Progress®



.NET Open Clients

OpenEdge®

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Preface

Purpose

The Open Client Toolkit exposes business logic on an application server to Open Clients (non-ABL clients) as discussed Learn about Open Clients, the ProxyGen tool allows you to generate proxy objects for .NET (and other) Open Clients. These proxy objects encapsulate remote ABL procedures and functions supported on an application server. Your .NET Open Client application can then access these application server procedures and functions through methods of the generated proxy objects.

This book contains .NET-specific information about creating and using Open Clients. It describes how to develop .NET Open Clients and how to provide access to ABL business logic from .NET clients.

Audience

This content is intended for .NET developers who want to develop Open Clients and OpenEdge developers who want to provide access to their ABL business logic from .NET clients.

Before reading this content, you should be familiar with Learn about Open Clients.

Organization

Configure and Deploy .NET Open Client Applications on page 11

Describes configuration prerequisites specific to .NET Open Client development and deployment.

Proxy Objects and Methods on page 17

Presents the objects and methods generated by ProxyGen for a .NET Open Client.

Connect to the application server on page 29

Describes how to connect to an application server, by instantiating an AppObject and, optionally, a connection object.

Data Type Mappings for Parameters on page 37

Discusses mappings for basic data types, static and dynamic temp-tables, and static and dynamic ProDataSets (ABL ProDataSets), when data is passed between a .NET application and OpenEdge business logic.

Access Proxy Properties on page 85

Describes the different ways you can access the proxy properties that govern behavior across an entire application.

Handle Errors on page 111

Describes error handling in .NET Open Client applications.

Use OpenEdge .NET Proxy Objects in Microsoft Visual Studio on page 119

Lists the types of .NET Open Clients and gives an example to get started building a .NET Open Client application using Microsoft Visual Studio.

Use the Open Client .NET OpenAPI to Directly Access the application server on page 121

Describes an API for accessing application services on the application server from a .NET client without the need to generate Open Client proxies using ProxyGen.

Documentation Conventions

See Documentation Conventions for an explanation of the terminology, format, and typographical conventions used throughout the OpenEdge content library, including information about the following:

- Using ABL documentation
- Examples of syntax descriptions
- OpenEdge messages

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Configure and Deploy .NET Open Client Applications

This content describes configuration prerequisites specific to .NET Open Client development and deployment.

For details, see the following topics:

- Select a .NET Open Client Runtime package
- Prepare to generate proxies for a .NET client using ProxyGen or Batch ProxyGen
- Build a .NET Open Client application using a .NET proxy
- Deploy a .NET Open Client application using a .NET proxy

Select a .NET Open Client Runtime package

.NET Open Clients use the .NET Open Client Runtime. This supports connections to the application server using HTTP or HTTPS connection protocols. The assemblies that make up the .NET Open Client Runtime are:

- `Progress.o4glrt.dll`
- `Progress.Messages.dll`

Based on the run-time configuration you want to support, you have the option of selecting one of the following Open Client Runtime distribution packages:

- **Strong-named and digitally-signed runtime package**—Supports tightly secure .NET applications. If you use this set of Open Client Runtime assemblies, you must use these exact same assemblies for generating

proxies both for building your .NET client application and for deployment. For OpenEdge product updates, you must regenerate your proxies using the new (updated) assemblies, rebuild your application using the updated proxies, and then deploy the updated proxy and application along with the new OpenEdge assemblies.

This configuration gives you the ability to strong-name the proxy and the .NET application. You can also digitally sign the proxy and .NET application. This configuration also allows you to load the OpenEdge .NET assemblies into the Global Assembly Cache.

This set of assemblies is located in:

```
OpenEdge-install-directory
\dotnet\deploy\strongnamed-signed
```

- **Digitally-signed only runtime package**—Supports .NET applications where security is not a high concern. You can use these assemblies to generate proxies and build and deploy your application. For OpenEdge product updates, you do not need to regenerate your proxies or rebuild your application. You can simply give your users the updated OpenEdge assemblies.

  This configuration does **not** give you the ability to strong-name the proxy and the .NET application. As a result, this configuration prevents you from loading the OpenEdge .NET assemblies, the proxy, and the .NET application into the Global Assembly Cache. However, you can digitally sign the proxy and .NET application.

  This set of assemblies is located in:

```
OpenEdge-install-directory
\dotnet\deploy\signed
```

- **Strong-named only runtime package**—Supports a less common type of assembly required by some applications. The assemblies are strong-named but are not digitally signed. A strong-named assembly will allow the Windows system to determine the assembly's data-integrity (i.e., has it been altered since it was compiled and linked). But the strong-name cannot be used as a proof of authenticity because it lacks the digital signature that can be used to identify the author of the assembly.

  If you use this set of Open Client Runtime assemblies, you must use these exact same assemblies for generating proxies both for building your .NET client application and for deployment. For OpenEdge product updates, you must regenerate your proxies using the new (updated) assemblies, rebuild your application using the updated proxies, and then redeploy the updated proxy and application along with the new OpenEdge assemblies.

  This configuration gives you the ability to strong-name both the proxy and the .NET application. You can also have the OpenEdge .NET assemblies loaded into the .NET Global Assembly Cache. However, you cannot digitally sign the proxy or the .NET application.

  This set of assemblies is located in:

```
OpenEdge-install-directory\dotnet\deploy\strongnamed
```

- **Strong-named and digitally-signed runtime package for .NET Core**—

In ProxyGen, in the .NET client settings of the **Generate Proxy** dialog box, you can specify what distribution package to use. The selected assemblies are copied to the ProxyGen output directory (which is the location of the generated proxies).

Note: Only the message resources for the current locale are copied to the ProxyGen output directory. To support additional languages, you must copy the files yourself as described in Support localized messages for .NET client interfaces on page 13.

The classes in the .NET Open Client Runtime are written in C#, but can be accessed by any .NET language.

Support localized messages for .NET client interfaces

When ProxyGen builds the .NET proxy, it copies the required .NET runtime assemblies to the proxy generation output directory. For the message assembly, only the resources for the language matching the current local language are copied to the output directory. If you need to support a different language, you must manually copy some additional files to the output directory.

To support an alternative language or more than one language, you must copy the language resources from one of the following locations depending on your generation option:

- **Strong-named and digitally-signed runtime assemblies** — Copy the resource for the languages you want to support from the following directory:

  ```
  OpenEdge-install-directory\dotnet\deploy\strongnamed-signed\
  ```

- **Digitally-signed only runtime assemblies** — Copy the resource for the languages you want to support from the following directory:

  ```
  OpenEdge-install-directory\dotnet\deploy\signed\
  ```

- **Strong-named only runtime assemblies** — Copy the resource for the languages you want to support from the following directory:

  ```
  OpenEdge-install-directory\dotnet\deploy\strongnamed
  ```

For example, if you want to support a French deployment for a signed-only environment, copy the `fr` directory from *`OpenEdge-install-directory`*`\dotnet\deploy\signed\` to your proxy generation output directory.

Prepare to generate proxies for a .NET client using ProxyGen or Batch ProxyGen

To configure your environment to generate a .NET proxy:

Before generating a proxy, you must configure your environment.

1. Install Progress Developer Studio for OpenEdge, Progress Application Server for OpenEdge, or 4GL Development in Windows where you plan to run ProxyGen.

   Note: If you install on networked storage on your local intranet, you must adjust your .NET security settings to fully trust your local intranet storage device. (Microsoft's default is to **not** fully trust these storage devices.) For more information, see Microsoft's documentation on security settings.

2. Install Microsoft Visual Studio or Microsoft .NET SDK Version 4.7 or later. Follow the instructions on the Microsoft Web site to complete the installation.
3. Make sure the ABL r-code for the proxy is accessible to your system, and the directory structure for the r-code is the same as the Propath relative path on the application server.
4. Choose one:

   - Run ProxyGen from the icon.
   - Run Batch ProxyGen by executing the `bproxygen` command with an existing project file.

   Note: For more information, see the content on generating proxies and Web service definitions in OpenEdge Development: Open Client Introduction and Programming.

Build a .NET Open Client application using a .NET proxy

Several steps are involved in building an Open Client application that uses a .NET proxy.

To build a client application that uses a .NET proxy:

1. Install Microsoft Visual Studio.
2. To build the client application on a machine other than the proxy machine, you must:

   a) Copy the proxy assembly (`.dll` file) to a directory on the system.

   b) Copy the OpenEdge .NET Open Client Runtime assemblies (`Progress.o4glrt.dll` and `Progress.Messages.dll`) and the message resource files from the ProxyGen output directory to a directory on the system or, if the assemblies are strong-named, you can install them into the .NET Global Assembly Cache. For information on strong-named assemblies, see Select a .NET Open Client Runtime package on page 11.

3. Create your client application as a project using Microsoft Visual Studio:

   Ensure that:

   - The compiler version specified in the proxy is the same compiler version used to develop the client application.
   - You have the components you need for .NET development, which are available from Microsoft.

4. Add to your client application project a reference to the proxy assembly (`.dll` file).

5. If you selected the **Delay Sign** option in the .NET **Client Details** group of the ProxyGen **Generate Proxies** dialog box, you must complete the signing process for the proxy using the private/public key pair. For details, see the Microsoft Visual Studio documentation about the Strong Name Tool (`sn.exe`).
6. To your client application project, add a reference to the main Open Client Runtime assembly, `Progress.o4glrt.dll`. See Step 2 for the location.
7. Write, compile, and execute the client application. (This is the focus of the remainder of this book.)

Note: For information on creating a .NET client application, see the Microsoft Visual Studio documentation.

Deploy a .NET Open Client application using a .NET proxy

To deploy a client application that uses a .NET proxy, you must first perform certain steps on the system where you plan to run the application.

To deploy a client application that uses a .NET proxy:

1. Install the Microsoft .NET Redistributable Framework Version 4.7 or later.
2. Copy the required files for the client application and proxy:
   a) Copy the client application.
   b) Copy the proxy assembly (`.dll` file) to the directory required by the client application.
   c) Copy the OpenEdge .NET Open Client Runtime assemblies (`Progress.o4glrt.dll` and `Progress.Messages.dll`) and the message resource files from the ProxyGen output directory to the directory required by the client application or, if the assemblies are strong-named, you can install them into the .NET Global Assembly Cache.
   d) Run your .NET Open Client application as designed.

Note: Alternately, you can follow Microsoft's .NET deployment model. For information, see the Microsoft Visual Studio help.

2

Proxy Objects and Methods

Using the Open Client architecture, .NET Open Clients access business logic through proxy code.

The application developer identifies business logic to define the Open Client interface, using ProxyGen. Once the interface is defined, the application developer generates the .NET client proxy, also using ProxyGen. The client programmer writes a .NET client application in any .NET language. The client application accesses application server functionality through methods on the generated .NET proxy objects.

The generated .NET proxy code uses the .NET Open Client Runtime to communicate with the application server. The .NET Open Client Runtime converts parameters and return values between ABL (Advanced Business Language) and .NET data types as needed. The .NET proxies can be generated only on Microsoft operating systems.

For details on the Open Client architecture, see *OpenEdge Development: Open Client Introduction and Programming*.

The .NET proxies generated by ProxyGen contain one or more classes, packaged as a .NET assembly.

For details, see the following topics:

- Proxy objects
- Proxy methods
- Run methods on session-free AppObjects
- Sample proxy

Proxy objects

For a .NET Open Client proxy, ProxyGen generates one class for each Open Client object, each unique static temp-table, and each unique static ProDataSet, as shown in the following table:

For each . . .	ProxyGen generates . . .	Example
AppObject	A .NET class	`public class Account`
SubAppObject	A .NET class	`public class Tax`
ProcObject	A .NET class whose name matches the name of the persistent, single-run, or singleton procedure	`public class AccountInfo`
Static temp-table	A strongly typed ADO.NET DataTable class	`public class CustomerTableDataTable : Progress.Open4GL.ProDataTable`
Static ProDataSet (ABL DataSet)	A strongly typed ADO.NET DataSet class	`public class PurchaseOrderDataSet : Progress.Open4GL.ProDataSet`

ProxyGen creates one assembly, *AppObject*`.dll`, which contains the above Open Client classes and strongly typed ADO.NET DataTable and ADO.NET DataSet classes (for example, `Account.dll`).

ProxyGen also generates *AppObject*`.log`, an activity log file with status and error information (for example, `Account.log`).

All these files are placed in the output directory specified in the general settings of the ProxyGen **Generate Proxies** dialog box. In addition, the assemblies for the selected Open Client Runtime package are copied to the output directory.

Namespace for proxy objects

All .NET Open Client proxy objects can be defined within a *namespace* specified using the **General** field of the **Namespaces** group in the .NET **Client Details** of the **Generate Proxies** dialog box. A namespace is an organizational unit for classes or types. All Open Client proxy objects are defined in the specified namespace. If no namespace is specified, the objects are defined in the global namespace. Progress Software Corporation recommends that you specify a namespace, to help ensure the uniqueness of your proxy objects.

For example, if the namespace specified in ProxyGen is `Acme`, and an AppObject named `Account` is defined, ProxyGen generates the following .NET class:

```
Acme.Account
```

The namespace for strongly typed proxy classes for ADO.NET DataTables and DataSets is, by default, is defined by appending `StrongTypesNS` to the specified **General** namespace. For example, if a static temp-table named `OrderTT` is defined in a procedure added to the `Account` AppObject, ProxyGen generates the following .NET class for the temp-table:

```
Acme.StrongTypesNS.OrderTT
```

Note that the `StrongTypesNS` namespace is prepended with the `Acme` namespace specified using the **General** field, resulting in the namespace `Acme.StrongTypesNS`.

You can also define your own namespace for strongly typed DataTable and DataSet classes using the **DataSet** field of the **Namespaces** group in .NET **Client Details**. By deselecting the **Use Default** option, you can enter your own value in **DataSet** that ProxyGen appends to the specified **General** namespace.

Proxy methods

The proxies you generate include several types of methods and properties:

- Connection methods on page 19
- Remote ABL methods on page 19
- Class factory methods on page 20
- Common properties on page 21
- Common methods on page 23

Connection methods

The constructor of the AppObject is used to establish a connection to an application server. For details, see Connect to the application server on page 29.

Remote ABL methods

ProxyGen maps each ABL non-persistent procedure, internal procedure, and user-defined function exposed on the application server to a *remote ABL method*. These methods are part of an AppObject, SubAppObject, or ProcObject. ProxyGen generates method names using automatic conversion and conventions. For more information on proxy generation, see *OpenEdge Development: Open Client Introduction and Programming.*

A sample non-persistent procedure follows:

```
AddCustomer.p:
DEFINE INPUT PARAMETER name  AS CHARACTER.
DEFINE INPUT PARAMETER phone AS CHARACTER.
DEFINE INPUT PARAMETER email AS CHARACTER.
DEFINE OUTPUT PARAMETER CustomerNumber AS INTEGER.
. . .
```

ProxyGen generates the following .NET proxy method:

```
public void AddCustomer(string name, string phone, string email,
     out int CustomerNumber)
```

Pass parameters

ProxyGen maps ABL data types to equivalent data types in .NET for ABL `INPUT`, `OUTPUT`, and `INPUT-OUTPUT` parameters. For details, see Data Type Mappings for Parameters on page 37.

Handle return values

When using ProxyGen, you optionally can specify whether the ABL `RETURN-VALUE` should be added to the proxy method, for each non-persistent procedure and internal procedure. (User-defined functions always return a value.) If you specify this, the method returns `string`; otherwise, the method returns `void`. If specified for the non-persistent previous procedure, ProxyGen generates the following .NET proxy method:

```
public string AddCustomer(string name, string phone, string email,
  out int CustomerNumber)
```

Also, if you did not specify that the ABL `RETURN-VALUE` should be returned, the client can access the current value of the ABL `RETURN-VALUE` function with the `ProcReturnString` property on the Open Client object. See Common properties on page 21 for additional information.

Class factory methods

ProxyGen generates two class factory methods.

SubAppObject

The following method allows AppObjects to create SubAppObjects that share an application server connection with an existing AppObject:

```
public SubAppObject
CreateAO_SubAppObject( )
```

For example, a SubAppObject named `Tax` defined in ProxyGen generates this .NET method:

```
public Tax CreateAO_Tax( )
```

ProcObject

The following method allows AppObjects or SubAppObjects to create ProcObjects that share an application server connection with an existing AppObject or SubAppObject:

```
public ProcObject
CreatePO_ProcObject( )
```

For example, a procedure `AccountInfo.p` added in ProxyGen as persistent, single-run, or singleton generates this .NET method:

```
public AccountInfo CreatePO_AccountInfo( )
```

Note that `AccountInfo.p` cannot be run as single-run or singleton if it has parameters in its main block, and ProxyGen will not allow you to designate a procedure as single-run or singleton if that procedure has parameters in its main block.

Common properties

The Open Client interface provides common properties that provide information about the current state of .NET proxy AppObjects, SubAppObjects, and ProcObjects, with respect to their connection to the application service. The section lists common Open Client properties and describes the information they provide. This information might differ based on whether the application service is session-managed or session-free. (For an overview of session models, see *OpenEdge Development: Open Client Introduction and Programming*.)

Connection ID

The `ConnectionId` property is most often used to identify entries in application server log files. This is a read-only property.

For session-managed applications, the `ConnectionId` property returns a string containing a unique identifier for this connection.

For session-free applications, the `ConnectionId` property returns a string containing a unique identifier for the connection most recently used by the current thread. For example:

```
public string
ConnectionId
```

The `ConnectionId` property returns null if the Application Service is not connected.

Procedure return string

This is a read-only property.

For session-managed applications, the following property retrieves the return value of the method most recently run on any thread.

For session-free applications, the following property retrieves the return value of the method most recently run on the current thread:

```
public String
ProcReturnString
```

This property can also contain a return string from the application server connection procedure immediately after connecting, if the connection procedure returns a string.

The return value cannot be retrieved by another thread.

For more information on handling return values, see *OpenEdge Development: Open Client Introduction and Programming*.

Procedure type

The `ProcedureType` property identifies the type of procedure that a ProcObject encapsulates as persistent, single-run, or singleton. The property holds a .NET enum type with a value of `Persistent`, `SingleRun`, or `Singleton`:

Syntax

```
public ProcedureType
ProcedureType
```

Request ID

This is a read-only property.

For session-managed applications, the `RequestId` property returns a unique string identifying the request most recently run on any thread.

For session-free applications, the `RequestId` property returns a unique string identifying the request most recently run on the current thread. For example:

```
public String
RequestId
```

The `RequestId` cannot be retrieved by another thread.

The RequestId property returns null if the Application Service is not connected.

TLS subject name

This is a read-only property.

The SSLSubjectName property provides the TLS server's subject name that is obtained from its validated digital certificate. For example:

```
public String
SSLSubjectName
```

Common methods

The Open Client interface provides common methods which provide information about the current state of .NET proxy AppObjects, SubAppObjects, and ProcObjects, with respect to their connection to the application service. This section lists these methods and describes the information they provide.

Cancel all requests

The following methods raise a STOP condition in the context of each outstanding request on the application server:

```
public void CancelAllRequests( )
public void _CancelAllRequests( )
```

Note: The _CancelAllRequests( ) method is not CLS-compliant; it is supported only for backward compatibility. Progress Software recommends that you use CancelAllRequests( ), instead.

The CancelAllRequests( ) method is most useful for multi-threaded clients.

The CancelAllRequests( ) method is defined to throw a Progress.Open4GL.Exceptions.Open4GLException.

A client can call the CancelAllRequests( ) method to do the following:

- Raise the STOP condition on a request that was initiated by any object in the proxy and is running (normally during a long execution).
- Normal STOP condition processing applies, including the ability to trap the STOP condition.

Dispose

The following method makes the object unavailable for further use:

```
public void
Dispose( )
```

When you execute the Dispose( ) method on the last available proxy object that shared a particular connection, the client disconnects from the application server. In addition, if you execute this method on a ProcObject, the associated persistent procedure on the application server is deleted. The connection to the application server is automatically released for single-run and singleton procedures after their internal procedures or user-defined functions are completed, and in the case of a single-run procedure, the procedure itself is also automatically deleted form the application server. However, the Dispose( ) method does clean up client-side resources for single-run and singleton procedures.

Run methods on session-free AppObjects

When a session-free AppObject is instantiated, a pool of connections to the application service is established, as specified by the run-time properties provided. Once instantiated, methods on that AppObject can be called in accordance with the standard Open Client programming model. In the session-free model, each external method call transparently runs a request using a separate connection from the connection pool. (An external method is one that corresponds to an external ABL procedure on the application server.) As such, a multi-threaded application may run remote application service requests concurrently. As each request completes, the connection is released back to the pool and is available for another request.

Connections for persistent procedures are handled slightly differently than for non-persistent procedures. When a persistent procedure is instantiated, a connection is reserved from the connection pool. All subsequent internal procedures and user-defined functions run on that persistent procedure use that same connection. The connection is released back to the connection pool only when the persistent procedure is released by calling the `Dispose()` method on the ProcObject.

Unlike persistent procedures, single-run and singleton procedures do not reserve connections. In these cases, the connection is released automatically when the internal procedure or user-defined function is complete. However, the `Dispose()` method does clean up client-side resources.

Session-free threading model

Open Client applications that use the session-free model are presumed to employ a threading model such that each request executes on a separate thread. This becomes particularly important in the following areas:

- When the application constrains the size of the connection pool, requests can become blocked if connections are unavailable. This is accomplished by the Open Client Runtime blocking the thread on which the request is run.
- Certain request-specific methods must be executed on the same thread on which the request was run. See Common methods on page 23 for more details.

Share the connection pool between session-free AppObjects

A session-free AppObject is instantiated using an explicitly provided `Connection` object. The `Connection` object instance establishes a reference to the AppObject's connection pool. If the same `Connection` object instance is then used to instantiate other session-free AppObject instances, the subsequent AppObject instances will share the connection pool referenced by the `Connection` object. SubAppObjects and ProcObjects always share the connection pool of their associated AppObject.

The `Connection` object's reference to the connection pool will be maintained until the `ReleaseConnection()` method is called on the `Connection` object. This reference might affect the life cycle of the connection pool. That is, the `Connection` object may be used to sustain the existence of the connection pool beyond the lifetime of the AppObject (and its associated SubAppObjects and ProcObjects). It is your responsibility to call `ReleaseConnection()` on the `Connection` object to remove the reference to the connection pool.

Note that a single `Connection` object can be used to instantiate instances of different AppObject classes, provided that the `Connection` object refers to an application server that provides the necessary application services. This is possible since a single application server can serve multiple application services. However, no validation of this is provided.

The Connection object does not maintain a reference to a session-managed AppObject, regardless of how it is constructed. If a session-managed AppObject is constructed using a Connection object that contains a reference to a connection pool, an exception is thrown. In other words, Connection objects cannot be shared between session-free and session-managed AppObjects.

Sample proxy

This section presents examples of .NET proxy objects and their methods. All .NET proxies are generated using C#.

Sample AppObject

The methods in this section comprise the definition of a sample .NET AppObject, Account, as shown:

- The AppObject constructors that connect to an Application Service:

```
public Account(Connection connectObj)

public Account(string urlString, string userId, string password,
     string appServerInfo)

public Account(string userId, string password, string appServerInfo)
public Account( )
```

- A SubAppObject class factory method that creates a SubAppObject called Tax:

```
public Tax CreateAO_Tax( )
```

- A ProcObject class factory method that creates a ProcObject called AccountInfo and runs and instantiates the persistent procedure AccountInfo.p on the application server:

```
public AccountInfo CreatePO_AccountInfo(int accountNum)
```

If AccountInfo.p were to be run as a single-run or singleton procedure, the parameter in its main block would have to be removed and passed to its internal procedures or user-defined functions directly. The class factory method would then look like this:

```
public AccountInfo CreatePO_AccountInfo( )
```

See Sample ProcObject on page 26 for an example of how the methods for the internal procedures and user-defined functions of might look if AccountInfo.p were called as a single-run or singleton procedure.

- Remote ABL methods to run the non-persistent procedures `Add` (defined by `Add.p`) and `Remove` (defined by `Remove.p`) on the application server:

```
public void Add(int accountNum, string name)
public void Remove(int accountNum)
```

- Common properties in all .NET proxy objects, excluding the `ProcedureType` property:

```
public string ConnectionId

public string ProcReturnString

public string RequestId

public string SSLSubjectName
```

- Common methods in all .NET proxy objects:

```
public void CancelAllRequests( )

public void Dispose( )
```

Sample SubAppObject

The following methods comprise the definition of a sample .NET SubAppObject, `Tax`:

- A ProcObject class factory method that creates a ProcObject called `TaxInfo` and runs and instantiates the persistent procedure `TaxInfo.p` on the application server. For example:

```
public TaxInfo CreatePO_TaxInfo(int accountNum)
```

- A remote ABL method to run the non-persistent procedure `SetStatus` (defined by `SetStatus.p`) on the application server. For example:

```
public void SetStatus(int status)
```

- Common methods in all .NET proxy objects.

Sample ProcObject

The following methods comprise the definition of a sample .NET ProcObject, `AccountInfo`:

- Remote ABL methods to run the internal procedures `getPaymentsInfo`, `setDirectDeposit`, and `getDirectDeposit` (defined in `AccountInfo.p`) on the application server:

```
public void getPaymentsInfo(System.DateTime fromDate,
                            System.Data.DataTable payeeList,
                            int paymentsNum,
                            System.Data.DataTable paymentsInfo)

public void setDirectDeposit(System.Data.DataTable ddData)

public void getDirectDeposit(System.Data.DataTable ddData)
```

  If `AccountInfo.p` were to be run as single-run or singleton, then its input parameter `accountNum`would have to removed from the main block and instead be passed directly to its internal procedures or user-defined functions. In that case, the internal procedure methods might look like the following:

```
public void getPaymentsInfo(int accountNum,
                            System.DateTime fromDate,
                            System.Data.DataTable payeeList,
                            int paymentsNum,
                            System.Data.DataTable paymentsInfo)

public void setDirectDeposit(int accountNum,
                             System.Data.DataTable ddData)

public void getDirectDeposit(int accountNum,
                             System.Data.DataTable ddData)
```

- The `ProcedureType` property
- Common methods in all .NET proxy objects.

3

Connect to the application server

To make it easier to connect to the application server, a *connection object*, `Progress.Open4GL.Proxy.Connection` stores application server connection information to pass to the `AppObject` constructor when connecting to the application server.

Create a connection object using url, userid, password and application server information

This constructor specifies the application server connection information *`url`*, *`user ID`*, *`password`* and *`info`* required by the application server application at connection time:

```
public Connection(string url, string userid, string password,
     string info)
```

`url`

Specifies the *`url`* to connect to the root ABL web application it would look like this `http://`*`host`*`:`*`portnumber`*`/apsv`. Alternatively you can specify a named ABL web application using this format `http://`*`host`*`:`*`portnumber`*`/`*`ABLwebapplication`*`/apsv`

Note: This is the preferred constructor because it allows you to customize the url. The combined length of the `url`, `userid`, `password`, and `info` fields must not exceed 30,000 non-Unicode characters when connecting to an application server.

