EDB .NET Connector

Version 10.0.1.1

Built at 2026-02-19T13:42:10

1 EDB .NET Connector

The EDB .NET Connector distributed with EDB Postgres Advanced Server provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server. You can:

- Connect to an instance of EDB Postgres Advanced Server.
- Retrieve information from an EDB Postgres Advanced Server database.
- Update information stored on an EDB Postgres Advanced Server database.

To understand these examples, you need a solid working knowledge of C# and .NET. The EDB .NET Connector functionality is built on the core functionality of the Npgsql open source project. For details, see the Npgsql User Guide.

2 Release notes

The EDB .NET connector documentation describes the latest version of EDB .NET connector.

These release notes describe what's new in each release, and highlights differences with the community version. When a minor or patch release introduces new functionality, indicators in the content identify the version that introduced the new feature.

Version	Release Date
10.0.1.1	19 Feb 2026
9.0.3.1	21 May 2025
8.0.5.1	22 Nov 2024
8.0.2.1	15 May 2024
7.0.6.2	15 Feb 2024
7.0.6.1	25 Oct 2023
7.0.4.1	07 Jul 2023
6.0.2.1	25 Jul 2022
5.0.7.1	06 Aug 2021
4.1.6.1	17 Dec 2020
4.1.5.1	11 Nov 2020
4.1.3.1	27 Aug 2020
4.0.10.2	12 Mar 2020
4.0.10.1	26 Sep 2019
4.0.6.1	01 Aug 2019

2.1 Version 10.0.1.1

Released: 19 Feb 2026

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

> **Note**
>
> Unlike the upstream Npgsql community driver, the EDB .NET Connector retains full support for .NET Framework 4.7.2+.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `10.0.1.1` include:

Type	Description	Addresses
Upstream merge	Merged with community .NET driver version 10.0.1. See release notes for more information about merge updates.	
Deprecation	Removed .NET5, .NET6, and .NET7 targets as they have reached end of support.	
Enhancement	Added support for EDB Postgres Advanced Server 18.	

> **Note**
>
> In version 10, Npgsql introduced a breaking change regarding `DateOnly` and `TimeOnly` set as default mappings. EDB .NET Connector doesn't contain this breaking change, and `DateTime` and `TimeSpan` are still the default mappings to their PostgreSQL date/time counterparts.

2.2 Version 9.0.3.1

Released: 21 May 2025

Release notes updated: 25 Nov 2025, 23 Jan 2026

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

> **Note**
>
> Unlike the upstream Npgsql community driver, the EDB .NET Connector retains full support for .NET Framework 4.7.2+.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `9.0.3.1` include:

Type	Description	Addresses
Upstream merge	Merged with community .NET driver version 9.0.3. See release notes for more information about merge updates.	
Bug fix	Populated the `EDBAQMessage.MessageId` property with a string uniquely identifying the message, instead of the previously used `byte[]` .	#41979
Deprecation	Removed .NET5, .NET6, and .NET7 targets as they have reached end of support.	
Enhancement	Added support for EDB Postgres Advanced Server 18.	

2.3 Version 8.0.5.1

Released: 22 Nov 2024

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `8.0.5.1` include:

Type	Description	Addresses
Upstream merge	Merged with community .NET driver version 8.0.5 and EF Core Driver 8.0.10. See release notes for more information about merge updates.	
Bug fix	Fixed a performance issue. Performance is now improved when reading data while targeting .NET Framework 4.7.2, 4.8, and 4.8.1.	#41979
Enhancement	Added support for EDB Postgres Advanced Server 17.2.	
Enhancement	Added support for `IS TABLE OF`. EDB Postgres Advanced Server supports Oracle nested table collection types created with `CREATE TYPE ... AS TABLE OF` statements. See Using nested tables for more information.	
Deprecation	Removed .NET5 and .NET7 targets as they have reached end of support.	

2.4 Version 8.0.2.1

Released: 15 May 2024

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `8.0.2.1` include:

Type	Description
Upstream merge	Merged with community .NET driver version 8.0.2. See release notes for more information about merge updates.
Security fix	Fixed a security issue CVE-2024-32655. This security fix fixes the Npgsql that was vulnerable to SQL injection via protocol message size overflow.
Bug fix	Fixed an issue for SPL CALLS. SPL CALLs with output parameters are now returning DataReader with a row of parameters on the batch commands.
Bug fix	EnableErrorBarriers is now functional on the batch commands. See the EnableErrorBarriers documentation for more information.

2.5 Version 7.0.6.2

Released: 15 Feb 2024

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `7.0.6.2` include:

Type	Description
Enhancement	.NET packages are now available on nuget.org.
Bug fix	Fixed an issue while any attempt to connect synchronously hung indefinitely, referencing the .Net Framework assembly using non-ASYNC code.

2.6 Version 7.0.6.1

Released: 25 Oct 2023

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `7.0.6.1` include:

> **Deprecation**
>
> This release removes support for .NET 5 and .NET Core 3.1.

Type	Description
Upstream merge	Merged with community .NET driver version 7.0.6. For more information about the merge updates, see community release notes.
Enhancement	Added support for .NET 4.7.2, .NET 4.8, .NET 4.8.1

2.7 Version 7.0.4.1

Released: 07 Jul 2023

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `7.0.4.1` include:

Type	Description
Upstream merge	Merged with community .NET driver version 7.0.4. For more information about the merge updates, see https://www.npgsql.org/doc/release-notes/7.0.html.
Enhancement	Added support for .NET 7.0.

2.8 Version 6.0.2.1

Released: 25 Jul 2022

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `6.0.2.1` include:

Type	Description
Upstream merge	Merged with community .NET driver version 6.0.2. For more information about the merge updates, see https://www.npgsql.org/doc/release-notes/6.0.html.
Enhancement	Support for .NET 6.0 is added.

2.9 Version 5.0.7.1

Released: 06 Aug 2021

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `5.0.7.1` include:

Type	Description
Upstream merge	Merged with the upstream Npgsql driver version 5.0.7. For more information about the merge updates, see https://www.nuget.org/packages/Npgsql/5.0.7.
Enhancement	Support for .NET 5.0 and .NET Core 3.1 (earlier available as .NET Core 3.0).

2.10 Version 4.1.6.1

Released: 17 Dec 2020

The EDB .NET Connector provides connectivity between a .NET client application and an Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `4.1.6.1` include:

Type	Description
Upstream Merge	Merged with the upstream Npgsql driver version 4.1.6. For more information about the merge updates, see https://www.nuget.org/packages/Npgsql/4.1.6.
Enhancement	Support for .NET Framework 4.7.2 and .NET Framework 4.8.

2.11 Version 4.1.5.1

Released: 11 Nov 2020

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `4.1.5.1` include:

Type	Description
Upstream merge	Merged with the upstream Npgsql driver version 4.1.5. For more information about the merge updates, see https://www.nuget.org/packages/Npgsql/4.1.5.
Enhancement	Support for EDB Postgres Advanced Server 13.

2.12 Version 4.1.3.1

Released: 27 Aug 2020

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `4.1.3.1` include:

Type	Description
Upstream merge	Merged with the upstream Npgsql driver version 4.1.3. For more information about the merge updates, see https://www.nuget.org/packages/Npgsql/4.1.3.
Enhancement	Support for .NET Framework 4.6.1, .NET Core 3.0 and .NET Standard 2.1.

2.13 Version 4.0.10.2

Released: 12 Mar 2020

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `4.0.10.2` include:

Type	Description
Enhancement	Added connection parameter, `Load Role Based Tables`.

2.14 Version 4.0.10.1

Released: 26 Sep 2019

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `4.0.10.1` include:

Type	Description
Upstream merge	Merged with the upstream community driver version 4.0.10.
Enhancement	Added support for Windows Server 2019 platform.
Enhancement	Added support for VSIX for Visual Studio 2019.

2.15 Version 4.0.6.1

Released: 01 Aug 2019

The EDB .NET Connector provides connectivity between a .NET client application and an EDB Postgres Advanced Server database server.

New features, enhancements, bug fixes, and other changes in the EDB .NET Connector `4.0.6.1` include:

Type	Description
Upstream merge	Merged with the upstream community driver version 4.0.6.
Enhancement	Added Advanced Queueing feature that provides message queueing and message processing support for the EDB Advanced Server database.

3 Product compatibility

The following sections detail the supported platforms and database versions for the EDB .NET Connector.

Supported .NET versions

The .NET Connector supports the following runtime environments:

- .NET Framework 4.7.2, 4.8 and 4.8.1
- .NET 8, .NET 9 and .NET10
- .NET Standard 2.1 and .NET Standard 2.0

Version compatibility for Entity Framework Core is strictly mapped to the EDB .NET Connector major version. Make sure that both components share the same major version (9.x, etc.) for supported operation.

> **Note**
>
> Unlike the upstream Npgsql community driver, the EDB .NET Connector retains full support for .NET Framework 4.7.2+.

Supported platforms

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

64-bit Windows:

- Windows Server 2019 and 2022
- Windows 10 and 11

32-bit Windows:

- Windows 10

Supported database server versions

This table lists the latest EDB .NET Connector versions and their supported corresponding EDB Postgres Advanced Server (EPAS) versions.

EDB .NET Connector	EPAS 18	EPAS 17	EPAS 16	EPAS 15	EPAS 14	EPAS 13
10.0.1.1	Y	Y	Y	Y	Y	Y
9.0.3.1	Y	Y	Y	Y	Y	Y
8.0.5.1	N	Y	Y	Y	Y	Y
8.0.2.1	N	N	Y	Y	Y	Y
7.0.6.2	N	N	Y	Y	Y	Y
7.0.6.1	N	N	Y	Y	Y	Y
7.0.4.1	N	N	N	Y	Y	Y
6.0.2.1	N	N	N	N	Y	Y

EDB .NET Connector	EPAS 18	EPAS 17	EPAS 16	EPAS 15	EPAS 14	EPAS 13
5.0.7.1	N	N	N	N	N	Y
4.1.6.1	N	N	N	N	N	Y
4.1.5.1	N	N	N	N	N	Y
4.1.3.1	N	N	N	N	N	Y
4.0.10.2	N	N	N	N	N	N
4.0.10.1	N	N	N	N	N	N
4.0.6.1	N	N	N	N	N	N

4 EDB .NET Connector overview

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

The .NET class hierarchy

The .NET class hierarchy contains classes that you can use to create objects that control a connection to the EDB Postgres Advanced Server database and manipulate the data stored on the server. The following are a few of the most commonly used object classes.

`EDBDataSource`

`EDBDataSource` is the entry point for all the connections made to the database. It's responsible for issuing connections to the server and efficiently managing them. Starting with EDB .NET Connector 7.0.4.1, you no longer need direct instantiation of `EDBConnection`. Instantiate `EDBDataSource` and use the method provided to create commands or execute queries.

`EDBConnection`

The `EDBConnection` class represents a connection to EDB Postgres Advanced Server. An `EDBConnection` object contains a `ConnectionString` that tells the .NET client how to connect to an EDB Postgres Advanced Server database. Obtain `EDBConnection` from an `EDBDataSource` instance, and use it directly only in specific scenarios, such as transactions.

`EDBCommand`

An `EDBCommand` object contains a SQL command that the client executes against EDB Postgres 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 EDB Postgres 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 EDB Postgres Advanced Server database. You can modify values and use the `EDBDataAdapter` class to update the data stored in an EDB Postgres Advanced Server database.

5 Installing and configuring the .NET Connector

Installing the .NET Connector

You can install the EDB .NET Connector using either the EDB installer or the installer from NuGet.org.

Installing and configuring the .NET Connector from NuGet.org

Install NuGet package via command line

Launch a terminal from your solution folder and run:

```
dotnet add package EnterpriseDB.EDBClient
```

This command downloads and installs the EDB .NET Connector matching your .NET version. Your project is then ready to import the EDB .NET Connector namespace:

```
using EnterpriseDB.EDBClient;
```

You can find all the EDB .NET Connector satellite packages at NuGet.org.

For more information, see the EDB .NET Connector Now Published on NuGet blog post.

Install NuGet package via Visual Studio interface

1. Right-click your project or solution and select **Manage NuGet package**.
2. Search the package using `enterprisedb.edbclient` as the search text.
3. Select the EnterpriseDB.EDBClient package.
4. Select **Install** to proceed to package download and installation.

This command downloads and installs the EDB .NET Connector matching your .NET version. Your project is then ready to import the EDB .NET Connector namespace:

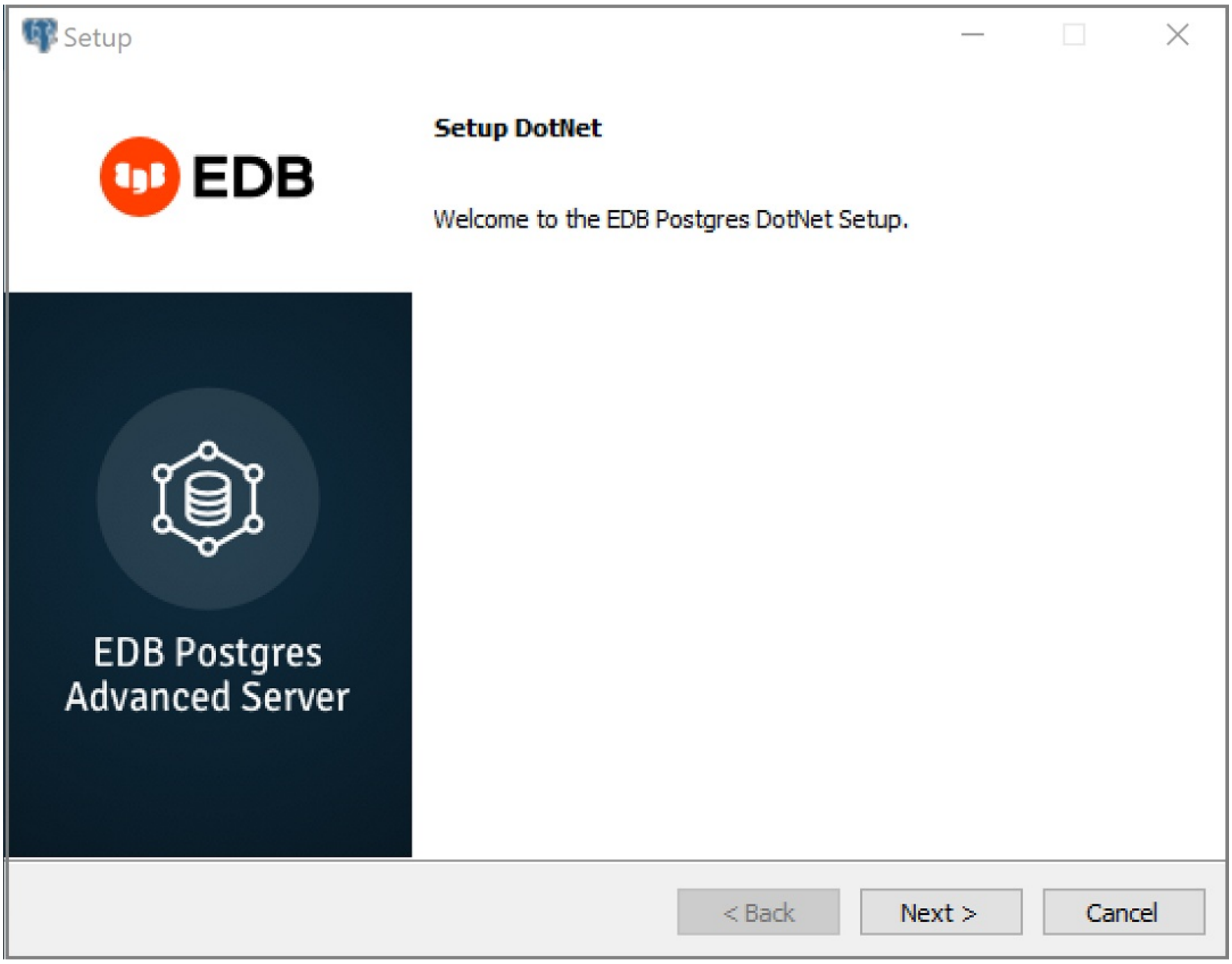
```
using EnterpriseDB.EDBClient;
```

For more information, see the EDB .NET Connector Now Published on NuGet blog post.

