EDB .NET Connector

Release 4.1.6.1

EDB .NET Connector User’s Guide

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## Contents

1 What's New 2  
2 Requirements Overview 3  
  2.1 Supported Server Versions and Platforms 3  
3 The EDB .NET Connector - Overview 4  
  3.1 The .NET Class Hierarchy 5  
4 Installing and Configuring the .NET Connector 6  
  4.1 Installing the .NET Connector 6  
  4.2 Configuring the .NET Connector 7  
    4.2.1 Referencing the Library Files 7  
    4.2.2 .NET Framework Setup 7  
      4.2.2.1 .NET Framework 4.6.1 7  
      4.2.2.2 .NET Framework 4.7.2 7  
      4.2.2.3 .NET Framework 4.8 7  
      4.2.2.4 .NET Standard 2.0 7  
      4.2.2.5 .NET Standard 2.1 7  
      4.2.2.6 .NET Core 3.0 7  
    4.2.3 Entity Framework 6 7  
    4.2.4 EDB VSIX for Visual Studio 2015/2017/2019 7  
      4.2.4.1 Installation and Configuration for Visual Studio 2015/2017/2019 7  
      4.2.4.2 Model First and Database First Usage 7  
5 Using the .NET Connector 28  
6 Opening a Database Connection 29  
  6.1 Connection String Parameters 30  
  6.2 Example - Opening a Database Connection using ASP.NET 33  
  6.3 Example - Opening a Database Connection from a Console Application 35
6.4 Example - Opening a Database Connection from a Windows Form Application . . 37

7 Retrieving Database Records 39
7.1 Retrieving a Single Database Record . . . . . . . . . . . . . . . . . . . . . . . . 42

8 Parameterized Queries 44

9 Inserting Records in a Database 46

10 Deleting Records in a Database 48

11 Using SPL Stored Procedures in your .NET Application 50
11.1 Example - Executing a Stored Procedure without Parameters . . . . . . . . . 51
11.2 Example - Executing a Stored Procedure with IN Parameters . . . . . . . . . 53
11.3 Example - Executing a Stored Procedure with IN, OUT, and INOUT Parameters . 57

12 Using Advanced Queueing 61
12.1 Enqueueing or Dequeueing a Message . . . . . . . . . . . . . . . . . . . . . . . . 62
12.1.1 Server-Side Setup . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 62
12.1.2 Client-side Example . . . . . . . . . . . . . . . . . . . . . . . . . . . . 63
12.2 EDBAQ Classes . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 71

13 Using a Ref Cursor in a .NET Application 75

14 Using Plugins 78
14.1 GeoJSON . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 79
14.2 Json.NET . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 80
14.3 LegacyPostGIS . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 81
14.4 NetTopologySuite . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 82
14.5 NodaTime . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 84
14.6 RawPostGIS . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 85

15 Using Object Types in .NET 86
15.1 Using an Object Type . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 86

16 Security and Encryption 91
16.1 Scram Compatibility . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 91

17 EDB .NET Connector Logging 92

18 API Reference 95

19 Conclusion 96

Index 98
The EDB .NET Connector distributed with EDB Postgres™ Advanced Server (Advanced Server) provides connectivity between a .NET client application and an Advanced Server database server. This guide provides installation instructions, usage instructions, and examples that demonstrate the functionality of the EDB .NET Connector:

- How to connect to an instance of Advanced Server.
- How to retrieve information from an Advanced Server database.
- How to update information stored on an Advanced Server database.

This document assumes that you have a solid working knowledge of both C# and .NET. The EDB .NET Connector functionality is built on the core functionality of the Npgsql open source project. The Npgsql User's Manual is available online.
The following features are added to create EDB .NET Connector 4.1.6.1:

- Merged with the upstream Npgsql driver version 4.1.6. For more information about the merge updates, visit https://www.nuget.org/packages/Npgsql/4.1.6.

The following section details the supported platforms for the EDB .NET Connector.

2.1 Supported Server Versions and Platforms

The EDB .NET Connector is certified with Advanced Server version 9.5 and above.

The EDB .NET Connector graphical installers are supported on the following Windows platforms:

64-bit Windows:
- Windows Server 2019
- Windows Server 2016
- Windows Server 2012 R2
- Windows 10
- Windows 8.1

32-bit Windows:
- Windows 10
- Windows 8.1
The EDB .NET Connector is a .NET data provider that allows a client application to connect to a database stored on an Advanced Server host. The .NET Connector accesses the data directly, allowing the client application optimal performance, a broad spectrum of functionality, and access to Advanced Server features.

The .NET Connector supports following frameworks:

- .NET Framework versions 4.6.1, 4.7.2 and 4.8
- .NET Standard 2.0 and 2.1
- .NET Core 3.0
- Entity Framework 6
- EDB VSIX
3.1 The .NET Class Hierarchy

The .NET Class Hierarchy contains a number of classes that you can use to create objects that control a connection to the Advanced Server database and manipulate the data stored on the server. The following are just a few of the most commonly used object classes:

**EDBConnection**

The EDBConnection class represents a connection to Advanced Server. An EDBConnection object contains a ConnectionString that instructs the .NET client how to connect to an Advanced Server database.

**EDBCommand**

An EDBCommand object contains an SQL command that the client will execute against Advanced Server. Before you can execute an EDBCommand object, you must link it to an EDBConnection object.

**EDBDataReader**

An EDBDataReader object provides a way to read an Advanced Server result set. You can use an EDBDataReader object to step through one row at a time, forward-only.

**EDBDataAdapter**

An EDBDataAdapter object links a result set to the Advanced Server database. You can modify values and use the EDBDataAdapter class to update the data stored in an Advanced Server database.
Chapter 4

Installing and Configuring the .NET Connector

This chapter describes how to install and configure the EDB .NET Connector.

4.1 Installing the .NET Connector

You can use the EDB .NET Connector Installer (available from the EDB website) to add the .NET Connector to your system. After downloading the installer, right-click on the installer icon, and select Run As Administrator from the context menu. When prompted, select an installation language and click OK to continue to the Setup window.
Click Next to continue.

Fig. 1: The .NET Connector Installation wizard
Use the **Installation Directory** dialog to specify the directory in which the connector will be installed, and click **Next** to continue.
Click **Next** on the **Ready to Install** dialog to start the installation; popup dialogs confirm the progress of the installation wizard.
When the wizard informs you that it has completed the setup, click the Finish button to exit the dialog.

Fig. 4: The installation is complete
You can also use StackBuilder Plus to add or update the connector on an existing Advanced Server installation; to open StackBuilder Plus, select StackBuilder Plus from the Windows Apps menu.

Fig. 5: Starting StackBuilder Plus
When StackBuilder Plus opens, follow the onscreen instructions.

Select the EnterpriseDB.Net Connector option from the Database Drivers node of the tree control.

![Fig. 6: Selecting the Connectors installer](image)

Follow the directions of the onscreen wizard to add or update an installation of an EDB Connector.
4.2 Configuring the .NET Connector

Please see the following environment-specific sections for information about configuring the .NET Connector:

- **Referencing the Library Files.** *General configuration information* applicable to all components.

- **.NET Framework 4.6.1** Instructions for configuring for use with *NET Framework 4.6.1*.

- **.NET Framework 4.7.2** Instructions for configuring for use with *NET Framework 4.7.2*.

- **.NET Framework 4.8** Instructions for configuring for use with *NET Framework 4.8*.

- **.NET Standard 2.0**. Instructions for configuring for use with *NET Standard 2.0*.

- **.NET Standard 2.1**. Instructions for configuring for use with *NET Standard 2.1*.

- **.NET Core 3.0** Instructions for configuring for use with *NET Core 3.0*.

- **Entity Framework 6**. Instructions for configuring for use with *Entity Framework*.

- **EDB VSIX**. Instructions for configuring for use with *EDB VSIX*.
4.2.1 Referencing the Library Files

To reference library files with Microsoft Visual Studio:

1. Select the project in the Solution Explorer.
2. Select Add Reference from the Project menu.
3. When the Add Reference dialog box opens, browse to select the appropriate library files.

Optionally, the library files can be copied to the specified location.

Before you can use an EDB .NET class, you must import the namespace into your program. Importing a namespace makes the compiler aware of the classes available within the namespace. The namespace is:

   EnterpriseDB.EDBClient

If you are using Entity Framework 6, the following additional namespace is required:

   EntityFramework6.EnterpriseDB.EDBClient

The method you use to include the namespace varies by the type of application you are writing. For example, the following command imports a namespace into an ASP.NET page:

   <%= import namespace="EnterpriseDB.EDBClient" %> \\

To import a namespace into a C# application, write:

   using EnterpriseDB.EDBClient;
4.2.2 .NET Framework Setup

The following sections describe the setup for various .NET versions.

4.2.2.1 .NET Framework 4.6.1

If you are using .NET Framework version 4.6.1, the data provider installation path is:

C:\Program Files\edb\dotnet\net461\

You must add the following dependencies to your project:

EnterpriseDB.EDBClient.dll
Microsoft.Bcl.AsyncInterfaces.dll
System.Memory.dll
System.Numerics.Vectors.dll
System.Runtime.dll
System.Text.Json.dll
System.Threading.Tasks.Extensions.dll
System.ValueTuple.dll

Depending upon the type of application you use, you may be required to import the namespace into the source code. See Referencing the Library Files for this and other information about referencing library files.
4.2.2.2 .NET Framework 4.7.2

If you are using .NET Framework version 4.7.2, the data provider installation path is:

C:\Program Files\edb\dotnet\net472\n
You must add the following dependencies to your project:

- EnterpriseDB.EDBClient.dll
- Microsoft.Bcl.AsyncInterfaces.dll
- System.Memory.dll
- System.Numerics.Vectors.dll
- System.Text.Json.dll
- System.Threading.Tasks.Extensions.dll

Depending upon the type of application you use, you may be required to import the namespace into the source code. See *Referencing the Library Files* for this and other information about referencing library files.
4.2.2.3 .NET Framework 4.8

If you are using .NET Framework version 4.8, the data provider installation path is:

C:\Program Files\edb\dotnet\net48\

You must add the following dependencies to your project:

EnterpriseDB.EDBClient.dll
Microsoft.Bcl.AsyncInterfaces.dll
System.Memory.dll
System.Numerics.Vectors.dll
System.Text.Json.dll
System.Threading.Tasks.Extensions.dll

Depending upon the type of application you use, you may be required to import the namespace into the source code. See *Referencing the Library Files* for this and other information about referencing library files.
4.2.2.4 .NET Standard 2.0

For .NET Standard Framework 2.0, the data provider installation path is:

C:\Program Files\edb\dotnet\netstandard2.0\n
You must add the following dependencies to your project:

EnterpriseDB.EDBClient.dll
System.Threading.Tasks.Extensions.dll
System.ValueTuple.dll

**Note:** If your target framework is .Net Core 2.0, then include the following file in your project:

System.Threading.Tasks.Extensions.dll

Depending upon the type of application you use, you may be required to import the namespace into the source code. See _Referencing the Library Files_ for this and other information about referencing library files.
4.2.2.5 .NET Standard 2.1

