jRIAppTS, the RIA application framework – user's guide

jRIAppTS, the application framework

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jRIAppTS, the RIA application framework

1.1 *What is the jRIAppTS framework*

jRIAppTS – is application framework for developing rich internet applications - RIA's. It consists of two parts – the client and the server parts. The client part was written in typescript language. The server part was written in C# and the demo application was implemented in ASP.NET MVC (*it can also be written in other languages, for example Ruby or Java, but you have to roll up your sleeves and prepare to write them*).
The Server part resembles Microsoft WCF RIA services, featuring data services which is consumed by the clients.
The Client part resembles Microsoft Silverlight client development, only it is based on HTML (*not XAML*), and uses typescript language for the coding.
The framework was designed primarily for creating data centric Line of Business (LOB) applications which will work natively in browsers without the need for plugins .
The framework supports wide range of essential features for creating LOB applications, such as, declarative use of data bindings, integration with the server side service, data templates, client and server side data validation, localization, authorization, and a set of GUI controls, like the datagrid, the stackpanel , the dataform and a lot of utility code.
Unlike many other existing frameworks, which use MVC design pattern, the framework uses Model View View Model (MVVM) design pattern for creating applications. The use of data bindings and view models resembles Microsoft Silverlight data bindings style used in the XAML.

The framework was designed for gaining maximum convenience and performance, and for this sake it works in browsers which support ECMA Script 5.1 level of javascript and has features like native property setters and getters.

The supported browsers are Internet Explorer 9 and above, Mozilla Firefox 4+, Google Chrome 13+, and Opera 11.6+. Because the framework is primarily designed for

developing LOB applications, the exclusion of antique browsers does not harm the purpose, and improves framework's performance and ease of use.

The framework is distinguished from other frameworks available on the market by its full stack implementation of the features required for building real world LOB applications in HTML5.
It has the server side component - the data service. It has GUI controls that are aware of the events raised by data centric objects like the DbSet and the Entity.

For the creation of data centric applications the framework has GUI controls for working with the server originated data, with editing support, and submitting changes to the server with the data passing through the data validation and authorization stages of the data processing, then returning autogenerated field values - such as primary keys, timestamp values to the client. The framework includes the ability to track changes (*auditing*) and do the error logging.

For this very purpose the framework contains a set of user controls such as:
DataGrid – the control for displaying and editing of the data in the table form. It supports databinding, row selection with keyboard keys, column sorting, data paging, a detail row, data templates, different column's types (*expander column, row selector column, actions column*). For editing it can use the builtin inline editor, and has the support for a popup editor which can be designed with the help of a data template.
StackPanel - the control for displaying and editing of the data as a horizontal or vertical list with the help of a data template and the support for item selections with keyboard keys.
ListBox - the control integrates HTML select tag with the collection's data for displaying options.
DataForm - the control for displaying and editing of the data item with the help of a data template.
DbContext – the control used as a data manager to store collections of data (*DbSets*) and to cache changes on the client for submitting them to the server backend.

It has also special element view registered by the name dynacontent, which helps to create templated content regions on a page. The templates in these regions are easily switchable. This feature enables to create real world single page applications.

This is just an overview of the main features, they and the other ones will be discussed in more details later in this user guide.

1.2 *Licensing*

1.3 *The Framework's files and deployment*

The framework is written in typescript, and HTML5 browser applications work with javascript. So the typescript code first is compiled to javascript files.
The typescript code is contained in the Microsoft Visual Studio Project with the name jriappTS. The main file, which contains the Application class and has references to other core files (*modules*) of the framework is jriapp.ts. In the solution there is a compile.bat file which is used to compile jriapp.ts - that is the core application. The core application consists of only a jriapp.js file. It contains all the core modules needed for the application.
Which are referenced in the main jriapp.ts file:

```
/// <reference path="jquery\jquery.d.ts" />
/// <reference path="jriapp_en.ts"/>
/// <reference path="baseobj.ts"/>
/// <reference path="globalobj.ts"/>
/// <reference path="modules\consts.ts"/>
/// <reference path="modules\utils.ts"/>
/// <reference path="modules\errors.ts"/>
/// <reference path="modules\converter.ts"/>
/// <reference path="modules\defaults.ts"/>
/// <reference path="modules\parser.ts"/>
/// <reference path="modules\mvvm.ts"/>
/// <reference path="modules\baseElView.ts"/>
/// <reference path="modules\binding.ts"/>
/// <reference path="modules\collection.ts"/>
/// <reference path="modules\template.ts"/>
/// <reference path="modules\baseContent.ts"/>
/// <reference path="modules\dataform.ts"/>
//*** the rest are optional modules, which can be removed if not needed ***
/// <reference path="modules\db.ts"/>
/// <reference path="modules\listbox.ts"/>
/// <reference path="modules\datadialog.ts"/>
/// <reference path="modules\datagrid.ts"/>
/// <reference path="modules\pager.ts"/>
/// <reference path="modules\stackpanel.ts"/>
```

Note: *all the above modules are compiled to one file jriapp.js, which is the main client file of the framework. The project contains compile.bat for convenience.*

The Client part of the framework is usually deployed (*as in the demo application*) in one folder, jriapp, which is located under Scripts web application folder (*it can be renamed if desired*).
Inside jriapp folder is jriapp.css (*the styles for the frameworks's GUI controls*) and img folder – which contains the image files used by the framework's controls.

The demo application which demonstrates the use and capabilities of the framework is created using ASP.NET MVC web site project. The project uses the layout page (*_LayoutDemo.cshtml*), which is used by all the pages included in the demo web site.

This layout page includes the core files of the framework and javascript and css which are used on each demo page.

```
<head>
    <meta charset="utf-8" />
    <title>@ViewBag.Title</title>
    <link href="@Url.Content("~/Content/themes/redmond/jquery-ui-1.9.2.custom.min.css")" rel="stylesheet" type="text/css" />
    <link href="@Url.Content("~/Scripts/bootstrap/css/bootstrap.min.css")" rel="stylesheet" type="text/css" />
    <link href="@Url.Content("~/Scripts/qtip/jquery.qtip.min.css")" rel="stylesheet" type="text/css" />
    <link href="@Url.Content("~/Scripts/jriapp/jriapp.css",true)" rel="stylesheet" type="text/css" />
    <link href="@Url.Content("~/Content/Site.css",true)" rel="stylesheet" type="text/css" />


    @RenderSection("CssImport", false)

    <script src="@Url.Content("~/Scripts/jquery/jquery-1.8.3.min.js")" type="text/javascript"></script>
    <script src="@Url.Content("~/Scripts/jquery/jquery-ui-1.9.2.custom.min.js")" type="text/javascript"></script>
    <script src="@Url.Content("~/Scripts/bootstrap/js/bootstrap.min.js")" type="text/javascript"></script>
    <script src="@Url.Content("~/Scripts/qtip/jquery.qtip.min.js")" type="text/javascript"></script>
    <script src="@Url.Content("~/Scripts/datejs/date.js")" type="text/javascript"></script>
    <script src="@Url.Content("~/Scripts/jriapp/jriapp.js",true)" type="text/javascript"></script>

    @RenderSection("JSImport", false)
</head>
```

The framework is dependent on several third party javascript libraries: JQuery (*1.7 and higher*), JQuery UI (*for calendars, tabs and the other UI controls*), datejs (*for dates formatting*), and qtip (*for tooltips)*. Thus, these javascript libraries files should be referenced on the html page for the framework's code to work properly.

Individual demo pages besides the files includes in the layout page includes the specific code for the page - such as the the code which contains view models, converters, extended application class, needed extra css styles and so on.
For example *DataGridDemo.cshtml* contains such a code:

```
@section CssImport
{
}

@section JSImport
{
    <script src="@Url.Content("~/Scripts/RIAppDemo/common.js",true)" type="text/javascript"></script>
    <script src="@Url.Content("~/Scripts/RIAppDemo/header.js",true)" type="text/javascript"></script>
    <script src="@Url.Content("~/Scripts/RIAppDemo/demoDB.js",true)" type="text/javascript"></script>
    <script src="@Url.Content("~/Scripts/RIAppDemo/gridDemo.js",true)" type="text/javascript"></script>
}
```

Typically, the pages which consume the data service include a code generated from the dataservice's *GetTypeScript* method, which contains the autogenerated classes and interfaces for strongly typed entities and DbContext classes. This database interface also helps to work with the dataservice in a strongly typed way. The typescript code is then compiled to javascript code and then it is included in the ASP.NET MVC demo pages. For example in *DataGridDemo.cshtml* ~/Scripts/RIAppDemo/demoDB.js is included for exactly such purpose. The next file (~/Scripts/RIAppDemo/gridDemo.js) contains view models and the application class.

Note: *most of the javascript files included in the demo web pages were initially as a typescript code and then they were compiled to javascript. For example, ~/Scripts/RIAppDemo/demoDB.js was* ***user_modules\demoDB.ts*** *file in the jriappTS project.*

The framework's types (classes) and objects

2.1 *The BaseObject class*

All the types used in the client part of the framework derived from the RIAPP.BaseObject type. The RIAPP.BaseObject defined in baseobj.ts file and this class adds common logic for an object's destruction and adds events support for all the objects derived from it.

BaseObject's methods:

Methods	Description
addHandler	adds an event handler for an event (*with optional support for event namespaces like in jQuery*)
removeHandler	removes a handler for an event (*can be used to remove all handlers registered within a namespace*)
removeNSHandlers	removes all handlers for events registered with an event namespace
addOnPropertyChange	adds a handler for a property change notification
removeOnPropertyChange	removes a handler for a property change notification
raisePropertyChanged	triggers registered events handlers for a property change notification
raiseEvent	triggers registered events handlers for an event
destroy	the method is invoked when the object needs to be destroyed for cleaning up resources such as registered event handlers and other resources. It is usually overridden in descendants (*but don't forget to always invoke super mehod!)*
_getEventNames	defines event names supported by the object type. BaseObject type supports 'error', and 'destroyed' events. descendants of the BaseObject can override this method to add their own events.
_onError	typically it is invoked by descendants of the BaseObject on error conditions. It triggers the error event and returns boolean value of handled the error or not. Many frameworks object types override this method, for example, in BaseElView type it invokes _onError inherited from BaseObject, and if the error was not handled it invokes application's _onError method.

BaseObject's events:

Event name	Description
error	event is raised from the BaseObject's _onError method.
destroyed	event is raised when the object's destroy method completed

BaseObject's properties:

Property	Description
_isDestroyed	Is set to true in the BaseObject's destroy method when the destruction of the object is completed. After it was set the destroy

	event is fired.
_isDestroyCalled	Is set to true (*typically in the descendants*) when the destroy method was called. The destruction of the object is not completed, but it is in the progress.

The BaseObject type has no public properties, although it has useful protected fields. For example, each framework's object has _isDestroyCalled field which indicates the object's state. When the destroy method is called this field is set to true (*even if full destruction of object is not completed*). You can check this field value in asynchronously invoked methods' callbacks, to be sure that the object is still alive after some asynchronous operation completed (*because in the meantime the object can be disposed*), like in the next example:

```
setTimeout(function () {
        if (self._isDestroyCalled)  //the object state is already destroyed or is destroying
            return;
        self._checkQueue(property, self._owner[property]);
}, 0);
```

The BaseObject class also has _isDestroyed field, which is set to true after the object's complete destruction. This field is usually checked in overridden destroy methods, so when the object is destroyed to exit the destroy method immediately (*preventing repeated destroys*), like in the next example:

```
destroy() {
        if (this._isDestroyed) //prevents repeated destroys, if destroyed just return and do nothing
            return;

        this._unbindDS();
        this._clearContent();
        this._$el.removeClass(_css.pager);
        this._el = null;
        this._$el = null;
        super.destroy();
}
```

The initialization of new object's instance is done in the object's constructor.

an example of an object definition (derived from RIAPP.BaseObject) :

```
export class TestObject extends BaseObject {
        _testProperty1: string;
        _testProperty2: string;
        _testCommand: MOD.mvvm.ICommand;
        _month: number;
        _months: MOD.collection.Dictionary;
        _format: string;
        _formats: MOD.collection.Dictionary;

        constructor(initPropValue: string) {
            super();
            var self = this;
            this._testProperty1 = initPropValue;
            this._testProperty2 = null;
            this._testCommand = new MOD.mvvm.Command(function (sender, args) {
                self._onTestCommandExecuted();
            }, self,
             function (sender, args) {
                 //if this function return false, then the command is disabled
                 return utils.check.isString(self.testProperty1) && self.testProperty1.length > 3;
             });
```

```
            this._month = new Date().getMonth() + 1;
            this._months = new MOD.collection.Dictionary('MonthType', { key: 0, val: '' }, 'key');
            this._months.fillItems([{ key: 1, val: 'January' }, { key: 2, val: 'February' }, { key: 3, val: 'March' },
                { key: 4, val: 'April' }, { key: 5, val: 'May' }, { key: 6, val: 'June' },
                { key: 7, val: 'July' }, { key: 8, val: 'August' }, { key: 9, val: 'September' }, { key: 10, val: 'October' },
                { key: 11, val: 'November' }, { key: 12, val: 'December' }], true);

            this._format = 'PDF';
            this._formats = new MOD.collection.Dictionary('format', { key: 0, val: '' }, 'key');
            this._formats.fillItems([{ key: 'PDF', val: 'Acrobat Reader PDF' }, { key: 'WORD', val: 'MS Word DOC' },
                    { key: 'EXCEL', val: 'MS Excel XLS' }], true);
        }
        _onTestCommandExecuted() {
            alert(utils.format("testProperty1:{0}, format:{1}, month: {2}", this.testProperty1, this.format,
                    this.month));
        }
        get testProperty1() { return this._testProperty1; }
        set testProperty1(v) {
            if (this._testProperty1 != v) {
                this._testProperty1 = v;
                this.raisePropertyChanged('testProperty1');
                //let the command to evaluate its availability
                this._testCommand.raiseCanExecuteChanged();
            }
        }
        get testProperty2() { return this._testProperty2; }
        set testProperty2(v) {
            if (this._testProperty2 != v) {
                this._testProperty2 = v;
                this.raisePropertyChanged('testProperty2');
            }
        }
        get testCommand() { return this._testCommand; }
        get testToolTip() {
            return "Click the button to execute the command.<br/>" +
                    "P.S. <b>command is active when the testProperty length > 3</b>";
        }
        get format() { return this._format; }
        set format(v) {
            if (this._format !== v) {
                this._format = v;
                this.raisePropertyChanged('format');
            }
        }
        get formats() { return this._formats; }
        get month() { return this._month; }
        set month(v) {
            if (v !== this._month) {
                this._month = v;
                this.raisePropertyChanged('month');
            }
        }
        get months() { return this._months; }
    }
```

An object's instance can fire two predefined events 'error', 'destroyed'.

The *error* event is raised from the BaseObject's _onError method.
The Error event handler can set isHandled to true , and then the error handling is successfully finished.

The destroyed event is raised from the BaseObject's destroy method. It is used to notify about object destruction and can be used by subscribers to remove references to the destroyed object.

The BaseObject class allows derived classes to override _getEventNames method in order to define new custom events as in the example:

```
_getEventNames():string[] {
        var base_events = super._getEventNames();
        return ['open','close', 'error', 'message', 'status_changed'].concat(base_events);
}
```

The users can subscribe to events by using addHandler method, as in the example:

```
theObject.addHandler('status_changed', function (sender, args) {
            if (args.item._isDeleted){
                self.dbContext.submitChanges();
            }
        }, self.uniqueID);
```

The last argument of the addHandler method is the event's namespace, which is an optional parameter and helps to remove subscriptions to the events in this namespace. For this you can use the removeNSHandlers method. For removing the subscriptions you can also use removeHandler method, and provide to it the event's name and optionally the event's namespace.

```
//remove subscription by the event name, plus the event namespace is an optional parameter.
ourCustomObject.removeHandler('status_changed', this.uniqueID);
```

The events can be triggered by using raiseEvent method as in the example:

```
_onMsg(event:string) {
    this.raiseEvent('message', { message: event.data, data: JSON.parse(event.data) });
}
```

You also can subscribe to a property change notification using addOnPropertyChange method as in the example:

```
ourCustomObject.addOnPropertyChange('currentItem', function (sender, data) {
            self._onCurrentChanged();
        },
//the event namespace is an optional parameter.
self.uniqueID);
```

If you want to get notifications for all properties changes you can provide '*' instead of a real property name. Inside the handler you can obtain the name of the property which triggered the notification using args.property value, as in the example:

```
ourCustomObject.addOnPropertyChange('*',function(s,a){alert('property that has been changed: '+ a.property);},
self.uniqueID);
```

To unsubscribe from property change notification you can use removeOnPropertyChange method, or use removeNSHandlers method, as in the example:

```
//remove a subscription by a property name, plus an event namespace (is an optional parameter).
obj.removeOnPropertyChange('currentItem', this.uniqueID);
//remove all subscriptions in the event's namespace
obj.removeNSHandlers(this.uniqueID);
```

2.2 *The Global class*

All the code in the client part of framework is structured into modules. The Global object instance (*namely, instance of RIAPP.Global*) is created by the framework at the time of loading of the framework's jriapp.js file. It is a singleton object. The RIAPP.Global type is defined in globalobj.ts file. An instance of this object is accessed in the code via RIAPP.global variable. It can be also accessed by the global property on the Application object instance.

RIAPP.global - is used to hold references for registered types, application instances, loaded modules, and manages subscriptions to some window.document's events, it also subscribes to window.onerror event to handle errors. It also dispatches DOM document keydown events to the currently selected on HTML page UI control (*a DataGrid or a StackPanel*), so that only one instance of the user control can handle keyboard events at a time (*for example,it is used for selecting a row in the DataGrid with the help of up or down keyboard keys*). Also the Global object exposes load event which is fired when all the HTML DOM is parsed (*like the jQuery's ready method*).

For convenience, the global object exposes references to the Window HTML DOM object and to the JQuery function. The global object also holds references for registered converters (*some converters are registered in the converter module*).

The global object has defaults property, which exposes an instance of the Defaults object type (*it is instantiated in defaults global module*). Using this property we can set or change the default values used in the framework, such as: default date format, time format, decimal point, thousand's separator, datepicker's defaults, path to the images, as in the example:

```
global.defaults.dateFormat = 'dd.mm.yy'; //russian style date format
global.defaults.imagesPath = '/Scripts/jriapp/img/';
```

Global object's methods:

Method	Description
findApp	Finds an application instance by its name.
registerType	Registers a type by its name. The type can be later retrieved anywhere in the code by using getType method.
getType	Retrieves registered type by its name.
registerConverter	Registers a converter by its name. Registered converters can be used in the databinding's expressions by their names. P.S. - The Application class also has the registerConverter method. If you register converter with an application by the same name as in global class then it will be used by the databindings of this application.
registerElView	Registers an element's view by its name. Registered element's views are used directly (*using their names*) or indirectly in the databindings.
getImagePath	Get common images paths used in the framework by their names. It just appends provided image name to the default path for the images. It is just a helper method.
registerTemplateGroup	Registers a template's group by its name. The template's group can contain several templates. When one template from a

	group is needed by a user control, then the whole group of template is loaded from the server. P.S.- Typically this is used in complex SPAs, which has a lot of templates and it is difficult to maintain them in one file. And the application class also has this method. Which is mainly used instead of global's one.
loadTemplates	Loads templates as a batch (*as a file with templates*) from the server. They are later available to all application instances. It should be used only before an application instance is created. Typically in the global.onload event handler.

Global object properties:

Property	ReadOnly	Description
$	Yes	JQuery function for easier access in the code.
window	Yes	DOM Window object instance
document	Yes	DOM Document object instance
currentSelectable	No	The currently selected control the DataGrid or the StackPanel which accepts keyboard input like Up or Down keys for scrolling them by keyboard keys. It is set automatically when the control is clicked on a page. P.S.- you can set it in the code, to make sure that the control has keyboard input.
defaults	Yes	Instance of the Default object type, to access or change the default values. This property is initialized by the global defaults module.
UC	--	the namespace (*empty object instance*) for attaching any custom user code. You can attach any code to it which can be used globally.
utils	Yes	Object which contains common utility methods. This property is initialized by the global utils module.
modules	Yes	the namespace (*object instance*) for obtaining global modules' instances, and through the modules instances you can get access to the types. But it is rarely used because global object has all modules exposed through its respective properties, like: *utils, consts, defaults*.
consts	Yes	Object which contains public globally accessed constants, like: global.consts.KEYS.
isLoading	Yes	Returns true if the application's instance or global object loads templates from the server.

Global object events:

Event name	Description
unload	Raised when the browser's window unloads
load	Raised when the document DOM structure is fully loaded. The same as using JQuery.ready event handler.

2.3 *The Application class*

RIAPP.Application - object type which represents the application.
On creation of the application's instance we can provide application's options to the constructor. Their interface is defined as this:

```
export interface IAppOptions {
        application_name?: string;
        user_modules?: { name: string; initFn: (app: Application) => any; }[];
        application_root?: { querySelectorAll: (selectors: string) => NodeList; };
 }
```

The options include a name for the application (*can be used if you have several applications on a HTML page, if not the default is OK*). It also includes an array of types for user modules initialization. The initFn is invoked when a user module is initialized by the application.
Also, the options can provide the application's root. It is a scope (*a region*) of the application on the HTML page. By default, the whole HTML page is the scope and the application root refers to window.document property. But if you have several applications in one HTML page you can provide different scope (*typically, a div element*) for each application.

The main method of the application is the startUp, which is used to trigger execution of the callback function (*which is provided as part of the parameter*) and data binding. The callback function used as a sandbox environment, in which can be created instances of view models (*which are usually defined in custom user modules*) and any other user defined objects. After executing the callback function, the application invokes its *onStartup* method (*which can be overridden in derived classes*) and then processes the databindings on the HTML page.

Usually each SPA (*single page application*) uses a specialized application class (*derived from the Application class*), which is defined in a custom user module. It can also accept extended options.
For example, the grid demo example extends its application options by adding more properties to it.

```
export interface IMainOptions extends IAppOptions {
          service_url: string;
          permissionInfo?: MOD.db.IPermissionsInfo;
          images_path: string;
          upload_thumb_url: string;
          templates_url: string;
          productEditTemplate_url: string;
          sizeDisplayTemplate_url: string;
          modelData: any;
          categoryData: any;
 }
```

The demo uses a new specialized application's class which exposes instances of view models (*which are defined in that or other modules*) through its new properties and also exposes the DbContext's instance (*to allow communication with the data service*).

```
//strongly typed aplication's class
 export class DemoApplication extends Application {
          _dbContext: DEMODB.DbContext;
          _errorVM: COMMON.ErrorViewModel;
          _headerVM: HEADER.HeaderVM;
          _productVM: ProductViewModel;
          _uploadVM: UploadThumbnailVM;

          constructor(options: IMainOptions) {
             super(options);
             var self = this;
```

```
    this._dbContext =null;
    this._errorVM =null;
    this._headerVM = null;
    this._productVM = null;
    this._uploadVM = null;
}
onStartUp() {
    var self = this, options: IMainOptions = self.options;
    this._dbContext = new DEMODB.DbContext();
    this._dbContext.initialize({ serviceUrl: options.service_url, permissions: options.permissionInfo });
    function toText(str) {
        if (str === null)
            return '';
        else
            return str;
    };

    this._dbContext.dbSets.Product.defineIsActiveField(function () {
        return !this.SellEndDate;
    });
    this._errorVM = new COMMON.ErrorViewModel(this);
    this._headerVM = new HEADER.HeaderVM(this);
    this._productVM = new ProductViewModel(this);
    this._uploadVM = new UploadThumbnailVM(this, options.upload_thumb_url);
    function handleError(sender, data) {
        self._handleError(sender, data);
    };
    //here we could process application's errors
    this.addOnError(handleError);
    this._dbContext.addOnError(handleError);

    //adding event handler for our custom event
    this._uploadVM.addOnFilesUploaded(function (s, a) {
        //need to update ThumbnailPhotoFileName
        a.product.refresh();
    });
    this.productVM.filter.modelData = options.modelData;
    this.productVM.filter.categoryData = options.categoryData;
    this.productVM.load().done(function (loadRes) {/*alert(loadRes.outOfBandData.test);*/ return; });
    super.onStartUp();
}
private _handleError(sender, data) {
    debugger;
    data.isHandled = true;
    this.errorVM.error = data.error;
    this.errorVM.showDialog();
}
//really, the destroy method is redundant here because the application lives while the page lives
destroy() {
    if (this._isDestroyed)
        return;
    this._isDestroyCalled = true;
    var self = this;
    try {
        self._errorVM.destroy();
        self._headerVM.destroy();
        self._productVM.destroy();
        self._uploadVM.destroy();
        self._dbContext.destroy();
    } finally {
        super.destroy();
    }
}
get options() { return <IMainOptions>this._options; }
get dbContext() { return this._dbContext; }
get errorVM() { return this._errorVM; }
get headerVM() { return this._headerVM; }
```

```
        get productVM() { return this._productVM; }
        get uploadVM() { return this._uploadVM; }
}
```

The application's instance is usually created in *global.onload* handler (*which has the semantics as JQuery's ready method*) and then the application is started by invoking the application's startUp method.

```
RIAPP.global.addOnLoad(function (sender, a) {
        var global = sender;
        //initialize images folder path
        global.defaults.imagesPath = mainOptions.images_path;
        //create and then start application
        var thisApp = new DemoApplication(mainOptions);

        thisApp.startUp((app) => {
        });
});
```

Before invoking the startUp method you can register template groups, or start loading data templates from the server.

