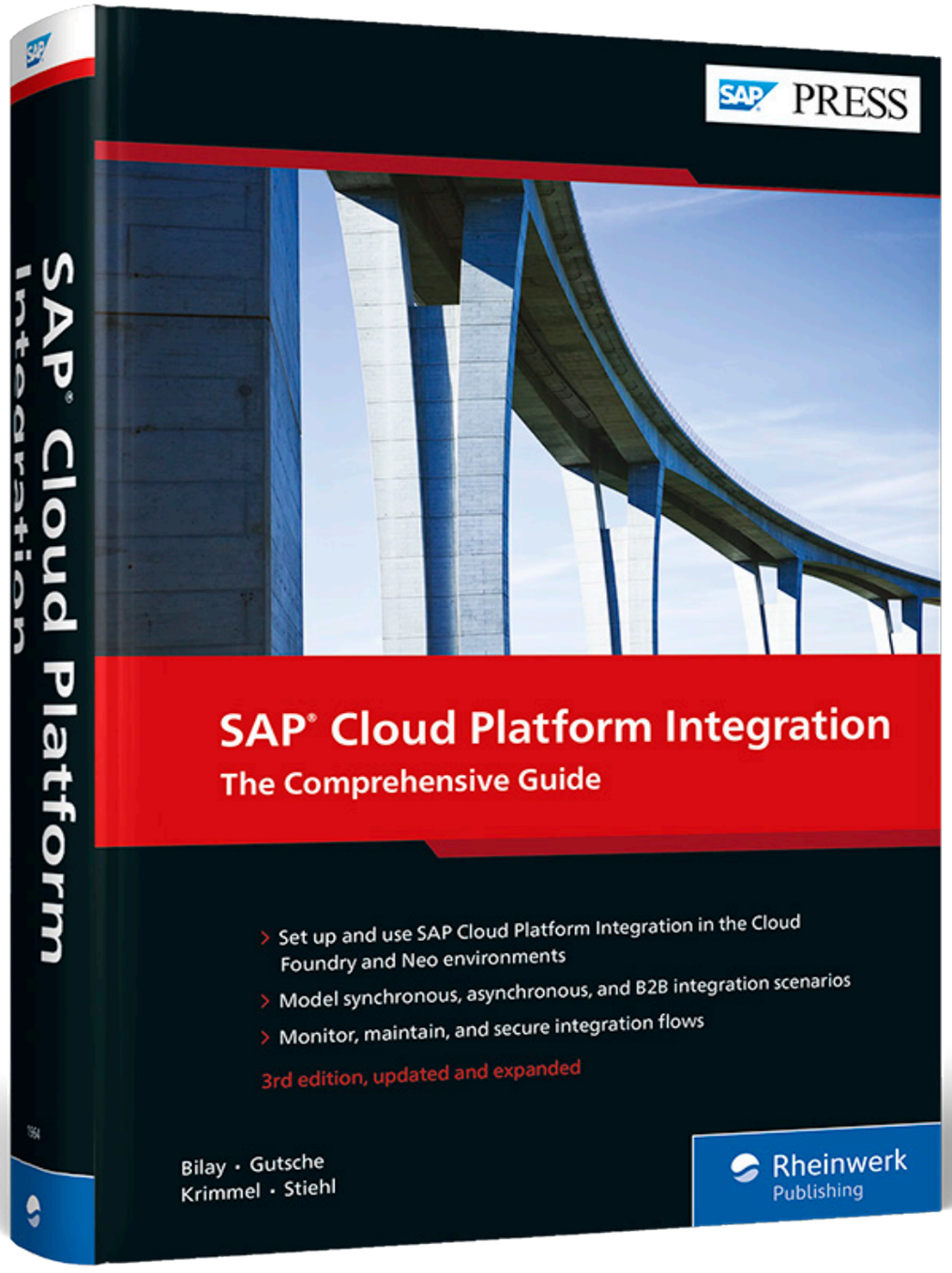

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SAP Cloud Platform Integration provides the option to access integration-related artifacts based on an application programming interface (API). The available APIs are described in detail in Chapter 9. This chapter also shows you how you can use Cloud Integration APIs together with SAP Cloud Platform API Management, a dedicated service. of SAP Cloud Platform that helps you to develop, manage, and publish your own APIs.

"Application Programming Interfaces"

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Chapter 9
Application Programming Interfaces

SAP enables the consumption and provision of application programming interfaces (APIs) to expose different functionalities to the outside world. This chapter dives into the specifics of using APIs in the context of SAP Cloud Platform Integration, presents available features, and explores the APIs currently available for customers.

In today's connected world, almost everything is a click away. From traditional desktops and mobile phones to connected devices like smartwatches, you can purchase goods, write articles, and book flight tickets. But how does data move from application A to B when, for instance, booking a flight or a car? The hidden enablers in most cases are known as application programming interfaces (APIs).

An API within the context of integration is an interface through which data exchange is made possible between applications. APIs are used to expose functionalities (or programmable interfaces) to the outside world through a service path or URL.

Simply put, an API takes a request from the caller, performs a task on a server application, and returns a response to the caller. The application providing the API is known as a *service provider*, and the application or user using the API is generally called a *service consumer*.

In this chapter, we'll introduce you to the Java and OData APIs provided by SAP Cloud Platform Integration and explain how to use them. This chapter further explores SAP Cloud Platform API Management and how to use it together with SAP Cloud Platform Integration.

9.1 Introduction

Much can be said about APIs—a topic that deserves its own book. This descriptive introduction is only intended to provide you a brief overview.

If you're familiar with the topic of integration, you might be wondering what the difference is between an API and a traditional web service. Table 9.1 points out some differences between an API and a web service.

Aspects	Web Service	API
Network	Needs a network connection for its operation	Can also operate offline
Protocols	Simple Object Access Protocol (SOAP), Representational State Transfer (REST), and XML-RPC. XML-RPC enables the calling of remote procedure using XML as the encoding and HTTP as the transport protocol.	SOAP and REST but can also communicate via cURL
Exposed via	XML over HTTP	Java Archive (JAR), Dynamic Link Library (DLL), XML, or JavaScript Object Notation (JSON) over HTTP

Table 9.1 Comparing Web Services to APIs

Furthermore, besides the differences listed in Table 9.1, all web services can be considered APIs, but not all APIs can be considered web services.

A *web service* is a type of API that almost always operates over HTTP (hence the "web" in the name). However, some protocols like SOAP (Simple Object Access Protocol) can use alternate transports, for example, Simple Mail Transfer Protocol (SMTP). The official World Wide Web Consortium (W3C) definition specifies that web services don't necessarily use HTTP, but this is almost always the case and is usually assumed unless mentioned otherwise.

On the other hand, one could argue that every bit of every function ever created—whether Dynamic Link Library (DLL), Java Archive (JAR), web service, or plain code—is an API. APIs can use any type of communication protocol and aren't limited to HTTP like web services are.

Now that you have a good, high-level understanding of what APIs are, let's explore the Java APIs currently provided by SAP Cloud Platform Integration.

9.2 Java APIs Provided by SAP Cloud Platform Integration

SAP Cloud Platform Integration provides some Java-based APIs to access and control the processing of messages on your tenant. At the time of this writing, you can use Groovy or JavaScript as the programming language to access these APIs. Accessing the functionality provided by these APIs in a script step or while creating a user-defined function (UDF) for mapping can be handy, which we'll describe in detail in Section 9.3.

Furthermore, you can use APIs when developing custom SAP Cloud Platform Integration adapters using the Adapter Development Kit (ADK). Note, however, that for a custom adapter, Java is used as a development language. We discussed the ADK in Chapter 6, Section 6.9.

Existing APIs can be classified under the following categories:

- **Generic APIs**
  Complete and parent set of APIs covering various features. These APIs are kept in the package `com.sap.it.api`. Table 9.2 provides a list of interfaces contained in this package.
- **Message APIs**
  Provides APIs to access properties of a message. These APIs are kept in the package `com.sap.it.api.msg`. Table 9.2 provides a list of interfaces contained in this package.
- **Script APIs**
  Provides APIs to control scripts.
- **Mapping APIs**
  Provides APIs to control mappings. These APIs are contained under the package `com.sap.it.api.mapping`. Table 9.2 lists a few commonly used packages and their corresponding interfaces.

Package	Interface	Description
`com.sap.it.api.msg`	`ExchangePropertyProvider`	Provides access to the properties of a message exchange.
`com.sap.it.api.msg`	`MessageSizeInformation`	Provides information about the size of a message.
`com.sap.it.api.mapping`	`MappingContext`	Mapping context object to be provided to mapping user-defined functions (UDFs).
`com.sap.it.api.mapping`	`Output`	Class used in advanced UDFs (execution type `All values of Context` or `All values of a Queue`) to return the result of a function.
`com.sap.it.api.mapping`	`ValueMappingApi`	Used to execute value mappings with the given parameters.
`com.sap.gateway.ip.core.customdev.util`	`Message`	Accesses the exchanged message. The API provides an extensive set of functionalities, including manipulating attachments; reading and changing payloads; and retrieving message properties such as size, header, and so on.

Table 9.2 API Packages and Interfaces

Package	Interface	Description
com.sap.it.script.logging	ILogger	Performs different operations on the logs (e.g., writing message logs).
com.sap.it.public.generic.api	ITApiException, KeyStoreService, SecureStoreService, UserCredential	Global API covering a wide range of functionalities, including access to key storage services, access to deployed user credentials, and access to exception objects.
com.sap.it.api.pd	PartnerDirectoryService	Performs different operations on Partner Directory parameter values, the partner IDs, the alternative partner IDs, and the authorized users of a partner. Using the Partner Directory was discussed in Chapter 7, Section 7.4.
com.sap.it.api.pd	BinaryData	Container for binary data relevant for Partner Directory binary parameters. Using the Partner Directory was discussed in Chapter 7, Section 7.4.

Table 9.2 API Packages and Interfaces (Cont.)

For a full list of interfaces and classes, refer to the JavaDocs at *http://s-prs.co/5077150*.

> **Note**
> Note that the summary of API packages listed in Table 9.2 relates to API version 2.12.0.

To illustrate the usage of the APIs, let's next look at UDFs in a mapping.

9.3 Using the Java API in a User-Defined Function

Let's say you need a message mapping to perform a complex transformation between a source and target message. In Chapter 4, Section 4.4, you learned how to work with mappings. Furthermore, imagine that none of the existing standard functions can fulfill the needed logic. Luckily, a user-defined function (UDF) can come to the rescue.

A UDF is a custom function built for special mapping needs that can't be expressed by the predefined mapping functions in the mapping editor. In SAP Cloud Platform Integration, a UDF can be built using Groovy or JavaScript. A UDF generally uses the

mapping-related APIs listed in Table 9.2 to transform the messages. (To see an illustration of a UDF in use, go to the example in Chapter 4, Section 4.4.)

In this section, we've built an integration flow that consumes an external OData service. After invoking the OData service, we received the response shown in Figure 9.1.

```
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
   <soap:Header/>
   <soap:Body>
      <nsl:OrderShippingDetails_MT xmlns:nsl="http://hci.sap.com/demo">
         <orderNumber>10249</orderNumber>
         <customerName>Toms Spezialitäten</customerName>
         <shipCity>Münster</shipCity>
         <shipStreet>Luisenstr. 48</shipStreet>
         <shipPostalCode>44087</shipPostalCode>
         <shipCountry>DE</shipCountry>
         <shipDate>1996-07-10T00:00:00.000</shipDate>
      </nsl:OrderShippingDetails_MT>
   </soap:Body>
</soap:Envelope>
```

Figure 9.1 Response of the Integration Flow from Chapter 4

Let's imagine that, with regard to the consumer application, you would prefer not to have the empty spaces in the element `shipStreet` between the street name and the house number. Furthermore, let's say the consumer requires that the street field to be appended with the order number as a suffix, and the entire field should be returned in uppercase. Looking at the example shown in Figure 9.1, the value `Luisenstr. 48` should be transformed into `LUISENSTR.48_10249`.

You can implement this requirement by using a combination of predefined functions in the mapping. However, for the sake of illustration, let's try to achieve this requirement using a UDF by following these steps:

1. On the **Design** page of SAP Cloud Platform Integration Web UI, navigate to the concerned package and open the integration flow.
2. Click the **Edit** button.
3. Select the **Message Mapping** step to be enhanced with the UDF, as shown in Figure 9.2.

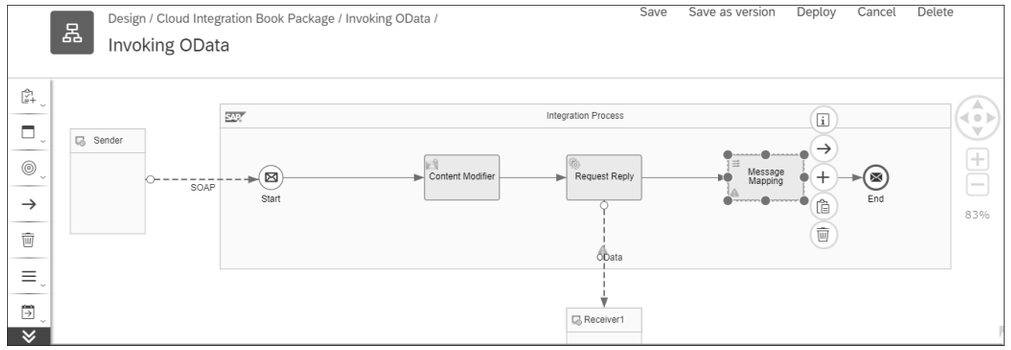

Figure 9.2 Selecting the Message Mapping Step to Be Enhanced with a UDF

4. Under the **Processing** tab, click on the **/ODate2XML.mmap** link, as shown in Figure 9.2, to open the mapping editor.
5. Select an element on the target message structure (e.g., the **shipStreet** field shown in Figure 9.3). Notice that a section called **Functions** appears in the bottom-left corner of the mapping editor, as shown in Figure 9.3.

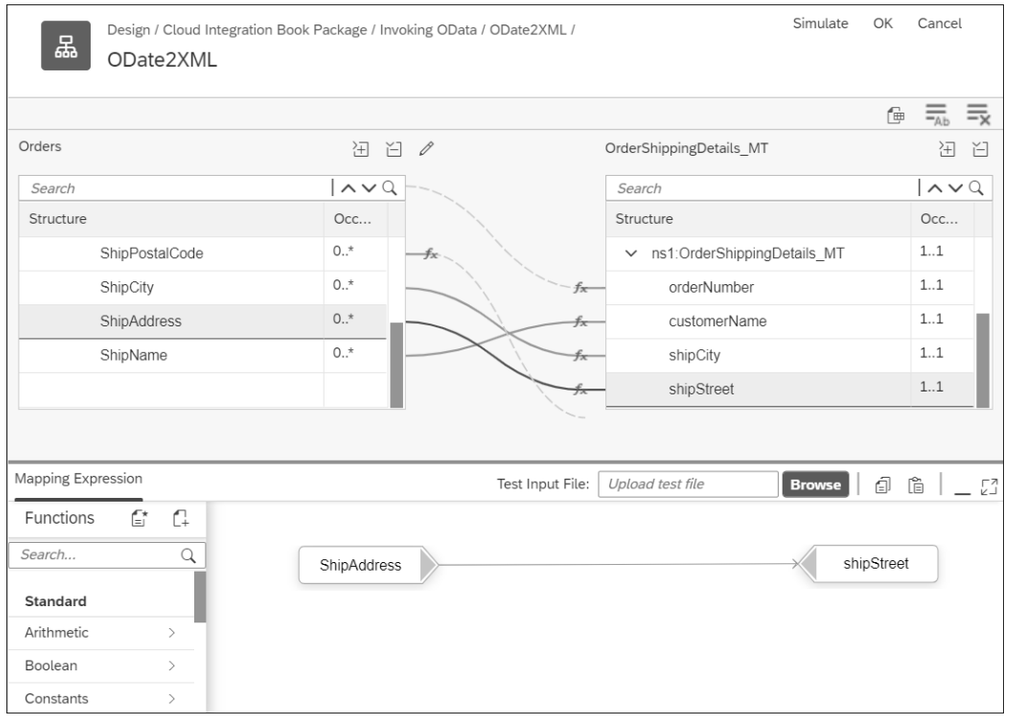

Figure 9.3 Mapping Editor with the Details of the Mapping to Be Enhanced

6. Let's now create a new UDF by clicking the **Create** icon next to the **Functions** box in the mapping editor.
7. Specify a name for the UDF to be created, as shown in Figure 9.4.

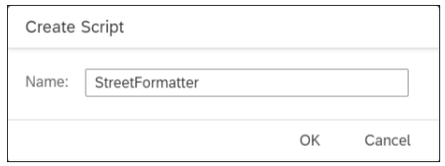

Figure 9.4 Providing a Name for the UDF

You're redirected to the UDF editor, which will contain some standard code, as shown in Figure 9.5.

Note

As shown at the top of Figure 9.5, the mapping API has been imported by the statement `import com.sap.it.api.mapping.*;`, which is the same package described earlier in Table 9.2.

Note that Figure 9.5 also shows some sample source code to showcase what is possible. The sample code is included between the /* and */ characters.

Figure 9.5 Standard Groovy Script Code Provided When Creating a UDF

8. Rename the Groovy method (e.g., "streetFormatterFunc") and adapt the source code to suit your needs, for example, with the code shown in Figure 9.6. In line 5, this code removes all extra spaces and converts the result to uppercase. Then, line 6 of the code shown in Figure 9.6 indicates that the code provided is using the Java API to retrieve the `OrderNo` from the message header. Furthermore, line 8 concatenates the input with the retrieved `OrderNo` from the message header.

Figure 9.6 Code Adapted to Remove Empty Spaces, Retrieve Message Header Attributes, and Perform a Concatenation

9. Click the **OK** button in the top-right corner of the screen shown in Figure 9.6.

10. Return to the mapping editor and find the newly created **StreetFormatter** UDF under the **Custom** section, as shown in Figure 9.7.

Figure 9.7 The Newly Created UDF Now Available in the Mapping

11. Click on the **StreetFormatter** UDF to see its method name. In our example, the method is called **streetFormatterFunc**, as shown in Figure 9.8. Note that the **streetFormatterFunc** comes from the name that we provided for the Groovy method shown earlier in Figure 9.6.
12. Let's now use our new function by dragging and dropping it between **ShipAddress** and **shipStreet**, as shown in Figure 9.8.

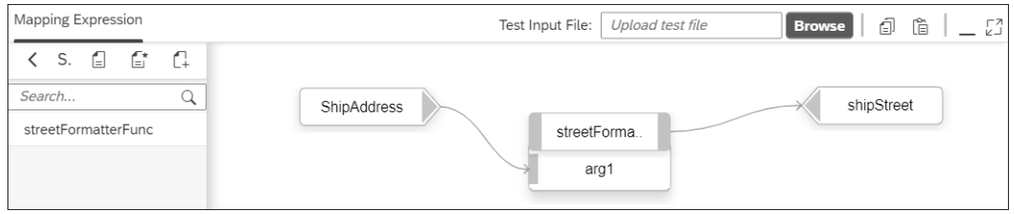

Figure 9.8 Inserting the UDF into Your Mapping Logic

13. Save and deploy the integration flow.
14. Test the service using SoapUI. You'll get a response in the field `shipStreet` without spaces, in uppercase, and suffixed with the order number, as shown in Figure 9.9.

```
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  <soap:Header/>
  <soap:Body>
    <ns1:OrderShippingDetails_MT xmlns:ns1="http://hci.sap.com/demo">
      <orderNumber>10249</orderNumber>
      <customerName>Toms Spezialitäten</customerName>
      <shipCity>Münster</shipCity>
      <shipStreet>LUISENSTR.48_10249</shipStreet>
      <shipPostalCode>44087</shipPostalCode>
      <shipCountry>DE</shipCountry>
      <shipDate>1996-07-10T00:00:00.000</shipDate>
    </ns1:OrderShippingDetails_MT>
  </soap:Body>
</soap:Envelope>
```

Figure 9.9 Response Returned by the Integration Flow after Adding the UDF

You now know how to create a UDF that uses SAP Cloud Platform Integration Java APIs to perform transformation logic in a mapping. Let's now move to the next section, where we'll show you how to use a script step in SAP Cloud Platform Integration.

9.4 Using the Script Step

SAP Cloud Platform Integration provides a script step that enables you to write different custom scripts to perform a wide range of activities and utilize the Java APIs we explored earlier in Section 9.2. The scripting feature opens the door to your development imagination so you can do almost anything. Note, however, that scripting should be used with due diligence and caution to avoid unnecessary overheads and performance issues.

At the time of this writing, the script step supports Groovy and JavaScript. Groovy is a Java syntax-compatible, object-oriented programming language for Java platforms. To learn more about Groovy, go to *http://groovy-lang.org*.

JavaScript is a dynamic, weakly typed, prototype-based, and multiparadigm programming language for the web. Many websites use JavaScript. To learn more about JavaScript, go to *www.w3schools.com/js*.

Both languages are relatively easy to learn, and plenty of resources are available on the Internet that you can use as references.

SAP Cloud Platform Integration provides a Script API in a form of a JAR file. Using this JAR file, a Java developer can easily import a library into his or her development tool of preference and inspect the provided methods. The Script API JAR file can be downloaded from *https://tools.hana.ondemand.com/#cloudintegration*. On that page, search for the **Using Script API** section, as shown in Figure 9.10. Then, click on the **Download** link to save the JAR file to your local file system.

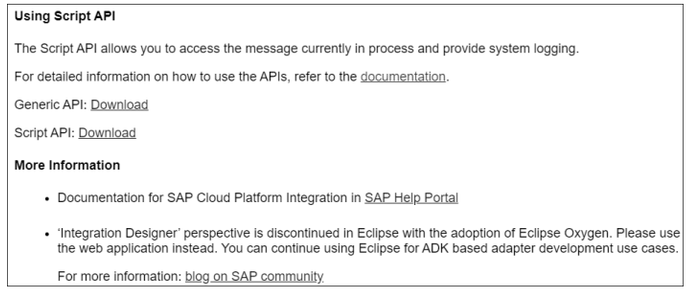

Figure 9.10 Downloading the Script API JAR File

At the time of this writing, the JAR file is called *cloud.integration.script.apis-1.36.1.jar*.

