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# Alibaba Cloud

## Key Management Service
## Best Practices

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Alibaba Cloud

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# Document conventions

| Style | Description | Example |
| --- | --- | --- |
| Danger | A danger notice indicates a situation that will cause major system changes, faults, physical injuries, and other adverse results. | **Danger:** Resetting will result in the loss of user configuration data. |
| Warning | A warning notice indicates a situation that may cause major system changes, faults, physical injuries, and other adverse results. | **Warning:** Restarting will cause business interruption. About 10 minutes are required to restart an instance. |
| Notice | A caution notice indicates warning information, supplementary instructions, and other content that the user must understand. | **Notice:** If the weight is set to 0, the server no longer receives new requests. |
| Note | A note indicates supplemental instructions, best practices, tips, and other content. | **Note:** You can use Ctrl + A to select all files. |
| > | Closing angle brackets are used to indicate a multi-level menu cascade. | Click **Settings**> **Network**> **Set network type**. |
| **Bold** | Bold formatting is used for buttons , menus, page names, and other UI elements. | Click **OK**. |
| `Courier font` | Courier font is used for commands | Run the `cd /d C:/window` command to enter the Windows system folder. |
| *Italic* | Italic formatting is used for parameters and variables. | `bae log list --instanceid` *Instance_ID* |
| [] or [a\|b] | This format is used for an optional value, where only one item can be selected. | `ipconfig [-all\|-t]` |
| {} or {a\|b} | This format is used for a required value, where only one item can be selected. | `switch {active\|stand}` |

# Table of Contents

# 1.Use the exponential backoff method to retry requests

When you call API operations of Key Management Service (KMS), errors are returned sometimes. This topic describes how to use the exponential backoff method to retry the failed requests.

## Background information

If an error occurs when you call an API operation, you can retry the request in the application.

Some Alibaba Cloud SDKs support automatic retries. For example, you can configure automatic retry policies for Alibaba Cloud SDKs for .NET. If your SDK does not support automatic retries, you can use the method described in this topic.

## Retry methods

If a server error (5xx) is returned or your request is denied due to throttling, you can use one of the following methods:

- Simple retry

  Retry a request at fixed intervals within a specified period of time.

- Exponential backoff

  For consecutive errors, increase the waiting time between retries exponentially based on a maximum backoff time and a maximum number of retries. This method helps prevent constant errors returned during the retry process. For example, you can use this method to retry a request that was denied due to throttling. This reduces the number of throttling errors returned within a short period of time.

## Pseudocode for exponential backoff

The following pseudocode demonstrates how to achieve exponential increase of waiting time between retries:

```
initialDelay = 200
retries = 0
DO
  wait for (2^retries * initialDelay) milliseconds
  status = CallSomeAPI()
  IF status == SUCCESS
    retry = false // Succeeded, stop calling the API again.
  ELSE IF status = THROTTLED || status == SERVER_NOT_READY
    retry = true  // Failed because of throttling or server busy, try again.
  ELSE
    retry = false // Some other error occurred, stop calling the API again.
  END IF
  retries = retries + 1
WHILE (retry AND (retries < MAX_RETRIES))
```

## Use the exponential backoff method to process throttling errors in KMS

The following Java code demonstrates how to use the exponential backoff method to process the throttling errors returned when the Decrypt operation is called.

- You can make simple modifications to the code to process certain server errors, such as HTTP error 503.
- You can estimate the number of requests that the client will initiate within a specific period of time. Then, adjust the initial delay ( `initialDelay` ) and maximum number of retries ( `maxRetries` ) in the code based on the estimation result.

```
import com.aliyuncs.DefaultAcsClient;
import com.aliyuncs.exceptions.ClientException;
import com.aliyuncs.http.FormatType;
import com.aliyuncs.http.HttpClientConfig;
import com.aliyuncs.http.MethodType;
import com.aliyuncs.http.ProtocolType;
import com.aliyuncs.kms.model.v20160120.DecryptRequest;
import com.aliyuncs.kms.model.v20160120.DecryptResponse;
import com.aliyuncs.profile.DefaultProfile;
import com.aliyuncs.profile.IClientProfile;
import java.io.*;
public class CmkDecrypt {
  private static DefaultAcsClient kmsClient(String regionId, String accessKeyId, String accessKeySecret) {
    IClientProfile profile = DefaultProfile.getProfile(regionId, accessKeyId, accessKeySecret);
    HttpClientConfig clientConfig = HttpClientConfig.getDefault();
    profile.setHttpClientConfig(clientConfig);
    return new DefaultAcsClient(profile);
  }
  private static String kmsDecrypt(String cipherTextBlob) throws ClientException {
    final DecryptRequest request = new DecryptRequest();
    request.setSysProtocol(ProtocolType.HTTPS);
    request.setAcceptFormat(FormatType.JSON);
    request.setSysMethod(MethodType.POST);
    request.setCiphertextBlob(cipherTextBlob);
    DecryptResponse response = kmsClient.getAcsResponse(request);
    return response.getPlaintext();
  }
  public static long getWaitTimeExponential(int retryCount) {
    final int initialDelay = 200L;
    long waitTime = ((long) Math.pow(2, retryCount) * initialDelay);
    return waitTime;
```

```
    }
    public static void main(String[] args) {
        String regionId = "xxxxx" //"cn-shanghai";
        String accessKeyId = "xxxxx";
        String accessKeySecret = "xxxxxx";
        String cipherTextBlob = "xxxxxx";
        int maxRetries = 5;
        kmsClient = kmsClient(regionId, accessKeyId, accessKeySecret);
        for (int i=0; i<maxRetries; i++) {
            try {
                String plainText = kmsDecrypt(cipherTextBlob);
                return;
            } catch (ClientException e){
                if (e.getErrCode().contains("Rejected.Throttling")) {//need retry
                    try {
                        Thread.sleep(getWaitTimeExponential(i+1));
                    } catch (InterruptedException ignore) {
                    }
                }
            } catch (IOException e) {
                e.printStackTrace();
            }
        }
    }
}
```