Installing the .NET Connector using EDB installer

You can use the EDB .NET Connector installer to add the .NET Connector to your system. The installer is available fromthe EDB website.

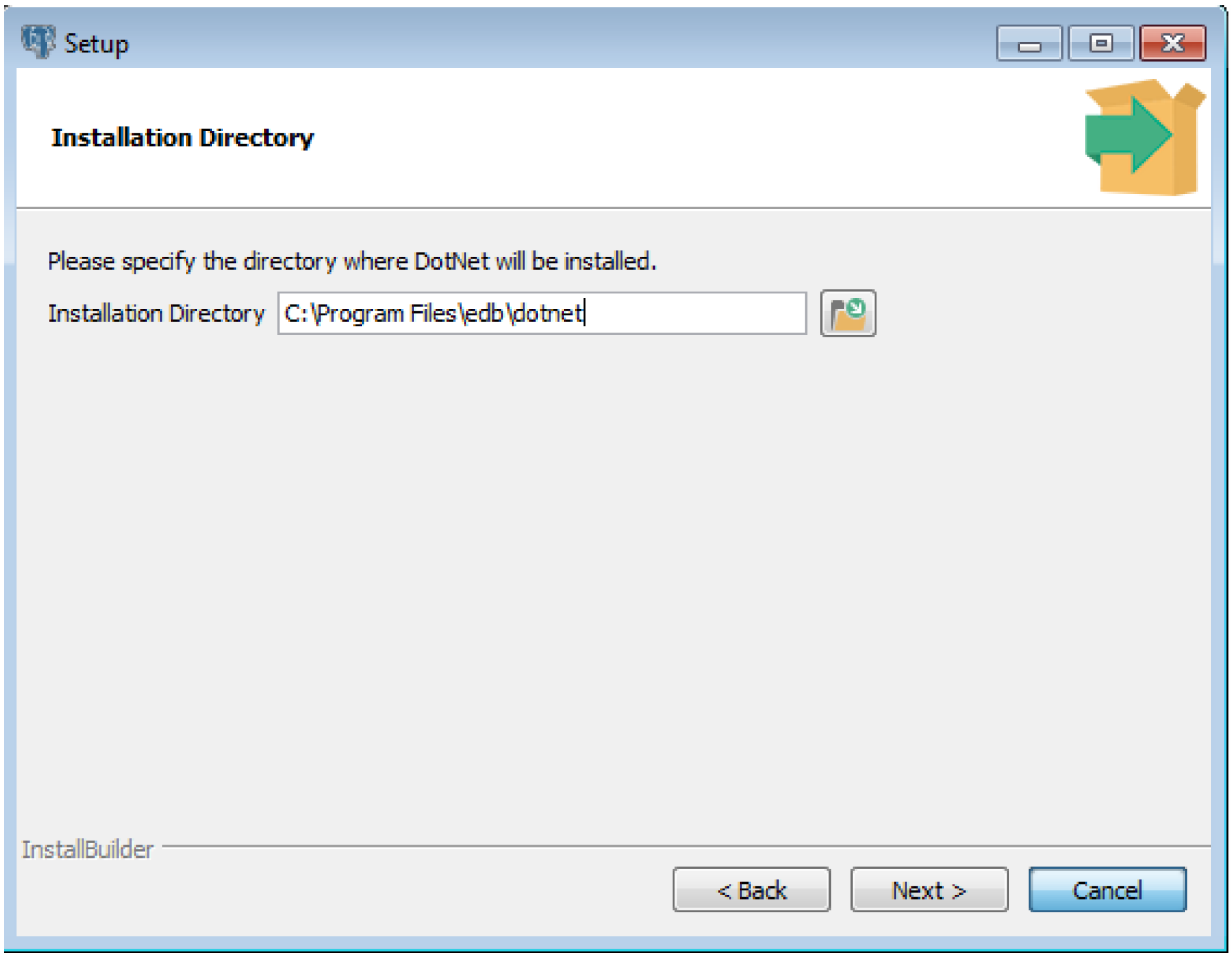
1. After downloading the installer, right-click the installer icon, and select **Run As Administrator**. When prompted, select an installation language and select **OK** to continue to the Setup window.



Setup DotNet

Welcome to the EDB Postgres DotNet Setup.

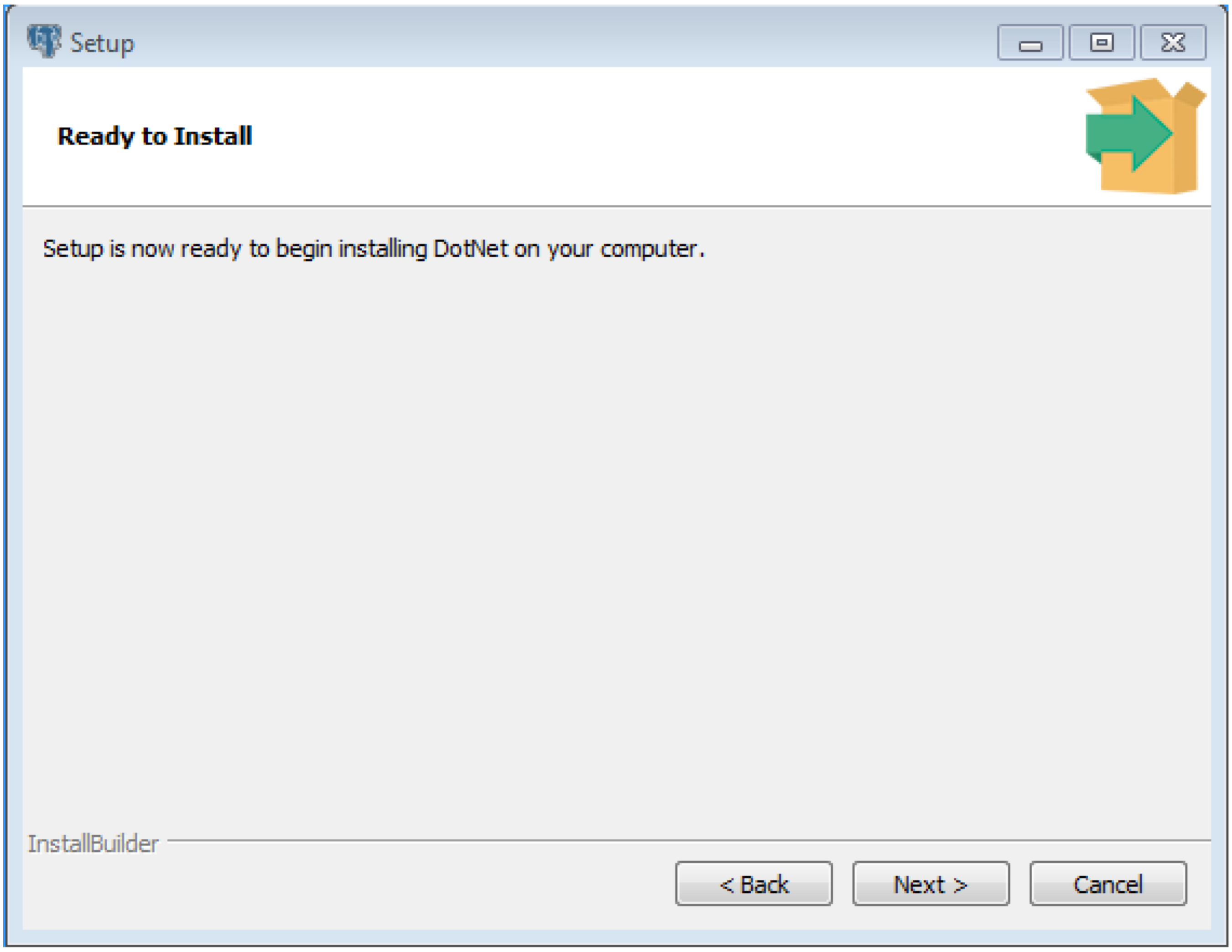
2. Select **Next**.



Please specify the directory where DotNet will be installed.

Installation Directory C:\Program Files\edb\dotnet

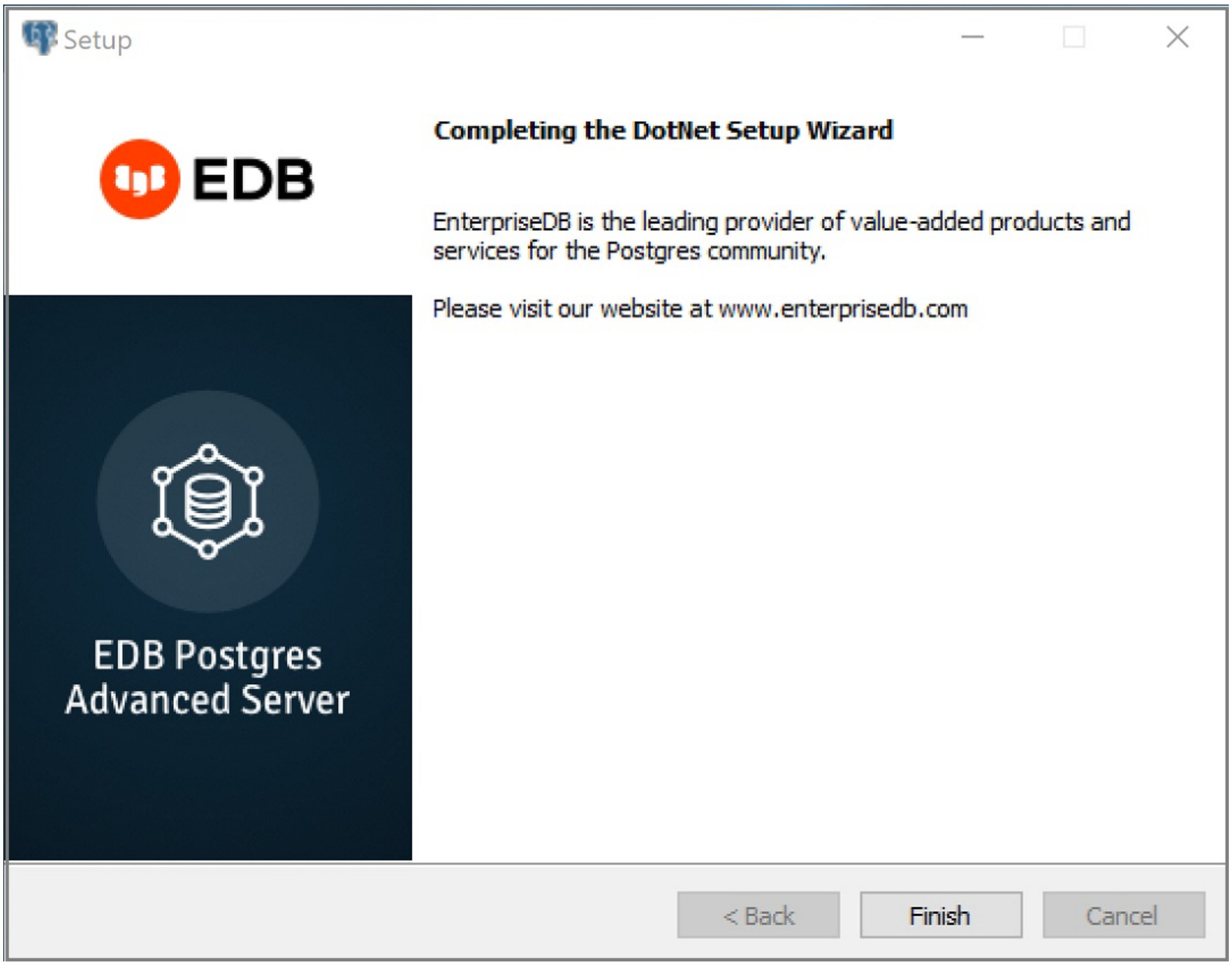
3. Use the Installation Directory dialog box to specify the directory in which to install the connector. Select**Next**.



Ready to Install

Setup is now ready to begin installing DotNet on your computer.

4. To start the installation, on the Ready to Install dialog box, select**Next**. Popups confirm the progress of the installation wizard.



Completing the DotNet Setup Wizard

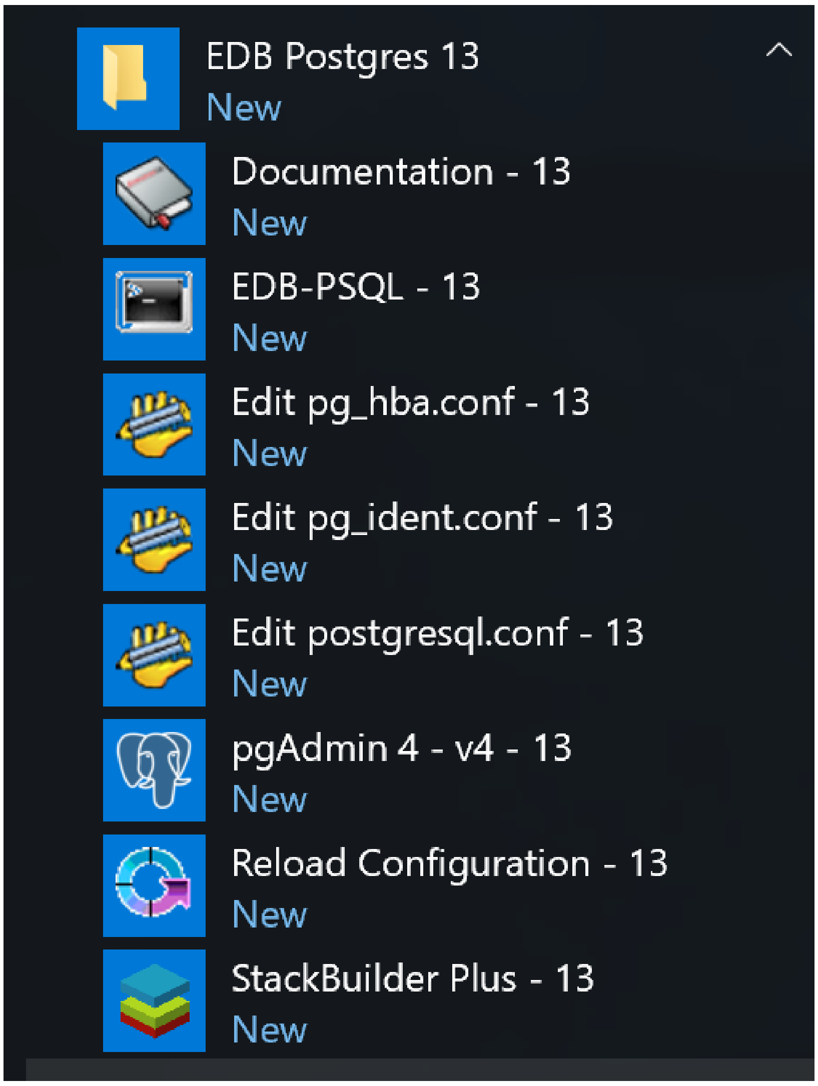
EnterpriseDB is the leading provider of value-added products and services for the Postgres community.

