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TMS XData Documentation

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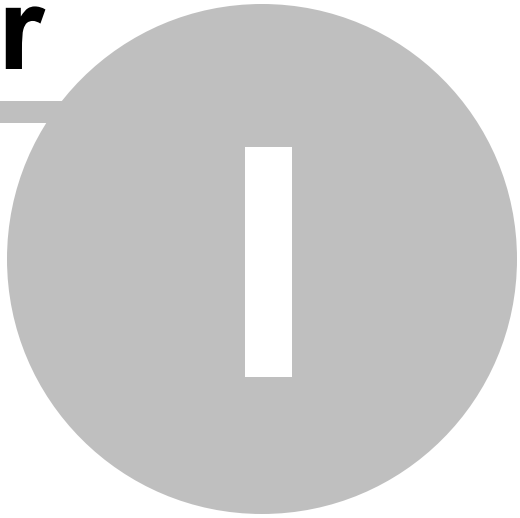

Introduction

1 Introduction

TMS XData is a Delphi framework that allows you to create HTTP/HTTPS servers that exposes data through REST/JSON. It is highly integrated with TMS Aurelius in such a way that creating XData services based on applications with existing Aurelius mappings is just a matter of a few lines of code. XData defines URL conventions for adressing resources, and specifies the JSON format of message payloads. It's heavily based on OData standard. Such conventions, with the benefit of existing Aurelius mapping, allows building a full REST/JSON server with minimum code writing. TMS XData uses TMS Sparkle as the core communication library.

TMS XData product page: http://www.tmssoftware.com/site/xdata.asp
TMS Software site: http://www.tmssoftware.com
PDF version of this documentation: http://www.tmssoftware.com/business/xdata/doc/xdata_manual.pdf

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- Web Applications with TMS Web Core

- Setting Up the Connection with TXDataWebConnection
- Using TXDataWebClient
- Using TXDataWebDataset
- XData Web Application Wizard

1.1 Overview

TMS XData is a full-featured Delphi framework that allows you to create HTTP/HTTPS servers that exposes TMS Aurelius objects through REST/JSON and implement service operations. Suppose you have an Aurelius class mapped like the following.

```
[Entity, Automapping]
TCustomer = class
strict private
  FId: integer;
  FName: string;
  FTitle: string;
  FBirthday: TDateTime;
  FCountry: TCountry;
public
  property Id: Integer read FId write FId;
  property Name: string read FName write FName;
  property Title: string read FTitle write FTitle;
  property Birthday: TDateTime read FDateTime write FDateTime;
  property Country: TCountry read FCountry write FCountry;
end;
```

With a few lines of code you can create a XData to expose those objects. You could retrieve an existing TCustomer with id equals to 3 using the following HTTP request, for example:

```
GET /tms/xdata/Customer(3) HTTP/1.1
Host: server:2001
```

And the JSON representation the customer will be returned in the body of HTTP response:

```
{
  "$id": 1,
  "@xdata.type": "XData.Default.Customer",
  "Id": 3,
  "Name": "Maria Anders",
  "Title": "Sales Representative",
  "Birthday": "1980-05-20",
  "Country": null
}
```

You can perform changes to objects through the REST interface, using POST method to create new objects, DELETE to remove objects, and PUT or PATCH to update the objects. The following example will change the value of FTitle property of the customer resource specified in previous example:

```
PATCH /tms/xdata/Customer(1) HTTP/1.1
Host: server:2001

{
  "Title": "Marketing Manager"
}
```

You can also perform queries on existing objects. The following example will retrieve all customers with country name equals to "USA", ordered by customer's name.

```
GET /tms/xdata/Customer?$filter=Country/Name eq
'USA'&$orderby=Name&$top=10 HTTP/1.1
Host: server:2001
```

And server will return with a JSON array of objects containing all the filtered objects. You can use query paging to restrict the number of objects returned in each request.

Also, you can use service operations to implement custom business logic using the Aurelius objects. By defining an interface and an implementation:

```
type
  [ServiceContract]
  IMyService = interface(IInvokable)
  ['{F0BADD7E-D4AE-4521-8869-8E1860B0A4A0}']
    function GetTopCustomersByState(const State: string):
TList<TCustomer>;
  end;

{...}
function TMyService.GetTopCustomersByState(const State: string):
TList<TCustome>;
begin
  Result :=
TXDataOperationContext.Current.GetManager.Find<TTCustomer>
    .Where(TLinq.Eq('State', State) and TLinq.Eq('Category',
TStatus.VIP))
    .List;
end;
```

you can easily invoke them from Delphi client:

```
Client := TXDataClient.Create;
Client.Uri := 'http://server:2001/tms/xdata';
MyService := Client.Service<IMyService>;
TopNYCustomers := MyService.GetTopCustomersByState('NY');
// process customers
```

or from HTTP client:

```
POST /tms/xdata/MyService/GetTopCustomersByState HTTP/1.1
Host: server:2001

{
  "State": "NY"
}
```

Please refer to the Introduction topic in this manual which lists all major topics to learn more about XData and all its features.

1.2 Features

Here is a list of main features of TMS XData framework:

- Server based on REST/JSON architecture style
- Easily accessible from different client platforms like .NET, Java, JavaScript, since it's Rest/Json based
- Uses standard POST, GET, PUT and DELETE HTTP methods for data request and data modification operations
- Service Operations for custom server-side business logic
- Partial update of objects (PATCH)
- Full-featured query mechanism
- Well-defined JSON representation of resources including entities, associations, streams and proxies
- Support for streams (blobs)
- Several databases supported in back end: SQL Server, MySQL, PostgreSQL, Oracle, Firebird, etc.. (through TMS Aurelius)

Based on TMS Sparkle HTTP/HTPS server architecture, which provides:

- HTTP server based on Windows http.sys stack
- Built-in authentication mechanism with JWT (Json Web Token) or Basic methods
- Support for Http Secure (HTTPS)
- Kernel-mode caching and kernel-mode request queuing (less overhead in context switching)
- Multiple applications/process can share (respond) the same port (at different addresses)
- Secure Sockets Layer (SSL) support in kernel-mode

1.3 What's New

Version 4.2 (Dec-2018)

- **Improved**: TXDataWebConnection now "disconnects" (cleans model object, requiring a new connection) when URL is modified.

- **Fixed**: Workaround a bug in Delphi Rio causing JWT tokens to be always rejected due to expiration (TJSONNumber.Null always returning true).

- **Fixed**: TXDataWebClient.RawInvoke was not allowing receiving a full JSON object as a single parameter.
- **Fixed**: XData Web App Application Wizard was incorrectly creating TExtendedField fields for Int64 types in server.
- **Fixed**: Typo in generated XData service code: "form the client" should be "from the client".

Version 4.1 (Nov-2018)

- **New: XData Web Application Wizard now can optionally generate GUI for performing CRUD operations on entities.** You can now generate a web application that allows users to insert, modify and/or delete entities.
- **New: Support for Delphi 10.3 Rio.**
- **Fixed**: TTime fields not correclty supported in TXDataWebDataset.
- **Fixed**: XData Service Wizard was creating new service units in the first project of a project group. Now it's being created in the currently active project.

Version 4.0 (Nov-2018)

- **New: XData Web App Generator wizard.** This wizard creates a full TMS Web Core client app based on a responsive Bootstrap template. The generated application should be based on a XData server and will provide user-interface for listing XData server entities, including searching, ordering and pagination.
- **New: Design-time support with new set of components for XData: TXDataServer and TXDataConnectionPool components.**
- **New: XData Service Operation wizard.** Makes it very easy to create new service operations (server-side business logic).
- **Improved:** TXDataWebDataset.Load now automatically connects the TXDataWebConnection if it's still not connected.
- **Improved**: TXDataServerModule.SetEntitySetPermissions allows providing '*' as the entity set name which will be considered the default permissions for all entity sets.
- **Improved**: TXDataClientResponse.ResultAsArray and ResultAsObject for quick access to Result as Json array or object.
- **Fixed:** TXDataWebClient.RawInvoke was incorrectly requiring parameters of type "out".

- **Fixed:** TXDataWebDataset not setting correct datetime values on entity properties.

Version 3.2 (Sep-2018)

- **New: TXDataWebDataset properties QueryTop, QuerySkip, ServerRecordCount, ServerRecordCountMode**. This makes it easier to retrieve paged results from server (QueryTop, QuerySkip) and retrieve the total number of records in server (ServerRecordCount, ServerRecordCountMode), regardless of the page number and size

- **New: TJwtMiddleware.AllowExpiredToken and ForbidAnonymousAccess properties**. This makes it easier to reject requests with expired tokens or requests without tokens (anonymous) just by setting those properties. This is a breaking change as the middleware now rejects expired tokens by default. Please refer to TMS Sparkle documentation for more info.

- **New: TCorsMiddleware middleware** makes it straightforward to add CORS support to any Sparkle module. Please refer to TMS Sparkle documentation for more info.

- **Improved:** XData Music Demo now includes options for ordering, paging and filtering (search) of listed records.

- **Improved**: "New TMS XData Server" Wizard now adds commented code to include CORS and Compress middleware. Uncomment the generated code to easily enable it.

- **Improved**: URIPathSegment attribute with empty string is now possible in a service contract, allowing creating service operations at the "root" of the server.

- **Fixed**: TXDataWebDataset now correctly creates TStringField for GUID properties (TGuidField is not supported in TMS Web Core).

- **Fixed:** Removed memory leaks in desktop client JWT Auth demo.

- **Fixed:** "New TMS XData Server" wizard updated with option to use new TMS Aurelius native database drivers.

Version 3.1 (Jul-2018)

- **New: XData Music Web Application demo.** A full web application example using TMS XData server using TMS Web Core as web front-end. Full source code is provide, and the online version of demo is available at https://app.devgems.com/xdata/music/app.

- **New: TXDataWebClient.ReferenceSolvingMode** allows automatic solving of $ref occurrences in JSON response, which is now the default behavior.

- **New: Demos XData Web-Client Framework,** showing use of TXDataWebClient, TXDataWebDataset and integration with FNC Grid
- **New: TXDataWebConnection.OnResponse** event intercepts any successful HTTP request made by XData web client framework (3.1.1).
- **Fixed**: Servers with Int64 type in model were not supported when used from TMS Web client (3.1.1).

Version 3.0 (Jul-2018)

- **New:** Full-featured TMS XData Web-Client Framework provides RAD, design-time and high-level components for building web applications using TMS Web Core and TMS XData. Buildling a REST API-based web application has never been as easy, including dataset-like usage that feels home to Delphi developers.
- **New:** TXDataWebClient.RawInvoke allows high-level invoking of service operations from TMS Web Core applications.
- **New**: TXDataWebConnection.OnRequest and TXDataWebClient.OnRequest events allow intercepting and modifying outgoing requests (for example, to add authentication headers).
- **New**: TXDataWebDataset.CurrentData provides the underlying JSON object of the current web dataset record.
- **New**: TXDataWebConnection.OnError event which is fired whenever an error happens while performing requests to XData server from TMS Web Core apps.
- **New:** TXDataWebClient request methods (List, Get, Post, RawInvoke, etc.) now have overloaded methods that accept callback functions.
- **New:** TXDataWebConnection.Open method allows providing callbacks for connection successful and connection error.
- **New:** TXDataWebConnection.DesignData allows adding custom headers at design-time (for example authorization) to properly connect to XData server.
- **Improved:** Smooth design-time experience with TXDataWebDataset. Manually loading field defs are not necessary anymore - just connect dataset to a web connection, provide the URL and fields will be loaded automatically at both design-time or runtime. Design-time menu option "Load Field Defs" has been removed.
- **Improved:** Editing TXDataWebDataset.EntitySetName at design-time in object inspector now provides a combobox with the list of available names retrieved from the server.
- **Improved:** Dataset fields now supported in TXDataWebDataset. They will contain data (list of objects) for associated lists (many-valued associations).

- **Improved:** TXDataWebDataset.SetJsonData now accepts non-array values (to edit a single object, for example).
- **Improved:** TXDataWebClient.Get overloaded method allows passing an additional query string (to use $expand option for example).
- **Improved:** TXDataServerModule.Create overload requiring just BaseUrl - no database connection pool is needed. Useful for XData servers that do not connect to a database or have specific database usage.
- **Improved:** TMS Web Core-only TXDataConnection and TXDataDataset components has been renamed to TXDataWebConnection and TXDataWebDataset. This is a breaking change.
- **Fixed**: Exceptions that were not inherited from EXDataHttpException were wrongly reporting an error code (regression)
- **Fixed:** Memory leaks when using mobile/Linux compilers (when using automatic reference counting)

Version 2.9 (May-2018)

- **New: OnModuleException event** allows for a more flexible custom error-handling processing of exception raised during XData processing request.
- **Fixed**: OnEntityModifying event was being fired before merge operation thus not providing correct information about the object in manager and previous state. Breaking change that can be disabled by using _FixEntityModifyingOnUpsert := False
- **Fixed**: deserialization of array of objects was keeping the same instance for all objects in the array.

Version 2.8 (Feb-2018)

- **New: TMS RADical WEB enabled!** The TMS framework for front-end Web development, TMS RADical WEB has been released and TMS XData is immediately a first-class citizen of this new ecosystem. XData users now have a high-level framework to write Web clients, by using the new TXDataConnection, TXDataDataset and TXDataWebClient components to access XData servers. TMS RADical WEB is in Tech Preview status as well TMS XData support to it.
- **New: TXDataClient.Count method.** Allows retrieving the number of entities in a specific resource endpoint, optionally using a query filter

```
TotalCustomersFromLondon := XDataClient.Count('$filter=City eq
''London''');
```

- **New: TQueryParser.AddMethod allows registering custom SQL Functions to be called from XData query API.** Using TMS Aurelius you can add custom SQL functions to use from LINQ. You can now also register such method in XData so clients can use such functions from the XData API:

```
TQueryParser.AddMethod('unaccent',
TQueryMethod.Create('unaccent', 1));
```

Then use it from query API:

```
http://server:2001/tms/xdata/Customer?$filter=unaccent(Name) eq
'Andre'
```

- **New**: **/$model** built-in URL returns metadata for the whole XData API.
- **New: MultiTentant Demo** included in distribution shows how to use XData with multi-tentant applications (multiple databases being accessed by the same server). The demo shows how to specify the tentant by different URL or by using a custom HTTP header.
- **Improved**: A connection was being retrieved from the pool even when the context manager was not being used by a service operation.
- **Fixed**: Service operations invoked via GET method using enumerated type parameters are now supported.

Version 2.7 (Oct-2017)

- **New: OpenAPI/Swagger support!** XData server can now optionally provide a JSON file containing the OpenAPI Specification (OAS, formerly Swagger) for your whole server API. This opens up a lot of possibilities, usage of several tools of the OpenAPI ecosystem is now possible. Main one would be the Swagger UI, a web front-end to describe and test your API.
- **New: Several new types supported in service operations.** Lots of new Delphi types can now be (de)serialized to JSON, meaning that those types can be use service operations, either in input parameters, or in function results, or even as properties of PODO objects sent/received. The new supported types in include:
  - **Generic arrays**: values of type TArray<T>, where T can be any supported type;
  - **Generics lists of primitive types**: values of type TList<T>, where T can by any supported type. In previous versions only lists of objects was supported;
  - **Sets**: values of type "set of T" where T is an enumerated type.
  - **TStrings** type;
- **New: Support for default parameter values in service operations.** You can now specify default values for parameters in service operations, using the [XDefault] attribute, and make them not required when invoking the service operations from non-Delphi clients (default parameters were already supported in Delphi clients).

- **New**: **JsonInclude attribute in PODO classes**. You can configure how properties/fields with default values will be serialized in PODO classes. This attribute makes it possible to have a smaller JSON representation, by removing properties which value is null, zero, empty string, etc. Usage example: [JsonInclude(TInclusionMode.NonDefault)].

- **New: JsonNamingStrategy attribute.** Allows you to automatically define a strategy for naming the JSON properties based on the field/property names of the class. You can use several predefined strategies: default, identity, camelCase, snake_case, identityCamelCase, identity_snake_case.

- **New: JsonEnumValues attribute**. You can use this attribute to specify different values when serializing enumerated values.

- **New: TXDataRequestHandler.ManagedObjects property**. This property provides more flexibility when it comes to automatic memory management at server side, allowing you to add objects to that collection and don't worrying about destroyed them - XData will do that for you.

- **Fixed**: Error when using params of type TDate (TDateTime was not affected) in service operations (Regression).

- **Fixed**: Design-time wizard icon not showing correctly in Delphi 10.2 Tokyo.

Version 2.6 (Jul-2017)

- **New: XDataProperty and XDataExcludeProperty attributes.** When converting Aurelius entities to/form JSON, by default XData serializes all (and only) fields/properties that are mapped using Aurelius attributes. You can now include other (transient) properties or fields in JSON by using XDataProperty attribute. You also have the option to exclude an existing mapped member by using XDataExcludeProperty attribute.

- **New: JsonProperty and JsonIgnore attributes.** When serializing regular Delphi objects (DTO) to JSON, XData includes all class fields by default. You can use JsonProperty attribute to add properties to the JSON (and/or change their name in JSON object) and use JsonIgnore attribute to exclude fields from JSON.

- **New: Support for passing parameters by reference in service operations.** You can now declare and use service operations (methods) that receive parameters by reference. A server method like *Swap(var A, B: Integer)* is now supported for both server-side and client-side (using TXDataClient or regular HTTP requests).

- **New: Filter functions *startswith*, *endswith* and *contains***. You can now perform $filter queries with those functions to search for substrings in entity fields. For example: *?$filter=contains(Name, 'Walker') or startswith(Name, 'John').*

- **New: Filter function *concat***. You can now use *concat* function when performing queries to concatenate two or more strings. For example: *?$filter=concat(concat(FirstName, ' '), LastName) = 'James Smith'.*

- **New: TXDataSeverModule.UnknownMemberHandling property.** You can now optionally tell the server to ignore unknown JSON properties sent by the client (instead of raising an InvalidJsonProperty error).

- **Fixed**: Using TStream as a parameter for service operations was causing "JSON converter not found" error.

Version 2.5 (May-2017)

- **New: Linux support using Delphi 10.2 Tokyo and later**. Using XData on Linux doesn't require any specific change in your XData-related code. All your Linux specific code relates to TMS Sparkle - creating an Apache module and configuring TMS Sparkle to respond to requests. Once you do that, you just add the XData module to the Sparkle dispatcher as usual.

- **Fixed:** Location header of POST responses now uses host of the client request, not the host configured in XData module.

version 2.4 (Mar-2017)
- New: Delphi 10.2 Tokyo Support
- Fixed: Server-side stack overflow when trying to load a proxy property sent by the client, if the parent entity of that proxy was merged into the current Object Manager

version 2.3 (Jan-2017)
- New: Demo project showing authentication using JWT (JSON Web Token)
- Fixed: Sporadic server error loading proxied lists sent by the client
- Fixed: JWT encoding not working on XE6
- Fixed: XData Server Wizard generating corrupted source code when TMS Component Pack was installed

version 2.2 (Aug-2016)
- New: Url convention now allows $count path segment to retrieve number of entities in a resource.
- Fixed: RefCount property was wrongly being serialized in PODO objects from mobile clients
- Fixed: TXDataClient.Service<T> failing for Android clients when compiling in Release config

version 2.1 (Jul-2016)
- New: $expand query option allows clients to have full control on how associated entities appear in JSON response.
- New: Support for entities that have associations in ID (primary key containing foreign keys)
- New: Support for Variant-type parameters in service operations when using GET HTTP method.

- New: **Breaking change**: TXDataServerModule.PutMode property controls how PUT will behave at server-side
- New: TXDataServerModule.SerializeInstanceRef property controls how instances of same object will be represented in JSON response
- New: TXDataServerModule.SerializeInstanceType property controls how xdata type metadata will appear in JSON response
- New: Support for Nullable<T> values in PODO classes
- Improved: Errors on query syntax now return http code 400 instead of 500
- Fixed: JSON Proxies (@xdata.proxy) sent by the client were not being solved when reading such properties at server-side
- Fixed: Association references (@xdata.ref) were not being solved when receiving entities in service operations parameters.

version 2.0 (May-2016)
- New: Service operations can now receive and return any type of object. This increases flexibility significantly as you can use any type of object for structure input/output parameters, or to send/receive DTO classes, etc.
- New: Server-Side Events allow subscribing listeners events and perform additional server-side logic
- New: JWT (Json Web Token) authentication and Basic authentication, thanks to new TMS Sparkle
- New: Authentication and authorization mechanism, based on TMS Sparkle
- New: Delphi 10.1 Berlin support
- New: Service operations can now receive and return TJSONAncestor objects (Delphi XE6 and up only). This allows full control over the JSON request and response.
- New: Service operations can now receive and return TCriteriaResult objects, making it easy to return Aurelius query results that use projections.
- New: $inlinecount query option allow retrieving the total number of entities when using paged results
- New: Method TXDataModelBuilder.RemoveEntitySet for more flexibility when building XData models.
- New: TXDataServerModule.SetEntitySetPermissions allows configuring what operations are available in each resource type
- Improved: All server-side operation (entity CRUD, service operation execution) are now performed in database transactions
- Improved: TXDataOperationContext.Current now also available in entity resources

version 1.6 (Feb-2016)
- New: Design-time wizard to create a XData Server with a few clicks
- Fixed: Service operation using enumerated types as parameters or function results not working properly
- Fixed: EntitySet requests were not taking xdata-expandlevel header into consideration. This is a breaking change.

version 1.5.1 (Sep-2015)
- New: Delphi 10 Seattle support

version 1.5 (Aug-2015)
- New: Several built-in functions available to increase flexibility when querying objects in REST requests. New available functions are Upper, Lower, Length, Substring, Position, Year, Month, Day, Hour, Minute and Second

- New: TXDataClient.HttpClient property provides low level access to the Http client and allows using OnSendingRequest events to customize requests
- New: TXDataOperationContext Request and Response properties gives full control for service implementations to customize the processing of client requests
- New: TXDataServerModule.DefaultExpandLevel allows defining the expand level of JSON responses when it's not defined by client request
- Fixed: TXDataClient Get, Delete, Patch and Put operations were broken when using entities with composite id
- Fixed: POST requests not working correctly with entities with composite key
- Fixed: Data Modification requests sending content-type header with parameter (for example, ";charset=UTF8") were causing errors

version 1.4 (Jun-2015)
- New: HttpMethod attribute allows specifying the HTTP method a service operation should respond to
- New: URIPathSegment attribute allows specifying a different name for operation/service to be used in URL
- Fixed: GET requests with query order was sometimes causing the same column to appear multiple times in a "ORDER BY" SQL clause

version 1.3.1 (Apr-2015)
- New: Delphi XE8 support

version 1.3 (Mar-2015)
- New: Support for CORS (Cross-origin resource sharing) preflighted requests

version 1.2 (Dec-2014)
- New: TXDataClient methods Get, Post, Put, Delete and List allows easy and high-level access to XData server objects from Delphi clients
- New: Android and iOS support for XData client objects
- New: Server support for "*x-http-method-override*" header (allowing clients to tunnel HTTP methods to server through POST requests)
- Fixed: Issues with floating-point literals in Query URL with non-English server systems
- Fixed: Service operations returning nil entities should respond with status code 404

version 1.1 (Oct-2014)
- New: Service Operations allow adding custom business logic to your server using interfaces and methods
- New: Multi-Model design makes it easy to create multiple servers with different mapping, types and service operations
- New: UserName and Password properties in TXDataServerModule for basic authentication protection
- Fixed: Malfunctioning with $skip and $top query options

version 1.0.1 (Sep-2014)
- New: Delphi XE7 support

version 1.0 (Aug-2014)
- First public release

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1.5 Getting Support

General notes
Before contacting support:
- Make sure to read this whole manual and any readme.txt or install.txt files in component distributions, if available.
- Search TMS support forum and TMS newsgroups to see if you question hasn't been already answer.
- Make sure you have the latest version of the component(s).

When contacting support:
- Specify with which component is causing the problem.
- Specify which Delphi or C++Builder version you're using and preferably also on which OS.

- For registered users, use the special priority support email address (mentioned in registration email) & provide your registration email & code. This will guarantee the fastest route to a solution.

- Send email from an email account that
1) allows to receive replies sent from our server
2) allows to receive ZIP file attachments
3) has a properly specified & working reply address

Getting support
For general information: info@tmssoftware.com
Fax: +32-56-359696
For all questions, comments, problems and feature request for our products: help@tmssoftware.com

Important note:
All topics covered by this manual are officially supported and it's unlikely that future versions will break backward compatibility. If this ever happens, all breaking changes will be covered in this manual and guidelines to update to a new version will be described. However, it's important to note that parts of the source code of this product that are undocumented are not officially supported and are **subject to change**, which includes breaking backward compatibility. In case you are using an unsupported/undocumented feature we will not provide support for upgrading and will not officially support it.

1.6 Breaking Changes

List of changes in each version that breaks backward compatibility from a previous version.

version 3.0

This version is the first "official" (non-beta) support for TMS Web Core, and it has renamed two key components:

- TXDataWebDataset (formely TXDataDataset)
- TXDataWebConnection (formely TXDataConnection)

If you have used previous version and used the above components in TMS Web Core applications, you might get an error "TXDataConnection not found" when opening the form asking for Cancel or Ignore. Just click Cancel, close the project, and open the offending .pas/.dfm in your preferred text editor (not Delphi - it can be Notepad, for example).
Then replace any occurrence of TXDataDataset by TXDataWebDataset, and any occurrence of TXDataConnection by TXDataWebConnection). In both .pas and .dfm files. Save the files and this should fix the issue.

version 2.9

OnEntityModifying event was being fired before merge operation thus not providing correct information about the object in manager and previous state. In case you want to go back to previous behavior, set _FixEntityModifyingOnUpsert global variable to false.

```
uses XData.Server.Module;

_FixEntityModifyingOnUpsert := False;
```

version 2.1

- TXDataServerModule.PutMode property controls how PUT will behave at server-side

version 1.5.2

This version fixes a bug where header xdata-expandlevel was being ignored when returning entity sets. Even though it's a bug fix, this is a breaking change as the server changed its behavior.

version 1.1

a) Example provided in Building The Entity Model topic has changed to illustrate how to correctly build the model in version 1.1 (TXDataModelBuilder constructor and Build method changed the signature).

b) Model is not owned by the TXDataServerModule class and must be now destroyed explicitly. So in the following code:

```
XDataServerModule := TXDataServerModule.Create(MyUrl,
MyConnectionPool, MyModel);
```

now you need to destroy the model when server is shutdown:

```
MyModel.Free;
```

note this is not a critical issue because if there is a leak, it will only happen when the whole server application is shutdown. Also, with the new multiple model feature, it's very rare that you would need to create your own model explicitly.

1.6.1 version 2.1 - Breaking Changes

Version 2.1 introduces the TXDataServerModule.PutMode property which defines how PUT requests will be implemented by the server. The two options are "Update" and "Merge". Basically, the server receives the object to be updated in JSON, deserializes it to an object, and uses the TMS Aurelius TObjectManager and either Update or Merge method:

```
// TXDataPutMode.Update
Manager.Update(ReceivedObject);
Manager.Flush;
```

```
// TXDataPutMode.Merge
Manager.Merge(ReceivedObject);
Manager.Flush;
```

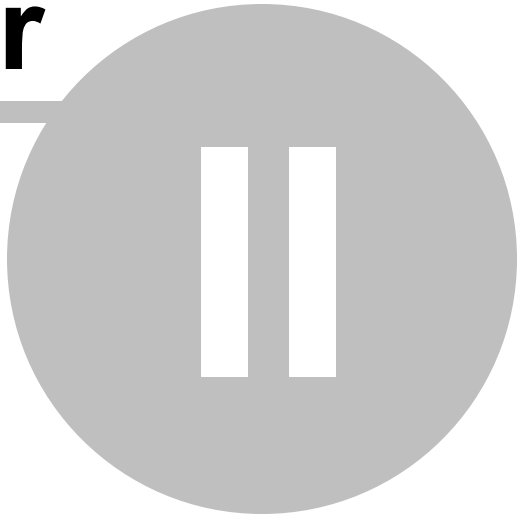
The breaking change here is that until the version prior to 2.1, the one and only behavior was Update. Now, the default has changed to Merge. We're not aware of any serious issue with this change, but the behavior has changed in some specific cases - for the better. Suppose you have a JSON request with the following object:

```
{
  "$id": 1,
  "@xdata.type": "XData.Default.Product",
  "Id": 10,
  "Name": "Ball",
  "Category1": {
    "$id": 2,
    "@xdata.type": "XData.Default.Category",
    "Id": 5,
    "Name": "Toys"
  },
  "Category2": {
    "$id": 2,
    "@xdata.type": "XData.Default.Category",
    "Id": 5,
    "Name": "Toys"
  }
}
```

In the example above, the client is sending a Product entity which has two category properties: Category1 and Category2. Both properties are pointing to the same "Toys" category (id = 5) so the PUT request is intending to set both product categories to "Toys".
With previous behavior, the server would raise an error, because there are two different instances of the same category in the product. With the new Merge behavior, the PUT request will process just fine.