# 2.Use a KMS CMK to encrypt and decrypt data online

You must encrypt sensitive information in your IT assets that are deployed on Alibaba Cloud. You can call cryptographic API operations of Key Management Service (KMS) to encrypt or decrypt data less than 6 KB online.

## Context

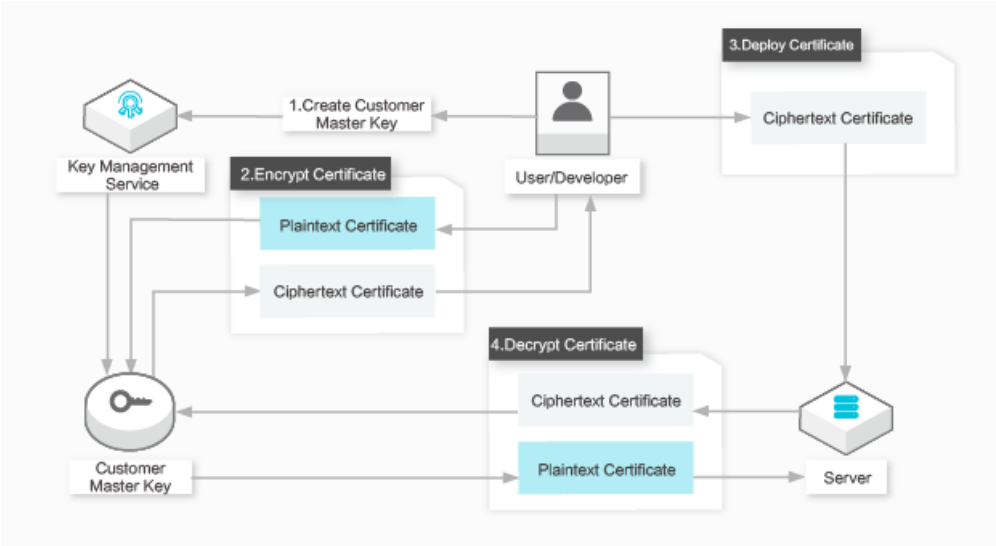
You can use this feature in, but not limited to, the following typical scenarios:

- Encrypt configuration files.
- Encrypt private keys of Secure Sockets Layer (SSL) certificates.

This topic shows you how to call KMS API operations to encrypt and decrypt private keys of SSL certificates online.

## Architecture

User data is transmitted to the KMS server over an encrypted channel. The KMS server encrypts or decrypts the data and then returns the data to the user over the encrypted channel. The following figure shows the architecture.




Procedure:

1. Create a customer master key (CMK) in the KMS console or by calling the CreateKey operation.
2. Call the Encrypt operation of KMS to encrypt the private key of an SSL certificate. The ciphertext of the private key is returned.
3. Install the SSL certificate and the encrypted private key on an Elastic Compute Service (ECS) instance.
4. Call the Decrypt operation of KMS to decrypt the encrypted private key when the ECS instance starts and needs to use the SSL certificate.

## Related API operations

You can call the following KMS API operations to encrypt and decrypt data.

| Operation | Description |
| --- | --- |
| CreateKey | Creates a CMK. |
| CreateAlias | Assigns an alias to a CMK. |
| Encrypt | Encrypts data by using a specified CMK. |
| Decrypt | Decrypts data that is encrypted by KMS. You do not need to specify a CMK. |

## Encrypt and decrypt the private key of an SSL certificate

1. Call the CreateKey operation to create a CMK.

```
$ aliyun kms CreateKey
{
 "KeyMetadata": {
  "CreationDate": "2019-04-08T07:45:54Z",
  "Description": "",
  "KeyId": "1234abcd-12ab-34cd-56ef-12345678****",
  "KeyState": "Enabled",
  "KeyUsage": "ENCRYPT/DECRYPT",
  "DeleteDate": "",
  "Creator": "111122223333",
  "Arn": "acs:kms:cn-hangzhou:111122223333:key/1234abcd-12ab-34cd-56ef-12345678****",
  "Origin": "Aliyun_KMS",
  "MaterialExpireTime": ""
 },
 "RequestId": "2a37b168-9fa0-4d71-aba4-2077dd9e80df"
}
```

2. (Optional)Assign an alias to the CMK. We recommend that you perform this step.Aliases are optional to CMKs. If a CMK does not have an alias, you can use the ID of the CMK.

```
$ aliyun kms CreateAlias --AliasName alias/Apollo/WorkKey --KeyId 1234abcd-12ab-34cd-56ef-12345678***
```

> **Note** In this example, `Apollo/WorkKey` is assigned to the CMK used in the Apollo project as the alias. This alias is used in the subsequent sample code. You can use `alias/Apollo/WorkKey` to reference the CMK when you call the Encrypt operation.