Please visit our website at www.enterprisedb.com

5. When the wizard informs you that it has completed the setup, select**Finish**.

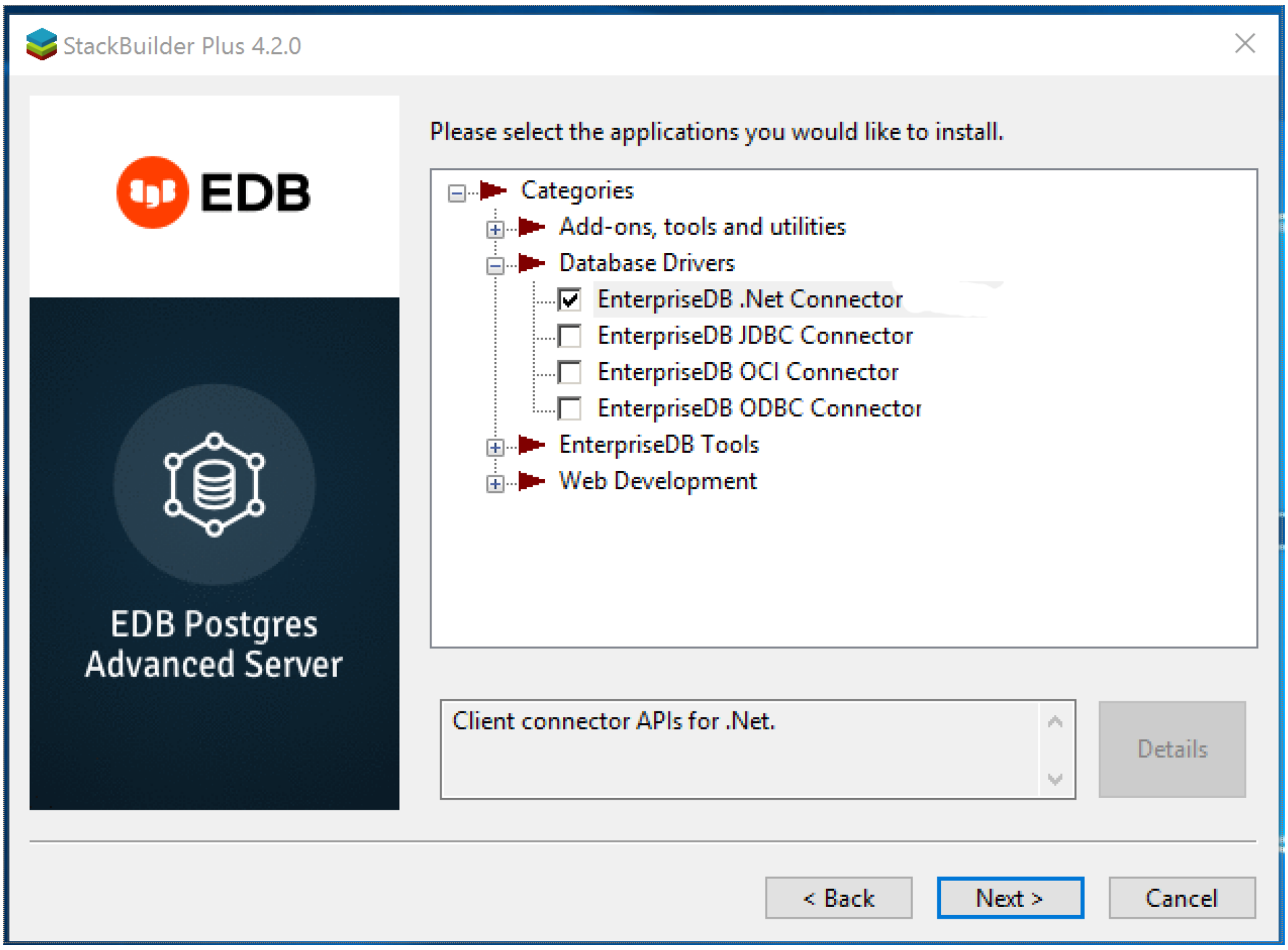
You can also use StackBuilder Plus to add or update the connector on an existing EDB Postgres Advanced Server installation.

1. To open StackBuilder Plus, from the Windows **Apps** menu, select **StackBuilder Plus**.



2. When StackBuilder Plus opens, follow the onscreen instructions.

3. From the Database Drivers node of the tree control, select the **EnterpriseDB.Net Connector** option.



Please select the applications you would like to install.

- Categories
  - Add-ons, tools and utilities
  - Database Drivers
    - [✓] EnterpriseDB .Net Connector
    - [ ] EnterpriseDB JDBC Connector
    - [ ] EnterpriseDB OCI Connector
    - [ ] EnterpriseDB ODBC Connector
  - EnterpriseDB Tools
  - Web Development

Client connector APIs for .Net.

4. Follow the directions of the onscreen wizard to add or update an installation of an EDB Connector.

Configuring the .NET Connector

For information about configuring the .NET Connector in each environment, see:

- **Referencing the Library Files.** General configuration information applicable to all components.
- **.NET 10** Instructions for configuring for use with .NET 10.
- **.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 Framework 4.8.1** Instructions for configuring for use with .NET Framework 4.8.1.
- **.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 EntityFramework Core** Instructions for configuring for use with .NET EntityFramework Core.

Referencing the library files

To reference library files with Microsoft Visual Studio:

1. In the Solution Explorer, select the project.
2. Select **Project > Add Reference**.
3. In the Add Reference dialog box, browse to select the appropriate library files.

Optionally, you can copy the library files 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 in the namespace. The namespace is `EnterpriseDB.EDBClient`.

The method you use to include the namespace varies by the type of application you're 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, use:

```
using EnterpriseDB.EDBClient;
```

.NET framework setup

Each .NET version has specific setup instructions.

.NET 10

For .NET 10, the data provider installation path is:

`C:\Program Files\edb\dotnet\net10.0\`

You must add the following dependencies to your project:

`EnterpriseDB.EDBClient.dll`

Depending upon the type of application you use, you may be required to import the namespace into the source code. SeeReferencing the library files for this and other information about referencing library files.

.NET Framework 4.7.2

For .NET Framework 4.7.2, the data provider installation path is:

`C:\Program Files\edb\dotnet\net472\`.

You must add the following dependency to your project. You may also need to add other dependencies from the same directory:

- `EnterpriseDB.EDBClient.dll`

Depending on your application type, you might need to import the namespace into the source code. See Referencing the library files for this and the other information about referencing the library files.

.NET Framework 4.8

For .NET Framework 4.8, the data provider installation path is:

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

You must add the following dependency to your project. You may also need to add other dependencies from the same directory:

- `EnterpriseDB.EDBClient.dll`

Depending on your application type, you might need to import the namespace into the source code. See Referencing the library files for this and the other information about referencing the library files.

.NET Framework 4.8.1

For .NET Framework 4.8.1, the data provider installation path is:

`C:\Program Files\edb\dotnet\net481\` .

You must add the following dependency to your project. You may also need to add other dependencies from the same directory:

- `EnterpriseDB.EDBClient.dll`

Depending on your application type, you might need to import the namespace into the source code. See Referencing the library files for this and the other information about referencing the library files.

.NET Standard 2.0

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

`C:\Program Files\edb\dotnet\netstandard2.0\` .

You must add the following dependencies to your project:

- `EnterpriseDB.EDBClient.dll`
- `System.Threading.Tasks.Extensions.dll`
- `System.Runtime.CompilerServices.Unsafe.dll`
- `System.ValueTuple.dll`

Depending on your application type, you might need to import the namespace into the source code. See Referencing the library files for this and the other information about referencing the library files.

.NET Standard 2.1

For .NET Standard Framework 2.1, the data provider installation path is `C:\Program Files\edb\dotnet\netstandard2.1\` .

The following shared library files are required:

- `EnterpriseDB.EDBClient.dll`
- `System.Memory.dll`
- `System.Runtime.CompilerServices.Unsafe.dll`

- `System.Text.Json.dll`
- `System.Threading.Tasks.Extensions.dll`
- `System.ValueTuple.dll`

Depending on your application type, you might need to import the namespace into the source code. See Referencing the library files for this and the other information about referencing the library files.

.NET Entity Framework Core

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

`C:\Program Files\edb\dotnet\EF.Core\EFCore.PG\net10.0` The following shared library file is required:

- `EnterpriseDB.EDBClient.EntityFrameworkCore.PostgreSQL.dll`

See Referencing the library files for information about referencing the library files.

The following NuGet packages are required:

- `Microsoft.EntityFrameworkCore.Design`
- `Microsoft.EntityFrameworkCore.Relational`
- `Microsoft.EntityFrameworkCore.Abstractions`

For usage information about Entity Framework Core, see the Microsoft documentation.

Prerequisite

To open a command prompt:

Select **Tools > Command Line > Developer Command Prompt**.

Install dotnet-ef (using the command prompt),

```
dotnet tool install --global dotnet-ef
```

Sample project

Create a new Console Application based on .NET 10.0.

Add Reference to the following EDB assemblies:

- `EnterpriseDB.EDBClient.EntityFrameworkCore.PostgreSQL.dll`
- `EnterpriseDB.EDBClient.dll`

Add the following NuGet packages:

- `Microsoft.EntityFrameworkCore.Design`
- `Microsoft.EntityFrameworkCore.Relational`
- `Microsoft.EntityFrameworkCore.Abstractions`

Database-first scenario

Issue the following command to create model classes corresponding to all objects in the specified database:

```
dotnet ef dbcontext scaffold Host=<HOST>;Database=<DATABASE>;Username=<USER>;Password=<PASSWORD>;Port=
<PORT> EnterpriseDB.EDBClient.EntityFrameworkCore.PostgreSQL -o Models
```

Code-first scenario

Add code for defining a DbContext and create, read, update, and delete operations.

For more details, see the Microsoft documentation.

Issue the following commands to create the initial database and tables:

```
  dotnet ef migrations add InitialCreate --context BloggingContext

  dotnet ef database update --context BloggingContext
```

6 Opening a database connection

An `EDBConnection` object is responsible for handling the communication between an instance of EDB Postgres Advanced Server and a .NET application. Before you can access data stored in an EDB Postgres Advanced Server database, you must create and open an `EDBConnection` object.

Creating an EDBConnection object

Once you have installed and configured the .NET Connector, you can open a connection using one of the following approaches. In either case, you must import the namespace `EnterpriseDB.EDBClient`.

Connection with a data source

1. Create an instance of the `EDBDataSource` object using a connection string as a parameter to the create method of the `EDBDataSource` class.

2. To open a connection, call the `OpenConnection` method of the `EDBDataSource` object.

This example shows how to open a connection using a data source:

```
// EDBDataSource should be long lived through your
application
await using var dataSource = EDBDataSource.Create(connectionString);
await using var connection = await dataSource.OpenConnectionAsync();

// your code here
await connection.CloseAsync();
```

```
// EDBDataSource should be long lived through your
application
using (var dataSource = EDBDataSource.Create(connectionString))
{
    using (var connection = await dataSource.OpenConnectionAsync())
    {
        // your code here
        await connection.CloseAsync();
    }
}
```

Connection without a data source

1. Create an instance of the `EDBConnection` object using a connection string as a parameter to the constructor of the `EDBConnection` class.

2. Call the `Open` method of the `EDBConnection` object to open the connection.

Note

For `EnterpriseDB.EDBClient 8.0.4` and later, we recommend `EDBDataSource` to connect to EDB Postgres Advanced Server database or execute SQL directly against it. For more information on the data source, see the Npgsql documentation.

This example shows how to open a connection without a data source:

```
await using var connection = new EDBConnection(connectionString);
await connection.OpenAsync();
// your code here
await connection.CloseAsync();
```

```
using (var connection = new EDBConnection(ConnectionString))
{
    await connection.OpenAsync();
    // your code here
    await connection.CloseAsync();
}
```

Connection string parameters

A valid connection string specifies location and authentication information for an EDB Postgres 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 EDB Postgres Advanced Server database
- The name of an EDB Postgres Advanced Server user
- The password associated with that user

You can include the following parameters in the connection string:

Parameter	Description	Default
`Host` or `Server`	The name or IP address of the EDB Postgres Advanced Server host	*Required*
`Port`	The TCP port of the EDB Postgres Advanced Server host	5444
`Database`	The name of the database to connect to.	name of connected user
`User Id` or `UserName`	The username to connect with.	OS username
`Password`	Password associated to the user to establish a connection with the server	*Authentication dependent*
`Command Timeout`	Specifies the length of time (in seconds) to wait for a command to finish executing before throwing an exception.	30
`Pooling`	Specify a value of false to disable connection pooling	`true`
`No Reset On Close`	When Pooling is enabled and the connection is closed, reopened, and the underlying connection is reused, then some operations are executed to discard the previous connection resources. You can override this behavior by enabling No Reset On Close.	`false`

Parameter	Description	Default
`SSL Mode`	Controls whether SSL is used, depending on server support. Prefer — Use SSL if possible. This is the default behavior. Require — Throw an exception if an SSL connection can't be established. Allow — Connect without SSL unless server requires it Disable — Don't attempt an SSL connection. VerifyCA — SSL with certificate validation VerifyFull — SSL with certificate validation and host name validation See Npgsql docs for possible values and more info.	`Prefer`

For other parameters please refer to the community documentation.

Example: Opening a database connection

This example shows how to open a connection to an instance of EDB Postgres Advanced Server and then close the connection.

```
using EnterpriseDB.EDBClient;  // Add NuGet package
EnterpriseDB.EDBClient

namespace OpeningDatabaseConnection;

internal class Program
{
    static async Task Main(string[] args)
    {
        // NOT FOR PRODUCTION Consider moving the connection string in a configuration
file
        var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=enterprisedb;Database=edb";
        try
        {
            await using var dataSource = EDBDataSource.Create(connectionString);
            await using var conn = await dataSource.OpenConnectionAsync();
            Console.WriteLine("Connection opened
successfully");
            await conn.CloseAsync();
        }
        catch (EDBException
exp)
        {
            Console.Write($"Error:
{exp}");
        }
    }
}
```

```
using
System;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;  // Add NuGet package
EnterpriseDB.EDBClient

namespace OpeningDatabaseConnection
{
    internal class Program
    {
        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION Consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=enterprisedb;Database=edb";
            try
            {
                using (var dataSource = EDBDataSource.Create(connectionString))
                {
                    var conn = await dataSource.OpenConnectionAsync();
                    Console.WriteLine("Connection opened
successfully");
                    await conn.CloseAsync();
                }
            }
            catch (EDBException
exp)
            {
                Console.Write($"Error:
{exp}");
            }
        }
    }
}
```

In a production application, connection strings should be moved outside of the code, using configuration files for example. See official Microsoft .NET documentation.

7 Retrieving database records

You can use a `SELECT` statement to retrieve records from the database using a `SELECT` command. To execute a `SELECT` statement you must:

1. Create and open a database connection.
2. Create an `EDBCommand` object that represents the `SELECT` statement.
3. Execute the command with the `ExecuteReader()` method of the `EDBCommand` object returning `EDBDataReader`.
4. 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 EDB Postgres 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.

Loop through the contents of the `EDBDataReader` object to display the records returned by the query in a `WHILE` loop.

The `Read()` method advances to the next record (if there is one) and returns `true` if a record exists. It returns `false` if `EDBDataReader` has reached the end of the result set.

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

namespace RetrievingDatabaseRecords;

internal class Program
{
    static async Task Main(string[] args)
    {
        try
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            await using var dataSource = EDBDataSource.Create(connectionString);
            await using var conn = await dataSource.OpenConnectionAsync();
            await using var selectCommand = new EDBCommand("SELECT * FROM dept",
conn);
            selectCommand.CommandType =
CommandType.Text;

            await using var reader = await
selectCommand.ExecuteReaderAsync();
            while (await
reader.ReadAsync())
            {
                Console.Write($"Department Number: {reader["deptno"]}");
                Console.Write($"\tDepartment Name: {reader["dname"]}");
                Console.Write($"\tDepartment Location: {reader["loc"]}");
                Console.WriteLine();
            }
            await
reader.CloseAsync();
            await conn.CloseAsync();
        }
        catch (Exception
exp)
        {
            Console.WriteLine($"An error occured:
{exp}");
        }
    }
}
```

```
using
System;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;

namespace RetrievingDatabaseRecords
{
    internal class Program
    {
        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=localhost;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
            try
            {
                using (var dataSource = EDBDataSource.Create(connectionString))
                using (var conn = await dataSource.OpenConnectionAsync())
                {
                    using (var selectCommand = new EDBCommand("SELECT * FROM dept",
conn))
                    {
                        selectCommand.CommandType =
CommandType.Text;
                        using (var reader = await
selectCommand.ExecuteReaderAsync())
                        {
                            while (await
reader.ReadAsync())
                            {
                                Console.Write($"Department Number: {reader["deptno"]}");
                                Console.Write($"\tDepartment Name: {reader["dname"]}");
                                Console.Write($"\tDepartment Location: {reader["loc"]}");
                                Console.WriteLine();
                            }
                            await
reader.CloseAsync();
                        }
                    }
                    await conn.CloseAsync();
                }
            }
            catch (Exception
exp)
            {
                Console.WriteLine($"An error occured:
{exp}");
            }
        }
    }
}
```

This program should output the following text on the console :

```
Department Number: 10   Department Name: ACCOUNTING     Department Location: NEW YORK
Department Number: 20   Department Name: RESEARCH       Department Location: DALLAS
Department Number: 30   Department Name: SALES          Department Location: CHICAGO
Department Number: 40   Department Name: OPERATIONS     Department Location: BOSTON
```

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 result set generated by the specified query.