To better illustrate the usage of the Script API, let's use a sample scenario in the next section.

9.4.1 Target Scenario

Let's reuse the example from Chapter 4, Section 4.3, to illustrate the use of the script step. In that example, we invoked an external OData service from our integration flow. Figure 9.11 shows the integration flow that we built for it.

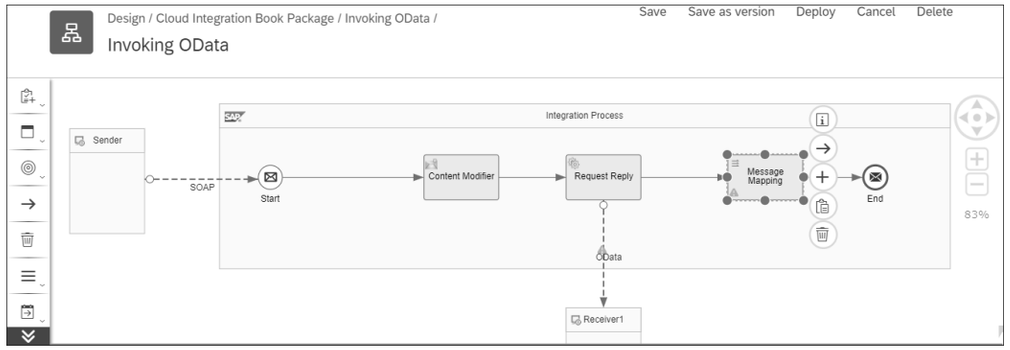

Figure 9.11 Invoking an OData Service

Imagine that the organization providing this integration flow is currently running a lottery on every incoming message. The sender of one randomly selected message will win a prize. As an integration developer, you've been asked to change the integration flow by generating a random number to be associated with each call. This random number will be used by your organization later to pick the lucky winner.

Keeping the solution simple, you can create a script that generates a random number and uses the API to save this value as a message header.

9.4.2 Enhancing the Integration Flow

Let's now change our integration flow. Note that we won't describe every step because, at this point, you should already be familiar with editing integration flows. Follow these steps:

1. On the **Design** page of the SAP Cloud Platform Integration Web UI, navigate to the correct package and integration flow.
2. In the opened integration flow, click the **Edit** button.
3. Select a **Script** step from the palette, as shown in Figure 9.12. You'll find this shape in the palette under **Message Transformers**.
4. Another menu appears from the palette with a choice of **JavaScript** or **GroovyScript**. Click on **GroovyScript**, as shown in Figure 9.13.
5. Place the shape in your integration flow, right after the **Start** icon .
6. The **Script Editor** automatically opens with some sample script, as shown in Figure 9.14. Note that this editor is the same toll we used when we created a UDF in Section 9.3.

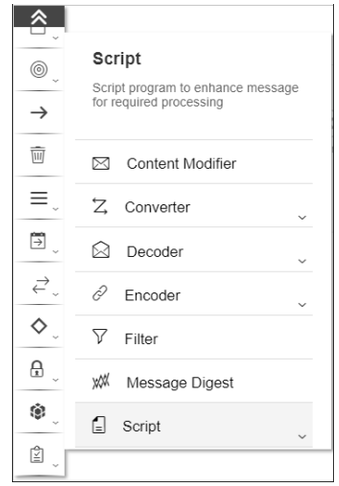

Figure 9.12 Adding the Script Step to the Integration Flow

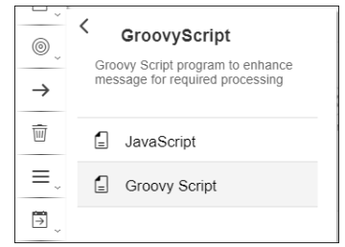

Figure 9.13 Selecting Groovy Script from the Palette

Figure 9.14 Sample Code Included in the Groovy Script Editor

7. Change the `processData` method part of the script shown in Figure 9.14 to adapt the script to meet your requirements. In our case, we used the code shown in Figure 9.15. Note that the `processData` method takes a `Message` object as input and also returns a

`Message` object as an output. If you're a programmer, the script shown in Figure 9.15 is self-explanatory. The code generates a random number between 0 and 1000. The generated random number is then added as a message header named `LuckyNumber`. The code also includes comments in plain English for those less familiar with Groovy. The Groovy script shown in Figure 9.15 is included with the book's downloads at *www.sap-press.com/5077*.

Design / Cloud Integration Book Package / Invoking OData / script2.groovy / OK Cancel

script2.groovy

```
1  /*
2   The integration developer needs to create the method processData
3   This method takes Message object of package com.sap.gateway.ip.core.customdev.util
4  which includes helper methods useful for the content developer:
5  The methods available are:
6      public java.lang.Object getBody()
7      public void setBody(java.lang.Object exchangeBody)
8      public java.util.Map<java.lang.String,java.lang.Object> getHeaders()
9      public void setHeaders(java.util.Map<java.lang.String,java.lang.Object> exchangeHeaders)
10     public void setHeader(java.lang.String name, java.lang.Object value)
11     public java.util.Map<java.lang.String,java.lang.Object> getProperties()
12     public void setProperties(java.util.Map<java.lang.String,java.lang.Object> exchangeProperties)
13        public void setProperty(java.lang.String name, java.lang.Object value)
14  */
15 import com.sap.gateway.ip.core.customdev.util.Message;
16 import java.util.HashMap;
17 def Message processData(Message message) {
18
19         //Generate a random Number
20         int max = 1000;
21         int min = 0;
22         Random r = new Random();
23         def value = r.nextInt((max - min) + 1) + min;
24         //Properties
25         map = message.getProperties();
26         message.setHeader("LuckyNumber", value);
27
28         return message;
29 }
```

Figure 9.15 Final Result of the Groovy Script

8. Click the **OK** button in the top-right corner of Figure 9.15 to return to the integration flow. Figure 9.16 shows the final look of the integration flow extended with the **Script** step.

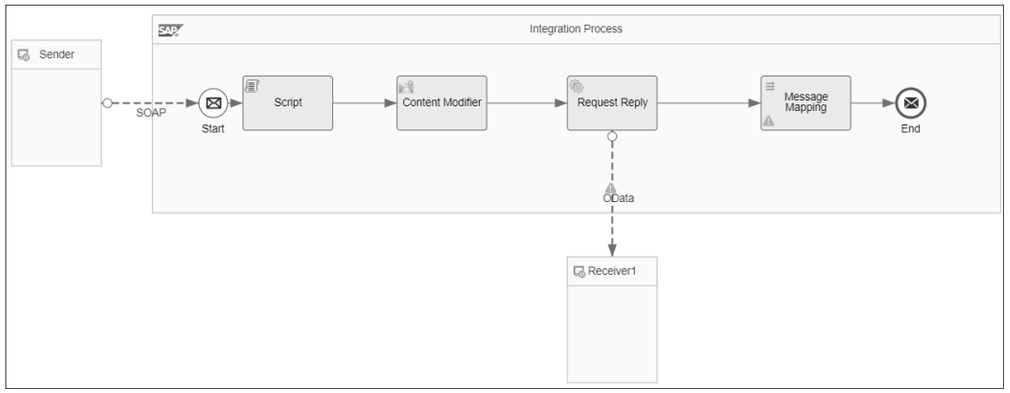

Figure 9.16 Enhanced Overview of the Integration Flow

9. Save and deploy the integration flow.

You're now ready to send a message via SoapUI. After you've triggered the message, the randomly generated number is returned in the header of the response message. Notice the `LuckyNumber` in the header section of the response shown in Figure 9.17 and Figure 9.18. This result is exactly what we asked the script to do (see line 15 of the code shown in Figure 9.16).

```
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/" xmlns:demo="http://cpi.sap.com/demo">
   <soapenv:Header/>
   <soapenv:Body>
      <demo:OrderNumber_MT>
         <orderNumber>10249</orderNumber>
      </demo:OrderNumber_MT>
   </soapenv:Body>
</soapenv:Envelope>
```

Figure 9.17 Returned Response Headers A

Body | Cookies (4) | Headers (21) | Test Results — Status: 200 OK Time: 3.48s Size: 1.04 KB — Save Response

KEY	VALUE
Set-Cookie	JSESSIONID=11696AE7D64F68045F9AD20892401CDF; Path=/; Secure; HttpOnly
Address	http://services.odata.org/Northwind
AutheticationType	None
clientSidePageSize	200
ComponentContentType	xml
destinationAlias	IGNORE
destinationManagerImpl	com.sap.it.rt.adapter.odata.destination.HCIDestinationManagerImpl@6858bc27
HttpStatusCodes	OK
LuckyNumber	516

Figure 9.18 Returned Response Headers B

Congratulations! You can now use the **Script** step to perform different tasks using the APIs. Let's now move to discuss the OData API.

9.5 OData API

Besides the Java APIs, SAP Cloud Platform Integration also allows you to access various aspects of the platform using an OData API. These APIs are Representational State Transfer (REST) APIs that use the Open Data Protocol (OData) as a technical protocol. As a result, these APIs use the well-known HTTP methods of `GET`, `POST`, `PUT`, `FETCH`, and `DELETE`. The concept of OData is not completely new; you already came across OData in Chapter 7, Section 7.4.

Note

Note that, at the time of this writing, OData specification version 2.0 is supported by the SAP Cloud Platform Integration OData APIs. To read more about the OData V2 specification, go to *www.odata.org/documentation/odata-version-2-0*.

The OData APIs can be accessed using an HTTP URL in the following format:

https://<host>/api/v1/<resource>?$<property1>=<property1_value>&$<property2>=<property2_value>

In this URL, note the following:

- ***<host>***
  Represents the URL address of the service instance in Cloud Foundry, also called the SAP Cloud Platform Integration Management Host Address. We introduced this service in Chapter 2, Section 2.1.3. In the Neo environment, you'll need to use the URL address of the tenant management node.
- ***<resource>***
  Represents the path of the entity types to be called. Some entity resources are listed later in Table 9.5. For example, you can use the resource `MessageProcessingLogs` to address the message processing log (MPL).
- ***<property1>***
  Represents the name of the property to be queried. For example, you can use the property `count` to return the total number of MPLs. This property is always prefixed by a dollar sign ($). Note that the property field is optional. Furthermore, you're can add as many properties as you need by using an ampersand (&) between them.

OData APIs are protected by OAuth in Cloud Foundry, whereas in the Neo environment these same OData APIs are protected by basic authentication (user name and password) and require the API client to enable HTTP cookies. Furthermore, to use an API, you must have the correct role collection assigned to your user. Table 9.3 lists the role collections required for the various API actions in Cloud Foundry. Similarly, Table 9.4 lists the authorization groups required for different API actions in the Neo environment.

Role Collection	Description
`PI_Business_Expert`	Enables a business expert to perform tasks such as monitoring integration flows and monitoring message content stored in temporary storage
`PI_Administrator`	Enables the tenant administrator to perform administrative tasks on the tenant cluster, for example, deploying security content and integration flows
`PI_Integration_Developer`	Enables an integration developer to display, download, and deploy artifacts (e.g., integration flows)
`PI_Read_Only`	Enables a user to display integration content and to monitor messages

Table 9.3 Required Authorization Groups for Cloud Foundry

Authorization Group	Description
`AuthGroup.Administrator` or `AuthGroup.IntegrationDeveloper`	Ability to display message overview
`AuthGroup.IntegrationDeveloper`	Undeploy integration content
`AuthGroup.BusinessExpert`	Download a message

Table 9.4 Required Authorization Groups for Neo

SAP Cloud Platform Integration's OData APIs are structured around entity types or resources. Every entity type contains a number of properties. A property can also refer to another entity type, which means you can start with one entity type and navigate to another entity type. Therefore, you must fully understand the various entity types, their tasks, and their relationships with each other. Table 9.5 lists all available entity types and describes their use.

Entity Types	Task Description
`MessageProcessingLog`	Reads an MPL
`MessagePropcessingLogCustomHeaderProperty`	Reads custom header properties of the MPL
`MessageProcessingLogErrorInformation`	Reads error information for a message
`MessageProcessingLogAdapterAttribute`	Reads adapter-specific attributes
`MessageProcessingLogAttachment`	Reads an MPL attachment
`MessageStoreEntry`	Reads a message from the message store
`MessageStoreEntryProperty`	Reads a header property of a message from the message store
`MessageStoreEntryAttachment`	Reads an attachment of a message from the message store
`MessageStoreEntryAttachmentProperties`	Reads properties of message attachments from the message store
`IntegrationRuntimeArtifact`	Reads properties of deployed integration content
`PartnerDirectory`	Accesses the Partner Directory, creates entries, and helps manage them
`LogFile`	Accesses all current (nonarchived) log files
`LogFileArchives`	Accesses all archived log files

Table 9.5 Entity Types and Their Tasks

To illustrate how entity types relate to each other, Figure 9.19 shows an entity model around the MessageProcessingLogs entity type to help you better grasp how to use the APIs related to the monitoring of message flows.

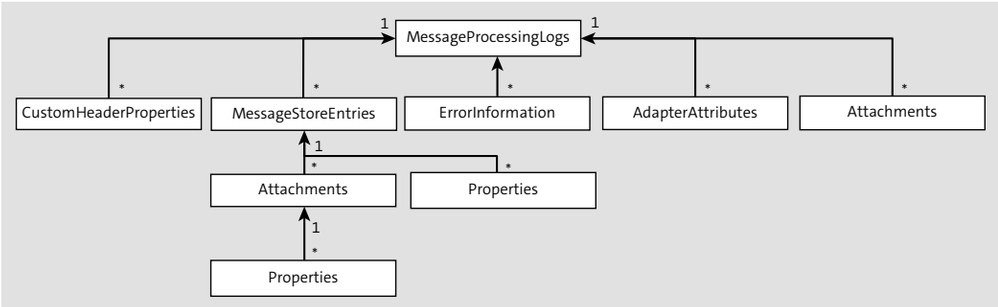

Figure 9.19 Entity Model Diagram for MessageProcessingLogs

As specified by the SAP documentation (shown in Figure 9.19), the `MessageProcessingLogs` entity contains several subentities, including `CustomHeaderProperties`, `MessageStoreEntries`, `ErrorInformation`, `AdapterAttributes`, and `Attachments`. Descriptions of each subentity's function are listed in Table 9.5.

Additionally, the OData APIs provided by SAP Cloud Platform Integration make use of common query options. These query options can be used on different entity types to perform specific actions on them. However, not all options are supported by each entity type. Table 9.6 lists some common query options.

Option	Description
`$filter`	Retrieves a set of entries based on the resource entity and the filter expression used in the Uniform Resource Identifier (URI)
`$metadata`	Retrieves the data model and structure of all resources
`$select`	Retrieves a subset of information on the entities identified by the resource path section of the URI
`$top`	Returns a subset of *n* top records from the resource used in the URI
`$count`	Returns the number of entries that matches the resource specified in the URI or the filter-specified criteria
`$inlinecount`	Indicates that the response contains a count of the number of entries in the collection of records identified by the resource path section of the URI
`$value`	Retrieves specific values of an entity resource specified by a Global Unique Identifier (GUID)

Table 9.6 Commonly Used Query Options

Option	Description
`$skip`	Skips *n* records in the collection returned according to the resource path section of the URI
`$expand`	Retrieves related and correlated entities for a given navigation property in line with the entities being retrieved
`$orderby`	Specifies the sorting of the returned collection by one or more values

Table 9.6 Commonly Used Query Options (Cont.)

Note

The OData APIs provided by SAP Cloud Platform Integration limit the number of entries in a response to a maximum of 1,000 entries for each call. This limitation protects against negative impact in the performance of the SAP Cloud Platform Integration runtime environment and potential problems from queries returning huge amounts of data.

Queries with more than 1,000 entries are capped, and a **Next** link element is added to the response, which can be used to initiate the return of the additional entries.

Later in this chapter, we'll explore APIs and entities related to the following aspects:

- Monitoring MPLs
- Deployed integration content
- Log files
- Message store
- Security material
- Partner Directory

These APIs can easily be tested and explored using the SAP API Business Hub, which we'll discuss next.

9.5.1 SAP API Business Hub

The available OData APIs are exposed and documented in the SAP API Business Hub, which represents the central catalog of all SAP-provided and partner-developed APIs for developers to build sample apps, extensions, and open integrations with SAP. The SAP API Business Hub landing page can be found at *https://api.sap.com*, as shown in Figure 9.20.

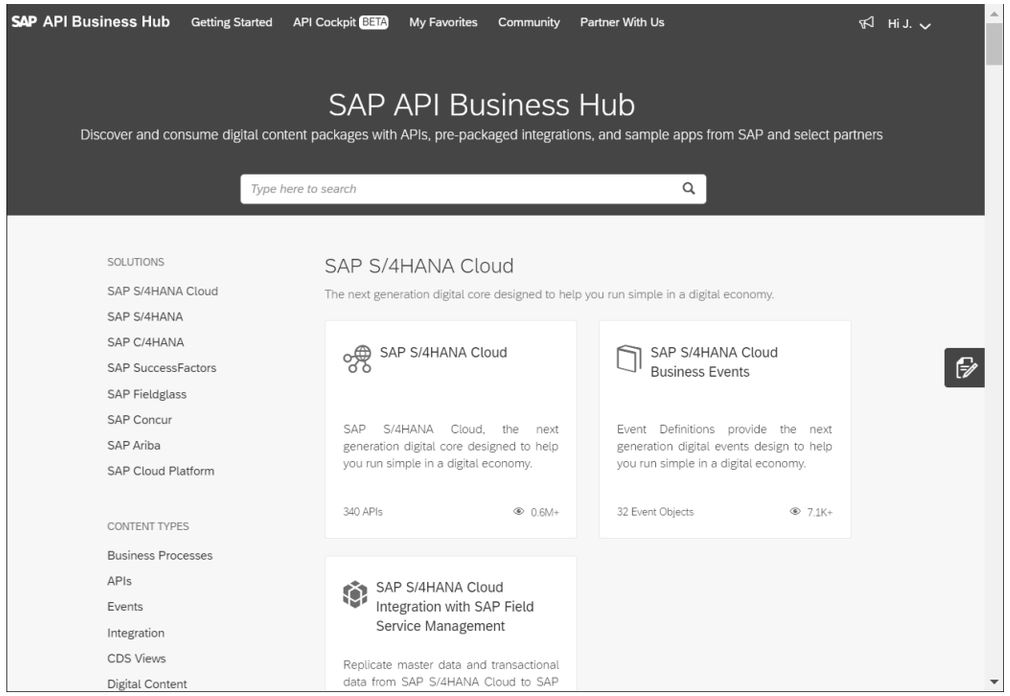

Figure 9.20 SAP API Business Hub Landing Page

Click on **APIs** on the left to open a view similar to the view shown in Figure 9.21. From this page, click on the **View more** link to move to another page where you can select different packages, as shown in Figure 9.22.

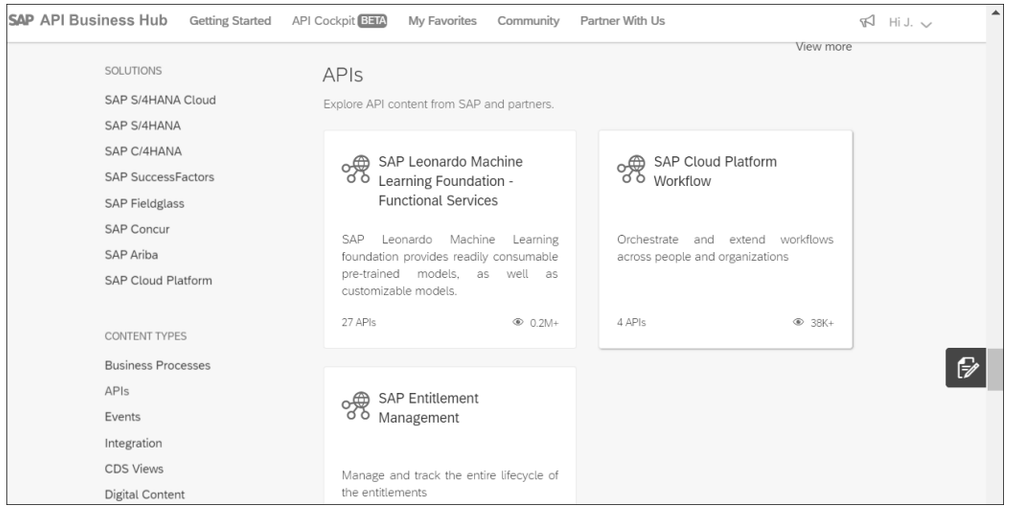

Figure 9.21 SAP API Business Hub Landing Page: APIs Section

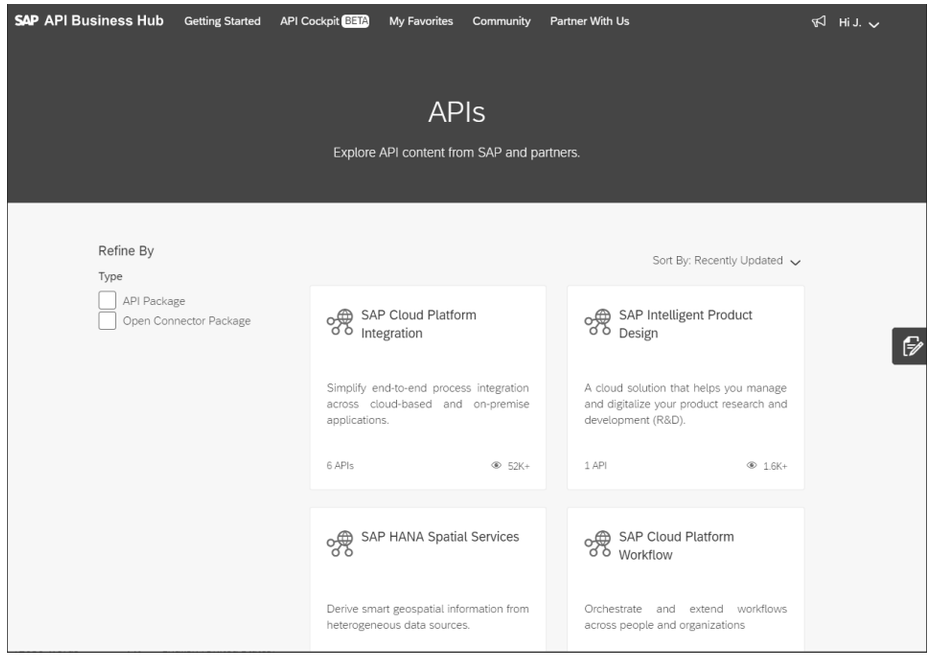

Figure 9.22 List of Available API Packages

Select the package called **SAP Cloud Platform Integration**. If you can't find this package, filter the list of packages by specifying a category, as shown in Figure 9.23.