`userid`

Specifies a user ID required to access the application server. Optional

password

Specifies a password required to access the applications server.Optional

info

Specifies information required by the application service at connection time.You can set a number of session and run-time properties to manage access to an application service. For more information on setting session properties see Access Proxy Properties on page 85.

Create a connection object using userId, password and application server information

This constructor specifies the user ID, password and information required by the application at connection time. It does not allow you to specify a url:

```
public Connection(string userid, string password, string info)
```

userid

Specifies a user ID required to access the application server. If security is not implemented, empty string are allowed.

password

Specifies a password required to access the applications server.If security is not implemented, empty string are allowed.

info

Specifies information required by the application service at connection time.You can set a number of session and run-time properties to manage access to an application service. For more information on setting session properties see Access Proxy Properties on page 85.

Note: This constructor is depricated. It supports backwards compatibility to the classic AppServer and is not intended for use with PAS for OpenEdge. The default URL is

`http://localhost:8810/apsv/`, where *apsv* is the **AppService Name** setting specified in the **General Settings** of the **ProxyGen** > **Generate Proxies** dialog box.

For details, see the following topics:

- Establish the connection
- Handle connection exceptions
- Return a user defined string to the client from the application server connection procedure
- Release a session-free Connection object

Establish the connection

To establish a connection to an application server, you must instantiate an AppObject. You can create an AppObject using one of the available constructors.

Establish a connection with a connection object

This constructor establishes an application connection, with the application server information specified in the `Connection` object (*`connectObj`*):

```
public AppObject(Progress.Open4GL.Proxy.Connection connectObj)
```

`AppObject`

Specifies the name of the AppObject as defined in ProxyGen.

`connectObj`

Specifies a `Progress.Open4GL.Proxy.Connection` object, which defines connection parameters to access the application server.

Note: This is the recommended constructor for developers who customize the `connection` class to specify the `url` for their application server.

Establish a connection with a URL, username, password and application server information

This constructor establishes an application server connection, with the specified application server connection information (*`url`*), user ID, password, and information required by the application server application at connection time:

```
public AppObject(string url, string userid, string password,
     string info)
```

`AppObject`

Specifies the name of the AppObject as defined in ProxyGen.

`url`

Specifies the name of the AppObject as defined in ProxyGen.

connectObj

Specifies the PAS for OpenEdge ABL web application. The root ABL web application is `http://host:portnumber/apsv/`. Alternatively, a named ABL web application is `http://host:portnumber/ablwebapplication/apsv`

Note: For an HTTPS connection, you must specify the Internet host name in the *url* parameter exactly as it appears in the CN field of the application server certificate.

`userid`Specifies a user ID required to access the application server. If security is not implemented, empty string are allowed.

`password` Specifies a password required to access the application server. If security is not implemented, empty string are allowed.

`info`Specifies information required by the application service at connection time.You can set a number of session and run-time properties to manage access to an application service. For more information on setting session properties see Access Proxy Properties on page 85.

Note: This is the recommended constructor for developers who want the ability to customize the connection URL, username and password without using a connection object.

Establish a connection with a default url, userID, password and application server information

This constructor establishes an application server connection, with the specified user ID, password, and information required by the application server application at connection time:

```
public AppObject(string userid, string password, string info)
```

AppObject is the name of the AppObject as defined in ProxyGen.

`userid` Specifies a user ID required to access the application server. If security is not implemented, empty string are allowed.

`password` Specifies a password required to access the application server. If security is not implemented, empty string are allowed.

`info`Specifies information required by the application service at connection time.You can set a number of session and run-time properties to manage access to an application service. For more information on setting session properties see Access Proxy Properties on page 85.

The constructor above uses a default application connection. This constructor defaults the URL to `http://localhost:8810/apsv/`, where *apsv* is the **AppService Name** setting specified in the general settings of the ProxyGen **Generate Proxies** dialog box.

Note: This constructor is deprecated it supports backwards compatibility to the classic AppServer and is not intended for use with PAS for OpenEdge because it uses a URL associated with classic AppServer.

Establish a connection with default details

The following constructor establishes an application server connection, with no specified application server information:

```
public AppObject(string appservice)
```

AppObject Specifies the name of the AppObject as defined in ProxyGen.

appservice Specifies the name of the application service.

Note: This constructor constructor is deprecated and supports backwards compatibility to the classic AppServer and is not intended for use with PAS for OpenEdge because it uses a URL associated with classic AppServer and the appservice is not used by PAS for OpenEdge.

Secure server connections to .NET Open Clients

.NET Open Clients securely connect to ABL application servers using **HTTPS** (Hypertext Transfer Protocol Secure) connections. This protocol encrypts data sent between clients and application servers. To encrypt the data, the clients and servers must share a certificate. **TLS** (Transport Layer Security) is configured on the application server by the system administrator. The system administrator supplies the necessary certificate files used to verify that the server is a trusted applications server.

For more information on how to set up server security, see 'Use TLS in PAS for OpenEdge' in *Manage Progress Application Server (PAS) for OpenEdge*. Client developers must then import the server certificates into their client keystore.

Import server certificates on .NET Open Clients

.NET Open Clients use the .NET Framework certificate management systems.

1. Search for **Manage User Certificates** in the **Windows Search box**.
2. The **certmgr** opens.
3. Create or select the folder where you want to store your server certificates.
4. Right click to select **All Tasks...** > **Import**.
5. Locate and import your certificate.
6. When clients connect to the application server using HTTPS , the keystore is automatically checked for a valid server certification.

Certificates for development and test systems

OpenEdge ships a small set of root digital certificates from leading industry Certificate Authorities (CAs), with the Open Client Toolkit. These digital certificates are intended only for use during development and test cycles. Production systems should use certificates from a Certificate Authority.

The certificate files included with the Open Client Toolkit are stored in .zip and .jar files called **certificate store files**, in the DLC/certs directory. Each certificate store file holds several individual root digital certificates and contains one digital certificate list (.dcl file) that lists all certificate files stored in the file.

The individual certificates have one of the following formats:

- **DER** — These file types have extensions of .cer and .crt. There is no difference between these types. One file stores one binary certificate.

- **PEM** — These file types have extensions of `.pem`, `.txt`, and `.0`. There is no difference between these types. One file stores one or more certificates.

You can use `procertm` to convert digital certificates between `.der` and `.pem` file formats. For more information see 'Convert digital certificates' in *Java Open Clients*.

Handle connection exceptions

The creation of a connection to an application server should be wrapped with exception-handling code to avoid memory leaks and unnecessary allocation of client and server resources. Also, information received from a caught exception can be valuable in tracing and fixing connection errors.

The following is an example of handling connection exceptions:

```
Customer appObj;
try
{
   //Create Customer AppObject to connect
   appObj = new Customer(ConnectObj);
}
catch (Progress.Open4GL.Exceptions.ConnectException ex)
{
   MessageBox.Show(ex.ToString( ));
}finally
{   if (appObj != null)
   {
      appObj.Dispose( );
   }
}
```

This example executes the connect in the `try` block. If there is an exception thrown by the process, the `catch` block displays the exception message to the user.

The `catch` block is specifically catching the `ConnectException`. For more information on .NET Open Client exceptions, see Handle Errors on page 111.

The `finally` block ensures that the `Dispose( )` method is called on the AppObject. By putting the `Dispose( )` method in the `finally` block, you ensure that the connection is closed whether an exception occurs or the connect is successful.

Return a user defined string to the client from the application server connection procedure

When you establish a connection to the application server with the .NET Open Client, you instantiate an AppObject using one of the four constructors provided by ProxyGen. If the connection to the application server fails, the AppObject constructor throws a standard exception. This exception can also contain a user defined string, if you set up your application server to do so.

The `Connection` object communicates with a remote ABL procedure stored on the application server known as the **connection procedure**. If that procedure contains the ABL `RETURN`*`string`* statement, then that string will be contained in the connection failure exception.

If the connection is successful, and the connection procedure has a RETURN*string* statement, you can access the string using the existing AppObject public property ProcReturnString. If the connect procedure does not return a value, then the ProcReturnString property will be null.

The following sample .NET Open Client code illustrates this functionality:

```
 Customer appObj;
try
{
   //Create Customer AppObject to connect
   appObj = new Customer(ConnectObj);

   MessageBox.Show(appObj.ProcReturnString);
}
catch (Progress.Open4GL.Exceptions.Open4GLException ex)
{
   // if there is a application defined return string, then display it
   if (ex.ProcReturnString != string.Empty)
   {
      MessageBox.Show(ex.ProcReturnString);
   }
   else
   {
      // display Progress defined error message
      MessageBox.Show(ex.ToString());

      // or display new generic message
      MessageBox.Show("Connection failed");
  }
}
finally
{
   if (appObj != null)
   {
      appObj.Dispose();
   }
}
```

If the connection is successful and the connect procedure returns a string, then the string value is displayed by the first message box. If the connect procedure failed and returns a string, then the string value is displayed by the second message box.

Note: This feature is only available to applications using the managed-session application server model, since it is this type of application that uses a connection procedure.

Release a session-free Connection object

For .NET Open Clients, the supported application server operating modes are the session-managed and the session-free modes. For more information, see the information on session models in the topic on generating proxies and Web service definitions in *Learn About Open Clients*.

To access a session-free application server, you must set the proxy property PROGRESS.Session.SessionModel to 1. For more information, see Access Proxy Properties on page 85.

ReleaseConnection

For session-free applications, you must explicitly release the connections held by a `Connection` object when they are no longer needed. Use the following method on the `Connection` object for this purpose:

```
public void ReleaseConnection( )
```

Note: This method is not necessary for and has no effect in session-managed applications.

4

Data Type Mappings for Parameters

This content describes the data type mappings for parameter passing as well as the process for passing and mapping temp-tables and ProDataSets.

For details, see the following topics:

- ABL data type mappings
- ABL temp-table to ADO.NET DataTable mappings
- ABL ProDataSet to ADO.NET DataSet mappings
- PassTABLE and TABLE-HANDLE parameters
- Pass DATASET and DATASET-HANDLE parameters
- ProDataTable class methods
- ProDataSet class methods

ABL data type mappings

.NET data types are defined as part of the common type system within .NET. The common type system supports two general categories of types, *value types* and *reference types*. Many ABL data types are mapped to built-in value types provided by .NET. Reference types are classes, either those provided by .NET or user-defined classes. Some ABL data types are mapped to .NET-provided classes, and a few are mapped to ABL-provided classes.

An ABL parameter is mapped directly to its corresponding .NET data type or OpenEdge-provided class, as shown in the following table. These mappings also apply to user-defined function return types, although LONGCHAR and MEMPTR types cannot be returned across the Open Client interface.

Table 1: ABL to .NET data-type mapping for parameters

ABL	.NET
CHARACTER	System.String
COM-HANDLE	Progress.Open4GL.COMHandle
DATASET	Strongly typed DataSet See Pass DATASET and DATASET-HANDLE parameters on page 66.
DATASET-HANDLE	System.Data.DataSet See Pass DATASET and DATASET-HANDLE parameters on page 66.
DATE DATETIME DATETIME-TZ	System.DateTime
DECIMAL	System.Decimal
HANDLE	Progress.Open4GL.Handle
INT64	System.Int64
INTEGER	System.Int32
LOGICAL	System.Boolean
LONGCHAR	System.String
MEMPTR	Progress.Open4GL.Memptr
RAW	System.Byte[ ]
RECID	System.Int64

ABL	.NET
ROWID	Progress.Open4GL.Rowid
TABLE	Strongly typed DataTable.See PassTABLE and TABLE-HANDLE parameters on page 59.
TABLE-HANDLE	System.Data.DataTable See PassTABLE and TABLE-HANDLE parameters on page 59.
WIDGET-HANDLE	Progress.Open4GL.Handle

The COM-HANDLE, HANDLE, RECID, ROWID, and WIDGET-HANDLE data types are not meaningful outside the ABL environment. Their use is restricted to obtaining the value from an ABL procedure and passing it back to another ABL procedure.

The mapping for the individual fields of a temp-table or temp-tables within a ProDataSet differs from that of other parameters. For information on data type mapping for fields within these parameters, see Data type mapping for temp-table fields on page 60.

.NET Open Clients do not support the ABL BUFFER parameter.

Date and time conversions

The following table details the conversions for date and time between the application server and the .NET Open Client.

Table 2: .NET Open Client DATE, DATETIME, and DATETIME-TZ conversions

ABL data type	Process
DATE	**Input:** Extract Date portion **Output:** Time is set to midnight
DATETIME	**Input and Output:** Date and Time preserved
DATETIME-TZ	**Input:** Use time zone of the .NET Client **Output:** Convert to .NET Client time zone

Arrays as parameters

ABL allows arrays (called EXTENTs in ABL) to be passed as run-time parameters, using the same data type mapping shown in the following table:

Table 3: ABL to .NET data-type mapping for array parameters

ABL EXTENT data type	Proxy code (C#) return type for values	Proxy code (C#) return type for unknown values
INTEGER	System.Int32[]	IntHolder[]
INT64	System.Int64[]	LongHolder[]
DECIMAL)	System.Decimal[]	DecimalHolder[]
CHARACTER	System.String[]	
LOGICAL	System.Boolean[]	BooleanHolder[]
DATE DATETIME DATETIME-TZ	System.DateTime[]	DateHolder[]
RECID	System.Int64[]	
RAW	System.Byte[][]	
ROWID	Progress.Open4GL.Rowid[]	
COM-HANDLE	Progress.Open4GL.COMHandle[]	
WIDGET-HANDLE	Progress.Open4GL.Handle[]	

The size of an array is not part of its definition in .NET, so the EXTENT value is not reflected in the .NET proxy's parameter definition. If the extent of the data passed by the client does not match the extent of the parameter declaration of the ABL procedure, the proxy returns an error to the client at run time.

Note: Arrays defined with EXTENT 0 are treated as scalars (consistent with ABL). The proxy will contain a scalar for the parameter, and not an array.

Pass arguments by reference

In .NET, parameters can be passed by value or by reference. Most .NET languages provide a way to declare a parameter's mode. For example, in C#, parameters are passed by value by default, and you can use `ref` and `out` to specify passing the parameter by reference. In Visual Basic .NET, use `ByVal` and `ByRef` to identify the parameter mode.

INPUT-OUTPUT parameters

An `INPUT-OUTPUT` parameter is mapped to its .NET data type, with the parameter mode set based on the .NET language. For example, in C# you would use the `ref` parameter modifier. The `ref` modifier requires that the variable be initialized before being passed to a method.

OUTPUT parameters

An `OUTPUT` parameter is mapped to its .NET data type, with the parameter mode set based on the .NET language. For example, in C# you would use the `out` parameter modifier. The `out` modifier does not require that the variable be initialized before being passed to a method.

Note: If the variable already contains a value, it is replaced for `INPUT-OUTPUT` and `OUTPUT` parameters.

For more information about parameter passing in .NET, see the documentation for your .NET programming language.

Unknown value (?) as a parameter

The `Unknown value (?)` is mapped to a null value for a .NET reference type (class); however, the .NET value types referenced by a .NET proxy (`System.Boolean`, `System.Decimal`, `System.Int32`, `System.Int64`, and `System.DateTime`) always have a default value, and the null value does not belong to the set of values they support. For each of these value types, OpenEdge provides two options for representing a null value:

- A .NET *nullable value type*, which is a structure that can be set to a null value as well as to one of the values of a corresponding .NET value type.
- An OpenEdge *holder class*, which is defined in the `Progress.Open4GL` namespace, and can be set to a null value as well as to one of the values of a corresponding .NET value type. This option is provided for backward compatibility in ProxyGen projects created using previous OpenEdge releases that do not support .NET nullable types.

You can select the option you want to represent the `Unknown value (?)` for parameters and user-defined function return values in ProxyGen using the **Unknown Support** options in the .NET **Client Details** of the **Generate Proxies** dialog box.

Note: For ProxyGen projects created in OpenEdge releases without support for nullable types, the project defaults to using holder classes to represent the `Unknown value (?)`. For ProxyGen projects created in OpenEdge releases that support nullable types, the project defaults to using nullable types to represent the `Unknown value (?)`.

Use .NET nullable value types

In ProxyGen, if you specify that a supported value type parameter or return value can have the `Unknown value (?)`, and you have chosen the option to use nullable value types, the method is defined with the corresponding nullable type; otherwise the parameter is defined using the .NET value type.

The following is an example of a C# proxy method signature that does not support `Unknown value (?)` for the first and third parameters:

```
foo(int i, string s, bool b)
```

The following is an example of a C# proxy method that allows all the parameter values to have `Unknown value (?)`, using nullable value types where necessary:

```
foo(System.Int32? i, string s, System.Boolean? b)
```

.NET nullable types are represented using the following syntax:

Syntax

```
ValueType?
```

Where *ValueType* is a built-in .NET value type that has a corresponding nullable type, and ? identifies the value type as nullable.

A nullable type is actually a generic structure type and the *ValueType*? syntax is shorthand for the generic structure `System.Nullable<`*ValueType*`>`. These forms are interchangeable. However, the .NET Open Client uses the *ValueType*? form to represent nullable types in a proxy.

The following table shows the mapping between ABL primitive types and the corresponding .NET nullable value types.

Table 4: ABL primitive type to .NET nullable value type mappings

This ABL primitive type...	Maps to this .NET nullable type...
DATE DATETIME DATETIME-TZ	System.Datetime?
DECIMAL	System.Decimal?
INT64	System.Int64?
INTEGER	System.Int32?
LOGICAL	System.Boolean?
RECID	System.Int64?

To set the value of an object with a nullable value type (nullable type object), you can directly assign it a value as if you were setting an object with the corresponding value type, and you can also assign it directly to `null`. When reading the value of a nullable type object, you need to know if the object is `null` (has no value) in order to avoid throwing an exception when reading its value, which is undefined when set to `null`. Also, to read the value of a nullable type object, you must access a property of the object that contains the value. Therefore, the `System.Nullable<`*`ValueType`*`>` generic structure supports the following read-only properties for nullable type objects:

- **`HasValue`** — A property of type `System.Boolean` that is `true` if the object has a value and is `false` otherwise (the object is set to `null`)
- **`Value`** — A property of type *`ValueType`* that returns the object's value if `HasValue` is `true`, and throws a `System.InvalidOperationException` exception if `HasValue` is `false`

You can also directly test a nullable type object for `null` using the == and != operators, and directly access the value of a non-`null` nullable type object.

For example, within a C# method, you can use nullable type objects as follows:

```
System.Int32? intNullable; // Nullable value type object
System.Int32  intValue;    // Corresponding value type object

intNullable = 10;                // Set a nullable object to a value
intValue = intNullable.Value;    // Get the value of the nullable object
intNullable = null;              // Set the nullable object to null
. . .

if (intNullable.HasValue)  // Test if nullable object is null before reading
  intValue = intNullable.Value;  // The object has a value; read its property
else
  intValue = 0;                  // The object is set to null; assigning 0

. . .

if (intNullable != null)  // Directly test if nullable object is null
  intValue = intNullable;        // The object has a value; read directly
else
  intValue = 0;                  // The object is set to null; assigning 0
```

For more information on the characteristics of nullable value types, including additional methods and C# operators that they support, see the Microsoft .NET documentation on using nullable types in C#.

Set an INPUT or INPUT-OUTPUT parameter to the Unknown value (?)

For `INPUT` or `INPUT-OUTPUT` parameters, you can set an input value to the `Unknown value (?)` by directly setting the nullable type object to `null`, as shown in the previous example.

Test an INPUT-OUTPUT or OUTPUT parameter for the Unknown value (?)

For `OUTPUT` and `INPUT-OUTPUT` parameters, you can find out whether an output `Unknown value (?)` is returned by testing if the output object's `HasValue` property is `false` or if the object equals `null`, shown in the previous example.

Use OpenEdge holder classes

In ProxyGen, if you specify that a supported value type parameter or return value can have the `Unknown value (?)`, and you have chosen to use holder classes, the method is defined with the corresponding holder class; otherwise the parameter is defined using the .NET value type.

The following is an example of a C# proxy method signature that does not support `Unknown value (?)` for the first and third parameters:

```
foo(int i, string s, bool b)
```

The following is an example of a C# proxy method that allows all the parameter values to have `Unknown value (?)`, using holder classes where necessary:

```
foo(IntHolder i, string s, BooleanHolder b)
```

For each ABL data type that maps to a .NET value type, there is a `Holder` class. These `Holder` classes belong to the `Progress.Open4GL` namespace and extend the `Progress.Open4GL.Holder` class, as shown in the following table.

Table 5: Holder class definitions

Class	Constructors	Property
`BooleanHolder`	`BooleanHolder( )` `BooleanHolder(bool value)`	`System.Boolean` `BooleanValue;`
`DateHolder`	`DateHolder( )` `DateHolder(System.DateTime value)`	`System.DateTime` `DateValue;`
`DecimalHolder`	`DecimalHolder(decimal value)` `DecimalHolder(double value)`	`System.Decimal` `DecimalValue;`
`IntHolder`	`IntHolder( )` `IntHolder(int value)`	`System.Int32 IntValue;`
`LongHolder`	`LongHolder( )` `LongHolder(long value)`	`System.Int64 LongValue;`

The property specified in the above table allows you to set and get a value with the .NET value type for which it is defined. These classes all contain two additional properties that allow you to set and test for `null`:

- `Value` — To which you can set or get `null`, which corresponds to setting or getting the `Unknown value (?)` for an ABL primitive type.
- `isNull` — A `System.Boolean` property that returns true if the `Value` property of the holder class is set to `null`.

The following table shows ABL primitive types that have a default .NET value-type mapping that cannot accept `Unknown value (?)`. To accept the `Unknown value (?)`, these ABL primitive types are mapped to holder classes in the `Progress.Open4GL` namespace, as shown in the table.

Table 6: ABL primitive type to holder class mappings

This ABL primitive type...	Maps to this holder class...
DATE DATETIME DATETIME-TZ	Progress.Open4GL.DateHolder
DECIMAL	Progress.Open4GL.DecimalHolder
INT64	Progress.Open4GL.LongHolder
INTEGER	Progress.Open4GL.IntHolder
LOGICAL	Progress.Open4GL.BooleanHolder
RECID	Progress.Open4GL.LongHolder

Set an INPUT or INPUT-OUTPUT parameter to the Unknown value (?)

For `INPUT` or `INPUT-OUTPUT` parameters, you can set an input value to the `Unknown value (?)` by setting the `Value` property on the holder object to `null`.

So, in C#, to set the value of a holder object (*`Holder`*) to the `Unknown value (?)`, use the `Value` property, as shown:

Syntax

```
Holder.Value=null
```

Test an INPUT-OUTPUT or OUTPUT parameter for the Unknown value (?)

For `OUTPUT` and `INPUT-OUTPUT` parameters, you can find out whether an output `Unknown value (?)` is returned by testing if the `IsNull` property is `true` or the `Value` property on the holder object equals `null`.

For example, in C#, to test the value of a holder object (*`Holder`*), check the `isNULL` or `Value` property, as shown:

Syntax

```
if (Holder.isNull) | if (Holder.Value == null)
```

ABL temp-table to ADO.NET DataTable mappings

The ABL temp-table maps closely to an ADO.NET DataTable. The temp-table can be passed in a remote ABL procedure or user-defined function, between .NET and the application server, as a parameter or as part of a ProDataSet parameter (see ABL temp-table to ADO.NET DataTable mappings on page 48). For static temp-table parameters, ProxyGen creates extended ADO.NET DataTable classes for each unique temp-table definition. For dynamic temp-tables, ProxyGen uses the standard ADO.NET DataTable class for the parameters.

In ABL, you can define a temp-table as being `LIKE` a database table, and you can add fields of any type to this definition, or you can define the table as a set of fields independent of any particular database table. You can also define indexes to manage large sets of data efficiently.

An ADO.NET DataTable shares all of these characteristics. Thus, OpenEdge supports:

- The creation of a temp-table on the application server
- Passing that temp-table to a .NET client application
- Allowing that application to manipulate the data using an ADO.NET DataTable
- Returning data changes to the application server to update any data source for the temp-table

To support the mapping of ABL temp-tables to ADO.NET DataTables, OpenEdge establishes detailed correspondences between temp-table components and similar ADO.NET objects. This includes the mapping of such elements as temp-table field data types and temp-table component attributes. For more information on the mapping of temp-table field data types, see PassTABLE and TABLE-HANDLE parameters on page 59. The following sections describe the mapping of temp-table components and their attributes:

- Map temp-table components on page 48
- Map temp-table component attributes on page 49
- Resolve differences between ABL and .NET date and time implementations on page 54
- Map the XML-NODE-TYPE attribute to ADO.NET on page 54

Map temp-table components

The following table shows how a given ABL temp-table and its related components map to its companion objects in ADO.NET.

Table 7: ABL temp-table component to ADO.NET object mapping

ABL component	.NET object

Buffer / Temp-Table	`System.Data.DataTable`
	`System.Data.DataRow`
	
	or strongly typed DataTable

Buffer Field	`System.Data.DataColumn`
Primary Key	`System.Data.UniqueConstraint`
Unique non-primary index	`System.Data.UniqueConstraint`

Map temp-table component attributes

In addition to mapping temp-table components, OpenEdge maps relevant attributes of temp-table components for use in a .NET Open Client. These ABL attributes are similar to .NET properties and some of them map to actual ADO.NET properties.

Attributes on temp-table and related ABL components are similar to object properties. They allow you to query and modify information for these components in ABL. Many of these attributes are not meaningful in the .NET environment and require no mapping by OpenEdge. Among those attributes that are meaningful, some correspond to equivalent ADO.NET properties that already maintain the same information for equivalent .NET objects. Still others require some form of mapping by OpenEdge in order to maintain the corresponding information in ADO.NET.

For those ABL attributes that require mapping, OpenEdge maps some of them to existing ADO.NET properties. For other mapped attributes, OpenEdge provides static methods on a `Progress.Open4GL.ProDataTable` utility class that allow you to maintain these values in the corresponding ADO.NET DataTable.

Note: `Progress.Open4GL.ProDataTable` participates in the class hierarchy of strongly-typed DataTable classes generated by ProxyGen. However, you only use `Progress.Open4GL.ProDataTable` directly as a utility class in order to access its static methods.

The following sections describe the attribute mappings supported by OpenEdge using existing ADO.NET properties or OpenEdge `ProDataTable` class methods. For more information on mappings that use an OpenEdge `ProDataTable` class method, see the corresponding method description in ProDataTable class methods on page 75.

Temp-table and buffer attribute mappings

The following table lists ABL attributes of a temp-table parameter and its buffer (or of a temp-table that is part of a ProDataSet parameter) and how they map to the corresponding ADO.NET DataTable passed in a .NET Open Client.

