Enterprise Message API C++ Edition 3.6.1.L1

ENTERPRISE MESSAGE API DEVELOPERS GUIDE

Document Version: 3.6.1.L1
Date of issue: March 2021
Document ID: EMAC361UM.210

REFINITIV™

Contents

1	**Introduction**	**1**
1.1	About this Manual	1
1.2	Audience	1
1.3	Programming Language	1
1.4	Acronyms and Abbreviations	1
1.5	References	2
1.6	Document Conventions	3
2	**Product Overview**	**4**
2.1	Enterprise Message API Product Description	4
2.2	Product Documentation and Learning the Enterprise Message API	4
2.2.1	*Consumer Examples*	*5*
2.2.2	*Provider Examples*	*5*
2.3	Supported Features	5
2.4	Product Architecture	8
2.4.1	*Enterprise Message API Consumer Architecture*	*8*
2.4.2	*Enterprise Message API Provider Architecture*	*8*
2.4.3	*Enterprise Message API Codec Architecture*	*9*
2.5	Tunnel Streams	10
3	**OMM Containers and Messages**	**11**
3.1	Overview	11
3.2	Classes	12
3.2.1	*DataType Class*	*12*
3.2.2	*DataCode Class*	*12*
3.2.3	*Data Class*	*12*
3.2.4	*Msg Class*	*13*
3.2.5	*OmmError Class*	*13*
3.2.6	*TunnelStreamRequest and ClassOfService Classes*	*13*
3.3	Working with OMM Containers	14
3.3.1	*Example: Populating a* `FieldList` *Class*	*14*
3.3.2	*Example: Populating a* `Map` *Class Relying on the* `FieldList` *Memory Buffer*	*15*
3.3.3	*Example: Populating a* `Map` *Class Relying on the* `Map` *Class Buffer*	*15*
3.3.4	*Example: Extracting Information from a* `FieldList` *Class*	*16*
3.3.5	*Example: Application Filtering on the* `FieldList` *Class*	*17*
3.3.6	*Example: Extracting FieldList information using a Downcast Operation*	*17*
3.4	Working with OMM Messages	19
3.4.1	*Example: Populating the* `GenericMsg` *with an* `ElementList` *Payload*	*19*
3.4.2	*Example: Extracting Information from the* `GenericMsg` *Class*	*19*
3.4.3	*Example: Working with the* `TunnelStreamRequest` *Class*	*20*
4	**Consumer Classes**	**21**
4.1	OmmConsumer Class	21
4.1.1	*Connecting to a Server and Opening Items*	*21*
4.1.2	*Opening Items Immediately After OmmConsumer Object Instantiation*	*22*
4.1.3	*Destroying the OmmConsumer Object*	*22*
4.1.4	*Example: Working with the OmmConsumer Class*	*22*
4.1.5	*Working with Items*	*22*
4.1.6	*Example: Working with Items*	*23*
4.1.7	*Working with Tunnel Streams*	*23*

4.1.8 *Example: Working with Tunnel Streams* *24*
4.2 OmmConsumerClient Class 25
4.2.1 *OmmConsumerClient Description* *25*
4.2.2 *Example: OmmConsumerClient* *25*
4.3 OmmConsumerConfig Class 26
4.3.1 *OmmConsumerConfig Description* *26*
4.3.2 *Unencrypted Connections* *26*
4.3.3 *Encrypted Connections* *26*
4.3.4 *HTTP Proxy Connections* *27*

5 Provider Classes 28
5.1 OmmProvider Class 28
5.1.1 *Connecting to ADH and Submitting Items* *28*
5.1.2 *Interactive Providers: Post OmmProvider Object Instantiation* *29*
5.1.3 *Non-Interactive Providers: Post OmmProvider Object Instantiation* *29*
5.1.4 *Non-Interactive Providers: Encrypted Connections and HTTP Proxy Tunneling* *29*
5.1.5 *Destroying the OmmProvider Object* *29*
5.1.6 *Non-Interactive Example: Working with the OmmProvider Class* *30*
5.1.7 *Interactive Provider Example: Working with the OmmProvider Class* *31*
5.1.8 *Interactive Provider Example: Handling Post Message* *31*
5.1.9 *Interactive Provider Example: Handling RTT Responses from Consumer* *32*
5.1.10 *Working with Items* *32*
5.2 OmmProviderClient Class 33
5.2.1 *OmmProviderClient Description* *33*
5.2.2 *Non-Interactive Example: OmmProviderClient* *33*
5.2.3 *Interactive Example: OmmProviderClient* *34*
5.3 OMMIProviderConfig 36
5.4 OmmNiProviderConfig Class 36

6 Consuming Data from the Cloud 37
6.1 Overview 37
6.2 Encrypted Connections 37
6.3 Authentication Token Management 38
6.3.1 *Client_ID (AppKey) and Client Secret* *38*
6.3.2 *Obtaining Initial Access and Refresh Tokens* *38*
6.3.3 *Refreshing the Access Token and Sending a Login Reissue* *39*
6.3.4 *Session Management per User Credential* *40*
6.4 Service Discovery 40
6.5 Consuming Market Data 41
6.6 HTTP Error Handling for Reactor Token Reissues 41
6.7 Cloud Connection Use Cases 42
6.7.1 *Session Management Use Case* *42*
6.7.2 *Query Service Discovery* *42*
6.8 Logging of Authentication and Service Discovery Interaction 43
6.8.1 *Logged Request Information* *43*
6.8.2 *Logged Response Information* *43*

7 Troubleshooting and Debugging 44
7.1 Enterprise Message API Logger Usage 44
7.2 Omm Error Client Classes 44
7.2.1 *Error Client Description* *44*
7.2.2 *Example: Error Client* *45*
7.3 OmmException Class 46
7.4 Creating a DACSLOCK for Publishing Permission Data 46

1 Introduction

1.1 About this Manual

This document is authored by Enterprise Message API architects and programmers. Several of its authors have designed, developed, and maintained the Enterprise Message API product and other Refinitiv products which leverage it.

This guide documents the functionality and capabilities of the Enterprise Message API C++ Edition. The Enterprise Message API can also connect to and leverage many different Refinitiv and customer components. If you want the Enterprise Message API to interact with other components, consult that specific component's documentation to determine the best way to configure for optimal interaction..

1.2 Audience

This document is intended to provide detailed yet supplemental information for application developers writing to the Enterprise Message API.

1.3 Programming Language

The Enterprise Message API is written using the C++ programming language taking advantage of the object oriented approach to design and development of API and applications.

1.4 Acronyms and Abbreviations

ACRONYM / TERM	MEANING
ADH	Refinitiv Real-Time Advanced Data Hub is the horizontally scalable service component within the Refinitiv Real-Time Distribution System providing high availability for publication and contribution messaging, subscription management with optional persistence, conflation and delay capabilities.
ADS	Refinitiv Real-Time Advanced Distribution Server is the horizontally scalable distribution component within the Refinitiv Real-Time Distribution System providing highly available services for tailored streaming and snapshot data, publication and contribution messaging with optional persistence, conflation and delay capabilities.
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
Enterprise Message API	The Enterprise Message API (EMA) is an ease of use, open source, Open Message Model API. EMA is designed to provide clients rapid development of applications, minimizing lines of code and providing a broad range of flexibility. It provides flexible configuration with default values to simplify use and deployment. EMA is written on top of the Enterprise Transport API (ETA) utilizing the Value Added Reactor and Watchlist features of ETA.
Enterprise Transport API (ETA)	Enterprise Transport API is a high performance, low latency, foundation of the Refinitiv Real-Time SDK. It consists of transport, buffer management, compression, fragmentation and packing over each transport and encoders and decoders that implement the Open Message Model. Applications written to this layer achieve the highest throughput, lowest latency, low memory utilization, and low CPU utilization using a binary Refinitiv Wire Format when publishing or consuming content to/from Refinitiv Real-Time Distribution Systems.
HTTP	Hypertext Transfer Protocol

Table 1: Acronyms and Abbreviations

ACRONYM / TERM	MEANING
HTTPS	Hypertext Transfer Protocol (Secure)
JSON	JavaScript Object Notation
OMM	Open Message Model
QoS	Quality of Service
RDM	Refinitiv Domain Model
Refinitiv Real-Time Distribution System	Refinitiv Real-Time Distribution System is Refinitiv's financial market data distribution platform. It consists of the Refinitiv Real-Time Advanced Distribution Server and Refinitiv Real-Time Advanced Data Hub. Applications written to the Refinitiv Real-Time SDK can connect to this distribution system.
Reactor	The Reactor is a low-level, open-source, easy-to-use layer above the Enterprise Transport API. It offers heartbeat management, connection and item recovery, and many other features to help simplify application code for users.
RMTES	A multi-lingual text encoding standard
RSSL	Refinitiv Source Sink Library
RTT	Round Trip Time, this definition is used for round trip latency monitoring feature.
RWF	Refinitiv Wire Format, a Refinitiv proprietary binary format for data representation.
RDF-D	Refinitiv Data Feed Direct
UML	Unified Modeling Language
UTF-8	8-bit Unicode Transformation Format

Table 1: Acronyms and Abbreviations

1.5 References

1. Enterprise Message API C++ Edition *Refinitiv Domain Model Usage Guide*
2. *API Concepts Guide*
3. *Enterprise Message API C++ Configuration Guide*
4. Enterprise Message API C++ Edition *Developers Guide*
5. The Refinitiv Developer Community

1.6 Document Conventions

This document uses the following types of conventions:

- C++ classes, methods, in-line code snippets, and types are shown in **`Courier New`** font.
- Parameters, filenames, tools, utilities, and directories are shown in **Bold** font.
- Document titles and variable values are shown in *italics*.
- When initially introduced, concepts are shown in ***Bold, Italics***.
- Longer code examples are shown in Courier New font against a gray background. For example:

```
AppClient client;
    OmmConsumer consumer( OmmConsumerConfig().operationModel(
   OmmConsumerConfig::UserDispatchEnum ).host( "localhost:14002" ).username( "user" ) );
    consumer.registerClient( ReqMsg().domainType( MMT_MARKET_BY_PRICE ).serviceName(
   "DIRECT_FEED" ).name( "BBH.ITC" ).privateStream( true ), client );
    unsigned long long startTime = getCurrentTime();
```

2 Product Overview

2.1 Enterprise Message API Product Description

The Enterprise Message API is a data-neutral, multi-threaded, ease-of-use API providing access to OMM and RWF data. As part of the Refinitiv Real-Time Software Development Kit, or RTSDK, the Enterprise Message API allows applications to consume and provide OMM data at the message level of the API stack. The message level is set on top of the transport level which is handled by the Enterprise Transport API.

The Enterprise Message API:

- Provides a set of easy-to-use and intuitive interfaces and features intended to aid in message-level application development. These interfaces simplify the setting of information in and getting information from OMM containers and messages. Other interfaces abstract the behavior of consumer-type and provider-type applications.
- Enables applications to source market data from, and provide it to, different components that support OMM and/or RWF (e.g. Refinitiv Real-Time, Refinitiv Real-Time Distribution System, Refinitiv Real-Time Advanced Transformation Server, Refinitiv Data Feed Direct, etc).
- Leaves a minimal code footprint in applications written to it. The design of the Enterprise Message API and its interfaces allows application development to focus more on the application business logic than on the usage of the Enterprise Message API.
- Includes training applications that provide basic, yet still functional, examples of Enterprise Message API applications.
- Presents applications with simplified access to OMM messages and containers while providing all necessary transport level functionalities. Generally, Enterprise Message API applications are meant to process market data items (e.g. open and receive item data or provide item data).
- Abstracts and hides all the transport level functionality minimizing application involvement to just optional transport level configuration and server address specification.
- Provides simple **`set`**- and **`get`**-type functionality to populate and read OMM containers and messages. Enterprise Message API takes advantage of fluent interface design, which users can leverage to set disparate values of the same message or container by stringing respective interface methods together, one after the other. Fluent interfaces provide the means for visual code simplification which helps in understanding and debugging applications.

Transport level functionality is abstracted, specialized, and encapsulated by the Enterprise Message API in a few classes whose functionality is implied by their class name.

2.2 Product Documentation and Learning the Enterprise Message API

When learning the Enterprise Message API, Refinitiv recommends you set up a sandbox environment where developers can experiment with various iterations of Enterprise Message API applications. Enterprise Message API is designed to facilitate a hands-on (experiment-based) learning experience (versus a documentation-based methodology). To support a hands-on learning methodology, the Enterprise Message API package provides a set of training examples which showcase the usage of Enterprise Message API interfaces in increasing levels of complexity and sophistication. While coding and debugging applications, developers are encouraged to refer to the and/or to the features provided by their IDE (e.g., IntelliSense).