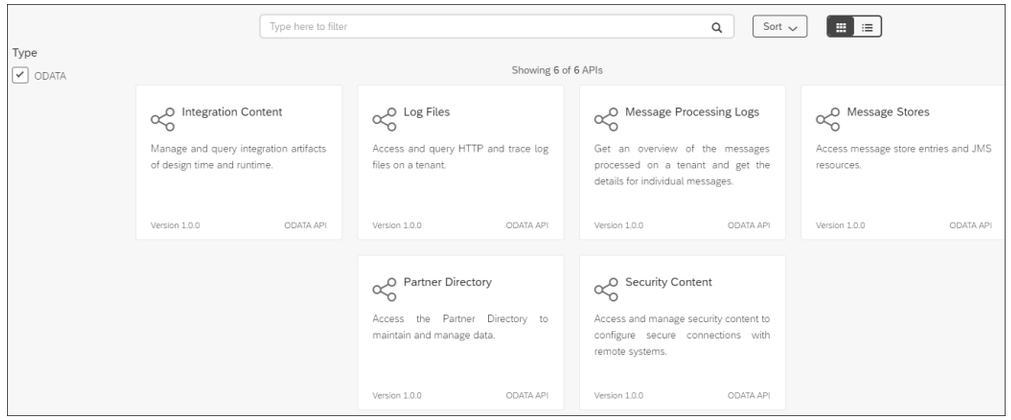

Figure 9.23 Artifacts of the OData APIs in the SAP Cloud Platform Integration Package

From the page shown in Figure 9.23, you can explore many APIs. Using the SAP API Business Hub, you can try out and test APIs directly without having to implement any code or using a third-party REST client such as Postman (*www.getpostman.com*). For APIs implementing the HTTP `GET` method, you can also use a simple browser.

The SAP API Business Hub has two different approaches to performing tests:

- An API sandbox
- Your SAP Cloud Platform Integration tenant

Each of these testing approaches will be explored next.

API Sandbox

If you don't have access to an SAP Cloud Platform Integration tenant to use for testing, you can always use the API sandbox, which is provided by SAP. The API sandbox is filled with test data and presents a quick way to get a feel for the way the APIs operate. Note that only operations using the `GET` method are supported in the API sandbox. Operations needing write access are forbidden because you need to log on before you can call operations requiring write access in the API sandbox.

For instance, let's use the Log Files API to illustrate testing using the API sandbox approach. Note that the Log Files API is not yet available in the Cloud Foundry environment at the time of this writing. But we can still use the Log Files API to illustrate how to test an API against a sandbox machine (which is still in a Neo environment). You're already familiar with the Log Files API because, in Chapter 8, Section 8.5.2, we discussed how to access log files in the Web UI, on the **Monitor** page. For that, follow these steps:

1. Click on **Log Files** from the page shown earlier in Figure 9.23.
2. The resulting page lists all operations of the API. Note that the **API Endpoint** field is automatically assigned with a sandbox-related URL.
3. Assuming we want to test the **LogFileArchives** API, we'll need to click on the **Show/Hide** link to the right of **LogFileArchives**, as shown in Figure 9.24.

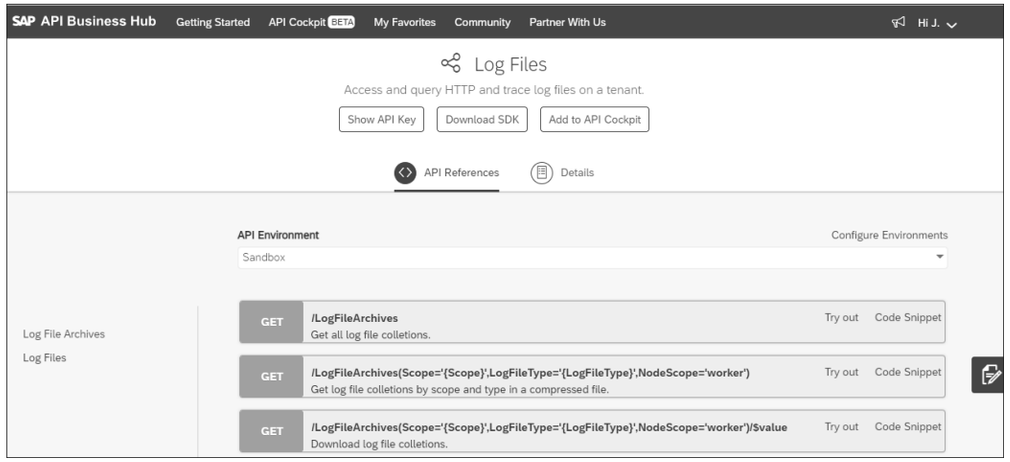

Figure 9.24 List of Entity Types Available for the Log Files API

4. From the resulting page, click the **GET** button to the left of **/LogFileArchives**.

5. A page similar to the page shown in Figure 9.25 will open. Click the **Try it out** button. Note that, if your API requires input parameters, these parameters will be listed on this page. You'll need to fill in the required parameters at a minimum.

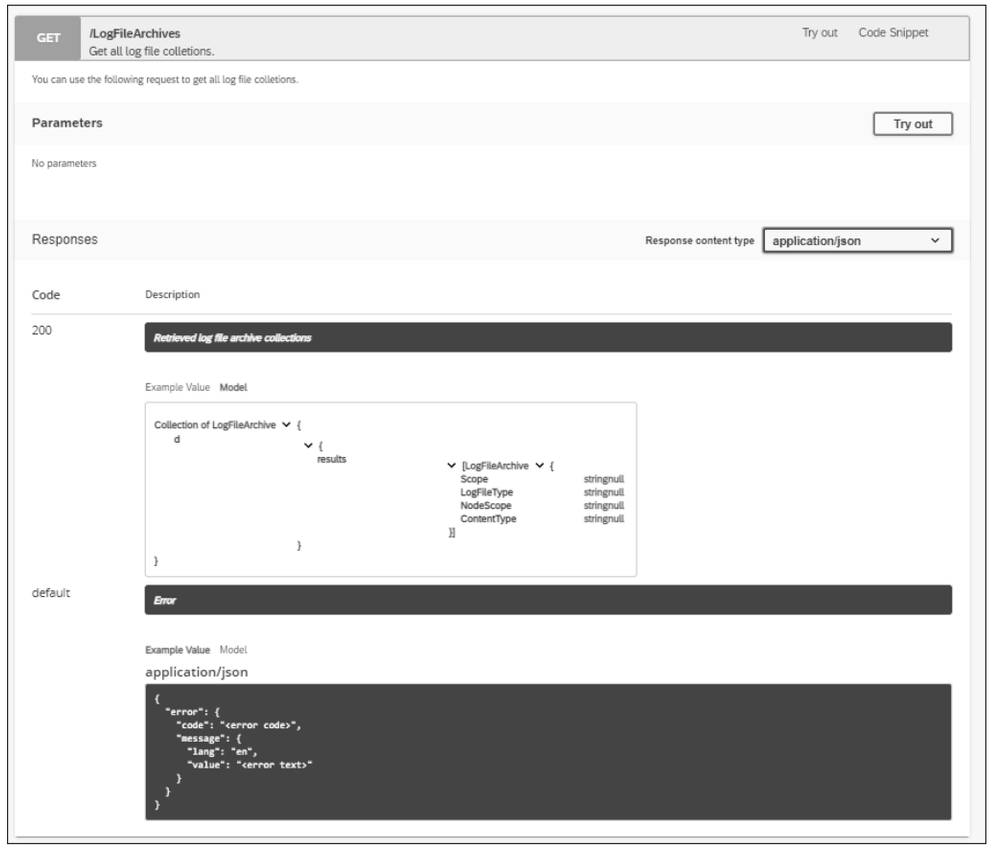

Figure 9.25 The SAP API Business Hub Try it Out Page

From the page shown in Figure 9.25, a number of attributes and functionalities are available, as listed in Table 9.7.

Properties	Description
Description	Describes the operation.
Parameters	Used to add the header or query parameters for the request message of the API.
Response Messages	Documents the possible response messages, including the different HTTP status codes and example response messages. After calling the API, both response body and response header are also returned.

Table 9.7 Properties in the SAP API Business Hub's Try It Out Page

6. After clicking on the **Try it out** button, a response header and body will be returned on the page. Table 9.8 lists the functionalities and features available in the page shown in Figure 9.26.

Functionality	Description
Code Snippet	Retrieve the documentation and code snippet describing how to invoke this API. Currently, snippets in the following languages and technologies are supported: JavaScript, Java, Swift, cURL, ABAP, and SAPUI5 (as shown in Figure 9.26). This snippet can serve as a head start for your implementation.
Download API	Download the API in one of the following formats: JavaScript Object Notation (JSON), YAML Ain't Markup Language (YAML), or Entity Data Model Designer (EDMX).
Show API Key	Use to retrieve the API key in the sandbox host URL to try out APIs.
Download SDK	Download a prepopulated Java Software Development Kit (SDK) for the API. Note that this download includes a full Java project that you can use.

Table 9.8 Functionalities in the SAP API Business Hub's Try It Out Page

Figure 9.26 Code Snippet to Consume the API in Different Languages

Let's look at how to configure the SAP API Business Hub to test against your own SAP Cloud Platform Integration Cloud Foundry tenant in next.

Your SAP Cloud Platform Integration Tenant for Cloud Foundry

As mentioned earlier, SAP API Business Hub also makes it possible to test against your tenant. For this approach, you'll need to configure the SAP API Business Hub to point to your tenant by changing the API endpoint. Follow these steps:

1. Click on the **Configure Environments** link in the top-right corner of the page shown earlier in Figure 9.24.
2. If you're not already logged in, the **Login Required** popup window, shown in Figure 9.27, will open. Click the **Login** button and provide your credentials. If you're already logged in, proceed to step 4.

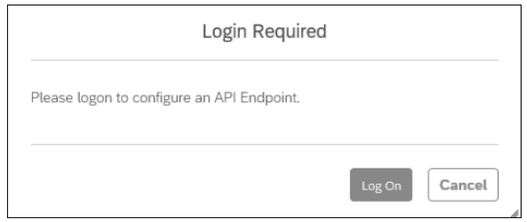

Figure 9.27 Login Page When Configuring the API Endpoint

3. You're redirected back to the main page (shown earlier in Figure 9.24). Click on the **Configure Environments** link one more time. You'll then presented with the popup window shown in Figure 9.28.

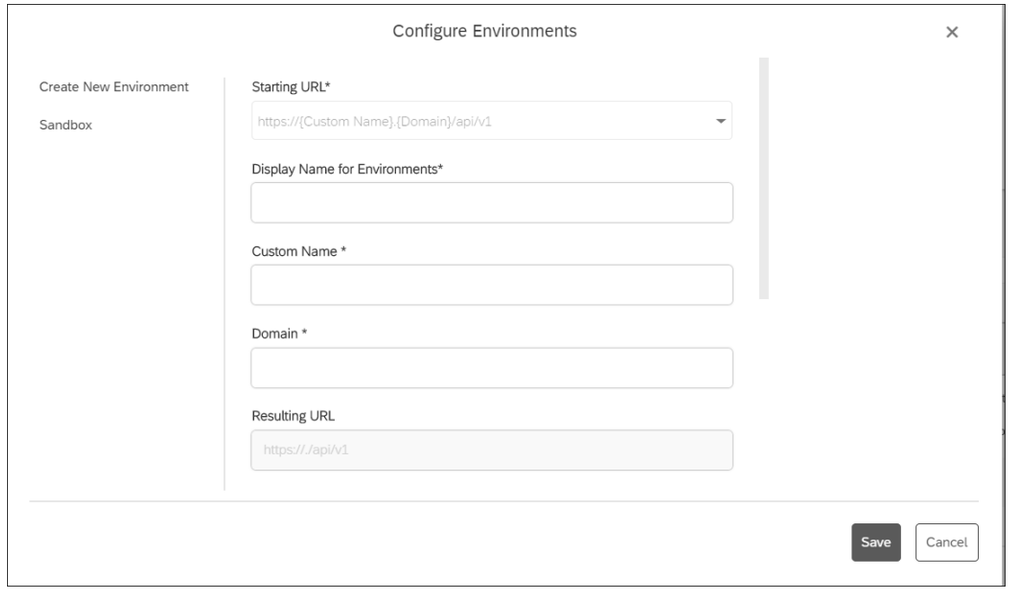

Figure 9.28 Filling in Environment Details for Your SAP Cloud Platform Integration Tenant

4. For the Cloud Foundry environment, you'll need to select **https://{Custom Name}{Domain}/api/v1** from the **Starting URL** dropdown menu.
5. You'll then need to fill in the fields on the screen shown in Figure 9.28 according to the details listed in Table 9.9, which lists and describes all the relevant fields.

Column	Description
Display Name for Environment	Enter a human-readable alias name, for example, "Development," "Test," or "Acceptance."
Custom Name	Based on the URL of your Cloud Foundry tenant, the custom name is the part of the URL found between the double slashes (//) and the first dot (.).
Domain	Based on the URL of your Cloud Foundry tenant, the domain is the part of the URL found from the first dot (.) until the end of the URL.
Resulting URL	The resulting URL is automatically built for you. Ensure that this URL is the same as your Cloud Foundry tenant URL.
User name	The user name of your SAP Cloud Platform Integration tenant account.
Password	The password of your SAP Cloud Platform Integration tenant account.

Table 9.9 Attributes of the Configure API Endpoint Page for Cloud Foundry

Voilà! From this point, you can perform the API calls against your own tenant. As mentioned earlier, Cloud Foundry requires OAuth to connect to its APIs. (We'll discuss OAuth in more detail in Chapter 11, Section 11.4.3.) Additionally, you'll need to add specific authorization groups, listed earlier in Table 9.3, relevant to the operation to be performed. (These authorization groups were listed earlier in Table 9.3.) To enable OAuth, first, you must perform the following activities:

- Define a service instance, which represents the technical user to be used when calling the API later. Within the context of OAuth, a service instance represents an OAuth client.
- Define a service key for the API client, which contains the OAuth credential values including **client id**, **client secret**, **token URL**, and **url**.

You already came across these entities (the service instance and the service key) in Chapter 2 Section 2.3.3, when we defined authorization enabling a user to call and access an integration flow's endpoint. (We'll also further discuss these entities in Chapter 11, Section 11.4.4.) For now, let's discuss the steps required for each of the activities listed earlier.

To define a service instance, follow these steps:

1. From the SAP Cloud Platform cockpit, navigate to your subaccount and select the **Entitlements** menu item on the left, as shown in Figure 9.29. Then, verify that the API **Plan** under the **Process Integration on Runtime** service is available and enabled.

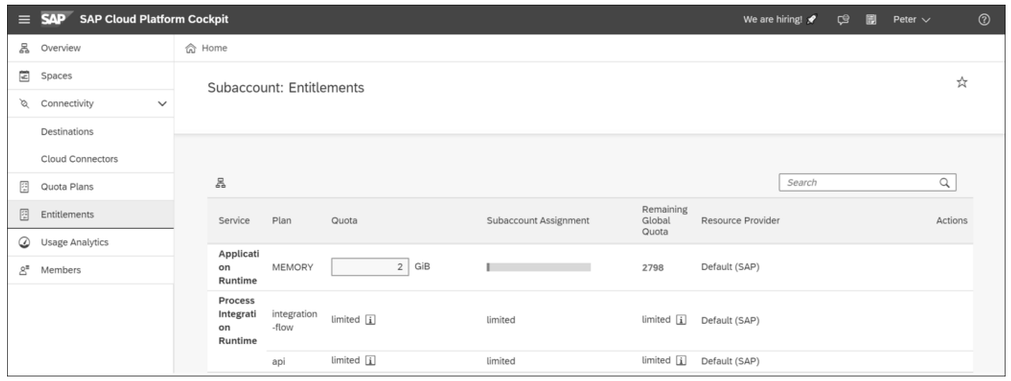

Figure 9.29 Checking That the API Plan Is Enabled

2. Then, navigate to the space management page by clicking on the **Spaces** menu item on the left, as shown in Figure 9.30.

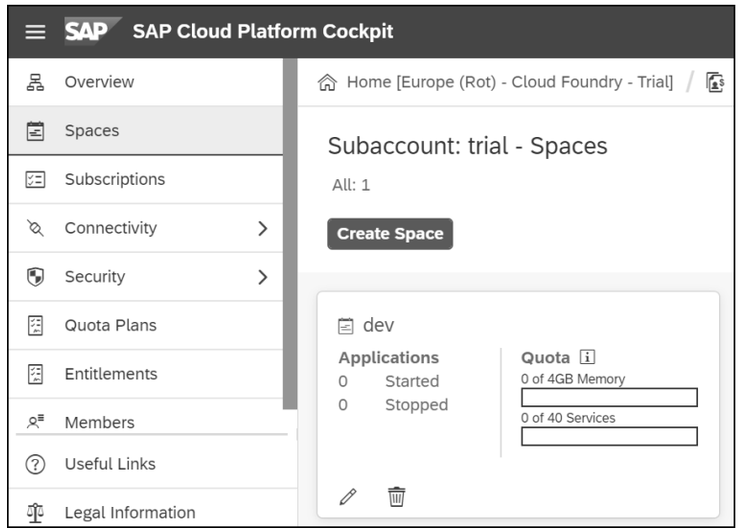

Figure 9.30 Selecting the Space to Hold the API Client

3. Select the space under which the API client should be created. For our example, as shown in Figure 9.30, you'll need to select the **dev** tile.
4. Under the **Services** menu item on the left, select **Service Marketplace**, as shown in Figure 9.31.

5. On the **Service Marketplace** page, search for the "process integration" keyword, as shown in Figure 9.31.

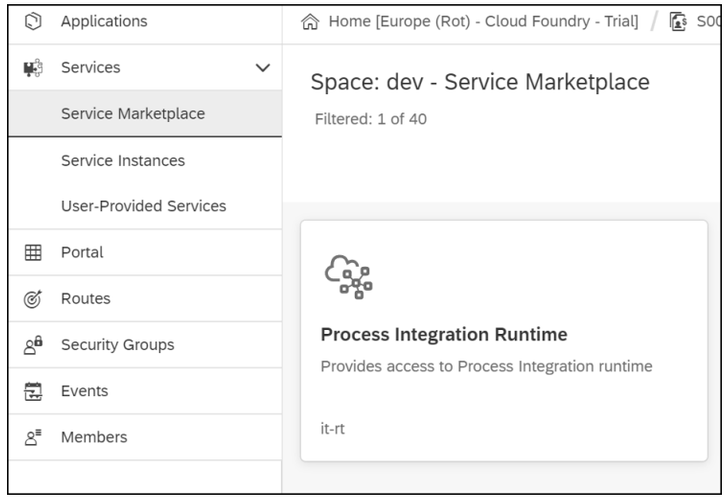

Figure 9.31 Selecting a Service from the Service Marketplace

6. On the returned results, select the **Process Integration Runtime** service.
7. Click on the **Instances** menu item on the left to view a list of existing instances, as shown in Figure 9.32.

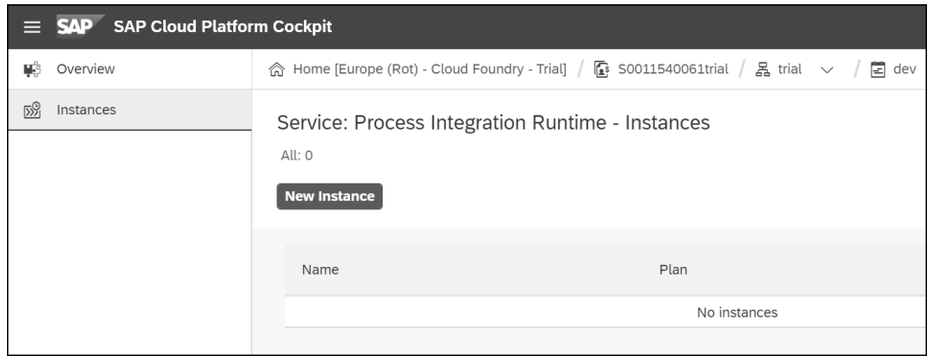

Figure 9.32 Creating a Process Integration Runtime Instance

8. To create an API client, click the **New instance** button, as shown in Figure 9.32. A new creation wizard will open.
9. On the next page, for the **Choose Service Plan** step, select **api** from the **Plan** drop-down list, as shown in Figure 9.33.
10. Then, click the **Next** button, located in the bottom-right corner of the page shown in Figure 9.33.