To handle errors you can subscribe to the application's 'error' event.
This event is raised when some object instance inside the application catches an error and executes the _onError method (*typically, databindings and user defined view models do this*). If the error is not handled in the application's error hander, the error is passed on to the global object, where it can be handled in the global's error event handler.

Application's methods:

Method name	Description
registerElView	Registers element views in the application type system
getElementView	Returns the element view which is already attached to the element or creates new element view and attaches it to the DOM element and then returns this new instance.
_getElViewType	Returns the element view type by its registered name. Typically it is used internally by the framework.
registerType	Registers an object type by its name. The type can be later retrieved by getType method.
getType	Returns the registered type by its name.
registerObject	Almost the same as the registerType, only this method is used to register object's instances, instead of types. The object is automatically unregistered when it is destroyed.
getObject	Returns the registered object by its name.
registerConverter	Registers a converter by its name.
getConverter	Returns the registered converter by its name.
startUp	Starts an application's instance. It accepts a callback function which is executed when the application is started.
registerTemplateLoader	Registers function which loads individual template asynchronously (*on as needed basis*) - returns a promise which resolves with a template as a html string. P.S.- *See the DataGrid demo, for an example how it is used*.
getTemplateLoader	Returns registered template's loader by its name.
loadTemplates	The same as the global's loadTemplates, only it loads

	templates in the application's scope. They are available only to this application. This method should be used only before the application's startUp method is invoked.
loadTemplatesAsync	Loads templates using a provided loader function, which returns a promise which resolves with the loaded templates as a html string. This method is used internally by loadTemplates method. You can use it in special cases, when templates are obtained from some custom place.
registerTemplateGroup	Registers a group of templates to load on as needed basis from the server. Accepts a group's name and options for the group. Each template's group can contain one or several templates. P.S. - The templates names must be unique between different groups. (*See the Single Page Application demo for an example*)
registerContentFactory	Registers a factory class for a new custom content. (*For example, in listbox.ts module new content factory is registered in its initModule function*). The default content factory is registered in baseContent.ts module. P.S.- *data grid and data form use content factory to create a specialized content class for each type (string, bool, integer,.. etc) .*

Applications's properties:

Property	Read Only	Description
options	Yes	Exposes application's options. Typically it is not used directly.
appRoot	Yes	Exposes the root (*element or window.document*) of the application.
appName	Yes	the application's unique name. If it is not provided on creation with the options, it will have the default value 'default'.
modules	--	the namespace (*object instance*) for obtaining application modules' instances. But it is hardly ever is used in custom code.
global	Yes	exposes an instance of RIAPP.Global object for easier access to the global object.
contentFactory	Yes	exposes the content factory which is used by the application.
UC	---	the namespace (*empty object instance*) for attaching any custom user code. We can attach any code to it.
VM	---	the namespace (*empty object instance*) for attaching user defined view models. We can attach view model's instances to this namespace.
app	Yes	Returns self reference. Can be used to assign application's instance as a source for the databindings. It can be helpful in some cases, because databinding's source expression (*if we use fixed source*) is evaluated from the application instance and we can not leave it empty in that case.

		`{this.dataContext,to=VM.viewModel,source=app}`
		We can not use empty source like this (*invalid usage*)
		~~`{this.dataContext,to=VM.viewModel,source=}`~~
		If we don't use the source at all like in the next expression
		`{this.dataContext,to=VM.viewModel}`
		Then the source is not fixed and is defined by the current data context and is volatile as the data context can change.

Usually any real world application uses some user modules. The names and init functions of user modules are provided with the application's options. For example, in the Grid demo example are used 3 user modules - COMMON, HEADER and GRIDDEMO.

```
//properties with null values must be initialized on the HTML page
export var mainOptions: IMainOptions = {
        service_url: null,
        permissionInfo: null,
        images_path: null,
        upload_thumb_url: null,
        templates_url: null,
        productEditTemplate_url: null,
        sizeDisplayTemplate_url: null,
        modelData: null,
        categoryData: null,
        user_modules: [{ name: "COMMON", initFn: COMMON.initModule },
        { name: "HEADER", initFn: HEADER.initModule },
        { name: "GRIDDEMO", initFn: initModule }]
};
```

In the user module provided to the application (*in the options*) , you must define a function (*conventionally named initModule*), which accepts a parameter and returns the current module, like this:

```
function initModule(app: Application) {
    return GRIDDEMO;
};
```

This function is invoked when the application initializes the modules. In this function you can register converters, object instances and etc, like this:

```
export function initModule(app: Application) {
        app.registerConverter('listTypeConverter', new ListTypeConverter());
        app.registerConverter('channelConverter', new ChannelConverter());
        app.registerConverter('errorColorConverter', new ErrorColorConverter());
        return MAIL;
};
```

2.4 *The Binding class*

The framework's Binding type has 7 properties:

Binding's properties:

Property	Description
targetPath	the path for the property which is updated when the source

	property's value changes
sourcePath	the path for the property which provides a value to the target property
mode	the mode of binding ('OneTime', 'OneWay', 'TwoWay')
source	the source of the data (*must be a descendant of the BaseObject*)
target	the target of the data (*must be a descendant of the BaseObject*)
converter	converts the data when it flows between the source and the target (*for example, object value to string value and backward*)
converterParam	the converter can use the parameter to adjust data conversion (*for example, formatting style*)
isSourceFixed	Returns true if we set the source in the databinding's expression explicitly.
isDisabled	Is used to turn off the databinding when it is not needed, to conserve resources.

The target of the data binding can be explicitly set when an instance of the Binding's type is created in the code. The application's type has a helper method bind which internally creates and returns an instance of the Binding.

An example of databinding objects' properties in code (typescript code):

```
appInstance.bind({ sourcePath: 'selectedSendListID', targetPath: 'sendListID',
   source: this._sendListVM, mode: 'OneWay',
   target: this._uploadVM, converter: null, converterParam: null
});
```

When the data bindings are created by an application from the data binding expressions (*which are defined declaratively*), the application evaluates all the paths used in the expression to get real object instances, then it creates instances of the Bindings and sets its properties.

When a declarative binding expression is parsed, HTML DOM element is wrapped with a class derived from the BaseElView class (*which is defined in baseElView module*) to expose properties which can be databound. Element views serve the purpose of the real databinding targets (*in place of the raw DOM elements*). The selection of which descendant of the BaseElView to create is determined by the HTML element tag or it can be determined by specifying the name of element view in the custom data-view attribute.

For example, we can specify to create our custom Expander element view for a span tag (*instead of the default element view for the span tag*):

```
<span data-bind="{this.command,to=expanderCommand,mode=OneWay,source=headerVM}"
data-view="name=expander"></span>
```

We can also provide some optional parameters to an element view via using the options in the data-view attribute value, as in the example:

```
<table data-bind="{this.dataSource,to=dbSet,source=productVM}{this.propChangedCommand,
to=propChangeCommand,source=productVM}"
data-view="options={wrapCss:productTableWrap,containerCss:productTableContainer,
headerCss:productTableHeader,
rowStateField:IsActive,isHandleAddNew:true,
```

```
isCanEdit:true,editor:{templateID:productEditTemplate,width:550,height:650,submitOnOK:true,title:'Product
editing'},details:{templateID:productDetailsTemplate}}">
```

or in

```
<select size="1" data-bind="{this.dataSource,to=filter.ProductModels}
{this.selectedValue,to=filter.modelID,mode=TwoWay}
{this.selectedItem,to=filter.selectedModel,mode=TwoWay}{this.toolTip,to=filter.selectedModel.Name}"
data-view="options:{valuePath=ProductModelID,textPath=Name}"></select>
```

Databindings expressions are contained inside a custom data-bind attribute value. The data-bind attribute value can contain multiple binding expressions. Each binding expression is enclosed in curly braces {} *(you can omit them if you have only one expression, but it is not recommended*). The target of the data binding in this expression is always the element view which is created when the framework's application code parses this expression. The data binding can be done only to the properties exposed by the element view (*the wrapper of the HTML DOM element*), and not directly to the HTML DOM element.

For example, the expression:
`{this.dataSource,to=mailDocsVM.dbSet,mode=OneWay,source=sendListVM}`

instructs to bind the dataSource property on the current element view to the property path mailDocsVM.dbSet on the source of the databinding (*an instance of the SendListVM view model in this case, which is exposed through an application's property)* in the OneWay mode (*which is default value, and can be omitted here*).

When databindings are used **not inside** data templates and data forms, without explicitly providing the source, then the source is assumed to be the application's instance, but when they are used inside templates, the implicit source is a template's current datacontext (*data templates have datacontexts, as well as data forms*).

When the source is explicitly provided by the databinding expression, the databinding path is always evaluated starting from the application's instance. The above expanded expression path can be represented in pseudocode as:
[Current Application's instance].sendListVM.mailDocsVM.dbSet.

Very often we can omit the source attribute in the data binding's expression (*using the implicit source, not fixed one*), and can write previous binding expression as:

`{this.dataSource,to=sendListVM.mailDocsVM.dbSet}`

But then we should heed where this databinding is used! If you use this binding expression inside a data template, then the path evaluation will start from the data context object which is assigned to the data template (*data templates have dataContext property*), and the datacontext's value can change when the program runs. (*the same applies to dataform's datacontext*)

A data template's datacontext property is assigned when an instance of the template is created and can be later reassigned with a new object or be set to null value (*effectively changing the binding's implicit source property value*).
Otherwise, if you explicitly name the source in the databinding's expression, then even if it was used inside a data template, the source will be fixed, and will not change for this

binding's instance even if the template's dataContext property is changed (*and the path's evaluation in that case always starts from an application's instance*).

In the above examples, there were the shortcut style of the data binding expression, but you can write a databinding expression in another (*expanded, and rarely used*) way:

```
{targetPath=dataSource,sourcePath=sendListVM.mailDocsVM.dbSet}
```

because this.dataSource is semantically equivalent to the targetPath =dataSource and the to=sendListVM.mailDocsVM.dbSet is equivalent to the sourcePath=sendListVM.mailDocsVM.dbSet.

In the databinding expressions, instead of = sign (*which separates the name and the value*), you can equally use **:** sign, such as:

```
{targetPath:dataSource,sourcePath:VM.sendListVM.mailDocsVM.dbSet}
```

It is just a matter of personal preference which separator to use, **=** or **:**.

Data binding instances are created not only on the startup of the application, they also can be created when the application runs. It can happen when the controls on the page create data templates during their life cycle. The data templates can include data binding expressions, and they are evaluated at the time when instances of the data templates are created.
For example, when the DataGrid control instance is data bound to a datasource (*or the dataSource is refreshed*), the datagrid creates cells for each grid's row. The grid's DataCell can have a templated data content (*cells in which content is defined by data templates*), and when the template instances are created then the data bindings on the template elements are evaluated. Later, when the template instances are destroyed (*when a row in the DataGrid is removed*), the data bindings instances are also destroyed with the template's instance.

The Data Bindings can use converters to convert values from the source to the target and vice versa.

an example of a converter definition (typescript code):

```
export class UppercaseConverter extends MOD.converter.BaseConverter {
        convertToSource(val, param, dataContext) {
            if (utils.check.isString(val))
                return val.toLowerCase();
            else
                return val;
        }
        convertToTarget(val, param, dataContext) {
            if (utils.check.isString(val))
                return val.toUpperCase();
            else
                return val;
        }
}
```

an example of using a converter declaratively:

```
<input type="radio" name="radioItem"
```

```
data-bind="{this.checked,to=radioValue,mode=TwoWay,converter=radioValueConverter,
converterParam='radioValue3',source=demoVM}" />
```

A special case is when a method of the converter (*any of it*) return undefined value. In this case the data binding ignores the value returned by the converter and does not updates the source or the target,

an example of a converter which returns undefined value

```
export class ListTypeConverter extends MOD.converter.BaseConverter {
        convertToSource(val, param, dataContext) {
            return !!val ? param : undefined;
        }
        convertToTarget(val, param, dataContext) {
            return (val == param) ? true : false;
        }
}
```

In the above example, the converter returns undefined value when a value from the target is false. This prevents it from updating the property value on the source in this case. The scenario is very helpful to bind several radio buttons or check boxes to one source property (*see collections demo, only one radio button updates the source - the one which is checked*).

2.5 *The Command class*

The Command provide means for declarative execution of methods defined on view models. Some of element views provide means to bind their commands to implementations of the command in view models (*for example, the button's element view, for the click scenario*).

an example of binding a custom command to a button:

```
<input type='button' value=' Upload file ' data-bind="{this.command,to=uploadCommand}"/>
```

In the above example, the button (*its element view*) exposes a command property which is data bound to the view model's command implementation (*uploadCommand*). When the button is clicked, it triggers the execution of an action (*typically, a method on a view model*) assigned for the uploadCommand.

an example of the command's definition (typescript code):

```
this._uploadCommand = new MOD.mvvm.Command(function (sender, param) {
                try {
                    self.uploadFiles(self._fileEl.files);
                } catch (ex) {
                    self._onError(ex, this);
                }
            }, self, function (sender, param) {
                return self._canUpload();
 });
```

The first parameter of the command's constructor is a callback function (*the action*), which is invoked when a command is triggered by the UI element (*in this case when the button is clicked*).
The second parameter is an object which defines the this context for the command's action (*inside the action, this will be this property value*).

The third parameter is a callback function which returns a boolean result. It determines if the command is currently in an enabled or in a disabled state.

When we want to trigger the reevalulation of the condition when the command is disabled or enabled, then we invoke the command's raiseCanExecuteChanged method, as in the example:

```
this._uploadCommand.raiseCanExecuteChanged();
```

The command's action function accepts two parameters – the first is the sender object, which is the invoker of the command (*typically, element view's instance*), the second argument is a parameter which can be explicitly provided in the data binding's expression.

an example of a HTML markup inside a data template's definition:

```
<!--bind the commandParameter to current datacontext, which here is the product's entity-->
<span data-name="upload"
data-bind="{this.command,to=dialogCommand,source=uploadVM}{this.commandParam}"
data-view="name='link-button',options={text: Upload Thumbnail,tip='click me to upload product thumbnail
photo'}"></span>
```

P.S.- *{this.commandParam} expression binds commandParam property on the element view to the current template's datacontext .*

Using a command parameter in the command's action (typecript code):

```
this._dialogCommand = new MOD.mvvm.Command(function (sender, param) {
                try {
                    //using command parameter to provide the product item
                    self._product = param;
                    self.id = self._product.ProductID;
                    self._dialogVM.showDialog('uploadDialog', self);
                } catch (ex) {
                    self._onError(ex, this);
                }
            }, self, function (sender, param) {
                return true;
});
```

2.6 *Element views*

Element views are wrappers around HTML DOM element's and can also wrap other controls which you want to use in a declarative style. They expose properties which can be data bound declaratively in the HTML markup. Element views help to use databindings declaratively. They are created when the databinding expressions are parsed.

Note: *You can not directly databind a HTML DOM element's property, because you can only databind properties of an object derived from the framework's BaseObject class. Element views are objects which are all derived from the BaseObject, so they can expose properties which can be databound.*

When an element view is created, its constructor accepts a HTML DOM element, and options. Without the options the element view uses its default values.

For example, the StackPanelElView uses the options to determine how it can be displayed - horizontally or vertically. The TextBoxElView uses the updateOnKeyUp option, to decide when to update databinding's source – when the textbox loses the focus (*the default value*) or when a keyup event occurs.

```
<!--without the updateOnKeyUp option, the value is updated only when the textbox loses the focus-->
 <input type="text" data-bind="{this.value,to=testProperty,mode=TwoWay,source=testObject1}"
   data-view="options:{updateOnKeyUp=true}" />
```

The above data-view attribute expression provides only the options, but we can also explicitly provide view name and therefore to select which type of the element view will be created for a DOM element, as in the example:

a HTML markup which uses data-view attribute to provide the view name:

```
<span  data-bind="{this.command,to=expanderCommand,source=headerVM}"
data-view="name=expander"></span>
```

When data binding expressions are evaluated by the application's code, the code obtains element view using getElementView application's method. This method checks if the element view has already been created for this HTML DOM element. If there's no element view, then the code checks for data-view attribute on the DOM element, and if it exists, the method tries to get the name of the element view and create it explicitly by the name. If the name of element view is not provided explicitly, the method tries to find the default element view for the DOM element tag name. For example, for <input type='text'/> tag, the default element view is the TextBoxElView , but if you provided explicit name you would override that selection.

Registration of common element views in baseElView.ts:

```
global.registerElView('template', TemplateElView);
global.registerElView('busy_indicator', BusyElView);
global.registerElView(global.consts.ELVIEW_NM.DYNACONT, DynaContentElView);
global.registerElView('input:checkbox', CheckBoxElView);
global.registerElView('threeState', CheckBoxThreeStateElView);
global.registerElView('input:text', TextBoxElView);
global.registerElView('input:hidden', HiddenElView);
global.registerElView('textarea', TextAreaElView);
global.registerElView('input:radio', RadioElView);
global.registerElView('input:button', ButtonElView);
global.registerElView('input:submit', ButtonElView);
global.registerElView('button', ButtonElView);
global.registerElView('a', AnchorElView);
global.registerElView('abutton', AnchorElView);
global.registerElView('expander', ExpanderElView);
global.registerElView('span', SpanElView);
global.registerElView('div', BlockElView);
global.registerElView('section', BlockElView);
global.registerElView('block', BlockElView);
global.registerElView('img', ImgElView);
global.registerElView('tabs', TabsElView);
```

An element view can be simple, only exposing several properties of the DOM element (*like the TextBoxElView*) and can be also complex (*like the GridElView*).

The BaseElView – base element view type, which provides support for the display of validation errors, and also provides several properties for all descendants of this type. The BaseElView and all its descendants can accept tip and css options. The first sets a

tooltip to the wrapped DOM element, and the second adds a css class to the element at the moment when the element view is created.

BaseElView's properties:

Property	IsRead Only	Description
app	Yes	application instance, which created this element's view
$el	Yes	jQuery wrapper of the DOM element
el	Yes	The wrapped HTML DOM element
uniqueID	Yes	unique id which can be used as a namespace, for event's subscription inside element's view code (*in the constructor and methods*)
isVisible	No	boolean value, determines DOM element visibility on the page
propChangedCommand	No	A command *(typically, defined in a view model)* for property change notification. For example, GridElView invokes this command when element view's grid property changes. So, the view model can obtain an instance of the element view through this notification mechanism.
toolTip	No	A valid HTML string which can be provided for display over element view's DOM element.
css	No	A css class which can be provided for the element view's DOM element. It is useful to change display style of the element based on the data bound data.
validationErrors	No	internally used by the framework. The data bindings can set this property, for the element view's validation error display.

InputElView – a descendant of the BaseElView. It is not used directly, but is used as a base class for several element views (*TextBoxElView, CheckBoxElView, RadioElView*). It adds a property isEnabled to all of its descendants and a value property.

TextBoxElView – it is a wrapper around <input type="text"/> element.
Besides inherited properties, it exposes a value property, which exposes text value of the DOM element. The default behaviour of this view is to update the value when the textbox loses the focus. It can be tweaked by using the updateOnKeyUp option, so the value is changed on every keyup event.

```
<input type="text" data-bind="{this.value,to=testProperty,mode=TwoWay,source=testObject1}"
data-view="options:{updateOnKeyUp=true}" />
```

TextAreaElView – it is a wrapper around <textarea /> element. It is a descendant of the BaseElView. It has isEnabled, value (*to get or set text*), rows, cols, wrap properties.

```
<textarea data-bind="{this.value,to=testProperty,mode=TwoWay,source=testObject1}" rows="10" cols="40"
wrap="soft"></textarea>
```

CheckBoxElView – it is a wrapper around ☐ element.

It exposes checked property of the HTML DOM element.

```
<input type="checkbox" data-bind="{this.checked,to=boolProperty,mode=TwoWay,source=testObject1}" />
```

RadioElView – it is a wrapper around <input type=”radio”/> element.
It exposes checked property of the HTML DOM element. Typically the databinding expression for the radio element uses a converter, so that only one radio button (*which is checked*) updates the source. It also exposes a readonly name property.

```
<input type="radio" name="radioItem" data-
bind="{this.checked,to=radioValue,mode=TwoWay,converter=radioValueConverter,
converterParam=radioValue2,source=diemoVM}" />
```

CommandElView - a descendant of the BaseElView. It is not used directly, but is used as a base class for several element views (*like ButtonElView, AnchorElView*). It adds two properties command and commandParam to all of its descendants. The decendants internally use invokeCommand method to trigger the command (*typically, when a button or a link is clicked*). It also exposes *isEnabled* property.

