Border Gateway Protocol (BGP) with an Autonomous System Number (ASN). To create a virtual interface, you use an MD5 cryptographic key for message authorization. MD5 creates a keyed hash using your secret key. You can have AWS automatically generate a BGP MD5 key or you can provide your own.

Amazon Simple Storage Service (Amazon S3) Security

Amazon Simple Storage Service (S3) allows you to upload and retrieve data at any time, from anywhere on the web. Amazon S3 stores data as *objects* within *buckets*. An object can be any kind of file: a text file, a photo, a video, etc. When you add a file to Amazon S3, you have the option of including metadata with the file and setting permissions to control access to the file. For each bucket, you can control access to the bucket (who can create, delete, and list objects in the bucket), view access logs for the bucket and its objects, and choose the geographical region where Amazon S3 will store the bucket and its contents.

Data Access

Access to data stored in Amazon S3 is restricted by default; only bucket and object owners have access to the Amazon S3 resources they create (note that a bucket/object owner is the AWS Account owner, not the user who created the bucket/object). There are multiple ways to control access to buckets and objects:

- **Identity and Access Management (IAM) Policies.** AWS IAM enables organizations with many employees to create and manage multiple users under a single AWS Account. IAM policies are attached to the users, enabling centralized control of permissions for users under your AWS Account to access buckets or objects. With IAM policies, you can only grant *users within your own AWS account* permission to access your Amazon S3 resources.
- **Access Control Lists (ACLs).** Within Amazon S3, you can use ACLs to give read or write access on buckets or objects to groups of users. With ACLs, you can only grant *other AWS accounts* (not specific users) access to your Amazon S3 resources.
- **Bucket Policies.** Bucket policies in Amazon S3 can be used to add or deny permissions across some or all of the objects within a single bucket. Policies can be attached to users, groups, or Amazon S3 buckets, enabling centralized management of permissions. With bucket policies, you can grant users within your AWS Account *or* other AWS Accounts access to your S3 resources.

Type of Access Control	AWS Account-Level Control?	User-Level Control?
IAM Policies	No	Yes
ACLs	Yes	No
Bucket Policies	Yes	Yes

You can further restrict access to specific resources based on certain conditions. For example, you can restrict access based on request time (Date Condition), whether the request was sent using SSL (Boolean Conditions), a requester's IP address (IP Address Condition), or based on the requester's client application (String Conditions). To identify these conditions, you use *policy keys*. For more information about action-specific policy keys available within Amazon S3, refer to the Amazon Simple Storage Service Developer Guide.

Amazon S3 also gives developers the option to use *query string authentication*, which allows them to share Amazon S3 objects through URLs that are valid for a predefined period of time. Query string authentication is useful for giving HTTP or browser access to resources that would normally require authentication. The signature in the query string secures the request.

Data Transfer

For maximum security, you can securely upload/download data to Amazon S3 via the SSL encrypted endpoints. The encrypted endpoints are accessible from both the Internet and from within Amazon EC2, so that data is transferred securely both within AWS and to and from sources outside of AWS.

Data Storage

Amazon S3 provides multiple options for protecting data at rest. For customers who prefer to manage their own encryption keys, they can use a client encryption library like the Amazon S3 Encryption Client to encrypt data before uploading to Amazon S3. Alternatively, you can use Amazon S3 Server Side Encryption (SSE) if you prefer to have Amazon S3 manage encryption keys for you. With Amazon S3 SSE, you can encrypt data on upload simply by adding an additional request header when writing the object. Decryption happens automatically when data is retrieved.

Note that metadata, which you can include with your object, is not encrypted. Therefore, AWS recommends that customers not place sensitive information in S3 metadata.

Amazon S3 SSE uses one of the strongest block ciphers available – 256-bit Advanced Encryption Standard (AES-256). With Amazon S3 SSE, every protected object is encrypted with a unique encryption key. This object key itself is then encrypted with a regularly rotated master key. Amazon S3 SSE provides additional security by storing the encrypted data and encryption keys in different hosts. Amazon S3 SSE also makes it possible for you to enforce encryption requirements. For example, you can create and apply bucket policies that require that only encrypted data can be uploaded to your buckets.

For long-term storage, you can automatically archive the contents of your S3 buckets to AWS's archival service called Glacier. You can have data transferred at specific intervals to Glacier by creating lifecycle rules in S3 that describe which objects you want to be archived to Glacier and when. As part of your data management strategy, you can also specify how long S3 should wait after the objects are put into S3 to delete them.

When an object is deleted from Amazon S3, removal of the mapping from the public name to the object starts immediately, and is generally processed across the distributed system within several seconds. Once the mapping is removed, there is no remote access to the deleted object. The underlying storage area is then reclaimed for use by the system.

Data Durability and Reliability

Amazon S3 is designed to provide 99.999999999% durability and 99.99% availability of objects over a given year. Objects are redundantly stored on multiple devices across multiple facilities in an Amazon S3 region. To help provide durability, Amazon S3 PUT and COPY operations synchronously store customer data across multiple facilities before returning SUCCESS. Once stored, Amazon S3 helps maintain the durability of the objects by quickly detecting and repairing any lost redundancy. Amazon S3 also regularly verifies the integrity of data stored using checksums. If corruption is detected, it is repaired using redundant data. In addition, Amazon S3 calculates checksums on all network traffic to detect corruption of data packets when storing or retrieving data.

Amazon S3 provides further protection via Versioning. You can use Versioning to preserve, retrieve, and restore every version of every object stored in an Amazon S3 bucket. With Versioning, you can easily recover from both unintended user actions and application failures. By default, requests will retrieve the most recently written version. Older versions of an object can be retrieved by specifying a version in the request. You can further protect versions using Amazon S3 Versioning's MFA Delete feature. Once enabled for an S3 bucket, each version deletion request must include the six-digit code and serial number from your multi-factor authentication device.

Access Logs

An Amazon S3 bucket can be configured to log access to the bucket and objects within it. The access log contains details about each access request including request type, the requested resource, the requestor's IP, and the time and date of the request. When logging is enabled for a bucket, log records are periodically aggregated into log files and delivered to the specified Amazon S3 bucket.

Cross-Origin Resource Sharing (CORS)

AWS customers who use S3 to host static web pages or store objects used by other web pages can load content securely by configuring an S3 bucket to explicitly enable cross-origin requests. Modern browsers use the Same Origin policy to block JavaScript or HTML5 from allowing requests to load content from another site or domain as a way to help ensure that malicious content is not loaded from a less reputable source (such as during cross-site scripting attacks). With the Cross-Origin Resource Sharing (CORS) policy enabled, assets such as web fonts and images stored in an S3 bucket can be safely referenced by external web pages, style sheets, and HTML5 applications.

AWS Glacier Security

Like Amazon S3, the Amazon Glacier service provides low-cost, secure, and durable storage. But where S3 is designed for rapid retrieval, Glacier is meant to be used as an archival service for data that is not accessed often and for which retrieval times of several hours are suitable.

Amazon Glacier stores files as *archives* within *vaults*. Archives can be any data such as a photo, video, or document, and can contain one or several files. You can store an unlimited number of archives in a single vault and can create up to 1,000 vaults per region. Each archive can contain up to 40 TB of data.

Data Upload

To transfer data into Amazon Glacier vaults, you can upload an archive in a single upload operation or a multipart operation. In a single upload operation, you can upload archives up to 4 GB in size. However, customers can achieve better results using the Multipart Upload API to upload archives greater than 100 MB. Using the Multipart Upload API allows you to upload large archives, up to about 40,000 GB. The Multipart Upload API call is designed to improve the upload experience for larger archives; it enables the parts to be uploaded independently, in any order, and in parallel. If a multipart upload fails, you only need to upload the failed part again and not the entire archive.

When you upload data to Glacier, you must compute and supply a tree hash. Glacier checks the hash against the data to help ensure that it has not been altered en route. A tree hash is generated by computing a hash for each megabyte-sized segment of the data, and then combining the hashes in tree fashion to represent ever-growing adjacent segments of the data.

As an alternate to using the Multipart Upload feature, customers with very large uploads to Amazon Glacier may consider using the AWS Import/Export service instead to transfer the data. AWS Import/Export facilitates moving large amounts of data into AWS using portable storage devices for transport. AWS transfers your data directly off of storage devices using Amazon's high-speed internal network, bypassing the Internet.

You can also set up S3 to transfer data at specific intervals to Glacier. You can create lifecycle rules in S3 that describe which objects you want to be archived to Glacier and when. You can also specify how long S3 should wait after the objects are put into S3 to delete them.

To achieve even greater security, you can securely upload/download data to Amazon Glacier via the SSL-encrypted endpoints. The encrypted endpoints are accessible from both the Internet and from within Amazon EC2, so that data is transferred securely both within AWS and to and from sources outside of AWS.

Data Retrieval

Retrieving archives from Amazon Glacier requires the initiation of a retrieval job, which is generally completed in 3 to 5 hours. You can then access the data via HTTP GET requests. The data will remain available to you for 24 hours.

You can retrieve an entire archive or several files from an archive. If you want to retrieve only a subset of an archive, you can use one retrieval request to specify the range of the archive that contains the files you are interested or you can initiate multiple retrieval requests, each with a range for one or more files. You can also limit the number of vault inventory items retrieved by filtering on an archive creation date range or by setting a maximum items limit. Whichever method you choose, when you retrieve portions of your archive, you can use the supplied checksum to help ensure the integrity of the files provided that the range that is retrieved is aligned with the tree hash of the overall archive.

Data Storage

Amazon Glacier automatically encrypts the data using AES-256 and stores it durably in an immutable form. Amazon Glacier is designed to provide average annual durability of 99.999999999% for an archive. It stores each archive in multiple facilities and multiple devices. Unlike traditional systems which can require laborious data verification and manual repair, Glacier performs regular, systematic data integrity checks and is built to be automatically self-healing.

Data Access

Only your account can access your data in Amazon Glacier. To control access to your data in Amazon Glacier, you can use AWS IAM to specify which users within your account have rights to operations on a given vault.

AWS Storage Gateway Security

The AWS Storage Gateway service connects your on-premises software appliance with cloud-based storage to provide seamless and secure integration between your IT environment and AWS's storage infrastructure. The service enables you to securely upload data to AWS' scalable, reliable, and secure S3 storage service for cost-effective backup and rapid disaster recovery.

AWS Storage Gateway transparently backs up data off-site to Amazon S3 in the form of Amazon EBS snapshots. Amazon S3 redundantly stores these snapshots on multiple devices across multiple facilities, detecting and repairing any lost redundancy. The Amazon EBS snapshot provides a point-in-time backup that can be restored on-premises or used to instantiate new Amazon EBS volumes. Data is stored within a single region that you specify.

AWS Storage Gateway offers three options:

- **Gateway-Stored Volumes (where the cloud is backup)**. In this option, your volume data is stored locally and then pushed to Amazon S3, where it is stored in redundant, encrypted form, and made available in the form of Elastic Block Storage (EBS) snapshots. When you use this model, the on-premises storage is primary, delivering low-latency access to your entire dataset, and the cloud storage is the backup.

- **Gateway-Cached Volumes (where the cloud is primary)**. In this option, your volume data is stored encrypted in Amazon S3, visible within your enterprise's network via an iSCSI interface. Recently accessed data is cached on-premises for low-latency local access. When you use this model, the cloud storage is primary, but you get low-latency access to your active working set in the cached volumes on premises.
- **Gateway-Virtual Tape Library (VTL)**. In this option, you can configure a Gateway-VTL with up to 10 virtual tape drives per gateway, 1 media changer and up to 1500 virtual tape cartridges. Each virtual tape drive responds to the SCSI command set, so your existing on-premises backup applications (either disk-to-tape or disk-to-disk-to-tape) will work without modification.

No matter which option you choose, data is asynchronously transferred from your on-premises storage hardware to AWS over SSL. The data is stored encrypted in Amazon S3 using Advanced Encryption Standard (AES) 256, a symmetric-key encryption standard using 256-bit encryption keys. The AWS Storage Gateway only uploads data that has changed, minimizing the amount of data sent over the Internet.

The AWS Storage Gateway runs as a virtual machine (VM) that you deploy on a host in your data center running VMware ESXi Hypervisor v 4.1 or v 5 or Microsoft Hyper-V (you download the VMware software during the setup process). You can also run within EC2 using a gateway AMI. During the installation and configuration process, you can create up to 12 Stored volumes, 20 Cached volumes, or 1500 virtual tape cartridges per gateway. Once installed, each gateway will automatically download, install, and deploy updates and patches. This activity takes place during a maintenance window that you can set on a per-gateway basis.

The iSCSI protocol supports authentication between targets and initiators via CHAP (Challenge-Handshake Authentication Protocol). CHAP provides protection against man-in-the-middle and playback attacks by periodically verifying the identity of an iSCSI initiator as authenticated to access a storage volume target. To set up CHAP, you must configure it in both the AWS Storage Gateway console and in the iSCSI initiator software you use to connect to the target.

After you deploy the AWS Storage Gateway VM, you must activate the gateway using the AWS Storage Gateway console. The activation process associates your gateway with your AWS Account. Once you establish this connection, you can manage almost all aspects of your gateway from the console. In the activation process, you specify the IP address of your gateway, name your gateway, identify the AWS region in which you want your snapshot backups stored, and specify the gateway time zone.

AWS Import/Export Security

AWS Import/Export is a simple, secure method for physically transferring large amounts of data to AWS S3, EBS, or Glacier storage. This service is typically used by customers who have over 100 GB of data and/or slow connection speeds that would result in very slow transfer rates over the Internet. With AWS Import/Export, you prepare a portable storage device that you ship to a secure AWS facility. AWS transfers the data directly off of the storage device using Amazon’s high-speed internal network, thus bypassing the Internet. Conversely, data can also be exported from AWS to a portable storage device.

Like all other AWS services, the AWS Import/Export service requires that you securely identify and authenticate your storage device. In this case, you will submit a job request to AWS that includes their Amazon S3 bucket, Amazon EBS region, AWS Access Key ID, and return shipping address. You then receive a unique identifier for the job, a digital signature for authenticating your device, and an AWS address to ship the storage device to. For Amazon S3, you place the signature file on the root directory of your device. For Amazon EBS, you tape the signature barcode to the exterior of the device. The signature file is used only for authentication and is not uploaded to S3 or EBS.