```
static async Task Main(string[] args)
{
    // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
    var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
    try
    {
        await using var dataSource = EDBDataSource.Create(connectionString);
        await using var connection = await dataSource.OpenConnectionAsync();
        await using var command = new EDBCommand("SELECT MAX(sal) FROM emp",
connection);
        command.CommandType =
CommandType.Text;

        var maxSalObject = await command.ExecuteScalarAsync();
        if (maxSalObject is decimal
maxSal)
        {
            Console.WriteLine($"Max Salary: {maxSal}");
        }

        await connection.CloseAsync();
    }
    catch (Exception
exp)
    {
        Console.WriteLine($"An error occured:
{exp}");
    }
}
```

```
static async Task Main(string[] args)
{
    // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
    var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
    try
    {
        using (var dataSource = EDBDataSource.Create(connectionString))
        using (var connection = await dataSource.OpenConnectionAsync())
        {
            using (var command = new EDBCommand("SELECT MAX(sal) FROM emp",
connection))
            {
                command.CommandType =
CommandType.Text;

                var maxSalObject = await command.ExecuteScalarAsync();
                if (maxSalObject is decimal
maxSal)
                {
                    Console.WriteLine($"Max Salary: {maxSal}");
                }
            }
            await connection.CloseAsync();
        }
    }
    catch (Exception
exp)
    {
        Console.WriteLine($"An error occured:
{exp}");
    }
}
```

This program should output the following text on the console :

```
Max Salary: 5000.00
```

The sample includes an explicit conversion of the value returned by the ExecuteScalar() method. The ExecuteScalar() method returns an object (it's a decimal value boxed into an object). You can access the native value by using an explicit cast to a nullable decimal value.

8 Parameterized queries

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 need to supply values dynamically (from user input or from other data in memory, for example). Parameterized queries are also great to prevent SQL injection and for performance, as a query plan can be reused.

As shown 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` property.

The example shows using a parameterized query with an `UPDATE` statement that increases an employee salary:

```
using EnterpriseDB.EDBClient;

namespace ParameterizedQueries;

internal static class Program
{
    static async Task Main(string[] args)
    {
        try
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

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

            await using var dataSource = EDBDataSource.Create(connectionString);
            await using var connection = await dataSource.OpenConnectionAsync();
            await using var updateCommand = new EDBCommand(updateQuery, connection);

            var idParameter = updateCommand.Parameters.Add(new EDBParameter(":ID",
EDBTypes.EDBDbType.Integer));
            idParameter.Value =
7788;

            var numRowsUpdated = await
updateCommand.ExecuteNonQueryAsync();

            Console.WriteLine($"{numRowsUpdated} record(s)
updated");
            await connection.CloseAsync();

        }
        catch (Exception
exp)
        {
            Console.WriteLine($"An error occured:
{exp}");
        }
    }
}
```

```
using
System;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;

namespace ParameterizedQueries
{
    internal static class Program
    {
        static async Task Main(string[] args)
        {
            try
            {
                // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
                var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

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

                using (var dataSource = EDBDataSource.Create(connectionString))
                using (var connection = await dataSource.OpenConnectionAsync())
                {
                    using (var updateCommand = new EDBCommand(updateQuery, connection))
                    {

                        var idParameter = updateCommand.Parameters.Add(new EDBParameter(":ID",
EDBTypes.EDBDbType.Integer));
                        idParameter.Value =
7788;

                        var numRowsUpdated = await
updateCommand.ExecuteNonQueryAsync();

                        Console.WriteLine($"{numRowsUpdated} record(s)
updated");
                    }
                    await connection.CloseAsync();
                }
            }
            catch (Exception
exp)
            {
                Console.WriteLine($"An error occured:
{exp}");
            }
        }
    }
}
```

This program should show the following output in the Console:

```
1 record(s) updated
```

9 Inserting records in a database

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

In the example that follows, the `INSERT` command is stored in the variable `insertCommand`. 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 `insertCommand` object.

Note that `ExecuteNonQuery()` method returns the number of rows affected by the command. It is usually a good practice to check the number of affected rows matches your expectations (1 in this example).

The example adds an employee to the `emp` table:

```
using EnterpriseDB.EDBClient;

namespace
InsertingRecords;

internal static class Program
{
    static async Task Main(string[] args)
    {
        // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
        var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
        try
        {
            await using var dataSource = EDBDataSource.Create(connectionString);
            await using var conn = await dataSource.OpenConnectionAsync();

            var query = "INSERT INTO emp(empno,ename) VALUES(:EmpNo,
:EName)";
            using var insertCommand = new EDBCommand(query, conn);
            var empNo = insertCommand.Parameters.Add(new EDBParameter("EmpNo",
EDBTypes.EDBDbType.Integer));
            var empName = insertCommand.Parameters.Add(new EDBParameter("EName",
EDBTypes.EDBDbType.Text));
            empNo.Value = 1234;
            empName.Value = "Lola";

            var numRows = await insertCommand.ExecuteNonQueryAsync();

            Console.WriteLine($"{numRows} record(s) inserted
successfully");
            await conn.CloseAsync();
        }
        catch (Exception
exp)
        {
            Console.WriteLine($"An error occured:
{exp}");
        }
    }
}
```

```
using
System;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;

namespace
InsertingRecords
{
    internal static class Program
    {
        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
            try
            {
                using (var dataSource = EDBDataSource.Create(connectionString))
                using (var conn = await dataSource.OpenConnectionAsync())
                {

                    var query = "INSERT INTO emp(empno,ename) VALUES(:EmpNo,
:EName)";
                    using (var insertCommand = new EDBCommand(query, conn))
                    {

                        var empNo = insertCommand.Parameters.Add(new EDBParameter("EmpNo",
EDBTypes.EDBDbType.Integer));
                        var empName = insertCommand.Parameters.Add(new EDBParameter("EName",
EDBTypes.EDBDbType.Text));
                        empNo.Value = 1234;
                        empName.Value = "Lola";

                        var numRows = await insertCommand.ExecuteNonQueryAsync();

                        Console.WriteLine($"{numRows} record(s) inserted
successfully");
                    }
                    await conn.CloseAsync();
                }
            }
            catch (Exception
exp)
            {
                Console.WriteLine($"An error occured:
{exp}");
            }
        }
    }
}
```

This program should show the following output in the Console:

```
1 record(s) inserted successfully
```

> **Note**
>
> There are several ways to declare parameters and assign their values. Here are some examples :
>
> ```
> // One-liners (parameter types are induced from their
> value)
> insertCommand.Parameters.AddWithValue("EmpNo", 1234);
> insertCommand.Parameters.AddWithValue("EName", "Lola");
>
> // Using the parameter variable to set its value, instead of getting it via the
> command
> var empParam = insertCommand.Parameters.Add(new EDBParameter("EmpNo",
> EDBTypes.EDBDbType.Integer));
> empParam.Value = 1234;
> var nameParam = insertCommand.Parameters.Add(new EDBParameter("EName",
> EDBTypes.EDBDbType.Text));
> nameParam.Value = "Lola";
>
> insertCommand.Parameters[0].Value = 1234; // works but not recommended: access by index is error-
> prone
> insertCommand.Parameters["EmpNo"].Value = 1234; // works but any parameter name change will break
> here
> ```

10 Deleting records in a database

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

In the example that follows, the `DELETE` command is stored in the variable `deleteCommand`. The values prefixed with a colon (`:`) are placeholders for EDBParameters.

The `EDBParameter` for the employee ID is created and assigned at the same time using command's parameter collection `EDBParameterCollection.AddWithValue(string parameterName, object value)` method.

The `DELETE` command is then executed by the `ExecuteNonQuery()` method of the `deleteCommand` object.

Note that `ExecuteNonQuery()` method returns the number of rows affected by the command. It is usually a good practice to check that the number of affected rows matches your expectations (0 or 1 in this example).

The example deletes an employee having the 1234 ID from the `emp` table:

```
using EnterpriseDB.EDBClient;

namespace DeletingRecords;

internal static class Program
{
    static async Task Main(string[] args)
    {
        // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
        var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
        try
        {
            await using var dataSource = EDBDataSource.Create(connectionString);
            await using var conn = await dataSource.OpenConnectionAsync();
            await using var deleteCommand = new EDBCommand("DELETE FROM emp WHERE empno = :ID",
conn);

            deleteCommand.Parameters.AddWithValue(":ID", 1234);

            var numRows = await deleteCommand.ExecuteNonQueryAsync();

            Console.WriteLine($"{numRows} record(s) deleted successfully");

            await conn.CloseAsync();
        }
        catch (Exception
exp)
        {
            Console.WriteLine($"An error occured:
{exp}");
        }
    }
}
```

```
using
System;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;

namespace DeletingRecords
{
    internal static class Program
    {
        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
            try
            {
                using (var dataSource = EDBDataSource.Create(connectionString))
                using (var conn = await dataSource.OpenConnectionAsync())
                {
                    using (var deleteCommand = new EDBCommand("DELETE FROM emp WHERE empno = :ID",
conn))
                    {
                        deleteCommand.Parameters.AddWithValue(":ID", 1234);

                        var numRows = await deleteCommand.ExecuteNonQueryAsync();

                        Console.WriteLine($"{numRows} record(s) deleted successfully");
                    }
                    await conn.CloseAsync();
                }
            }
            catch (Exception
exp)
            {
                Console.WriteLine($"An error occured:
{exp}");
            }
        }
    }
}
```

This program should show the following output in the Console:

```
1 record(s) deleted successfully
```

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 an improvement in performance by using stored procedures. A stored procedure needs to be parsed, compiled, and optimized only once on the server side. A SQL statement that's included in an application might be parsed, compiled, and optimized each time it's executed from a .NET application.

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

1. Create an SPL stored procedure on the EDB Postgres Advanced Server host.
2. Import the `EnterpriseDB.EDBClient` namespace.
3. Pass the name of the stored procedure to the instance of the `EDBCommand`.
4. Change the `EDBCommand.CommandType` to `CommandType.StoredProcedure`.
5. `Prepare()` the command.
6. Execute the command.

Example: Executing a stored procedure without parameters

This 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 EDB Postgres 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 EDB Postgres Advanced Server validates the stored procedure, it echoes `CREATE PROCEDURE`.

Using the EDBCommand object to execute a stored procedure

The `CommandType` property of the `EDBCommand` object indicates 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.

This example :

- Creates an `EDBDataSource` and issues an opened `EDBConnection`.
- Registers a handler (a local function) to connection's `Notice` event, thus listening to server side notices, raised by `DBMS_OUTPUT.PUT_LINE`. The handler will display the notice text to the Console.
- Unregisters the handler to free up the connection.

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

namespace
UsingSPLStoredProcedures_Basics;

internal static class Program
{
    static async Task Main(string[] args)
    {
        // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
        var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
        await using var dataSource = EDBDataSource.Create(connectionString);
        await using var conn = await dataSource.OpenConnectionAsync();

        // register event
handler
        conn.Notice += Connection_Notice;

        await using var storedProcCommand = new EDBCommand("list_dept10", conn);
        storedProcCommand.CommandType =
CommandType.StoredProcedure;
        await storedProcCommand.PrepareAsync();
        await storedProcCommand.ExecuteNonQueryAsync();

        Console.WriteLine("Stored Procedure executed
successfully.");

        // unregister event handler
        conn.Notice -= Connection_Notice;

        await conn.CloseAsync();

        // Handles notices from server (eg: output messages, errors and
warnings)
        void Connection_Notice(object sender, EDBNoticeEventArgs e)
            => Console.WriteLine($"Notice received: {e.Notice.MessageText}");
    }
}
```

```
using
System;
using
System.Data;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;

namespace
UsingSPLStoredProcedures_Basics
{
    internal static class Program
    {
        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
            using (var dataSource = EDBDataSource.Create(connectionString))
            using (var conn = await dataSource.OpenConnectionAsync())
            {
                // register event
handler
                conn.Notice += Connection_Notice;
                using (var storedProcCommand = new EDBCommand("list_dept10", conn))
                {
                    storedProcCommand.CommandType =
CommandType.StoredProcedure;

                    await storedProcCommand.PrepareAsync();
                    await storedProcCommand.ExecuteNonQueryAsync();

                    Console.WriteLine("Stored Procedure executed
successfully.");
                }

                // unregister event handler
                conn.Notice -= Connection_Notice;

                await conn.CloseAsync();
            }

            // Handles notices from server (eg: output messages, errors and
warnings)
            void Connection_Notice(object sender, EDBNoticeEventArgs e)
                => Console.WriteLine($"Notice received: {e.Notice.MessageText}");
        }
    }
}
```

This program should display the following result in the Console:

```
Notice received: Dept No: 10
Notice received: Dept Name: ACCOUNTING
Stored Procedure executed successfully.
```

Example: Executing a stored procedure with IN parameters

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

```
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 EDB Postgres Advanced Server validates the stored procedure, it echoes `CREATE PROCEDURE`.

Passing input values to a stored procedure

In the example below, the body of the `Main` 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 `AddWithValue` method of the `EDBCommand`'s parameter collection to add six input parameters. 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. Note that the `Prepare()` method is mandatory for SPL procedures.

The `ExecuteNonQuery()` method of the `EDBCommand` object executes the stored procedure.