ButtonElView - a descendant of the CommandElView. It is a wrapper around <button/> or <input type=”button” /> DOM element. It exposes value, text, html properties of a button element. It also exposes boolean *preventDefault* property, so to choose when the button should trigger its default action or not. Exposed by this element view command property can be databound to a command implementation, so to trigger an action when the button clicked.

```
<button data-name="btnCancel"  data-bind="{this.text,to=txtCancel,source=localizable.TEXT}"></button>
```

P.S.- *data-name attribute is used to find element's view in a data template's instance by the name. It can be used in user code, to select only the needed elements. It is an alternative to the name attribute, because in HTML5 some elements can not have the name attribute, but data-name can be used universally.*

AnchorElView - a descendant of the CommandElView. It is a wrapper around <a/> element. The link can display a text or an image (*which can be determined by the options*). It exposes imageSrc, html, text, href, preventDefault properties of the DOM element. The Anchor DOM element behaves similar to the button element, but has a different default action.

```
<a class="btn btn-info btn-small" data-bind="{this.command,to=loadCommand}"><i class="icon-
search"></i> Filter</a>
```

ExpanderElView - is a descendant of the AnchorElView. It adds a default image to the ancor element, which changes its appearance depending on expanded or collapsed state. When the image is clicked it triggers the command (*if it is databound*) to invoke an action on the view model. The element view is registered by the name ‘expander’.

```
<a href="#" data-bind="{this.command,to=expanderCommand,source=headerVM}"
data-view="name=expander"></a>

//an example of the definition of the command on the view model
this._expanderCommand = new MOD.mvvm.Command(function (sender, param) {
      if (sender.isExpanded) {
            self.expand();
      }
      else
            self.collapse();
}, self, null);
```

TemplateElView - a descendant of the CommandElView. It is a special case element view. It has no other properties besides the inherited from the base type. One property which is important for this element view is the command property. This view is used only inside the data templates to get notifications when the data template's instance is created or is going to be destroyed. The command property must be databound only to a fixed source (*the source should be provided in the data binding expression explicitly*). The command is triggered when the data template is loaded or is starting to unload. This behavior can be used, to access DOM elements (*you can assign some event handlers to them or add some attributes*) inside the template. The element view is registered by the name 'template'.

an example of the data template which uses TemplateElView (*see the DataGrid demo*):

```
<!--upload thumbnail dialog template-->
<div id="uploadTemplate" style="margin:5px;" data-role="template"
data-bind="{this.command,to=templateCommand,source=uploadVM}"  data-view="name=template">
    <!--dummy form action to satisfy HTML5 specification-->
    <form data-name="uploadForm" action='#'>
    <div data-name="uploadBlock">
        <input data-name="files-to-upload" type="file" style="visibility: hidden;" />
        <div class="input-append">
            <input data-name="files-input" class="span4" type="text">
            <a data-name="btn-input" class="btn btn-info btn-small"><i class="icon-folder-open">
            </i></a><a data-name="btn-load" class="btn btn-info btn-small"
            data-bind="{this.command,to=uploadCommand}"
            data-view="options={tip='Click to upload a file'}">Upload</a>
        </div>
        <span>File info:</span><text> </text>
        <div style="display: inline-block" data-bind="{this.html,to=fileInfo}">
        </div>
        <div data-name="progressDiv">
            <progress data-name="progressBar" class="span4" value="0" max="100">
            </progress><span data-name="percentageCalc"></span>
        </div>
    </div>
    </form>
</div>
```

an example of the command definition databound to the TemplateElView's command property (*see UploadThumbnailVM in gridDemo.ts*):

```
//executed when template is loaded or unloading
this._templateCommand = new MOD.baseElView.TemplateCommand(function (sender, param) {
                try {
                    var template = param.template, $ = global.$,
                     fileEl = $('input[data-name="files-to-upload"]', template.el);

                    if (fileEl.length == 0)
                        return;

                    if (param.isLoaded) {
                        fileEl.change(function (e) {
                            $('input[data-name="files-input"]', template.el).val($(this).val());
                        });
                        $('*[data-name="btn-input"]', template.el).click(function (e) {
                            e.preventDefault();
                            e.stopPropagation();
                            fileEl.click();
                        });
                    }
                    else {
```

```
                    fileEl.off('change');
                    $('*[data-name="btn-input"]', template.el).off('click');
                }
            } catch (ex) {
                self._onError(ex, this);
            }
        }, self, function (sender, param) {
            return true;
});
```

SpanElView - a wrapper around element. It is used to data bind some text or html to the content inside a span DOM element. It exposes value, text, html, color, fontSize properties which can be data bound. The value property is semantically the same as the text property.

Warning: Data binding to the html property should be used carefully, because it inserts a HTML content inside an element. It should not be used to display the user input without first checking the content to prevent XSS attacks!

```
<span data-bind="{this.value,to=testProperty1,source=testObject1}"></span>
<span data-bind="{this.text,to=testProperty2,source=testObject1}"></span>
<span data-bind="{this.html,to=testProperty3,source=testObject1}"></span>
```

BlockElView - a descendant of the SpanElView. It is a wrapper around element or some other block element like <section/>. Besides the properties inherited from the SpanElView, it adds borderColor, borderStyle, width, height properties, which can be data bound. It is registered also by the name 'block', which can be provided in data-view attribute. But for <section/> and elements it is not needed (*because it is default element view for them*).

```
<div data-bind="{this.html,to=testProperty2,source=testObject1}"></div>
```

ImgElView - a wrapper around <img/> element. It exposes the DOM image's src property.

```
<img data-bind="{this.src,to=srcProperty,source=testObject1}"/>
```

BusyElView - Ia wrapper around a any block HTML DOM element (*typically, the div element*).
It exposes the isBusy and the delay property.
It is used to display an animated loader gif image above the content of a HTML DOM element to which it is attached. The element view is registered by the name 'busy_indicator'.

```
<div data-bind="{this.isBusy,to=dbContext.isBusy}" data-view="name=busy_indicator">
… some html content
</div>
```

GridElView - a wrapper around <table/> element. It is used to attach to the HTML DOM element the logic and the markup of the DataGrid control. It exposes the dataSource and the grid property. It is used to display the datagrid with the data obtained through a Collection which is data bound to the dataSource property. The DataGrid control has a lot of features which is better understood from the Demo application.

Note: grid property is read only and exposes the underlying DataGrid control.

an example of the markup for the DataGrid (*see the DataGrid demo*):

```
<table data-name="gridProducts" data-bind="{this.dataSource,to=dbSet,source=productVM}
        {this.propChangedCommand,to=propChangeCommand,source=productVM}"
    data-view="options={wrapCss:productTableWrap,containerCss:productTableContainer,
    headerCss:productTableHeader,rowStateField:IsActive,isHandleAddNew:true,isCanEdit:true,
    editor:{templateID:productEditTemplate,width:550,height:650,submitOnOK:true,
    title:'Product editing'},details:{templateID:productDetailsTemplate}}">
     <thead>
     <tr>
        <th data-column="width:35px,type:row_expander"></th>
        <th data-column="width:50px,type:row_actions"></th>
        <th data-column="width:40px,type:row_selector,rowCellCss:selectorCell,colCellCss:selectorCol"></th>
        <th data-column="width:100px,sortable:true,title:ProductNumber"
         data-content="fieldName:ProductNumber,css:{displayCss:'number-display',editCss:'number-edit'},readOnly:true">
         </th>
        <th data-column="width:25%,sortable:true,title:Name" data-content="fieldName:Name,readOnly:true"></th>
        <th data-column="width:90px,title:'Weight',sortable:true" data-content="fieldName:Weight,readOnly:true"></th>
        <th data-column="width:15%,title=CategoryID,sortable:true,sortMemberName=ProductCategoryID"
         data-content= "fieldName=ProductCategoryID,name:lookup,
options:{dataSource=dbContext.dbSets.ProductCategory,valuePath=ProductCategoryID,textPath=Name},readOnly:true">
         </th>
        <th data-column="width:100px,sortable:true,title='SellStartDate'"
         data-content="fieldName=SellStartDate,readOnly:true">
         </th>
        <th data-column="width:100px,sortable:true,title='SellEndDate'"
         data-content="fieldName=SellEndDate,readOnly:true">
         </th>
        <th data-column="width:90px,sortable:true,title='IsActive'" data-content="fieldName=IsActive,readOnly:true"></th>
        <th data-column="width:10%,title=Size,sortable:true,sortMemberName=Size"
         data-content="template={displayID=sizeDisplayTemplate}">
         </th>
    </tr>
    </thead>
    <tbody></tbody>
</table>
```

PagerElView - a wrapper around a block HTML DOM element (*typically, *). It is used to attach to the HTML DOM element the logic and the markup of the Pager control. It exposes the dataSource and the pager properties. The element view is registered by the name 'pager'.

an example of the markup for the Pager (*see the DataGrid demo*):

```
<div data-bind="{this.dataSource,to=dbSet,source=productVM}"
data-view="name=pager,options={sliderSize:20,hideOnSinglePage=false}"></div>
```

StackPanelElView - a wrapper around a block HTML DOM element (*typically, *). It is used to attach to the div element the logic and the markup of the StackPanel control. It exposes the dataSource and the panel properties. It is used to display horizonally or vertically stacked panels (*which are templated*) on the page. The element view is registered by the name 'stackpanel'.

an example of the markup for the StackPanel (*see the CollectionsDemo demo*):

```
<div style="border: 1px solid gray;float:left;width:150px; min-height:65px; max-height:250px; overflow:auto;"
data-bind="{this.dataSource,to=historyList,source=demoVM}"
data-view="name=stackpanel,options:{templateID:stackPanelItemTemplateV,orientation:vertical}"></div>
```

SelectElView - a wrapper around <select/> element.
It is used to attach to the HTML DOM element the logic of the ListBox control.
It exposes isEnabled, dataSource, selectedValue, selectedItem, and listBox properties.
The data source of the element view gives data to fill select element options.

an example of the markup for the select elements:

```
<select id="prodMCat" size="1" class="span3"
```

```
data-bind="{this.dataSource,to=filter.ParentCategories}
{this.selectedValue,to=filter.parentCategoryID,mode=TwoWay}"
data-view="options:{valuePath=ProductCategoryID,textPath=Name}"></select>

<select id="prodSCat" size="1" class="span2"
data-bind="{this.dataSource,to=filter.ChildCategories}{this.selectedValue,to=filter.childCategoryID,mode=TwoWay}
{this.selectedItem,to=filter.selectedCategory,mode=TwoWay}{this.toolTip,to=filter.selectedCategory.Name}"
data-view="options:{valuePath=ProductCategoryID,textPath=Name}"></select>
```

DataFormElView - a wrapper around or <form/> element. It attaches to them the logic of the DataForm control for managing the data context (*see more info in DataForm control section of the guide*). It exposes the dataContext and the form properties. It is used to display the data for the editing and viewing purposes. The element view is registered by the name 'dataform'.

an example of the markup for the dataform:

```
<div style="width: 100%; margin:0px;" data-bind="{this.dataContext,mode=OneWay}" data-
view="name=dataform">
   <table style="width: 95%">
      <thead>
         <tr>
            <th>
               Field Name
            </th>
            <th>
               Field Value
            </th>
         </tr>
      </thead>
      <tbody>
         <tr>
            <td>
               ID:
            </td>
            <td>
               <span data-content="fieldName:ProductID"></span>
            </td>
         </tr>
         <tr>
            <td>
               Name:
            </td>
            <td>
               <span data-content="fieldName:Name,css:{displayCss:'name-display',editCss:'name-
edit'},name:multyline,options:{rows:3,cols:20,wrap:hard}">
               </span>
            </td>
         </tr>
         <tr>
            <td>
               ProductNumber:
            </td>
            <td>
               <span data-content="fieldName:ProductNumber"></span>
            </td>
         </tr>
         <tr>
            <td>
               Color:
            </td>
            <td>
               <span data-content="fieldName:Color"></span>
```

```
            </td>
        </tr>
        <tr>
            <td>
                Cost:
            </td>
            <td>
                <span data-content="fieldName:StandardCost"></span>
            </td>
        </tr>
        <tr>
            <td>
                Price:
            </td>
            <td>
                <span data-content="fieldName:ListPrice,readOnly:true"></span>
            </td>
        </tr>
        <tr>
            <td>
                Size:
            </td>
            <td>
                <span data-content="fieldName:Size"></span>
            </td>
        </tr>
        <tr>
            <td>
                Weight:
            </td>
            <td>
                <span data-content="fieldName:Weight"></span>
            </td>
        </tr>
        <tr>
            <td>
                Category:
            </td>
            <td>
                <span data-content="fieldName=ProductCategoryID,name:lookup,
options:{dataSource=dbContext.dbSets.ProductCategory,valuePath=ProductCategoryID,textPath=Name},
css:{editCss:'listbox-edit'}">
                </span>
            </td>
        </tr>
        <tr>
            <td>
                Model:
            </td>
            <td>
                <span data-content="fieldName=ProductModelID,name:lookup,
options:{dataSource=dbContext.dbSets.ProductModel,valuePath=ProductModelID,textPath=Name},
css:{editCss:'listbox-edit'}">
                </span>
            </td>
        </tr>
        <tr>
            <td>
                SellStartDate:
            </td>
            <td>
                <span data-content="fieldName:SellStartDate"></span>
            </td>
        </tr>
        <tr>
            <td>
                SellEndDate:
```

```
            </td>
            <td>
               <span data-content="fieldName:SellEndDate"></span>
            </td>
         </tr>
         <tr>
            <td>
               DiscontinuedDate:
            </td>
            <td>
               <span data-content="fieldName:DiscontinuedDate"></span>
            </td>
         </tr>
         <tr>
            <td>
               rowguid:
            </td>
            <td>
               <span data-content="fieldName:rowguid"></span>
            </td>
         </tr>
         <tr>
            <td>
               When Modified:
            </td>
            <td>
               <span data-content="fieldName=ModifiedDate"></span>
            </td>
         </tr>
         <tr>
            <td>
               IsActive:
            </td>
            <td>
               <span data-content="fieldName=IsActive"></span>
            </td>
         </tr>
      </tbody>
   </table>
</div>
```

TabsElView - a wrapper around element. It attaches to the HTML DOM element the JQuery UI Tabs plugin logic for managing the content displayed in tabs. It exposes tabsEventCommand property. The element view is registered by the name 'tabs'.

Note: *The tabsEventCommand is used to get notifications on tabs events (like when a tab was selected, added, showed, enabled, disabled, removed, loaded) and handle them in the view model.*

an example of the markup for the tabs:

```
<div id="productDetailsTemplate" style="width: 100%; margin: 0px;" data-role="template">
   <div data-name="tabs" style="margin: 5px; padding: 5px; width: 95%;" data-
bind="{this.tabsEventCommand,to=tabsEventCommand,source=productVM}"  data-view="name='tabs'">
      <div id="myTabs">
         <ul>
            <li><a href="#a">Tab 1</a></li>
            <li><a href="#b">Tab 2</a></li>
         </ul>
         <div id="a">
            <span>Product Name: </span>
            <input type="text" style="color: Green; width: 220px; margin: 5px;"
         data-bind="{this.value,to=Name,mode=TwoWay}" />
            <br />
```

```
            <a class="btn btn-info btn-small"
          data-bind="{this.command,to=testInvokeCommand,source=productVM}{this.commandParam}"
          data-view="options={tip='Invokes method on the server and displays result'}">Click Me to invoke service
method</a>
          </div>
          <div id="b">
              <img style="float:left" data-bind="{this.id,to=ProductID}{this.fileName,to=ThumbnailPhotoFileName}"
alt="Product Image" src=""
data-view="name=fileImage,options={baseUri:'@Url.RouteUrl("Default", new { controller = "Download", action =
"ThumbnailDownload" })'}"/><br />
              <div style="float: left; margin-left: 8px;">
                  click to download the image: <a class="btn btn-info btn-small"
data-bind="{this.text,to=ThumbnailPhotoFileName}{this.id,to=ProductID}"
data-view="name=fileLink,options={baseUri:'@Url.RouteUrl("Default", new { controller = "Download", action =
"ThumbnailDownload" })'}">
                  </a>
              </div>
              <div style="clear: both; padding: 5px 0px 5px 0px;">
                  <!--bind commandParameter to current datacontext, that is product entity-->
                  <a class="btn btn-info btn-small" data-name="upload"
data-bind="{this.command,to=dialogCommand,source=uploadVM}{this.commandParam}"
data-view="options={tip='click me to upload product thumbnail photo'}">Upload product thumbnail</a>
              </div>
          </div>
      </div>
      <!--myTabs-->
   </div>
</div>
```

an example of handling tabs plugin events in a view model:

```
this._tabsEventCommand = new MOD.mvvm.Command(function (sender, param) {
                var index = param.args.index, tab = param.args.tab, panel = param.args.panel;
                //alert('event: '+ param.eventName + ' was triggered on tab: '+index);
}, self, null);
```

DynaContentElView - It is a wrapper around a block HTML DOM element (*typically *).
It exposes the templateID and the dataContext properties.
It is used to mark the block element as a content region which will contain templated content. The templates (*used for display in this region*) can be switched at runtime. - When templates are switching then current template unloads, and the new one replaces the current one.
The template switching is triggered when the templateID (*the currently displayed template*) property value is changed. The dataContext property is used to provide the dataContext to the currently displayed template.
The element view is registered by the name 'dynacontent'.

an example of the markup for the dynacontent:

```
<div id="demoDynaContent"
data-bind="{this.templateID,to=viewName,source=customerVM.uiMainView}
{this.dataContext,source=customerVM}" data-view="name=dynacontent"></div>
```

Note: *See the SPA Demo (Single Page Application) for the example how it is used.*

Custom built element views - Besides the core element views, it is easy to add custom element views.

For example, in the demo application there has been added several custom element views, such as AutoCompleteElView, DownloadLinkElView, FileImageElView – they all have been defined in custom modules.

```
<!--using a custom element view for the display of a product image-->
<img data-bind="{this.id,to=ProductID}{this.fileName,to=ThumbnailPhotoFileName}"
alt="Product Image" src=""
data-view="name=fileImage,options={baseUri:'@Url.RouteUrl("Default", new { controller = "Download", action =
"ThumbnailDownload" })'}"/>
```

Note: *The BaseElView has a property propChangedCommand which needs more explanations.*
You can use this command to get instances of element views in your code (typically view models), because if you can get an element view instance then you can get any property value on the element view.
It is invoked when a property on the element view had been changed. So in the action for this command we can get reference to the element view instance and to the name of the changed property.
For example, it can be used, to obtain references to the instance of the datagrid when the datagrid instance is created by the element view. Then if we have its instance we we can attach event handlers to it and handle these events in the view model.

an example of binding expression (used in datagrid's demo) to bind propChangedCommand to the handler in our viewmodel's instance:

```
{this.propChangedCommand,to=propChangeCommand,source=productVM}

//our product's view model defines handler for the command
//we can obtain datagrid instance from the sender - (the sender is the element view - GridElView)
 this._propChangeCommand = new MOD.baseElView.PropChangedCommand(function (sender, data) {
                if (data.property == '*' || data.property == 'grid') {
                    if (self._dataGrid === sender.grid)
                        return;
                    self._dataGrid = sender.grid;
                }
                //example of binding to dataGrid events
                if (!!self._dataGrid) {
                    self._dataGrid.addOnPageChanged(function (s, a) {
                        self._onGridPageChanged();
                    }, self.uniqueID);
                    self._dataGrid.addOnRowSelected(function (s, a) {
                        self._onGridRowSelected(a.row);
                    }, self.uniqueID);
                    self._dataGrid.addOnRowExpanded(function (s, a) {
                        self._onGridRowExpanded(a.old_expandedRow, a.expandedRow, a.isExpanded);
                    }, self.uniqueID);
                    self._dataGrid.addOnRowStateChanged(function (s, a) {
                        if (!a.val) {
                            a.css = 'rowInactive';
                        }
                    }, self.uniqueID);
                }
}, self, null);
```

2.7 *The Data templates*

The data templates are pieces of the HTML markup which can be used in RIA applications by cloning their structure for display on the page where they are needed.

They are typically used by the controls which are aware of them. The framework contains several built-in controls, which are data template aware: DataEditDialog, DataGrid, StackPanel, DynaContentElView.
When defining the data templates, they must have the id attribute for referencing them in the options of data aware controls. The data template aware controls create instances of the data templates and then add the newly created data template's instance to the HTML DOM tree, and can usually set the template's dataContext property. The data template's dataContext can be set or reset at any time on the data template's instance.

an example shows programmatic creation of the template's instance:

```
_createTemplate(dcxt) {
     var t = new template.Template(this._app, this._templateID);
     //you can set it to the disabled state
     t.isDisabled = true;
     //set template's data context
     t.dataContext = dcxt;
     //return instance
     return t;
}
```

The data templates can be defined in four ways (*using their loading method*):

1) Define them on the page in a special section for the templates
2) Preload them all from the server in a single file per page (*at the start of the application*)
3) Make them loadable on as needed basis (*register loader function*)
4) Register a group of templates for loading them on as needed basis (*but they be loadable as groups of templates*)

The first way of templates definition - *defining them on the page*

The templates are defined in a special section on the html page (*but not necessarily one section, there can be several of such sections on the page*). Each section should have a special css class "ria-template", which makes the section invisible on the page and distinguishable from other regions. Each template must have data-role attribute with the value "template". The templates loaded by this method available to all application's instances (*so they are in the global scope*).

Note: *This method is the simplest way for templates definition. And in many cases is the best.*

an example of a template's section on the page:

```
@*invisible section to hold data templates*@
<section class="ria-template">

@*data template's – id attribute is mandatory*@
<div id="stackPanelItemTemplate" data-role="template" class="stackPanelItem" >
  <fieldset>
    <legend><span data-bind="{this.value,to=radioValue}"></span></legend>
     Time: 
    <span data-bind="{this.value,to=time,converter=dateTimeConverter,converterParam='HH:mm:ss'}"></span>
   </fieldset>
 </div>
```

```
@*HERE can be more data templates ...*@
</section>
```

The second way of templates definition - *loading them all at the start from the server*

The templates are defined on the server in a file. The rules for the templates definition are the same as in the first way, but the file contains just the templates definition (*no section tag around them*). They are loaded by the application's loadTemplates method. (*See DataGrid Demo for an example*). You can invoke their loading before calling application's startUp method.

Note: *This method is not much different from defining templates on the page, only it allows not to clutter the page with templates definition and define them separately (But in the ASP.NET MVC you can do this using partial views).*

an example of a loading templates using loadTemplates:

```
RIAPP.global.addOnLoad(function (sender, a) {
        var global = sender;
        global.defaults.imagesPath = mainOptions.images_path;
        var thisApp = new DemoApplication(mainOptions);

        //example of how to load templates from the server
         thisApp.loadTemplates(mainOptions.templates_url);

        thisApp.startUp((app) => {
        });
});
```

The third way of templates definition -loading them on as needed basis

The templates can be loaded when they are needed. First the application registers a loader function per each template. The loader function should return a promise which is resolved (*if all is ok*) to the template in the form of html string.
The loader function is agnostic from the way you obtain the template definition, you need only to return promise from it. Each time the template is needed the loader function will be executed. So it is advisable to cache the result inside this function, to prevent excessive network traffic.

Note: *This method of loading of templates is not very efficient (if caching is not used), but can be helpful when on each template's loading it should be generated on the server dynamically by server side code.*

an example of a loading templates by registering the loader function:

```
RIAPP.global.addOnLoad(function (sender, a) {
        var global = sender;
        global.defaults.imagesPath = mainOptions.images_path;
        var thisApp = new DemoApplication(mainOptions);

        thisApp.registerTemplateLoader('productEditTemplate', function () {
           return thisApp.global.$.get(mainOptions.productEditTemplate_url);
        });

        //using memoize pattern so there will not be repeated loads of the same template
        thisApp.registerTemplateLoader('sizeDisplayTemplate',
          (function() {
            var savePromise;
            return function () {
```

```
            if (!!savePromise)
                return savePromise;
            savePromise = thisApp.global.$.get(mainOptions.sizeDisplayTemplate_url);
            return savePromise;
        };
    } ())
);

thisApp.startUp((app) => {
});
});
```

The fourth way of templates definition - loading templates in groups on as needed basis

The templates can be loaded in groups (*several templates per group*), and their definitions are automatically cached on the client. For every group of templates you register unique group's name and also the names of templates the group includes. The group registration is done before application's startUp method is invoked.
When the application will need a template, then the whole group (*containing that template*) will be loaded from the server (*See Single Page Application demo for an example*). The group is loaded only one time, all the templates in the group are cached on the client. Any template from the group later on will be served from the cache.

Note: *This method is very good for complex SPAs, because the SPA usually displays many different screen views not reloading the page. So it is good, to define groups of the templates per each screen view. Groups will be loaded when they are needed and only when they are needed.*

an example of a loading templates in groups:

```
RIAPP.global.addOnLoad(function (sender, a) {
    var global = sender;
    global.defaults.imagesPath = mainOptions.images_path;
    var thisApp = new DemoApplication(mainOptions);

    thisApp.registerTemplateGroup('custGroup',
    {
      url: mainOptions.spa_template1_url,
      names: ["SPAcustTemplate", "goToInfoColTemplate", "SPAcustDetailTemplate", "customerEditTemplate",
     "customerDetailsTemplate", "orderEditTemplate",
     "orderDetEditTemplate", "orderDetailsTemplate", "productTemplate1", "productTemplate2",
     "prodAutocompleteTemplate"]
    });

    thisApp.registerTemplateGroup('custInfoGroup',
    {
        url: mainOptions.spa_template2_url,
        names: ["customerInfo", "salespersonTemplate1", "salespersonTemplate2",
                "salePerAutocompleteTemplate"]
    });

    thisApp.registerTemplateGroup('custAdrGroup',
    {
        url: mainOptions.spa_template3_url,
        names: ["customerAddr", "addressTemplate", "addAddressTemplate", "linkAdrTemplate",
                "newAdrTemplate"]
    });

    thisApp.startUp((app) => { });
});
```

2.8 *The Data contents*

The data content is a piece of code used for displaying specific content types in a predetermined way. For example, a boolean value can be displayed as a checkbox on the page and a string value as a textbox (*using the input element*). Also this values can have different display if they are not in editing state - then the string value can be displayed as a text inside the span element.
This is the exact situation which the data content handles.