3. Encrypt the private key to protect it in your business system.

   In the following sample code:

   - `alias/Apollo/WorkKey` is the alias of the CMK.

- *./certs/key.pem* is the plaintext key file.
- *./certs/key.pem.cipher* is the ciphertext key file.

```
#! /usr/bin/env python
#coding=utf-8
import json
from aliyunsdkcore import client
from aliyunsdkkms.request.v20160120 import EncryptRequest
from aliyunsdkkms.request.v20160120 import DecryptRequest
def KmsEncrypt(client, plaintext, key_alias):
 request = EncryptRequest.EncryptRequest()
 request.set_accept_format('JSON')
 request.set_KeyId(key_alias)
 request.set_Plaintext(plaintext)
 response = json.loads(clt.do_action(request))
 return response.get("CiphertextBlob")
def ReadTextFile(in_file):
 file = open(in_file, 'r')
 content = file.read()
 file.close()
 return content
def WriteTextFile(out_file, content):
 file = open(out_file, 'w')
 file.write(content)
 file.close()
clt = client.AcsClient('<Access-Key-Id>','Access-Key-Secret','<Region-Id>')
key_alias = 'alias/Apollo/WorkKey'
in_file = './certs/key.pem'
out_file = './certs/key.pem.cipher'
# Read private key file in text mode
in_content = ReadTextFile(in_file)
# Encrypt
ciphertext = KmsEncrypt(clt, in_content, key_alias)
# Write encrypted key file in text mode
WriteTextFile(out_file, ciphertext)
```

4. Decrypt the encrypted private key that you have installed on the ECS instance.

   In the following sample code:

   - *./certs/key.pem.cipher* is the ciphertext key file.
   - *./certs/decrypted_key.pem* is the plaintext key file.

```
#! /usr/bin/env python
#coding=utf-8
import json
from aliyunsdkcore import client
from aliyunsdkkms.request.v20160120 import EncryptRequest
from aliyunsdkkms.request.v20160120 import DecryptRequest
def KmsDecrypt(client, ciphertext):
 request = DecryptRequest.DecryptRequest()
 request.set_accept_format('JSON')
 request.set_CiphertextBlob(ciphertext)
 response = json.loads(clt.do_action(request))
 return response.get("Plaintext")
def ReadTextFile(in_file):
 file = open(in_file, 'r')
 content = file.read()
 file.close()
 return content
def WriteTextFile(out_file, content):
 file = open(out_file, 'w')
 file.write(content)
 file.close()
clt = client.AcsClient('<Access-Key-Id>','Access-Key-Secret','<Region-Id>')
in_file = './certs/key.pem.cipher'
out_file = './certs/decrypted_key.pem'
# Read encrypted key file in text mode
in_content = ReadTextFile(in_file)
# Decrypt
ciphertext = KmsDecrypt(clt, in_content)
# Write Decrypted key file in text mode
WriteTextFile(out_file, ciphertext)
```

# 3.Use envelope encryption to encrypt and decrypt local data

You must encrypt sensitive information in your IT assets that are deployed on Alibaba Cloud. If you need to encrypt a large volume of local data, you can call cryptographic API operations of Key Management Service (KMS) to generate a data key online and then use the data key to encrypt the local data offline. This encryption mechanism is known as envelope encryption.

## Prerequisites

An Alibaba Cloud account is created. To create an Alibaba Cloud account, visit the account registration page.

## Context

You can use envelope encryption in but not limited to the following scenarios:

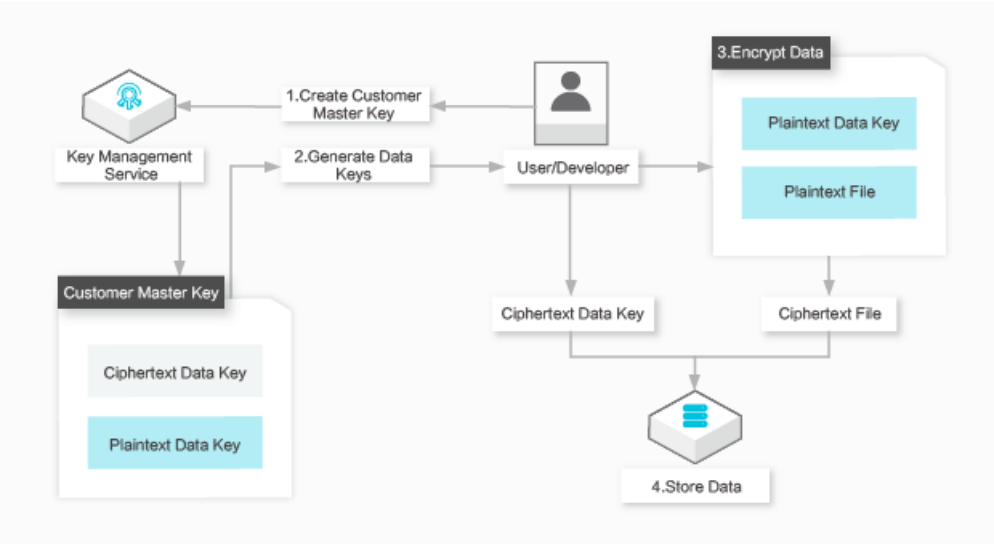
- Encrypt business data files.
- Encrypt all data stored on local disks.