For transfers to S3, customers specify the specific buckets to which the data should be loaded and ensure that the account doing the loading has write permission for the buckets. They should also specify the access control list to be applied to each object loaded to S3.

For transfers to EBS, you specify the target region for the EBS import operation. If the storage device is less than or equal to the maximum volume size of 1 TB, its contents are loaded directly into an Amazon EBS snapshot. If the storage device's capacity exceeds 1 TB, a device image is stored within the specified Amazon S3 log bucket. You can then create a RAID of Amazon EBS volumes using software such as Logical Volume Manager, and copy the image from Amazon S3 to this new volume.

For added protection, you can encrypt the data on your device before you ship it to AWS. For S3 data, AWS Import/Export supports encryption using TrueCrypt. For EBS and Glacier data, you can use any encryption method you choose. AWS will decrypt your S3 data before importing using the TrueCrypt password you supply in your import manifest. EBS and Glacier data will not be decrypted before import, but will be stored encrypted. The following table summarizes your encryption options for each type of import/export job.

Import to Amazon S3		
Source	Target	Result
• Files on a device file system • Encrypt data using TrueCrypt before shipping device	• Objects in an existing Amazon S3 bucket • AWS decrypts the data before performing the import	• One object for each file. • AWS erases your device after every import job prior to shipping
Export from Amazon S3		
Source	Target	Result
• Objects in one or more Amazon S3 buckets • Provide a password that AWS will use to encrypt your data	• Files on your storage device • AWS formats your device • AWS copies your data to an encrypted file container on your device	• One file for each object • AWS encrypts your data prior to shipping • Use TrueCrypt to decrypt the files
Import to Amazon Glacier		
Source	Target	Result
• Entire device • Encrypt the data using the encryption method of your choice before shipping	• One archive in an existing Amazon Glacier vault • AWS does not decrypt your device	• Device image stored as a single archive • AWS erases your device after every import job prior to shipping
Import to Amazon EBS (Device Capacity < 1 TB)		
Source	Target	Result
• Entire device • Encrypt the data using the encryption method of your choice before shipping	• One Amazon EBS snapshot • AWS does not decrypt your device	• Device image is stored as a single snapshot • If the device was encrypted, the image is encrypted • AWS erases your device after every import job prior to shipping

Import to Amazon EBS (Device Capacity > 1 TB)		
Source	Target	Result
• Entire device • Encrypt the data using the encryption method of your choice before shipping	• Multiple objects in an existing Amazon S3 bucket • AWS does not decrypt your device	• Device image chunked into series of 1 TB snapshots stored as objects in S3 bucket specified in manifest file • If the device was encrypted, the image is encrypted • AWS erases your device after every import job prior to shipping

After the import is complete, AWS Import/Export will erase the contents of your storage device to safeguard the data during return shipment. AWS overwrites all writable blocks on the storage device with zeros. You will need to repartition and format the device after the wipe. If AWS is unable to erase the data on the device, it will be scheduled for destruction and our support team will contact you using the email address specified in the manifest file you ship with the device.

When shipping a device internationally, the customs option and certain required subfields are required in the manifest file sent to AWS. AWS Import/Export uses these values to validate the inbound shipment and prepare the outbound customs paperwork. Two of these options are whether the data on the device is encrypted or not and the encryption software's classification. When shipping encrypted data to or from the United States, the encryption software must be classified as 5D992 under the United States Export Administration Regulations.

AWS Data Pipeline

The AWS Data Pipeline service helps you process and move data between different data sources at specified intervals using data-driven workflows and built-in dependency checking. When you create a pipeline, you define data sources, preconditions, destinations, processing steps, and an operational schedule. Once you define and activate a pipeline, it will run automatically according to the schedule you specified.

With AWS Data Pipeline, you don't have to worry about checking resource availability, managing inter-task dependencies, retrying transient failures/timeouts in individual tasks, or creating a failure notification system. AWS Data Pipeline takes care of launching the AWS services and resources your pipeline needs to process your data (e.g., Amazon EC2 or EMR) and transferring the results to storage (e.g., Amazon S3, RDS, DynamoDB, or EMR).

When you use the console, AWS Data Pipeline creates the necessary IAM roles and policies, including a trusted entities list for you. IAM roles determine what your pipeline can access and the actions it can perform. Additionally, when your pipeline creates a resource, such as an EC2 instance, IAM roles determine the EC2 instance's permitted resources and actions. When you create a pipeline, you specify one IAM role that governs your pipeline and another IAM role to govern your pipeline's resources (referred to as a "resource role"), which can be the same role for both. As part of the security best practice of least privilege, we recommend that you consider the minimum permissions necessary for your pipeline to perform work and define the IAM roles accordingly.

Like most AWS services, AWS Data Pipeline also provides the option of secure (HTTPS) endpoints for access via SSL.

Amazon Simple Database (SimpleDB) Security

Amazon SimpleDB is a non-relational data store that offloads the work of database administration, allowing you to simply store and query data items via web services requests. Amazon SimpleDB then creates and manages multiple geographically distributed replicas of your data automatically to enable high availability and data durability.

Data in Amazon SimpleDB is stored in domains, which are similar to database tables except that you cannot perform functions across multiple domains. Amazon SimpleDB APIs provide domain-level controls that only permit authenticated access by the domain creator; therefore, you maintain full control over who has access to your data.

Amazon SimpleDB does not offer its own resource-based permissions system. However, the service integrates with AWS IAM so that you can give other users in your AWS Account access to Amazon SimpleDB domains within the AWS Account. Access to each individual domain is controlled by an independent ACL that maps authenticated users to the domains they own. A user created with AWS IAM only has access to the operations and domains for which they have been granted permission via policy.

In addition, each request to the SimpleDB service must contain a valid HMAC-SHA signature, or the request is rejected. When accessing Amazon SimpleDB using one of the AWS SDKs, the SDK handles the authentication process for you. However, when accessing Amazon SimpleDB using a REST request, you must provide your AWS Access Key ID, a valid HMAC-SHA signature (either HMAC-SHA1 or HMAC-SHA256), and a timestamp so the request can be authenticated. AWS uses your Access Key ID to retrieve your Secret Access Key and generate a signature from the request data and the Secret Access Key using the same algorithm you used to calculate the signature you sent in the request. If the signature generated by AWS matches the one you sent in the request, the request is considered authentic. If the comparison fails, the request is discarded, and AWS returns an error response.

Amazon SimpleDB is accessible via SSL-encrypted endpoints. The encrypted endpoints are accessible from both the Internet and from within Amazon EC2. Data stored within Amazon SimpleDB is not encrypted by AWS; however, the customer can encrypt data before it is uploaded to Amazon SimpleDB. These encrypted attributes would be retrievable as part of a Get operation only. They could not be used as part of a query filtering condition. Encrypting before sending data to Amazon SimpleDB helps protect against access to sensitive customer data by anyone, including AWS.

When a domain is deleted from Amazon SimpleDB, removal of the domain mapping starts immediately, and is generally processed across the distributed system within seconds. Once the mapping is removed, there is no remote access to the deleted domain.

When item and attribute data are deleted within a domain, removal of the mapping within the domain starts immediately, and is also generally complete within seconds. Once the mapping is removed, there is no remote access to the deleted data. That storage area is then made available only for write operations and the data are overwritten by newly stored data.

Data stored in Amazon SimpleDB is redundantly stored in multiple physical locations as part of normal operation of those services and at no additional charge. Amazon SimpleDB provides object durability by storing objects multiple times across multiple availability zones on the initial write and then actively doing further replication in the event of device unavailability or detected bit-rot.

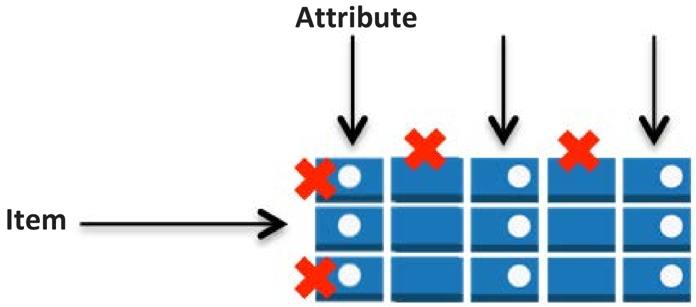
Amazon DynamoDB Security

Amazon DynamoDB is a fully managed NoSQL database service that provides fast and predictable performance with seamless scalability. Amazon DynamoDB enables you to offload the administrative burdens of operating and scaling distributed databases to AWS, so you don't have to worry about hardware provisioning, setup and configuration, replication, software patching, or cluster scaling.

You can create a database table that can store and retrieve any amount of data, and serve any level of request traffic. DynamoDB automatically spreads the data and traffic for the table over a sufficient number of servers to handle the request capacity you specified and the amount of data stored, while maintaining consistent, fast performance. All data items are stored on Solid State Drives (SSDs) and are automatically replicated across multiple availability zones in a region to provide built-in high availability and data durability.

You can set up automatic backups using a special template in AWS Data Pipeline that was created just for copying DynamoDB tables. You can choose full or incremental backups to a table in the same region or a different region. You can use the copy for disaster recovery (DR) in the event that an error in your code damages the original table, or to federate DynamoDB data across regions to support a multi-region application.

To control who can use the DynamoDB resources and API, you set up permissions in AWS IAM. In addition to controlling access at the resource-level with IAM, you can also control access at the database level—you can create database-level permissions that allow or deny access to items (rows) and attributes (columns) based on the needs of your application. These database-level permissions are called *fine-grained access controls*, and you create them using an IAM policy that specifies under what circumstances a user or application can access a DynamDB table. The IAM policy can restrict access to individual items in a table, access to the attributes in those items, or both at the same time.



You can optionally use web identity federation to control access by application users who are authenticated by Login with Amazon, Facebook, or Google. Web identity federation removes the need for creating individual IAM users; instead, users can sign in to an identity provider and then obtain temporary security credentials from AWS Security Token Service (AWS STS). AWS STS returns temporary AWS credentials to the application and allows it to access the specific DynamoDB table.

In addition to requiring database and user permissions, each request to the DynamoDB service must contain a valid HMAC-SHA256 signature, or the request is rejected. The AWS SDKs automatically sign your requests; however, if you want to write your own HTTP POST requests, you must provide the signature in the header of your request to Amazon DynamoDB. To calculate the signature, you must request temporary security credentials from the AWS Security Token Service. Use the temporary security credentials to sign your requests to Amazon DynamoDB.

Amazon DynamoDB is accessible via SSL-encrypted endpoints. The encrypted endpoints are accessible from both the Internet and from within Amazon EC2.

Amazon Relational Database Service (Amazon RDS) Security

Amazon RDS allows you to quickly create a relational database (DB) instance and flexibly scale the associated compute resources and storage capacity to meet application demand. Amazon RDS manages the database instance on your behalf by performing backups, handling failover, and maintaining the database software. Currently, Amazon RDS is available for MySQL, Oracle, Microsoft SQL Server, and PostgreSQL database engines.

Amazon RDS has multiple features that enhance reliability for critical production databases, including DB security groups, permissions, SSL connections, automated backups, DB snapshots, and multi-AZ deployments. DB instances can also be deployed in an Amazon VPC for additional network isolation.

Access Control

When you first create a DB Instance within Amazon RDS, you will create a master user account, which is used only within the context of Amazon RDS to control access to your DB Instance(s). The master user account is a native database user account that allows you to log on to your DB Instance with all database privileges. You can specify the master user name and password you want associated with each DB Instance when you create the DB Instance. Once you have created your DB Instance, you can connect to the database using the master user credentials. Subsequently, you can create additional user accounts so that you can restrict who can access your DB Instance.

You can control Amazon RDS DB Instance access via DB Security Groups, which are similar to Amazon EC2 Security Groups but not interchangeable. DB Security Groups act like a firewall controlling network access to your DB Instance. Database Security Groups default to a “deny all” access mode and customers must specifically authorize network ingress. There are two ways of doing this: authorizing a network IP range or authorizing an existing Amazon EC2 Security Group. DB Security Groups only allow access to the database server port (all others are blocked) and can be updated without restarting the Amazon RDS DB Instance, which allows a customer seamless control of their database access. Using AWS IAM, you can further control access to your RDS DB instances. AWS IAM enables you to control what RDS operations each individual AWS IAM user has permission to call.

Network Isolation

For additional network access control, you can run your DB Instances in an Amazon VPC. Amazon VPC enables you to isolate your DB Instances by specifying the IP range you wish to use, and connect to your existing IT infrastructure through industry-standard encrypted IPsec VPN. Running Amazon RDS in a VPC enables you to have a DB instance within a private subnet. You can also set up a virtual private gateway that extends your corporate network into your VPC, and allows access to the RDS DB instance in that VPC. Refer to the Amazon VPC User Guide for more details.

For Multi-AZ deployments, defining a subnet for all availability zones in a region will allow Amazon RDS to create a new standby in another availability zone should the need arise. You can create DB Subnet Groups, which are collections of subnets that you may want to designate for your RDS DB Instances in a VPC. Each DB Subnet Group should have at least one subnet for every availability zone in a given region. In this case, when you create a DB Instance in a VPC, you select a DB Subnet Group; Amazon RDS then uses that DB Subnet Group and your preferred availability zone to select a subnet and an IP address within that subnet. Amazon RDS creates and associates an Elastic Network Interface to your DB Instance with that IP address.

DB Instances deployed within an Amazon VPC can be accessed from the Internet or from Amazon EC2 Instances outside the VPC via VPN or bastion hosts that you can launch in your public subnet. To use a bastion host, you will need to set up a public subnet with an EC2 instance that acts as a SSH Bastion. This public subnet must have an Internet gateway and routing rules that allow traffic to be directed via the SSH host, which must then forward requests to the private IP address of your Amazon RDS DB instance.

DB Security Groups can be used to help secure DB Instances within an Amazon VPC. In addition, network traffic entering and exiting each subnet can be allowed or denied via network ACLs. All network traffic entering or exiting your Amazon VPC via your IPsec VPN connection can be inspected by your on-premises security infrastructure, including network firewalls and intrusion detection systems.