NOTE: Enterprise Message API application developers should already be familiar with OMM and Market Data distribution systems.

2.2.1 Consumer Examples

The complexity of a consumer example is reflected in its series number as follows:

- 100-series examples simply open an item and print its received content to the screen (using the `Data::toString()` method). Applications in this series illustrate Enterprise Message API support for stringification, containers, and primitives. Though useful for learning, debugging, and writing display applications, stringification by itself is not sufficient to develop more sophisticated applications.
- The 200-series examples illustrate how to extract information from OMM containers and messages in native data formats, (e.g., UInt64, EmaString, and EmaBuffer).
- The 300- and 400- series examples depict usage of particular Enterprise Message API features such as posting, generic message, programmatic configuration, and etc.

2.2.2 Provider Examples

The complexity of an example is reflected in its series number. Each provider type (i.e., non-interactive versus interactive) has its own directory structure in the product package:

- 100-series examples simply create streaming items and submit their refreshes and updates. Applications in this series use the hardcoded Enterprise Message API configuration.
- The 200-series examples showcase the submission of multiple, streaming items from different market domains. Applications in this series use the **EmaConfig.xml** file to modify its configuration.
- The 300- and 400- series examples depict usage of particular Enterprise Message API features such as user control of the source directory domain, login streaming, connection recovery, programmatic configuration, and etc.

2.3 Supported Features

FEATURE	DESCRIPTION
New in 3.5 Round Trip Time (RTT) monitoring support and configuration option added	The provider can initiate RTT monitoring by sending RTT requests to the consumer over the Generic Login stream. In Enterprise Message API, the consumer's automatic support of this feature can be configured either via the configuration file or programmatically.
New in 3.5 Port information added for Consumer and NIProvider	`ChannelInformation.port()` returns the port to which the consumer or NIProvider is connected.
New in 3.5 Support for the WebSocket protocol over ETA	Enterprise Message API C++ Edition supports the Web Socket transport protocol over the Enterprise Transport API.
New in 3.3.1 Ability to manage Client_ID and passwords for cloud connections Ability to clone and copy messages Centralized management of multiple OAuth tokens	• Enterprise Message API no longer stores an application's passwords for the Refinitiv Data Platform. The application must manage its own passwords. • Enterprise Message API supports multi-channel OAuth credential management. • Enterprise Message API requires the use of a generated **Client_ID** from the AppGenerator for use when obtaining access and refresh tokens for cloud connections. • Enterprise Message API messages can now be cloned and copied to decode the payload outside of message callbacks
New in 3.3.0 Encryption and Cloud Connectivity	You can encrypt content sent over Enterprise Message API and configure Session Management behaviors when connecting to cloud infrastructure.

Table 2: Supported Features

FEATURE	DESCRIPTION
New in 3.1.2 Support for Programmatic Configuration of *Provider*	You can use Enterprise Message API to programmatically configure parameters for interactive and non-interactive providers in the Enterprise Message API configuration file. For details, refer to the *Enterprise Message API C++ Configuration Guide*.
New in 3.1.2 Support for HTTP and ENCRYPTED Connection Types	Enterprise Message API provides support for **`ChannelType::RSSL_HTTP`** and **`ChannelType::RSSL_ENCRYPTED`** connection types for Enterprise Message API consumers. For further details, refer to Section 4.3.
New in 3.1 Domain Representations for Admin Domain Login Messages	Enterprise Message API provides domain representations for Admin Domain Login Messages. Domain Representations are easy-to-use objects which can setup and return encoded OMM Messages without extensive effort. For further details, refer to *Enterprise Message API RDM Usage Guide*.
New in 3.1 Refinitiv Real-Time Distribution System Authentication	Enterprise Message API provides support for the Refinitiv Real-Time Distribution System Authentication feature for consumers and non-interactive providers. For more information, refer to *Enterprise Message API RDM Usage Guide* and to the *Refinitiv Real-Time Distribution System Authentication user manual*[a].
New in 3.1 Enhanced Login Stream Handling	Enterprise Message API applications can register for Login events when they create OmmConsumer or non-interactive OmmProvider objects.
New in 3.0.6 Interactive Provider	Enterprise Message API provides interactive provider connectivity (e.g., for ADH or other directly-connected consumers).
New in 3.0.3 Non-interactive Provider	Applications can connect to an ADH Refinitiv Real-Time Distribution System component to non-interactively provide item data.
Connection Failover	You can specify a list of failover servers via the **ChannelSet** configuration. If a connection attempt fails, Enterprise Message API attempts to connect to the next channel in the **ChannelSet** list. Both Enterprise Message API consumers and non-interactive providers support the connection failover feature.
Refinitiv Real-Time Advanced Distribution Server Multicast	Applications can connect to the Refinitiv Real-Time Advanced Distribution Server multicast component by specifying the connection type **RSSL_RELIABLE_MCAST**.
Default Admin Domain Messages	The Enterprise Message API consumer uses default login, directory, and dictionary requests when connecting to a provider or Refinitiv Real-Time Advanced Distribution Server: • The Login request uses the current user's name and defaults all other login attributes. • The Directory request calls for all services and filters. • RDM dictionaries are requested from the first available service that accepts requests. The Enterprise Message API non-interactive provider uses the default login request and configured directory refresh when connecting to ADH: • The login request uses the current user's name and defaults all other login attributes. • The directory refresh message defaults all message attributes as well as status, while its payload is either hardcoded or read from the Enterprise Message API configuration. The Enterprise Message API interactive provider can use default, preconfigured directory and dictionary refresh messages. • The directory refresh message defaults appropriate message attributes as well as status, while its payload is either hard coded or read from the Enterprise Message API configuration. • The dictionary refresh message is handled based on either its hard-coded configuration or read from the Enterprise Message API configuration.
Configurable Admin Domain Messages	Enterprise Message API provides the means to modify default Admin domain messages.
Batch Request	A consumer application can use a single request message to specify interest in multiple items via the item list.

Table 2: Supported Features (Continued)

FEATURE	DESCRIPTION
Dynamic View	A consumer application can specify a subset of fields or elements for a particular item.
Optimized Pause and Resume	A consumer application can send a request to the server to pause and resume item stream.
Single Open	The Enterprise Message API supports application-selected, single-open functionality.
RMTES Decoder	The Enterprise Message API provides a built-in RMTES decoder. If needed, the application can cache **`RmtesBuffer`** objects and apply all received changes to them.
`Data::toString()`	Prints all OMM containers, primitives, and messages to screen in a standardized output format (called “stringification”).
`Data::getAsHex()`	Applications can obtain binary representations of all OMM containers, primitives, and messages.
Programmatic Configuration	The application can programmatically specify and overwrite its Enterprise Message API configuration for the consumer for the consumer, NiProvider, and IProvider.
File Configuration	An Enterprise Message API configuration can be specified in an **EmaConfig.xml** file.
Tunnel Stream (also known as a Qualified Stream)	Enterprise Message API supports private streams, with additional associated behaviors (e.g., end-to-end authentication, reliable delivery, and flow control).
File Logger	Enterprise Message API allows the application to turn on / off Enterprise Message API logging, to specify the desired severity level of error reporting, and to specify whether to send logger messages to stdout or a file.
Connected Component Information	Whenever Enterprise Message API connects to a component, Enterprise Message API sends its component version information, and if the connection is successful, Enterprise Message API logs the component’s version.

Table 2: Supported Features (Continued)

a. The *Refinitiv Real-Time Distribution System Authentication User Manual* can be obtained on MyRefinitiv under the DACS product content set.

2.4 Product Architecture

2.4.1 Enterprise Message API Consumer Architecture

The Enterprise Message API incorporates the ValueAdded Reactor component (called the Transport API VA Reactor) from the Transport API, which provides the watchlist and transport-level functionality. The Enterprise Message API wraps up the reactor component in its own class of **`OmmConsumer`**. **`OmmConsumer`** provides interfaces to open, modify, and close market items or instruments, as well as submit Post and Generic messages. To complete the set of consumer application functionalities, the **`OmmConsumer`** class provides the **`dispatch()`** method. Depending on its design and configuration, an application might need to call this method to dispatch received messages. The **`OmmConsumerConfig`** class configures the reactor and **`OmmConsumer`**.

The **`OmmConsumerClient`** class provides the callback mechanism for Enterprise Message API to send incoming messages to the application. The application needs to implement a class inheriting from the **`OmmConsumerClient`** class to receive and process messages. By default, **`OmmConsumerClient`** callback methods are executed in Enterprise Message API's thread of control. However, you can use the **`OmmConsumerConfig::operationModel()`** interface to execute callback methods on the application thread. If you choose to execute callback methods in this manner, the application must also call the **`OmmConsumer::dispatch()`** method to dispatch received messages.

While the **`OmmConsumer`** class throws an **`OmmException`** to report error conditions, the **`OmmConsumerErrorClient`** class provides an alternate reporting mechanism via callbacks. To use the alternate error reporting, pass the **`OmmConsumerErrorClient`** on the constructor of the **`OmmConsumer`** class, which switches the error reporting from exception throwing to callbacks. In addition to its error reporting mechanisms, Enterprise Message API provides a logger mechanism which is useful in monitoring Enterprise Message API behavior and debugging any issues that might arise.

The Enterprise Message API consumer will always have at least one thread, which is implemented by the VA Reactor and runs the internal, VA Reactor logic. For details on this thread, refer to the *Transport API C Edition Value Added Component Developers Guide*. Additionally, you can configure the Enterprise Message API to create a second, internal thread to dispatch received messages. To create a second thread, set the **`OmmConsumerConfig`** operation model to **`OmmConsumerConfig::ApiDispatchEnum`**. If the **`OmmConsumerConfig`** operation model is set to the **`OmmConsumerConfig::UserDispatch`**, the Enterprise Message API will not run a second thread. Without running a second thread, the application is responsible for calling the **`Ommconsumer::dispatch()`** method to dispatch all received messages.

WARNING! If the application delays in dispatching messages, it can result in slow consumer behavior.

2.4.2 Enterprise Message API Provider Architecture

The Enterprise Message API provider incorporates the Value Added (VA) Reactor component from the Transport API, which provides transport-level functionality. The Enterprise Message API wraps the reactor component in its own class of **`OmmProvider`**. **`OmmProvider`** provides interfaces to submit item messages as well as handling login, directory, and dictionary domains (depending on Enterprise Message API's specific provider role). To complete the set of provider functionalities, the **`OmmProvider`** class provides the **`dispatch()`** method. Depending on its design and configuration, an application might need to call this method to dispatch received messages. The provider configuration class (i.e., **`OmmNiProviderConfig`** or **`OmmIProviderConfig`**) class configures both the reactor and **`OmmProvider`**.

Enterprise Message API sends incoming messages to the application using the **`OmmProviderClient`** callback mechanism. To receive and process messages, the application needs to implement a class that inherits from the **`OmmProviderClient`** class. By default, **`OmmProviderClient`** callback methods are executed in Enterprise Message API's thread of control. However, you can use either the **`OmmNiProviderConfig::operationModel()`** or **`OmmIProviderConfig::operationModel()`** interface to execute callback methods on the application's thread, in which case the application must also call the **`OmmProvider::dispatch()`** method to dispatch received messages.

While the **`OmmProvider`** class throws an **`OmmException`** to report error conditions, the **`OmmProviderErrorClient`** class provides an alternate reporting mechanism via callbacks. To use the alternate error reporting, pass the **`OmmProviderErrorClient`** on the constructor of the **`OmmProvider`** class, which switches the error reporting from exception throwing to callbacks. In addition to its error-reporting mechanisms, Enterprise Message API provides a logger mechanism which you can use to monitor Enterprise Message API behavior and debug any issues that arise.

An Enterprise Message API provider must always have at least one thread, which is implemented by the VA Reactor and runs the internal, VA Reactor logic. For details on this thread, refer to the *Transport API C Edition Value Added Component Developers Guide*. Additionally, you can configure Enterprise Message API to create a second internal thread over which to dispatch received messages:

- For non-interactive providers, set the **`OmmNiProviderConfig`** operation model to **`OmmNiProviderConfig::ApiDispatchEnum`**. If the operation model is set to **`OmmNiProviderConfig::UserDispatchEnum`**, Enterprise Message API will not run a second thread.
- For interactive providers, set the **`OmmIProviderConfig`** operation model to **`OmmIProviderConfig::ApiDispatchEnum`**. If the operation model is set to **`OmmIProviderConfig::UserDispatchEnum`**, Enterprise Message API will not run a second thread.

Without running a second thread, the application is responsible for calling the **`OmmProvider::dispatch()`** method to dispatch all received messages.

