ComponentOne

OLAP for WPF and Silverlight

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OLAP for WPF and Silverlight Overview

Deliver in-depth business intelligence (BI) functionality with **OLAP for WPF and Silverlight**. Create pivot grids and charts that slice and dice your tabular and cube data to give you real-time information, insights, and results in seconds. The easy to use controls are modeled after Microsoft Excel® Pivot Tables, so they're powerful and familiar for all users.

> **Note: ComponentOne OLAP for WPF and Silverlight** controls (**C1OlapPage**, **C1OlapPanel**, **C1OlapGrid** and **C1OlapChart**) require a separate **OLAP for** WPF and Silverlight license in order to run without unlicensed messages.

What is C1Olap

OLAP for WPF and Silverlight is a suite of Silverlight controls that provide analytical processing features similar to those found in Microsoft Excel's Pivot Tables and Pivot Charts. Asynchronous processing improves the performance of the controls as multiple processes can occur simultaneously on separate threads.

For example: In case of synchronous processing, when you make any heavy update, the entire application stops responding to any action made by the user till the update is completed. In case of C1Olap, that supports asynchronous processing, when you make any heavy update (such as adding multiple fields to row or column box of a C1OlapPage), the application responds to all user actions even while the update is in progress.


Asynchronous processing is available in WPF only.

OLAP for WPF and Silverlight takes raw data in any format and provides an easy-to-use interface so users can quickly and intuitively create summaries that display the data in different ways, uncovering trends and providing valuable insights interactively. As the user modifies the way in which he wants to see the data, **OLAP for WPF and Silverlight** instantly provides pivot grids and charts (and soon reporting) that can be saved, exported, or printed.

Introduction to OLAP

OLAP means "online analytical processing". It refers to technologies that enable the dynamic visualization and analysis of data.

Typical OLAP tools include "OLAP cubes" and pivot tables such as the ones provided by Microsoft Excel. These tools take large sets of data and summarize it by grouping records based on a set of criteria. For example, an OLAP cube might summarize sales data grouping it by product, region, and period. In this case, each grid cell would display the total sales for a particular product, in a particular region, and for a specific period. This cell would normally represent data from several records in the original data source.

OLAP tools allow users to redefine these grouping criteria dynamically (on-line), making it easy to perform ad-hoc analysis on the data and discover hidden patterns.

For example, consider the following table:

Date	Product	Region	Sales
Oct 2007	Product A	North	12
Oct 2007	Product B	North	15
Oct 2007	Product C	South	4
Oct 2007	Product A	South	3
Nov 2007	Product A	South	6
Nov 2007	Product C	North	8
Nov 2007	Product A	North	10
Nov 2007	Product B	North	3

Now suppose you were asked to analyze this data and answer questions such as:

- Are sales going up or down?
- Which products are most important to the company?
- Which products are most popular in each region?

In order to answer these simple questions, you would have to summarize the data to obtain tables such as these:

Sales by Date and by Product

Date	Product A	Product B	Product C	Total
Oct 2007	15	15	4	34
Nov 2007	16	3	8	27
Total	**31**	**18**	**12**	**61**

Sales by Product and by Region

Product	North	South	Total

Product A	22	9	31
Product B	18		18
Product C	8	4	12
Total	**48**	**13**	**61**

Each cell in the summary tables represents several records in the original data source, where one or more values fields are summarized (sum of sales in this case) and categorized based on the values of other fields (date, product, or region in this case).

This can be done easily in a spreadsheet, but the work is tedious, repetitive, and error-prone. Even if you wrote a custom application to summarize the data, you would probably have to spend a lot of time maintaining it to add new views, and users would be constrained in their analyses to the views that you implemented.

OLAP tools allow users to define the views they want interactively, in ad-hoc fashion. They can use pre-defined views or create and save new ones. Any changes to the underlying data are reflected automatically in the views, and users can create and share reports showing these views. In short, OLAP is a tool that provides flexible and efficient data analysis.

Key Features

The following are some of the main features of **OLAP for WPF and Silverlight** that you may find useful:

- **OLAP for WPF and Silverlight provides ultimate flexibility for building OLAP applications**
  Drop one control, C1OlapPage, on your form and set the data source to start displaying your data in a grid or chart–it's that easy! But suppose you need to show multiple charts or grids. No problem. **OLAP for WPF and Silverlight** also provides the C1OlapPanel, C1OlapChart, and C1OlapGrid controls to give you the flexibility you need. See the C1Olap Architecture topic for an overview of each of the controls.
- **Choose from five chart types and twenty-two palette options to enhance your charts**
  C1OlapChart provides the most common chart types to display your information, including: Bar, Column, Area, Line, and Scatter. You can select from twenty-two palette options that define the colors of the chart and legend items. See Using the Chart Menu to view all of the chart types and palettes.
- **Print, preview, or export data to PDF**
  You can create and preview reports containing data, grids, or charts and then print or export them to PDF. See Creating a Report and the OLAP for WPF and Silverlight Task-Based Help for more information.
- **Remove a field or data in a field from the grid or chart view**
  You can easily filter a field so it doesn't appear in your grid or chart view. Simply drag the field to the **Filter** area of a C1OlapPanel; see Removing a Field from a Data View for more information. If you want to filter on data in a field, for example, if you want to find all employees whose last names start with "Sim", you can use the **Field Settings** dialog box. See Filtering Data in a Field for detailed steps.
- **Display information in a grid or chart view**
  OLAP for WPF and Silverlight provides a C1OlapGrid and C1OlapChart control to display data. These controls are built into the C1OlapPage control, but they are also available as separate controls so you can customize your OLAP application. See the C1Olap Architecture topic for an overview of each of the controls.
- **Decide how information is displayed at run time**
  Use the C1OlapPanel to determine which fields of your data source should be used to display your data and how. Drag fields between the lower areas of the C1OlapPanel to create a filter, column headers, row headers, or get the sum of values from a column or row. See the C1OlapPanel topic for more information.
- **OLAP for WPF provides cube support**
  Olap (C1Olap) allows you to connect to OLAP data sources from Microsoft® SQL Server® Analysis Services (SSAS). Build a complete front-end or dashboard for your database using OLAP while writing just a couple lines of code. With **C1Olap**, users can build a multi-dimensional pivot table that slices and dices the dimensions, measures and Key Performance Indicators (KPIs) present in the OLAP cube. See OLAP Cubes for more information on cube support.
- **Asynchronous Processing**: Multiple processes can run simultaneously and independent of each other.

  > Asynchronous processing is available in WPF only.

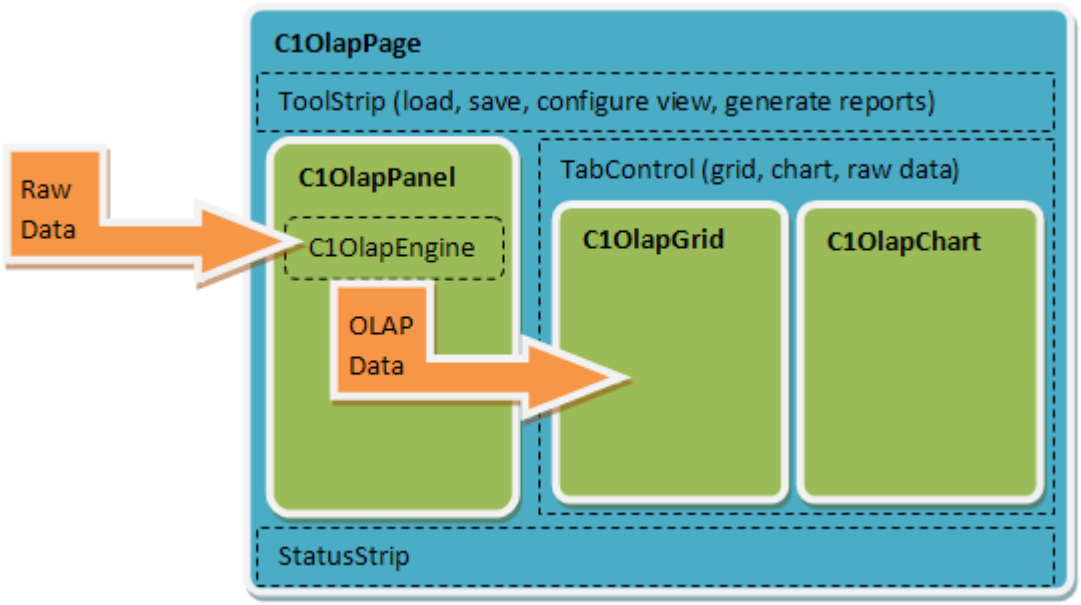
C1Olap Architecture

OLAP includes the following controls:

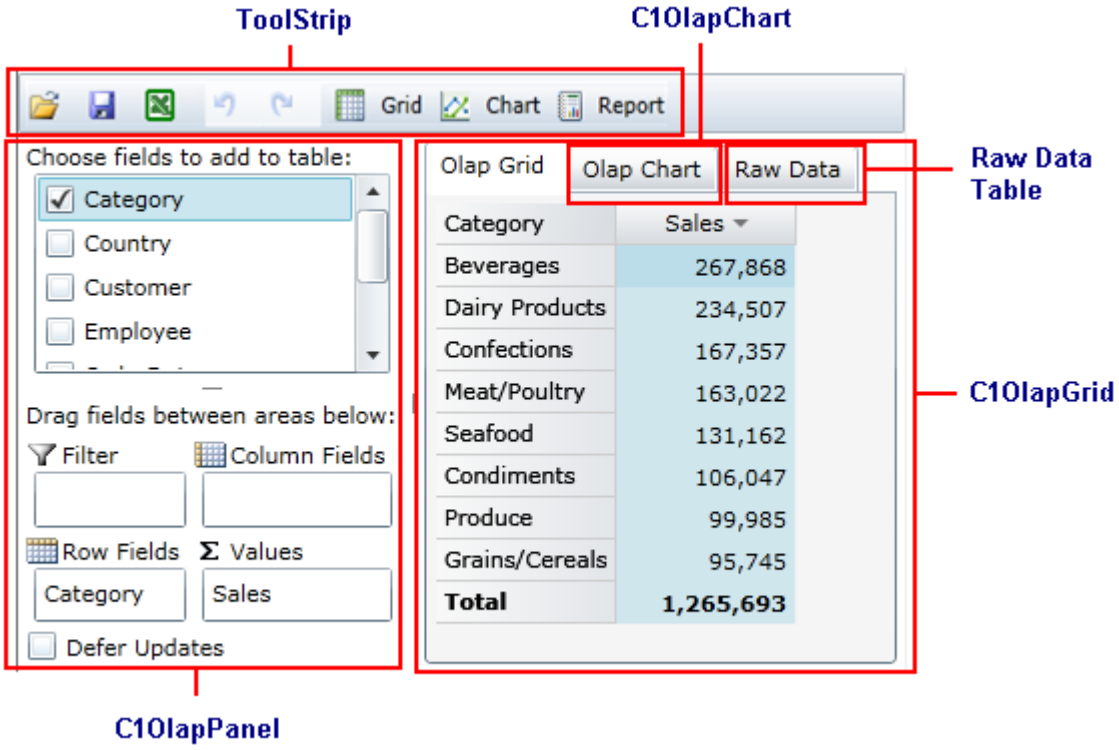
C1OlapPage

The C1OlapPage control is the easiest way to develop OLAP applications quickly and easily. It provides a complete OLAP user interface built using the other controls in C1OlapGrid. The C1OlapPage object model exposes the inner controls, so you can easily customize it by adding or removing interface elements. If you want more extensive customization, the source code is included and you can use it as a basis for your own implementation.

The diagram below shows how the C1OlapPage is organized:



In Visual Studio, the control looks like this:



C1OlapPanel

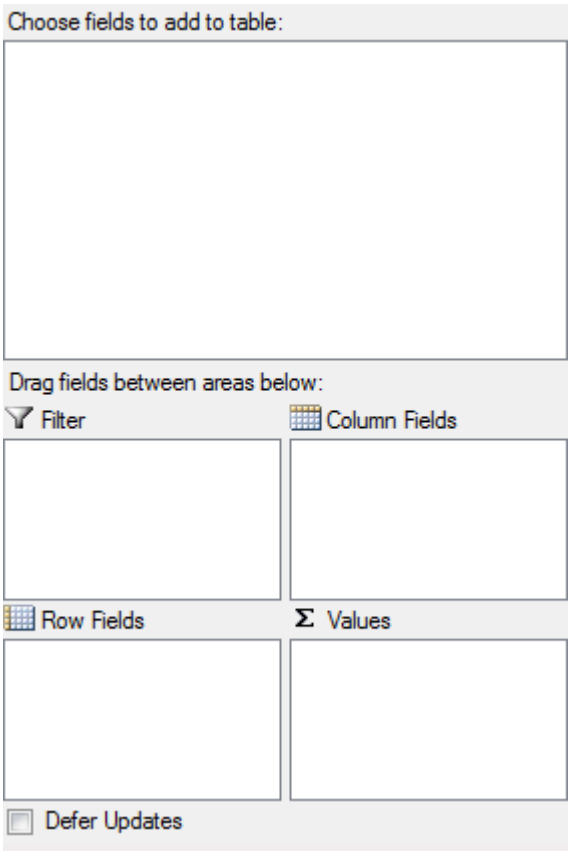
The C1OlapPanel control is the core of the C1OlapGrid product. It has a **DataSource** property that takes raw data as input, and an **PivotTable** property that provides custom views summarizing the data according to criteria provided by the user. The **PivotTable** is a regular **DataTable** object that can be used as a data source for any regular control.