Encryption

You can encrypt connections between your application and your DB Instance using SSL.For MySQL and SQL Server, RDS creates an SSL certificate and installs the certificate on the DB instance when the instance is provisioned. For MySQL, you launch the mysql client using the --ssl_ca parameter to reference the public key in order to encrypt connections. For SQL Server, download the public key and import the certificate into your Windows operating system. Oracle RDS uses Oracle native network encryption with a DB instance. You simply add the native network encryption option to an option group and associate that option group with the DB instance. Once an encrypted connection is established, data transferred between the DB Instance and your application will be encrypted during transfer. You can also require your DB instance to only accept encrypted connections.

Amazon RDS supports Transparent Data Encryption (TDE) for SQL Server (SQL Server Enterprise Edition) and Oracle (part of the Oracle Advanced Security option available in Oracle Enterprise Edition). The TDE feature automatically encrypts data before it is written to storage and automatically decrypts data when it is read from storage. If you require your MySQL data to be encrypted while “at rest” in the database, your application must manage the encryption and decryption of data.

Note that SSL support within Amazon RDS is for encrypting the connection between your application and your DB Instance; it should not be relied on for authenticating the DB Instance itself.

While SSL offers security benefits, be aware that SSL encryption is a compute intensive operation and will increase the latency of your database connection. To learn more about how SSL works with MySQL, you can refer directly to the MySQL documentation found here. To learn how SSL works with SQL Server, you can read more in the RDS User Guide.

Automated Backups and DB Snapshots

Amazon RDS provides two different methods for backing up and restoring your DB Instance(s): automated backups and database snapshots (DB Snapshots).

Turned on by default, the automated backup feature of Amazon RDS enables point-in-time recovery for your DB Instance. Amazon RDS will back up your database and transaction logs and store both for a user-specified retention period. This allows you to restore your DB Instance to any second during your retention period, up to the last 5 minutes. Your automatic backup retention period can be configured to up to 35 days.

During the backup window, storage I/O may be suspended while your data is being backed up. This I/O suspension typically lasts a few minutes. This I/O suspension is avoided with Multi-AZ DB deployments, since the backup is taken from the standby.

DB Snapshots are user-initiated backups of your DB Instance. These full database backups are stored by Amazon RDS until you explicitly delete them. You can copy DB snapshots of any size and move them between any of AWS’s public regions, or copy the same snapshot to multiple regions simultaneously. You can then create a new DB Instance from a DB Snapshot whenever you desire.

DB Instance Replication

Amazon cloud computing resources are housed in highly available data center facilities in different regions of the world, and each region contains multiple distinct locations called Availability Zones. Each Availability Zone is engineered to be isolated from failures in other Availability Zones, and to provide inexpensive, low-latency network connectivity to other Availability Zones in the same region.

To architect for high availability of your Oracle, PostgreSQL, or MySQL databases, you can run your RDS DB instance in several Availability Zones, an option called a Multi-AZ deployment. When you select this option, Amazon automatically provisions and maintains a synchronous standby replica of your DB instance in a different Availability Zone. The primary DB instance is synchronously replicated across Availability Zones to the standby replica. In the event of DB instance or Availability Zone failure, Amazon RDS will automatically failover to the standby so that database operations can resume quickly without administrative intervention.

For customers who use MySQL and need to scale beyond the capacity constraints of a single DB Instance for read-heavy database workloads, Amazon RDS provides a Read Replica option. Once you create a read replica, database updates on the source DB instance are replicated to the read replica using MySQL's native, asynchronous replication. You can create multiple read replicas for a given source DB instance and distribute your application's read traffic among them. Read replicas can be created with Multi-AZ deployments to gain read scaling benefits in addition to the enhanced database write availability and data durability provided by Multi-AZ deployments.

Automatic Software Patching

Amazon RDS will make sure that the relational database software powering your deployment stays up-to-date with the latest patches. When necessary, patches are applied during a maintenance window that you can control. You can think of the Amazon RDS maintenance window as an opportunity to control when DB Instance modifications (such as scaling DB Instance class) and software patching occur, in the event either are requested or required. If a "maintenance" event is scheduled for a given week, it will be initiated and completed at some point during the 30-minute maintenance window you identify.

The only maintenance events that require Amazon RDS to take your DB Instance offline are scale compute operations (which generally take only a few minutes from start-to-finish) or required software patching. Required patching is automatically scheduled only for patches that are security and durability related. Such patching occurs infrequently (typically once every few months) and should seldom require more than a fraction of your maintenance window. If you do not specify a preferred weekly maintenance window when creating your DB Instance, a 30-minute default value is assigned. If you wish to modify when maintenance is performed on your behalf, you can do so by modifying your DB Instance in the AWS Management Console or by using the ModifyDBInstance API. Each of your DB Instances can have different preferred maintenance windows, if you so choose.

Running your DB Instance as a Multi-AZ deployment can further reduce the impact of a maintenance event, as Amazon RDS will conduct maintenance via the following steps: 1) Perform maintenance on standby, 2) Promote standby to primary, and 3) Perform maintenance on old primary, which becomes the new standby.

When an Amazon RDS DB Instance deletion API (DeleteDBInstance) is run, the DB Instance is marked for deletion. Once the instance no longer indicates 'deleting' status, it has been removed. At this point the instance is no longer accessible and unless a final snapshot copy was asked for, it cannot be restored and will not be listed by any of the tools or APIs.

Event Notification

You can receive notifications of a variety of important events that can occur on your RDS instance, such as whether the instance was shut down, a backup was started, a failover occurred, the security group was changed, or your storage space is low. The Amazon RDS service groups events into categories that you can subscribe to so that you can be notified when an event in that category occurs. You can subscribe to an event category for a DB instance, DB snapshot, DB security group, or for a DB parameter group. RDS events are published via AWS SNS and sent to you as an email or text message. For more information about RDS notification event categories, refer to the RDS User Guide.

Amazon RedShift Security

Amazon Redshift is a petabyte-scale SQL data warehouse service that runs on highly optimized and fully managed AWS compute and storage resources. The service has been architected to not only scale up or down rapidly, but to significantly improve query speeds—even on extremely large datasets. To increase performance, Redshift uses techniques such as columnar storage, data compression, and zone maps to reduce the amount of IO needed to perform queries. It also has a massively parallel processing (MPP) architecture, parallelizing and distributing SQL operations to take advantage of all available resources.

When you create a Redshift data warehouse, you provision a single-node or multi-node cluster, specifying the type and number of nodes that will make up the cluster. The node type determines the storage size, memory, and CPU of each node. Each multi-node cluster includes a leader node and two or more compute nodes. A leader node manages connections, parses queries, builds execution plans, and manages query execution in the compute nodes. The compute nodes store data, perform computations, and run queries as directed by the leader node. The leader node of each cluster is accessible through ODBC and JDBC endpoints, using standard PostgreSQL drivers. The compute nodes run on a separate, isolated network and are never accessed directly.

After you provision a cluster, you can upload your dataset and perform data analysis queries by using common SQL-based tools and business intelligence applications.

Cluster Access

By default, clusters that you create are closed to everyone. Amazon Redshift enables you to configure firewall rules (security groups) to control network access to your data warehouse cluster. You can also run Redshift inside an Amazon VPC to isolate your data warehouse cluster in your own virtual network and connect it to your existing IT infrastructure using industry-standard encrypted IPsec VPN.

The AWS account that creates the cluster has full access to the cluster. Within your AWS account, you can use AWS IAM to create user accounts and manage permissions for those accounts. By using IAM, you can grant different users permission to perform only the cluster operations that are necessary for their work.

Like all databases, you must grant permission in Redshift at the database level in addition to granting access at the resource level. Database users are named user accounts that can connect to a database and are authenticated when they login to Amazon Redshift. In Redshift, you grant database user permissions on a per-cluster basis instead of on a per-table basis. However, a user can see data only in the table rows that were generated by his own activities; rows generated by other users are not visible to him.

The user who creates a database object is its owner. By default, only a superuser or the owner of an object can query, modify, or grant permissions on the object. For users to use an object, you must grant the necessary permissions to the user or the group that contains the user. And only the owner of an object can modify or delete it.

Data Backups

Amazon Redshift distributes your data across all compute nodes in a cluster. When you run a cluster with at least two compute nodes, data on each node will always be mirrored on disks on another node, reducing the risk of data loss. In addition, all data written to a node in your cluster is continuously backed up to Amazon S3 using snapshots. Redshift stores your snapshots for a user-defined period, which can be from one to thirty-five days. You can also take your own snapshots at any time; these snapshots leverage all existing system snapshots and are retained until you explicitly delete them.

Amazon Redshift continuously monitors the health of the cluster and automatically re-replicates data from failed drives and replaces nodes as necessary. All of this happens without any effort on your part, although you may see a slight performance degradation during the re-replication process.

You can use any system or user snapshot to restore your cluster using the AWS Management Console or the Amazon Redshift APIs. Your cluster is available as soon as the system metadata has been restored and you can start running queries while user data is spooled down in the background.

Data Encryption

When creating a cluster, you can choose to encrypt it in order to provide additional protection for your data at rest. When you enable encryption in your cluster, Amazon Redshift stores all data in user-created tables in an encrypted format using hardware-accelerated AES-256 block encryption keys. This includes all data written to disk as well as any backups.

Amazon Redshift uses a four-tier, key-based architecture for encryption. These keys consist of data encryption keys, a database key, a cluster key, and a master key:

- *Data encryption keys*encrypt data blocks in the cluster. Each data block is assigned a randomly-generated AES-256 key. These keys are encrypted by using the database key for the cluster.
- The *database key* encrypts data encryption keys in the cluster. The database key is a randomly-generated AES-256 key. It is stored on disk in a separate network from the Amazon Redshift cluster and encrypted by a master key. Amazon Redshift passes the database key across a secure channel and keeps it in memory in the cluster.
- The *cluster key* encrypts the database key for the Amazon Redshift cluster. You can use either AWS or a hardware security module (HSM) to store the cluster key. HSMs provide direct control of key generation and management, and make key management separate and distinct from the application and the database.
- The *master key* encrypts the cluster key if it is stored in AWS. The master key encrypts the cluster-key-encrypted database key if the cluster key is stored in an HSM.

You can have Redshift rotate the encryption keys for your encrypted clusters at any time. As part of the rotation process, keys are also updated for all of the cluster's automatic and manual snapshots.

Note that enabling encryption in your cluster will impact performance, even though it is hardware accelerated. Encryption also applies to backups. When restoring from an encrypted snapshot, the new cluster will be encrypted as well.

To encrypt your table load data files when you upload them to Amazon S3, you can use Amazon S3 server-side encryption. When you load the data from Amazon S3, the COPY command will decrypt the data as it loads the table.

Database Audit Logging

Amazon Redshift logs all SQL operations, including connection attempts, queries, and changes to your database. You can access these logs using SQL queries against system tables or choose to have them downloaded to a secure Amazon S3 bucket. You can then use these audit logs to monitor your cluster for security and troubleshooting purposes.

Automatic Software Patching

Amazon Redshift manages all the work of setting up, operating, and scaling your data warehouse, including provisioning capacity, monitoring the cluster, and applying patches and upgrades to the Amazon Redshift engine. Patches are applied only during specified maintenance windows.

SSL Connections

To protect your data in transit within the AWS cloud, Amazon Redshift uses hardware-accelerated SSL to communicate with Amazon S3 or Amazon DynamoDB for COPY, UNLOAD, backup, and restore operations. You can encrypt the connection between your client and the cluster by specifying SSL in the parameter group associated with the cluster. To have your clients also authenticate the Redshift server, you can install the public key (.pem file) for the SSL certificate on your client and use the key to connect to your clusters.

Amazon ElastiCache Security

Amazon ElastiCache is a web service that makes it easy to set up, manage, and scale distributed in-memory cache environments in the cloud. The service improves the performance of web applications by allowing you to retrieve information from a fast, managed, in-memory caching system, instead of relying entirely on slower disk-based databases. It can be used to significantly improve latency and throughput for many read-heavy application workloads (such as social networking, gaming, media sharing, and Q&A portals) or compute-intensive workloads (such as a recommendation engine). Caching improves application performance by storing critical pieces of data in memory for low-latency access. Cached information may include the results of I/O-intensive database queries or the results of computationally-intensive calculations.

The Amazon ElastiCache service automates time-consuming management tasks for in-memory cache environments, such as patch management, failure detection, and recovery. It works in conjunction with other Amazon Web Services (such as Amazon EC2, Amazon CloudWatch, and Amazon SNS) to provide a secure, high-performance, and managed in-memory cache. For example, an application running in Amazon EC2 can securely access an Amazon ElastiCache Cluster in the same region with very low latency.

Using the Amazon ElastiCache service, you create a Cache Cluster, which is a collection of one or more Cache Nodes, each running an instance of the Memcached service. A Cache Node is a fixed-size chunk of secure, network-attached RAM. Each Cache Node runs an instance of the Memcached service, and has its own DNS name and port. Multiple types of Cache Nodes are supported, each with varying amounts of associated memory. A Cache Cluster can be set up with a specific number of Cache Nodes and a Cache Parameter Group that controls the properties for each Cache Node. All Cache Nodes within a Cache Cluster are designed to be of the same Node Type and have the same parameter and security group settings.

Amazon ElastiCache allows you to control access to your Cache Clusters using Cache Security Groups. A Cache Security Group acts like a firewall, controlling network access to your Cache Cluster. By default, network access is turned off to your Cache Clusters. If you want your applications to access your Cache Cluster, you must explicitly enable access from hosts in specific EC2 security groups. Once ingress rules are configured, the same rules apply to all Cache Clusters associated with that Cache Security Group.

To allow network access to your Cache Cluster, create a Cache Security Group and use the Authorize Cache Security Group Ingress API or CLI command to authorize the desired EC2 security group (which in turn specifies the EC2 instances allowed). IP-range based access control is currently not enabled for Cache Clusters. All clients to a Cache Cluster must be within the EC2 network, and authorized via Cache Security Groups.

Amazon Simple Queue Service (Amazon SQS) Security

Amazon SQS is a highly reliable, scalable message queuing service that enables asynchronous message-based communication between distributed components of an application. The components can be computers or Amazon EC2 instances or a combination of both. With Amazon SQS, you can send any number of messages to an Amazon SQS queue at any time from any component. The messages can be retrieved from the same component or a different one right away or at a later time (within 4 days). Messages are highly durable; each message is persistently stored in highly available, highly reliable queues. Multiple processes can read/write from/to an Amazon SQS queue at the same time without interfering with each other.

