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Intelligent Speech Interaction
Real-time Speech Recognition

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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.SDK for C++

This topic describes how to use the C ++ SDK provided by Alibaba Cloud Intelligent speech interaction, including the SDK installation method and SDK sample code.

> Note
>
> - The latest version of the SDK for C++ is 3.0.8, which was released on January 09, 2020.
>
> This version applies only to the Linux operating system. The Windows operating system is not supported.
> - Before you use this SDK, make sure that you understand how this SDK works. Fore more information, see Overview.
> - The methods of this SDK version are different from those of the earlier version. If you are familiar with the earlier version, pay attention to the updated methods described in this topic.

Download and installation

Download the SDK:

To download the SDK for C++, click here. The compressed package contains the following files or folders:

- CMakeLists.txt: the CMakeList file of the demo project.
- readme.txt: the SDK description.
- release.log: the release notes.
- version: the version number.
- build.sh: the demo compilation script.
- lib: the SDK libraries.
- build: the compilation directory.
- demo: the folder that contains demo.cpp files, which are the configuration files of various Intelligent Speech Interaction services. The following table describes the files contained in the folder.

File name	Description
speechRecognizerDemo.cpp	The demo of short sentence recognition.
speechSynthesizerDemo.cpp	The demo of speech synthesis.
speechTranscriberDemo.cpp	The demo of real-time speech recognition.
speechLongSynthesizerDemo.cpp	The demo of long-text-to-speech synthesis.
test0.wav/test1.wav	The 16-bit audio files with a sampling rate of 16,000 Hz for testing.

- include: the folder that contains SDK header files. The following table describes the files contained in the folder.

File name	Description
nlsClient.h	The header file of the NlsClient object.
nlsEvent.h	The header file of callback events.
speechRecognizerRequest.h	The header file of short sentence recognition.
speechSynthesizerRequest.h	The header file of speech synthesis and long-text-to-speech synthesis.
speechTranscriberRequest.h	The header file of real-time speech recognition.

Compile and run the demo project:

1. Check the local operating system to ensure that required tools are installed based on the following minimum requirements:
   i. Cmake 3.1
   ii. Glibc 2.5
   iii. Gcc 4.1.2
2. Run the following script on the Linux terminal.

```
mkdir build
cd build && cmake .. && make
cd... /demo# The following executable demo programs are generated: srDemo for short sentence recognition, stDemo for real-time speech recognition, syDemo for speech synthesis, and syLongDemo for long-text-to-speech synthesis.
./stDemo appkey <yourAccessKey Id> <yourAccessKey Secret> # The data is used for testing.
```

Key objects

- Basic objects
  - NlsClient: the speech processing client, which is equivalent to a factory for all speech processing classes. You can globally create an NlsClient object.
  - NlsEvent: the event object. You can use this object to obtain the request status code, response from the server, and error message.
- Recognition object

  SpeechTranscriberRequest: The request object of real-time speech recognition. It is used for real-time speech recognition.

Error codes of the SDK for C++

Error code	Error message	Description and solution
10000001	SSL: couldn't create a ……!	The error message returned because an internal error has occurred. Try again later.
10000002	An official OpenSSL error message.	The error message returned because an internal error has occurred. Resolve the error based on the error message and try again later.
10000003	A system error message.	The error message returned because a system error has occurred. Resolve the error based on the error message.
10000004	URL: The url is empty.	The error message returned because no endpoint is specified. Check whether an endpoint is specified.
10000005	URL: Could not parse WebSocket url.	The error message returned because the specified endpoint is invalid. Check whether the specified endpoint is correct.
10000006	MODE: unsupport mode.	The error message returned because the specified Intelligent Speech Interaction service is not supported. Check whether the Intelligent Speech Interaction service is correctly configured.
10000007	JSON: Json parse failed.	The error message returned because the server returns an invalid response. Submit a ticket and provide the task ID to Alibaba Cloud.
10000008	WEBSOCKET: unkown head type.	The error message returned because the server returns an invalid WebSocket type. Submit a ticket and provide the task ID to Alibaba Cloud.
10000009	HTTP: connect failed.	The error message returned because the client fails to connect to the server. Check the network and try again later.

Error code	Error message	Description and solution
Official HTTP status code	`HTTP: Got bad status.`	The error message returned because an internal error has occurred. Resolve the error based on the error message.
System error code	`IP: ip address is not valid.`	The error message returned because the IP address is invalid. Resolve the error based on the error message.
System error code	`ENCODE: convert to utf8 error.`	The error message returned because the file fails to be converted to the UTF-8 format. Resolve the error based on the error message.
10000010	`please check if the memory is enough.`	The error message returned because the memory is insufficient. Check the memory of the local device.
10000011	`Please check the order of execution.`	The error message returned because the client calls methods in an invalid order. For example, if the client receives a failed or complete message, the SDK disconnects the client from the server. If the client calls the relevant method to send data, this error message is returned.
10000012	`StartCommand/StopCommand Send failed.`	The error message returned because the request contains invalid parameters. Check the settings of request parameters.
10000013	`The sent data is null or dataSize <= 0.`	The error message returned because the client sends invalid data. Check the settings of request parameters.
10000014	`Start invoke failed.`	The error message returned because the start method times out. Call the stop method to release resources, and then start the recognition process again.

Error code	Error message	Description and solution
10000015	connect failed.	The error message returned because the connection between the client and the server fails. Release resources and start the recognition process again.

Service status codes

For more information about the service status codes, see the "Service status codes" section of the API reference topic.

Sample code

Note

- The demo uses an audio file with the sampling rate of 16,000 Hz. To obtain correct recognition results, set the model to universal model for the project to which the appkey is bound in the Intelligent Speech Interaction console. You must select a model that matches the audio sampling rate based on your business scenario. For more information about model setting, see Manage projects.
- The demo uses the default Internet access URL built in the SDK to access the real-time speech recognition service. To use an Elastic Compute Service (ECS) instance that resides in the China (Shanghai) region to access this service in an internal network, set the URL for internal access when you create the SpeechRecognizerRequest object.

  ```
  request->setUrl("ws://nls-gateway.cn-shanghai-internal.aliyuncs.com/ws/v1");
  ```