For .NET Standard Framework 2.1, the data provider installation path is:

    C:\Program Files\edb\dotnet\netstandard2.1\n
The following shared library files are required:

    EnterpriseDB.EDBClient.dll
    System.Memory.dll
    System.Text.Json.dll
    System.Threading.Tasks.Extensions.dll
    System.ValueTuple.dll

Depending upon the type of application you use, you may be required to import the namespace into the source code. See *Referencing the Library Files* for this and other information about referencing library files.
4.2.2.6 .NET Core 3.0

If you are using .NET Core 3.0, the data provider installation path is:

C:\Program Files\edb\dotnet\netcoreapp3.0\

The following shared library files are required:

- EnterpriseDB.EDBClIENT.dll
- System.Threading.Tasks.Extensions.dll
- System.ValueTuple.dll
- System.Memory.dll

Depending upon the type of application you use, you may be required to import the namespace into the source code. See Referencing the Library Files for this and other information about referencing library files.
4.2.3 Entity Framework 6

To configure the .NET Connector for use with Entity Framework, the data provider installation path is:

**For net461**

C:\Program Files\edb\dotnet\EF\net461

The following shared library file is required:

EntityFramework6.EnterpriseDB.EDBClient.dll

**For net472**

C:\Program Files\edb\dotnet\EF\net472

The following shared library file is required:

EntityFramework6.EnterpriseDB.EDBClient.dll

**For net48**

C:\Program Files\edb\dotnet\EF\net48

The following shared library file is required:

EntityFramework6.EnterpriseDB.EDBClient.dll

**Note:** Entity Framework can be used with the EnterpriseDB.EDBClient.dll library available in the net461, net472 and net48 subdirectories.

See *Referencing the Library Files* for information about referencing library files.

Add the `<DbProviderFactories>` entries for the ADO.NET driver for Postgres to the app.config file. Add the following entries:

```xml
<add name="EnterpriseDB.EDBClient"  
invariant="EnterpriseDB.EDBClient"  
description=".NET Data Provider for EnterpriseDB PostgreSQL"  
type="EnterpriseDB.EDBClient.EDBFactory, EnterpriseDB.EDBClient, Version=4.1.6.1, Culture=neutral, PublicKeyToken=5d8b90d52f46fda7"  
support="FF"/>
```

In the project’s app.config file add the following entry for provider services under the EntityFramework/providers tag:

```xml
<provider invariantName="EnterpriseDB.EDBClient"  
type="EnterpriseDB.EDBClient.EDBServices, EntityFramework6.EDBClient">  
</provider>
```
The following is an example of the **app.config** file:

```xml
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
  <configSections>
  </configSections>

  <startup>
    <supportedRuntime version="v4.0" sku=".NETFramework,Version=v4.5" />
  </startup>

  <entityFramework>
    <providers>
      <provider invariantName="EnterpriseDB.EDBClient" type="EnterpriseDB.EDBClient.EDBServices, EntityFramework6.EnterpriseDB.EDBClient"/>
    </providers>
  </entityFramework>

  <system.data>
    <DbProviderFactories>
      <remove invariant="EnterpriseDB.EDBClient"/>
      <add name="EnterpriseDB Data Provider" invariant="EnterpriseDB.EDBClient" support="FF" description=".Net Framework Data Provider for Postgresql" type="EnterpriseDB.EDBClient.EDBFactory, EnterpriseDB.EDBClient"/>
    </DbProviderFactories>
  </system.data>

</configuration>
```

**Note:** The same entries for `<providers>` and `<DbProviderFactories>` are valid for the `web.config` file and the `app.config` file.

Depending upon the type of application you are using, you may be required to import the namespace into the source code (see *Referencing the Library Files*).

For usage information about Entity Framework, refer to the Microsoft documentation.
4.2.4 EDB VSIX for Visual Studio 2015/2017/2019

The EDB Data Designer Extensibility Provider (EDB VSIX) is a component that integrates Advanced Server database access into Visual Studio, thus providing Visual Studio integrated features.

EDB VSIX allows you to connect to Advanced Server from within Visual Studio’s Server Explorer and create a model from an existing database. Therefore, if Visual Studio features are desired, then EDB VSIX must be utilized.

EDB VSIX files are located in the following directory:

```
C:\Program Files\edb\dotnet\vsix
```

The files available at the above location are:

- edb_logo.ico
- EnterpriseDB.vsix
- SSDILToPgSQL.tt
- System.ValueTuple.dll

4.2.4.1 Installation and Configuration for Visual Studio 2015/2017/2019

Use the following steps to install and configure EDB VSIX.

**Step 1:** Install EDB VSIX to the desired version of Visual Studio with the `EnterpriseDB.vsix` installer.

If you already have an earlier version of the VSIX installed, we highly recommended that you uninstall it to avoid conflicts.

It is no longer necessary or recommended to have `EnterpriseDB.EDBClient` in your global assembly cache (GAC).

**Step 2:** Relaunch Visual Studio and verify from the `Tools > Extensions and Updates...` menu that the EDB extension is installed.

**Step 3:** Use the `gacutil` utility at the Visual Studio Developers Command Line to add following libraries to the global assembly cache (GAC):

```
System.ValueTuple.dll
System.Threading.Tasks.Extensions.dll
System.Memory.dll
Microsoft.Bcl.AsyncInterfaces.dll
System.Text.Json.dll
```

4.2. Configuring the .NET Connector
For example:

```bash
> gacutil.exe /i System.ValueTuple.dll
```

**Step 4:** From the Server Explorer, right-click on Data Connections, click Add Connection, and verify that the Enterprisedb Postgres Database data source is available.
4.2.4.2 Model First and Database First Usage

Step 1: Add the `<DbProviderFactories>` entries for the ADO.NET driver to the `machine.config` file. Include the following entries:

```xml
<add name="EnterpriseDB.EDBClient"
    invariant="EnterpriseDB.EDBClient"
    description=".NET Data Provider for EnterpriseDB PostgreSQL"
    type="EnterpriseDB.EDBClient.EDBFactory, EnterpriseDB.EDBClient,
    Version=4.1.6.1, Culture=neutral, PublicKeyToken=5d8b90d52f46fda7"
    support="FF"/>
```

For the attribute-value pairs, the double-quoted strings should not contain excess white space characters, but be configured on a single line. The examples shown in this section may be split on multiple lines for clarity, but should actually be configured within a single line such as the following:

```xml
description=".NET Data Provider for EnterpriseDB PostgreSQL"
```

For 64-bit Windows, the `machine.config` file is in the following location:

C:\Windows\Microsoft.NET\Framework64\v4.0.30319\Config\machine.config

For 32-bit Windows, the `machine.config` file is in the following location:

C:\Windows\Microsoft.NET\Framework\v4.0.30319\Config\machine.config

Step 2: Place the DDL generation template `SSDLToPgSQL.tt` in the Visual Studio EntityFramework Tools\DBGen\ folder as shown in the following example:

```plaintext
C:\Program Files (x86)\Microsoft Visual Studio 14.0\Common7\IDE\Extensions\Microsoft\EntityFramework Tools\DBGen\n```

Note: Select this template `SSDLToPgSQL.tt` in your EDMX file properties.

Step 3: Add the `EnterpriseDB.EDBClient.dll` and `EntityFramework6. EnterpriseDB.EDBClient.dll` files to project references. See Referencing the Library Files for information about referencing library files.

Step 4: Configure your Entity Framework application in either of following two ways:

- Code-based
- Config-based.

Code-based
Define a class that inherits from `DbConfiguration` in the same assembly as your class inheriting `DbContext`. Ensure that you configure provider services, a provider factory, and a default connection factory as shown below:

```csharp
using EnterpriseDB.EDBClient;
using System.Data.Entity;

class EDBConfiguration : DbConfiguration
{
    public EDBConfiguration()
    {
        var name = "EnterpriseDB.EDBClient";

        SetProviderFactory(providerInvariantName: name,
                            providerFactory: EnterpriseDB.EDBClient.EDBFactory.Instance);

        SetProviderServices(providerInvariantName: name,
                            provider: EnterpriseDB.EDBClient.EDBServices.Instance);

        SetDefaultConnectionFactory(connectionFactory: new
                                     EnterpriseDB.EDBClient.EDBConnectionFactory());
    }
}
```

**Config-based**

In the project’s `app.config` file, add the following entry for provider services under the EntityFramework/providers tag:

```xml
<provider invariantName="EnterpriseDB.EDBClient" type="EnterpriseDB.EDBClient.EDBServices, EntityFramework6.0.0.0, Version=6.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089" requirePermission="false"/>
```

The following is an example of the `app.config` file.

```xml
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
    <configSections>
    </configSections>
</configuration>
```

(continues on next page)
<startup>
  <supportedRuntime version="v4.0" sku=".NETFramework,Version=v4.5" />
</startup>

<entityFramework>
  <providers>
    <provider invariantName="EnterpriseDB.EDBClient" type="EnterpriseDB.EDBClient.EDBServices, EntityFramework6.EnterpriseDB.EDBClient"></provider>
  </providers>
</entityFramework>

<system.data>
  <DbProviderFactories>
    <remove invariant="EnterpriseDB.EDBClient" />
    <add name="EnterpriseDB Data Provider" invariant="EnterpriseDB.EDBClient" support="FF" description=".Net Framework Data Provider for EDB Postgres" type="EnterpriseDB.EDBClient.EDBFactory, EnterpriseDB.EDBClient" />
  </DbProviderFactories>
</system.data>

</configuration>
CHAPTER 5

Using the .NET Connector

The sections that follow provide examples that demonstrate using the EDB object classes that are provided by the EDB .NET Connector that allow a .NET application to connect to and interact with an Advanced Server database.

To use the examples in this guide, place the .NET library files in the same directory as the compiled form of your application. All of the examples are written in C# and each is embedded in an ASP.NET page; the same logic and code would be applicable with other .NET applications (WinForm or console applications, for example).

Please create and save the following web.config file in the same directory as the sample code. The examples make use of the DB_CONN_STRING key from this configuration file to return a connection string from the Advanced Server host.