The Enterprise Message API provider includes an internal, hard-coded, and configurable initial source directory refresh message. The application can either use the internal hard-coded source directory, configure its own internal one via the **EmaConfig.xml** file, or programmatically create one and/or disable the internal one. To disable the internal source directory message:

- When running Enterprise Message API as a non-interactive provider: the application must set **`OmmNiProviderConfig::UserControlEnum`** through the **`OmmNiProviderConfig::adminControlDirectory()`** method.
- When running Enterprise Message API as an interactive provider: the application must set **`OmmIProviderConfig::UserControlEnum`** through the **`OmmIProviderConfig::adminControlDirectory()`** method. Additionally, you can configure the ability to disable internal dictionary responses by setting **`OmmIProviderConfig::UserControlEnum`** through the **`OmmIProviderConfig::adminControlDictionary()`** method.

NOTE: If the user control is enabled, the application is responsible for sending the response messages.

An Enterprise Message API provider also supports the programmatic configuration of a source directory refresh of dictionary information, which overrides any configuration in **EmaConfig.xml**. To programmatically configure a source directory refresh:

- When running Enterprise Message API as a non-interactive provider: the application must set **`OmmNiProviderConfig::ApiControlEnum`** through the **`OmmNiProviderConfig::adminControlDirectory()`** method. An Enterprise Message API non-interactive provider does not support programmatically configuring dictionary information.
- When running Enterprise Message API as an interactive provider: the application must set **`OmmIProviderConfig::ApiControlEnum`** through the **`OmmIProviderConfig::adminControlDirectory()`** method. Additionally, you can programmatically configure dictionary information, which overrides any dictionary information defined from **EmaConfig.xml**. To programmatically configure dictionary information, set **`OmmIProviderConfig::ApiControlEnum`** through the **`OmmIProviderConfig::adminControlDictionary()`** method.

2.4.3 Enterprise Message API Codec Architecture

The Enterprise Message API Codec uses the Enterprise Transport API decoding and encoding functions to read and populate OMM containers and messages. Each OMM container and message is represented by a respective Enterprise Message API interface class, which provides relevant methods for setting information on, and accessing information from, these containers and messages. All classes representing OMM containers, messages, and primitives inherit from the common parent class of **`Data`**. Through such inheritance, classes provide the same basic, common, and easy to use functionality that applications might expect from them (e.g., printing contained data using **`toString()`**).

2.5 Tunnel Streams

By leveraging the Transport API Value Added Reactor, the Enterprise Message API allows users to create and use special tunnel streams. A tunnel stream is a private stream that has additional behaviors associated with it, such as end-to-end line of sight for authentication and reliable delivery. Because tunnel streams are founded on the private streams concept, these are established between consumer and provider endpoints and then pass through intermediate components, such as Refinitiv Real-Time Distribution System or the Refinitiv Real-Time Edge Device.

The user creating the tunnel stream sets any additional behaviors to enforce, which Enterprise Message API sends to the provider application end point. The provider endpoint acknowledges the creation of the stream as well as the behaviors it will enforce on the stream. Once this is accomplished, negotiated behaviors are enforced on the content exchanged via the tunnel stream.

The tunnel stream allows for multiple substreams to exist, where substreams flow and coexist within the confines of a specific tunnel stream. In the following diagram, imagine the tunnel stream as the orange cylinder that connects the consumer application and the Provider application. Notice that this passes directly through any intermediate components. The tunnel stream has end-to-end line of sight so the Provider and Consumer are effectively talking to each other directly, although they are traversing multiple devices in the system. Each of the black lines flowing through the cylinder represent a different substream, where each substream is its own independent stream of information. Each of these could be for different market content, for example one could be a Time Series request while another could be a request for Market Price content.

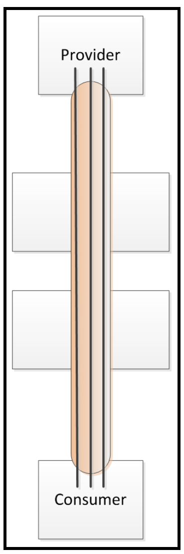


Figure 1. Tunnel Stream

3 OMM Containers and Messages

3.1 Overview

Enterprise Message API supports a full set of OMM containers, messages, and primitives (e.g. **FieldList**, **Map**, **RefreshMsg**, **Int**). For simplicity, Enterprise Message API uses:

- The "set / add" type of functionality to populate OMM containers, messages, and primitives
  - Set functionality is used to specify variables that occur once in an OMM container or message.
  - Add functionality is used to populate entries in OMM containers.
  - Set and add type methods return a reference to the modified object (for fluid interface usage).
- The "get" type of functionality to read and extract data from OMM containers, messages, and primitives.Enterprise Message API uses a simple iterative approach to extract entries from OMM containers, one at a time. Applications iterate over every OMM container type in the same way.

While iterating, an application can apply a filtering mechanism. For example, while iterating over a **FieldList**, the application can specify a field ID or field name in which it is interested; the Enterprise Message API skips entries without matching identification. Individual container entries are extracted during iteration. Depending on the container type, the entry may contain:

- Its own identity (e.g., field id)
- An action to be applied to the received data (e.g., add action)
- Permission information associated with the received data
- An entry's load and its **data** type.

The Enterprise Message API has two different ways of extracting an entry's load:

- Use ease-of-use interfaces to return references to contained objects (with reference type being based on the load's data type)
- Use the **getLoad** interface to return a reference to the base **Data** class. The **getLoad** interface enables more advanced applications to use the down-cast operation (if desired).

For details on ease of use interfaces and the down-cast operation, refer to Section 3.3.

To provide compile time-type safety on the set-type interfaces, Enterprise Message API provides the following, deeper inheritance structure:

- All classes representing primitive / intrinsic data types inherit from the **Data** class (e.g. **OmmInt**, **OmmBuffer**, **OmmRmtes**, etc.).
- **OmmArray** class inherits from the **Data** class. The **OmmArray** is treated as a primitive instead of a container, because it represents a set of primitives.
- **OmmError** class inherits from the **Data** class. **OmmError** class is not an OMM data type.
- All classes representing OMM containers (except **OmmArray**) inherit from the **ComplexType** class, which in turn inherits from the **Data** class (e.g., **OmmXml**, **OmmOpaque**, **Map**, **Series**, or **Vector**).
- All classes representing OMM messages inherit from the **Msg** class, which in turn inherits from the **ComplexType** class (e.g., **RefreshMsg**, **GenericMsg**, or **PostMsg**).

3.2 Classes

3.2.1 DataType Class

The **DataType** class provides the set of enumeration values that represent each and every supported OMM data type, including all OMM containers, messages, and primitives. Each class representing OMM data identifies itself with an appropriate **DataType** enumeration value (e.g., **DataType::FieldListEnum**, **DataType::RefreshMsgEnum**). You can use the **Data::getDataType()** method to learn the data type of a given object.

The **DataType** class list of enumeration values contains two special enumeration values, which can only be received when reading or extracting information from OMM containers or messages:

- **DataType::ErrorEnum**, which indicates an error condition was detected. For more details, refer to Section 3.2.5.
- **DataType::NoDataEnum**, which signifies a lack of data on the summary of a container, message payload, or attribute.

3.2.2 DataCode Class

The **DataCode** class provides two enumeration values that indicate the data's state:

- The **DataCode::NoCodeEnum** indicates that the received data is valid and application may use it.
- The **DataCode::BlankEnum** indicates that the data is not present and application needs to blank the respective data fields.

3.2.3 Data Class

The **Data** class is a parent abstract class from which all OMM containers, messages, and primitives inherit. **Data** provides interfaces common across all its children, which in turn enables down-casting operations. The **Data** class and all classes that inherit from it are optimized for efficiency and built so that data can be easily accessed. Though all primitive data types are represented by classes that inherit from the **Data** class, the ease-of-use interfaces do not return such references: all primitive data types are returned by their intrinsic representation.

WARNING! The **Data** class and all classes that inherit from it are designed as temporary and short-lived objects. For this reason, do not use them as storage or caching devices.

The Enterprise Message API does not support immediately retrieving data from freshly created OMM containers or messages. The following code snippet demonstrates this restriction:

```
FieldList fieldList;

fieldList.addAscii( 1, "ascii" ).addInt( 10, 20 ).complete();

while ( fieldList.forth() )
{
    const FieldEntry& fieldEntry = fieldList.getEntry();

    ...
}
```

3.2.4 Msg Class

The **Msg** class is a parent class for all the message classes. It defines all the interfaces that are common across all message classes.

3.2.5 OmmError Class

The **OmmError** class is a special purpose class. It is a read only class implemented in the Enterprise Message API to notify applications about errors detected while processing received data. This class enables applications to learn what error condition was detected. Additionally it provides the **getAsHex()** method to obtain binary data associated with the detected error condition. The sole purpose of this class is to aid in debugging efforts.

The following code snippet presents usage of the **OmmError** class while processing **ElementList**.

```
void decode( const ElementList& elementList )
{
    while ( elementList.forth() )
    {
        const ElementEntry& elementEntry = elementList.getEntry();

        if ( elementEntry.getCode() == Data::BlankEnum )
            continue;
        else
            switch ( elementEntry.getLoadType() )
            {
            case DataType::RealEnum:
                cout << elementEntry.getReal().getAsDouble() << endl;
                break;
            case DataType::ErrorEnum:
                cout << elementEntry.getError().getErrorCode() << "( " <<
                        elementEntry.getError().getErrorCodeAsString() << " )" << endl;
                break;
        }
    }
}
```

3.2.6 TunnelStreamRequest and ClassOfService Classes

The **TunnelStreamRequest** class specifies request information for use in establishing a tunnel stream. A tunnel stream is a private stream that provides additional functionalities such as user authentication, end-to-end flow control and reliable delivery. You can configure these features on a per-tunnel stream basis. The **ClassOfService** class specifies these features and some other related parameters. The identity of the tunnel stream is specified on the **TunnelStreamRequest** class.

3.3 Working with OMM Containers

Enterprise Message API supports the following OMM containers: **ElementList**, **FieldList**, **FilterList**, **Map**, **Series**, and **Vector**.

Each of these classes provides set type interfaces for container header information (e.g., dictionary id, element list number, and the add-type interfaces for adding entries). You must set the container header and optional summary before adding the first entry.

Though it is treated as an OMM primitive, the **OmmArray** acts like a container and therefore provides add-type interfaces for adding primitive entries.

NOTE: OMM Container classes do perform some validation of their usage. If a usage error is detected, an appropriate **OmmException** will be thrown.

3.3.1 Example: Populating a FieldList Class

The following example illustrates how to populate a **FieldList** class with fluid interfaces.

```
try {
    FieldList fieldList;

    fieldList.info( 1, 1 )
        .addUInt( 1, 64 )
        .addReal( 6, 11, OmmReal::ExponentNeg2Enum )
        .addDate( 16, 1999, 11, 7 )
        .addTime( 18, 02, 03, 04, 005 )
        .complete();
} catch ( const OmmException & excp  ) {
    cout << excp << endl;
}
```

3.3.2 Example: Populating a Map Class Relying on the FieldList Memory Buffer

The following code snippet illustrates how to populate a **Map** class with summary data and a single entry containing a **FieldList**. In this example, the **FieldList** class uses its own memory buffer to store content while it is populated. This buffer later gets copied to the buffer owned by the **Map** class. This container population model applies to all OMM containers that might contain other containers, primitives, or messages.

```
try {
    FieldList fieldList;

    fieldList.addUInt( 1, 64 )
        .addReal( 6, 11, OmmReal::ExponentNeg2Enum )
        .addDate( 16, 1999, 11, 7 )
        .addTime( 18, 02, 03, 04, 005 )
        .complete();

    Map map;
    map .summary( fieldList ).addKeyAscii( "entry_1", MapEntry::AddEnum, fieldList
            ).complete();
} catch ( const OmmException& excp  ) {
    cout << excp << endl;
}
```

3.3.3 Example: Populating a Map Class Relying on the Map Class Buffer

The following example illustrates how to populate a **Map** class with a single entry containing a **FieldList**. In this case, the **FieldList** class uses the memory buffer owned by the **Map** class to store its own content while it is populated, therefore avoiding the internal buffer copy described in Section 3.3.2. This container population model applies to iterable containers only (e.g., OmmArray, ElementList, FieldList, FilterList, Map, Series, and Vector).

```
try {
    FieldList fieldList;

    Map map;
    fieldList.addUInt( 1, 64 )
        .addReal( 6, 11, OmmReal::ExponentNeg2Enum )
        .addDate( 16, 1999, 11, 7 )
        .addTime( 18, 02, 03, 04, 005 )
        .complete();

    map.addKeyAscii( "entry_1", MapEntry::AddEnum, fieldList );

        map.complete();
} catch ( const OmmException& excp  ) {
    cout << excp << endl;
}
```