Table 8: Mapping ABL temp-table and buffer attributes to ADO.NET

ABL temp-table or buffer attribute	ADO.NET mapping	Description
BEFORE-TABLE	Progress.Open4GL.ProDataTable .GetBImageFlag (System.Data.DataTable *dt*) Progress.Open4GL.ProDataTable .SetBImageFlag (System.Data.DataTable *dt*, bool *flag*)	For the ADO.NET DataTable specified by *dt*, these static methods get or set an indication of whether the DataTable corresponds to an ABL temp-table that has a before-table defined for it on the application server using the BEFORE-TABLE option (or attribute). For more information, see Before-image methods on page 76.
DATA-SOURCE-MODIFED	Progress.Open4GL.ProDataTable .GetDataSourceModified (System.Data.DataTable *dt*)	For the ADO.NET DataTable specified by *dt*, this static method returns an indication whether any data source row is modified from the original temp-table values passed from the application server as part of a ProDataSet. For more information, see GetDataSourceModified( ) on page 81.
ERROR-STRING	Progress.Open4GL.ProDataTable .GetErrorString (System.Data.DataTable *dt*) Progress.Open4GL.ProDataTable .SetErrorString (System.Data.DataTable *dt*, string *newValue*) System.Data.DataRow.RowError	For the ADO.NET DataTable specified by *dt*, these static methods get or set the value of the corresponding temp-table ERROR-STRING attribute. For more information, see Error handling methods on page 80.The RowError property gets or sets the ERROR-STRING attribute on the corresponding temp-table buffer (row value).
NAME	System.Data.DataTable.TableName	Gets or sets the name of the corresponding temp-table.
NAMESPACE-PREFIX	System.Data.DataTable.Prefix	Gets or sets the XML namespace prefix on the specified ADO.NET DataTable for the corresponding ABL temp-table.
NAMESPACE-URI	System.Data.DataTable.Namespace	Gets or sets the XML namespace on the specified ADO.NET DataTable for the corresponding ABL temp-table.
PRIMARY	System.Data.UniqueConstraint System.Data.DataTable.PrimaryKey	

ABL temp-table or buffer attribute	ADO.NET mapping	Description
		The `DataTable.PrimaryKey` maps to the corresponding temp-table's primary index. It contains an array of `DataColmun` objects that compose the primary key. This same array of columns is contained in the `DataTable.Constraints` collections as a `UniqueConstraint` object, where the `UniqueConstraint.isPrimary` property is `true`.
`REJECTED`	`Progress.Open4GL.ProDataTable.GetRejected (System.Data.DataTable dt)`	For the ADO.NET DataTable specified by *`dt`*, this static method returns an indication of whether any changes from the corresponding temp-table values in the original ProDataSet were rejected on the application server. For more information, see GetRejected( ) on page 81.
`ROW-STATE`	`System.Data.DataRow.RowState`	Returns the current change state of the corresponding row (buffer) of a temp-table in a ProDataSest parameter.
`UNDO`	`Progress.Open4GL.ProDataTable.GetUndo (System.Data.DataTable dt)`	For the ADO.NET DataTable specified by *`dt`*, this static method returns an indication of whether the corresponding temp-table is defined as `UNDO` on the application server. For more information, see GetUndo( ) on page 83.

Buffer-field attribute mappings

The following table lists ABL attributes of a buffer-field component from a row of a temp-table parameter (or of a temp-table that is part of a ProDataSet parameter) and how they map to the corresponding ADO.NET DataColumn in a row of the corresponding DataTable passed in a .NET Open Client.

Table 9: Mapping ABL buffer-field attributes to ADO.NET

ABL buffer-field attribute	ADO.NET mapping	Description
BUFFER-VALUE	System.Data.DataRow.Item	Gets or sets the current data value of a corresponding buffer-field.
COLUMN-LABEL	System.Data.DataColumn.Caption	Gets or sets the label for the column of data associated with the corresponding buffer-field. **Note:** If this attribute is blank, the Caption property maps the LABEL attribute, and if the LABEL attribute is blank, the property maps the NAME attribute.
DATA-TYPE	Progress.Open4GL.ProDataTable .GetColumnProType( ) Progress.Open4GL.ProDataTable .SetColumnProType( ) System.Data.DataColumn.DataType	For a given ADO.NET DataTable or DataColumn (depending on overloading), these static methods get or set the ABL data type of the corresponding buffer-field. For more information, see Column-related (buffer-field) methods on page 77.The DataType property gets or sets a .NET data type that maps to the ABL data type of the corresponding buffer-field according to the mappings shown in Data type mapping for temp-table fields on page 60.
EXTENT	Progress.Open4GL.ProDataTable .IsExtentColumn (System.Data.DataTable *dt*, string *colName*) Progress.Open4GL.ProDataTable .SetExtentColumns (System.Data.DataTable *dt*, string *proFieldName*, string *startColName*, int *extent*)	For the ADO.NET DataTable specified by *dt*, these static methods indicate if a given DataColumn is part of a corresponding ABL array field (IsExtentColumn( )) or set the location and number of DataColumns that comprise the extent associated with a corresponding ABL array field (SetExtentColumns( )). For more information, see Array methods on page 75.
INITIAL	System.Data.DataColumn.DefaultValue	

ABL buffer-field attribute	ADO.NET mapping	Description
		Gets or sets the default value for the specified ADO.NET DataColumn when creating new rows. This value corresponds to the value of the initial schema field (always CHARACTER) in the corresponding ABL buffer-field object, formatted with the specified buffer-field format. **Note:** When working with ABL DATE, DATETIME, and DATETIME-TZ temp-table fields, you must work around differences between the corresponding ABL and .NET data types. For more information, see Resolve differences between ABL and .NET date and time implementations on page 54.
KEY	System.Data.DataColumn.Unique	Indicates if the corresponding buffer-field participates in a temp-table index.
LABEL	System.Data.DataColumn.Caption	Gets or sets the label for the corresponding buffer-field. **Note:** Maps if the COLUMN-LABEL attribute for the corresponding buffer-field is blank. However, if LABEL is also blank, maps to the NAME attribute.
MANDATORY	System.Data.DataColumn.AllowDBNull	Indicates if a corresponding buffer-field is a required field.
NAME	System.Data.DataColumn.ColumnName DataColumn.Caption Progress.Open4GL.ProDataTable .GetArrayFieldName( )	Gets or sets the name of the corresponding buffer-field. If the COLUMN-LABEL and LABEL attributes are both blank for a corresponding buffer-field, the Caption property also maps this attribute value.For a given ADO.NET DataTable or DataColumn (depending on overloading), the static method (GetArrayFieldName( )) gets the name of the corresponding array buffer-field of which the specified column is a part. For more information, see Array methods on page 75.

ABL buffer-field attribute	ADO.NET mapping	Description
POSITION	Progress.Open4GL.ProDataTable .GetPosition (System.Data.DataColumn *dc*)	For the ADO.NET DataColumn specified by *dc*, this static method gets the position of the buffer-field object in the original database record. For more information, see GetPosition( ) on page 79.
READ-ONLY	System.Data.DataColumn.ReadOnly	Indicates if the corresponding buffer-field is write-protected.
XML-NODE-TYPE	System.Data.DataColumn.ColumnMapping	Gets or sets the MappingType Enumeration of the specified ADO.NET DataColumn when it is written to XML using the WriteXml( ) method. The possible values correspond to the ABL CHARACTER values that you can specify for the XML-NODE-TYPE attribute. For more information, see Map the XML-NODE-TYPE attribute to ADO.NET on page 54.

Resolve differences between ABL and .NET date and time implementations

An ABL DATE field can have its initial value set to the ABL TODAY built-in function, which returns the current date. Similarly, an ABL DATETIME or DATETIME-TZ field can have its initial value set to the ABL NOW built-in function, which returns the current date and time. When you create a new record for a temp-table in ABL that contains fields with these data types, and these fields are defined as initialized with the corresponding built-in functions, they are initialized to the date or date and time (respectively) when the record is created.

However, .NET does not provide exactly the same capability for the corresponding ADO.NET DataColumn of type System.DateTime. The System.Data.DataColumn.DefaultValue property sets a specific value for an object (the DataColumn). So, for a DateTime DataColumn, you must set a specific (and static) date or date and time.

To work around this limitation, you can programmatically set the value for any ADO.NET DataColumn of type System.DateTime using two .NET properties that correspond to the ABL TODAY and NOW built-in functions, thus:

1. The System.DataTime.Today property returns a DateTime instance initialized with the current date.
2. The System.DataTime.Now property returns a DateTime instance initialized with the current date and time.

Map the XML-NODE-TYPE attribute to ADO.NET

As shown in the above table, the XML-NODE-TYPE attribute on a given ABL buffer-field directly corresponds to the System.Data.DataColumn.ColumnMapping property for the corresponding ADO.NET DataColumn. The following table shows how the CHARACTER value of the ABL attribute corresponds to the ADO.NET MappingType Enumeration member values.

Table 10: Mapping the XML-NODE-TYPE attribute

This XML-NODE-TYPE value . . .	Corresponds to this ADO.NET MappingType member value . . .
"ATTRIBUTE"	Attribute
"ELEMENT"	Element
"HIDDEN"	Hidden
"TEXT"	SimpleContent

ABL ProDataSet to ADO.NET DataSet mappings

The ABL DATASET (*ProDataSet*) maps closely to an ADO.NET DataSet. The ProDataSet is passed between .NET and the application server as a parameter to a procedure or user-defined function. For static ProDataSets, ProxyGen creates extended ADO.NET DataSet classes for each unique ProDataSet definition. For dynamic ProDataSets, ProxyGen uses the standard ADO.NET DataSet class for the parameters.

The ProDataSet is a collection of one or more member temp-table buffers. It also optionally contains a collection of data-relations among the member temp-table buffers. Each of these temp-table buffers can also have a data source associated with it. You can define temp-tables for ProDataSets in exactly the same way as for passing temp-table parameters (see ABL temp-table to ADO.NET DataTable mappings on page 48).

An ADO.NET DataSet shares all of these characteristics. Thus, OpenEdge supports:

- The creation of a ProDataSet on the application server
- Passing that ProDataSet to a .NET client application
- Allowing that application to manipulate the data using an ADO.NET DataSet
- Returning any data changes to the application server to update the data source for the ProDataSet

To support the mapping of ABL ProDataSets to ADO.NET DataSets, OpenEdge establishes detailed correspondences between ProDataSet components and similar ADO.NET objects. This includes the mapping of such elements as temp-table field data types and ProDataSet component attributes. For more information on the mapping of temp-table field data types, see PassTABLE and TABLE-HANDLE parameters on page 59.

The following sections describe the mapping of ProDataSet components and their attributes:

- Map ProDataSet components on page 56
- Map ProDataSet component attributes on page 56

Map ProDataSet components

The following table shows how a given ABL ProDataSet and its related components map to its companion objects in ADO.NET.

Table 11: ABL ProDataSet component to ADO.NET object mapping

ABL component	.NET object
ProDataSet	`System.Data.Dataset` or strongly typed DataSet

Buffer / Temp-Table	`System.Data.DataTable`
	`System.Data.DataRow`
	
	or strongly typed DataTable

Buffer Field	`System.Data.DataColumn`
Data-Relation	`System.Data.DataRelation`
Primary Key	`System.Data.UniqueConstraint`
Unique non-primary index	`System.Data.UniqueConstraint`

Map ProDataSet component attributes

In addition to mapping ProDataSet components, OpenEdge maps relevant attributes of ProDataSet components for use in a .NET Open Client. These ABL attributes are similar to .NET properties and some of them map to actual ADO.NET properties.

Attributes on ProDataSet and related ABL components are similar to object properties. They allow you to query and modify information for these components in ABL. Many of these attributes are not meaningful in the .NET environment and require no mapping by OpenEdge. Among those attributes that are meaningful, some correspond to equivalent ADO.NET properties that already maintain the same information for equivalent .NET objects. Still others require some form of mapping by OpenEdge in order to maintain the corresponding information in ADO.NET.

For those ABL attributes that require mapping, OpenEdge maps some of them to existing ADO.NET properties. For other attributes, OpenEdge provides static methods on a `Progress.Open4GL.ProDataSet` utility class that allow you to maintain these values in the corresponding ADO.NET DataSet.

Note: `Progress.Open4GL.ProDataSet` participates in the class hierarchy of strongly-typed DataSet classes generated by ProxyGen. However, you only use `Progress.Open4GL.ProDataSet` directly as a utility class in order to access its static methods.

The following sections describe the attribute mappings supported by OpenEdge using existing ADO.NET properties or OpenEdge `ProDataSet` class methods. For more information on mappings where OpenEdge provides a `ProDataSet` class method, see the corresponding method description in ProDataSet class methods on page 83.

ProDataSet attribute mappings

The following table lists ABL attributes of an ABL ProDataSet parameter and how they map to the corresponding ADO.NET DataSet parameter passed in a .NET Open Client.

Table 12: Mapping ABL ProDataSet attributes to ADO.NET

ABL ProDataSet attribute	ADO.NET mapping	Description
DATA-SOURCE-MODIFED	`Progress.Open4GL.ProDataSet .GetDataSourceModified (System.Data.DataSet ds)`	For the ADO.NET DataSet specified by *ds*, this static method returns an indication whether any data source row is modified from the original temp-table values passed from the application server as part of the ProDataSet. For more information, see GetDataSourceModified( ) on page 81.
NAME	`System.Data.DataSet.DataSetName`	Gets or sets the name of the corresponding ProDataSet.
NAMESPACE-PREFIX	`System.Data.DataSet.Prefix`	Gets or sets the XML namespace prefix on the specified ADO.NET DataSet for the corresponding ABL ProDataSet.
NAMESPACE-URI	`System.Data.DataSet.Namespace`	Gets or sets the XML namespace on the specified ADO.NET DataSet for the corresponding ABL ProDataSet.
REJECTED	`Progress.Open4GL.ProDataSet .GetRejected (System.Data.DataSet ds)`	For the ADO.NET DataSet parameter specified by *ds*, this static method returns an indication of whether any changes from original ProDataSet values were rejected on the application server. For more information, see GetRejected( ) on page 81.

Data-relation attribute mappings

The following table lists ABL attributes of an ABL data-relation component passed as part of a ProDataSet parameter and how they map to the corresponding ADO.NET DataRelation of the corresponding ADO.NET DataSet parameter passed in a .NET Open Client.

Table 13: Mapping ABL data-relation attributes to ADO.NET

ABL data-relation attribute	ADO.NET mapping	Description
NAME	System.Data.DataRelation.RelationName	Gets or sets the name of the corresponding ABL data-relation.
NESTED	System.Data.DataRelation.Nested	Gets or sets a logical (.NET boolean) value indicating whether child rows of the specified ADO.NET DataRelation are nested within parent rows when they are written as XML. If the value is true, the child row elements are nested within respective parent row elements. If the value is false, the child row elements follow their respective parent row elements in sequence.
RELATION-FIELDS	System.Data.DataRelation.ChildColumns System.Data.DataRelation.ParentColumns	Gets or sets the list of join fields between the parent and child of the corresponding ABL data-relation.

PassTABLE and TABLE-HANDLE parameters

This section describes mapping ABL temp-tables to ADO.NET DataTables, using the TABLE and TABLE-HANDLE parameters.

ABL procedures can pass TABLE or TABLE-HANDLE parameters to an application server. This is a convenient and efficient way to pass relational data between the client and the application server code. The .NET Open Client environment provides the same capability using an ADO.NET DataTable. A .NET Open Client passes an ABL TABLE parameter using an ADO.NET strongly typed DataTable object that is generated by ProxyGen and mapped to the specified temp-table. This strongly typed DataTable object inherits from Progress.Open4GL.ProDataTable, which in turn inherits from the standard ADO.NET class, System.Data.DataTable.

TABLE–HANDLE parameters allow the transfer of dynamic temp-tables between Open Clients and the application server, without requiring a complete, static definition of the table on each side of the transfer (as with TABLE parameters). A .NET Open Client passes an ABL TABLE-HANDLE parameter using an ADO.NET DataTable object, System.Data.DataTable.

For each unique static temp-table (TABLE parameter), ProxyGen generates a strongly typed DataTable class, *TypedDataTable*.cs. *TypedDataTable* is the name of the static temp-table in the ABL procedure, appended with DataTable. For example, in a procedure with a static temp-table CustTT, *TypedDataTable* is CustTTDataTable. If other temp-table parameters in other methods in the proxy share the same schema, ProxyGen does not create additional strongly typed DataTable classes but uses the same strongly typed DataTable class for these methods. The name of the temp-table parameter does not matter when comparing the schema of temp-table parameters. However, field names, types, and indexes **do** need to match. (This differs from ABL in which field names and indexes do **not** need to match.)

Also, if ProxyGen detects two or more temp-table parameters with the same name but different schemas, ProxyGen creates multiple strongly typed DataTable classes, one for each unique schema. ProxyGen appends a unique number to the end of the temp-table name, to create unique class names. For example, if multiple procedures define a static temp-table `CustTT`, each with a different schema, *`TypedDataTable`* can be `CustTTDataTable`, `CustTT2DataTable`, and so on.

All strongly typed DataTable classes are defined in the following namespace:

```
[namespace.]StrongTypesNS
```

Where *`namespace`* is the **General** namespace you optionally entered in the .NET **Client Details** group of the ProxyGen **Generate Proxies** dialog box. (See Namespace for proxy objects on page 18.)

This section covers the following topics:

- Static and dynamic temp-tables on page 60
- Data type mapping for temp-table fields on page 60
- Unknown value (?) on page 62
- Temp-table array fields on page 62
- Indexes for temp-tables on page 62
- Pass a TABLE or TABLE-HANDLE as an INPUT parameter on page 62
- Provide ABL extensions for INPUT TABLE-HANDLE parameters on page 63
- Pass a TABLE or TABLE-HANDLE as an INPUT parameter on page 62
- Pass a TABLE or TABLE-HANDLE as an OUTPUT parameter on page 63
- Temp-table examples on page 64

Static and dynamic temp-tables

In ABL, you can pass a static temp-table using the `TABLE` parameter, in which case the table is copied from one procedure to the other. You also can pass a temp-table as a dynamic object, by using the `TABLE-HANDLE` parameter. In this case, the table also is copied, but without the expectation that there is a static temp-table definition in the procedure using the `TABLE-HANDLE` parameter.

The `TABLE` and `TABLE-HANDLE` parameters can be intermixed freely in procedure calls.

Data type mapping for temp-table fields

The following table shows the mappings between individual fields in an ABL temp-table to their corresponding data types in an individual ADO.NET DataTable.

Table 14: Data type conversions for temp-table fields

ABL data type	.NET
BLOB	System.Byte[ ]
CHARACTER	System.String
CLOB	System.String
COM-HANDLE	System.Int64
DATE DATETIME DATETIME-TZ	System.DateTime
DECIMAL	System.Decimal
HANDLE	System.Int64
INT64	System.Int6
INTEGER	System.Int32
LOGICAL	System.Boolea
RAW	System.Byte[ ]
RECID	System.Int64
ROWID	System.Byte[ ]
WIDGET-HANDLE	System.Int64

Unknown value (?)

All temp-table fields can contain the `Unknown value (?)`. For an ADO.NET DataTable, this is specified by each corresponding ADO.NET DataColumn's `AllowDBNull` property being set to `true`. (The default value of a DataColumn's `AllowDBNull` property is `true`.)

Temp-table array fields

In ABL, fields in a temp-table can be defined with an extent option to create a one-dimensional array of the specified data type, with the number of elements specified by the extent. In .NET, an array field in an ABL temp-table is flattened, such that each array element becomes a separate column of the DataTable.

For static temp-table parameters, the strongly typed class generated by ProxyGen automatically flattens array fields in the table into the required number of columns. The meta data for the table knows which columns are part of the array and maps the data between the flattened model in .NET and the array model in ABL.

For dynamic temp-table parameters, the parameter is mapped to a .NET `System.Data.DataTable` class. For `OUTPUT` parameters, this DataTable is created with any array fields flattened, such that each array element becomes a separate column of the DataTable. For `INPUT` and `INPUT-OUTPUT` parameters, the client must create an instance of a .NET `System.Data.DataTable` to provide the schema and data. For temp-tables with array fields, the client must provide ABL-specific mappings for the DataTable. For more information, see Pass a TABLE or TABLE-HANDLE as an INPUT-OUTPUT parameter on page 63 and Provide ABL extensions for INPUT TABLE-HANDLE parameters on page 63.

Indexes for temp-tables

In ABL, you can define indexes for temp-tables, one of which can be marked as the primary index. An index can consist of one of more fields in the temp-table.

.NET DataTables can only represent unique indexes (unique primary indexes and unique non-primary indexes).

If an ABL procedure has a temp-table parameter or a ProDataSet parameter (which contains temp-tables) and a temp-table has one or more unique indexes, the resulting .NET DataTable has a `UniqueConstraint` object for each index. For the primary index, its corresponding `UniqueConstraint.PrimaryKey` property is set to `true`. All other non-unique indexes are ignored because there is no corresponding .NET constraint to which they can be mapped.

For more information on .NET DataTable constraints, see the Microsoft .NET documentation.

Pass a TABLE or TABLE-HANDLE as an INPUT parameter

When the client application passes a static temp-table (`TABLE` parameter) as an `INPUT` parameter, the client must provide an instance of the strongly typed DataTable class provided by ProxyGen. In this case, the definition of the temp-table is known at compile time, and the proxy already knows the schema (meta data) for the temp-table; therefore, the client application does not need to supply the schema, only the data. The client can add rows to the temp-table using the `Rows.Add( )` method on the strongly typed DataTable class.

When the client application passes a dynamic temp-table (`TABLE-HANDLE` parameter) as an `INPUT` parameter, the proxy does not know the schema (meta data) for the temp-table. In this case, the client must provide an instance of `System.Data.DataTable` that contains both the schema and data for the `TABLE-HANDLE` parameter. The client can use the methods on the `System.Data.DataTable` class to add the schema and rows for the temp-table. Also, the client might need to define ABL-specific mappings for the DataTable. See Provide ABL extensions for INPUT TABLE-HANDLE parameters on page 63.

Note: It is important that the schema field order defined for the .NET DataTable match the physical order defined for the temp-table in ABL. See Provide ABL extensions for INPUT TABLE-HANDLE parameters on page 63.

Since all strongly typed DataTable classes inherit from `System.Data.DataTable` and contain extensions necessary to provide the ABL-specific mappings, these classes can also be passed as an `INPUT TABLE-HANDLE` parameter, as long as the ABL procedure is written to process the schema and data provided in the strongly typed DataTable class.

For `INPUT` parameters, all the data must be put into the parameter before the proxy call is made.

Provide ABL extensions for INPUT TABLE-HANDLE parameters

For dynamic temp-table `INPUT` parameters, you can create an instance of the ADO.NET `System.Data.DataTable` class with the appropriate schema, data, and ABL-specific mappings, or you can use an existing instance (if appropriate) of a strongly-typed DataTable class as defined by ProxyGen.

To support ABL-specific features for a new `DataTable` instance, you might also need to specify ABL extensions for the DataTable that support the mapping to an ABL temp-table. ABL provides the `Progress.Open4GL.ProDataTable` utility class to define these ABL extensions for a DataTable. For more information, see ProDataTable class methods on page 75.

Pass a TABLE or TABLE-HANDLE as an INPUT-OUTPUT parameter

`INPUT-OUTPUT TABLE` and `TABLE-HANDLE` parameters are a combination of `INPUT` and `OUTPUT` parameters. The client application must pass an object instance for the parameter as defined for input parameters. For a `TABLE` parameter, the client must provide an instance of the strongly typed DataTable class provided by ProxyGen. For a `TABLE-HANDLE` parameter, the client must provide a strongly typed DataTable (if applicable) or an instance of `System.Data.DataTable` that contains both the schema and data, as well as any ABL-specific mappings. For more information, see Pass a TABLE or TABLE-HANDLE as an INPUT parameter on page 62.

`OUTPUT TABLE-HANDLE` parameters can be returned as Unknown or undefined. As a result, you must ensure the client code is written to handle these cases.

For `INPUT-OUTPUT` parameters, all the data must be put into the parameter before the proxy call is made. Any data in the parameter at the time of the method is replaced on return from the proxy call. All output data is immediately available to the client after the proxy call returns.

During this process, the input object is supplied by the client, then cleared, repopulated with output data, and retuned. For this reason, the schema for the object must match on both sides of the call.

Pass a TABLE or TABLE-HANDLE as an OUTPUT parameter

When the client application calls a method with a static temp-table (`TABLE` parameter) `OUTPUT` parameter, the client must provide a variable of the strongly typed DataTable class provided by ProxyGen. In this case, the client does not need to instantiate the object.

Note: This strongly typed DataTable class instance can then be used to pass an appropriate proxy `INPUT` temp-table parameter.

When the client application calls a method with a dynamic temp-table (TABLE-HANDLE parameter) OUTPUT parameter, the client must provide a variable of type System.Data.DataTable. Again, the client does not need to instantiate the object. In this case, the parameter can be returned as Unknown or undefined. As a result, you must ensure the client code is written to handle these cases.

On return from the method, the client can access rows of the temp-table using the Rows property on the strongly typed DataTable or System.Data.DataTable class.

Any data in the parameter at the time of the method call is replaced on return from the proxy object. All output data is immediately available to the client after the proxy call returns.

Temp-table examples

This section provides some code examples for temp-tables.

Note: These samples are not available for download on the Progress Communities Web site.

Sample static temp-table

The following example shows a static temp-table definition in a persistent procedure, PaymentInfo.p.

Static temp-table in a persistent procedure

```
DEFINE TEMP-TABLE PaymentInfoTT
  FIELD payment-date AS DATE
  FIELD payee-id     AS INTEGER
  FIELD payee-name   AS CHARACTER
  FIELD amount       AS DECIMAL
  FIELD cleared      AS LOGICAL.

PROCEDURE getPaymentsInfo:
  DEFINE INPUT  PARAMETER fromDate AS DATE.
  DEFINE OUTPUT PARAMETER TABLE FOR PaymentInfoTT.
```

For this parameter, ProxyGen generates the following:

- PaymentInfoTT.cs with the following class definition:

```
Acme.StrongTypesNS.PaymentInfoTTDataTable
```

- The following method in the proxy:

```
public void getPaymentsInfo(System.DateTime fromDate,
        out Acme.StrongTypesNS.PaymentInfoTTDataTable PaymentInfoTT)
```

The following example shows a static temp-table definition in an external procedure, setPaymentInfo.p.

Static temp-table in an external procedure

```
DEFINE TEMP-TABLE MySetPaymentInfoTT
  FIELD payment-date   AS DATE
  FIELD payee-id       AS INTEGER
  FIELD payee-name     AS CHARACTER
  FIELD amount         AS DECIMAL
  FIELD cleared        AS LOGICAL.

DEFINE INPUT PARAMETER TABLE FOR MySetPaymentInfoTT.
```

Since the schema for these two static temp-table parameters is the same, ProxyGen uses the previously generated, strongly typed DataTable in the proxy method generated for this external procedure. For example:

```
public void setPaymentInfo(System.DateTime fromDate,
        out Acme.StrongTypesNS.PaymentInfoTTDataTable MySetPaymentInfoTT)
```

For `INPUT` and `INPUT-OUTPUT` parameters, the .NET client code must supply an instance of the strongly typed DataTable object. For `OUTPUT` parameters, the strongly typed DataTable variable must be declared, but the instance is created by ABL and returned to the .NET client.

Sample dynamic parameter

The following example shows a `TABLE-HANDLE` parameter.