- You can obtain the complete sample code from the speechTranscriberDemo.cpp file in the demo folder of the SDK package.

```
#include <pthread.h>
#include <unistd.h>
#include <ctime>
#include <stdlib.h>
#include <string.h>
#include <string>
#include <vector>
#include <fstream>
#include "nlsClient.h"
#include "nlsEvent.h"
#include "speechTranscriberRequest.h"
#include "nlsCommonSdk/Token.h"

#define FRAME_SIZE 3200
```

```
#define FRAME_SIZE 3200
#define SAMPLE_RATE 16000
using namespace AlibabaNlsCommon;
using AlibabaNls::NlsClient;
using AlibabaNls::NlsEvent;
using AlibabaNls::LogDebug;
using AlibabaNls::LogInfo;
using AlibabaNls::SpeechTranscriberRequest;

// Customize the thread parameters.
struct ParamStruct {
    std::string fileName;
    std::string token;
    std::string appkey;
};

// Customize the callback parameters.
struct ParamCallBack {
    int userId;
    char userInfo[10];
};

// Specify a token for service authentication and the timestamp that indicates the validity period of th
e token. The token and timestamp can be used throughout the project.
// Each time before you call the service, you must check whether the specified token expires.
// If the token expires, you can use the AccessKey ID and AccessKey secret of your Alibaba Cloud acco
unt to obtain a new token. Then, reset the g_token and g_expireTime parameters.
// Note: Do not obtain a new token each time you call the real-time speech recognition service. A toke
n can be used for service authentication when it is valid. In addition, you can use the same token for al
l Intelligent Speech Interaction services.
std::string g_akId = "";
std::string g_akSecret = "";
std::string g_token = "";
long g_expireTime = -1;

// Obtain a new token by using the AccessKey ID and AccessKey secret and obtain a timestamp for the
validity period of the token.
// A token can be used when it is valid. You can use the same token for multiple processes, multiple th
reads, or multiple applications. We recommend that you apply for a new token when the current token
is about to expire.
int generateToken(std::string akId, std::string akSecret, std::string* token, long* expireTime) {
```

```
    NlsToken nlsTokenRequest;
    nlsTokenRequest.setAccessKeyId(akId);
    nlsTokenRequest.setKeySecret(akSecret);

    if (-1 == nlsTokenRequest.applyNlsToken()) {
        // Receive the error message.
        printf("generateToken Failed: %s\n", nlsTokenRequest.getErrorMsg());
        return -1;
    }

    *token = nlsTokenRequest.getToken();
    *expireTime = nlsTokenRequest.getExpireTime();
    return 0;
}

// @brief: Call the sendAudio method to obtain the sleep duration of audio data sending.
// @param dataSize: the size of the audio data to be sent.
// @param sampleRate: the audio sampling rate. Supported sampling rates include 8,000 Hz and 16,000 Hz.
// @param compressRate: the data compression rate. Set this parameter to 10 for Opus-encoded audio data with a sampling rate of 16,000 Hz and a data compression rate of 10:1. Set this parameter to 1 if the data is not compressed.
// @return: the sleep duration after the audio data is sent.
// @note: For 16-bit pulse-code modulation (PCM)-encoded audio data with a sampling rate of 8,000 Hz, we recommend that you set the sleep duration to 100 ms for every 1,600 bytes sent.
For 16-bit PCM-encoded audio data with a sampling rate of 16,000 Hz, we recommend that you set the sleep duration to 100 ms for every 3,200 bytes sent.
// For audio data in other formats, calculate the sleep duration based on the compression rate. For example, if the compression rate is 10:1 for Opus-encoded audio data with a sampling rate of 16,000 Hz, the sleep duration is calculated in the following way: 3200/10 = 320 ms.
unsigned int getSendAudioSleepTime(int dataSize, int sampleRate, int compressRate) {
    // Only 16-bit audio data is supported.
    const int sampleBytes = 16;
    // Only mono audio data is supported.
    const int soundChannel = 1;

    // The current sampling rate, which indicates the size of data in the specified audio bit depth sampled per second.
    int bytes = (sampleRate * sampleBytes * soundChannel) / 8;
    // The current sampling rate, which indicates the size of data in the specified audio bit depth sampled per millisecond.
```

```
    int bytesMs = bytes / 1000;
    // The sleep duration is the size of the audio data to be sent divided by the sampling rate per millis
econd.
    int sleepMs = (dataSize * compressRate) / bytesMs;
    return sleepMs;
}

// @brief: Call the start method to connect the client to the server. The SDK reports a started event in
an internal thread.
// @param cbEvent: the syntax of the event in a callback. For more information, see the nlsEvent.h file
.
// @param cbParam: the custom parameter in a callback. The default value is null. You can set this par
ameter based on your business requirements.
void onTranscriptionStarted(NlsEvent* cbEvent, void* cbParam) {
 ParamCallBack* tmpParam = (ParamCallBack*)cbParam;
    // The following code demonstrates how to obtain details of the started event and customize callba
ck parameters.
    printf("onTranscriptionStarted: %d\n", tmpParam->userId);
    // The ID of the current recognition task. The task ID is the unique identifier that indicates the inter
action between the caller and the server. You must record the task ID. If an error occurs, you can subm
it a ticket and provide the task ID to Alibaba Cloud to facilitate troubleshooting.
    printf("onTranscriptionStarted: status code=%d, task id=%s\n", cbEvent->getStatusCode(), cbEvent
->getTaskId());
    // Obtain the complete information returned by the server.
    //printf("onTranscriptionStarted: all response=%s\n", cbEvent->getAllResponse());
}

// @brief: The server detects the beginning of a sentence. Then, the SDK reports a SentenceBegin ev
ent in an internal thread.
// @param cbEvent: the syntax of the event in a callback. For more information, see the nlsEvent.h file
.
// @param cbParam: the custom parameter in a callback. The default value is null. You can set this par
ameter based on your business requirements.
void onSentenceBegin(NlsEvent* cbEvent, void* cbParam) {
 ParamCallBack* tmpParam = (ParamCallBack*)cbParam;
    // The following code demonstrates how to obtain details of the SentenceBegin event and customiz
e callback parameters.
    printf("onSentenceBegin: %d\n", tmpParam->userId);
    // The ID of the current recognition task. The task ID is the unique identifier that indicates the inter
action between the caller and the server. You must record the task ID. If an error occurs, you can subm
it a ticket and provide the task ID to Alibaba Cloud to facilitate troubleshooting.
```

```
it a ticket and provide the task ID to Alibaba Cloud to facilitate troubleshooting.
    printf("onSentenceBegin: status code=%d, task id=%s, index=%d, time=%d\n", cbEvent->getStatusC
ode(), cbEvent->getTaskId(),
            cbEvent->getSentenceIndex(), // The sequence number of the sentence, which starts from 1.
            cbEvent->getSentenceTime() // The duration of the audio stream that has been processed, i
n milliseconds.
            );
    // Obtain the complete information returned by the server.
    //printf("onTranscriptionStarted: all response=%s\n", cbEvent->getAllResponse());
}

// @brief: The server detects the end of a sentence. Then, the SDK reports a SentenceEnd event in an
internal thread.
// @param cbEvent: the syntax of the event in a callback. For more information, see the nlsEvent.h file
.
// @param cbParam: the custom parameter in a callback. The default value is null. You can set this par
ameter based on your business requirements.
void onSentenceEnd(NlsEvent* cbEvent, void* cbParam) {
 ParamCallBack* tmpParam = (ParamCallBack*)cbParam;
    // The following code demonstrates how to obtain details of the SentenceEnd event and customize
callback parameters.
    printf("onSentenceEnd: %d\n", tmpParam->userId);
    // The ID of the current recognition task. The task ID is the unique identifier that indicates the inter
action between the caller and the server. You must record the task ID. If an error occurs, you can subm
it a ticket and provide the task ID to Alibaba Cloud to facilitate troubleshooting.
    printf("onSentenceEnd: status code=%d, task id=%s, index=%d, time=%d, begin_time=%d, result=%s
\n", cbEvent->getStatusCode(), cbEvent->getTaskId(),
            cbEvent->getSentenceIndex(), // The sequence number of the sentence, which starts from 1.
            cbEvent->getSentenceTime() // The duration of the audio stream that has been processed, i
n milliseconds.
            cbEvent->getSentenceBeginTime(), // The time when the SentenceBegin event occurred.
            cbEvent->getResult()    // The recognition result of the current sentence.
            );
      //  << ", confidence: " << cbEvent->getSentenceConfidence()    // The confidence level of the reco
gnition result. Valid values: 0.0 to 1.0. A larger value indicates a higher confidence level.
      //  << ", stashResult begin_time: " << cbEvent->getStashResultBeginTime() // The time when the
next sentence begins.
      //  << ", stashResult current_time: " << cbEvent->getStashResultCurrentTime() // The current time
when the next sentence is being processed.
      //  << ", stashResult Sentence_id: " << cbEvent->getStashResultSentenceId() //The ID of the sent
ence.
```

```
    //  << ", stashResult Text: " << cbEvent->getStashResultText() // The beginning words of the next sentence.
    // Obtain the complete information returned by the server.
    //printf("onTranscriptionStarted: all response=%s\n", cbEvent->getAllResponse());
}

// @brief: The recognition result is updated. When the SDK receives the updated result, the SDK reports a ResultChanged event in an internal thread.
// @param cbEvent: the syntax of the event in a callback. For more information, see the nlsEvent.h file.
// @param cbParam: the custom parameter in a callback. The default value is null. You can set this parameter based on your business requirements.
void onTranscriptionResultChanged(NlsEvent* cbEvent, void* cbParam) {
 ParamCallBack* tmpParam = (ParamCallBack*)cbParam;
    // The following code demonstrates how to obtain details of the ResultChanged event and customize callback parameters.
    printf("onTranscriptionResultChanged: %d\n", tmpParam->userId);
    // The ID of the current recognition task. The task ID is the unique identifier that indicates the interaction between the caller and the server. You must record the task ID. If an error occurs, you can submit a ticket and provide the task ID to Alibaba Cloud to facilitate troubleshooting.
    printf("onTranscriptionResultChanged: status code=%d, task id=%s, index=%d, time=%d, result=%s\n", cbEvent->getStatusCode(), cbEvent->getTaskId(),
            cbEvent->getSentenceIndex(), // The sequence number of the sentence, which starts from 1.
            cbEvent->getSentenceTime() // The duration of the audio stream that has been processed, in milliseconds.
            cbEvent->getResult()    // The recognition result of the current sentence.
            );
    // Obtain the complete information returned by the server.
    //printf("onTranscriptionStarted: all response=%s\n", cbEvent->getAllResponse());
}

// @brief: When the server stops the real-time recognition of the audio stream, the SDK reports a Completed event in an internal thread.
// @note: After a Completed event is reported, the SDK disconnects the client from the server in an internal thread. At this time, if you call the sendAudio method, -1 is returned. Stop sending audio data in this case.
// @param cbEvent: the syntax of the event in a callback. For more information, see the nlsEvent.h file.
// @param cbParam: the custom parameter in a callback. The default value is null. You can set this parameter based on your business requirements.
void onTranscriptionCompleted(NlsEvent* cbEvent, void* cbParam) {
```

```
 ParamCallBack* tmpParam = (ParamCallBack*)cbParam;
    // The following code demonstrates how to obtain details of the Completed event and customize cal
lback parameters.
    printf("onTranscriptionCompleted: %d\n", tmpParam->userId);
    printf("onTranscriptionCompleted: status code=%d, task id=%s\n", cbEvent->getStatusCode(), cbEv
ent->getTaskId());
}

// @brief: When an error occurs during the recognition process that covers calls of the start, send, an
d stop methods, the SDK reports a TaskFailed event in an internal thread.
// @note: After a TaskFailed event is reported, the SDK disconnects the client from the server in an in
ternal thread. At this time, if you call the sendAudio method, -1 is returned. Stop sending audio data in
this case.
// @param cbEvent: the syntax of the event in a callback. For more information, see the nlsEvent.h file
.
// @param cbParam: the custom parameter in a callback. The default value is null. You can set this par
ameter based on your business requirements.
void onTaskFailed(NlsEvent* cbEvent, void* cbParam) {
 ParamCallBack* tmpParam = (ParamCallBack*)cbParam;