The data-content attribute can be used only inside the data forms and the data grids (*to define cell's content*).
When the data content is data bound to an object which supports MOD.utils.IEditable interface (*entities and collection items support it*), it starts to observe the editing state of the object. When the state changes then the appearance of the data content also changes.

an example of using data contents in the data form:

```
<form action="#" style="width: 100%" data-bind="{this.dataContext}" data-view="name=dataform">
        <table style="width: 95%; border: none; table-layout: fixed; background-color: transparent;">
          <colgroup>
            <col style="width: 125px; border: none; text-align: left;" />
            <col style="width: 100%; border: none; text-align: left;" />
          </colgroup>
          <tbody>
            <tr>
              <td>ID:
              </td>
              <td>
                <span data-content="fieldName:CustomerID,css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
              </td>
            </tr>
            <tr>
              <td>Title:
              </td>
              <td>
                <span data-content="fieldName:Title,css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
              </td>
            </tr>
            <tr>
              <td>FirstName:
              </td>
              <td>
                <span data-content="fieldName:FirstName,css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
              </td>
            </tr>
            <tr>
              <td>MiddleName:
              </td>
              <td>
                <span data-content="fieldName:MiddleName,css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
              </td>
            </tr>
            <tr>
              <td>LastName:
              </td>
              <td>
                <span data-content="fieldName:LastName,css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
              </td>
            </tr>
            <tr>
              <td>Suffix:
              </td>
              <td>
                <span data-content="fieldName:Suffix,css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
```

```
                </td>
            </tr>
            <tr>
                <td>CompanyName:
                </td>
                <td>
                    <span data-content="fieldName:CompanyName,css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
                </td>
            </tr>
            <tr>
                <td>SalesPerson:
                </td>
                <td>
                    <span data-content="template={displayID=salespersonTemplate1,editID=salespersonTemplate2},
                            css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
                </td>
            </tr>
            <tr>
                <td>Email:
                </td>
                <td>
                    <span data-content="fieldName=EmailAddress,css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
                </td>
            </tr>
            <tr>
                <td>Phone:
                </td>
                <td>
                    <span data-content="fieldName:Phone,css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
                </td>
            </tr>
        </tbody>
    </table>
</form>
```

There can be two types of the data content :

1) Which bind directly to a field name.
2) Which use the data templates.

The first option (*bind field directly*):

The simplest option, but the way it is displayed is predefined by the field's data type. For example, when the field's data type is the text, then in not editing mode the data content is rendered as the text inside a tag, and when in editing mode it is rendered as an <input type="text"/>. All these data content's types derived from BindingContent type. Currently, the framework includes: BoolContent, DateContent, DateTimeContent, NumberContent, StringContent, MultyLineContent, and LookupContent types.

The type for the creation of an instance of the data content is mainly determined by the data type of the field (*Number, String, Bool, Date*) to which the data content is data bound. The decision is made by the ContentFactory, which is used to create instances of the data content types in the application. But this decision can be tweaked by explicitly specifying the name of the data content and some data contents may also need the options for their normal initialization.

an example of specifying the multyline option for the data content:

```
 <span data-content="fieldName:Name,css:{displayCss:'name-display',editCss:'name-
edit'},name:multyline,options:{rows:3,cols:20,wrap:hard}"></span>
```

an example of specifying the lookup option for the data content:

```
<span data-content="fieldName=ProductCategoryID,name:lookup,
        options:{dataSource=dbContext.dbSets.ProductCategory,
        valuePath=ProductCategoryID,textPath=Name},css:{editCss:'listbox-edit'}"></span>
```

also you can use in the data content the readOnly option to ensure that it will not be displayed in editing mode.

an example of specifying the readOnly option for the data content:

```
<th data-column="width:20%,title=Address2,sortable:true"
data-content="fieldName:Address.AddressLine2,readOnly:true" ></th>
```

The second option (*use templates*):

It is more versatile than the first option because the template looks like how you define it. The display also can be more complex than one field, because there's no restrictions on the number of the fields in the template. The only drawback here it is that it needs more efforts than the first option.
The templated data content is defined by the TemplateContent type.

an example of defining the templated data content:

```
<span data-content="template={displayID=salespersonTemplate1,editID=salespersonTemplate2},
css:{displayCss:'custInfo',editCss:'custEdit'}"></span>
```

Note: *editID or displayID can be omitted if you need only to display content in one state.*

2.9 *The Controls*

The DataGrid:

The DataGrid is a control for attaching logic to the table HTML element. Without this control table content is static. With this control the table turns into desktop applications equivalent of data grid.

The DataGrid control adds to the table the following features:

1) Data binding to a data source
2) Inline or pop up data editors
3) Paging the data (*with the help of the pager control*)
4) Sorting the data on column clicking
5) Specialized column types (*like row selector, row actions, row expander*)
6) Usage of templates for the data display and editing
7) Support for visual row state (*its display*) based on a field's value
8) Column headers are fixed like in desktop data grids
9) Support for use of the keyboard keys (*up, down, left, right, space*)
10) Row selection (*when row selector column is present*) by space key
11) Navigation between pages using pageup or pagedown keys.

The DataGrid – is defined in the datagrid module. There are several types in the module which are needed for the DataGrid's functionality (*BaseCell, DataCell, ExpanderCell, ActionsCell, RowSelectorCell, DetailsCell, Row, DetailsRow, BaseColumn, DataColumn, ExpanderColumn, ActionsColumn, RowSelectorColumn, DataGrid*).

The data grid control's constructor accepts options for the control. They are defined as:

```
export interface IGridOptions {
		isUseScrollInto: boolean;
		isUseScrollIntoDetails: boolean;
		containerCss: string;
		wrapCss: string;
		headerCss: string;
		rowStateField: string;
		isCanEdit: boolean;
		isCanDelete: boolean;
		isHandleAddNew: boolean;
		details?: { templateID: string; };
		editor?: datadialog.IDialogConstructorOptions;
}
```

Where datadialog.IDialogConstructorOptions are defined as:

```
export interface IDialogConstructorOptions {
		dataContext?: any;
		templateID: string;
		width?: any;
		height?: any;
		title?: string;
		submitOnOK?: boolean;
		canRefresh?: boolean;
		canCancel?: boolean;
		fn_OnClose?: (dialog: DataEditDialog) => void;
		fn_OnOK?: (dialog: DataEditDialog) => number;
		fn_OnShow?: (dialog: DataEditDialog) => void;
		fn_OnCancel?: (dialog: DataEditDialog) => number;
		fn_OnTemplateCreated?: (template: template.Template) => void;
		fn_OnTemplateDestroy?: (template: template.Template) => void;
}
```

The DataGrid is a control, so it can be used in the code. In order to allow declarative use of the control, there's a supplementing this feature element view - GridElView.

an example of the data grid definition (HTML markup):

```
  <table data-name="gridCustAddr"
data-bind="{this.dataSource,to=custAdressView,source=customerVM.customerAddressVM}"
data-view="options={wrapCss:findAddrTableWrap,isCanDelete=false,isCanEdit=true,isUseScrollInto=false}">
  <thead>
  <tr>
 <th data-column="width:50px,type:row_actions" ></th>
 <th data-column="width:40%,title=AddressType" data-content="fieldName:AddressType" ></th>
 <th data-column="width:60%,title=Address,sortable:true" data-content="fieldName:Address.AddressLine1"></th>
  </tr>
 </thead>
		<tbody>
		</tbody>
 </table>
```

The columns in the datagrid are defined by adding to the <th /> tag data-column and data-content attributes.
The Data-column attribute can have width, title, sortable, rowCellCss, colCellCss, type, sortMemberName options.

The sortMemberName option can contain several field names separated by semicolons, as in the next example:

```
<th data-column="width:200px,title:'FIO',sortable:true,sortMemberName:MCOD;FAM;IM;OT;DR;INFOTYPE"
```

```
data-content="fieldName:FIO" />
```

The type option determines which type of data column is. If the type option is ommited, then it is the default, which is the data column. The other types of columns can be actions, expander or row selector columns.
The data-content attribute is used for data columns and specifies the data which will be displayed in the data cell (*binds it to a field*).

```
<th data-column="width:75px,title:'MCOD',sortable:true,sortMemberName:MCOD;FAM;IM;OT;DR;INFOTYPE"
data-content="fieldName:MCOD" />
```

The data content can also be templated.

```
<th data-column="width:60%,title:'PERIOD'"
data-content="template={displayID=monthsTemplate,editID=monthsTemplate}" />
```

The grid only displays the data when its data source is databound. Also, there may be the need to handle datagrid's events in the view model's code, so you need to bind propChangedCommand and then in the command's action we can access the instance of the grid element view, and can add event handlers for the datagrid's events.

example of adding the event handlers to the grid in the view model's code:

```
//our product's view model defines handler for the command
//we can obtain datagrid instance from the sender - (the sender is the element view - GridElView)
 this._propChangeCommand = new MOD.baseElView.PropChangedCommand(function (sender, data) {
                if (data.property == '*' || data.property == 'grid') {
                    if (self._dataGrid === sender.grid)
                        return;
                    self._dataGrid = sender.grid;
                }
                //example of binding to dataGrid events
                if (!!self._dataGrid) {
                    self._dataGrid.addOnPageChanged(function (s, a) {
                        self._onGridPageChanged();
                    }, self.uniqueID);
                    self._dataGrid.addOnRowSelected(function (s, a) {
                        self._onGridRowSelected(a.row);
                    }, self.uniqueID);
                    self._dataGrid.addOnRowExpanded(function (s, a) {
                        self._onGridRowExpanded(a.old_expandedRow, a.expandedRow, a.isExpanded);
                    }, self.uniqueID);
                    self._dataGrid.addOnRowStateChanged(function (s, a) {
                        if (!a.val) {
                            a.css = 'rowInactive';
                        }
                    }, self.uniqueID);
                }
}, self, null);
```

The other important piece of the markup, which is used in a declarative data grid definition, is the data-view attribute which allows to provide the options for the control:

```
data-view="options={wrapCss:tableWrap,containerCss:tableContainer,headerCss:tableHeader,
rowStateField:IsActive,isHandleAddNew:true,editor:{templateID:productEditTemplate,width:550,height:650,
submitOnOK:true,title:'Product editing'},details:{templateID:productDetailsTemplate}}"
```

The important option is the table's wrap style, using this, we can add to the table the vertical scrolling for the table's data (*the table's body*), and allow the table's header fixed even when the table's body is scrolled down.

an example of the overall table's markup structure rendered on the page:

```
<!-- the table container is added when grid's code is attached to the table -->
<div class="ria-table-container tableContainer">
    <!-- these columns are always on the top of the table.
            they replace the original table's columns, which are invisible
    -->
 <div class="ria-table-header tableHeader" style="width: 1207px;">
   <div class="ria-ex-column" style="width: 35px; position: relative; top: 0.0666667px;
      left: 1px;">
      <div class="cell-div row-expander">
      </div>
   </div>
   <div class="ria-ex-column" style="width: 50px; position: relative; top: 0.0666667px;
      left: 1px;"><div class="cell-div row-actions"></div>
   </div>
   <div class="ria-ex-column" style="width: 40px; position: relative; top: 0.0666667px;
      left: 1px;">
      <div class="cell-div row-selector selectorCol selected">
         <input type="checkbox">
      </div>
   </div>
   <div class="ria-ex-column" style="width: 100px; position: relative; top: 0.0666667px;
      left: 1px;">
      <div class="cell-div data-column sortable">ProductNumber</div>
   </div>
   <!--  the other columns markup here -->
</div>

   <!-- the real table is wrapped in the div tag, for scrolling the data -->
   <div class="ria-table-wrap tableWrap">
      <table class="ria-data-table" data-view=" … "   data-bind=" … "
         data-name="gridProducts"  data-elvwkey0="s_10">
         <thead><!-- the real table's columns are invisible --></thead>
         <tbody><!-- table's rows here --><tbody/>
      </table>
   </div>
</div>
```

an example of the overall a table's row markup structure rendered on the page:

```
<tr class="row-highlight">
   <td class="row-collapsed row-expander" style="width: 35px;">
      ...
   </td>
   <td class="row-actions cell-div ria-nobr" style="width: 50px;">
       <!-- cells data here-->
   </td>
   <td class="row-selector" style="width: 40px;">
       <!-- cells data here-->
   </td>
   <div class="cell-div ria-content-field selectorCell" data-scope="51">
      <input type="checkbox" data-elvwkey0="s_125" style="opacity: 1;">
   </div>
   </td>
   <td style="width: 100px;">
      <div class="cell-div ria-content-field number-display" data-scope="52">
         <span data-elvwkey0="s_126">FD-2342</span>
      </div>
   </td>
   <td style="width: 25%;">
      <div class="cell-div ria-content-field" data-scope="53">
         <span data-elvwkey0="s_127">Front Derailleur</span>
      </div>
   </td>
   <!-- the other cells-->
</tr>
```

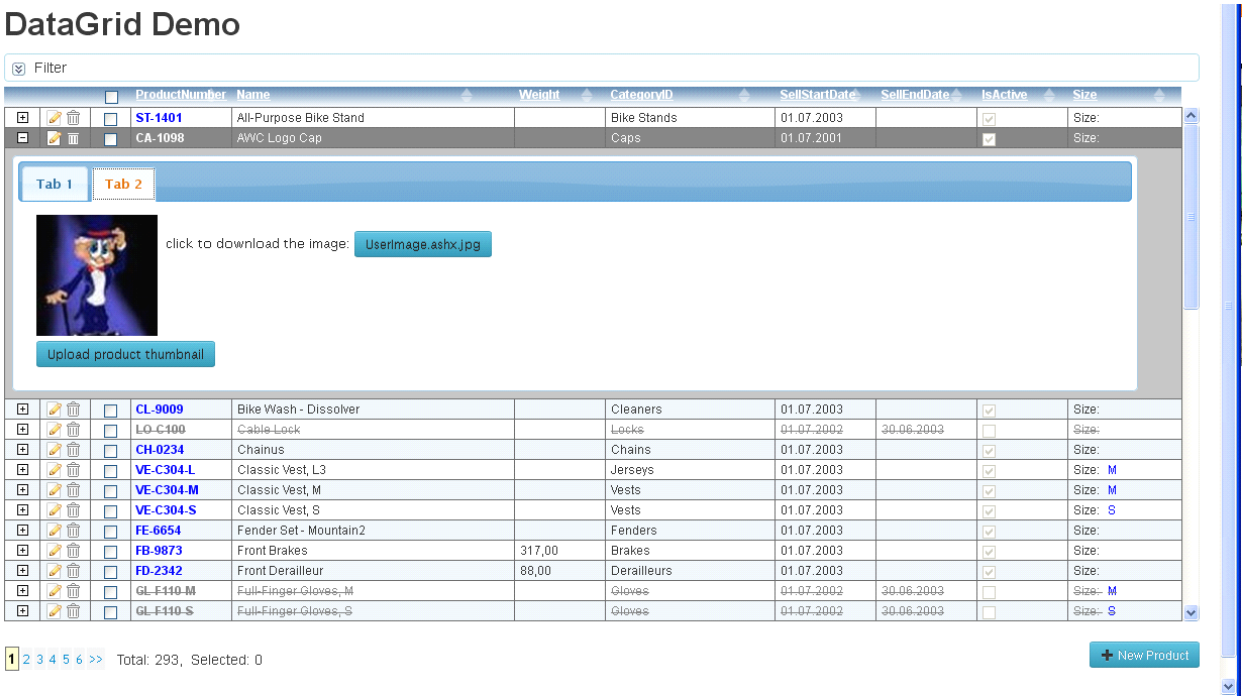
The DataGrid's options also include:

isUseScrollInto - If true, then when using keyboard keys for scrolling the table's data, the active record is positioned on the screen using HTML DOM element's scrollInto method. The default is true.
isUseScrollIntoDetails - If true, then when expanding the table's details, the details are positioned on the screen using HTML DOM element's scrollInto method. The default is true.
rowStateField - a name of the field, on which value's change the grid's row_state_changed event is invoked. When this event is handled the field's value can be inspected, and based on that value can be selected the css style for the row display.
isCanEdit and isCanDelete - if the options values are false. Then the grid will never be in the edit state and it will be in readonly mode.
isHandleAddNew - if set to true, then if the grid's datasource adds a new item, then the grid will automatically show data edit dialog for editing this item. The default is false.

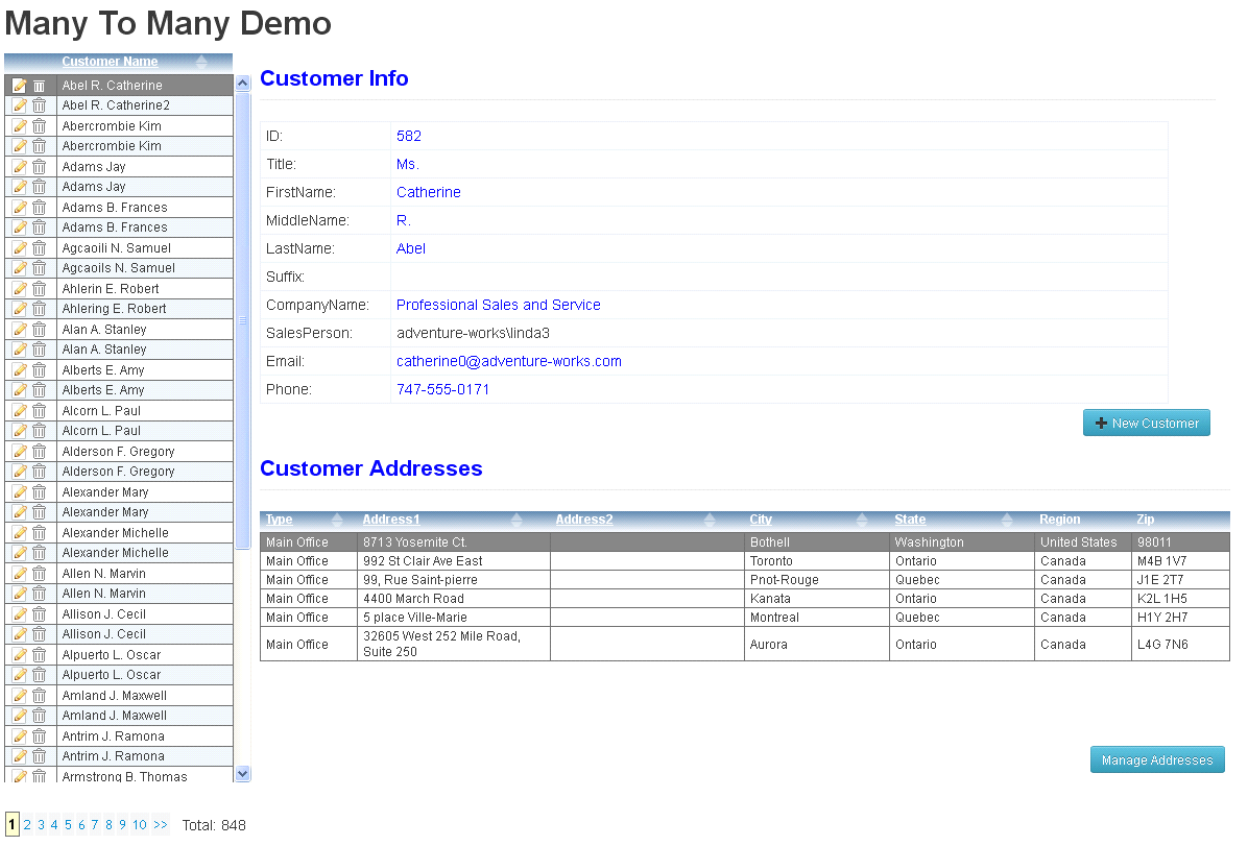
The DataGrid's editor options include:

templateID - name of the template which will be used for the dialog display.
width - the width of the dialog.
height - the height of the dialog.
submitOnOK - if true, then when clicking OK button of the dialog automatically submits changes to the server, and the dialog is not closed until the response from the server confirms successful commit of the changes.
title - the title used in the dialog's header.
canRefresh - can be used to suppress showing the refresh button in the dialog.
canCancel - can be used to suppress showing the cancel button in the dialog.

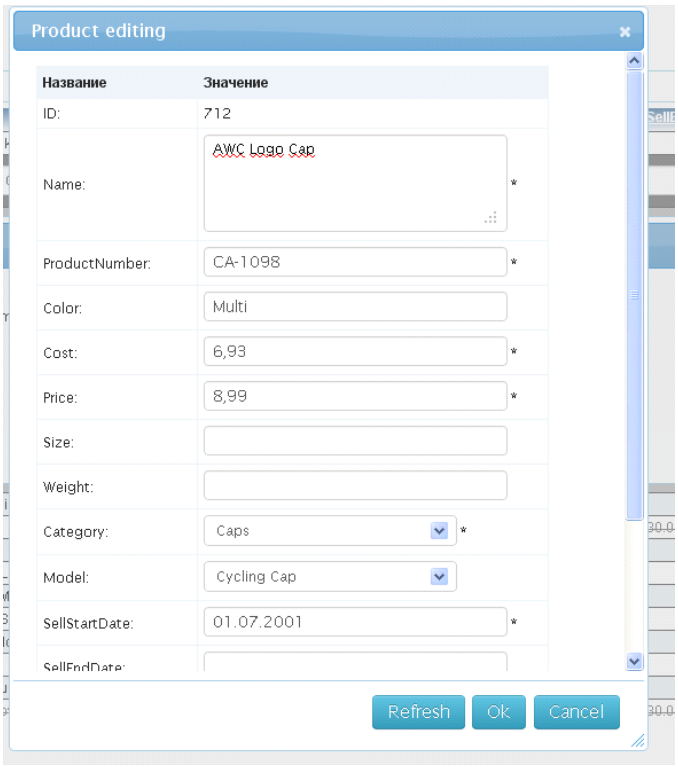
a DataGrid on a page and expanded row details:



Several DataGrids on a page:



The datagrid's edit dialog:



The DataGrid has a feature of changing the row display depending on some field's value of the entity. For example, the DataGrid demo uses this feature to display differently rows with isActive field value true or false. It is done by providing in grid's

options the name of the field to observe, as in rowStateField:IsActive , then add handler to the grid's instance to change css style of the row depending on the value.

```
self._dataGrid.addOnRowStateChanged(function (s, a) {
                        if (!a.val) {
                            a.css = 'rowInactive';
                        }
}, self.uniqueID);
```

The DataPager:

The Data Pager is a separate control. Like all the controls defined in the framework, for their use in declarative style, it has special element view PagerElView.
In order to display it on the page, we need to add an additional markup, as in the example:

```
<div  data-bind="{this.dataSource,to=dbSet,source=productVM}"
      data-view="name=pager,options={sliderSize:20,hideOnSinglePage=false}"></div>
```

The DataEditDialog:

The DataEditDialog is a control used to display modal popup dialogs. This control is used by the DataGrid control to display edit dialogs. But this control can also be used independently from the DataGrid.