This topic describes how to use envelope encryption to encrypt and decrypt local files.

## How envelope encryption works

Use KMS to create a customer master key (CMK), use the CMK to generate a data key, and then use the data key to encrypt and decrypt local files. Envelope encryption is suitable for encrypting large volumes of data. The following figure shows the entire envelope encryption procedure.

- Envelope encryption




Procedure:

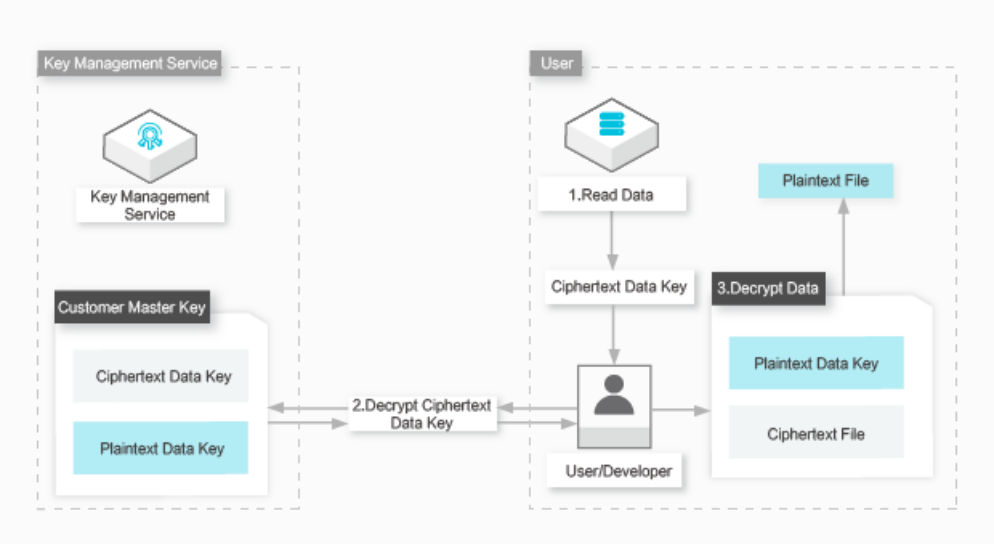
i. Create a CMK in the KMS console or by calling the CreateKey operation.

ii. Call the GenerateDataKey operation to generate a data key. KMS returns the plaintext and ciphertext of a data key.

iii. Use the plaintext data key to encrypt the local files and then delete the plaintext data key from memory.

iv. Store the ciphertext data key and encrypted data files on a persistent storage device or service.

- Envelope decryption




Procedure:

i. Retrieve the ciphertext data key from the storage device or service.

ii. Call the Decrypt operation of KMS to decrypt the ciphertext data key. The plaintext of the data key is returned.

iii. Use the plaintext data key to decrypt the local files and then delete the plaintext data key from memory.

## Related API operations

You can call the following KMS API operations to encrypt and decrypt local data.

| Operation | Description |
| --- | --- |
| CreateKey | Creates a CMK. |
| CreateAlias | Assigns an alias to a CMK. |
| GenerateDataKey | Generates a data key, uses a specific CMK to encrypt the data key, and then returns the plaintext and ciphertext of the data key. |
| Decrypt | Decrypts data that is encrypted in KMS, including the ciphertext data key generated by calling the GenerateDataKey operation. You do not need to specify a CMK. |

## Encrypt and decrypt local files

1. Create a CMK.

```
$ aliyun kms CreateKey
{
 "KeyMetadata": {
  "CreationDate": "2019-04-08T07:45:54Z",
  "Description": "",
  "KeyId": "1234abcd-12ab-34cd-56ef-12345678****",
  "KeyState": "Enabled",
  "KeyUsage": "ENCRYPT/DECRYPT",
  "DeleteDate": "",
  "Creator": "111122223333",
  "Arn": "acs:kms:cn-hangzhou:111122223333:key/1234abcd-12ab-34cd-56ef-12345678****",
  "Origin": "Aliyun_KMS",
  "MaterialExpireTime": ""
 },
 "RequestId": "2a37b168-9fa0-4d71-aba4-2077dd9e80df"
}
```

2. (Optional)Assign an alias to the CMK.

   Aliases are optional to CMKs. If a CMK does not have an alias, you can use its ID.

   ```
   $ aliyun kms CreateAlias --AliasName alias/Apollo/WorkKey --KeyId 1234abcd-12ab-34cd-56ef-12345678*
   ***
   ```

   > **Note** In this example, Apollo/WorkKey is assigned to the CMK in the Apollo project as the alias for key encryption. This alias is used in the subsequent sample code. This means that you can specify alias/Apollo/WorkKey to use the CMK to encrypt a data key.

3. Encrypt a local file.

   In the following sample code:

   - `alias/Apollo/WorkKey` is the alias of the CMK.
   - *./data/sales.csv* is the plaintext data file.
   - *./data/sales.csv.cipher* is the returned ciphertext data file.