```
using
System.Data;
using
EDBTypes;
using EnterpriseDB.EDBClient;

namespace
UsingSPLStoredProcedures_INParameters;
```

```
internal static class Program
{
    static async Task Main(string[] args)
    {
        // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
        var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

        var empName = "EDB";
        var empJob =
"Manager";
        var salary =
1000.0;
        var commission = 0.0;
        var deptno =
20;
        var manager = 7839;

        try
        {
            await using var dataSource = EDBDataSource.Create(connectionString);
            await using var conn = await dataSource.OpenConnectionAsync();
            await using var cmdStoredProc = new
EDBCommand("EMP_INSERT(:EmpName,:Job,:Salary,:Commission,:DeptNo,:Manager)", conn);
            cmdStoredProc.CommandType =
CommandType.StoredProcedure;

            // AddWithValue allows to create parameter, specify its type and value,
            // and add it to the command's parameter collection at
once
            cmdStoredProc.Parameters.AddWithValue("EmpName", EDBDbType.Varchar, empName);
            cmdStoredProc.Parameters.AddWithValue("Job", EDBDbType.Varchar,
empJob);
            cmdStoredProc.Parameters.AddWithValue("Salary", EDBDbType.Real,
salary);
            cmdStoredProc.Parameters.AddWithValue("Commission", EDBDbType.Real, commission);
            cmdStoredProc.Parameters.AddWithValue("DeptNo", EDBDbType.Integer,
deptno);
            cmdStoredProc.Parameters.AddWithValue("Manager", EDBDbType.Integer, manager);

            await cmdStoredProc.PrepareAsync();
            await cmdStoredProc.ExecuteNonQueryAsync();

            Console.WriteLine($"""
                Following information inserted
successfully:
                Employee Name:
{empName}
                Job:
{empJob}
                Salary:
{salary}
                Commission: {commission}
                Manager: {manager}
                """);

            await conn.CloseAsync();

        }
        catch (Exception
exp)
        {
            Console.WriteLine($"An error occured:
{exp}");
        }
    }
}
```

```
using
System;
using
System.Data;
using
System.Threading.Tasks;
using
EDBTypes;
using EnterpriseDB.EDBClient;

namespace
UsingSPLStoredProcedures_INParameters
{
    internal static class Program
    {
        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            var empName = "EDB";
            var empJob =
"Manager";
            var salary =
1000.0;
            var commission = 0.0;
            var deptno =
20;
            var manager = 7839;

            try
            {
                using (var dataSource = EDBDataSource.Create(connectionString))
                using (var conn = await dataSource.OpenConnectionAsync())
                {
                    using (var cmdStoredProc = new
EDBCommand("EMP_INSERT(:EmpName,:Job,:Salary,:Commission,:DeptNo,:Manager)", conn))
                    {

                        cmdStoredProc.CommandType =
CommandType.StoredProcedure;

                        // AddWithValue allows to create parameter, specify its type and value,
                        // and add it to the command's parameter collection at
once
                        cmdStoredProc.Parameters.AddWithValue("EmpName", EDBDbType.Varchar, empName);
                        cmdStoredProc.Parameters.AddWithValue("Job", EDBDbType.Varchar,
empJob);
                        cmdStoredProc.Parameters.AddWithValue("Salary", EDBDbType.Real,
salary);
                        cmdStoredProc.Parameters.AddWithValue("Commission", EDBDbType.Real, commission);
                        cmdStoredProc.Parameters.AddWithValue("DeptNo", EDBDbType.Integer,
deptno);
                        cmdStoredProc.Parameters.AddWithValue("Manager", EDBDbType.Integer, manager);

                        await cmdStoredProc.PrepareAsync();
                        await cmdStoredProc.ExecuteNonQueryAsync();

                        Console.WriteLine("Following information inserted
successfully:");
                        Console.WriteLine($"Employee Name: {empName}");
                        Console.WriteLine($"Job: {empJob}");
                        Console.WriteLine($"Salary: {salary}");
                        Console.WriteLine($"Commission: {commission}");
                        Console.WriteLine($"Manager: {manager}");

                    }
                    await conn.CloseAsync();
                }
            }
            catch (Exception
exp)
            {
                Console.WriteLine($"An error occured:
{exp}");
            }
        }
    }
}
```

After the stored procedure executes, a test record is inserted into the `emp` table, and the values inserted are displayed in the Console:

```
Following information inserted successfully:
Employee Name: EDB
Job: Manager
Salary: 1000
Commission: 0
Manager: 7839
```

Example: Executing a stored procedure with IN, OUT, and INOUT parameters

The previous example showed how to pass `IN` parameters to a stored procedure. The following examples show 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, invoke EDB-PSQL and connect to the EDB Postgres Advanced Server host database. Enter the following SPL code at the command line:

```
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 EDB Postgres Advanced Server validates the stored procedure, it echoes `CREATE PROCEDURE`.

Receiving output values from a stored procedure

When retrieving values from `INOUT` or `OUT` parameters, you must explicitly specify the direction of those parameters respectively as `ParameterDirection.InputOutput` and `ParameterDirection.Output`. You can retrieve the values from these parameters in two ways:

Call the `ExecuteReader` method of the `EDBCommand` and explicitly loop through the returned `EDBDataReader`. The reader will contain one row where columns reflect `INOUT` or `OUT` parameters returned. Note that this behavior is legacy and should no longer be used.

Call the `ExecuteNonQuery` method of `EDBCommand` and explicitly get the value of a declared `INOUT` or `OUT` parameter by calling EDBParameter.Value property.

In each method, you must declare each parameter, indicating the direction of the parameter (`ParameterDirection.Input`, `ParameterDirection.Output`, or `ParameterDirection.InputOutput`). Values are mandatory for `IN` and `INOUT` parameters, and does not need to be provided for `OUT` parameters.

After the procedure returns, you can retrieve the `OUT` and `INOUT` parameter values from the `command.Parameters[]` array, or from the `EDBParameter` itself if you have backed its instance.

This code shows using the `ExecuteReader` method to retrieve a result set:

```
using
System.Data;
using
EDBTypes;
```

```
using EnterpriseDB.EDBClient;

namespace UsingSPLStoredProcedures_INOUTParameters;

internal static class Program
{
    static async Task Main(string[] args)
    {
        // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
        var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

        try
        {
            await using var dataSource = EDBDataSource.Create(connectionString);
            await using var conn = await dataSource.OpenConnectionAsync();
            await using var command = new EDBCommand("DEPT_SELECT (:pDEPTNO,:pDNAME,:pLOC)", conn);

            command.CommandType =
CommandType.StoredProcedure;

            var depNoParam = command.Parameters.Add(new EDBParameter("pDEPTNO", EDBDbType.Integer) {
Direction = ParameterDirection.Input });

            var nameParam = command.Parameters.Add(new EDBParameter("pDNAME", EDBDbType.Varchar) {
Direction = ParameterDirection.Output });
            var locParam = command.Parameters.Add(new EDBParameter("pLOC", EDBDbType.Varchar) { Direction
= ParameterDirection.Output });

            await command.PrepareAsync();

            // set input parameter value before
executing
            // out parameters don't need a value to be
set
            depNoParam.Value = 10;

            await using var reader = await
command.ExecuteReaderAsync();

            // Getting OUT parameters values in the first
row
            Console.WriteLine("Retrieve OUT parameters values in the first returned
row.");
            // only one row is returned, no need for a while
loop
            if (await
reader.ReadAsync())
            {
                for (var i = 0; i < reader.FieldCount;
i++)
                {
                    Console.WriteLine($"reader[{i}]={Convert.ToString(reader[i])}");
                }
            }
            await
reader.CloseAsync();

            // Getting OUT parameters values
directly
            // EDBCommand.ExecuteNonQuery() would also work here
            Console.WriteLine("Retrieve OUT parameters values
directly.");
```

```
            Console.WriteLine($"{nameof(nameParam)}={nameParam.Value}");
            Console.WriteLine($"{nameof(locParam)}={locParam.Value}");

            await conn.CloseAsync();
        }
        catch (Exception
exp)
        {
            Console.WriteLine($"An error occured:
{exp}");
        }
    }
}
```

```
using
System;
using
System.Data;
using
System.Threading.Tasks;
using
EDBTypes;
using EnterpriseDB.EDBClient;

namespace UsingSPLStoredProcedures_INOUTParameters
{
    internal static class Program
    {
        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            try
            {
                using (var dataSource = EDBDataSource.Create(connectionString))
                using (var conn = await dataSource.OpenConnectionAsync())
                {
                    using (var command = new EDBCommand("DEPT_SELECT (:pDEPTNO,:pDNAME,:pLOC)", conn))
                    {
                        command.CommandType =
CommandType.StoredProcedure;

                        var depNoParam = command.Parameters.Add(new EDBParameter("pDEPTNO",
EDBDbType.Integer) { Direction = ParameterDirection.Input });

                        var nameParam = command.Parameters.Add(new EDBParameter("pDNAME",
EDBDbType.Varchar) { Direction = ParameterDirection.Output });
                        var locParam = command.Parameters.Add(new EDBParameter("pLOC", EDBDbType.Varchar)
{ Direction = ParameterDirection.Output });

                        await command.PrepareAsync();

                        // set input parameter value before
executing
                        // out parameters don't need a value to be
set
                        depNoParam.Value = 10;

                        // Getting OUT parameters values in the first
row
```

```
                        Console.WriteLine("Retrieve OUT parameters values in the first returned
row.");
                        using (var reader = await
command.ExecuteReaderAsync())
                        {
                            // only one row is returned, no need for a while
loop
                            if (await
reader.ReadAsync())
                            {
                                for (var i = 0; i < reader.FieldCount;
i++)
                                {
                                    Console.WriteLine($"reader[{i}]={Convert.ToString(reader[i])}");
                                }
                            }
                            await
reader.CloseAsync();
                        }

                        // Getting OUT parameters values
directly
                        // EDBCommand.ExecuteNonQuery() would also work here
                        Console.WriteLine("Retrieve OUT parameters values
directly.");
                        Console.WriteLine($"{nameof(nameParam)}={nameParam.Value}");
                        Console.WriteLine($"{nameof(locParam)}={locParam.Value}");

                    }
                    await conn.CloseAsync();
                }
            }
            catch (Exception
exp)
            {
                Console.WriteLine($"An error occured:
{exp}");
            }
        }
    }
}
```

This program should display the following result in the Console:

```
Retrieve OUT parameters values in the first returned row.
reader[0]=ACCOUNTING
reader[1]=NEW YORK
Retrieve OUT parameters values directly.
pDNAME=ACCOUNTING
pLOC=NEW YORK
```

Note

The preferred method (less error-prone) to retrieve `OUT` parameter values is by using `EDBCommand.ExecuteNonQuery()`. In that case, `EDBParameter.Value` will hold the output value and can be accessed directly without going through a data row. This is the preferred method, less error-prone, as the value is held by the parameter itself.

```
// Assign OUT parameters to local
variables
var deptNameParam = command.Parameters.Add(new EDBParameter("pDNAME", EDBDbType.Varchar) {
Direction = ParameterDirection.Output });
var locParam = command.Parameters.Add(new EDBParameter("pLOC", EDBDbType.Varchar) { Direction =
ParameterDirection.Output });

// Prepare, ExecuteNonQuery
await command.PrepareAsync();
await command.ExecuteNonQueryAsync();

// Parameter values are fed!
Console.WriteLine($"pDNAME={deptNameParam.Value}");
Console.WriteLine($"pLOC={locParam.Value}");
```

12 Using advanced queueing

EDB Postgres Advanced Server advanced queueing provides message queueing and message processing for the EDB Postgres Advanced Server database. User-defined messages are stored in a queue. A collection of queues is stored in a queue table. Create a queue table before creating a queue that depends 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 messages to or remove messages from a queue or register or unregister a PL/SQL callback procedure. For more information about `DBMS_AQ` and `DBMS_AQADM`, see DBMS_AQ.

On the client side, the application uses the EDB .NET Connector driver to enqueue and dequeue messages.

Enqueueing or dequeueing a message

For more information about using EDB Postgres Advanced Server's advanced queueing functionality, seeBuilt-in packages.

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 EDB Postgres Advanced Server host database. Use the following SPL commands at the command line.

Creating a user-defined type

To specify a RAW data type, create a user-defined type. This example shows creating a user-defined type named `myxml`:

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

Creating the queue table

A queue table can hold multiple queues with the same payload type. This example shows creating a table named `MSG_QUEUE_TABLE`:

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

Creating the queue

This example shows creating a queue named `MSG_QUEUE` in the table `MSG_QUEUE_TABLE`:

```
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:

```
BEGIN
DBMS_AQADM.START_QUEUE
(queue_name => 'MSG_QUEUE');
END;
```

Client-side example

Once you've created a user-defined type, the queue table, and the 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 an `EDBAQMessage` message set its payload.
4. Call the `EDBAQQueue.Enqueue` method.
5. The `EDBAQMessage.MessageID` property will be populated with a string uniquely identifying your message.

The following code shows how to use `EDBAQQueue.Enqueue` method. A custom message payload is created and then enqueued.

> **Note**
>
> As an example, we are using the ambient Connection via `EDBAQQueue.Connection` to begin a transaction, so that if anything goes wrong the queue won't be polluted.

```
using EnterpriseDB.EDBClient;

namespace EnterpriseDB;

internal static class Program
{
    // Sample message
payload
    class MyXML
    {
        public string Value { get; set; }
    }

    public static async Task Main(string[] args)
    {
        // not for production, move connection string to app
settings
```

```
        string connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

        // Note registration of MyXml type
        var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);
        dataSourceBuilder
            .MapComposite<MyXML>("enterprisedb.myxml");

        await using var dataSource = dataSourceBuilder.Build();
        await using var connection = await dataSource.OpenConnectionAsync();
        using var queue = CreateQueue("MSG_QUEUE", connection);

        // Enqueue 5
messages
        int messagesToSend =
5;
        for (int i = 0; i < messagesToSend;
i++)
        {
            var payload = new MyXML()
            {
                Value = $"(<Message><MessageText>Test message: {i}</MessageText>
</Message>)"
            };

            if (TryEnqueueMessage(queue, payload, out var
_))
            {
                // MessageId is populated with a unique
identifier
                Console.WriteLine($"Message {i} ({message.MessageId})
enqueued");
            }
            else
            {
                Console.WriteLine($"Message {i} enqueue
failed");
            }
        }

    }

    // Creates and returns a queue ready for use in our
sample
    private static EDBAQQueue CreateQueue(string queueName, EDBConnection connection)
    {
        var queue = new EDBAQQueue(queueName, connection);
        queue.MessageType =
EDBAQMessageType.Udt;
        queue.EnqueueOptions.Visibility = EDBAQVisibility.ON_COMMIT;
        queue.UdtTypeName = "myxml";

        return queue;
    }

    // Enqueues the
payload
    // If the enqueuing was successfull, message variable receives the queue message and the function
returns true
    // otherwise message is null and the function returns
false
    private static bool TryEnqueueMessage<T>(EDBAQQueue queue, T payload, out EDBAQMessage
message)
```

```
    {
        using EDBTransaction transaction =
queue.Connection.BeginTransaction();

        try
        {
            message = new EDBAQMessage() { Payload = payload };
            queue.Enqueue(message);

transaction.Commit();

            return true;
        }
        catch (Exception ex)
        {
            Console.WriteLine($"Error while enqueing message:
{ex.Message}");

transaction?.Rollback();

            message = null;
            return false;
        }
    }
}
```

```
using
System;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;

namespace EnterpriseDB
{
    internal static class Program
    {
        // Sample message
payload
        class MyXML
        {
            public string Value { get; set; }
        }

        public static async Task Main(string[] args)
        {
            // not for production, move connection string to app
settings
            string connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            // Note registration of MyXml type
            var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);
            dataSourceBuilder
                .MapComposite<MyXML>("enterprisedb.myxml");

            using (var dataSource = dataSourceBuilder.Build())
            using (var connection = await dataSource.OpenConnectionAsync())
            using (var queue = CreateQueue("MSG_QUEUE", connection))
            {
                // Enqueue 5
messages
```

```
                int messagesToSend =
5;
                for (int i = 0; i < messagesToSend;
i++)
                {
                    var payload = new MyXML()
                    {
                        Value = $"(<Message><MessageText>Test message: {i}</MessageText>
</Message>)"
                    };

                    if (TryEnqueueMessage(queue, payload, out var
_))
                    {
                        // MessageId is populated with a unique
identifier
                        Console.WriteLine($"Message {i} ({message.MessageId})
enqueued");
                    }
                    else
                    {
                        Console.WriteLine($"Message {i} enqueue
failed");
                    }
                }
            }
        }

        // Creates and returns a queue ready for use in our
sample
        private static EDBAQQueue CreateQueue(string queueName, EDBConnection connection)
        {
            var queue = new EDBAQQueue(queueName, connection);
            queue.MessageType =
EDBAQMessageType.Udt;
            queue.EnqueueOptions.Visibility = EDBAQVisibility.ON_COMMIT;
            queue.UdtTypeName = "myxml";

            return queue;
        }

        // Enqueues the
payload
        // If the enqueuing was successfull, message variable receives the queue message and the
function returns true
        // otherwise message is null and the function returns
false
        private static bool TryEnqueueMessage<T>(EDBAQQueue queue, T payload, out EDBAQMessage
message)
        {
            using (EDBTransaction transaction =
queue.Connection.BeginTransaction())
            {
                try
                {
                    message = new EDBAQMessage() { Payload = payload };
                    queue.Enqueue(message);

transaction.Commit();

                    return true;
                }
                catch (Exception ex)
                {
                    Console.WriteLine($"Error while enqueing message:
{ex.Message}");

transaction?.Rollback();

                    message = null;
                    return false;
                }
            }
        }
    }
}
```

Dequeue a message

To dequeue 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. Call the `EDBAQQueue.Dequeue()` method.

> **Note**
>
> The following code shows how to use the `EDBAQQueue.Dequeue` method. A queue is retrieved by its name, and a attempt is made to dequeue a message.
>
> If a `PostgresException` with `SqlState` set to `P0002` is raised, then the queue is empty or the wait time (set with `queue.DequeueOptions.Wait`) has expired, and the code gracefully returns a `null` message.