The DataEditDialog uses a template to create the visual display.
The dialog's options and the dialog are defined in the datadialog.ts file.

```
export interface IDialogConstructorOptions {
            dataContext?: any;
            templateID: string;
            width?: any;
            height?: any;
            title?: string;
            submitOnOK?: boolean;
            canRefresh?: boolean;
            canCancel?: boolean;
            fn_OnClose?: (dialog: DataEditDialog) => void;
            fn_OnOK?: (dialog: DataEditDialog) => number;
            fn_OnShow?: (dialog: DataEditDialog) => void;
            fn_OnCancel?: (dialog: DataEditDialog) => number;
            fn_OnTemplateCreated?: (template: template.Template) => void;
            fn_OnTemplateDestroy?: (template: template.Template) => void;
}
```

For the use of the dialog in code it is useful to use special view model:

```
export class DialogVM extends MOD.mvvm.BaseViewModel {
        _dialogs: { [name: string]: () => MOD.datadialog.DataEditDialog; };

        constructor(app: Application) {
            super(app);
            this._dialogs = {};
        }
        createDialog(name: string, options: MOD.datadialog.IDialogConstructorOptions) {
            var self = this;
            this._dialogs[name] = function () {
                var dialog = new MOD.datadialog.DataEditDialog(self.app, options);
                var f = function () {
                    return dialog;
```

```
                };
                self._dialogs[name] = f;
                return f();
            };
            return this._dialogs[name];
        }
        showDialog(name:string, dataContext) {
            var dlg = this.getDialog(name);
            if (!dlg)
                throw new Error(utils.format('Invalid dialog name:  {0}', name));
            dlg.dataContext = dataContext;
            dlg.show();
            return dlg;
        }
        getDialog(name:string) {
            var factory = this._dialogs[name];
            if (!factory)
                return null;
            return factory();
        }
        destroy() {
            if (this._isDestroyed)
                return;
            this._isDestroyCalled = true;
            var keys = Object.keys(this._dialogs);
            keys.forEach(function (key:string) {
                this._dialogs[key].destroy();
            }, this);
            this._dialogs = {};
            super.destroy();
        }
}
```

Then, it simplifies dialog's creation in a custom code.

```
 this._dialogVM = new COMMON.DialogVM(app);
 var dialogOptions: MOD.datadialog.IDialogConstructorOptions = {
                templateID: 'invokeResultTemplate',
                width: 600,
                height: 250,
                canCancel: false, //no cancel button
                title: 'Result of a service method invocation',
                fn_OnClose: function (dialog) {
                    self.invokeResult = null;
                }
};
this._dialogVM.createDialog('testDialog', dialogOptions);
```

Then to trigger dialog's showing there's only needed to invoke the DialogVM's showDialog method. Which expects to parameters: the name of the dialog, and the data context.

```
self._dialogVM.showDialog('testDialog', self);
```

The option's fn_OnTemplateCreated needs a special mention.
This option's parameter is used to supply a function which will be invoked when the instance of the data template used by the dialog is created.
As an example, we can get HTML DOM elements inside the template.

an example of the dialog which uses fn_onTemplateCreated option's parameter:

```
//a template example
<div id="treeTemplate">
    <div data-name="tree" style="height:90%;"></div>
    <span style="position:absolute;left:15px;bottom:5px;font-weight:bold;font-size:10px;color:Blue;"
```

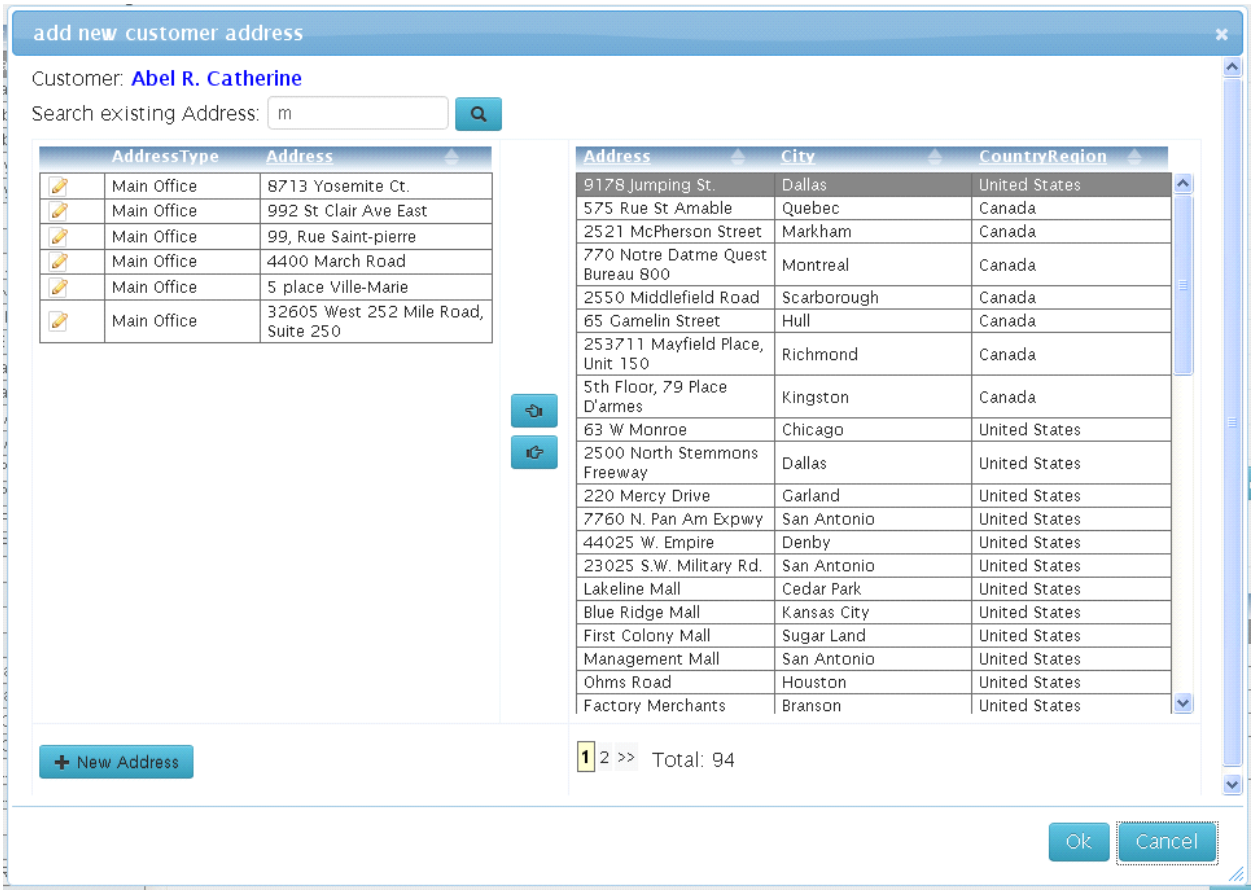
```
    data-bind="{this.text,to=selectedItem.fullPath,mode=OneWay}"></span>
</div>

var dialogOptions: MOD.datadialog.IDialogConstructorOptions = {
                templateID: 'treeTemplate',
                width: 650,
                height: 700,
                title: self._includeFiles ? 'File Browser' : 'Folder Browser',
                fn_OnTemplateCreated: function (template) {
                    var dialog = this, $ = global.$; //the function is executed in the context of the dialog
                    var $tree = global.$(fn_getTemplateElement(template, 'tree'));
                    var options: IFolderBrowserOptions = utils.mergeObj(app.options, { $tree: $tree, includeFiles:
self._includeFiles });
                    self._folderBrowser = new FolderBrowser(options);
                    self._folderBrowser.addOnNodeSelected(function (s, a) {
                        self.selectedItem = a.item;
                    }, self.uniqueID)
                },
                fn_OnShow: function (dialog) {
                    self.selectedItem = null;
                    self._folderBrowser.loadRootFolder();
                },
                fn_OnClose: function (dialog) {
                    if (dialog.result == 'ok' && !!self._selectedItem) {
                        self._onSelected(self._selectedItem, self._selectedItem.fullPath);
                    }
                }
            };
            this._dialogVM.createDialog('folderBrowser', dialogOptions);

            this._dialogCommand = new MOD.mvvm.Command(function (sender, param) {
                try {
                    self._dialogVM.showDialog('folderBrowser', self);
                } catch (ex) {
                    self._onError(ex, this);
                }
             }, self, function (sender, param) {
                return true;}
             );
```

The dialog also has the next options:

fn_OnOK - function is invoked when the user clicks the dialog's OK button. The result of this function is checked by the dialog. If this function returns DIALOG_ACTION.StayOpen, then the dialog is not closed (*you can see how it was done in ManyToMany demo's view model*).

submitOnOK - when is set to true, then when the OK button is clicked the dialog submits changes to the server and waits for the submit completion. If the changes are submitted without errors then the dialog is closed, in the other case the dialog stays open.
Note: *For the submitOnOk to work, the data context used for the dialog needs to implement MOD.utils.ISubmittable interface.*

an example of a more complex dialog:



The DataForm:

The DataForm is a control that attaches to its scope a data context. The data context is provided to the DataForm through its dataContext property.
The DataForm control is usually attached to a block tag (* or <form/>*).

Also the DataForm allows to use data contents inside it. They can display the data in non editing and editing state differently. Also the data form displays automatically validation errors.

The DataForm – is defined in the dataform.ts file.
In order to make it possible to attach the DataForm to an element in declarative style, there is a special element view - the DataFormElView. It is registered by the name dataform.

an example of the DataForm definition on the page:

```
<form action="#" style="width: 100%" data-bind="{this.dataContext,to=Address}" data-view="name=dataform">
        <dl class="dl-horizontal">
          <dt><span class="addressLabel">AddressLine1:</span></dt>
          <dd>
            <!--inside data form we can use span tag with data-content attribute-->
            <span class="address" data-content="fieldName:AddressLine1"></span>
          </dd>
          <dt><span class="addressLabel">AddressLine2:</span></dt>
          <dd>
            <span class="address" data-content="fieldName:AddressLine2"></span>
          </dd>
          <dt><span class="addressLabel">City:</span></dt>
```

```
            <dd>
               <span class="address" data-content="fieldName:City"></span>
            </dd>
            <dt><span class="addressLabel">StateProvince:</span></dt>
            <dd>
               <span class="address" data-content="fieldName:StateProvince"></span>
            </dd>
            <dt><span class="addressLabel">CountryRegion:</span></dt>
            <dd>
               <span class="address" data-content="fieldName:CountryRegion"></span>
            </dd>
            <dt><span class="addressLabel">PostalCode:</span></dt>
            <dd>
               <span class="address" data-content="fieldName:PostalCode"></span>
            </dd>
         </dl>
</form>
```

The StackPanel:

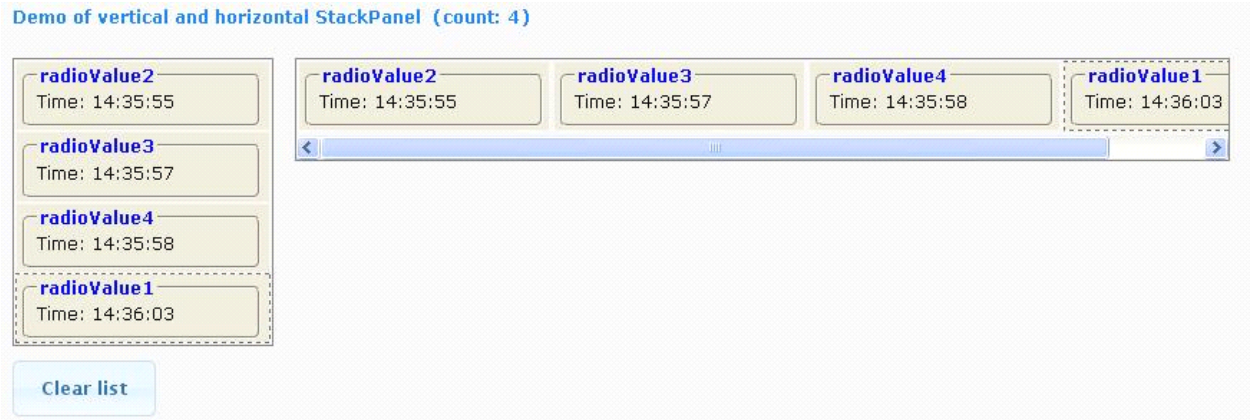
The StackPanel - is a control which used to attach to a block tag (*typically, the tag*) the logic and markup for displaying a vertical or horizontal list of objects. Each object from the collection bound to the StackPanel's data source property is displayed using a data template. It is very much like ASP.NET repeater control, only fully functional on the client side. The control allows to use the keyboard keys (*left, right or up,down*) to navigate to the previous or the next elements in the list.

The StackPanel control is defined in the stackpanel.ts file. In order to use the control declaratively there is a special element view StackPanelElView. It is registered by the name stackpanel.

an example of definitions of the StackPanels on the page:

```
 <!--example of using stackpanel for vertical and horizontal list view-->
<div style="border: 1px solid gray;float:left;width:180px; min-height:50px; max-height:250px; overflow:auto;"
data-bind="{this.dataSource,to=historyList,source=demoVM}"
data-view="name=stackpanel,options:{templateID:stackPanelItemTemplate,orientation:vertical}"></div>

<div style="border: 1px solid gray;float:left;min-height:50px; min-width:170px; max-width:650px; overflow:auto;
margin-left:15px;" data-bind="{this.dataSource,to=historyList,source=demoVM}"
data-view="name=stackpanel,options:{templateID:stackPanelItemTemplate,orientation:horizontal}"></div>
```

an example of the display of the StackPanels on the page:



an example of the overall StackPanel's markup structure rendered on the page:

```
<div class="ria-stackpanel" data-
view="name=stackpanel,options:{templateID:stackPanelItemTemplate,orientation:horizontal}"
   data-bind="{this.dataSource,to=historyList,source=VM.demoVM}" style="border: 1px solid gray;
   float: left; min-height: 50px; min-width: 170px; max-width: 650px; overflow: auto;
   margin-left: 15px;" data-elvwkey0="s_10">
   <div class="stackpanel-item" style="display: inline-block;" data-key="clkey_0">
      <div class="stackPanelItem" style="width: 170px;">
         <fieldset>
            <legend><span data-elvwkey0="s_14">radioValue2</span> </legend>Time:  <span
               data-elvwkey0="s_15">14:35:55</span>
         </fieldset>
      </div>
   </div>
   <div class="stackpanel-item" style="display: inline-block;" data-key="clkey_1">
         <!-- another template data here-->
   </div>
   <div class="stackpanel-item" style="display: inline-block;" data-key="clkey_2">
         <!-- another template data here-->
   </div>
   <div class="stackpanel-item current-item" style="display: inline-block;" data-key="clkey_3">
         <!-- another template data here-->
   </div>
</div>
```

The ListBox:

The ListBox - is a control which is used to attach to a <select/> tag the logic for data binding its data to a data source.
It is displayed on the page like an ordinary combobox, only the options in it are created and removed in response to the changes in the datasource.

The ListBox control is defined in the listbox.ts file. In order to use the control declaratively there is a special element view the SelectElView.
This control is also used internally in the LookupContent to display lookup fields.

an example of definitions of the ListBoxes on the page:

```
<select id="prodMCat" size="1" class="span3"
data-bind="{this.dataSource,to=filter.ParentCategories}
{this.selectedValue,to=filter.parentCategoryID,mode=TwoWay}"
data-view="options:{valuePath=ProductCategoryID,textPath=Name}"></select>

<select id="prodSCat" size="1" class="span2"
data-bind="{this.dataSource,to=filter.ChildCategories}{this.selectedValue,to=filter.childCategoryID,mode=TwoWay}
{this.selectedItem,to=filter.selectedCategory,mode=TwoWay}{this.toolTip,to=filter.selectedCategory.Name}"
data-view="options:{valuePath=ProductCategoryID,textPath=Name}"></select>
```

Working with the data on the client side

3.1 *Working with the simple collection's data*

The framework collectionss hierarchy starts from BaseCollection<TItem extends CollectionItem> type (*defined in the collection.ts file*), which is the base abstract type for all the specialized collections. The CollectionItem is the base type for all the item types in these collections.
These base classes are defined in the *collection* module, which has also ListItem, BaseList, and BaseDictionary definitions. All the collections in the framework use generics argument for their item's type.

These collections are used as data sources for the controls like the DataGrid , the StackPanel, the ListBox.
Every collection instance has the currentItem property and the events which notify the controls about the changing current position, adding or removing of a collection item, and also about the start and the end of the editing of the item. Only one item in the collection can be in the editing state.

All the types in the framework, including the BaseCollection and the CollectionItem types are descendants of the BaseObject type, and they have all the properties, methods and events of that base type.

Collection's properties:

Property	Is readOnly	Description
permissions	Yes	Exposes the permissions for the updating, inserting and refreshing of the entities in the collection. export interface IPermissions { canAddRow: boolean; canEditRow: boolean; canDeleteRow: boolean; canRefreshRow: boolean; }
currentItem	No	Current item
count	Yes	Number of the items in the collection
totalCount	No	Total number of the items. Used for the paging support.
pageSize	No	Size of the data page. Used for the paging support.
pageIndex	No	Current page index. Zero based value.
items	Yes	Array of the collection items.
isPagingEnabled	Yes	If true then the collection supports paging.
isEditing	Yes	Returns true if the collection is in editing state.
isHasErrors	Yes	Returns true if the collection items have validation errors.
isLoading	No	Returns true if the items are loading.
isUpdating	No	Can be set to true to mark the collection for the bulk updates. Used when it is needed to update the items without triggering begin_edit and end_edit events. Which prevents UI controls flickering.
pageCount	Yes	The calculated number of the pages (*if the paging is supported*)

options	Yes	Exposes the options object, which is created in the constructor.
		export interface ICollectionOptions {
		enablePaging: boolean; pageSize: number;
		}

Collection's methods:

Method	Description
getFieldInfo	Returns information about a field by providing a field's name. export interface IFieldInfo { isPrimaryKey: number; isRowTimeStamp: boolean; dataType: number; isNullable: boolean; maxLength: number; isReadOnly: boolean; isAutoGenerated: boolean;

	allowClientDefault: boolean; dateConversion: number; isClientOnly: boolean; isCalculated: boolean; isNeedOriginal: boolean; dependentOn: string; range: string; regex: string; isNavigation: boolean; fieldName: string; dependents?: string[]; }
getFieldNames	Returns an array of the field names.
cancelEdit	Cancels the editing
endEdit	Ends the editing if there are no validation errors, otherwise cancels the editing.
getItemsWithErrors	Returns an array of the items which have validation errors.
addNew	Creates and returns the new item. Leaving the collection in the editing state. You can cancel adding the new item by invoking cancelEdit, or otherwise you can commit it with the endEdit method.
getItemByPos	Returns item (*if found*) by position or null value.
getItemByKey	Returns an item by the key (or null). The key value is the CollectionItem's property _key which has string type. The Dictionary uses one property on the items as a key value. The DbSet's items are returned from the data service layer and they have the server side generated key (*string values of the primary key concantenated by ;*). If the item is created on the client side before it is submitted to the server, the _key property contains client side generated value.
findByPK	Returns the item by primary key values (or null). Primary key values supplied as arguments ordered exactly as the fields in the primary key.
moveFirst	Moves the current position to the first item in the collection. Returns a boolean value indicating if the move was successful. Accepts an optional boolean parameter skipDeleted, which indicates if deleted (*and not submitted*) items should be skipped.
movePrev	Moves the current position to the previous item in the collection. Returns a boolean value indicating if the move was successful. Accepts an optional boolean parameter skipDeleted, which indicates if deleted (*and not submitted*) items should be skipped.
moveNext	Moves the current position to the next item in the collection. Returns a boolean value indicating if the move was successful. Accepts an optional boolean parameter skipDeleted, which indicates if deleted (*and not submitted*) items should be skipped.
moveLast	Moves the current position to the last item in the collection. Returns a boolean value indicating if the move was successful. Accepts an optional boolean parameter skipDeleted, which indicates if deleted (*and not submitted*) items should be skipped.
goTo	Moves the current item position to the provided in the method argument. Returns a boolean value indicating if the move was successful.
forEach	The same functionality as the array's forEach method.
removeItem	Immediately removes the item from the collection.

sortLocal	Sorts the collection items locally on the client. First parameter must be the array of field names, the second 'ASC' or 'DESC'.
sortLocalByFunc	Sorts the collection items locally on the client. Expects a sorting function for the items.
clear	Removes all the items from the collection.
waitForNotLoading	A utility method which allows to wait for a callback function. It is executed only when the collection is not loading the data, otherwise it waits till that moment. The call is nonblocking.

Collection's events:

Event	Description
begin_edit	Raised when an item started editing.
end_edit	Raised when an item ended editing.
fill	Raised when the population of the collection with items is started or ended.
coll_changed	Raised when the collection has been changed - items added, removed, item has changed _key property, or collection has been reset.
item_deleting	Raised before an item was deleted.
item_added	Raised after a new item was added to the collection.
item_adding	Raised before a new item was added to the collection.
validate	Raised when an item is validated.
current_changing	Raised when the current item is changing.
page_changing	Raised when the current page is changing.
errors_changed	Raised when an item's error status is changed.
status_changed	Raised when an item's _changeType property value (*deleted, updated, unchanged, added*) is changed.
clearing	Raised before the collection is cleared (*emptied*)
cleared	Raised after the collection is cleared (*emptied*)
commit_changes	Raised when changes on a collection item are accepted or rejected.

CollectionItem's properties:

Property	Is readOnly	Description
_isNew	Yes	Returns true if the item is newly created by the addNew method on the collection and before the changes are commited to the server.
_isDeleted	Yes	Returns true if the item in the deleted state.
_key	False	Returns the key (*a string value*) value of the item in the collection.
_collection	Yes	Returns parent collection. (*DbSet, List, Dictionary*)
_isUpdating	Yes	Returns true if the collection in the updating state.

isEditing	Yes	Returns true if the item in the editing state.
		It is part of implementation of the IEditable interface:
		`export interface IEditable {`
		`  beginEdit(): boolean;`
		`  endEdit(): boolean;`
		`  cancelEdit(): boolean;`
		`  isEditing: boolean;`
		`};`

_isCanSubmit	Yes	Returns true if the item supports submitting changes to the server.
		It is part of implementation of the ISubmittable interface:
		`export interface ISubmittable {`
		`  submitChanges(): IVoidPromise;`
		`  _isCanSubmit: boolean;`
		`}`

_changeType	Yes	Returns a status of changes for the item `export enum STATUS { NONE= 0, ADDED= 1, UPDATED= 2, DELETED= 3 }`

CollectionItem's methods:

Property	Description
getFieldInfo	Returns IFieldInfo value by the name of the field.
getFieldNames	Returns an array of field names.
beginEdit	Starts items's editing. Returns true if the editing started successfully.
endEdit	Ends (commits) items's editing. Returns true if the editing ended successfully.
cancelEdit	Cancels current items's editing. Returns true if the editing canceled successfully.
deleteItem	Deletes the item. Returns true if the item is really deleted.
addOnItemErrorsChanged	Adds an event handler for the errors change event

getFieldErrors	Returns an array of IValidationInfo for the field by field's name. If field's name is asterisk * , then it returns result of the item's validation.
	`export interface IValidationInfo {`
	`  fieldName: string;`
	`  errors: string[];`
	`}`

getAllErrors	Returns an array of IValidationInfo for the item.
getErrorString	Returns errors in the string form.
submitChanges	Submits changes to the server if the collection supports it.
getIsHasErrors	Returns true if the item has any validation errors.

CollectionItem's events:

Event	Description
errors_changed	Occurs when item's errors collection is changed.

The descendants of the collection type:

BaseList – is a simple collection of ListItem types.
BaseDictionary – is a simple collection of ListItem types. It is has also keyName parameter in constructor arguments, so the items are indexed by the key and can be found by their keys.