The C1OlapPanel also provides the familiar, Excel-like drag and drop interface that allows users to define custom views of the data. The control displays a list containing all the fields in the data source, and users can drag the fields to lists that represent the row and column dimensions of the output table, the values summarized in the output data cells, and the fields used for filtering the data.

At the core of the C1OlapPanel control, there is a C1OlapEngine object that is responsible for summarizing the raw data according to criteria selected by the user. These criteria are represented by C1OlapField objects, which contain a connection to a specific column in the source data, filter criteria, formatting and summary options. The user creates custom views by dragging C1OlapField objects from the source **Fields** list to one of four auxiliary lists: the **RowFields**, **ColumnFields**, **ValueFields**, and **FilterFields** lists. Fields can be customized using a context menu.

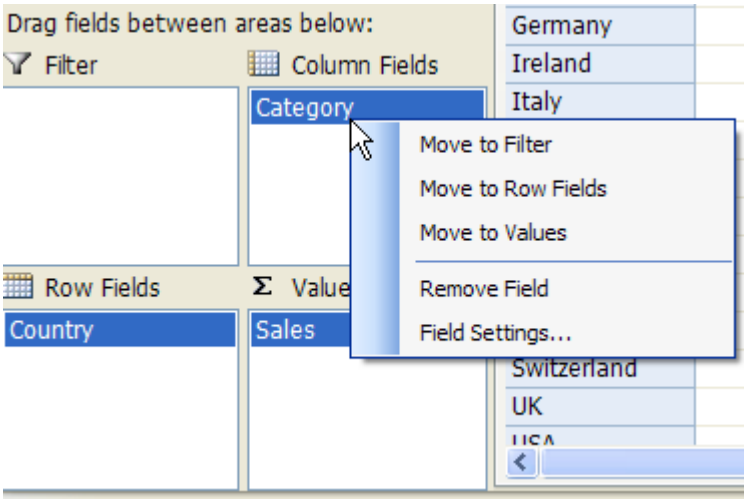
Notice that the C1OlapGrid architecture is open. The C1OlapPanel takes any regular collection as a **DataSource**, including data tables, generic lists, and LINQ enumerations; it then summarizes the data and produces a regular **DataTable** as output. C1OlapGrid includes two custom controls that are optimized for displaying the OLAP data, the C1OlapGrid and C1OlapChart, but you could use any other control as well.

The C1OlapPanel looks like this:



C1OlapPanel Area	Description
Filter	Specifies the field to filter.
Row Field	The items in the field specified become the row headers of a grid. These items populate the Y-axis in a chart.
Column Fields	The items in the field specified become the column headers of a grid. These items are used to populate the legend in a chart.
Values	Shows the sum of the field specified.
Defer Updates	Suspends the automatic updates that occur while the user modifies the view definition when this checkbox is selected.

If you right-click fields in the **Filter**, **Column Fields**, **Row Fields**, or **Values** area at run time, a context menu appears, allowing you to move the field to a different area. You can also remove the field or click **Field Settings** to format and apply a filter to the field. See Filtering Data in a Field for more information.



C1OlapGrid

The C1OlapGrid control is used to display OLAP tables. It extends the **C1FlexGrid** control and provides automatic data binding to C1OlapPanel objects, grouped row and column headers, as well as custom behaviors for resizing columns, copying data to the clipboard, and showing details for any given cell.

The C1OlapGrid control extends the **C1FlexGrid** control, our general-purpose grid control. This means the whole **C1FlexGrid** object model is also available to C1OlapGrid users. For example, you can export the grid contents to Excel or use styles and owner-draw cells to customize the grid's appearance.

To populate C1OlapGrid, bind it to a C1OlapPanel that is bound to a data source. See Binding C1OlapGrid to a C1OlapPanel for steps on how to do this.

For information on **C1FlexGrid** control, see FlexGrid for WPF and Silverlight documentation.

C1OlapChart

The C1OlapChart control is used to display OLAP charts. It extends the **C1Chart** control and provides automatic data binding to C1OlapPanel objects, automatic tooltips, chart type and palette selection.

The C1OlapChart control extends the **C1Chart** control, our general-purpose charting control. This means the whole **C1Chart** object model is also available to C1OlapGrid users. For example, you can export the chart to different file formats including PNG and JPG or customize the chart styles and interactivity.

To populate C1OlapChart, bind it to a C1OlapPanel that is bound to a data source. See Binding C1OlapChart to a C1OlapPanel for steps on how to do this.

For information on the **C1Chart** control, see Chart for WPF and Silverlight documentation.

C1OlapPrintDocument

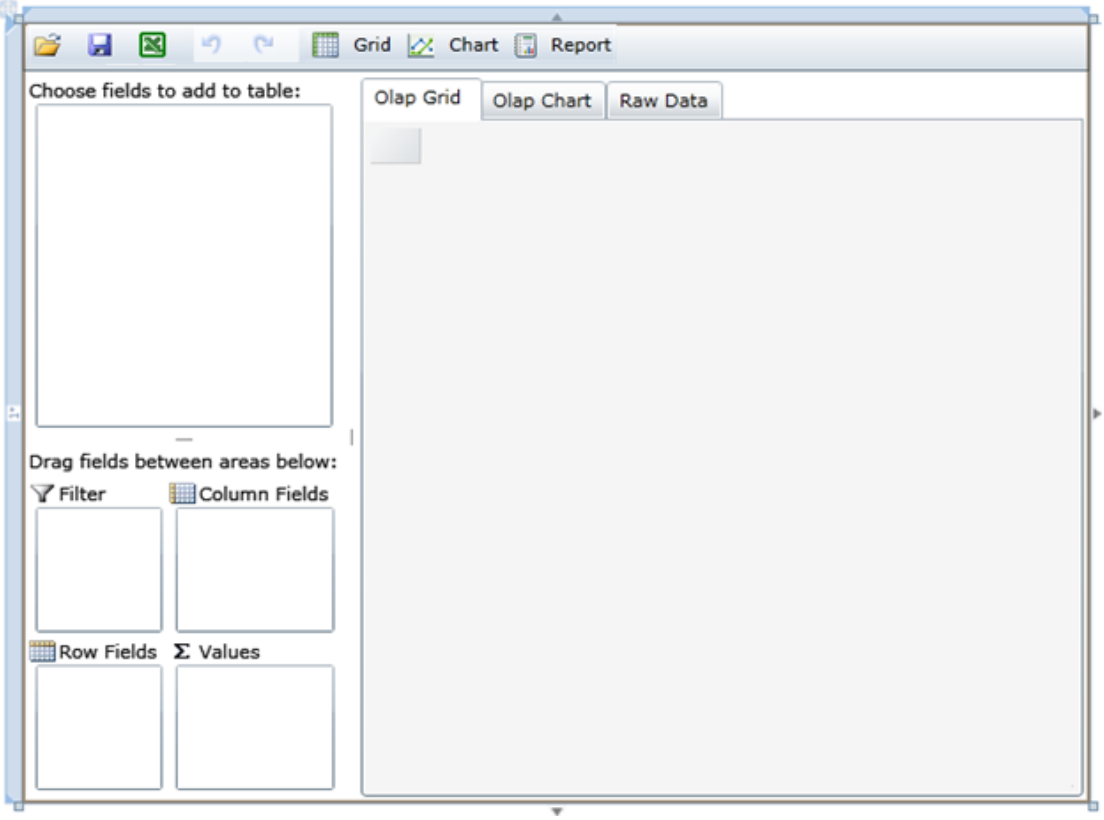
The **C1OlapPrintDocument** component is used to create reports based on OLAP views. It extends the **PrintDocument** class and provides properties that allow you to specify content and formatting for showing OLAP grids, charts, and the raw data used to create the report.

C1Olap Quick Start

This section presents code walkthroughs that start with the simplest WPF or Silverlight application and progress to introduce commonly used features.

A simple OLAP application

To create the simplest **C1OLAP** application, start by creating a new WPF or Silverlight application and dragging a C1OlapPage control onto the page. Allow the C1OlapPage control to fill the entire page by removing all margin and alignment settings.



Now, let us set a data source for the application.

For this sample, we load Northwind product data from an XML data schema file. We use **ComponentOne Data** , which provides us the familiar DataSet and DataTable objects to read the data in. We also use **ComponentOne Zip** to unpackage the zipped XML file on the client.

Visual Basic

```
' load data from embedded zip resource
Dim ds = New DataSet()
Dim asm = Assembly.GetExecutingAssembly()
Using s = asm.GetManifestResourceStream("OlapQuickStart.nwind.zip")

    Dim zip = New C1ZipFile(s)
    Using zr = zip.Entries(0).OpenReader()

        ' load data
```

```
        ds.ReadXml(zr)
    End Using
End Using
```

C#

```
// load data from embedded zip resource
var ds = new DataSet();
var asm = Assembly.GetExecutingAssembly();
using (var s = asm.GetManifestResourceStream("OlapQuickStart.nwind.zip"))
       {
 var zip = new C1ZipFile(s);

        using (var zr = zip.Entries[0].OpenReader())
         {
             // load data
             ds.ReadXml(zr);
         }
   }
```

Then we simply set the **DataSource** property on the C1OlapPage control. We could use any data binding method with this control.

Visual Basic

```
' bind olap page to data
_c1OlapPage.DataSource = ds.Tables(0).DefaultView
```

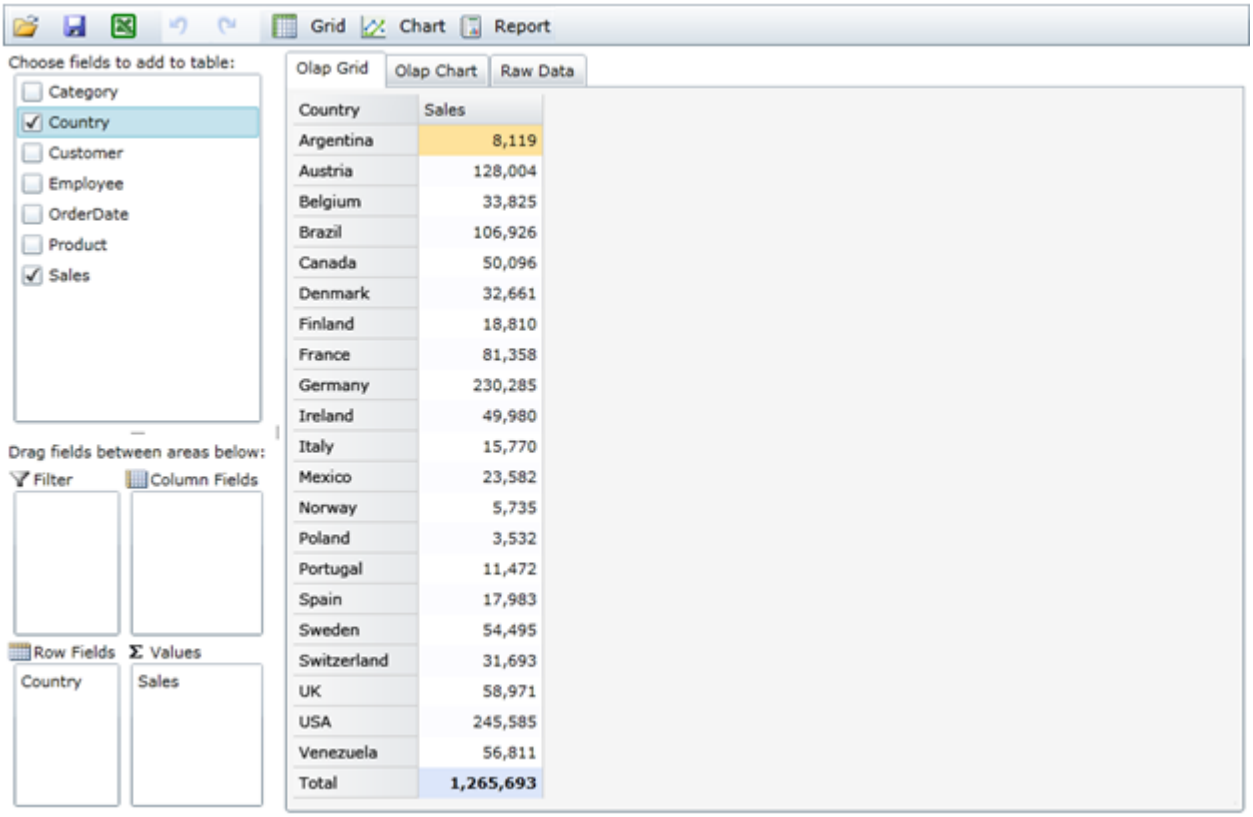
C#

```
// bind olap page to data
_c1OlapPage.DataSource = ds.Tables[0].DefaultView;
```

The application is now ready. The following sections describe the functionality provided by default, without writing any code aside from configuring our data source.