   ```
   #! /usr/bin/env python
   #coding=utf-8
   import json
   import base64
   from Crypto.Cipher import AES
   from aliyunsdkcore import client
   from aliyunsdkkms.request.v20160120 import GenerateDataKeyRequest
   def KmsGenerateDataKey(client, key_alias):
     request = GenerateDataKeyRequest.GenerateDataKeyRequest()
   ```

```
    request.set_accept_format('JSON')
    request.set_KeyId(key_alias)
    request.set_NumberOfBytes(32)
    response = json.loads(client.do_action(request))
    datakey_encrypted = response["CiphertextBlob"]
    datakey_plaintext = response["Plaintext"]
    return (datakey_plaintext, datakey_encrypted)
def ReadTextFile(in_file):
  file = open(in_file, 'r')
  content = file.read()
  file.close()
  return content
def WriteTextFile(out_file, lines):
  file = open(out_file, 'w')
  for ln in lines:
    file.write(ln)
    file.write('\n')
  file.close()
# Out file format (text)
# Line 1: b64 encoded data key
# Line 2: b64 encoded IV
# Line 3: b64 encoded ciphertext
# Line 4: b64 encoded authentication tag
def LocalEncrypt(datakey_plaintext, datakey_encrypted, in_file, out_file):
  data_key_binary = base64.b64decode(datakey_plaintext)
  cipher = AES.new(data_key_binary, AES.MODE_EAX)
  in_content = ReadTextFile(in_file)
  ciphertext, tag = cipher.encrypt_and_digest(in_content)
  lines = [datakey_encrypted, base64.b64encode(cipher.nonce), base64.b64encode(ciphertext), base64.
b64encode(tag)];
  WriteTextFile(out_file, lines)
clt = client.AcsClient('Access-Key-Id','Access-Key-Secret','Region-Id')
key_alias = 'alias/Apollo/WorkKey'
in_file = './data/sales.csv'
out_file = './data/sales.csv.cipher'
# Generate Data Key
datakey = KmsGenerateDataKey(clt, key_alias)
# Locally Encrypt the sales record
LocalEncrypt(datakey[0], datakey[1], in_file, out_file)
```

4. Decrypt a local file.

   In the following sample code:

   - *./data/sales.csv.cipher* is the ciphertext data file.
   - *./data/decrypted_sales.csv* is the returned plaintext data file.

```
#! /usr/bin/env python
#coding=utf-8
import json
import base64
from Crypto.Cipher import AES
from aliyunsdkcore import client
from aliyunsdkkms.request.v20160120 import DecryptRequest
def KmsDecrypt(client, ciphertext):
 request = DecryptRequest.DecryptRequest()
 request.set_accept_format('JSON')
 request.set_CiphertextBlob(ciphertext)
 response = json.loads(client.do_action(request))
 return response.get("Plaintext")
def ReadTextFile(in_file):
 file = open(in_file, 'r')
 lines = []
 for ln in file:
  lines.append(ln)
 file.close()
 return lines
def WriteTextFile(out_file, content):
 file = open(out_file, 'w')
 file.write(content)
 file.close()
def LocalDecrypt(datakey, iv, ciphertext, tag, out_file):
 cipher = AES.new(datakey, AES.MODE_EAX, iv)
 data = cipher.decrypt_and_verify(ciphertext, tag).decode('utf-8')
 WriteTextFile(out_file, data)
clt = client.AcsClient('Access-Key-Id','Access-Key-Secret','Region-Id')
in_file = './data/sales.csv.cipher'
out_file = './data/decrypted_sales.csv'
# Read encrypted file
in_lines = ReadTextFile(in_file)
# Decrypt data key
datakey = KmsDecrypt(clt, in_lines[0])
# Locally decrypt the sales record
```

```
LocalDecrypt(
 base64.b64decode(datakey),
 base64.b64decode(in_lines[1]), # IV
 base64.b64decode(in_lines[2]), # Ciphertext
 base64.b64decode(in_lines[3]), # Authentication tag
 out_file
 )
```

# 4.Use KMS to protect ECS instance workloads with one click

In most scenarios, the production data that you use ECS instance workloads to process contains your business secrets, privacy information, or critical credentials. Therefore, you must protect these workloads against information leak. KMS supports one-click encryption for ECS instance workloads to protect transient and persistent data generated in a computing environment. This meets your requirements for data confidentiality, privacy, and compliance. KMS helps you build a secure cloud computing environment at low costs.

## Background information

Customers have data security requirements on business secrets and personal privacy. These types of data are essential to enterprises and are subject to regulatory compliance. For example, General Data Protection Regulation (GDPR) requires enterprises to protect personal privacy data. The data is stored in databases. Before you store the data of an application system in databases, you must encrypt the data to reduce the risk of data breach caused by attacks such as credential stuffing.

To ensure the security and compliance of encryption, you can use KMS or Data Encryption Service to encrypt business data of an application system. For more information about how to encrypt your business data at the application layer, see Use envelope encryption to encrypt and decrypt local data.

If you have encrypted your business data, the workloads used to encrypt and decrypt data are a weak link in your system. Take note of the following points, which may cause security risks:

- Your applications deployed in an ECS instance contain the key credentials that are used to access KMS, HSMs, microservices, or subsystems.
- The system disks of your ECS instances may generate some temporary files, including sensitive data involved in network transmission and local data processing.
- Disk backup based on automatic snapshot is enabled for disks of your ECS instances to store a large volume of sensitive data.

> **Note** When you deploy business systems, you may encounter additional issues. For example, with the application deployment and lifecycle change mechanisms in DevOps mode, O&M and security engineers are unaware of whether new sensitive data types are generated for workloads. They cannot determine whether to introduce new business logic to process sensitive data.