```xml
<?xml version="1.0" encoding="utf-8"?>
<configuration>
    <appSettings>
        <add key="DB_CONN_STRING" value="Server=127.0.0.1;Port=5444;User Id=enterprisedb;Password=enterprisedb;Database=edb" />
    </appSettings>
</configuration>
```

An Advanced Server connection string for an ASP.NET web application is stored in the web.config file. If you are writing an application that does not use ASP.NET, provide the connection information in an application configuration file (such as app.config).
An EDBConnection object is responsible for handling the communication between an instance of Advanced Server and a .NET application. Before you can access data stored in an Advanced Server database, you must create and open an EDBConnection.

The examples that follow demonstrate the basic steps for connecting to an instance of Advanced Server. You must:

1. Import the namespace EnterpriseDB.EDBClient.
2. Create an instance of EDBConnection.
3. Initialize the EDBConnection object by passing a connection string as a parameter to the constructor for the EDBConnection class.
4. Call the Open method of the EDBConnection object to open the connection.
6.1 Connection String Parameters

A valid connection string should specify location and authentication information for an Advanced Server instance. You must provide the connection string before opening the connection. A connection string must contain:

- The name or IP address of the server
- The name of the Advanced Server database
- The name of an Advanced Server user
- The password associated with that user

The following parameters may be included in the connection string:

CommandTimeout

CommandTimeout specifies the length of time (in seconds) to wait for a command to finish execution before throwing an exception. The default value is 20.

ConnectionLifeTime

Use ConnectionLifeTime to specify the length of time (in seconds) to wait before closing unused connections in the pool. The default value is 15.

Database

Use the Database parameter to specify the name of the database to which the application should connect. If a database name is not specified, the database name will default to the name of the connecting user.

Encoding

The Encoding parameter is obsolete; the parameter always returns the string unicode, and silently ignores attempts to set it.

Integrated Security

By default, Integrated Security is set to false, and Windows Integrated Security is disabled. Specify a value of true to use Windows Integrated Security.

Load Role Based Tables

Use Load Role Based Tables to load table OIDs based on role. This change only impacts the loading of table type OID, and not the composite type. The default value is false. Setting this parameter to true triggers the new functionality.

MaxPoolSize

MaxPoolSize instructs EDBConnection to dispose of pooled connections when the pool exceeds the specified number of connections. The default value is 20.

MinPoolSize
MinPoolSize instructs EDBConnection to pre-allocate the specified number of connections with the server. The default value is 1.

Password

When using clear text authentication, specify the password that will be used to establish a connection with the server.

Pooling

By default, Pooling is set to true to enable connection pooling. Specify a value of false to disable connection pooling.

Port

The Port parameter specifies the port to which the application should connect.

Protocol

The specific protocol version to use (instead of automatic); specify an integer value of 2 or 3.

SearchPath

Use the SearchPath parameter to change the search path to named and public schemas.

Server

The name or IP address of the Advanced Server host.

SSL

By default, SSL is set to false; specify a value of true to attempt a secure connection.

sslmode

Use sslmode to specify an SSL connection control preference. sslmode can be:
prefer - Use SSL if possible.
require - Throw an exception if an SSL connection cannot be established.
allow - Connect without SSL. This parameter is not supported.
disable - Do not attempt an SSL connection. This is the default behavior.

SyncNotification

Use the SyncNotification parameter to specify that EDBDataprovider should use synchronous notifications. The default value is false.

Timeout

Timeout specifies the length of time (in seconds) to wait for an open connection. The default value is 15.
User Id

The User Id parameter specifies the user name that should be used for the connection.
6.2 Example - Opening a Database Connection using ASP.NET

The following example demonstrates how to open a connection to an instance of Advanced Server and then close the connection. The connection is established using the credentials specified in the DB_CONN_STRING configuration parameter (see Using the .Net Connector for an introduction to connection information and also see Connection String Parameters for connection parameters).

```csharp
<% @ Page Language="C#" %>
<% @Import Namespace="EnterpriseDB.EDBClient" %>
<% @Import Namespace="System.Configuration" %>

<script language="C#" runat="server">
private void Page_Load(object sender, System.EventArgs e)
{
    string strConnectionString = ConfigurationManager.AppSettings
        ["DB_CONN_STRING"];

    EDBConnection conn = new EDBConnection(strConnectionString);

    try
    {
        conn.Open();
        Response.Write("Connection opened successfully");
    }

    catch(EDBException exp)
    {
        exp.ToString();
    }

    finally
    {
        conn.Close();
    }
}
</script>
```

If the connection is successful, a browser will display the following:
Fig. 1: *Connection Opened Successfully*
6.3 Example - Opening a Database Connection from a Console Application

The following example opens a connection with an Advanced Server database using a console-based application.

Before writing the code for the console application, create an app.config file that stores the connection string to the database. Using a configuration file makes it convenient to update the connection string if the information changes.

```xml
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
  <appSettings>
    <add key="DB_CONN_STRING" value = "Server=localhost;Port=5444;User Id=enterprisedb;Password=enterprisedb;Database=edb"/>
  </appSettings>
</configuration>
```

Using your text editor of choice, enter the following code sample into a file:

```csharp
using System;
using System.Data;
using EnterpriseDB.EDBClient;
using System.Configuration;

namespace EnterpriseDB
{
    class EDB
    {
        static void Main(string[] args)
        {
            string strConnectionString = ConfigurationManager.AppSettings ["DB_CONN_STRING"];

            EDBConnection conn = new EDBConnection(strConnectionString);

            try
            {
                conn.Open();
                Console.WriteLine("Connection Opened Successfully");
            }
        }
    }
}
```
catch(Exception exp)
{
    throw new Exception(exp.ToString());
}

finally
{
    conn.Close();
}
}

Save the file as EDBConnection-Sample.cs and compile it with the following command:

csc /r:EnterpriseDB.EDBClient.dll /out:Console.exe
EDBConnection-Sample.cs

Compiling the sample should generate a Console.exe file; you can execute the sample code by entering Console.exe. When executed, the console should verify that the:

Connection Opened Successfully
6.4 Example - Opening a Database Connection from a Windows Form Application

The following example demonstrates opening a database connection using a .NET WinForm application. To use the example, save the following code as `WinForm-Example.cs` in a directory that contains the library files.

```csharp
using System;
using System.Windows.Forms;
using System.Drawing;
using EnterpriseDB.EDBClient;

namespace EDBTestClient
{
    class Win_Conn
    {
        static void Main(string[] args)
        {
            Form frmMain = new Form();
            Button btnConn = new Button();
            btnConn.Location = new System.Drawing.Point(104, 64);
            btnConn.Name = "btnConn";
            btnConn.Text = "Open Connection";
            btnConn.Click += new System.EventHandler(btnConn_Click);
            frmMain.Controls.Add(btnConn);
            frmMain.Text = "EnterpriseDB";
            Application.Run(frmMain);
        }

        private static void btnConn_Click(object sender, System.EventArgs e)
        {
            EDBConnection conn = null;
            try
            {
                string connectionString = "Server=10.90.1.29;port=5444;username=edb;password=edb;database=edb";
                conn = new EDBConnection(connectionString);
            }
            catch {}
            finally
            {
                conn.Close();
            }
            MessageBox.Show("Connection successful.");
        }
    }
}
```

(continues on next page)
conn.Open();
    MessageBox.Show("Connection Open");
}
catch(EDBException exp)
{
    MessageBox.Show(exp.ToString());
}
finally
{
    conn.Close();
}

Note that you must change the database connection string to point to the database that you want to connect to before compiling the file with the following command:

csc /r:EnterpriseDB.EDBClient.dll /out:WinForm.exe
WinForm-Example.cs

This command should generate a WinForm.exe file within the same folder that the executable was compiled under. Invoking the executable will display:

![A successful connection](image)

Fig. 2: A successful connection
You can use a `SELECT` statement to retrieve records from the database via a `SELECT` command. To execute a `SELECT` statement you must:

- Create and open a database connection.
- Create an `EDBCommand` object that represents the `SELECT` statement.
- Execute the command with the `ExecuteReader()` method of the `EDBCommand` object returning a `EDBDataReader`.
- Loop through the `EDBDataReader` displaying the results or binding the `EDBDataReader` to some control.

An `EDBDataReader` object represents a forward-only and read-only stream of database records, presented one record at a time. To view a subsequent record in the stream, you must call the `Read()` method of the `EDBDataReader` object.

The example that follows:

1. Imports the Advanced Server namespace: `EnterpriseDB.EDBClient`.
2. Initializes an `EDBCommand` object with a `SELECT` statement.
3. Opens a connection to the database.
4. Executes the `EDBCommand` by calling the `ExecuteReader` method of the `EDBCommand` object.

   The results of the SQL statement are retrieved into an `EDBDataReader` object.
5. Loops through the contents of the EDBDataReader object to display the records returned by the query within a WHILE loop.

The Read() method advances to the next record (if a record exists) and returns true if a record exists, or false to indicate that the EDBDataReader has reached the end of the result set.

```csharp
<% @ Page Language="C#" %>
<% @Import Namespace="EnterpriseDB.EDBClient" %>
<% @Import Namespace="System.Data" %>
<% @Import Namespace="System.Configuration" %>

<script language="C#" runat="server">

private void Page_Load(object sender, System.EventArgs e)
{
    string strConnectionString = ConfigurationManager.AppSettings["DB_CONN_STRING"];  // Line 15
    EDBConnection conn = new EDBConnection(strConnectionString);

    try
    {
        conn.Open();
        EDBCommand cmdSelect = new EDBCommand("SELECT * FROM dept", conn);
        cmdSelect.CommandType = CommandType.Text;
        EDBDataReader drDept = cmdSelect.ExecuteReader();

        while(drDept.Read())
        {
            Response.Write("Department Number: " + drDept["deptno"]);  // Line 46
            Response.Write("Department Name: " + drDept["dname"]);  // Line 47
            Response.Write("Department Location: " + drDept["loc"]);  // Line 48

            Response.Write("<br>");
        }
    }
    catch(Exception exp)
    {
        Response.Write(exp.ToString());
    }
    finally
    {
        conn.Close();
    }
</script>

(continues on next page)
To exercise the sample code, save the code in your default web root directory in a file named:

```c
selectEmployees.aspx
```

To invoke the program, open a web-browser, and browse to:

```c
http://localhost/selectEmployees.aspx
```
7.1 Retrieving a Single Database Record

To retrieve a single result from a query, use the `ExecuteScalar()` method of the `EDBCommand` object. The `ExecuteScalar()` method returns the first value of the first column of the first row of the `DataSet` generated by the specified query.

```csharp
<% @ Page Language="C#" %>
<% @Import Namespace="EnterpriseDB.EDBClient" %>
<% @Import Namespace="System.Data" %>
<% @Import Namespace="System.Configuration" %>

<script language="C#" runat="server">
private void Page_Load(object sender, System.EventArgs e)
{
    string strConnectionString = ConfigurationManager.AppSettings["DB_CONN_STRING"];  
    EDBConnection conn = new EDBConnection(strConnectionString);
    try
    {
        conn.Open();
        EDBCommand cmd = new EDBCommand("SELECT MAX(sal) FROM emp", conn);
        cmd.CommandType = CommandType.Text;
        int maxSal = Convert.ToInt32(cmd.ExecuteScalar());
        Response.Write("Emp Number: "+ maxSal);
    }
    catch(Exception exp)
    {
        Response.Write(exp.ToString());
    }
    finally
    {
        conn.Close();
    }
}
</script>

Save the sample code in a file in a web root directory named:

selectscalar.aspx

To invoke the sample code, open a web-browser, and browse to:
Please note that the sample includes an explicit conversion of the value returned by the `ExecuteScalar()` method. The `ExecuteScalar()` method returns an object; to view the object, you must convert it into an integer value by using the `Convert.ToInt32` method.
A parameterized query is a query with one or more parameter markers embedded in the SQL statement. Before executing a parameterized query, you must supply a value for each marker found in the text of the SQL statement.

Parameterized queries are useful when you don’t know the complete text of a query at the time you write your code. For example, the value referenced in a WHERE clause may be calculated from user input.

As demonstrated in the following example, you must declare the data type of each parameter specified in the parameterized query by creating an EDBParameter object and adding that object to the command’s parameter collection. Then, you must specify a value for each parameter by calling the parameter’s Value() function.

The example demonstrates use of a parameterized query with an UPDATE statement that increases an employee salary:

```csharp
private void Page_Load(object sender, System.EventArgs e) {
    string strConnectionString = ConfigurationManager.AppSettings["DB_CONN_STRING"]; 
    // ... (remaining code continues)
```
EDBConnection conn = new EDBConnection(strConnectionString);

    string updateQuery = "UPDATE emp SET sal = sal+500 where empno = :ID";

    try {
        conn.Open();

        EDBObject cmdUpdate = new EDBObject(updateQuery, conn);

        cmdUpdate.Parameters.Add (new EDBObjectParameter(":ID", EDBTypes.EDBDbType.Integer));

        cmdUpdate.Parameters[0].Value = 7788;

        cmdUpdate.ExecuteNonQuery();

        Response.Write("Record Updated");
    }
    catch(Exception exp) {
        Response.Write(exp.ToString());
    }
    finally {
        conn.Close();
    }
</script>

Save the sample code in a file in a web root directory named:

updateSalary.aspx

To invoke the sample code, open a web-browser, and browse to:

http://localhost/updateSalary.aspx
Inserting Records in a Database

You can use the `ExecuteNonQuery()` method of `EDBCommand` to add records to a database stored on an Advanced Server host with an `INSERT` command.

In the example that follows, the `INSERT` command is stored in the variable `cmd`. The values prefixed with a colon (:) are placeholders for `EDBParameters` that are instantiated, assigned values, and then added to the `INSERT` command’s parameter collection in the statements that follow. The `INSERT` command is executed by the `ExecuteNonQuery()` method of the `cmdInsert` object.

The example adds a new employee to the `emp` table:

```csharp
<% @ Page Language="C#" Debug="true" %>
<% @Import Namespace="EnterpriseDB.EDBClient" %>
<% @Import Namespace="System.Data" %>
<% @Import Namespace="System.Configuration" %>

<script language="C#" runat="server">
private void Page_Load(object sender, System.EventArgs e)
{
    string strConnectionString = ConfigurationManager.AppSettings
["DB_CONN_STRING"];
    EDBConnection conn = new EDBConnection(strConnectionString);

    try
    {
        conn.Open();
    }
```
string cmd = "INSERT INTO emp(empno,ename) VALUES(:EmpNo,
    :EName)";

EDBCommand cmdInsert = new EDBCommand(cmd, conn);

cmdInsert.Parameters.Add(new EDBParameter(":EmpNo",
    EDBTypes.EDBDbType.Integer));

cmdInsert.Parameters[0].Value = 1234;

cmdInsert.Parameters.Add(new EDBParameter(":EName",
    EDBTypes.EDBDbType.Text));

cmdInsert.Parameters[1].Value = "Lola";

cmdInsert.ExecuteNonQuery();
Response.Write("Record inserted successfully");

} catch (Exception exp)
{
    Response.Write(exp.ToString());
}
finally
{
    conn.Close();
}
</script>

Save the sample code in a file in a web root directory named:
insertEmployee.aspx

To invoke the sample code, open a web-browser, and browse to:
http://localhost/insertEmployee.aspx
Deleting Records in a Database

You can use the `ExecuteNonQuery()` method of `EDBCommand` to delete records from a database stored on an Advanced Server host with a `DELETE` statement.

In the example that follows, the `DELETE` command is stored in the variable `strDeleteQuery`. The code passes the employee number to the Delete command (specified by: `EmpNo`). The command is then executed using the `ExecuteNonQuery()` method. The following example deletes the employee inserted in the previous example:

```csharp
<% @ Page Language="C#" Debug="true" %>
<% @Import Namespace="EnterpriseDB.EDBClient" %>
<% @Import Namespace="System.Data" %>
<% @Import Namespace="System.Configuration" %>

<script language="C#" runat="server">
private void Page_Load(object sender, System.EventArgs e)
{
    string strConnectionString = ConfigurationManager.AppSettings["DB_CONN_STRING"];  // (continues on next page)

    EDBConnection conn = new EDBConnection(strConnectionString);
    string strDeleteQuery = "DELETE FROM emp WHERE empno = :ID";
    try
    {
```
conn.Open();

EDBCommand deleteCommand = new EDBCommand(strDeleteQuery, conn);

deleteCommand.Parameters.Add (new EDBParameter(":ID", EDBTypes.EDBDbType.Integer));

deleteCommand.Parameters[0].Value = 1234;

deleteCommand.ExecuteNonQuery();

Response.Write("Record Deleted");

}

catch(Exception exp)
{
    Response.Write(exp.ToString());
}

finally
{
    conn.Close();
}
</script>

Save the sample code in a file in a web root directory named:

deleteEmployee.aspx

To invoke the sample code, open a web-browser, and browse to:

http://localhost/deleteEmployee.aspx
CHAPTER 11

Using SPL Stored Procedures in your .NET Application

You can include SQL statements in an application in two ways:

- By adding the SQL statements directly in the .NET application code.
- By packaging the SQL statements in a stored procedure, and executing the stored procedure from the .NET application.

In some cases, a stored procedure can provide advantages over embedded SQL statements. Stored procedures support complex conditional and looping constructs that are difficult to duplicate with SQL statements embedded directly in an application.

You can also see a significant improvement in performance by using stored procedures; a stored procedure only needs to be parsed, compiled and optimized once on the server side, while a SQL statement that is included in an application may be parsed, compiled and optimized each time it is executed from a .NET application.

To use a stored procedure in your .NET application you must:

1. Create an SPL stored procedure on the Advanced Server host.
2. Import the EnterpriseDB.EDBClient namespace.
3. Pass the name of the stored procedure to the instance of the EDBCommand.
5. Prepare() the command.
6. Execute the command.
11.1 Example - Executing a Stored Procedure without Parameters

Our sample procedure prints the name of department 10; the procedure takes no parameters, and returns no parameters. To create the sample procedure, invoke EDB-PSQL and connect to the Advanced Server host database. Enter the following SPL code at the command line:

```
CREATE OR REPLACE PROCEDURE list_dept10
IS
  v_deptname VARCHAR2(30);
BEGIN
  DBMS_OUTPUT.PUT_LINE('Dept No: 10');
  SELECT dname INTO v_deptname FROM dept WHERE deptno = 10;
  DBMS_OUTPUT.PUT_LINE('Dept Name: ' || v_deptname);
END;
```

When Advanced Server has validated the stored procedure it will echo `CREATE PROCEDURE`.

Using the EDBCommand Object to Execute a Stored Procedure

The `CommandType` property of the `EDBCommand` object is used to indicate the type of command being executed. The `CommandType` property is set to one of three possible `CommandType` enumeration values:

- Use the default `Text` value when passing a SQL string for execution.
- Use the `StoredProcedure` value, passing the name of a stored procedure for execution.
- Use the `TableDirect` value when passing a table name. This value passes back all records in the specified table.

The `CommandText` property must contain a SQL string, stored procedure name, or table name depending on the value of the `CommandType` property.

The following example executes the stored procedure:

```
<% @ Page Language="C#" Debug="true" %>
<% @Import Namespace="EnterpriseDB.EDBClient" %>
<% @Import Namespace="System.Data" %>
<% @Import Namespace="System.Configuration" %>

<script language="C#" runat="server">
private void Page_Load(object sender, System.EventArgs e) {
    string strConnectionString = ConfigurationManager.AppSettings ["DB_CONN_STRING"];
    EDBConnection conn = new EDBConnection(strConnectionString);
}
```

(continues on next page)
try{
    conn.Open();
    EDBCommand cmdStoredProc = new EDBCommand("list_dept10", conn);
    cmdStoredProc.CommandType = CommandType.StoredProcedure;
    cmdStoredProc.Prepare();
    cmdStoredProc.ExecuteNonQuery();
    Response.Write("Stored Procedure Executed Successfully");
}
catch(Exception exp){
    Response.Write(exp.ToString());
}
finally{
    conn.Close();
}
</script>

Save the sample code in a file in a web root directory named: storedProc.aspx
To invoke the sample code, open a web-browser, and browse to: http://localhost/storedProc.aspx
11.2 Example - Executing a Stored Procedure with IN Parameters

The following example demonstrates calling a stored procedure that includes IN parameters. To create the sample procedure, invoke EDB-PSQL and connect to the Advanced Server host database. Enter the following SPL code at the command line:

```sql
CREATE OR REPLACE PROCEDURE EMP_INSERT
    (pENAME IN VARCHAR,
pJOB IN VARCHAR,
pSAL IN FLOAT4,
pCOMM IN FLOAT4,
pDEPTNO IN INTEGER,
pMgr IN INTEGER)
AS
DECLARE
    CURSOR TESTCUR IS SELECT MAX(EMPNO) FROM EMP;
    MAX_EMPNO INTEGER := 10;
BEGIN
    OPEN TESTCUR;
    FETCH TESTCUR INTO MAX_EMPNO;
    INSERT INTO EMP(EMPNO,ENAME,JOB,SAL,COMM,DEPTNO,MGR)
        VALUES(MAX_EMPNO+1,pENAME,pJOB,pSAL,pCOMM,pDEPTNO,pMgr);
    CLOSE testcur;
END;
```

When Advanced Server has validated the stored procedure it will echo `CREATE PROCEDURE`. 

**Passing Input Values to a Stored Procedure**

Calling a stored procedure that contains parameters is very similar to executing a stored procedure without parameters. The major difference is that when calling a parameterized stored procedure you must use the `EDBParameter` collection of the `EDBCommand` object. When the `EDBParameter` is added to the `EDBCommand` collection, properties such as `ParameterName`, `DbType`, `Direction`, `Size`, and `Value` are set.

The following example demonstrates the process of executing a parameterized stored procedure from a C#.