Amazon SQS access is granted based on an AWS Account or a user created with AWS IAM. Once authenticated, the AWS Account has full access to all user operations. An AWS IAM user, however, only has access to the operations and queues for which they have been granted access via policy. By default, access to each individual queue is restricted to the AWS Account that created it. However, you can allow other access to a queue, using either an SQS-generated policy or a policy you write.

Amazon SQS is accessible via SSL-encrypted endpoints. The encrypted endpoints are accessible from both the Internet and from within Amazon EC2. Data stored within Amazon SQS is not encrypted by AWS; however, the user can encrypt data before it is uploaded to Amazon SQS, provided that the application utilizing the queue has a means to decrypt the message when retrieved. Encrypting messages before sending them to Amazon SQS helps protect against access to sensitive customer data by unauthorized persons, including AWS.

Amazon Simple Notification Service (Amazon SNS) Security

Amazon Simple Notification Service (Amazon SNS) is a web service that makes it easy to set up, operate, and send notifications from the cloud. It provides developers with a highly scalable, flexible, and cost-effective capability to publish messages from an application and immediately deliver them to subscribers or other applications.

Amazon SNS provides a simple web services interface that can be used to create topics that customers want to notify applications (or people) about, subscribe clients to these topics, publish messages, and have these messages delivered over clients' protocol of choice (i.e., HTTP/HTTPS, email, etc.). Amazon SNS delivers notifications to clients using a "push" mechanism that eliminates the need to periodically check or "poll" for new information and updates. Amazon SNS can be leveraged to build highly reliable, event-driven workflows and messaging applications without the need for complex middleware and application management. The potential uses for Amazon SNS include monitoring applications, workflow systems, time-sensitive information updates, mobile applications, and many others. Amazon SNS provides access control mechanisms so that topics and messages are secured against unauthorized access. Topic owners can set policies for a topic that restrict who can publish or subscribe to a topic. Additionally, topic owners can encrypt transmission by specifying that the delivery mechanism must be HTTPS.

Amazon SNS access is granted based on an AWS Account or a user created with AWS IAM. Once authenticated, the AWS Account has full access to all user operations. An AWS IAM user, however, only has access to the operations and topics for which they have been granted access via policy. By default, access to each individual topic is restricted to the AWS Account that created it. However, you can allow other access to SNS, using either an SNS-generated policy or a policy you write.

Amazon Simple Workflow Service (Amazon SWF) Security

The Amazon Simple Workflow Service (SWF) makes it easy to build applications that coordinate work across distributed components. Using Amazon SWF, you can structure the various processing steps in an application as “tasks” that drive work in distributed applications, and Amazon SWF coordinates these tasks in a reliable and scalable manner. Amazon SWF manages task execution dependencies, scheduling, and concurrency based on a developer’s application logic. The service stores tasks, dispatches them to application components, tracks their progress, and keeps their latest state.

Amazon SWF provides simple API calls that can be executed from code written in any language and run on your EC2 instances, or any of your machines located anywhere in the world that can access the Internet. Amazon SWF acts as a coordination hub with which your application hosts interact. You create desired workflows with their associated tasks and any conditional logic you wish to apply and store them with Amazon SWF.

Amazon SWF access is granted based on an AWS Account or a user created with AWS IAM. All actors that participate in the execution of a workflow—deciders, activity workers, workflow administrators—must be IAM users under the AWS Account that owns the Amazon SWF resources. You cannot grant users associated with other AWS Accounts access to your Amazon SWF workflows. An AWS IAM user, however, only has access to the workflows and resources for which they have been granted access via policy.

Amazon Simple Email Service (Amazon SES) Security

Amazon Simple Email Service (Amazon SES) is a highly scalable and cost-effective bulk and transactional email-sending service for businesses and developers. Amazon SES eliminates the complexity and expense of building an in-house email solution or licensing, installing, and operating a third-party email service. The Amazon SES service integrates with other AWS services, making it easy to send emails from applications being hosted on services such as Amazon EC2.

Unfortunately, some people are intent on sending bulk email or spam to those who do not want to receive it and spoof others’ identities to conceal their own. To mitigate these problems, Amazon SES requires new users to verify their email address or domain in order to confirm that they own it and to prevent others from using it. In addition, AWS periodically reviews domain verification status, and revokes verification in cases where it is no longer valid.

Amazon SES takes proactive steps to prevent questionable content from being sent, so that ISPs receive consistently high-quality email and therefore view the service as a trusted email origin. This maximizes deliverability and dependability for all of our senders. Below are some of the safeguards in place:

- ISPs often interpret a sudden increase in email volume as a potential indicator of spam activity, and may respond by blocking such email. To help you avoid this pitfall, Amazon SES automatically “ramps up” the volume of email that you can send from the service until you reach your target volume.
- Amazon SES uses content-filtering technologies to help detect and block messages containing spam or malware before they can be sent.
- Amazon SES maintains complaint feedback loops from major ISPs. Complaint feedback loops indicate which emails a recipient marked as spam. Amazon SES provides you access to these delivery metrics (for your email campaigns) to help guide your sending strategy.

Amazon SES uses Simple Mail Transfer Protocol (SMTP) to send email. By itself, SMTP does not provide any authentication; it is possible for a spammer to send email messages that claim to originate from someone else, while hiding their true origin. Most ISPs have taken measures to evaluate whether email is legitimate. One such action that ISPs consider is email authentication, in which senders provide evidence that they are the owner of the account that they are sending from. In some cases, ISPs will refuse to forward email that is not authenticated. Amazon SES supports three authentication mechanisms that ISPs use to determine whether email is legitimate: SPF, Sender ID, and DKIM. AWS recommends that SES customers follow these standards to help ensure optimal deliverability.

- Sender Policy Framework (SPF) provides a means for tracing an email message back to the system from which it was sent. To be SPF-compliant, an email sender publishes one or more DNS records that establish the sending domain's identity. These DNS records are usually specified as TXT (text); they identify a set of hosts that are authorized to send email. After these DNS records are created and published, ISPs can authenticate a host by comparing its IP address with the set of IP addresses specified in the SPF record. For more information about SPF, go to www.openspf.org and RFC 4408.
- Sender ID is an authentication system similar to SPF. Like SPF, Sender ID relies on cooperation between senders and ISPs to verify that an email message can be traced back to the system from which it was sent. To be Sender ID-compliant, an email sender publishes one or more DNS records to establish the sending domain's identity. For more information about Sender ID, go to http://www.microsoft.com/mscorp/safety/technologies/senderid/default.mspx and RFC 4406.
- DomainKeys Identified Mail (DKIM) is a standard that allows senders to sign their email messages using digital signatures, and ISPs to use those signatures to verify that those messages are legitimate. An ISP receiving the message can decode the cryptographic signature using a public key, published in the sender's DNS record, to help ensure that the message is authentic. If you want to enhance deliverability of your mail with DKIM-compliant ISPs, you can sign your email messages using DKIM. For more information about DKIM, refer to http://www.dkim.org.

To use the Amazon SES SMTP interface, you must first create an SMTP user name and password, which is different from your AWS Access Key ID and Secret Access Key. After you have obtained your SMTP credentials, you can begin sending email through Amazon SES using any email client application, provided that it can communicate via SMTP and connect to an SMTP endpoint using Transport Layer Security (TLS). To configure your email client, you must provide the Amazon SES SMTP interface hostname (email-smtp.us-east-1.amazonaws.com) and port number, along with your SMTP user name and password.

The Amazon SES SMTP endpoint (email-smtp.us-east-1.amazonaws.com) requires that all connections be encrypted using TLS. Amazon SES supports two mechanisms for establishing an encrypted connection: STARTTLS and TLS Wrapper. If your software does not support STARTTLS or TLS Wrapper, you can use the open source stunnel program to set up an encrypted connection (called a "secure tunnel"), and then use the secure tunnel to connect to the Amazon SES SMTP endpoint.

Amazon SES access is granted based on an AWS Account or a user created with AWS IAM. An AWS IAM user, however, only has access to the administrative functions for which they have been granted access via policy.

Amazon Elastic Transcoder Service Security

The Amazon Elastic Transcoder service simplifies and automates what is usually a complex process of converting media files from one format, size, or quality to another. The Elastic Transcoder service converts standard-definition (SD) or high-definition (HD) video files as well as audio files. It reads input from an Amazon S3 bucket, transcodes it, and writes the resulting file to another S3 bucket. You can use the same bucket for input and output, and the buckets can be in any AWS region. The Elastic Transcoder accepts input files in a wide variety of web, consumer, and professional formats. Output file types include the MP4, TS, and WebM container types, storing H.264 or VP8 video and AAC or Vorbis audio.

You'll start with one or more input files, and create transcoding jobs in a type of workflow called a transcoding pipeline for each file. When you create the pipeline you'll specify input and output buckets as well as an IAM role. Each job must reference a media conversion template called a transcoding preset, and will result in the generation of one or more output files. A preset tells the Elastic Transcoder what settings to use when processing a particular input file. You can specify many settings when you create a preset, including the sample rate, bit rate, resolution (output height and width), the number of reference and keyframes, a video bit rate, some thumbnail creation options, etc.

A best effort is made to start jobs in the order in which they're submitted, but this is not a hard guarantee and jobs typically finish out of order since they are worked on in parallel and vary in complexity. You can pause and resume any of your pipelines if necessary.

Elastic Transcoder supports the use of SNS notifications when it starts and finishes each job, and when it needs to tell you that it has detected an error or warning condition. The SNS notification parameters are associated with each pipeline. It can also use the List Jobs By Status function to find all of the jobs with a given status (e.g.,"Completed") or the Read Job function to retrieve detailed information about a particular job.

Like all other AWS services, Elastic Transcoder integrates with AWS Identity and Access Management (IAM), which allows you to control access to the service and to other AWS resources that Elastic Transcoder requires, including Amazon S3 buckets and Amazon SNS topics. By default, IAM users have no access to Elastic Transcoder or to the resources that it uses. If you want IAM users to be able to work with Elastic Transcoder, you must explicitly grant them permissions.

Amazon Elastic Transcoder requires every request made to its control API be authenticated so only authenticated processes or users can create, modify, or delete their own Amazon Transcoder pipelines and presets. Requests are signed with an HMAC-SHA256 signature calculated from the request and a key derived from the user's secret key. Additionally, the Amazon Elastic Transcoder API is only accessible via SSL-encrypted endpoints.

Durability is provided by Amazon S3, where media files are redundantly stored on multiple devices across multiple facilities in an Amazon S3 region. For added protection against users accidently deleting media files, you can use the Versioning feature in S3 to preserve, retrieve, and restore every version of every object stored in an Amazon S3 bucket. You can further protect versions using Amazon S3 Versioning's MFA Delete feature. Once enabled for an S3 bucket, each version deletion request must include the six-digit code and serial number from your multi-factor authentication device.

Amazon CloudWatch Security

Amazon CloudWatch is a web service that provides monitoring for AWS cloud resources, starting with Amazon EC2. It provides customers with visibility into resource utilization, operational performance, and overall demand patterns—including metrics such as CPU utilization, disk reads and writes, and network traffic. Customers can set up CloudWatch alarms to notify them if certain thresholds are crossed, or to take other automated actions such as adding or removing EC2 instances if Auto-Scaling is enabled.

Like all AWS Services, Amazon CloudWatch requires that every request made to its control API be authenticated so only authenticated users can access and manage CloudWatch. Requests are signed with an HMAC-SHA1 signature calculated from the request and the user's private key. Additionally, the Amazon CloudWatch control API is only accessible via SSL-encrypted endpoints.

You can further control access to Amazon CloudWatch by creating users under your AWS Account using AWS IAM, and controlling what CloudWatch operations these users have permission to call.

Amazon CloudFront Security

Amazon CloudFront gives customers an easy way to distribute content to end users with low latency and high data transfer speeds. It delivers dynamic, static, and streaming content using a global network of edge locations. Requests for customers' objects are automatically routed to the nearest edge location, so content is delivered with the best possible performance. Amazon CloudFront is optimized to work with other AWS services, like Amazon S3, Amazon EC2, Amazon Elastic Load Balancing, and Amazon Route 53. It also works seamlessly with any non-AWS origin server that stores the original, definitive versions of your files.

Amazon CloudFront requires every request made to its control API be authenticated so only authorized users can create, modify, or delete their own Amazon CloudFront distributions. Requests are signed with an HMAC-SHA1 signature calculated from the request and the user's private key. Additionally, the Amazon CloudFront control API is only accessible via SSL-encrypted endpoints.

There is no guarantee of durability of data held in Amazon CloudFront edge locations. The service may from time to time remove objects from edge locations if those objects are not requested frequently. Durability is provided by Amazon S3, which works as the origin server for Amazon CloudFront holding the original, definitive copies of objects delivered by Amazon CloudFront.

If you want control over who is able to download content from Amazon CloudFront, you can enable the service's private content feature. This feature has two components: the first controls how the Amazon CloudFront edge locations access objects in Amazon S3. The second controls how content is delivered from the Amazon CloudFront edge location to viewers on the Internet. You can also customize the method of blocking access to your content based on the geographic location of your viewers by enabling the geo-restriction feature in CloudFront. You can use geo-restriction to specify whether to whitelist or blacklist IPs from specific countries.

To control access to the original copies of your objects in S3, Amazon CloudFront allows you to create one or more "Origin Access Identities" and associate these with your distributions. When an Origin Access Identity is associated with an Amazon CloudFront distribution, the distribution will use that identity to retrieve objects from Amazon S3. You can then use Amazon S3's ACL feature, which limits access to that Origin Access Identity so the original copy of the object is not publicly readable.