TABLE-HANDLE parameter

```
PROCEDURE getOrderInfo:
  DEFINE INPUT PARAMETER TABLE-HANDLE tth1.
```

For this parameter, ProxyGen generates the following method in the proxy:

```
public void getOrderInfo(System.Data.DataTable tth1)
```

For `INPUT` and `INPUT-OUTPUT` parameters, the .NET client code must supply an instance of a strongly typed DataTable or an instance of a `System.Data.DataTable` object that contains the appropriate schema and data, as well as any required ABL-specific mappings. For `OUTPUT` parameters, the DataTable variable must be declared, but the instance is created by ABL and returned to the .NET client with all necessary ABL mappings. For more information on these mappings, see ABL temp-table to ADO.NET DataTable mappings on page 48.

Sample .NET Open Client application using a temp-table

The following examples show sample code for calling a procedure with a temp-table.

Calling a procedure with an output dynamic temp-table

```
// Calling a procedure with an output dynamic temp-table.
Account appObj = new Account("http://host:portnumber/apsv", "", "", "");
System.Data.DataTable outDT = null;

// Call the procedure
appObj.GetTTOut(out outDT);

// Run through the ABL DataTable. First output the schema.
int numCols = outDT.Columns.Count;
for (int ix = 0; ix < numCols; ix++)
{
   System.Console.WriteLine(outDT.Columns[ix].ColumnName + " " +
       outDT.Columns[ix].DataType.ToString( ));
}
// Output the data.
foreach (DataRow dr in outDT.Rows)
// Print the first column in the row.
{
   System.Console.WriteLine(" Column 1 " + dr.Columns[0]);
}
```

Calling a procedure with an input dynamic temp-table

```
// Calling a procedure with an input dynamic temp-table.
// The ABL DataTable has 2 columns, integer and string.
Account appObj = new Account("http://host:portnumber/apsv", "", "", "");
System.Data.DataTable inDT = new System.Data.DataTable( );
inDT.Columns.Add("acctnum", typeof(int));
inDT.Columns.Add("Name", typeof(string));
DataRow testRow;

// Add 3 rows of data.
for (int i = 1; i <= 3; i++)
{
   testRow = inDT.NewRow( );
   testRow[0] = i;
   testRow[1] = "Test String " + i.ToString( );
   inDT.Rows.Add(testRow);
}

// Call the procedure
appObj.SetTTIn(inDT);
```

Pass DATASET and DATASET-HANDLE parameters

This section describes mapping ABL ProDataSets to ADO.NET DataSets, using the `DATASET` and `DATASET-HANDLE` parameters.

ABL procedures can pass DATASET or DATASET-HANDLE parameters to an application server. This is a convenient and efficient way to pass relational data between the client and the application server code. The .NET Open Client environment provides the same capability using an ADO.NET DataSet. A .NET Open Client passes an ABL DATASET parameter using an ADO.NET strongly typed DataSet object that is generated by ProxyGen and mapped to the specified ProDataSet. This strongly typed DataSet object inherits from Progress.Open4GL.ProDataSet, which in turn inherits from the standard ADO.NET System.Data.DataSet class.

DATASET-HANDLE parameters allow the transfer of dynamic ProDataSets between Open Clients and the application server, without requiring a complete, static definition of the ProDataSet on each side of the transfer (as with DATASET parameters). A .NET Open Client passes an ABL DATASET-HANDLE parameter using an ADO.NET DataSet object, System.Data.DataSet.

For each unique static ProDataSet (DATASET parameter), ProxyGen generates a strongly typed DataSet class, *TypedDataSet*.cs. *TypedDataSet* is the name of the static ProDataSet in the ABL procedure, appended with DataSet. When comparing the static definitions of two ProDataSets, the name of the ProDataSet and the member buffers do not need to match for the ProDataSets to map to a single ADO.NET DataSet. However, field names, types, and indexes **do** need to match. (This differs from ABL in which field names and indexes do **not** need to match.) For example, in a procedure with a static ProDataSet CustOrderDS, *TypedDataSet* is CustOrderDSDataSet. Each temp-table in the ProDataSet is created as a DataTable within the DataSet class. If other ProDataSet parameters in other methods in the proxy share the same schema, ProxyGen does not create additional strongly typed DataSet classes but uses the same strongly typed DataSet class for these methods. The name of the ProDataSet parameter does not matter when comparing the schema of ProDataSet parameters.

Also, if ProxyGen detects two or more ProDataSet parameters with the same name but different schemas, ProxyGen creates multiple strongly typed DataSet classes, one for each unique schema. ProxyGen appends a unique number to the end of the DataSet name, to create unique class names. For example, if multiple procedures define a static ProDataSet CustOrderDS, each with a different schema, *TypedDataSet* can be CustOrderDSDataSet, CustOrderDS2DataSet, and so on.

All strongly typed DataSet classes are defined in the following namespace:

```
[namespace.]StrongTypesNS
```

Where *namespace* is the **General** namespace you optionally entered in the .NET **Client Details** group of the ProxyGen **Generate Proxies** dialog box. (See Namespace for proxy objects on page 18.)

This section covers the following topics:

- Static and dynamic ProDataSets on page 68.
- Data-type mapping for ProDataSets on page 68.
- Pass a DATASET or DATASET-HANDLE as an INPUT parameter on page 68.
- Provide ABL extensions for INPUT DATASET-HANDLE parameters on page 68.
- Pass a DATASET or DATASET-HANDLE as an INPUT-OUTPUT parameter on page 69.
- Pass a DATASET or DATASET-HANDLE as an OUTPUT parameter on page 69.
- Update a DataSet on page 69.
- ProDataSet examples on page 70.

Static and dynamic ProDataSets

In ABL, you can pass a static ProDataSet using the DATASET parameter, in which case the ProDataSet is copied from one procedure to the other. You also can pass a ProDataSet as a dynamic object, by using the DATASET-HANDLE parameter. In this case, the ProDataSet also is copied, but without the expectation there is a static ProDataSet definition in the procedure using the DATASET-HANDLE parameter.

The DATASET and DATASET-HANDLE parameters can be intermixed freely in procedure calls.

Data-type mapping for ProDataSets

In ABL, since ProDataSets contain a collection of temp-tables, the data-type mapping defined for temp-tables is used for ProDataSets. See Data type mapping for temp-table fields on page 60.

Pass a DATASET or DATASET-HANDLE as an INPUT parameter

When the client application passes a static ProDataSet (DATASET parameter) as an INPUT parameter, the client must provide an instance of the strongly typed DataSet class provided by ProxyGen. In this case, the definition of the ProDataSet is known at compile time, and the proxy already knows the schema (meta data) for the ProDataSet, including the tables it contains; therefore, the client application does not need to supply the schema, only the data. The client can add rows to each of the tables within the dataset using the Rows.Add( ) method on the DataTable class.

When the client application passes a dynamic ProDataSet (DATASET-HANDLE parameter) as an INPUT parameter, the proxy does not know the schema (meta data) for the ProDataSet. In this case, the client must provide an instance of System.Data.DataSet that contains both the schema and data for the DATASET-HANDLE parameter. The client can use the methods on the System.Data.DataSet class to add the schema, tables, and rows for each table of the ProDataSet. Also, the client might need to define ABL-specific mappings for the DataSet. See Provide ABL extensions for INPUT DATASET-HANDLE parameters on page 68.

Since all strongly typed DataSet classes inherit from System.Data.DataSet and contain extensions necessary to provide the ABL-specific mappings, these classes can also be passed for an INPUT DATASET-HANDLE parameter, as long as the ABL procedure is written to process the schema and data provided in the strongly typed DataSet class.

For INPUT parameters, all the data must be put into the parameter before the proxy call is made.

Provide ABL extensions for INPUT DATASET-HANDLE parameters

For dynamic ProDataSet INPUT parameters, you can create an instance of the ADO.NET System.Data.DataSet class, or you can use an existing instance (if appropriate) of a strongly-typed DataSet class as defined by ProxyGen. For a new DataSet instance, you must then define the schema of the DataSet and add the tables and any data.

To support ABL-specific features for a new DataSet instance, you might also need to specify ABL extensions for the DataTables within the DataSet that provide mappings to the corresponding ABL temp-tables. ABL provides the Progress.Open4GL.ProDataTable utility class to define these ABL extensions for each DataTable. For more information, see ProDataTable class methods on page 75. You might also need to specify ABL extensions for the DataSet that support the mapping to an ABL ProDataSet. ABL provides the Progress.Open4GL.ProDataSet utility class to define these ABL extensions for a DataSet. For more information, see ProDataSet class methods on page 83.

Pass a DATASET or DATASET-HANDLE as an INPUT-OUTPUT parameter

INPUT-OUTPUT DATASET and DATASET-HANDLE parameters are a combination of INPUT and OUTPUT parameters. The client application must pass an object instance for the parameter as defined for input parameters. For a DATASET parameter, the client must provide an instance of the strongly typed DataSet class provided by ProxyGen. For a DATASET-HANDLE parameter, the client must provide a strongly typed DataSet (if applicable) or an instance of System.Data.DataSet that contains both the schema and data, as well as any ABL-specific mappings.

For more information on the DATASET and DATASET-HANDLE forms for specifying a dataset parameter, see 'Pass a ProDataSet as a parameter' in the *Use ProDataSets* documentation.

DATASET-HANDLE parameters can be returned as Unknown or undefined. As a result, you must ensure the client code is written to handle these cases.

On return from the method, the client can access the rows of the tables contained in the ProDataSet using the Tables and Rows properties on the strongly typed DataSet or System.Data.DataSet class.

For INPUT-OUTPUT parameters, all the data must be put into the parameter before the proxy call is made. Any data in the parameter at the time of the method is replaced on return from the proxy call. All output data is immediately available to the client after the proxy call returns.

During this process, the input object is supplied by the client, then cleared, repopulated with output data, and retuned. For this reason, the schema for the object must match on both sides of the call.

Pass a DATASET or DATASET-HANDLE as an OUTPUT parameter

When the client application calls a method with a static ProDataSet (DATASET parameter) OUTPUT parameter, the client must provide a variable of the strongly typed DataSet class provided by ProxyGen. In this case, the client does not need to instantiate the object.

Note: This strongly typed DataSet class instance can then be used to pass an appropriate proxy INPUT ProDataSet parameter.

When the client application calls a method with a dynamic ProDataSet (DATASET-HANDLE parameter) OUTPUT parameter, the client must provide a variable of type System.Data.DataSet. Again, the client does not need to instantiate the object. In this case, the parameter can be returned as Unknown or undefined. As a result, you must ensure the client code is written to handle these cases.

On return from the method, the client can access the rows of the tables contained in the ProDataSet using the Tables and Rows properties on the on the strongly typed DataSet or System.Data.DataSet class.

Any data in the parameter at the time of the method call is replaced on return from the proxy object. All output data is immediately available to the client after the proxy call returns.

Update a DataSet

DataSets are useful for passing updated data between a client and server. Typically, the client obtains the DataSet from the application server, makes changes to the DataSet, and sends those changes back to the application server. The application server matches the records back to the original datasource, verifies that the records were not changed by other users, and then applies the changes to the datasource. The server passes back the final versions of records that may have been further changed on the server, along with any errors.

DataSets in both .NET and ABL have built-in support for updating. In addition to being an in-memory cache of data, DataSets keep track of which records were changed (modified, added, or deleted). They also keep track of the original or before-image versions of modified or deleted records, so the server can compare those records against the current records in the datasource. (ProDataSets on the application server need to define a before table to keep track of original values.)

The normal processing of DataSets for update is as follows:

1. Get an original DataSet to the client, normally using an `OUPUT` parameter.
2. Make changes to the DataSet on the client.
3. When you are ready to send updates to the server, call the `GetChanges` method on the `System.Data.DataSet` class. This returns you a new `System.Data.DataSet` with only the changed (modified, added, or deleted) records, including the original versions of the modified and deleted records. This is the DataSet that should be sent back to the application server for update, since there is no reason to send back any records that did not change.

   Note: You may find it best to send updates to the application server whenever a single set of related records are updated, for example, a Customer record and all associated orders. Packaging updates simplifies the reconciliation process back from the application server to the original DataSet on the client.

4. Send the changes-only DataSet from Step 3 to the application server. Typically, this DataSet is sent as an `INPUT-OUTPUT` parameter, so the results from the application server's DataSet update can be passed back to the client.
5. Process the return from the application server. On output, the DataSet contains the changes-only DataSet, including any further updated records or errors from the application server. Note that only updates to the current set of changed records are included, not updates by other users to records not in the current set.
6. Match each row in the changes-only DataSet back to the row in the original DataSet, and refresh the client DataSet as necessary. Once the refresh is complete, call the `AcceptChanges( )` method on your DataSet. Your DataSet is now ready for more changes, as in Step 2.

ProDataSet examples

This section provides some code examples for ProDataSets.

Note: These samples are not available for download on the Progress Communities Web site.

Sample static ProDataSet

The following example shows a static ProDataSet definition in a persistent procedure, `CustomersAndOrders.p`.

Static ProDataSet in a persistent procedure

```
DEFINE TEMP-TABLE OrderInfo
  FIELD order-date AS DATE
  FIELD quantity   AS INTEGER.

DEFINE TEMP-TABLE CustomerInfo
  FIELD cust-name AS CHARACTER
  FIELD address   AS CHARACTER.

DEFINE DATASET OrderDS for OrderInfo, CustomerInfo.

PROCEDURE getOrders:
  DEFINE OUTPUT PARAMETER DATASET FOR OrderDS.
```

For this parameter, ProxyGen generates the following:

- `OrderDS.cs` with the following class definition:

```
Acme.StrongTypesNS.OrderDSDataSet
```

- The following method in the proxy:

```
public void getOrders(out Acme.StrongTypesNS.OrderDSDataSet orderDS)
```

The following example shows a static ProDataSet definition in an external procedure, `SetCustomersAndOrders.p`.

Static ProDataSet in a procedure

```
DEFINE TEMP-TABLE OrderInfo
  FIELD order-date AS DATE
  FIELD quantity   AS INTEGER.

DEFINE TEMP-TABLE CustomerInfo
  FIELD cust-name AS CHARACTER
  FIELD address   AS CHARACTER.

DEFINE DATASET MySetOrderDS FOR OrderInfo, CustomerInfo.

DEFINE INPUT PARAMETER DATASET FOR MySetOrderDS.
```

Since the schema for these two static DataSet parameters is the same, ProxyGen uses the previously generated, strongly typed DataSet in the proxy method generated for this external procedure. For example:

```
public void SetCustomersAndOrders(Acme.StrongTypesNS.OrderDSDataSet mySetOrderDS)
```

For INPUT and INPUT-OUTPUT parameters, the .NET client code must supply an instance of the strongly typed DataSet object. For OUTPUT parameters, the strongly typed DataSet variable must be declared, but the instance is created by ABL and returned to the .NET client as a parameter.

Sample dynamic ProDataSet

The following example shows a DATASET-HANDLE parameter.

DATASET-HANDLE parameter

```
PROCEDURE getOrders:
  DEFINE OUTPUT PARAMETER DATASET-HANDLE dsetHndl.
```

For this parameter, ProxyGen generates the following method in the proxy:

```
public void getOrders(out System.Data.DataSet dsetHndl)
```

For INPUT and INPUT-OUTPUT parameters, the .NET client code must supply an instance of a strongly typed DataSet or an instance of the System.Data.DataSet object that contains the appropriate schema and data, as well as any required ABL-specific mappings. For OUTPUT parameters, the DataSet variable must be declared, but the instance is created by ABL and returned to the .NET client as a parameter with all the necessary ABL mappings. For more information on these mappings, see ABL ProDataSet to ADO.NET DataSet mappings on page 55.

Sample .NET Open Client application using a ProDataSet

The following example shows sample code for calling a procedure with a ProDataSet.

Calling a procedure with an output static ProDataSet

```
// The specified namespace is Acme
using Acme.StrongTypesNS;

// Calling a procedure with an output static ProDataSet.
Account appObj = new Account("http://host:portnumber/apsv", "", "", "");
OrderDSDataSet outDS = null;

// Call the procedure.
appObj.GetCustomersAndOrders(out outDS);

// Assign the ProDataSet to a DataGrid.
myForm.dataGrid1.DataSource = outDS;
myForm.dataGrid1.DataMember = "Customers";
myForm.dataGrid1.ReadOnly = true;
myForm.dataGrid1.CaptionText = "Number of Customers: " +
    outDS.Tables["ttCust"].Rows.Count;
```

Sample ProDataSet update

The code examples in this section show how to pass a changes-only DataSet (that is, a DataSet that contains only records that have been added, updated, or deleted) to the application server and properly process the changes.

The following example shows one way to handle updates in a .NET Open Client environment.

.NET update DataSet procedure

```
//Define two strongly-typed DataSets
using Acme.StrongTypesNS;
dsOrderDataSet dsOrders;
dsOrderDataSet dsUpdatedRecs;
      .
      .
      .
// Populate the dsUpdatedRecs DataSet with only the changed rows
dsUpdatedRecs = (dsOrderDataSet)
 (dsOrders.GetChanges( ));
// Confirm that there are updates before continuing
if (dsUpdatedRecs != null)
   {
      appObj.UpdateDS(ref dsUpdatedRecs);
      if (dsUpdateRecs.Tables["orderline"].HasErrors)
         {
            displayMessage = "The following Orderline rows were not updated:";
            foreach(DataRow failedRow in
                    dsUpdatedRecs.Tables ["orderline"].Rows)
            {
               if (failedRow.HasErrors)
               {
                 displayMessage += "\n\r Line number: " +
                        failedRow["linenum"].ToString( ) +  ",
                 Error Message: " + failedRow.RowError;
               }
                .
                .
                .
            }
        }
    }
else
   {
      dspMsg ="All updates succeeded";
      dspCaption = "Save completed";
      dspButton = MessageBoxButtons.OK;
      resultDlog = MessageBox.Show(this, dspMsg, dspCaption, dspButton,
         MessageBoxIcon.Information,
         MessageBoxDefaultButton.Button1,
         MessageBoxOptions.RightAlign);
   }
// Remove the pending additional order lines before merging to prevent
// duplicate rows if the key fields on the row number were changed during the //
 update.
foreach(DataRow curRow in dtTableTwo.Select("", "", DataViewRowState.Added))
   {
      dtTableTwo.Rows.Remove(curRow);
   }
// Merge the changes
dsOrders.Merge(dsUpdatedRecs);

   // Reset the row state for the modified rows now that changes
dsOrders.AcceptChanges( );
```

Note: For the sake of simplicity, this example does not include standard error checking. Make sure that you include error checking in your application code.

The following example shows temp-table definitions in an ABL include file, `sOrderTables.i`.

Include file definition of temp-table definitions

```
/* dsOrderTables.i -- include file for Temp-Table definitions */
DEFINE TEMP-TABLE ttOrder FIELDS (...)
  INDEX OrderNum IS UNIQUE PRIMARY OrderNum.
DEFINE TEMP-TABLE ttOLine FIELDS (...) BEFORE-TABLE ttOlineBefore
  INDEX orderline IS UNIQUE PRIMARY Ordernum Linenum.
```

The following example shows a static ProDataSet definition in an ABL include file, `dsOrderDef.i`.

Include file definition of DataSet dsOrder

```
/* dsOrderDef.i -- include file definition of DATASET dsOrder. */
DEFINE DATASET dsOrder FOR ttOrder, ttOLine
  DATA-RELATION OrderLine FOR ttOrder, ttOLine
    RELATION-FIELDS (OrderNum, OrderNum).
```

The following example shows an ABL procedure that updates the database with a DataSet that contains only records that have been modified (added, updated, or deleted).

ABL update DataSet procedure

```
{OrderTables.i}
{OrderDS.i}

DEFINE INPUT-OUTPUT PARAMETER DATASET FOR dsOrder.

DEFINE VARIABLE hSrcOline   AS HANDLE  NO-UNDO.
DEFINE VARIABLE returnValue AS LOGICAL NO-UNDO.

DEFINE DATA-SOURCE srcOline FOR Orderline.
hSrcOline = DATA-SOURCE srcOline:HANDLE.

BUFFER ttOLine:ATTACH-DATA-SOURCE(hSrcOline).

FOR EACH ttOlineBefore TRANSACTION:
  returnValue = BUFFER ttOlineBefore:SAVE-ROW-CHANGES("Orderline") NO-ERROR.
END.

DELETE OBJECT hSrcOline.
RETURN.
```

ProDataTable class methods

The Open Client toolkit provides a `Progress.Open4GL.ProDataTable` utility class that you can use to extend the standard functionality available in the ADO.NET `System.Data.DataTable` class. These extensions complete features that allow any `DataTable` object to fully map an ABL temp-table. You can add these extensions to any DataTable using `ProDataTable` class (static) methods. These methods associate extended property name/value pairs with a specified ADO.NET `DataTable` object. These extended properties map meaningful functionality in a .NET environment that is available in ABL temp-tables but is not otherwise supported by the ADO.NET `System.Data.DataTable` class. You can use these methods to get or set the specified property values for both DataTable instances that you create and strongly-typed DataTable instances generated by ProxyGen.

The syntax for the methods available on this class are given in the following sections.

Array methods

The following methods provide information about array fields in a temp-table. (For more information, see Column-related (buffer-field) methods on page 77.)

GetArrayFieldName( )

Returns the array field name with which the specified DataColumn is associated. If it is not part of an array, it returns null. The syntax is:

Syntax

```
static string GetArrayFieldName(System.Data.DataTable dt, string colName)
static string GetArrayFieldName(System.Data.DataColumn dc)
```

The array field name for a DataColumn is set when `ProDataTable.SetExtentColumns()` is called.

IsExtentColumn( )

Returns `true` if the specified column in the specified DataTable is part of a temp-table array field. The syntax is:

Syntax

```
static bool IsExtentColumn(System.Data.DataTable dt, string colName)
```

Where *colName* is the name of the column in the DataTable.

SetExtentColumns( )

Specifies a set of columns that are the flattened representation of a temp-table array field for the specified DataTable. The syntax is:

Syntax

```
static void SetExtentColumns(System.Data.DataTable dt, string proFieldName,
                             string startColName, int extent)
```

Where:

- *proFieldName* is the name of the array field in the temp-table. If *proFieldName* is not specified, the value of *startColName* is used
- *startColName* is the name of the first flattened column in the DataTable
- *extent* is the number of columns, including *startColName*, to include in the array

For example, a DataTable with the columns Name, Phone, Month1, Month2, Month3, Month4, Month5, Month6, Month7, Month8, Month9, Month10, Month11, and Month12 that mapped to a temp-table with three columns, Name, Phone, and Month with extent 12, would need to have a call to this method as follows:

```
ProdataTable.SetExtentColumns(myDataTbl, "Month", "Month1", 12)
```

Before-image methods

The following methods get or set a flag based on whether the corresponding ABL temp-table has a before-table defined for it on the application server using the ABL BEFORE-TABLE option (or attribute). This before-table is a temp-table that contains the original records of an ABL temp-table that have been modified as part of a changed ProDataSet, and it corresponds to the set of original DataRow instances maintained internally for a changed ADO.NET DataTable.

GetBImageFlag( )

Syntax

Returns true if the specified DataTable maps to an ABL temp-table that has a before-table defined for it. The syntax is:

```
static bool GetBImageFlag(System.Data.DataTable dt)
```

SetBImageFlag( )

Sets a value for *flag* that indicates if the DataTable specified by *dt* maps to an ABL temp-table that has a before-table defined for it on the application server. The syntax is:

Syntax

```
static void SetBImageFlag(System.Data.DataTable dt, bool flag)
```

If you set *flag* to `true`, you can only pass *dt* back to an application server as part of an ADO.NET DataSet that corresponds to a ProDataSet `INPUT` parameter. You must also ensure that the corresponding ABL temp-table has a before-table defined for it on the application server.

Column-related (buffer-field) methods

The following methods access information about temp-table fields (buffer-fields) that correspond to a specified DataTable column. (See also, Array methods on page 75.) For methods that get or set the ABL data type of a DataTable column, the *proType* argument must correspond to one of the valid ABL temp-table field data types found in the `Progress.Open4GL.Parameter` class, as shown in the following table.

Table 15: ABL temp-table field data types

ABL temp-table field data type	Progress.Open4GL.Parameter class constant
BLOB	PRO_BLOB
CHARACTER	PRO_CHARACTE
CLOB	PRO_CLOB
COM-HANDLE	PRO_COMHANDLE
DATE	PRO_DAT
DATETIME	PRO_DATETIME
DATETIME-TZ	PRO_DATETIMETZ
DECIMAL	PRO_DECIMAL
INT64	PRO_INT64
INTEGER	PRO_INTEGER
LOGICAL	PRO_LOGICAL
RAW	PRO_RAW
RECID	PRO_RECID
ROWID	PRO_ROWID
	PRO_WIDGETHANDLE

ABL temp-table field data type	Progress.Open4GL.Parameter class constant
WIDGET-HANDLE	

GetColumnProType( )

Returns the integer value representing the ABL data type (see Table 15) for the specified DataColumn. The syntax is:

Syntax

```
static int GetColumnProType(System.Data.DataTable dt, string colName)
```

Where *colName* is the name of the column in the DataTable.

```
static int GetColumnProType(System.Data.DataColumn dc)
```

Where *dc* is the DataColumn.

GetPosition( )

Gets the position in the original database record of the database field that corresponds to the temp-table buffer-field object mapped to the `DataColumn` object, *dc*. The syntax is:

Syntax

```
static int GetPosition(System.Data.DataColumn dc)
```

Note: This setting applies only to ABL buffer-field objects that originate in an OpenEdge RDBMS.

GetUserOrder( )

Returns the 0-based display position of the specified DataColumn within its DataTable. The syntax is:

Syntax

```
static int GetUserOrder(System.Data.DataColumn dc)
```

SetColumnProType( )

Sets the ABL data type for the specified data column, where *proType* must correspond to one of the valid ABL-specific class constants found in the `Progress.Open4GL.Parameter` class (see Table 15). The syntax is:

Syntax

```
static void SetColumnProType(System.Data.DataTable dt, string colName,
                             int proType)
```

Where *colName* is the name of the column in the DataTable.

```
static void SetColumnProType(System.Data.DataColumn dc, int proType)
```

Where *dc* is the DataColumn.

SetUserOrder( )

Sets the 0-based display position of the specified DataColumn. The syntax is:

Syntax

```
static void SetUserOrder(System.Data.DataColumn, int userOrder)
```

Error handling methods

The following methods get or set an error string associated with the specified DataTable returned from or sent to ABL. These methods map to the temp-table `ERROR-STRING` attribute.

GetErrorString( )

When passed a DataTable that corresponds to an `INPUT-OUTPUT` or `OUTPUT` temp-table parameter, returns any error information provided by the remote ABL method. The syntax is:

Syntax

```
static string GetErrorString(System.Data.DataTable dt)
```

SetErrorString( )

Sets the ABL error string associated with the specified DataTable. When passed a DataTable that corresponds to an `INPUT` or `INPUT-OUTPUT` temp-table parameter, you can use the following method to relay the error string to the remote ABL method:

Syntax

```
static void SetErrorString(System.Data.DataTable dt, string newValue)
```

Where *newValue* is the error string value.

Data source related methods

The following methods return information about updates to the application server data source for a specified temp-table that is passed as part of a ProDataSet parameter.