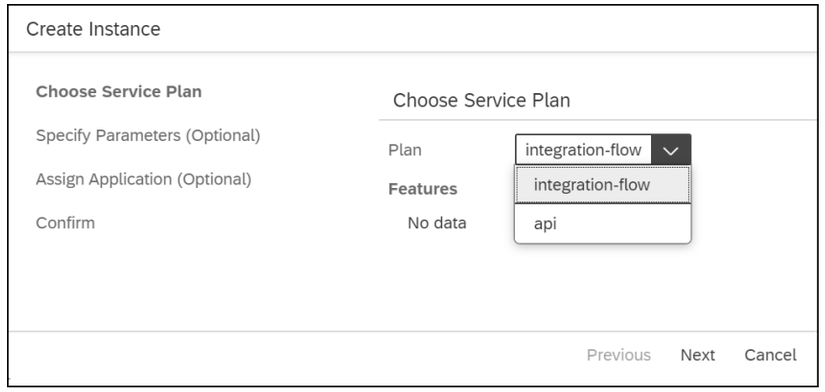

Figure 9.33 Selecting the API Service Plan

11. On the next page, you must enter a role assignment. Assuming that we're trying to access the MPLs in our SAP Cloud Platform Integration on the Cloud Foundry environment, you'll need to paste the sample JSON code shown in Listing 9.1.

```
{
    "roles": [
        "MonitoringDataRead"
    ]
}
```

Listing 9.1 Example JSON for Role Assignment

> **Note**
>
> A role assigned enables you to specify the type of action a user can perform on an API. The `MonitoringDataRead` role, used in Listing 9.1, enables a user to read monitoring data, including MPLs. For a full list of roles for both Neo and Cloud Foundry, refer to the documentation for SAP Cloud Platform Integration at *https://help.sap.com/viewer/product/CLOUD_INTEGRATION/Cloud* and search for "Tasks and Permissions." To specify multiple roles for a user, separate the roles with a comma, for example, `MonitoringDataRead`, `WorkspaceArtifactsDeploy`.

12. Click the **Next** button, then **Next** again on the page that follows.
13. Then, enter an instance name of your choice and click **Finish**.

Now, create a service key by following these steps:

1. Select our newly created service instance to open a screen similar to the screen shown in Figure 9.34.
2. Click the **Create Service Key** button.
3. Provide a name for the service key and click **Save**.

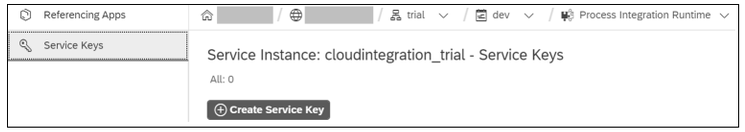

Figure 9.34 Creating a Service Key from a Service Instance

You're then presented with parameters values of your service key. Note that the service key contains few security parameters, including `clientid`, `clientsecret`, `tokenurl`, and `url`, as shown in Figure 9.35. A description of each parameter field is provided in Table 9.10.

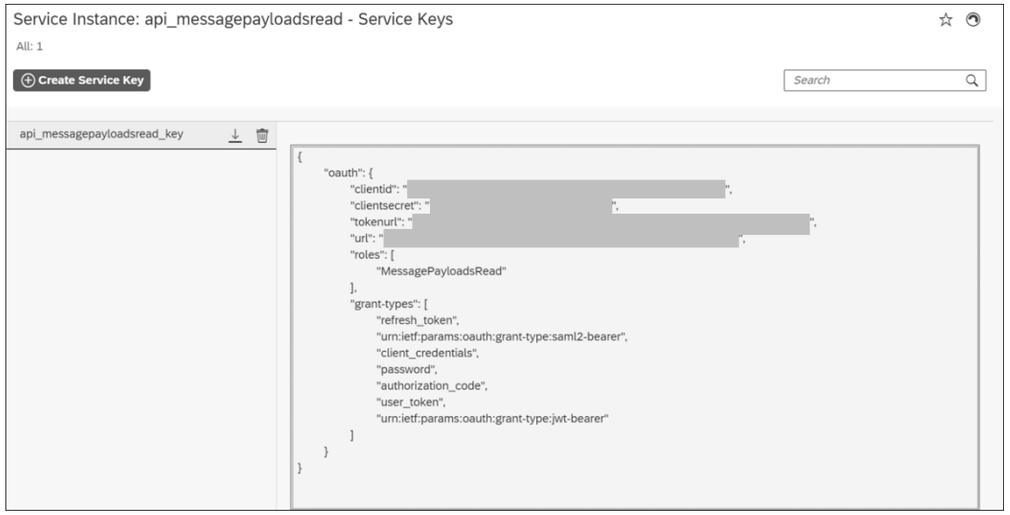

Figure 9.35 List of Generated Service Key Parameters to Be Used for OAuth Authentication

Parameter	Description
`clientid`	Represents the user name to be used by the API client to call the API.
`clientsecret`	Represents the password to be used by the API client to call the API.
`tokenurl`	The URL of the authorization server. This URL is responsible for issuing the OAuth token.
`url`	Represents the base URL of the OData API.

Table 9.10 Service Key Parameters

Voilà! You now have the details you need to perform an OAuth OData API call to your SAP Cloud Platform Integration in Cloud Foundry. Let's now explore how to use the service key parameters we obtained earlier, as shown in Figure 9.35, to connect to an OData API using OAuth 2.0.

You can use any API client of your choice, but for illustration, we'll use Postman (*www.getpostman.com/*), since you already installed Postman for a scenario in Chapter 7. You'll first need to retrieve an OAuth token with the OAuth credentials by following these steps:

1. Perform an HTTP `POST` request on a request URL, which follows the format *https://<tokenurl>?grant_type=client_credentials*.
2. Select **Basic Auth** from the **Type** dropdown list, as shown in Figure 9.36.

> **Note**
>
> For the URL, the *<tokenurl>* can be retrieved from the screen shown in Figure 9.35. With the basic authentication, enter "clientid" in the **Username** field and "clientsecret" in the **Password** field. Both clientid and clientsecret values can be retrieved from the service key shown in Figure 9.35.

3. Trigger the call by clicking the **Send** button.

As a result of the call, an `access_token` is returned in the response. You'll need to append the `access_token` to any subsequent OData API calls.

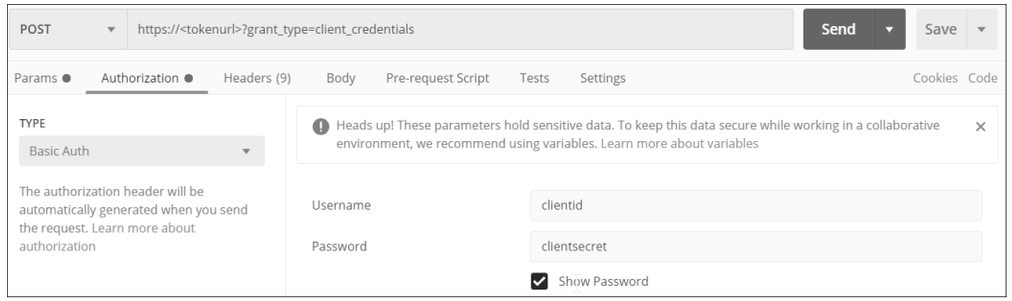

Figure 9.36 Postman Set Up to Retrieve the OAuth Token

Assuming that you intended to retrieve MPL data in your subsequent API call, you'll need to use a URL in the following format:

```
https://<tokenurl>/api/v1/MessageProcessingLogs?access_token=< access_token_value>
```

Note that, for the `<access_token_value>`, use the `access_token` value returned from the previous call.

If you're using SAP Cloud Platform Integration in the Neo environment, you can explore how to configure your tenant in the next section.

Your SAP Cloud Platform Integration Tenant for Neo

When using the Neo environment, you must select the region-specific host of your SAP Cloud Platform Integration tenant from the **Starting url** dropdown list, which is shown in Figure 9.37. Compare your tenant URL with one of the entries shown in Figure 9.37 to find the right match.

Then, maintain the **Display Name for Environment**, **Account Short Name**, and **SSL Host** fields and your user credentials. Refer to Table 9.11 for more details about these attributes.

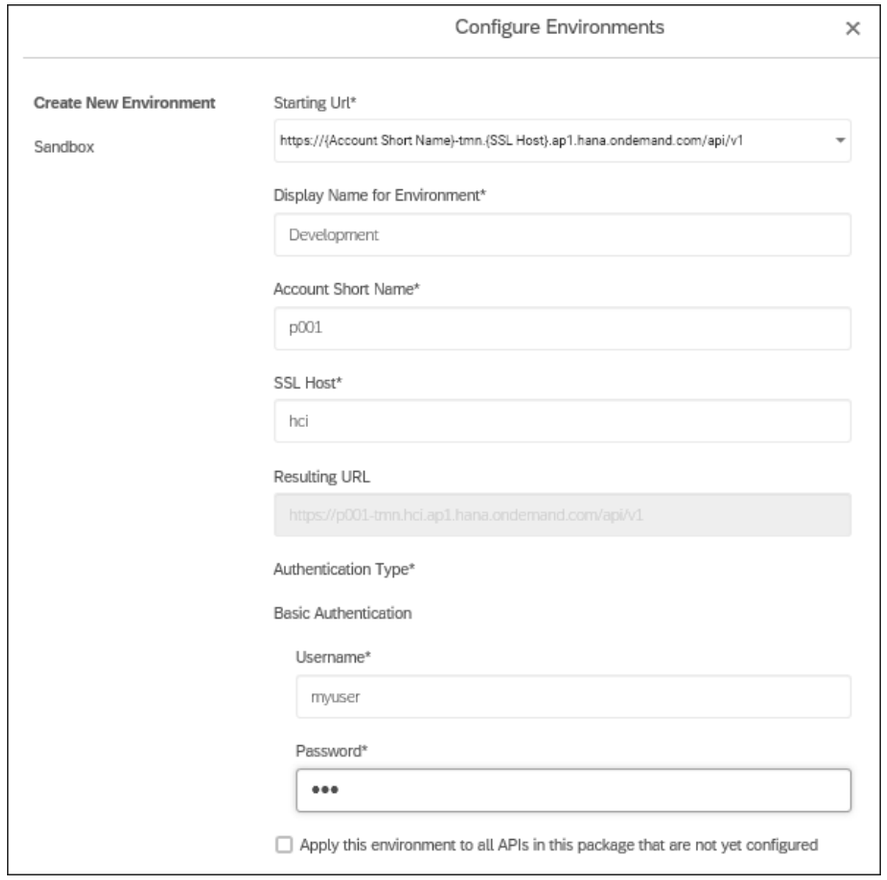

Figure 9.37 Selecting the Region of Your Tenant for Neo

Column	Description
Display Name for Environment	Enter a human-readable alias name, for example, "Development," "Test," or "Acceptance."

Table 9.11 Attributes of the Configure API Endpoint Page for Neo

Column	Description
Account Short Name	This value is your tenant ID, which can be found between the `//` and `-tmn` in your tenant URL. The tenant URL is always of the format: *https://{Account Short Name}-tmn.{SSLHost}.{Region}.hana.ondemand.com.*
SSL Host	This value can be retrieved from your tenant URL. The tenant URL is always of the format: *https://{Account Short Name}-tmn.{SSLHost}.{Region}.hana.ondemand.com.* Example: For *{SSL Host}*, use hci.
User name	The user name of your SAP Cloud Platform Integration tenant account.
Password	The password of your SAP Cloud Platform Integration tenant account.

Table 9.11 Attributes of the Configure API Endpoint Page for Neo (Cont.)

For those using the Neo environment, let's now discuss the cross-site request forgery (CSRF) token handling in the next section. If you're using Cloud Foundry, you can skip the next section.

9.5.2 Cross-Site Request Forgery Token Handling for Neo

Since APIs on the Neo environment use basic authentication, they are vulnerable for cross-site request forgery (CSRF) attacks. This type of security attack or malicious exploit occurs when unauthorized commands are transmitted from a user that the web application trusts. CSRF exploits the trust that a site has in a user's browser. One example is a banking website that uses cookies to identify you in the future.

Within the context of APIs, thus, a CSRF attacker can execute an action on the target application via an API without the knowledge or permission of the consumer application. In general, CSRF attacks have the following characteristics:

- These attacks generally involve sites that rely on a user's identity.
- They exploit the site's trust in that identity.
- They trick the consumer application into sending HTTP requests to a target site.
- They involve HTTP requests that change application data.

To prevent CSRF attacks, some OData APIs provided by SAP Cloud Platform Integration require X-CSRF token validation. An X-CSRF token is mostly required for APIs that need permission to write and change objects via the `POST`, `PUT`, and `DELETE` HTTP operations. We don't have the time to go into how X-CSRF tokens work, so for further reference, you can consult the many resources available online, including *http://s-prs.co/507754*.

When an API uses an X-CSRF token, calls made to the API without an X-CSRF token are rejected. As a result, you must retrieve an X-CSRF token first, before invoking such an API. Let's now explore how you can fetch an X-CSRF token.

Let's use Postman as our API client, since we already installed it back in Chapter 7. To retrieve the X-CSRF token, you'll need to use the following endpoint:

- *https//<TMN-host>/api/v1* for Neo
- *https//<tokenurl>/api/v1* for Cloud Foundry

For the remaining sections in this chapter, whenever an OData endpoint is presented with *https//<tokenurl>/...*, you can assume that this represents a Cloud Foundry URL. The equivalent Neo URL can be constructed by replacing *<tokenurl>* with *<TMN-host>*.

In this context, *<TMN-host>* represents the tenant host of SAP Cloud Platform Integration. As shown in Figure 9.38, select **GET** as the HTTP method and specify the OData API endpoint. For Neo, you'll also need to select **Basic Auth** and enter your credentials. For Cloud Foundry, you'll need to select **No Auth** and extend the URL with the `access_token` query parameter, as discussed in Section 9.5.1.

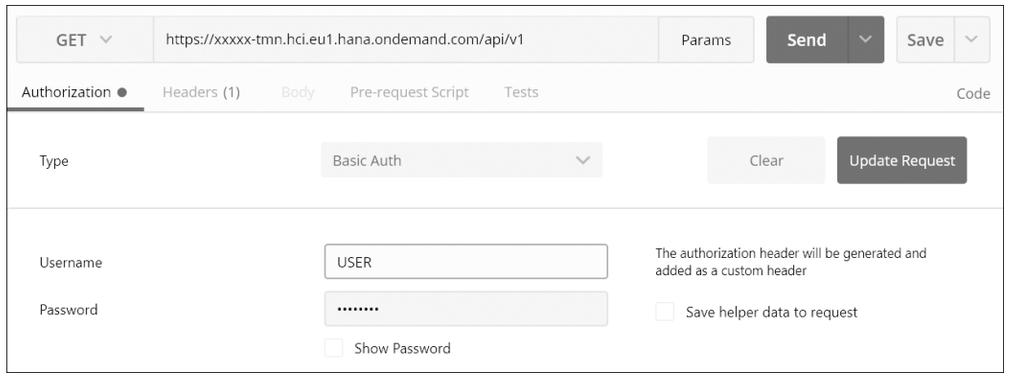

Figure 9.38 Configuring Endpoint and Authorization in Postman for Neo

Under the **Headers** tab, add a new key named **X-CSRF-Token** with the value `Fetch` to request an X-CSRF token, as shown in Figure 9.39.

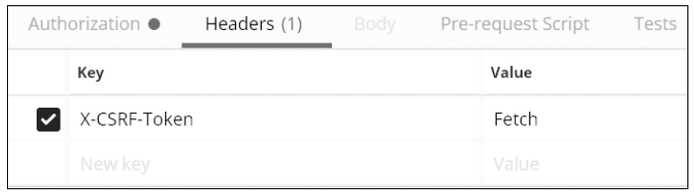

Figure 9.39 Adding the X-CSRF-Token Header

Click the **Send** button (shown earlier in Figure 9.38 in the top right) to trigger the request. The response message includes a number of headers, including the X-CSRF token, which can be identified by the label `X-CSRF-Token` under the **Headers** tab, as shown in Figure 9.40.

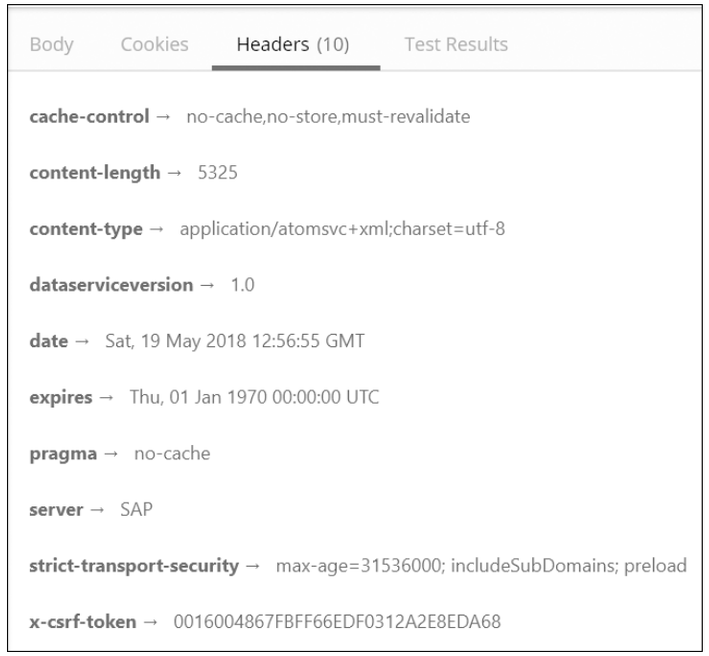

Figure 9.40 X-CSRF-Token in the Headers Tab

You can now use value of the X-CSRF token in the header of your next OData API request. Furthermore, the body of the response message is filled with a list of entity types that the X-CSRF token can be used with. In other words, the scope of the X-CSRF token is limited to the entity types listed in the response, as shown in Figure 9.41.

In the following sections, we'll explore the following different API categories:

- Monitoring message flows using the API
- Managing deployed integration content using the API
- Managing log files using the API
- Managing the message store using the API
- Managing security material using the API
- Managing the Partner Directory using the API

Let's start with message flow APIs.

Body Cookies Headers (10) Test Results Status

Pretty Raw Preview XML

```
1  <?xml version="1.0" encoding="utf-8"?>
2  <service xml:base="https://p0262-tmn.hci.eu1.hana.ondemand.com:443/api/v1/" xmlns="http://www.w3.org/2
       :atom="http://www.w3.org/2005/Atom">
3      <workspace>
4          <atom:title>Default</atom:title>
5          <collection href="Configurations">
6              <atom:title>Configurations</atom:title>
7          </collection>
8          <collection href="LogFileArchives">
9              <atom:title>LogFileArchives</atom:title>
10         </collection>
11         <collection href="IntegrationRuntimeArtifacts">
12             <atom:title>IntegrationRuntimeArtifacts</atom:title>
13         </collection>
14         <collection href="MessageProcessingLogCustomHeaderProperties">
15             <atom:title>MessageProcessingLogCustomHeaderProperties</atom:title>
16         </collection>
17         <collection href="CertificateResources">
18             <atom:title>CertificateResources</atom:title>
19         </collection>
20         <collection href="KeystoreEntries">
21             <atom:title>KeystoreEntries</atom:title>
22         </collection>
```

Figure 9.41 Response Body Associated with the X-CSRF Token

9.5.3 Monitoring Message Flows Using the API

In Chapter 8, Section 8.2.3, we described how you can monitor message processing. In APIs related to monitoring message flows, the following entity types play key roles:

- `MessageProcessingLogs`
  Entity responsible for MPLs. This entity is the main and parent entity of the API. From this entity, you can navigate to all other entities.
- `MessageProcessingLogAdapterAttributes`
  Encapsulates the adapter attributes of the MPL of a specified message entry. This entity includes details such as the type of adapter used in the related integration flow.
- `MessageProcessingLogAttachments`
  Contains attachments of the MPL related to a specified message entry.
- `MessageProcessingLogCustomHeaderProperties`
  Contains custom header properties of MPLs related to a specified message entry.
- `MessageProcessingLogErrorInformation`
  Contains error information for the message related to a specified message entry.

Many APIs are included in these entities. Describing all of these APIs in detail is beyond the scope of this chapter. However, you can find extensive details and examples in the SAP documentation at *http://s-prs.co/507755*. You can also explore these APIs via the SAP API Business Hub at *http://s-prs.co/507756*.

Figure 9.42 shows the entities and APIs available for MPLs. You can test and explore each API using one of the testing approaches we explored in Section 9.5.1.

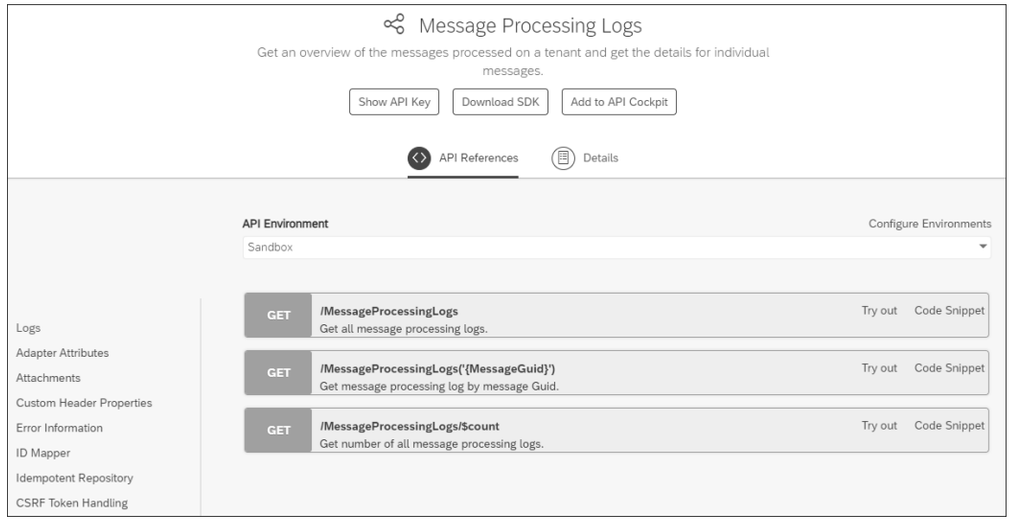

Figure 9.42 Entity Types and APIs in the MPLs

Let's walk through an example scenario to illustrate some functionalities and the usage of APIs related to the monitoring of message flows.