Creating OLAP Views

Run the application and you will see an interface similar to the one in Microsoft Excel. Drag the “Country” field to the “Row Fields” list and “Sales” to the “Values” list and you will see a summary of prices charged by country as shown below:

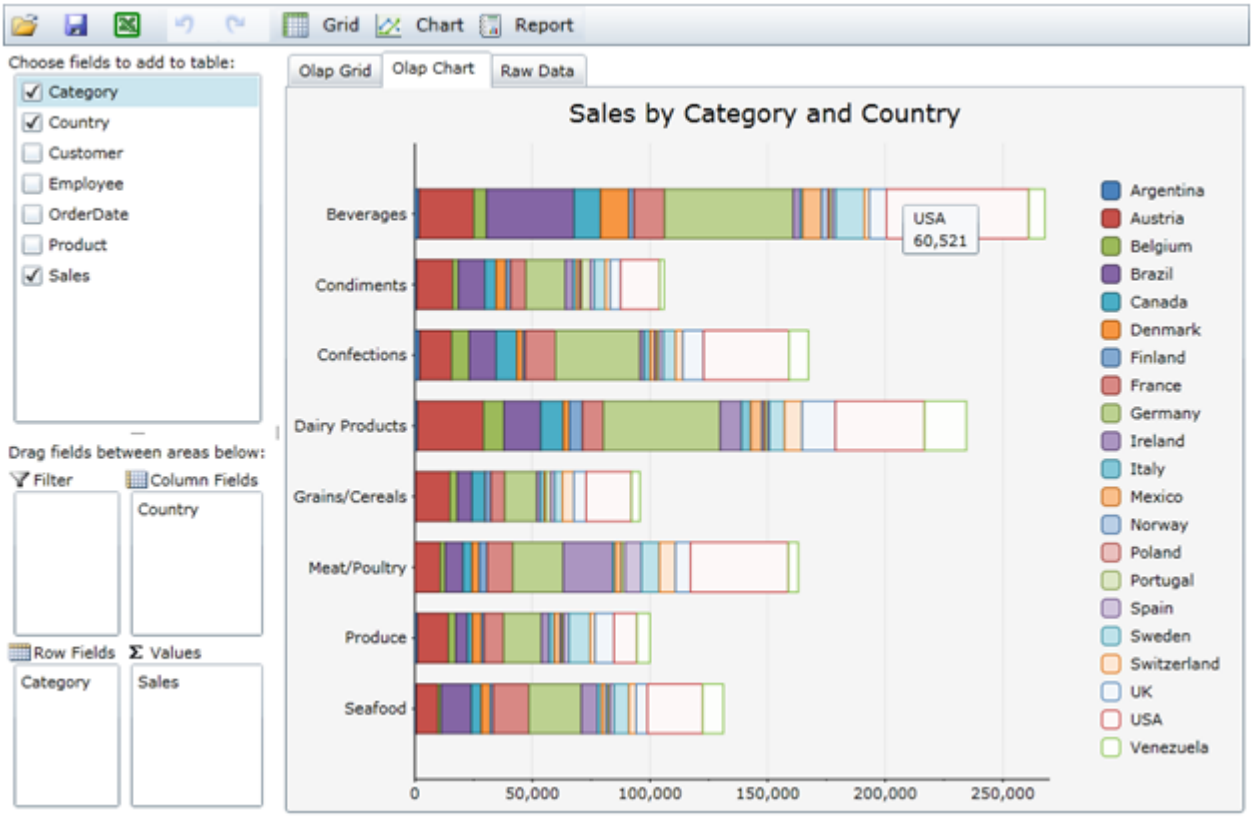


Click the "Olap Chart" tab and you will see the same data in chart format, showing that the main customers are the US, Germany, and Austria.

Now drag the "Category" field into the "Column Fields" list to see a new summary, this time of sales per country and per category. If you still have the chart tab selected, you should be looking at a chart similar to the previous one, except this time the bars are split to show how much was sold by each salesperson:

Move the mouse over the chart and you will see tooltips that show the name of the category and the amount sold when you hover over the chart elements.

Now create a new view by swapping the "Category" and "Country" fields by dragging them to the opposite lists. This will create a new chart that emphasizes category instead of country:



The chart shows that Beverages was the top selling category in the period being analyzed, followed closely by Dairy Products.

As we make changes to the view, the C1OlapPanel control keeps record. We can simply click the undo button in the C1OlapPanel menu to go back to a previous view we created.

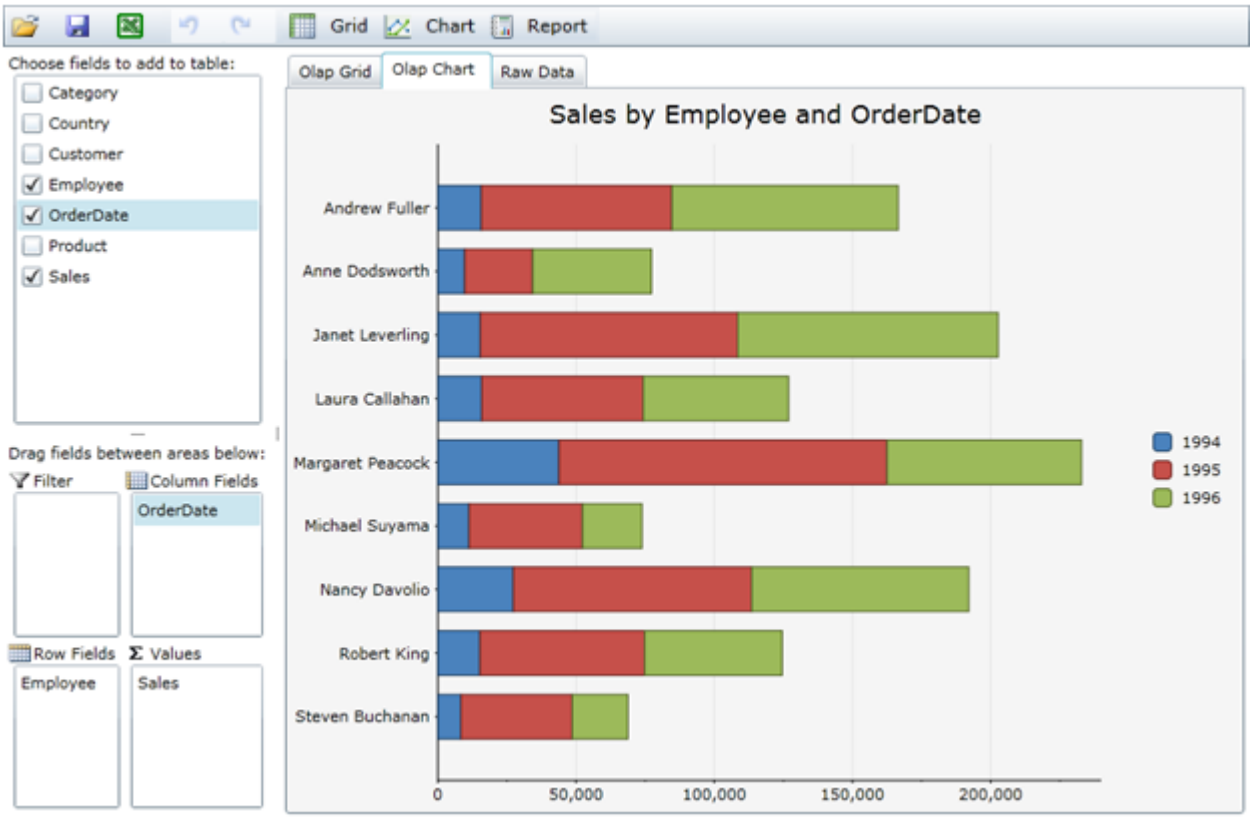
Summarizing Data

Let's create a new view to illustrate how you can easily summarize data in different ways.

This time, drag the "Employee" field to the "Row Fields" list and the "OrderDate" field to the "Column Fields" list. The resulting view contains one column for each day when an order was placed. This is not very useful information, because there are too many columns to show any trends clearly. We would like to summarize the data by month or year instead.

One way to do this would be to modify the source data, either by creating a new query in SQL or by using LINQ. Both of these techniques will be described in later sections. Another way is simply to modify the parameters of the "OrderDate" field. To do this, right-click the "OrderDate" field and select the "Field Settings" menu. Then select the "Format" tab in the dialog, choose the "Custom" format, enter "yyyy", and click OK.

The dates are now formatted and summarized by year, and the OLAP chart looks like this:

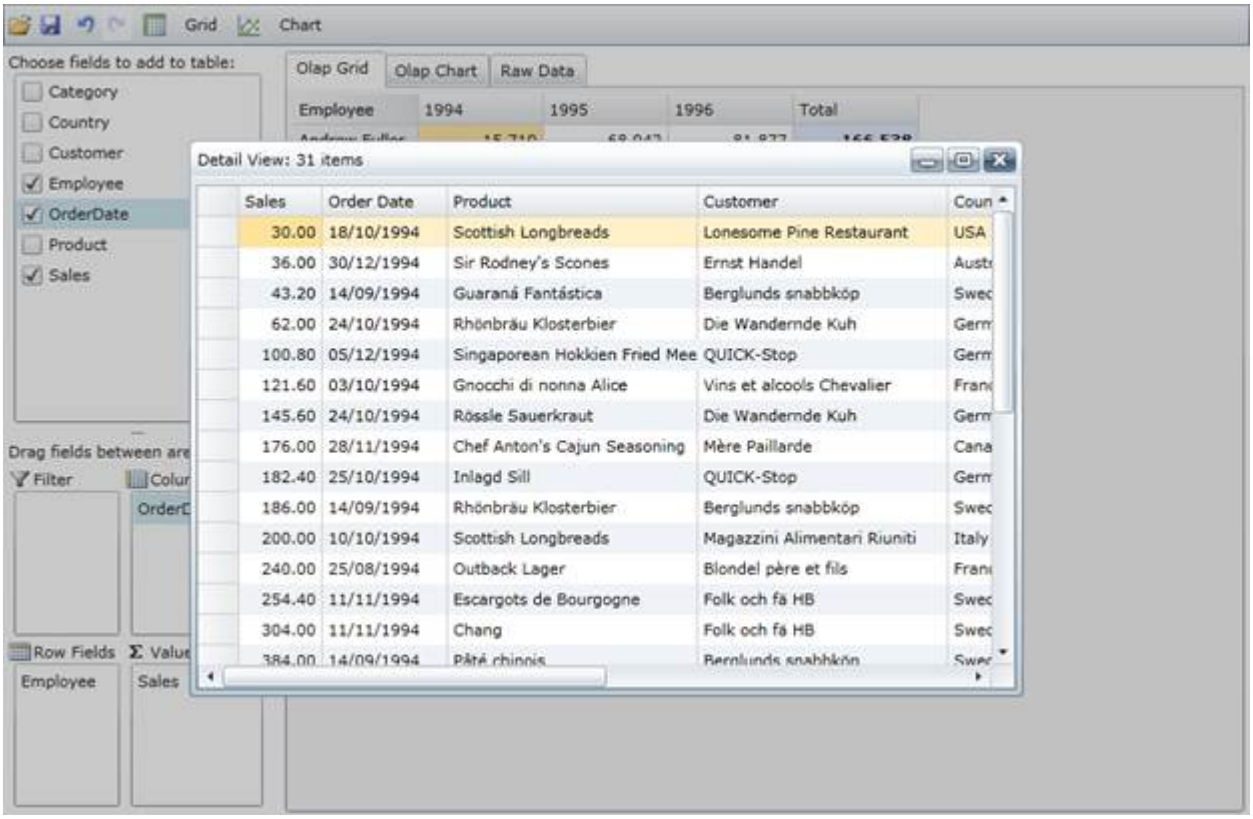


If you wanted to check how sales are placed by month or weekday, you could simply change the format to “MMMM” or “dddd”.

Drilling Down on the Data

As we mentioned before, each cell in the OLAP grid represents a summary of several records in the data source. You can see the underlying records behind each cell in the OLAP grid by double clicking it with the mouse.

To see this, click the “Olap Grid” tab and double-click the first cell on the grid, the one that represents Andrew Fullers’s sales in 1994. You will see another grid showing the 31 records that were used to compute the total displayed in the Olap grid:



Customizing the C1OlapPage

The previous example showed how you can create a complete OLAP application using only a C1OlapPage control and minimal code. This is convenient, but in most cases you will want to customize the application and the user interface to some degree.

Configuring Fields in Code

One of the main strengths in OLAP applications is interactivity. Users must be able to create and modify views easily and quickly see the results. **OLAP for WPF and Silverlight** enables this with its Excel-like user interface and user friendly, simple dialogs.

But in some cases you may want to configure views using code. **OLAP for WPF and Silverlight** enables this with its simple yet powerful object model, especially the **Field** and **Filter** classes.

The example that follows shows how you can configure a view on load with **OLAP for WPF and Silverlight**.

Visual Basic

```
' show sales by customer and category
Dim olap = _c1OlapPage.OlapPanel.OlapEngine

olap.DataSource = ds.Tables(0).DefaultView
olap.BeginUpdate()
olap.RowFields.Add("Country")
olap.ColumnFields.Add("Category")
olap.ValueFields.Add("Sales")
olap.Fields("Sales").Format = "n0"
```

```
olap.EndUpdate()
```

C#

```
// show sales by customer and category
var olap = _c1OlapPage.OlapPanel.OlapEngine;

olap.DataSource = ds.Tables[0].DefaultView;
olap.BeginUpdate();
olap.RowFields.Add("Country");
olap.ColumnFields.Add("Category");
olap.ValueFields.Add("Sales");
olap.Fields["Sales"].Format = "n0";
olap.EndUpdate();
```

The code first calls the BeginUpdate method which suspends automatic updates to the output table. It adds fields for the Row, Column and Value field collections so that the user does not have to do this action. We could therefore, hide the C1OlapPanel portion of our application. This code also applies a numeric format to the "Sales" field, and finally calls the EndUpdate method.