    // The following code demonstrates how to obtain details of the TaskFailed event and customize cal
lback parameters.
    printf("onTaskFailed: %d\n", tmpParam->userId);
    printf("onTaskFailed: status code=%d, task id=%s, error message=%s\n", cbEvent->getStatusCode()
, cbEvent->getTaskId(), cbEvent->getErrorMessage());
    // Obtain the complete information returned by the server.
    //printf("onTaskFailed: all response=%s\n", cbEvent->getAllResponse());
}

// @brief: The SDK reports the final recognition result in an internal thread.
// @param cbEvent: the syntax of the event in a callback. For more information, see the nlsEvent.h file
.
// @param cbParam: the custom parameter in a callback. The default value is null. You can set this par
ameter based on your business requirements.
void onSentenceSemantics(NlsEvent* cbEvent, void* cbParam) {
    ParamCallBack* tmpParam = (ParamCallBack*)cbParam;
    // The following code demonstrates how to obtain details of the SentenceSemantics event and cust
omize callback parameters.
    printf("onSentenceSemantics: %d\n", tmpParam->userId);
    // Obtain the complete information returned by the server.
    printf("onSentenceSemantics: all response=%s\n", cbEvent->getAllResponse());
}
```

```
}

// @brief: When the recognition ends or an error occurs during the recognition process, the SDK disco
nnects the client from the server and reports a ChannelClosed event in an internal thread.
// @param cbEvent: the syntax of the event in a callback. For more information, see the nlsEvent.h file
.
// @param cbParam: the custom parameter in a callback. The default value is null. You can set this par
ameter based on your business requirements.
void onChannelClosed(NlsEvent* cbEvent, void* cbParam) {
 ParamCallBack* tmpParam = (ParamCallBack*)cbParam;
   delete tmpParam; // The recognition process ends and the callback parameter is released.
}

// The worker thread.
void* pthreadFunc(void* arg) {
   int sleepMs = 0;
   ParamCallBack *cbParam = NULL;
   // Initialize custom callback parameters. The following settings are used as an example to demonstr
ate how to pass parameters. The settings have no effect on the demo.
   // The settings of callback parameters are stored in a heap. When the SDK clears the request object
s, it clears the parameter settings as well. You do not need to manually release the parameters.
   cbParam = new ParamCallBack;
   cbParam->userId = 1234;
   strcpy(cbParam->userInfo, "User.");

   // 1. Obtain parameters such as the token and configuration files from custom thread parameters.
   ParamStruct* tst = (ParamStruct*)arg;
   if (tst == NULL) {
      printf("arg is not valid\n");
      return NULL;
   }

   /* Open the audio file and obtain audio data.*/
   std::ifstream fs;
   fs.open(tst->fileName.c_str(), std::ios::binary | std::ios::in);
   if (!fs) {
      printf("%s isn't exist..\n", tst->fileName.c_str());
      return NULL;
   }

   // 2. Create the SpeechTranscriberRequest object of real-time speech recognition.
```

```
    SpeechTranscriberRequest* request = NlsClient::getInstance()->createTranscriberRequest();
    if (request == NULL) {
        printf("createTranscriberRequest failed.\n");
        return NULL;
    }

    request->setOnTranscriptionStarted(onTranscriptionStarted, cbParam);            // Set a callback to be fired when the speech recognition starts.
    request->setOnTranscriptionResultChanged(onTranscriptionResultChanged, cbParam);    // Set a callback to be fired when a recognition result is returned.
    request->setOnTranscriptionCompleted(onTranscriptionCompleted, cbParam);        // Set a callback to be fired when the speech recognition is completed.
    request->setOnSentenceBegin(onSentenceBegin, cbParam);                      // Set a callback to be fired when the beginning of a sentence is detected.
    request->setOnSentenceEnd(onSentenceEnd, cbParam);                          // Set a callback to be fired when the end of a sentence is detected.
    request->setOnTaskFailed(onTaskFailed, cbParam);                            // Set a callback to be fired when an error occurs.
    request->setOnChannelClosed(onChannelClosed, cbParam);                      // Set a callback to be fired when the TCP connection set up for the recognition task is closed.
    request->setOnSentenceSemantics(onSentenceSemantics, cbParam);              // Set a callback to be fired when an updated recognition result is returned. The result is returned when the enable_nlp parameter is used.

    request->setAppKey(tst->appkey.c_str());        // Specify the appkey. This parameter is required. If you do not have an appkey, obtain it as instructed on the Alibaba Cloud international site (alibabacloud.com).
    request->setFormat("pcm");                      // Specify the audio encoding format. Default value: pcm.
    request->setSampleRate(SAMPLE_RATE);            // Specify the audio sampling rate. This parameter is optional. Valid values: 16000 and 8000. Default value: 16000.
    request->setIntermediateResult(true);           // Specify whether to return intermediate recognition results. This parameter is optional. Default value: false.
    request->setPunctuationPrediction(true);        // Specify whether to add punctuation marks during post-processing. This parameter is optional. Default value: false.
    request->setInverseTextNormalization(true);     // Specify whether to convert Chinese numerals to Arabic numerals during post-processing. This parameter is optional. Default value: false.

    // Specify the threshold for detecting the end of a sentence. If the silence duration exceeds the specified threshold, the system determines the end of a sentence. Unit: milliseconds. Valid values: 200 to 2000. Default value: 800.
    //request->setMaxSentenceSilence(800);
```

```
    //request->setCustomizationId("TestId_123"); // Specify the ID of the custom model. This parameter is optional.
    //request->setVocabularyId("TestId_456"); // Specify the vocabulary ID of custom extensive hotwords. This parameter is optional.
    // Pass custom or advanced parameters in the JSON format of {"key": "value"}.
    //request->setPayloadParam("{\"vad_model\": \"farfield\"}");
    // Specify whether to return the recognition results of words.
    request->setPayloadParam("{\"enable_words\": true}");

    // Specify whether to enable voice activity detection (VAD). Default value: false. We recommend that you do not enable VAD unless otherwise required.
    //request->setPayloadParam("{\"enable_semantic_sentence_detection\": false}");
    // Specify whether to enable disfluency detection. Default value: false. We recommend that you do not enable disfluency detection unless otherwise required.
    //request->setPayloadParam("{\"disfluency\": true}");

    // Specify the ID of the VAD mode. By default, this parameter is left empty. We recommend that you do not set this parameter unless otherwise required.
    //request->setPayloadParam("{\"vad_model\": \"farfield\"}");
    // Specify whether to ignore the recognition timeout issue of a single sentence.
    //request->setPayloadParam("{\"enable_ignore_sentence_timeout\": false}");
    // Specify whether to enable post-processing for VAD. Default value: false. We recommend that you do not enable post-processing unless otherwise required.
    //request->setPayloadParam("{\"enable_vad_unify_post\": true}");

    request->setToken(tst->token.c_str());

    // 3. Call the start method in asynchronous callback mode. If the method is called, a started event is returned. If the method fails, a TaskFailed event is returned.
    if (request->start() < 0) {
  printf("start() failed. may be can not connect server. please check network or firewalld\n");
        NlsClient::getInstance()->releaseTranscriberRequest(request); // The start method fails. The SpeechTranscriberRequest object is released.
        return NULL;
    }

    while (!fs.eof()) {
        uint8_t data[FRAME_SIZE] = {0};

        fs.read((char *)data, sizeof(uint8_t) * FRAME_SIZE);
```

```
        size_t nlen = fs.gcount();
        if (nlen <= 0) {
            continue;
        }

        // 4. Send audio data. If the sendAudio method returns -1, indicating that data fails to be sent, th
e client stops sending data.
        int ret = request->sendAudio(data, nlen);
        if (ret < 0) {
            // Indicate that data fails to be sent. The client stops sending data cyclically.
            printf("send data fail.\n");
            break;
        }

        // Set the transmission speed of data sending:
        // If you recognize a real-time recording, you do not need to specify the transmission speed by us
ing the sleep method.
        // If you recognize an audio file, you must specify the transmission speed. Ensure that the data si
ze sent per unit interval approaches to the data size of a unit interval in the audio file.
        sleepMs = getSendAudioSleepTime(nlen, SAMPLE_RATE, 1); // Obtain the sleep duration based on
the size of sent data, audio sampling rate, and data compression rate.

        // 5. Set the latency for audio data sending.
        usleep(sleepMs * 1000);
    }

    // Close the audio file.
    fs.close();

    // 6: Notify the server that the audio data is sent.
    // Call the stop method in asynchronous callback mode. If the method fails, a TaskFailed event is ret
urned.
    request->stop();
    // 7. Release the SpeechRecognizerRequest object after the recognition is completed.
    NlsClient::getInstance()->releaseTranscriberRequest(request);
    return NULL;
}

// Recognize a single audio file.
int speechTranscriberFile(const char* appkey) {
    // Obtain the timestamp of the current system time to check whether the token expires.
```

```
    std::time_t curTime = std::time(0);
    if (g_expireTime - curTime < 10) {
  printf("the token will be expired, please generate new token by AccessKey-ID and AccessKey-Secret.
\n");
        if (-1 == generateToken(g_akId, g_akSecret, &g_token, &g_expireTime)) {
            return -1;
        }
    }

    ParamStruct pa;
    pa.token = g_token;
    pa.appkey = appkey;
    pa.fileName = "test0.wav";

    pthread_t pthreadId;
    // Start a worker thread to perform speech recognition.
    pthread_create(&pthreadId, NULL, &pthreadFunc, (void *)&pa);
    pthread_join(pthreadId, NULL);
  return 0;
}

// Recognize multiple audio files.
// If the SDK uses multiple concurrent threads at a time, the SDK recognizes each audio file in a thread
. The SDK does not recognize the same audio file in different threads.
// In the sample code, two threads are used to recognize two audio files.
// If you are a free-trial user, you can make only a maximum of two concurrent calls.
#define AUDIO_FILE_NUMS 2
#define AUDIO_FILE_NAME_LENGTH 32
int speechTranscriberMultFile(const char* appkey) {
    // Obtain the timestamp of the current system time to check whether the token expires.
    std::time_t curTime = std::time(0);
    if (g_expireTime - curTime < 10) {
  printf("the token will be expired, please generate new token by AccessKey-ID and AccessKey-Secret.
\n");
        if (-1 == generateToken(g_akId, g_akSecret, &g_token, &g_expireTime)) {
            return -1;
        }
    }

    char audioFileNames[AUDIO_FILE_NUMS][AUDIO_FILE_NAME_LENGTH] = {"test0.wav", "test1.wav"};
    ParamStruct pa[AUDIO_FILE_NUMS];
```

```
    ParamStruct pa[AUDIO_FILE_NUMS];
    for (int i = 0; i < AUDIO_FILE_NUMS; i ++) {
        pa[i].token = g_token;
        pa[i].appkey = appkey;
        pa[i].fileName = audioFileNames[i];
    }

    std::vector<pthread_t> pthreadId(AUDIO_FILE_NUMS);
    // Start two worker threads and recognize two audio files at a time.
    for (int j = 0; j < AUDIO_FILE_NUMS; j++) {
        pthread_create(&pthreadId[j], NULL, &pthreadFunc, (void *)&(pa[j]));
    }
    for (int j = 0; j < AUDIO_FILE_NUMS; j++) {
        pthread_join(pthreadId[j], NULL);
    }
 return 0;
}

int main(int arc, char* argv[]) {
    if (arc < 4) {
  printf("params is not valid. Usage: ./demo <your appkey> <your AccessKey ID> <your AccessKey Secr
et>\n");
        return -1;
    }

    std::string appkey = argv[1];
    g_akId = argv[2];
    g_akSecret = argv[3];

    // Configure output logs of the SDK. The configuration is optional. As configured in the following co
de, the SDK logs are generated in the log-Transcriber.txt file. LogDebug specifies that logs at all level
s are generated.
    int ret = NlsClient::getInstance()->setLogConfig("log-transcriber", LogDebug);
    if (-1 == ret) {
  printf("set log failed\n");
        return -1;
    }

    // Start the worker thread.
    NlsClient::getInstance()->startWorkThread(4);
```

```
    // Recognize a single audio file.
    speechTranscriberFile(appkey.c_str());

    // Recognize multiple audio files.
    // speechTranscriberMultFile(appkey.c_str());

    // All the tasks are completed. Release the NlsClient object before the process exits. Note that the r
eleaseInstance method is not thread-safe.
    NlsClient::releaseInstance();
    return 0;
}
```