We'll assume that your organization uses many integration platforms, including SAP Process Orchestration, SAP Cloud Platform Integration, and other third-party platforms. You've been asked to build a custom dashboard monitoring solution so that users can see, at a glance, statistics and lists of messages failing in the various integration platforms. The advantage of this dashboard is that the user won't need to log on to each of these platforms individually. Instead, after logging on to the custom dashboard, the user will see errors as they occur on all integration platforms.

How you can programmatically retrieve the relevant information from the MPLs in SAP Cloud Platform Integration and find the entries with errors? Monitoring message flows APIs come to the rescue.

To solve this challenge, you'll need an API that retrieves all MPLs in an error state from the last hour, which will require the use of the `MessageProcessingLogs` entity. One potential solution is to use the following OData endpoint:

```
https://<tokenurl>/api/v1/MessageProcessingLogs?$inlinecount=allpages&$filter=
Status eq  'FAILED ' and LogStart gt datetime '2020-05-24T12:00:00 ' and LogEnd
lt datetime '2020-05-24T13:00:00 '&$expand=AdapterAttributes
```

Let's examine this OData endpoint with the help of the attributes listed in Table 9.12 to understand what's happening. (Note that some attributes described in Table 9.12 were also previously explained in Table 9.6.)

API Endpoint Element	Description	Example
MessageProcessingLogs	Retrieves MPL entries.	MessageProcessingLogs
inlinecount	Indicates that the response should contain a count of the number of entries in the returned collection.	allpages
filter	Filters the result based on various criteria. In the example column, we're filtering for all messages that have the status **Failed**. Additionally, we're filtering for all message logs that have been created between 29/04/2018 at 12:00:00 and 29/04/2018 at 13:00:00.	Status eq 'FAILED' and LogStart gt datetime'2018-04-29T12:00:00' and LogEnd lt datetime'2018-04-29T13:00:00'
expand	Retrieves correlated entities for a given navigation. In our case, we also want to retrieve adapter-specific attributes.	AdapterAttributes

Table 9.12 Attributes Included in the OData Endpoint to Retrieve Entries with Errors

After calling the OData endpoint that solves our challenge, you'll get the response message shown in Listing 9.2.

```
<feed xmlns="http://www.w3.org/2005/Atom" xmlns:m="http://schemas.microsoft.com/
ado/2007/08/dataservices/metadata" xmlns:d="http://schemas.microsoft.com/ado/
2007/08/dataservices" xml:base="https://p0262-tmn.hci.eu1.hana.ondemand.com:443/
api/v1/">
<id>
https://p0262-tmn.hci.eu1.hana.ondemand.com:443/api/v1/MessageProcessingLogs
</id>
<title type="text">MessageProcessingLogs</title>
<updated>2018-04-29T12:58:12.413Z</updated>
<author>
<name/>
</author>
<link href="MessageProcessingLogs" rel="self" title="MessageProcessingLogs"/>
```



```
<m:count>1</m:count>
<entry>
<id>
https://p0262-tmn.hci.eu1.hana.ondemand.com:443/api/v1/
MessageProcessingLogs('Afr1v7POJUYGSI2bXJAGRQ74HMyP')
</id>
<title type="text">MessageProcessingLogs</title>
<updated>2018-04-29T12:58:12.413Z</updated>
<category term="com.sap.hci.api.MessageProcessingLog" scheme="http://
schemas.microsoft.com/ado/2007/08/dataservices/scheme"/>
<link href="MessageProcessingLogs('Afr1v7POJUYGSI2bXJAGRQ74HMyP')" rel="edit"
title="MessageProcessingLog"/>
<link href="MessageProcessingLogs('Afr1v7POJUYGSI2bXJAGRQ74tiHyP')/
CustomHeaderProperties" rel="http://schemas.microsoft.com/ado/2007/08/
dataservices/related/CustomHeaderProperties" title="CustomHeaderProperties"
type="application/atom+xml;type=feed"/>
<link href="MessageProcessingLogs('Afr1v7POJUYGSI2bXJAGRQ74HMyP')/
MessageStoreEntries" rel="http://schemas.microsoft.com/ado/2007/08/dataservices/
related/MessageStoreEntries" title="MessageStoreEntries" type="application/
atom+xml;type=feed"/>
<link href="MessageProcessingLogs('Afr1v7POJUYGSI2bXJAGRQ74tiHyP')/
ErrorInformation" rel="http://schemas.microsoft.com/ado/2007/08/dataservices/
related/Errorinformation" title="Errorinformation" type="application/
atom+xml;type=entry"/>
<link href="MessageProcessingLogs('Afr1v7POJUYGSI2bXJAGRQ74HMyP')/
AdapterAttributes" rel="http://schemas.microsoft.com/ado/2007/08/dataservices/
related/AdapterAttributes" title="AdapterAttributes" type="application/
atom+xml;type=feed">
<m:inline>...</m:inline>
</link>
<link href="MessageProcessingLogs('Afr1v7POJUYGSI2bXJAGRQ74tiHyP')/Attachments"
rel="http://schemas.microsoft.com/ado/2007/08/dataservices/related/Attachments"
title="Attachments" type="application/atom+xml;type=feed"/>
<link href="MessageProcessingLogs('Afr1v7POJUYGSI2bXJAGRQ74HMyP')/Runs"
rel="http://schemas.microsoft.com/ado/2007/08/dataservices/related/Runs"
title="Runs" type="application/atom+xml;type=feed"/>
<content type="application/xml">
    <m:properties>
                <d:MessageGuid>Afr1v7POJUYGSI2bXJAGRQ74HMyP</d:MessageGuid>
         <d:CorrelationId>Afr1v7MGmzLrpFr0xqOolvAcig5Y</d:CorrelationId>
        <d:ApplicationMessageId m:null="true"/>
        <d:ApplicationMessageType m:null="true"/>
        <d:LogStart>2018-04-29T12:50:59.723</d:LogStart>
        <d:LogEnd>2018-04-29T12:51:00.12</d:LogEnd>
```

```
        <d:Sender>Sender_SOAP</d:Sender>
        <d:Receiver m:null="true"/>
         <d:IntegrationFlowName>Invoking_OData</d:IntegrationFlowName>
        <d:Status>FAILED</d:Status>
        <d:AlternateWeblink>...</d:AlternateWeblink>
        <d:IntegrationArtifact m:type="com.sap.hci.api.IntegrationArtifact">
            <d:Id>Invoking_OData</d:Id>
            <d:Name>Invoking OData</d:Name>
            <d:Type>INTEGRATION_FLOW</d:Type>
        </d:IntegrationArtifact>
        <d:LogLevel>INFO</d:LogLevel>
        <d:CustomStatus>FAILED</d:CustomStatus>
</m:properties>
</content>
</entry>
</feed>
```

Listing 9.2 Response of the OData Endpoint Call

When examining the response message shown in Listing 9.2, you'll notice an element named `entry`, which represents a log entry in the message monitor. Note that, if multiple entries are returned, the entries are sorted in descending order (with the oldest entry on the top) by default. The entries returned in this response can also be found in the SAP Cloud Platform Integration Web UI, on the **Monitor** page.

In addition, notice that the entry shown in Listing 9.2 has a `MessageGuid` with a value `AFrlv7POJUYGSI2bXJAGRQ74HMyP`. The same entry can also be found in the **Monitor Message Processing** section of SAP Cloud Platform Integration, shown in Figure 9.43, next to the **Message ID** field. Also note that the response message has a field labeled `count`, which specifies the number of returned entries. Furthermore, note that the field `IntegrationFlowName` has the value `Invoking_OData`, which will be of use later in Section 9.5.4.

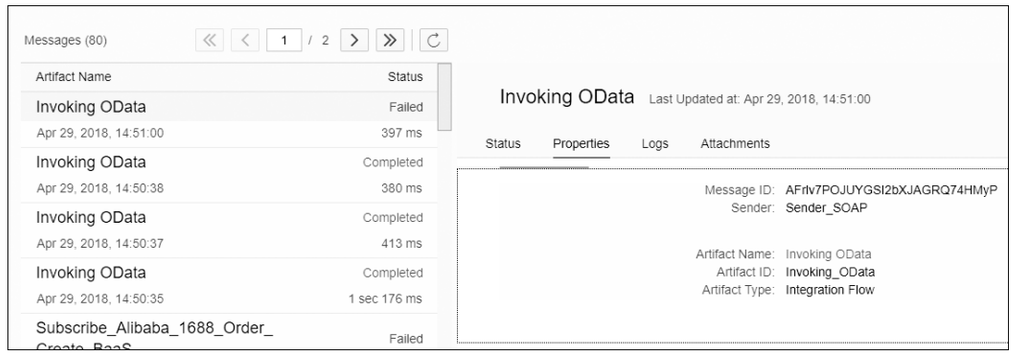

Figure 9.43 MPLs in SAP Cloud Platform Integration

The entry returned in the OData API call contains a number of properties, as shown earlier in Listing 9.2. Table 9.13 lists the `MessageProcessingLogs` properties and their descriptions.

Property	Description
`MessageGuid`	GUID of the message that the processing log concerns.
`CorrelationId`	GUID of the correlated messages.
`ApplicationMessageId`	GUID specific to a particular application. Think about this value as an identifier set for the sake of identification by an external application. This value can be set using a **Content Modifier** step and assigning a value to the `SAP_ApplicationID` header element.
`ApplicationMessageType`	Property to represent a type of message as known by a business application. Use a **Script** step in the integration flow to set this property.
`LogStart`	Date and time that the writing of the log started.
`LogEnd`	Date and time that the writing of the log ended.
`Sender`	Identifier of the sender system.
`Receiver`	Identifier of the receiver system.
`IntegrationFlowName`	Name of the integration flow.
`Status`	Status of the message processing. Currently, the following statuses are possible: **COMPLETED**, **PROCESSING**, **RETRY**, **ERROR**, **ESCALATED**, and **FAILED**.
`AlternateWebLink`	Link used to directly open the MPL on this monitoring entry.
`IntegrationArtifact/Id`	Technical name or ID of the integration flow.
`IntegrationArtifact/Name`	Name of the integration flow. This value is identical to the `IntegrationFlowName` property.
`IntegrationArtifact/Type`	Type of artifact that this message processing concerns, for example, `INTEGRATION_FLOW`.

Table 9.13 Properties of the MessageProcessingLogs

In the following sections, we'll continue with our OData API journey by exploring APIs that relate to deployed integration content.

9.5.4 Managing Deployed Integration Content Using the API

Using the OData APIs provided by SAP Cloud Platform Integration, you can query the content of integration artifacts deployed on a tenant. The APIs that access the deployed integration content revolve around the following entity types:

- **`IntegrationRuntimeArtifact`**
  Manages all deployed integration artifacts in the tenant. It's also possible to use the `POST` method to deploy an artifact from the file system. Additionally, an already deployed artifact can be undeployed using the `DELETE` method.
- **`IntegrationRuntimeArtifactsErrorInformation`**
  Holds error information of a specific deployed integration artifact.
- **`CSRF Token Handling`**
  Holds the X-CSRF token for this session. The X-CSRF token is only required for write access (as discussed in Section 9.5.2).

Too many APIs use these entities to discuss them all in this chapter. However, you can find extensive details and examples in the SAP documentation at *http://s-prs.co/507757*. You can also explore these APIs via the SAP API Business Hub at *http://s-prs.co/507758*.

Figure 9.44 shows the entities and APIs available. You can test and explore each API using one of the testing approaches we explored in Section 9.5.1.

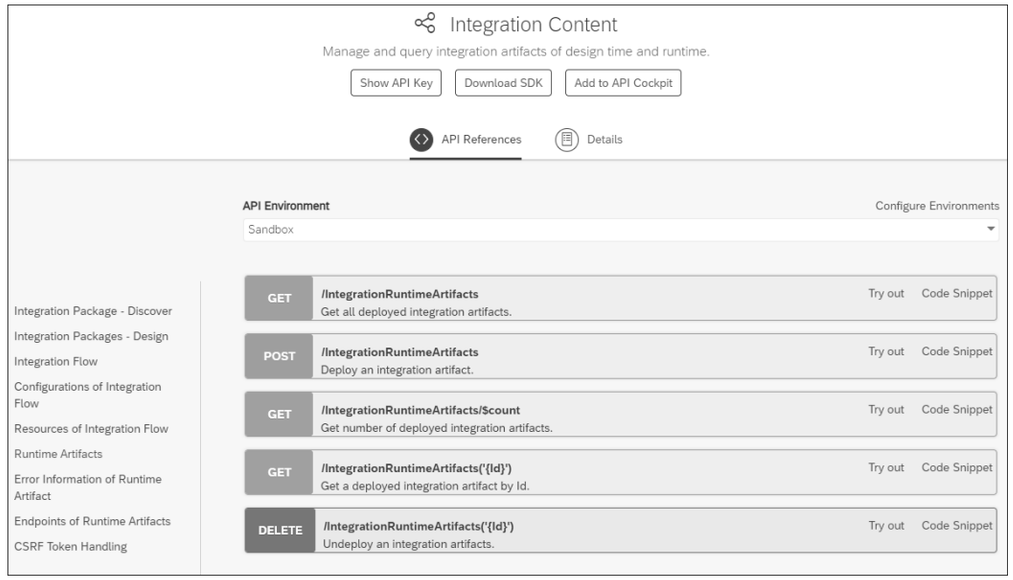

Figure 9.44 Entity Types and APIs Related to Deployed Integration Content

Let's further enhance the example scenario from Section 9.5.3 to illustrate the usage and functionalities for managing deployed integration content. In the previous

section, we retrieved an entry with an error using the APIs for MPLs. Imagine that, after retrieving and displaying an entry with an error in your custom dashboard, you now also want to see details about the related deployed integration content. Perhaps, you're interested to know the name, status, and version of the deployed content, as well as the user who deployed it and when.

To solve this challenge, you'll need to use the `IntegrationRuntimeArtifact` entity. One solution is to use the following OData endpoint:

https://< tokenurl>/api/v1/IntegrationRuntimeArtifacts('Invoking_OData').

Note the value `Invoking_OData` was retrieved from the field `IntegrationFlowName` within the `content` node, as shown in Listing 9.2.

The resulting response of the preceding OData endpoint is shown in Figure 9.45.


```
▼<entry xmlns="http://www.w3.org/2005/Atom" xmlns:m="http://schemas.microsoft.com/ado/2007/08/dataservices/metadata"
 xmlns:d="http://schemas.microsoft.com/ado/2007/08/dataservices" xml:base="https://p0262-tmn.hci.eu1.hana.ondemand.com:443/api/v1/">
  ▼<id>
     https://p0262-tmn.hci.eu1.hana.ondemand.com:443/api/v1/IntegrationRuntimeArtifacts('Invoking_OData')
   </id>
   <title type="text">IntegrationRuntimeArtifacts</title>
   <updated>2018-04-29T15:49:08.406Z</updated>
   <category term="com.sap.hci.api.IntegrationRuntimeArtifact" scheme="http://schemas.microsoft.com/ado/2007/08/dataservices/scheme"/>
   <link href="IntegrationRuntimeArtifacts('Invoking_OData')" rel="edit" title="IntegrationRuntimeArtifact"/>
   <link href="IntegrationRuntimeArtifacts('Invoking_OData')/$value" rel="edit-media" type="application/octet-stream"/>
   <link href="IntegrationRuntimeArtifacts('Invoking_OData')/ErrorInformation"
   rel="http://schemas.microsoft.com/ado/2007/08/dataservices/related/ErrorInformation" title="ErrorInformation"
   type="application/atom+xml;type=entry"/>
   <content type="application/octet-stream" src="IntegrationRuntimeArtifacts('Invoking_OData')/$value"/>
  ▼<m:properties>
     <d:Id>Invoking_OData</d:Id>
     <d:Version>1.0.0</d:Version>
     <d:Name>Invoking OData</d:Name>
     <d:Type>INTEGRATION_FLOW</d:Type>
     <d:DeployedBy>S0011540061</d:DeployedBy>
     <d:DeployedOn>2018-04-28T21:11:25.951</d:DeployedOn>
     <d:Status>STARTED</d:Status>
   </m:properties>
 </entry>
```


Figure 9.45 Response of the OData Endpoint Call

Note that every `<entry>` element returned in the response shown in Figure 9.45, represents an artifact in SAP Cloud Platform Integration. In our case, we only have one entry returned. The `properties` element of the response message shown in Figure 9.45 includes a number of attributes to describe the deployed integration content. These properties are listed in Table 9.14.

Attributes	Description
`Id`	Technical identification of the integration content.
`Version`	Latest version of the integration content when deployed.
`Name`	Name of the integration
`Type`	Type of artifact that this message processing concerns. Possible values include `INTEGRATION_FLOW`, `VALUE_MAPPING`, `DATA_INTEGRATION`, and `ODATA_SERVICE`.

Table 9.14 Properties Available for the Deployed Integration Content OData API

Attributes	Description
DeployedBy	Name of the user who deployed the content.
DeployedOn	Date and time that the integration content was last deployed.
Status	Current status of deployed integration content. Possible values include STARTED, STARTING, and ERROR.

Table 9.14 Properties Available for the Deployed Integration Content OData API (Cont.)

In the next section, we'll explore APIs that relate to log files.

9.5.5 Managing Log Files Using the APIs

Using the OData APIs provided by SAP Cloud Platform Integration, you can query log files on a tenant. Note that, at the time of this writing, the Log Files API is only available in the Neo environment and not yet in Cloud Foundry.

Note that log files come in two types:

- **Default trace**
  These log files include processing information of a technical nature.
- **HTTP access logs**
  These log files include information about all inbound HTTP requests arriving in SAP Cloud Platform Integration.

The APIs that facilitate the access to log files revolve around two main entity types:

- **LogFileArchives**
  Used for all archived log files.
- **LogFiles**
  Used for all current (nonarchived) log files.

These entities include a number of APIs. We won't explore them all in this section, but we'll look at a scenario to showcase what's possible. To get a full description of the different APIs, refer to the SAP documentation at *http://s-prs.co/507759*. You can also explore these APIs via the SAP API Business Hub at *http://s-prs.co/507760*.

Figure 9.46 shows the available entities and APIs. You can test and explore each API using one of the testing approaches we explored in Section 9.5.1.

Let's return to our example scenario to illustrate the usage and functionalities of APIs relating to log files. In Section 9.5.3, we retrieved an entry with an error using the MPL API. Imagine that you want to further troubleshoot the error from your custom dashboard. For this task, you want to download a copy of all log files of type HTTP around the time that the error occurred. Note that the error occurred around 12:51, as indicated by the LogStart field shown earlier in Listing 9.2.

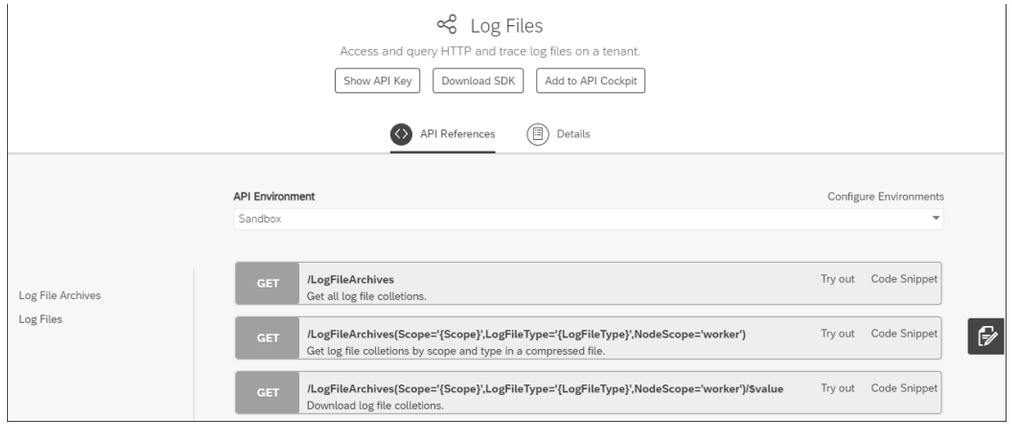

Figure 9.46 Entity Types and APIs Related to Log Files

To solve this challenge, we can use the LogFileArchives entity by invoking the following OData endpoint:

https://<tokenurl>/api/v1/LogFileArchives(Scope='all',LogFileType='http',NodeScope='worker')/$value?modifiedAfter=2018-04-29T12:50:00Z

Let's now examine this OData endpoint in detail to understand what is happening, referring to the details listed in Table 9.15.

Endpoint Attribute	Description
LogFileArchives	Entity used to retrieve an archived log file.
Scope	Indicates which scope/type of log files you want to download. Possible values include all (to download all existing HTTP log files) and latest (to only retrieve the latest HTTP log files).
LogFileType	Filters the result based on the type of log file. Possible values include http and Trace.
NodeScope	Specifies that we're only interested in retrieving log files from runtime nodes (also referred to as worker nodes).
value	Specifies that the next parameter in the URL will contain parameter values.
modifiedAfter	Specifies the time after which the filtered log file was changed.

Table 9.15 Attributes Included in the OData Endpoint to Log Archive Entries

Note that you must have the role IntegrationOperationServer.read assigned to your user to call log file APIs.

In the next section, we'll explore APIs that relate to the message store.

9.5.6 Managing Message Store Entries Using APIs

Using the OData APIs provided by SAP Cloud Platform Integration, you can access the tenant's message store entries. In scenarios with the requirement to persist messages, message content can be written and saved in the message store using the **Persist Message** step of an integration flow. You can then access the stored message and analyze it later. However, note that a message is stored on the runtime for a maximum of 90 days. After this time, the message is automatically deleted.

> **Note**
> At the time of this writing, no user interface (UI) available for the message store. The OData API is the only option for accessing the content of a message store.

For each entry in a message store, you can retrieve its properties, headers, payload, and attachments. The APIs that access message stores revolve around the following four main entity types:

- `MessageStoreEntries`
  Used to manage message store entries.
- `MessageStoreEntryProperties`
  Used to manage properties of message store entries.
- `MessageStoreEntryAttachments`
  Used to manage attachments from a specific message store entry.
- `MessageStoreEntryAttachmentProperties`
  Used to manage properties of an attachment in the message store.