In any case, if you want to go back to previous behavior you can just set TXDataServerModule.PutMode property to TXDataPutMode.Update.

Chapter



Getting Started

2 Getting Started

This chapter provides you the very basic steps to get started using TMS XData. They are simple examples, but shows you how quickly you can start use it, and how simple is that. The intention is to explain the macro structure of the framework and what are the major steps to setup it. For a full usage of the framework and full flexibility, see other chapters in this manual.

The following topics are covered in this chapter.

Quick Start
Wizard For New XData Server
Using Design-Time Components
Creating the Server Manually
Example 1: In-memory SQLite for testing/development
Example 2: MySQL Server with dbExpress (from Delphi code)
Example 3: MS SQL Server with FireDAC (using TDataModule)

2.1 Quick Start

Here we describe minimal steps to get started using TMS XData.

1. Create (or use existing) Aurelius classes and mapping in your server application
2. Optionally, create additional server-side logic using service operations
3. Reserve your server root URL in Windows
4. Create and run the server
5. Send requests to the server

1. Create (or use existing) Aurelius classes and mapping in your server application

This Quick Start guide assumes you have an existing basic knowledge about TMS Aurelius and your application already have some objects mapped to the database. Please refer to TMS Aurelius documentation, "Quick Start" section for a brief introduction. Consider, for example, that your application has the following class mapped to the database.

```
uses {...}, Aurelius.Mapping.Attributes;

type
  [Entity, Automapping]
  TCountry = class
  private
    FId: integer;
    FName: string;
  public
    property Id: integer read FId write FId;
    property Name: string read FName write FName;
```

```
  end;

  [Entity, Automapping]
  TCustomer = class
  private
    FId: integer;
    FName: string;
    FCountry: TCountry;
  public
    property Id: integer read FId write FId;
    property Name: string read FName write FName;
    property Country: TCountry read FCountry write FCountry;
  end;
```

Don't forget that you have to use those classes anywhere in your server application otherwise they will be removed by the linker. You could do something as simple as "TCountry.Create.Free" or just manually register the entity classes using TMS Aurelius mapping setup.

2. Optionally, create additional server-side logic using service operations

TMS XData already publishes all your mapped objects through a REST-ful interface, accessible through URL conventions, without the need to write any line of code.
But if you want to add additional, custom server-side logic, you can use Service Operations. For that, just declare an interface with methods and an implementation class that implements the methods on server side, and all you need to do is mark those types with special attributes [ServiceContract] and [ServiceImplementation]:

Service interface:

```
unit MyServiceInterface;
uses {...}, XData.Service.Common;

type
  [ServiceContract]
  IMyService = interface(IInvokable)
  ['{BAD477A2-86EC-45B9-A1B1-C896C58DD5E0}']
    function CustomerByName(const Name: string): TCustomer;
  end;

initialization
  RegisterServiceType(TypeInfo(IMyService));
end.
```

Service implementation (you can easily use Aurelius on server side to receive/ send objects automatically):

```
uses {...}, XData.Service.Common, XData.Server.Module,
Aurelius.Criteria.Linq;

type
  [ServiceImplementation]
  TMyService = class(TInterfacedObject, IMyService)
  private
    function CustomerByName(const Name: string): TCustomer;
  end;

function TMyService.CustomerByName(const Name: string):
TCustomer;
begin
  Result :=
TXDataOperationContext.Current.GetManager.Find<TCustomer>
    .Where(TLinq.Eq('Name', Name)).UniqueResult;
end;

initialization
  RegisterServiceType(TMyService);
end.
```

3. Reserve your server root URL in Windows

XData HTTP server is based on TMS Sparkle framework. According to Sparkle documentation, you must first reserve the URL your service will process requests from. If you have installed TMS Sparkle in your computer, the URL "http://+:2001/tms" is already reserved, so you can create your XData server under that address (all examples in this documentation uses the base address "http://server:2001/tms/xdata")

4. Create and run the server

Run the "New XData Server Wizard" to create the server application with a few clicks. Alternatively you can create the server manually.

5. Send requests to the server

Once your server is running, Aurelius entities are accessible through a Rest/ Json architecture. XData server defines URL conventions so you know how to build the URL to access the resources you need. The message payload in HTTP request and responses must be in JSON format that also follows XData spepecification. Then, XData clients can retrieve Aurelius entities by requesting data to the server, or request data modification on Aurelius entities. You can also invoke service operations.

To illustrate, given the classes used in step 1 in this quick start guide, these are some valid URL addresses that represent resources

http://server:2001/tms/xdata/Customer (lists all TCustomer entities)
http://server:2001/tms/xdata/Country (lists all TCountry entities)

http://server:2001/tms/xdata/Customer(1) (retrieves TCustomer entity with id = 1)
http://server:2001/tms/xdata/Customer(2)/Country (retrieves the TCountry object associated to the customer with id = 2 via Country property)
http://server:2001/tms/xdata/Customer?$filter=Country/Name eq 'USA'&$orderby=Name&$top=10 HTTP/1.1 (retrieves top 10 USA customers ordered by name)

You can then perform GET requests to retrieve entities, POST to create new entities, PUT/PATCH to update existing entities, and DELETE to remove entities.

You can also easily execute service operations from Delphi code through the service interfaces using a TXDataClient object:

```
uses {...},  MyServiceInterface, XData.Client;

var
  Client: TXDataClient;
  MyService: IMyService;
  Customer: TCustomer;
begin
  Client := TXDataClient.Create;
  Client.Uri := 'http://server:2001/tms/xdata';
  MyService := Client.Service<IMyService>;
  Customer := Client.CustomerByName('Joe');
  {...}
end;
```

2.2 Wizard For New XData Server

You can use the "New TMS XData Server" wizard to create a new server with a few clicks. You can also freely create the server manually, the wizard is not mandatory and it's just a way to get started quickly.

To create a new XData Server:

1. chose **File > New > Other** and then look for "**TMS Business**" category under "Delphi Projects". Then double click "**TMS XData Server**".

2. Chose the kind of applications you want to server to run on, then click Next. Available options are **VCL**, **FMX**, **Service** and **Console**. You can choose multiple ones (for example, you can have a VCL project for quick test the server and a Service one to later install it in production, both sharing common code.

3. Chose the **Host Name**, **Port** and **Path** for the server, then click Next. Usually you don't need to change the host name, for more info check URL namespace and reservation. Port and Path form the rest of base URL where your server will be reached.

4. Select the **Driver** (component to access database) and the **SQL Dialect** (type of database server), then click Create.

The new server will be created and ready to run.

2.3 Using Design-Time Components

Another way to create a TXDataServer is by using the design-time components. If you want the RAD, component dropping approach, this is the way.
There is a full chapter about the design-time components, but here is a short summary about how to use it:

1. Drop a dispatcher component in the form (for example, TSparkeHttpSysDispatcher)

2. Drop a TXDataServer component in the form

3. Associated the TXDataServer component to the dispatcher through the Dispatcher property

4. Specify the BaseUrl property of the server (for example, *http://+:2001/tms/xdata*)

5. Set Active property of dispatcher component to true

From now on you can already create server-side business logic using service operations.
If you want to use database connection and the automatic entity publishing feature, follow the next steps:

6. Drop a TAureliusConnection in the form and configure it to connect to your database (you might need to drop additional database-access components, like TFDConnection if you want to use FireDac).

7. Drop a TXDataConnectionPool component and associated it to TAureliusConnection through the Connection property

8. Associated the TXDataServer component to the pool through the Pool property

Now your XData server is able to publish database data automatically and you can also use the TXDataOperationContext to use Aurelius to retrieve data from database.

You can also use the TAureliusConnection component to automatically generate Aurelius classes from the database, right-clicking the component and choosing "Generate entities from the database".

2.4 Creating the Server Manually

Here we describe steps to create the XData server manually. You can alternatively use the XData Server Wizard.

1. Create an IDBConnectionFactory interface
2. Create an IDBConnectionPool interface
3. Create a TXDataServerModule object
4. Create a THttpSysServer, add the module to it and start the server

1. Create an IDBConnectionFactory interface

The IDBConnectionFactory interface is used to create TMS Aurelius IDBConnection interfaces that will be used by the server to connect to the desired databse (where Aurelius objects will be persisted). You can read more details in the specific topic about IDBConnectionFactory interface. Below we provide a code example that creates an IDBConnectionFactory interface which products IDBConnection interfaces that connect to an MS SQL Server database, based on an existing TSQLConnection component named SQLConnection1 in a data module TMyConnectionDataModule.

```
uses
  {...}, Aurelius.Drivers.Interfaces, Aurelius.Drivers.Base,
  Aurelius.Drivers.dbExpress;

var
  ConnectionFactory: IDBConnectionFactory;
begin
  ConnectionFactory := TDBConnectionFactory.Create(
      function: IDBConnection
      var
        MyDataModule: TMyConnectionDataModule;
      begin
        MyDataModule := TMyConnectionDataModule.Create(nil);
        Result :=
TDBExpressConnectionAdapter.Create(MyDataModule.SQLConnection1,
MyDataModule);
      end
    ));

  // Use the ConnectionFactory interface to create an
IDBConnectionPool interface
end;
```

2. Create an IDBConnectionPool interface

The IDBConnectionPool interface is used by the server to retrieve an IDBConnection interface when it's needed. It holds a list of such interfaces, and if there is none available, it uses the IDBConnectionFactory interface to create a new one. Example:

```
uses
  {...}, Aurelius.Drivers.Interfaces,
XData.Aurelius.ConnectionPool;

var
  ConnectionPool: IDBConnectionPool;
  ConnectionFactory: IDBConnectionFactory;
begin
  {...}
  ConnectionPool := TDBConnectionPool.Create(
    50, // maximum of 50 connections available in the pool
        // Define a number that best fits your needs
    ConnectionFactory
  );

  // Use the IDBConnectionPool interface to create the XData
server module
end;
```

3. Create a TXDataServerModule object

The TXDataServerModule is the main class of XData server. It's a Sparkle server module that is added to Sparkle server under a specific address. Example:

```
uses
  {...}, XData.Server.Module;
var
  XDataModule: TXDataServerModule;
  ConnectionPool: IDBConnectionPool;
begin
  {...}
  XDataModule := TXDataServerModule.Create('http://server:2001/
tms/xdata', ConnectionPool);
```

4. Create a THttpSysServer, add the module to it and start the server

Finally, create a TMS Sparkle THttpSysServer object, add the XData module to it, and start the server. Example:

```
uses
  {...}, Sparkle.HttpSys.Server, XData.Server.Module;
var
  XDataModule: TXDataServerModule;
  Server: THttpSysServer;
begin
  Server := THttpSysServer.Create;
  Server.AddModule(XDataModule);
  Server.Start;
end;
```

Later on, don't forget to destroy Server when application finishes.

2.5 Example 1: In-memory SQLite for testing/development

The following example is a minimum console application that illustrates how to start a XData server at address "http://localhost:2001/tms/music", using an in-memory SQLite database. It uses an unit named "AureliusEntities" which is not showed here to simplification. Such unit should just have the Aurelius mapped classes that will be exposed by the server.

An extra note about this example: since it's an in-memory database, every time the server starts the database will be empty. Thus, before starting the server, this example calls the method "UpdateDatabase(Connection)", declared in unit DatabaseUtils (also not listed here) to create required tables and data. Such thing is a regular TMS Aurelius procedure and is out of the scope of this example as well. The purpose of this example is just show how to get the XData server started.

```
program SQLiteConsoleServer;

{$APPTYPE CONSOLE}

uses
  System.SysUtils,
  Aurelius.Drivers.Interfaces,
  Aurelius.Drivers.SQLite,
  Aurelius.Sql.SQLite,
  Aurelius.Schema.SQLite,
  Sparkle.HttpSys.Server,
  XData.Aurelius.ConnectionPool,
  XData.Server.Module,
  AureliusEntities,
  DatabaseUtils;

procedure StartServer;
var
  Server: THttpSysServer;
  Connection: IDBConnection;
begin
  Server := THttpSysServer.Create;
  try
    Connection :=
TSQLiteNativeConnectionAdapter.Create(':memory:');
    UpdateDatabase(Connection);
    Server.AddModule(TXDataServerModule.Create('http://
localhost:2001/tms/music',
      TDBConnectionPool.Create(1,
        function: IDBConnection
        begin
          Result := Connection;
        end)));
    Server.Start;
    WriteLn('Server started. Press ENTER to stop.');
    ReadLn;
  finally
    Server.Free;
  end;
end;

begin
  StartServer;
end.
```

2.6 Example 2: MySQL Server with dbExpress (from Delphi code)

The following example is a minimum console application that illustrates how to start a XData server at address "http://localhost:2001/tms/music", using dbExpress to connect to a MySQL database, configured from code. It uses an

unit named "AureliusEntities" which is not showed here to simplification. Such unit should just have the Aurelius mapped classes that will be exposed by the server.
The connection pool is configured to hold up to 25 connections to the database.

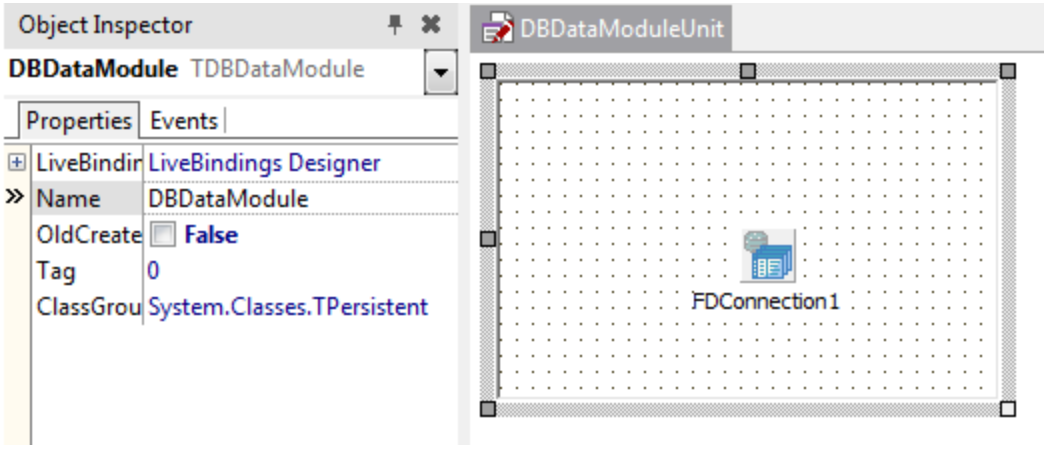
```
program DBExpressConsoleServer;

{$APPTYPE CONSOLE}

uses
  System.SysUtils, SqlExpr, DBXMySQL,
  Aurelius.Drivers.Base,
  Aurelius.Drivers.Interfaces,
  Aurelius.Drivers.dbExpress,
  Aurelius.Sql.MySQL,
  Aurelius.Schema.MySQL,
  Sparkle.HttpSys.Server,
  XData.Aurelius.ConnectionPool,
  XData.Server.Module,
  AureliusEntities in '..\common\AureliusEntities.pas';

procedure StartServer;
var
  Server: THttpSysServer;
  ConnFactory: IDBConnectionFactory;
begin
  Server := THttpSysServer.Create;
  try
    // Example using dbExpress. Create a connection factory to
use later
    ConnFactory := TDBConnectionFactory.Create(
      function: IDBConnection
      var
        SqlConn: TSQLConnection;
      begin
        SqlConn := TSQLConnection.Create(nil);
        SqlConn.DriverName := 'MySQL';
        SqlConn.GetDriverFunc := 'getSQLDriverMySQL';
        SqlConn.VendorLib := 'libmysql.dll';
        SqlConn.LibraryName := 'dbxmys.dll';
        SqlConn.Params.Values['HostName'] := 'dbserver';
        SqlConn.Params.Values['Database'] := 'xdata';
        SqlConn.Params.Values['User_Name'] := 'user';
        SqlConn.Params.Values['Password'] := 'mysql';
        SqlConn.LoginPrompt := false;
        Result := TDBExpressConnectionAdapter.Create(SqlConn,
true);
      end
    );
    Server.AddModule(TXDataServerModule.Create(
      'http://localhost:2001/tms/music',
      TDBConnectionPool.Create(25, ConnFactory)
    ));
    Server.Start;
    WriteLn('Server started. Press ENTER to stop.');
    ReadLn;
  finally
    Server.Free;
```

```
  end;
end;

begin
  StartServer;
end.
```

2.7 Example 3: MS SQL Server with FireDAC (using TDataModule)

The following example illustrates how to start a XData server at address "http://localhost:2001/tms/music", using FireDac to connect to any database (in the example, MS SQL Server database). Different from Example 2, this example uses a TFDConnection dropped in a TDataModule to configure the database connection at design-time. It uses an unit named "AureliusEntities" which is not showed here to simplification. Such unit should just have the Aurelius mapped classes that will be exposed by the server. The connection pool is configured to hold up to 15 connections to the database.

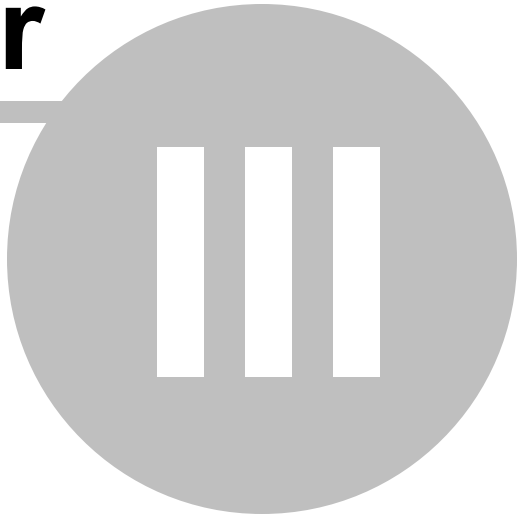
Thus considering you have a data module with an existing configured database connection using FireDac:



You can use such configuration and create one instance of that data module when required by the server and using the TFDConnection component from it.

```
program FireDacConsoleServer;

{$APPTYPE CONSOLE}

uses
  System.SysUtils,
  Aurelius.Drivers.Base,
  Aurelius.Drivers.Interfaces,
  Aurelius.Drivers.FireDac,
  Aurelius.Sql.MSSQL,
  Aurelius.Schema.MSSQL,
  Sparkle.HttpSys.Server,
  XData.Aurelius.ConnectionPool,
  XData.Server.Module,
  AureliusEntities in '..\common\AureliusEntities.pas',
  DBDataModuleUnit in 'DBDataModuleUnit.pas' {DBDataModule:
TDataModule};

procedure StartServer;
var
  Server: THttpSysServer;
begin
  Server := THttpSysServer.Create;
  try
    Server.AddModule(TXDataServerModule.Create('http://
localhost:2001/tms/music',
      TDBConnectionPool.Create(15, TDBConnectionFactory.Create(
        function: IDBConnection
        var
          DBDataModule: TDBDataModule;
        begin
          // Example using FireDac and Data Module
          DBDataModule := TDBDataModule.Create(nil);
          Result :=
TFireDacConnectionAdapter.Create(DBDataModule.FDConnection1,
DBDataModule);
        end
    ))));
    Server.Start;
    WriteLn('Server started. Press ENTER to stop.');
    ReadLn;
  finally
    Server.Free;
  end;
end;

begin
  StartServer;
end.
```

Chapter



Basic XData Programming

3 Basic XData Programming

This chapter explains basic tasks you can do with XData from code. It basically explains how to setup and start the server and how do some basic configuration using the available classes and interfaces. The following topics describe the most common XData programming tasks and main classes and interfaces

Creating XData Server
TXDataServerModule
IDBConnectionPool Interface
IDBConnectionFactory Interface
OpenAPI/Swagger Support

3.1 Creating XData Server

TMS XData Server is based on TMS Sparkle framework. The actual XData Server is a Sparkle server module that you add to the Sparkle HTTP Server.

Please refer to the following topics to learn more about TMS Sparkle servers:

Overview of TMS Sparkle HTTP Server
Creating an HTTP Server to listen for requests
TMS Sparkle Server Modules

To create the XData Server, just create and add a XData Server Module (TXDataServerModule class, declared in unit XData.Server.Module) to the Sparkle HTTP Server. The following code illustrates how to create and run the server. Note that the code that creates the XData server module is not displayed here. You should refer to "XData Server Module" topic to learn about how to create the module:

```
uses
  {...},
  Sparkle.HttpSys.Server, XData.Server.Module;

function CreateXDataServerModule(const BaseUrl: string):
TXDataServerModule;
begin
  // Create and return the TXDataServerModule here,
  // using the BaseUrl as the server address
end;

var
  Module: TXDataServerModule;
  Server: THttpSysServer;
begin
  Server := THttpSysServer.Create;
  Module := CreateXDataServerModule('http://server:2001/tms/
xdata');
  Server.AddModule(Module);
  Server.Start;
  ReadLn;
  Server.Stop;
  Server.Free;
end;
```

The code above will create and start an XData server that will receive and respond to HTTP requests on the address "http://server:2001/tms/xdata".

3.2 TXDataServerModule

To create a XData server, you need to add a TXDataServerModule object to the Sparkle HTTP Server. As with any Sparkle module, it will have a base (root) URL associated with it, and will respond to requests sent to any URL which matches the root URL of the module.

The TXDataServerModule is the main XData class, because it's the one which receives and handles all HTTP requests, so in a way, that's the class that implements the XData server. Although it's a very important class, its usage is very simple. You just need to create the class using one of the available overloaded constructors (TXDataServerModule is declared in unit XData.Server.Module):

```
constructor Create(const ABaseUrl: string); overload;
constructor Create(const ABaseUrl: string; AConnectionPool:
IDBConnectionPool); overload;
constructor Create(const ABaseUrl: string; AConnectionPool:
IDBConnectionPool; AModel: TXDataAureliusModel); overload;
constructor Create(const ABaseUrl: string; AConnection:
IDBConnection); overload;
constructor Create(const ABaseUrl: string; AConnection:
IDBConnection; AModel: TXDataAureliusModel); overload;
```

In summary, you must provide the base URL and optionally an IDBConnectionPool interface so that the server can retrieve IDBConnection interfaces to operate with the database. For example:

```
XDataServerModule := TXDataServerModule.Create('http://
server:2001/tms/xdata', TDBConnectionPool.Create(50,
  TDBConnectionFactory.Create(
      function: IDBConnection
      var
        MyDataModule: TMyDataModule;
      begin
        MyDataModule := TMyDataModule.Create(nil);
        Result :=
TFireDacConnectionAdapter.Create(MyDataModule.FDConnection1,
MyDataModule);
      end
)));
```

The example above creates the server with the rootl URL "http://server:2001/tms/xdata", providing a connection pool of maximum 50 simultaneous connections. The database connection used will be a FireDac TFDConnection component named FDConnection1, declared in a data module named TMyDataModule. That's all you need to have your XData server running and exposing your Aurelius objects.

The first overloaded constructor, used in previous example, takes just two parameters: base url and connection pool. The other overloaded versions are just variations that provides different settings.

If you have multiple Aurelius mapping models in your application, you can optionally use an entity model different from default, or explicitly build an entity model and provide it to the constructor, for specific mapping. This allows a better control for which classes and mapping settings are available from the XData server. If the model is not provided, XData uses the default entity model, which in turn uses default Aurelius model. Note that the model provided to the constructor will be not owned by the server module and must be destroyed manually. For example, the following code creates a module using the "Sample" model:

```
XDataServerModule := TXDataServerModule.Create('http://
server:2001/tms/xdata', MyConnectionPool,
TXDataAureliusModel.Get('Sample'));
```

There are also versions of Create constructor that receive an IDBConnection interface instead of an IDBConnectionPool. Those are just easy-to-use variations that internally create a connection pool with a single connection (no simultaneous connections available). It's an easy approach for testing and debug purposes, but should not be used in production environments because performance might not be ideal.

Properties

Name	Description

property UserName: string property Password: string	TXDataServerModule provides you these properties to specify UserName and Password required by the server, using Basic authentication. By default, the values are empty which means no authentication is performed and any client can access server resources and operations. When basic authentication is used, be sure to use HTTP secure (HTTPS) if you don't want your user name/ password to be retrieved by middle-man attack. If you don't use it, user name and password are transmitted in plain text in HTTP requests. These properties provide very limited basic authentication mechanism. For a more advanced one, you should use the TMS Sparkle built-in Basic authentication mechanism.
property AccessControlAllowOrigin: string	Specifies the accepted client hosts for which CORS will be enabled. If you want to accept any client connection, set this property value to '*'. This will enable CORS in the server including proper responses to preflighted requests.
property DefaultExpandLevel: integer	Defines the minimum level that associated entities will be expanded (included inline) in JSON responses. Default value is 0 meaning that all associated entities will be represented as references, unless specified otherwise. Clients can override this value by using xdata-expand-level header.
property Events: TXDataModuleEvents	Container for server-side events.
property PutMode: TXDataPutMode	Defines how PUT will be implemented at server side with Aurelius: either TXDataPutMode.Update or TXDataPutMode.Merge method (default). You will rarely need to change this property unless to ensure backward compatibility with older versions. This property value can be overriden in a specific request by using xdata-put-mode HTTP Request header.
property SerializeInstanceRef: TInstanceRefSerialization	Controls how instance reference ($ref) will appear in JSON response. Options are: *TInstanceRefSerialization.Always*: $ref is always used if the same instance appears again in the JSON tree. This mode is more optimized for use with TXDataClient, and is the default option. *TInstanceRefSerialization.IfRecursive*: $ref is only used if the instance appears as an associated object of itself. If the instance appears in a non-recursive way, $ref is not used and the instance is fully serialized inline instead. This mode is more suited to JavaScript and

	other non-Delphi clients, as those clientes don't need to resolve the $ref objects. This property value can be overriden in a specific request by using xdata-serialize-instance-ref HTTP Request header.
property SerializeInstanceType: TInstanceTypeSerialization	Controls whenever the entity/object type appears in JSON response (property annotation "xdata.type"). Options: *TInstanceTypeSerialization.Always*: The xdata.type annotation always appear in JSON responses. *TInstanceTypeSerialization.IfNeeded*: The xdata.type annotation is only present if the entity/object type is a descendant of the expected type. For example, suppose a GET request is performed in url Customers. For any entity in JSON that is of type Customer, the annotation will not present. If the entity is JSON is a descendendant of Customer (e.g., DerivedCustomer) then xdata.type apppears. Basically it means that xdata.type is implicit when absent, and is of the expected type of the request/specification. This property value can be overriden in a specific request by using xdata-serialize-instance-type HTTP Request header.
property UnknownMemberHandling: TUnknownMemberHandling	Defines server behavior when receiving a JSON from the client with a property that is now known for that request. For example, a JSON representing an entity with a property that does not belong to that entity. Options: *TUnknownMemberHandling.Error:* An InvalidJsonProperty error is raised if JSON contains an invalid property. This is default behavior. *TUnknownMemberHandling.Ignore*: Invalid properties in JSON will be ignored and request will be processed.

Methods

Name	Description
procedure SetEntitySetPermissions(const EntitySetName: string; Permissions: TEntitySetPermissions)	Specify the permissions for a specified entity set.

3.3 IDBConnectionPool Interface

The IDBConnectionPool interface is used by the XData server module to retrieve an IDBConnection interface, used to connect to the database. As client requests arrive, XData server needs an IDBConnection interface to connect to the database server and execute the SQL statements. It does that by trying to acquire an IDBConnection interface from the IDBConnectionPool interface. Thus, providing an IDBConnectionPool interface to the XData server module is mandatory for it to work.

The IDBConnectionPool interface is declared in unit Aurelius.Drivers.Interfaces and contains a single GetConnection method:

```
IDBConnectionPool = interface
  function GetConnection: IDBConnection;
end;
```

The easiest way to create an IDBConnectionPool interface is by using the TDBConnectionPool class, which implements the IDBConnectionPool interface. To instantiate it, you need to call Create constructor passing an IDBConnectionFactory interface which will be used by the connection pool to create a new connection, if needed. Or, alternatively, you can pass an anonymous method that creates and returns a new IDBConnection interface each time it's called.

Also, you need to specify the maximum number of IDBConnection interfaces (database connections) available in the pool. Whenever a client requests arrive, XData server acquires an IDBConnection from the pool, do all the database processing using it, and then return it to the pool. If many simultaneous requests arrive, the pool might run out of available connections, if the number of acquired IDBConnection interfaces reaches the maximum number specified. If that happens, the client request will wait until a new connection is available in the pool. TDBConnectionPool class is declared in unit XData.Aurelius.ConnectionPool.