GetDataSourceModified( )

Returns `true` if a data source row associated with the specified DataTable was modified from original temp-table values. This method maps to the temp-table `DATA-SOURCE-MODIFIED` attribute that is typically set during invocation of the ABL buffer object `SAVE-ROW-CHANGES( )` method on the application server. The syntax is:

Syntax

```
static bool GetDataSourceModified(System.Data.DataTable dt)
```

You typically query this value on the corresponding temp-table from an output ProDataSet parameter that was previously passed as input with changes from the .NET Open Client.

GetRejected( )

Returns `true` if any changes to the specified DataTable from the corresponding temp-table values in the original ProDataSet were rejected on the application server. This method maps to the temp-table `REJECTED` attribute. The syntax is:

Syntax

```
static bool GetRejected(System.Data.DataTable dt)
```

You typically query this value on the corresponding temp-table of an output ProDataSet parameter that was previously passed as input with changes from the .NET Open Client.

Schema marshaling methods

The following methods verify or specify if schema information is to be marshalled with a given DataTable that is passed to the application server.

Note: ABL temp-tables support a SCHEMA-MARSHAL attribute that controls the marshalling of schema information from the application server to the client. However, these methods do not map that attribute, but provide corresponding functionality for a DataTable.

GetNoSchemaMarshal( )

Returns `true` if the DataTable parameter is not marshaled with schema information to the application server; it returns `false` if schema information is marshaled. The syntax is:

Syntax

```
static bool GetNoSchemaMarshal(System.Data.DataTable dt)
```

SetNoSchemaMarshal( )

When *`flag`* is set to `true`, allows the specified DataTable to be marshaled from the .NET client to the application server without schema information. The syntax is:

Syntax

```
static void SetNoSchemaMarshal(System.Data.DataTable dt, bool flag)
```

Using this method suppresses index descriptions and all field information and aids in faster transmission of data, thereby increasing the performance of your application.

You can use this method when the receiving side knows the schema definition for the table and validation is not necessary.

The corresponding ABL temp-table on the application server must have the same schema as the DataTable on the client. You can use the `SetNoSchemaMarshal( )` method with a strongly typed DataTable parameter or a DataTable within a strongly typed DataSet parameter. If set to `true`, when the DataTable is sent to the application server, the AVM generates a `Progress.Open4GL.Exceptions.RunTime4GLErrorException` if the ABL temp-table's schema does not match the incoming data from the .NET client.

Also see PROGRESS.Session.NoSchemaMarshal on page 105 for related functionality.

Transaction methods

OpenEdge provides a single method that returns information about how the corresponding temp-table behaves during an OpenEdge transaction.

GetUndo( )

Returns `true` if the corresponding temp-table (passed as a parameter or as part of a ProDataSet parameter) is defined statically as `UNDO` or has its temp-table object `UNDO` attribute set to `TRUE`. The syntax is:

Syntax

```
static bool GetUndo(System.Data.DataTable dt)
```

ProDataSet class methods

The Open Client toolkit provides a `Progress.Open4GL.ProDataSet` utility class that you can use to extend the standard functionality available in the ADO.NET `System.Data.DataSet` class. These extensions complete features that allow any `DataSet` object to fully map an ABL ProDataSet. You can add these extensions to any ADO.NET DataSet using `ProDataSet` class (static) methods. These methods associate extended property name/value pairs with a specified ADO.NET `DataSet` object. These extended properties map meaningful functionality in a .NET environment that is available in ABL ProDataSets but is not otherwise supported by the ADO.NET `System.Data.DataSet` class. You can use these methods to get or set the specified property values for both DataSet instances that you create and the strongly-typed DataSet instances generated by ProxyGen.

The syntax for the methods available on this class are given in the following sections.

Data source update-related methods

The following methods return information about updates to the application server data sources for a specified ProDataSet parameter.

GetDataSourceModified( )

Returns `true` if any data source row in DataTables associated with the specified DataSet was modified from original ProDataSet values. This method maps to the ProDataSet `DATA-SOURCE-MODIFIED` attribute that is typically set during invocation of the temp-table buffer object `SAVE-ROW-CHANGES( )` method. The syntax is:

Syntax

```
static bool GetDataSourceModified(System.Data.DataSet ds)
```

You typically query this value on an output ProDataSet parameter that was previously passed as input with changes from the .NET Open Client.

GetRejected( )

Returns `true` if any changes to the specified DataSet from the corresponding values in the original ProDataSet were rejected on the application server. This method maps to the ProDataSet `REJECTED` attribute. The syntax is:

Syntax

```
static bool GetRejected(System.Data.DataSet ds)
```

You typically query this value on an output ProDataSet parameter that was previously passed as input with changes from the .NET Open Client.

5

Access Proxy Properties

The Open Client Runtime provides several properties that determine the behavior of the client application. These properties are called *proxy properties*. You can specify proxy properties default behavior with an application configuration file and/or by calling methods on the OpenEdge-provided classes, `Progress.Open4GL.RunTimeProperties` and `Progress.Open4GL.Connection`.

There are several properties that govern behavior across an entire application. These properties do not affect any particular object, but they affect the behavior of all objects created by the application. They are referred to as *proxy run-time properties*.

Other properties govern behavior across a single application service. These properties are called *Connection properties*.

This content describes the different ways you can access proxy properties.

For details, see the following topics:

- Application configuration file
- RunTimeProperties and Connection classes
- Access properties with methods
- Access properties directly
- Relationship between RunTimeProperties and Connection objects
- Modify an instantiated Connection object's properties
- Alphabetical listing of properties

Application configuration file

You can control some of the capabilities of a client application using an application configuration file. This allows the application capabilities to be modified without requiring any changes to the client code. The application configuration file is optional; if none is provided, the default behavior is used.

For a list of the properties that you can set in the configuration file, see Alphabetical listing of properties on page 100.

To create an application configuration file, you can define an XML file for the application, with the extension `.config`. For example, if the client application is named `MyApp.exe`, create an XML file named `MyApp.exe.config` (in the same directory as the `.exe` file). A sample application configuration file follows:

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
   <appSettings>
       <add key="PROGRESS.Session.LoggingLevel" value="2" />
       <add key="PROGRESS.Session.EnableTracing" value="0" />
   </appSettings>
</configuration>
```

For more information about application configuration files in .NET, see the Microsoft .NET documentation.

RunTimeProperties and Connection classes

.NET Open Client provides two classes that you can use to access the properties of an application:

- `RunTimeProperties` class
- `Connection` class

RunTimeProperties class

The `Progress.Open4GL.RunTimeProperties` class contains static methods and global property values. You can call the methods on this class to change the value of the proxy properties. You can also access the properties directly.

The `RunTimeProperties` class has a set of default values. Any properties set using an application configuration file are represented by the `RunTimeProperties` class.

ServerName RunTime Property

You can set the Subject Name Indicator (SNI) name for a .NET client by using the following property:

```
Progress.Open4GL.RunTimeProperties.ServerName = "servername";
```

`servername`

Specifies the server name in TLS connection initialization for client that it sends to the server as part of the TLS negotiation.

For example, `Progress.Open4GL.RunTimeProperties.ServerName = "www.example.com";`

If the .NET client does not send any valid SNI name available in the server configuration, the server selects a default virtual hostname and returns the respective certificate.

Connection class

The `Progress.Open4GL.Connection` class stores application server connection information, which can be passed to the AppObject constructor when connecting to the application server. It contains methods and property values; however, it does not contain any static methods. You must create an instance of the class and call methods to change the value of the proxy properties.

When you create an instance of the `Connection` class (a `Connection` object), it inherits the initial values of its properties from the `RunTimeProperties` class. You can then override these values programmatically.

When you create an instance of the `Connection` class (a `Connection` object), it inherits the initial values of its properties from the `RunTimeProperties` class. You can then override these values programmatically. These changes only affect the proxy objects that are associated with this `Connection` object.

If you change the value of a property in a `Connection` object after it has been instantiated, the Connection object might not recognize the change, depending on the session model. For more information, see Modify an instantiated Connection object's properties on page 98.

Note: Changes to the properties of a `Connection` object have no effect on the global values of the `RunTimeProperties` class.

Access properties with methods

You can access properties on the `RunTimeProperties` class and on instances of the `Connection` class using a set of general property accessor methods. These methods access properties according to the method type (get or set) and the property name:

- General property accessor methods for the RunTimeProperties class on page 87
- General property accessor methods for Connection objects on page 88
- Available properties on page 89
- Access properties using purposed accessor methods on page 91

General property accessor methods for the RunTimeProperties class

You can access global properties by property name using the `get` and `set` general purpose methods. When you use these methods, you must call the correct accessor based on the data type of the property. The following is the syntax for these general methods:

Get property methods syntax

```
public static string    GetStringProperty(string propName)
public static int       GetIntProperty(string propName)
public static long      GetLongProperty(string propName)
public static boolean   GetBooleanProperty(String propName)
```

Set property methods syntax

```
public static void   SetStringProperty(string propName, string propValue)
public static void   SetIntProperty(string propName, int propValue)
public static void   SetLongProperty(string propName, long propValue)
public static void   SetBooleanProperty(string propName, boolean propValue)
```

propName

The property name. This can be any of the properties listed in the tables in Available properties on page 89.

propValue

The value for *propName*.

Example

For example, to set the PROGRESS.Session.InitialConnections property to 5, use the following method to set an integer property:

```
RunTimeProperties.SetIntProperty("PROGRESS.Session.InitialConnections",5);
```

General property accessor methods for Connection objects

You can access Connection object properties by property name using the get and set general purpose methods. When you use these methods, you must call the correct accessor based on the data type of the property. The following is the syntax for these general methods:

Get property methods syntax

```
public string    GetStringProperty(string propName)
public int       GetIntProperty(string propName)
public long      GetLongProperty(string propName)
public boolean   GetBooleanProperty(String propName)
```

Set property methods syntax

```
public void   SetStringProperty(string propName, string propValue)
public void   SetIntProperty(string propName, int propValue)
public void   SetLongProperty(string propName, long propValue)
public void   SetBooleanProperty(string propName, boolean propValue)
```

propName

The property name. This can be any of the properties listed in the tables in Available properties on page 89.

propValue

The value for *propName*.

Example

For example, to set the PROGRESS.Session.InitialConnections property to 5, use the following method to set an integer property:

```
ConnectObj.SetIntProperty("PROGRESS.Session.InitialConnections",5);
```

Where *ConnectObj* is an instance of the Progress.Open4GL.Proxy.Connection class.

Available properties

The following table lists all of the available properties according to their functional category. For more information on these property categories, see Access properties directly on page 92. For a detailed description of each property, see Alphabetical listing of properties on page 100.

Table 16: Available properties

Category	Properties
Session	• PROGRESS.Session.ConnectionLifetime on page 101 • PROGRESS.Session.ConnectionTimeout on page 101 • PROGRESS.Session.HttpTimeout on page 102 • PROGRESS.Session.IdleConnectionTimeout on page 103 • PROGRESS.Session.InitialConnections on page 103 • PROGRESS.Session.MaxConnections on page 104 • PROGRESS.Session.MinConnections on page 104 • PROGRESS.Session.NoSchemaMarshal on page 105 • PROGRESS.Session.RequestWaitTimeout on page 108 • PROGRESS.Session.SessionModel on page 108 • PROGRESS.Session.TcpKeepAliveInterval on page 109 • PROGRESS.Session.TcpKeepAliveTime on page 109 • PROGRESS.Session.TcpMaxDataRetranmission on page 110
Thread control	• PROGRESS.Session.WaitIfBusy on page 110
Proxy server	• PROGRESS.Session.ProxyHost on page 106 • PROGRESS.Session.ProxyPassword on page 106 • PROGRESS.Session.ProxyPort on page 107 • PROGRESS.Session.ProxyUserId on page 107
Secure Sockets Layer management	• PROGRESS.Session.NoHostVerify on page 105

Category	Properties
Tracing	• PROGRESS.Session.EnableTracing on page 102 • PROGRESS.Session.LogFileName on page 103 • PROGRESS.Session.LoggingLevel on page 104 **Note:** These tracing properties apply to the RunTimeProperties class only. (They do **not** apply to Connection objects.)
Compression	• PROGRESS.Session.CompressionEnabled on page 100 • PROGRESS.Session.CompressionLevel on page 100 • PROGRESS.Session.CompressionThreshold on page 101

Access properties using purposed accessor methods

In addition to the general property accessor methods, you can access some properties using purposed methods.

The methods in the following table provide tracing functionality to the Open Client application. These methods apply to the `RunTimeProperties` class only. (They do **not** apply to `Connection` objects.)

Table 17: Tracing methods

Method	Description
`TraceOn(String` *`ConnectObj`*`.SetIntProperty, int` *`ConnectObj`*`.SetIntProperty)`	Sets these properties: • PROGRESS.Session.EnableTracing on page 102=true • PROGRESS.Session.LogFileName on page 103 • PROGRESS.Session.LoggingLevel on page 104
`TraceOn(int` *`ConnectObj`*`.SetIntProperty)`	Sets these properties: • PROGRESS.Session.EnableTracing on page 102=true • PROGRESS.Session.LoggingLevel on page 104
`TraceOn(String` *`ConnectObj`*`.SetIntProperty)`	Sets these properties: • PROGRESS.Session.EnableTracing on page 102=true • PROGRESS.Session.LogFileName on page 103

Access properties directly

In addition to using the property accessor methods, you can access properties directly.

When accessing these properties on the `RunTimeProperties` class, use the class name to access the property. For example:

```
RunTimeProperties.InitialConnections = 5
```

When calling these properties on a `Connection` object, use the instance of the object to access the property. For example:

```
ConnectObj.SetIntProperty.InitialConnections = 5
```

Where *`ConnectObj`* is an instance of the `Progress.Open4GL.Proxy.Connection` class.

Session properties

The following table lists the session properties. For a detailed description of each property, see Alphabetical listing of properties on page 100.

Table 18: Session properties

Property	Description
SessionModel	Sets and gets PROGRESS.Session.SessionModel on page 108
InitialConnections	Sets and gets PROGRESS.Session.InitialConnections on page 103
MaxConnections	Sets and gets PROGRESS.Session.MinConnections on page 104
MinConnections	Sets and gets PROGRESS.Session.MinConnections on page 104
IdleConnectionTimeout	Sets and gets PROGRESS.Session.IdleConnectionTimeout on page 103
ConnectionLifetime	Sets and gets PROGRESS.Session.ConnectionLifetime on page 101
RequestWaitTimeout	Sets and gets PROGRESS.Session.RequestWaitTimeout on page 108

Thread control property

The application server can be accessed from a multi-threaded client. However, the application server itself is not multi-threaded. As a result, only one request can be serviced at a time. If a method is made from the client while another one is still running on the application server, the application can decide which of the following should happen:

- The second call can be queued and executed when the application server becomes available
- The client can get an exception

The application can set the run-time properties to do either and can switch the setting at any time. The default is to throw an exception (`WaitIfBusy=false`).

The property in the following table provides thread control to the Open Client Runtime. For a detailed description of this property, see Alphabetical listing of properties on page 100.

Table 19: Thread control property

Property	Description/Property
WaitIfBusy	Sets and gets PROGRESS.Session.TcpKeepAliveInterval on page 109

Proxy server specification properties

You use proxy server specification properties if a Proxy Web server exists between the client and the application server.

The properties in the following table provide Proxy Web server support to a .NET Open Client application. For a detailed description of each property, see Alphabetical listing of properties on page 100.

Table 20: Proxy server specification properties

Property	Description
`ProxyHost`	Sets and gets `PROGRESS.Session.ProxyHost` on page 106
`ProxyPort`	Sets and gets `PROGRESS.Session.ProxyPort` on page 107
`ProxyUserId`	Sets and gets `PROGRESS.Session.ProxyUserId` on page 107
`ProxyPassword`	Sets and gets `PROGRESS.Session.ProxyPassword` on page 106

Transport Layer Security management properties

When using HTTPS or direct TLS to access the application server, you might need to configure the TLS connections with your client application.

The properties in the following table provide TLS connection options to the Open Client application. For a detailed description of each property, see Alphabetical listing of properties on page 100.

Table 21: Secure Sockets Layer management properties

Property	Description
nohostverify	Sets and gets `PROGRESS.Session.NoHostVerify` on page 105

Tracing property (RunTimeProperties only)

You can use tracing to log highlights of proxy execution, including data received by the client and data passed to the application server. The property in the following table provides tracing functionality to the Open Client application. This property applies to the `RunTimeProperties` class only. (It does **not** apply to `Connection` objects.) For a detailed description of this property, see Alphabetical listing of properties on page 100.

Table 22: Tracing property

Property	Description
`EnableTracing`	Gets and sets `PROGRESS.Session.EnableTracing` on page 102

Compression property

You can compress messages exchanged between the .NET Open Client and the application server. The properties listed in the following table provide compression functionality to the .NET Open Client.

Table 23: Compression property

Property	Description
`CompressionEnabled()`	Gets and sets `PROGRESS.Session.TcpKeepAliveInterval` on page 109Returns `TRUE` if `getCompressionEnabled()` is called. The default value is `FALSE`,
`CompressionLevel()`	Gets and sets `PROGRESS.Session.CompressionLevel` on page 100
`CompressionThreshold()`	Gets and Sets `PROGRESS.Session.CompressionThreshold` on page 101

You can enable compression for the .NET Open Client using the following syntax:

```
using System.Collections.Generic;
using System.Linq;
using System.Text;
using Progress.Open4GL.Proxy;
using Progress.Open4GL.DynamicAPI;

namespace AppServerCompressionExample

{

    class Program

      {
        static void Main(string[] args)
         { Connection conn = new Connection(null, null, "http://host:portnumber/apsv");
            conn.CompressionEnabled = true;
            conn.CompressionLevel = 5;
            conn.CompressionThreshold = 256;

            OpenAppObject app = new OpenAppObject(conn, "testapp");

            ParameterSet pset = new ParameterSet(2);
            pset.setLongCharParameter(0, "longchar value",
            ParameterSet.INPUT);
            pset.setLongCharParameter(1, "", ParameterSet.OUTPUT);
            app.runProcedure("echo.p", pset);

            String echoret = (String) pset.getOutputParameter(1);
            Console.WriteLine("Return : " + echoret);

            app.Dispose();
            conn.ReleaseConnection();
          }
        }
      }
```

The following example uses the `RunTimeProperties` object code to illustrate that compression is enabled, compression level is set to 5, and the message size is set to 256 bytes.

```
Progress.Open4GL.RunTimeProperties.CompressionEnabled = true;

Progress.Open4GL.RunTimeProperties.CompressionLevel = 5;

Progress.Open4GL.RunTimeProperties.CompressionThreshold = 256;
```

Relationship between RunTimeProperties and Connection objects

The values set in a `Connection` object supersede the static `RunTimeProperties` values. This relationship is particularly important if a static `RunTimeProperties` object is updated after a `Connection` object has been instantiated. In this situation, the effect on a `Connection` object instance depends on whether that specific property was overridden in that object after it was instantiated, as described in the following table.

Table 24: Relationship between RunTimeProperties and Connection object properties

If the RunTimeProperties property has . . .	And the property in the Connection object has . . .	Then the value of the property is returned from the . . .
Not changed	Not changed	*RunTimeProperties* class
Changed	Not changed	*RunTimeProperties* class
Not changed	Changed	*Connection* object
Changed	Changed	*Connection* object

Note: The converse of this relationship is not true. That is, changing the value of a property for a `Connection` object does not affect the static value of that property, nor does it affect the value of that property in any other object instance.

The following example uses the `WaitifBusy` property to illustrate the relationship between `RunTimeProperties` and `Connection` object properties:

```
Connection conn;
bool ret;

RunTimeProperties.WaitIfBusy = true;
conn = new Connection(url, userid, password, appserverInfo);
ret = conn.GetBooleanProperty("PROGRESS.Session.WaitIfBusy");
System.Console.WriteLine("(A) WaitIfBusy= " + ret);

RunTimeProperties.WaitIfBusy = false;// change static property
ret = conn.WaitIfBusy; // equivalent accessor method
System.Console.WriteLine("(B) WaitIfBusy= " + ret);

conn.WaitIfBusy = true; // change conn object property
ret = conn.GetBooleanProperty("PROGRESS.Session.WaitIfBusy");
System.Console.WriteLine("(C) WaitIfBusy= " + ret);
RunTimeProperties.SetBooleanProperty("PROGRESS.Session.WaitIfBusy",
                                     false);
ret = conn.WaitIfBusy;
System.Console.WriteLine("(D) WaitIfBusy= " + ret);

RunTimeProperties.WaitIfBusy = true;
ret = conn.GetBooleanProperty("PROGRESS.Session.WaitIfBusy");
System.Console.WriteLine("(E) WaitIfBusy= " + ret);
```

When executed, this program prints the following result:

```
(A) WaitIfBusy= true
(B) WaitIfBusy= false
(C) WaitIfBusy= true
(D) WaitIfBusy= true
(E) WaitIfBusy= true
```

Modify an instantiated Connection object's properties

If you change the value of a property in a `Connection` object after it has been instantiated, the `Connection` object might not recognize the change, depending on the session model as described in the following table.

Table 25: Relationship between Connection object properties and session model

If this Connection object property is updated . . .	Then the update is . . .	
	Session-managed	**Session-free**
PROGRESS.Session.ConnectionLifetime on page 101	*Not applicable*	Ignored
PROGRESS.Session.ConnectionTimeout on page 101	*Recognized once pick list is refreshed*	Recognized once pick list is refreshed
PROGRESS.Session.IdleConnectionTimeout on page 103	*Not applicable*	Ignored
PROGRESS.Session.InitialConnections on page 103	*Not applicable*	Ignored
PROGRESS.Session.MaxConnections on page 104	*Not applicable*	Ignored
PROGRESS.Session.MinConnections on page 104	*Not applicable*	Ignored
PROGRESS.Session.NoHostVerify on page 105	Ignored	Ignored
PROGRESS.Session.ProxyHost on page 106	Ignored	Ignored
PROGRESS.Session.ProxyPassword on page 106	Ignored	Ignored
PROGRESS.Session.ProxyPort on page 107	Ignored	Ignored
PROGRESS.Session.ProxyUserId on page 107	Ignored	Ignored
PROGRESS.Session.RequestWaitTimeout on page 108	*Not applicable*	Recognized for new requests

If this Connection object property is updated . . .	Then the update is . . .	
	Session-managed	Session-free
PROGRESS.Session.TcpKeepAliveInterval on page 109	Recognized	Recognized for new requests

Alphabetical listing of properties

This section contains a reference to the following properties that you can set for a `RuntimeProperties` object or a `Connection` object, including the applicable session model, a complete description of usage, and the default value for each property.

PROGRESS.Session.CompressionEnabled

Data Type:

Logical

Session model:

Session-free and Session-managed

A logical property that allows you to enable or disable compression. This property must be set before establishing the connection between application server and the .NET Open Client. If this property is modified after the connection is established, it does not affect the existing session between other clients and the application server.

Default:

False

PROGRESS.Session.CompressionLevel

Data Type:

Integer

Session model:

Session-free and Session-managed

An integer value that sets the compression level for compressing the body of a message sent to and from the application server. The highest supported value for compression is 9. The valid range for compression is 1-9. If a value is set beyond the range, then, the value that is closest to the range is used. If a value greater than 9 or less than 1 is used, then, the compression level is set to 9 or 1 respectively. The higher the level of compression, the more time it takes to compress a message. Higher compression level results in smaller messages.

Default:

1

PROGRESS.Session.CompressionThreshold

Data Type:

Integer

Session model:

Session-free and Session-managed

An integer value that sets the minimum size in bytes that a message body must have before it can be compressed. The minimum value for compression threshold is 256. The range for compression is 256-32764. If a value is set beyond the specified range, then, the value that is closest to the range is used. If a value greater than 32764 or less than 256 is used, then, the size of the message is set to 32764 or 256 bytes respectively.

Default:

256

PROGRESS.Session.ConnectionLifetime

Data Type:

Integer

Session model:

Session-free only

The maximum number of seconds that a given connection can be used before it is destroyed. Connections whose lifetime exceeds the specified value are destroyed as they become available. (This might cause the number of connections in the pool to temporarily fall below the `PROGRESS.Session.MinConnections` on `page 104` value.)

An available connection is one that is not currently reserved to run a request. Bound connections associated with remote persistent procedures are not available for reuse until the persistent procedure is deleted. As a result, bound connections remain available as long as necessary, even if they exceed the specified value.

Default:

300

PROGRESS.Session.ConnectionTimeout

Data Type:

Integer

Session model:

Session-managed and Session-free only

The connectionTimeout property specifies the duration, in Integer, for which a client must stay connected to the session-managed or session-free application server. A positive Integer value indicates the number of milliseconds after which the client will time out with a connection-timeout or a socket-timeout exception, and then disconnect from the application server . You use this property when you want a client program to disconnect from a long executing connection request.

Default:

0 (indefinite wait)

PROGRESS.Session.EnableTracing

Data Type:

Integer

Session model:

Session-free and session-managed

Determines whether tracing is on (1) or off (0). Tracing logs highlights of proxy execution, including data received by the client and data passed to the application server.

This property applies to the `RunTimeProperties` class only (it does not apply to `Connection` objects).

Default:

0

PROGRESS.Session.HttpTimeout

Data Type:

Integer

Session model:

Session-free and Session-managed

The amount of time, in seconds, that the .NET open client request, to the application server over HTTP, waits before timing out. Progress.Session.HttpTimeout only applies to the .NET OpenClient and then only to the HTTP tunneling of the application server protocol. The property is a passthrough to the .NET HttpWebRequest.Timeout property.

The maximum value for this property is 2,147,483,647 (in seconds).

Default:

100

Default is determined by the .NET HttpWebRequest.Timeout property for the .NET framework.

PROGRESS.Session.IdleConnectionTimeout

Data Type:

Integer

Session model:

Session-free only

The amount of time, in seconds, that the client waits before it attempts to shut down idle network connections to the application server, based on client demand. However, the number of connections does not fall below the PROGRESS.Session.MinConnections on page 104 value.

If this value is zero, idle network connections remain connected.

Default:

0

PROGRESS.Session.InitialConnections

Data Type:

Integer

Session model:

Session-free only

The number of socket connections established when the AppObject is instantiated. If the specified number of connections cannot be created, the AppObject constructor fails and any connections that were successfully created are closed.

Default:

1

PROGRESS.Session.LogFileName

Data Type:

String

Session model:

Session-free and session-managed

The name of the log file to which trace messages are sent. If this property is not set, the tracing output is Standard Error.

This property applies to the `RunTimeProperties` class only (it does not apply to `Connection` objects).

Default:

None

PROGRESS.Session.LoggingLevel

Data Type:

Integer

Session model:

Session-free and session-managed

Determines the level of information logged for tracing. 0 is minimum logging; 7, maximum. The higher the value for this property, the greater the level of information. For more information about logging levels, see *Troubleshoot ABL Applications*.

This property applies to the `RunTimeProperties` class only (it does not apply to `Connection` objects).

Default: 2

PROGRESS.Session.MaxConnections

Data Type:

Integer

Session model:

Session-free only

The maximum number of connections that can be established for a given AppObject. The value must be greater than or equal to zero.

If this value is zero, there is no limit to the number of connections that can be created.

Default:

0

PROGRESS.Session.MinConnections

Data Type:

Integer

Session model:

Session-free only

The minimum number of connections that can be established for a given AppObject. The value should not be greater than the value of `PROGRESS.Session.MaxConnections` on page 104.

If the number of connections falls below the PROGRESS.Session.MinConnections on page 104 value, then sufficient new connections are created (when the next request is run) to bring the size of the connection pool back up to the PROGRESS.Session.MinConnections on page 104 value.

Default:

0

PROGRESS.Session.NoHostVerify

Data Type:

Boolean

Session model:

Session-free and session-managed

Controls domain name checking. If specified, turns off host verification for a TLS-enabled connection, either using HTTPS with the AIA or using a direct connection to a TLS-enabled application server. Without this property specified, the client compares the host name specified in the URL with the Common Name specified in the server certificate, and raises an error if they do not match. With this property specified, the client never raises the error. For more information on TLS-enabled connections, see the sections on PKI and TLS in *OpenEdge Getting Started: Core Business Services - Security and Auditing*.

Specifying FALSE enables domain name checking. Specifying TRUE disables domain name checking.

Default:

FALSE

PROGRESS.Session.NoSchemaMarshal

Data Type:

Boolean

Session model:

Session-free and session-managed

When set to true, this property prevents .NET from sending schema information to the application server for input-output and output DataSet and DataTable properties. The property applies to all DataSet and DataTable parameters for subsequent method calls. Set the property before a proxy method is called. Reset the NoSchemaMarshal property back to false for subsequent proxy method calls if needed.

This property must be used for output only DataSet or DataTable parameters, and not the ProDataTable.SetNoSchemaMarshal( ) method.

This is because the c# compiler considers an output parameter unassigned and it must be assigned before its value is used, therefore, the .NET proxy code is not able to look at the output DataSet or DataTable object to detect if SetNoSchemaMarshal( ) was called.

The property can be used in place of the ProDataTable SetNoSchemaMarshal( ) method. Use this method if you need all DataSet and DataTable parameters in a single proxy method to not pass schema info from .NET to the application server.

For example:

```
RunTimeProperties.NoSchemaMarshal = true;
appObj.getMyDSet(1, out myOutDS);
```

See SetNoSchemaMarshal( ) on page 82 for more details on disabling schema marshaling.

This property applies to the `RunTimeProperties` class only (it does not apply to `Connection` objects).

Note: This property affects schema marshaling from the .NET Open Client to the application server **only**. To alter marshaling from the application server to the client, you can use the `-ttmarshal` startup parameter, or you can use the temp table properties `NO-SCHEMA-MARSHAL` and `MIN-SCHEMA-MARSHAL`. For more information, see *OpenEdge Deployment: Startup Command and Parameter Reference* and *OpenEdge Development: ABL Reference*.

Default:

False

PROGRESS.Session.ProxyHost

Data Type:

String

Session model:

Session-free and session-managed

The name of the host or the IP address of the host at which the Proxy Web server is located. This value can be a string with either the DNS name of the Proxy Web server or its dot-formatted IP address.

When you specify this parameter, all connections made by an application server client using the HTTP or HTTPS protocol connect to an application server using the proxy server at the specified host and port.

Note: If you specify the `PROGRESS.Session.ProxyHost` on page 106 property, you must also specify the `PROGRESS.Session.ProxyPort` on page 107 property.

Default:

None

PROGRESS.Session.ProxyPassword

Data Type:

String

Session model:

Session-free and session-managed

Use to authenticate the application server client to the Proxy Web server. The value can be a string of up to 512 printable ASCII characters.

You should use PROGRESS.Session.ProxyPassword on page 106 when PROGRESS.Session.ProxyHost on page 106 and PROGRESS.Session.ProxyPort on page 107 are specified and the Proxy server requires authentication.

If PROGRESS.Session.ProxyUserId on page 107 is not specified, the connection ignores any value for PROGRESS.Session.ProxyPassword on page 106.

Default:

None

PROGRESS.Session.ProxyPort

Data Type:

Integer

Session model:

Session-free and session-managed

When you specify this property, all connections made by an application server client using the HTTP or HTTPS protocol connect to the application server using the proxy server at the specified host and port.

Note: If you specify the PROGRESS.Session.ProxyPort on page 107 property, you must also specify the PROGRESS.Session.ProxyHost on page 106 property.

Default:

None

PROGRESS.Session.ProxyUserId

Data Type:

String

Session model:

Session-free and session-managed

Use to authenticate an application server client to the Proxy Web server. The user-id can be a string of up to 512 printable ASCII characters, including the space character.

Default:

None

PROGRESS.Session.RequestWaitTimeout

Data Type:

Integer

Session model:

Session-free only

The way requests are handled when no connections are available and the connection pool is full, specified by one of the values shown in the following table.

Table 26: requestWaitTimeout property values

If the value is . . .	The Open Client Runtime . . .
`-1`	Queues the request indefinitely until an application server session becomes available.
`0`	Rejects the request and returns an error message to the client indicating that there are too many concurrent requests.
N	Queues the request the number of seconds specified by the value (*N* must be greater than zero) until the application server becomes available. If no connection becomes available in that time, an error message is returned to the client.

Default:

-1

PROGRESS.Session.SessionModel

Data Type:

Integer

Session model:

Session-free and session-managed

Session model supported by the application server operating mode, specified by one of the values shown in the following table.

Table 27: sessionModel property values

Value	Description
`0`	Session-managed
`1`	Session-free

This property must be set for session-free application. It is optional for session-managed applications.

This value must match the application server operating mode or the connection fails.

Default:

0

PROGRESS.Session.TcpKeepAliveInterval

Data Type:

Integer

Session model:

All

Indicates the interval the client waits before resending a TCP KeepAlive message to the application server. You can customize the time interval by any of the following methods:

- Setting the value of the property in the .NET application configuration file. For more information, see the section on checking for failed client connections section in *OpenEdge Application Server: Administration*.
- Passing the value as an integer parameter in the `setTcpKeepAliveProperty` method. If a user passes an invalid value for the parameter, `TcpKeepAliveInterval`, the system takes the default value. For more information, see the section on checking for failed client connections section in *OpenEdge Application Server: Administration*.

Default:

1000 ms

Note: For more information about the parameter, see Microsoft Windows documentation.

PROGRESS.Session.TcpKeepAliveTime

Data Type:

Integer

Session model:

All

Indicates the duration (in milliseconds), during which the TCP connection between a .NET client and its corresponding application server remains idle before the client sends a TCP KeepAlive message to the application server. You can customize the time duration by any of the following methods:

- Setting the value of the property in the .NET application configuration file. For more information, see the section on checking for failed client connections section in *OpenEdge Application Server: Administration*.
- Passing the value as an integer parameter in the `setTcpKeepAliveProperty` method. If a user passes an invalid value for the parameter, `TcpKeepAliveTime`, the system takes the default value. For more information, see the section on checking for failed client connections section in *OpenEdge Application Server: Administration*.

Default:

7,200,000 ms

Note: For more information about the parameter, see Microsoft Windows documentation.

PROGRESS.Session.TcpMaxDataRetranmission

Data Type:

Integer

Session model:

All

Indicates the maximum number of times a client is allowed to send TCP KeepAlive message to the application server, before the client hangs up the connection. `TcpMaxDataRetranmission` is a system property. The system administrator must configure this property in the system registry.

To edit the number of TCP KeepAlive retrials, you must set the `TcpMaxDataRetransmission` system property. Navigate in your registry to: `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters` and set `TcpMaxDataRetransmission.`

Default:

5

PROGRESS.Session.WaitIfBusy

Data Type:

Integer

Session model:

Session-managed only

An integer value that determines how to handle client requests to a service that is busy processing a prior request. If the value is 1, the Open Client Runtime queues multiple requests for this service and executes them one at a time until the queue is empty. If the value is 0 and the Open Client Runtime is executing a prior request for the service, each subsequent request for the same service fails until the client completes the request it is currently executing.

Default:

0

6

Handle Errors

.NET developers can process ABL error objects as .NET exceptions. To enable .NET proxies to throw these exceptions, OpenEdge establishes the following exception class hierarchies:

- **General ABL exceptions** — A hierarchy of exception classes that extends the `Open4GLException` class.
- **DataSet/DataTable exceptions** — A `ProDataException` class that extends the standard `System.Data.DataException` class.

For a complete object hierarchy see Exception class hierarchy on page 115. To learn more about error handling in ABL code, see "Introduction to error and condition handling" in *ABL Error Handling*

A.NET developers can process ABL error objects as .NET exceptions. To enable .NET proxies to throw these exceptions, OpenEdge establishes the following exception class hierarchies:

- **General ABL exceptions** — A hierarchy of exception classes that extend the `Open4GLException` class. `Open4GLException`, in turn, extends the `ProException` class.
- **DataSet/DataTable exceptions** — A `ProDataException` class that extends the standard `System.Data.DataException` class.

For a complete object hierarchy see Exception class hierarchy on page 115. To learn more about error handling in ABL code,see "Introduction to error and condition handling" in *ABL Error Handling*.

Explore RunTime4GLErrorException class

The Runtime4GLErrorException class hierarchy is shown here.

```
System.Exception
  Progress.Open4GL.Exceptions
    ProException
      Open4GLException
        Runtime4GLException
           RunTime4GLErrorException
             RunTime4GLAppErrorException
```

The following PUBLIC properties are available for classes that inherit from Runtime4GLErrorException class.

- CallStack provides details including the file and line number that threw the error.
- NumMsgs provides the number of error messages.
- Severity provides ABL developers a way to rank their application error objects according to a severity scheme.

The following PUBLIC methods are available for classes that inherit from Runtime4GLErrorException class.

- GetMessage (int) retrieves the message.
- GetMessageNum (int) retrieves the message number for lookup.

Access CallStack information

System administrators must enable the ability to store CallStack information during the testing phase. This allows errors to send the file and line number where errors occurred.

1. Edit the openedge.properties file.
   a. Locate the AppServer.SessMgr properties.
   b. Add -errorstack to the agentStartupParam property.

```
[AppServer.SessMgr]
...
agentStartupParam=-T "${catalina.base}/temp" -errorstack
...
```

2. Save.

When an error is thrown, the message contains CallStack details.

```
CallStack() procAppErrorThrow server.p at line 57 (usr1/work/oepas1/openedge/server.r)
```

Runtime system error condition

In this example, a call made from .NET to the poorly written ABL code raises a runtime system error when the procedure attempts to use the `int()` function on a `character`.

```
// required for errors to get thrown back to the client
ROUTINE-LEVEL ON ERROR UNDO, THROW.
PROCEDURE procInt:
  // this raises a RunTime4GLError
  //  attempts to use INT on a character
  INT (‘a’) .
END.
```

In the .NET client, the exception provides a return message that identifies the issue. The return message is `RunTime4GLErrorException.ERROR condition: Invalid character in numeric input a. (76) (7211)`. The `invalid character in a numeric input a (76) (7211)`, identifies the problem in the ABL code.

Additionally, .NET developers are thrown a specific exception class **`RunTime4GLErrorException`** that can help determine how to process the exception.

Throw an application error

ABL developers can explicitly throw an error to .NET developers. This procedure shows the type of statements needed to throw an error. In the ABL code, developers would use an `UNDO, THROW appErr` where `appErr` is of type `Progress.lang.App` that maps to the .NET `RunTime4GLAppErrorException` exception . In this example, the ABL developer uses the `AppError` object to store a custom message that provides additional details to the .NET developers.

```
ROUTINE-LEVEL ON ERROR UNDO, THROW.
PROCEDURE procAppErrorThrow:
    DEFINE VARIABLE appErr AS Progress.lang.AppError.
    // Note the second parameter creates an error message
    appErr = NEW progress.lang.AppError("Your custom message here", 1).
    UNDO, THROW appErr.
END.
```

.NET developer can determine how to handle the exception in the.NET code with the information provided in the A.

Explore Runtime4GLException class

The `Runtime4GLException` class hierarchy is shown here.

```
System.Exception
  Progress.Open4GL.Exceptions
    ProException
      Open4GLException
        Runtime4GLException
          RunTime4GLErrorException
            RunTime4GLAppErrorException
          RunTime4GLQuitException
          RunTime4GLStopException
            RunTime4GLLockConflictException
            RunTime4GLStopAfterException
            Runtime4GLStopErrorException
```

The following `PUBLIC` properties are available for classes that inherit from `Runtime4GLException` class.

- `hasProcReturnString` flags existence of a return string.
- `ProErrorNum` error number
- `ProcReturnString` get a custom return string

Return custom ProcReturnString

Prior to the addition of the application error, developers may have used the `ProcReturnString` to customize an error string. ABL developers can use `RETURN ERROR` with a custom `ProcReturnString` to communicate information to .NET developer.

```
PROCEDURE procAppErrorReturn:
  // this code produces a stop
  RETURN ERROR "ProcAppErrorReturn: My custom return error string".
END.
```

The exception that is thrown is `Progress.Open4GL.Exceptions.RunTime4GLAppErrorException: Error condition: The Server application has returned an error. (7243) (7211)`. The .NET developer can access the custom message `ProcReturnString`.

```
System.Console.Out.WriteLine("ProcErrorNum: " + e.ProErrorNum);
System.Console.Out.WriteLine("HasProcReturnString: " + e.hasProcReturnString());
System.Console.Out.WriteLine("ProcReturnString: " + e.ProcReturnString);
```

.NET developer can determine how to handle the exception on the.NET side based on the custom value returned. The .NET developer can then display or process the custom string.

```
ProcErrorNum: 7243
HasProcReturnString: true
ProcReturnString: ProcAppErrorReturn: My custom return error string
```

Stop conditions

In this example, an ABL procedure called `non-existent.p` is not found in the `PROPATH`.

```
PROCEDURE procStop:
  // this code produces a stop
  RUN non-existent.p.
END.
```

An attempt by the .NET developer to call `non-existent.p` raises a `STOP` condition and returns an exception. The return message is `Progress.Open4GL.Exceptions.RunTime4GLStopErrorException: ** “non-existent.p” was not found (293) (7211)`. The message,`“non-existent.p” was not found` . The exception indicates that the errors is a `RunTime4GLStopErrorException` which allows the .NET developer to code for that exception.

For details, see the following topics:

- General ABL exceptions

General ABL exceptions

This topic presents the hierarchy of ABL exception classes and then describes each one.

Exception class hierarchy

The ABL exceptions classes are shown below, hierarchically. You can use the **Object Browser** or **Class Browser** in your .NET development environment to explore the hierarchy. The classes are part of the `Progress.Open4GL.Exceptions` namespace.

```
System.Exception
  ApplicationException
    ProError
      Open4GLError
  Progress.Open4GL.Exceptions
    ProException
      Open4GLException
         BusySessionException
         Progress.Open4GL.Exceptions.ConnectException
           AppServerIOException
           BadURLException
           BrokerIOException
           ConnectAIAException
           ConnectFailedException
           ConnectHttpAuthException
           ConnectHttpsAuthException
           ConnectProtocolException
           ConnectProxyAuthException
           HostUnknownException
           InvalidNameServerPortException
           MsgVersionInvalidException
           NameServerClientPortException
           NameServerClientPortRangeException
           NameServerClientPortRetryException
           NameServerCommunicationsException
           NameServerInterruptException
           NameServerMessageFormatException
           NoSuchAppServiceException
           SystemErrorException
           UnknowHostnameException
         OutputSetException
         Runtime4GLException
           RunTime4GLErrorException
             RunTime4GLAppErrorException
           RunTime4GLQuitException
           RunTime4GLStopException
             RunTime4GLLockConflictException
             RunTime4GLStopAfterException
             Runtime4GLStopErrorException
         MetaDataException
         SchemaValidationException
         SystemErrorException
       OutputSetException
  SystemException
    DataException
      ProDataException
        DeletedRowAccessException
```

Exception descriptions

The following table shows the general .NET exception classes, in alphabetical order. The description provides common causes of each exception. Use the **Object Browser** in Visual Studio to explore the following exceptions.

Exception class	Description
`AppServerIOException`	A general I/O exception was raised while initializing a connection to an OpenEdge application server, and the connection was not completed.
`BadURLException`	Invalid URL format in connection parameter.
`BrokerIOException`	A general I/O exception was raised while attempting to initiate a connection to an OpenEdge application server, and the connection was not completed.
`BusySessionException`	Busy servicing another request.
`ConnectAIAException`	A connection attempt to an AIA/APSV adapter returned and the connection was not completed.
`ConnectException`	Error connecting to application server.
`ConnectFailedException`	Failed application server connection attempt. The message contains the specified reason for the failure.
`ConnectHttpAuthException`	The HTTP BASIC userid/password authentication failed when connecting to an AIA/APSV adapter, and the connection was not completed.
`ConnectHttpsAuthException`	The HTTPS (TLS) connection's authentication failed when connecting to an AIA/APSV adapter, and the connection was not completed.
`ConnectProtocolException`	An uncategorized error occurred while attempting to initiate and initialize a connection to an OpenEdge application server, and the connection was not completed.
`ConnectProxyAuthException`	An error was detected while attempting to initiate and initialize a connection to an AIA/APSV adapter via an HTTP proxy server, and the connection was not completed.
`DeletedRowAccessException`	Application tried to access a deleted row in a `SDOResultSet` object.
`HostUnknownException`	Invalid NameServer host specified in the URL.
`InvalidNameServerPortException`	Invalid NameServer port specified in the URL.
`MsgVersionInvalidException`	Incorrect version for message received from NameServer.

Exception class	Description
NameServerClientPortException	A free UDP network port could not be found when attempting to connect to a NameServer and resolve the address of an OpenEdge authentication server, and the connection was not completed.
NameServerClientPortRangeException	The range of UDP port numbers configured for connecting to a NameServer included an invalid value, and no NameServer connection was attempted.
NameServerClientPortRetryException	The number of allowed retries to connect to a NameServer and resolve an OpenEdge application server network address was exceeded, and the connection was not completed.
NameServerCommunicationsException	NameServer communications error. The message contains the specified reason for the failure.
NameServerInterruptException	NameServer communications broken. Either no response was received from the NameServer or the thread was interrupted before the response was received.
NameServerMessageFormatException	Invalid format for message received from NameServer.
NoSuchAppServiceException	Application Service specified is unknown.
NetworkException	A socket I/O error occurred on the connection to the application server.
NoSuchAppServiceException	Application Service specified in URL unknown to NameServer.
Open4GLError	System errors.
Open4GLException	The root exception for all Open Client conditions.
OutputSetException	Output ResultSet error, for example, trying to get a column value out of column order or trying to make an illegal type conversion.
ProDataException	Standard exception for errors that occur while using the ProDataGraph object.
ProException	The base class for all customer-visible Open Client errors.
RunTime4GLAppErrorException	When the top level ABL procedure does `RETURN ERROR` or throws a `Progress.Lang.AppError`.
RunTime4GLErrorException	When an `ERROR` condition is returned from the top level ABL procedure.
RunTime4GLException	Corresponds to ABL `ERROR`, `STOP`, and `QUIT` conditions.

Exception class	Description
RunTime4GLLockConflictException	This condition is returned from the top level ABL procedure when a lock conflict occurs and the application opted not to wait or when the -lkwtmo has been exceeded.
RunTime4GLQuitException	ABL QUIT condition.
RunTime4GLStopException	ABL STOP condition.
SchemaValidationException	A schema validation inconsistency occurred when using the ProDataGraph object.
SystemErrorException	An unexpected error that indicates an ABL bug or an unusual environmental problem (such as running out of disk space).
UnknownHostnameException	The host address/DNS name specified when connecting to an OpenEdge application server was invalid and the connection was not completed.

7

Use OpenEdge .NET Proxy Objects in Microsoft Visual Studio

This content describes how to use Microsoft Visual Studio to build .NET Open Client applications.

For details, see the following topics:

- Types of .NET open clients
- Get started building a .NET Open Client application using Microsoft Visual Studio

Types of .NET open clients

The following types of .NET Open Clients can use proxies created by ProxyGen:

- Windows forms (GUI) on page 119
- Web forms (ASP.NET) on page 120
- .NET Web services (ASP Web services) on page 120

Windows forms (GUI)

The Windows forms model is the GUI development and deployment model for .NET applications. With Windows forms, you can build rich, interactive client interfaces that are deployed directly to client machines. Open Client proxy objects are accessible to Windows forms clients as native .NET objects, including support for advanced data binding.

To develop and deploy Windows forms that use Open Client proxy objects, the OpenEdge .NET Open Client Runtime assemblies (`Progress.o4glrt.dll` and `Progress.Messages.dll`) and the message resource files must be directly available to the client application. These files, along with your proxies, must be deployed on the client machine.

Web forms (ASP.NET)

The Web forms model is the active server page development and deployment model for .NET. Web forms are for browser-based .NET clients. In this model, an Internet Information Services (IIS) server is responsible for the generation and delivery of the browser-based client code. Your Open Client proxy objects fully support a Web forms model, as long as the `Progress.o4glrt.dll` and `Progress.Messages.dll` assemblies, the message resource files, and your proxies are accessible to the server-side code for your Web forms.

.NET Web services (ASP Web services)

The .NET Web service model is a similar deployment model to Web forms. Proxy objects can be integrated into your .NET classes, which then can be deployed as Web services. As with Web forms, your run-time assemblies and proxies must be available to the server-side code. While .NET Web services are possible with your .NET proxy objects, OpenEdge tools such as Web services tools provide a more seamless approach by providing native Web service capability directly to the OpenEdge application server.

Get started building a .NET Open Client application using Microsoft Visual Studio

This section describes how to build a .NET Open Client application using Microsoft Visual Studio.

To begin building a client application that uses a .NET proxy:

1. Run Microsoft Visual Studio .
2. Create a new project.
3. In your **Solution Explorer** window, add references to the following:
   - • The proxy `.dll` file (created by ProxyGen)
     - The main OpenEdge .NET Open Client Runtime assembly (`Progress.o4glrt.dll`) in the ProxyGen output directory

Once you add a reference to the proxy `.dll` file, your new client application can access application server functionality through methods on the generated proxy objects. To view these proxy classes, bring up the Object Browser in Microsoft Visual Studio. The Object Browser allows you to examine objects (namespaces, classes, and so on) and their members in your project.

8

Use the Open Client .NET OpenAPI to Directly Access the application server

The Open Client .NET OpenAPI is a generic set of .NET classes that can be used instead of the generated .NET proxies produced by ProxyGen. Without proxies, you must do all of the setup work in your client code to an access application service on the application server. You must know the procedure names, including relative path information (for the equivalent ABL RUN statement), the number of parameters along with their type, and the return type for user-defined functions. When using the OpenAPI, there is no compile time checking so all function prototype error checking is done at run time.

For details, see the following topics:

- Overview of .NET OpenAPI classes
- Connect to the application server with .NET Open Client APIs
- Run procedures and user-defined functions
- Set up parameters and return types
- Pass parameters
- Handle returned values
- Sample .NET OpenAPI code

Overview of .NET OpenAPI classes

The following table shows a summary of the classes that support the .NET OpenAPI.

Table 28: .NET OpenAPI Classes

Class	Description
`Progress.Open4GL.Proxy.OpenAppObject`	Accesses external ABL procedures in an application service using the OpenAPI
`Progress.Open4GL.Proxy.OpenProcObject`	Accesses an ABL persistent, single-run, or singleton procedure using the OpenAPI
`Progress.Open4GL.Proxy.ParamArray`	An object containing an array for passing parameters to an ABL procedure or user-defined function
`Progress.Open4GL.Proxy.ParamArrayMode`	Constants for specifying the mode of an ABL procedure or user-defined function parameter (`INPUT`, `INPUT-OUTPUT`, or `OUTPUT`)
`Progress.Open4GL.Parameter`	Constants for specifying the ABL data type of a procedure or user-defined function parameter, return type, or temp-table field
`Progress.Open4gl.ProcedureType`	A .NET enum for specifying a procedure type as `Persistent`, `SingleRun`, or `Singleton`
`Progress.Open4GL.Proxy.ProDataRelationMetaData`	To define a ProDataSet data-relation
`Progress.Open4GL.Proxy.ProDataSetMetaData`	To define the schema of an ABL ProDataSet mapped to an ADO.NET `DataSet`
`Progress.Open4GL.Proxy.TempTableMetaData`	To define the schema of an ABL temp-table mapped to an ADO.NET `DataTable`

This content describes how to use these classes to access an application server using the .NET OpenAPI.

Connect to the application server with .NET Open Client APIs

To establish a connection to an application server using the .NET OpenAPI, you must instantiate a `Progress.Open4GL.Proxy.OpenAppObject`. You can create an `OpenAppObject` using one of the following constructors:

Syntax

```
public OpenAppObject(Connection connectObj, string appservice)

public OpenAppObject(string url, string userid, string password,
                     string info, string appservice)

public OpenAppObject(string userid, string password,
                     string info, string appservice)

public OpenAppObject(string appservice)
```

connectObj

Specifies a `Progress.Open4GL.Proxy.Connection` object, which defines connection parameters to access the application server. For more information on this object, see Connect to the application server on page 29.

appservice

Specifies the name of the application service. This parameter is not used by PAS for OpenEdge. It is deprecated but remains for backwards compatibility to classic AppServer.

url

Specifies the *url* to connect to the root ABL web application it would look like this `http://host:portnumber/apsv`. Alternatively you can specify a named ABL web application using this format `http://host:portnumber/ABLwebapplication/apsv`

Note: This is the preferred constructor because it allows you to customize the url. The combined length of the `url`, `userid`, `password`, and `info` fields must not exceed 30,000 non-Unicode characters when connecting to an application server.

---

userid

Specifies a user ID required to access the application server. If security is not implemented, empty string are allowed.

password

Specifies a password required to access the applications server. If security is not implemented, empty string are allowed.

info

Specifies information required by the application service at connection time.

You can set a number of session and run-time properties to manage access to an application service. For example, to access a session-free application server using the .NET OpenAPI, you must set the proxy property `PROGRESS.Session.SessionModel` to 1. For more information on setting this and other session properties see Access Proxy Properties on page 85.

Run procedures and user-defined functions

After connecting to an application server and creating a `Progress.Open4GL.Proxy.OpenAppObject`, you can invoke application service code as follows:

1. (Optional) In OpenEdge 12.3 and above, if it has been some time since a request and you want to ensure a server session is still valid, use the `isConnected()` method to Return the validity of the server session on an OpenAppObject on page 124.
2. Run any external non-persistent, persistent, single-run, or singleton procedure that is available on the `OpenAppObject`. (Running a persistent, single-run, or singleton procedure instantiates an `OpenProcObject`.)
3. Run any available internal procedure or user-defined function on an instantiated `OpenProcObject`.

   Before running any procedure or user-defined function, you must set up any parameters and return types required by the procedure or user-defined function. For more information, see Set up parameters and return types on page 127. You can then pass the parameters to the procedure or user-defined function and manage them according to their modes (`INPUT`, `INPUT-OUTPUT` or `OUTPUT`). For more information, see Pass parameters on page 152.

   After running any procedure or user-defined function, you must handle any output (returned values) or error conditions. For more information, see Handle returned values on page 155.

   The following sections describe:

   - Run a non-persistent procedure on an OpenAppObject on page 125
   - Run a persistent procedure (OpenProcObject) on an OpenAppObject on page 125
   - Run a single-run or singleton procedure (OpenProcObject) on an OpenAppObject on page 126
   - Run an internal procedure or user-defined function on an OpenProcObject on page 126

   For examples that show how to run application service code, see Sample .NET OpenAPI code on page 157.

Return the validity of the server session on an OpenAppObject

OpenEdge 12.3 and above offers the `isConnected()` method for instantiated `Progress.Open4GL.Proxy.OpenAppObject` instances, which is a boolean value that indicates whether there is a valid session on the PAS for OpenEdge server for the requesting client.

The `isConnected()` method:

- Returns `true` if there is a valid session on the server for the client.
- Resets the session inactivity timer, so that you can ensure a request sent after the `isConnected()` method is called does not fail due to inactivity.

isConnected() method code sample for .NET

The following .NET code sample makes a connection to a PAS for OpenEdge instance's APSV transport:

```
Connection connection = new Connection ("http://localhost:8810/apsv", "", "", "");

connection.setSessionModel( Connection.SM_SESSION_MANAGED );
```

```
OpenAppObject appobj = new OpenAppObject (connection, "");

if (appobj.isConnected())  {

     Console.WriteLine("connected: true");
     // The session on the PAS for OpenEdge server is valid.
 // write code to run a procedure with this OpenAppObject.