There are also two collections List and Dictionary which have resolved generics arguments. Their items are untyped (*has any type*). They exist for the cases when the DataService's GetTypeScript method was not used to generate strongly typed collections definitions from server side types. But this is a rare case. They are defined as:

```
export class List extends BaseList<ListItem, any> {
            constructor(type_name: string, properties: any) {
                var props: IPropInfo[] = getPropInfos(properties);
                var fieldNames: string[] = props.map(function (p) { return p.name; });
                var itemType = getItemType(fieldNames);
                super(itemType, props);
                this._type_name = type_name;
            }
}

export class Dictionary extends BaseDictionary<ListItem, any> {
            constructor(type_name: string, properties: any, keyName: string) {
                var props: IPropInfo[] = getPropInfos(properties);
                var fieldNames: string[] = props.map(function (p) { return p.name; });
                var itemType = getItemType(fieldNames);
                super(itemType, keyName, props);
                this._type_name = type_name;
            }
            _getNewKey(item: ListItem) {
                if (!item) {
                    return super._getNewKey(null);
                }
                var key = item[this._keyName];
                if (utils.check.isNt(key))
                    throw new Error(utils.format(RIAPP.ERRS.ERR_DICTKEY_IS_EMPTY, this._keyName));
                return '' + key;
            }
 }
```

an example of creation of an untyped Dictionary and filling its items:

```
 //one property in a dictionary  must be unique and used as key
this._radioValues = new MOD.collection.Dictionary('RadioValueType', ['key', 'value', 'comment'], 'key');
this._radioValues.fillItems([
{ key: 'radioValue1', value: 'This is some text value #1', comment: 'This is some comment for value #1' },
{ key: 'radioValue2', value: 'This is some text value #2', comment: 'This is some comment for value #2' },
{ key: 'radioValue3', value: 'This is some text value #3', comment: 'This is some comment for value #3' },
{ key: 'radioValue4', value: 'This is some text value #4', comment: 'This is some comment for value #4' }], false);
```

But the better way is to use strongly typed collections generated by DataService's GetTypeScript method. They don't need any constructor arguments, and therefore it is simple to create their instances. Their fillItems method checks at the compile time that you provide the expected values.

an example of a generated typescript definition of a strongly typed Dictionary by DataService's GetTypeScript method:

```
/*
 Generated from C# KeyVal model
*/
export interface IKeyVal {
    key: number;
    val: string;
}

export class KeyValListItem extends RIAPP.MOD.collection.ListItem implements IKeyVal {
          constructor(coll: RIAPP.MOD.collection.BaseList<KeyValListItem, IKeyVal>, obj?: IKeyVal) {
              super(coll, obj);
          }
          get key(): number { return <number>this._getProp('key'); }
          set key(v: number) { this._setProp('key', v); }
```

```
        get val(): string { return <string>this._getProp('val'); }
        set val(v: string) { this._setProp('val', v); }
        asInterface() { return <IKeyVal>this; }
}

export class KeyValDictionary extends RIAPP.MOD.collection.BaseDictionary<KeyValListItem, IKeyVal> {
        constructor() {
            super(KeyValListItem, 'key', [{ name: 'key', dtype: 3 }, { name: 'val', dtype: 1 }]);
            this._type_name = 'KeyValDictionary';
        }
        get items2() { return <IKeyVal[]>this.items; }
}
```

an example of creation of a strongly typed Dictionary:

```
this._orderStatuses = new DEMODB.KeyValDictionary();
this._orderStatuses.fillItems([{ key: 0, val: 'New Order' }, { key: 1, val: 'Status 1' },
                { key: 2, val: 'Status 2' }, { key: 3, val: 'Status 3' },
                { key: 4, val: 'Status 4' }, { key: 5, val: 'Completed Order' }], true);
```

When the fillItems method is used on the above dictionary it will expect that you will provide an array of IKeyVal values.

3.2 *Working with the data provided by the DataService*

In order to work with the data originated from the server side in a consistent and a safe way there should be a set of components which implement some protocol of interaction between the server and the client side. For the server side there is the DataService which provides the data, accepts the updates originated on the client side, checks permissions for the clients to execute certain operations on the server, validates the updates, and then it provides the result of the operations back to the clients.
For the updates on the server (*CRUD operations*) there is often a need to make those updates in the order of the relations between the entities, then the entities can have autogenerated fields which values should be propagated back to the clients with the results of the operations. For validation purposes the server side must have the metadata which describes entities, relationship between them. This is all done by the DataService.
For the client side, the set of components implemented in db.ts file. The main component which works directly with the DataService is the DbContext.

The DbContext:

An instance of the DbContext is used to interact with the data service.
The DbContext stores the data in the collections with their the type derived from the DbSet.

The DataContext prevents repeated loading of the entities in the DbSet. If the entity is loaded twice then it not replaces the entity in the collection but only refreshes its data.
The DbContext checks entities' equality by comparing their keys. Each entity in the DbSet must have the unique key (*primary key*).

DbContext's properties:

Property	Is readonly	Description
isBusy	Yes	Boolean property, which indicates that the DbContext

		doing some work (*typically asynchronous*).
isSubmiting	Yes	Boolean property, which indicates that the DbContext submits updates to the service end.
serverTimezone	Yes	The timezone of the server from which the application was loaded.
dbSets	Yes	A special object which contains all the DbSets for the DbContext.
serviceMethods	Yes	A map (*indexed by names*) of the service methods (*methods exposed from the data service*). Service method invocation is an asynchronous operation. It returns a promise which will be resolved with the data returned from the method, or rejected if the invocation failed.
hasChanges	Yes	Boolean property which indicates that the DbContext has pending changes (*not submitted*).
service_url	Yes	Returns the data service's url.
isInitialized	Yes	Returns true when the DbContext is initialized with the metadata.

DbContext's methods:

Property	Description
getDbSet	Returns a DbSet by its name.
submitChanges	Submits the changes to the service. It is the asynchronous operation and returns a promise.
load	Loads the data from the data service. It is the asynchronous operation and accepts a query object. It returns a promise IPromise<ILoadResult<Entity>>.
acceptChanges	Accepts all the changes turning all entities' statuses to STATUS.None. Typically it is automatically invoked when the DbConntext successfully submits the changes.
rejectChanges	Rejects all the changes turning all entities' statuses to STATUS.None and the values are restored to the original ones.
waitForNotBusy	Used internally to wait for all asynchronous operations to complete.
waitForNotSubmiting	Used internally to wait for a submit to complete.
initialize	Initializes the DbContext, with the metadata and the service url.
getAssociation	Returns a parent-child association object instance by its name.

DbContext's events:

Event	Description
submit_error	Raised when a submit of the changes is not successful. It allows to handle the submit error without rejecting all the changes.

The DbContext which is defined in the db.ts file is generally not used directly. Instead it is used as a class derived from this original DbContext. The DataService's GetTypeScript method creates a ready script with typed entities classes and a typed DbContext. It encapsulates all the information for the associations and the methods and it exposes strongly typed dbSets and serviceMethods properties.

an example of a derived DbContext class:

```
export class DbContext extends RIAPP.MOD.db.DbContext {
        _initDbSets() {
            super._initDbSets();
            this._dbSets = new DbSets(this);
            var associations = [a number of association's infos here];
            this._initAssociations(associations);
            var methods = [a number of method's infos here];
            this._initMethods(methods);
        }
        get associations() { return <IAssocs>this._assoc; }
        get dbSets() { return <DbSets>this._dbSets; }
        get serviceMethods() { return <ISvcMethods>this._svcMethods; }
}
```

an example of a strongly typed DbContext creation:

```
this._dbContext = new SVMDB.DbContext();
this._dbContext.initialize({ serviceUrl: options.service_url, permissions:
options.permissionInfo });
```

an example of loading the data using the DbContext:

```
 load() {
      var query = this.dbSet.createReadProductQuery({ param1: [10, 11, 12, 13, 14], param2: 'Test' });
      query.pageSize = 50;
      query.loadPageCount = 20; //load 20 pages at once (only one will be visible, others will be in the local cache)
      query.isClearCacheOnEveryLoad = true; //clear local cache when a new batch of data is loaded from the server
       addTextQuery(query, 'ProductNumber', this._filter.prodNumber);
       addTextQuery(query, 'Name', this._filter.name);
       if (!utils.check.isNt(this._filter.childCategoryID)) {
            query.where('ProductCategoryID', '=', [this._filter.childCategoryID]);
       }
       if (!utils.check.isNt(this._filter.modelID)) {
                query.where('ProductModelID', '=', [this._filter.modelID]);
       }

        query.orderBy('Name', 'ASC').thenBy('SellStartDate', 'DESC');

      return query.load();  //the same as: return this.dbContext.load(query);
}
```

Where addTextQuery is a helper function defined in the same module as:

```
export function addTextQuery(query:MOD.db.DataQuery, fldName: string, val:string) {
          var tmp:string;
          if (!!val) {
              if (utils.str.startsWith(val, '%') && utils.str.endsWith(val, '%')) {
                  tmp = utils.str.trim(val, '% ');
                  query.where(fldName, 'contains', [tmp])
              }
              else if (utils.str.startsWith(val, '%')) {
                  tmp = utils.str.trim(val, '% ');
                  query.where(fldName, 'endswith', [tmp])
              }
              else if (utils.str.endsWith(val, '%')) {
                  tmp = utils.str.trim(val, '% ');
                  query.where(fldName, 'startswith', [tmp])
              }
              else {
                  tmp = utils.str.trim(val);
                  query.where(fldName, '=', [tmp])
              }
```

```
        }
        return query;
};
```

Note: *You can can create several query methods on the data service which return the same entity type but they must have different names (no overloads). These methods can accept parameters which can be used to select the data.*

Note: *Generally it is better for simplicity to use query.load method instead of dbContext.load method. You can use the Promise returned by the load method to wait when the load is completed.*

The DbContext class also allows to execute on the DataService special methods annotated with the Invoke attribute. They are useful to execute some arbitrary code on the server side. They can accept parameters and can return result. The DataService's GetTypeScript method generates strongly typed versions of those methods, which are easy to use from the client code.

an example of two generated call signatures for the service methods:

```
export interface ISvcMethods {
        TestInvoke: (args: {
            param1: number[];
            param2: string;
        }) => IPromise<string>;
        TestComplexInvoke: (args: {
            info: IAddressInfo2;
            keys: IKeyVal[];
        }) => IVoidPromise;
}
```

an example of a service method invocation from the application's code:

```
self.invokeResult = null;
var promise = self.dbContext.serviceMethods.TestInvoke({ param1: [10, 11, 12, 13, 14], param2: param.Name });
    promise.done(function (res) {
                    self.invokeResult = res;
                    self._dialogVM.showDialog('testDialog', self);
                });

     promise.fail(function () {
                    //do something on fail if you need
                    //but the error message display is automatically shown
                });
```

The DataCache:

The DataCache is used to cache the data on the client. You can set the query's loadPageCount property to a value more than 1. If loadPageCount more than 1 then the loading operation returns several pages of the data (*exactly the number you set on the loadPageCount*).
Those extra pages of the data rows are cached inside the query's instance with the help of **internally** used DataCache class.
If the DbSet's pageIndex property value is changed (*page navigation in a data grid*), then before loading the data from the server it is checked in the local cache. If it exists then the page's data is served from the local cache.

Note: *the local data caching is very useful for returning more data rows than can be displayed in the DataGrid (several pages at once). If the query execution is slow (it is often for complex queries), and if navigation from one page to the next takes considerable time, then it is better to preload several pages of the data to the client in one query operation.*

The DataQuery:

The DbSet's createQuery method return an instance of the DataQuery type, which can be used to modify a query options and to provide additional query parameters.

DataQuery's properties:

Property	Is readonly	Description
loadPageCount	No	It determines, how many pages to load. If the pageSize is 100 and loadPageCount is 25 then the loading will try to load 2500 records from the server.
isClearCacheOnEveryLoad	No	It determines if the cached data is cleared when the DbContext's load method is called explicitly. If you will set it to true then the already cached data would be cleared. If you will set to false, then the new data would be appended to the previous data.
isIncludeTotalCount	No	It determines if the query will try to return the total count of the records.
params	No	It used to set the query parameters if the data service query method expects arguments.

The applications generally use strongly typed DataQuery. Every strongly typed DbSet (*generated by the data service's GetTypeScript method*) exposes strongly typed createQuery methods.

an example of a strongly typed DbSet generated by the DataService's GetTypeScript method:

```
export class CustomerDb extends RIAPP.MOD.db.DbSet<Customer>
{
        constructor(dbContext: DbContext) {
            var self = this, opts: RIAPP.MOD.db.IDbSetConstuctorOptions = {
                dbContext: dbContext,
                dbSetInfo: { a dbSet info here}
            }, utils = RIAPP.global.utils;
            super(opts);
            self._entityType = Customer;

            opts.dbSetInfo.fieldInfos.forEach(function (f) {
                f.dependents = [];
                self._fieldMap[f.fieldName] = f;
            });

            opts.dbSetInfo.fieldInfos.forEach(function (f) {
                if (!!f.isNavigation) {
                    self._navfldMap[f.fieldName] = self._doNavigationField(opts, f);
                }
```

```
            else if (!!f.isCalculated) {
                self._calcfldMap[f.fieldName] = self._doCalculatedField(opts, f);
            }
        });

        self._mapAssocFields();
    }
    createReadCustomerQuery(args?: {
        includeNav?: boolean;
    }) {
        var query = this.createQuery('ReadCustomer');
        query.params = args;
        return query;
    }

    defineNameField(getFunc: () => string) { this.defineCalculatedField('Name', getFunc); }

    get items2() { return <ICustomerEntity[]>this.items; }
}
```

The DbSet:

The DbSet is derived from the Collection class so it supports all its methods and properties. But it usually loads items (entities) from the server.

It also supports to fill it with the data directly using its fillItems method.
This way of direct loading is useful when we want that the data will be already present in the DbSet when HTML page will be loaded. It reduces a number of roundtrips to the server.

Note: *You can see how it is done in the GridDemo sample (Models and Categories in the filter are loaded using this method).*

The DbSet also adds or overloads implementation of some methods and properties inherited from the base Collection type:

DbSet's specific methods:

Property	Description
fillItems	Loads the DbSet with locally stored data. (*Useful for lookups*)
acceptChanges	Accepts pending changes.
rejectChanges	Rejects pending changes.
deleteOnSubmit	Deletes an entity on submit.
createQuery	Creates an instance of the DataQuery's (*by query name*).
clearCache	Explicitly clears local cache.
defineCalculatedField	Defines calculated field. You need to provide the field name and the function which performs calculations.

DbSet's specific properties:

Property	is readonly	Description
dbContext	Yes	Returns the parent DbContext
dbSetName	Yes	Returns the DbSet's name, as it is defined in the metadata.

entityType	Yes	Returns the type of the entities which the DbSet can contain.
isSubmitOnDelete	No	If it is set to true, then after any entity is submitted for delete, the changes is automatically submitted to the server.
query	Yes	Returns the current query which is used to load the DbSet
hasChanges	Yes	Returns true if there is pending changes.
cacheSize	Yes	Returns the count of records currently stored in the local cache.

The DataService's GetTypeScript method produces the script which contains all DbSets which are exposed by the DataService. Those DbSets are strongly typed and if the DbSet contains a calculated field (*defined in the metadata*) then the strongly typed DbSet will have a special method to define this calculated field.

an example of a strongly typed DbSet with several methods to define different calculated fields:

```
export class RegistrDb extends RIAPP.MOD.db.DbSet<Registr>
 {
        constructor(dbContext: DbContext) {
            var self = this, opts: RIAPP.MOD.db.IDbSetConstuctorOptions = {
                dbContext: dbContext,
                dbSetInfo: { a dbSet info here },
                childAssoc: [associations infos here],
                parentAssoc: [ associations infos here]
            }, utils = RIAPP.global.utils;
            super(opts);
            self._entityType = Registr;

            opts.dbSetInfo.fieldInfos.forEach(function (f) {
                f.dependents = [];
                self._fieldMap[f.fieldName] = f;
            });

            opts.dbSetInfo.fieldInfos.forEach(function (f) {
                if (!!f.isNavigation) {
                    self._navfldMap[f.fieldName] = self._doNavigationField(opts, f);
                }
                else if (!!f.isCalculated) {
                    self._calcfldMap[f.fieldName] = self._doCalculatedField(opts, f);
                }
            });

            self._mapAssocFields();
        }

        //two query methods with different arguments
        createReadRegistrQuery(args?: {
            d1: string;
            d2: string;
            cod: string;
        }) {
            var query = this.createQuery('ReadRegistr');
            query.params = args;
            return query;
        }
        createReadOldRegistrQuery(args?: {
            period: string;
        }) {
```

```
            var query = this.createQuery('ReadOldRegistr');
            query.params = args;
            return query;
        }
        //a set of different methods to define calculated fields

        defineLPUField(getFunc: () => string) { this.defineCalculatedField('LPU', getFunc); }
        defineDTYPEField(getFunc: () => string) { this.defineCalculatedField('DTYPE', getFunc); }
        defineFIOField(getFunc: () => string) { this.defineCalculatedField('FIO', getFunc); }
        defineS_OPLField(getFunc: () => number) { this.defineCalculatedField('S_OPL', getFunc); }
        defineSMOField(getFunc: () => string) { this.defineCalculatedField('SMO', getFunc); }
        defineADDRESSField(getFunc: () => string) { this.defineCalculatedField('ADDRESS', getFunc); }
        defineerrorsField(getFunc: () => any) { this.defineCalculatedField('errors', getFunc); }

        get items2() { return <IRegistrEntity[]>this.items; }
}
```

Calculated fields (*if they are present*) should be defined after DbContext's initialize method has been invoked, but before you load any data into the DbSet. Usually it is done in the Application's onStartUp method.

an example of several calculated fields definitions:

```
this._dbContext.dbSets.Registr.defineerrorsField(function(){
      return self.dbContext.associations.getErrorToRegistr().getChildItems(this);
});

this._dbContext.dbSets.Registr.defineFIOField(function () {
    //this function is executed in the context of the entity, so 'this' refers to the entity
    return this.FAM + " " + this.IM + " " + this.OT;
});

this._dbContext.dbSets.Registr.defineDTYPEField(function () {
      var res = filter.cls.dtypeRDict[this.D_TYPE_R];
      return !!res ? res.v : this.D_TYPE_R;
});

this._dbContext.dbSets.Registr.defineLPUField(function () {
      var res = filter.cls.lpuDict[this.MCOD];
      return !!res ? res.v : null;
 });

this._dbContext.dbSets.Registr.defineS_OPLField(function () {
      var errs = this.errors, sall = this.S_ALL;
                if (!errs)
                    return sall;
                errs = errs.filter(function (e) {
                    return !!e.SFNUM;
                });
                var udl = 0;
                errs.forEach(function (e) {
                    udl += e.SUM_UDL;
                });
       return sall - udl;
});

this._dbContext.dbSets.Registr.defineSMOField(function () {
          var res = filter.cls.smoDict[this.Q];
          return !!res ? res.v : this.Q;
  });
```

Entities:

The Entity is base class for the derived entity classes.
Basicaly the Entity is a collection item which is specific for the DbSet type collections.
The concrete entity types have all the properties defined in the metadata for the DbSet.
Entities can have also the navigation properties added by the associations.
You can see for example in the Demo - in the file
RIAppDemo.BLL\DataServices\RIAppDemoMetadata.xaml
This is a xaml file in which every DbSet used by the DataService is defined in xml format. It simplifies editing the metadata, because xml is more readable format than the definition of this information in code. This data is kept on the server and some (*not all*) of this information is available on the client. Using this information the DataService's GetTypeScript method generates entities and DbSets classes.

an example of a DbSet's schema definition:

```
 <data:DbSetInfo dbSetName="Customer" insertDataMethod="Insert{0}" updateDataMethod="Update{0}"
deleteDataMethod="Delete{0}" refreshDataMethod="Refresh{0}" enablePaging="True" pageSize="25"
EntityType="{x:Type dal:Customer}">
                <data:DbSetInfo.fieldInfos>
                    <data:FieldInfo fieldName="CustomerID" dataType="Integer" maxLength="4" isNullable="False"
isAutoGenerated="True" isReadOnly="True" isRowTimeStamp="False" isNeedOriginal="True" isPrimaryKey="1" />
                    <data:FieldInfo fieldName="NameStyle" dataType="Bool" maxLength="1" isNullable="False"
isAutoGenerated="False" isReadOnly="False" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="Title" dataType="String" maxLength="8" isNullable="True"
isAutoGenerated="False" isReadOnly="False" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="FirstName" dataType="String" maxLength="50" isNullable="False"
isAutoGenerated="False" isReadOnly="False" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="MiddleName" dataType="String" maxLength="50" isNullable="True"
isAutoGenerated="False" isReadOnly="False" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="LastName" dataType="String" maxLength="50" isNullable="False"
isAutoGenerated="False" isReadOnly="False" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="Suffix" dataType="String" maxLength="10" isNullable="True"
isAutoGenerated="False" isReadOnly="False" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="CompanyName" dataType="String" maxLength="128"
isNullable="True" isAutoGenerated="False" isReadOnly="False" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="SalesPerson" dataType="String" maxLength="256" isNullable="True"
isAutoGenerated="False" isReadOnly="False" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="EmailAddress" dataType="String" maxLength="50" isNullable="True"
regex="^[_a-z0-9-]+(\.[_a-z0-9-]+)*@[a-z0-9-]+(\.[a-z0-9-]+)*(\.[a-z]{2,4})$" isReadOnly="False"
isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="Phone" dataType="String" maxLength="25" isNullable="True"
isAutoGenerated="False" isReadOnly="False" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="PasswordHash" dataType="String" maxLength="128"
isNullable="False" isAutoGenerated="True" isReadOnly="True" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="PasswordSalt" dataType="String" maxLength="10" isNullable="False"
isAutoGenerated="True" isReadOnly="True" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="rowguid" dataType="Guid" maxLength="16" isNullable="False"
isAutoGenerated="True" isReadOnly="True" isRowTimeStamp="True" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="ModifiedDate" dataType="DateTime" maxLength="8"
isNullable="False" isAutoGenerated="True" isReadOnly="True" isRowTimeStamp="False" isNeedOriginal="True" />
                    <data:FieldInfo fieldName="Name" dataType="String" isCalculated="True"
dependentOn="FirstName,MiddleName,LastName"  />
                </data:DbSetInfo.fieldInfos>
</data:DbSetInfo>
```

an example of an association definition:

```
<data:Association name="CustAddrToCustomer" parentDbSetName="Customer"
childDbSetName="CustomerAddress" childToParentName="Customer"
parentToChildrenName="CustomerAddresses" >
                <data:Association.fieldRels>
                    <data:FieldRel parentField="CustomerID" childField="CustomerID"></data:FieldRel>
                </data:Association.fieldRels>
```

</data:Association>

The Entity type specific methods (besides inherited from CollectionItem):

Property	Description
deleteOnSubmit	Marks the item for deletion and the item status (*changetType*) is set to deleted.
deleteItem	The same as deleteOnSubmit. The methods are semantically equivalent.
getDbContext	Returns the DbContext's instance.
getDbSet	Returns the DbSet's instance.
refresh	Invokes the entity's data refresh. The method is asynchronous, it returns a promise.
acceptChanges	Accepts the changes.
rejectChanges	Reject the changes and restores the values to original.

The Entity type specific properties (besides inherited from CollectionItem):

Property	is readonly	Description
_dbSetName	Yes	Returns the name of the parent DbSet.
_changeType	Yes	Returns the status of the entity. export enum STATUS { NONE= 0, ADDED= 1, UPDATED= 2, DELETED= 3 }
_serverTimezone	Yes	Returns the time zone of the server.
_isRefreshing	Yes	Returns true if the entity is refreshing its values.
_isCached	Yes	Returns true if the entity is cached locally. Generally it is used internally.
isHasChanges	Yes	Returns true if the values are modified and not submitted to the server.
_isCanSubmit	Yes	Always returns true.
_isNew	Yes	Returns true if the entity was added, but not submitted to the server.
_isDeleted	Yes	Returns true if the entity is deleted but not submitted to the server.
_srvKey	Yes	Returns the key of the entity which is obtained from the server (*primary key values concatenated using separator ,*).