The following code illustrates how to create an IDBConnectionPool interface. It uses a function named CreateMyConnectionFactory which is not showed in this example. To learn how to create such interface, please refer to IDBConnectionFactory topic.

```
uses
  {...}, Aurelius.Drivers.Interfaces,
XData.Aurelius.ConnectionPool;

var
  ConnectionPool: IDBConnectionPool;
  ConnectionFactory: IDBConnectionFactory;
begin
  ConnectionFactory := CreateMyConnectionFactory; //  Creates
IDBConnectionFactory
  ConnectionPool := TDBConnectionPool.Create(
    50, // maximum of 50 connections available in the pool
        // Define a number that best fits your needs
    ConnectionFactory
  );

  // Use the IDBConnectionPool interface to create the XData
server module
end;
```

Alternatively, you can just provide an anonymous method that creates the IDBConnection, instead of providing the IDBConnectionFactory interface:

```
uses
  {...}, Aurelius.Drivers.Interfaces,
XData.Aurelius.ConnectionPool;

var
  ConnectionPool: IDBConnectionPool;
begin
  ConnectionPool := TDBConnectionPool.Create(
    50, // maximum of 50 connections available in the pool
    function: IDBConnection
    var
      SQLConn: TSQLConnection;
    begin
      // Create the IDBConnection interface here
      // Be sure to also create a new instance of the database-
access component here
      // Two different IDBConnection interfaces should not share
the same database-access component

      // Example using dbExpress
      SQLConn := TSQLConnection.Create(nil);
      { Define SQLConn connection settings here, the server
         to be connected, user name, password, database, etc. }
      Result := TDBExpressConnectionAdapter.Create(SQLConn,
true);
    end
  ));

  // Use the IDBConnectionPool interface to create the XData
server module
end;
```

If you don't need a pooling mechanism but just want one database connection to be created for each time someone asks for a connection from the pool, you can use the TDBConnectionFactory class. It also implements the IDBConnectionPool interface:

```
var
  ConnectionPool: IDBConnectionPool;
begin
  ConnectionPool := TDBConnectionFactory.Create(
      function: IDBConnection
      var
        MyDataModule: TMyDataModule;
      begin
        // Creates a datamodule which contains a
        // TSQLConnection component that is already configured
        MyDataModule := TMyDataModule.Create(nil);

        // The second parameter makes sure the data module will
be destroyed
        // when IDBConnection interface is released
        Result :=
TDBExpressConnectionAdapter.Create(MyDataModule.SQLConnection1,
MyDataModule);
      end
    ));
end;
```

3.4 IDBConnectionFactory Interface

The IDBConnectionFactory interface is used to create an IDBConnectionPool interface, used by the XData module. As client requests arrive, XData server needs to retrieve an IDBConnection interface from the IDBConnectionPool so it can perform operations on the database through it. The connection pool creates a new IDBConnection by calling IDBConnectionFactory.CreateConnection method.

IDBConnectionFactory interface is declared in unit Aurelius.Drivers.Interfaces, and contains a single CreateConnection method.

```
  IDBConnectionFactory = interface
    function CreateConnection: IDBConnection;
  end;
```

The easiest way to create such interface is using TDBConnectionFactory class, which implements the IDBConnectionFactory interface. To create a TDBConnectionFactory object, you just need to pass an anonymous method that creates and returns a new IDBConnection interface each time it's called. TDBConnectionFactory class is declared in unit Aurelius.Drivers.Base.

The IDBConnection interface is part of TMS Aurelius library, used by XData. You can referer to TMS Aurelius documentation to learn how to create the IDBConnection interface.

In the following example, the factory will create an IDBConnection pointing to a Microsoft SQL Server database using dbExpress. You can connect to many other database servers (Oracle, Firebird, MySQL, etc.) using many different database-access components (FireDac, dbExpress, UniDac, ADO, etc.). You

can refer to Database Connectivity topic on TMS Aurelius documentation to learn all about those options. Regardless of what you use, the structure of the following code will be the same. What will change is the content of function: IDBConnection.

```
uses
  {...}, Aurelius.Drivers.Interfaces, Aurelius.Drivers.Base,
  Aurelius.Drivers.dbExpress;

var
  ConnectionFactory: IDBConnectionFactory;
begin
  ConnectionFactory := TDBConnectionFactory.Create(
      function: IDBConnection
      var
        conn: TSQLConnection;
      begin
        // Create the IDBConnection interface here
        // Be sure to also create a new instance of the
database-access component here
        // Two different IDBConnection interfaces should not
share the same database-access component

        // Example using dbExpress
        conn := TSQLConnection.Create(nil);
        conn.DriverName := 'MSSQL';
        conn.GetDriverFunc := 'getSQLDriverMSSQL';
        conn.VendorLib := 'sqlncli10.dll';
        conn.LibraryName := 'dbxmss.dll';
        conn.Params.Values['HostName'] := 'server';
        conn.Params.Values['Database'] := 'master';
        conn.Params.Values['User_Name'] := 'sa';
        conn.Params.Values['Password'] := 'password';
        conn.LoginPrompt := false;
        Result := TDBExpressConnectionAdapter.Create(SQLConn,
true);
      end
    ));

  // Use the ConnectionFactory interface to create an
IDBConnectionPool interface
end;
```

It's possible that you already have your database-access component configured in a TDataModule and you don't want to create it from code. In this case, you can just create a new instance of the data module and return the IDBConnection associated to the component. But you must be sure to destroy the data module (not only the database-access component) to avoid memory leaks:

```
var
  ConnectionFactory: IDBConnectionFactory;
begin
  ConnectionFactory := TDBConnectionFactory.Create(
      function: IDBConnection
      var
        MyDataModule: TMyDataModule;
      begin
        // Creates a datamodule which contains a
        // TSQLConnection component that is already configured
        MyDataModule := TMyDataModule.Create(nil);

        // The second parameter makes sure the data module will
be destroyed
        // when IDBConnection interface is released
        Result :=
TDBExpressConnectionAdapter.Create(MyDataModule.SQLConnection1,
MyDataModule);
      end
    ));

  // Use the ConnectionFactory interface to create an
IDBConnectionPool interface
end;
```

3.5 OpenAPI/Swagger Support

XData server can optionally provide a JSON file containing the OpenAPI Specification (OAS, formerly Swagger) for your whole server API. This opens up a lot of possibilities, usage of several tools of the OpenAPI ecosystem is now possible. Main one would be the Swagger UI, a web front-end to describe and test your API.

Enabling support for OpenAPI

To enable OpenAPI support in your server, just use the unit XData.OpenAPI.Service and call the method RegisterOpenAPIService anywhere in your application:

```
uses {...}, XData.OpenAPI.Service;

{...}
  RegisterOpenAPIService;
```

Retrieving the OpenAPI Specification (OAS) file

The OAS file is available through a GET request to the URL "*/openapi/swagger.json*" relative to your server root URL. For example, if your server root is *http://server:2001/tms/xdata/*, then you will be able to access the file from this URL:

```
GET http://server:2001/tms/xdata/openapi/swagger.json
```

Configuring the returned specification

You can use some parameters to configure the specification returned by the server. The parameters can be passed in the query part of the URL, and can be one of the following:

Name	Description
ExcludeEntities	Boolean parameter. Default is False. When True, specification will not contain the automatic CRUD operations on entities provided automatically by XData (entity resources). Example: `/openapi/swagger.json?ExcludeEntities=True`
ExcludeOperations	Boolean parameter. Default is False. When True, specification will not contain service operations. Example: `/openapi/swagger.json?ExcludeOperations=True`

Using Swagger UI

One of the main use cases is to be able to use the Swagger UI. It's a web-based front-end to dynamically document and test your API. From their website: "Swagger UI allows anyone — be it your development team or your end consumers — to visualize and interact with the API's resources without having any of the implementation logic in place. It's automatically generated from your Swagger specification, with the visual documentation making it easy for back end implementation and client side consumption.".

You can visit their site for more information, but here are quick steps to see it in action from your own server:

1. Create your XData Server and enable OpenAPI support as described above.

2. Enable CORS in your TXDataServerModule:

```
Module.AccessControlAllowOrigin := '*';
```

3. Open the existing live demo of the Swagger UI at http://petstore.swagger.io.

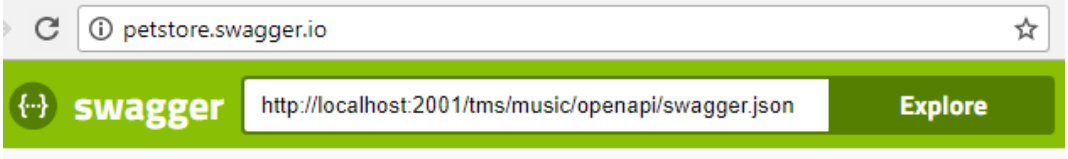
4. In the edit box that appears at the top of the page, just type the URL that returns the OpenAPI Specification. For example, *http://server:2001/tms/xdata/openapi/swagger.json*, and click "Explore". That would be enough to list your API.

If you want an even faster way to see it in action with XData:

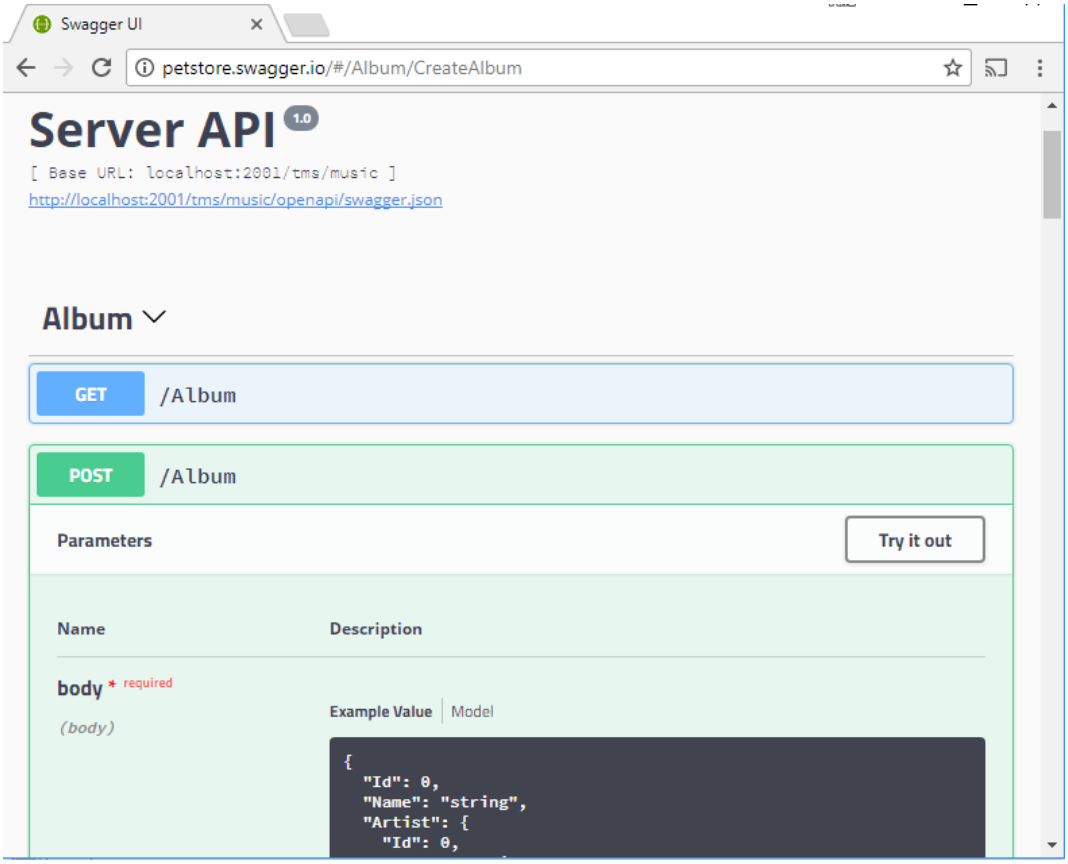
1. Run the demo named *SQLiteConsoleServer*. It's located in folder *demos \simple_sqlite.* That demo is available when you install TMS XData trial or licensed version.

2. Open web site http://petstore.swagger.io.

3. In the edit box, enter the OAS file address: *http://localhost:2001/tms/music/openapi/swagger.json*



4. Click *Explore* to browse the API and test.



Chapter



Design-Time Components

4 Design-Time Components

TMS XData provides several components for design-time usage. The main purpose is to provide a RAD experience, by just dropping components in the form and configuring them, allowing setting up servers with almost no line of code.

Even though you can use the components at runtime, creating them from code, that would usually be not necessary, as the components are just **wrappers** for the existing non-component classes, like TXDataServerModule or IDBConnectionPool.

Since TMS XData is based on TMS Sparkle components, you might want to read about TMS Sparkle design-time component usage, to learn more details about the architecture, like the common features and middleware system usage.

General usage is:

1. Drop a dispatcher component in the form (for example, TSparkeHttpSysDispatcher)

2. Drop a TXDataServer component in the form

3. Associated the TXDataServer component to the dispatcher through the Dispatcher property

4. Specify the BaseUrl property of the server (for example, *http://+:2001/tms/xdata*)

5. Set Active property of dispatcher component to true

From now on you can already create server-side business logic using service operations.
If you want to use database connection and the automatic entity publishing feature, follow the next steps:

6. Drop a TAureliusConnection in the form and configure it to connect to your database (you might need to drop additional database-access components, like TFDConnection if you want to use FireDac).

7. Drop a TXDataConnectionPool component and associated it to TAureliusConnection through the Connection property

8. Associated the TXDataServer component to the pool through the Pool property

Now your XData server is able to publish database data automatically and you can also use the TXDataOperationContext to use Aurelius to retrieve data from database.

You can also use the TAureliusConnection component to automatically generate Aurelius classes from the database, right-clicking the component and choosing "Generate entities from the database".

4.1 TXDataServer Component

TXDataServer component wraps the TXDataServerModule module. Basically all properties in the component has a direct relation with the properties of the TXDataServerModule, in case of doubt refer to TXDataServerModule reference to learn more details about each property.

Properties

Name	Description
Pool: TXDataConnectionPool	Contains a reference to a TXDataConnectionPool component. This will be used as the connection pool for the XData server database operations.
ModelName: string	Specifies the name of the model to be used to create the TXDataServerModule instance.
DefaultExpandLevel: Integer PutMode: TXDataPutMode PostMode: TXDataPostMode FlushMode: TXDataFlushMode ProxyLoadDepth: Integer ProxyListLoadDepth: Integer SerializeInstanceRef: TInstanceRefSerialization SerializeInstanceType: TInstanceTypeSerialization UnknownMemberHandling: TUnknownMemberHandling	All those property values will be used to set the a property with same name in the TXDataServerModule instance when it's created. Refer to TXDataServerModule topic to learn the purpose of each property.
DefaultEntitySetPermissions : TEntitySetPermissions	Specifies the default permissions for all entity sets. By default no permissions are provided, which means entity publish will not be available. This is **different behavior** than when creating TXDataServerModule directly, since it automatically publishes all entities.
EntitySetPermissions: TEntitySetPermissionItems	A collection where you can specify entity set permissions for an entity set in particular. This will override the default entity set permissions.

Events

Name	Description
OnModuleCreate: TXDataModuleEvent	Fired when the TXDataServerModule instance is created. `TXDataModuleEvent = procedure(Sender: TObject; Module: TXDataServerModule) of object;` Module parameter is the newly created TXDataServerModule instance.
OnGetPoolInterface: TGetPoolInterfaceEvent	Fired when the IDBConnectionPool interface is created by the TXDataConnectionPool component. `TGetPoolInterfaceEvent = procedure(Sender: TObject; var Pool: IDBConnectionPool) of object;` Pool parameter is the newly created IDBConnectionPool interface. You can override that value by creating your own interface and passing it in the Pool variable.
OnEntityInserting OnEntityModifying OnEntityDeleting OnEntityGet OnEntityList OnModuleException	These are wrappers around the events described in the server-side events chapter. Please refer to that chapter to know more about the events and how to use them. Arguments (event-handler parameters) are exactly the same.

4.2 TXDataConnectionPool Component

TXDataConnectionPool component creates IDBConnectionPool instances using a TAureliusConnection to create the IDBConnection interfaces.

Properties

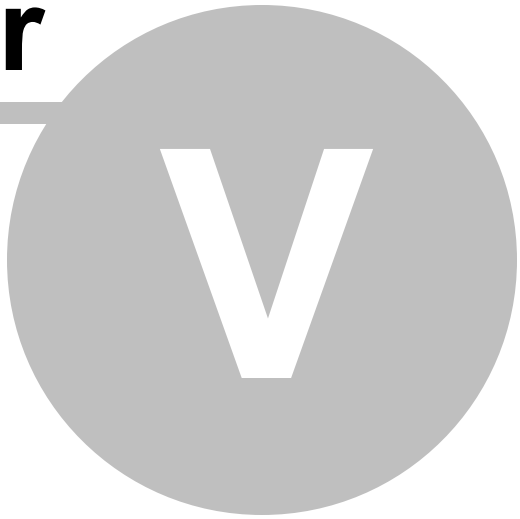
Name	Description
Connection: TAureliusConnection	Contains a reference to a TAureliusConnection component, used to create IDBConnection interfaces used by the pool.
Size: Integer	The size of the pool to be created.

Events

Name	Description
OnPoolInterfaceCreate: TPoolInterfaceEvent	Fired when the IDBConnectionPool interface is created by the TXDataConnectionPool component.

	`TPoolInterfaceEvent = procedure(Sender: TObject; var Pool: IDBConnectionPool) of object;` Pool parameter is the newly created IDBConnectionPool interface. You can override that value by creating your own interface and passing it in the Pool variable.

Chapter



Server-Side Events

5 Server-Side Events

TXDataServerModule published several events that you can use to implement additional server-side logic, customize XData behavior, among other tasks. You can use events, for example, to:

- Implement custom authorization, refusing or accepting an operation based on the user credentials or any other context information;
- Restrict/change the data returned to the client, by adding more filters to a query made by the user, for example
- Implement additional server-side logic, for example, performing extra operations after a resource is saved

Events in XData are available in the *Events* property of the TXDataServerModule object. Such property refers to a TXDataModuleEvents (declared in unit XData.Module.Events) object with several subproperties, each to them related to an event.

Read Using Events for more detailed info. You can also see real-world usage of events by checking the Authentication Example using JSON Web Token (JWT).

Events in TXDataModuleEvents

Name	Description
OnEntityGet	Occurs after an entity is retrieved, right before being sent to the client.
OnEntityList	Occurs when the client queries an entity collection.
OnEntityInserting	Occurs right before an entity creation.
OnEntityModifying	Occurs right before an entity update.
OnEntityDeleting	Occurs right before an entity delete.
OnModuleException	Occurs when an exception is raised during request processing. You can use it to provide custom error-handling.

5.1 Using Events

Events in XData are available in the *Events* property of the TXDataServerModule object. Such property refers to a TXDataModuleEvents (declared in unit XData.Module.Events) object with several subproperties, each to them related to an event. For example, to access the OnEntityInserting event:

```
uses {...}, XData.Server.Module, XData.Module.Events;

// Module is an instance of TXDataServerModule object
Module.Events.OnEntityInserting.Subscribe(
  procedure(Args: TEntityInsertingArgs)
  begin
    // Use Args.Entity to retrieve the entity being inserted
  end
);
```

In a less direct way, using method reference instead of anonymous method:

```
uses {...}, XData.Server.Module, XData.Module.Events;

procedure TSomeClass.MyEntityInsertingProc(Args:
TEntityInsertingArgs);
begin
  // Use Args.Entity to retrieve the entity being inserted
end;

procedure TSomeClass.RegisterMyEventListeners(Module:
TXDataServerModule);
var
  Events: TXDataModuleEvents;
begin
  Events := Module.Events;
  Events.OnEntityInserting.Subscribe(MyEntityInsertingProc);
end;
```

Listeners are method references that receive a single object as a parameter. Such object has several properties containing relevant information about the event, and differ for each event type. Names of event properties, method reference type and arguments follow a standard. The event property is named "On<event>", method reference type is "T<event>Proc" and parameter object is "T<event>Args". For example, for the "EntityInserting" event, the respective names will be "OnEntityInserting", "TEntityInsertingProc" and "TEntityInsertingArgs".

All events in XData are multicast events, which means you can add several events handlers (listeners) to the same event. When an event occurs, all listeners will be notified. This allows you to add a listener in a safe way, without worrying if it will replace an existing listener that might have been set by other part of the application.

It's always safe to set the events before adding the module and running the server.

5.2 OnEntityGet Event

Occurs after an entity is retrieved, right before being sent to the client. This event is also fired when the client requests part of that entity, for example, individual properties of the entity, blob data, or associated entities.

Example:

```
Module.Events.OnEntityGet.Subscribe(
  procedure(Args: TEntityGetArgs)
  begin
    // code here
  end
);
```

TEntityGetArgs Properties:

Name	Description
Entity: TObject	The retrieved entity
Handler: TXDataBaseRequestHandler	The XData request processor object.

5.3 OnEntityList Event

Occurs when the client queries an entity collection. This event is fired after the TCriteria object is built based on the client request, and right before the criteria is actually executed to retrieve the entities and sent to the client.

Example:

```
Module.Events.OnEntityList.Subscribe(
  procedure(Args: TEntityListArgs)
  begin
    // code here
  end
);
```

TEntityGetArgs Properties:

Name	Description
Criteria: TCriteria	The Aurelius criteria built based on client request that will be used to retrieve the collections. You can modify the request here, adding extra filters, orders, etc., before it's executed and results are sent to the client
Handler: TXDataBaseRequestHandler	The XData request processor object.

5.4 OnEntityInserting Event

Occurs right before an entity creation.

Example:

```
Module.Events.OnEntityInserting.Subscribe(
  procedure(Args: TEntityInsertingArgs)
  begin
    // code here
  end
);
```

TEntityInsertingArgs Properties:

Name	Description
Entity: TObject	The entity being inserted.
Handler: TXDataBaseRequestHandler	The XData request processor object.

5.5 OnEntityModifying Event

Occurs right before an entity update.

Example:

```
Module.Events.OnEntityModifying.Subscribe(
  procedure(Args: TEntityModifyingArgs)
  begin
    // code here
  end
);
```

TEntityModifyingArgs Properties:

Name	Description
Entity: TObject	The entity being modified
Handler: TXDataBaseRequestHandler	The XData request processor object.

5.6 OnEntityDeleting Event

Occurs right before an entity delete.

Example:

```
Module.Events.OnEntityDeleting.Subscribe(
  procedure(Args: TEntityDeletingArgs)
  begin
    // code here
  end
);
```

TEntityDeletingArgs Properties:

Name	Description
Entity: TObject	The entity being deleted
Handler: TXDataBaseRequestHandler	The XData request processor object.

5.7 OnModuleException Event

Occurs when an unexpected exception is raised during server request processing. By default, when that happens XData will send a response to the client with the property HTTP status code (usually 500 but other codes might be provided as well) and a JSON response with details of the error (a JSON object with properties ErrorCode and ErrorMessage). You can use this event to change that behavior when a specific exception occurs.

Example:

```
Module.Events.OnModuleException.Subscribe(
  procedure(Args: TModuleExceptionArgs)
  begin
    // code here, for example:
    if Args.Exception is EInvalidJsonProperty then
      Args.StatusCode := 400;
  end
);
```

TModuleExceptionArgs Properties:

Name	Description
Exception: Exception	The Exception object raised while processing the requested.

StatusCode: Integer	The HTTP status code to be returned to the client. You can change this property to tell XData to send a different status code.
ErrorCode: string	The value of the ErrorCode property in the JSON response to be sent to the client. You can modify this value.
ErrorMessage: string	The value of the ErrorMessage property in the JSON response to be sent to the client. You can modify this value.
Action: TModuleExceptionAction	The action to be performed. Default value is SendError which means XData will send the HTTP response to the client with the specified StatusCode and with a JSON response that includes ErrorCode and ErrorMessage. You can optionally use RaiseException, which means re-raising the original exception and let it propagate through the code. This gives an opportunity for some Sparkle middleware to catch the raise exception. If that doesn't happen, the exception will be handled by the Sparkle dispatcher. The third option is simply choose Ignore. Use this option if you want to send a custom HTTP response yourself. In this case XData will simply do nothing and finish processing request silently. `TModuleExceptionAction = (SendError, RaiseException, Ignore);`

5.8 Authentication Example using JSON Web Token (JWT)

Authentication and Authorization mechanisms in XData are available through the built-in auth mechanisms provided in TMS Sparkle, the underlying HTTP framework which XData is based on. The authentication/authorization in Sparkle is generic and can be used for any types of HTTP server, not only XData. But this topic illustrates how to use it integrated with XData server-side events to build an authentication system using JSON Web Tokens.

JSON Web Token (JWT)

From Wikipedia: "JSON Web Token (JWT) is a JSON-based open standard (RFC 7519) for passing claims between parties in web application environment". That doesn't say if we are just learning about it. There is plenty of information out there, so here I'm going directly to the point in a very summarized practical way.

A JWT is a string with this format:

```
aaaaaaaaaaa.bbbbbbbbbb.ccccccccc
```

It's just three sections in string separated by dots. Each section is a text encoded using base64-url:

```
<base64url-encoded header>.<base64url-encoded
claims>.<base64url-encoded signature>
```

So a real JWT looks like this:

```
eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJuYW1lIjoidG1zdXNlciIsIml
zcyI6IlRNUyBYRGF0YSBTZXJ2ZXIiLCJhZG1pbiI6dHJ1ZX0.
pb-4JAajpYxTsDTqWtgyIgpoqCQH8wlHl4RoTki8kpQ
```

If we decode each part of the JWT separately (remember, we have three parts separated by dots), this is what we will have from part one (spaces and returns added to make it more readable). It's the **header**:

```
{
  "alg":"HS256",
  "typ":"JWT"
}
```

And this is part two decoded, which is the **payload** or **claims set**:

```
{
  "name":"tmsuser",
  "iss":"TMS XData Server",
  "admin":true
}
```

Finally the third part is the **signature**. It makes no sense to decode it here since it's just a bunch of bytes that represent the hash of the header, the payload, and a secret that only the generator of the JWT knows.

The **payload** is the JSON object that "matters", it's the actualy content that end-user applications will read to perform actions. The **header** contains meta information the token, mostly the hashing algorithm using to generate the **signature**, also present in the token. So, we could say that a JWT is just an alternative way to represent a JSON object, but with a signature attached to it.

What does it has to do with authentication and authorization? Well, you can think of the JWT as a "session" or "context" for an user accessing your server. The JSON object in the payload will contain arbitrary information that you are going to put in there, like permissions, user name, etc.. This token will be generated by your server upon some event (for example, an user "login"), and then the client will resend the token to the server whenever he wants to perform any operation. This would be the basic workflow:

1. Client performs "login" in the server by passing regular user credentials (user name and password for example)
2. The server validates the credentials, generate a JWT with relevant info, using the *secret*, and sends the JWT back to the client

3. The client sends the JWT in next requests, passing the JWT again to the server
4. When processing each request, the server checks if the JWT signature is valid. If it is, then it can trust that the JSON Object in payload is valid and process actions accordingly.

Since only the server has the secret, there is no way the client can change the payload, adding "false" information to it for example. When the server receives the modified JWT, the signature will not match and the token will be rejected by the server.

For more detailed information on JSON Web Tokens (JWT) you can refer to https://jwt.io, the Wikipedia article or just the official specification. It's also worth mentioning that for handling JWT internally, either to create or validate the tokens, TMS XData uses under the hood the open source Delphi JOSE and JWT library.

JWT Authentication with TMS XData

Enough of theory, the next steps will show you how to implement authentication/authorization using JWT in TMS XData. This is just a suggestion, and it's up to you to define with more details how your system will work. In this example we will create a login service, add the middleware and use server-side events to implement authorization.

User Login and JWT Generation

We're going to create a service operation to allow users to perform login. Our service contract will look like this:

```
[ServiceContract]
ILoginService = interface(IInvokable)
['{BAD477A2-86EC-45B9-A1B1-C896C58DD5E0}']
  function Login(const UserName, Password: string): string;
end;
```

Users will send user name and password, and receive the token. Delphi applications can invoke this method using the TXDataClient, or invoke it using regular HTTP, performing a POST request passing user name and password parameters in the body request in JSON format. Nevertheless, it's worth noting that you should always use a secure connection (HTTPS) in your server to protect such requests.