} else {

     Console.WriteLine("connected: false");

}
```

Run a non-persistent procedure on an OpenAppObject

Once you create your `Progress.Open4GL.Proxy.OpenAppObject` instance, you can run any non-persistent procedure on the connected application using the following method on the `OpenAppObject`:

Syntax

```
public void RunProc(string procName, ParamArray paramArray)
```

procName

Specifies the name of the procedure to run, including any path relative to the PROPATH setting for the application server.

paramArray

Specifies a `Progress.Open4GL.Proxy.ParamArray` object that holds the procedure parameters. For more information, see Set up a parameter array on page 128.

Run a persistent procedure (OpenProcObject) on an OpenAppObject

Once you create your `Progress.Open4GL.Proxy.OpenAppObject` instance, you can run any persistent procedure on the connected application server using the following method on the `OpenAppObject`:

Syntax

```
public OpenProcObject CreatePO(string procName, ParamArray paramArray)
```

procName

Specifies the name of the procedure to run, including any path relative to the PROPATH setting for the application server.

paramArray

Specifies a `Progress.Open4GL.Proxy.ParamArray` object that holds the procedure parameters. For more information, see Set up a parameter array on page 128. A procedure with no parameters in the main block can also be run as persistent using an alternative syntax (see Run a single-run or singleton procedure (OpenProcObject) on an OpenAppObject on page 126), or the null value can be passed through *paramArray*.

This method returns a `Progress.Open4GL.Proxy.OpenProcObject`, which you will use to run internal procedures and user-defined functions provided by the persistent procedure.

Run a single-run or singleton procedure (OpenProcObject) on an OpenAppObject

You can run a procedure with no parameters in the main block as single-run, singleton, or persistent on the connected application server using the following method on the `OpenAppObject`:

Syntax

```
public OpenProcObject CreatePO(String procName, ProcedureType procType)
```

procName

Specifies the name of the procedure to run, including any path relative to the PROPATH setting for the application server.

procType

A .NET enum type that specifies the procedure as persistent (`ProcedureType.Persistent`), single-run (`ProcedureType.SingleRun`), or singleton (`ProcedureType.Singleton`).

This method returns a `Progress.open4gl.Proxy.OpenProcObject`, which you can use to run internal procedures and user-defined functions provided by the procedure.

Note: The main block of a singleton or single-run procedure cannot have any parameters, so there is no *paramArray* available with this syntax. Although persistent procedures can have parameters in general, only persistent procedures without parameters can be run using this syntax.

The `OpenProcObject` also contains the public property `ProcedureType`, which holds a value of `Persistent`, `SingleRun`, or `Singleton`, depending on the procedure type of the object:

Run an internal procedure or user-defined function on an OpenProcObject

Once you obtain your `Progress.Open4GL.Proxy.OpenProcObject` instance, you can run any internal procedure or user-defined function defined in the object. However, if you are calling a user-defined function, you must identify the return type of the function before calling it. For more information, see Define the return type for a user-defined function on page 148. For information on accessing the return value after calling the function, see Access user-defined function return values on page 156.

Run the internal procedure or user-defined function using the following method on the `OpenProcObject`:

Syntax

```
public void RunProc(string procName, ParamArray paramArray)
```

procName

The name of an internal procedure or user-defined function provided by the `OpenProcObject`.

paramArray

Specifies a `Progress.Open4GL.Proxy.ParamArray` that holds the parameters for the internal procedure or user-defined function. For more information, see Set up a parameter array on page 128.

Set up parameters and return types

Before running an application service procedure or user-defined function, it might require parameters that you must pass. Before passing the parameters, you must set them up in two basic steps using the .NET OpenAPI.

set up parameters for passing to an application service procedure or function and to define return types for returning function values:

1. Create a variable for each parameter.
2. Add each variable to a parameter array as required for the procedure or function you are calling.

   The following sections describe how to complete these steps:

   - Create variables for parameters on page 127.
   - Set up a parameter array on page 128.
   - Add parameters using data type-specific methods on page 128.
   - Add parameters using a generic method on page 138.
   - Define the schema for a temp-table parameter on page 141.
   - Define the schema for a ProDataSet parameter on page 145.
   - Define the return type for a user-defined function on page 148.

Create variables for parameters

Before passing a parameter, you must create a variable of the correct .NET data type. If you want to pass the ABL `Unknown value (?)` (`null` in .NET) for .NET value types (`System.Boolean`, `System.Decimal`, `System.Int32`, `System.Int64`, and `System.DateTime`), you must use the corresponding holder object. The ABL to .NET mappings are the same as the ones defined for passing parameters to Open Client proxy methods. For more information on the supported mappings between ABL and .NET data types, see Data Type Mappings for Parameters on page 37.

Set up a parameter array

You must place all parameters for a procedure (external, persistent, and internal) or user-defined function into a `Progress.Open4GL.Proxy.ParamArray` object before running the procedure or user-defined function.

Create a parameter array

You can create a `ParamArray` using the following constructor:

Syntax

```
public ParamArray(int numParams)
```

numParams

Specifies the total number of parameters (including all `INPUT`, `INPUT-OUTPUT`, and `OUTPUT` parameters).

You can add each parameter to the `ParamArray` using a set of methods that add a parameter based on the data type of the parameter or a single generic add parameter method. You must identify the parameter position as well as the mode of the parameter. For temp-tables and ProDataSets, you must identify the meta data. You must also pass in an initial value for input and input-output parameters.

If you want to reuse the `ParamArray` for another call:

- The number of parameters for the next call must match the number of parameters in the `ParamArray` object
- You must clear any current values in the `ParamArray` using the `Clear( )` method, as shown:

```
// Create the ParamArray
ParamArray parms = new ParamArray(1);
.
.
.

// Clear for reuse
parms.Clear( );
```

Add parameters using data type-specific methods

You can set each parameter using one of the methods on the `Progress.Open4GL.Proxy.ParamArray` class that is specified for the corresponding ABL data type. Data types that are mapped to supported value types in .NET (`System.Boolean`, `System.Decimal`, `System.Int32`, `System.Int64`, and `System.DateTime`) have the following three sets of methods:

- One for the value type, which cannot be set to the ABL `Unknown value (?)` (`null` in .NET)
- One for a corresponding .NET nullable value type that can accept the ABL `Unknown value (?)`.
- One for a corresponding OpenEdge type-holder class in the `Progress.Open4GL` namespace that can accept the ABL `Unknown value (?)` (supported for backward compatibility only).

Methods to add arrays of each data type are also provided.

For more information on the use of .NET nullable types and OpenEdge type-holder classes, see Unknown value (?) as a parameter on page 42.

General syntax for add parameter methods

The general syntax of these methods is as follows:

Table 29: Syntax

```
public void Add ProgressType(int position, DataTypevalue, int mode,
                             [ int extentValue | MetaType metaData ])
            throws Open4GLException
```

ProgressType

Indicates the ABL data type of the parameter, such as `Decimal` in `AddDecimal( )`, for adding a parameter of data type `DECIMAL`, or `DecimalArray` in `AddDecimalArray( )`, for adding a parameter of data type `DECIMAL EXTENT`.

position

Specifies a 0-based index indicating the parameter position.

DataType

Specifies the .NET data type of the parameter, for example, `Decimal`, `Decimal?`, `Progress.Open4GL.DecimalHolder`, `Decimal[]`, `Decimal?[]`, or `Progress.Open4GL.DecimalHolder[]`. In the syntax that follows, for any *DataType* not qualified by a namespace, `System` is assumed.

value

Specifies a variable that contains the value of the parameter, or `null` for an `OUTPUT` parameter.

mode

Specifies the ABL mode (passing direction) of the parameter. This can be one of the following constant values:

- `ParamArrayMode.INPUT`
- `ParamArrayMode.INPUT_OUTPUT`
- `ParamArrayMode.OUTPUT`

extentValue

Specifies the extent of an array for methods that add an array parameter (where *ProgressType* is appended with `Array`, as in `AddDecimalArray( )`).

MetaType

Specifies one of the following classes for methods that add a temp-table or ProDataSet parameter:

- **`TempTableMetaData`** — Provides the schema information for temp-table parameters or temp-tables in a ProDataSet. For more information on defining this schema, see Define the schema for a temp-table parameter on page 141.
- **`ProDataSetMetaData`** — Provides the schema information for ProDataSet parameters. For information on defining the schema for ProDataSet parameters, see Define the schema for a ProDataSet parameter on page 145.

`metaData`

Specifies an instance of *`MetaType`*. When *`mode`* is `ParamArrayMode.OUTPUT` and *`ProgressType`* is `DatasetHandle` or `TableHandle` (passing a dynamic ProDataSet or temp-table parameter), you can set this parameter to `null`.

Syntax summaries of all data type-specific add parameter methods

The following sections list syntax summaries for all of the data type-specific methods for adding parameters to a `ParamArray` object:

- CHARACTER on page 131
- COM-HANDLE on page 131
- DATASET and DATASET-HANDLE on page 131
- DATE on page 131
- DATETIME on page 132
- DATETIME-TZ on page 132
- DECIMAL on page 133
- HANDLE on page 133
- INTEGER on page 134
- LOGICAL on page 135
- LONGCHAR on page 135
- MEMPTR on page 136
- RAW on page 136
- RECID on page 136
- ROWID on page 137
- TABLE and TABLE-HANDLE on page 137

CHARACTER

Syntax

The following are the data type-specific methods for adding an ABL CHARACTER parameter:

```
public void AddCharacter(int position, String value, int mode)
public void AddCharacterArray(int position, String[] value, int mode,
                              int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

COM-HANDLE

The following are the data type-specific methods for adding an ABL COM-HANDLE parameter:

Syntax

```
public void AddCOMHandle(int position,
                         Progress.Open4GL.COMHandle value, int mode)
public void AddCOMHandleArray(int position,
                              Progress.Open4GL.COMHandle[] value, int mode,
                              int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

DATASET and DATASET-HANDLE

The following are the data type-specific methods for adding an ABL ProDataSet (DATASET or DATASET-HANDLE) parameter:

Syntax

```
public void AddDataset(int position, System.Data.DataSet value, int mode,
                       ProDataSetMetaData metaData)
public void AddDatasetHandle(int position, System.Data.DataSet value,
                             int mode, ProDataSetMetaData metaData)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

DATE

The following are the data type-specific methods for adding an ABL DATE parameter:

Syntax

```
public void AddDate(int position, DateTime value, int mode)

public void AddDate(int position, DateTime? value, int mode)

public void AddDate(int position,
                    Progress.Open4GL.DateHolder value, int mode)

public void AddDateArray(int position, DateTime[] value, int mode,
                         int extentValue)

public void AddDateArray(int position,
                         DateTime?[] value, int mode, int extentValue)

public void AddDateArray(int position,
                         Progress.Open4GL.DateHolder[] value, int mode,
                         int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

DATETIME

The following are the data type-specific methods for adding an ABL `DATETIME` parameter:

Syntax

```
public void AddDateTime(int position, DateTime value, int mode)

public void AddDateTime(int position, DateTime? value, int mode)

public void AddDateTime(int position,
                        Progress.Open4GL.DateHolder value, int mode)

public void AddDateTimeArray(int position, DateTime[] value, int mode,
                             int extentValue)

public void AddDateTimeArray(int position,
                             DateTime?[] value, int mode,
                             int extentValue)

public void AddDateTimeArray(int position,
                             Progress.Open4GL.DateHolder[] value, int mode,
                             int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

DATETIME-TZ

The following are the data type-specific methods for adding an ABL `DATETIME-TZ` parameter:

Syntax

```
public void AddDateTimeTZ(int position, DateTime value, int mode)

public void AddDateTimeTZ(int position, DateTime? value, int mode)

public void AddDateTimeTZ(int position,
                          Progress.Open4GL.DateHolder value, int mode)

public void AddDateTimeTZArray(int position, DateTime[] value, int mode,
                               int extentValue)

public void AddDateTimeTZArray(int position,
                               DateTime?[] value, int mode,
                               int extentValue)

public void AddDateTimeTZArray(int position,
                               Progress.Open4GL.DateHolder[] value,
                               int mode, int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

DECIMAL

Thee following are the data type-specific methods for adding an ABL `DECIMAL` parameter:

Syntax

```
public void AddDecimal(int position, Decimal value, int mode)

public void AddDecimal(int position, Decimal? value, int mode)

public void AddDecimal(int position,
                       Progress.Open4GL.DecimalHolder value, int mode)

public void AddDecimalArray(int position, Decimal[] value, int mode,
                            int extentValue)

public void AddDecimalArray(int position,
                            Decimal?[] value, int mode,
                            int extentValue)

public void AddDecimalArray(int position,
                            Progress.Open4GL.DecimalHolder[] value,
                            int mode, int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

HANDLE

The following are the data type-specific methods for adding an ABL `HANDLE` parameter:

Syntax

```
public void AddHandle(int position, Progress.Open4GL.Handle value, int mode)

public void AddHandleArray(int position, Progress.Open4GL.Handle[] value,
                           int mode, int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

INT64

The following are the data type-specific methods for adding an ABL `INT64` parameter:

Syntax

```
public void AddInt64(int position, Int64 value, int mode)

public void AddInt64(int position, Int64? value, int mode)

public void AddInt64(int position, Progress.Open4GL.LongHolder value,
                     int mode)

public void AddInt64Array(int position, Int64[] value, int mode,
                          int extentValue)

public void AddInt64Array(int position,
                          Int64?[] value, int mode,
                          int extentValue)

public void AddInt64Array(int position, Progress.Open4GL.LongHolder[] value,
                          int mode, int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

INTEGER

The following are the data type-specific methods for adding an ABL `INTEGER` parameter:

Syntax

```
public void AddInteger(int position, Int32 value, int mode)

public void AddInteger(int position, Int32? value, int mode)

public void AddInteger(int position, Progress.Open4GL.IntHolder value,
                       int mode)

public void AddIntegerArray(int position, Int32[] value, int mode,
                            int extentValue)

public void AddIntegerArray(int position,
                            Int32?[] value, int mode,
                            int extentValue)

public void AddIntegerArray(int position,
                            Progress.Open4GL.IntHolder[] value, int mode,
                            int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

LOGICAL

The following are the data type-specific methods for adding an ABL LOGICAL parameter:

Syntax

```
public void AddLogical(int position, Boolean value, int mode)

public void AddLogical(int position, Boolean? value, int mode)

public void AddLogical(int position,
                       Progress.Open4GL.BooleanHolder value, int mode)

public void AddLogicalArray(int position, Boolean[] value, int mode,
                            int extentValue)

public void AddLogicalArray(int position,
                            Boolean?[] value, int mode,
                            int extentValue)

public void AddLogicalArray(int position,
                            Progress.Open4GL.BooleanHolder[] value,
                            int mode, int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

LONGCHAR

The following are the data type-specific methods for adding an ABL LONGCHAR parameter:

Syntax

```
public void AddLongChar(int position, String value, int mode)

public void AddLongCharArray(int position, String[] value, int mode,
                             int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

MEMPTR

The following are the data type-specific methods for adding an ABL `MEMPTR` parameter:

Syntax

```
public void AddMemptr(int position, Progress.Open4GL.Memptr value,
                      int mode)

public void AddMemptrArray(int position, Progress.Open4GL.Memptr[] value,
                      int mode, int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

RAW

The following are the data type-specific methods for adding an ABL `RAW` parameter:

Syntax

```
public void AddRaw(int position, Byte[] value, int mode)

public void AddRawArray(int position, Byte[][] value, int mode,
                        int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

RECID

The following are the data type-specific methods for adding an ABL `RECID` parameter:

Syntax

```
public void  AddRecid(int position, Int64 value,
                      int mode)

public void AddRecid(int position, Int64? value, int mode)

public void AddRecid(int position, Progress.Open4GL.LongHolder value,
                     int mode)

public void AddRecidArray(int position, Int64[] value,
                          int mode, int extentValue)

public void AddRecidArray(int position,
                          Int64?[] value, int mode,
                          int extentValue)

public void AddRecidArray(int position, Progress.Open4GL.LongHolder[] value,
                          int mode, int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

ROWID

The following are the data type-specific methods for adding an ABL `ROWID` parameter:

Syntax

```
public void AddRowid(int position, Progress.Open4GL.Rowid value,
                     int mode)

public void AddRowidArray(int position, Progress.Open4GL.Rowid[] value,
                          int mode, int extentValue)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

TABLE and TABLE-HANDLE

The following are the data type-specific methods for adding an ABL temp-table (`TABLE` or `TABLE-HANDLE`) parameter:

Syntax

```
public void AddTable(int position, System.Data.DataTable value, int mode,
                     TempTableMetaData metaData)

public void AddTableHandle(int position, System.Data.DataTable value,
                           int mode, TempTableMetaData metaData)
```

For information on the parameters to these methods, see General syntax for add parameter methods on page 129.

Add parameters using a generic method

You can use the following generic method on the `Progress.Open4GL.Proxy.ParamArray` class to set the parameters in the `ParamArray`:

Syntax

```
public void AddParameter(Int32 position, Object value, Int32 mode,
                         Int32 proType, Int32 extentValue,
                         Progress.Open4GL.DynamicAPI.MetaDataBase metaData)
```

position

Specifies a 0-based index indicating the parameter position.

value

Specifies a variable of the appropriate `Object` data type that contains the value for the parameter, or `null` for an `OUTPUT` parameter.

mode

Specifies the ABL mode (passing direction) of the parameter. This can be one of the following constant values:

- `ParamArrayMode.INPUT`
- `ParamArrayMode.INPUT_OUTPUT`
- `ParamArrayMode.OUTPUT`

proType

Specifies the ABL data type of the parameter indicated by a class constant defined in the `Progress.Open4GL.Parameter` class, as shown in the following table.

Table 30: ABL parameter data types for the OpenAPI

ABL data type	Progress.Open4GL.Parameter class constant
CHARACTER	PRO_CHARACTER
COM-HANDLE	PRO_COMHANDLE
DATASET	PRO_DATASET
DATASET-HANDLE	PRO_ DATASETHANDLE
DATE	PRO_DATE
DATETIME	PRO_DATETIME
DATETIME-TZ	PRO_DATETIMETZ
DECIMAL	PRO_DECIMAL
HANDLE	PRO_WIDGETHANDLE
INT64	PRO_INT64
INTEGER	PRO_INTEGER
LOGICAL	PRO_LOGICAL
LONGCHAR	PRO_LONGCHAR
MEMPTR	PRO_MEMPTR

ABL data type	Progress.Open4GL.Parameter class constant
RAW	PRO_RAW
RECID	PRO_RECID
ROWID	PRO_ROWID
TEMP-TABLE	PRO_TEMPTABLE
TABLE-HANDLE	PRO_TABLEHANDLE
WIDGET-HANDLE	PRO_WIDGETHANDLE

extentValue

Specifies the extent of an array, 0 or 1 for a scalar value.

metaData

Specifies the schema for ProDataSet or temp-table parameters, where *proType* is one of the following:

- Parameter.PRO_DATASET
- Parameter.PRO_DATASETHANDLE
- Parameter.PRO_TEMPTABLE
- Parameter.PRO_TABLEHANDLE

The value can be specified using one of the following classes:

- **TempTableMetaData** — Defines the schema information for temp-table parameters or temp-tables in a ProDataSet. For more information on defining this schema, see Define the schema for a temp-table parameter on page 141.
- **ProDataSetMetaData** — Defines the schema information for ProDataSet parameters. For more information on defining the schema for ProDataSet parameters, see Define the schema for a ProDataSet parameter on page 145.

When *mode* is ParamArrayMode.OUTPUT and *proType* is Parameter.PRO_DATASETHANDLE or Parameter.PRO_TABLEHANDLE (passing a dynamic ProDataSet or temp-table parameter), you can set this parameter to null.

Define the schema for a temp-table parameter

Defining the schema for an ABL temp-table (TABLE or TABLE-HANDLE) parameter is a multi-step process.

To define the schema for a temp-table parameter:

1. If the parameter is for input or input-output, define an ADO.NET DataTable to hold the parameter value.
2. Define a TempTableMetaData object to hold the parameter schema.
3. Add field descriptions to the TempTableMetaData object.
4. Add the TempTableMetaData object and the DataTable (if applicable) as a temp-table parameter to your ParamArray object using the appropriate set parameter method.

Define a TempTableMetaData object

For each temp-table (DataTable), you must define a Progress.Open4GL.Proxy.TempTableMetaData object to hold the schema using the following constructor:

Syntax

```
public TempTableMetaData(string dataTableName, string strongTypeName,
                         int numFields, bool bimageFlag,
                         int numIndexes, string multiIxCols,
                         string XMLNamespace, string XMLPrefix)
```

dataTableName

Specifies a name for the specified DataTable. This name is typically identical to any ABL temp-table to which this collection is mapped.

strongTypeName

Specifies the type name for a strongly-typed ADO.NET DataTable, or null.

numFields

Specifies the number of fields in the specified DataTable.

bimageFlag

Specifies true if the corresponding ABL temp-table is defined with the BEFORE-TABLE option, indicating that the temp-table (and hence the DataTable) can be modified. Otherwise, this value must be false and you cannot pass modified data between the Open Client and the application server.

numIndexes

Specifies the number of indexes on the table.

multiIxCols

Specifies `null` if there are no indexes or a formatted string that contains all the index info for this temp-table, as follows:

```
"[primeUniqueFlag,primeFld1[,primeFldn]...:primeIdxName.]
[uniqueIdxfld1[,uniqueIdxfldn]...:uniqueIdxName.]..."
```

primeUniqueFlag

Specifies a primary index with a value of 1 if the index is unique and a value of 0 if the index is not unique.

primeFld1 **[***,primeFldn***]...**

Specifies the names of one or more fields involved in the primary index.

primeIdxName

Specifies the primary index name.

uniqueIdxfld1 **[***,uniqueIdxfldn***]...**

Specifies names of one or more fields involved in a unique secondary index.

uniqueIdxName

Specifies a unique secondary index name.

Thus, a table can have no indexes, a single primary index followed by zero or more secondary unique indexes, or it can have a single secondary unique index followed by zero or more additional secondary unique indexes. See the following examples:

- **Table with a single primary index:**

```
"1, custNum:CustIndex"
```

This is a primary unique index named `CustIndex` with one column named `custNum`.

- **Table with a single secondary index:**

```
"orderDate:OrderIndex"
```

This is a secondary unique index named `OrderIndex` with one column named `orderDate`.

- **Table with two indexes:**

```
"1,custNum:CustIndex.orderDate,shipDate:OrderIndex"
```

These two indexes include:

- A primary unique index named `CustIndex` with one column named `custNum`
- A secondary unique index named `OrderIndex` with two columns named `orderDate` and `shipDate`

- **Table with three indexes:**

```
"0,custNum,custName:CustIndex.orderDate:OrderIndex.
itemNum:ItemIndex"
```

These three indexes include:

- A primary non-unique index named `CustIndex` with two columns named `custNum` and `custName`
- A secondary unique index named `OrderIndex` with one column named `orderDate`
- A secondary unique index named `ItemIndex` with one column named `itemNum`

`XMLNamespace`

Specifies the namespace for XML serialization or `null`.

`XMLPrefix`

Specifies the prefix for XML serialization or `null`.

Add field descriptions to the TempTableMetaData object

Add the meta data for each field of the temp-table by calling the `SetFieldMetaData( )` method on the `TempTableMetaData` object for each column in the temp-table:

Syntax

```
public void SetFieldMetaData(int fieldNumber, string fieldName,
                             int extentValue, int proType,
                             int userOrder, int xmlMapping)
```

`fieldNumber`

Specifies a 1-based position that corresponds to the position of a mapped field in an ABL temp-table.

`fieldName`

Specifies a name that is typically identical to a mapped field in the corresponding ABL temp-table. The value cannot be `null` and must be unique among fields (column properties) in the specified `ProDataObject` type.

extentValue

Specifies if and how the field represents an array field in the corresponding temp-table. The value must be 0 or greater. If the value is greater than 1, this column property is many-valued (represents an array field) and the value is its extent. If the property represents a `BLOB` or `CLOB` field, the value must be 0 or 1.

proType

Specifies the value of a class constant defined in the Progress.Open4GL.Parameter class. The specified class constant indicates the ABL data type of the mapped temp-table field. For more information on these class constants, see the sections on specifying the ABL temp-table field data types for the `ProDataTable` class in Data Type Mappings for Parameters on page 37. To identify the Java data type that the column property assumes for the specified ABL data type, see the information on data type mapping for temp-table fields in Data Type Mappings for Parameters on page 37.

userOrder

Specifies a 0-based user order position for the column property.

xmlMapping

Reserved for future use. Always specify 0.

Add the TempTableMetaData with its DataTable as a temp-table parameter

Add the `TempTableMetaData` object together with ADO.NET `DataTable` it describes by passing them as parameters of the `AddTable( )` or `AddTableHandle( )` method that you use to add the temp-table parameter to the `ParamArray` object. For more information, see TABLE and TABLE-HANDLE on page 137.

The following example adds a temp-table parameter defined with no indexes.

Sample OpenAPI fragment adding a temp-table parameter

```
// Create the ParamArray
ParamArray parms = new ParamArray(1);

//Create Data table
DataTable table = new DataTable( );
...