```csharp
<% @ Page Language="C#" Debug="true" %>
<% @Import Namespace="EnterpriseDB.EDBClient" %>
```

(continues on next page)
-% Import Namespace="System.Data" %>
-% Import Namespace="System.Configuration" %>

<script language="C#" runat="server" >

private void Page_Load(object sender, System.EventArgs e)
{
    string strConnectionString = ConfigurationManager.AppSettings
["DB_CONN_STRING"];
    EDBConnection conn = new EDBConnection(strConnectionString);
    string empName = "EDB";
    string empJob = "Manager";
    double salary = 1000;
    double commission = 0.0;
    int deptno = 20;
    int manager = 7839;

    try
    {
        conn.Open();

        EDBCommand cmdStoredProc = new EDBCommand
("emp_insert(:EmpName,:Job,:Salary,:Commission,:DeptNo,
:Manager)",conn);
        cmdStoredProc.CommandType = CommandType.StoredProcedure;

        cmdStoredProc.Parameters.Add(new EDBParameter
("EmpName", EDBTypes.EDBDbType.Varchar));
        cmdStoredProc.Parameters[0].Value = empName;

        cmdStoredProc.Parameters.Add(new EDBParameter
("Job", EDBTypes.EDBDbType.Varchar));
        cmdStoredProc.Parameters[1].Value = empJob;

        cmdStoredProc.Parameters.Add(new EDBParameter
("Salary", EDBTypes.EDBDbType.Real));

        cmdStoredProc.Parameters.Add(new EDBParameter
("Commission", EDBTypes.EDBDbType.Real));
        cmdStoredProc.Parameters[3].Value = commission;

        cmdStoredProc.Parameters.Add(new EDBParameter
("DeptNo", EDBTypes.EDBDbType.Integer));

        (continues on next page)

11.2. Example - Executing a Stored Procedure with IN Parameters 54
cmdStoredProc.Parameters[4].Value = deptno;

cmdStoredProc.Parameters.Add(new EDBParameter("Manager", EDBTypes.EDBDbType.Integer));

cmdStoredProc.Parameters[5].Value = manager;

cmdStoredProc.Prepare();

cmdStoredProc.ExecuteNonQuery();

Response.Write("Following Information Inserted Successfully<br>

string empInfo = "Employee Name: " + empName + "<br>
empInfo += "Job: " + empJob + "<br>
empInfo += "Salary: " + salary + "<br>
empInfo += "Commission: " + commission + "<br>
empInfo += "Manager: " + manager + "<br>

Response.Write(empInfo);

} catch(Exception exp)
{
    Response.Write(exp.ToString());
}

finally
{
    conn.Close();
}
</script>
</script>

Save the sample code in a file in a web root directory named:

storedProcInParam.aspx

To invoke the sample code, open a web-browser, and browse to:

http://localhost/storedProcInParam.aspx

In the example, the body of the Page_Load method declares and instantiates an EDBConnection object. The sample then creates an EDBCommand object with the properties
needed to execute the stored procedure.

The example then uses the `Add` method of the `EDBCommand` `Parameter` collection to add six input parameters.

```csharp
EDBCommand cmdStoredProc = new EDBCommand
("emp_insert(:EmpName,:Job,:Salary,:Commission,:DeptNo,:Manager)",
 conn);

cmdStoredProc.CommandType = CommandType.StoredProcedure;
```

It assigns a value to each parameter before passing them to the `EMP_INSERT` stored procedure.

The `Prepare()` method prepares the statement before calling the `ExecuteNonQuery()` method.

The `ExecuteNonQuery` method of the `EDBCommand` object executes the stored procedure. After the stored procedure has executed, a test record is inserted into the `emp` table and the values inserted are displayed on the webpage.
11.3 Example - Executing a Stored Procedure with IN, OUT, and INOUT Parameters

The previous example demonstrated how to pass IN parameters to a stored procedure; the following examples demonstrate how to pass IN values and return OUT values from a stored procedure.

Creating the Stored Procedure

The following stored procedure passes the department number, and returns the corresponding location and department name. To create the sample procedure, open the EDB-PSQL command line, and connect to the Advanced Server host database. Enter the following SPL code at the command line:

```sql
CREATE OR REPLACE PROCEDURE DEPT_SELECT
    (pDEPTNO IN INTEGER,
     pDNAME OUT VARCHAR,
     pLOC OUT VARCHAR)
AS
DECLARE
    CURSOR TESTCUR IS SELECT DNAME, LOC FROM DEPT;
    REC RECORD;
BEGIN
    OPEN TESTCUR;
    FETCH TESTCUR INTO REC;
    pDNAME := REC.DNAME;
    pLOC := REC.LOC;
    CLOSE testcur;
END;
```

When Advanced Server has validated the stored procedure it will echo CREATE PROCEDURE.

Receiving Output Values from a Stored Procedure

When retrieving values from OUT parameters you must explicitly specify the direction of out parameters as Output. You can retrieve the values from Output parameters in two ways:

- Call the ExecuteReader method of the EDBCommand and explicitly loop through the returned EDBObjectReader, searching for the values of OUT parameters.

- Call the ExecuteNonQuery method of EDBCommand and explicitly get the value of a declared Output parameter by calling that EDBObject value property.
In each method, you must declare each parameter, indicating the direction of the parameter (ParameterDirection.Input, ParameterDirection.Output or ParameterDirection.InputOutput). Before invoking the procedure, you must provide a value for each IN and INOUT parameter. After the procedure returns, you may retrieve the OUT and INOUT parameter values from the command.Parameters[] array.

The following code listing demonstrates using the ExecuteReader method to retrieve a result set:

```csharp
private void Page_Load(object sender, System.EventArgs e)
{
    string strConnectionString =
        ConfigurationManager.AppSettings["DB_CONN_STRING"];
    EDBConnection conn = new EDBConnection(strConnectionString);
    try
    {
        conn.Open();
        EDBCommand command = new EDBCommand("DEPT_SELECT
           (:pDEPTNO,:pDNAME,:pLOC)", conn);
        command.CommandType = CommandType.StoredProcedure;
        command.Parameters.Add(new EDBParameter("pDEPTNO",
            EDBTypes.EDBDbType.Integer,10,"pDEPTNO",
            ParameterDirection.Input,false ,2,2,
            System.Data.DataRowVersion.Current,1));
        command.Parameters.Add(new EDBParameter("pDNAME",
            EDBTypes.EDBDbType.Varchar,10,"pDNAME",
            ParameterDirection.Output,false ,2,2,
            System.Data.DataRowVersion.Current,1));
        command.Parameters.Add(new EDBParameter("pLOC",
            EDBTypes.EDBDbType.Varchar,10,"pLOC",
            ParameterDirection.Output,false ,2,2,
            System.Data.DataRowVersion.Current,1));
        command.Prepare();
    }
```

(continues on next page)
command.Parameters[0].Value = 10;
EDBDataReader result = command.ExecuteReader();

int fc = result.FieldCount;

for (int i = 0; i < 3; i++)
{
    Console.WriteLine("RESULT[" + i + "]=" + Convert.
    ToString(command.Parameters[i].Value));
    Console.WriteLine("\n");
}

catch(EDBException exp)
{
    Response.Write(exp.ToString());
}
finally
{
    conn.Close();
}

</script>

The following code listing demonstrates using the ExecuteNonQuery method to retrieve a result set:

```csharp
private void Page_Load(object sender, System.EventArgs e)
{
    string strConnectionString = ConfigurationManager.AppSettings
        ["DB_CONN_STRING"];
    EDBConnection conn = new EDBConnection(strConnectionString);
    try
    {
```
conn.Open();
EDBCommand command = new EDBCommand("DEPT_SELECT (:pDEPTNO,:pDNAME,:pLOC)", conn);
command.CommandType = CommandType.StoredProcedure;


command.Prepare();
command.Parameters[0].Value = 10;
command.ExecuteNonQuery();

Response.Write(command.Parameters["pDNAME"].Value.ToString());
Response.Write(command.Parameters["pLOC"].Value.ToString());
}

catch(EDBException exp)
{
    Response.Write(exp.ToString());
}
finally
{
    conn.Close();
}
</script>
CHAPTER 12

Using Advanced Queueing

EDB Postgres Advanced Server Advanced Queueing provides message queueing and message processing for the Advanced Server database. User-defined messages are stored in a queue; a collection of queues is stored in a queue table. You should first create a queue table before creating a queue that is dependent on it.

On the server side, procedures in the DBMS_AQADM package create and manage message queues and queue tables. Use the DBMS_AQ package to add or remove messages from a queue, or register or unregister a PL/SQL callback procedure. For more information about DBMS_AQ and DBMS_AQADM, click here.

On the client side, application uses EDB.NET driver to enqueue/dequeue message.
12.1 Enqueueing or Dequeueing a Message

For more information about using Advanced Servers Advanced Queueing functionality, see the Database Compatibility for Oracle Developers Built-in Package Guide.

12.1.1 Server-Side Setup

To use Advanced Queueing functionality on your .NET application, you must first create a user defined type, queue table, and queue, and then start the queue on the database server. Invoke EDB-PSQL and connect to the Advanced Server host database. Use the following SPL commands at the command line:

Creating a User-defined Type

To specify a RAW data type, you should create a user-defined type. The following example demonstrates creating a user-defined type named as `myxml`.

```sql
CREATE TYPE myxml AS (value XML);
```

Creating the Queue Table

A queue table can hold multiple queues with the same payload type. The following example demonstrates creating a table named `MSG_QUEUE_TABLE`.

```sql
EXEC DBMS_AQADM.CREATE_QUEUE_TABLE
    queue_table => 'MSG_QUEUE_TABLE',
    queue_payload_type => 'myxml',
    comment => 'Message queue table');
END;
```

Creating the Queue

The following example demonstrates creating a queue named `MSG_QUEUE` within the table `MSG_QUEUE_TABLE`.