To control who is able to download objects from Amazon CloudFront edge locations, the service uses a signed-URL verification system. To use this system, you first create a private-key public-key pair, and upload the public key to your account via the AWS website. Second, you configure your Amazon CloudFront distribution to indicate which accounts you would authorize to sign requests – you can indicate up to five AWS Accounts you trust to sign requests. Third, as you receive requests you will create policy documents indicating the conditions under which you want Amazon CloudFront to serve your content. These policy documents can specify the name of the object that is requested, the date and time of the request, and the source IP (or CIDR range) of the client making the request. You then calculate the RSA-SHA1 encoding of your policy document and sign this using your private key. Finally, you include both the encoded policy document and the signature as query string parameters when you reference your objects. When Amazon CloudFront receives a request, it will decode the signature using your public key. Amazon CloudFront will only serve requests that have a valid policy document and matching signature.

Note that private content is an optional feature that must be enabled when you set up your CloudFront distribution. Content delivered without this feature enabled will be publicly readable by anyone.

Amazon Cloudfront provides the option to transfer content over an encrypted connection (HTTPS). By default, Cloudfront will accept requests over both HTTP and HTTPS protocols. However, you can also configure CloudFront to require HTTPS for all requests or have CloudFront redirect HTTP requests to HTTPS. You can even configure CloudFront cache behavior in the same distribution to allow both HTTP and HTTPS, so you can require HTTPS for some objects but not for others.

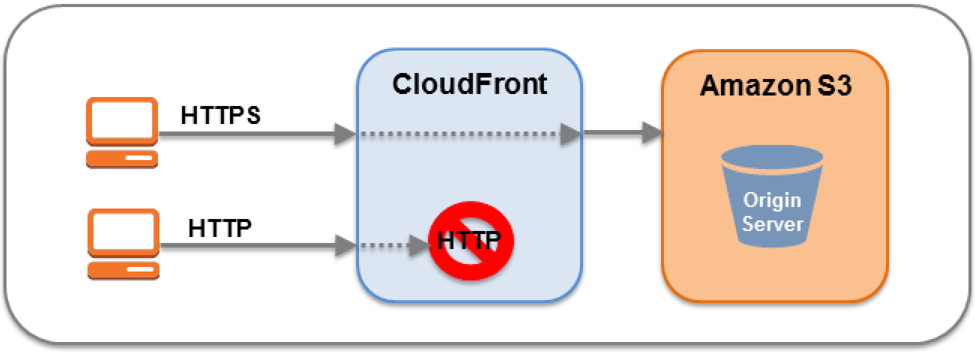


Figure 6: Amazon CloudFront Encrypted Transmission

You can configure one or more CloudFront origins to require that CloudFront fetches objects from your origin using the protocol that the viewer used to request the objects. For example, when you use this CloudFront setting and the viewer uses HTTPS to request an object from CloudFront, CloudFront also uses HTTPS to forward the request to your origin.

Note that if you're using an HTTP server as your origin, and you want to use HTTPS both between viewers and CloudFront and between CloudFront and your origin, you must install an SSL certificate on the HTTP server that is signed by a third-party certificate authority, for example, VeriSign or DigiCert.

No matter whether you're using HTTP or HTTPS, you can use alternate domain names (for example, example.com) instead of the domain name that CloudFront assigns to your distribution. With HTTP, Amazon dedicates IP addresses to your SSL certificate at each CloudFront edge location so that CloudFront can associate the incoming requests with the proper SSL certificate. For HTTPS, modern web browsers and HTTP client libraries transmit the destination host name at the beginning of the SSL handshaking process, so dedicated IP addresses are no longer necessary.

Amazon CloudFront access logs contain a comprehensive set of information about requests for content, including the object requested, the date and time of the request, the edge location serving the request, the client IP address, the referrer, and the user agent. To enable access logs, just specify the name of the Amazon S3 bucket to store the logs in when you configure your Amazon CloudFront distribution.

Amazon Elastic MapReduce (Amazon EMR) Security

Amazon Elastic MapReduce (Amazon EMR) is a managed web service you can use to run Hadoop clusters that process vast amounts of data by distributing the work and data among several servers. It utilizes an enhanced version of the Apache Hadoop framework running on the web-scale infrastructure of Amazon EC2 and Amazon S3. You simply upload your input data and a data processing application into Amazon S3. Amazon EMR then launches the number of Amazon EC2 instances you specify. The service begins the job flow execution while pulling the input data from Amazon S3 into the launched Amazon EC2 instances. Once the job flow is finished, Amazon EMR transfers the output data to Amazon S3, where you can then retrieve it or use it as input in another job flow.

When launching job flows on your behalf, Amazon EMR sets up two Amazon EC2 security groups: one for the master nodes and another for the slaves. The master security group has a port open for communication with the service. It also has the SSH port open to allow you to SSH into the instances, using the key specified at startup. The slaves start in a separate security group, which only allows interaction with the master instance. By default both security groups are set up to not allow access from external sources, including Amazon EC2 instances belonging to other customers. Since these are security groups within your account, you can reconfigure them using the standard EC2 tools or dashboard. To protect customer input and output datasets, Amazon EMR transfers data to and from Amazon S3 using SSL.

Amazon EMR provides several ways to control access to the resources of your cluster. You can use AWS IAM to create user accounts and roles and configure permissions that control which AWS features those users and roles can access. When you launch a cluster, you can associate an Amazon EC2 key pair with the cluster, which you can then use when you connect to the cluster using SSH. You can also set permissions that allow users other than the default Hadoop user to submit jobs to your cluster.

By default, if an IAM user launches a cluster, that cluster is hidden from other IAM users on the AWS account. This filtering occurs on all Amazon EMR interfaces—the console, CLI, API, and SDKs—and helps prevent IAM users from accessing and inadvertently changing clusters created by other IAM users. It is useful for clusters that are intended to be viewed by only a single IAM user and the main AWS account. You also have the option to make a cluster visible and accessible to all IAM users under a single AWS account.

For an additional layer of protection, you can launch the EC2 instances of your EMR cluster into an Amazon VPC, which is like launching it into a private subnet. This allows you to control access to the entire subnetwork. You can also launch the cluster into a VPC and enable the cluster to access resources on your internal network using a VPN connection.You can encrypt the input data before you upload it to Amazon S3 using any common data encryption tool. If you do encrypt the data before it's uploaded, you then need to add a decryption step to the beginning of your job flow when Amazon Elastic MapReduce fetches the data from Amazon S3.

Amazon Route 53 Security

Amazon Route 53 is an authoritative DNS system. An authoritative DNS system provides an update mechanism that you can use to manage your public DNS names. It then answers DNS queries, translating domain names into IP addresses so computers can communicate with each other. Route 53 can be used to connect user requests to infrastructure running in AWS – such as an Amazon EC2 instance or an Amazon S3 bucket – or to infrastructure outside of AWS.

Amazon Route 53 performs two DNS functions. It lets you manage the IP addresses (records) listed for your domain names and it answers requests (queries) to translate specific domain names into their corresponding IP addresses. Queries for your domain are automatically routed to nearby DNS server using anycast in order to provide the lowest latency possible. In addition, you can utilize Weighted Round-Robin (WRR), Latency Based Routing (LBR), and DNS Failover to manage routing policies that dynamically determine the DNS answers with which the system will reply.

Amazon Route 53 is built using AWS's highly available and reliable infrastructure. The distributed nature of the AWS DNS servers helps ensure a consistent ability to route your end users to your application. Route 53 also helps ensure the availability of your website by providing health checks and DNS failover capabilities. You can easily configure Route 53 to check the health of your website on a regular basis (even secure web sites that are available only over SSL), and to switch to a backup site if the primary one is unresponsive.

Like all AWS Services, Amazon Route 53 requires that every request made to its control API be authenticated so only authenticated users can access and manage Route 53. API requests are signed with an HMAC-SHA1 or HMAC-SHA256 signature calculated from the request and the user's AWS Secret Access key. Additionally, the Amazon Route 53 control API is only accessible via SSL-encrypted endpoints. It supports both IPv4 and IPv6 routing.

You can control access to Amazon Route 53 DNS management functions by creating users under your AWS Account using AWS IAM, and controlling which Route 53 operations these users have permission to perform.

Amazon CloudSearch Security

Amazon CloudSearch is a fully-managed service in the cloud that makes it easy to set up, manage, and scale a search solution for your website. Amazon CloudSearch enables you to search large collections of data such as web pages, document files, forum posts, or product information. It enables you to quickly add search capabilities to your website without having to become a search expert or worry about hardware provisioning, setup, and maintenance. As your volume of data and traffic fluctuates, Amazon CloudSearch automatically scales to meet your needs.

An Amazon CloudSearch domain encapsulates a collection of data you want to search, the search instances that process your search requests, and a configuration that controls how your data is indexed and searched. You create a separate search domain for each collection of data you want to make searchable. For each domain, you configure indexing options that describe the fields you want to include in your index and how you want to us them, text options that define domain-specific stopwords, stems, and synonyms, rank expressions that you can use to customize how search results are ranked, and access policies that control access to the domain’s document and search endpoints.

Access to your search domain's endpoints is restricted by IP address so that only authorized hosts can submit documents and send search requests. IP address authorization is used only to control access to the document and search endpoints. All Amazon CloudSearch configuration requests must be authenticated using standard AWS authentication.

Amazon CloudSearch provides separate endpoints for accessing the configuration, search, and document services:

- The configuration service is accessed through a general endpoint: cloudsearch.us-east-1.amazonaws.com
- The document service endpoint is used to submit documents to the domain for indexing and is accessed through a domain-specific endpoint: http://doc-domainname-domainid.us-east-1.cloudsearch.amazonaws.com
- The search endpoint is used to submit search requests to the domain and is accessed through a domain-specific endpoint: http://search-domainname-domainid.us-east-1.cloudsearch.amazonaws.com

Note that if you do not have a static IP address, you must re-authorize your computer whenever your IP address changes. If your IP address is assigned dynamically, it is also likely that you're sharing that address with other computers on your network. This means that when you authorize the IP address, all computers that share it will be able to access your search domain's document service endpoint.

Like all AWS Services, Amazon CloudSearch requires that every request made to its control API be authenticated so only authenticated users can access and manage your CloudSearch domain. API requests are signed with an HMAC-SHA1 or HMAC-SHA256 signature calculated from the request and the user’s AWS Secret Access key. Additionally, the Amazon CloudSearch control API is accessible via SSL-encrypted endpoints. You can control access to Amazon CloudSearch management functions by creating users under your AWS Account using AWS IAM, and controlling which CloudSearch operations these users have permission to perform.

AWS Elastic Beanstalk Security

AWS Elastic Beanstalk is a deployment and management tool that automates the functions of capacity provisioning, load balancing, and auto scaling for your applications. You can upload your deployable code and AWS Elastic Beanstalk does the rest. Once the application is running, Elastic Beanstalk automates management tasks such as monitoring, application version deployment, log file snapshots, and health checks, replacing resources (such as EC2 instances) if they are deemed unhealthy in order to keep your application up and running.

AWS Elastic Beanstalk uses several AWS features and services such as Amazon EC2, Amazon RDS, Elastic Load Balancing, Auto Scaling, Amazon S3, and Amazon SNS to create an environment that seamlessly runs your application. It automatically launches one or more EC2 instances using a securely configured AMI, stores the application in S3, initiates load balancing and auto-scaling, and monitors the health of the application environment.

When your application needs to call an AWS service API (like DynamoDB or CloudWatch), you can pass the AWS access key and secret key to your application using Elastic Beanstalk environment variables or use an IAM role to create temporary credentials. When you create an IAM role, your application can use the instance profile associated with that role to obtain temporary security credentials to make AWS API calls. When you deploy your application to AWS Elastic Beanstalk, Elastic Beanstalk launches the EC2 instances using the instance profile you specify. Your application uses the role credentials that are available on the EC2 instance. Your application retrieves the role credentials from the Instance Meta Data Service (IMDS), and then makes API calls to the AWS service using those credentials. An additional security benefit of using IAM roles is that the temporary credentials are automatically rotated for you multiple times a day.

For an additional layer of privacy, you can also run Elastic Beanstalk applications within a Virtual Private Cloud (VPC). You can define and provision a private, virtual network in the AWS cloud and connect it to your corporate network using a VPN connection. This allows you to run a broader variety of applications on Elastic Beanstalk. For example, you can run your intranet applications such as a trouble ticketing application or a reporting site on Elastic Beanstalk.

Even though Elastic Beanstalk automates the provisioning and deployment of an application, you can use the Elastic Beanstalk console to manually override the default settings for the AWS resources, retaining as much control as you'd like over the underlying infrastructure. In addition, you can configure a variety of monitoring and security features, including:

- Enforcing secure transmission of data to and from your application by enabling HTTPS on the load balancer
- Receiving e-mail notifications through Amazon Simple Notification Service (Amazon SNS) when application health changes or application servers are added or removed
- Enabling secure transmission of email notifications by specifying HTTPS as the notification protocol
- Adjusting application server settings and passing environment variables, including the AWS Secret Access Key, which is needed by an application in order to authenticate to AWS resources
- Enabling secure login access to Amazon EC2 instances for immediate and direct troubleshooting
- Enabling log file rotation, which will copy the customer's EC2 instance log files on an hourly basis to the Amazon S3 bucket associated with the application
- Accessing built-in Amazon CloudWatch monitoring metrics such as average CPU utilization, request count, and average latency

All AWS Elastic Beanstalk endpoints use the HTTPS protocol for access. You can control access to Elastic Beanstalk services by using IAM policies. To simplify the process of granting access to AWS Elastic Beanstalk, you can use one of the policy templates in the AWS IAM console to get started. AWS Elastic Beanstalk offers two templates: a read-only access template and a full-access template. The read-only template grants read access to AWS Elastic Beanstalk resources. The full-access template grants full access to all AWS Elastic Beanstalk operations as well as permissions to manage dependent resources such as Elastic Load Balancing and Auto Scaling. Customers can also use the AWS Policy Generator to create custom policies to allow or deny permissions to specific AWS Elastic Beanstalk resources such as applications, application versions, and environments.

AWS CloudFormation Security

AWS CloudFormation is a provisioning tool that allows you to record the baseline configuration of the AWS resources needed to run your applications so that you can provision and update them in an orderly and predictable fashion. You define the AWS resources needed to run your application in a simple text file called a template, which can be used repeatedly to create identical copies of the same resource stack (or used as a foundation to start a new stack). You can capture and control region-specific infrastructure variations such as Amazon EC2 AMIs, EBS snapshot names, RDS database sizes, etc., using parameters. Parameters allow values to be declared that can be passed to the template when the stack is created. Parameters are also an effective way to specify sensitive information, such as user names and passwords, that should not be stored in the template itself.