```
using EnterpriseDB.EDBClient;

namespace EnterpriseDB;
internal static class Program
{
    // Sample message
payload
    class MyXML
    {
        public string Value { get; set; }
    }

    public static async Task Main(string[] args)
    {
        // not for production, move connection string to app
settings
        string connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

        // Note registration of MyXml type
        var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);
        dataSourceBuilder
            .MapComposite<MyXML>("enterprisedb.myxml");

        await using var dataSource = dataSourceBuilder.Build();
        await using var connection = await dataSource.OpenConnectionAsync();
        using var queue = CreateQueue("MSG_QUEUE", connection);
        // Dequeue 5
messages
        int messagesToDequeue = 5;
        for (int i = 0; i < messagesToDequeue;
i++)
        {
            if (TryDequeueMessage(queue, out var message))
            {
                Console.WriteLine($"Message {message.MessageId}
dequeued");

                if (message?.Payload is MyXML myXML)
                {
                    Console.WriteLine($"MyXML Message received:
{myXML.Value}");
                }
                else
                {
                    Console.WriteLine($"Other message received");
                }
            }
            else
            {
                Console.WriteLine($"No
message");
            }
        }
    }

    // Creates and returns a queue ready for use in our
sample
    private static EDBAQQueue CreateQueue(string queueName, EDBConnection connection)
    {
        var queue = new EDBAQQueue(queueName, connection);
        queue.MessageType =
EDBAQMessageType.Udt;
        queue.DequeueOptions.Navigation =
EDBAQNavigationMode.FIRST_MESSAGE;
        queue.DequeueOptions.Visibility = EDBAQVisibility.ON_COMMIT;
        queue.DequeueOptions.Wait = 1; // wait for 1
seconds
        queue.UdtTypeName = "myxml";

        return queue;
    }

    // Dequeues a
payload
    // If the dequeuing was successfull, message variable receives the queue message and the function
returns true
    // otherwise message is null and the function returns
false
    private static bool TryDequeueMessage(EDBAQQueue queue, out EDBAQMessage message)
    {
        using EDBTransaction transaction =
queue.Connection.BeginTransaction();

        try
        {
            message = queue.Dequeue();

transaction.Commit();
```

```
            return true;
        }
        catch (PostgresException pgException) when (pgException.SqlState ==
"P0002")
        {
            // Queue empty or time
out

transaction.Commit();

            message = null;
            return false;
        }
        catch (Exception ex)
        {
            Console.WriteLine($"Error while dequeuing message:
{ex.Message}");

transaction?.Rollback();

            message = null;
            return false;
        }
    }
}
```

```
using
System;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;

namespace EnterpriseDB
{
    internal static class Program
    {
        // Sample message
payload
        class MyXML
        {
            public string Value { get; set; }
        }

        public static async Task Main(string[] args)
        {
            // not for production, move connection string to app
settings
            string connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            // Note registration of MyXml type
            var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);
            dataSourceBuilder
                .MapComposite<MyXML>("enterprisedb.myxml");

            using (var dataSource = dataSourceBuilder.Build())
            using (var connection = await dataSource.OpenConnectionAsync())
            using (var queue = CreateQueue("MSG_QUEUE", connection))
            {
                // Dequeue 5
messages
                int messagesToDequeue = 5;
                for (int i = 0; i < messagesToDequeue;
i++)
                {
                    if (TryDequeueMessage(queue, out var message))
                    {
                        Console.WriteLine($"Message {message.MessageId}
dequeued");

                        if (message?.Payload is MyXML myXML)
                        {
                            Console.WriteLine($"MyXML Message received:
{myXML.Value}");
                        }
                        else
                        {
                            Console.WriteLine($"Other message received");
                        }
                    }
                    else
                    {
                        Console.WriteLine($"No
message");
                    }
                }
            }
        }

        // Creates and returns a queue ready for use in our
sample
        private static EDBAQQueue CreateQueue(string queueName, EDBConnection connection)
        {
            var queue = new EDBAQQueue(queueName, connection);
            queue.MessageType =
EDBAQMessageType.Udt;
            queue.DequeueOptions.Navigation =
EDBAQNavigationMode.FIRST_MESSAGE;
            queue.DequeueOptions.Visibility = EDBAQVisibility.ON_COMMIT;
            queue.DequeueOptions.Wait = 1; // wait for 1
seconds
            queue.UdtTypeName = "myxml";

            return queue;
        }

        // Dequeues a
payload
        // If the dequeuing was successfull, message variable receives the queue message and the
function returns true
        // otherwise message is null and the function returns
false
        private static bool TryDequeueMessage(EDBAQQueue queue, out EDBAQMessage message)
        {
            using (EDBTransaction transaction =
queue.Connection.BeginTransaction())
            {
                try
                {
                    message = queue.Dequeue();

transaction.Commit();

                    return true;
                }
                catch (PostgresException pgException) when (pgException.SqlState ==
"P0002")
                {
                    // Queue empty or time
out

transaction.Commit();

                    message = null;
                    return false;
                }
                catch (Exception ex)
                {
                    Console.WriteLine($"Error while dequeuing message:
{ex.Message}");

transaction?.Rollback();

                    message = null;
                    return false;
                }
            }
        }
    }
}
```

EDBAQ classes

The following EDBAQ classes are used in this application.

EDBAQDequeueMode

The `EDBAQDequeueMode` class lists all the dequeuer modes available.

Value	Description
Browse	Reads the message without locking.
Locked	Reads and gets a write lock on the message.
Remove	Deletes the message after reading. This is the default value.
Remove_NoData	Confirms receipt of the message.

EDBAQDequeueOptions

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

Property	Description
ConsumerName	The name of the consumer for which to dequeue the message.
DequeueMode	Set from `EDBAQDequeueMode` . It represents the locking behavior linked with the dequeue option.
Navigation	Set from `EDBAQNavigationMode` . It represents the position of the message to fetch.
Visibility	Set from `EDBAQVisibility` . It represents whether the new message is dequeued as part of the current transaction.

Property	Description
Wait	The wait time for a message as per the search criteria.
Msgid	The message identifier.
Correlation	The correlation identifier.
DeqCondition	The dequeuer condition. It's a Boolean expression.
Transformation	The transformation to apply before dequeuing the message.
DeliveryMode	The delivery mode of the dequeued message.

EDBAQEnqueueOptions

The `EDBAQEnqueueOptions` class lists the options available when enqueuing a message.

Property	Description
Visibility	Set from `EDBAQVisibility`. It represents whether the new message is enqueued as part of the current transaction.
RelativeMsgid	The relative message identifier.
SequenceDeviation	The sequence when to dequeue the message.
Transformation	The transformation to apply before enqueuing the message.
DeliveryMode	The delivery mode of the enqueued message.

EDBAQMessage

The `EDBAQMessage` class lists a message to enqueue/dequeue.

Property	Description
Payload	The actual message to queue.
MessageId	The ID of the queued message.

EDBAQMessageProperties

The `EDBAQMessageProperties` lists the message properties available.

Property	Description
Priority	The priority of the message.
Delay	The duration after which the message is available for dequeuing, in seconds.
Expiration	The duration for which the message is available for dequeuing, in seconds.
Correlation	The correlation identifier.
Attempts	The number of attempts taken to dequeue the message.
RecipientList	The recipients list that overthrows the default queue subscribers.
ExceptionQueue	The name of the queue to move the unprocessed messages to.
EnqueueTime	The time when the message was enqueued.
State	The state of the message while dequeued.
OriginalMsgid	The message identifier in the last queue.

Property	Description
TransactionGroup	The transaction group for the dequeued messages.
DeliveryMode	The delivery mode of the dequeued message.

EDBAQMessageState

The `EDBAQMessageState` class represents the state of the message during dequeue.

Value	Description
Expired	The message is moved to the exception queue.
Processed	The message is processed and kept.
Ready	The message is ready to be processed.
Waiting	The message is in waiting state. The delay isn't reached.

EDBAQMessageType

The `EDBAQMessageType` class represents the types for payload.

Value	Description
Raw	The raw message type. Note: Currently, this payload type isn't supported.
UDT	The user-defined type message.
XML	The XML type message. Note: Currently, this payload type isn't supported.

EDBAQNavigationMode

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

Value	Description
First_Message	Returns the first available message that matches the search terms.
Next_Message	Returns the next available message that matches the search items.
Next_Transaction	Returns the first message of next transaction group.

EDBAQQueue

The `EDBAQQueue` class represents a SQL statement to execute `DMBS_AQ` functionality on a PostgreSQL database.

Property	Description
Connection	The connection to use.
Name	The name of the queue.

Property	Description
MessageType	The message type that's enqueued/dequeued from this queue, for example `EDBAQMessageType.Udt` .
UdtTypeName	The user-defined type name of the message type.
EnqueueOptions	The enqueue options to use.
DequeuOptions	The dequeue options to use.
MessageProperties	The message properties to use.

EDBAQVisibility

The `EDBAQVisibility` class represents the visibility options available.

Value	Description
Immediate	The enqueue/dequeue isn't part of the ongoing transaction.
On_Commit	The enqueue/dequeue is part of the current transaction.

Note

- To review the default options for these parameters, see DBMS_AQ.
- EDB advanced queueing functionality uses user-defined types for calling enqueue/dequeue operations. `Server Compatibility Mode=NoTypeLoading` can't be used with advanced queueing because `NoTypeLoading` doesn't load any user-defined types.

13 Using a ref cursor in a .NET application

A `ref cursor` is a cursor variable that contains a pointer to a query result set. The result set is determined by executing the `OPEN FOR` statement using the cursor variable. A cursor variable isn't tied to a particular query like a static cursor. You can open the same cursor variable a number of times with the `OPEN FOR` statement containing different queries each time. A new result set is created for that query and made available by way of the cursor variable. You can declare a cursor variable in two ways:

- 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:

```
 name
SYS_REFCURSOR;
```

Following is an example of a strongly typed ref cursor:

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

Creating the stored procedure

This sample code creates a stored procedure called `refcur_inout_callee`. It specifies the data type of the ref cursor being passed as an OUT parameter. To create the sample procedure, invoke EDB-PSQL and connect to the EDB Postgres Advanced Server host database. Enter the following SPL code at the command line:

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

This C# code uses the stored procedure to retrieve employee names from the `emp` table.

> **Note**
>
> Ref cursors live only within the current scope of the caller/callee. The sample below creates an ambient transaction to leave the cursor variable alive and ready to fetch.

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

namespace
UsingRefCursor
{
    internal static class Program
    {
        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
            try
            {
                await using var dataSource = EDBDataSource.Create(connectionString);
                await using var connection = await dataSource.OpenConnectionAsync();
                await using var tran = await connection.BeginTransactionAsync();
                await using var command = new EDBCommand("refcur_inout_callee", connection);

                command.CommandType =
CommandType.StoredProcedure;
                command.Transaction = tran;

                var refCursorParam = command.Parameters.Add(new EDBParameter("refCursor",
EDBTypes.EDBDbType.Refcursor));
                refCursorParam.Direction =
ParameterDirection.Output;

                await command.PrepareAsync();
                await command.ExecuteNonQueryAsync();

                if (refCursorParam.Value is null)
                {
                    Console.WriteLine("Error: Ref cursor is
null!");
                    return;
                }
                var cursorName =
refCursorParam.Value.ToString();
                command.CommandText = "fetch all in \"" + cursorName +
"\"";
                command.CommandType =
CommandType.Text;

                await using (var reader = await
command.ExecuteReaderAsync())
                {
                    var fc =
reader.FieldCount;
                    while (await
reader.ReadAsync())
                    {
                        for (int i = 0; i < fc;
i++)
                        {
                            Console.WriteLine($"{reader.GetName(i)} =
{reader.GetString(i)}");
                        }
                    }
                    await
reader.CloseAsync();
                }

                await tran.CommitAsync();
                await connection.CloseAsync();

            }
            catch (Exception
exp)
            {
                Console.WriteLine($"An error occured:
{exp}");
```

```
            }
        }
    }
}
```

```
using
System;
using
System.Data;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;

namespace
UsingRefCursor
{
    internal static class Program
    {
        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
            try
            {
                using (var dataSource = EDBDataSource.Create(connectionString))
                using (var connection = await dataSource.OpenConnectionAsync())
                using (var tran = connection.BeginTransaction())
                {
                    using (var command = new EDBCommand("refcur_inout_callee", connection))
                    {
                        command.CommandType =
CommandType.StoredProcedure;
                        command.Transaction = tran;

                        var refCursorParam = command.Parameters.Add(new EDBParameter("refCursor",
EDBTypes.EDBDbType.Refcursor));
                        refCursorParam.Direction =
ParameterDirection.Output;

                        await command.PrepareAsync();
                        await command.ExecuteNonQueryAsync();

                        if (refCursorParam.Value is null)
                        {
                            Console.WriteLine("Error: Ref cursor is
null!");
                            return;
                        }

                        var cursorName =
refCursorParam.Value.ToString();
                        command.CommandText = "fetch all in \"" + cursorName +
"\"";
                        command.CommandType =
CommandType.Text;

                        using (var reader = await
command.ExecuteReaderAsync())
                        {
                            var fc =
reader.FieldCount;
```

```
                            while (await
reader.ReadAsync())
                            {
                                for (int i = 0; i < fc;
i++)
                                {
                                    Console.WriteLine($"{reader.GetName(i)} =
{reader.GetString(i)}");
                                }
                            }
                            await
reader.CloseAsync();
                        }
                    }
                    await tran.CommitAsync();
                    await connection.CloseAsync();
                }
            }
            catch (Exception
exp)
            {
                Console.WriteLine($"An error occured:
{exp}");
            }
         }
    }
}
```

This .NET code snippet displays the result on the console:

```
ename = ALLEN
ename = WARD
ename = JONES
ename = MARTIN
ename = BLAKE
ename = CLARK
ename = KING
ename = TURNER
ename = ADAMS
ename = JAMES
ename = FORD
ename = MILLER
ename = EDB
ename = EDB
ename = EDB
ename = EDB
ename = EDB
ename = Mark
ename = SCOTT
```

14 Using plugins

EDB .NET Connector plugins support the enhanced capabilities for different data types that are otherwise not directly available using only the default type mappings. The different plugins available support:

- GeoJSON
- Json.NET
- NetTopologySuite
- NodaTime
- Dependency Injection
- OpenTelemetry

The plugins support the use of spatial, data/time, and JSON types. The following are the supported frameworks and data provider installation path for these plugins.

Note that the plugins are also available on NuGet. See our blog post on Using EDB .NET Connector with NuGet for more information.

GeoJSON

If you're using the GeoJSON plugin on .NET Standard 2.0, the data provider installation paths are:

- `C:\Program Files\edb\dotnet\plugins\GeoJSON\netstandard2.0`
- `C:\Program Files\edb\dotnet\plugins\GeoJSON\net472`
- `C:\Program Files\edb\dotnet\plugins\GeoJSON\net48`
- `C:\Program Files\edb\dotnet\plugins\GeoJSON\net481`

The following shared library files are required:

- `EnterpriseDB.EDBClient.GeoJSON.dll`

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

Json.NET

If you're using the Json.NET plugin on .NET Standard 2.0, the data provider installation paths are:

- `C:\Program Files\edb\dotnet\plugins\Json.NET\netstandard2.0`
- `C:\Program Files\edb\dotnet\plugins\Json.NET\net472`
- `C:\Program Files\edb\dotnet\plugins\Json.NET\net48`
- `C:\Program Files\edb\dotnet\plugins\Json.NET\net481`

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.