If you run the sample now, you will see an OLAP view similar to the first example.

Next, let's use the **OLAP for WPF and Silverlight** object model to change the format used to display the order dates and extended prices:

Visual Basic

```
' format order date
Dim field = olap.Fields("OrderDate")
field.Format = "yyyy"

' format extended price and change the Subtotal type
' to show the average extended price (instead of sum)
field = olap.Fields("Sales")
field.Format = "c"
field.Subtotal = C1.Olap.Subtotal.Average
```

C#

```
// format order date
var field = olap.Fields["OrderDate"];
field.Format = "yyyy";

// format extended price and change the Subtotal type
// to show the average extended price (instead of sum)
field = olap.Fields["Sales"];
field.Format = "c";
field.Subtotal = C1.Olap.Subtotal.Average;
```

The code retrieves the individual fields from the **Fields** collection which contains all the fields specified in the data source. Then it assigns the desired values to the **Format** and **Subtotal** properties. **Format** takes a regular .NET format string, and **Subtotal** determines how values are aggregated for display in the OLAP view. By default, values are added, but many other aggregate statistics are available including average, maximum, minimum, standard deviation, and variance.

Now suppose you are interested only in a subset of the data, say a few products and one year. A user would right-

click the fields and apply filters to them. You can do the exact same thing in code as shown below:

Visual Basic

```
' format order date and extended price
' no changes…
' apply value filter to show only a few products
Dim filter As C1.Olap.C1OlapFilter = olap.Fields("Product").Filter
filter.Clear()
filter.ShowValues = "Chai,Chang,Geitost,Ikura".Split(","C)
' apply condition filter to show only some dates
filter = olap.Fields("OrderDate").Filter
filter.Clear()

filter.Condition1.[Operator] = C1.Olap.ConditionOperator.GreaterThanOrEqualTo
filter.Condition1.Parameter = New DateTime(1996, 1, 1)

filter.Condition2.[Operator] = C1.Olap.ConditionOperator.LessThanOrEqualTo
filter.Condition2.Parameter = New DateTime(1996, 12, 31)
filter.AndConditions = True
```

C#

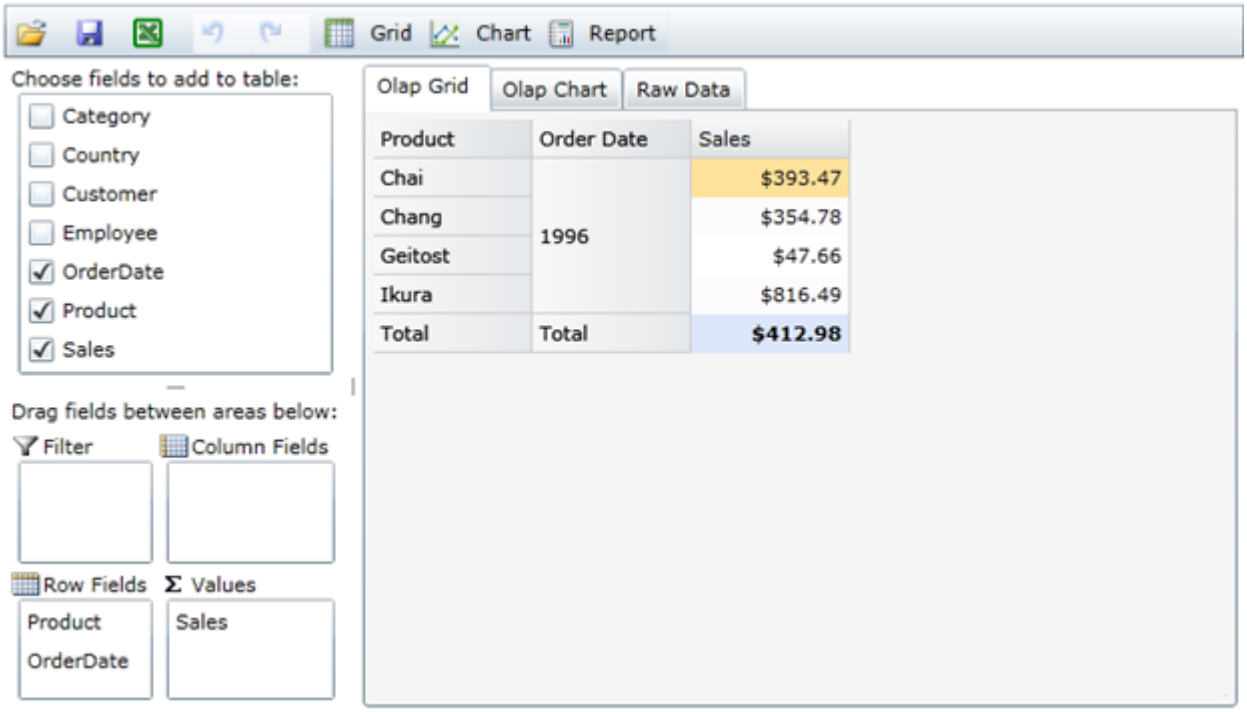
```
// format order date and extended price
// no changes…
// apply value filter to show only a few products
C1.Olap.C1OlapFilter filter = olap.Fields["Product"].Filter;
filter.Clear();
filter.ShowValues = "Chai,Chang,Geitost,Ikura".Split(',');
// apply condition filter to show only some dates
filter = olap.Fields["OrderDate"].Filter;
filter.Clear();
filter.Condition1.Operator =
         C1.Olap.ConditionOperator.GreaterThanOrEqualTo;
filter.Condition1.Parameter = new DateTime(1996, 1, 1);
filter.Condition2.Operator =
         C1.Olap.ConditionOperator.LessThanOrEqualTo;
filter.Condition2.Parameter = new DateTime(1996, 12, 31);
filter.AndConditions = true;
```

The code starts by retrieving the C1OlapFilter object that is associated with the "Product" field. Then it clears the filter and sets its ShowValues property. This property takes an array of values that should be shown by the filter. In **OLAP for WPF and Silverlight** we call this a "value filter".

Next, the code retrieves the filter associated with the "OrderDate" field. This time, we want to show values for a specific year. But we don't want to enumerate all days in the target year. Instead, we use a "condition filter" which is defined by two conditions.

The first condition specifies that the "OrderDate" should be greater than or equal to January 1st, 1996. The second condition specifies that the "OrderDate" should be less than or equal to December 31st, 1996. The **AndConditions** property specifies how the first and second conditions should be applied (AND or OR operators). In this case, we want dates where both conditions are true, so **AndConditions** is set to true.

If you run the project again, you should see the following:



Persisting OLAP views in Local Storage

While loading a default view is great, users might get tired of always having to change it each time they run the application. In Silverlight we can store some simple data to the isolated storage to save views across sessions. We will start by creating a default view that is persisted across sessions in isolated storage. The **IsolatedStorageSettings.ApplicationSettings** class allows you to save and load application settings very easily. By default, the isolated storage is limited to 1 MB, but the size of the OLAP view is not affected by this.

In this example we will save the current view in the current application's Exit event. So any customizations made by the user are automatically saved when he closes the application and can be restored next time he runs it.

Visual Basic

```
' save the current view to storage when closing the app
Private Sub Current_Exit(sender As Object, e As EventArgs)

    Dim userSettings = IsolatedStorageSettings.ApplicationSettings
    userSettings(VIEWDEF_KEY) = _c1OlapPage.ViewDefinition
    userSettings.Save()
End Sub
```

C#

```
// save the current view to storage when closing the app
void Current_Exit(object sender, EventArgs e)
{
    var userSettings = IsolatedStorageSettings.ApplicationSettings;
    userSettings[VIEWDEF_KEY] = _c1OlapPage.ViewDefinition;
    userSettings.Save();
}
```

Notice here we access the application settings using a unique key index. We store data from the ViewDefinition property, a string in XML format which defines our view for this data set. At any point in our application we can restore the OLAP view by reversing the second line of code. Next we will load the view from isolated storage.

Visual Basic

```
Const  VIEWDEF_KEY As String = "C1OlapViewDefinition"
```

C#

```
const string VIEWDEF_KEY = "C1OlapViewDefinition";
```

Add this line of code which declares our VIEWDEF_KEY constant so we can easily use the same unique key to access our stored data view throughout the application.

Application.Current.Exit += Current_Exit;

The above line of code attaches our exit event which will fire before the application closes. Next, we will load the view from isolated storage by reversing the code used to save it.

Visual Basic

```
' initialize olap view
Dim userSettings = IsolatedStorageSettings.ApplicationSettings
If userSettings.Contains(VIEWDEF_KEY) Then

    ' load last used olap view from isolated storage

    _c1OlapPage.ViewDefinition = TryCast(userSettings(VIEWDEF_KEY), String)
End If
```

C#

```
// initialize olap view
var userSettings = IsolatedStorageSettings.ApplicationSettings;
if (userSettings.Contains(VIEWDEF_KEY))
{
     // load last used olap view from isolated storage
      _c1OlapPage.ViewDefinition = userSettings[VIEWDEF_KEY] as string;
}
```

If you run the project now, you will notice that it starts with the default view created by code. If you make any changes to the view, close the application, and then re-start it, you will notice that your changes are restored.

Creating Predefined Views

In addition to the **ViewDefinition** property, which gets or sets the current view as an XML string, the **C1OlapPage** control also exposes **ReadXml** and **WriteXml** methods that allow you to persist views to files and streams. These methods are automatically invoked by the **C1OlapPage** when you click the “Load” and “Save” buttons in the built-in menu.

These methods allow you to implement predefined views very easily. To do this, start by creating some views and saving each one by pressing the “Save” button. For this sample, we will create five views showing sales by:

1. Product and Country

2. Employee and Country
3. Employee and Month
4. Employee and Weekday
5. Employee and Year

Once you have created and saved all the views, create a new XML file called "DefaultViews.xml" with a single "OlapViews" node, then copy and paste all your default views into this document. Next, add an "id" tag to each view and assign each one a unique name. This name will be shown in the user interface (it is not required by **C1OlapGrid**). Your XML file should look like this:

XAML

```
<OlapViews>
  <C1OlapPage id="Product vs Country">
   <!-- view definition omitted... -->
  <C1OlapPage id="Employee vs Country">
    <!-- view definition omitted... -->
  <C1OlapPage id="Employee vs Month">
   <!-- view definition omitted... -->
  <C1OlapPage id="Employee vs Weekday">>
    <!-- view definition omitted... -->
  <C1OlapPage id="Employee vs Year">
    <!-- view definition omitted... -->
</OlapViews>
```

Now add this file to the project as a resource. To do this, add a new folder to your project and call it "Resources." Then right-click the Resources folder in the solution explorer, then select the "Add Existing File..." option. Select the XML file and click OK.

Now that the view definitions are ready, we need to expose them in our menu so the user can select them. To do this, copy the following code into the project:

Visual Basic

```
Public Sub New()

    InitializeComponent()
    'no changes here
    '…
    ' get predefined views from XML resource
    Dim views = New Dictionary(Of String, String)()
    Using s = asm.GetManifestResourceStream("OlapQuickStart.Resources.OlapViews.xml")
        Using reader = XmlReader.Create(s)

            ' read predefined view definitions
            While reader.Read()

                If reader.NodeType = XmlNodeType.Element AndAlso reader.Name =
"C1OlapPage" Then

                    Dim id = reader.GetAttribute("id")
                    Dim def = reader.ReadOuterXml()
```

```
                    views(id) = def
                End If
            End While
        End Using
    End Using
    ' build new menu with predefined views
    Dim menuViews = New C1MenuItem()
    menuViews.Header = "View"
    menuViews.Icon = GetImage("Resources/views.png")
    menuViews.VerticalAlignment = VerticalAlignment.Center
    ToolTipService.SetToolTip(menuViews, "Select a predefined Olap view.")
    For Each id As var In views.Keys

        Dim mi = New C1MenuItem()
        mi.Header = id
        mi.Tag = views(id)
        mi.Click += mi_Click

        menuViews.Items.Add(mi)
    Next
    ' add new menu to the page's main menu

    _c1OlapPage.MainMenu.Items.Insert(6, menuViews)
End Sub
```

C#

```
public MainPage()
{
    InitializeComponent();
    //no changes here
//…
   // get predefined views from XML resource
    var views = new Dictionary<string, string>();
    using (var s =
asm.GetManifestResourceStream("OlapQuickStart.Resources.OlapViews.xml"))
    using (var reader = XmlReader.Create(s))
    {
        // read predefined view definitions
        while (reader.Read())
        {
            if (reader.NodeType == XmlNodeType.Element && reader.Name ==
"C1OlapPage")
            {
                var id = reader.GetAttribute("id");
                var def = reader.ReadOuterXml();
                views[id] = def;

            }
        }
    }
```

```
    // build new menu with predefined views
    var menuViews = new C1MenuItem();
    menuViews.Header = "View";
    menuViews.Icon = GetImage("Resources/views.png");
    menuViews.VerticalAlignment = VerticalAlignment.Center;
    ToolTipService.SetToolTip(menuViews, "Select a predefined Olap view.");
    foreach (var id in views.Keys)
    {
        var mi = new C1MenuItem();
        mi.Header = id;
        mi.Tag = views[id];
        mi.Click += mi_Click;
        menuViews.Items.Add(mi);
    }
   // add new menu to the page's main menu
    _c1OlapPage.MainMenu.Items.Insert(6, menuViews);
}
```

The code loads the XML document with the OLAP definitions, creates a new drop-down menu item using C1Menu, and populates the drop-down with the views found. Each menu item contains the view name in its **Header** property, and the actual XML node in its **Tag** property. The node will be used later to apply the view when the user selects it.