The implementation of such service operation would be something like this:

```
uses {...}, Bcl.Jose.Core.JWT, Bcl.Jose.Core.Builder;

function TLoginService.Login(const UserName, Password: string):
string;
var
  JWT: TJWT;
  Role: string;
  IsAdmin: Boolean;
begin
  { check if UserName and Password are valid, retrieve User data
from database,
   add relevant claims to JWT and return it. In this example, we
will only
   add two claims: Role and IsAdmin.  }

  // Now that application specific logic is finished, generate
the token
  JWT := TJWT.Create(TJWTClaims);
  try
    JWT.Claims.SetClaimOfType<string>('role', Role);
    JWT.Claims.SetClaimOfType<Boolean>('isadmin', IsAdmin);
    JWT.Claims.Issuer := 'XData Server';
    Result := TJOSE.SHA256CompactToken('secret', JWT);
  finally
    JWT.Free;
  end;
end;
```

Now, users can simply login to the server by performing a request like this (some headers removed):

```
POST /loginservice/login HTTP/1.1
content-type: application/json

{
  "UserName": "tmsuser",
  "Password": "tmsuser"
}
```

and the response will be a JSON object containing the JSON Web Token (some headers removed and JWT modifi):

```
HTTP/1.1 200 OK
Content-Type: application/json

{
    "value":
"eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJyb2xlcyI6InRtc3VzZXIiLC
Jpc3MiOiJYRGF0YSBTZXJ2ZXIifQ.CAxxa3aizZheG3VXmBoXtfdg3N5jN9tNAZH
EV7R-W4Q"
}
```

For further requests, clients just need to add that token in the request using the authorization header by indicating it's a bearer token. For example:

```
GET /customers?$orderby=Name HTTP/1.1
content-type: application/json
authorization: Bearer
eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJyb2xlcyI6InRtc3VzZXIiLCJ
pc3MiOiJYRGF0YSBTZXJ2ZXIifQ.CAxxa3aizZheG3VXmBoXtfdg3N5jN9tNAZHE
V7R-W4Q
```

Adding TJwtMiddleware to process tokens in requests

The second step is to add the TJwtMiddleware to our XData server module. It's done just once, before starting up the server with the module. All we need to inform is the secret our server will use to validate the signature of the tokens it will receive:

```
uses {...}, Sparkle.Middleware.Jwt;

{...}
  Module.AddMiddleware(TJwtMiddleware.Create('secret'));
```

That's it. What this will do? It will automatically check for the token in the authorization header. If it does exist and signature is valid, it will create the IUserIdentity interface, set its Claims based on the claims in the JWT, and set such interface to the User property of THttpRequest object. Regardless if the token exists or not and the User property is set or not, the middleware will forward the processing of the request to your server anyway. It's up to you to check if user is present in the request or not. The only situation where the middleware will return immediately is if the token is present and is invalid. In this case it will return an to the client immediately and your server code will not be executed.

Authorizing the requests

Finally, in your application specific code, all you have to do is check for such User property and take actions based on it. For example, suppose you have a service operation DoSomething that does an arbitrary action. You don't want to allow anonymous requests (not authenticated) to perform such action. And you will only execute such action is authenticated user is an adminstrator. This is how you would implement it:

```
uses {...}, Sparkle.Security, XData.Sys.Exceptions;

procedure TMyService.DoSomething;
var
  User: IUserIdentity;
begin
  User := TXDataOperationContext.Current.Request.User;
  if User = nil then
    raise EXDataHttpUnauthorized.Create('User not
authenticated');
  if not (User.Claims.Exists('isadmin') and
User.Claims['isadmin'].AsBoolean) then
    raise EXDataHttpForbidden.Create('Not enough privileges');

  // if code reachs here, user is authenticated and is
administrador
  // execute the action
end;
```

Server-side events

The above code is valid for service operations. But you can also use server-side events to protect the entity sets published by XData. For example, you can use the OnEntityDeleting event to not allow non-admin users to delete resources. The event handler implementation would be pretty much the same as the code above (Module refers to a TXDataServerModule object):

```
  Module.Events.OnEntityDeleting.Subscribe(procedure(Args:
TEntityDeletingArgs)
    var User: IUserIdentity;
    begin
      User := TXDataOperationContext.Current.Request.User;
      if User = nil then
        raise EXDataHttpUnauthorized.Create('User not
authenticated');
      if not (User.Claims.Exists('isadmin') and
User.Claims['isadmin'].AsBoolean) then
        raise EXDataHttpForbidden.Create('Not enough
privileges');
    end
  );
```

That applies to all entities. Of course, if you want to restrict the code to some entities, you can check the Args.Entity property to verify the class of object being deleted and perform actions accordingly.

Finally, another nice example for authorization and server-side events. Suppose that every entity in your application has a property named "Protected" which means only admin users can see those entities. You can use a code similar to the one above to refuse requests that try to modify, create or retrieve a protected entity if the requesting user is not admin.

But what about complex queries? In this case you can use the OnEntityList event, which will provide you with the Aurelius criteria (TCriteria) that will be used to retrieve the entities:

```
  Module.Events.OnEntityList.Subscribe(procedure(Args:
TEntityListArgs)
    var
      User: IUserIdentity;
      IsAdmin: Boolean;
    begin
      User := Args.Handler.Request.User;
      IsAdmin := (User <> nil) and User.Claims.Exists('isadmin')
and User.Claims['isadmin'].AsBoolean;
    if not IsAdmin then
        Args.Criteria.Add(TLinq.EqualsTo('Protected', false));
    end
  );
```

The code above simply checks if the requesting user has elevated privileges. If it does not, then it adds an extra condition to the criteria (whatever the criteria is) which filters only the entities that are not protected. So non-admin users will not see the protected entities in the server response.

Authentication using TXDataClient

If you are using TXDataClient from a Delphi application to access the XData server, you can simply use the OnSendingRequest event to add authentication credentials (the token you retrieved from the server):

```
var
  Login: ILoginService;
  vToken: string;
begin
   vToken := Client.Service<ILoginService>.Login(edtUser.Text,
edtPassword.Text);
   Client.HttpClient.OnSendingRequest := procedure(Req:
THttpRequest)
     begin
       Req.Headers.SetValue('Authorization','Bearer '+vToken);
     end;
end;
```

Chapter



Entity Model

6 Entity Model

All the data exposed by the XData server is specified by an Entity Model represented by the class TXDataAureliusModel (declared in unit XData.AureliusModel). The Entity Model describes all the types (classes) and properties provided by the server, among other info.

Although XData uses Aurelius mapping to know all the classes and properties of the data objects, the Entity Model is used as an extra, intermediate metadata layer between XData and Aurelius. XData uses the Entity Model as the "official" metadata, and in turn, the Entity Model contains the links to the Aurelius mapping. This allows additional flexibility, like for example, having a property name in XData to be different than the property name in the mapped Aurelius class, although both point to the same property.

The entity model in summary, describes the published entities (through entity sets) and the service operations available.

The following topics explain in more details how XData uses the entity model.

Entity Model Concepts
Aurelius Equivalence to Entity Model
Using TXDataModelBuilder
Multiple servers and models

6.1 Entity Model Concepts

This topic describes the main concepts used in the Entity Model:

Entity Type
The entity type relates to an entity in the same way as a class relates to an object in object-oriented programming. In other words, an entity type is the "class definition" used by XData to retrieve info about an entity it receives or provides. An entity type contain a list of properties, what of those properties are considered the primary key for the entity, etc.. The entity type is related to a Delphi class, and as such it also supports inheritance (an entity type can be inherited from another entity type). By default the name of entity type is the name of the class, with the "T" prefix removed (if any). For example, there might be an entity type named "Customer", related to class TCustomer, with simples properties "Name", "City" and navigation property "Country".

Enum Type
Enum types are named scalar, primitive types that contain a list of name/value pairs which indicates its valid values. For example, the enum type "TSex" might have two name/value pairs: First is name "Male", with value 0, and second is name "Female", with value 1. Simple properties which types are enum types can only receive such values.

Simple Property

A simple property is a property of a scalar type, belonging to an entity type. A simple property can be of any primitive type as integer, boolean, string, etc., or enum types, and can have several facets indicating for example if the property is nullable, or its maximum length. For example, an entity type "TCustomer" can have a simple property "Name" of type string, and a simple property "Sex" of enum type "TSex".

Navigation Property
A navigation property is a property that represents a relationship between two entity types. It might relate to a single entity or a collection of other entities. It's the equivalent of an association in Aurelius mapping, or a foreign key in a database definition. A navigation property has a target property which points to another entity type. For example, an entity type "TOrder" might have a navigation property named "Customer" which target type is the "TCustomer" entity type.

Entity Set
An entity set is a logical container for instances of an entity type (entities) and instances of any type derived from that entity type. It can also be though as a collection of entities of a specified entity type. Thus, each entity set is associated with a entity type. Entity sets could be though as equivalent of a table in a database, but it's not exactly the same, since conceptually you might have different entity sets for the same entity type (although it's not often used). By default the name of the entity set is the name of the entity type associated to it so an entity set "Customer" will provide list of entities of type "Customer". It might be confused that both have same names, but they have different concepts

Services/Contracts
Services (specified by contracts) are a set of service operations, actions that are executed based on a client request and HTTP method. The service contracts are defined by service interfaces (contracts) and implemented by the server. For more information, see service operations.

6.2 Aurelius Equivalence to Entity Model

When you create the XData server module, the Entity Model (EM) is automatically created from the current Aurelius mapping, using a default entity model builder, and you don't need to define it yourself. This topic describes the rules used by the model builder to create the model based on Aurelius mapping.

Note that the XData server module creates the EM based on a TMappingExplorer object, which contains all the Aurelius mapping information.

Classes become entity types
Every mapped class in Aurelius becomes an entity type. By default, the name of entity type is the class name. So, if for example your mapping has classes TCustomer, TOrder and TCountry, each of those classes become an entity type in the EM.

Entity sets

XData creates an entity set for each entitytype, so that all entities can be easily accessible from the server. The entity set associated with the class contains all entities (objects) of that class. By default the name of the entity set is the name of the entity type associated to it. Thus, if you have a mapped class named "TCustomer", XData will define an entity type "Customer" in the EM, and will also define an entity set "Customer" that represents all entities of that type. You can prevent the "T" from being removed from class name by using the entity model builder.

Properties
Every mapped property or field in an Aurelius class becomes either a property or navigation property in the entity type. If the class property/field is an association, it becomes a navigation property. If it's a scalar property, it becomes a single property. It's important to note that only *mapped* class members become an entity type property. The name of the property in the EM will be the name of the mapped class property or the name of mapped class field with the "F" prefix removed. As an example, consider the following Aurelius mapping:

```
  [Entity]
  [Automapping]
  TCustomer = class
  strict private
    FId: Integer;
    FName: string;
    [Transient]
    FSex: Nullable<TSex>;
    [Column('BIRTHDAY', [])]
    FBirthday: Nullable<TDate>;
    FCountry: TTC_Country;
    [Column('Description', [])]
    FDescription: TBlob;
    [Transient]
    FPhoto: TBlob;
    [Transient]
    FPhoto2: TBlob;
  public
    property Id: Integer read FId write FId;
    property Name: string read FName write FName;
    [Column('SEX', [])]
    property Sex: Nullable<TSex> read FSex write FSex;
    property Birthday: Nullable<TDate> read FBirthday write
FBirthday;
    property Country: TCountry read FCountry write FCountry;
    property Description: TBlob read FDescription write
FDescription;
    [Column('Photo', [TColumnProp.Lazy])]
    property Photo: TBlob read FPhoto write FPhoto;
    property Photo2: TBlob read FPhoto2 write FPhoto2;
  end;
```

The above class will become an entity type named "TCustomer", with the following named properties: Id, Name, Birthday, Country, Description, Sex and Photo. Fields like FId and FName are considered because the class is marked

with [Automapping] attribute, so all fields are included (with "F" prefix removed). Also, properties Sex and Photo are also included because they are explicitly mapped. Finally, fields FSex, FPhoto and FPhoto2 are not included because they were excluded from Aurelius mapping because of the [Transient] attribute usage. You can prevent the "F" from being removed of field names by using the entity model builder.
All properties will be created as simple properties, except "Country" which will be a navigation property associated with the "TCountry" that is also an entity type created from TCountry class.

6.3 Using TXDataModelBuilder

XData server uses an entity model to specify the data it will publish through the Rest/Json interface. To work properly, the server module (TXDataServerModule object) needs an entity model, represented by a TXDataAureliusModel to work properly.

However, you can create the TXDataSeverModule without explicitly providing an entity model. In this case, the server will create one internally, based on the default TMappingExplorer, using the rules of equivalence between Aurelius mapping (specified in the mapping explorer) and the entity model. That's the most straightforward and common way to use it, and you will rarely need to create an entity model yourself.

In the case you want to build your own model and create a server based on it (for example, when you don't want classes and fields to have their "T" and "F" prefix removed from their names), you can do it using the TXDataModelBuilder.

The following example creates a model based on the default mapping explorer, however it sets properties UseOriginalClassNames and UseOriginalFieldNames to true to avoid the model builder to remove the "T" prefix from class names when naming entity types, and remove "F" prefix from field names when naming properties and navigation properties.

```
uses
  {...}, XData.Aurelius.ModelBuilder, XData.Aurelius.Model,
  XData.Server.Module, Aurelius.Mapping.Explorer;

var
  Builder: TXDataModelBuilder;
  Model: TXDataAureliusModel;
  Explorer: TMappingExplorer;
  Module: TXDataServerModule;
begin
  // model uses a TMappingExplorer instance with Aurelius
mapping
  // this example doesn't explain how to obtain one, please
refer to Aurelius documentation
  Explorer := TMappingExplorer.DefaultInstance;
  Model := TXDataAureliusModel.Create(Explorer);
  try
    Builder := TXDataModelBuilder.Create(Model);
    try
      Builder.UseOriginalClassNames := true;
      Builder.UseOriginalFieldNames := true;
      Builder.Build;
    finally
      Builder.Free;
    end;
  except
    Model.Free; // destroy the model in case an error occurs
    raise;
  end;

  // create the module using the created model.
  Module := TXDataServerModule.Create(MyServerUrl,
MyConnectionPool, Model);
end;
```

When adding service operations, to the model, the model builder will only take into consideration those service interfaces that belong to the same model of the TMappingExplorer instance you are using. For example, if your TMappingExplorer represents the model "Sample", only service contracts marked for the "Sample" model will be included in the entity model.

You can use the methods and properties of TXDataModelBuilder to better define your XData Model:

TXDataModelBuilder class

Declared in Unit

XData.Aurelius.ModelBuilder

Properties

Name	Description

UseOriginalClassNames: Boolean	By default XData removes the leading "T" of the class name to define the entity set name. So a class TCustomer will correspond to the entity set "Customer". If you don't want this behavior and wants the entity set name to be exactly the name of the class, set this property to true.
UseOriginalFieldNames: Boolean	By default XData removes the leading "F" of a mapped field name to define the property name of an entity type. So a field named "FName" will correspond to a property "Name" in JSON responses. If you don't want this behavior and wants the property name to be exactly the name of the field, set this property to true.
UseOriginalContractNames: Boolean	By default XData removes the leading "I" of the interface name to define the url segment of a service operation. So an interface ITestService will correspond to a service URL which path segment will beign with "TestService". If you don't want this behavior and wants the service operation base URL to be exactly the name of the interface, set this property to true.

Methods

Name	Description
function AddEntitySet(AClass: TClass): TXDataEntitySet	Creates a new entity set based on the class defined by AClass. The class **must** be an Aurelius entity. This will automatically create the entity type associated with the entity set.
procedure AddService<T>	Adds a new service operation contract to the model. Example: `Model.AddService<IMyService>;`
procedure RemoveEntitySet(AClass: TClass);	Use this to remove an entity set already created by the model. This is useful when you want to use the automatic creation of entity sets, based on Aurelius entities, but then you want to remove a few entity sets from the model.

6.4 Multiple servers and models

You can create multiple XData servers (TXDataServerModule instances), at different addresses. This makes more sense if you use different entity models for each of those XData modules. It's very easy to do so in XData if you are using the Aurelius multi-model design. When defining different models with different classes (and service operations), you can easily create different XData modules in a single server application.

To specify the different models in each server module, you just need to provide an instance of a TXDataAureliusModel that represents the desired entity model. And you can easily retrieve the correct instance by using the TXDataAureliusModel.Get class method, passing the model name to the function. The entity model will then only consider entity types and service operations that belongs to that model.

For example, the following code creates two different TXDataServerModule modules, using two different entity models:

```
XDataSampleModule := TXDataServerModule.Create('http://
server:2001/tms/xdata/sample',
  SampleConnectionPool, TXDataAureliusModel.Get('Sample'));

XDataSecurityModule := TXDataServerModule.Create('http://
server:2001/tms/xdata/security',
  SecurityConnectionPool, TXDataAureliusModel.Get('Security'));

HttpServer.AddModule(XDataSampleModule);
HttpServer.AddModule(XDataSecurityModule);
```

Note that this approach will filter all classes (entity types) belonging that specific model (for example, XDataSampleModule will only publish entity types which classes are marked with Model('Sample') attribute:

```
[Model('Sample')]
```

It will **also** filter the service operations according to the model name. So XDataSampleModule will only have services operations which service interfaces are marked with the Model('Sample') attribute.

6.5 Entity Sets Permissions

By default, all entity sets defined in the XData model will be published by the server with full permissions. This means the clients can list, retrieve, modify, delete, create entities using the entity sets (see Requesting Data and Data Modification for more information).

You can change those permissions individually by each entity set, by choosing which operations can be performed in each entity set.

This is accomplished using the SetEntitySetPermissions method of the TXDataServerModule object, declared as following

```
procedure SetEntitySetPermissions(const EntitySetName: string;
Permissions: TEntitySetPermissions);
```

The EntitySetName parameter specifies the name of the entity set (note that it's not necessarily the name of the class), or '*' for all entity sets and Permissions parameter defines the allowed operations in that entity set. Valid values are (declared in unit XData.Module.Base):

```
type
  TEntitySetPermission = (List, Get, Insert, Modify, Delete);
  TEntitySetPermissions = set of TEntitySetPermission;

const
  EntitySetPermissionsAll =
[Low(TEntitySetPermission)..High(TEntitySetPermission)];
  EntitySetPermissionsRead = [TEntitySetPermission.List,
TEntitySetPermission.Get];
  EntitySetPermissionsWrite = [TEntitySetPermission.Insert,
TEntitySetPermission.Modify,
    TEntitySetPermission.Delete];
```

So you can use constants EntitySetPermissionsAll (all operations), EntitySetPermissionsRead (read-only operations), EntitySetPermissionsWrite (write-only operations), or any combination of TEntitySetPermission enumerated value, which mean:

TEntitySetPermission values

Name	Description
TEntitySetPermission.List	Allows clients to query entities from the entity set using query criteria
TEntitySetPermission.Get	Allows clients to retrieve a single entity and its subproperties and associated entities.
TEntitySetPermission.Insert	Allows clients to create a new entity in the entity set.
TEntitySetPermission.Modify	Allows clients to modify an entity, by either method (PUT, PATCH, etc.) or even modifying properties or collection properties.
TEntitySetPermission.Delete	Allows clients to delete an entity from the entity set.

Examples

Allows all operations in entity set Country, except deleting an entity:

```
Module.SetEntitySetPermissions('Country',
EntitySetPermissionsAll - [TEntitySetPermission.Delete]);
```

Allows read-only operatiosn in City entity set:

```
Module.SetEntitySetPermissions('City',
EntitySetPermissionsRead);
```

For the History entity set, allows only querying entities, retrieve a single entity, or create a new one:

```
Module.SetEntitySetPermissions('History',
[TEntitySetPermission.List, TEntitySetPermission.Get,
TEntitySetPermission.Insert]);
```

Allows all entities to be read-only by default (list and get only). You can override this setting by setting permissions for a specific entity set:

```
Module.SetEntitySetPermissions('*', EntitySetPermissionsRead);
```

Chapter VII

URL Conventions

7 URL Conventions

This chapter describes what URL addresses are made available by the XData Server based on the entity model. It explains the rules for constructing URL address that identify data and metadata exposed by the server.
When you create the XData server, the root URL must be specified. Following the root URL part, additional URL constructions might be added, like path segments, query or fragment parts. In this manual, all examples consider the server root URL to be *http://server:2001/tms/xdata/*.

The URL used by the XData server for entity resources has three significant parts: root URL, resource path and query options, according to the example below.

```
http://server:2001/tms/xdata/Customer?$top=2&$orderby=Name
\_____________________________/\______/ \_________________/
              |                  |              |
           Root URL        resource path   query options
```

For service operations, the URL uses the following format:

```
http://server:2001/tms/xdata/MathService/Multiply
\_____________________________/\___________/\______/
              |                     |         |
           Root URL              service   operation
```

The following topics describe in details the parts of the URL as understood by the XData Server.

Resource Path
Query Options
Built-in Functions
Literals in URI
Custom Functions

7.1 Resource Path

This topic defines the rules for resource path construction according to XData URL conventions. Resources exposed by the XData server are addressable by corresponding resource path URL components to enable interaction of the client with that resource aspect. To illustrate the concept, some examples for resources might be: customers, a single customer, orders related to a single customer, and so forth. Examples of addressable aspects of these resources as exposed by the data model might be: collections of entities, a single entity, properties, and so on.

The following topics explain several different ways to access data through an URL:

Addressing Entity Sets
Addressing Single Entity
Addressing Associated Entities
Addressing Simple Properties
Addressing Streams (Blobs)
Counting Entities
Model Metadata

7.1.1 Addressing Entity Sets

An entity set can be addressed by using the name of entity set after the server root. As a general rule, the name of the entity set is the name of the base entity type of all entities belonging to that entity set (see Aurelius Equivalence to EDM for more information). So, for example, the entity set "Customer" will contain all entities of type "Customer" and its descendants. The collection of all Customer entities, for example, can be accessed with the following URL:

```
http://server:2001/tms/xdata/Customer
```

A query part can be appended to the URL address of an entity set, so entities in an entity set can be filtered, ordered, etc., for example:

```
http://server:2001/tms/xdata/Customer?$order=Name
```

There is a specific chapter about all the query options you can use in the query part of the URL.

XData uses JSON Format to represent the entity set resources available in such addresses. To know more about the format specification, please refer to the topic that explains JSON format representation of a collection of entities.

You can suffix the address with $count segment to return the number of entities:

```
http://server:2001/tms/xdata/Customer/$count
```

7.1.2 Addressing Single Entity

A single entity in an entity set can be addressed by passing the entity key between parenthesis after the entity set name. The following example represents a specified Customer object with id (key) equals to 3.

```
http://server:2001/tms/xdata/Customer(3)
```

The literals in key predicates can also represent other types than integer, such as strings or guids. The following example retrieves the employee with id equals to "XYZ".

```
http://server:2001/tms/xdata/Employee('XYZ')
```

If you have entity types with compound keys (not recommended, actually), you can access it by naming each value and separate them using commas. The

order is not significant. The next example represents the URL address of a Person entity identified by a compounded key made up of two properties, LastName and FirstName, which values are "Doe" and "John", respectively.

```
http://server:2001/tms/xdata/
Person(LastName='Doe',FirstName='John')
```

XData uses JSON Format to represent the entity resources available in such URL addresses. To know more about the format specification, please refer to the topic that explains JSON format representation of a single entity.

7.1.3 Addressing Navigation Properties

From a single entitiy, you can access associated entities through navigation properties. For example, if a customer type has a country associated to it, you can access it using the name of navigation property. The following example retrieves the country object associated with customer 3:

```
http://server:2001/tms/xdata/Customer(3)/Country
```

You can only have a maximum of one level of nested navigation property. The next address, for example, trying to request the country associated with a customer that is associated to on order, is **not valid.** To request such country, you should use the address in previous example (Customer()/Country) or access the country directly using Country(<key>).

```
http://server:2001/tms/xdata/Order(41)/Customer/Country (invalid address)
```

Note that it's also possible to retrieve collection of entities if the navigation property is a collection. For example, the following URL addresses the collection of order items for a specific order:

```
http://server:2001/tms/xdata/Order(41)/OrderItems
```

For such navigation properties that represents collections (many-valued associations), it's not possible to use key predicates (to identify a single entity in the collection), or query options (to filter or order the collection).

XData uses JSON Format to represent the entity resources available in such URL addresses. To know more about the format specification, please refer to the topic that explains JSON format representation of a single entity.

7.1.4 Addressing Individual Properties

It's also possible to directly access a simple property. In the example below, the URL represents the Name property of customer 3. Note there is a specific behavior for streams (blob) properties.

```
http://server:2001/tms/xdata/Customer(3)/Name
```

When accessing a simple property resource, it contains a JSON representation of the property value. You can also alternatively access the raw value of property using $value suffix:

```
http://server:2001/tms/xdata/Customer(3)/Name/$value
```

The difference between the two address is that the latter ($value) contains the property value in raw format (plain text), while the former, contains the property value wrapped in JSON format.
The only exception is a property address that represents a named stream (blob). In this case, the resource will contain the raw value of the blob, without needing to add the "$value" suffix. As an example, the following URL address contains the raw binary data representing the photo of a customer:

```
http://server:2001/tms/xdata/Customer(3)/Photo
```

XData uses JSON Format to represent the individual property resources available in such URL addresses. To know more about the format specification, please refer to the topic that explains JSON format representation of an individual property.

7.1.5 Addressing Streams (Blobs)

You can access a stream (blob) property directly using the property name. In the example below, the URL represents the Photo property of customer 3.

```
http://server:2001/tms/xdata/Customer(3)/Photo
```

The stream property resource contains the raw (binary) value of the blob content. Content-type is not specified. Unlike addressing individual properties, stream properties do not support the $value suffix, since the stream property resource already provides the raw value of the property.

7.1.6 Counting Entities

You can append "$count" path segment to a url that retrieves an entity set or a navigation property that returns a list of entities. That will retrieve the number of entities in that resource, in text/plain format, instead of the entities themselves.

For example, the following url will return the total number of Customer entities:

```
http://server:2001/tms/xdata/Customer/$count
```

While the following url will return the number of Customer entities with name is equal to John:

```
http://server:2001/tms/xdata/Customer/$count?$filter=Name eq
'John'
```

You can also use $count with associated entities:

```
http://server:2001/tms/xdata/Order(41)/OrderItems/$count
```

7.1.7 Model Metadata

Any XData module provides the *$model* URL that returns the metadata for the API model. It lists the entities, service operations, parameters, etc. For now the model metadata is used by XData tools (like clients) and is subject to modification.

```
http://server:2001/tms/xdata/$model
```

7.2 Query Options

When addressing resources, it's possible to include a query string in the URL to perform extra operations on the resource being addressed, like filtering or ordering entities. Query options start with *?* character and can be provided in the format *name=value*, separated by the *&* character. Many query options can be applied in a single URL. For example, the URL below retrieves the first 10 customers which country is USA, ordered by name:

```
http://server:2001/tms/xdata/Customer?$filter=Country/Name eq
'USA'&$orderby=Name&$top=10
```

The following table lists all the query options that can be used in a query string:

Query option	Description
$filter	Allows filtering the entities in an entity set by a specified condition
$orderby	Specifies the order of retrieved entities, by one or more properties or expression
$top	Specifies the maximum number of entities to be returned by the server
$skip	Specifies the number of entities that the server should skip before returning the requested entities
$inlinecount	Includes the total number of entities (without paging) in the JSON response
$expand	Expands associated objects in by forcing the server to include them inline in JSON response

7.2.1 $filter

The $filter query option can be used in a URI query string to specify a predicate by which entities will be filtered from an entity set. The $filter option only applies when addressing entity sets. The filter format is the following:

$filter=<boolean expression>

where <boolean expression> is a boolean expression with the predicate. Example:

```
http://server:2001/tms/xdata/Customer?$filter=Name eq 'John'
```

Properties can be accessed through their name, as in the previous example. The properties available are the ones from the entity type of the specified entity set. In the previous example, the entity set being retrieved contains instances of entity type Customer, which means properties of Customer are directly accessible in the boolean expression.

To access a property of an associated entity (navigation property), you can use slashes to build the path to the property name. The following example retrieves all customers which country is USA:

```
http://server:2001/tms/xdata/Customer?$filter=Customer/Name eq
'USA'
```

You can use logical operators and parenthesis to define multiple expressions and change evaluation order:

```
http://server:2001/tms/xdata/Customer?$filter=(Name eq 'John' or
Name eq 'Jack') and Customer/Name eq 'USA'
```

The previous examples use string literals in the expressions. String literals are always defined using single quotes. You can have literals of other types in the expression. Since the filter query option is part of URL, you must always format the literals according to the rules defined in Literals in URI section.

The following table lists the operators supported in filter expressions, and the order of precedence from highest to lowest. Operators in the same category have equal precedence.