2.NUI SDK for mobile clients

2.1. Overview

The real-time speech recognition service provides the Natural User Interaction (NUI) SDK for mobile clients to recognize speech data streams that last for a long time. The NUI SDK applies to uninterrupted speech recognition scenarios such as conference speeches and live streaming.

Description

Compared with common SDKs, the NUI SDK is smaller in size and supports more comprehensive status management. The NUI SDK provides comprehensive speech processing capabilities and can also serve as an atomic SDK, meeting diverse user requirements. In addition, the NUI SDK uses a unified API.

Features

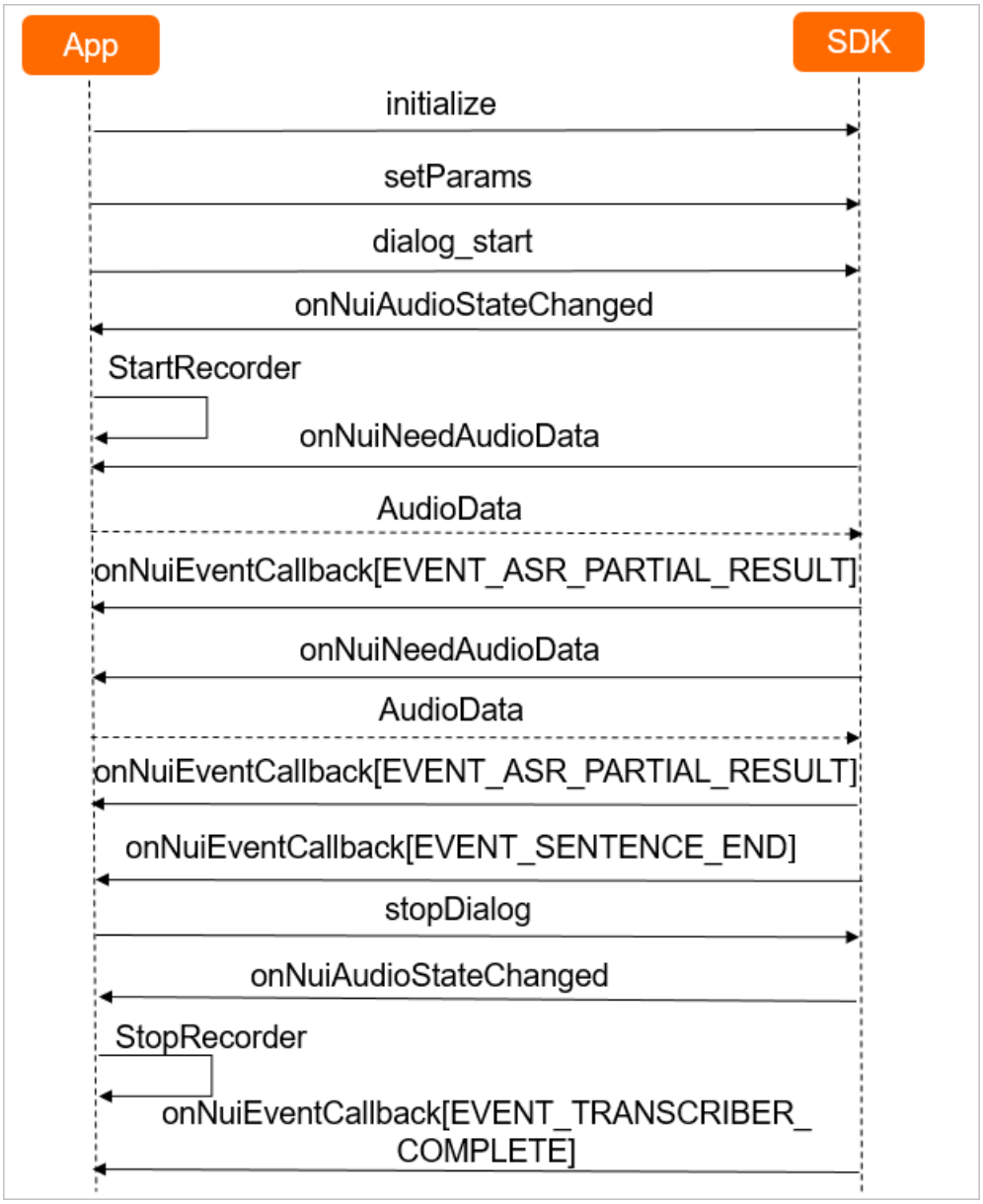
- Supports pulse-code modulation (PCM) encoded 16-bit mono audio files.
- Supports the audio sampling rates of 8,000 Hz and 16,000 Hz.
- Allows you to specify whether to return intermediate results, whether to add punctuation marks during post-processing, and whether to convert Chinese numerals to Arabic numerals.
- Allows you to select linguistic models to recognize speeches in different languages when you manage projects in the Intelligent Speech Interaction console. For more information, see Manage projects.

Endpoints

Access type	Description	URL
External access from the Internet	This endpoint allows you to access the real-time speech recognition service from any host over the Internet. By default, the Internet access URL is built in the SDK.	wss://nls-gateway.cn-shanghai.aliyuncs.com/ws/v1

Access type	Description	URL
Internal access from an Elastic Compute Service (ECS) instance located in the China (Shanghai) region	This endpoint allows you to access the real-time speech recognition service from an ECS instance located in the China (Shanghai) region over an internal network. You cannot access an AnyTunnel virtual IP address (VIP) from a classic network-connected ECS instance. This means that you cannot use such an ECS instance to access the real-time speech recognition service over an internal network. To access this service by using an AnyTunnel VIP, you must create a virtual private network (VPC) and access the service from the VPC. **Note** • Access from an ECS instance over the internal network does not consume Internet access traffic. • For more information about the network types of ECS instances, see Network types.	ws://nls-gateway.cn-shanghai-internal.aliyuncs.com:80/ws/v1

Interaction process



Note

The server adds the task_id parameter to the response header for all responses to indicate the ID of the recognition task. You can record the value of this parameter. If an error occurs, you can submit a ticket to report the task ID and error message.

1. Authenticate the client and initialize the SDK

To establish a WebSocket connection with the server, the client must use a token for authentication. For more information about how to obtain the token, see Obtain a token.

The following table describes the parameters used for authentication and initialization.

Parameter	Type	Required	Description
Parameter	Type	Required	Description
workspace	String	Yes	The working directory from which the SDK reads the configuration file.
app_key	String	Yes	The appkey of your project created in the Intelligent Speech Interaction console.
token	String	Yes	The token provided as the credential for you to use Intelligent Speech Interaction. Make sure that the token is valid. You can set the token when you initialize the SDK and update the token when you set the request parameters.
device_id	String	Yes	The unique identifier of the device, for example, the media access control (MAC) address, serial number, or pseudo unique ID of the device.
debug_path	String	No	The directory where audio files generated during the debugging are stored. If the save_log parameter is set to true when you initialize the SDK, intermediate results are stored in this directory.

Parameter	Type	Required	Description
save_wav	String	No	This parameter is valid if the save_log parameter is set to true when you initialize the SDK. This parameter specifies whether to store audio files generated during the debugging in the directory specified by the debug_path parameter. Make sure that the directory is writable.

2. Send a request to use the real-time speech recognition service

You must set the request parameters for the client to send a service request. You can set the request parameters in the JSON format by using the setParams method in the SDK. The parameter configuration applies to all service requests. The following table describes the request parameters.

Parameter	Type	Required	Description
appkey	String	No	The appkey of your project created in the Intelligent Speech Interaction console. This parameter is generally set when you initialize the SDK.
token	String	No	The token provided as the credential for you to use Intelligent Speech Interaction. You can update the token as required by setting this parameter.
service_type	Int	Yes	The type of speech service to be requested. Set this parameter to 4, which indicates the real-time speech recognition service.

Parameter	Type	Required	Description
direct_ip	String	No	The IP address that is resolved from the Domain Name System (DNS) domain name. The client completes the resolution and uses the obtained IP address to access the service.
nls_config	JsonObject	No	The service parameters.

The following table describes the parameters in the nls_config parameter.

Parameter	Type	Required	Description
sr_format	String	No	The audio encoding format. The real-time speech recognition service supports the Opus and PCM formats. Default value: OPUS. Note: This parameter must be set to PCM if the sample_rate parameter is set to 8000.
sample_rate	Integer	No	The audio sampling rate. Unit: Hz. Default value: 16000. After you set this parameter, you must specify a model or scene that is applicable to the audio sampling rate for your project in the Intelligent Speech Interaction console.
enable_intermediate_result	Boolean	No	Specifies whether to return intermediate results. Default value: False.