3.3.4 Example: Extracting Information from a `FieldList` Class

In the following example illustrates how to use the **`FieldList::forth()`** method to extract information from the **`FieldList`** class by iterating over the class. The following code extracts information about all entries.

```
void decode( const FieldList& fieldList )
{
    if ( fieldList.hasInfo() )
    {
        Int16 dictionaryId = fieldList.getInfoDictionaryId();
        Int16 fieldListNum = fieldList.getInfoFieldListNum();
    }

    while ( fieldList.forth() )
    {
        const FieldEntry& fieldEntry = fieldList.getEntry();

        if ( fieldEntry.getCode() == Data::BlankEnum )
            continue;

        switch ( fieldEntry.getLoadType() )
        {
        case DataType::AsciiEnum :
            const EmaString& value = fieldEntry.getAscii();
            break;
        case DataType::IntEnum :
            Int64 value = fieldEntry.getInt();
            break;
        }
    }
}
```

3.3.5 Example: Application Filtering on the `FieldList` Class

In the following code snippet application filters or extracts select information from FieldList class. The FieldList::forth(Int16) method is used to iterate over the FieldList class. In this case only entries with field id of 22 will be extracted; all the other ones will be skipped.

```
void decode( const FieldList& fieldList )
{
    while ( fieldList.forth( 22 ) )
    {
        const FieldEntry& fieldEntry = fieldList.getEntry();

        if ( fieldEntry.getCode() == Data::BlankEnum )
            continue;

        switch ( fieldEntry.getLoadType() )
        {
        case DataType::AsciiEnum :
            const EmaString& value = fieldEntry.getAscii();
            break;
        case DataType::IntEnum :
            Int64 value = fieldEntry.getInt();
            break;
        }
    }
}
```

3.3.6 Example: Extracting FieldList information using a Downcast Operation

The following example illustrates how to extract information from a **`FieldList`** object using the down-cast operation.

```
void AppClient::decodeFieldList( const FieldList& fl )
{
    if ( fl.hasInfo() )
        cout << "FieldListNum: " << fl.getInfoFieldListNum() << " DictionaryId: " << fl
fl.getInfoDictionaryId() << endl;

    while ( fl.forth() )
    }
        cout << "Load" << endl;
        decode( fl.getEntry().getLoad() );
    }
}

void AppClient::decode( const Data& data )
{
    if ( data.getCode() == Data::BlankEnum )
        cout << "Blank data" << endl;
    else
        switch ( data.getDataType() )
```

```
        {
        case DataType::RefreshMsgEnum :
            decodeRefreshMsg( static_cast<const RefreshMsg&>( data ) );
            break;
        case DataType::UpdateMsgEnum :
            decodeUpdateMsg( static_cast<const UpdateMsg&>( data ) );
            break;
        case DataType::FieldListEnum :
            decodeFieldList( static_cast<const FieldList&>( data ) );
            break;
        case DataType::MapEnum :
            decodeMap( static_cast<const Map&>( data ) );
            break;
        case DataType::NoDataEnum :
            cout << "NoData" << endl;
            break;
        case DataType::TimeEnum :
            cout << "OmmTime: " << static_cast<const OmmTime&>( data ).toString() << endl;
            break;
        case DataType::DateEnum :
            cout << "OmmDate: " << static_cast<const OmmDate&>( data ).toString() << endl;
            break;
        case DataType::RealEnum :
            cout << "OmmReal::getAsDouble: " << static_cast<const OmmReal&>( data
                    ).getAsDouble() << endl;
            break;
        case DataType::IntEnum :
            cout << "OmmInt: " << static_cast<const OmmInt&>( data ).getInt() << endl;
            break;
        case DataType::UIntEnum :
            cout << "OmmUInt: " << static_cast<const OmmUInt&>( data ).getUInt() << endl;
            break;
        case DataType::EnumEnum :
            cout << "OmmEnum: " << static_cast<const OmmEnum&>( data ).getEnum() << endl;
            break;
        case DataType::AsciiEnum :
            cout << "OmmAscii: " << static_cast<const OmmAscii&>( data ).toString() << endl;
            break;
        case DataType::ErrorEnum :
            cout << "Decoding error: " << static_cast<const OmmError&>( data
                    ).getErrorCodeAsString() << endl;
            break;
        default :
            break;
        }
}
```

3.4 Working with OMM Messages

Enterprise Message API supports the following OMM messages: **RefreshMsg**, **UpdateMsg**, **StatusMsg**, **AckMsg**, **PostMsg** and **GenericMsg**. As appropriate, each of these classes provide set and get type interfaces for the message header, permission, key, attribute, and payload information.

3.4.1 Example: Populating the GenericMsg with an ElementList Payload

The following example illustrates how to populate a **GenericMsg** with a payload consisting of an **ElementList**.

```
try {
    GenericMsg genMsg;

    genMsg.domainType( 200 ).name( "TR.N" ).serviceId( 234 ).payload( ElementList().addAscii(
            "entry_1", "value_1" ).complete() );
} catch ( const OmmException& excp  ) {
    cout << excp << endl;
}
```

3.4.2 Example: Extracting Information from the GenericMsg Class

The following example illustrates how to extract information from the **GenericMsg** class.

```
void decode( const GenericMsg& genMsg )
{
    if ( genMsg.hasName() )
        cout << endl << "Name: " << genMsg.getName();

    if ( genMsg.hasHeader() )
        const EmaBuffer& header = genMsg.getHeader();

    switch ( genMsg.getPayload().getDataType() )
    {
    case DataType::FieldListEnum :
        decode( genMsg.getPayload().getFieldList() );
        break
    }
}
```

3.4.3 Example: Working with the `TunnelStreamRequest` Class

The following code snippet demonstrates using the **`TunnelStreamRequest`** class in the consumer application to open a tunnel stream.

```
CosAuthentication cosAuthentication;
cosAuthentication.type( CosAuthentication::OmmLoginEnum );

CosDataIntegrity cosDataIntegrity;
cosDataIntegrity.type( CosDataIntegrity::ReliableEnum );

CosFlowControl cosFlowControl;
cosFlowControl.type( CosFlowControl::BidirectionalEnum ).recvWindowSize( 1200
       ).sendWindowSize( 1200 );

ClassOfService cos;
cos.authentication( cosAuthentication ).dataIntegrity( cosDataIntegrity ).flowControl(
       cosFlowControl );

TunnelStreamRequest tsr;
tsr.classOfService( cos ).domainType( MMT_SYSTEM ).name( "TUNNEL" ).serviceName( "DIRECT_FEED" );
```

4 Consumer Classes

4.1 OmmConsumer Class

The **`OmmConsumer`** class is the main consumer application interface to the Enterprise Message API. This class encapsulates watchlist functionality and transport level connectivity. It provides all the interfaces a consumer-type application needs to open, close, and modify items, as well as submit messages to the connected server (both **`PostMsg`** and **`GenericMsg`**). The **`OmmConsumer`** class provides configurable admin domain message processing (i.e., login, directory, and dictionary requests).

4.1.1 Connecting to a Server and Opening Items

Applications observe the following steps to connect to a server and open items:

- **(Optional)** Specify a configuration using the **EmaConfig.xml** file.

  This step is optional because the Enterprise Message API provides a default configuration which is usually sufficient in simple application cases.
- Create **`OmmConsumerConfig`** object (for details, refer to Section 4.3).
- **(Optional)** Change Enterprise Message API configuration using methods on the **`OmmConsumerConfig`** class.

  If an **EmaConfig.xml** file is not used, then at a minimum, applications might need to modify the default host address and port.
- Implement an application callback client class that inherits from the **`OmmConsumerClient`** class (for details, refer to Section 4.2).

  An application needs to override the default implementation of callback methods and provide its own business logic. Not all methods need to be overridden; only methods required for the application's business logic.
- **(Optional)** Implement an application error client class that inherits from the **`OmmConsumerErrorClient`** class (for details, refer to Section 7.2).

  The application needs to override default error call back methods to be effectively notified about error conditions.
- Create an **`OmmConsumer`** object and pass the **`OmmConsumerConfig`** object (and if needed, also pass in the application error client object), and optionally register for Login events by passing in an application callback client class.
- Open items of interest using the **`OmmConsumer::registerClient()`** method.
- Process received messages.
- **(Optional)** Submit **`PostMsg`** and **`GenericMsg`** messages and modify / close items using appropriate **`OmmConsumer`** class methods.
- Exit.

4.1.2 Opening Items Immediately After OmmConsumer Object Instantiation

To allow applications to open items immediately after creating the **OmmConsumer** object, the Enterprise Message API performs the following steps when creating and initializing the **OmmConsumer** object:

- Create an internal item watchlist.
- Establish connectivity to a configured server / host.
- Log into the server and obtain source directory information.
- Obtain dictionaries (if configured to do so).

4.1.3 Destroying the OmmConsumer Object

Destroying an **OmmConsumer** object causes the application to log out and disconnect from the connected server, at which time all items are closed.

4.1.4 Example: Working with the OmmConsumer Class

The following example illustrates the simplest application managing the OmmConsumer Class.

```
try {
   AppClient client;
   OmmConsumer consumer( OmmConsumerConfig().host( "localhost:14002" ).username( "user" ) );
   consumer.registerClient( ReqMsg().serviceName( "DIRECT_FEED" ).name( "IBM.N" ), client );
   sleep( 60000 );
} catch ( const OmmException& excp ) {
   cout << excp << endl;
}
```

4.1.5 Working with Items

The Enterprise Message API assigns all opened items or instruments a unique numeric identifier (e.g. **UInt64**), called a handle, which is returned by the **OmmConsumer::registerClient()** call. A handle is valid as long as its associated item stays open. Holding onto these handles is important only to applications that want to modify or close particular items, or use the items' streams for sending **PostMsg** or **GenericMsg** messages to the connected server. Applications that just open and watch several items until they exit do not need to store item handles.

While opening an item, on the call to the **OmmConsumer::registerClient()** method, an application can pass an item closure or an application-assigned numeric value. The Enterprise Message API will maintain the association of the item to its closure as long as the item stays open.

Respective closures and handles are returned to the application in an **OmmConsumerEvent** object on each item callback method.

4.1.6 Example: Working with Items

The following example illustrates using the item handle while modifying an item's priority and posting modified content.

```
void AppClient::onRefreshMsg( const RefreshMsg& refreshMsg, const OmmConsumerEvent& event )
{
   cout << "Received refresh message for item handle = " << event.getHandle() << endl;
   cout << refreshMsg << endl;
}

try {
   AppClient client;
   OmmConsumer consumer( OmmConsumerConfig().host( "localhost:14002" ).username( "user" ) );

   Int64 closure = 1;
   UInt64 itemHandle = consumer.registerClient( ReqMsg().serviceName( "DIRECT_FEED" ).name(
            "IBM.N" ), client, (void*)closure );

   consumer.reissue( ReqMsg().serviceName( "DIRECT_FEED" ).name( "IBM.N" ).priority( 2, 2 ),
            itemHandle );

   consumer.submit( PostMsg().payload( FieldList().addInt( 1, 100 ).complete() ), itemHandle
            );

   sleep( 60000 );
} catch ( const OmmException& excp ) {
   cout << excp << endl;
}
```

4.1.7 Working with Tunnel Streams

Enterprise Message API assigns all tunnel streams a unique numeric identifier (e.g., UInt64), called a parent handle, which is returned by the call: **`OmmConsumer::registerClient(TunnelStreamRequest,…)`**. A parent handle is valid only as long as its associated tunnel stream is open. You can use parent handles to open substreams (as illustrated in Section 4.1.8).

When opening a tunnel stream, on the call to the **`OmmConsumer::registerClient(TunnelStreamRequest,…)`** method, an application can pass a tunnel stream closure or an application-assigned numeric value. The Enterprise Message API will maintain the association of the tunnel stream to its closure as long as the tunnel stream stays open. Respective closures and parent handles are returned to the application in an **`OmmConsumerEvent`** object on each tunnel stream callback method.

For more details on a **`TunnelStreamRequest`** and how to create it, refer to Section 3.2.6 and Section 3.4.3.