Category	Expression	Description
Grouping	(x)	Enclosing parenthesis - expressions are evaluated with higher precedence
Primary	Name/SubName	Slash, allowing access to a sub property (navigation property)
Unary	-x	Negate x
Unary	not x	Logical not applied to x
Multiplicative	x mul y	Multiplies x by y
Multiplicative	x div y	Divides x by y
Additive	x add y	Adds x and y
Additive	x sub y	Subtracts y from x
Relational	x lt y	Evaluates true if x is lower than y
Relational	x gt y	Evaluates true is x is greater than y
Relational	x le y	Evaluates true if x is lower than or equal to y
Relational	x ge y	Evaluates true if x is greater than or equal to y
Equality	x eq y	Evaluates true if x is equal to y

Equality	x ne y	Evaluates true is x is not equal to y
AND Condition	x and y	Evaluates true is both x and y are true
OR Condition	x or y	Evaluates true is either x or y are true

7.2.2 $orderby

The $orderby query option can be used in a URL query string to determine which values are used to order the entities in the entity set. The $orderby option only applies for URI addressing entity sets. The format is the following:

$orderby=<expression> [asc/desc]
$orderby=<expression> [asc/desc], <expression> [asc/desc], ... , <expression> [asc/desc]

Where <expression> must contain the value by which the entities must be order, which is mostly the name of a property of sub property. Example:

```
http://server:2001/tms/xdata/Customer?$orderby=Name
```

The asc/desc identifier is optional and indicates if the entities must be sorted by the specified expression values in ascending or descending order. If not specified, ascending order is used. You can use slashes to access associations (navigation properties) and sort by values of such associations. As an example, the following URI will retrieve all invoices sorted by the name of the customer's country associated with that invoice, in descending order:

```
http://server:2001/tms/xdata/Invoice?$orderby=Customer/Country/
Name desc
```

You can also order by multiple values, separated by comma. The following example lists all customers by last name and for customers with the same last name, by first name;

```
http://server:2001/tms/xdata/
Customer?$orderby=LastName,FirstName
```

7.2.3 $top

The $top query option can be used in a URI query string to specify the maximum number of entities that will be returned by the server. The $top option only applies for URI addressing entity sets. The format is the following:

$top=<integer>

The returned entities are always the first entities in the result set. Usually $top is used together with $orderby query option so that the order by which the entities are returned are known. It is also often used together with $skip query option to perform paging of results. In the following example, the server will

return the first 10 invoice entities ordered by Date, even if there are more than 10 invoices in the server:

```
http://server:2001/tms/xdata/Order?$orderby=Date&$top=10
```

7.2.4 $skip

The $skip query option can be used in a URI query string to specify the number of entities that will be skipped by the server before returning the results. The $skip option only applies for URI addressing entity sets. The format is the following:

$skip=<integer>

The skipped entities are always the first entities in the result set. Usually $skip is used together with $orderby query option so that the order by which the entities are returned are known. It is also often used together with $top query option to perform paging of results. In the following URI example, the server will return invoice entities ordered by Date in descending order, buy skipping the 10 first invoices and starting in the 11th one:

```
http://server:2001/tms/xdata/Order?$orderby=Date desc&$skip=10
```

7.2.5 $inlinecount

The $inlinecount query option allows including the total number of entities in the JSON response representing a collection of objects. The counting of entities ignores paging query options like $top and $skip. It's useful when paging results, so you can get a single page but also retrieve the total number of entities so the client can know in a single request how many entities are in total even when requesting only a page.

The $inline option only applies for URI addressing entity sets. The format is the following:

$inlinecount=none|allpages

When using "none" (the default), no info is included. When using "allpages", the total number of entities for all pages will be included in the JSON response, in a property named $xdata.count.

In the following example, the server will return the first 10 invoice entities ordered by Date, and ask for the total number of entities available.

```
http://server:2001/tms/xdata/
Order?$orderby=Date&$top=10&$inlinecount=allpages
```

The JSON result would be something like this (supposing the total number of entities is 142):

```
{
  "@xdata.count": 142,
  "value": [
    < list of Order objects here >
  ]
}
```

7.2.6 $expand

The $expand query option allows fine-grain control about how associations will be represented in JSON response sent by the server. By default, the server will represent any associated object in a JSON response using the reference convention. For example, suppose a request for a Customer object:

```
http://server:2001/tms/xdata/Customer(3)
```

will return a JSON response like this:

```
{
  "$id": 1,
  "@xdata.type": "XData.Default.Customer",
  "Id": 3,
  "Name": "Bill",
  "Country@xdata.ref": "Country(10)"
}
```

Note the associated Country is represented as a reference (Country with Id = 10). This is very handy when using Delphi client (TXDataClient) or even non-Delphi client where you just want to modify the country reference without needing to retrieve the whole object.

However, in some cases you might want to have the full Country object inline. With the $expand query option you can explicitly indicate which associated properties you want to be inline:

```
http://server:2001/tms/xdata/Customer(3)?$expand=Country
```

Response will be:

```
{
  "$id": 1,
  "@xdata.type": "XData.Default.Customer",
  "Id": 3,
  "Name": "Bill",
  "Country": {
    "$id": 2,
    "@xdata.type": "XData.Default.Country",
    "Id": 10,
    "Name": "Germany",
  }
}
```

$expand applies to both single association and lists. It also forces any server-side proxy to be loaded, so even if Country is lazy-loaded, $expand will retrieve the entity inline. XData optimizes this retrieval process by forcing the proxy to be loaded eagerly in a single SQL statement (except for lists).

You can expand multiple properties by separating them using comma. The following example expands properties Customer, Seller and Products:

```
http://server:2001/tms/xdata/
Invoice(10)?$expand=Customer,Seller,Products
```

You can also expand subproperties (deeper levels) by using slash to specify subproperties. The following example expands property Customer and also the Country property of such customer (and Seller) property:

```
http://server:2001/tms/xdata/Invoice(10)?$expand=Customer/
Country,Seller
```

7.3 Built-in Functions

In addition to operators, a set of functions is also defined for use with the $filter or $orderby system query options. The following sections describe the available functions.

Upper
Lower
Length
Substring
Position
Concat
Contains
StartsWith
EndsWith
Year
Month
Day
Hour
Minute
Second

7.3.1 Upper

The upper function returns the input parameter string value with all characters converted to uppercase.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=upper(Name) eq
'PAUL'
```

7.3.2 Lower

The lower function returns the input parameter string value with all characters converted to lowercase.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=lower(Name) eq
'paul'
```

7.3.3 Length

The length function returns the number of characters in the parameter value.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=length(Name) eq 15
```

7.3.4 Substring

The substring function returns a substring of the first parameter string value identified by selecting M characters starting at the Nth character (where N is the second parameter integer value and M is the third parameter integer value). N parameter is 1-based, thus N = 1 means the first character

Example:

```
http://server:2001/tms/xdata/
Customer?$filter=substring(CompanyName, 2, 4) eq 'oogl'
```

7.3.5 Position

The position function returns the 1-based character position of the first occurrence of the first parameter value in the second parameter value. If the string in first parameter is not found in the string in second parameter, it returns zero.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=position('jr',
Name) gt 0
```

7.3.6 Concat

The concat function returns the string concatenation of the two string input parameters passed to it.

Example:

```
http://server:2001/tms/xdata/
Customer?$filter=concat(concat(Name, ' '), LastName) eq 'PAUL
SMITH'
```

7.3.7 Contains

The contains function returns True if the first string parameter contains the string specified by the second string parameter. False otherwise.

The following example will return all customers which Name contains the string "Walker".

```
http://server:2001/tms/xdata/Customer?$filter=contains(Name,
'Walker')
```

7.3.8 StartsWith

The startswith function returns True if the first string parameter starts with the string specified by the second string parameter. False otherwise.

The following example will return all customers which Name starts with the string "Paul".

```
http://server:2001/tms/xdata/Customer?$filter=startswith(Name,
'Paul')
```

7.3.9 EndsWith

The endswith function returns True if the first string parameter ends with the string specified by the second string parameter. False otherwise.

The following example will return all customers which Name ends with the string "Smith".

```
http://server:2001/tms/xdata/Customer?$filter=endswith(Name,
'Smith')
```

7.3.10 Year

The year function returns the year component of a single date/time parameter value.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=year(BirthDate) eq
1971
```

7.3.11 Month

The month function returns the month component of a single date/time parameter value.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=month(BirthDate)
eq 12
```

7.3.12 Day

The day function returns the day component of a single date/time parameter value.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=day(BirthDate) eq
31
```

7.3.13 Hour

The hour function returns the hour component of a single date/time parameter value.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=hour(BirthDate) eq
14
```

7.3.14 Minute

The minute function returns the minute component of a single date/time parameter value.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=minute(BirthDate)
eq 45
```

7.3.15 Second

The second function returns the second component of a single date/time parameter value.

Example:

```
http://server:2001/tms/xdata/Customer?$filter=second(BirthDate)
eq 30
```

7.4 Literals in URI

When building an URI to perform a request to the server, you sometimes need to include literal values in it. You might need to use literals, for example, when addresing a single entity, where you need to pass the key value in the URI. Or when you use query options like $filter, where you usually include boolean expressions that compare property values to literal values. The following table indicates how to build literal values of several different data types.

Data Type	Examples	Description
null	null	Null value
Boolean	true false	Boolean values
DateTime	2013-12-25 2013-12-25T12:12 2013-12-25T12:12:20.125	Date time value must be in the ISO 8601 format (YYYY-MM-DDTdd:mm:ss.zzz). Parts of time can be omitted, for example, you can omit the milliseconds part (zzz) and seconds part (ss), or the full time and provide only the date part.
Float	3.14 1.2e-5	Float number values. Exponential format is also supported.
Guid	E314E4B3-ECE5-4BD5-9D41-65B7E74F7CC8	Guid value must not have enclosing brackets, must have the hyphens separating the five guid blocks (8 char, 4 char, 4 char, 4 char, 12 char). Each guid block is composed by hexadecimal digits.
Integer	1234	Integer values
String	'John'	Strings must be enclosed in single quotes

7.5 Custom Functions

Besides the built-in functions you can use in $filter and $orderby query options, you can also register your own custom functions. Such functions will then be translated into Aurelius' LINQ "SQL functions" that also need to be previously registered for the query to work.

For example, to register a function named "unaccent":

```
uses {...}, XData.Query.Parser;

TQueryParser.AddMethod('unaccent',
TQueryMethod.Create('unaccent', 1));
```

The numeric parameter (1) indicates the number of parameters the function receives.
Then to use the function from query API:

```
http://server:2001/tms/xdata/Customer?$filter=unaccent(Name) eq
'Andre'
```

Chapter



JSON Format

8 JSON Format

XData server uses JSON format in message payloads when receiving and sending HTTP messages to represent several different structures like entities, collection of entities or individual properties. Although JSON specification is very simple and describes completely how to use JSON format, the meaning of each JSON structure (especially name/value pairs) depend on the application and server behavior.

The following topics describes how each different structure is represented in JSON format by XData, and additional useful info about it.

Entity Representation
Collection of Entities
Individual Properties
Error Response
Canonical Id

8.1 Entity and Object Representation

Any entity or simple object is serialized as a JSON object. Each property is represented as a name/value pair within the object.

The name of the properties in JSON for an entity will be the same as property names defined in the Entity Model.
The name of the properties in JSON for a simple object will be the field names of the object class, with the leading "F" removed from the name, if it exists.

An entity in a payload may be a complete entity, with all existing properties for that entity type, or a partial entity update (for partial update operations), which do not list all properties of the entity.
An object in payload will always have all properties.

The following text illustrates how XData represents a simple Customer entity (TCustomer class).

```
{
  "$id": 1,
  "@xdata.type": "XData.Default.Customer",
  "Id": 55,
  "Name": "Joseph",
  "Birthday": "1980-05-20",
  "Sex": "tsMale",
  "Picture": null
}
```

In above JSON representation, Customer entity type contains simple properties Id (integer), Name (string), Birthday (date), Sex (enumeration) and Picture (blob). The property values are represented as direct JSON values. Note that XData also includes some metadata information in the JSON object, like "$id" name which represents the object reference id, and the "xdata.type"

annotation which is needed for it to work properly. The following topics describe more specific details about how entities and its properties are represented in XData.

Property Values
Object References
Annotation "xdata.type"
Representing Associated Entities
Blob Representation
Including or Excluding Properties

8.1.1 Property Values

Simple (scalar) properties of an entity/object are represented in as name/value pairs in the JSON object. The JSON name contains the property name, and value contains a JSON value that can be either a JSON string, number, boolean or null, depending on the property type. The format of most types are very straightforward (a string property is represented as a string JSON, an integer property as integer JSON, and so on), but a few types have some specific representation. The following table explains the JSON representation of the most common property types.

Data Type	Examples	Description
<null values>	null	Represented as JSON null literal
Binary	"T0RhdGE"	Represented as JSON string, whose content must be the binary value encoding as Base64.
Boolean	true false	Represented as JSON true or false literals
DateTime	"2013-12-25" "2013-12-25T12:12" "2013-12-25T12:12:20.050"	Represented as JSON string, whose content must be the date/time in ISO 8601 format (YYYY-MM-DDTdd:mm:ss.zzz). The time part can be completely omitted. If time part is present, hour and minutes are required, and seconds and milliseconds parts can also optionally be omitted.
Enum types	"tsMale" "Yellow"	Represented as JSON string, whose content is the name corresponding to the ordinal value of the enumerated property.
Float	3.14 1.2e-5	Represented as JSON number.
Guid	"E314E4B3-ECE5-4BD5-9D41-65B7E74F7CC8"	Represented as JSON string, whoe content must be the string representation of the GUID, must not have enclosing brackets and must have the hyphens separating the five guid blocks (8 char, 4 char, 4 char, 4 char,

		12 char). Each guid block is composed by hexadecimal digits.
Integer	1234	Represented as a JSON number
String	"John"	Represented as JSON string, using JSON string escaping rules.

8.1.2 Object References

XData provides the concept of object referencing in JSON. This is useful to indicate which objects are the same object instance, and also to avoid circular references. Please note that this concept is used only to reference JSON objects in a single JSON representation. It's not in any way related to representing association references.

When serializing objects, XData attributes an "instance id" for that object and serializes it. The instance id is serialized as the first property of the object, with the name "$id". If during serialization the serializer finds another reference to the same object, it won't serialize the object again, but instead, will create a "instance reference" that refers to the instance id of the object previously serialized. For example, consider you have Product entity type which has a Category property that points to a Category entity type. Suppose you have a list of two Product entities "Ball" and "Doll" that point to the same "Toys" category. This is how such list would be serialized:

```
[
  {
    "$id": 1,
    "@xdata.type": "XData.Default.Product",
    "Id": 10,
    "Name": "Ball",
    "Category": {
      "$id": 2,
      "@xdata.type": "XData.Default.Category",
      "Id": 5,
      "Name": "Toys"
    }
  },
  {
    "$id": 2,
    "@xdata.type": "XData.Default.Product",
    "Id": 12,
    "Name": "Doll",
    "Category": {
      "$ref": 2,
    }
  }
]
```

The deserializer also uses such notation to avoid duplicating objects and using the same object instance for multiple references. When the deserializer finds a JSON object with a "$ref" property it will try to find the object instance with the same "$id" value as the "$ref" property value. Then it will use the reference to that object instead of creating a new one. In the JSON example above, when creating the second Product instance and setting the Category property, the deserializer will not create a new Category object. Instead, it will use the same Category object created in the first product. Thus, the Category property of both Product objects will point to the same Category object instance.

If the deserializer can't find an instance pointed by the "$ref" property, an error will be raised. All other properties of a JSON object containing a "$ref" property will be ignored.

Although the XData serializers adds an "$id" property to all objects, such property is not required in XData notation, thus the deserializer won't raise an error if an object doesn't have an instance id. But if present, this property must have the very first property (name/value pair) in the JSON object.

The rule of when object reference ($ref) will be used depend on the TXDataServerModule.SerializaInstanceRef property. By default, it's always used whenever an instance appears again. But it can be configured to only appear for recursive ocurrences (thus avoiding an infinite loop). Please refer to the property documentation for more info. When used only for recursive ocurrences, the example above will not include $ref, and the Category object will be repeated in the response:

```
[
  {
    "$id": 1,
    "@xdata.type": "XData.Default.Product",
    "Id": 10,
    "Name": "Ball",
    "Category": {
      "$id": 2,
      "@xdata.type": "XData.Default.Category",
      "Id": 5,
      "Name": "Toys"
    }
  },
  {
    "$id": 2,
    "@xdata.type": "XData.Default.Product",
    "Id": 12,
    "Name": "Doll",
    "Category": {
      "$id": 2,
      "@xdata.type": "XData.Default.Category",
      "Id": 5,
      "Name": "Toys"
    }
  }
]
```

8.1.3 Annotation "xdata.type"

All JSON objects in XData that represent an entity might contain a metadata property named "@xdata.type". Is must be present before any regular (non-metadata) property, otherwise an error is raised while deserializing the object. This property indicates the entity type of the JSON object. This is used by the deserializer to know which class to be used to instantiate the object. The value of this property is the name of the entity type, prefixed by "XData.Default".

An example of an object of type "Customer".

```
{
  "$id": 1,
  "@xdata.type": "XData.Default.Customer",
  "Id": 55,
  "Name": "Joseph"
}
```

When sending requests to the server, "@xdata.type" annotation is optional. If not present, XData will try to infer the entity type from the context (for example, if you are creating an entity POST'ing to address "http://server:2001/tms/xdata/Customer", then it will assume the entity type is "Customer" if xdata.type annotation is missing. Thus, this annotation is mostly used when dealing with polymorphism, so you be sure that the entity will be deserialized as the correct type.

The presence of xdata.type annotation in server responses depend on the configuration of TXDataServerModule.SerializeInstanceType property. By default, it always send entity/object representations with the xdata.type, but the server can be configured to only include the annotatino for derived types. Please refer to the property documentation for more info.

8.1.4 Representing Associated Objects

There are several ways to represent an associated entity/object in a JSON object.

An associated entity is the entity object that relates to another entity through a navigation property (association).
An associated object is any property of the object that references another object.

For example, you might have an entity type Customer with a navigation property Country, which target is the Country entity type. So the Country object is associated with the Customer object through the Country property, and might be represented in JSON notation. The equivalent Aurelius class would be something like this (parts of code removed):

```
TCustomer = class
  { code stripped }
  property Country: TCountry;
end;
```

Here we describe the different ways to represent an associated entity/object in JSON format. Please note that this is not related to representing object references, they are different concepts.

XData server responses will often use entity references when responding to resource requests. This behavior might be affected by the XData-ExpandLevel request header. Some other classes might also make use of such header transparently, like TXDataClient which automatically sets an expand level to 3 (thus all non-proxy entities will be serialized inline until the 3rd level in object tree).

Note that all the following options are only available for associated entities. For associated objects, only inline representation is allowed.

Entity Reference

This only applies to associated entities.
This is the most common way to represent an associated entity and should be preferred over any other method, if possible. It's somehow related to reference to an object instance, in a programming language. It's represented by annotating the navigation property name with "xdata.ref" sufix. The value of such property must be the canonical id of the associated object:

```
  "Country@xdata.ref": "Country(10)"
```

In the simplified example above, the property Country is associated to the Country object with id equals to 10.

Clients can use that value to retrieve further info about the associated object by using the rules described in "canonical id" topic, performing an extra request to the server. Also, in update/insert operations, clients can also use this format to tell the server how to update the association. In the example above, if you send such object to the server in an update operation, the customer object will have its Country property updated to point to the Country(10) object (country with id equals to 10).

Entity/Object Inline

In some specific situations, the associated entity might be represented inline (for associated objects, this is always the case). That would be represented as a JSON object representing the whole object inline:

```
"Country": {
  "$id": 2,
  "@xdata.type": "XData.Default.Country",
  "Id": 10,
  "Name": "Germany",
}
```

Such representation would usually be used by client applications that want to provide associated entities that still do not have an id, thus can't be represented using the association reference format. Or can be returned by the server, if the expand level is increased. You can also explicitly ask for this format using the $expand query option.

To illustrate how association references are different from object references, you can have an entity represented inline, but using an object reference. For example, if the country object represented in the previous code (country of id 10 represented inline) was already present in the JSON tree before, it could be represented as an object reference:

```
"Country": {
  "$ref": 2
}
```

Proxy Info

This only applies to associated entities.
For performance reasons, the server might provide an object representation using proxy info instead of an association reference. The format is similar to the association reference, but the annotation is "xdata.proxy". The value must contain an URL (relative to server base URL) that clients can use to retrieve the associated object using a GET request:

```
"Country@xdata.proxy": "$proxy?
id=52&classname='Customer'&classmember='Country'"
```

Association reference and proxy info are very similar, but they have two differences:

1. An association reference value has a very specific format (canonical id). Thus, association references, in addition to be a valid relative URL to retrieve the associated object, it is also in a specific format so that entity type and id can be parsed from the value, allowing you to safely know the entity type and id of the associated object without performing a GET request. Proxy info, in turn, is just a relative URL to retrieve the object, but the URL format is not standard and no additional metadata info can be safely extracted from the URL

2. On data modification requests (insert/update) operations, association references are used to update the value of the navigation property (the object associated with the main object). Proxy info, in turn, are completely ignored by the server and do not cause any modification in the navigation property.

8.1.5 Blob Representation

In general, binary values are represented in JSON notation as base-64 value, following the rules for serializing simple property values. The following JSON name/value pair is an example of a binary property Data representation:

```
"Data": "T0RhdGE"
```

When the property type in Aurelius is declared as TBlob type, though, the name/value pair in JSON notation might declared using the "xdata.proxy" annotation after the property name, which allows clients to load the blob content in a lazy (deferred) way. The value of such name/value pair is the URL used to retrieve the blob content:

```
"Data@xdata.proxy": "Customer(55)/Data"
```

If the property is a TBlob type, the property will always be represented like that, unless the object to which the property belongs is a transient object (in the example above, if the customer object didn't have an id). The other exception is if the blob content is somehow available to the server when the object is retrieved from database, and the blob content is empty. In this case, the property will be serialized normally (without annotation), and value is "null":

```
"Data": null
```

8.1.6 Including or Excluding Properties

This is how XData decides what properties to serialize/deserialize in JSON. When we mention "serialize" here it also implies "deserialize" (meaning that the JSON property will be recognized as valid and associated field/property will be updated from the JSON value).

- For entities, all class members (fields or properites) that are mapped using Aurelius will be serialized. Any transient field or property will not be serialized.
- For objects, all class fields will be serialized. No property will be serialized.

You can override this default and choose, for both your entity and object classes, what property will be included in JSON. The way to do that is different for entities and objects.

Entities

For entities you can use attributes XDataProperty and XDataExcludeProperty (declared in unit XData.Model.Attributes). They have no arguments, and when put in a class member (field or property) it imply indicates that such property will be added or removed from the JSON.

In the following example, even though FBirthday is the field being mapped to the database, the final JSON will not include it, but instead will have three properties: Year, Month and Day.

```
uses {...}, XData.Model.Attributes;

  [Entity, Automapping]
  TCustomer = class
  private
    FId: Integer;
    FName: string;
    [XDataExcludeProperty]
    FBirthday: TDateTime;
    function GetDay: Integer;
    function GetMonth: Integer;
    function GetYear: Integer;
    procedure SetDay(const Value: Integer);
    procedure SetMonth(const Value: Integer);
    procedure SetYear(const Value: Integer);
  public
    property Id: Integer read FId write FId;
    property Name: string read FName write FName;
    property Birthday: TDateTime read FBirthday write FBirthday;
    [XDataProperty]
    property Year: Integer read GetYear write SetYear;
    [XDataProperty]
    property Month: Integer read GetMonth write SetMonth;
    [XDataProperty]
    property Day: Integer read GetDay write SetDay;
  end;
```

PODO (Plain Old Delphi Objects)

JsonProperty and *JsonIgnore* attributes

For regular objects, you can use similar approach, but using attributes *JsonProperty* and *JsonIgnore* (declared in unit Bcl.Json.Attributes). One small difference is that JsonProperty can optionally receive a string which is the name of the property in final JSON.

In the following example, final Json will have properties Id, PersonName, Birthday and YearOfBirth. Field FTransient will not be serialized because of attribute JsonIgnore. Field FName will be serialized with a different name (PersonName) and property YearOfBirth will also be serialized because of the presence of attribute JsonProperty.

```
uses {...}, Bcl.Json.Attributes

  TDTOPerson = class
  private
    FId: Integer;
    [JsonProperty('PersonName')]
    FName: string;
    FBirthday: TDateTime;
    [JsonIgnore]
    FTransient: string;
  public
    property Id: Integer read FId write FId;
    property Name: string read FName write FName;
    [JsonProperty]
    property YearOfBirth: Integer read GetYearOfBirth;
    property Birthday: TDateTime read FBirthday write FBirthday;
    property Transient: string read FTransient write FTransient;
  end;
```

JsonInclude attribute

You can also use JsonInclude attribute to specify which properties will be serialized to JSON based on their values. JsonInclude attribute should be added to the class type and receive a parameter of type TInclusionMode:

```
[JsonInclude(TInclusionMode.NonDefault)]
TDTOAddress = class
private
  {...}
```

Valid TInclusionMode values are:

Value	Description
TInclusionMode.Always	Always serialize all DTO fields/properties (default behavior).
TInclusionMode.NonDefault	Only serialize the fields/property if the value is a non-default value (not "empty", so to speak). Here is the list of checked types and what is considered their default value: Object types: Nil pointer String types: Empty string Numeric types: Zero Enumerated Types: First enumerated value (ordinal value of zero) Set Types: Empty set Array Types: Empty array

JsonEnumValues attribute

When serializing an enumerated value, by default it's the enumerated name value that will be serialized. For example:

```
type
  TMyEnum = (myFirst, mySecond, myThird);
```

A property of type TMyEnum could be serialized as following:

```
 "MyEnumProp": "myFirst"
```

You can change that value using the JsonEnumValues property, passing the new values in a comma-separated string:

```
type
  [JsonEnumValues('first,second,third')]
  TMyEnum = (myFirst, mySecond, myThird);
```

That will generate the following JSON:

```
 "MyEnumProp": "first"
```

JsonNamingStrategy attribute

If you have a general rule for naming the properties in the final JSON, you can use JsonNamingStrategy attribute instead of using a JsonProperty attribute for every single field/property you want to define a name. You add this attribute to the class informing the naming strategy to be used:

```
[JsonNamingStrategy(TCamelCaseNamingStrategy)]
TMySimpleClass = class
```

Here is the list of available naming strategies. The JSON examples are based on a class with the following field and property:

```
  FFirstName: string;
  property LastName: string;
```

Value	Description
TDefaultNamingStrategy	This is the default strategy to be used in you don't specify one. It will keep the property name as-is, field names will have leading "F" removed: `{ "FirstName": "Joe", "LastName": "Smith" }`
TCamelCaseNamingStrategy	Names will be camel case, with first letter in lower case. Field names will have leading "F" removed before converting:

	<pre>{
	  "firstName": "Joe",
	  "lastName": "Smith"
	}</pre>

TSnakeCaseNamingStrategy	Names will be snake case: all lower case with words separated by underlines. Field names will have leading "F" removed before converting.
	<pre>{
	  "first_name": "Joe",
	  "last_name": "Smith"
	}</pre>

TIdentityNamingStrategy	Property and field names will be kept-as is:
	<pre>{
	  "FFirstName": "Joe",
	  "LastName": "Smith"
	}</pre>

TIdentityCamelCaseNamingStrategy	Same as TCamelCaseNamingStrategy, but no leading "F" will be removed from field name:
	<pre>{
	  "fFirstName": "Joe",
	  "lastName": "Smith"
	}</pre>

TIdentitySnakeCaseNamingStrategy	Same as TSnakeCaseNamingStrategy, but no leading "F" will be removed from field name:
	<pre>{
	  "ffirst_name": "Joe",
	  "last_name": "Smith"
	}</pre>

8.2 Collection of Objects

A collection of objects is represented as JSON array where each element is the representation of an entity or the representation of an entity reference, or representation of any simple object type supported by XData. An empty collection is represented as an empty JSON array.

Example of collection of entities with objects inline:

```
[
  {
    "$id": 1,
    "@xdata.type": "XData.Default.Country",
    "Id": 10,
    "Name": "Germany",
  },
  {
    "$id": 2,
    "@xdata.type": "XData.Default.Country",
    "Id": 13,
    "Name": "USA",
  }
]
```

When the server is responding to a request to an entity set resource address or a navigation property that returns an entity collection, or any service operation that returns a list of arbitrary objects, it wraps the collection in a JSON object with a name/value pair named "value":