## Benefits

Alibaba Cloud ECS instances use KMS to protect the resources that workloads involve. The resources include system disks and data disks of ECS instances and relevant images and snapshots.

You can authorize ECS instances to use CMKs in KMS to encrypt the resources with one click. This protects known, potential, transient, and persistent sensitive data against unauthorized download. In case of emergencies, you can disable KMS-based decryption on an ECS instance by revoking authorization or disabling CMKs.

> **Note** For O&M and security engineers, it is a simple and efficient security solution to encrypt resources that ECS instance workloads involve in DevOps mode.

## Encrypt a system disk

A system disk contains the operating system and application software required for business operations. It is always packaged as an image.

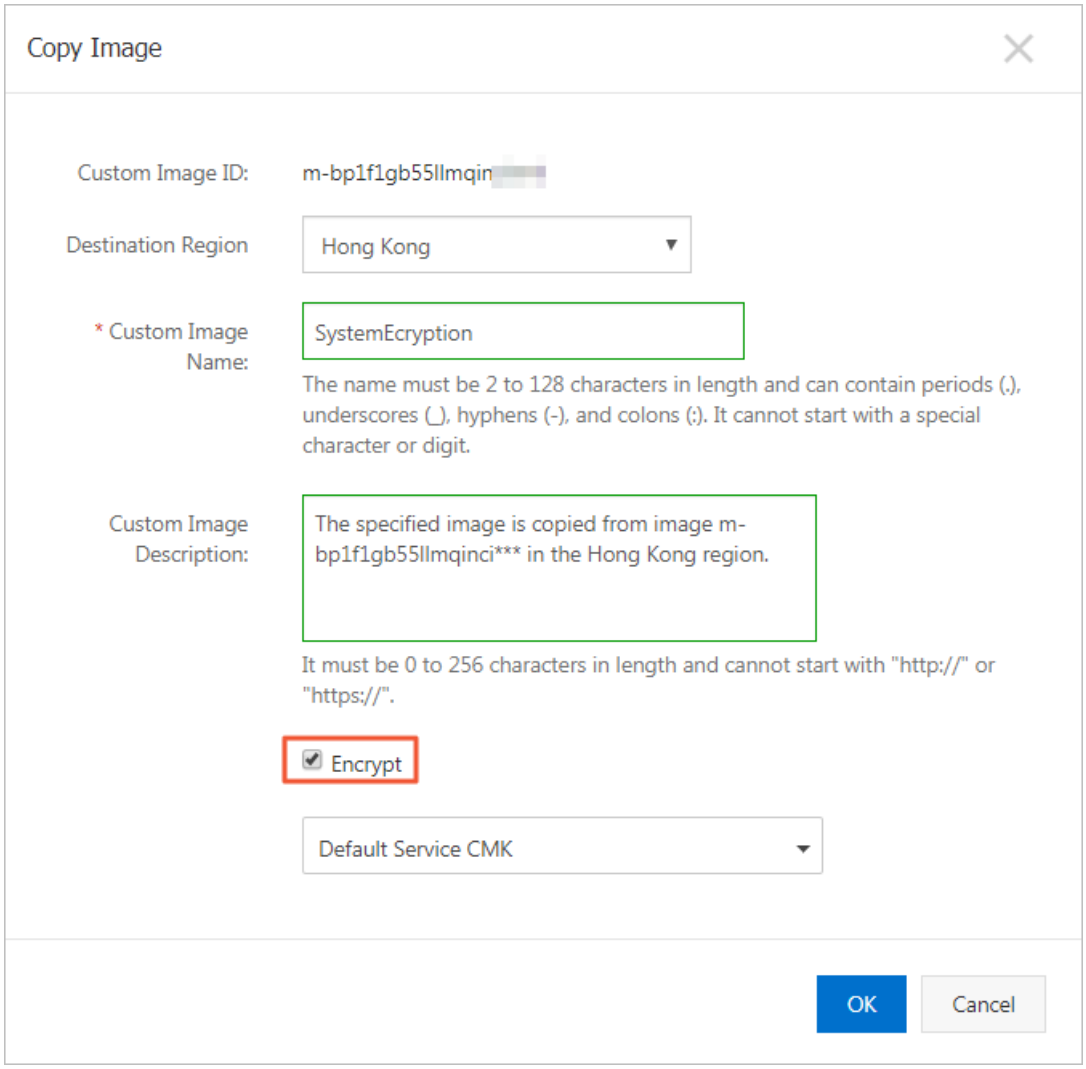
After you create a custom image that can run in a production environment and use the custom image as a baseline, you can copy and encrypt the image. This way, an encrypted system disk is created.

1. Log on to the ECS console.
2. In the left-side navigation pane, choose **Instances & Images > Images**.
3. In the top navigation bar, select a region.
4. On the **Images** page, click the **Custom Images** tab.
5. Find your image and click **Copy Image** in the **Actions** column.

   > **Note** If the size of your custom image is greater than 500 GiB, you are prompted to submit a ticket to complete the operation when you click **Copy Image**.

6. In the **Copy Image** dialog box, select **Encrypt** and then select a key from the drop-down list.Alibaba Cloud uses the service managed key (**Default Service CMK**) by default. You can also specify the BYOK-based CMK that you created in KMS for encryption. We recommend that you use a BYOK-based CMK for encryption.