Once the drop-down is ready, the code adds it to the **C1OlapPage** using the **MainMenu** property. The new button is added after the first several buttons.

There is a simple method called above to load the new menu button's image, GetImage. Loading a single image does not require this amount of work; however if you load multiple images you will want a nice common method to use time and again.

Visual Basic

```
' utility to load an image from a URI
Private Shared Function GetImage(name As String) As Image

    Dim uri = New Uri(name, UriKind.Relative)
    Dim img = New Image()
    img.Source = New BitmapImage(uri)
    img.Stretch = Stretch.None
    img.VerticalAlignment = VerticalAlignment.Center
    img.HorizontalAlignment = HorizontalAlignment.Center
    Return img

End Function
```

C#

```
// utility to load an image from a URI
static Image GetImage(string name)
{
    var uri = new Uri(name, UriKind.Relative);
    var img = new Image();
    img.Source = new BitmapImage(uri);
    img.Stretch = Stretch.None;
    img.VerticalAlignment = VerticalAlignment.Center;
    img.HorizontalAlignment = HorizontalAlignment.Center;
```

```
    return img;

}
```

The only part still missing is the code that will apply the views to the **C1OlapPage** when the user selects them by clicking the menu item. This is accomplished with the following code:

Visual Basic

```
' apply a predefined view
Private Sub mi_Click(sender As Object, e As SourcedEventArgs)

    Dim mi = TryCast(sender, C1MenuItem)
    Dim viewDef = TryCast(mi.Tag, String)
    _c1OlapPage.ViewDefinition = viewDef
End Sub
```

C#

```
// apply a predefined view
void mi_Click(object sender, SourcedEventArgs e)
{
    var mi = sender as C1MenuItem;
    var viewDef = mi.Tag as string;
    _c1OlapPage.ViewDefinition = viewDef;
}
```

The code retrieves the OLAP definition as an XML string by reading the menu's **Tag** property, then assigns it to the **C1OlapPage.ViewDefinition** property.

If you need further customization, you can also choose not to use the **C1OlapPage** at all, and build your interface using the lower-level **C1OlapPanel**, **C1OlapGrid**, and **C1OlapChart** controls. The source code for the **C1OlapPage** control is included with the package and can be used as a starting point. The example in the "Building a custom User Interface" section shows how this is done.

Updating the OLAP View

At certain points you may want to force an update on the **C1OlapPage** or **C1O** to regenerate the analysis. You can call the Update method on the C1OlapEngine. To add this functionality to your UI, add a button and in its click event add this code:

Visual Basic

```
' regenerate the olap view
Private Sub Button_Click(sender As Object, e As RoutedEventArgs)

    _c1OlapPage.OlapPanel.OlapEngine.Update()
End Sub
```

C#

```
// regenerate the olap view
void Button_Click(object sender, RoutedEventArgs e)
{
```

```
    _c1OlapPage.OlapPanel.OlapEngine.Update();
}
```

Conditional Formatting

The **C1OlapGrid** control derives from the **C1FlexGrid** control, so you can use the grid's custom cells features to apply styles to cells based on their contents. This sample shows a grid where values greater than 100 appear with a light green background.

The **C1OlapGrid** control has a **CellFactory** class that is responsible for creating every cell shown on the grid. To create custom cells, you have to create a class that implements the **ICellFactory** interface and assign this class to the grid's **CellFactory** property. Like custom columns, custom **ICellFactory** classes can be highly specialized and application-specific, or they can be general, reusable, configurable classes. In general, custom **ICellFactory** classes are a lot simpler than custom columns since they deal directly with cells.

Here is the code which implements a ConditionalCellFactory class responsible applying a custom green background to cells with values over 100.

Visual Basic

```
Public Class ConditionalCellFactory
    Inherits C1.Silverlight.FlexGrid.CellFactory

    Public Overrides Function CreateCell(grid As C1FlexGrid, cellType__1 As CellType,
range As CellRange) As FrameworkElement

        ' let base class to most of the work
        Dim cell = MyBase.CreateCell(grid, cellType__1, range)
        ' apply green background if necessary
        If cellType__1 = CellType.Cell Then

            Dim cellValue = grid(range.Row, range.Column)
            If TypeOf cellValue Is Double AndAlso CDbl(cellValue) > 100 Then


                Dim border = TryCast(cell, Border)

                border.Background = _greenBrush
            End If
        End If
        ' done
        Return cell
    End Function
    Shared _greenBrush As Brush = New SolidColorBrush(Color.FromArgb(&Hff, 88, 183,
112))
End Class
```

C#

```
public class ConditionalCellFactory : C1.Silverlight.FlexGrid.CellFactory
{
    public override FrameworkElement CreateCell(C1FlexGrid grid, CellType cellType,
CellRange range)
```

```
    {
       // let base class to most of the work
        var cell = base.CreateCell(grid, cellType, range);
       // apply green background if necessary
        if (cellType == CellType.Cell)
        {
            var cellValue = grid[range.Row, range.Column];
            if (cellValue is double && (double)cellValue > 100)

            {
                var border = cell as Border;
                border.Background = _greenBrush;
            }
        }
        // done
        return cell;
    }
    static Brush _greenBrush = new SolidColorBrush(Color.FromArgb(0xff, 88, 183,
112));
}
```

And here is the code required to use this on our C1OlapGrid:

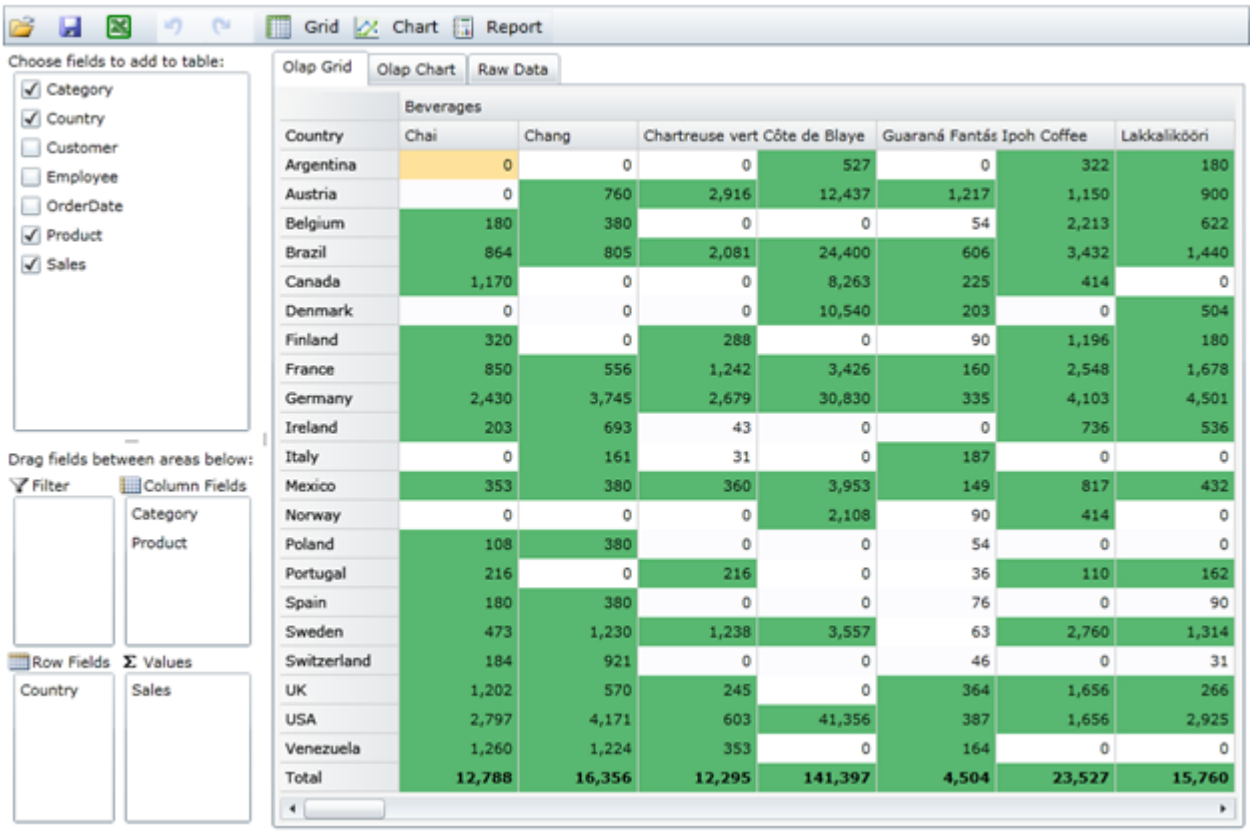
Visual Basic

```
' apply conditional formatting to grid cells
_c1OlapPage.OlapGrid.CellFactory = New ConditionalCellFactory()
```

C#

```
// apply conditional formatting to grid cells
_c1OlapPage.OlapGrid.CellFactory = new ConditionalCellFactory();
```

If you were to add this code to a previous example, you would see how this appears at run-time.



Large Data Sources

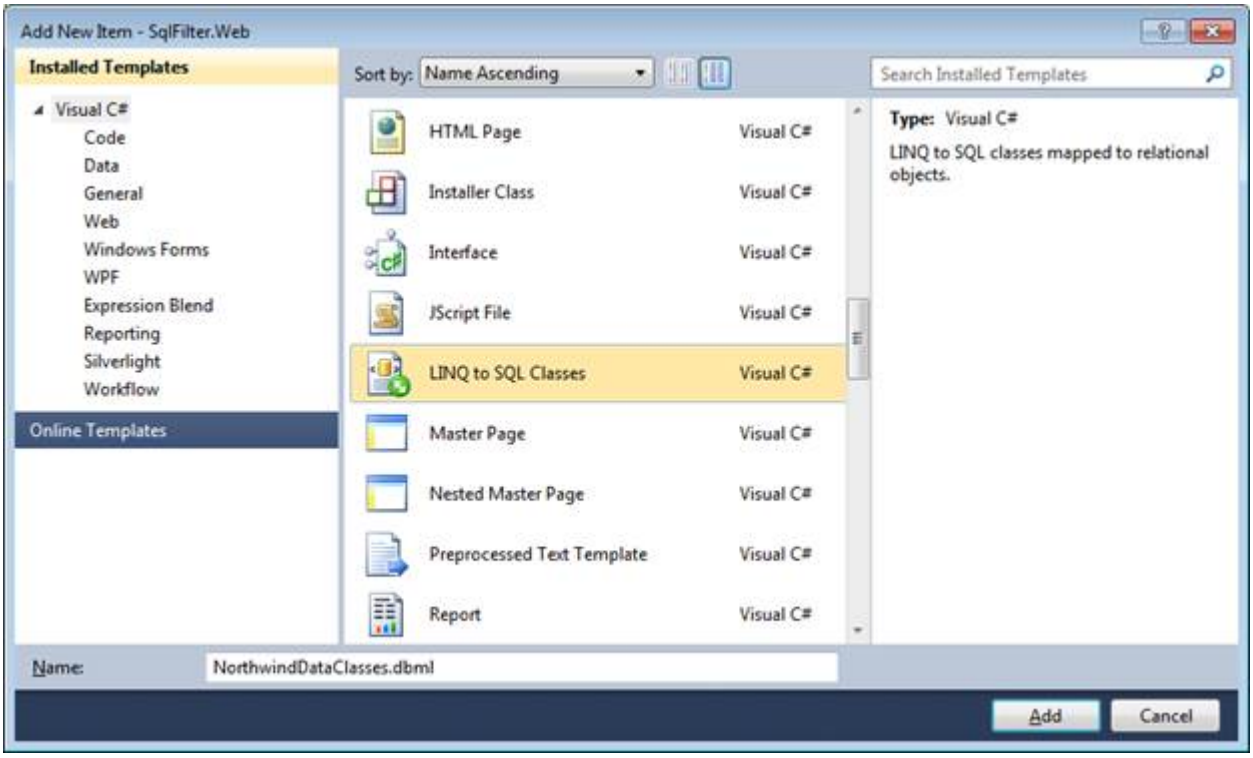
In some cases there may be too much data to load into memory at once. Consider for example a table with a million rows or more. Even if you could load all this data into memory, the process would take a long time.

There are many ways to deal with these scenarios. You could create queries that summarize and cache the data on the server and use web services to deliver data to your Silverlight client. Still you would end up with tables that can be used with **C1OlapPage**.