```
{
  "value": [
    {
      "$id": 1,
      "@xdata.type": "XData.Default.Country",
      "Id": 10,
      "Name": "Germany",
    },
    {
      "$id": 2,
      "@xdata.type": "XData.Default.Country",
      "Id": 13,
      "Name": "USA",
    }
  ]
}
```

8.3 Individual Properties

When performing requests to an URL that represents an individual property, such property is represented as a JSON object (except for blob properties). The property is represented as an object with a single name/value pair, whose name is "value" and whose value is represented according to the XData JSON Format notation for property values. For example, when requesting the Name property of a TCustomer object (such as from address "http://server:2001/tms/xdata/Customer(3)/Name"), result might be:

```
{
  "value": "John Doe"
}
```

Note that when the URL is suffixed with "$value" segment or the property represents a blob property, then the content is the raw value of the property (or binary value), not a JSON representation.

8.4 Error Response

When an error happens in the XData server while processing a client request, the server might provide information about the error in the HTTP message body as a single JSON object, with a single name/value pair named "error" which value is also a JSON object. Such inline JSON object might contain the following name/value pairs:

"code", which provides a JSON string representing the error code for the error raised by the server;
"message": which provides a JSON string with a human-readable text describing the error.

Example:

```
{
  "error": {
    "code": "EntityNotFound",
    "message": "Requested entity does not exist."
  }
}
```

8.5 Canonical Id

The canonical id is a string representation that completely defines and identifies an entity. It's used by XData in several places in JSON format, like when using association references.

The format of canonical id is "<entityset>(<id>)", where <entityset> is the name of the entity set which contains the entity, and <id> is the id entity in URL literal representation. The entity set must be the one which related entity type is the exact type of the entity being identifies. What this means is that if an entity belongs to more than one entity set, the type of the entity set must match the type of entity. For example, when dealing with inheritance between entity types, an entity of type "Dog" might belong to entity sets "Dog", "Mammal" and "Animal". In this case, the entity set must be "Dog".

Here are some examples of canonical id's:

```
"Invoice(5)"
"Customer('John')"
"InvoiceItem(15)"
```

It's important to note that the canonical id also represents the URI of the associated entity, relative to the server base URI. In other words, if you append the canonical id to the server base URI, you will end up with the URI of the associated entity, which you can use to retrieve, update or delete the

entity (depending on the HTTP method used). For example, suppose the server base URI of the above entities is "http://myserver:2001/tms/xdata", then the resource URI of those entities are:

```
http://server:2001/tms/xdata/Invoice(5)
http://server:2001/tms/xdata/Customer('John')
http://server:2001/tms/xdata/InvoiceItem(15)
```

Chapter



Requesting Data

9 Requesting Data

XData server support requests for data via HTTP GET requests. You can follow URL conventions to determine the correct URL to be requested according to data needed.

The resource path of the URL specifies the target of the request (for example, collection of entities, entity, associated entity (navigation property), etc.). Additional query operators, such as filter, sort, page are specified through query options. The format of returned data depends on the data being requested but usually follows the specified XData JSON Format.

This following topics describe the types of data requests defined by XData and related information.

Requesting Single Entities
Querying Collections
Requesting Associated Entities
Requesting Individual Properties
Requesting Streams (Blobs)

9.1 Requesting Single Entities

To retrieve a single entity, the client makes a GET request to the read URL of an entity.

The read URL can be obtained by following the URL conventions, either that addresses a single entity, or associated entities. The read URL can be also obtained from a response payload in JSON format containing information about associated entities (through navigation properties of the entity represented in the payload).

If no entity exists with the key values specified in the request URL, the service responds with 404 Not Found.

Examples:
Retrieving a customer with id equals to 3

```
GET /tms/xdata/Customer(3) HTTP/1.1
Host: server:2001
```

Retrieving the customer associated with order 10:

```
GET /tms/xdata/Order(10)/Customer HTTP/1.1
Host: server:2001
```

In both examples above, the response content might be:

```
{
  "$id": 1,
  "@xdata.type": "XData.Default.Customer",
  "Id": 55,
  "Name": "Joseph",
  "Birthday": "1980-05-20",
  "Sex": "tsMale",
  "Picture": null
}
```

9.2 Querying Collections

XData server supports querying collections of entities. The target collection is specified through a URL that addresses an entity set (or an URL that addresses navigation properties representing a collection of items, like items of an order for example), and query operations such as filter, sort, paging are specified as system query options provided as query options. The names of all system query options are prefixed with a dollar ($) character.

For example, to query all the existing Country objects in the server, you perform a GET request to the respective entity set URL:

```
GET http://server:2001/tms/xdata/Country HTTP/1.1
```

You can add query options to the URL to filter the collection of entities. The following GET request returns the first 10 customers which country name is equals to "USA", ordered by customer name:

```
GET http://server:2001/tms/xdata/Customer?$filter=Country/Name
eq 'USA'&$orderby=Name&$top=10 HTTP/1.1
```

The following example retrieves the items of order with id equals to 10.

```
GET http://server:2001/tms/xdata/Order(10)/Items HTTP/1.1
```

Note that you can only use query options on entity sets. When addressing navigation properties that represent a collection (like the previous example), query options are NOT available.

9.3 Requesting Associated Entities

To request associated entities according to a particular relationship, the client issues a GET request to the source entity's request URL, followed by a forward slash and the name of the navigation property representing the relationship, according to URL conventions for addressing associated entities.

If the navigation property does not exist on the entity indicated by the request URL, the service returns 404 Not Found.

If the association terminates on a collection (many-valued association), then behavior is similar as described in topic "Querying Collections", without the exception that query options (filtering, ordering, etc.) cannot be applied.

If the association terminates on a single entity (single-valued association), then behavior is the same as described in topic "Requesting Single Entities". If no entity is related, the service returns 204 No Content

Examples: Retrieving the customer associated with order 10 (single entity):

```
GET http://server:2001/tms/xdata/Order(10)/Customer HTTP/1.1
```

Retrieving items associated with order 10 (collection of entities):

```
GET http://server:2001/tms/xdata/Order(10)/Items HTTP/1.1
```

9.4 Requesting Individual Properties

To retrieve an individual property, the client issues a GET request to the property URL. The property URL is the entity read URL with "/" and the property name appended, according to URL conventions for addressing simple properties. For example:

```
GET http://server:2001/tms/xdata/Product(1)/Name HTTP/1.1
```

The result format following the JSON format specification for individual properties, i.e., a JSON object with a name/value pair which name is "value" and the value contains the actual property value. The result for the above request might be, for example:

```
{
  "value": "Silver Hammer XYZ"
}
```

If the property has the null value, the service responds with 204 No Content. If the property doesn't exist the service responds with 404 Not Found.

You can alternatively request the raw value of the property. To retrieve the raw value of a primitive type property, the client sends a GET request to the property value URL, which is the property value URL suffixed with "$value":

```
GET http://server:2001/tms/xdata/Product(1)/Name/$value HTTP/1.1
```

The Content-Type of the response is text/plain and the response content is the property value in plain text, formatted according to the JSON format specification for property values. The response content of the above request might something like the following:

```
Silver Hammer XYZ
```

A $value request for a property that is null results in a 204 No Content response.
If the property doesn't exist the service responds with 404 Not Found.

9.5 Requesting Streams (Blobs)

To retrieve the content of a stream (blob) property, the client issues a GET request to a URL that addresses a stream (blob) resource. For example:

```
GET http://server:2001/tms/xdata/Customer(1)/Photo HTTP/1.1
```

The server will provide the binary blob content in response body, without specifying the content type. It's up to your client application to determine the type of content and process it accordingly. Note that this behavior is different from when you request individual properties, which in this case provide a JSON representation of the property value.

If the property has the null value, or the stream content is empty, the service responds with 204 No Content, otherwise a sucessful 200 OK response is provided.
If the property doesn't exist the service responds with 404 Not Found.

9.6 HTTP Request Headers

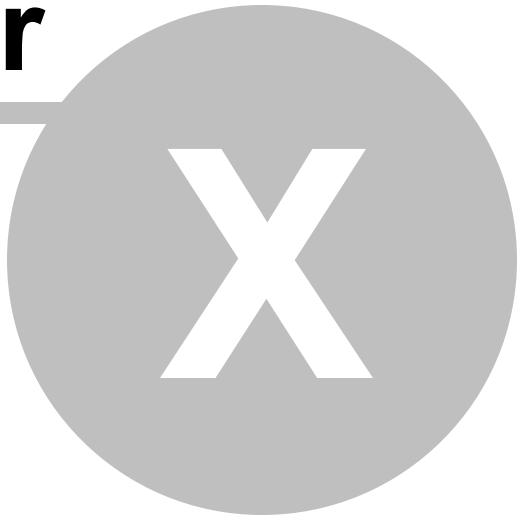
XData defines semantics around the following HTTP request and response headers. Additional headers may be specified, but have no unique semantics defined in XData.

Available Request Headers

Name	Description
xdata-expand-level	Clients can optionally include this header in the request to define the maximum depth for which the associated entities will be expanded (serialized inline) in an entity JSON representation. `xdata-expand-level: 3` An associated entity (navigation property) can be represented as an association reference, or inline object. If XData-ExpandLevel is not present, the value 0 (zero) is assumed, which means all direct associated entities will be represented as references. When the header is present and value is higher, then all associated entities will be serialized inline, until the depth level specified by the header. The higher the expand level, the bigger the response payload will be, since more objects will be serialized. But if client will need those objects anyway, this will minimize the need

	of further server requests to retrieve associated objects. Proxies are not affected by this.
xdata-put-mode	Overrides the value of TXDataServerModule.PutMode property for the request. Please refer to the property documentation for more info. Example: `xdata-put-mode: update` Valid values are "update" and "merge".
xdata-serialize-instance-ref	Overrides the value of TXDataServerModule.SerializeInstanceRef property for the request. Please refer to the property documentation for more info. Example: `xdata-serialize-instance-ref: ifrecursive` Valid values are "always" and "ifrecursive".
xdata-serialize-instance-type	Overrides the value of TXDataServerModule.SerializeInstanceType property for the request. Please refer to the property documentation for more info. Example: `xdata-serialize-instance-type: ifneeded` Valid values are "always" and "ifneeded".

Chapter



Data Modification

10 Data Modification

XData Server supports Create, Update, and Delete operations for some or all exposed resources (entities, individual properties, etc.). You can follow URL conventions to determine the correct URL address of the resource path in order to perform the data modification operation.

Since XData Server follows REST/JSON architecture, such data modification operations are performed by sending HTTP requests to the server using POST, PUT, PATCH or DELETE methods, and when applicable, providing data in message payload using JSON format.

This following topics explains the several different methods of performing data modification in a XData Server.

Create an Entity
Update an Entity
Delete an Entity
Managing Streams (Blobs)

10.1 Create an Entity

To create an entity in a collection, clients must perform a POST request to that collection's URL, which can be either the entity set URL address or a navigation property URL address that represents a collection. The POST body must contain a single valid JSON representation of the entity. The entity representation can be full (all possible properties) or partial (a subset of all available properties for the entity type).

Properties in entity representation must be valid properties or navigation properties of the entity type as specified in the entity model. Additional property values beyond those specified in the entity type should not be sent in the request body. The request will fail if unable to persist all property values specified in the request. Missing properties will be set to their default value. If a missing property is required and does not have a default value in the database server, the request will fail.

The following example creates a new Country entity in the server.

```
POST /tms/xdata/Country HTTP/1.1
Host: server:2001

{
  "@xdata.type": "XData.Default.Country",
  "Name": "Brazil"
}
```

When creating an entity, the "xdata.type" annotation is not required. If present, it indicates the type of the entity which should be created by the server. It can be useful when creating derived entities, for example, even though you POST to an URL representing an entity set of base types (for

example, Animal), the entity being created might be a type inherited from the base type. In the following example the request will create a Cat entity in entity set Animal. It's a valid request. If the provided xdata.type annotation indicates a type that is different or not inherited from the type of entity set being POST'ed, the request will fail.

```
POST /tms/xdata/Animal HTTP/1.1
Host: server:2001

{
  "@xdata.type": "XData.Default.Cat",
  "Name": "Wilbur",
  "CatBreed": "Persian"
}
```

If "xdata.type" is not present, the created entity will have the same type as the base entity type of the collection addressed by the URL. For example, if client POST to the url "Cat" without "xdata.type" annotation present in payload, an entity of type Cat wil be created.

The entity representation in request payload must not contain associated entities as inline content. If values for navigation properties should be specified, then they must be represented as an association reference. For single-valued (single entity) navigation properties, this will update the relationship (set the value of property to reference the associated object represented in the association reference) after entity is created. The following example creates a new City entity which is associated with a Country object of id 2.

```
POST /tms/xdata/City HTTP/1.1
Host: server:2001

{
  "$id": 1,
  "Name": "Frankfurt",
  "Country@xdata.ref": "Country(2)"
}
```

Proxy values can be present in the entity payload (for example, when you are sending back a modified JSON representation previously retrieved from the server, it's possible that proxy values are present), but they are ignored by the server and navigation properties with proxy values that were not modified.

When perform POST request to a navigation property URL that represents a collection property, for example, Order(1)/Items which represent items of a specific order, the newly created entity will be automatically associated with (added to) that collection.

On successful update, the server returns with a 201 Created success response and the JSON representation of the updated entity in the message payload. The response will also contain a Location header that contains the URL of the created entity. Note that the returned entity might be different from the one sent by the client, since some properties might have been updated automatically by XData Server and/or the database server.

10.2 Update an Entity

To update an entity, clients must perform a PATCH or PUT request to a single entity URL address, providing the JSON representation of the entity in message payload of the request. The entity representation can be full (all possible properties) or partial (a subset of all available properties for the entity type).

PATCH method should be preferred for updating an entity as it provides more resiliency between clients and services by directly modifying only those values specified by the client. The semantics of PATCH, as defined in [RFC5789], are to merge the content in the request payload with the entity's current state, applying the update only to those components specified in the request body. Thus, properties provided in the payload will replace the value of the corresponding property in the entity or complex type. Missing properties of the containing entity will not be altered. In the following example, only properties Name and DogBreed of resource Dog(1) will be updated in the server.

```
PATCH /tms/xdata/Dog(1) HTTP/1.1
Host: server:2001

{
  "@xdata.type": "XData.Default.Dog",
  "Id": 1,
  "Name": "Willy",
  "DogBreed": "Yorkshire"
}
```

PUT method can also be used, but you should be aware of the potential for data-loss for missing properties in the message payload. When using PUT, all property values will be modified with those specified in the request body. Missing properties will be set to their default values. In the following example, properties Name and DogBreed will be updated, and any other existing property of Dog will be set to its default value (strings will be blank, associations will be nil, etc.). If one of missing properties is required and not present, the server might raise an error indicating a required property should have a value.

```
PUT /tms/xdata/Dog(1) HTTP/1.1
Host: server:2001

{
  "@xdata.type": "XData.Default.Dog",
  "Id": 1,
  "Name": "Willy",
  "DogBreed": "Yorkshire"
}
```

Key and other non-updatable properties can be omitted from the request. If the request contains a value for one of these properties the server will ignore that value when applying the update. That's the reason why Id property is not updated in the above examples

The entity must not contain associated entities as inline content. If values for navigation properties should be specified, then they must be represented as

an association reference. For single-valued (single entity) navigation properties, this will update the relationship (set the value of property to reference the associated object represented in the association reference). The following example updates the Country association of a City object to the country with id equals to 2.

```
PATCH /tms/xdata/City(1) HTTP/1.1
Host: server:2001

{
  "$id": 1,
  "@xdata.type": "XData.Default.City",
  "Country@xdata.ref": "Country(2)"
}
```

Proxy values can be present in the entity payload (for example, when you are sending back a JSON representation previously retrieved from the server, it's possible that proxy values are present), but they are ignored by the server and navigation properties with proxy values are not modified.

For update operations (PUT and PATCH), the "xdata.type" annotation is not required. Since you are updating an existing server resource, the type of resource is already known. Actually, including "xdata.type" annotation will force the server to perform a type check, if the type declared in the request doesn't match the type of server resource, an error occurs. So if you include xdata.type annotation in payload, be sure it matches the type of server resource you are trying to update.

On successful update, the server returns with a success response and the JSON representation of the updated entity in the message payload. Note that the returned entity might be different from the one sent by the client, since some properties might have been updated automatically by XData Server and/or the database server.

10.3 Delete an Entity

To delete an entity, clients must perform a DELETE request to a single entity URL address. The request body must be empty. The entity represented by that address will be removed from server.

The following example will delete the entity resource at address /tms/xdata/TDog(1) - which is a Dog entity with id equals to 1:

```
DELETE /tms/xdata/Dog(1) HTTP/1.1
Host: server:2001
```

Note that depending on cascades configured in the server, associated entities might also be removed. If the entity being removed is associated by another entity that can't be removed in a cascade operation, a constraint enforcement will fail and the server will return an error without actually removing the entity.

On successful delete, the server responds with a 204 No Content response and no content in message payload.

10.4 Managing Streams (Blobs)

To update the content of a stream (blob) property, clients must perform a PATCH or PUT request to a stream property URL address, providing stream content in message body. You don't need to specify content-type and if you do, it will be ignored. Using either PATCH or PUT method results in same server behavior.

The request is an example of how to update the content of Photo property of the customer identified by id equals to 3.

```
PUT /tms/xdata/Customer(1)/Photo HTTP/1.1
Host: server:2001

<binary photo content>
```

You can also use DELETE method to clear the blob content (remove any data):

```
DELETE /tms/xdata/Customer(1)/Photo HTTP/1.1
Host: server:2001
```

On successful UPDATE or DELETE calls, the server will respond with a 204 No Content status code.

Chapter



Service Operations

11 Service Operations

Service operations allow the execution of server-side business custom logic on parts of a data model. Besides the built-in operations for data request and data modification, you can add custom business logic by implementing server-side logic manually and retrieving/returning values and entities. This chapter explain hows to implement and use service operations.

- XData Service Wizard
- Service Operations Tutorial
- Creating Service Contract
  - Defining Service Interface
  - Specifying HTTP Method
  - URIPathSegment Attribute
  - Supported Types
- Service Implementation
- TXDataOperationContext
- Server Memory Management
- Invoking Operations using XData Client
- Invoking Operations using HTTP

11.1 XData Service Wizard

Easiest way to create service operations is by using the XData Service wizard.

From the Delphi IDE, choose **File > New > Other...**

From the dialog that appears, navigate to **Delphi Projects > TMS Business** and choose the wizard **TMS XData Service**.

That will launch the "New XData Service" dialog, which will provide you with the following options:

Service Name: Specifies the base name for the service contract interface and service implementation class, as well the unit names to be generated.

Generate interface and implementation in separated units: If checked, service contract interface and service implementation classes will be created in two different units. This makes it easy to reuse the interface for use in client applications using TXDataClient. This is true by default. If you are not going to use interfaces at client-side or if you simply prefer to put all code in a single unit, uncheck this option.

Add sample methods: If checked the wizard will add some sample methods (service operations) as an example.

Use a specific model: If checked, adds a Model attribute to the service contract/implementation with the name specified in the edit box.

After options are set, click Finish and the full source code with the service contract and service implementation will be generated for you.

If you prefer to create the source code manually, or simply want to learn more about the generated source code, refer to the following topics:

Service Operations Tutorial
Creating Service Contract
Service Implementation

11.2 Service Operations Tutorial

This chapter describes basic steps you need to follow to implement service operations at server side and invoke them from Delphi side. For detailed information about the steps, please refer to Service Operations main topic. The presented source code samples are not complete units and only display the relevant piece of code for understanding service operations usage. Some obvious code and keywords might have been removed to improve readability. Here we will implement two server operations, one using scalar types (Sum), and another using entities (FindOverduePayments). This tutorial also assumes that you will create the HTTP server and the TXDataServerModule accordingly, with the proper IDBConnectionFactory to point to the database you want the operations to work on.

1. Define a service interface and declare the operations (methods) in it

```
unit MyServiceInterface;

uses
  {...}, XData.Service.Common;

type
  [ServiceContract]
  IMyService = interface(IInvokable)
  ['{F0BADD7E-D4AE-4521-8869-8E1860B0A4A0}']
    function Sum(A, B: double): double;
    function FindOverduePayments(CustomerId: integer):
TList<TPayment>;
  end;

initialization
  RegisterServiceType(TypeInfo(IMyService));
end.
```

This will add the contract to the default entity model. You can use the Aurelius Model attribute to specify the model where the contract belongs to:

```
uses {...}, Aurelius.Mapping.Attributes;
{...}
[ServiceContract]
[Model('Sample')] // adds interface to "Sample" model
IMyService = interface(IInvokable)
{...}
```

2. Create a service implementation class that implements the interface

```
uses
  {...}, MyServiceInterface,
  XData.Server.Module,
  XData.Service.Common;

type
  [ServiceImplementation]
  TMyService = class(TInterfacedObject, IMyService)
  private
    function Sum(A, B: double): double;
    function FindOverduePayments(CustomerId: integer):
TList<TPayment>;
  end;

implementation

function TMyService.Sum(A, B: double): double;
begin
  Result := A + B;
end;

function TMyService.FindOverduePayments(CustomerId: integer):
TList<TPayment>;
begin
  Result :=
TXDataOperationContext.Current.GetManager.Find<TPayment>
    .CreateAlias('Customer', 'c')
    .Where(TLinq.Eq('c.Id', CustomerId) and
TLinq.LowerThan('DueDate', Now))
    .List;
end;

initialization
  RegisterServiceType(TMyService);

end.
```

3. Create the XData Server.
It will automatically detect the service interfaces and implementation. Your operations can now be invoked.

4. Invoke the operation using XData client, from Delphi applications.
This tutorial assumes you created the xdata server at base address "http://server:2001/tms/xdata".

```
uses
  {...}
  MyServiceInterface,
  XData.Client;

var
  Client: TXDataClient;
  MyService: IMyService;
  SumResult: double;
  Payments: TList<TPayment>;
begin
  Client := TXDataClient.Create;
  Client.Uri := 'http://server:2001/tms/xdata';
  MyService := Client.Service<IMyService>;
  SumResult := MyService.Sum(5, 10);
  try
    Payments := MyService.FindOverduePayments(5142);
  finally
    // process payments
    Payments.Free;
  end;
  Client.Free;
end;
```

5. Invoke the operation using HTTP, from any platform and/or development tool

Request:

```
POST /tms/xdata/MyService/Sum HTTP/1.1
Host: server:2001

{
  "a": 5,
  "b": 8
}
```

Response:

```
HTTP/1.1 200 OK

{
    "result": 13
}
```

11.3 Creating Service Contract

Service operations are grouped in service contracts, or service interfaces. You can define multiple service interfaces in your XData server, and each interface can define multiple operations (methods). You create a service contract by defining the service interface (a regular interface type to your Delphi

application). The following topics in this chapter describes the steps and options you have to create such contract.

Defining Service Interface
Specifying HTTP Method
URIPathSegment Attribute
Supported Types
Default Parameters

11.3.1 Defining Service Interface

These are the basic steps you need to follow to create an initial service contract interface:

1. Declare an interface inheriting from IInvokable
2. Create a GUID for the interface (Delphi IDE creates a GUID automatically for you using Shift+Ctrl+G shortcut key)
3. Add XData.Service.Common unit to your unit uses clause
4. Add [ServiceContract] attribute to your interface
5. Declare methods in your interface
6. Call RegisterServiceType method passing the typeinfo of your interface (usually you can do that in initialization section of your unit).

When you add the unit where interface is declared to either your server or client application, XData will automatically detect it and add it to the entity model as a service contract, and define all interface methods as service operations. The client will be able to perform calls to the server, and the server just needs to implement the interface. The source code below illustrates how to implement the service interface.

```
unit MyServiceInterface;

interface

uses
  System.Classes, Generics.Collections,
  XData.Service.Common;

type
  [ServiceContract]
  IMyService = interface(IInvokable)
  ['{BAD477A2-86EC-45B9-A1B1-C896C58DD5E0}']
    function Sum(A, B: double): double;
    function HelloWorld: string;
  end;

implementation

initialization
  RegisterServiceType(TypeInfo(IMyService));
end.
```

You can use the Aurelius Model attribute to specify the model where the contract belongs to. This way you can have a server with multiple server modules and models.

```
uses {...}, Aurelius.Mapping.Attributes;
{...}
[ServiceContract]
[Model('Sample')] // adds interface to "Sample" model
IMyService = interface(IInvokable)
{...}
```

11.3.2 Specifying HTTP Method

By default, any service operation responds to (is invoked by) a POST request form the client. You can change that by using adding an attribute to service interface method specifying the HTTP method the operation should respond to. For example:

```
[HttpGet]
function Sum(A, B: double): double;
```

The above declaration will define that Sum method should be invoked using a GET request instead of a POST request. Available attributes are:

HttpGet
HttpPut
HttpDelete
HttpPost (not needed since it's default value)

Note that usually the parameters are sent as JSON in the body of request. When you specify GET method, though, the parameters must be send in the URL, since GET requests can't have message body. The mechanism of passing parameters either in message body or URL is described in topic "Invoking Operations using HTTP".

You can't use parameters of non-scalar types (objects, for example) in GET requests. If you add [HttpGet] attribute to a method that receives an object parameter, for example, an error will raise when the server is started (more precisely, when the model is needed by the framework).

It's also worth noting that when using TXDataClient you don't need to worry about which HTTP method to use to invoke the service operation - it's done automatically by it.

11.3.3 URIPathSegment Attribute

You can use URIPathSegment attribute to change the URI that routes to the service operation. For example, with the following service interface declaration:

```
IMyService = interface(IInvokable)
  function Sum(A, B: double): double;
```

you use the following URI to invoke the Sum method:

```
<server_root>/MyService/Sum
```

By using URIPathSegment attribute, you can change the path segments of either service contract or operation name:

```
[URIPathSegment('CustomName')]
IMyService = interface(IInvokable)
  [URIPathSegment('Add')]
  function Sum(A, B: double): double;
```

which will change the URI to:

```
<server_root>/CustomName/Add
```

You also have the option to define an empty operation name, which will map to the root name of service contract:

```
IMyService = interface(IInvokable)
  [URIPathSegment('')]
  function SomeMethod: string;
```

to invoke SomeMethod you will simply use the following URI:

```
<server_root>/MyService
```

It's also worth noting that when using TXDataClient you don't need to worry about the correct URI you need to use to invoke the service operation - it's done automatically by it when you just call the interface method.

11.3.4 Supported Types

When defining service interfaces, there are several types you can use for both parameter and return types of the operations.

Scalar types

You can use the regular simple Delphi types, such as Integer, String, Double, Boolean, TDateTime and TGUID, and its variations (like Longint, Int64, TDate, etc.). The server will marshal such values using the regular JSON representation of simple types. Variant type is also supported as long the variant value is one of the supported simple types (String, Integer, etc.)

Examples:

```
function Sum(A, B: double): double;
function GetWorld: string;
```

Enumerated and Set Types

Enumerated types and set types are also supported, including in DTO properties. For example:

```
type
  TMyEnum = (First, Second, Third);
  TMyEnums = set of TMyEnum;

procedure ReceiveEnums(Value: TMyEnums);
```

Entities

You can use class types (entities) to receive/return objects in your operations. The class type must represent a valid entity type in the entity model. This means the class must be an Aurelius entity with valid mapping. The entities will be marshaled in the HTTP request using entity representation in JSON Format.

Examples:

```
function ProcessInvoiceAndReturnDueDate(Invoice: TInvoice):
TDateTime;
function AnimalByName(const Name: string): TAnimal;
```

Simple objects - PODO (Plain Old Delphi Objects)

In addition to entities, which receive a special treatment, you can also receive/return objects of any type. The objects will be marshaled in the HTTP request using object representation in JSON format, which is actually very similar to entity representation, with only minor differentes (like representation of proxies and associated entities). One common case for simple objects is to use it as structure input/output parameters, or to use them as DTO classes.

```
function ReturnClientDTO(Id: Integer): TClientDTO;
function FunctionWithComplexParameters(Input: TMyInputParam):
TMyOutputParam;
```

Generic Lists: TList<T>

You can use TList<T> types when declaring parameters and result types of operations. The generic type T can be of any supported type. If an entity list will be marshaled in the HTTP request using the JSON representation for a collection of entities.

```
procedure HandleAnimals(Animals: TList<TAnimal>);
function GetActiveCustomers: TList<TCustomer>;
function ReturnItems: TList<string>;
```

Generics arrays: TArray<T>

Values of type TArray<T> are supported and will be serialized as a JSON array of values. The generic type T can be any supported type.