   > **Note** If this is the first time that you select a different custom encryption key, click **Confirm Authorization** and select AliyunECSDiskEncryptDefaultRole to allow ECS to access your KMS resources. This procedure describes only how to configure the encryption setting when you copy a custom image. For more information about other configurations, see Copy custom images.




7. Click **OK**.

## Encrypt a data disk

You can encrypt a data disk when you create an instance or create the disk.

### Encrypt a data disk when you create an instance

1. Log on to the ECS console.
2. In the left-side navigation pane, choose **Instances & Images > Instances**.
3. In the upper-right corner of the **Instances** page, click **Create Instance**.
4. In the **Storage** section of the **Basic Configurations** step, perform the following operations:

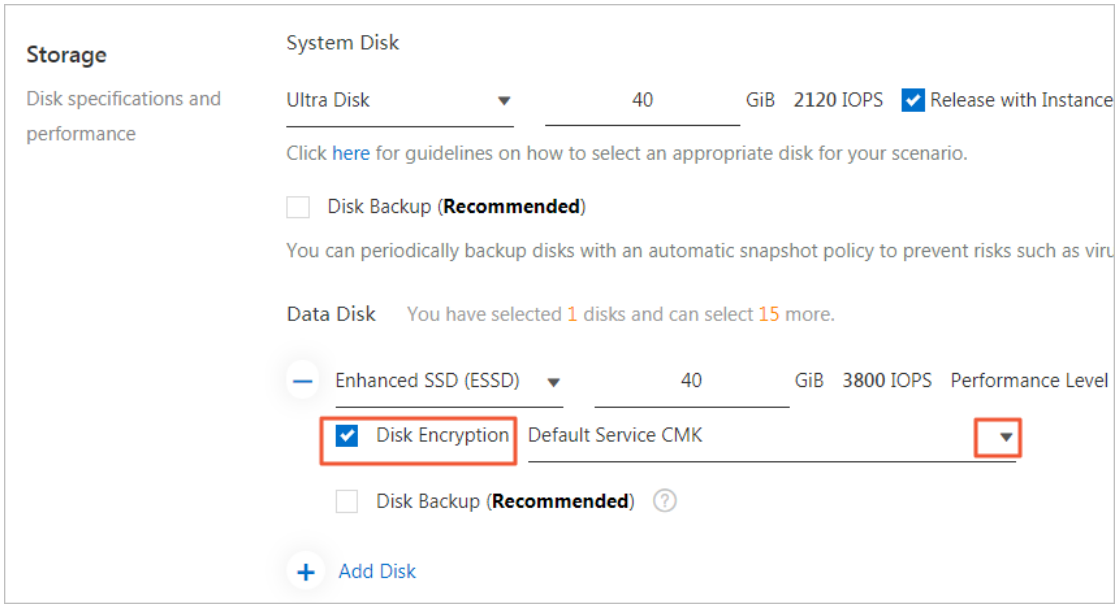
   > **Note** This procedure describes only how to configure the encryption setting when you create an instance. For more information about other configurations, see Create an instance by using the wizard.

   i. Click **Add Disk**.

   ii. Specify the disk category and capacity of the data disk.

iii. Select **Disk Encryption** and then select a key from the drop-down list.Alibaba Cloud uses the service managed key (**Default Service CMK**) by default. You can also specify the BYOK-based CMK that you created in KMS for encryption. We recommend that you use a BYOK-based CMK for encryption.

> **Note** If this is the first time that you select a different custom encryption key, click **Confirm Authorization** and select AliyunECSDiskEncryptDefaultRole to allow ECS to access your KMS resources.



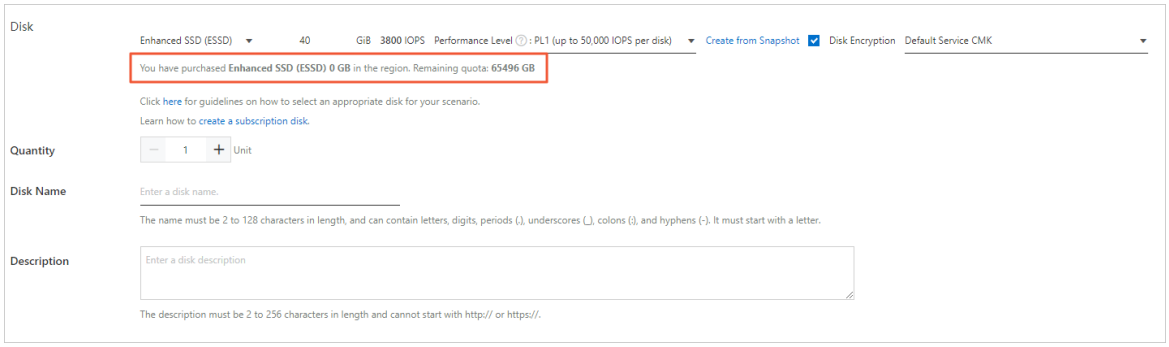

### Encrypt a data disk when you create the disk

1. Log on to the ECS console.
2. In the left-side navigation pane, choose **Storage & Snapshots > Disks**.
3. In the upper-right corner of the **Disks** page, click **Create Disk**.
4. Specify the disk category and capacity.

> **Note** This procedure describes only how to configure the encryption setting when you create a disk. For more information about other configurations, see Create a disk.