Parameter	Type	Required	Description
enable_punctuation_prediction	Boolean	No	Specifies whether to add punctuation marks during post-processing. Default value: False.
enable_inverse_text_normalization	Boolean	No	Specifies whether to enable inverse text normalization (ITN) during post-processing. Valid values: true and false. Default value: false. If you set this parameter to true, Chinese numerals are converted to Arabic numerals. Note: ITN is not implemented on words.
customization_id	String	No	The ID of the custom speech training model.
vocabulary_id	String	No	The vocabulary ID of custom extensive hotwords.
max_sentence_silence	Integer	No	The threshold for detecting the end of a sentence. If the silence duration exceeds the specified threshold, the system determines the end of a sentence. Unit: milliseconds. Valid values: 200 to 2000. Default value: 800.
enable_words	Boolean	No	Specifies whether to return information about words. Default value: False.
enable_ignore_sentence_timeout	Boolean	No	Specifies whether to ignore the recognition timeout issue of a single sentence in real-time speech recognition. Default value: False.

Parameter	Type	Required	Description
disfluency	Boolean	No	Specifies whether to enable disfluency detection. Default value: False.
vad_model	String	No	Optional. The ID of the voice activity detection (VAD) model used by the server.
speech_noise_threshold	float	No	The threshold for recognizing audio streams as noise. Valid values: -1 to 1. The closer the parameter value is to -1, the more likely an audio stream is recognized as a normal speech. In other words, noise is more likely recognized as normal speeches and processed by the service. In addition, the closer the parameter value is to 1, the more likely an audio stream is recognized as noise. In other words, normal speeches are more likely recognized as noise and ignored by the service. Note: This parameter is an advanced parameter. Proceed with caution when you adjust the parameter value. Perform a test after you adjust the parameter value.

3. Send audio data from the client

The client cyclically sends audio data to the server and continuously receives recognition results from the server.

- If an EVENT_SENTENCE_START event is reported, the server detects the beginning of a sentence. Real-time speech recognition uses VAD to determine the beginning and end of a sentence. For example, the server returns the following response:

```
{
  "header": {
    "namespace": "SpeechTranscriber",
    "name": "SentenceBegin",
    "status": 20000000,
    "message_id": "a426f3d4618447519c9d85d1a0d1****",
    "task_id": "5ec521b5aa104e3abccf3d361822****",
    "status_text": "Gateway:SUCCESS:Success."
  },
  "payload": {
    "index": 1,
    "time": 0
  }
}
```

The following table describes the parameters in the header object.

Parameter	Type	Description
namespace	String	The namespace of the message.
name	String	The name of the message. The SentenceBegin message indicates that the server detects the beginning of a sentence.
status	Integer	The HTTP status code. It indicates whether the request is successful. For more information, see the "Error codes" section of this topic.
message_id	String	The ID of the message, which is automatically generated by the SDK.
task_id	String	The GUID of the task. Record the value of this parameter to facilitate troubleshooting.
status_text	String	The status message.

The following table describes the parameters in the payload object.

Parameter	Type	Description
index	Integer	The sequence number of the sentence, which starts from 1.
time	Integer	The duration of the processed audio stream. Unit: milliseconds.

- If the enable_intermediate_result parameter is set to true, the SDK reports multiple EVENT_ASR_PARTIAL_RESULT events by calling the onNuiEventCallback method to return intermediate results of a sentence. For example, the server returns the following response:

```
{
  "header": {
    "namespace": "SpeechTranscriber",
    "name": "TranscriptionResultChanged",
    "status": 20000000,
    "message_id": "dc21193fada84380a3b6137875ab****",
    "task_id": "5ec521b5aa104e3abccf3d361822****",
    "status_text": "Gateway:SUCCESS:Success."
  },
  "payload": {
    "index": 1,
    "time": 1835,
    "result": "Sky in Beijing",
    "confidence": 1.0,
    "words": [{
      "text": "Sky",
      "startTime": 630,
      "endTime": 930
    }, {
      "text": "in",
      "startTime": 930,
      "endTime": 1110
    }, {
      "text": "Beijing",
      "startTime": 1110,
      "endTime": 1140
    }]
  }
}
```


Note

As shown in the header object, the value of the name parameter is TranscriptionResultChanged, which indicates that an intermediate result is obtained. For more information about other parameters in the header object, see the preceding table.

The following table describes the parameters in the payload object.

Parameter	Type	Description
index	Integer	The sequence number of the sentence, which starts from 1.
time	Integer	The duration of the processed audio stream. Unit: milliseconds.
result	String	The recognition result of the sentence.
words	List< Word >	The word information of the sentence. The word information is returned only when the enable_words parameter is set to true.
confidence	Double	The confidence level of the recognition result of the sentence. Valid values: 0.0 to 1.0. A larger value indicates a higher confidence level.

- If an EVENT_SENTENCE_END event is reported, the server detects the end of a sentence and returns the recognition result of the sentence. For example, the server returns the following response:

```
{
    "header": {
        "namespace": "SpeechTranscriber",
        "name": "SentenceEnd",
        "status": 20000000,
        "message_id": "c3a9ae4b231649d5ae05d4af36fd****",
        "task_id": "5ec521b5aa104e3abccf3d361822****",
        "status_text": "Gateway:SUCCESS:Success."
    },
    "payload": {
        "index": 1,
        "time": 1820,
        "begin_time": 0,
        "result": "Weather in Beijing.",
        "confidence": 1.0,
        "words": [{
            "text": "Weather",
            "startTime": 630,
            "endTime": 930
        }, {
            "text": "in",
            "startTime": 930,
            "endTime": 1110
        }, {
            "text": "Beijing",
            "startTime": 1110,
            "endTime": 1380
        }]
    }
}
```


> **Note**
>
> As shown in the header object, the value of the name parameter is SentenceEnd, which indicates that the server detects the end of the sentence. For more information about other parameters in the header object, see the preceding table.

The following table describes the parameters in the payload object.

Parameter	Type	Description
index	Integer	The sequence number of the sentence, which starts from 1.
time	Integer	The duration of the processed audio stream. Unit: milliseconds.
begin_time	Integer	The time when the server returns the SentenceBegin message for the sentence. Unit: milliseconds.
result	String	The recognition result of the sentence.
words	List< Word >	The word information of the sentence. The word information is returned only when the enable_words parameter is set to true.
confidence	Double	The confidence level of the recognition result of the sentence. Valid values: 0.0 to 1.0. A larger value indicates a higher confidence level.

The following table describes the parameters in the words object.

Parameter	Type	Description
text	String	The text of the word.
startTime	Integer	The time when the word appears in the sentence. Unit: milliseconds.
endTime	Integer	The time when the word ends in the sentence. Unit: milliseconds.

4. Complete the recognition task

The client notifies the server that all audio data is sent. The server completes the recognition task and notifies the client that the task is completed.

Error codes

For more information about the error codes that the real-time speech recognition service may return, see error code.

2.2. NUI SDK for Android

The real-time speech recognition service provides a Natural User Interaction (NUI) SDK for Android. This topic describes how to download the NUI SDK for Android, lists the key methods in the SDK, and provides sample code for you to use the SDK.

Prerequisites

- You understand how the SDK works. For more information, see Overview.
- The appkey of your project is obtained. For more information, see create a project.
- A token used to access the service is obtained. For more information, see Obtain a token.

Download and install the SDK

1. Download the NUI SDK for Android and sample code.
2. Decompress the downloaded package to obtain the demo project and find the SDK package in the app/libs directory, which is an AAR package.
3. Open the demo project in Android Studio.

   The sample code for the real-time speech recognition service is stored in the SpeechTranscriberActivity.java file.

Key methods

- **initialize**: initializes the SDK.

```
/**
    * Initialize the SDK. The SDK uses a singleton pattern. To initialize the SDK again, you must first r
elease the SDK. Do not call the SDK on the user interface (UI) thread. Otherwise, the process may b
e blocked.
    * @param callback: the event listener callback. For more information, see the following callback m
ethods.
    * @param parameters: the parameters used in the initialization. For more information, see Overvi
ew.
    * @param level: the log level to use. The smaller the parameter value is, the more logs are record
ed.
    * @param save_log: specifies whether to store logs in files. The debug_path parameter specifies
the directory where log files are stored.
    * @return: the returned error code. For more information, see Error codes.
    */
   public synchronized int initialize(final INativeNuiCallback callback,
                                      String parameters,
                                      final Constants.LogLevel level,
                                      final boolean save_log)
```

INativeNuiCallback supports the following callback methods.

- **onNuiAudioStateChanged**: determines whether to enable recording based on the value of AudioState.

```
/**
    * When the start, stop, or cancel method is called, the SDK uses this callback method to instruct
the client to enable or disable recording.
    * @param state: specifies whether to enable recording.
    */
   void onNuiAudioStateChanged(AudioState state);
```

- **onNuiNeedAudioData**: provides audio data.

```
/**
    * When the server starts a recognition task, this method is continuously called to read audio d
ata from the client.
    * @param buffer: the storage space of the server for storing audio data.
    * @param len: the required number of bytes of the audio data to be read from the client.
    * @return: the actual number of bytes of the audio data that is read from the client.
    */
   int onNuiNeedAudioData(byte[] buffer, int len);
```

- **onNuiEventCallback**: reports the occurred event to the server.

```
/**
    * Report the occurred event to the server.
    * @param event: the event to be reported by the client. You can view possible events in the fol
lowing table.
    * @param resultCode: the returned error code. This parameter is valid for the EVENT_ASR_ERR
OR event.
    * @param arg2: Reserved.
    * @param kwsResult: the wake-up word recognition feature.
    * @param asrResult: the recognition result of the audio stream.
    */
   void onNuiEventCallback(NuiEvent event, final int resultCode, final int arg2, KwsResult kwsResu
lt, AsrResult asrResult);
```

The following table lists the possible events in the SDK.

Name	Description
EVENT_VAD_START	Detects the beginning of a speech.
EVENT_VAD_END	Detects the end of a speech.
EVENT_ASR_PARTIAL_RESULT	Generates the intermediate recognition result.
EVENT_ASR_RESULT	Generates the final recognition result.
EVENT_ASR_ERROR	Determines the error cause based on the returned error code.
EVENT_MIC_EEROR	Returns a recording error.
EVENT_SENTENCE_START	Detects the beginning of a sentence. This event is valid for the real-time speech recognition service.
EVENT_SENTENCE_END	Detects the end of a sentence. This event is valid for the real-time speech recognition service.
EVENT_SENTENCE_SEMANTICS	Reserved.
EVENT_TRANSCRIBER_COMPLETE	Indicates that the recognition task is completed.