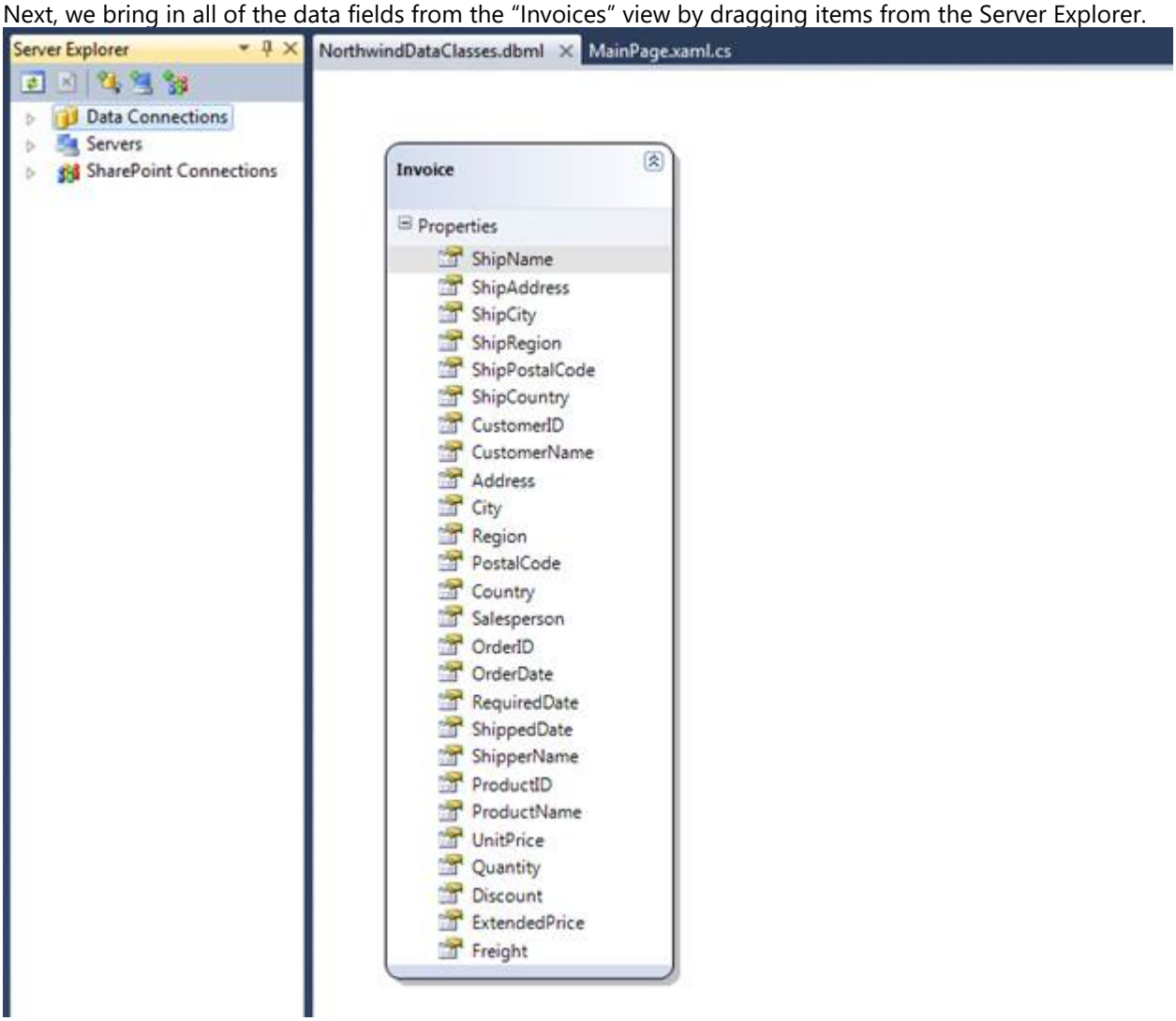
In this sample we will use a WCF service to access Northwind data stored in a SQL database. The interesting part of this sample is that not all data will be loaded into memory at one time. The **C1OlapPage** only requests data for customers that are currently included in the filter.

For this sample we will create a Silverlight project inside an ASP.Net web site. We will also use LINQ to SQL classes to query data from the sample Northwind database. LINQ to SQL is an ORM (object relational mapping) implementation that ships with Visual Studio (2008 and higher). It allows you to model a relational database using .NET classes which you can query against using LINQ.

First, we create a LINQ to SQL representation of the Northwind database. Right-click the web site project associated with your Silverlight project and click “Add New Item…” Select LINQ to SQL Classes and name it NorthwindDataClasses.dbml.



Next, we bring in all of the data fields from the "Invoices" view by dragging items from the Server Explorer.



Then we create a WCF Service that queries this data using LINQ and our LINQ to SQL Classes (NorthwindDataClasses) just created. Right-click the web site project node and click “Add New Item...” Select WCF Service and name it NorthwindDataService.svc.

Replace the code in NorthwindDataService.svc with the following code:

Visual Basic

```
Imports System.Linq
Imports System.Runtime.Serialization
Imports System.ServiceModel
Imports System.ServiceModel.Activation
Imports System.Collections.Generic
Imports System.Text
Namespace SqlFilter.Web
    <ServiceContract([Namespace] := "")> _
    <AspNetCompatibilityRequirements(RequirementsMode :=
AspNetCompatibilityRequirementsMode.Allowed)> _
    Public Class NorthwindDataService
        ''' <summary>/// Get all invoices. /// </summary>        [OperationContract]
        Public Function GetInvoices() As List(Of Invoice)
            Dim ctx = New NorthwindDataClassesDataContext()
            Dim invoices = From inv In ctx.Invoicesinv
            Return invoices.ToList()
        End Function
        ''' <summary>/// Get all customers. /// </summary>        [OperationContract]
        Public Function GetCustomers() As List(Of String)
            Dim ctx = New NorthwindDataClassesDataContext()
            Dim customers = (From inv In ctx.Invoicesinv.CustomerName).Distinct()
            Return customers.ToList()
        End Function
        ''' <summary>/// Get all invoices for a specific set of customers. ///
</summary>        [OperationContract]
        Public Function GetCustomerInvoices(ParamArray customers As String()) As
List(Of Invoice)
            ' build hashset            var hash = new HashSet<string>();
            For Each c As String In customers
                hash.Add(c)
            Next
            Dim customerList As String() = hash.ToArray()
            ' get invoices for customers in the list            var ctx = new
NorthwindDataClassesDataContext();
            Dim invoices = From inv In ctx.Invoices Where
customerList.Contains(inv.CustomerName)inv
            Return invoices.ToList()
        End Function
    End Class
End Namespace
```

C#

```
using System;
using System.Linq;
```

```
using System.Runtime.Serialization;
using System.ServiceModel;
using System.ServiceModel.Activation;
using System.Collections.Generic;
using System.Text;
namespace SqlFilter.Web
{
    [ServiceContract(Namespace = "")]
    [AspNetCompatibilityRequirements(RequirementsMode =
AspNetCompatibilityRequirementsMode.Allowed)]
    public class NorthwindDataService
    {
        /// <summary>/// Get all invoices. /// </summary>        [OperationContract]
        public List<Invoice> GetInvoices()
        {
            var ctx = new NorthwindDataClassesDataContext();
            var invoices =
                from inv in ctx.Invoices
                select inv;
            return invoices.ToList();
        }
        /// <summary>/// Get all customers. /// </summary>        [OperationContract]
        public List<string> GetCustomers()
        {
            var ctx = new NorthwindDataClassesDataContext();
            var customers =
                (from inv in ctx.Invoices
                    select inv.CustomerName).Distinct();
            return customers.ToList();
        }
        /// <summary>/// Get all invoices for a specific set of customers. ///
</summary>        [OperationContract]
        public List<Invoice> GetCustomerInvoices(params string[] customers)
        {
            // build hashset            var hash = new HashSet<string>();
            foreach (string c in customers)
            {
                hash.Add(c);
            }
            string[] customerList = hash.ToArray();
            // get invoices for customers in the list            var ctx = new
NorthwindDataClassesDataContext();
            var invoices =
                from inv in ctx.Invoices
                where customerList.Contains(inv.CustomerName)
                select inv;
            return invoices.ToList();
        }
    }
}
```

Notice here we have defined 3 methods for our web service. The first two are simple Get methods which return a list of items using LINQ and our LINQ to SQL classes created earlier. The GetCustomerInvoices method is special in that it accepts an array of customers as parameter. This is our filter that will be defined on the client in our Silverlight C1OlapGrid project.

Before moving to the Silverlight project we must build the web site project, and add a reference to our web service. To add the reference, right-click the Silverlight project node in the Solution Explorer and click "Add Service Reference." Then click "Discover" and select the NorthwindDataService.svc. Rename it "NorthwindDataServiceReference" and click OK.

Now that the data source is ready, we need to connect it to **C1OlapPage** to ensure that:

1. The user can see all the customers in the filter (not just the ones that are currently loaded) and
2. When the user modifies the filter, new data is loaded to show any new customers requested.

Before we accomplish these tasks we should set up our UI. In MainPage.XAML, add a **C1OlapPage** control and a couple of TextBlocks which will be used as status strips:

XAML

```
<Grid x:Name="LayoutRoot">
<Grid.RowDefinitions>
              <RowDefinition />
              <RowDefinition Height="Auto"/>
</Grid.RowDefinitions>
<olap:C1OlapPage x:Name="_c1OlapPage"/>
<TextBlock x:Name="_lblLoading"FontSize="24"Opacity=".5"Text="Loading
data..."HorizontalAlignment="Center"VerticalAlignment="Center"/>
<TextBlock x:Name="_lblStatus"Text="Ready"HorizontalAlignment="Right"Grid.Row="1"/>
</Grid>
```

Then add the following code to the form:

Visula Basic

```
Dim _allCustomers As ObservableCollection(Of String)
Dim _invoices As ObservableCollection(Of NorthwindDataServiceReference.Invoice)
Dim _customerFilter As C1OlapFilter
```

C#

```
ObservableCollection<string> _allCustomers;
ObservableCollection<NorthwindDataServiceReference.Invoice> _invoices;
C1OlapFilter _customerFilter;
```

These fields will contain a complete list of all the customers in the database, a list of the customers currently selected by the user, and the maximum number of customers that can be selected at any time.

We need to assign the complete list of customers to the **C1OlapField.Values** property. This property contains a list of the values that are displayed in the filter. By default, **C1OlapPage** populates this list with values found in the raw data. In this case, the raw data will only contain a partial list, so we need to provide the complete version instead. The **_allCustomers** ObservableCollection will hold our entire collection of possible customers for the user to select among. The **C1OlapPage** will actually work with the _invoices collection, which will be the dataset filtered by the selected customers.

Replace the following code in MainPage():

Visual Basic

```
Public Sub New()
    InitializeComponent()
    ' initialize OlapPage data source    _invoices = new
ObservableCollection<SqlFilter.NorthwindDataServiceReference.Invoice>();
    _c1OlapPage.DataSource = _invoices
    ' initialize OlapPage view    var olap = _c1OlapPage.OlapEngine;
    olap.BeginUpdate()
    olap.ColumnFields.Add("OrderDate")
    olap.RowFields.Add("CustomerName")
    olap.ValueFields.Add("ExtendedPrice")
    olap.RowFields(0).Width = 200
    olap.Fields("OrderDate").Format = "yyyy"
    olap.Fields("CustomerName").Filter.ShowValues = selectedCustomers.ToArray()
    olap.EndUpdate()
    ' get list of all customers in the database    var sc = new
SqlFilter.NorthwindDataServiceReference.NorthwindDataServiceClient();
    sc.GetCustomersCompleted += sc_GetCustomersCompleted
        ' show status    _lblStatus.Text = "Retrieving customer list...";
    sc.GetCustomersAsync()
End Sub
```

C#

```
public MainPage()
{
    InitializeComponent();
     // initialize OlapPage data source    _invoices = new
ObservableCollection<SqlFilter.NorthwindDataServiceReference.Invoice>();
    _c1OlapPage.DataSource = _invoices;
    // initialize OlapPage view    var olap = _c1OlapPage.OlapEngine;
    olap.BeginUpdate();
    olap.ColumnFields.Add("OrderDate");
    olap.RowFields.Add("CustomerName");
    olap.ValueFields.Add("ExtendedPrice");
    olap.RowFields[0].Width = 200;
    olap.Fields["OrderDate"].Format = "yyyy";
    olap.Fields["CustomerName"].Filter.ShowValues = selectedCustomers.ToArray();
    olap.EndUpdate();

    // get list of all customers in the database    var sc = new
SqlFilter.NorthwindDataServiceReference.NorthwindDataServiceClient();
    sc.GetCustomersCompleted += sc_GetCustomersCompleted;
    sc.GetCustomersAsync();
    // show status    _lblStatus.Text = "Retrieving customer list...";
}
```

Here we initialize our **C1OlapPage** data source, we create a default view and we get a list of all customers in the database. We need to get a complete list of all the customers in the database so the user can select the ones he wants to look at. Note that this is a long list but compact list. It contains only the customer name, not any of the associated details such as orders, order details, etc.

Since our data is coming from a web service, it is being retrieved asynchronously and the sc_GetCustomersCompleted

event is fired when the data has finished loading.