5. In the **Disk** section of the Disk page, select **Disk Encryption** and select a key from the drop-down list.Alibaba Cloud uses the service managed key (**Default Service CMK**) by default. You can also specify the BYOK-based CMK that you created in KMS for encryption. We recommend that you use a BYOK-based CMK for encryption.

> **Note** If this is the first time that you select a different custom encryption key, click **Confirm Authorization** and select AliyunECSDiskEncryptDefaultRole to allow ECS to access your KMS resources.


Disk
Enhanced SSD (ESSD)
40
GiB
3800 IOPS
Performance Level
: PL1 (up to 50,000 IOPS per disk)
Create from Snapshot
Disk Encryption
Default Service CMK
You have purchased Enhanced SSD (ESSD) 0 GB in the region. Remaining quota: 65496 GB
Click here for guidelines on how to select an appropriate disk for your scenario.
Learn how to create a subscription disk.
Quantity
1
Unit
Disk Name
Enter a disk name.
The name must be 2 to 128 characters in length, and can contain letters, digits, periods (.), underscores (_), colons (:), and hyphens (-). It must start with a letter.
Description
Enter a disk description
The description must be 2 to 256 characters in length and cannot start with http:// or https://.

# 5.Use KMS to encrypt Kubernetes secrets at rest

Alibaba Cloud Container Service for Kubernetes (ACK) allows you to use a KMS customer master key (CMK) to encrypt the secrets of Kubernetes clusters at rest.

## Scenarios

ACK provides powerful capabilities in operation orchestration management. It obtains secrets such as passwords, certificates, credentials, and access keys across products, services, and modules. ACK uses secret modules to store and manage the sensitive information of Kubernetes clusters and that of business applications in the clusters. It also stores sensitive information in etcd. The replication feature of etcd supports distributed storage.

A Kubernetes cluster in the initialized state (without any business load) has about 50 secrets. The leak of any secret may cause immeasurable loss to the cluster, the business system, or even the entire enterprise. Therefore, you must protect the secrets hosted in Kubernetes clusters.

## Encryption mechanism

Professional managed Kubernetes clusters allow you to use a KMS CMK to encrypt secrets. The KMS provider mechanism of Kubernetes is used during encryption. A KMS provider uses an envelope encryption scheme to encrypt or decrypt the keys of secrets that are stored in etcd. For more information about envelope encryption, see What is envelope encryption?. Key encryption and decryption procedures:

- When you store a Kubernetes secret over the Kubernetes Secret API, the API server generates a random data key to encrypt your business key. Then, the system uses a KMS CMK to encrypt the data key and store the cyphertext of the data key in etcd.
- When you decrypt the Kubernetes secret, the system calls the Decrypt API operation of KMS to decrypt the data key first. Then, the system uses the plaintext of the data key to decrypt the Kubernetes secret and returns the decrypted secret.

## Before you begin

- Make sure that the ACK account is authorized to assume the AliyunCSManagedSecurityRole role. If you use an unauthorized account to enable secret encryption at rest for a new or existing professional managed Kubernetes cluster, you are prompted to authorize the account first.
- If the current account is a RAM user, make sure that the RAM user has the AliyunKMSCryptoAdminAccess permission. For more information, see Grant permissions to a RAM user.
- Make sure that you have created a CMK in the KMS console. For more information, see Create a CMK.

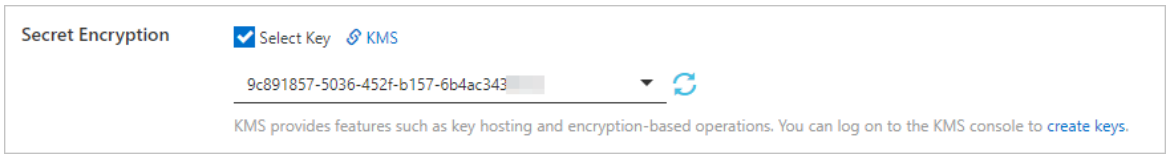
> **Note** Only CMKs of the Aliyun_AES_256 type are supported.

## Create a professional managed Kubernetes cluster and enable secret encryption at rest

1. Log on to the Container Service for Kubernetes (ACK) console.
2. In the left-side navigation pane, click **Clusters**.
3. In the upper-right corner of the Clusters page, click **Create Kubernetes Cluster**. In the **Select**

**Cluster Template** panel, find the **Professional Managed Cluster** card and click **Create**.

4. On the **ACK managed edition** tab, find **Secret Encryption**, select **Select Key**, and then select a CMK ID from the drop-down list.




5. Configure other parameters as prompted. For more information, see Create a professional managed Kubernetes cluster.

## Enable secret encryption at rest for an existing professional managed Kubernetes cluster

1. Log on to the Container Service for Kubernetes (ACK) console.
2. In the left-side navigation pane, click **Clusters**.
3. On the **Clusters** page, click the name of the cluster for which you want to enable secret encryption at rest.
4. Click the **Basic Information** tab. In the **Basic Information** section, turn on **Secret Encryption**. If the state of the cluster changes from **Updating** to **Running**, secret encryption at rest is enabled for the cluster.

## Results

If you can find encryption or decryption events performed by the AliyunCSManagedSecurityRole role on the **Query Event Details** page of the ActionTrail console, you have enabled secret encryption at rest for the cluster. You can view all the KMS CMK calling records in the ActionTrail console.