- **set_params**: sets SDK parameters in the JSON format.

```
/**
    * Set parameters in the JSON format.
    * @param params: the request parameters. For more information, see Overview.
    * @return: the returned error code. For more information, see Error codes.
    */
   public synchronized int setParams(String params)
```

- **startDialog**: starts the recognition task.

```
/**
    * Start the recognition task.
    * @param vad_mode: the voice activity detection (VAD) mode of the task. Use the Production-to-Test (P2T) mode for a recognition task.
    * @return: the returned error code. For more information, see Error codes.
    */
public synchronized int startDialog(VadMode vad_mode, String dialog_params)
```

- **stopDialog**: completes the recognition task.

```
/**
    * When this method is called, the server returns the final recognition result to the client and completes the recognition task.
    * @return: the returned error code. For more information, see Error codes.
    */
   public synchronized int stopDailog()
```

- **release**: releases the SDK.

```
/**
    * Release the SDK.
    * @return: the returned error code. For more information, see Error codes.
    */
public synchronized int release()
```

Procedure

1. Initialize the SDK and the recorder instance.
2. Set request parameters based on your business requirements.
3. Call the startDialog method to start the recognition task.
4. Call the onNuiAudioStateChanged method based on the value of AudioState and then enable recording accordingly.
5. Call the onNuiNeedAudioData method to send audio data to the server.
6. Obtain the recognition result in the EVENT_ASR_PARTIAL_RESULT and EVENT_SENTENCE_END callback events.

7. Call the stopDialog method to complete the recognition task.
8. Call the release method to release the SDK.

ProGuard configuration

If you use the obfuscating code, configure the following command in the proguard-rules.pro file:

```
-keep class com.alibaba.idst.nui. *{*;}
```

Sample code

Initialize the NUI SDK

```
CommonUtils.copyAssetsData(this);
int ret = NativeNui.GetInstance().initialize(this, genInitParams(path,path2), Constants.LogLevel.LOG_L
EVEL_VERBOSE, true);
```

The genInitParams method generates a JSON string that contains the information about the resource directory and user. The user information contains the following parameters:

```
private String genInitParams(String workpath, String debugpath) {
      String str = "";
      try{
         JSONObject object;
         object.put("app_key","");
         object.put("token","");
         object.put("device_id",Utils.getDeviceId());
         object.put("url","wss://nls-gateway.cn-shanghai.aliyuncs.com:443/ws/v1");
         object.put("workspace", workpath);
         object.put("debug_path",debugpath);
         str = object.toString();
      } catch (JSONException e) {
         e.printStackTrace();
      }
  return str;
}
```

Set the request parameters

Set the request parameters in the format of a JSON string, as shown in the following code:

```
private String genParams() {
 String params = "";
 try {
  JSONObject nls_config = new JSONObject();
  nls_config.put("enable_intermediate_result", true);
  JSONObject parameters = new JSONObject();
  parameters.put("nls_config", nls_config);
  // Select the real-time speech recognition service.
  parameters.put("service_type", Constants.kServiceTypeSpeechTranscriber);
  params = parameters.toString();
 } catch (JSONException e) {
  e.printStackTrace();
 }
 return params;
}
NativeNui.GetInstance().setParams(genParams());
```

Start the recognition task

Call the startDialog method to start the recognition task.

```
NativeNui.GetInstance().startDialog(Constants.VadMode.TYPE_P2T, genDialogParams());
```

Handle callbacks

- Call the onNuiAudioStateChanged method based on the value of AudioState. Then, the SDK determines whether to enable recording based on the obtained value.

```
public void onNuiAudioStateChanged(Constants.AudioState state) {
      Log.i(TAG, "onNuiAudioStateChanged");
      if (state == Constants.AudioState.STATE_OPEN) {
         Log.i(TAG, "audio recorder start");
         mAudioRecorder.startRecording();
      } else if (state == Constants.AudioState.STATE_CLOSE) {
         Log.i(TAG, "audio recorder close");
         mAudioRecorder.release();
      } else if (state == Constants.AudioState.STATE_PAUSE) {
         Log.i(TAG, "audio recorder pause");
         mAudioRecorder.stop();
      }
   }
```

- Call the onNuiNeedAudioData method to send audio data to the server.

```
public int onNuiNeedAudioData(byte[] buffer, int len) {
    int ret = 0;
    if (mAudioRecorder.getState() ! = AudioRecord.STATE_INITIALIZED) {
      Log.e(TAG, "audio recorder not init");
      return -1;
    }
    ret = mAudioRecorder.read(buffer, 0, len);
    return ret;
  }
```

- Call the onNuiEventCallback method to report the occurred event to the server. Do not call an SDK method in the callbacks. Otherwise, a deadlock may occur.

```
public void onNuiEventCallback(Constants.NuiEvent event, final int resultCode, final int arg2, KwsRe
sult kwsResult, AsrResult asrResult) {
    Log.i(TAG, "event=" + event);
    if (event == Constants.NuiEvent.EVENT_ASR_RESULT) {
      showText(asrView, asrResult.asrResult);
    } else if (event == Constants.NuiEvent.EVENT_ASR_PARTIAL_RESULT ||
        event == Constants.NuiEvent.EVENT_SENTENCE_END) {
      showText(asrView, asrResult.asrResult);
    } else if (event == Constants.NuiEvent.EVENT_ASR_ERROR) {
      ;
    } else if (event == Constants.NuiEvent.EVENT_TRANSCRIBER_COMPLETE) {
      ;
    }
  }
```

Complete the recognition task

```
NativeNui.GetInstance().stopDialog();
```

2.3. NUI SDK for iOS

The real-time speech recognition service provides a Natural User Interaction (NUI) SDK for iOS. This topic describes how to download the NUI SDK for iOS, lists the key methods in the SDK, and provides sample code for you to use the SDK.

Prerequisites

- You understand how the SDK works. For more information, see Overview.
- The appkey of your project is obtained. For more information, see Create a project.
- A token used to access the service is obtained. For more information, see Obtain a token.

Download and install the SDK

1. Download the NUI SDK for iOS and sample code.
2. Decompress the downloaded package to obtain the demo project and use the nuisdk.framework to integrate the demo project with the iOS system.

   > **Note**
   >
   > The demo project is written in the Objective-C and C++ programming languages. You must use the files with the .mm file extension.

3. Use Xcode to open the demo project.

   The sample code for the real-time speech recognition service is stored in the SpeechTranscriberViewController.mm file.

Key methods

- **nui_initialize**: initializes the SDK.

```
/**
    * Initialize the SDK. The SDK uses a singleton pattern. To initialize the SDK again, you must first r
elease the SDK. Do not call the SDK on the user interface (UI) thread. Otherwise, the process may b
e blocked.
    * @param parameters: the parameters used in the initialization. For more information, see Overvi
ew.
    * @param listener: the event listener callback. For more information, see the following callback m
ethods.
    * @param async_listener: the asynchronous callback mode. A value of nullptr specifies that the c
allback is executed synchronously.
    * @param level: the log level to use. The smaller the parameter value is, the more logs are record
ed.
    * @param save_log: specifies whether to store logs in files. The debug_path parameter specifies
the directory where log files are stored.
    * @return: the returned error code. For more information, see Error codes.
    */
NuiResultCode nui_initialize(const char *parameters,
                             const NuiSdkListener *listener,
                             const NuiAsyncCallback *async_listener = nullptr,
                             NuiSdkLogLevel level = LOG_LEVEL_VERBOSE,
                             bool save_log = false);
```

The following table lists the parameters in the NuiSdkListener method.

Name	Type	Description
event_callback	FuncDialogListenerOnEvent	Reports the occurred event to the server.
user_data_callback	FuncDialogUserProvideData	Sends the captured audio data to the server.
audio_state_changed_callback	FuncDialogAudioStateChange	Sends the status of the microphone to the server.
audio_extra_event_callback	FuncDialogAudioExtraEvent	Reserved. Reports special events to the server.
user_data	void *	Obtains the user data, which corresponds to the first parameter in the callback.

FuncDialogListenerOnEvent: reports the occurred event to the server.

```
/**
    * Report the occurred event to the server.
    * @param user_data: Reserved.
    * @param event: the event to be reported by the client. You can view possible events in the follo
wing table.
    * @param dialog: (reserved) the sequence number of the session.
    * @param wuw: the wake-up word recognition feature.
    * @param asr_result: the recognition result of the audio stream.
    * @param finish: specifies whether the recognition task is completed.
    * @param resultCode: the returned error code. This parameter is valid for the EVENT_ASR_ERROR
event.
    */
   typedef void (*FuncDialogListenerOnEvent) (void *user_data,
   NuiCallbackEvent event, long dialog,
   const char *wuw, const char *asr_result, bool finish, int code);
```

The following table lists the possible events in the SDK.

Name	Description
EVENT_VAD_START	Detects the beginning of a speech.
EVENT_VAD_END	Detects the end of a speech.
EVENT_ASR_PARTIAL_RESULT	Generates the intermediate recognition result.

Name	Description
EVENT_ASR_RESULT	Generates the final recognition result.
EVENT_ASR_ERROR	Determines the error cause based on the returned error code.
EVENT_MIC_EEROR	Returns a recording error.
EVENT_SENTENCE_START	Detects the beginning of a sentence. This event is valid for the real-time speech recognition service.
EVENT_SENTENCE_END	Detects the end of a sentence. This event is valid for the real-time speech recognition service.
EVENT_SENTENCE_SEMANTICS	Reserved.
EVENT_TRANSCRIBER_COMPLETE	Indicates that the recognition task is completed.