4.1.8 Example: Working with Tunnel Streams

The following example illustrates the use of a parent handle (as returned by **OmmConsumer::registerClient(TunnelStreamRequest,…)**) to open a substream from the **OmmConsumerClient::onStatusMsg()** callback.

```
void onStatusMsg(const StatusMsg& statusMsg, const OmmConsumerEvent& event)
{
    if (event.getHandle() == _tunnelStreamHandle &&
        statusMsg.hasState() &&
        statusMsg.getState().getStreamState() == OmmState::OpenEnum )
    {
        // open substream with parent handle returned when opening tunnel stream below
        _pOmmConsumer->registerClient( ReqMsg().name( "TUNNEL_IBM" ).serviceId( 1 ), *this,
                (void*)1, _tunnelStreamHandle );
    }
}

int main()
{
    try {
        AppClient client;
        OmmConsumer consumer( OmmConsumerConfig().username( "user" ) );
        client.setOmmConsumer( consumer );
        CosAuthentication cosAuthentication;
        cosAuthentication.type( CosAuthentication::OmmLoginEnum );
        CosDataIntegrity cosDataIntegrity;
        cosDataIntegrity.type( CosDataIntegrity::ReliableEnum );
        CosFlowControl cosFlowControl;
        cosFlowControl.type( CosFlowControl::BidirectionalEnum ).recvWindowSize( 1200
                ).sendWindowSize( 1200 );
        ClassOfService cos;
        cos.authentication( cosAuthentication ).dataIntegrity( cosDataIntegrity
                ).flowControl( cosFlowControl );
        TunnelStreamRequest tsr;
        tsr.classOfService( cos ).domainType( MMT_SYSTEM ).name( "TUNNEL" ).serviceName(
                "DIRECT_FEED" );
        /* open tunnel stream and save tunnel stream parent handle to be used for opening
        substreams in onStatusMsg() callback above */
        _tunnelStreamHandle = consumer.registerClient( tsr, client );

        sleep( 60000 ); // API calls onRefreshMsg(), onUpdateMsg(), or onStatusMsg()
    } catch ( const OmmException& excp ) {
        cout << excp << endl;
    }
}
```

4.2 OmmConsumerClient Class

4.2.1 OmmConsumerClient Description

The **`OmmConsumerClient`** class provides a callback mechanism through which applications receive OMM messages on items for which they subscribe. The **`OmmConsumerClient`** is a parent class that implements empty, default callback methods. Applications must implement their own class (inheriting from **`OmmConsumerClient`**), and override the methods they are interested in processing. Applications can implement many specialized client-type classes; each according to their business needs and design. Instances of client-type classes are associated with individual items while applications register item interests.

The **`OmmConsumerClient`** class provides default implementation for the processing of **`RefreshMsg`**, **`UpdateMsg`**, **`StatusMsg`**, **`AckMsg`** and **`GenericMsg`** messages. These messages are processed by their respectively named methods: **`onRefreshMsg()`**, **`onUpdateMsg()`**, **`onStatusMsg()`**, **`onAckMsg()`**, and **`onGenericMsg()`**. Applications only need to override methods for messages they want to process.

4.2.2 Example: OmmConsumerClient

The following example illustrates an application client-type class, depicting **`onRefreshMsg()`** method implementation.

```
class AppClient : public refinitiv::ema::access::OmmConsumerClient
{
protected :

   void onRefreshMsg( const refinitiv::ema::access::RefreshMsg&, const
            refinitiv::ema::access::OmmConsumerEvent& );

   void onUpdateMsg( const refinitiv::ema::access::UpdateMsg&, const
            refinitiv::ema::access::OmmConsumerEvent& );

   void onStatusMsg( const refinitiv::ema::access::StatusMsg&, const
            refinitiv::ema::access::OmmConsumerEvent& );
};
void AppClient::onRefreshMsg( const RefreshMsg& refreshMsg, const OmmConsumerEvent& )
{
   if ( refreshMsg.hasMsgKey() )
      cout << endl << "Item Name: " << refreshMsg.getName() << endl << "Service Name: " <<
            refreshMsg.getServiceName();

   cout << endl << "Item State: " << refreshMsg.getState().toString() << endl;

   if ( DataType::NoDataEnum != refreshMsg.getPayload().getDataType() )
      decode( refreshMsg.getPayload().getData() );
}
```

4.3 OmmConsumerConfig Class

4.3.1 OmmConsumerConfig Description

You can use the **`OmmConsumerConfig`** class to customize the functionality of the **`OmmConsumer`** class. The default behavior of **`OmmConsumer`** is hard coded in the **`OmmConsumerConfig`** class. You can configure **`OmmConsumer`** in any of the following ways:

- Using the **EmaConfig.xml** file
- Using interface methods on the **`OmmConsumerConfig`** class
- Passing OMM-formatted configuration data through the **`OmmConsumerConfig::config( const Data& )`** method.

For more details on using the **`OmmConsumerConfig`** class and associated configuration parameters, refer to the *Enterprise Message API Configuration Guide*.

4.3.2 Unencrypted Connections

The Enterprise Message API supports unencrypted connections via a **ChannelType** of **RSSL_SOCKET** (on Linux or Windows), **RSSL_WEBSOCKET**, and **RSSL_HTTP** (on Windows only). You set **ChannelType** inside of a **ChannelGroup**. For detailed information on **ChannelGroup** and its **ChannelType**s, refer to the *Enterprise Message API C++ Configuration Guide*.

4.3.3 Encrypted Connections

The Enterprise Message API supports encrypted TCP connections for both **Consumer** and **NiProvider** via a **`ChannelType`** of **`RSSL_ENCRYPTED`** (i.e., **`ChannelType::RSSL_ENCRYPTED`**).

4.3.3.1 Implementing Protocols and Encryption Behavior

The Enterprise Message API's implementation of TLS protocol and encryption depends on a number of factors including:

- The operating system you use (which in turn determines the types of protocols the Enterprise Message API can use):
  - On Linux, the Enterprise Message API uses only OpenSSL.
  - On Windows, the Enterprise Message API can use either WinINet or OpenSSL.
- The type of protocol you use (as specified by **`EncryptedProtocolType`**):
  - WinINet (specified by **`EncryptedProtocolType::RSSL_HTTP`**), or
  - OpenSSL (specified by **`EncryptedProtocolType::RSSL_SOCKET`** or **`EncryptedProtocolType::RSSL_WEBSOCKET`**).

The Enterprise Message API supports both OpenSSl 1.0 and OpenSSL 1.1. By default, the Enterprise Message API first attempts to load OpenSSL1.1; if it cannot, then the Enterprise Message API loads OpenSSL 1.0. For details on the specific libraries loaded by the Enterprise Message API, refer to Section 4.3.3.2.

For OpenSSL connections, you can set the specific TLS encryption protocol you want to use in the **`SecurityProtocol`** flag (for details on setting **`SecurityProtocol`** flags, refer to the *Enterprise Message API C++ Configuration Guide*). Though currently, only TLS 1.2 (0x4) is accepted.

4.3.3.2 OpenSSL Libraries

The libraries that the Enterprise Message API uses to implement OpenSSL encryption depends on the machine's operating system and version of OpenSSL in use:

- On Linux:
  - If using OpenSSL1.1, the Enterprise Message API uses **libssl.so.1.1** and **libcrypto.so.1.1**.
  - If using OpenSSL1.0, the Enterprise Message API uses **libssl.so.10** and **libcrypto.so.10**.
- On Windows:
  - If using OpenSSL1.1, the Enterprise Message API uses **libssl-1_1-x64.dll** and **libcrypto-1_1-x64.dll**.
  - If using OpenSSL1.0, the Enterprise Message API uses **ssleay32.dll** and **libeay32.dll**.

If you want the Enterprise Message API to load a specific version, you can specify **libssl** and **libcrypto** libraries using **`libsslName`** and **`libcryptoName`** (for details on setting these channel parameters, refer to the *Enterprise Message API C++ Configuration Guide*).

NOTE: The RTSDK package does not include OpenSSL libraries. You can obtain compiled OpenSSL libraries from the appropriate OS vendor.

4.3.3.3 Certificate Authority

If you use an OpenSSL Certificate Authority store, you can specify the authority store's location using **`openSSLCAStore`**. For details on this parameter and the Enterprise Message API's default behavior, refer to the parameter's description in the *Enterprise Message API C++ Configuration Guide*.

4.3.4 HTTP Proxy Connections

The Enterprise Message API supports HTTP proxy tunneling for **`ChannelType::RSSL_SOCKET`**, **`ChannelType::RSSL_HTTP`**, and all **`ChannelType::RSSL_ENCRYPTED`** connection types.

On Windows, WinINet provides legacy HTTP connection type functionality, and you must configure the proxy through the Internet Explorer configuration. You can override WinINet's proxy configuration by using **`tunnelingProxyHostName()`** and **`tunnellingProxyPort()`**.

For **`RSSL_SOCKET`** connection types (standard or encrypted), **libcurl** manages the proxy connection. As with OpenSSL, you can specify a particular **libcurl** library using **`libcurlName`**. By default:

- On Linux, the Enterprise Message API loads **libcurl.so**
- On Windows, the Enterprise Message API loads **libcurl.dll**

For **libcurl** connections, you can provide additional proxy authentication credentials with the following functions:

- **`proxyUserName()`**: set the proxy user name.
- **`proxyPasswd()`**: set the password for proxy authentication.
- **`proxyDomain()`**: set the domain for proxy authentication.

5 Provider Classes

5.1 OmmProvider Class

The **`OmmProvider`** class is the main provider application interface to the Enterprise Message API. This class encapsulates transport-level connectivity. It provides all the interfaces a provider-type application needs to submit item messages (i.e., refresh, update, status, generic) as well as handle the login, directory, and dictionary domains (depending upon whether or not the application is an interactive provider). The **`OmmProvider`** class provides configurable admin domain message processing (i.e., login, directory, and dictionary).

5.1.1 Connecting to ADH and Submitting Items

In the following process, the value for ***`ProviderType`*** is dependent on the type of provider with which you are dealing:

- For non-interactive providers, ***`ProviderType`*** is **`NiProvider`**.
- For interactive providers, ***`ProviderType`*** is **`IProvider`**.

▶ To establish a connection and submit items:

1. (**Optional**) Specify a configuration using the **EmaConfig.xml** file.

   Specifying a configuration in **EmaConfig.xml** is optional because the Enterprise Message API provides a default configuration which is usually sufficient in simple application cases.

2. Create the appropriate **`Omm`*`ProviderType`*`Config`** object (for details, refer to Section 5.4):
   - For a non-interactive provider, create an **`OmmNiProviderConfig`** object.
   - For an interactive provider, create an **`OmmIProviderConfig`** object

3. (**Optional**) Change the Enterprise Message API configuration using methods on the **`Omm`*`ProviderType`*`Config`** class.

   If **EmaConfig.xml** file is not used, then at a minimum:
   - Non-interactive provider applications might need to modify both the default host address and port.
   - Interactive provider applications might need to modify the default port.

4. (**Conditional**) Implement an application callback client class that inherits from the **`OmmProviderClient`** class (for details, refer to Section 5.2).

   An application might need to override the default callback implementation and provide its own business logic. Not all methods need to be overridden: only those that require the application's business logic.
   - For non-interactive providers, this step is optional because the application may choose not to open login or dictionary items. In such cases, the provider application will not receive return messages.
   - For interactive providers, this step is required, because at a minimum, the application needs to handle all inbound login domain and item request messages.

5. (**Optional**) Implement an application error client class that inherits from the **`OmmProviderErrorClient`** class (for details, refer to Section 5.2).

   To be effectively notified about error conditions, the application needs to override any default, error callback methods.

6. Create an **`OmmProvider`** object and pass the **`Omm`*`ProviderType`*`Config`** object (and if needed, also pass in the application error client object), and optionally in **`NiProvider`** only, register for Login events by passing in an application callback client class.
7. (**Optional**) For non-interactive providers, open login and dictionary items using the **`OmmProvider::registerClient()`** method.
8. Process received messages.
9. Create, populate, and submit item messages (refresh, update, status).
   - For non-interactive providers, the application needs to associate each item with a handle that uniquely identifies the item.
   - For interactive providers, the application needs to use the handle from the **`OMMProviderEvent`**.

10. (**Optional**) Submit **`GenericMsg`** messages using the appropriate **`OmmProvider`** class methods.
11. Exit.

5.1.2 Interactive Providers: Post OmmProvider Object Instantiation

Before an interactive provider can start submitting items, the application must first accept a login request. Though the Enterprise Message API accepts connections, it is the responsibility of the application to send the login response. Subsequently, the consumer will request the source directory, and the Enterprise Message API will respond by submitting the source directory.

After creating an **`OmmProvider`** object, the Enterprise Message API observes the following process when creating and initializing the **`OmmProvider`** object so that applications can begin submitting items:

- Accept the connection request from a consumer
- Accept the login
- Submit the source directory information

5.1.3 Non-Interactive Providers: Post OmmProvider Object Instantiation

After creating an **`OmmProvider`** object, the Enterprise Message API performs the following steps when creating and initializing the **`OmmProvider`** object so that applications can begin submitting items:

- Establish connectivity to a configured server / host
- Log into ADH and submit source directory information

5.1.4 Non-Interactive Providers: Encrypted Connections and HTTP Proxy Tunneling

Non-interactive providers support both encrypted and HTTP proxy tunneling connections. Configuration details are identical to that of the Consumer when setting up these types of connections.