AWS CloudFormation enables you to make simple changes, such as updating the properties of existing resources, or more complex changes, such as adding or removing resources from the stack. Changes to the stack are made by modifying the template and updating a stack. AWS CloudFormation understands the differences between the current template and the new template and modifies the stack accordingly.

You can create your own templates using the CloudFormer tool to describe the AWS resources and any associated dependencies or runtime parameters, or you can use AWS CloudFormation's sample templates. And just like AWS Elastic Beanstalk, CloudFormation automatically deploys the resources so you don't need to figure out the order in which AWS resources need to be provisioned or the subtleties of how to make those dependencies work.

AWS CloudFormation records resource creation and deletion for each stack, so you can see a list of all resources that have been provisioned for a stack as well as the history of provisioning events. The template is a text file, so it can be version-controlled, just like other application artifacts. With AWS CloudFormation, you can version control your infrastructure definition just like you version control their application sources

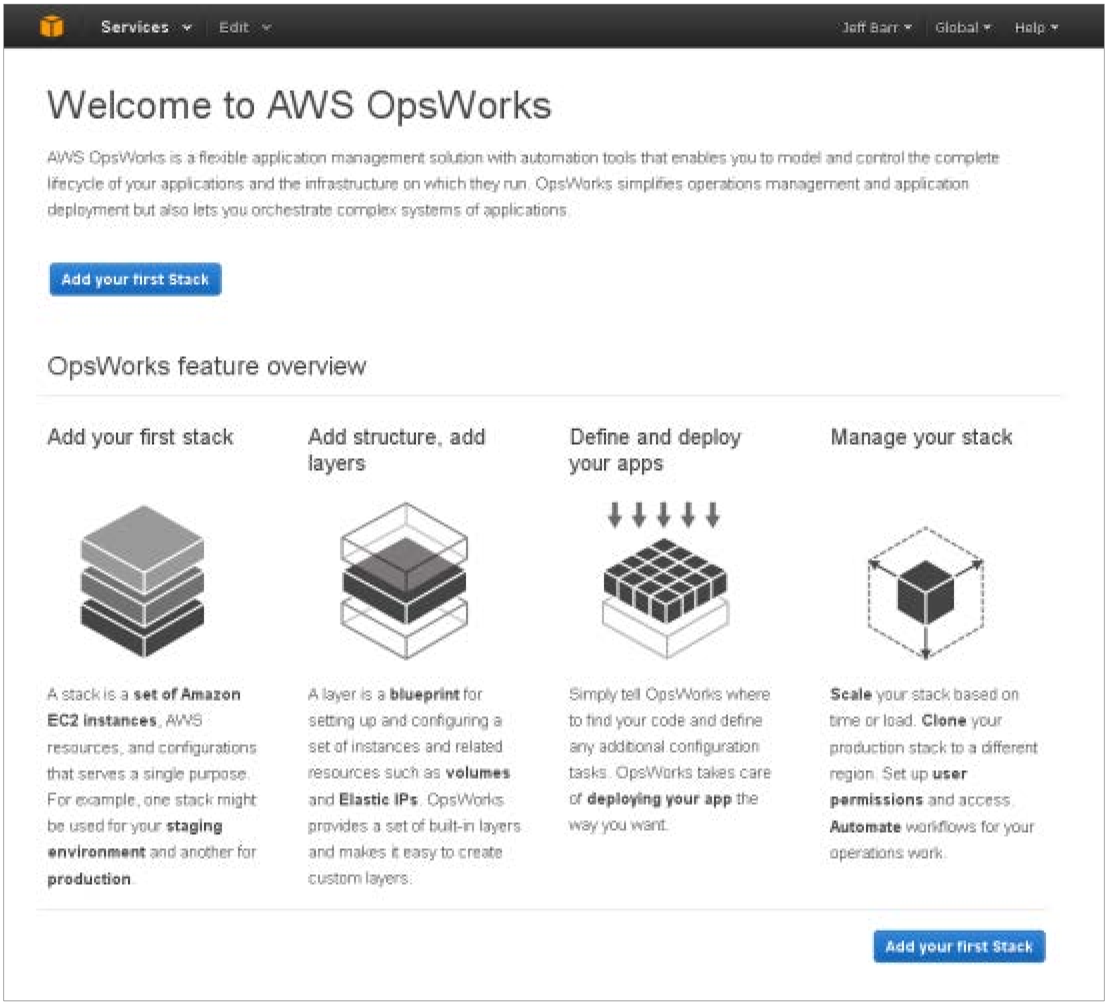
All AWS CloudFormation endpoints use the HTTPS protocol for access. You can control access to AWS CloudFormation template creation and management functions by creating users under your AWS Account using AWS IAM, and controlling which CloudFormation operations these users have permission to perform.

AWS OpsWorks Security

AWS OpsWorks is an application management service that helps you control the complete application lifecycle. It allows you to automate and manage all the processes involved in the deployment of your applications, including resource provisioning, configuration management, application deployment, software updates, monitoring, and access control.

You start in OpsWorks by creating a *stack*, which is a collection of both EC2 instances and *layers*, which are blueprints that are used to configure, launch, and manage the instances. You define the software configuration for each layer, including installation scripts and initialization tasks. When an instance is added to a layer, OpsWorks automatically applies the specified configuration.

Each stack hosts one or more applications and also serves as the container for any other AWS resources your application might need (such as EBS volumes and Elastic IP addresses) as well as user permissions associated with the application. You tell OpsWorks to install the application on the EC2 instances by pulling code from one or more code repositories, such as Git or Subversion, fetching via an HTTP request, or downloading from an Amazon S3 bucket.



Welcome to AWS OpsWorks

AWS OpsWorks is a flexible application management solution with automation tools that enables you to model and control the complete lifecycle of your applications and the infrastructure on which they run. OpsWorks simplifies operations management and application deployment but also lets you orchestrate complex systems of applications.

OpsWorks feature overview

Add your first stack

A stack is a **set of Amazon EC2 instances**, AWS resources, and configurations that serves a single purpose. For example, one stack might be used for your **staging environment** and another for **production**.

Add structure, add layers

A layer is a **blueprint** for setting up and configuring a set of instances and related resources such as **volumes** and **Elastic IPs**. OpsWorks provides a set of built-in layers and makes it easy to create custom layers.

Define and deploy your apps

Simply tell OpsWorks where to find your code and define any additional configuration tasks. OpsWorks takes care of **deploying your app** the way you want.

Manage your stack

Scale your stack based on time or load. **Clone** your production stack to a different region. Set up **user permissions** and access. **Automate** workflows for your operations work.

After you have defined a stack, its layers, and its applications, you can create EC2 instances and assign them to specific layers. You can launch the instances manually, or you can define scaling based on load or by time. Either way, you have full control over the instance type, Availability Zone, security group(s), and operating system. You can use custom AMIs for even greater control over installed packages and versions. As the instances launch, they will be configured to your specifications using the recipes that you defined for the layer that contains the instance.

You can use AWS IAM to control how users are allowed to interact with OpsWorks, such as managing stacks and using SSH to connect to EC2 instances. You even have the flexibility to give users access to AWS OpsWorks but deny them direct access to dependent services such as Amazon EC2. For example, you can give a user permission to stop instances by using AWS OpsWorks, but deny them the ability to terminate instances by using the Amazon EC2 console or API.

You can also use IAM to control how OpsWorks can act on your behalf to manage stack resources, and how apps that run on instances controlled by AWS OpsWorks can access AWS resources (this applies only if you deploy apps that access other AWS services and get their credentials through roles in EC2 instances).

AWS OpsWorks allows you to require the use of a *deploy key* to retrieve apps from a Github repository. A deploy key is an SSH key with no password that allows AWS OpsWorks to asynchronously deploy apps or cookbooks from a private Github repository without requiring any further input from you.

Additionally, the AWS OpsWorks API is only accessible via an SSL-encrypted endpoint (opsworks.us-east-1.amazonaws.com). You must connect to that endpoint to access OpsWorks, but you can then use the API to direct AWS OpsWorks to create stacks in any AWS Region.

Amazon Kinesis Security

Amazon Kinesis is a managed service designed to handle real-time streaming of big data. It can accept any amount of data, from any number of sources, scaling up and down as needed. You can use Kinesis in situations that call for large-scale, real-time data ingestion and processing, such as server logs, social media or market data feeds, and web clickstream data.

Applications read and write data records to Amazon Kinesis in *streams*. You can create any number of Kinesis streams to capture, store, and transport data. Amazon Kinesis automatically manages the infrastructure, storage, networking, and configuration needed to collect and process your data at the level of throughput your streaming applications need. You don't have to worry about provisioning, deployment, or ongoing-maintenance of hardware, software, or other services to enable real-time capture and storage of large-scale data. Amazon Kinesis also synchronously replicates data across three facilities in an AWS Region, providing high availability and data durability.

In Amazon Kinesis, data records contain a sequence number, a partition key, and a data blob, which is an un-interpreted, immutable sequence of bytes. The Amazon Kinesis service does not inspect, interpret, or change the data in the blob in any way. Data records are accessible for only 24 hours from the time they are added to an Amazon Kinesis stream, and then they are automatically discarded.

Your application is a consumer of an Amazon Kinesis stream, which typically runs on a fleet of Amazon EC2 instances. A Kinesis application uses the Amazon Kinesis Client Library to read from the Amazon Kinesis stream. The Kinesis Client Library takes care of a variety of details for you including failover, recovery, and load balancing, allowing your application to focus on processing the data as it becomes available. After processing the record, your consumer code can pass it along to another Kinesis stream; write it to an Amazon S3 bucket, a Redshift data warehouse, or a DynamoDB table; or simply discard it. A connector library is available to help you integrate Kinesis with other AWS services (such as DynamoDB, Redshift, and S3) as well as third-party products like Apache Storm.

You can control logical access to Kinesis resources and management functions by creating users under your AWS Account using AWS IAM, and controlling which Kinesis operations these users have permission to perform. To facilitate running your producer or consumer applications on an Amazon EC2 instance, you can configure that instance with an IAM role. That way, AWS credentials that reflect the permissions associated with the IAM role are made available to applications on the instance, which means you don't have to use your long-term AWS security credentials. Roles have the added benefit of providing temporary credentials that expire within a short timeframe, which adds an additional measure of protection. See the Using IAM guide for more information about IAM roles.

The Amazon Kinesis API is only accessible via an SSL-encrypted endpoint (kinesis.us-east-1.amazonaws.com) to help ensure secure transmission of your data to AWS. You must connect to that endpoint to access Kinesis, but you can then use the API to direct AWS Kinesis to create a stream in any AWS Region

Amazon AppStream

The Amazon AppStream service provides a framework for running streaming applications, particularly applications that require lightweight clients running on mobile devices. It enables you to store and run your application on powerful, parallel-processing GPUs in the cloud and then stream input and output to any client device. This can be a pre-existing application that you modify to work with Amazon AppStream or a new application that you design specifically to work with the service.

The Amazon AppStream SDK simplifies the development of interactive streaming applications and client applications. The SDK provides APIs that connect your customers' devices directly to your application, capture and encode audio and video, stream content across the Internet in near real-time, decode content on client devices, and return user input to the application. Because your application's processing occurs in the cloud, it can scale to handle extremely large computational loads.

Amazon AppStream deploys streaming applications on Amazon EC2. When you add a streaming application through the AWS Management Console, the service creates the Amazon Machine Image (AMI) required to host your application and makes your application available to streaming clients. The service scales your application as needed within the capacity limits you have set to meet demand. Clients using the Amazon AppStream SDK automatically connect to your streamed application.

In most cases, you'll want to ensure that the user running the client is authorized to use your application before letting him obtain a session ID. We recommend that you use some sort of entitlement service, which is a service that authenticates clients and authorizes their connection to your application. In this case, the entitlement service will also call into the Amazon AppStream REST API to create a new streaming session for the client. After the entitlement service creates a new session, it returns the session identifier to the authorized client as a single-use entitlement URL. The client then uses the entitlement URL to connect to the application. Your entitlement service can be hosted on an Amazon EC2 instance or on AWS Elastic Beanstalk.

Amazon AppStream utilizes an AWS CloudFormation template that automates the process of deploying a GPU EC2 instance that has the AppStream Windows Application and Windows Client SDK libraries installed; is configured for SSH, RDC, or VPN access; and has an elastic IP address assigned to it. By using this template to deploy your standalone streaming server, all you need to do is upload your application to the server and run the command to launch it. You can then use the Amazon AppStream Service Simulator tool to test your application in standalone mode before deploying it into production.

Amazon AppStream also utilizes the STX Protocol to manage the streaming of your application from AWS to local devices. The Amazon AppStream STX Protocol is a proprietary protocol used to stream high-quality application video over varying network conditions; it monitors network conditions and automatically adapts the video stream to provide a low-latency and high-resolution experience to your customers. It minimizes latency while syncing audio and video as well as capturing input from your customers to be sent back to the application running in AWS.

AWS CloudHSM Security

The AWS CloudHSM service provides customers with dedicated access to a hardware security module (HSM) appliance designed to provide secure cryptographic key storage and operations within an intrusion-resistant, tamper-evident device. You can generate, store, and manage the cryptographic keys used for data encryption so that they are accessible only by you. AWS CloudHSM appliances are designed to securely store and process cryptographic key material for a wide variety of uses such as database encryption, Digital Rights Management (DRM), Public Key Infrastructure (PKI), authentication and authorization, document signing, and transaction processing. They support some of the strongest cryptographic algorithms available, including AES, RSA, and ECC, and many others.

The AWS CloudHSM service is designed to be used with Amazon EC2 and VPC, providing the appliance with its own private IP within a private subnet. You can connect to CloudHSM appliances from your EC2 servers through SSL/TLS, which uses two-way digital certificate authentication and 256-bit SSL encryption to provide a secure communication channel.

Selecting CloudHSM service in the same region as your EC2 instance decreases network latency, which can improve your application performance. You can configure a client on your EC2 instance that allows your applications to use the APIs provided by the HSM, including PKCS#11, MS CAPI and Java JCA/JCE (Java Cryptography Architecture/Java Cryptography Extensions).