FuncDialogUserProvideData: provides audio data.

```
/**
    * When the server starts a recognition task, this method is continuously called to read audio data from the client.
    * @param user_data: Reserved.
    * @param buffer: the storage space of the server for storing audio data.
    * @param len: the required number of bytes of the audio data to be read from the client.
    * @return: the actual number of bytes of the audio data that is read from the client.
    */
   typedef int (*FuncDialogUserProvideData)(void *user_data, char *buffer, int len);
```

FuncDialogAudioStateChange: determines whether to enable recording based on the value of AudioState.

```
/**
    * When the start, stop, or cancel method is called, the SDK uses this callback method to instruct the client to enable or disable recording.
    * @param user_data: Reserved.
    * @param state: specifies whether to enable recording.
    */
   typedef void (*FuncDialogAudioStateChange) (void *user_data, NuiAudioState state);
```

- nui_set_params: sets SDK parameters in the JSON format.

```
/**
    * Set parameters in the JSON format.
    * @param params: the request parameters. For more information, see Overview.
    * @param async_listener: the asynchronous callback mode. A value of nullptr specifies that the c
allback is executed synchronously.
    * @return: the returned error code. For more information, see Error codes.
    */
   NuiResultCode nui_set_params(const char *params, const NuiAsyncCallback *listener = nullptr);
```

- **nui_dialog_start**: starts the recognition task.

```
/**
    * Start the recognition task.
    * @param vad_mode: the voice activity detection (VAD) mode of the task. Use the Production-to-
Test (P2T) mode for a recognition task.
    * @param dialog_params: the parameters used for recognition. This parameter can be left empty.
    * @param async_listener: the asynchronous callback mode. A value of nullptr specifies that the c
allback is executed synchronously.
    * @return: the returned error code. For more information, see Error codes.
    */
   NuiResultCode nui_dialog_start(NuiVadMode vad_mode, const char *dialog_params, const NuiAsyn
cCallback *listener = nullptr);
```

- **nui_dialog_cancel**: completes the recognition task.

```
/**
    * When this method is called, the server returns the final recognition result to the client and com
pletes the recognition task.
    * @param force: specifies whether to ignore the final recognition result and forcibly complete the
recognition task. A value of false specifies that the server stops the task but waits until the final re
cognition result is returned.
    * @param async_listener: the asynchronous callback mode. A value of nullptr specifies that the c
allback is executed synchronously.
    * @return: the returned error code. For more information, see Error codes.
    */
   NuiResultCode nui_dialog_cancel(bool force, const NuiAsyncCallback *listener = nullptr);
```

- **nui_release**: releases the SDK.

```
/**
    * Release the SDK.
    * @param async_listener: the asynchronous callback mode. A value of nullptr specifies that the c
allback is executed synchronously.
    * @return: the returned error code. For more information, see Error codes.
    */
   NuiResultCode nui_release(const NuiAsyncCallback *async_listener = nullptr);
```

Procedure

1. Initialize the SDK and the recorder instance.
2. Set request parameters based on your business requirements.
3. Call the nui_dialog_start method to start the recognition task.
4. Call the audio_state_changed_callback method based on the value of AudioState and then enable recording accordingly.
5. Call the user_data_callback method to send audio data to the server.
6. Obtain the recognition result in the EVENT_ASR_PARTIAL_RESULT and EVENT_SENTENCE_END callback events.
7. Call the nui_dialog_cancel method to complete the recognition task.
8. Call the nui_release method to release the SDK.

Sample code

Initialize the NUI SDK

```
NSString * initParam = [self genInitParams];
    //nui listener
    NuiSdkListener nuiListener;
    nuiListener.event_callback = nuiDialogListenerOnEvent;
    nuiListener.audio_state_changed_callback = nuiDialogAudioStateChange;
    nuiListener.audio_extra_event_callback = nullptr;
    nuiListener.user_data = nullptr;
    nuiListener.user_data_callback = nuiDialogUserProvideData;
    [_nui nui_initialize:[initParam UTF8String] Listener:&nuiListener asyncCallback:nullptr logLevel:LOG_
LEVEL_VERBOSE saveLog:save_log];
```

The genInitParams method generates a JSON string that contains the information about the resource directory and user. The user information contains the following parameters:

```
    [dictM setObject:id_string forKey:@"device_id"];
    [dictM setObject:@"" forKey:@"url"];
    [dictM setObject:@"" forKey:@"app_key"];
    [dictM setObject:@"" forKey:@"token"];
```

Set the request parameters

Set the request parameters in the format of a JSON string, as shown in the following code:

```
-(NSString*) genParams {
    NSMutableDictionary *nls_config = [NSMutableDictionary dictionary];
    [nls_config setValue:@true forKey:@"enable_intermediate_result"];
    [nls_config setValue:@true forKey:@"enable_voice_detection"];
    NSMutableDictionary *dictM = [NSMutableDictionary dictionary];
    [dictM setObject:nls_config forKey:@"nls_config"];
    [dictM setValue:@(nuisdk::SERVICE_TYPE_SPEECH_TRANSCRIBER) forKey:@"service_type"];
    NSData *data = [NSJSONSerialization dataWithJSONObject:dictM options:NSJSONWritingPrettyPrinte
d error:nil];
    NSString * jsonStr = [[NSString alloc]initWithData:data encoding:NSUTF8StringEncoding];
    return jsonStr;
}
NSString * parameters = [self genParams];
[_nui nui_set_params:[parameters UTF8String] asyncCallback:nullptr];
```

Start the recognition task

Call the nui_dialog_start method to start the recognition task.

```
[_nui nui_dialog_start:MODE_P2T dialogParam:[param_string UTF8String] asyncCallback:nullptr];
```

Handle callbacks

- Call the onNuiAudioStateChanged method based on the value of AudioState. Then, the SDK determines whether to enable recording based on the obtained value.

  ```
  -(void)onNuiAudioStateChanged:(nuisdk::NuiAudioState)state{
      TLog(@"onNuiAudioStateChanged state=%u", state);
      if (state == STATE_CLOSE || state == STATE_PAUSE) {
          [_voiceRecorder stop:YES];
      } else if (state == STATE_OPEN){
          self.recordedVoiceData = [NSMutableData data];
          [_voiceRecorder start];
      }
  }
  ```

- Call the onNuiNeedAudioData method to send audio data to the server.

```
-(int)onNuiNeedAudioData:(char *)audioData length:(int)len {
    static int emptyCount = 0;
    @autoreleasepool {
        @synchronized(_recordedVoiceData){
            if (_recordedVoiceData.length > 0) {
                int recorder_len = 0;
                if (_recordedVoiceData.length > len)
                    recorder_len = len;
                else
                    recorder_len = _recordedVoiceData.length;
                NSData *tempData = [_recordedVoiceData subdataWithRange:NSMakeRange(0, recorder_le
n)];
                [tempData getBytes:audioData length:recorder_len];
                tempData = nil;
                NSInteger remainLength = _recordedVoiceData.length - recorder_len;
                NSRange range = NSMakeRange(recorder_len, remainLength);
                [_recordedVoiceData setData:[_recordedVoiceData subdataWithRange:range]];
                emptyCount = 0;
                return recorder_len;
            } else {
                if (emptyCount++ >= 50) {
                    TLog(@"_recordedVoiceData length = %lu! empty 50times.", (unsigned  long)_recordedVoi
ceData.length);
                    emptyCount = 0;
                }
                return 0;
            }
        }
    }
    return 0;
}
```

- Call the onNuiEventCallback method to report the occurred event to the server. Do not call an SDK method in the callbacks. Otherwise, a deadlock may occur.

```
-(void)onNuiEventCallback:(nuisdk::NuiCallbackEvent)nuiEvent
                   dialog:(long)dialog
                kwsResult:(const char *)wuw
                asrResult:(const char *)asr_result
                 ifFinish:(bool)finish
                  retCode:(int)code {
    TLog(@"onNuiEventCallback event %d finish %d", nuiEvent, finish);
    if (nuiEvent == nuisdk::EVENT_ASR_PARTIAL_RESULT || nuiEvent == nuisdk::EVENT_SENTENCE_END)
{
        TLog(@"ASR RESULT %s finish %d", asr_result, finish);
        NSString *result = [NSString stringWithUTF8String:asr_result];
        [myself showAsrResult:result];
    } else if (nuiEvent == nuisdk::EVENT_ASR_ERROR) {
        TLog(@"EVENT_ASR_ERROR error[%d]", code);
    } else if (nuiEvent == nuisdk::EVENT_MIC_ERROR) {
        TLog(@"MIC ERROR");
        [_voiceRecorder stop:true];
        [_voiceRecorder start];
    }
    if (finish) {
        [myself showStart];
    }
    return;
}
```

Complete the recognition task

```
[_nui nui_dialog_cancel:false asyncCallback:nullptr];
```

2.4. Error codes

This topic describes the error codes and error messages that may be returned during the use of Intelligent Speech Interaction to facilitate troubleshooting.

Description

An error code may be returned by the SDK or the server.

- Error codes returned by the SDK:

  These error codes may be generated during the use of the Intelligent Speech Interaction SDK. The SDK returns an error code in a callback.

- Error codes returned by the server:

If a DEFAULT_NLS_ERROR or HTTP_SERVER_ERROR event is returned, an error occurred during the service use. The status parameter in the header object of the event displays the error code.

> **Note**
>
> The error codes and error messages described in this topic apply to the short sentence recognition and real-time speech recognition services.

Successful requests

Error code	Error message	Description
0	SUCCESS	The task is successful.

Configuration or Parameter errors

Error code	Error message	Description
240999	DEFAULT_ERROR	The error message returned because a default internal error occurred.
240001	NUI_CONFIG_INVALID	The error message returned because the configuration file is invalid.
240002	ILLEGAL_PARAM	The error message returned because a specified parameter is invalid.
240003	ILLEGAL_INIT_PARAM	The error message returned because an initialization parameter is invalid.
240004	NECESSARY_PARAM_LACK	The error message returned because a required parameter is missing.
240005	NULL_PARAM_ERROR	The error message returned because a parameter is left empty.
240006	NULL_LISTENER_ERROR	The error message returned because the listener callback is not specified.