Referring to the entity model diagram shown earlier in Figure 9.19, notice that a direct relationship exists between a message store entry (represented by the entity type `MessageStoreEntries`) and `MessageProcessingLogs`. This relationship means that, for every entry in the processing log with an attachment, you can try to retrieve its related message store entries (if available).

In this section, we won't explore all APIs involving in the entities listed earlier, but we'll look at a scenario to showcase what is possible. To get a full description of the different APIs, refer to the SAP documentation at *http://s-prs.co/507761*. You can also explore these APIs via the SAP API Business Hub at *http://s-prs.co/507762*.

Figure 9.47 shows the entities and APIs available. You can test and explore each one of these APIs using the testing approaches we explored in Section 9.5.1.

Note that you must have the role `esbmessagestorage.read` assigned to your user to call message store APIs.

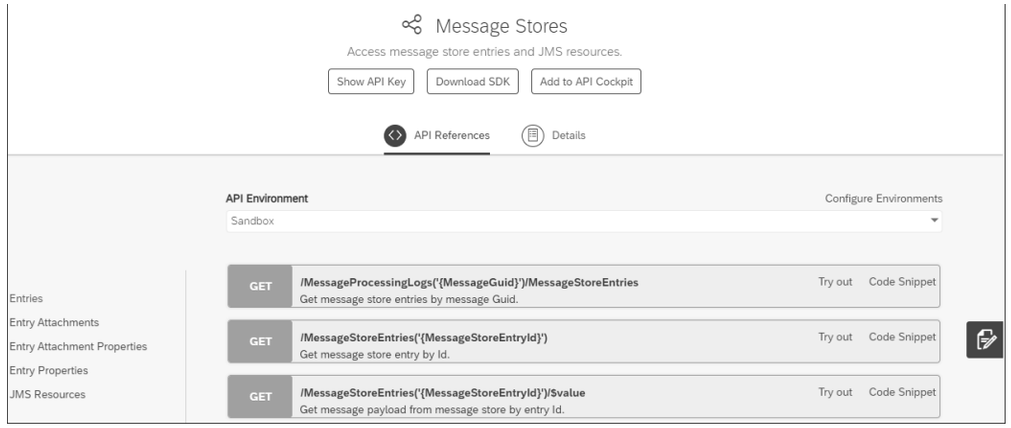

Figure 9.47 Entity Types and APIs Related to the Message Store

Consider the message aggregation scenario we explored in Chapter 4, Section 4.6. In that scenario, we aggregated correlated messages. Imagine that, after the aggregation process is finished, we want to persist the final aggregated payload in the message store. We can write the payload to the message store using the **Persist Message** step to our integration flow.

To start developing this integration flow, follow these steps:

1. On the **Design** page of SAP Cloud Platform Integration, open the integration flow that we created in Chapter 4, Section 4.6.
2. Switch to the edit mode by clicking the **Edit** button in the top-right corner of the integration flow screen.
3. Add the **Persist Message** step to the integration flow. The **Persist** step can be found in the palette on the left, as shown in Figure 9.48.

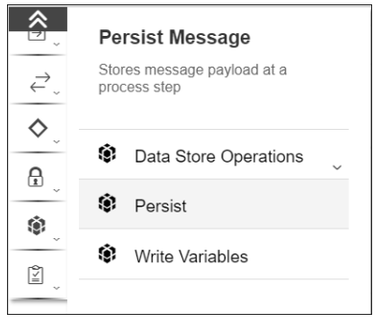

Figure 9.48 Selecting the Persist Step from the Palette

4. Ensure that the **Step ID** of the newly added step is unique. The final integration flow should be similar to the processes shown in Figure 9.49 and Figure 9.50. Note that,

according to our integration flow, the message store is only populated after all messages have been collected because the **Persist** step comes after the **Aggregator** step.

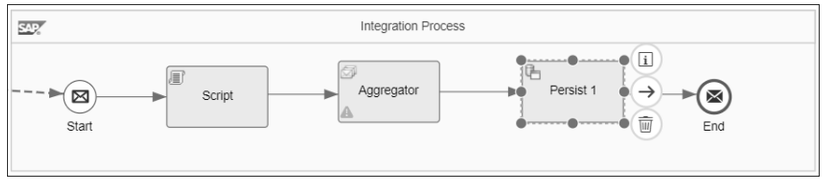

Figure 9.49 Overview of the Integration Flow Extended with a Persist Step A

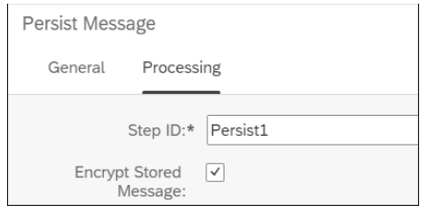

Figure 9.50 Overview of the Integration Flow Extended with a Persist Step B

5. Save and deploy the integration flow.

Now, let's assume that, in our custom dashboard application that we started building in Section 9.5.3, we want to be warned if a failed message flow contains entries in the message store. In this case, you'll retrieve the payload of the entry in the message store.

To retrieve the payload of the entry in the message store, you'll need to call several OData APIs in the following sequence:

1. Use `MessageProcessingLogs` to retrieve the list of failing messages. You already know how to query for failed messages from our discussion in Section 9.5.3.
2. Use the message `Guid` of the message retrieved from the first call to make a second call to query if there are message store entries for messages with the specified message `Guid`. In this step, you can use the following endpoint:

   https://<tenant>/api/v1/MessageProcessingLogs('<Guid>')/MessageStoreEntries

   The response of the API call is shown in Listing 9.3.

   ```
   <content type="application/octet-stream" src="MessageStoreEntries("sap-it-
   res%3Amsg%3Aac965bd8f%3Abe694f69-73a5-4430-b681-1673c963fd4c")/$value"/>
   ```

   Listing 9.3 Response of the OData API Call

3. Retrieve the payload of the entry in the message store. Looking at the entry returned in Listing 9.3, notice the `src` attribute of the `content` element. The value of this attribute provides details regarding how to retrieve the payload. In this example, use the following link to retrieve the payload:


```
https://<tokenurl>/api/v1/MessageStoreEntries('sap-it-
res%3Amsg%3Aac965bd8f%3Abe694f69-73a5-4430-b681-1673c963fd4c')/$value
```

Note that, in this URL, the value between */v1/* and */$value* is copied from the `src` attribute of Listing 9.3. The API returns the aggregated payload as shown in Figure 9.51.

```
<?xml version="1.0" encoding="UTF-8"?><multimap:Messages xmlns:multimap="http://sap.com/xi/XI/SplitAndMerge"><multimap:Message1>
<OrderItem xmlns:demo="http://hci.sap.com/demo" xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/">
         <orderNumber>AA2345</orderNumber>
         <Item>
            <ItemNo>1</ItemNo>
            <Quantity>1</Quantity>
            <Unit>1</Unit>
            <LastStatus>false</LastStatus>
         </Item>
      </OrderItem><OrderItem xmlns:demo="http://hci.sap.com/demo" xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/">
         <orderNumber>AA2345</orderNumber>
         <Item>
            <ItemNo>2</ItemNo>
            <Quantity>5</Quantity>
            <Unit>1</Unit>
            <LastStatus>false</LastStatus>
         </Item>
      </OrderItem><OrderItem xmlns:demo="http://hci.sap.com/demo" xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/">
         <orderNumber>AA2345</orderNumber>
         <Item>
            <ItemNo>3</ItemNo>
            <Quantity>25</Quantity>
            <Unit>1</Unit>
            <LastStatus>true</LastStatus>
         </Item>
      </OrderItem></multimap:Message1></multimap:Messages>
```

Figure 9.51 Aggregated Payload Returned by the Message Store API

Now that you know how to use the message store API, let's explore the OData APIs related to security materials.

9.5.7 Managing Security Material Using the API

Using the OData APIs provided by SAP Cloud Platform Integration, we can access keystore content and other security-related artifacts, for example, **User Credentials** artifacts. This API contains a lot of features that can't all be explored in this section.

For a full description of the different APIs available for managing security material, refer to the SAP documentation via *http://s-prs.co/507763*.

To give you an idea of how to use these APIs, let's work through an example scenario to illustrate its usage. Let's assume that you want your keystore entries to be automatically backed up at the end of each month. Given that you don't want to perform this activity manually every month, you're looking for some way to automate the process via your custom dashboard application. (Note that we discussed the topic of keystores in detail in Chapter 8, Section 8.3.2.)

You can easily achieve this automation task by getting your custom application to call the Security Material API. More specifically, you can use an API that enables backs up all keystore entries via the endpoint:

https://<tokenurl>/api/v1/KeystoreResources

Note that you'll need to use a POST method for this request. Listing 9.4 shows an example request. You can also include, in the request, the query option indicated in Table 9.16.

```
{"Name":"backup_admin_system"}
```

Listing 9.4 Example Request Body to Back Up Keystore Entries

Query Option	Description
returnKeystoreEntries	Possible values include true and false. When set to true, the KeystoreEntry instances that have been backed up are returned in the response. Note that this query is optional and defaults to false.

Table 9.16 Possible Query Option for Renaming an Alias

Because the keystore OData API is protected against CSRF attacks, you must first fetch an X-CSRF token before you can make this API call. (We explored how to fetch X-CSRF tokens in Chapter 7, Section 7.4.3.)

Let's now explore APIs that relate to managing the Partner Directory in the next section.

9.5.8 Managing the Partner Directory Using the API

In Chapter 7, Section 7.4, we introduced you to the tenant Partner Directory. We described how, during a business-to-business (B2B) project, an SAP Cloud Platform Integration owner might decide to build an application where partners involved in the scenario can maintain their own configuration data.

At the time of this writing, Partner Directory information can only be maintained via an OData API. The HTTP addresses required to make outbound calls to the partner systems are examples of the type of data stored in the Partner Directory.

Assuming that the purpose of the Partner Directory is clear to you, we'll now focus on using the Partner Directory OData APIs provided by SAP Cloud Platform Integration. These APIs access the Partner Directory, create entries, and help manage them. These APIs revolve around the following entity types:

- AlternativePartners
- AuthorizedUsers
- BinaryParameters
- Partners
- StringParameters
- UserCredentialParameters
- CSRF Token Handling

Updated details about these APIs can be found via the SAP API Business Hub at *https://api.sap.com/api/PartnerDirectory*.

Figure 9.52 shows the entities and APIs available. You can test and explore each of these APIs using one of the testing approaches we explored in Section 9.5.1.

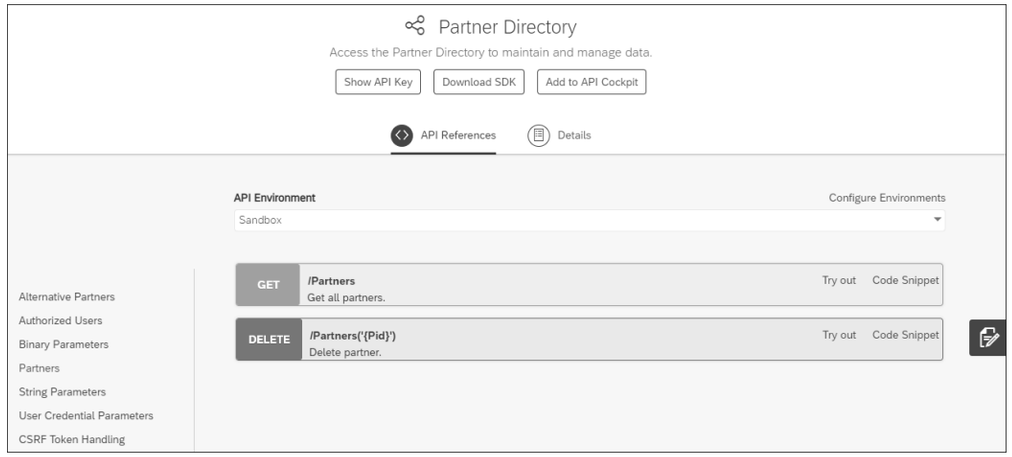

Figure 9.52 Entity Types and APIs Related to the Partner Directory

To get an idea of how to use these APIs, refer to the sample scenario in Chapter 7, Section 7.4. That scenario used the OData API to store an endpoint URL and a credential alias in Partner Directory. We therefore won't repeat these details in this section.

Note

Be aware of the following Partner Directory limitations:

- The number of AlternativePartners in the tenant is limited to a maximum of 1,000,000.
- The number of AuthorizedUsers in the tenant is limited to a maximum of 500,000.
- The number of BinaryParameters in the tenant is limited to a maximum of 400,000.
- The number of StringParameters in the tenant is limited to a maximum of 3,000,000.

9.6 Using SAP Cloud Platform Integration with SAP Cloud Platform API Management

In the past, APIs were mostly only known to programmers, but in today's digital era, even business executives are aware of APIs and their potential financial impacts. In a digitized world, many companies are generating revenue by exposing their APIs to business partners, suppliers, and customers like they would for any other service offering.

Companies likes Amazon, Facebook, Twitter, Netflix, Uber, and Google are generating huge revenues based on their APIs. So, chances are high that APIs will play a key role in the digital transformation journey of your organization. Today, APIs are managed like traditional products!

SAP Cloud Platform API Management (SAP API Management) is, next to SAP Cloud Platform Integration, a key constituent of the SAP Cloud Platform Integration Suite. The SAP API Management solution can help you in your digital transformation journey by providing simple, scalable, and secure access to your organization's digital assets through APIs. SAP API Management enables developer communities to consume and discover your organization's APIs. Refer to *http://s-prs.co/5077119* to read more about SAP Cloud Platform API Management.

Some key capabilities of SAP API Management, include the following features, just to name a few:

- The ability to provision APIs via REST, OData, and SOAP in a standardized and consistent way
- Real-time and historic analytics on API usage, errors, monitoring, and traffic
- High security standards for the APIs to prevent against attacks such as denial-of-service (DoS) attacks, cross-site scripting (XSS), cross-site request forgery (CSRF), and so on
- Robust traffic management of APIs
- Full API lifecycle management
- Management, discovery, testing, subscription, and consumption of APIs by the developer community
- Monetization of APIs

Figure 9.53 shows the positioning of SAP API Management within your landscape. Different applications can consume APIs via SAP API Management, which is acting as a gateway. SAP API Management also proxies the calls to the backend systems (which are either on-premise or cloud-based systems). SAP API Management connects to these backend systems via various protocols, such as SOAP, REST, OData, and so on.

Figure 9.53 shows the different personas involved with SAP API Management, such as the following:

- **External applications (mobile, web, etc.)**
  These applications consume the APIs provided by SAP API Management.
- **App developer**
  This developer is responsible for making external applications that consume APIs. This developer must be able to discover existing APIs and easily figure out how to consume them.

- **API developer**
  This person is responsible for designing and implementing APIs via SAP API Management.
- **API admins and owners**
  These people are responsible for administering and managing APIs via monitoring, analyzing, and monetizing processes.

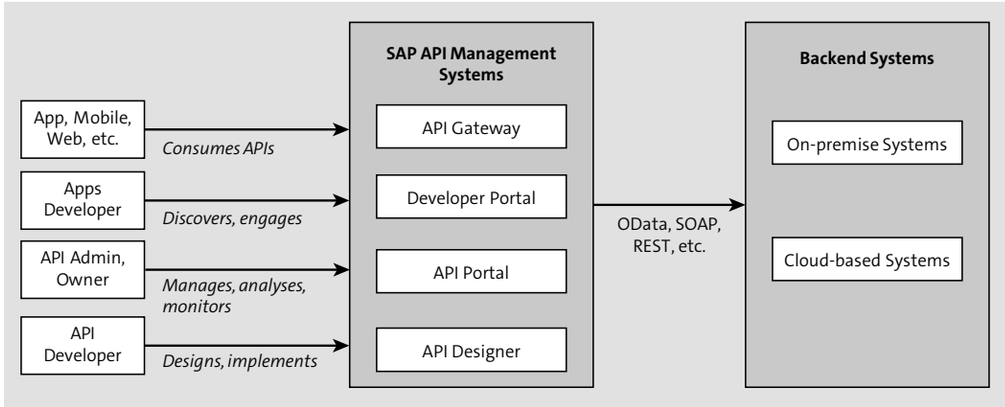

Figure 9.53 Positioning of SAP API Management and Its Personas

The positioning of SAP API Management, as shown in Figure 9.53, also means that SAP API Management can proxy services provided by SAP Cloud Platform Integration, which is the main subject of this section.

SAP API Management is a big topic that deserves its own book. In the following sections, we'll briefly explore how you can use SAP API Management to publish APIs from services provided by SAP Cloud Platform Integration in a secure manner. To find out more about SAP API Management, follow the tutorials available at the SAP Community (*www.sap.com/community.html*).

Note that SAP API Management also sits on top of SAP Cloud Platform and is included in the SAP Cloud Platform Integration, Enterprise Edition, as discussed in Chapter 1, Section 1.4. You can also register for a free trial account at *https://account.hanatrial.ondemand.com/#/home/welcome*.

You might be wondering how SAP API Management and the SAP API Business Hub are different. SAP API Management enables any organization to expose its own APIs. This solution also allows their business partners to discover and consume these APIs in a secure manner. In contrast, SAP API Business Hub allows you to discover, explore, and test the APIs offered by SAP.

After obtaining your SAP API Management tenant, one of your first tasks will be to establish a connection to your SAP Cloud Platform Integration tenant. Let's explore how this task can be achieved next.

9.6.1 Establishing a Connection between SAP Cloud Platform Integration and SAP API Management

Note that connecting SAP API Management to SAP Cloud Platform Integration is a one-time action. After that, this connection can be reused.

To connect SAP API Management to SAP Cloud Platform Integration, follow these steps:

1. Log on to your SAP API Management tenant via the following URL (if you have a trial account):

   https://account.hanatrial.ondemand.com/cockpit.

   The link to the productive account is given in the tenant provisioning email you received from SAP when getting a new tenant.

   If you don't have a trial account, refer to this blog post:

   https://developers.sap.com/tutorials/hcp-apim-enable-service.html
2. Navigate to the **Services** section from the menu on the left, as shown in Figure 9.54.
3. Click on the **API Management** link under the **Integration** section, as shown in Figure 9.54, in the right panel.

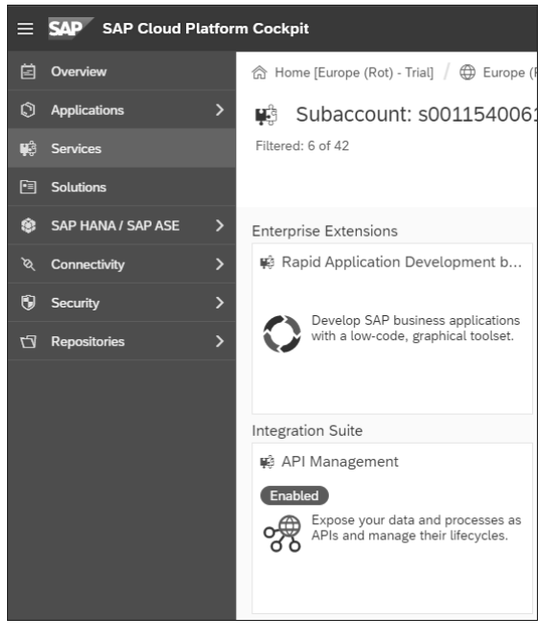

Figure 9.54 Navigating to the SAP API Management Service

4. On the next screen, select the **Access API Portal** link, as shown in Figure 9.55.

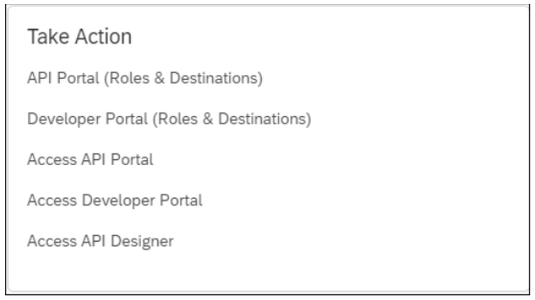

Figure 9.55 SAP API Management Landing Page with an Overview of Possible Actions

5. The next screen presents an overview of the **API Portal** page, which contains information like API traffic, error, usage, performance, applications, and so on. From this page, select **Configure** from the menu on the left, as shown in Figure 9.56.

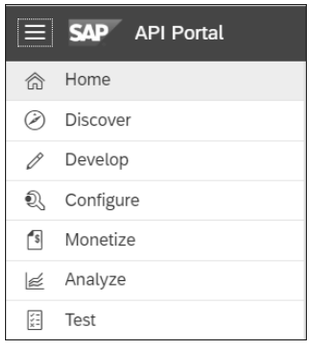

Figure 9.56 Overview of the API Portal

6. On the next page, select the **API Providers** tab, as shown at the top of Figure 9.57. Click the **Create** button to add a new API provider. An API provider represents the backend system that will receive and execute the call.