- For details on using an encrypted connection, refer to Section 4.3.3.
- For details on using an HTTP proxy tunneling connection, refer to Section 4.3.4.

5.1.5 Destroying the OmmProvider Object

For non-interactive providers, destroying an **`OmmProvider`** object causes the application to log out and disconnect from the connected ADH, at which time all items are closed.

For interactive providers, destroying an **`OmmProvider`** object causes Enterprise Message API to close all consumer connections.

5.1.6 Non-Interactive Example: Working with the OmmProvider Class

The following example illustrates the simplest application managing the **`OmmProvider`** class.

```
try
    {
        OmmProvider provider( OmmNiProviderConfig().host( "localhost:14003").username
                ( "user" ) );
        UInt64 itemHandle = 5;

        provider.submit( RefreshMsg().serviceName( "NI_PUB" ).name( "IBM.N" )
            .state( OmmState::OpenEnum, OmmState::OkEnum, OmmState::NoneEnum, "UnSolicited
                    Refresh Completed" )
            .payload( FieldList()
                .addReal( 22, 3990, OmmReal::ExponentNeg2Enum )
                .addReal( 25, 3994, OmmReal::ExponentNeg2Enum )
                .addReal( 30, 9, OmmReal::Exponent0Enum )
                .addReal( 31, 19, OmmReal::Exponent0Enum )
                .complete() )
            .complete(), itemHandle );

        sleep( 1000 );

        for ( Int32 i = 0; i < 60; i++ )
        {
            provider.submit( UpdateMsg().serviceName( "NI_PUB" ).name( "IBM.N" )
                .payload( FieldList()
                    .addReal( 22, 3391 + i, OmmReal::ExponentNeg2Enum )
                    .addReal( 30, 10 + i, OmmReal::Exponent0Enum )
                    .complete() ), itemHandle );
            sleep( 1000 );
        }
    }
    catch ( const OmmException& excp )
    {
        cout << excp << endl;
    }
    return 0;
}
```

5.1.7 Interactive Provider Example: Working with the OmmProvider Class

The following example illustrates the simplest interactive application managing the **OmmProvider** class.

```
try
    {
        AppClient appClient;

        OmmProvider provider( OmmIProviderConfig().port( "14002" ), appClient );

        while ( itemHandle == 0 ) sleep(1000);

        for ( Int32 i = 0; i < 60; i++ )
        {
            provider.submit( UpdateMsg().domainType( MMT_MARKET_BY_ORDER ).payload( Map()
                .addKeyAscii( OrderNr, MapEntry::UpdateEnum, FieldList()
                    .addRealFromDouble( 3427, 7.76 + i * 0.1, OmmReal::ExponentNeg2Enum )
                    .addRealFromDouble( 3429, 9600 )
                    .addEnum( 3428, 2 )
                    .addRmtes( 212, EmaBuffer( "Market Maker", 12 ) )
                    .complete() )
                .complete() ), itemHandle );

            sleep( 1000 );
        }
    }
    catch ( const OmmException& excp )
    {
        cout << excp << endl;
    }

    return 0;
```

5.1.8 Interactive Provider Example: Handling Post Message

The following example illustrates how to have **OmmProvider** send an **AckMsg** in response to a **PostMsg**. For more information on support of post messages by a provider, refer to the *Transport API C Edition Developers Guide*.

```
void AppClient::onPostMsg( const PostMsg& postMsg, const OmmProviderEvent& event )
{
    if (postMsg.getSolicitAck())
    {
        AckMsg ackMsg;
        ackMsg.domainType(postMsg.getDomainType());
        ackMsg.ackId(postMsg.getPostId());
        if (postMsg.hasSeqNum())
        {
```

```
            ackMsg.seqNum(postMsg.getSeqNum());
        }
        event.getProvider().submit(ackMsg, event.getHandle());
    }
}
```

5.1.9 Interactive Provider Example: Handling RTT Responses from Consumer

The following example implements a provider's callback for Generic messages. The example illustrates how the provider can identify and process consumer responses to RTT requests.

```
void AppClient::onGenericMsg(const GenericMsg& genericMsg, const OmmProviderEvent& event)
{
    if (genericMsg.getDomainType() == MMT_LOGIN && event.getHandle() == loginHandle &&
            genericMsg.getPayload().getDataType() == DataType::ElementListEnum)
    {
        cout << "Received login RTT message from Consumer " << event.getHandle() << endl;
        TimeValue currTicks = GetTime::getTicks();
        const ElementList& elementList = genericMsg.getPayload().getElementList();
        while ( elementList.forth() )
        {
            const ElementEntry& elementEntry = elementList.getEntry();
            if ( elementEntry.getName() == ENAME_RTT_TICKS && elementEntry.getLoadType() ==
                    DataType::UIntEnum ) // "Ticks"
            {
                cout << "\tRTT Tick value is " << elementEntry.getUInt() << "us." << endl;
                lastLatency = (UInt64)(((double)currTicks - (double)elementEntry.getUInt()) /
                        GetTime::ticksPerMicro());
                cout << "\tLast RTT message latency is " << lastLatency << "us." << endl;
            }
            else if ( elementEntry.getName() == ENAME_RTT_TCP_RETRANS && elementEntry.getLoadType() ==
                    DataType::UIntEnum ) // "TcpRetrans"
            {
                cout << "\tConsumer side TCP retransmissions: " << elementEntry.getUInt() << endl;
            }
        }
    }
}
```

5.1.10 Working with Items

The application assigns unique numeric identifiers, called handles (e.g., UInt64) to all open items it is providing. Application must pass this identifier along with an item message on the call to **`submit()`**. The handles are used to manage item stream ids. To reassign a handle to a different item, application must first close the item previously associated with the given handle.

5.2 OmmProviderClient Class

5.2.1 OmmProviderClient Description

The **OmmProviderClient** class provides a callback mechanism through which applications receive OMM messages on items for which they subscribe. The **OmmProviderClient** is a parent class that implements empty, default callback methods. Applications must implement their own class (inheriting from **OmmProviderClient**), and override the methods they are interested in processing. Applications can implement many specialized client-type classes; each according to their business needs and design. Instances of client-type classes are associated with individual items while applications register item interests. The **OmmProviderClient** class provides default implementation for the processing of **RefreshMsg**, **StatusMsg**, and **GenericMsg** messages. These messages are processed by their respectively named methods: **onRefreshMsg()**, **onStatusMsg()**, **onGenericMsg()**, **onRequest()**[1], **onReIssue()**[1], **onClose()**[1], and **onPost()**[1]. Applications only need to override methods for messages they want to process.

5.2.2 Non-Interactive Example: OmmProviderClient

The following example illustrates an application client-type class, depicting **onRefreshMsg()** method implementation.

```
class AppClient : public refinitiv::ema::access::OmmProviderClient
{
protected :
    void onRefreshMsg( const refinitiv::ema::access::RefreshMsg&, const
            refinitiv::ema::access::OmmProviderEvent& );
    void onStatusMsg( const refinitiv::ema::access::StatusMsg&, const
            refinitiv::ema::access::OmmProviderEvent& );
    bool  _bConnectionUp;
};

void AppClient::onRefreshMsg( const RefreshMsg& refreshMsg, const OmmProviderEvent&
        ommEvent )
{
    cout << endl << "Handle: " << ommEvent.getHandle() << " Closure: " <<
            ommEvent.getClosure() << endl;
    cout << refreshMsg << endl;

    if ( refreshMsg.getState().getStreamState() == OmmState::OpenEnum )
    {
        if ( refreshMsg.getState().getDataState() == OmmState::OkEnum )
                _bConnectionUp = true;
        else
                _bConnectionUp = false;
    }
    else
        _bConnectionUp = false;
}
```

1. Interactive Provider Only

5.2.3 Interactive Example: OmmProviderClient

The following example illustrates an application client-type class, depicting **`onRefreshMsg()`** method implementation.

```
void AppClient::processLoginRequest( const ReqMsg& reqMsg, const OmmProviderEvent& event )
{
    event.getProvider().submit(RefreshMsg().domainType(MMT_LOGIN).name(reqMsg.getName()).
            nameType(USER_NAME).complete().solicited( true ).
            state( OmmState::OpenEnum, OmmState::OkEnum, OmmState::NoneEnum,
            "Login accepted" ),event.getHandle() );
}

void AppClient::processMarketByOrderRequest( const ReqMsg& reqMsg, const OmmProviderEvent&
        event )
{
    if ( itemHandle != 0 )
    {
        processInvalidItemRequest(reqMsg, event);
        return;
    }

    event.getProvider().submit(RefreshMsg().domainType(MMT_MARKET_BY_ORDER).
            name(reqMsg.getName()).serviceName(reqMsg.getServiceName()).solicited(true)


            .summaryData( FieldList().addEnum( 15, 840 ).addEnum( 53, 1 ).addEnum( 3423, 1 ).
                    addEnum( 1709, 2 ).complete() )
            .addKeyAscii( OrderNr, MapEntry::AddEnum, FieldList()
                .addRealFromDouble( 3427, 7.76, OmmReal::ExponentNeg2Enum )
                .addRealFromDouble( 3429, 9600 )
                .addEnum( 3428, 2 )
                .addRmtes( 212, EmaBuffer( "Market Maker", 12 ) )
                .complete() )
            .complete() )
        .complete(), event.getHandle() );

    itemHandle = event.getHandle();
}

void AppClient::processInvalidItemRequest( const ReqMsg& reqMsg, const OmmProviderEvent&
        event )
{
    event.getProvider().submit( StatusMsg().name( reqMsg.getName() ).serviceName(
            reqMsg.getServiceName() )
        .domainType( reqMsg.getDomainType() )
        .state( OmmState::ClosedEnum, OmmState::SuspectEnum, OmmState::NotFoundEnum,
                "Item not found" ),
```

```
        event.getHandle() );
}

void AppClient::onReqMsg( const ReqMsg& reqMsg, const OmmProviderEvent& event )
{
    switch ( reqMsg.getDomainType() )
    {
    case MMT_LOGIN:
        processLoginRequest( reqMsg, event );
        break;
    case MMT_MARKET_BY_ORDER:
        processMarketByOrderRequest( reqMsg, event );
        break;
    default:
        processInvalidItemRequest( reqMsg, event );
        break;
    }
}
```

5.3 OMMIProviderConfig

You can use the **`OmmNiProviderConfig`** class to customize the functionality of the **`OmmProvider`** class. The default behavior of **`OmmProvider`** is hard coded in the **`OmmNiProviderConfig`** class. You can configure **`OmmProvider`** in any of the following ways:

- Using the **EmaConfig.xml** file
- Using interface methods on the **`OmmNiProviderConfig`** class
- Passing OMM-formatted configuration data through the **`OmmNiProviderConfig::config( const Data& )`** method.

For more details on using the **`OmmNiProviderConfig`** class and associated configuration parameters, refer to the *Enterprise Message API Configuration Guide*.

5.4 OmmNiProviderConfig Class

In the following, the value for ***`ProviderType`*** is dependent on the type of provider with which you are dealing, thus:

- For non-interactive providers, ***`ProviderType`*** is **`NiProvider`**.
- For interactive providers, ***`ProviderType`*** is **`IProvider`**.

You can use the **`Omm`*`ProviderType`*`Config`** class to customize the functionality of the **`OmmProvider`** class. The default behavior of **`OmmProvider`** is hard coded in the **`Omm`*`ProviderType`*`Config`** class. You can configure **`OmmProvider`** in any of the following ways:

- Using the **EmaConfig.xml** file
- Using interface methods on the **`Omm`*`ProviderType`*`Config`** class
- Passing OMM-formatted configuration data through the **`Omm`*`ProviderType`*`Config::config( const Data& )`** method.

For more details on using the **`Omm`*`ProviderType`*`Config`** class and associated configuration parameters, refer to the *Enterprise Message API Configuration Guide*.

6 Consuming Data from the Cloud

6.1 Overview

You can use the Enterprise Message API to consume data from a cloud-based Refinitiv Real-Time Advanced Distribution Server. The API interacts with cloud-based servers using the following work flows:

- Authentication Token Management (for details, refer to Section 6.3)
- Service Discovery (for details, refer to Section 6.4)
- Consuming Market Data (for details, refer to Section 6.5)
- Login Reissue (for details, refer to Section 6.3.3)

By default, for cloud connections the Enterprise Message API connects to a server in the **us-east** cloud location.

For further details on Refinitiv Real-Time as it functions in the cloud, refer to the *Refinitiv Real-Time - Optimized: Installation and Configuration for Client Use*. For details on the parameters you use to configure cloud connections, refer to the *EMA C++ Edition Configuration Guide*.