Error code	Error message	Description
240007	NULL_DIALOG_ERROR	The error message returned because no valid dialog instance is specified. This is generally an internal status error.
240008	NULL_ENGINE_ERROR	The error message returned because no valid engine instance is specified. Check whether the engine initialization is successful.
240009	ILLEGAL_DATA	The error message returned because the URL of the audio data is invalid or the size of the audio data exceeds the upper limit.

Status errors related to the SDK

Error code	Error message	Description
240010	ILLEGAL_REENTRANT	The error message returned because you used the SDK after you exited the client.
240011	SDK_NOT_INIT	The error message returned because the SDK is not properly initialized.
240012	SDK_ALREADY_INIT	The error message returned because the SDK is repeatedly initialized.
240013	DIALOG_INVALID_STATE	The error message returned because the internal dialog instance is in an abnormal state.
240014	STATE_INVALID	The error message returned because the SDK is in an abnormal state.
240015	ILLEGAL_FUNC_CALL	The error message returned because the SDK is not used in a valid mode.

System errors

Error codes	Error message	Description
240020	MEM_ALLOC_ERROR	The error message returned because memory resources failed to be allocated.
240021	FILE_ACCESS_FAIL	The error message returned because the file failed to be accessed.
240022	CREATE_DIR_ERROR	The error message returned because the storage directory failed to be created.

Internal SDK call errors

Error code	Error message	Description
240030	CREATE_NUI_ERROR	The error message returned because the engine failed to be created.
240031	TEXT_DIALOG_START_FAIL	The error message returned because the text comprehension task failed to be started.
240032	TEXT_CANCEL_START_FAIL	The error message returned because the text comprehension task failed to be canceled.
240033	WUW_DUPLICATE	The error message returned because you specified repeated dynamic wake-up words.

Client engine errors

Error code	Error message	Description
240040	CEI_INIT_FAIL	The error message returned because the client engine failed to be initialized.

Error code	Error message	Description
240041	CEI_SET_PARAM_FAIL	The error message returned because an engine parameter failed to be set.
240042	CEI_COMPILE_GRAMMER_FAIL	The error message returned because the code syntax failed to be compiled.
240043	CEI_STOP_FAIL	The error message returned because the client engine failed to stop the recognition task.
240044	CEI_CANCEL_FAIL	The error message returned because the client engine failed to cancel the recognition task.
240045	CEI_UNLOAD_KWS_FAIL	The error message returned because the client engine failed to cancel the specified wake-up words.
240046	GET_WUW_ERROR	The error message returned because the client engine failed to obtain the specified wake-up words.

Errors related to audio data

Error code	Error message	Description
240050	SELECT_RECORDER_ERROR	The error message returned because the recording device is not properly selected.
240051	UPDATE_AUDIO_ERROR	The error message returned because the audio data failed to be pushed to the server. The general cause is that the size of the audio data exceeds the upper limit.
240052	MIC_ERROR	The error message returned because the microphone has not captured any audio data for 2 consecutive seconds.

Errors related to request timeout

Error code	Error message	Description
240080	ENGINE_INIT_TIMEOUT	The error message returned because the request to initialize the engine timed out.
240081	SET_PARAM_TIMEOUT	The error message returned because the request to set parameters timed out.
240082	SET_WUW_TIMEOUT	The error message returned because the request to set wake-up words timed out.
240083	SELECT_RECORDER_TIMEOUT	The error message returned because the request to select the recording device timed out.
240084	STOP_TIMEOUT	The error message returned because the request to terminate the dialog timed out.
240085	ASR_ENGINE_STOP_TIMEOUT	The error message returned because the request to disable the engine timed out.
240086	UNLOAD_DYNAMIC_WUW_TIMEOUT	The error message returned because the request to cancel the dynamic wake-up words timed out.
240087	ADD_DYNAMIC_WUW_TIMEOUT	The error message returned because the request to add the dynamic wake-up words timed out.
240100	WAIT_TIMEOUT	The error message returned because the engine request timed out.
240101	HANDLE_API_TIMEOUT	The error message returned because the API request timed out.

Network errors

Error code	Error message	Description

Error code	Error message	Description
240060	CREATE_DA_REQUEST_ERROR	The error message returned because the dialog assistant failed to be created.
240061	START_DA_REQUEST_ERROR	The error message returned because the dialog assistant failed to be started.
240062	DEFAULT_NLS_ERROR	The error message returned because an error occurred on the server. Note: This error also generates an error code that is returned by the server. For more information, see the Error codes returned by the server table.
240063	SSL_ERROR	The error message returned because the Secure Sockets Layer (SSL) certificate failed to be created.
240064	SSL_CONNECT_FAILED	The error message returned because the SSL connection failed.
240065	HTTP_CONNECT_FAILED	The error message returned because the HTTP connection failed.
240066	DNS_FAILED	The error message returned because the Domain Name System (DNS) resolution failed.
240067	CONNECT_FAILED	The error message returned because the socket connection failed.
240068	SERVER_NOT_ACCESS	The error message returned because the server cannot be accessed.
240069	SOCKET_CLOSED	The error message returned because the socket is closed.
240070	AUTH_FAILED	The error message returned because the authentication failed.

Error code	Error message	Description
240071	HTTPDNS_FAILED	The error message returned because the connection between the server and the client by using the specified IP address failed.

Errors related to network timeout

Error code	Error message	Description
240090	UPDATE_CONTEXT_TIMEOUT	The error message returned because the request to update the client timed out.
240091	CONNECTION_TIMEOUT	The error message returned because the network connection timed out.
240092	PARTIAL_ASR_TIMEOUT	The error message returned because the request to obtain the intermediate recognition result timed out.
240093	ASR_TIMEOUT	The error message returned because the request to obtain the final recognition result timed out.
240094	DIALOG_TIMEOUT	The error message returned because the request to obtain the dialog processing result timed out.
240095	WWV_TIMEOUT	The error message returned because the request to obtain the wake-up result of the server timed out.

Error codes returned by the server

If the client receives an EVENT_ASR_ERROR event, and the error code and error message returned by the SDK are 240062 and DEFAULT_NLS_ERROR respectively, the status parameter in the header object of the event displays the error code that is returned by the server.

Error code	Cause	Solution
40000001	The authentication failed.	Check whether the token expires or is invalid.

Error code	Cause	Solution
40000002	The message is invalid.	Check whether the message that is sent meets the requirement.
403	The token expires or is invalid.	1. Check whether the token expires.2. Check whether the token is valid.
40000004	The idle connection timed out.	Check whether no data has been sent to the server for 10 consecutive seconds.
40000005	The number of requests exceeds the upper limit.	Check whether the number of concurrent connections or the queries per second (QPS) exceeds the upper limit. If the number of concurrent connections exceeds the upper limit, we recommend that you upgrade Intelligent Speech Interaction from the trial edition to Commercial Edition. If you have upgraded the service to Commercial Edition, we recommend that you purchase more resources for higher concurrency.
40000000	A client error occurred. This is the default client error code.	Check the error message or submit a ticket.
41010120	The client timed out.	The client has not sent audio data for 10 or more consecutive seconds.
50000000	A server error occurred. This is the default server error code.	If the error code is occasionally returned, ignore it. If the error code is returned multiple times, submit a ticket.
50000001	An internal call error occurred.	If the error code is occasionally returned, ignore it. If the error code is returned multiple times, submit a ticket.
52010001	An internal call error occurred.	If the error code is occasionally returned, ignore it. If the error code is returned multiple times, submit a ticket.
40010001	The method is not supported.	If you use the SDK, submit a ticket.

Error code	Cause	Solution
40010002	The instruction is not supported.	If you use the SDK, submit a ticket.
40010003	The instruction is invalid.	If you use the SDK, submit a ticket.
40010004	The client is disconnected.	Check whether the client is disconnected before the server completes the requested task.
40010005	The task is in an abnormal state.	Check whether the instruction is supported in the current task status.
40020105	The specified appkey is invalid.	Resolve the route to check whether the application exists.
40020106	The specified appkey and token do not match.	Check whether the appkey of the application is valid and belongs to the same Alibaba Cloud account as the token.
40020503	Resource Access Management (RAM) user authentication fails.	Use your Alibaba Cloud account to authorize the RAM user to access the POP API.
41040201	The client has not sent data for 10 consecutive seconds.	Check the network connection or whether no business data needs to be sent.
41040202	The client sends data at a high transmission rate and consumes all resources of the server.	Check whether the client sends data at an appropriate transmission rate, for example, at the real-time factor of 1:1.
41040203	The client sends audio data in an invalid audio coding format.	Convert the audio coding format of audio data to a format supported by the SDK.
41040204	The client calls methods in an invalid order.	Check whether the client calls the relevant method to send a request before it calls other methods.
41040205	The specified MAXSILENCE_PARAM parameter is invalid.	Check whether the value of the MAXSILENCE_PARAM parameter is in the range of 200 to 2000.

Error code	Cause	Solution
41050008	The specified sampling rate does not match that of the selected model.	Check whether the audio sampling rate specified for the service call matches the audio sampling rate of the automatic speech recognition (ASR) model that is bound to the application in the console.
51040101	An internal error occurred on the server.	Resolve the error based on the error message.
51040102	Reserved.	N/A
51040103	The real-time speech recognition service is unavailable.	Check whether the number of real-time speech recognition tasks exceeds the upper limit.
51040104	The request for real-time speech recognition timed out.	Check the logs of the real-time speech recognition service.
51040105	The real-time speech recognition service failed to be called.	Check whether the real-time speech recognition service is enabled and whether the port works properly.
51040106	The load balancing of the real-time speech recognition service failed and the client failed to obtain the IP address of the real-time speech recognition service.	Check whether the real-time speech recognition server in the configured virtual private cloud (VPC) works properly.