OpenTelemetry

> **Note**
>
> OpenTelemetry metrics differ from Npgsql community driver:
>
> - `db.system.name` is set to `edb_postgresql` instead of `postgresql`
> - `db.namespace` is set to `edb-dotnet` instead of `npgsql`
> - All metrics are prefixed with `db.edb_dotnet.` instead of `db.npgsql.`

If you're using the OpenTelemetry plugin on .NET Standard 2.0, the data provider installation paths are:

- `C:\Program Files\edb\dotnet\plugins\OpenTelemetry\netstandard2.0`
- `C:\Program Files\edb\dotnet\plugins\OpenTelemetry\net472`
- `C:\Program Files\edb\dotnet\plugins\OpenTelemetry\net48`
- `C:\Program Files\edb\dotnet\plugins\OpenTelemetry\net481`

The following shared library files are required:

- `EnterpriseDB.EDBClient.OpenTelemetry.dll`

NetTopologySuite

If you're using the NetTopologySuite plugin on .Net Standard 2.0, the data provider installation paths are:

- `C:\Program Files\edb\dotnet\plugins\NetTopologySuite\netstandard2.0`
- `C:\Program Files\edb\dotnet\plugins\NetTopologySuite\net472`
- `C:\Program Files\edb\dotnet\plugins\NetTopologySuite\net48`
- `C:\Program Files\edb\dotnet\plugins\NetTopologySuite\net481`

The following shared library files are required:

- `EnterpriseDB.EDBClient.NetTopologySuite.dll`

For detailed information about using the NetTopologySuite type plugin, see theNpgsql documentation.

NodaTime

If you're using the NodaTime plugin on .Net Standard 2.0, the data provider installation paths are:

- `C:\Program Files\edb\dotnet\plugins\NodaTime\netstandard2.0`
- `C:\Program Files\edb\dotnet\plugins\NodaTime\net472`
- `C:\Program Files\edb\dotnet\plugins\NodaTime\net48`
- `C:\Program Files\edb\dotnet\plugins\NodaTime\net481`

The following shared library files are required:

- `EnterpriseDB.EDBClient.NodaTime.dll`

For detailed information about using the NodaTime plugin, see theNpgsql documentation.

Available plugins on NuGet

See our blog post on Using EDB .NET Connector with NuGet for more information.

EDB NuGet package ID	Description
EnterpriseDB.EDBClient	Core EDB .NET Connector
EnterpriseDB.EDBClient.DependencyInjection	Dependency Injection helpers for EDB .NET Connector (.NET Core only)
EnterpriseDB.EDBClient.EntityFrameworkCore.PostgreSQL	Entity Framework Core driver (.NET Core only)
EnterpriseDB.EDBClient.Json.NET	Json.NET plugin for EDB .NET Connector, allowing transparent serialization/deserialization of JSON objects directly to and from the database.
EnterpriseDB.EDBClient.NodaTime	NodaTime plugin for EDB .NET Connector, allowing mapping of PostgreSQL date/time types to NodaTime types.
EnterpriseDB.EDBClient.NetTopologySuite	NetTopologySuite plugin for Npgsql, allowing mapping of PostGIS geometry types to NetTopologySuite types.
EnterpriseDB.EDBClient.EntityFrameworkCore.PostgreSQL.NetTopologySuite	NetTopologySuite PostGIS spatial support plugin for PostgreSQL/EDB .NET Connector Entity Framework Core provider. (.NET Core only)
EnterpriseDB.EDBClient.EntityFrameworkCore.PostgreSQL.NodaTime	NodaTime support plugin for PostgreSQL/EDB .NET Connector Entity Framework Core provider. (.NET Core only)

To install one of those plugins packages, simply add a package reference using Visual Studio IDE or using the .NET CLI.

15 Using object types in .NET

The SQL `CREATE TYPE` command creates a user-defined object type, which is stored in the EDB Postgres Advanced Server database. You can then reference these user-defined types in SPL procedures, SPL functions, and .NET programs.

Create the basic object type with the `CREATE TYPE AS OBJECT` command. Optionally, use the `CREATE TYPE BODY` command.

Using an object type

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

```
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. 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:

```
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;
```

This example is a complete .NET program that uses these user-defined object types:

```
using
System.Data;
using
EDBTypes;
using EnterpriseDB.EDBClient;

namespace
UsingObjectTypes;

internal class Program
{
    // The following.NET types are defined to map to the types in EDB Postgres Advanced
Server
    // Note the PgName attribute that allows to choose any name in .NET for the type
attributes
    public class Address
    {
        [PgName("street")]
        public string
Street;
        [PgName("city")]
        public string City;
        [PgName("state")]
        public string State;
        [PgName("zip")]
        public decimal
Zip;
    }
    public class
Employee
    {
        [PgName("empno")]
        public decimal
Number;
        [PgName("ename")]
        public string Name;
        [PgName("addr")]
        public Address Address;
    }

    static async Task Main(string[] args)
    {
        // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
        var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
        var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);

        // MapComposite maps the .NET type to the EDB Postgres Advanced Server
types
        dataSourceBuilder.MapComposite<Address>("enterprisedb.addr_object_type");
        dataSourceBuilder.MapComposite<Employee>("enterprisedb.emp_obj_typ");

        await using var dataSource = dataSourceBuilder.Build();
        try
        {
            await using var connection = await dataSource.OpenConnectionAsync();
            Console.WriteLine("Connection opened
successfully");

            Console.WriteLine("Preparing database...");
            await SetupDatabaseAsync(connection);
            var address = new Address()
            {
                Street = "123 MAIN
STREET",
                City = "EDISON",
                State = "NJ",
                Zip =
8817
            };
            var emp = new
Employee()
            {
                Number =
9001,
                Name = "JONES",
                Address = address
            };
            await using var cmd = new EDBCommand("emp_obj_typ.display_emp",
connection);

            cmd.CommandType =
CommandType.StoredProcedure;

            var empParameter = cmd.Parameters.AddWithValue("emp_obj_typ",
emp);
            empParameter.Direction = ParameterDirection.InputOutput;
            empParameter.DataTypeName = "enterprisedb.emp_obj_typ";

            // Listen to server
notices
            connection.Notice += Connection_Notice;

            await
cmd.PrepareAsync();
            await
cmd.ExecuteNonQueryAsync();

            var empOut = empParameter.Value as
Employee;
            Console.WriteLine($"Emp No:
{empOut?.Number}");
            Console.WriteLine($"Emp Name: {empOut?.Name}");
            Console.WriteLine($"Emp Address Street:
{empOut?.Address?.Street}");
            Console.WriteLine($"Emp Address City:
{empOut?.Address?.City}");
            Console.WriteLine($"Emp Address State:
{empOut?.Address?.State}");
            Console.WriteLine($"Emp Address Zip: {empOut?.Address?.Zip}");


            await connection.CloseAsync();

            connection.Notice -= Connection_Notice;
        }
        catch (EDBException
exp)
        {
            Console.Write($"Error:
{exp}");
        }
        finally
        {
            Console.WriteLine("Cleaning database...");
            await using var connection = await dataSource.OpenConnectionAsync();
            await CleanDatabaseAsync(connection);
        }

        Console.WriteLine("Press any key to close the
program...");
        Console.ReadKey();
    }

    private static void Connection_Notice(object sender, EDBNoticeEventArgs
e)
    {
        Console.WriteLine($"Server Notice: {e.Notice.MessageText}");
    }

    private async static Task SetupDatabaseAsync(EDBConnection connection)
    {
        await CleanDatabaseAsync(connection);

        string createScript = """
                            CREATE OR REPLACE TYPE addr_object_type AS
OBJECT
                            (
                                street
VARCHAR2(30),
                                city            VARCHAR2(20),
                                state           CHAR(2),
                                zip
NUMBER(5)
                            );
                            """;
        using EDBCommand createCommand = new(createScript, connection);
        await createCommand.ExecuteNonQueryAsync();


        createScript = """
            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)
            );
            """;
        createCommand.CommandText = createScript;
        await createCommand.ExecuteNonQueryAsync();

        createScript = """
            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;
            """;
        createCommand.CommandText = createScript;
        await createCommand.ExecuteNonQueryAsync();

        await connection.ReloadTypesAsync();
    }

    private static async Task CleanDatabaseAsync(EDBConnection connection)
    {
        try
        {
            string dropTypeScript = "DROP TYPE IF EXISTS
emp_obj_typ";
            using EDBCommand dropCommand = new(dropTypeScript,
connection);
            await
dropCommand.ExecuteNonQueryAsync();

        }
        catch (Exception ex)
        {
            Console.WriteLine($"Couldn't clean database :
{ex.Message}");
        }

    }
}
```

```
using
System;
using
System.Data;
using
System.Threading.Tasks;
using
EDBTypes;
using EnterpriseDB.EDBClient;

namespace
UsingObjectTypes
{

    internal class Program
    {
        // The following.NET types are defined to map to the types in EDB Postgres Advanced
Server
        // Note the PgName attribute that allows to choose any name in .NET for the type
attributes
        public class Address
        {
            [PgName("street")]
            public string
Street;
            [PgName("city")]
            public string City;
            [PgName("state")]
            public string State;
            [PgName("zip")]
            public decimal
Zip;
        }
        public class
Employee
        {
            [PgName("empno")]
            public decimal
Number;
            [PgName("ename")]
            public string Name;
            [PgName("addr")]
            public Address Address;
        }

        static async Task Main(string[] args)
        {
            // NOT FOR PRODUCTION, consider moving the connection string in a configuration
file
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";
            var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);

            // MapComposite maps the .NET type to the EDB Postgres Advanced Server
types
            dataSourceBuilder.MapComposite<Address>("enterprisedb.addr_object_type");
            dataSourceBuilder.MapComposite<Employee>("enterprisedb.emp_obj_typ");

            using (var dataSource = dataSourceBuilder.Build())
            {
                try
                {
                    using (var connection = await dataSource.OpenConnectionAsync())
                    {
                        Console.WriteLine("Connection opened
successfully");

                        Console.WriteLine("Preparing database...");
                        await SetupDatabaseAsync(connection);

                        var address = new Address()
                        {
                            Street = "123 MAIN
STREET",

                            City = "EDISON",
                            State = "NJ",
                            Zip =
8817
                        };
                        var emp = new
Employee()

                        {
                            Number =
9001,

                            Name = "JONES",
                            Address = address
                        };
                        using (var cmd = new EDBCommand("emp_obj_typ.display_emp",
connection))
                        {
                            cmd.CommandType =
CommandType.StoredProcedure;

                            var empParameter = cmd.Parameters.AddWithValue("emp_obj_typ",
emp);
                            empParameter.Direction = ParameterDirection.InputOutput;
                            empParameter.DataTypeName = "enterprisedb.emp_obj_typ";

                            // Listen to server
notices
                            connection.Notice += Connection_Notice;

                            await
cmd.PrepareAsync();
                            await
cmd.ExecuteNonQueryAsync();

                            var empOut = empParameter.Value as
Employee;
                            Console.WriteLine($"Emp No:
{empOut?.Number}");
                            Console.WriteLine($"Emp Name: {empOut?.Name}");
                            Console.WriteLine($"Emp Address Street:
{empOut?.Address?.Street}");
                            Console.WriteLine($"Emp Address City:
{empOut?.Address?.City}");
                            Console.WriteLine($"Emp Address State:
{empOut?.Address?.State}");
                            Console.WriteLine($"Emp Address Zip: {empOut?.Address?.Zip}");
                        }

                        await connection.CloseAsync();

                        connection.Notice -= Connection_Notice;
                    }
                }
                catch (EDBException
exp)
                {
                    Console.Write($"Error:
{exp}");
                }
                finally
                {
                    Console.WriteLine("Cleaning database...");
                    using (var connection = await dataSource.OpenConnectionAsync())
                    {
                        await CleanDatabaseAsync(connection);
                    }
                }
            }

            Console.WriteLine("Press any key to close the
program...");
            Console.ReadKey();
        }

        private static void Connection_Notice(object sender, EDBNoticeEventArgs
e)
        {
            Console.WriteLine($"Server Notice: {e.Notice.MessageText}");
        }
        private async static Task SetupDatabaseAsync(EDBConnection connection)
        {
            await CleanDatabaseAsync(connection);

            string createScript = "CREATE OR REPLACE TYPE addr_object_type AS OBJECT
"
                                    +"(
"
                                    +"    street          VARCHAR2(30),
"
                                    +"    city            VARCHAR2(20),
"
                                    +"    state           CHAR(2),
"
                                    +"    zip             NUMBER(5)
"
                                    +");
";
            using (var createCommand = new EDBCommand(createScript, connection))
            {
                await createCommand.ExecuteNonQueryAsync();

                createScript =  "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)
"
                                +");
";
                createCommand.CommandText = createScript;
                await createCommand.ExecuteNonQueryAsync();

                createScript = "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;
";
                createCommand.CommandText = createScript;
                await createCommand.ExecuteNonQueryAsync();
            }
            await connection.ReloadTypesAsync();
        }

        private static async Task CleanDatabaseAsync(EDBConnection connection)
        {
            try
            {
                string dropTypeScript = "DROP TYPE IF EXISTS
emp_obj_typ";
                using (var dropCommand = new EDBCommand(dropTypeScript,
connection))
                {
                    await
dropCommand.ExecuteNonQueryAsync();
                  }
            }
            catch (Exception ex)
            {
                Console.WriteLine($"Couldn't clean database :
{ex.Message}");
            }

        }
    }
}
```

This program should display the following output in the Console:

```
Connection opened successfully
Preparing database...
Server Notice: Employee No   : 9001
Server Notice: Name          : JONES
Server Notice: Street        : 123 MAIN STREET
Server Notice: City/State/Zip: EDISON, NJ 08817
Emp No: 9001
Emp Name: JONES
Emp Address Street: 123 MAIN STREET
Emp Address City: EDISON
Emp Address State: NJ
Emp Address Zip: 8817
Cleaning database...
```

16 Using nested tables

EDB Postgres Advanced Server supports nested table collection types created with `CREATE TYPE ... AS TABLE OF` statements. The EDB .NET Connector supports output parameters declared as nested tables out of the box, whether free-standing types or declared inside packages.

Nested table types mapping

Nested table types are mapped to `List<object>` s in C#, as it is preferred over `ArrayList`. These lists contain as many elements as the nested table type's rows. The nested table items are translated to be compatible with the C# application using the following rules:

- The connector resolves all nested table rows into a `List<object>` in C# while maintaining and converting each column's underlying type. For example, a `[text1, text2, num1]` row will be resolved as a `[string, string, decimal]` item in the list.
- If the nested type `IS TABLE OF` a domain type (int, varchar, decimal, etc.), all the rows will be their C# counterpart according to the Supported Types and their Mappings.
- If the nested type `IS TABLE OF` a record or composite type **not mapped** to a C# class, all rows become a nested List containing as many elements as the record or composite fields, with proper type translation.
- If the nested type `IS TABLE OF` a record or composite type **mapped** to a C# class (for example, `MyComposite`), all rows will be `MyComposite` instances.

Example: Retrieving nested table output parameter

This program:

- Creates a package with a nested `emp_tbl_typ` table type of `emp_rec_typ`. This package has a stored procedure that fills the nested table output parameter.
- Maps the nested table type to a C# class via `MapComposite<>`.
- Executes and displays the results.
- Cleans up the database by dropping the package (and implicitly the nested table type)

> **Note**
>
> Always provide type names in lowercase.

Program example

Create an empty console program and paste the following code.