6.2 Encrypted Connections

When connecting to a Refinitiv Real-Time Advanced Distribution Server in the cloud, you must use a **`ChannelType`** of **`RSSL_ENCRYPTED`** (for details on **`ChannelType`**, refer to the *Enterprise Message API C++ Configuration Guide*).

Encrypted connections to the cloud must use an OpenSSL-based connection type (on both Windows and Linux). WinINet is not supported for cloud connectivity.

6.3 Authentication Token Management

6.3.1 Client_ID (AppKey) and Client Secret

To connect to Refinitiv Real-Time - Optimized infrastructure, the Enterprise Message API requires a **Client_ID**, and optionally can include a client secret. **Client_ID**s are generated using **AppGenerator**, which refers to the **Client_ID** as an AppKey. Each user must obtain their unique **Client_ID** using the machine account email sent by Refinitiv, which includes a link to **AppGenerator**. Keep your **Client_ID** private: do not share **Client_ID**s.

- For further details on generating this ID, refer to the *Refinitiv Real-Time - Optimized: Installation and Configuration for Client Use* document. Each **Client_ID** is unique: do not share it with others.
- For further details on supporting client secret submissions, refer to the.
- For details on how OAuth uses a Client Secret with a Client ID and their relationship, refer to OAuth documentation at: the following URL: https://www.oauth.com/oauth2-servers/client-registration/client-id-secret/.

6.3.2 Obtaining Initial Access and Refresh Tokens

To obtain an access token, the RTSDK API sends its username, **Client_ID**, and password in a single message to the Refinitiv Data Platform.

TIP: You can also specify `tokenScope` and `clientSecret` in the OMMConsumerConfig.

In response, the Refinitiv Data Platform sends an access token, its expiration timeout (by default: 300 seconds), and a refresh token for use in the login reissue process (for details on the expiration timeout and login reissue process, refer to Section 6.3.3). The API must obtain an access token before executing a service discovery or obtaining market data.

The following diagram illustrates the process by which the RTSDK API obtains its tokens:

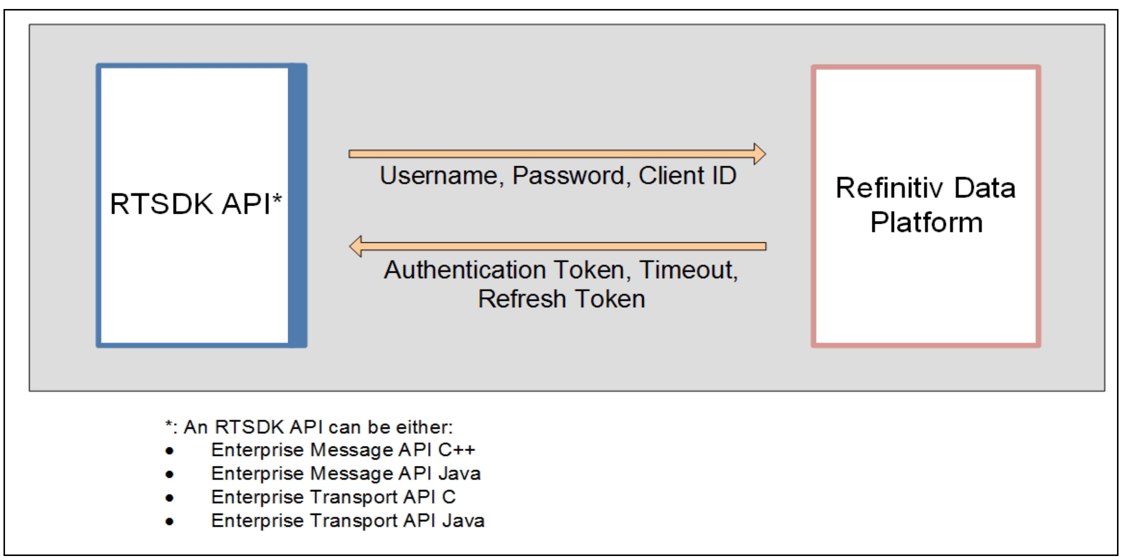


Figure 2. Obtaining an Authentication Token

6.3.3 Refreshing the Access Token and Sending a Login Reissue

In response to the API's token request, the Refinitiv Data Platform sends an access token and a refresh token, both with associated expiration timeouts which set the length of time for which the token is valid. If the Refinitiv Real-Time Advanced Distribution Server does not receive a new access token before the end of the expiration timeout, the Refinitiv Real-Time Advanced Distribution Server sends a login close status message and closes the connection.

NOTE: The life cycle of `OmmConsumer` in the Enterprise Message API depends on the state of the login stream because the Enterprise Message API closes the underlying channel whenever the API receives a close status message from Refinitiv Real-Time Advanced Distribution Server. To recover from this scenario, the application must create another `OmmConsumer` and resubscribe to all applicable items.

To create a seamless experience for API users, the API sends the refresh token to proactively obtain a new access token prior to the published expiration timeout. The Enterprise Message API calculates the time at which it requests a new access token by multiplying the token's published timeout by 4/5 (i.e., **0.8**).

In response to receiving a refresh token, the Refinitiv Data Platform sends a new access token with an associated timeout to the API. After receiving the new access token from the Refinitiv Data Platform, the API renews its connection by sending a Login Reissue with the new access token to the Refinitiv Real-Time Advanced Distribution Server. The process of renewing the access token and refreshing the Refinitiv Real-Time Advanced Distribution Server connection via a Login Reissue continues until the refresh token itself expires (which can take several hours or days). When using a **grant_type** of **refresh_token**, if the value for **expires_in** does not match the **expires_in** received from when the API obtained the **refresh_token** (i.e., when **grant_type** was **password**), this is an indication that the **refresh_token** is about to expire. In this case, the API will obtain a new set of both refresh and access tokens as described in Section 6.3.2.

The login reissue process is illustrated in the following diagram:

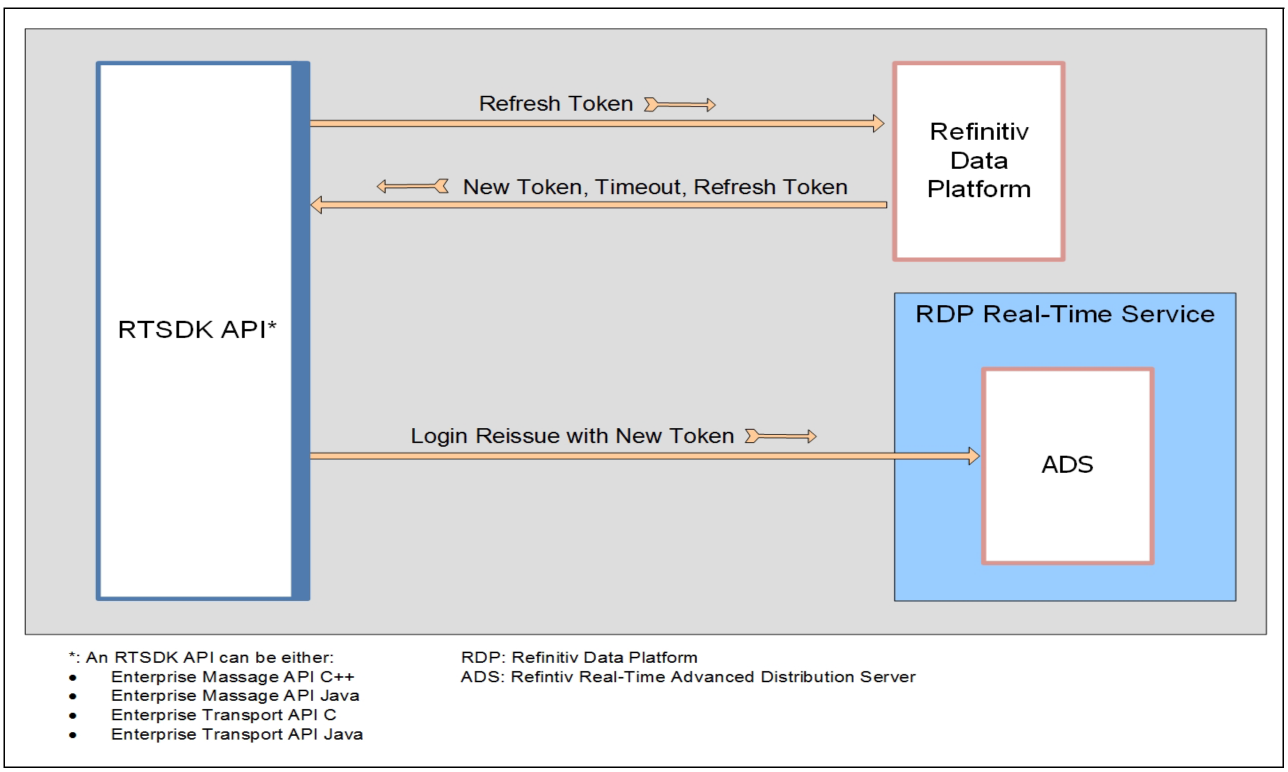


Figure 3. Login Reissue

6.3.4 Session Management per User Credential

Prior to Version 3.3.1, the Enterprise Message API would manage tokens separately across each channel, even when using the same Username, Client ID, and password credentials. So that each channel had a unique pair of access and refresh tokens. API would manage each channel distinct from the others.

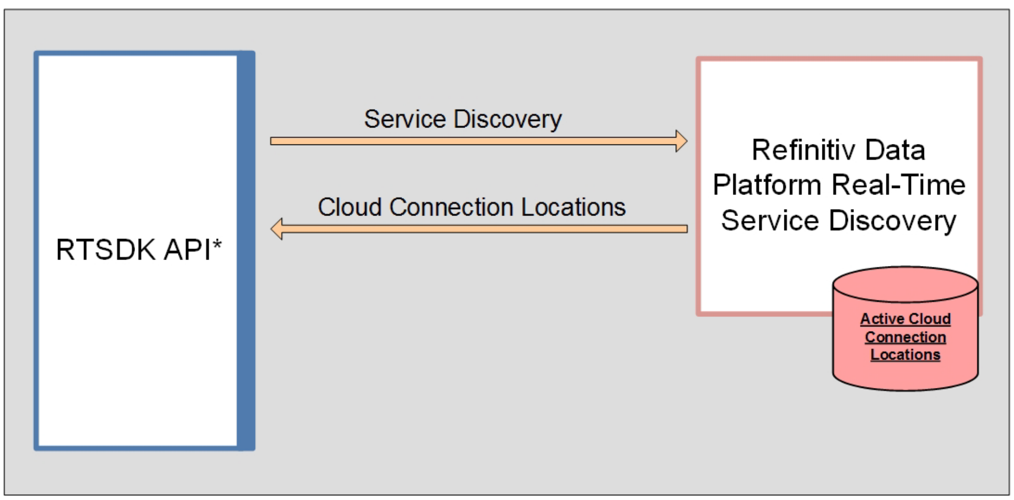
As of Version 3.3.1, the Enterprise Message API connects to the Refinitiv Data Platform once and reuses the same access and refresh tokens for all channels. The Enterprise Message API supports up to, but no more than, 5 channels per OAuth credential set.

6.4 Service Discovery

After obtaining a token (for details, refer to Section 6.3.2), the Enterprise Message API can perform a service discovery against the Refinitiv Data Platform (whose URL is set in **`OmmConsumerConfig`**) to obtain connection details for the Refinitiv Real-Time Advanced Distribution Server in the cloud.

In response to a service discovery, the Refinitiv Data Platform returns transport and data format protocols and a list of hosts and associated ports for the requested service(s) (i.e., a Refinitiv Real-Time Advanced Distribution Server running in the cloud). Refinitiv provides multiple cloud locations based on region, which is significant in how the Enterprise Message API chooses the IP address and port to use when connecting to the cloud.

From the list sent by the Refinitiv Data Platform, the Enterprise Message API identifies a Refinitiv Real-Time Advanced Distribution Server (i.e., an endpoint) set up for failover and whose regional location matches the API's location setting in **`ChannelGroup`** (for details, refer to Section 3.3.2). If you do not specify a location, the Enterprise Message API defaults to the **us-east** cloud location. An endpoint setup for failover lists multiple locations in its location field (e.g., **`location: [us-east-1a, us-east-1b]`**). If multiple endpoints are set up for failover, the Enterprise Message API chooses to connect to the first endpoint listed.