// Set up meta data
TempTableMetaData metaData1 = new TempTableMetaData
                          ("OrderDetails",
                            "OrderProxy.StrongTypesNS.OrderDetailsDataTable",
                           6, false, 0, null, null,null);

metaData1.SetFieldMetaData
             (1, "OrderNum",     0, Parameter.PRO_INTEGER,  0, 0);
metaData1.SetFieldMetaData
             (2, "SalesRep",     0, Parameter.PRO_CHARACTER 1, 0);
metaData1.SetFieldMetaData
             (3, "OrderDate",    0, Parameter.PRO_DATE      2, 0);
metaData1.SetFieldMetaData
             (4, "ShipDate",     0, Parameter.PRO_DATE      3, 0);
metaData1.SetFieldMetaData
             (5, "TotalDollars", 0, Parameter.PRO_DECIMAL   4, 0);
metaData1.SetFieldMetaData
             (6, "OrderStatus",  0, Parameter.PRO_CHARACTER 5, 0);

parms.AddTable(0, table, ParamArrayMode.INPUT, metaData1);
```

Define the schema for a ProDataSet parameter

Defining the schema for an ABL ProDataSet (`DATASET` or `DATASET-HANDLE`) parameter is a multi-step process.

To define the schema for a ProDataSet parameter:

1. If the parameter is for input or input-output, define an ADO.NET `DataSet` to hold the parameter value.
2. Define a `ProDataSetMetaData` object to specify its schema.
3. Define the temp-tables for the `ProDataSetMetaData` object.
4. Define the data-relations for the `ProDataSetMetaData` object.
5. Add the `ProDataSetMetaData` object and the `DataSet` (if applicable) as a ProDataSet parameter to your `ParamArray` object using the appropriate set parameter method.

Define a ProDataSetMetaData object

For each ProDataSet parameter you must define a `Progress.Open4GL.Proxy.ProDataSetMetaData` object. You use this object to specify the schema for the ProDataSet when you set the `DATASET` or `DATASET-HANDLE` parameter in the `ParamArray` object. You can create an instance of this object using the following constructor:

Syntax

```
public ProDataSetMetaData(string proDataSetName, string strongTypeName)
```

proDataSetName

Specifies the ProDataSet name in ABL.

strongTypeName

Specifies the type name for a strongly-typed ADO.NET `DataSet`, or `null`.

Define the temp-tables for the ProDataSetMetaData object

You must define the meta data for each temp-table contained by the `ProDataSetMetaData`. For more information, see Define a TempTableMetaData object on page 141 and Add field descriptions to the TempTableMetaData object on page 143.

You can then add the temp-table meta data (`TempTableMetaData`) to the `ProDataSetMetaData` object using the following `ProDataSetMetaData` method:

Syntax

```
public void AddDataTable(TempTableMetaData dtMetaData)
```

dtMetaData

Specifies the meta data for a temp-table.

Define the data-relations for the ProDataSetMetaData object

You must define any data-relations that are defined for the ABL ProDataSet using `Progress.Open4GL.Proxy.ProDataRelationMetaData` objects. You can create a `ProDataRelationMetaData` object for each data-relation between a parent and child temp-table using the following constructor:

Syntax

```
public ProDataRelationMetaData(string dataRelationName, int parentIx,
                               int childIx, int numPairs, string pairsList)
```

dataRelationName

Specifies the name of the `ProDataRelationMetaData` object.

parentIx

Specifies a 0-based index to a parent temp-table (ADO.NET `DataTable`) that corresponds to the order in which you have added the `TempTableMetaData` to the `ProDataSetMetaData` using the

ProDataSetMetaData AddDataTable( ) method. If you have the ADO.NET DataSet for the ProDataSet, you can also use the ADO.NET DataSet.Tables property to identify the order for this index value.

childIx

Specifies a 0-based index to a child temp-table (ADO.NET DataTable) that corresponds to the order in which you have added the TempTableMetaData to the ProDataSetMetaData using the ProDataSetMetaData AddDataTable( ) method. If you have the ADO.NET DataSet for the ProDataSet, you can also use the ADO.NET DataSet.Tables property to identify the order for this index value.

numPairs

Specifies the number of column property pairs (key field pairs) that represent this relationship. This allows multiple fields to represent a key relationship between the parent and child temp-table.

pairsList

Specifies a string containing a comma-separated list of field names. The list consists of *numPairs* field pairs, where the child temp-table field name for each pair is followed by its matching parent temp-table field name. The data types of the named child and parent temp-table field pairs must be comparable.

Note: For the equivalent ProDataRelationMetaData( ) constructor in the Java OpenAPI, the order of child and parent field names in the *pairsList* parameter is reversed. For more information, see *OpenEdge Development: Java Open Clients*.

You can add each data-relation definition to the ProDataSetMetaData object using the following method:

```
public void AddDataRelation(ProDataRelationMetaData drMetaData)
```

drMetaData

Specifies a data-relation to include in the ProDataSetMetaData object.

Add the ProDataSetMetaData object with its DataSet as a ProDataSet parameter

Add the ProDataSetMetaData object together with the ADO.NET DataSet it describes by passing them as parameters of the AddDataset( ) or AddDatasetHandle( ) method that you use to add the ProDataSet parameter to the ParamArray object. For more information, see DATASET and DATASET-HANDLE on page 131.

The following example adds a temp-table parameter defined with no indexes.

Sample OpenAPI fragment setting a ProDataSet parameter

```
// Create the ParamArray
ParamArray parms = new ParamArray(1);

//Create DataSet
DataSet proDataSet = new DataSet( );
...

// Create the ProDataSetMetaData
ProDataSetMetaData dsMetaData = new ProDataSetMetaData
             ("dsCustOrd", "ProDataSetTest.StrongTypesNS.dsCustOrdDataSet");

// Create the TempTableMetaData for the Customer table
TempTableMetaData ttCustMD = new TempTableMetaData
                        ("ttCust", "ttCustDataTable", 3, false, , 0,
                         null, null, null);

ttCustMD.SetFieldMetaData(1, "CustNum",  0, Parameter.PRO_INTEGER,  0, 0);
ttCustMD.SetFieldMetaData(2, "Name",     0, Parameter.PRO_CHARACTER 1, 0);
ttCustMD.SetFieldMetaData(3, "SalesRep", 0, Parameter.PRO_CHARACTER 2, 0);

// Create the TempTableMetaData for the Order table
TempTableMetaData ttOrderMD = new TempTableMetaData
                         ("OrderDetails",
                           "OrderProxy.StrongTypesNS.OrderDetailsDataTable",
                          6, false, , 0, null, null, null);

ttOrderMD.SetFieldMetaData
             (1, "OrderNum",     0, Parameter.PRO_INTEGER,  0, 0);
ttOrderMD.SetFieldMetaData
             (2, "SalesRep",     0, Parameter.PRO_CHARACTER 1, 0);
ttOrderMD.SetFieldMetaData
             (3, "OrderDate",    0, Parameter.PRO_DATE      2, 0);
ttOrderMD.SetFieldMetaData
             (4, "ShipDate",     0, Parameter.PRO_DATE      3, 0);
ttOrderMD.SetFieldMetaData
             (5, "TotalDollars", 0, Parameter.PRO_DECIMAL   4, 0);
ttOrderMD.SetFieldMetaData
             (6, "OrderStatus",  0, Parameter.PRO_CHARACTER 5, 0);

// Add the tables to the DataSet meta data
dsMetaData.AddDataTable(ttCustMD);
dsMetaData.AddDataTable(ttOrderMD);

// Create and add the relations to the DataSet meta data
ProDataRelationMetaData relation = new ProDataRelationMetaData
                              ("custNum", 1, 0, 1, "CustNum,CustNum",  null);
dsMetaData.AddDataRelation(relation);

parms.AddDataset(0, proDataSet, ParamArrayMode.OUTPUT, dsMetaData);
```

Define the return type for a user-defined function

For user-defined functions, there are four properties of the `Progress.Open4GL.Proxy.ParamArray` class that you can set to define the return type:

- ReturnType property on page 149
- IsReturnExtent property on page 150

- UnknownReturnType property on page 150
- IsReturnExtent property on page 150

The following sections describe these properties.

ReturnType property

This property sets the return type of the function return value. This is the syntax:

Syntax

```
public int ReturnType
```

You must set this property to the class constant defined in `Progress.Open4GL.Parameter` that corresponds to the ABL data type returned by the user-defined function, as shown in the following table.

Table 31: User-defined function return types for the OpenAPI

ABL data type	Progress.Open4GL.Parameter class constant
CHARACTER	PRO_CHARACTER
COM-HANDLE	PRO_COMHANDLE
DATE	PRO_DATE
DATETIME	PRO_DATETIME
DATETIME-TZ	PRO_DATETIMETZ
DECIMAL	PRO_DECIMAL
HANDLE	PRO_WIDGETHANDLE
INT64	PRO_INT64
INTEGER	PRO_INTEGER
LOGICAL	PRO_LOGICAL
RAW	PRO_RAW
RECID	PRO_RECID
ROWID	PRO_ROWID
WIDGET-HANDLE	PRO_WIDGETHANDLE

Note: User-defined functions returning LONGCHAR or MEMPTR cannot be run across the Open Client interfaces.

For example, to set the return type for a user-defined function to the ABL INTEGER data type, you can set the ReturnType property on a ParamArray object, parms, as follows:

```
parms.ReturnType = Parameter.PRO_INTEGER;
```

IsReturnExtent property

If the ReturnType property is set, and IsReturnExtent is set to TRUE, then the return value will be an array of the specified type. The default is FALSE. This is the syntax:

Syntax

```
public bool IsReturnExtent
```

UnknownReturnType property

This property allows you to specify if and how the user-defined function can return the ABL Unknown value (?). This is the syntax:

Syntax

```
public Progress.Open4GL.UnknownType UnknownReturnType
```

Progress.Open4GL.UnknownType is an enumeration type defined with the following values:

```
public enum Progress.Open4GL.UnknownType
{    NullableType,
    HolderClass,
    None
}
```

The UnknownType.NullableType and UnknownType.HolderClass value both indicate that the user-defined function can return the Unknown value (?), but specify a different mechanism for returning this value when the OpenAPI return type corresponds to a supported .NET value type (System.Boolean, System.DateTime, System.Decimal, System.Int32, or System.Int64).

The specified mechanism is used when the ReturnType property is set to one of the following Progress.Open4GL.Parameter class constants, each of which maps to a supported value type:

- PRO_DATE
- PRO_DATETIME
- PRO_DATETIMETZ
- PRO_DECIMAL
- PRO_INTEGER
- PRO_INT64

- PRO_LOGICAL
- PRO_RECID

Thus, if you set UnknownReturnType to:

- **UnknownType.NullableType** — The function can return the Unknown value (?) and returns its value as the matching nullable type (or nullable type array) when the ReturnType property setting corresponds to a supported .NET value type (or value type array). If the ReturnType property setting corresponds to a reference type, the specified reference type is returned.
- **UnknownType.HolderClass** — The function can return the Unknown value (?) and returns its value as the matching OpenEdge type-holder class (or holder class array) when the ReturnType property setting corresponds to a supported .NET value type (or value type array). If the ReturnType property setting corresponds to a reference type, the specified reference type is returned.

  Note: This value is provided for backward compatibility only.

- **UnknownType.None** — The function cannot return the Unknown value (?), which is the default. In this case, the function returns its value as the .NET value or reference type that corresponds to the ReturnType property setting.

  Note: If you set the IsReturnUnknown property to TRUE, this sets UnknownReturnType to UnknownType.HolderClass. If you set IsReturnUnknown to FALSE, this sets UnknownReturnType to UnknownType.None. Note also that IsReturnUnknown is supported for backward compatibility only. For more information on the IsReturnUnknown property, see IsReturnUnknown property on page 151.

For example, if the ReturnType property represents an ABL INTEGER EXTENT and UnknownReturnType is set to:

- **UnknownType.NullableType** — The ReturnValue property returns a System.Int32?[].
- **UnknownType.HolderClass** — the ReturnValue property returns an IntHolder[].
- **UnknownType.None** — The ReturnValue property returns a System.Int32[].

For information on the ReturnValue property, see Access user-defined function return values on page 156.

For more information on the use of .NET nullable types and OpenEdge type-holder classes, see Unknown value (?) as a parameter on page 42.

If a scalar return value can be the Unknown value (?), check if the ReturnValue property is null. If it is not null, you can then unbox ReturnValue to get the value on a ParamArray object, parms, as follows:

```
int intRetVal = (int)parms.ReturnValue;
```

IsReturnUnknown property

Set this property to TRUE in order to indicate that the user-defined function can return the Unknown value (?). This setting also sets the UnknownReturnType property to the enumeration value, UnknownType.HolderClass. If the function cannot return the Unknown value (?), set this property to FALSE, which also sets the UnknownReturnType property to the enumeration value, UnknownType.None.

Note: This property is supported for backward compatibility only. Progress Software recommends that you directly set and test the `UnknownReturnType` property instead. For more information, see UnknownReturnType property on page 150.

This is the syntax:

Syntax

```
public bool IsReturnUnknown
```

For example, if the `ReturnType` property is an `INTEGER EXTENT`, and this property is set to `TRUE`, the `ReturnValue` property returns an `IntHolder[]`. If it is set to `FALSE`, the `ReturnValue` property returns an `Int32[]`. The default is `FALSE`. For information on the `ReturnValue` property, see Access user-defined function return values on page 156.

If a scalar return value can be the `Unknown value (?)`, check if the `ReturnValue` property is `null`. If it is not `null`, you can then unbox `ReturnValue` to get the value on a `ParamArray` object, `parms`, as follows:

```
int intRetVal = (int)parms.ReturnValue;
```

Pass parameters

After you have set up the required parameter, you can pass the specified parameters to a procedure or user-defined function. The steps for setting up and passing parameters differs, depending on the parameter mode (`INPUT`, `OUTPUT`, or `INPUT-OUTPUT`).

Pass INPUT parameters

Passing an `INPUT` parameter requires several steps to provide a value as input to an application service procedure or user-defined function.

To pass an INPUT parameter:

1. Create and initialize a variable for the parameter of the correct .NET data type (see Create variables for parameters on page 127).
2. Add the parameter to a `ParamArray` object (see Set up a parameter array on page 128).
3. Run the procedure or user-defined function (see Run procedures and user-defined functions on page 124).

Passing an INPUT parameter using the .NET OpenAPI

INPUT parameter as Unknown value (?) using .NET OpenAPI

The following example passes an `INPUT` integer parameter that does not support the `Unknown value (?)`.

```
// Define and initialize the variable for the input parameter
Int32 CustomerNumber = 33;

// Create the ParamArray
ParamArray parms = new ParamArray(1);

// Add the input parameter to the ParamArray
parms.AddInteger(0, CustomerNumber, ParamArrayMode.INPUT);

// Run the procedure or user-defined function
...
```

The following example passes an `INPUT` integer parameter that supports the `Unknown value (?)`.

```
// Define and initialize the variable for the input parameter
Int32 CustomerNumber = 33;

...
//Define and set the holder class for the input parameter
//to null or an integer based on the variable value
IntHolder hCustomerNumber = new IntHolder( );
iCustomerNumber = new Integer(CustomerNumber)

if (CustomerNumber > 33)
   hCustomerNumber.Value = null;
else
   hCustomerNumber.Value = (Object) iCustomerNumber;

// Create the ParamArray
ParamArray parms = new ParamArray(1);

// Add the input parameter to the ParamArray
parms.AddInteger(0, hCustomerNumber, ParamArrayMode.INPUT);

// Run the procedure or user-defined function
...
```

Pass INTPUT-OUTPUT parameters

Passing an `INPUT-OUTPUT` parameter requires several steps to provide a value as input to an application service procedure or user-defined function, then to return a value as output using the same parameter.

To pass an INPUT parameter:

1. Create and initialize a variable for the parameter of the correct .NET data type (see Create variables for parameters on page 127).
2. Add the parameter to a `ParamArray` object (see Set up a parameter array on page 128).

3. Run the procedure or user-defined function (see Run procedures and user-defined functions on page 124).
4. Get the output value from the `ParamArray` (see Get OUTPUT parameter values on page 155). You might also want to reset the variable.

Passing an INPUT-OUTPUT parameter using the .NET OpenAPI

The following example passes an `INPUT-OUTPUT` integer parameter that does not support the `Unknown value (?)`.

```
// Define and initialize the variable for the input-output parameter
Int32 CustomerNumber = 33;

// Create the ParamArray
ParamArray parms = new ParamArray(1);

// Add the input-output parameter to the ParamArray
parms.AddInteger(0, CustomerNumber, ParamArrayMode.INPUT_OUTPUT);

// Run the procedure
...

// Fill output parameter
// The output value is always returned as an Object
// You need to cast the Object before assigning it.
CustomerNumber = (Int32) parms.GetOutputParameter(0);
```

Pass OUTPUT parameters

Passing an `OUTPUT` parameter requires several steps to provide a parameter as output from an application service procedure or user-defined function, then to get the value returned by the parameter.

To pass an OUTPUT parameter:

1. Create and initialize a variable for the parameter of the correct .NET data type (see Create variables for parameters on page 127).
2. Add the parameter to a `ParamArray` object (see Set up a parameter array on page 128).
3. Run the procedure or user-defined function (see Run procedures and user-defined functions on page 124).
4. Get the output value from the `ParamArray` (see Get OUTPUT parameter values on page 155).

Passing an OUTPUT parameter using the .NET OpenAPI

The following example passes an OUTPUT integer parameter that does not support the Unknown value (?).

```
// Define the variable for the output parameter
Int32 CustomerNumber;

// Create the ParamArray
ParamArray parms = new ParamArray(1);

// Set up output parameter - notice no variable is needed at this point
parms.AddInteger(0, null, ParamArrayMode.OUTPUT);

// Run the procedure
...

// Fill the output parameter
// The output value is always returned as an Object
// You need to cast the Object before assigning it.
CustomerNumber = (Int32) parms.GetOutputParameter(0);
```

Handle returned values

The .NET OpenAPI provides methods to access returned values for:

- Output parameters
- The RETURN-VALUE function set by running an ABL non-persistent, persistent, or internal procedure
- The value returned by an ABL user-defined function

The following sections describe how to access each type of return value.

Get OUTPUT parameter values

After running a procedure or user-defined function, you can access the OUTPUT parameters using the following ParamArray method:

Syntax

```
public System.Object GetOutputParameter(int paramNum)
```

paramNum

Specifies the 0-based position of the parameter.

The output value is always returned as a System.Object. If the Object returned cannot be null, you need to cast the Object to the output parameter data type and assign it to the output variable you have created to hold the cast value. If the Object returned can be null, you need to assign it to the Value property of a holder object, then test for null before obtaining the appropriate data type value as output.

The following example shows getting an output integer parameter (or the output side of an input-output parameter) that might be set to the `Unknown value (?)` in ABL.

Getting output parameters using the .NET OpenAPI

```
IntHolder hCustomerNumber = new IntHolder( );
Int32 CustomerNumber = 33;

// Set the parameter and run the procedure
ParamArray parms = new ParamArray(1);
parms.AddInteger(0, CustomerNumber, ParamArrayMode.INPUT-OUTPUT);
...

// Fill the output parameter
hCustomerNumber.Value = parms.GetOutputParameter(0);
if (hCustomerNumber.IsNull == true) ...;
else CustomerNumber = hCustomerNumber.IntValue;
...
```

Access RETURN-VALUE function output from procedures

You can access the value of the `RETURN-VALUE` function set by running an ABL procedure using the following property, which is available from any of three .NET OpenAPI objects:

Syntax

```
public string ProcReturnString
```

You can access this property from one of the following objects:

- **`Progress.Open4GL.Proxy.OpenAppObject`** — Returns the value set by the last procedure executed on the associated application server
- **`Progress.Open4GL.Proxy.OpenProcObject`** — Returns the value set by the last internal procedure executed in the associated persistent procedure
- **`Progress.Open4GLProxy.ParamArray`** — Returns the value set by the last non-persistent, persistent, or internal procedure executed and passed the specified `ParamArray` object

For more information on using these objects to execute procedures, see Run procedures and user-defined functions on page 124.

Access user-defined function return values

You can access the return value after running any user-defined function using the `ReturnValue` property on the `Progress.Open4GL.Proxy.ParamArray` object. This is the syntax:

Syntax

```
public System.Object ReturnValue
```

You need to cast the return `Object` to the correct return type for the function. For example:

```
string retVal = (string) parms.ReturnValue;
```

The subclass of `System.Object` that is returned depends on how you define the return type for a given function. For more information, see Define the return type for a user-defined function on page 148.

When the return value is an array, the `Progress.Open4GL.Proxy.ParamArray.IsReturnArray` property will be `TRUE`. Since the `ReturnValue` property returns an object, you can cast it to an array.

```
ParamArray parms = new ParamArray(1);
...
// Set up return type (udf does not return an unknown value)

parms.ReturnType = Parameter.PRO_DECIMAL;
parms.IsReturnExtent = true;

// Run procedure
openPO.RunProc("GetOrderTotalsByDollar", parms);

// Get return value
System.Decimal[] retValArray = (System.Decimal[])parms.ReturnValue;
```

Note: User-defined functions returning `LONGCHAR` or `MEMPTR` values cannot be run across the Open Client interface.

Sample .NET OpenAPI code

The following sections describe two types of sample code:

- Non-persistent procedure sample on page 157
- Persistent procedure sample on page 158
- Single-run/singleton procedure example on page 160

Note: These samples are not available for download on the Progress Communities Web site.

Non-persistent procedure sample

The following example shows a non-persistent procedure, `AddCustomer.p`.

Sample non-persistent procedure ABL for the OpenAPI

```
DEFINE INPUT PARAMETER CustName AS CHARACTER.
DEFINE INPUT PARAMETER phone AS CHARACTER.
DEFINE INPUT PARAMETER email AS CHARACTER.
DEFINE OUTPUT PARAMETER CustomerNumber AS INTEGER.
```

The following example shows an OpenAPI code to run a non-persistent procedure.

OpenAPI code to run a non-persistent procedure

```
namespace BigOrderInfoClient    {

  using Progress.Open4GL;
  using Progress.Open4GL.Proxy;

  public class samplecode  {

    public static void NonPersistentProcedure( )  {
      // Connect to the AppServer
      Connection myConn = new Connection
                          ("http://host:portnumber/apsv", "", "", "");
      OpenAppObject openAO = new OpenAppObject(myConn, "mySvc");

      // Set Session model for state-free
      myConn.SessionModel = 1;

      // Create the parameters
      System.String CustName = "abc";
      System.String phone = "999-555-1234";
      System.String email = "me@foo.com";
      System.Int32 outValue;

      // Create a place for RETURN-VALUE
      System.String retVal;

      // Create the ParamArray
      ParamArray parms = new ParamArray(4);

      // Set up input parameters
      parms.AddCharacter(0, CustName, ParamArrayMode.INPUT);
      parms.AddCharacter(1, phone, ParamArrayMode.INPUT);
      parms.AddCharacter(2, email, ParamArrayMode.INPUT);

      // Set up Out parameters
      parms.AddInteger(3, null, ParamArrayMode.OUTPUT);

      // Run the procedure
      openAO.RunProc("AddCustomer.p", parms);

      // Get output parameters - use holder to handle unknown value
      outValue = (System.Int32)parms.GetOutputParameter(3);

      // Get RETURN-VALUE. Will return null for AddCustomer( ) procedure
      retVal = (System.String)parms.ProcReturnString;
      openAO.Dispose( );
     }
  }
}
```

Persistent procedure sample

The following example shows a portion of code for a procedure, `CustomerInfo.p`, with a user-defined function.

Procedure CustomerInfo.p

```
DEFINE INPUT PARAMETER custNum AS INTEGER NO-UNDO.
...

FUNCTION GetTotalOrdersByNumber RETURNS INTEGER (threshold AS DECIMAL):
...
END.
...
```

The following example shows OpenAPI code that runs `CustomerInfo.p` as a persistent procedure.

OpenAPI code to run the persistent procedure

```
namespace BigOrderInfoClient  {

  using Progress.Open4GL;
  using Progress.Open4GL.Proxy;

  public class samplecode         {
    public static void PersistentProcedure( )  {
      // Connect to the application server
      Connection myConn = new Connection
                          ("http://host:portnumber/apsv", "", "", "");
      OpenAppObject openAO = new OpenAppObject(myConn, "mySvc");

      // Run the persistent procedure
      // First set up parameters
      ParamArray parms = new ParamArray(1);
      System.Int32 custNum = 3;

      // Set up input parameters
      parms.AddInteger(0, custNum, ParamArrayMode.INPUT);
      // Run procedure
      OpenProcObject openPO = openAO.CreatePO("OrderInfo/CustomerOrder.p",
                                              parms);

      // Call UDF
      // First set up parameters
      System.Decimal retVal;
      int Threshold = 1000;
      parms.Clear( ); // Clear ParamArray for next call

      // Set up input parameters
      parms.AddDecimal(0, Threshold, ParamArrayMode.INPUT);

      // Set up return type
      parms.ReturnType = Parameter.PRO_DECIMAL;

      // Run procedure
      openPO.RunProc("GetTotalOrdersByNumber", parms);

      // Get return value
      retVal = (System.Decimal)parms.ReturnValue;

      openPO.Dispose( );
      openAO.Dispose( );
    }
  }
}
```

Single-run/singleton procedure example

The following example shows a user-defined function defined by a procedure called `CustomerInfo.p`.

User-defined function defined by CustomerInfo.p

```
FUNCTION GetTotalOrdersByNumber RETURNS INTEGER (custNum AS INTEGER, threshold
AS DECIMAL):
...
END.
...
```

The version of `CustomerInfo.p` in Persistent procedure sample on page 158 cannot be run as a single-run (or singleton) because it has a parameter in the main block. Creating another internal procedure to set `CustNum` would also not work, because a single-run procedure is deleted from the application server after each call. Context must be established for each call. So in User-defined function defined by CustomerInfo.p `CustNum` is passed as a parameter to the user-defined function `GetTotalOrdersByNumber` instead.

The following OpenAPI code runs `CustomerInfo.p` as a single-run procedure and then calls its user-defined function. The code also shows how to access the procedure type using the `ProcedureType` parameter. A singleton procedure can be run in the same way, with `ProcedureType.Singleton` substituted into the `CreatePO` method.

OpenAPI code to run the single-run procedure

```
namespace BigOrderInfoClient  {

  using Progress.Open4GL;
  using Progress.Open4GL.Proxy;
  using Progress.Open4GL.ProcedureType;

  public class samplecode         {

    public static void SingleRunProcedure( )  {
      // Connect to the AppServer
      Connection myConn = new Connection("http://host:portnumber/apsv", "",
"", ""); OpenAppObject openAO = new OpenAppObject(myConn, "mySvc");

      // Run procedure as single-run
      OpenProcObject openPO = openAO.CreatePO("OrderInfo/CustomerInfo.p",
                                              ProcedureType.SingleRun);

      // Display procedure type using ProcedureType parameter
      System.Console.Out.WriteLine("Procedure object procedure type: "
                        + dynPO.ProcedureType);

      // Call UDF
      // First set up parameters
      System.Int32 custNum = 3;
      System.Decimal retVal;
      int Threshold = 1000;

      // Set up input parameters
      ParamArray parms = new ParamArray(2);
      parms.AddInteger(0, custNum, ParamArrayMode.INPUT);
      parms.AddDecimal(1, Threshold, ParamArrayMode.INPUT);

      // Set up return type
      parms.ReturnType = Parameter.PRO_DECIMAL;

      // Run UDF
      openPO.RunProc("GetTotalOrdersByNumber", parms);

      // Get return value
      retVal = (System.Decimal)parms.ReturnValue;

      // Even though the single-run procedure has been deleted on the
      // AppServer, use Dispose( ) to clean up the resources on the client.
      openPO.Dispose( );
      openAO.Dispose( );
    }
  }
}
```

A singleton procedure can be run in the same way, with `ProcedureType.Singleton` substituted into the `CreatePO` method. Unlike a single-run procedure, a singleton procedure remains instantiated on the application server after execution, but you still need to use `Dispose()` to clean up resources on the client side.

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