```
procedure ProcessIds(Ids: TArray<Integer>);
```

TJSONAncestor (XE6 and up)

For a low-level transfer of JSON data between client and server, you can use any TJSONAncestor descendant: TJSONObject, TJSONArray, TJSONString, TJSONNumber, TJSONBool, TJSONTrue, TJSONFalse and TJSONNull. The content of the object will be serialized/deserialized direct in JSON format.

Example:

```
procedure GenericFunction(Input: TJSONObject): TJSONArray;
```

TCriteriaResult

You can return TCriteriaResult objects, or of course a TList<TCriteriaResult> as a result type of a service operation. This is very handy to implement service operations using Aurelius projections. For example:

```
function TTestService.ProjectedCustomers(NameContains: string):
TList<TCriteriaResult>;
begin
  Result := TXDataOperationContext.Current.GetManager
    .Find<TCustomer>
    .CreateAlias('Country', 'c')
    .SetProjections(TProjections.ProjectionList
      .Add(TProjections.Prop('Id').As_('Id'))
      .Add(TProjections.Prop('Name').As_('Name'))
      .Add(TProjections.Prop('c.Name').As_('Country'))
    )
    .Where(TLinq.Contains('Name', NameContains))
    .OrderBy('Name')
    .ListValues;
end;
```

The JSON representation for each TCriteriaResult object is a JSON object which one property for each projected value. The following JSON is a possible representation of an item of the list returned by the method above:

```
{
  "Id": 4,
  "Name": "John",
  "Country": "United States"
}
```

TStrings

Properties of type TStrings are supported and will be serialized as JSON array of strings. Since TStrings is an abstract type, you should only use it as property type, and you should make sure the instance is already created by the object.

TStream

You can also use TStream as param/result types. When you do that, XData server won't perform any marshaling of the parameter or result value. Instead,

the TStream object will contain the raw content of the request (or response) message body. Thus, if you declare your method parameter as TStream, you will receive the raw message body of the client request in the server. If you use TStream as the result type of your method, the message body of the HTTP response send back to the client will contain the exact value of the TStream. This gives yous higher flexibility in case you want receive/send custom or binary data from/to client, such as images, documents, or just a custom JSON format. For obvious reasons, when declaring a parameter as TStream type, it must be the only input parameter in method, otherwise XData won't be able to marshal the remaining parameters.

```
function BuildCustomDocument(CustomerId: integer): TStream;
procedure ReceiveDocument(Value: TStream);
```

11.3.5 Default Parameters

You can declare service operations with default parameters. For example:

```
function Hello(const Name: string = 'World'): string;
```

This will work automatically if you are invoking this service operation from Delphi clients. However, it will not work if you invoke this service operation directly performing an HTTP request. In this case you would have to provide all the parameter values otherwise a server error will raise informing that a parameter is missing.

This is because the default value declared in the function prototype above is not available at runtime, but at compile time. That's why it works when calling from Delphi clients: the compiler will provide the default value automatically in the client call - but that's a client feature: the HTTP request will always have all parameter values.

To make the above method also work from raw HTTP requests and do not complain about missing parameters, you will need to inform (again) the default value using the [XDefault] attribute. This way XData server will know what is the default value to be used in case the client did not provide it:

```
function Hello([XDefault('World')] const Name: string =
'World'): string;
```

For more than one parameter, just add one Default attribute for each default parameter:

```
procedure DoSomething(
    [XDefault('Default')] Name: string = 'Default';
    [XDefault(0)] Value: Integer = 0
  );
```

You only have to add attributes to the method declaration in the service interface. Attributes in methods in service implementation class will be ignored.

11.4 Service Implementation

Once you have defined the service interface, you need to write the server-side implementation of the service. To do this you must:

1. Create a class implementing the service interface
2. Inherit the class from TInterfacedObject, or be sure the class implement automatic referencing counting for the interface
3. Add XData.Service.Common unit to your unit uses clause
4. Add [ServiceImplementation] attribute to your interface
5. Implement in your class all methods declared in the interface
6. Call RegisterServiceType method passing the implementation class (usually you can do that in initialization section of your unit).

When you create a TXDataServerModule to build your XData server, it will automatically find all classes that implement interfaces in the model and use them when operations are invoked by the client. When a client invokes the operation, the server will retrieve the class implementing the requested service, will create an instance of the class, marshal input parameters, and invoke the method. If the method returns a value, the server will marshal the value again and send it back to the client. The instance of the implementation class will then be destroyed.

The following source code illustrates how to implement the MyService interface defined in the topic "Defining Service Interface":

```
unit MyService;

interface

uses
  System.Classes, Generics.Collections,
  MyServiceInterface,
  XData.Service.Common;

type
  [ServiceImplementation]
  TMyService = class(TInterfacedObject, IMyService)
  private
    function Sum(A, B: double): double;
    function HelloWorld: string;
  end;

implementation

function TMyService.Sum(A, B: double): double;
begin
  Result := A + B;
end;

function TMyService.GetWorld: string;
begin
  Result := 'Hello, World';
end;

initialization
  RegisterServiceType(TMyService);

end.
```

11.5 TXDataOperationContext

To help you implement your service operations, XData provides you some information under the context of the operation being executed. Such information is provided in a TXDataOperationContext object (declared in unit XData.Server.Module). The simplified declaration of such object is as followed.

```
TXDataOperationContext = class
public
  class function Current: TXDataOperationContext;
  function GetConnectionPool: IDBConnectionPool;
  function GetManager: TObjectManager;
  function Request: THttpServerRequest;
  function Response: THttpServerResponse;
end;
```

To retrieve the current instance of the context, use the class function Current.

```
Context := TXDataOperationContext.Current.GetManager;
```

Then you can use the context to retrieve useful info, like a ready-to-use, in-context TObjectManager to manipulate Aurelius entities (using the GetManager function) or the connection pool in case you want to acquire a database connection and use it directly (using GetConnectionPool method).

This way your service implementation doesn't need to worry about how to connect to the database or even to create a TObjectManager with proper configuration and destroy it at the end of process. All is being handled by XData and the context object. Another interesting thing is that when you use the TObjectManager provided by the context object, it makes it easier to manage memory (destruction) of entity objects manipulated by the server, since it can tell what objects will be destroyed automatically by the manager and what objects need to be destroyed manually. See Memory Management topic for more information.

The example is an example of an operation implementation that uses context manager to retrieve payments from the database.

```
uses
  {...}
  XData.Server.Module;

function TCustomerService.FindOverduePayments(CustomerId:
integer): TList<TPayment>;
begin
  Result :=
TXDataOperationContext.Current.GetManager.Find<TPayment>
    .CreateAlias('Customer', 'c')
    .Where(TLinq.Eq('c.Id', CustomerId) and
TLinq.LowerThan('DueDate', Now))
    .List;
end;
```

Note that the database connection to be used will be the one provided when you created the TXDataServerModule. This allows you keep your business logic separated from database connection. You can even have several modules in your server pointing to different databases, using the same service implementations.

Inspecting request and customizing response

The context also provides you with the request and response objects provided by the TMS Sparkle framework.
You can, for example, set the content-type of a stream binary response:

```
function TMyService.GetPdfReport: TStream;
begin
  TXDataOperationContext.Current.Response.Headers.SetValue('cont
ent-type', 'application/pdf');
  Result := InternalGetMyPdfReport;
end;
```

Or you can check for a specific header in the request to build some custom authentication system:

```
function TMyService.GetAppointment(const Id: integer):
TVetAppointment;
var
  AuthHeaderValue: string;
begin
  AuthHeaderValue :=
TXDataOperationContext.Current.Request.Headers.Get('custom-
auth');
  if not CheckAuthorized(AuthHeaderValue) then
    raise EXDataHttpException.Create(401, 'Unauthorized'); //
unauthorized

  // Proceed to normal request processing.
  Result :=
TXDataOperationContext.Current.GetManager.Find<TVetAppointment>(
Id);
end;
```

11.6 Server Memory Management

When executing service operations, XData provides a nice automatic memory management mechanism that destroy all objects involved in the service operation execution. This makes it easier for you to implement your methods (since you mostly don't need to worry about object destruction) and avoid memory leaks, something that is critical at the server-side.

In general, all objects are automatically destroyed by XData at server-side. This means that when implementing the service, you don't need to worry to destroy any object. However, it's important to know how this happens, so you implement your code correctly, and also knowing that in some specific situations of advanced operations, the previous statement might not be completely true. So strictly speaking, the objects automatically destroyed by XData are the following:

- Any object passed as parameter or returned in a function result (called param object or result object);
- Any object managed by the context TObjectManager;
- The context TObjectManager is also destroyed after the operation method returns.
- Any associated object that is also deserialized or serialized together with the param object or result object;

Example

Suppose the following meaningless service implementation:

```
function TMyService.DoSomething(Param: TMyParam): TMyResult;
var
  Entity: TMyEntity;
begin
  Entity := TMyEntity.Create;
  Entity.SomeProperty := Param.OtherProperty;
  TXDataOperationContext.Current.GetManager.Save(Entity);
  Result := TMyResult.Create('test');
end;
```

You have three objects involved here:

- Param, of type TMyParam and was created by XData;
- function Result, of type TMyResult, being created and returned in the last line of service implementation;
- Entity, of type TMyEntity, being created and then passed to context TObjectManager to be saved in the database.

You **don't need** to destroy any of those objects. Whatever objects are passed as param (Param) of function result are always destroyed by XData automatically. The context manager is automatically destroyed by XData, and since you have added an entity to it, it will be destroyed as well upon manager destruction (this is a TMS Aurelius feature, not XData).

Managed objects

To control what will be destroyed and avoid double destruction of same object instance (for example, if the same object is received as parameter and returned as function result), XData keeps a collection of object instances in a property named ManagedObjects, available in the TXDataRequestHandler object. You can access that property using the operation context:

```
TXDataOperationContext.Current.Handler.ManagedObjects
```

You can also add object to that collection in advance, to make sure the object you are creating is going to be destroyed eventually by XData. This can help you out in some cases. For example, instead of using a construction like this:

```
function TMyService.DoSomething: TMyResult;
begin
  Result := TMyResult.Create;
  try
    // do complex operation with Result object
  except
    Result.Free;
    raise;
  end;
end;
```

You could write it this way:

```
function TMyService.DoSomething: TMyResult;
begin
  Result := TMyResult.Create;
  // Make sure Result will be eventually destroyed no matter
what
  TXDataOperationContext.Current.Handler.ManagedObjects.Add(Resu
lt);

  // now do complex operation with Result object
end;
```

Specific cases

As stated before, in general you just don't need to worry, since the above rules cover pretty much all of your service implementation, especially if you use the context TObjectManager to perform database operations instead of creating your own manager. The situations where something might go wrong are the following:

1. If you create your own TObjectManager and save/retrieve entities with it that were also passed as parameter or are being returned in function result.

This will cause an Access Violation because when you destroy your object manager, the entities managed by it will be destroyed. But then XData server will also try to destroy those objects because they were passed as parameter or are being returned. To avoid this, you must set your TObjectManager.OwnsObjects property to false, or use the context TObjectManager so XData knows that the objects are in the manager and don't need to be destroyed. The latter option is preferred because it's more straightforward and more integrated with XData behavior.

2. If you are creating associated objects that are not serialized/deserialized together with your object

For example, suppose your method returns an object TCustomer. This TCustomer class has a property Foo: TFoo, but such property is **not mapped** in Aurelius as an association (or not marked to be serialized if TCustomer is a PODO). You then create a TFoo object, assign it to Foo property and return:

Result := TCustomer.Create;
Result.Foo := TFoo.Create;

Since the Foo property will not be serialized by the server, XData will not know about such object, and it will not be destroyed. So you must be sure to destroy temporary/non-mapped/non-serializable objects if you create them (or add them to ManagedObjects collection as explained above). This is a very rare situation but it's important that developers be aware of it.

There is a specific topic for client-side memory management using TXDataClient.

11.7 Invoking Operations using XData Client

If your client in a Delphi application, you can easily use the TXDataClient object to invoke the service operations. Please refer to "Invoking Service Operations" topic.

11.8 Invoking Operations using HTTP

To invoke an operation, the client issues an HTTP request to a URL identifying the operation. The URL for an operation is the service root, followed by the name of the service, followed by the name of operation in that service. The following is an example the URL of the operation "Multiply" in the service "MathService" (interface IMathService).

Note that, by default, the URL path the identifies the service is the same name as the service interface, but without the "I" prefix.

```
http://server:2001/tms/xdata/MathService/Multiply
```

By default, the server will respond to a POST method at that address. You can change the HTTP method used by request when defining the service contract. When invoking the operation through any method other than GET, multiple parameter values must be passed in the request body using JSON format for operation parameters. In summary it's a JSON object with name/value pair corresponding to each parameter. The pair name must contain the parameter name (according to the entity model - the parameter name is the one provided in the interface method used to describe the service), and value contains the JSON representation of the parameter value, which can be either scalar property values, the representation of an entity, or the representation of a collection of entities. The following is an example of a request that invokes the Multiply operation.

```
POST /tms/xdata/MathService/Multiply HTTP/1.1
Host: server:2001

{
  "a": 5,
  "b": 8
}
```

If the operation was modified to respond to a GET request, then the parameters must be provided in the query string of the URL, using name=value pairs separated by "&" character, and the parameter value must be represented as URI literal. Only scalar property values are allowed, you can't pass representation of entities or collection of entities in GET requests. If the Multiply operation of previous example was modified to respond to a GET request, this is how you should invoke it:

```
GET /tms/xdata/MathService/Multiply?a=5&b=8 HTTP/1.1
```

On success, the response is 200 OK for operations that return results or 204 No Content for operations without a return type. If the operation returns a value, it will also be in the same JSON format used for parameters. The value is sent by the server wrapped by a JSON object with a name/value pair named "value". The value of the "value" pair is the result of the operation. In the Multiply example, it would be like this:

```
HTTP/1.1 200 OK

{
    "value": 40
}
```

There are some exceptions for the general rule above:

Methods with parameters passed by reference

In this case, the result will be a JSON object where each property relates to a parameter passed by reference. If the method is also a function (returns a value), then an additional property with name "result" will be included. For example, suppose the following method:

```
function TMyService.DoSomething(const Input: string; var Param1,
Param2: Integer): Boolean;
```

This will be a possible HTTP response from a call to that method:

```
HTTP/1.1 200 OK

{
    "result": True,
    "Param1": 50,
    "Param2": 30
}
```

Method with a single object parameter

If the method has a single object parameter, for example:

```
procedure UpdateCustomer(C: TCustomer);
```

then clients must send the JSON entity representation of the customer directly in request body, without the need to wrap it with the parameter name.

Method which returns a single object

If the method returns a single object parameter, for example:

```
function FindCustomer(const Name: string): TCustomer;
```

then the server will return the JSON entity representation of the customer in the response body, without wrapping it in the "value" name/value pair.

Method with a single scalar parameter

If the method receives a single scalar parameter, for example:

```
procedure ChangeVersion(const Version: string);
```

In this case, clients can send the value of Version parameter in a name/value pair named "value", in addition to the original "Version" name/value pair. Both can be used.

Chapter



TXDataClient

12 TXDataClient

The TXDataClient object (declared in unit XData.Client) allows you to send and receive objects to/from a XData server in a high-level, easy-to-use, strong-typed way. From any platform, any development environment, any language, you can always access XData just by using HTTP and JSON, but if you are coding from Delphi client, TXDataClient makes it much easier to write client applications that communicate with XData server.

To start using a TXDataClient, you just need to instantiate it and set the Uri property to point to root URL of the XData server:

```
uses {...}, XData.Client;

{...}

Client := TXDataClient.Create;
Client.Uri := 'http://server:2001/tms/xdata';
// <use client>
Client.Free;
```

The following topics explain how to use TXDataClient in details.

Requesting a Single Entity
Requesting an Entity List
Creating Entities
Updating Entities
Removing Entities
Invoking Service Operations
Client Memory Management
Client and Multi-Model
Authentication Settings

12.1 Requesting a Single Entity

To request a single entity, use the Get generic method passing the Id of the object as parameter:

```
Customer := Client.Get<TCustomer>(10);
State := Client.Get<TState>('FL');
```

The Id parameter is of type TValue, which has implicit conversions from some types like integer and string in the examples above. If there is no implicit conversion from the type of the id, you can use an overloaded method where you pass the type of Id parameter:

```
var
  InvoiceId: TGuid;
begin
  { ... get invoice Id }
  Invoice := Client.Get<TInvoice, TGuid>(InvoiceId);
end;
```

You can use the non-generic version of Get in case you only know the entity type at runtime (it returns a TObject and you need to typecast it to the desired type):

```
Customer := TCustomer(Client.Get(TCustomer, 10)));
```

12.2 Requesting an Entity List

Use the List method to query and retrieve a list of entities from the server:

```
var
  Fishes: TList<TFish>;
begin
  Fishes := Client.List<TFish>;
```

The TXDataClient.List<T> function will always create and retrieve an object of type TList<T>. By default you must manually destroy that list object later, as explained in memory management topic.
Optionally you can provide a query string to send to the server to perform filtering, order, etc., using the XData query options syntax:

```
Customers := Client.List<TCustomer>('$filter=(Name eq ''Paul'')
or (Birthday lt 1940-08-01)&$orderby=Name desc');
```

Use the non-generic version in case you only know the type of the entity class at runtime. In this case, the function will create and return an object of type TList<TObject>:

```
var
  Fishes: TList<TObject>;
begin
  Fishes := XClient.List(TFish);
```

You also can use Count method to retrieve only the total number of entities without needing to retrieve the full entity list:

```
var
  TotalFishes: Integer;
  TotalCustomers: Integer;
begin
  TotalFishes := Client.Count(TFish);
  TotalCustomers := Client.Count(TCustomer, '$filter=(Name eq
''Paul'') or (Birthday lt 1940-08-01)&$orderby=Name desc');
end;
```

12.3 Creating Entities

Use TXDataClient.Post to create a new object in the server.

```
C := TCountry.Create;
try
  C.Name := 'Germany';
  Client.Post(C);
finally
  C.Free;
end;
```

Pay attention to client memory management to learn which objects you need to manually destroy. In this case, the client won't destroy the TCountry object automatically so you need to destroy it yourself.
The client makes sure that after a successful Post call, the Id of the object is properly set (if generated by the server).

12.4 Updating Entities

Use TXDataClient.Put to update an existing object in the server.

```
Customer := Client.Get<TCustomer>(10);
Customer.City := 'London'; // change city
Client.Put(Customer); // send changes
```

Pay attention to client memory management to learn which objects you need to manually destroy. Client won't destroy objects passed to Put method. In the above example, though, the object doesn't need to be destroyed because it was previously retrieved with Get, and in this case (for objects retrieved from the server), the client will manage and destroy it.

12.5 Removing Entities

Use TXDataClient.Delete to delete an object from the server. The parameter must be the object itself:

```
Customer := Client.Get<TCustomer>(10);
Client.Delete(Customer); // delete customer
```

Pay attention to client memory management to learn which objects you need to manually destroy. Client won't destroy objects passed to Delete method. In the above example, though, the object doesn't need to be destroyed because

it was previously retrieved with Get, and in this case (for objects retrieved from the server), the client will manage and destroy it.

12.6 Invoking Service Operations

You can easily invoke service operations from a Delphi application using the TXDataClient class. Even though XData implements service operations using standards HTTP and JSON, which allows you to easily invoke service operations using HTTP from any client or platform, the TXDataClient makes it even easier by providing strong typing and direct method calls that in turn perform the HTTP requests under the hood.

Another advantage is that you don't need to deal with marshaling parameters or even create client-side proxy classes. The same service interface you defined for the server can be used in the client. You can share the units containing the service interfaces between client and server and avoid code duplication.

To invoke service operations, you just need to:

1. Retrieve an interface using Service<I> method
2. Call methods from the interface.

Here is an example of invoking the method Sum of interface IMyService, declaring in the topic "defining service interface":

```
uses
  {...}
  MyServiceInterface,
  XData.Client;

var
  Client: TXDataClient;
  MyService: IMyService;
  SumResult: double;
begin
  // Instantiate TXDataClient
  Client := TXDataClient.Create;
  // Set server Uri
  Client.Uri := 'http://server:2001/tms/xdata';
  // Retrieve IMyService inteface
  MyService := Client.Service<IMyService>;
  // call inteface methods
  SumResult := MyService.Sum(5, 10);
end;
```

Note that the client won't destroy any object passed as parameters, and will only destroy entities created by it (that were returned from the server), but no regular objects (like TList<T> or TStream). See "Memory Management" topic for detailed information.

12.7 Client Memory Management

Since method operations can deal with several types of objects, either Aurelius entities, plain old Delphi objects or even normal classes like TList<T> or TStream, it's important to know exactly how XData handles the lifetime of those objects, in order to avoid memory leaks or access violation exceptions due to releasing the same object multiple times.

This is the behavior or TXDataClient when it comes to receiving/sending objects (there is a separated topic for server-side memory management).

- Any object sent to the server (passed as a parameter) is **not destroyed**. You must handle the lifetime of those objects yourself.
- Any object of type TStream or TList<T> returned from the server is **not destroyed**. You must handle the lifetime of those objects yourself.
- Any other object returned from the server which type is not the ones mentioned in the previous item **is automatically destroyed** by default.

So consider the example below:

```
var
  Customer: TCustomer;
  Invoices: TList<TInvoice>;

{...}
Items := Client.Service<ISomeService>.DoSomething(Customer);
Customer.Free;
Invoices.Free;
```

Customer object is being passed as parameter. It will not be destroyed by the client and you must destroy it yourself. This is the same if you call Post, Put or Delete methods.

Items object (TList<T>) is being returned from the function. You must destroy the list yourself, it's not destroyed by the client. It's the same behavior for List method.

The TInvoice objects that are inside the list will be destroyed automatically by the client. You must not destroy them. Also, the same behavior for Get and List methods - entities are also destroyed by the client.

Alternatively, you can disable automatic management of entity instances at the client side, by using the ReturnedInstancesOwnership property:

```
Client.ReturnedInstancesOwnership := TInstanceOwnership.None;
```

The code above will prevent the client from destroying the object instances. You can also retrieve the list of all objects created by the client (that are supposed to be destroyed automatically) using property ReturnedEntities, in case you need to destroy them manually:

```
for Entity in Client.ReturnedEntities do {...}
```

12.8 Client and Multi-Model

When you create the TXDataClient object, it uses the default entity model to retrieve the available entity types and service operations that can be retrieved/invoked from the server. When your server has multiple models, though, you need to specify the model you are using when accessing the server. This is useful for the client to know which service interface contracts it can invoke, and of course, the classes of entities it can retrieve from the server. To do that, you pass the instance of the desired model to the client constructor:

```
Client :=
TXDataClient.Create(TXDataAureliusModel.Get('Security'));
```

See topic "Multiple servers and models" for more information.

12.9 Authentication Settings

For the HTTP communication, TXDataClient uses under the hood the Sparkle THttpClient. Such object is accessible through the TXDataClient.HttpClient property. You can use all properties and events of THttpClient class there, and the most common is the OnSendingRequest event, which you can use to set custom headers for the request. One common usage is to set the Authorization header with credentials, for example, a JSON Web Token retrieved from the server:

```
XDataClient.HttpClient.OnSendingRequest :=
   procedure(Req: THttpRequest)
   begin
     Req.Headers.SetValue('Authorization', 'Bearer ' + vToken);
   end;
```

Legacy Basic authentication

TXDataClient class provides you with the following properties for accessing servers protected with basic authentication.

```
property UserName: string;
property Password: string;
```

Defines the UserName and Password to be used to connect to the server. These properties are empty by default, meaning the client won't send any basic authentication info. This is equivalent to set the Authorization header with property Basic authentication value

Chapter



Web Applications with TMS Web Core

13 Web Applications with TMS Web Core

TMS Web Core is the TMS Software framework for building web applications using Delphi. It allows you to create pure HTML/JS Single-Page-Applications that runs in your browser.

Even though the web application generated by TMS Web Core can run 100% stand alone in the browser, in many scenarios it needs data to work with, and such data needs to be retrieved from a server (and eventually sent back for modifications). Usually this data communication is done through a REST API Server - the web client performs requests using HTTP(S), and send/receive data in JSON format.

TMS XData is the ideal back-end solution for TMS Web Core. It not only allows you to create REST API servers from an existing database in an matter of minutes, but is also provides the most complete and high-level client-side framework for TMS Web Core, including Delphi design-time support with visual components, a TXDataWebClient component that abstracts low-level HTTP/JSON requests in a very easy and high-level way of use, and a dataset-like optional approach that simply feels home to Delphi users but still uses modern REST/JSON requests behind the scenes.

The following topics cover in details how to use TMS XData Web-Client Framework and make use of TMS XData servers from TMS Web Core applications.

Setting Up the Connection with TXDataWebConnection
Using TXDataWebClient
Using TXDataWebDataset
XData Web Application Wizard

13.1 Setting Up the Connection with TXDataWebConnection

TXDataWebConnection is the first (and key) component you need to use to connect to XData server from TMS Web Core applications. Simply drop the component in the form set its URL property to the root URL of XData server:

```
XDataWebConnection1.URL := 'http://localhost:2001/tms/music';
```

(Even though the examples above and below will show setting properties from code, since TXDataWebConnection is available at design-time, you can set most of the properties described here at design-time in object inspector, including testing the connection).

Then you perform the connection setting Connected property to true:

```
XDataWebConnection1.Connected := True;
```

It's as simple as that. However, for web applications, you must be aware that **all** connections are performed **asynchronously**. This means that you can't be sure when the connection will be performed, and any code after Connected is

set to true is not guaranteed to work if it expects the connection to be established. In the following code, for example, the second line will probably not work because the connection is probably not yet finished:

```
XDataWebConnection1.Connected := True;
// The following line will NOT work because connection
// is still being established asynchronously
PerformSomeRequestToXDataServer();
```

To make sure the component is connected and you can start performing requests to XData server, you should use OnConnect and OnError events:

OnConnect and OnError events

When connecting, either one of those two events will be fired upon request complete. Use the OnConnect event to be sure the connection was performed and start communicating with XData server:

```
procedure TForm1.ConnectButtonClick(Sender: TObject);
begin
  XDataWebConnection1.URL := 'http://localhost:2001/tms/music';
  XDataWebConnection1.OnConnect := XDataWebConnection1Connect;
  XDataWebConnection1.OnError := XDataWebConnection1Error;
  XDataWebConnection1.Connected := True;
end;

procedure TForm1.XDataWebConnection1Connect(Sender: TObject);
begin
  WriteLn('XData server connected succesfully!');
  PerformSomeRequest;
end;

procedure TForm1.XDataWebConnection1Error(Error:
TXDataWebConnectionError);
begin
  WriteLn('XData server connection failed with error: ' +
Error.ErrorMessage);
end;
```

Open method

As an alternative to events, you can connect using Open method, which you pass two parameters: a callback for success and a callback for error.