When a new entity is added, it exists in the editing state. To commit modifications the endEdit method should be called to end the editing. To discard modifications and undo adding the entity call the cancelEdit method.

An example of adding a new entity and setting its fields:

```
//create new entity
var item =  this.dbSet.addNew();

//modify new entity
item.LineTotal = 200;
item.UnitPrice =100;
item.ProductID = 1;

//commit the changes on the client
```

```
item.endEdit();

 //commit the changes to the server
app.dbContext.submitChanges();
```

If we assign a new value to a property, and the entity is not in editing state, then the its beginEdit method is called.
Every call to the beginEdit or endEdit method, if it completes successfully, will raise 'begin_edit' or 'end_edit' events. In order to prevent triggering those events, for example, when we want to mass update DbSet's items, we can use the DbSet's isUpdating property.

an example of updating DbSet's items without triggering editing events:

```
//prevent implicit calls to beginEdit method
self._dbSet.isUpdating = true; //mark the update started
 try
 {
       self._dbSet.items.forEach(function(item){
            item.pcounts=[];   //sets the entity's field
        });
 }
 finally
 {
      self._dbSet.isUpdating = false; //mark the update ended
 }
```

Besides the normal fields, entities can have calculated (*readonly,and calculated on the client side*) and client only (*editable, but for the client side use only*) fields.

Calculated fields:

The calculated fields are just what they are - they calculate their values. They must not have circular references. The calculated fields are read only. They can depend on other fields (*calculated or not*), and they are automatically refreshed when those fields are changed. The calculated fields are declared in the server side metadata in the DbSet's schema.

```
<data:FieldInfo fieldName="Name" dataType="String" isCalculated="True"
dependentOn="FirstName,MiddleName,LastName"  />
```

Client only fields:

The client only fields are just what they are - they are used only on the client. They don't exist in the database. So their changes are not submitted to the server and they don't take values from the server (*initially they have null values*).
They are declared on the server in the DbSet's schema.

```
<data:FieldInfo fieldName="Address" dataType="None" isClientOnly="True"  />
<data:FieldInfo fieldName="Customer" dataType="None" isClientOnly="True"  />
```

They can have a fixed type, like number, bool, string, date or can have None type which allows to store in them values of any type, like an entity or arrays of entities.

Navigation fields:

An entity can also have navigation properties. They are based on foreign key relations between entities. These foreign key relations in the framework are encapsulated in the association type. The relations (*parent - child*) are defined in these associations in the metadata definition. There can also exist many to many relations which are defined by using two simple associations.
The association definition can set (*optionally*) the names of the navigations fields, and if they were set, then the association definition adds to the corresponding entities the navigational fields. The parent entity can get (*using its navigational field*) an array of child entities and the child entity can get its parent entity.

If you want to insert into the database a parent entity along with a child entity in one transaction you can use the navigation field for that purpose.

Ordinarily (*without using navigation fields*), you insert a parent entity, then submit the changes to the server to obtain the primary key for the entity (*they are usually autogenerated on the server*) , then assign this primary key values to the child entities foreign key fields and then submit them to the server in the second batch.

But, using the navigation field, you can assign the parent entity directly to the childToParent navigation field. On submit, the data service fixes this relationship automatically, and the submit is done in one transaction.

an example of assigning parent entity to the navigation field:

```
var cust = this.currentCustomer;
var ca = this.custAdressView.addNew(); //create a new entity: CustomerAddress
ca.CustomerID = cust.CustomerID;
ca.AddressType = "Main Office"; //this is default, the user can edit it later
ca.Address = address; //assign parent entity - it can also be new and has no Primary key - the data service fixes this on submit
ca.endEdit();

//here we can submit changes to the server with dbContext's submitChanges method
//or do more changes on the client, and then submit them in one transaction
```

The Entity and fields validations:

The entity validation process is done on the client and as an additional insurance is also done on the server.
The client side validation is triggered when the new value is assigned to the field and when the entity's editing ends (*when the endEdit method is invoked implicitly or explicitly*).
For most cases automatic validation is usually enough. The automatic validation is based on the checks and constraints defined in the DbSet's schema. The DbSet's schema can include constraints for nullability (isNullable), maximum length (maxLength), field writability (isReadOnly) , type checking is based on the field's data type (string, number, bool, date) and checks defined using range and regex.

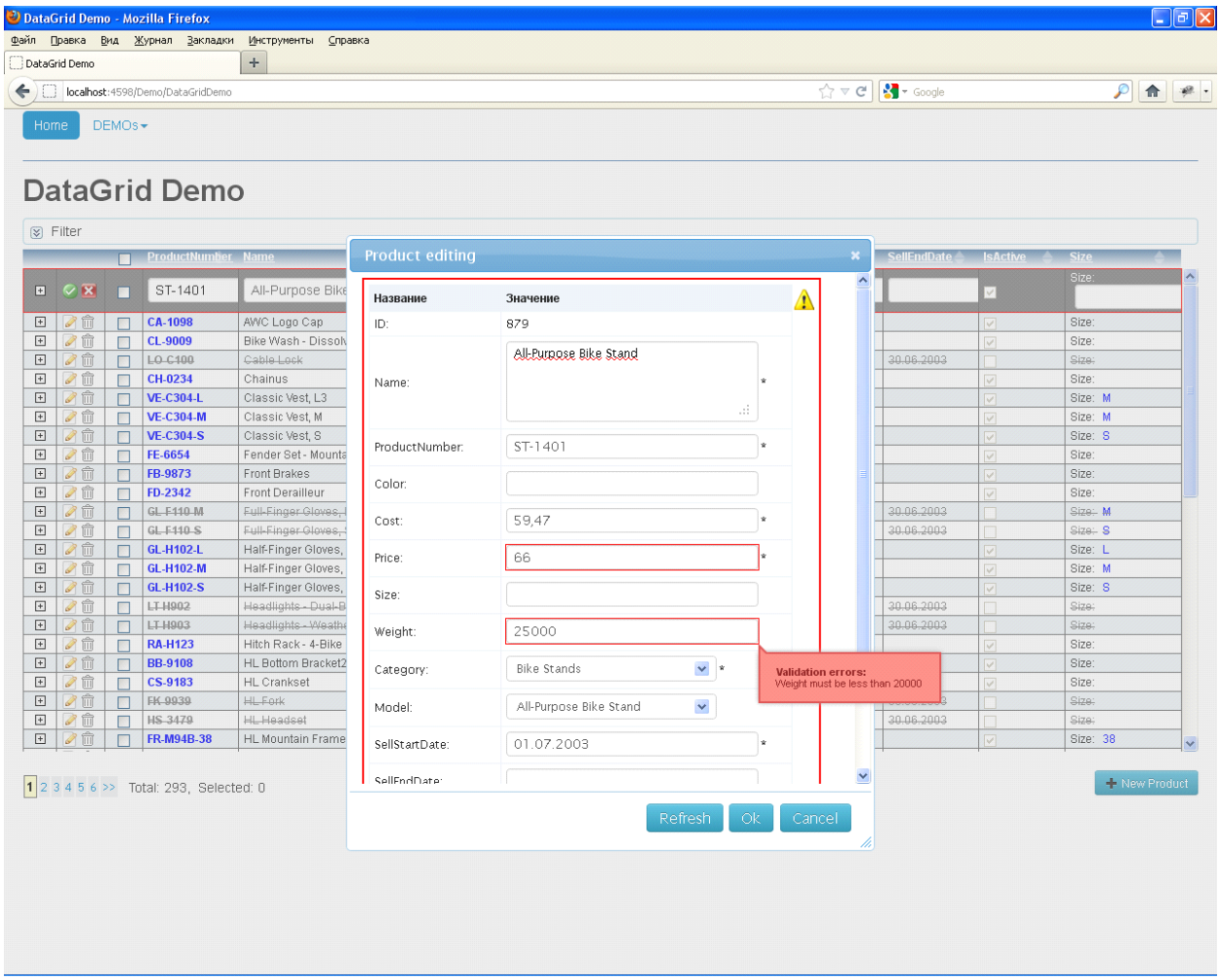
If it is not enough then you can use the custom validation.
The types derived from the Collection (*List, Dictionary, DbSet*) have validate event, which is used for the custom client side validation.
The event handler can check custom validation conditions and then can add errors to the error property if it is not validated.

an example of the custom client side data validation:

```
this._dbSet.addOnValidate(function (sender, args) {
                var item = args.item;
                if (!args.fieldName) { //full item validation
                    if (!!item.SellEndDate) { //check it must be after Start Date
                        if (item.SellEndDate < item.SellStartDate) {
                            args.errors.push('End Date must be after Start Date');
                        }
                    }
                }
                else //validation of field value
                {
                    if (args.fieldName == "Weight") {
                        if (args.item[args.fieldName] > 20000) {
                            args.errors.push('Weight must be less than 20000');
                        }
                    }
                }
}, self.uniqueID);
```

On an unsuccessful client side validation, the errors are added to the DbSet's internal collection of errors. The entity remains in the editing state and can not end editing while the errors exist.
In order end editing, the correct values should be assigned which pass the validation, or otherwise the changes must be canceled with the cancelEdit method.

The data bindings automatically handle validation errors.
If the the entity has errors, then a UI control (*DataGrid, DataForm*) will display error notifications (*red borders and tooltips on mouse hovering*) near not validated fields and the data form will have a validation summary at the top right corner (*if you hover a mouse over it, a tooltip will be shown*).



The errors are cleared when the correct values are assigned to the fields or the changes are discarded by using the cancelEdit method.

As it was noted above, the validation is done on the client and the server side, and for the automatic validation you need to define checks and constraints in the DbSet's schema.

For the custom validation on the server you need to implement the entity validation method in the data service. This method is executed before committing updates to the database, and if the validation had been unsuccessful, the updates would not be committed and the client side will be informed about the error.

an example of the server side custom validation method:

```
 public IEnumerable<ValidationErrorInfo> ValidateProduct(Product product, string[] modifiedField)
 {
        LinkedList<ValidationErrorInfo> errors = new LinkedList<ValidationErrorInfo>();
        if (Array.IndexOf(modifiedField,"Name") >-1 &&
product.Name.StartsWith("Ugly",StringComparison.OrdinalIgnoreCase))
            errors.AddLast(new ValidationErrorInfo{ fieldName="Name", message="Ugly name" });
        if (Array.IndexOf(modifiedField, "Weight") > -1 && product.Weight > 20000)
            errors.AddLast(new ValidationErrorInfo { fieldName = "Weight", message = "Weight must be less than
20000" });
        if (Array.IndexOf(modifiedField, "SellEndDate") > -1 && product.SellEndDate < product.SellStartDate)
            errors.AddLast(new ValidationErrorInfo { fieldName = "SellEndDate", message = "SellEndDate must be
after SellStartDate" });
```

```
        if (Array.IndexOf(modifiedField, "SellStartDate") > -1 && product.SellStartDate > DateTime.Today)
            errors.AddLast(new ValidationErrorInfo { fieldName = "SellStartDate", message = "SellStartDate must be
prior today" });

        return errors;
 }
```

Note: *the modifiedField parameter allows you to validate only modified fields. No sense to validate the data which is already stored in the database.*

The DataView:

The DataView – is a descendant of the collection type. It is used to wrap an existing collection, which we want to filter or sort for the display. You can use it to expose only a partial set of the data of the underlying collection.
For example you can load all child entities for all the loaded parent entities. The child dbSet in the relationship is wrapped with the DataView, and to display only a subset of child entities you can just change the filter condition on the DataView.
The child items relative to the current parent item will be filtered out the DbSet's data.

There are two ways of filtering the data in the DataView:

By providing a subset of the already prefiltered data through *fn_itemsProvider* and also by filtering the data with *fn_filter* function (*they are not mutually exclusive and can be combined*). The workflow of the data processing is:

If you don't provide *fn_itemsProvider* then the data is taken from the dataSource directly, but if you provide *fn_itemsProvider* then the data is taken by executing *fn_itemsProvider.* After that if you provide *fn_filter* then the data is filtered using this function, and then if you provide *in_sort* then the data is sorted.

an example of the DataView initialization:

```
//it filters addresses related to the current customer
 this._addressesView = new MOD.db.DataView<DEMODB.Address>(
 {
                    dataSource: this._addressesDb,
                    fn_sort: function (a: DEMODB.Address, b: DEMODB.Address) { return a.AddressID - b.AddressID; },
                    fn_filter: function (item: DEMODB.Address) {
                        if (!self._currentCustomer)
                            return false;
                        return item.CustomerAddresses.some(function (ca) {
                            return self._currentCustomer === ca.Customer;
                        });
                    },
                    fn_itemsProvider: function (ds) {
                        if (!self._currentCustomer)
                            return [];
                        var custAdrs = self._currentCustomer.CustomerAddresses;
                        return custAdrs.map(function (m) {
                            return m.Address;
                        }).filter(function (address) {
                            return !!address;
                        });
                    }
 });
```

One more example of the DataView initialization:

```
this._addressInfosView = new MOD.db.DataView<DEMODB.AddressInfo>(
                {
                    dataSource: this._addressInfosDb,
                    fn_sort: function (a: DEMODB.AddressInfo, b: DEMODB.AddressInfo) {
                        return a.AddressID - b.AddressID;
                        },
                    fn_filter: function (item: DEMODB.AddressInfo) {
                        return !item.CustomerAddresses.some(function (CustAdr) {
                            return self._currentCustomer === CustAdr.Customer;
                        });
                    }
});
```

The only mandatory option's property is the dataSource - which is an instance of the collection which will be wrapped up with the DataView. We can omit the sorting and filtering functions if we don't need to filter or sort the data.

When we want the data in the DataView to be refreshed (*refiltered and resorted*) we can call the DataView's *refresh* method.

```
addressInfosView.refresh();
```

The DataView's specific methods:

Property	Description
refresh	Refilters and resorts the data in the DataView
clear	Overriden collection's method. Clears only the dataview's data, the real data which is in the wrapped DbSet is not touched.
addNew	Overriden collection's method. Adds a new entity (*it creates new entity*) to the underlying DbSet.
appendItems	Overriden collection's method. Adds an array of existing in the DbSet entities to the view. The items are not filtered before adding to the view.

The DataView's specific properties:

Property	is readonly	Description
fn_filter	No	the filter function
fn_sort	No	the sort function
fn_itemsProvider	No	the function to provide already prefiltered items
isPagingEnabled	No	Overriden property. If it was set to true then the view split its data in pages.
permissions	Yes	Returns the wrapped collections's permissions property value.

the Association and the ChildDataView types:

The ChildDataView is descendant of the DataView class. It simplifies the task where you need to display details near a parent row in master- detail relationship. It uses an association to obtain child entities from the parent entity.
The association stores and updates a map of the parent-child relationship based on the foreign keys.
The definition of the relationship (*the association*) is done in the metadata on the server side.

an example of the metadata for a DbSet:

```
<data:Metadata x:Key="FolderBrowser">
        <data:Metadata.DbSets>
          <data:DbSetInfo dbSetName="FileSystemObject" enablePaging="False" EntityType="{x:Type
models:FolderModel}" deleteDataMethod="Delete{0}">
            <data:DbSetInfo.fieldInfos>
              <data:FieldInfo fieldName="Key" dataType="String" maxLength="255" isNullable="False"
isAutoGenerated="True" isReadOnly="True" isPrimaryKey="1" />
              <data:FieldInfo fieldName="ParentKey" dataType="String" maxLength="255" isNullable="True"
isReadOnly="True" />
              <data:FieldInfo fieldName="Name" dataType="String" maxLength="255" isNullable="False"
isReadOnly="True" />
              <data:FieldInfo fieldName="Level" dataType="Integer" isNullable="False" isReadOnly="True" />
              <data:FieldInfo fieldName="HasSubDirs" dataType="Bool" isNullable="False" isReadOnly="True" />
              <data:FieldInfo fieldName="IsFolder" dataType="Bool" isNullable="False" isReadOnly="True" />
              <data:FieldInfo fieldName="fullPath" dataType="String" isCalculated="True" />
            </data:DbSetInfo.fieldInfos>
          </data:DbSetInfo>
        </data:Metadata.DbSets>
        <data:Metadata.Associations>
          <!--the association definition -->
          <data:Association name="ChildToParent" parentDbSetName="FileSystemObject"
childDbSetName="FileSystemObject" childToParentName="Parent" parentToChildrenName="Children"
onDeleteAction="Cascade" >
            <data:Association.fieldRels>
              <data:FieldRel parentField="Key" childField="ParentKey"></data:FieldRel>
            </data:Association.fieldRels>
          </data:Association>
        </data:Metadata.Associations>
 </data:Metadata>
```

When you define an association in the metadata, you define what field in the child entity relates to the key field in the parent entity. You can also give names for navigation properties (*parentToChildrenName and childToParentName*). These navigation properties will be added to the generated entity classes.

an example of getting an association and the ChildDataView instantiation:

```
 var custAssoc = self.dbContext.associations.getCustAddrToCustomer();

 //the view to filter CustomerAddresses related to the current customer only
 this._custAdressView = new MOD.db.ChildDataView<DEMODB.CustomerAddress>(
     {
                 association: custAssoc,
                 fn_sort: function (a: DEMODB.CustomerAddress, b: DEMODB.CustomerAddress) {
                       return a.AddressID - b.AddressID;
                   }
       });
```

When you need to display details for a parent entity, you will assign the ChildDataView's parentItem property. It triggers refreshing of the view with new data. After assigning the parentItem property the view will contain only details (*chilo entities*) for the parent entity.

```
_onCurrentChanged() {
          //set a new parent item to the ChildDataView
           this._custAdressView.parentItem = this._dbSet.currentItem;
           this.raisePropertyChanged('currentItem');
 }
```

Association's methods:

Property	Description
getChildItems	Accepts an entity and returns an array of the child (*details*) entities
getParentItem	Accepts an entity and returns the parent (*master*) entity

Association's properties:

Property	is readonly	Description
app	Yes	Returns the current application instance.
name	Yes	Returns the name of the association as it was defined in the metadata.
parentToChildrenName	Yes	Returns the name of the navigation property on the entity which is used to get an array of the child entities.
childToParentName	Yes	Returns the name of the navigation property on the entity which is used to get the master entity.
parentDS	Yes	Returns the parent DbSet in the parent-child relationship.
childDS	Yes	Returns the child DbSet in the parent-child relationship.
onDeleteAction	Yes	Returns an enum value of what is the action to take when the parent entity is deleted, as it was defined in the metadata.

Working with the data on the server side

4.1 *The Data service*

The data service application is implemented in C# language and requires Microsoft Net Framework 4 be installed on the server side computer.

The data service implements a public interface which can be integrated into a web service framework, such as ASP.net.

```
public interface IDomainService: IDisposable
{
      //typescript strongly typed implementation of entities, DbSet and DbContext in the text form
      string ServiceGetTypeScript(string comment=null);
      string ServiceGetXAML();
      string ServiceGetCSharp();

     //information about permissions to execute service operations for the client
      PermissionsInfo ServiceGetPermissions();
      //information about service methods, DbSets and their fields information
      MetadataInfo ServiceGetMetadata();
      GetDataResult ServiceGetData(GetDataInfo getInfo);
      ChangeSet ServiceApplyChangeSet(ChangeSet changeSet);
      RefreshRowInfo ServiceRefreshRow(RefreshRowInfo getInfo);
      InvokeResult ServiceInvokeMethod(InvokeInfo parameters);
}
```

The interface contains methods which are invoked from the client (*using the DbContext type instance*).
The data service is usually hosted in ASP.NET MVC framework due to the web framework's very convenient design for the invocation of server side methods through Ajax calls.

RIAPP.DataService.Mvc assembly contains a descendant of *System.Web.Mvc.Controller* class: *DataServiceController*, which incapsulates the service methods invocations inside a mvc controller.

full implementation of the DataServiceController:

```
public abstract class DataServiceController<T> : Controller
        where T : BaseDomainService
{
        private readonly ISerializer _serializer;

        public DataServiceController()
        {
            this._serializer = new Serializer();
        }

        protected virtual IDomainService CreateDomainService()
        {
            ServiceArgs args = new ServiceArgs() { principal= this.User, serializer = this.Serializer };
            var service = (IDomainService)Activator.CreateInstance(typeof(T), args);
            return service;
        }

        private IDomainService _DomainService;

        [ChildActionOnly]
        public string Metadata()
        {
            var info = this.DomainService.ServiceGetMetadata();
            return this._serializer.Serialize(info);
        }

        [ChildActionOnly]
        public string PermissionsInfo()
        {
            var info = this.DomainService.ServiceGetPermissions();
            return this._serializer.Serialize(info);
        }

        [HttpGet]
        public ActionResult GetTypeScript()
        {
            string comment = string.Format("\tGenerated from: {0} on {1:yyyy-MM-dd HH:mm} at
{1:HH:mm}\r\n\tDon't make manual changes here, because they will be lost when this db interface will be
regenerated!", this.ControllerContext.HttpContext.Request.RawUrl, DateTime.Now);
            var info = this.DomainService.ServiceGetTypeScript(comment);
            var res = new ContentResult();
            res.ContentEncoding = System.Text.Encoding.UTF8;
            res.ContentType = System.Net.Mime.MediaTypeNames.Text.Plain;
            res.Content = info;
            return res;
        }

        [HttpGet]
        public ActionResult GetXAML()
        {
            var info = this.DomainService.ServiceGetXAML();
```

```
    var res = new ContentResult();
    res.ContentEncoding = System.Text.Encoding.UTF8;
    res.ContentType = System.Net.Mime.MediaTypeNames.Text.Plain;
    res.Content = info;
    return res;
}

[HttpGet]
public ActionResult GetCSharp()
{
    var info = this.DomainService.ServiceGetCSharp();
    var res = new ContentResult();
    res.ContentEncoding = System.Text.Encoding.UTF8;
    res.ContentType = System.Net.Mime.MediaTypeNames.Text.Plain;
    res.Content = info;
    return res;
}

[HttpPost]
public ActionResult GetPermissions()
{
    var info = this.DomainService.ServiceGetPermissions();
    return Json(info);
}

public ActionResult GetMetadata()
{
    var info = this.DomainService.ServiceGetMetadata();
    return Json(info, JsonRequestBehavior.AllowGet);
}

[HttpPost]
public ActionResult GetItems(GetDataInfo getInfo)
{
    return new IncrementalResult(this.DomainService.ServiceGetData(getInfo));
}

[HttpPost]
public ActionResult SaveChanges(ChangeSet changeSet)
{
    var res = this.DomainService.ServiceApplyChangeSet(changeSet);
    return Json(res);
}

[HttpPost]
public ActionResult RefreshItem(RefreshRowInfo getInfo)
{
    var res = this.DomainService.ServiceRefreshRow(getInfo);
    return Json(res);
}

[HttpPost]
public ActionResult InvokeMethod(InvokeInfo invokeInfo)
{
    var res = this.DomainService.ServiceInvokeMethod(invokeInfo);
    return Json(res);
}

protected IDomainService DomainService
{
    get
    {
        if (this._DomainService == null)
        {
            this._DomainService = this.CreateDomainService();
        }
        return this._DomainService;
```

```
        }
    }

    protected T GetDomainService()
    {
        return (T)this.DomainService;
    }

    public ISerializer Serializer
    {
        get { return this._serializer; }
    }

    protected override void Dispose(bool disposing)
    {
        if (disposing && this._DomainService != null)
        {
            this._DomainService.Dispose();
            this._DomainService = null;
        }
        base.Dispose(disposing);
    }
}
```

The base DataService class (*BaseDomainService*) is implemented in the *RIAPP.DataService* assembly. It is an abstract class, it has two abstract methods *GetMetadata* and *ExecuteChangeSet* which are needed to be implemented in the descendant.