Before you begin using an HSM, you must set up at least one partition on the appliance. A cryptographic partition is a logical and physical security boundary that restricts access to your keys, so only you control your keys and the operations performed by the HSM. AWS has administrative credentials to the appliance, but these credentials can only be used to manage the appliance, not the HSM partitions on the appliance. AWS uses these credentials to monitor and maintain the health and availability of the appliance. AWS cannot extract your keys nor can AWS cause the appliance to perform any cryptographic operation using your keys.

The HSM appliance has both physical and logical tamper detection and response mechanisms that erase the cryptographic key material and generate event logs if tampering is detected. The HSM is designed to detect tampering if the physical barrier of the HSM appliance is breached. In addition, after three unsuccessful attempts to access an HSM partition with HSM Admin credentials, the HSM appliance erases its HSM partitions.

When your CloudHSM subscription ends and you have confirmed that the contents of the HSM are no longer needed, you must delete each partition and its contents as well as any logs. As part of the decommissioning process, AWS zeroizes the appliance, permanently erasing all key material.

AWS CloudTrail Security

AWS CloudTrail provides a log of all requests for AWS resources within your account. For each event recorded, you can see what service was accessed, what action was performed, any parameters for the action, and who made the request. Not only can you see which one of your users or services performed an action on an AWS service, but you can see whether it was as the AWS root account user or an IAM user, or whether it was with temporary security credentials for a role or federated user.

CloudTrail basically captures information about every API call to an AWS resource, whether that call was made from the AWS Management Console, CLI, or an SDK. If the API request returned an error, CloudTrail provides the description of the error, including messages for authorization failures.

Once you have enabled CloudTrail, event logs are delivered every 5 minutes to the S3 bucket of your choice. The log files are organized by AWS Account ID, region, service name, date, and time. You can configure CloudTrail so that it aggregates log files from multiple regions into a single Amazon S3 bucket. From there, you can then upload them to your favorite log management and analysis solutions to perform security analysis and detect user behavior patterns.

By default, log files are stored indefinitely. The log files are automatically encrypted using S3's Server Side Encryption and will remain in the bucket until you choose to delete or archive them. You can use Amazon S3 lifecycle configuration rules to automatically delete old log files or archive them to Amazon Glacier for additional longevity at significant savings.

Like every other AWS service, you can limit access to CloudTrail to only certain users. You can use IAM to control which AWS users can create, configure, or delete AWS CloudTrail trails as well as which users can start and stop logging. You can control access to the log files by applying IAM or S3 bucket policies. You can also add an additional layer of security by enabling MFA Delete on your S3 bucket.

Amazon WorkSpaces

Amazon WorkSpaces is a managed desktop service that allows you to quickly provision cloud-based desktops for your users. Simply choose a Windows 7 bundle that best meets the needs of your users and the number of WorkSpaces that you would like to launch. Once the WorkSpaces are ready, users receive an email informing them where they can download the relevant client and log into their WorkSpace. They can then access their cloud-based desktops from a variety of endpoint devices, including PCs, laptops, and mobile devices. However, your organization’s data is never sent to or stored on the end-user device because Amazon WorkSpaces uses PC-over-IP (PCoIP), which provides an interactive video stream without transmitting actual data. The PCoIP protocol compresses, encrypts, and encodes the users’ desktop computing experience and transmits ‘pixels only’ across any standard IP network to end-user devices.

In order to access their WorkSpace, users must sign in using a set of unique credentials or their regular Active Directory credentials. When you integrate Amazon WorkSpaces with your corporate Active Directory, each WorkSpace joins your Active Directory domain and can be managed just like any other desktop in your organization. This means that you can use Active Directory Group Policies to manage your users’ WorkSpaces to specify configuration options that control the desktop. If you choose not to use Active Directory or other type of on-premises directory to manage your user WorkSpaces, you can create a private cloud directory within Amazon WorkSpaces that you can use for administration.

Each Workspace resides on its own EC2 instance within a VPC. You can create WorkSpaces in a VPC you already own or have the WorkSpaces service create one for you automatically using the WorkSpaces Quick Start option. When you use the Quick Start option, WorkSpaces not only creates the VPC, but it performs several other provisioning and configuration tasks for you, such as creating an Internet Gateway for the VPC, setting up a directory within the VPC that is used to store user and WorkSpace information, creating a directory administrator account, creating the specified user accounts and adding them to the directory, and creating the WorkSpace instances. Or the VPC can be connected to an on-premises network using a secure VPN connection to allow access to an existing on-premises Active Directory and other intranet resources.

Persistent storage for WorkSpaces is provided by Amazon EBS and is automatically backed up twice a day to Amazon S3. If WorkSpaces Sync is enabled on a WorkSpace, the folder a user chooses to sync will be continuously backed up and stored in Amazon S3. You can also use WorkSpaces Sync on a Mac or PC to sync documents to or from your WorkSpace so that you can always have access to your data regardless of the desktop computer you are using.

Because it’s a managed service, AWS takes care of several security and maintenance tasks like daily backups and patching. Updates are delivered automatically to your WorkSpaces during a weekly maintenance window. You can control how patching is configured for a user’s WorkSpace. By default, Windows Update is turned on, but you have the ability to customize these settings, or use an alternative patch management approach if you desire. For the underlying OS, Windows Update is enabled by default on WorkSpaces, and configured to install updates on a weekly basis. You can use an alternative patching approach or to configure Windows Update to perform updates at a time of your choosing.

You can use IAM to control who on your team can perform administrative functions like creating or deleting WorkSpaces or setting up user directories. You can also set up a WorkSpace for directory administration, install your favorite Active Directory administration tools, and create organizational units and Group Policies in order to more easily apply Active Directory changes for all your WorkSpaces users.

Appendix – Glossary of Terms

Access Key ID: A string that AWS distributes in order to uniquely identify each AWS user; it is an alphanumeric token associated with your Secret Access Key.

Access control list (ACL): A list of permissions or rules for accessing an object or network resource. In Amazon EC2, security groups act as ACLs at the instance level, controlling which users have permission to access specific instances. In Amazon S3, you can use ACLs to give read or write access on buckets or objects to groups of users. In Amazon VPC, ACLs act like network firewalls and control access at the subnet level.

AMI: An Amazon Machine Image (AMI) is an encrypted machine image stored in Amazon S3. It contains all the information necessary to boot instances of a customer's software.

API: Application Programming Interface (API) is an interface in computer science that defines the ways by which an application program may request services from libraries and/or operating systems.

Archive: An archive in Amazon Glacier is a file that you want to store and is a base unit of storage in Amazon Glacier. It can be any data such as a photo, video, or document. Each archive has a unique ID and an optional description.

Authentication: Authentication is the process of determining whether someone or something is, in fact, who or what it is declared to be. Not only do users need to be authenticated, but every program that wants to call the functionality exposed by an AWS API must be authenticated. AWS requires that you authenticate every request by digitally signing it using a cryptographic hash function.

Auto-Scaling: An AWS service that allows customers to automatically scale their Amazon EC2 capacity up or down according to conditions they define.

Availability Zone: Amazon EC2 locations are composed of regions and availability zones. Availability zones are distinct locations that are engineered to be insulated from failures in other availability zones and provide inexpensive, low latency network connectivity to other availability zones in the same region.

Bastion host: A computer specifically configured to withstand attack, usually placed on the external/public side of a demilitarized zone (DMZ) or outside the firewall. You can set up an Amazon EC2 instance as an SSH bastion by setting up a public subnet as part of an Amazon VPC.

Bucket: A container for objects stored in Amazon S3. Every object is contained within a bucket. For example, if the object named photos/puppy.jpg is stored in the johnsmith bucket, then it is addressable using the URL http://johnsmith.s3.amazonaws.com/photos/puppy.jpg.

Certificate: A credential that some AWS products use to authenticate AWS Accounts and users. Also known as an X.509 certificate. The certificate is paired with a private key.

CIDR Block: Classless Inter-Domain Routing Block of IP addresses.

Client-side encryption: Encrypting data on the client side before uploading it to Amazon S3.

CloudFormation: An AWS provisioning tool that allows customers to record the baseline configuration of the AWS resources needed to run their applications so that they can provision and update them in an orderly and predictable fashion.

Credentials: Items that a user or process must have in order to confirm to AWS services during the authentication process that they are authorized to access the service. AWS credentials include the Access Key ID and Secret Access Key as well as X.509 certificates and multi-factor tokens.

Dedicated instance: Amazon EC2 instances that are physically isolated at the host hardware level (i.e., they will run on single-tenant hardware).

Digital signature: A digital signature is a cryptographic method for demonstrating the authenticity of a digital message or document. A valid digital signature gives a recipient reason to believe that the message was created by an authorized sender, and that it was not altered in transit. Digital signatures are used by customers for signing requests to AWS APIs as part of the authentication process.

Direct Connect Service: Amazon service that allows you to provision a direct link between your internal network and an AWS region using a high-throughput, dedicated connection. With this dedicated connection in place, you can then create logical connections directly to the AWS cloud (for example, to Amazon EC2 and Amazon S3) and Amazon VPC, bypassing Internet service providers in the network path.

DynamoDB Service: A fully managed NoSQL database service from AWS that provides fast and predictable performance with seamless scalability.

EBS: Amazon Elastic Block Store (EBS) provides block-level storage volumes for use with Amazon EC2 instances. Amazon EBS volumes are off-instance storage that persists independently from the life of an instance.

ElastiCache: An AWS web service that allows you to set up, manage, and scale distributed in-memory cache environments in the cloud. The service improves the performance of web applications by allowing you to retrieve information from a fast, managed, in-memory caching system, instead of relying entirely on slower disk-based databases.

Elastic Beanstalk: An AWS deployment and management tool that automates the functions of capacity provisioning, load balancing, and auto scaling for customers' applications.

Elastic IP Address: A static, public IP address that you can assign to any instance in an Amazon VPC, thereby making the instance public. Elastic IP addresses also enable you to mask instance failures by rapidly remapping your public IP addresses to any instance in the VPC.

Elastic Load Balancing: An AWS service that is used to manage traffic on a fleet of Amazon EC2 instances, distributing traffic to instances across all availability zones within a region. Elastic Load Balancing has all the advantages of an on-premises load balancer, plus several security benefits such as taking over the encryption/decryption work from EC2 instances and managing it centrally on the load balancer.

Elastic MapReduce (EMR) Service: An AWS web service that utilizes a hosted Hadoop framework running on the web-scale infrastructure of Amazon EC2 and Amazon S3. Elastic MapReduce enables customers to easily and cost-effectively process extremely large quantities of data ("big data").

Elastic Network Interface: Within an Amazon VPC, an Elastic Network Interface is an optional second network interface that you can attach to an EC2 instance. An Elastic Network Interface can be useful for creating a management network or using network or security appliances in the Amazon VPC. It can be easily detached from an instance and reattached to another instance.

Endpoint: A URL that is the entry point for an AWS service. To reduce data latency in your applications, most AWS services allow you to select a regional endpoint to make your requests. Some web services allow you to use a general endpoint that doesn't specify a region; these generic endpoints resolve to the service's us-east-1 endpoint. You can connect to an AWS endpoint via HTTP or secure HTTP (HTTPS) using SSL.

Federated users: User, systems, or applications that are not currently authorized to access your AWS services, but that you want to give temporary access to. This access is provided using the AWS Security Token Service (STS) APIs.

Firewall: A hardware or software component that controls incoming and/or outgoing network traffic according to a specific set of rules. Using firewall rules in Amazon EC2, you specify the protocols, ports, and source IP address ranges that are allowed to reach your instances. These rules specify which incoming network traffic should be delivered to your instance (e.g., accept web traffic on port 80). Amazon VPC supports a complete firewall solution enabling filtering on both ingress and egress traffic from an instance. The default group enables inbound communication from other members of the same group and outbound communication to any destination. Traffic can be restricted by any IP protocol, by service port, as well as source/destination IP address (individual IP or Classless Inter-Domain Routing (CIDR) block).

Guest OS: In a virtual machine environment, multiple operating systems can run on a single piece of hardware. Each one of these instances is considered a guest on the host hardware and utilizes its own OS.

Hash: A cryptographic hash function is used to calculate a digital signature for signing requests to AWS APIs. A cryptographic hash is a one-way function that returns a unique hash value based on the input. The input to the hash function includes the text of your request and your secret access key. The hash function returns a hash value that you include in the request as your signature.

HMAC-SHA1/HMAC-SHA256: In cryptography, a keyed-Hash Message Authentication Code (HMAC or KHMAC), is a type of message authentication code (MAC) calculated using a specific algorithm involving a cryptographic hash function in combination with a secret key. As with any MAC, it may be used to simultaneously verify both the data integrity and the authenticity of a message. Any iterative cryptographic hash function, such as SHA-1 or SHA-256, may be used in the calculation of an HMAC; the resulting MAC algorithm is termed HMAC-SHA1 or HMAC-SHA256 accordingly. The cryptographic strength of the HMAC depends upon the cryptographic strength of the underlying hash function, on the size and quality of the key and the size of the hash output length in bits.

Hardware security module (HSM): An HSM is an appliance that provides secure cryptographic key storage and operations within a tamper-resistant hardware device. HSMs are designed to securely store cryptographic key material and use the key material without exposing it outside the cryptographic boundary of the appliance. The AWS CloudHSM service provides customers with dedicated, single-tenant access to an HSM appliance.

Hypervisor: A hypervisor, also called Virtual Machine Monitor (VMM), is computer software/hardware platform virtualization software that allows multiple operating systems to run on a host computer concurrently.

Identity and Access Management (IAM): AWS IAM enables you to create multiple users and manage the permissions for each of these users within your AWS Account.

Import/Export Service: An AWS service for transferring large amounts of data to AWS S3 or EBS storage by physically shipping a portable storage device to a secure AWS facility.

Instance: An instance is a virtualized server, also known as a virtual machine (VM), with its own hardware resources and guest OS. In EC2, an instance represents one running copy of an Amazon Machine Image (AMI).

IP address: An Internet Protocol (IP) address is a numerical label that is assigned to devices participating in a computer network utilizing the Internet Protocol for communication between its nodes.

IP spoofing: Creation of IP packets with a forged source IP address, called spoofing, with the purpose of concealing the identity of the sender or impersonating another computing system.