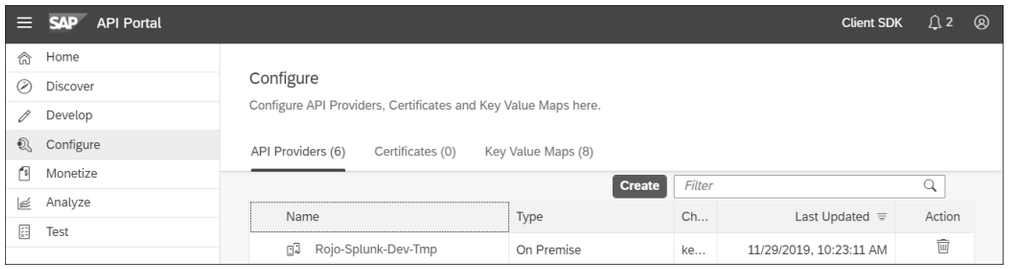

Figure 9.57 API Providers Tab

7. On the next page, provide a name and description for the new API provider, as shown in Figure 9.58.

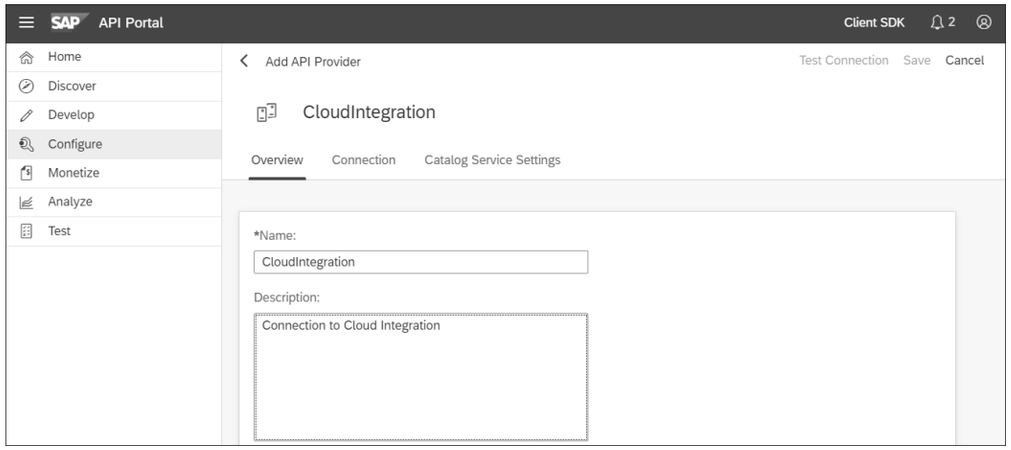

Figure 9.58 Providing a Name and Description

8. Maintain the host name, authentication, and other details related to your SAP Cloud Platform Integration tenant, as shown in Figure 9.59 and Figure 9.60.

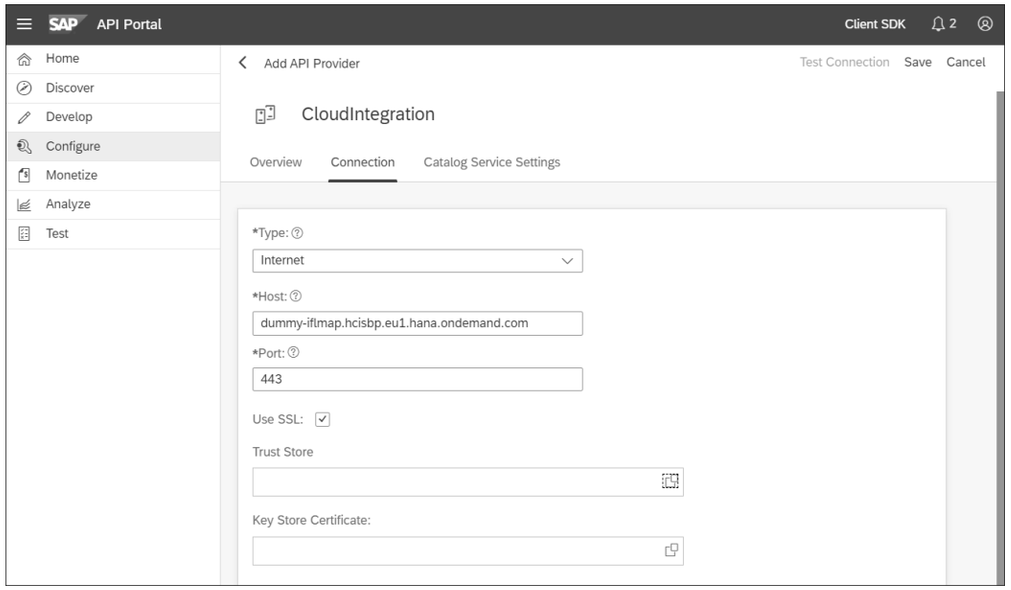

Figure 9.59 Connection Details to the SAP Cloud Platform Integration Tenant

9. Finally, click the **Save** button, as shown in Figure 9.60 in the top-right corner.

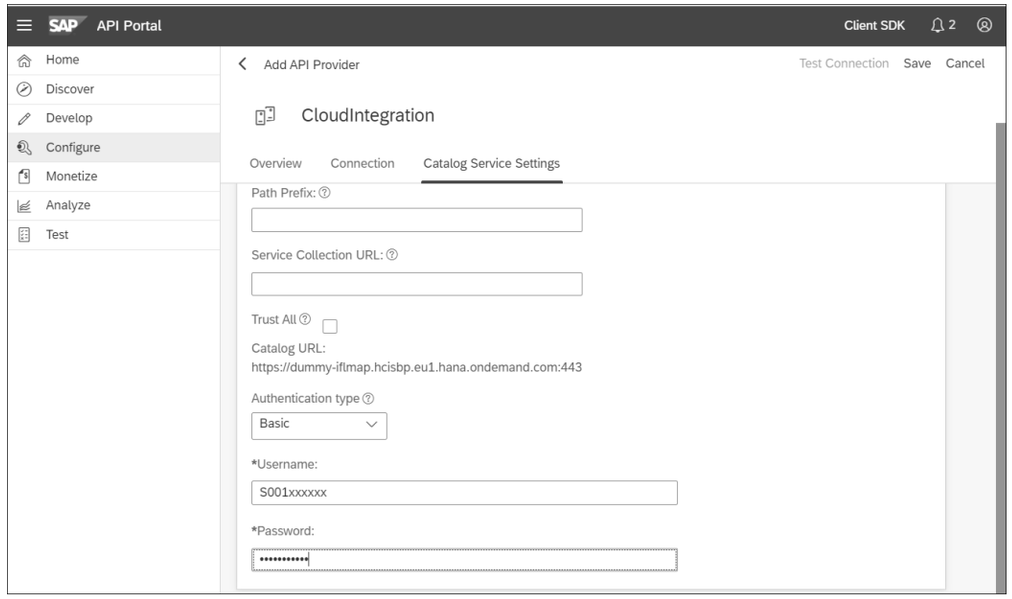

Figure 9.60 Authentication Details for the SAP Cloud Platform Integration Tenant

The connection between SAP API Management and SAP Cloud Platform Integration is now ready. In the next section, we'll explore how to expose an existing integration flow as a REST API.

9.6.2 Provisioning Application Programming Interfaces

Much could be said about the topic of provisioning APIs through SAP API Management. Our intention isn't to provide a guide for SAP API Management in this section, but rather to give you a glimpse of what it can do and how it can work in combination with SAP Cloud Platform Integration to create APIs.

To illustrate the provisioning of an API via SAP API Management, let's once again use our example integration flow built in Chapter 4, Section 4.3. We already used this integration flow in Section 9.3 when exploring the **Script** step (shown earlier in Figure 9.11). This scenario currently exposes a SOAP endpoint. Our goal is to provide this SOAP service as a REST-based API in SAP API Management and apply restrictions to the API by limiting the number of calls per minute. This approach of wrapping an existing service as an API is known as an *API proxy*. REST APIs can accept both JSON or XML as payloads. For simplicity, we'll stick to XML for our scenario. The final end-to-end scenario is shown in Figure 9.61. Because the integration flow already exists in SAP Cloud Platform Integration, we only need to expose it as an API.

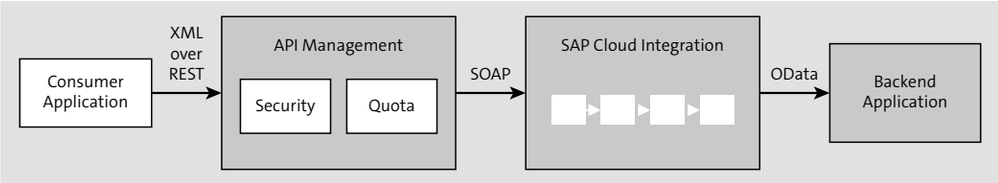

Figure 9.61 End-to-End Overview of Scenario

Let's recall from Chapter 4, Section 4.3, that the endpoint of the concerned integration flow was followed this format:

https://<tenant>/cxf/CPI_Book_Demo_OData

We can now start the provisioning of our API by first navigating to the landing page of SAP API Management, as shown in Figure 9.62. (We described how to get to this page earlier in Section 9.6.1.)

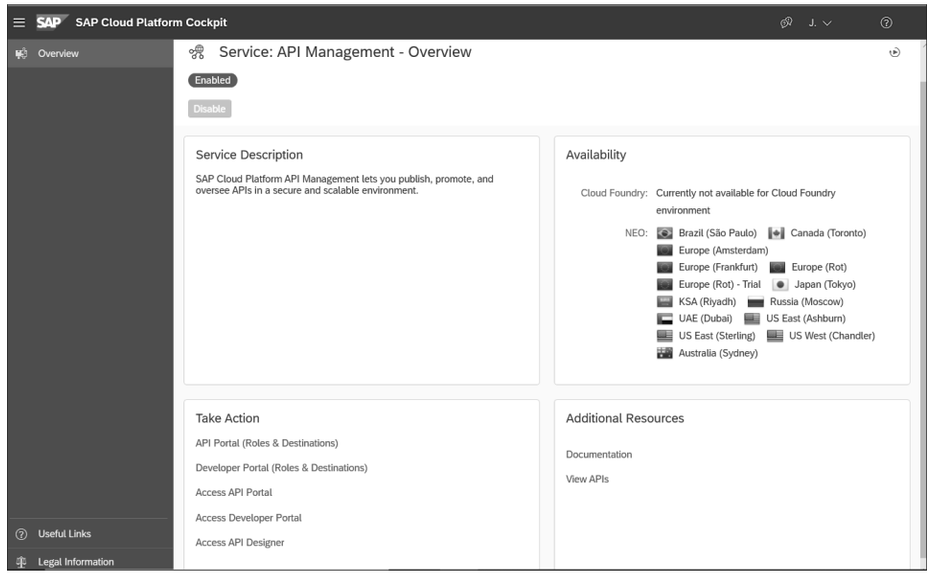

Figure 9.62 SAP API Management: Main Page

As shown in Figure 9.63, the **Take Action** section includes the following options:

- **API Portal (Roles & Destinations)**
  Used to assign roles to users who can create APIs. You can also create destinations to different API providers. A *destination* is an object that contains connection details to a remote system or application. The connection details include the URL of the remote system or service, authentication type, and the user credentials. A destination is defined once and reused throughout the system.

- **Developer Portal (Roles & Destinations)**
  Used to assign roles to users interested in discovering and consuming APIs. (They are also commonly referred to as "developers" from an SAP API Management point of view.) Additionally, from this option, you can create destinations to different API providers.
- **Access API Portal**
  Enables access to various monitoring matrixes about APIs, applications, and products. You can design and create new APIs with this option.
- **Access Developer Portal**
  Enables the developer community to access and subscribe to available APIs in SAP API Management.
- **Access API Designer**
  Enables access to an API editor with rich capabilities for importing existing open APIs, downloading APIs, generating equivalent HTML output views, and validating open API syntax.

Figure 9.63 SAP API Management: Take Action Options

For our discussion, from the page shown in Figure 9.62, click on the **Access API Portal** link. You'll be redirected to a page similar to the page shown in Figure 9.64.

From this page, you can access monitors and statistics about API performance, traffic, usage, and errors. Furthermore, you can create new APIs, API providers, and applications.

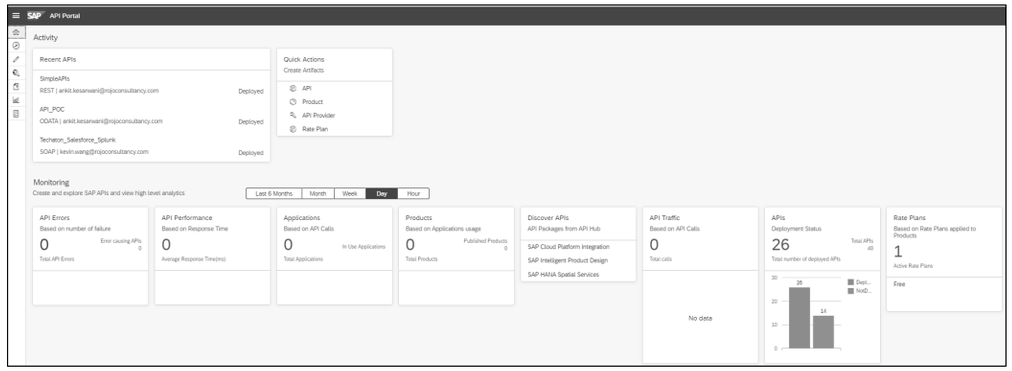

Figure 9.64 API Portal Landing Page

Let's continue by creating an API by clicking on the **API** icon , which can be found in the top-right corner of the **Quick Actions** tile, as shown in Figure 9.64. A page will open where you'll fill in the details about the API proxy. The API proxy must point to the integration flow in SAP Cloud Platform Integration. Specify the details as shown in Figure 9.65 and Figure 9.66. (Note that both figures are parts of the same page.)

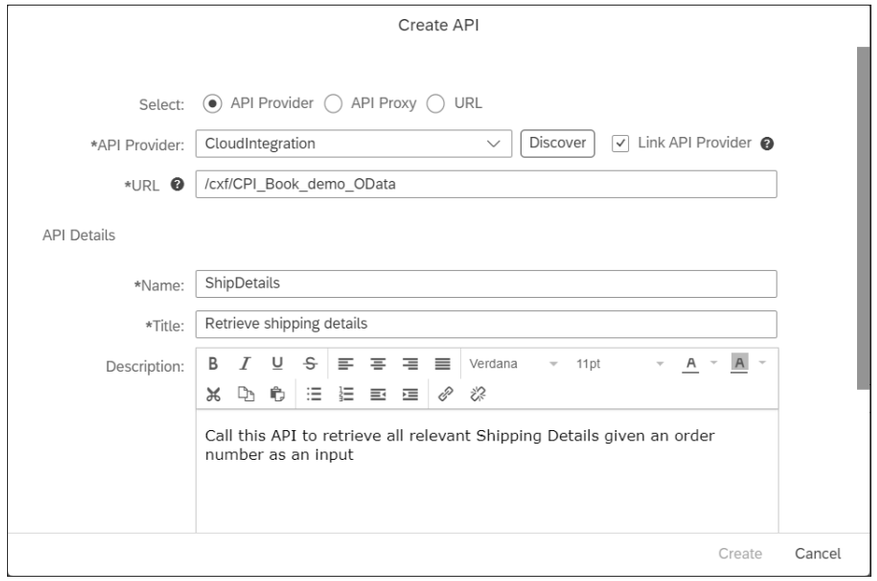

Figure 9.65 Adding Details of the API Proxy to Be Created: Top of Screen

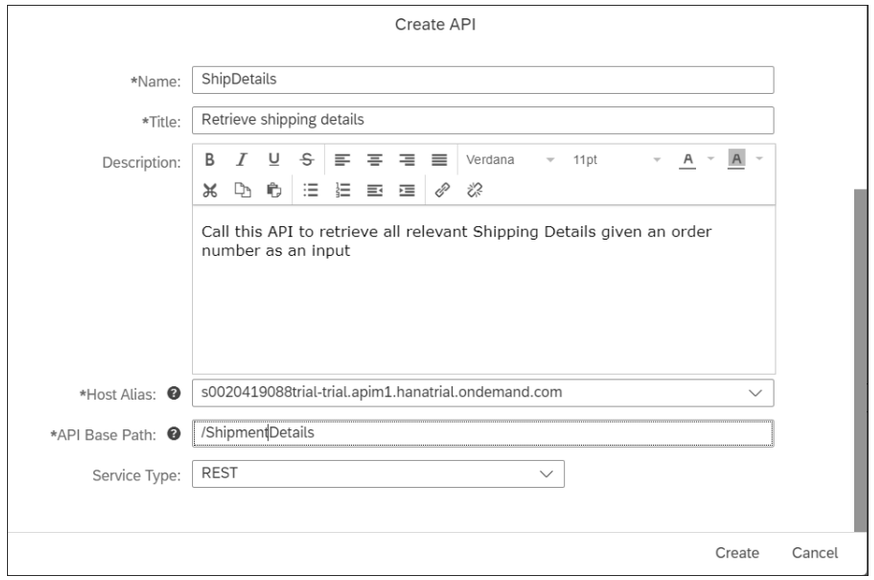

Figure 9.66 Adding Details of the API Proxy to Be Created: Bottom of Screen

Table 9.17 provides descriptions of the fields used in the screen shown in Figure 9.65 and Figure 9.66.

Field	Description
API Provider	Specifies the API provider we created in Section 9.6.1 to connect to the SAP Cloud Platform Integration tenant.
URL	The last part of the integration flow's endpoint, which can be found from integration artifact monitoring, as discussed in Chapter 4, Section 4.1.
Name	Meaningful name for the API.
Title	Title for the API.
Description	Description for the API.
Host Alias	Automatically populated with the host details of our SAP API Management tenant. Leave this field with its default value.
API Base Path	Specifies the base path to be used as part of the endpoint for the API.
Service Type	Possible values include **REST**, **SOAP**, and **ODATA**.

Table 9.17 API Proxy Fields

As shown in Figure 9.67, you can add a resource by clicking the **Add** button. An API can have multiple resources, and each a resource represents an endpoint.

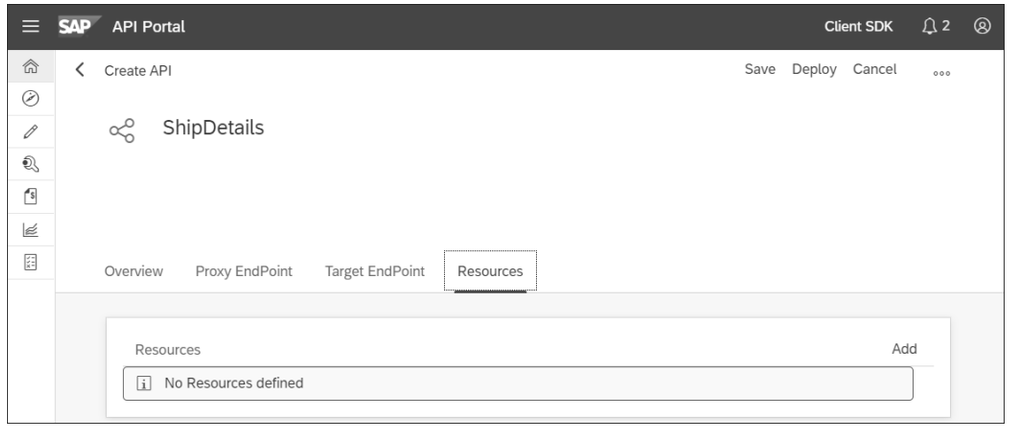

Figure 9.67 Resource Tab of the API Proxy

On the next screen, as shown in Figure 9.68, enter "RetrieveShipment" as the title in the **Tag** field and enter "Shipment" as the path prefix of the resource in the **Path Prefix** field. Remove all other HTTP methods and only select **POST** as the supported HTTP method. Then, specify a description and click the **Add** button.

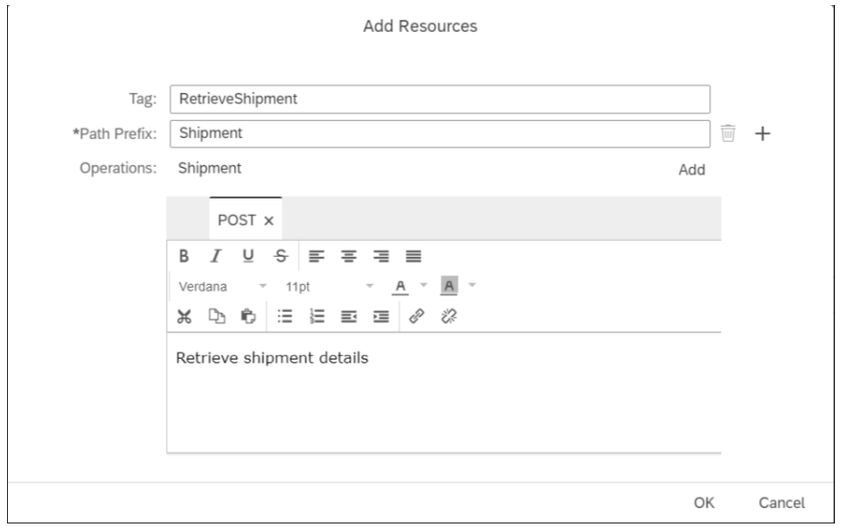

Figure 9.68 Adding a Resource to an API

Let's now add some policies to our API. An API policy is a module that implements a specific API behavior. API policies are designed to let you add common management capabilities to an API, such as security, rate-limiting, transformation, and mediation. You can access the policy editor by clicking the **Policies** button in the top-right corner of the screen, as shown in Figure 9.69.

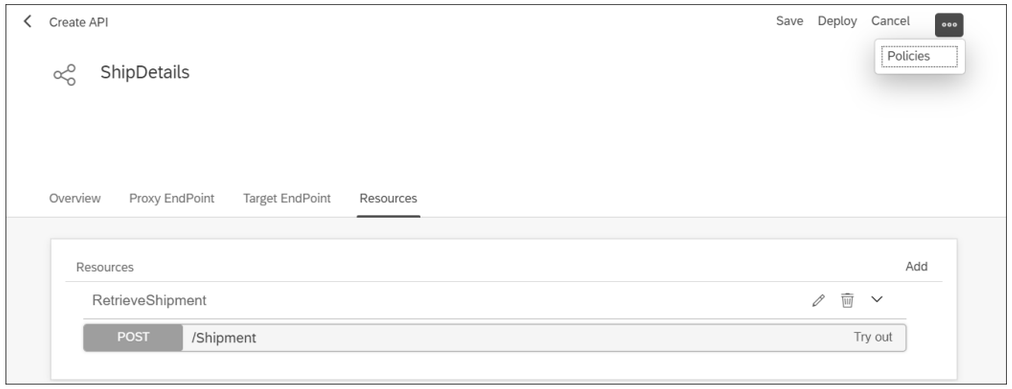

Figure 9.69 Navigating to the Policy Editor

You're redirected to the policy editor page from which a wide variety of policies can be added to fulfill your requirements, as shown in Figure 9.70.