```
using
System.Data;
using
EDBTypes;
using EnterpriseDB.EDBClient;
```

```
namespace
UsingNestedTableTypes
{
    internal static class Program
    {
        // Composite type, will be mapped to the nested table
type
        // This will work if field types are convertible from database
types
        public class
Employee
        {
            [PgName("empno")]
            public decimal
Number;
            [PgName("ename")]
            public string Name;
        }

        public static async Task Main(string[] args)
        {
            // not for production, move connection string to app
settings
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);
            dataSourceBuilder.MapComposite<Employee>("pkgextendtest.emp_rec_typ");

            await using var dataSource = dataSourceBuilder.Build();
            await using var connection = await dataSource.OpenConnectionAsync();
            try
            {
                await CreatePackageAsync(connection);
                Console.WriteLine("Package
created");

                await using var cstmt = new EDBCommand("pkgExtendTest.nestedTableExtendTest",
connection);
                cstmt.CommandType =
CommandType.StoredProcedure;
                var tableOfParam = cstmt.Parameters.Add(new EDBParameter()
                {
                    Direction = ParameterDirection.Output,
                    DataTypeName = "pkgextendtest.emp_tbl_typ" // nested table is always
lowercase
                });

                await cstmt.PrepareAsync();
                await cstmt.ExecuteNonQueryAsync();

                if (tableOfParam.Value is not List<object>
employees)
                {
                    Console.WriteLine($"No employee
found");
                    return;
                }

                foreach (var employeeRecord in
employees)
                {
                    if (employeeRecord is Employee
employee)
                    {
                        Console.WriteLine($"Employee {employee.Number}:
{employee.Name}");
                    }
                }
            }
            catch (Exception ex)
            {
                Console.WriteLine($"Error: {ex.Message}");
            }
            finally
            {
                await CleanupAsync(connection);
                Console.WriteLine("Package successfully
deleted");
            }
        }

        // helper methods to create package and cleaning up
        static async Task CreatePackageAsync(EDBConnection connection)
        {

            var createPackage = """
                                CREATE OR REPLACE PACKAGE pkgExtendTest
IS
                                    TYPE emp_rec_typ IS RECORD
(
                                        empno  NUMBER(4),
                                        ename  VARCHAR2(10)
                                    );
                                    TYPE emp_tbl_typ IS TABLE OF emp_rec_typ;
                                    PROCEDURE nestedTableExtendTest(emp_tbl OUT
emp_tbl_typ);
                                END
pkgExtendTest;
                                """;
            using (var com = new EDBCommand(createPackage, connection) { CommandType = CommandType.Text
})
            {
                await
com.ExecuteNonQueryAsync();
            }

            var createPackageBody = """
                                CREATE OR REPLACE PACKAGE BODY pkgExtendTest IS
                                    PROCEDURE nestedTableExtendTest(emp_tbl OUT emp_tbl_typ) IS
                                      DECLARE
                                      CURSOR emp_cur IS SELECT empno, ename FROM emp WHERE ROWNUM <= 10
order by empno;
                                      i  INTEGER := 0;
                                    BEGIN
                                       emp_tbl := emp_tbl_typ();
                                       FOR r_emp IN emp_cur LOOP
                                          i := i + 1;
                                          emp_tbl.EXTEND;
                                          emp_tbl(i) := r_emp;
                                       END LOOP;
                                    END nestedTableExtendTest;
                                END pkgExtendTest;
                                """;
            using (var com = new EDBCommand(createPackageBody, connection) { CommandType =
CommandType.Text })
            {
                await
com.ExecuteNonQueryAsync();
            }

            await connection.ReloadTypesAsync();
        }

        static async Task CleanupAsync(EDBConnection connection)
        {
            var dropPackageBody = "DROP PACKAGE BODY
pkgExtendTest";
            var dropPackage = "DROP PACKAGE
pkgExtendTest";

            using (var com = new EDBCommand(dropPackageBody, connection) { CommandType = CommandType.Text
})
            {
                await
com.ExecuteNonQueryAsync();
            }
            using (var com = new EDBCommand(dropPackage, connection) { CommandType = CommandType.Text
})
            {
                await
com.ExecuteNonQueryAsync();
            }
        }
    }
}
```

```
using
System;
using
System.Collections.Generic;
using
System.Data;
using
System.Threading.Tasks;
using
EDBTypes;
using EnterpriseDB.EDBClient;

namespace
UsingNestedTableTypes
{
    internal static class Program
    {
        // Composite type, will be mapped to the nested table
type
        // This will work if field types are convertible from database
types
        public class
Employee
        {
            [PgName("empno")]
            public decimal
Number;
            [PgName("ename")]
            public string Name;
        }
        public static async Task Main(string[] args)
        {
            // not for production, move connection string to app
settings
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);
            dataSourceBuilder.MapComposite<Employee>("pkgextendtest.emp_rec_typ");

            using (var dataSource = dataSourceBuilder.Build())
            using (var connection = await dataSource.OpenConnectionAsync())
            {

                try
                {
                    await CreatePackageAsync(connection);
                    Console.WriteLine("Package
created");

                    using (var cstmt = new EDBCommand("pkgExtendTest.nestedTableExtendTest", connection))
                    {
                        cstmt.CommandType =
CommandType.StoredProcedure;

                        var tableOfParam = cstmt.Parameters.Add(new EDBParameter()
                        {
                            Direction = ParameterDirection.Output,
                            DataTypeName = "pkgextendtest.emp_tbl_typ" // nested table is always
lowercase
                        });

                        await cstmt.PrepareAsync();
                        await cstmt.ExecuteNonQueryAsync();


                        List<object> employees = tableOfParam.Value as List<object>;
                        if (employees == null)
                        {
                            Console.WriteLine($"No employee
found");
                            return;
                        }

                        foreach (var employeeRecord in
employees)
                        {
                            if (employeeRecord is Employee
employee)
                            {
                                Console.WriteLine($"Employee {employee.Number}:
{employee.Name}");
                            }
                        }
                    }
                }
                catch (Exception ex)
                {
                    Console.WriteLine($"Error: {ex.Message}");
                }
                finally
                {
                    await CleanupAsync(connection);
                    Console.WriteLine("Package successfully
deleted");
                }
            }

        }

        // helper methods to create package and cleaning up
        static async Task CreatePackageAsync(EDBConnection connection)
        {

            var createPackage =
    "                 CREATE OR REPLACE PACKAGE pkgExtendTest IS  \n"
+
    "                    TYPE emp_rec_typ IS RECORD (  \n"
+
    "                       empno  NUMBER(4),  \n" +
    "                       ename       VARCHAR2(10)  \n" +
    "                      ); \n" +
    "                    TYPE emp_tbl_typ IS TABLE OF emp_rec_typ;  \n"
+
    "                    PROCEDURE nestedTableExtendTest(emp_tbl OUT emp_tbl_typ); \n"
+
    "                 END pkgExtendTest;
\n";
            using (var com = new EDBCommand(createPackage, connection) { CommandType = CommandType.Text
})
            {
                await
com.ExecuteNonQueryAsync();
            }

            var createPackageBody =
    "                     CREATE OR REPLACE PACKAGE BODY pkgExtendTest IS \n"
+
    "                     PROCEDURE nestedTableExtendTest(emp_tbl OUT emp_tbl_typ) IS \n"
+
    "                       DECLARE  \n" +
    "                       CURSOR emp_cur IS SELECT empno, ename FROM emp WHERE ROWNUM <= 10 order by
empno;  \n" +
    "                       i  INTEGER := 0;  \n"
+
    "                     BEGIN \n" +
    "                        emp_tbl := emp_tbl_typ();  \n"
+
    "                        FOR r_emp IN emp_cur LOOP  \n"
+
    "                           i := i + 1;  \n"
+
    "                           emp_tbl.EXTEND;  \n" +
    "                           emp_tbl(i) := r_emp;  \n"
+
    "                        END LOOP;  \n"
+
    "                     END nestedTableExtendTest; \n"
+
    "                     END pkgExtendTest;
\n";
            using (var com = new EDBCommand(createPackageBody, connection) { CommandType =
CommandType.Text })
            {
                await
com.ExecuteNonQueryAsync();
```

```
            }

            await connection.ReloadTypesAsync();
        }

        static async Task CleanupAsync(EDBConnection connection)
        {
            var dropPackageBody = "DROP PACKAGE BODY
pkgExtendTest";
            var dropPackage = "DROP PACKAGE
pkgExtendTest";

            using (var com = new EDBCommand(dropPackageBody, connection) { CommandType = CommandType.Text
})
            {
                await
com.ExecuteNonQueryAsync();
            }
            using (var com = new EDBCommand(dropPackage, connection) { CommandType = CommandType.Text
})
            {
                await
com.ExecuteNonQueryAsync();
            }
        }
    }
}
```

The output should look like this:

```
Package created
Employee 7499: ALLEN
Employee 7521: WARD
Employee 7566: JONES
Employee 7654: MARTIN
Employee 7698: BLAKE
Employee 7782: CLARK
Employee 7839: KING
Employee 7844: TURNER
Employee 7876: ADAMS
Employee 7900: JAMES
Package successfully deleted
```

17 Scram compatibility

The EDB .NET driver provides SCRAM-SHA-256 support for EDB Postgres Advanced Server version 10 and later. This support is available in EDB .NET 4.0.2.1 release and later.

18 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. EDB .NET Connector supports logging using the standard .NET `Microsoft.Extensions.Logging` package. For more information about logging in .Net, see Logging in C# and .NET in the Microsoft documentation.

> **Note**
>
> For versions earlier than 7.x, EDB .NET Connector had its own, custom logging API.

Console logging provider

The .NET logging API works with a variety of built-in and third-party logging providers. The console logging provider logs output to the console.

To use this provider in your application, make sure you have added a reference to the `Microsoft.Extensions.Logging.Console` nuget package.

Console logging with EDBDataSource

Create a `Microsoft.Extensions.Logging.LoggerFactory` and configure an `EDBDataSource` with it. Any use of connections opened through this data source log using this logger factory.

```
using EnterpriseDB.EDBClient;
using Microsoft.Extensions.Logging;

namespace EnterpriseDB;

internal static class Program
{
    public static async Task Main(string[] args)
    {
        // not for production, move connection string to app
settings
        var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

        var loggerFactory = LoggerFactory.Create(builder => builder.AddSimpleConsole());

        var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);
        dataSourceBuilder.UseLoggerFactory(loggerFactory);

        await using var dataSource = dataSourceBuilder.Build();
        await using var connection = await dataSource.OpenConnectionAsync();
        await using var command = new EDBCommand("SELECT 1", connection);

        _ = await
command.ExecuteScalarAsync();

    }
}
```

```
using
System;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;
using Microsoft.Extensions.Logging;

namespace EnterpriseDB
{
    internal static class Program
    {
        public static async Task Main(string[] args)
        {
            // not for production, move connection string to app
settings
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            var loggerFactory = LoggerFactory.Create(builder => builder.AddSimpleConsole());

            var dataSourceBuilder = new EDBDataSourceBuilder(connectionString);
            dataSourceBuilder.UseLoggerFactory(loggerFactory);

            using (var dataSource = dataSourceBuilder.Build())
            using (var connection = await dataSource.OpenConnectionAsync())
            {
                using (var command = new EDBCommand("SELECT 1", connection))
                {
                    _ = await
command.ExecuteScalarAsync();
                }
            }
        }
    }
}
```

This program should display the following result in the Console :

```
info: EnterpriseDB.EDBClient.Command[<ID>]
      Command execution completed (duration=761ms): SELECT 1
```

Console logging without EDBDataSource

Create a `Microsoft.Extensions.Logging.LoggerFactory` and configure EDB .NET Connector's logger factory globally using `EDBLoggingConfiguration.InitializeLogging`. Configure it at the start of your program, before using any other EDB .NET Connector API.

```
using
System;
using EnterpriseDB.EDBClient;
using Microsoft.Extensions.Logging;

namespace EnterpriseDB
{
    internal static class Program
    {
        public static async Task Main(string[] args)
        {
            // not for production, move connection string to app
settings
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            var loggerFactory = LoggerFactory.Create(builder => builder.AddSimpleConsole());
            EDBLoggingConfiguration.InitializeLogging(loggerFactory);

            await using var conn = new EDBConnection(connectionString);
            await conn.OpenAsync();

            await using var command = new EDBCommand("SELECT 1", conn);

            _ = await
command.ExecuteScalarAsync();
        }
    }
}
```

```
using
System;
using
System.Threading.Tasks;
using EnterpriseDB.EDBClient;
using Microsoft.Extensions.Logging;

namespace EnterpriseDB
{
    internal static class Program
    {
        public static async Task Main(string[] args)
        {
            // not for production, move connection string to app
settings
            var connectionString = "Server=127.0.0.1;Port=5444;User
Id=enterprisedb;Password=edb;Database=edb";

            var loggerFactory = LoggerFactory.Create(builder => builder.AddSimpleConsole());
            EDBLoggingConfiguration.InitializeLogging(loggerFactory);

            using (var conn = new EDBConnection(connectionString))
            {
                await conn.OpenAsync();
                using (var command = new EDBCommand("SELECT 1", conn))
                {
                    _ = await
command.ExecuteScalarAsync();
                }
            }
        }
    }
}
```

Log levels

The following log levels are available:

- Trace
- Debug
- Information
- Warning
- Error
- Critical

This example shows how to change the log level to Trace:

```
var loggerFactory = LoggerFactory.Create(builder => builder
    .SetMinimumLevel(LogLevel.Trace)
    .AddSimpleConsole()
    );
```

Formatting the log output

This example shows how to format your log output. Create a `LoggerFactory` to restrict each log message to a single line and add a date and time to the log:

```
var loggerFactory = LoggerFactory.Create(builder =>
builder
.SetMinimumLevel(LogLevel.Trace)
.AddSimpleConsole(
    options =>
    {
        options.SingleLine = true;
        options.TimestampFormat = "yyyy/MM/dd HH:mm:ss
";
    }
    ));
```

This program should display the following result in the Console. Output may vary depending on your connection settings.

```
trce: EnterpriseDB.EDBClient.Connection[1000] Opening connection to 127.0.0.1:5444/edb...
trce: EnterpriseDB.EDBClient.Connection[1110] Opening physical connection to 127.0.0.1:5444/edb...
trce: EnterpriseDB.EDBClient.Connection[0] Attempting to connect to 127.0.0.1:5444
trce: EnterpriseDB.EDBClient.Connection[0] Socket connected to 127.0.0.1:5444
trce: EnterpriseDB.EDBClient.Connection[1420024510] Start user action
trce: EnterpriseDB.EDBClient.Connection[534767465] End user action
dbug: EnterpriseDB.EDBClient.Connection[1111] Opened physical connection to 127.0.0.1:5444/edb (in
157ms)
dbug: EnterpriseDB.EDBClient.Connection[1001] Opened connection to 127.0.0.1:5444/edb
trce: EnterpriseDB.EDBClient.Connection[1420024510] Start user action
dbug: EnterpriseDB.EDBClient.Command[2000] Executing command: SELECT 1
trce: EnterpriseDB.EDBClient.Command[1049610950] Cleaning up reader
info: EnterpriseDB.EDBClient.Command[2001] Command execution completed (duration=68ms): SELECT 1
trce: EnterpriseDB.EDBClient.Connection[534767465] End user action
trce: EnterpriseDB.EDBClient.Connection[1003] Closing connection to 127.0.0.1:5444/edb...
trce: EnterpriseDB.EDBClient.Connection[1420024510] Start user action
trce: EnterpriseDB.EDBClient.Connection[534767465] End user action
dbug: EnterpriseDB.EDBClient.Connection[1004] Closed connection to 127.0.0.1:5444/edb
trce: EnterpriseDB.EDBClient.Connection[1112] Closing physical connection to 127.0.0.1:5444/edb...
trce: EnterpriseDB.EDBClient.Connection[0] Cleaning up connector
dbug: EnterpriseDB.EDBClient.Connection[1113] Closed physical connection to 127.0.0.1:5444/edb
```

19 API reference

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.
- To find the Npgsql API version that was included with a specific EDB .NET release, see the EDB .NET release notes. The release notes specify the upstream Npgsql version that was merged. The version information is important because the available API features can vary between versions.