For example, in the EFDomainService class (*which is designed to work with the Microsoft's Entity Framework*) the *ExecuteChangeSet* method saves updates in the System.Data.Objects.ObjectContext inside the transaction's scope.

```
protected override void ExecuteChangeSet()
{
        using (TransactionScope transScope = new TransactionScope(TransactionScopeOption.RequiresNew,
            new TransactionOptions { IsolationLevel = IsolationLevel.ReadCommitted, Timeout =
TimeSpan.FromMinutes(1.0) }))
        {
            this.DB.SaveChanges();

            transScope.Complete();
        }
}
```

The *GetMetadata* method should return *RIAPP.DataService.Metadata* class instance. The specialized data services which work with Microsoft Linq for SQL and Microsoft Entity Framework (*defined in RIAPP.DataService.Linq and RIAPP.DataService.EF respectively*). They take underlying *System.Data.Linq.DataContext* or *System.Data.Objects.ObjectContext* instance and extract the metadata information from it. But they produce only the raw metadata, which should be adjusted before exposing it to the clients.
The editing of the metadata is best done when it is in a human readable format - for example, XML. For this purpose you can override *ServiceGetXAML* method of the BaseDomainService class. This method is designed to provide XAML version of the metadata. The DataService (*RIAppDemoService*) in the demo application provides an example of this method.

full implementation of the ServiceGetXAML method in the DEMO:

```
public override string ServiceGetXAML()
{
        var metadata = base.GetMetadata();
        var xaml = System.Windows.Markup.XamlWriter.Save(metadata);
        XNamespace data = "clr-namespace:RIAPP.DataService;assembly=RIAPP.DataService";
        XNamespace dal = "clr-namespace:RIAppDemo.DAL;assembly=RIAppDemo.DAL";

        XElement xtree = XElement.Parse(xaml);
        foreach (XElement el in xtree.DescendantsAndSelf())
        {
           el.Name = data.GetName(el.Name.LocalName);
           if (el.Name.LocalName == "Metadata")
           {
              List<XAttribute> atList = el.Attributes().ToList();
              el.Attributes().Remove();
           }
           else if (el.Name.LocalName == "DbSetInfo")
           {
              XAttribute entityTypeAttr = el.Attributes().Where(a => a.Name.LocalName == "EntityType").First();
              entityTypeAttr.Value = string.Format("{{x:Type {0}}}", entityTypeAttr.Value);
           }

        }
        xtree.Add(new XAttribute(XNamespace.Xmlns + "data", "clr-
namespace:RIAPP.DataService;assembly=RIAPP.DataService"));
        return xtree.ToString();
}
```

After the *ServiceGetXAML* method is implemented you can get XAML representation of the metadata. Just navigate to GetXAML url in the browser like in the example *http://localhost:4264/RIAppDemoService/GetXAML*
After getting the XAML you can paste it inside the WPF user control resource (*for example, in the DEMO inside the file RIAppDemo.BLL\DataServices\RIAppDemoMetadata.xaml*)

If you get XAML version of the metadata and use it inside WPF user control, you can simplify the GetMetadata method of the DataService by returning the metadata obtained from the WPF control.

```
protected override Metadata GetMetadata()
{
        //returns raw (unedited) metadata from the base class implementation
        //return base.GetMetadata();

        //returns corrected metadata from WPF control
        return  (Metadata)(new RIAppDemoMetadata().Resources["MainDemo"]);
}
```

Note: *The good part of storing metadata in XAML form is that is agnostic to the technology with with the DataService works. It can be a Linq for SQL, an Entity framework, an ADO NET or any other technology.*

The DataService classes typically implement query methods, which are distinguished from the other methods by using Query attribute on them.

```
[Query]
public QueryResult<Product> ReadProduct(int[] param1, string param2)
{
        int? totalCount = null;
        var res = this.QueryHelper.PerformQuery(this.DB.Products,this.CurrentQueryInfo, ref
totalCount).AsEnumerable();
        var queryResult = new QueryResult<Product>(res, totalCount);
```

```
        //example of adding out of band information to the result and use it on the client (of course, it can be more
useful than this)
        queryResult.extraInfo = new { test = "ReadProduct Extra Info: " + DateTime.Now.ToString("dd.MM.yyyy
HH:mm:ss") };

        return queryResult;
 }
```

The query methods return QueryResult. In order to simplify the querying, there is a QueryHelper class, which can be used to perform queries in more generic way. It can take result of *this.CurrentQueryInfo* property, and use it to filter and sort the result of the query. Also this method can take arbitrary parameters, which can be used for custom filtering or for executing stored procedures.

One DbSet can have several query methods with different names (*no overloading*). For example the Product DbSet in the DEMO application have another query method which returns products by their ids.

```
[Query]
public QueryResult<Product> ReadProductByIds(int[] productIDs)
{
        int? totalCount = null;
        var res = this.DB.Products.Where(ca => productIDs.Contains(ca.ProductID));
        return new QueryResult<Product>(res, totalCount);
}
```

Query methods (*like the described ReadProduct method*) can also return an out of band info (*which is automatically serialized into json along with the query result*). The out of band info can include any information which can be used on the client for testing and other application development purposes.

If the query can return a large number of rows then you can set in the metadata for this DbSet the batch size of the rows fetching: FetchSize. Then the DataService will send the data in batches, not exceeding the set FetchSize.

an example of setting the fetchsize for product entities:

```
<data:DbSetInfo dbSetName="Product" isTrackChanges="True"
validateDataMethod="Validate{0}" refreshDataMethod="Refresh{0}"
insertDataMethod="Insert{0}" updateDataMethod="Update{0}" deleteDataMethod="Delete{0}"
enablePaging="True" pageSize="100" FetchSize="2000"  EntityType="{x:Type dal:Product}">
```

Aside from query methods, there can be a set of CRUD methods (*they are optional*) to perform inserts, deletes and updates on the entities. Their names are defined in the DbSet's metadata as insertDataMethod ,updateDataMethod, deleteDataMethod.

They usually have templated names, such as Insert{0}. The real name is got by replacing {0} with dbSetName.

Aside from the query and CRUD methods there are 3 more special types of methods which can be used in the data service: The refresh methods, the custom validation methods and the service methods (*which can be invoked from clients directly by their name*).

The refresh methods

are used to refresh an entity with the data from the service. The refresh can be also made by using a query method, but the refresh methods are more convenient to use from the client (*just use entity's refresh method*). The refresh method (*for a DbSet*)can be set in the metadata as refreshDataMethod property value.

an example of the refresh method implementation:

```
public Product RefreshProduct(RefreshRowInfo refreshInfo)
{
   return this.QueryHelper.GetRefreshedEntity<Product>(this.DB.Products, refreshInfo);
}
```

The Custom validation methods

are used to validate an entity when custom validation is needed. The validation method (*for a DbSet*) can be set in the metadata as validateDataMethod property value.

The Service methods

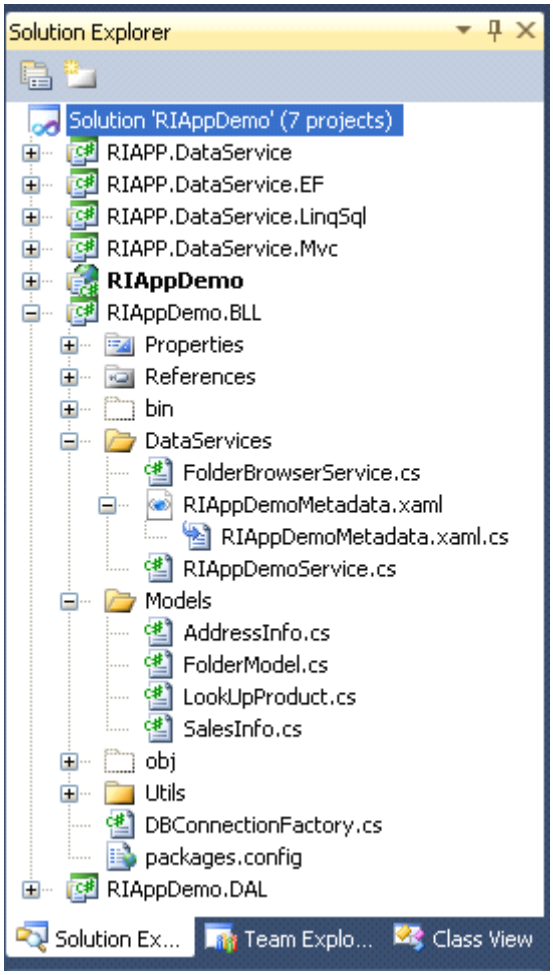
are used to be executed from the client, to make some sort of processing on the server and optionally to return a result. These methods are distinguished from the other ones by the Invoke attribute. They can also have the Authorize attribute.

```
[Invoke()]
 public string TestInvoke(byte[] param1, string param2)
 {
         StringBuilder sb = new StringBuilder();

         Array.ForEach(param1, (item) => {
            if (sb.Length > 0)
               sb.Append(", ");
            sb.Append(item);
         });

         /*
         int rand = (new Random(DateTime.Now.Millisecond)).Next(0, 999);
         if ((rand % 3) == 0)
            throw new Exception("Error generated randomly for testing purposes. Don't worry! Try again.");
         */

         return string.Format("TestInvoke method invoked with<br/><br/><b>param1:</b> {0}<br/> <b>param2:</b>
{1}", sb, param2);
 }

 [Invoke()]
 public void TestComplexInvoke(AddressInfo info, KeyVal[] keys)
  {
         //p.s. do something with info and keys
  }
```

The Data Service's Metadata

as it was said above it is usually defined in the form of a WPF user control's resources by using a XAML markup. For the metadata and the data services it is better to use a separate assembly (*class library*) in the solution.
In the demo application they were put in *RIAppDemo.BLL* class library project.
RIAppDemoMetadata.xaml is the WPF user control that contains the metadata.
RIAppDemoService.cs - file contains the DataService for demo project.
FolderBrowserService.cs - file contains the DataService for file and folder browser demo.

A view of the demo application from the VS2012 solution explorer (*with RIAppDemoMetadata.xaml file visible*):



The ASP.Net MVC project *RIAppDemo* includes in references the *RIAppDemo.BLL* library.
In the ASP.NET MVC project the DataServices are exposed through MVC controllers. First the web request from the client hits the controller and then the controller relays that request to the DataService.

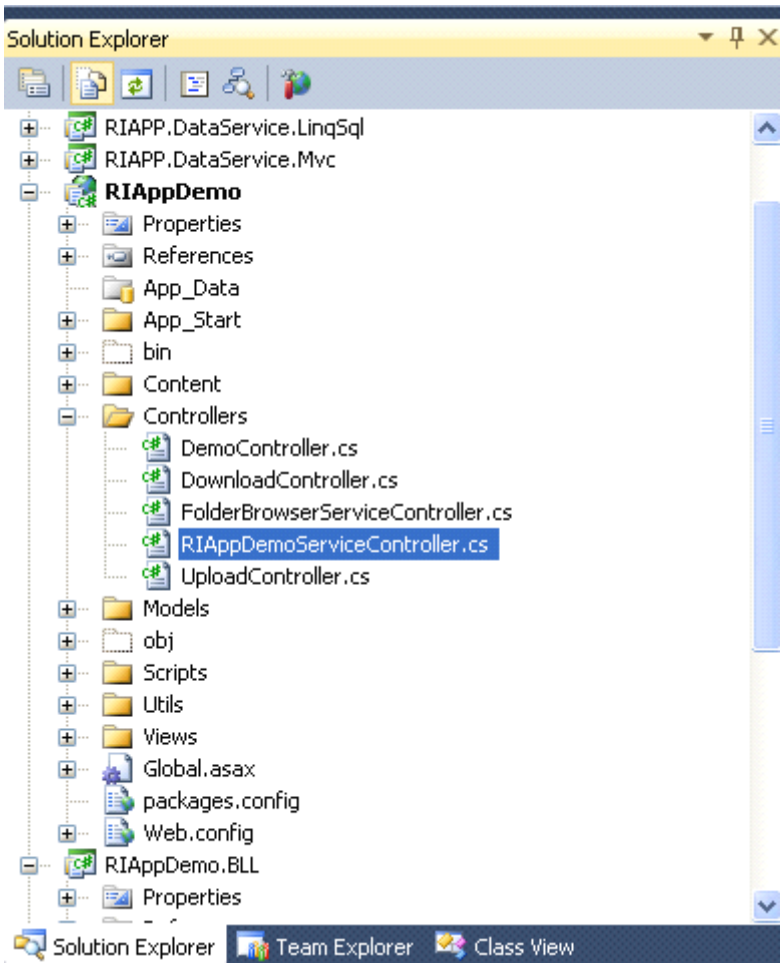
an example of the MVC controller implementation (from Demo project):

```
public class RIAppDemoServiceController : DataServiceController<RIAppDemoService>
{
        [ChildActionOnly]
        public string ProductModelData()
        {
            var info = this.GetDomainService().GetQueryData("ProductModel",
"ReadProductModel");
            return this.Serializer.Serialize(info);
        }

        [ChildActionOnly]
        public string ProductCategoryData()
        {
            var info = this.GetDomainService().GetQueryData("ProductCategory",
"ReadProductCategory");
            return this.Serializer.Serialize(info);
        }

}
```

Note: *You can add to the service controller any methods you need. For example the above controller includes to custom methods which are used on the page. They are used there to include the lookup data into the page, and not to request it using ajax requests.*

```
ops.modelData = @Html.Action("ProductModelData", "RIAppDemoService");
ops.categoryData = @Html.Action("ProductCategoryData", "RIAppDemoService");
```

A view of the RIAppDemoService controller in the RIAppDemo MVC project:



Every metadata definition for the data service has a key (*unique name*) by which it is taken from the control in the DataService's *GetMetadata* method.

```
protected override Metadata GetMetadata()
{
    return (Metadata)(new RIAppDemoMetadata().Resources["MainDemo"]);
}
```

Note: *The above method is executed in the STA thread by the DataService, and the metadata is cached inside the data service so this method is executed only on the first request .*

The Metadata class contains two collections: *DbSets* and *Associations.*
the DbSets collection contains DbSetInfo typed items (*which represent entities*), which in their turn contain collection of the FieldInfo items (*which represent entity's fields*).

Inside FieldInfo contains attributes of the field: its name, its data type and the other attributes. The FieldInfo is initialized with default attribute values:

```
this.isPrimaryKey = 0;
this.isRowTimeStamp = false;
this.dataType = DataType.None;
this.isNullable = true;
this.maxLength = -1;
this.isReadOnly = false;
this.isAutoGenerated = false;
this.allowClientDefault = false;
this.dateConversion = DateConversion.None;
this.isClientOnly = false;
this.isCalculated = false;
this.isNeedOriginal = true;
/*
        this.range = null;
        this.regex = null;
*/
```

Their meaning are clear from their names.
But several attributes need some explanations:

isPrimaryKey - is an integer typed attribute. So if you have two fields which are in a composite primary key, then for the first field it is set isPrimaryKey=1 and for the second isPrimaryKey=2. Each entity must have a primary key to uniquely identify the entity. Primary key fields are not editable (*readonly*), and should be generated on the server when a new entity is added. The other way is generate values for the primary key on the client side. In that case you need to allow the field assignment on the client (*for new entities only*) that is done by setting *allowClientDefault=true.* The dateConversion attribute determines how dates values between the server and the client is done. You can choose between three values.

```
public enum DateConversion : int
{
    None=0, ServerLocalToClientLocal=1, UtcToClientLocal=2
}
```

The first option means that no conversion is performed. The remaining two options take the server and the client timezones into consideration.
For example, if you choose *ServerLocalToClientLocal* then the date values will be converted from the server local time to the client local time (*and vice versa*).
If you choose *UtcToClientLocal* (*Note: make sure the dates on the server are really UTC*), then the dates values will be converted from UTC to the client local time zone (*and vice versa*).
This is helpful for distributed applications, because clients and servers can be in different time zones, and the dates will be displayed to the client in its own timezone.

isNeedOriginal - the default is true. By setting it to false can conserve a little of bandwidth. But it can be done carefully , because if you set *isNeedOriginal* attribute to false for the fields which needs original values on submit (*for optimistic concurency check*) - the the update will fail, saying that the row was modified before you applied the updates.

isAutoGenerated - prevents the field to accept updates from the client (*it ignores them*).

isRowTimeStamp - This attribute is used to mark the field that it always needs original

values for updates. The field's original value always returns to the client on submit operation. The field is usually *readOnly* on the client.

range - the attribute is used to set accepted range of values for automatic validation. For example, range="100,5000" or for dates, range="2000-01-01,2015-01-01"
regex - the attribute is used to set regular expression for automatic validation.
For example, regex="^[_a-z0-9-]+(\.[_a-z0-9-]+)*@[a-z0-9-]+(\.[a-z0-9-]+)*(\.[a-z]{2,4})$"

The Associations

An association defines foreign key references and navigation fields names.

There exist two ways of loading related entities to the client.
The first one is to include related entities to the result of a query method.

An example of inclusion of the related entities in the result:

```
[Query]
public QueryResult<Customer> ReadCustomer(bool? includeNav)
{
        string[] includeHierarchy = new string[0];
        if (includeNav == true)
        {
            DataLoadOptions opt = new DataLoadOptions();
            opt.LoadWith<Customer>(m => m.CustomerAddresses);
            opt.LoadWith<CustomerAddress>(m => m.Address);
            this.DB.LoadOptions = opt;

            //we can conditionally include entity hierarchy into results
            //making the path navigations decisions on the server enhances security
            //we can not trust clients to define navigation's expansions because it can influence the server performance
            //and is not good from security's standpoint
            includeHierarchy = new string[] { "CustomerAddresses.Address" };
        }

        int? totalCount = null;
        var res = this.QueryHelper.PerformQuery(this.DB.Customers, this.CurrentQueryInfo, ref
totalCount).AsEnumerable();
        return new QueryResult<Customer>(res, totalCount, includeHierarchy);
}
```

But this option is not always the best. This usually complicates queries and slows query execution in real world applications. In many cases it is better to load child and parent entities from the client using separate queries.
For example, we can load first the Customer entities, then we can execute another query to load the CustomerAddress entities for the loaded customers.

```
[Query]
 public QueryResult<CustomerAddress> ReadAddressForCustomers(int[] custIDs)
 {
        int? totalCount = null;
        var res = this.DB.CustomerAddresses.Where(ca => custIDs.Contains(ca.CustomerID));
        return new QueryResult<CustomerAddress>(res, totalCount);
  }
```

and then we can load the addresses by their keys.

```
[Query]
 public QueryResult<Address> ReadAddressByIds(int[] addressIDs)
 {
```

```
        int? totalCount = null;
        var res = this.DB.Addresses.Where(ca => addressIDs.Contains(ca.AddressID));
        return new QueryResult<Address>(res, totalCount);
}
```

The Authorization

The authorization can be applied on two levels - the data service class level and a method's level.
To make it work you need to annotate the data service class or a method with the Authorize attribute. The Authorize attribute can include roles. Without including the roles it is simply checked that the user is authenticated. the Authorize attribute is optional, and when it is not applied then it is assumed that the access is allowed on that level.

First the access is checked at the data service level, and if it is not allowed, there are no further checks except if the a method is annotated with the AllowAnonymous attribute. In that case the access to the method is allowed.

At the next level (*method's level*) which encompasses query methods, CRUD methods, refresh and service (*invoke*) methods attributes checks, the authorization checks method level permissions.

```
[Authorize()]
public class RIAppDemoService : LinqForSqlDomainService<RIAppDemoDataContext>
{
  private const string USERS_ROLE = "Users";
  private const string ADMINS_ROLE = "Admins";

 [Query]
  public QueryResult<Customer> ReadCustomer()
  {
          int? totalCount = null;
         var res = this.QueryHelper.PerformQuery(this.DB.Customers, this.CurrentQueryInfo,
           ref totalCount).AsEnumerable();
         return new QueryResult<Customer>(res, totalCount);
}

 [Authorize(Roles = new string[] { ADMINS_ROLE })]
 public void InsertCustomer(Customer customer)
      {
         customer.PasswordHash = "";
         customer.PasswordSalt = "";
         customer.ModifiedDate = DateTime.Now;
         customer.rowguid = Guid.NewGuid();
         this.DB.Customers.InsertOnSubmit(customer);
}

 [Authorize(Roles = new string[] { ADMINS_ROLE })]
 public void UpdateCustomer(Customer customer)
 {
         Customer orig = this.GetOriginal<Customer>();
         this.DB.Customers.Attach(customer, orig);
}

 [Authorize(Roles = new string[] { ADMINS_ROLE })]
 public void DeleteCustomer(Customer customer)
 {
         this.DB.Customers.Attach(customer);
         this.DB.Customers.DeleteOnSubmit(customer);
}

 public Customer RefreshCustomer(RefreshRowInfo refreshInfo)
 {
         return this.QueryHelper.GetRefreshedEntity<Customer>(this.DB.Customers, refreshInfo);
```

```
}

[AllowAnonymous()]
[Query]
public QueryResult<ProductCategory> ReadProductCategory()
{
        int? totalCount = null;
        var res = this.QueryHelper.PerformQuery(this.DB.ProductCategories, this.CurrentQueryInfo,
          ref totalCount).AsEnumerable();
        return new QueryResult<ProductCategory>(res, totalCount);
}
```

The authorization behaviour can be extended (*or replaced*) by creating a custom authorizer which implements the IAuthorizer interface.

```
public interface IAuthorizer
{
  void CheckUserRightsToExecute(IEnumerable<MethodInfo> methods);
  void CheckUserRightsToExecute(MethodInfo method);
  System.Security.Principal.IPrincipal principal { get; }
  Type serviceType { get; }
}
```

The BaseDomainService class has a virtual method which creates and returns the authorizer instance. This method can be overridden in the descendants.

```
protected virtual IAuthorizer CreateAuthorizer()
{
    return new AuthorizerClass(this.GetType(), this.CurrentPrincipal);
}
```

Change Tracking

The BaseDomainService has a virtual method OnTrackChange which can be overridden in the DataService. This method provides three arguments which can be used to get information about the entity values changes. The diffgram parameter contains a map of changes in xml form. You must set in the metadata for the DbSet *isTrackChanges* attribute to true, so this type of the entity should be tracked.

```
/// <summary>
 /// here can be tracked changes to the entities
 /// for example: product entity changes is tracked and can be seen here
 /// </summary>
 protected override void OnTrackChange(string dbSetName, ChangeType changeType, string diffgram)
 {
        /// can log changes here
 }
```

an example of a diffgram for the Product entity:

```
<changes>
  <Name old="Classic Vest, L2" new="Classic Vest, L3" />
  <StandardCost old="23.749" new="23.74" />
  <ListPrice old="63.5" new="100" />
  <Size old="L" new="M" />
</changes>
```

Error logging in the data service

The Error logging can be implemented in the data service by overriding OnError method. Each unhandled error can be seen in this method.

```
protected override void OnError(Exception ex)
{
   //Error logging could be implemented here
}
```

Disposing resources used by the data service (cleanup)

The data service has a Dispose method which can be overridden to clean up additional resources.

an example of an overridden Dispose method:

```
  protected override void Dispose(bool isDisposing)
  {
        if (this._connection != null)
        {
           this._connection.Close();
           this._connection = null;
        }

        base.Dispose(isDisposing);
   }
```

Obtaining a raw implementation of the data service's methods (code generation)

The data service has the ServiceGetCSharp method. It is not implemented in the base data service. The demo's RIAppDemoService implements this method as an example.

```
/// <summary>
      /// this METHOD should be commented, in release version!
      /// this is a helper method which can be used to create c# data service methods from metadata
      /// this C# code can be later pasted in the data service implemetation
      /// and of course it needs to be corrected, but it is faster than to type all this from the start in code editor
/// </summary>
public override string ServiceGetCSharp()
{
       var metadata =  this.ServiceGetMetadata();
       return RIAPP.DataService.LinqSql.Utils.DataServiceMethodsHelper.CreateMethods(metadata, this.DB);
}
```

Navigating in browser (*for the demo application*)
http://localhost:4264/RIAppDemoService/GetCSharp
will return crude methods implementation for the data service.

Note: The Entity framework version of the DataService has a similar helper class in the *RIAPP.DataService.EF.Utils* namespace.