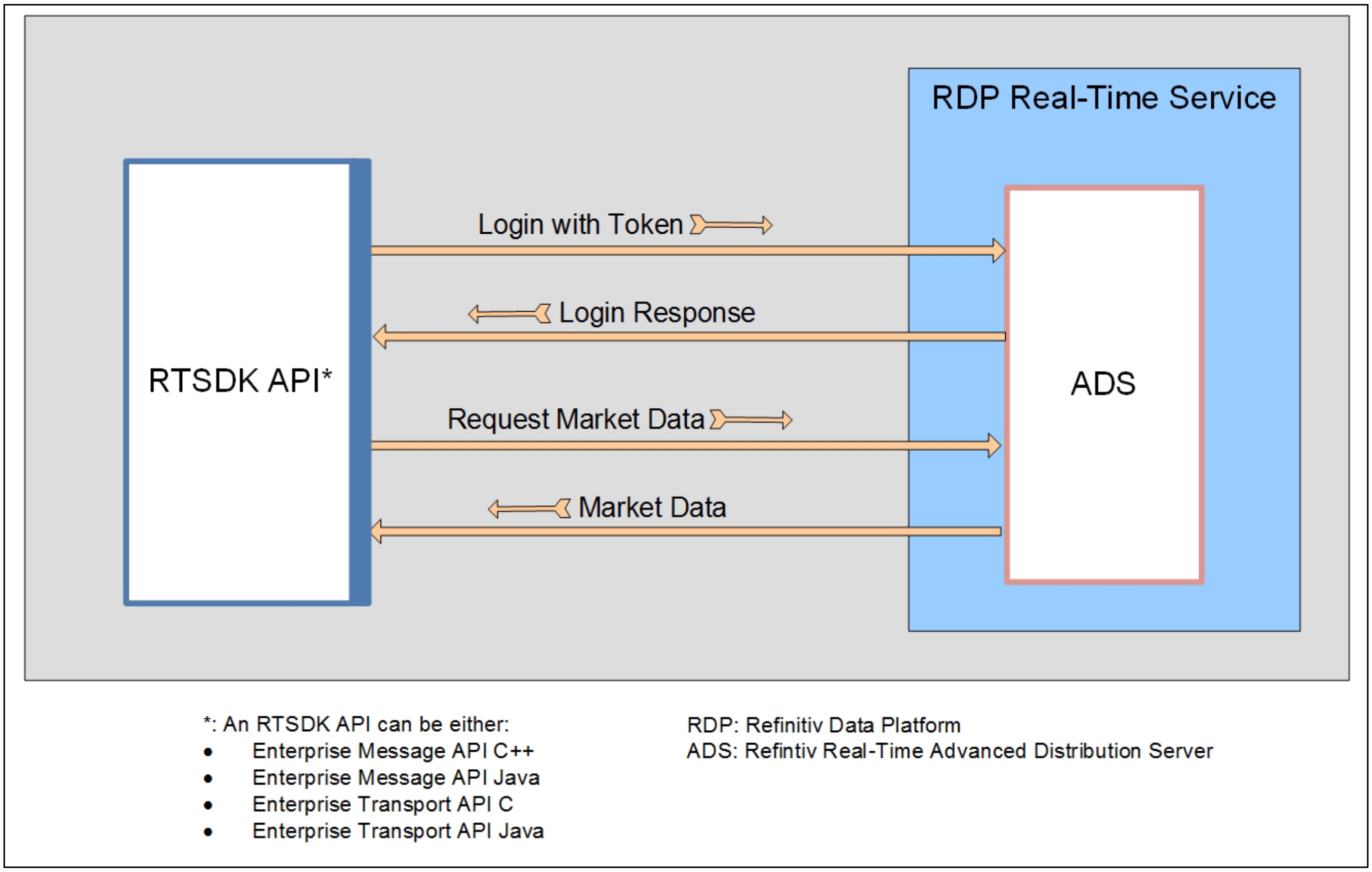
*: An RTSDK API can be either:

- Enterprise Message API C++
- Enterprise Message API Java
- Enterprise Transport API C
- Enterprise Transport API Java

Figure 4. Service Discovery

6.5 Consuming Market Data

After obtaining its login token (for details, refer to Section 6.3.2) and running a service discovery (for details, refer to Section 6.4), the API can connect to the Refinitiv Real-Time Advanced Distribution Server in the cloud and obtain market data. While consuming market data, the API must periodically renew its token via the login reissue workflow (for details, refer to Section 6.3.3).



6.6 HTTP Error Handling for Reactor Token Reissues

The Enterprise Message API supports handling for the following HTTP error codes from the API gateway:

- 300 Errors:
    - Perform URL redirect for 301, 302, 307 and 308 error codes.
    - Retry the request to the API gateway for all other error codes
- 400 Errors:
    - Retry with username and password for error codes 400 and 401
    - Stop retry the request for error codes 403 and 451
    - Retry the request to the API gateway for all other error codes
- 500 Errors: Retry the request to the API gateway for all error codes

6.7 Cloud Connection Use Cases

You can connect to the cloud and consume data according to the following use cases:

- Start to finish session management (for details, refer to Section 6.7.1)
- Query service discovery (for details, refer to Section 6.7.2)

6.7.1 Session Management Use Case

In the session management use case, the Enterprise Message API manages the entire connection from start to finish. To use session management, you need to configure the API to enable session management (i.e., in the **ChannelGroup**, set the **Channel** entry parameter **EnableSessionManagement**).

The API exhibits the following behavior (listed in order) when operating in a session management use case:

- Obtains a token (according to the details in Section 6.3.2)
- Queries service discovery (according to the details in Section 6.4)
- Consumes market data (according to the details in Section 6.5)
- Manages login reissues when needed on a cyclical basis (according to the details in Section 6.3.3)

EMA's **Consumer** example (*113__MarketPrice__SessionManagement example*) provides sample source to illustrate session management.

A special use case exists for connecting to a specific (i.e., non-default) host. As described in Section 6.4, by default the Enterprise Message API connects to whichever host is setup for failover in the location specified by the API. If you want to connect to a specific, non-default host, you must set this in the **ChannelGroup** parameters: **Host** and **Port**. In this case, the Enterprise Message API exhibits the same behavior listed above, but ignores the endpoints it receives from the service discovery.

6.7.2 Query Service Discovery

In the query service discovery use case, the API user wants to connect to the Refinitiv Data Platform only for a service discovery, and does not necessarily want to consume market data. The API exhibits the following behavior (listed in order) when operating in a query service discovery use case:

- Obtains a token (according to the details in Section 6.3.2)
- Queries service discovery (according to the details in Section 6.4)

EMA's **Consumer** example (*450__MarketPrice__QueryServiceDiscovery*) provides sample source that discovers an endpoint using the service discovery feature and establishes an encrypted connection to consume data.

6.8 Logging of Authentication and Service Discovery Interaction

If needed, you can log interactions with the Refinitiv Data Platform. To enable logging, use the parameters **RestEnableLog** and **RestLogFileName** in the EMA configuration file or programmatic configuration in the Consumer Group. For details on these parameters, refer to the *Enterprise Message API C++ Configuration Guide*.

6.8.1 Logged Request Information

With logging turned on in the fashion mentioned in Section 6.8, the Enterprise Message API writes the following request information in the log:

NOTE: If the request contains parameters **`password`**, **`newPassword`**, or **`client_secret`**, the Enterprise Message API uses a placeholder instead of the real value of the respective parameter (thus indicating that the value was present).

```
Request:
- Time stamp
- The Name of the class and method that made the request
- Request method
- URI
- Request headers
- Proxy information (if used)
- Body of request as set of pairs parameter_name: parameter_value
```

6.8.2 Logged Response Information

With logging turned on in the fashion mentioned in Section 6.8, the Enterprise Message API writes the following response information in the log:

```
Response:
- Time stamp
- The Name of the class and method that received the response
- Response status code
- Response headers
- Body of response in string format
```

7 Troubleshooting and Debugging

7.1 Enterprise Message API Logger Usage

The Enterprise Message API provides a logging mechanism useful for debugging runtime issues. In the default configuration, Enterprise Message API is set to log significant events encountered during runtime and direct logging output to a file. If needed, you can turn off logging, or direct its output to **`stdout`**. Additionally, applications can configure the logging level at which the Enterprise Message API logs event (to log every event, only error events, or nothing). For further details on managing and configuring the EMS logging function, refer to the *Enterprise Message API Configuration Guide*.

7.2 Omm Error Client Classes

7.2.1 Error Client Description

Enterprise Message API has two Error Client classes: **`OmmConsumerErrorClient`** and **`OmmProviderErrorClient`**. These two classes are an alternate error notification mechanism in the Enterprise Message API, which you can use instead of the default error notification mechanism (i.e., **`OmmException`**, for details, refer to Section 7.3). Both mechanisms deliver the same information and detect the same error conditions. To use Error Client, applications need to implement their own error client class, override the default implementation of each method, and pass this Error Client class on the constructor to **`OmmConsumer`** and **`OmmProvider`**.

7.2.2 Example: Error Client

The following example illustrates an application error client and depicts simple processing of the **onInvalidHandle()** method. In the following example, ***ClassName*** is either **OmmConsumerErrorClient** (for Enterprise Message API consumer applications) or **OmmProviderErrorClient** (for Enterprise Message API provider applications).

```
class AppErrorClient : public ClassName
{
public :

   void onInvalidHandle( UInt64 handle, const EmaString& text );

   void onInaccessibleLogFile( const EmaString& filename, const EmaString& text );

   void onMemoryExhaustion( const EmaString& text);

   void onInvalidUsage( const EmaString& text, Int32 errorCode );

   void onSystemError( Int64 code, void* ptr, const EmaString& text );

   void onJsonConverter( const EmaString& text, Int32 errorCode, const ConsumerSessionInfo&
            sessionInfo );
};

void AppErrorclient::onInvalidHandle( UInt64 handle, const EmaString& text )
{
   cout << "Handle = " << handle << endl << ", text = " << text <<endl;
}
```

7.3 OmmException Class

If the Enterprise Message API detects an error condition, the Enterprise Message API might throw an exception. All exceptions in the Enterprise Message API inherit from the parent class **`OmmException`**, which provides functionality and methods common across all **`OmmException`** types.

TIP: Refinitiv recommends you use **`try`** and **`catch`** blocks during application development and QA to quickly detect and fix any Enterprise Message API usage or application design errors.

The Enterprise Message API supports the following exception types:

- **`OmmInaccessibleLogFileException`**: Thrown when the Enterprise Message API cannot open a log file for writing.
- **`OmmInvalidConfigurationException`**: Thrown when the Enterprise Message API detects an unrecoverable configuration error.
- **`OmmInvalidHandleException`**: Thrown when an invalid / unrecognized item handle is passed in on **`OmmConsumer`** or **`OmmProvider`** class methods.
- **`OmmInvalidUsageException`**: Thrown when the Enterprise Message API detects invalid interface usage.
- **`OmmJsonConverterException`**: Thrown when the Enterprise Message API fails to perform a RWF/JSON conversion.
- **`OmmMemoryExhaustionException`**: Thrown when the Enterprise Message API detects an out-of-memory condition.
- **`OmmOutOfRangeException`**: Thrown when a passed-in parameter lies outside the valid range.
- **`OmmSystemException`**: Thrown when the Enterprise Message API detects a system exception.
- **`OmmUnsupportedDomainTypeException`**: Thrown if domain type specified on a message is not supported.

7.4 Creating a DACSLOCK for Publishing Permission Data

Provider applications can create a DACSLocks and publish it to permission data on the Refinitiv Real-Time Distribution System. A DACSLock controls access to data by users. For further details on the DACSLock API, refer to the *VAR_DACSGuide*.

The following example code illustrates how to create a DACSLock.

```
#include "dacs_lib.h"

typedef struct {
    char            _operator;
    unsigned short  pc_listLen;
    unsigned long   pc_list[256];
} PC_DATA;

PC_DATA pcData;
PRODUCT_CODE_TYPE* pcTypePtr = (PRODUCT_CODE_TYPE *)&pcData;
unsigned char* lockPtr = NULL;
int lockLen = 0;
DACS_ERROR_TYPE dacsError;
unsigned char dacsErrorBuffer[128];

printf("\nGenerates DACS lock \n");
pcData._operator = OR_PRODUCT_CODES;
pcData.pc_listLen = 1;
```

```
pcData.pc_list[0] = 1001;
int serviceId = 261;

if (DACS_GetLock(serviceId, pcTypePtr, &lockPtr, &lockLen, &dacsError) == DACS_FAILURE)
{
    if (DACS_perror(dacsErrorBuffer, sizeof(dacsErrorBuffer), (unsigned char *)"DACS_GetLock() failed
            with error", &dacsError) == DACS_SUCCESS)
    {
        printf("%s\n", dacsErrorBuffer);
    }
    else
    {
        printf("DACS_GetLock() failed\n");
    }
    return;
}
printf("DACS_GetLock() - Success\n");

EmaBuffer permissionData;
permissionData.setFrom((const char*)lockPtr, lockLen);
```

Code Example 1: Creating a DACSLOCK for Publishing Permission Data

Document ID: EMAC361UM.210
Date of issue: March 2021