```sql
BEGIN
    DBMS_AQADM.CREATE_QUEUE ( queue_name => 'MSG_QUEUE', queue_table => 'MSG_QUEUE_TABLE', comment => 'This queue contains pending messages.');
END;
```

Starting the Queue

Once the queue is created, invoke the following SPL code at the command line to start a queue in the EDB database.
12.1.2 Client-side Example

Once you have created a user-defined type, followed by queue table and queue, start the queue. Then, you can enqueue or dequeue a message using EDB .Net drivers.

Enqueue a message:

To enqueue a message on your .NET application, you must:

1. Import the EnterpriseDB.EDBClient namespace.
2. Pass the name of the queue and create the instance of the EDBAQQueue.
3. Create the enqueue message and define a payload.
4. Call the queue.Enqueue method.

The following code listing demonstrates using the queue.Enqueue method:

Note: The following code creates the message and serializes it. This is just an example code and is not going to compile if copied as it is. It is the responsibility of the user to serialize the message as XML.
int messagesToSend = 1;
if (args.Length > 0 && !string.IsNullOrEmpty(args[0]))
{
    messagesToSend = int.Parse(args[0]);
}
for (int i = 0; i < 5; i++)
{
    EnqueMsg("test message: " + i);
}

private static EDBConnection GetConnection()
{
    string connectionString = "Server=127.0.0.1;Host=127.0.0.1;Port=5444;User Id=enterprisedb;Password=test;Database=edb;Timeout=999";
    EDBConnection connection = new EDBConnection(connectionString);
    connection.Open();
    return connection;
}

private static string ByteArrayToString(byte[] byteArray)
{
    // Sanity check if it's null so we don't incur overhead of an exception
    if (byteArray == null)
    {
        return string.Empty;
    }
    try
    {
        StringBuilder hex = new StringBuilder(byteArray.Length * 2);
        foreach (byte b in byteArray)
        {
            hex.AppendFormat("{0:x2}", b);
        }
        return hex.ToString().ToUpper();
    }
    catch
    {
        return string.Empty;
    }
}
private static bool EnqueMsg(string msg)
{
    EDBConnection con = GetConnection();
    using (EDBAQQueue queue = new EDBAQQueue("MSG_QUEUE", con))
    {
        queue.MessageType = EDBAQMessageType.Xml;
        EDBTransaction txn = queue.Connection.
            →BeginTransaction();
        QueuedEntities.Message queuedMessage = new
            →QueuedEntities.Message() { MessageText = msg };
            →try
            →{
                string rootElementName = queuedMessage.GetType().
                    →Name;
                if (rootElementName.IndexOf(".") != -1)
                    →{
                        rootElementName = rootElementName.Split('\').
                            →Last();
                    }
                string xml = new Utils.XmlFragmentSerializer.
                    →<QueuedEntities.Message>().Serialize(queuedMessage);
                EDBAQMessage queMsg = new EDBAQMessage();
                queMsg.Payload = new MyXML { value = xml };
                queue.MessageType = EDBAQMessageType.Udt;
                queue.UdtTypeName = "myxml";
                queue.Enqueue(queMsg);
                var messageId = ByteArrayToString((byte[])queMsg.
                    →MessageId);
                Console.WriteLine("MessageID: " + messageId);
                txn.Commit();
                queMsg = null;
                xml = null;
                rootElementName = null;
                return true;
            }
            →catch (Exception ex)
            →{
               txn?.Rollback();
                Console.WriteLine("Failed to enqueue message.");
                Console.WriteLine(ex.ToString());
}
Dequeueing a message

To dequeue a message on your .NET application, you must:

1. **Import the** `EnterpriseDB.EDBClent` **namespace.**
2. Pass the name of the queue and create the instance of the `EDBAQQueue`.
3. Call the `queue.Dequeue` method.

**Note:** The following code creates the message and serializes it. This is just an example code and is not going to compile if copied as it is. It is the responsibility of the user to serialize the message as XML.

```csharp
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using EnterpriseDB.EDBClent;

namespace DequeueXML
{
    class MyXML
    {
        public string value { get; set; }
    }
    class Program
    {
        static void Main(string[] args)
        {
            DequeMsg();
        }
    }
}
```

(continues on next page)
private static EDBObject GetConnection()
{
    string connectionString = "Server=127.0.0.1;Host=127.0.0.1;Port=5444;User Id=enterprisedb;Password=test;Database=edb;Timeout=999"
    EDBObject connection = new()
    connection.Open();
    return connection;
}

private static string ByteArrayToString(byte[] byteArray)
{
    // Sanity check if it's null so we don't incur overhead of an exception
    if (byteArray == null)
    {
        return string.Empty;
    }
    try
    {
        StringBuilder hex = new StringBuilder(byteArray.Length * 2);
        foreach (byte b in byteArray)
        {
            hex.AppendFormat("{0:x2}", b);
        }
        return hex.ToString().ToUpper();
    }
    catch
    {
        return string.Empty;
    }
}

public static void DequeMsg(int waitTime = 10)
{
    EDBObject con = GetConnection();
    using (EDBAQQueue queueListen = new EDBAQQueue("MSG_QUEUE", con))
    {
        queueListen.UdtTypeName = "myxml";
    }
}
queueListen.DequeueOptions.Navigation = EDBAQNavigationMode.FIRST_MESSAGE;
queueListen.DequeueOptions.Visibility = EDBAQVisibility.ON_COMMIT;
queueListen.DequeueOptions.Wait = 1;
EDBTransaction txn = null;

while (1 == 1)
{
    {
        queueListen.Connection.Open();
    }

    string messageId = "Unknown";
    try
    {
        // the listen function is a blocking function. It will Wait the specified waitTime or until a message is received.
        Console.WriteLine("Listening...");
        string v = queueListen.Listen(null, waitTime);
        // If we are waiting for a message and we specify a Wait time,
        // then if there are no more messages, we want to just bounce out.
        if (waitTime > -1 && v == null)
        {
            Console.WriteLine("No message received during Wait period.");
            Console.WriteLine();
            continue;
        }

        // once we're here that means a message has been detected in the queue. Let's deal with it.
        txn = queueListen.Connection.BeginTransaction();
        Console.WriteLine("Attempting to dequeue message...");
    }
    // dequeue the message
    EDBAQMessage deqMsg;
try {
    deqMsg = queueListen.Dequeue();
} catch (Exception ex) {
    if (ex.Message.Contains("ORA-25228")) {
        Console.WriteLine("Message was not there. Another process must have picked it up.");
        Console.WriteLine();
        txn.Rollback();
        continue;
    } else {
        throw;
    }
}

messageId = ByteArrayToString((byte[])deqMsg.MessageId);
if (deqMsg != null) {
    Console.WriteLine("Processing received message...");
    // process the message payload
    MyXML obj = new MyXML();
    queueListen.Map<MyXML>(deqMsg.Payload, obj);
    QueuedEntities.Message msg = new Utils.XmlFragmentSerializer<QueuedEntities.Message>().Deserialize(obj.value);
    Console.WriteLine("Received Message:");
    Console.WriteLine("MessageID: " + messageId);
    Console.WriteLine("Message: " + msg.MessageText);
    Console.WriteLine("Enqueue Time" + queueListen.MessageProperties.EnqueueTime);
    txn.Commit();
}
Console.WriteLine("Finished processing message");

else {
    Console.WriteLine("Message was not dequeued.");
}

} catch (Exception ex) {
    Console.WriteLine("Failed To dequeue or process the dequeued message.");
    Console.WriteLine(ex.ToString());
    Console.WriteLine();
    if (txn != null) {
        txn.Rollback();
        if (txn != null) {
            txn.Dispose();
        }
    }
}
12.2 EDBAQ Classes

The following EDBAQ classes are used in this application:

EDBAQDequeueMode

The EDBAQDequeueMode class lists all the dequeuer modes available.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Browse</td>
<td>Read the message without locking.</td>
</tr>
<tr>
<td>Locked</td>
<td>Reads and gets a write lock on the message.</td>
</tr>
<tr>
<td>Remove</td>
<td>Deletes the message after reading. This is the default value.</td>
</tr>
<tr>
<td>Remove_NoData</td>
<td>Confirms receipt of the message.</td>
</tr>
</tbody>
</table>

EDBAQDequeueOptions

The EDBAQDequeueOptions class lists the options available when dequeuing a message.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer-Name</td>
<td>The name of the consumer for which to dequeue the message.</td>
</tr>
<tr>
<td>Dequeue-Mode</td>
<td>This is set from EDBAQDequeueMode. It represents the locking behavior linked with the dequeue option.</td>
</tr>
<tr>
<td>Navigation</td>
<td>This is set from EDBAQNavigationMode. It represents the position of the message that will be fetched.</td>
</tr>
<tr>
<td>Visibility</td>
<td>This is set from EDBAQVisibility. It represents whether the new message is dequeued or not as part of the current transaction.</td>
</tr>
<tr>
<td>Wait</td>
<td>The wait time for a message as per the search criteria.</td>
</tr>
<tr>
<td>Msgid</td>
<td>The message identifier.</td>
</tr>
<tr>
<td>Correlation</td>
<td>The correlation identifier.</td>
</tr>
<tr>
<td>DeqCondition</td>
<td>The dequeuer condition. It is a Boolean expression.</td>
</tr>
<tr>
<td>Transformation</td>
<td>The transformation that will be applied before dequeuing the message.</td>
</tr>
<tr>
<td>Delivery-Mode</td>
<td>The delivery mode of the dequeued message.</td>
</tr>
</tbody>
</table>

EDBAQEnqueueOptions

The EDBAQEnqueueOptions class lists the options available when enqueuing a message.
<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility</td>
<td>This is set from EDBAQVisibility. It represents whether the new message is enqueued or not as part of the current transaction.</td>
</tr>
<tr>
<td>RelativeMsg gid</td>
<td>The relative message identifier.</td>
</tr>
<tr>
<td>SequenceDeviation</td>
<td>The sequence when the message should be dequeued.</td>
</tr>
<tr>
<td>Transformation</td>
<td>The transformation that will be applied before enqueuing the message.</td>
</tr>
<tr>
<td>DeliveryMode</td>
<td>The delivery mode of the enqueued message.</td>
</tr>
</tbody>
</table>

**EDBAQMessage**

The *EDBAQMessage* class lists a message to be enqueued/dequeued.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payload</td>
<td>The actual message to be queued.</td>
</tr>
<tr>
<td>MessageId</td>
<td>The ID of the queued message.</td>
</tr>
</tbody>
</table>

**EDBAQMessageProperties**

The *EDBAQMessageProperties* lists the message properties available.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority</td>
<td>The priority of the message.</td>
</tr>
<tr>
<td>Delay</td>
<td>The duration post which the message is available for dequeuing. This is specified in seconds.</td>
</tr>
<tr>
<td>Expiration</td>
<td>The duration for which the message is available for dequeuing. This is specified in seconds.</td>
</tr>
<tr>
<td>Correlation</td>
<td>The correlation identifier.</td>
</tr>
<tr>
<td>Attempts</td>
<td>The number of attempts taken to dequeue the message.</td>
</tr>
<tr>
<td>RecipientList</td>
<td>The recipients list that overthrows the default queue subscribers.</td>
</tr>
<tr>
<td>ExceptionQueue</td>
<td>The name of the queue where the unprocessed messages should be moved.</td>
</tr>
<tr>
<td>EnqueueTime</td>
<td>The time when the message was enqueued.</td>
</tr>
<tr>
<td>State</td>
<td>The state of the message while dequeue.</td>
</tr>
<tr>
<td>OriginalMsgid</td>
<td>The message identifier in the last queue.</td>
</tr>
<tr>
<td>TransactionGroup</td>
<td>The transaction group for the dequeued messages.</td>
</tr>
<tr>
<td>DeliveryMode</td>
<td>The delivery mode of the dequeued message.</td>
</tr>
</tbody>
</table>

**EDBAQMessageState**

12.2. EDBAQ Classes
The EDBAQMessageState class represents the state of the message during dequeue.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expired</td>
<td>The message is moved to the exception queue.</td>
</tr>
<tr>
<td>Processed</td>
<td>The message is processed and kept.</td>
</tr>
<tr>
<td>Ready</td>
<td>The message is ready to be processed.</td>
</tr>
<tr>
<td>Waiting</td>
<td>The message is in waiting state. The delay is not reached.</td>
</tr>
</tbody>
</table>

EDBAQMessageType

The EDBAQMessageType class represents the types for payload.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw</td>
<td>The raw message type.</td>
</tr>
<tr>
<td></td>
<td>Note: Currently, this payload type is not supported.</td>
</tr>
<tr>
<td>UDT</td>
<td>The user defined type message.</td>
</tr>
<tr>
<td>XML</td>
<td>The XML type message.</td>
</tr>
<tr>
<td></td>
<td>Note: Currently, this payload type is not supported.</td>
</tr>
</tbody>
</table>

EDBAQNavigationMode

The EDBAQNavigationMode class represents the different types of navigation modes available.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>First_Message</td>
<td>Returns the first available message that matches the search terms.</td>
</tr>
<tr>
<td>Next_Message</td>
<td>Returns the next available message that matches the search items.</td>
</tr>
<tr>
<td>Next_Transaction</td>
<td>Returns the first message of next transaction group.</td>
</tr>
</tbody>
</table>

EDBAQQueue

The EDBAQQueue class represents a SQL statement to execute DMBS_AQ functionality on a PostgreSQL database.
<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection</td>
<td>The connection to be used.</td>
</tr>
<tr>
<td>Name</td>
<td>The name of the queue.</td>
</tr>
<tr>
<td>MessageType</td>
<td>The message type that is enqueued/dequeued from this queue. For example EDBAQMessageType.Udt.</td>
</tr>
<tr>
<td>UdtName</td>
<td>The user defined type name of the message type.</td>
</tr>
<tr>
<td>EnqueueOptions</td>
<td>The enqueue options to be used.</td>
</tr>
<tr>
<td>DequeueOptions</td>
<td>The dequeue options to be used.</td>
</tr>
<tr>
<td>MessageProperties</td>
<td>The message properties to be used.</td>
</tr>
</tbody>
</table>

**EDBAQVisibility**

The `EDBAQVisibility` class represents the visibility options available.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>The enqueue/dequeue is not part of the ongoing transaction.</td>
</tr>
<tr>
<td>On_Commit</td>
<td>The enqueue/dequeue is part of the current transaction.</td>
</tr>
</tbody>
</table>

**Note:**

- To review the default options for the above parameters, click [here](#).
- EDB Advanced Queueing functionality uses user-defined types for calling enqueue/dequeue operations. `Server Compatibility Mode=NoTypeLoading` cannot be used with Advanced Queueing because `NoTypeLoading` will not load any user-defined types.
A ref cursor is a cursor variable that contains a pointer to a query result set. The result set is determined by the execution of the OPEN FOR statement using the cursor variable. A cursor variable is not tied to a particular query like a static cursor. The same cursor variable may be opened a number of times with the OPEN FOR statement containing different queries and each time, a new result set will be created for that query and made available via the cursor variable. There are two ways to declare a cursor variable:

- Use the SYS_REFCURSOR built-in data type to declare a weakly-typed ref cursor.
- Define a strongly-typed ref cursor that declares a variable of that type.

SYS_REFCURSOR is a ref cursor type that allows any result set to be associated with it. This is known as a weakly-typed ref cursor. The following example is a declaration of a weakly-typed ref cursor:

```sql
name SYS_REFCURSOR;
```

Following is an example of a strongly-typed ref cursor:

```sql
TYPE <cursor_type_name> IS REF CURSOR RETURN emp%ROWTYPE;
```

Creating the Stored Procedure

The following sample code creates a stored procedure called refcur_inoutcallee. To create the sample procedure, invoke EDB-PSQL and connect to the Advanced Server host database. Enter the following SPL code at the command line:

```sql
CREATE OR REPLACE PROCEDURE
    refcur_inoutcallee(v_refcur IN OUT SYS_REFCURSOR)
```
IS
BEGIN
  OPEN v_refcur FOR SELECT ename FROM emp;
END;

To use the above defined procedure from .NET code, you must specify the data type of the ref
cursor being passed as an IN parameter, as shown in the above script.

The following C# code uses the stored procedure to retrieve employee names from the emp table:

```csharp
using System;
using System.Data;
using EnterpriseDB.EDBClient;
using System.Configuration;

namespace EDBRefCursor
{
  class EmpRefCursor
  {
    [STAThread]
    static void Main(string[] args)
    {
      string strConnectionString = ConfigurationManager.AppSettings["DB_CONN_STRING"];
      EDBConnection conn = new EDBConnection(strConnectionString);
      conn.Open();
      try
      {
        EDBTransaction tran = conn.BeginTransaction();
        EDBCommand command = new EDBCommand("refcur_inout_callee", conn);
        command.CommandType = CommandType.StoredProcedure;
        command.Transaction = tran;
        command.Prepare();
        command.Parameters[0].Value = null;
        command.ExecuteNonQuery();
        String cursorName = command.Parameters[0].Value.ToString();
      }
    }
  }
}
```
command.CommandText = "fetch all in \"" + cursorName + \\n\"\\\"; 
command.CommandType = CommandType.Text; 
EDBDataReader reader = 
command.ExecuteReader(CommandBehavior.SequentialAccess); 
int fc = reader.FieldCount; 
while (reader.Read()) 
{
    for (int i = 0; i < fc; i++) 
    {
        Console.WriteLine(reader.GetString(i));
    }
    Console.WriteLine(reader.GetString(i));
}
reader.Close();
tran.Commit();
} 
catch (Exception ex) 
{
    Console.WriteLine(ex.Message.ToString());
}
} 
}

The following .NET code snippet displays the result on the console:

for(int i = 0; i < fc; i++)
{
    Console.WriteLine(reader.GetString(i));
}

Please note that you must bind the EDBDbType.RefCursor type in EDBParameter() if you are using a ref cursor parameter.
EDB .Net driver plugins are introduced to support the enhanced capabilities for different data types, which are otherwise not available in .Net. The different plugins available support:

- GeoJSON
- Json.NET
- Legacy PostGIS
- NetTopologySuite
- NodaTime
- Rawpostgis

The plugins support the use of spatial, data/time and Json types. The following sections detail the supported frameworks and data provider installation path for these plugins.
14.1 GeoJSON

If you are using the GeoJSON plugin on .NET Framework 4.6.1, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\GeoJSON\net461

The following shared library files are required:

EnterpriseDB.EDBClient.GeoJSON.dll
GeoJSON.Net.dll
Newtonsoft.Json.dll

If you are using the GeoJSON plugin on .NET Framework 4.7.2, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\GeoJSON\net472

The following shared library files are required:

EnterpriseDB.EDBClient.GeoJSON.dll
GeoJSON.Net.dll
Newtonsoft.Json.dll

If you are using the GeoJSON plugin on .NET Framework 4.8, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\GeoJSON\net48

The following shared library files are required:

EnterpriseDB.EDBClient.GeoJSON.dll
GeoJSON.Net.dll
Newtonsoft.Json.dll

If you are using the GeoJSON plugin on .NET Standard 2.0, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\GeoJSON\netstandard2.0

The following shared library files are required:

EnterpriseDB.EDBClient.GeoJSON.dll

For detailed information about using the GeoJSON plugin, see the Npgsql documentation.
14.2 Json.NET

If you are using the Json.NET plugin on .NET Framework 4.6.1, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\Json.NET\net461

The following shared library files are required:

EnterpriseDB.EDBClient.Json.NET.dll
Newtonsoft.Json.dll

If you are using the Json.NET plugin on .NET Framework 4.7.2, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\Json.NET\net472

The following shared library files are required:

EnterpriseDB.EDBClient.Json.NET.dll
Newtonsoft.Json.dll

If you are using the Json.NET plugin on .NET Framework 4.8, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\Json.NET\net48

The following shared library files are required:

EnterpriseDB.EDBClient.Json.NET.dll
Newtonsoft.Json.dll

If you are using the Json.NET plugin on .NET Standard 2.0, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\Json.NET\netstandard2.0

The following shared library files are required:

EnterpriseDB.EDBClient.Json.NET.dll

For detailed information about using the Json.NET plugin, see the Npgsql documentation.
14.3 LegacyPostGIS

If you are using the LegacyPostGIS plugin on .Net Framework 4.6.1, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\LegacyPostgis\net461

The following shared library files are required:

EnterpriseDB.EDBClient.LegacyPostgis.dll

If you are using the LegacyPostGIS plugin on .Net Framework 4.7.2, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\LegacyPostgis\net472

The following shared library files are required:

EnterpriseDB.EDBClient.LegacyPostgis.dll

If you are using the LegacyPostGIS plugin on .Net Framework 4.8, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\LegacyPostgis\net48

The following shared library files are required:

EnterpriseDB.EDBClient.LegacyPostgis.dll

If you are using the LegacyPostGIS plugin on .Net Standard 2.0, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\LegacyPostgis\netstandard2.0

The following shared library files are required:

EnterpriseDB.EDBClient.LegacyPostgis.dll

For detailed information about using the LegacyPostGIS plugin, see the Npgsql documentation.
14.4 NetTopologySuite

If you are using the NetTopologySuite plugin on .Net Framework 4.6.1, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\NetTopologySuite\net461

The following shared library files are required:

- EnterpriseDB.EDBClient.NetTopologySuite.dll
- NetTopologySuite.dll
- NetTopologySuite.IO.PostGis.dll

If you are using the NetTopologySuite plugin on .Net Framework 4.7.2, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\NetTopologySuite\net472

The following shared library files are required:

- EnterpriseDB.EDBClient.NetTopologySuite.dll
- GeoAPI.dll
- NetTopologySuite.dll
- NetTopologySuite.IO.PostGis.dll

If you are using the NetTopologySuite plugin on .Net Framework 4.8, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\NetTopologySuite\net48

The following shared library files are required:

- EnterpriseDB.EDBClient.NetTopologySuite.dll
- GeoAPI.dll
- NetTopologySuite.dll
- NetTopologySuite.IO.PostGis.dll

If you are using the NetTopologySuite plugin on .Net Standard 2.0, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\NetTopologySuite\netstandard2.0

The following shared library files are required:

- EnterpriseDB.EDBClient.NetTopologySuite.dll
For detailed information about using the NetTopologySuite type plugin, see the Npgsql documentation.
14.5 NodaTime

If you are using the NodaTime plugin on .Net Framework 4.6.1, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\NodaTime\net461

The following shared library files are required:

 EnterpriseDB.EDBClient.NodaTime.dll
 NodaTime.dll

If you are using the NodaTime plugin on .Net Framework 4.7.2, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\NodaTime\net472

The following shared library files are required:

 EnterpriseDB.EDBClient.NodaTime.dll
 NodaTime.dll

If you are using the NodaTime plugin on .Net Framework 4.8, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\NodaTime\net48

The following shared library files are required:

 EnterpriseDB.EDBClient.NodaTime.dll
 NodaTime.dll

If you are using the NodaTime plugin on .Net Standard 2.0, the data provider installation path is:

C:\Program Files\edb\dotnet\plugins\NodaTime\netstandard2.0

The following shared library files are required:

 EnterpriseDB.EDBClient.NodaTime.dll

For detailed information about using the NodaTime plugin, see the Npgsql documentation.
14.6 RawPostGIS

If you are using the RawPostGIS plugin on .Net Framework 4.6.1, the data provider installation path is:

\C:\Program Files\edb\dotnet\plugins\RawPostgis\net461

The following shared library files are required:

EnterpriseDB.EDBClient.RawPostgis.dll

If you are using the RawPostGIS plugin on .Net Framework 4.7.2, the data provider installation path is:

\C:\Program Files\edb\dotnet\plugins\RawPostgis\net472

The following shared library files are required:

EnterpriseDB.EDBClient.RawPostgis.dll

If you are using the RawPostGIS plugin on .Net Framework 4.8, the data provider installation path is:

\C:\Program Files\edb\dotnet\plugins\RawPostgis\net48

The following shared library files are required:

EnterpriseDB.EDBClient.RawPostgis.dll

If you are using the RawPostGIS type plugin on .Net Standard 2.0, the data provider installation path is:

\C:\Program\Files\edb\dotnet\plugins\RawPostGis\netstandard2.0

The following shared library files are required:

EnterpriseDB.EDBClient.RawPostgis.dll

For detailed information about using the RawPostGIS plugin, see the documentation.
CHAPTER 15

Using Object Types in .NET

The SQL CREATE TYPE command is used to create a user-defined object type, which is stored in the Advanced Server database.

These user-defined types can then be referenced within SPL procedures, SPL functions, and .NET programs.

The basic object type is created with the CREATE TYPE AS OBJECT command along with optional usage of the CREATE TYPE BODY command.

An example that demonstrates using an object type is shown in the following section.

15.1 Using an Object Type

To use an object type, you must first create the object type in the Advanced Server database. Object type addr_object_type defines the attributes of an address:

```sql
CREATE OR REPLACE TYPE addr_object_type AS OBJECT
(
    street VARCHAR2(30),
    city VARCHAR2(20),
    state CHAR(2),
    zip NUMBER(5)
);
```

Object type emp_obj_typ defines the attributes of an employee. Note that one of these attributes is object type ADDR_OBJECT_TYPE as previously described. The object type body contains a
method that displays the employee information:

```sql
CREATE OR REPLACE TYPE emp_obj_typ AS OBJECT
(
    empno NUMBER(4),
    ename VARCHAR2(20),
    addr ADDR_OBJECT_TYPE,
    MEMBER PROCEDURE display_emp(SELF IN OUT emp_obj_typ)
);

CREATE OR REPLACE TYPE BODY emp_obj_typ AS
    MEMBER PROCEDURE display_emp (SELF IN OUT emp_obj_typ)
    IS
        BEGIN
            DBMS_OUTPUT.PUT_LINE('Employee No : ' || SELF.empno);
            DBMS_OUTPUT.PUT_LINE('Name : ' || SELF.ename);
            DBMS_OUTPUT.PUT_LINE('Street : ' || SELF.addr.street);
            DBMS_OUTPUT.PUT_LINE('City/State/Zip: ' || SELF.addr.city || ', ' || SELF.addr.state || ' ' || LPAD(SELF.addr.zip,5,'0'));
            END;
        END;

The following listing is a complete .NET program that uses these user-defined object types:

```csharp```
namespace ObjectTypesSample
{
    class Program
    {
        static void Main(string[] args)
        {
            EDBObject.GlobalTypeMapper.MapComposite<addr_object_type>("enterprisedb.addr_object_type");
            EDBObject.GlobalTypeMapper.MapComposite<emp_obj_typ>("enterprisedb.emp_obj_typ");
            EDBObject conn = new EDBObject("Server=localhost;Port=5444;database=test;User ID=enterprisedb;password=<PASSWORD>;");
            try
            {
                conn.Open();
                EDBObjectCommand cmd = new EDBObjectCommand("emp_obj_typ.display_emp", conn);
                cmd.CommandType = System.Data.CommandType.StoredProcedure;
            }
        }
    }
}'''
```
EDBCommandBuilder.DeriveParameters(cmd);

addr_object_type address = new addr_object_type()
{
    street = "123 MAIN STREET",
    city = "EDISON",
    state = "NJ",
    zip = 8817
};

emp_obj_typ emp = new emp_obj_typ()
{
    empno = 9001,
    ename = "JONES",
    addr = address
};

emp_obj_typ empOut = (emp_obj_typ)cmd.Parameters[0].Value;

Console.WriteLine("Emp No: " + empOut.empno);
Console.WriteLine("Emp Name: " + empOut.ename);
Console.WriteLine("Emp Address Street: " + empOut.addr.street);
Console.WriteLine("Emp Address City: " + empOut.addr.city);
Console.WriteLine("Emp Address State: " + empOut.addr.state);
Console.WriteLine("Emp Address Zip: " + empOut.addr.zip);

} catch (EDBException exp) {
    Console.WriteLine(exp.Message.ToString());
} finally {
    conn.Close();
}
The following .NET types are defined to map to the types in Advanced Server:

```csharp
public class addr_object_type
{
    public string street;
    public string city;
    public string state;
    public decimal zip;
}

public class emp_obj_typ
{
    public decimal empno;
    public string ename;
    public addr_object_type addr;
}
```

A call to `EDBConnection.GlobalTypeMapper.MapComposite` maps the .NET type to the Advanced Server types:

```csharp
EDBConnection.GlobalTypeMapper.MapComposite<addr_object_type>(
    "enterprisedb.addr_object_type");
EDBConnection.GlobalTypeMapper.MapComposite<emp_obj_typ>(
    "enterprisedb.emp_obj_typ");
```

A call to `EDBCommandBuilder.DeriveParameters()` gets parameter information for a stored procedure. This allows you to just set the parameter values and call the stored procedure:

```csharp
EDBCommandBuilder.DeriveParameters(cmd);
```
The value of the parameter is set by creating an object of the .NET type and assigning it to the `Value` property of the parameter:

```csharp
addr_object_type address = new addr_object_type()
{
    street = "123 MAIN STREET",
    city = "EDISON",
    state = "NJ",
    zip = 8817
};

emp_obj_typ emp = new emp_obj_typ()
{
    empno = 9001,
    ename = "JONES",
    addr = address
};

// Assigning the object to the parameter
cmd.Parameters[0].Value = emp;
```

A call to `cmd.ExecuteNonQuery()` executes the call to the `display_emp()` method:

```csharp
cmd.ExecuteNonQuery();
```
16.1 Scram Compatibility

The EDB .NET driver provides SCRAM-SHA-256 support for Advanced Server version 10 and above. This support is available from EDB .NET 4.0.2.1 release onwards.
CHAPTER 17

EDB .NET Connector Logging

EDB .NET Connector supports the use of logging to help resolve issues with the .NET Connector when used in your application. The connector uses classes in the EnterpriseDB. EDBClient.Logging namespace for logging.

Console Logging to Standard Error

EnterpriseDB.EDBClient.Logging.ConsoleLoggingProvider is a class that outputs error messages to STDERR. To use this class, include the following line in your application before using any of the Advanced Server .NET Connector APIs.

```csharp
EnterpriseDB.EDBClient.Logging.EDBLogManager.
Provider = new EnterpriseDB.EDBClient.Logging.
ConsoleLoggingProvider(EDBLogLevel.Debug, true, true);
```

The following log levels are available:

- Trace
- Debug
- Info
- Warn
- Error
- Fatal

Writing a Custom Logger
If the console logging provider does not fulfill your requirements, you can write a custom logger by implementing the `EnterpriseDB.EDBClient.Logging.IEDBLoggingProvider` interface, and extending the `EnterpriseDB.EDBClient.Logging.EDBLogger` class, for instance, writing your logs to a file. The following is a simple example of how to write a custom logger:

```csharp
public class MyLoggingProvider : IEDBLoggingProvider
{
    string _logFile;
    readonly EDBLogLevel _minLevel;
    readonly bool _printLevel;
    readonly bool _printConnectorId;

    public MyLoggingProvider(string logFile, EDBLogLevel minLevel,
                               bool printLevel = false, bool printConnectorId = false)
    {
        _logFile = logFile;
        _minLevel = minLevel;
        _printLevel = printLevel;
        _printConnectorId = printConnectorId;
    }

    public EDBLogger CreateLogger(string name)
    {
        return new MyLogger(_logFile, _minLevel, _printLevel, _
                             _printConnectorId);
    }
}

class MyLogger : EDBLogger
{
    string _logFile;
    readonly EDBLogLevel _minLevel;
    readonly bool _printLevel;
    readonly bool _printConnectorId;

    internal MyLogger(string logFile, EDBLogLevel minLevel, bool _
                       _printLevel, bool printConnectorId)
    {
        _logFile = logFile;
        _minLevel = minLevel;
        _printLevel = printLevel;
        _printConnectorId = printConnectorId;
    }

    public override bool IsEnabled(EDBLogLevel level) => level >= _
                                                  _minLevel;
}(continues on next page)
public override void Log(EDBLogLevel level, int connectorId, 
string msg, Exception exception = null)
{
    if (!IsEnabled(level))
        return;

    using (StreamWriter writer = new StreamWriter(_logFile, 
true))
    {
        var sb = new StringBuilder();
        if (_printLevel)
        {
            sb.Append(level.ToString().ToUpper());
            sb.Append(' ');
        }

        if (_printConnectorId && connectorId != 0)
        {
            sb.Append("[");
            sb.Append(connectorId);
            sb.Append("] ");
        }

        sb.AppendLine(msg);
        if (exception != null)
            sb.AppendLine(exception.ToString());

        writer.Write(sb.ToString());
    }
}

To use this custom logger, put the following line in your application before using any of the EDB .NET Connector APIs:

EDBLogManager.Provider = new MyLoggingProvider(filepath, 
EDBLogLevel.Debug, true, true);
For information about using the API, see the Npgsql documentation.

Usage notes:

- When using the API, replace references to Npgsql with EnterpriseDB.EDBClient.
- When referring to classes, replace Npgsql with EDB. For example, use the EDBBinaryExporter class instead of the NpgsqlBinaryExporter class.
CHAPTER 19

Conclusion

EDB .NET Connector Guide
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Symbols

.NET framework setup, 15

A
API Reference, 95

C
Conclusion, 96
configuring the .NET connector, 13

D
Deleting Records in a Database, 48
dequeue message, 62

E
EDB .NET Connector Logging, 92
edbaq classes, 71
enqueue message, 62
executing stored procedure with in, 57
executing stored procedure with in parameters, 53
executing stored procedure without parameters, 51

I
Inserting Records in a Database, 46
Installing and Configuring the .NET Connector, 6

O
Opening a Database Connection, 29
opening database connection
from console application, 35
opening database connection
from windows form application, 37
opening database connection
using asp.net, 33
out and inout parameters, 57

P
Parameterized Queries, 44

R
referencing the library files, 14
Requirements Overview, 3
Retrieving Database Records, 39

S
Scram Compatibility, 91
Security and Encryption, 91
Supported platforms, 3
Supported server versions, 3

T
the .net class hierarchy, 5
The EDB .NET Connector - Overview, 4

U
Using a Ref Cursor in a .NET
Application, 75
Using Advanced Queueing, 61
using object type, 86
Using Object Types in .NET, 86
Using Plugins, 78
Using SPL Stored Procedures in your .NET Application, 50
Using the .NET Connector, 28

W
What’s New, 2