```
procedure TForm1.ConnectButtonClick(Sender: TObject);

  procedure OnConnect;
  begin
    WriteLn('XData server connected succesfully!');
    PerformSomeRequest;
  end;

  procedure OnError(Error: TXDataWebConnectionError);
  begin
    WriteLn('XData server connection failed with error: ' +
Error.ErrorMessage);
  end;

begin
  XDataWebConnection1.URL := 'http://localhost:2001/tms/music';
  XDataWebConnection1.Open(@OnConnect, @OnError);
end;
```

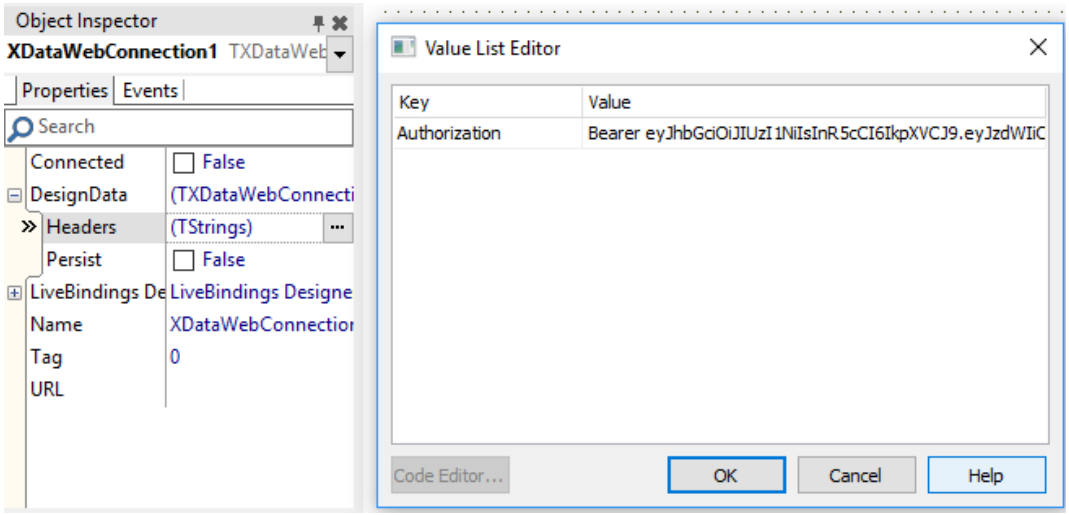
OnRequest event

OnRequest event is called before every request about to be sent to the XData server. This is an useful event to modify all requests at once. For example, it's often used to add authentication information the request, like a authorization token with a JWT header:

```
procedure TForm1.XDataWebConnection1Request(Request:
TXDataWebConnectionRequest);
begin
  Request.Request.Headers.SetValue('Authorization', 'Bearer ' +
LocalJWTToken);
end;
```

DesignData property

DesignData property is intended to be used just at design-time, as an opportunity for you to add custom headers to be sent to the server. Analogously to the OnRequest event, it's useful to add authorization header to the request so you can connect to XData server at design-time. To use it just click the ellipsis button in the DesignData.Headers property and add the headers you need.



Those headers will by default **not be saved** in the dfm, meaning you will lose that information if you close/open the project, or even the form unit. This is for security purposes. In the exceptional case you want information to be saved (and thus also loaded at runtime), you can set the Persist property to True.

13.2 Using TXDataWebClient

After setting up the connection, you can use TXDataWebClient component to communicate with the TMS XData Server from a TMS Web Core application. Note that the TXDataWebConnection **must be previously connected**. Performing operations with TXDataWebClient won't automatically setup the connection.

TXDataWebClient perform operations similar to the ones performed by TXDataClient, used in Delphi desktop and mobile applications. It means you can retrieve single and multipe entities (GET), insert (POST), update (PUT), delete (DELETE) and also invoke service operations.

However, there are several differences. The first and main one is that all requests are performed asynchronously. This means that when you call TXDataWebClient methods, you won't have a function result provided immediately to you, but instead you have to use event or callback to receive the result. Here is, for example, how to retrieve an entity (GET request) from server, more specifically retrieve an object artist, from entity set "Artist", with id 1:

```
procedure TForm1.GetArtistWithId1;
begin
  XDataWebClient1.Connection := XDataWebConnection1;
  XDataWebClient1.OnLoad := XDataWebClient1Load;
  XDataWebClient1.Get('Artist', 1);
end;
```

```
procedure TForm1.XDataWebClient1Load(Response:
TXDataClientResponse);
var
  Artist: TJSObject;
begin
  // Both lines below are equivalent.
  Artist := TJSObject(Response.Result);
  Artist := Response.ResultAsObject;

  // Use Artist object
end;
```

First, associate the TXDataWebClient component to an existing TXDataWebConnection component which will has the connection settings. This can be also done at design-time.

Second, set the OnLoad event of the component and add the code there to be executed when request is completed. Also can be done at design-time.

Finally, execute the method that perform the operation. In this case, Get method, passing the entity set name (Artist) and the id (1).

When the request is complete, the OnLoad event will be fired, and the result of the request (if it does return one) will be available in the Response.Result property. That property is of type JSValue, which can be any valid value. You will have to interpret the result depending on the request, if you are retrieving a single entity, that would be a TJSObject. If you are retrieving a list of objects, then the value can be a TJSArray, for example. You can alternatively use ResultAsObject or ResultAsArray.

TXDataWebClient component is very lightweight, so you can use as many components as you want. That means that you can drop one TXDataWebClient component in the form for each different request you want to perform, so that you will have one OnLoad event handler separated for each request. This is the more RAD and straightforward way to use it. In the case you want to use a single web client component for many requests, you can differentiate each request by the request id.

Using RequestId

Each response in the OnLoad event will have a request id. By default the request id is the name of the performed operation, in lowercase. So it will be "get" for get requests, "list" for list requests, etc.:

```
procedure TForm1.XDataWebClient1Load(Response:
TXDataClientResponse);
var
  Artist: TJSObject;
begin
  if Response.RequestId = 'get' then
  begin
    Artist := TJSObject(Response.Result);
  end;
end;
```

If you want to change the default request id, you can pass a different one as an extra parameter to the request, and check for it in the OnLoad event:

```
  XDataWebClient1.Get('Artist', 1, 'get artist');
```

Handling errors

If you don't specify anything, all request errors that might happen will fire the OnError event of the associated TXDataWebConnection component. This way you can have a centralized place to handle all request errors for that XData server.

But if you want to add error-handling code that is specific to a TXDataWebClient connection, TXDataWebClient also provides an OnError event:

```
procedure TForm1.XDataWebClient1Error(Error: TXDataClientError);
begin
  WriteLn('Error on request: ' + Error.ErrorMessage);
end;
```

Using callbacks

Alternatively to using OnLoad and OnError events, you can use the request methods passing callback as parameter. You can pass a callback for successful response, and optionally an extra callback for error response (if you don't pass the error callback, it will fallback to the OnError event).

```
procedure TForm1.GetArtistWithId1;

  procedure OnSuccess(Response: TXDataClientResponse);
  var
    Artist: TJSObject;
  begin
    Artist := TJSObject(Response.Result);
    // Use Artist object
  end;

  procedure OnError(Error: TXDataClientError);
  begin
    WriteLn('Error on request: ' + Error.ErrorMessage);
  end;

begin
  XDataWebClient1.Get('Artist', 1, @OnSuccess, @OnError);
end;
```

Available request methods

The following is a list of available request methods in TXDataWebClient. Remember that the method signatures in this list include only the required parameters. You can always also use either RequestId parameter or the callback parameters, as previously explained.

Name	Description
procedure Get(const EntitySet: string; Id: JSValue);	Retrieves a single entity from the server (GET request), from the specified entity set and with the specified id. Result will be a TJSObject value.
procedure Get(const EntitySet, QueryString: string; Id: JSValue);	Retrieves a single entity from the server (GET request), from the specified entity set and with the specified id. Optionally you can provide a QueryString parameter that must contain query options to added to the query part of the request. For get requests you would mostly use this with $expand query option. Result will be a TJSObject value.
procedure List(const EntitySet: string; const Query: string = '');	Retrieves a collection of entities from the specified entity set in the server (GET request). You can provide a QueryString parameter that must contain query options to added to the query part of the request, like $filter, $orderby, etc.. Result will be a TJSArray value.
procedure Post(const EntitySet: string; Entity: TJSObject);	Inserts a new entity in the entity set specified by the EntitySet parameter. The entity to be inserted is provided in the Entity parameter.
procedure Put(const	Updates an existing entity in the specified entity set. You don't need to provide an id separately since the

EntitySet: string; Entity: TJObject);	Entity parameter should already contain all the entity properties, including the correct id.
procedure Delete(const EntitySet: string; Entity: TJObject);	Deletes an entity from the entity set. The id of the entity will be retrieved from the Entity parameter. Since this is a remove operation, only the id properties are relevant, all the other properties will be ignored.
procedure RawInvoke(const OperationId: string; Args: array of JSValue);	Invokes a service operation in the server. The OperationId identifies the operation and Args contain the list of parameters. More info below.

Invoking service operations

You can invoke service operations using RawInvoke methods. Since you can't use the service contract interfaces in TMS Web Core yet, the way to invoke is different from TXDataClient. The key parameter here is OperationId, which identifies the service operation to be invoked. By default, it's the interface name plus dot plus method name.

For example, if in your server you have a service contract which is an interface named "IMyService" which contains a method "Hello", that receives no parameter, you invoke it this way:

```
XDataWebClient1.RawInvoke('IMyService.Hello', []);
```

If the service operation provides a result, you can get it the same way as described above: either using OnLoad event, or using callbacks:

```
procedure TForm2.WebButton1Click(Sender: TObject);

  procedure OnResult(Response: TXDataClientResponse);
  var
    GreetResult: string;
  begin
    GreetResult := string(TJSObject(Response.Result)['value']);
  end;

begin
  Client.RawInvoke('IMyService.Greet', ['My name'], @OnResult);
end;
```

Since we're in the web/JavaScript world, you must know in more details how results are returned by service operations in JSON format.

As the example above also illustrates, you can pass the operation parameters using an array of JSValue values. They can be of any type, inculding TJSObject and TJSArray values.

Other properties

Name	Description
property ReferenceSolvingMode: TReferenceSolvingMode	Specifies how $ref occurrences in server JSON response will be handled. **rsAll:** Will replace all $ref occurrences by the instance of the referred object. This is default behavior and will allow dealing with objects easier and in a more similar way as the desktop/mobile TXDataClient. It adds a small overhead to solve the references. **rsNone:** $ref occurrences will not be processed and stay as-id.

13.3 Using TXDataWebDataset

In addition to TXDataWebClient, you have the option to use TXDataWebDataset to communicate with TMS XData servers from web applications. It's even higher level of abstraction, at client side you will mostly work with the dataset as you are used to in traditional Delphi applications, and XData Web Client framework will translate it into REST/JSON requests.

Setting it up is simple:

1. Associate a TXDataWebConnection to the dataset through the Connection property (you can do it at design-time as well). Note that the TXDataWebConnection **must be previously connected**. Performing operations with TXDataWebDataset won't automatically setup the connection.

```
XDataWebDataset1.Connection := XDataWebConnection1;
```

2. Set the value for EntitySetName property, with the name of the entity set in XData server you want to manipulate data from. You can also set this at design-time, and object inspector will automatically give you a list of available entity set names.

```
XDataWebDataset1.EntitySetName := 'artist';
```

3. Optionally: specify the persistent fields at design-time. As with any dataset, you can simply use the dataset fields editor and add the desired fields. TXDataWebDataset will automatically retrieve the available fields from XData server metadata. If you don't, as with any dataset in Delphi, the default fields will be created.

And your dataset is set up. You can the use it in several ways, as explained below.

Loading data automatically

Once the dataset is configured, you just need to call Load method to retrieve data:

```
XDataWebDataset1.Load;
```

This will perform a GET request in XData server to retrieve the list of entities from the specific entity set. Always remember that such requests are **asynchronous**, and that's why you use Load method instead of Open. Load will actually perform the request, and when it's finished, it will provide data to the dataset and only then, call Open method. Which in turn will fire AfterOpen event. If you want to know when the request is finished and data is available in the dataset, use the AfterOpen event.

To filter out results, you can (and should) use the QueryString property, where you can put any query option you need, including $filter and $top, which you should be use to filter out the results server-side and avoiding retrieving all the objects to the client. Minimize the number of data sent from the server to the client!

```
XDataWebDataset1.QueryString := '$filter=startswith(Name,
''John'')&$top=50';
XDataWebDataSet1.Load;
```

Paging results

The above example uses a raw query string that includes "&$top=50" to retrieve only 50 records. You can do paging that way, by building the query string accordingly. But TXDataWebDataset provides additional high-level properties for paging results in an easier way. Simply use QueryTop and QuerySkip property to define the page size and how many records to skip, respectively:

```
XDataWebDataset1.QueryTop := 50; // page size of 50
XDataWebDataset1.QuerySkip := 100; // skip first 2 pages
XDataWebDataset1.QueryString := '$filter=startswith(Name,
''John'')';
XDataWebDataSet1.Load;
```

The datase also provides a property ServerRecordCount which might contain the total number of records in server, regardless of page size. By default, this information is not retrieved by the dataset, since it requires more processing at server side. To enable it, set ServerRecordCountMode:

XDataWebDataset1.ServerRecordCountMode := smInlineCount;

When data is loaded from the dataset (for example in the AfterOpen event), you can read ServerRecordCount property:

```
procedure TForm4.XDataWebDataSet1AfterOpen(DataSet: TDataSet);
begin
  TotalRecords := XDataWebDataset1.ServerRecordCount;
end;
```

Loading data manually

Alternatively you can simply retrieve data from the server "manually" using TXDataWebClient (or even using raw HTTP requests, if you are bold enough) and provide the retrieved data to the dataset using SetJsonData. Since the asynchronous request was already handled by you, in this case where data is already available, and you can simply call Open after setting data:

```
procedure TForm1.LoadWithXDataClient;

  procedure OnSuccess(Response: TXDataClientResponse);
  begin
    XDataWebDataset1.SetJsonData(Response.Result);
    XDataWebDataset1.Open;
  end;

begin
  XDataWebClient1.List('artist', '$filter=startswith(Name,
''New'')', @OnSuccess);
end;
```

Modifying data

When using regular dataset operations to modify records (Insert, Append, Edit, Delete, Post), data will only be modified in memory, client-side. The underlying data (the object associated with the current row) will have its properties modified, or the object will be removed from the list, or a new object will be created. You can then use those modified objects as you want - manually send changes to the server, for example.

But TXDataWebDataset you can have the modifications to be automatically and transparently sent to the server. You just need to call ApplyUpdates:

```
XDataWebDataset1.ApplyUpdates;
```

This will take all the cached modifications (all objects modified, deleted, inserted) and will perform the proper requests to the XData server entity set to apply the client modifications in the server.

Other properties

Name	Description
property SubPropsDepth: Integer	Allows automatic loading of subproperty fields. When adding persitent fields at design-time or when opening the dataset without persistent fields, one TField for each subproperty will be created. By increasing SubpropsDepth to 1 or more, dataset will also automatically include subproperty fields for each property in each association, up to the level indicated by SubpropsDepth. For example, if SubpropsDepth is 1, and the entity type has an association field named "Customer", the dataset will also create fields like "Customer.Name", "Customer.Birthday", etc.. Default is 0 (zero).

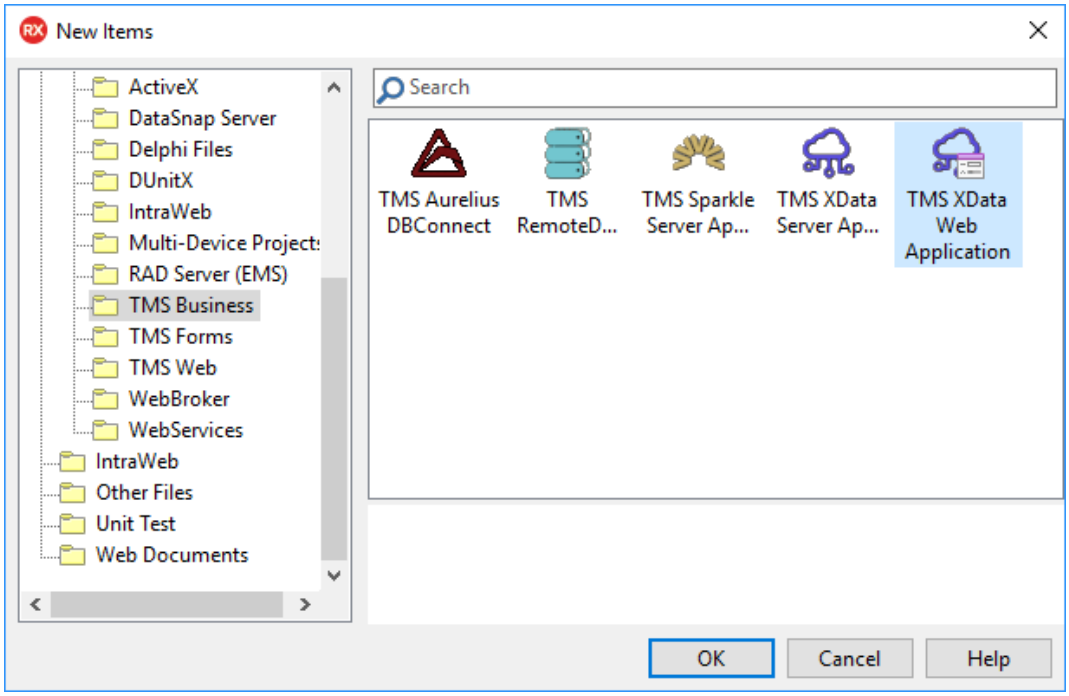
property CurrentData: JSValue	Provides the current value associated with the current row. Even though CurrentData is of type JSValue for forward compatibility, for now CurrentData will always be a TJSObject (an object).

13.4 XData Web Application Wizard

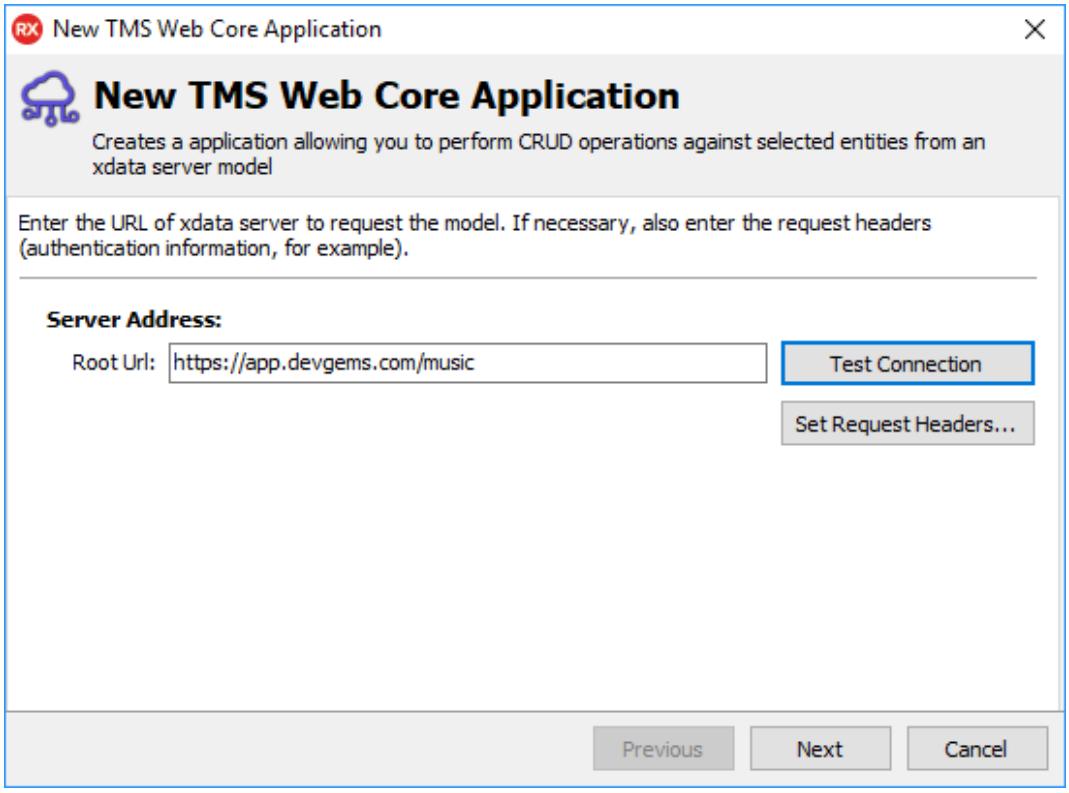
TMS XData provides a great wizard to scaffold a full TMS Web Core web client application.

This wizard will connect to an existing XData server and extract meta information it with the list of entities published by the server. With that information, it will create a responsive, Boostrap-based TMS Web Core application that will serve as a front-end for listing entities published by the server. The listing features include data filtering, ordering and paging.

To launch the wizard, go to Delphi menu **File > New > Other...**, then from the New Items dialog choose **Delphi Projects > TMS Business,** and select wizard "**TMS XData Web Application".**

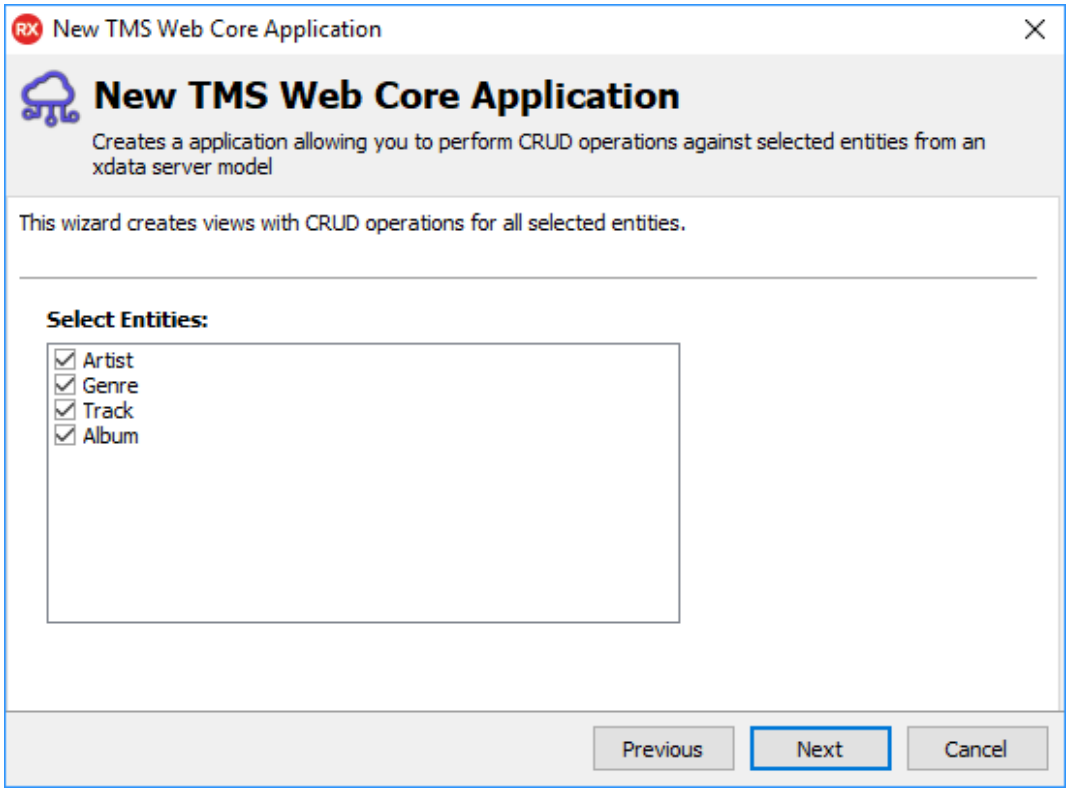


Click Ok and the wizard will be launched:

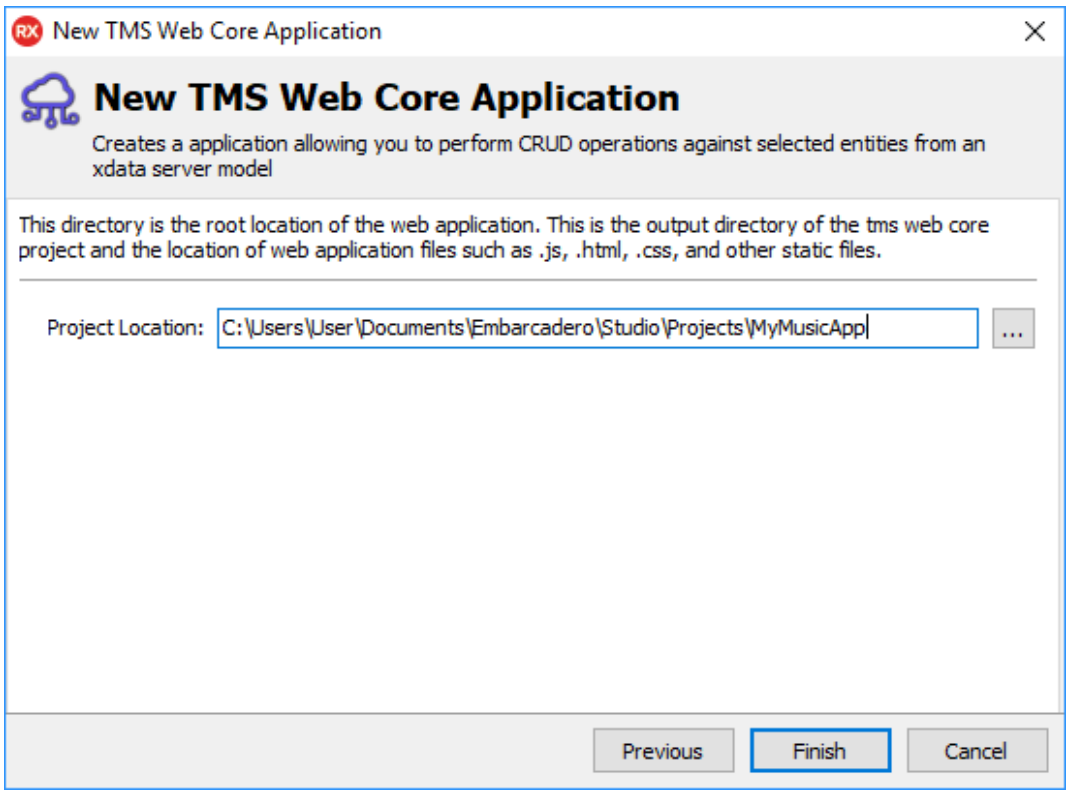


In this first page you must provide the URL address of a running XData server. You can click the "Test Connection" button to check if the connection can be established. If the server requires authentication or any extra information sent by the client, you can use the "Set Request Headers..." button to add more HTTP headers to the client request (for example, adding a JWT token to an Authorization header).

Once the server URL is provided and connecting, click Next to go to next page.

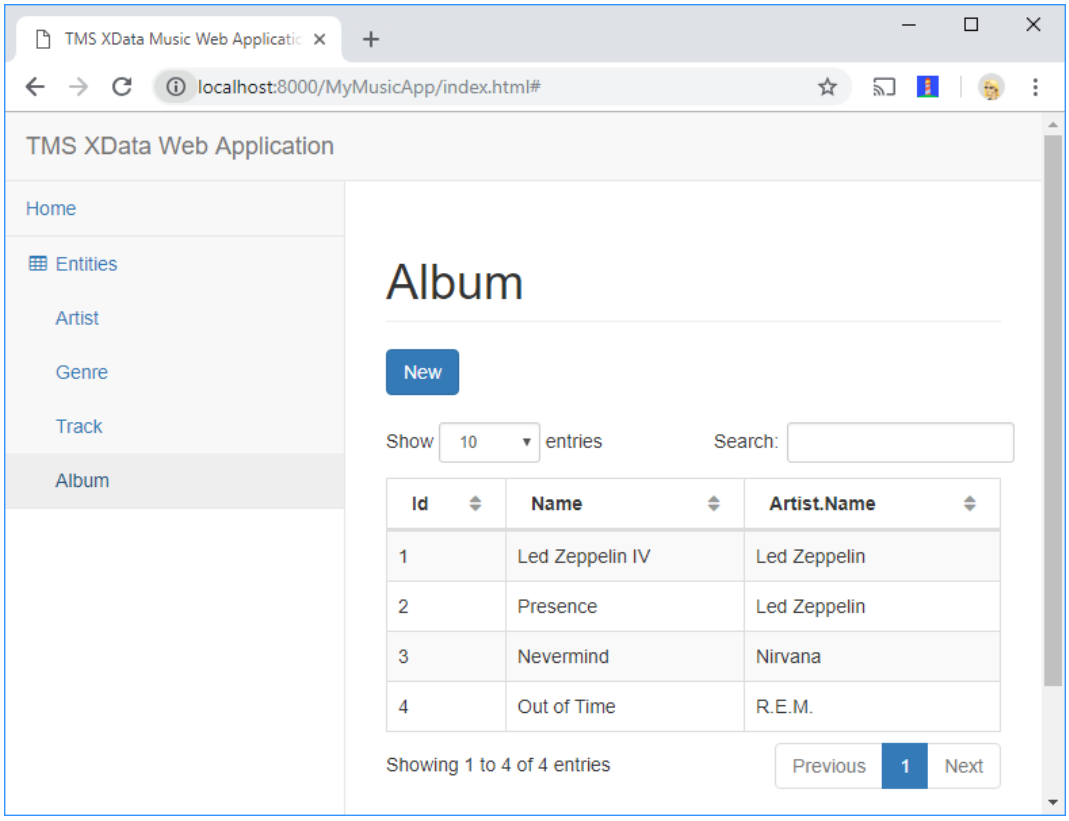


This will list all entities published by the XData server. You can then select the ones you want to generate a listing page for. Unselected entities will not have an entry in the menu nor will have a listing page. Select the entities you want and click Next.



The final wizard page will ask you for a directory where the source code of the web application will be generated. Choose the output folder you want and click Finish. The application source code will be generated in the specified folder, and the project will be open in Delphi IDE.

You can now compile and run the application, and of course, modify it as you want. This is a easy and fast way to start coding with TMS Web Core and TMS XData backend. Here is a screenshot of the generated application running in the browser, using the settings above:


TMS XData Music Web Applicatic
localhost:8000/MyMusicApp/index.html#
TMS XData Web Application
Home
Entities
Artist
Genre
Track
Album
Album
New
Show 10 entries
Search:
Id
Name
Artist.Name
1
Led Zeppelin IV
Led Zeppelin
2
Presence
Led Zeppelin
3
Nevermind
Nirvana
4
Out of Time
R.E.M.
Showing 1 to 4 of 4 entries
Previous
1
Next