Key: In cryptography, a key is a parameter that determines the output of a cryptographic algorithm (called a hashing algorithm). A key pair is a set of security credentials you use to prove your identity electronically and consists of a public key and a private key.

Key rotation: The process of periodically changing the cryptographic keys used for encrypting data or digitally signing requests. Just like changing passwords, rotating keys minimizes the risk of unauthorized access if an attacker somehow obtains your key or determines the value of it. AWS supports multiple concurrent access keys and certificates, which allows customers to rotate keys and certificates into and out of operation on a regular basis without any downtime to their application.

Multi-factor authentication (MFA): The use of two or more authentication factors. Authentication factors include something you know (like a password) or something you have (like a token that generates a random number). AWS IAM allows the use of a six-digit single-use code in addition to the user name and password credentials. Customers get this single-use code from an authentication device that they keep in their physical possession (either a physical token device or a virtual token from their smart phone).

Network ACLs: Stateless traffic filters that apply to all traffic inbound or outbound from a subnet within an Amazon VPC. Network ACLs can contain ordered rules to allow or deny traffic based upon IP protocol, by service port, as well as source/destination IP address.

Object: The fundamental entities stored in Amazon S3. Objects consist of object data and metadata. The data portion is opaque to Amazon S3. The metadata is a set of name-value pairs that describe the object. These include some default metadata such as the date last modified and standard HTTP metadata such as Content-Type. The developer can also specify custom metadata at the time the Object is stored.

Paravirtualization: In computing, paravirtualization is a virtualization technique that presents a software interface to virtual machines that is similar but not identical to that of the underlying hardware.

Peering: A VPC peering connection is a networking connection between two VPCs that enables you to route traffic between them using private IP addresses. Instances in either VPC can communicate with each other as if they are within the same network.

Port scanning: A port scan is a series of messages sent by someone attempting to break into a computer to learn which computer network services, each associated with a "well-known" port number, the computer provides.

Region: A named set of AWS resources in the same geographical area. Each region contains at least two availability zones.

Replication: The continuous copying of data from a database in order to maintain a second version of the database, usually for disaster recovery purposes. Customers can use multiple AZs for their Amazon RDS database replication needs, or use Read Replicas if using MySQL.

Relational Database Service (RDS): An AWS service that allows you to create a relational database (DB) instance and flexibly scale the associated compute resources and storage capacity to meet application demand. Amazon RDS is available for MySQL, Oracle, or Microsoft SQL Server database engines.

Role: An entity in AWS IAM that has a set of permissions that can be assumed by another entity. Use roles to enable applications running on your Amazon EC2 instances to securely access your AWS resources. You grant a specific set of permissions to a role, use the role to launch an Amazon EC2 instance, and let EC2 automatically handle AWS credential management for your applications that run on Amazon EC2.

Route 53: An authoritative DNS system that provides an update mechanism that developers can use to manage their public DNS names, answering DNS queries and translating domain names into IP address so computers can communicate with each other.

Secret Access Key: A key that AWS assigns to you when you sign up for an AWS Account. To make API calls or to work with the command line interface, each AWS user needs the Secret Access Key and Access Key ID. The user signs each request with the Secret Access Key and includes the Access Key ID in the request. To help ensure the security of your AWS Account, the Secret Access Key is accessible only during key and user creation. You must save the key (for example, in a text file that you store securely) if you want to be able to access it again.

Security group: A security group gives you control over the protocols, ports, and source IP address ranges that are allowed to reach your Amazon EC2 instances; in other words, it defines the firewall rules for your instance. These rules specify which incoming network traffic should be delivered to your instance (e.g., accept web traffic on port 80).

Security Token Service (STS): The AWS STS APIs return temporary security credentials consisting of a security token, an Access Key ID, and a Secret Access Key. You can use STS to issue security credentials to users who need temporary access to your resources. These users can be existing IAM users, non-AWS users (federated identities), systems, or applications that need to access your AWS resources.

Server-side encryption (SSE): An option for S3 storage for automatically encrypting data at rest. With Amazon S3 SSE, customers can encrypt data on upload simply by adding an additional request header when writing the object. Decryption happens automatically when data is retrieved.

Service: Software or computing ability provided across a network (e.g., Amazon EC2, Amazon S3).

Shard: In Amazon Kinesis, a shard is a uniquely identified group of data records in an Amazon Kinesis stream. A Kinesis stream is composed of multiple shards, each of which provides a fixed unit of capacity.

Signature: Refers to a digital signature, which is a mathematical way to confirm the authenticity of a digital message. AWS uses signatures calculated with a cryptographic algorithm and your private key to authenticate the requests you send to our web services.

Simple Data Base (Simple DB): A non-relational data store that allows AWS customers to store and query data items via web services requests. Amazon SimpleDB creates and manages multiple geographically distributed replicas of the customer’s data automatically to enable high availability and data durability.

Simple Email Service (SES): An AWS service that provides a scalable bulk and transactional email-sending service for businesses and developers. In order to maximize deliverability and dependability for senders, Amazon SES takes proactive steps to prevent questionable content from being sent, so that ISPs view the service as a trusted email origin.

Simple Mail Transfer Protocol (SMTP): An Internet standard for transmitting email across IP networks, SMTP is used by the Amazon Simple Email Service. Customers who used Amazon SES can use an SMTP interface to send email, but must connect to an SMTP endpoint via TLS.

Simple Notification Service (SNS): An AWS service that makes it easy to set up, operate, and send notifications from the cloud. Amazon SNS provides developers with the ability to publish messages from an application and immediately deliver them to subscribers or other applications.

Simple Queue Service (SQS): A scalable message queuing service from AWS that enables asynchronous message-based communication between distributed components of an application. The components can be computers or Amazon EC2 instances or a combination of both.

Simple Storage Service (S3): An AWS service that provides secure storage for object files. Access to objects can be controlled at the file or bucket level and can further restricted based on other conditions such as request IP source, request time, etc. Files can also be encrypted automatically using AES-256 encryption.

Simple Workflow Service (SWF): An AWS service that allows customers to build applications that coordinate work across distributed components. Using Amazon SWF, developers can structure the various processing steps in an application as “tasks” that drive work in distributed applications. Amazon SWF coordinates these tasks, managing task execution dependencies, scheduling, and concurrency based on a developer’s application logic.

Single sign-on: The capability to log in once but access multiple applications and systems. A secure single sign-on capability can be provided to your federated users (AWS and non-AWS users) by creating a URL that passes the temporary security credentials to the AWS Management Console.

Snapshot: A customer-initiated backup of an EBS volume that is stored in Amazon S3, or a customer-initiated backup of an RDS database that is stored in Amazon RDS. A snapshot can be used as the starting point for a new EBS volume or Amazon RDS database or to protect the data for long-term durability and recovery.

Secure Sockets Layer (SSL): A cryptographic protocol that provides security over the Internet at the Application Layer. Both the TLS 1.0 and SSL 3.0 protocol specifications use cryptographic mechanisms to implement the security services that establish and maintain a secure TCP/IP connection. The secure connection prevents eavesdropping, tampering, or message forgery. You can connect to an AWS endpoint via HTTP or secure HTTP (HTTPS) using SSL.

Stateful firewall: In computing, a stateful firewall (any firewall that performs stateful packet inspection (SPI) or stateful inspection) is a firewall that keeps track of the state of network connections (such as TCP streams, UDP communication) traveling across it.

Storage Gateway: An AWS service that securely connects a customer’s on-premises software appliance with Amazon S3 storage by using a VM that the customer deploys on a host in their data center running VMware ESXi Hypervisor. Data is asynchronously transferred from the customer’s on-premises storage hardware to AWS over SSL, and then stored encrypted in Amazon S3 using AES-256.

Temporary security credentials: AWS credentials that provide temporary access to AWS services. Temporary security credentials can be used to provide identity federation between AWS services and non-AWS users in your own identity and authorization system. Temporary security credentials consist of security token, an Access Key ID, and a Secret Access Key.

Transcoder: A system that transcodes (converts) a media file (audio or video) from one format, size, or quality to another. Amazon Elastic Transcoder makes it easy for customers to transcode video files in a scalable and cost-effective fashion.

Transport Layer Security (TLS): A cryptographic protocol that provides security over the Internet at the Application Layer. Customers who used Amazon's Simple Email Service must connect to an SMTP endpoint via TLS.

Tree hash: A tree hash is generated by computing a hash for each megabyte-sized segment of the data, and then combining the hashes in tree fashion to represent ever-growing adjacent segments of the data. Glacier checks the hash against the data to help ensure that it has not been altered en route.

Vault: In Amazon Glacier, a vault is a container for storing archives. When you create a vault, you specify a name and select an AWS region where you want to create the vault. Each vault resource has a unique address.

Versioning: Every object in Amazon S3 has a key and a version ID. Objects with the same key, but different version IDs can be stored in the same bucket. Versioning is enabled at the bucket layer using PUT Bucket versioning.

Virtual Instance: Once an AMI has been launched, the resulting running system is referred to as an instance. All instances based on the same AMI start out identical and any information on them is lost when the instances are terminated or fail.

Virtual MFA: The capability for a user to get the six-digit, single-use MFA code from their smart phone rather than from a token/fob. MFA is the use of an additional factor (the single-use code) in conjunction with a user name and password for authentication.

Virtual Private Cloud (VPC): An AWS service that enables customers to provision an isolated section of the AWS cloud, including selecting their own IP address range, defining subnets, and configuring routing tables and network gateways.

Virtual Private Network (VPN): The capability to create a private, secure network between two locations over a public network such as the Internet. AWS customers can add an IPsec VPN connection between their Amazon VPC and their data center, effectively extending their data center to the cloud while also providing direct access to the Internet for public subnet instances in their Amazon VPC. In this configuration, customers add a VPN appliance on their corporate data center side.

X.509: In cryptography, X.509 is a standard for a Public Key Infrastructure (PKI) for single sign-on and Privilege Management Infrastructure (PMI). X.509 specifies standard formats for public key certificates, certificate revocation lists, attribute certificates, and a certification path validation algorithm. Some AWS products use X.509 certificates instead of a Secret Access Key for access to certain interfaces. For example, Amazon EC2 uses a Secret Access Key for access to its Query interface, but it uses a signing certificate for access to its SOAP interface and command line tool interface.

Changes since last version (Nov 2013):

- Updated regions
- Updated several services with new features: CloudFront, DirectConnect, DynamoDB, EBS, ELB, EMR, Glacier, IAM, OpsWorks, RDS, RedShift, Route 53, Storage Gateway, and VPC
- Added AppStream Security
- Added CloudTrail Security
- Added Kinesis Security
- Added WorkSpaces Security

Changes since last version (May/June 2013):

- Updated IAM to incorporate roles and API access
- Updated MFA for API access for customer-specified privileged actions
- Updated RDS to add event notification, multi-AZ, and SSL to SQL Server 2012
- Updated VPC to add multiple IP addresses, static routing VPN, and VPC By Default
- Updated several other services with new features: CloudFront, CloudWatch, EBS, ElastiCache, Elastic Beanstalk, Route 53, S3, Storage Gateway
- Added Glacier Security
- Added RedShift Security
- Added Data Pipeline Security
- Added Transcoder Security
- Added Trusted Advisor Security
- Added OpsWorks Security
- Added CloudHSM Security

Changes since last version (May 2011):

- Reorganization to better identify infrastructure versus service-specific security
- Changed Control Environment Summary heading to AWS Compliance Program
- Changed Information and Communication heading to Management and Communication
- Changed Employee Lifecycle heading to Logical Access
- Changed Configuration Management heading to Change Management
- Merged Environmental Safeguards section with Physical Security section
- Incorporated information in Backups section into S3, SimpleDB, and EBS sections
- Update to certifications to reflect SAS70 name change to SSAE 16 and addition of FedRAMP
- Update to Network Security section to add Secure Network Architecture and Network Monitoring and Protection
- Update to IAM to incorporate roles/key provisioning, virtual MFA, temporary security credentials, and single sign on
- Update to regions to include new regions and GovCloud description
- Updated EBS, S3, SimpleDB, RDS, and EMR to clarify service and security descriptions
- Update to VPC to add configuration options, VPN, and Elastic Network Interfaces
- Addition of Amazon Direct Connect Security section
- Addition of Amazon Elastic Load Balancing Security
- Addition of AWS Storage Gateway Security
- Addition of AWS Import/Export Security
- Addition of Auto Scaling Security

- Addition of Amazon DynamoDB Security
- Addition of Amazon ElastiCache Security
- Addition of Amazon Simple Workflow Service (Amazon SWS) Security
- Addition of Amazon Simple Email Service (Amazon SES) Security
- Addition of Amazon Route 53 Security
- Addition of Amazon CloudSearch Security
- Addition of AWS Elastic Beanstalk Security
- Addition of AWS CloudFormation Security
- Updated glossary

Changes since last version (Aug 2010):

- Addition of AWS Identity and Access Management (AWS IAM)
- Addition of Amazon Simple Notification Service (SNS) Security
- Addition of Amazon CloudWatch Security
- Addition of Auto Scaling Security
- Update to Amazon Virtual Private Cloud (Amazon VPC)
- Update to Control Environment
- Removal of Risk Management because it has been expanded in a separate whitepaper

Changes since last version (Nov 2009):

- Major revision

Changes since last version (June 2009):

- Change to Certifications and Accreditations section to reflect SAS70
- Addition of Amazon Virtual Private Cloud (Amazon VPC)
- Addition of Security Credentials section to highlight AWS Multi-Factor Authentication and Key Rotation
- Addition of Amazon Relational Database Service (Amazon RDS) Security

Changes since last version (Sep 2008):

- Addition of Security Design Principles
- Update of Physical Security information and inclusion of background checks
- Backup section updated for clarity with respect to Amazon EBS
- Update of Amazon EC2 Security section to include:
- Certificate-based SSHv2
- Multi-tier security group detail and diagram
- Hypervisor description and Instance Isolation diagram
- Fault Separation
- Addition of Configuration Management
- Amazon S3 section updated for detail and clarity
- Addition of Storage Device Decommissioning
- Addition of Amazon SQS Security
- Addition of Amazon CloudFront Security
- Addition of Amazon Elastic MapReduce Security

Notices

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