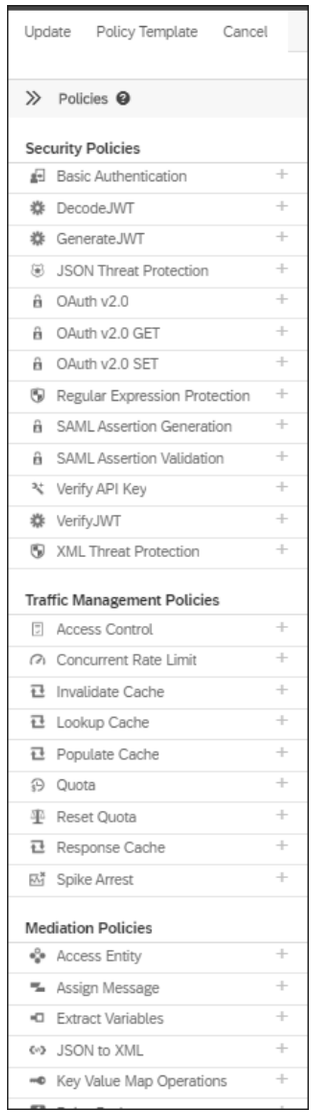

Figure 9.70 An Overview of the Policy Editors

At the time of this writing, the following categories of API policies are included in the policy editor:

- **Security**
  Includes various policies aimed at protecting your API. You can add basic authentication; use different versions of OAuth, Security Assertion Markup Language (SAML), and XML thread protection; verify API keys; and so on.

- **Traffic management**
  Helps you regulate your API traffic using techniques such as caching, quotas, access control, concurrent rate limit, and so on.
- **Mediation**
  Actions and scripts, such as for the extraction of variables and conversion of JSON to XML (and vice versa), are bundled in this category.

Note that any number of policies included in this editor can be mixed together and used in any combination to fulfill your desired requirements.

The rectangular image shown in the middle of Figure 9.71 represents a policy flow in SAP API Management. This policy flow defines a processing pipeline and the order of execution of the included policies.

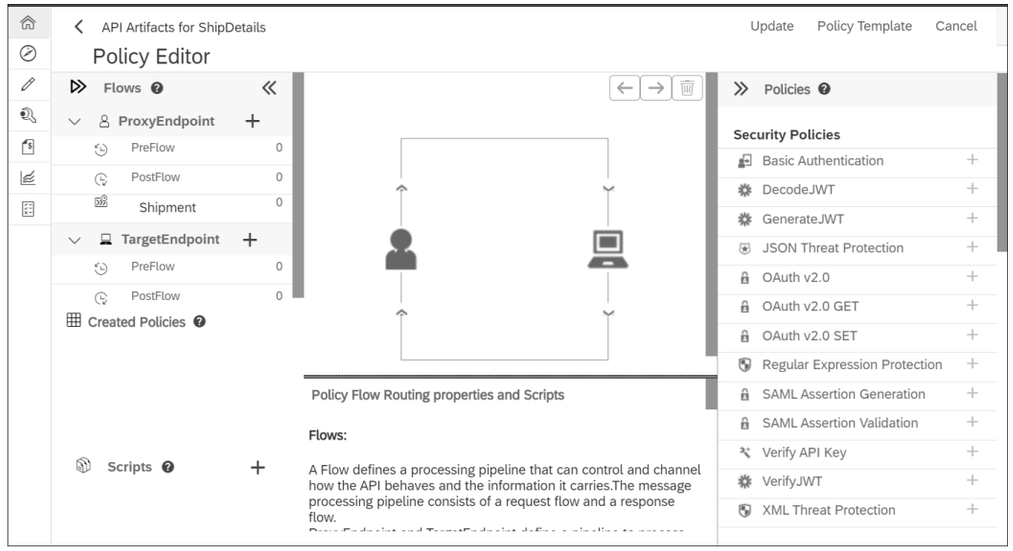

Figure 9.71 API Artifacts View

The flow has two main execution paths: **PreFlow** and **PostFlow**. The **PreFlow** path, the top part of the rectangle, represents the actions to be executed first before the control is passed to the API provider (SAP Cloud Platform Integration, in our case). On the other hand, the **PostFlow** path, the bottom part of the rectangle, represents the actions to be performed after the API provider has been called, that is, the actions to be performed before sending the response back to the API consumer.

For simplicity, let's add a policy to check the quotas on API calls. Assuming that our backend system can only accept a limited number of calls per minute, let's use SAP API Management to limit API consumption to a maximum of two API calls per minute. This approach could a good way to regulate traffic by preventing your backend system from

being flooded with calls. Adding a quota policy in the **PreFlow** path makes sense and prevents calls to SAP Cloud Platform Integration if a quota violation occurs.

Let's start by selecting **PreFlow** in the top-left corner, under the **Flows** section (shown earlier in Figure 9.70). Then, click on the plus icon + next to **Quota** on the right panel, under the **Traffic Management Policies** section. You're then presented with a popup window where you'll provide the name of the policy, as shown in Figure 9.72.

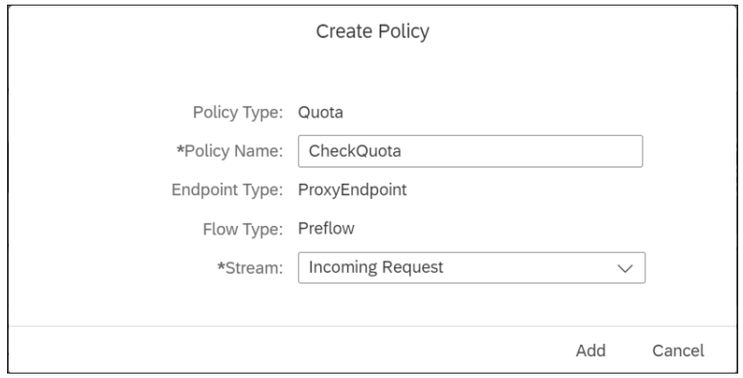

Figure 9.72 Adding the Quota Policy

Besides providing a name for the policy, select the **Incoming Request** value for the **Stream** dropdown, as shown in Figure 9.72. Then, click the **Add** button. On the next screen, specify the maximum number of allowed API calls per minute in the tag element `Allow count`, as shown in Figure 9.73. In our case, we used the value `2` to fulfill our requirement, as described previously.

```
1  <!-- can be used to configure the number of request messages that an app is allowed to submit to an API over a course of unit time -->
2  <Quota async="false" continueOnError="false" enabled="true" type="calendar" xmlns="http://www.sap.com/apimgmt">
3      <!-- specifies the number of requests allowed for the API Proxy -->
4          <Allow count="2"/>
5      <!-- the interval of time for which the quota should be applied -->
6      <Interval>1</Interval>
7      <!-- used to specify if a central counter should be maintained and continuously synchronized across all message processors -->
8      <Distributed>true</Distributed>
9      <!-- Use to specify the date and time when the quota counter will begin counting,
10         regardless of whether any requests have been received from any apps -->
11     <StartTime>2015-2-11 12:00:00</StartTime>
12     <!-- if set to true, the distributed quota counter is updated synchronously. This means that
13         the update to the counter will be made at the same time the API call is quota-checked -->
14     <Synchronous>true</Synchronous>
15     <!-- Use to specify the unit of time applicable to the quota. Can be second, minute, hour, day, or month -->
16     <TimeUnit>minute</TimeUnit>
17 </Quota>
```

Figure 9.73 Configuration of CheckQuota

Click the **Update** button, located in the top-right corner, as shown in Figure 9.74, to update the API with the added policies.

To find more information about any policy, refer to the SAP Documentation at *https://help.sap.com/viewer/product/CP/Cloud*. Search for "SAP Cloud Platform API Management."

On the next screen, click the **Save** button. Well done! You're now ready to consume the API, which we'll do in the next section.

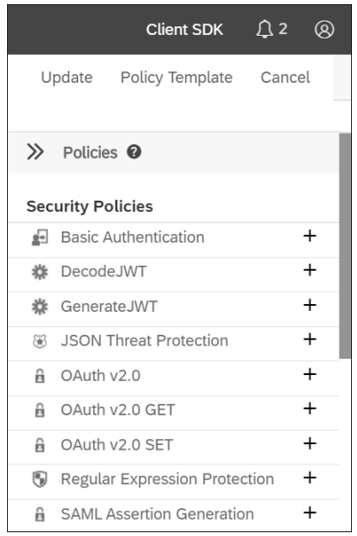

Figure 9.74 Updating the API with the Flow of Policies

9.6.3 Consuming the Application Programming Interface

Now that the API is ready, you can test it using any REST client of your choice (e.g., Postman). You can also perform a test directly in SAP API Management by navigating to the test tool via the **Test** icon , at the bottom of menu on the left, as shown in Figure 9.75.

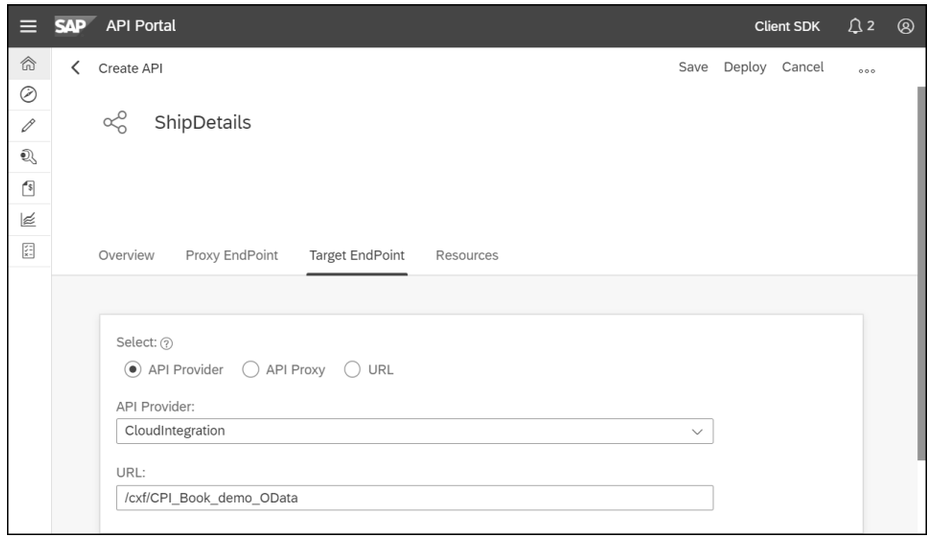

Figure 9.75 Overview of the Created API

You're then redirected to a new test page where you should select **ShipDetails** on the left side of the screen shown in Figure 9.76. Note that, by default, an endpoint ending with **/SWAGGER_JSON** is selected, as shown in Figure 9.76. You'll need to select the other endpoint from the dropdown list. The correct endpoint will end with the prefix used while creating the resource (in our scenario, **/Shipment**).

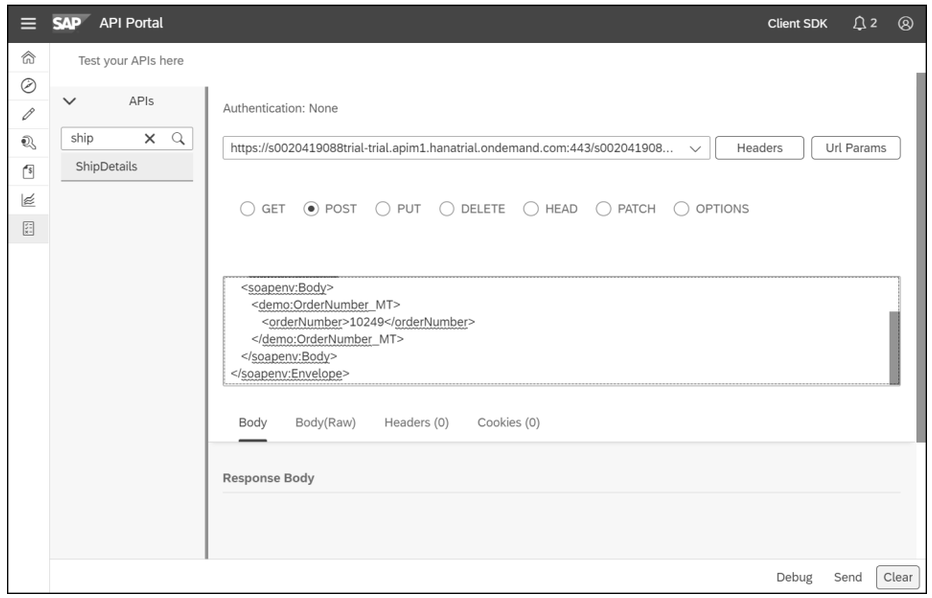

Figure 9.76 Setting Up the API Test Tool

> **Note**
>
> If you're using an external REST client such as Postman, you'll need an endpoint to post the API call to. The endpoint of the newly created API can be obtained via the drop-down menu, as shown in Figure 9.76.

After selecting the correct endpoint, specify the HTTP method as **POST** by selecting its radio button, provide the desired request XML payload, and change the authentication method to basic authentication. The authentication can be changed by clicking the **Authentication** link in the top-left corner of the screen shown in Figure 9.76.

You can now trigger the call by clicking on the **Send** button at the bottom-right corner of the screen. In the background, SAP API Management performs a check to validate whether we're still within our quota limits. Because this message is the first message, the call is accepted and sent to SAP Cloud Platform Integration, which in turn returns a valid response, as shown in the **Response Body** section shown in Figure 9.77.

Quickly perform the same call two more times to exceed our quota limit. You'll then see a quota violation error, as shown in Figure 9.78. This error indicates that we've exceeded the quota of two calls within the same minute.

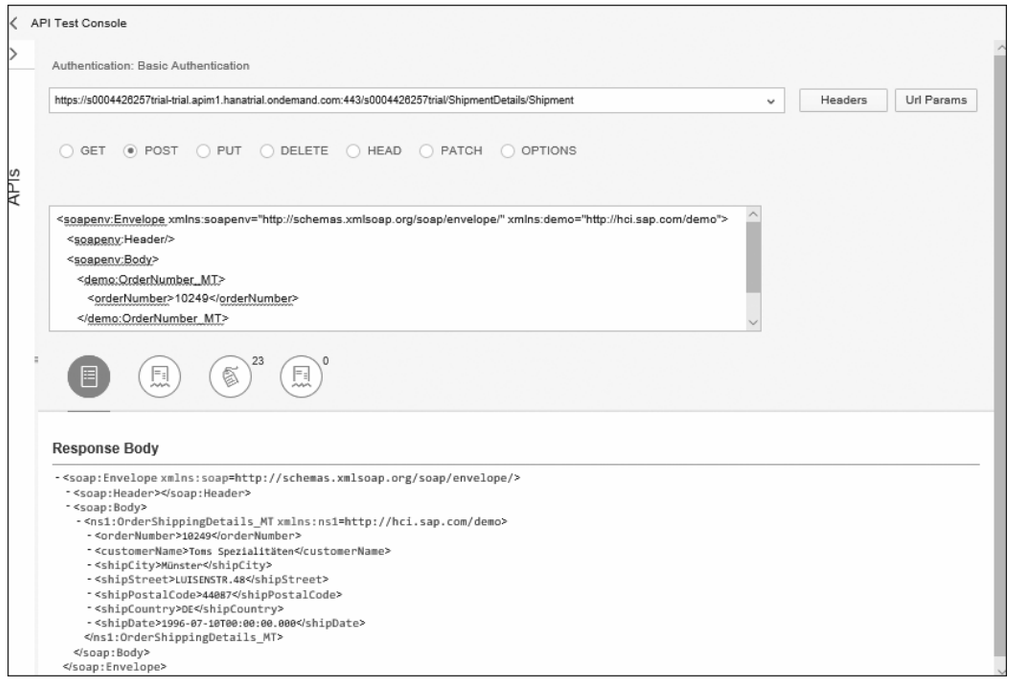

Figure 9.77 The Test Result of Our API Call

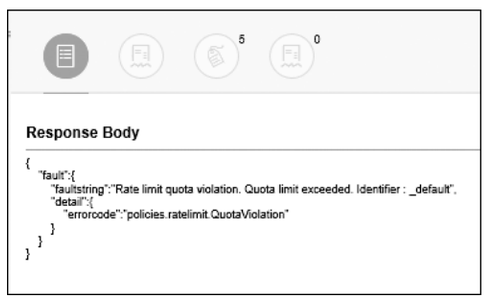

Figure 9.78 Response When Quota Is Exceeded

Congratulations, you've successfully provided, called, and consumed the API. Be aware that our scenario was quite simplistic. In a real-life scenario, you should consider the following additional aspects:

- **Authentication in SAP API Management**
  By default, the API exposed can be consumed without authentication. If you want to protect the API, you'll need to add the relevant policy (e.g., OAuth, API key, etc.).

- **Authentication in SAP Cloud Platform Integration**
  In our scenario, we're simply passing along to SAP Cloud Platform Integration whatever header was provided during the API call. Thus, the user name/password details used while calling the API are also forwarded and used for authentication in SAP Cloud Platform Integration. You could decide to use the basic authentication security policy to provide the logon details for SAP Cloud Platform Integration.
- **Payload**
  Note that the sample request message shown in Figure 9.76 includes the entire SOAP message. Given that we're exposing a REST API, we could decide to only use the SOAP body as input. This option, however, will require you to perform some logic to extract the relevant data from the incoming message and construct the SOAP message to send to SAP Cloud Platform Integration. This step is necessary because the service that we're consuming in SAP Cloud Platform Integration is of type SOAP.
- **Error message**
  Note that the error response returned by the API when the quota was exceeded (as shown in Figure 9.78) is in JSON format. In a real-life scenario, you'll want to convert the response to XML before returning this data to the consumer. (Hint: consider the JSON2XML policy.)

This chapter didn't tackle these points, which are beyond the scope of this chapter. For more insights on the subject of SAP API Management, refer to the book *SAP API Management* (SAP PRESS, 2019) written by Carsten Bönnen, Harsh Jegadeesan, Divya Mary, and Shilpa Vij (*www.sap-press.com/4928*).

You now understand how to use SAP API Management to wrap services available in SAP Cloud Platform Integration and expose them as APIs, as well as how to enforce different policies.

9.7 Summary

This chapter introduced you to the API-related capabilities and features of SAP Cloud Platform Integration. An overview of Java-based APIs was provided, and you also learned how to use APIs in UDFs. This chapter then explored a number of OData APIs available in SAP Cloud Platform Integration and walked you through some examples to illustrate their usage.

Finally, this chapter explored how to use SAP Cloud Platform Integration, in combination with SAP API Management, to provision APIs. Even though this chapter wasn't intended to be a chapter on SAP API Management, you also learned how to add policies to APIs through a scenario.

In the next chapter, we'll explore SAP Cloud Platform Open Connectors.

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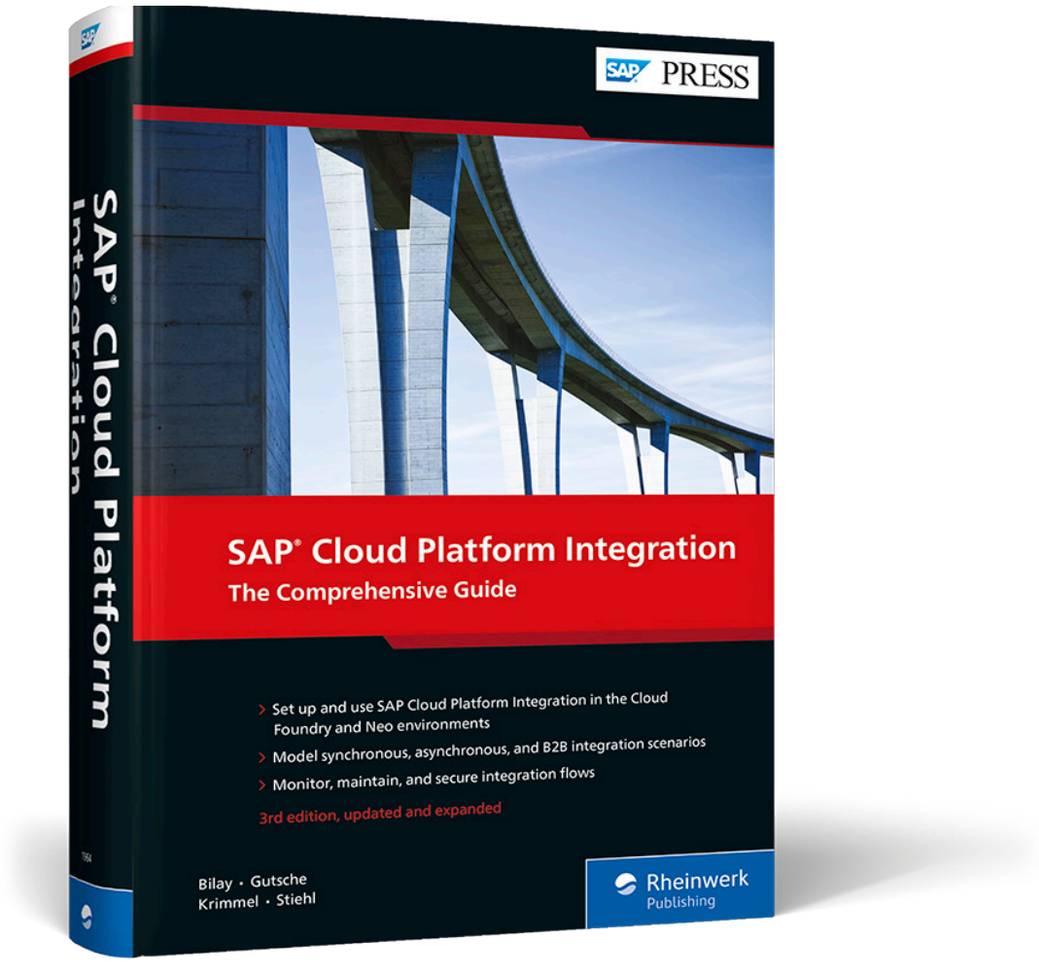

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