Visula Basic

```
Private Sub sc_GetCustomersCompleted(sender As Object, e As
SqlFilter.NorthwindDataServiceReference.GetCustomersCompletedEventArgs)
    ' hide 'loading' message    _lblLoading.Visibility = Visibility.Collapsed;
    ' monitor CustomerName filter    _customerFilter =
_c1OlapPage.OlapEngine.Fields["CustomerName"].Filter;
    _customerFilter.PropertyChanged += filter_PropertyChanged
    ' monitor view definition to ensure CustomerName field is always active
_c1OlapPage.ViewDefinitionChanged += _c1OlapPage_ViewDefinitionChanged;
    ' show available customers in the "CustomerName" field filter    _allCustomers =
e.Result;
    _customerFilter.Values = _allCustomers
    ' go get the data    GetData();
End Sub
```

C#

```
void sc_GetCustomersCompleted(object sender,
SqlFilter.NorthwindDataServiceReference.GetCustomersCompletedEventArgs e)
{
    // hide 'loading' message    _lblLoading.Visibility = Visibility.Collapsed;
    // monitor CustomerName filter    _customerFilter =
_c1OlapPage.OlapEngine.Fields["CustomerName"].Filter;
    _customerFilter.PropertyChanged += filter_PropertyChanged;
    // monitor view definition to ensure CustomerName field is always active
_c1OlapPage.ViewDefinitionChanged += _c1OlapPage_ViewDefinitionChanged;
    // show available customers in the "CustomerName" field filter    _allCustomers =
e.Result;
    _customerFilter.Values = _allCustomers;
    // go get the data    GetData();
}
```

This event gets the complete list of customers in the database. We store this to show in the filter. We need to listen to the **C1OlapField.PropertyChanged** event, which fires when the user modifies any field properties including the filter. When this happens, we retrieve the list of customers selected by the user and pass that list to the data source.

And here is the event handler that updates the data source when the filter changes:

Visual Basic

```
' CustomerName field filter has changed: get new datavoid
filter_PropertyChanged(object sender, System.ComponentModel.PropertyChangedEventArgs
e)
If True Then
    GetData()
End If
```

C#

```
// CustomerName field filter has changed: get new datavoid
filter_PropertyChanged(object sender, System.ComponentModel.PropertyChangedEventArgs
e)
```

```
{
    GetData();
}
```

The field's **Filter** property is only taken into account by the **C1OlapEngine** if the field in "active" in the view. "Active" means the field is a member of the **RowFields**, **ColumnFields**, **ValueFields**, or **FilterFields** collections. In this case, the "CustomerName" field has a special filter and should always be active. To ensure this, we must handle the engine's **ViewDefinitionChanged** event and make sure the "Customers" field is always active.

Here is the code that ensures the "CustomerName" field is always active:

Visual Basic

```
' make sure Customer field is always in the viewvoid
_c1OlapPage_ViewDefinitionChanged(object sender, EventArgs e)
If True Then
    Dim olap = _c1OlapPage.OlapEngine
    Dim field = olap.Fields("CustomerName")
    If Not field.IsActive Then
        olap.FilterFields.Add(field)
    End If
End If
```

C#

```
// make sure Customer field is always in the viewvoid
_c1OlapPage_ViewDefinitionChanged(object sender, EventArgs e)
{
    var olap = _c1OlapPage.OlapEngine;
    var field = olap.Fields["CustomerName"];
    if (!field.IsActive)
    {
        olap.FilterFields.Add(field);
    }
}
```

The GetData method is called to get the invoice data for the selected customers in the filter.

Visual Basic

```
' go get invoice data for the selected customersvoid GetData()
If True Then
    ' re-create active customer list based on the current filter settings    var
selectedCustomers = new ObservableCollection<string>();
    For Each customer As String In _allCustomers
        If _customerFilter.Apply(customer) Then
            selectedCustomers.Add(customer)
        End If
    Next
    _customerFilter.ShowValues = selectedCustomers.ToArray()
    ' go get invoices for the selected customers    var sc = new
SqlFilter.NorthwindDataServiceReference.NorthwindDataServiceClient();
    sc.GetCustomerInvoicesCompleted += sc_GetCustomerInvoicesCompleted
```

```
    sc.GetCustomerInvoicesAsync(selectedCustomers)
    ' show status    _lblStatus.Text = string.Format("Retrieving invoices for {0} customers...", selectedCustomers.Count);
End If
```

C#

```
// go get invoice data for the selected customersvoid GetData()
{
    // re-create active customer list based on the current filter settings    var selectedCustomers = new ObservableCollection<string>();
    foreach (string customer in _allCustomers)
    {
        if (_customerFilter.Apply(customer))
        {
            selectedCustomers.Add(customer);
        }
    }
    _customerFilter.ShowValues = selectedCustomers.ToArray();
    // go get invoices for the selected customers    var sc = new SqlFilter.NorthwindDataServiceReference.NorthwindDataServiceClient();
    sc.GetCustomerInvoicesCompleted += sc_GetCustomerInvoicesCompleted;
    sc.GetCustomerInvoicesAsync(selectedCustomers);
    // show status    _lblStatus.Text = string.Format("Retrieving invoices for {0} customers...", selectedCustomers.Count);
}
```

Here we use the C1OlapFilter (_customFilter) and call its **Apply** method to build a list of customers selected by the user. We make another asynchronous call to our web service which returns the filtered invoice data in the following event:

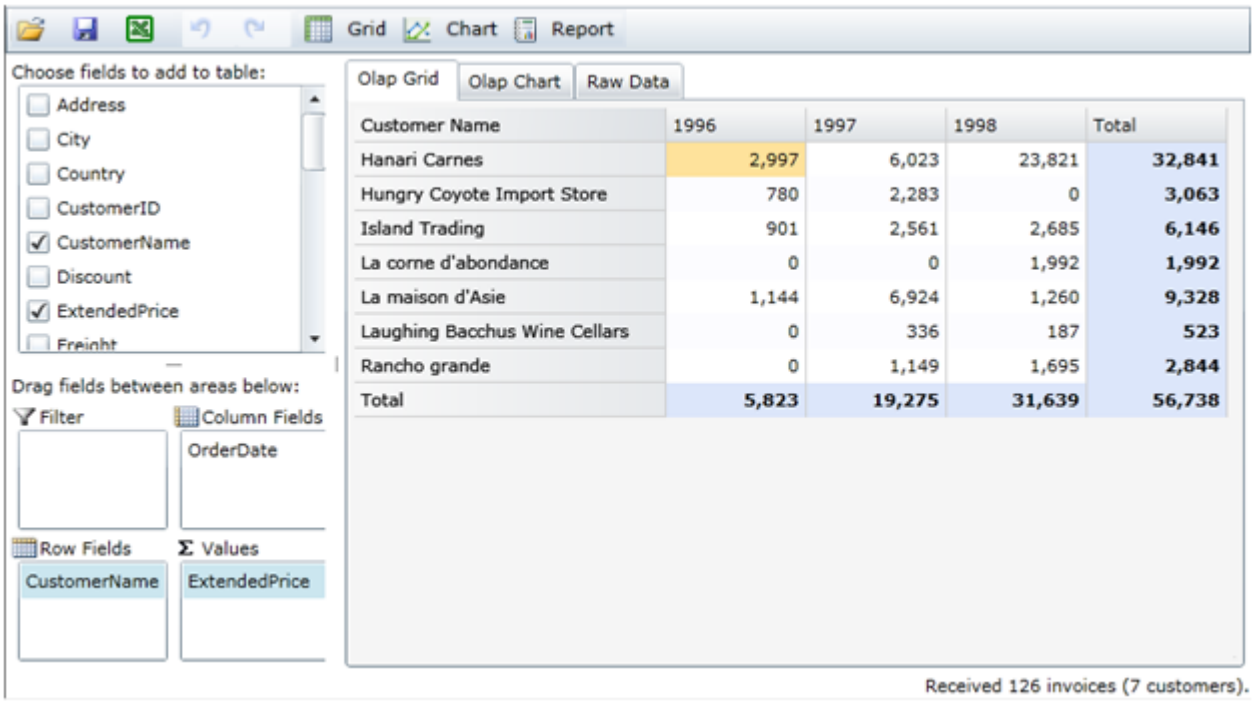
Visual Basic

```
' got new data: show it on C1OlapPagevoid sc_GetCustomerInvoicesCompleted(object sender, SqlFilter.NorthwindDataServiceReference.GetCustomerInvoicesCompletedEventArgs e)
If True Then
    If e.Cancelled OrElse e.[Error] IsNot Nothing Then
        _lblStatus.Text = String.Format("** Error: {0}", If(e.[Error] IsNot Nothing, e.[Error].Message, "Canceled"))
    Else
        _lblStatus.Text = String.Format("Received {0} invoices ({1} customers).", e.Result.Count, _customerFilter.ShowValues.Length)
        ' begin update        var olap = _c1OlapPage.OlapEngine;
        olap.BeginUpdate()
        ' update data source        _invoices.Clear();
        For Each invoice As var In e.Result
            _invoices.Add(invoice)
            ' finish update        olap.EndUpdate();
        Next
    End If
End If
```

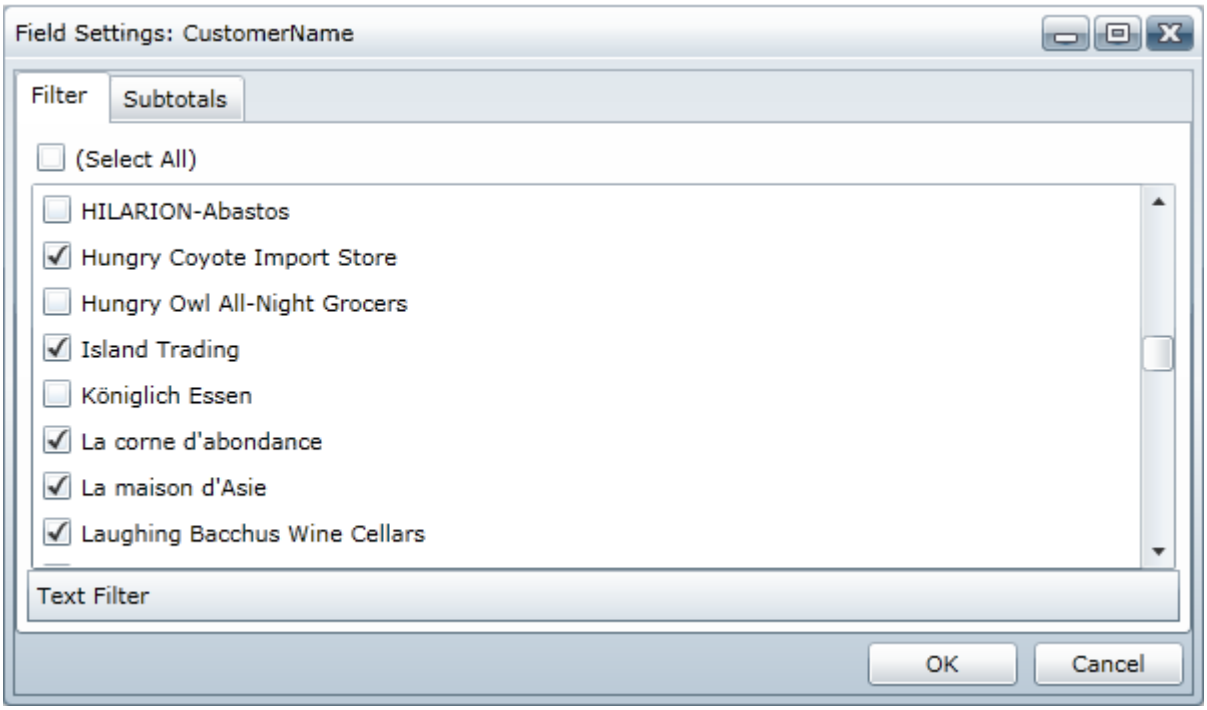
C#

```
// got new data: show it on C1OlapPagevoid sc_GetCustomerInvoicesCompleted(object
sender, SqlFilter.NorthwindDataServiceReference.GetCustomerInvoicesCompletedEventArgs
e)
{
    if (e.Cancelled || e.Error != null)
    {
        _lblStatus.Text = string.Format("** Error: {0}", e.Error != null ?
e.Error.Message : "Canceled");
    }
    else
    {
        _lblStatus.Text = string.Format("Received {0} invoices ({1} customers).",
            e.Result.Count,
            _customerFilter.ShowValues.Length);
        // begin update        var olap = _c1OlapPage.OlapEngine;
        olap.BeginUpdate();
        // update data source        _invoices.Clear();
        foreach (var invoice in e.Result)
        {
            _invoices.Add(invoice);
        }
        // finish update        olap.EndUpdate();
    }
}
```

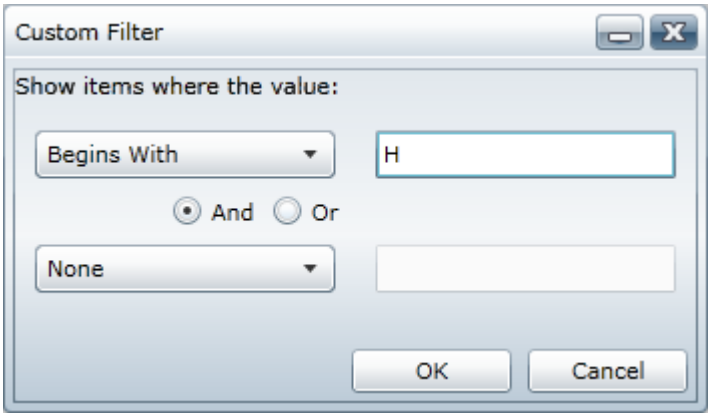
If you run the application now, you will notice that only the customers included in the “CustomerName” setting are included in the view:



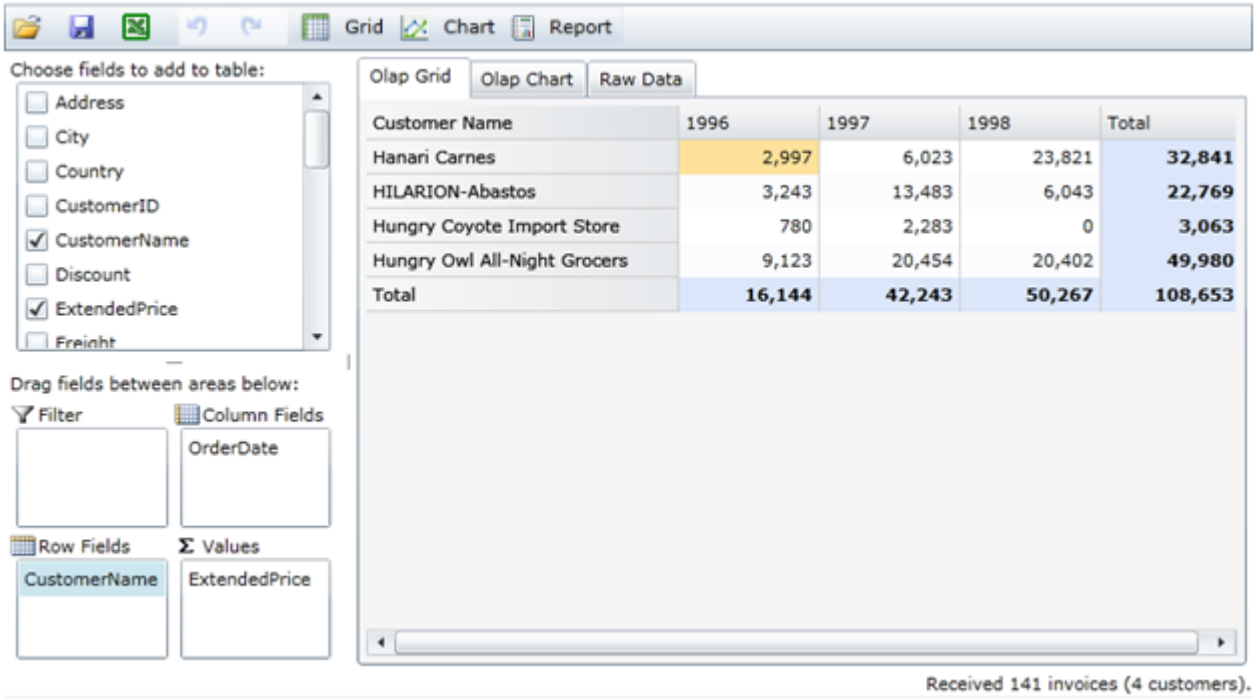
To see other customers, double-click the “CustomerName” field and select “Field Settings” to open its Filter settings.



Then edit the filter by selecting specific customers or by defining a condition. To define a custom filter condition, click "Text Filter" on the bottom of the Field Settings Filter tab, select a condition type (i.e. Equals or Begins with...), then enter your criteria as shown below:



When you click OK, the application will detect the change and will request the additional data from the **GetData** method. Once the new data has been loaded, **C1OlapPage** will detect the change and update the OLAP table automatically:



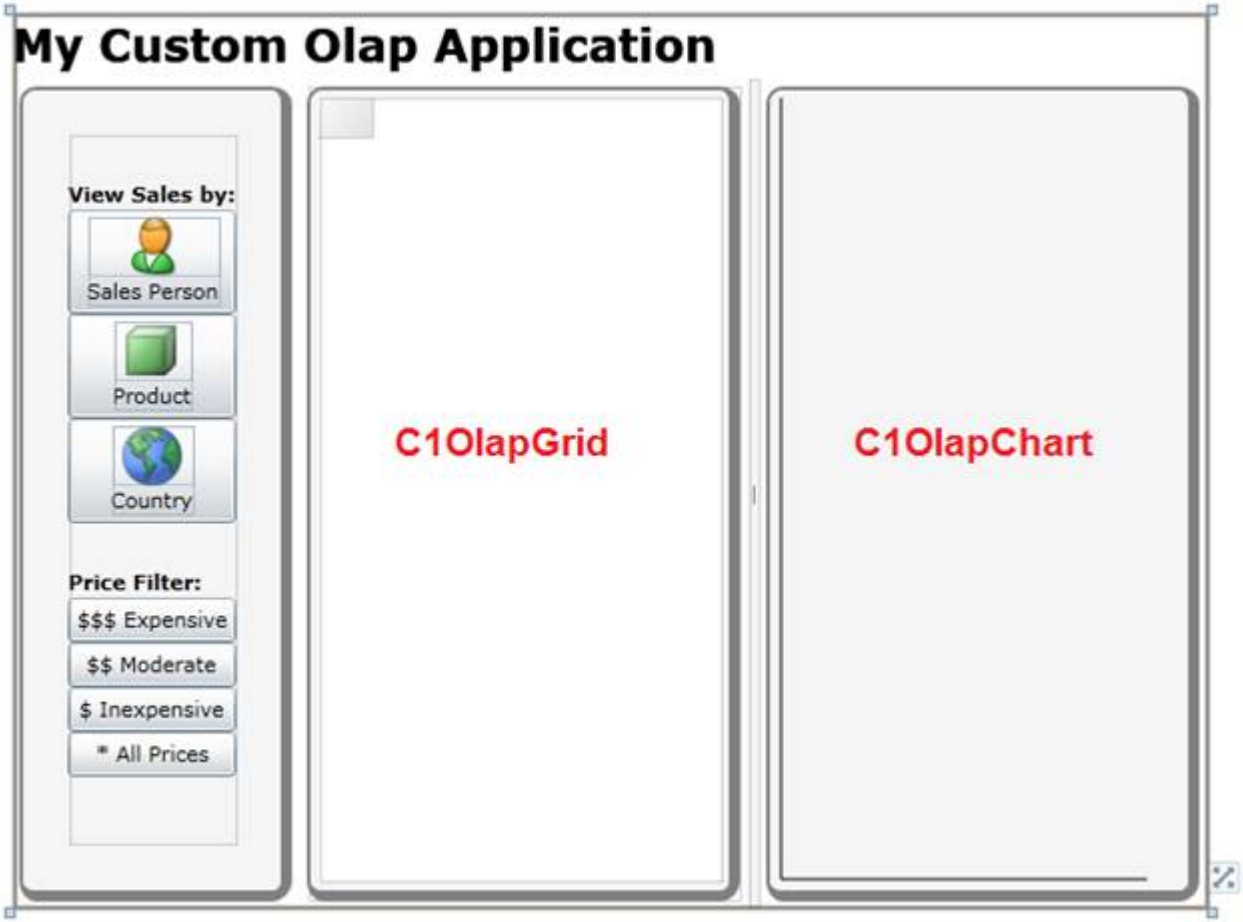
See the included sample "SqlFilter" for the full implementation described in the previous sections. We can extend this sample to also store the OLAP view with filters in local storage. See Persisting OLAP Views in Local Storage.

Building a Custom User Interface

The examples in previous sections all used the **C1OlapPage** control, which contains a complete UI and requires little or no code. In this section, we will walk through the creation of an OLAP application that does not use the **C1OlapPage**. Instead, it creates a complete custom UI using the **C1OlapGrid**, **C1OlapChart**, and some standard Silverlight controls.

The complete source code for this application is included in the "CustomUI" sample installed with **OLAP for Silverlight and WPF**.

The image below shows the application in design view:



Our Grid layout consists of 2 rows and 4 columns. There is a TextBlock filling to the top row showing the application title. There is a vertical StackPanel control in the left-most column with two groups of buttons. The top group allows users to pick one of three pre-defined views: sales by salesperson, by product, or by country. The next group allows users to apply a filter to the data based on product price (expensive, moderate, or inexpensive).

The remaining columns have an empty **C1OlapGrid**, GridSplitter and an empty **C1OlapChart** respectively. These are the controls that will display the view currently selected.

Once all the controls are in place, let's add the code that connects them all and makes the application work.

In code we declare a **C1OlapPanel**. In previous examples the C1OlapPanel part is visible to the end-user. But in this sample we use it behind-the scenes, so users won't ever see it. This invisible control is used as a data source for the grid and the chart, and is responsible for filtering and summarizing the data. Both the grid and the chart have their **DataSource** property set to the **C1OlapPanel**.

```
C1OlapPanel _olapPanel = new C1OlapPanel();
```

The code below first loads Northwind data from an XML data schema file. We use **Data for Silverlight**, which provides us the familiar DataSet and DataTable objects to read the data in. We also use **Zip for Silverlight** to unpackage the zipped XML file on the client. We assign the resulting **DataTable** to the **C1OlapPanel.DataSource** property. We also assign our **C1OlapPanel** control to our **C1OlapGrid** and **C1OlapChart** controls **DataSource** property. Finally, we simulate clicks on two buttons to initialize the current view and filter.

Visual Basic

```
Public MainPage()
    InitializeComponent()

    Dim ds = New DataSet()
```

```
    Dim asm = Assembly.GetExecutingAssembly()
    Using s = asm.GetManifestResourceStream("CustomUI.Resources.nwind.zip")
        Dim zip = New C1ZipFile(s)
                ' load data            ds.ReadXml(zr);
        Using zr = zip.Entries(0).OpenReader()
        End Using
    End Using
    ' bind olap grid/chart to panel    _olapChart.DataSource = _olapPanel;
    _olapGrid.DataSource = _olapPanel
    ' bind olap panel to data    _olapPanel.DataSource = ds.Tables[0].DefaultView;
    ' start with the SalesPerson view, all products    _btnSalesperson_Click(this,
null);
    _btnAllPrices_Click(Me, Nothing)
End Sub
'The event handlers for the buttons that select the current view look like this:
Private Sub _btnSalesperson_Click(sender As Object, e As RoutedEventArgs)
    BuildView("SalesPerson")
End Sub
Private Sub _btnProduct_Click(sender As Object, e As RoutedEventArgs)
    BuildView("ProductName")
End Sub
Private Sub _btnCountry_Click(sender As Object, e As RoutedEventArgs)
    BuildView("Country")
End Sub
'All handlers use a BuildView helper method given below:
' rebuild the view after a button was clickedvoid BuildView(string fieldName)
If True Then
    ' get olap engine    var olap = _olapPanel.OlapEngine;
    ' stop updating until done    olap.BeginUpdate();
    ' clear all fields    olap.RowFields.Clear();
    olap.ColumnFields.Clear()
    olap.ValueFields.Clear()
    ' format order dates to group by year    var f = olap.Fields["OrderDate"];
    f.Format = "yyyy"
    ' build up view    olap.ColumnFields.Add("OrderDate");
    olap.RowFields.Add(fieldName)
    olap.ValueFields.Add("ExtendedPrice")
    ' restore updates    olap.EndUpdate();
End If
```

C#

```
public MainPage()
{
    InitializeComponent();

    var ds = new DataSet();
    var asm = Assembly.GetExecutingAssembly();
    using (var s = asm.GetManifestResourceStream("CustomUI.Resources.nwind.zip"))
    {
        var zip = new C1ZipFile(s);
        using (var zr = zip.Entries[0].OpenReader())
```

```
        {
            // load data            ds.ReadXml(zr);
        }
    }
    // bind olap grid/chart to panel    _olapChart.DataSource = _olapPanel;
    _olapGrid.DataSource = _olapPanel;
    // bind olap panel to data    _olapPanel.DataSource = ds.Tables[0].DefaultView;
    // start with the SalesPerson view, all products    _btnSalesperson_Click(this,
null);
    _btnAllPrices_Click(this, null);
}
//The event handlers for the buttons that select the current view look like this:
void _btnSalesperson_Click(object sender, RoutedEventArgs e)
{
    BuildView("SalesPerson");
}
void _btnProduct_Click(object sender, RoutedEventArgs e)
{
    BuildView("ProductName");
}
void _btnCountry_Click(object sender, RoutedEventArgs e)
{
    BuildView("Country");
}
//All handlers use a BuildView helper method given below:
// rebuild the view after a button was clickedvoid BuildView(string fieldName)
{
    // get olap engine    var olap = _olapPanel.OlapEngine;
    // stop updating until done    olap.BeginUpdate();
    // clear all fields    olap.RowFields.Clear();
    olap.ColumnFields.Clear();
    olap.ValueFields.Clear();
    // format order dates to group by year    var f = olap.Fields["OrderDate"];
    f.Format = "yyyy";
    // build up view    olap.ColumnFields.Add("OrderDate");
    olap.RowFields.Add(fieldName);
    olap.ValueFields.Add("ExtendedPrice");
    // restore updates    olap.EndUpdate();
}
```

The **BuildView** method gets a reference to the **C1OlapEngine** object provided by the **C1OlapPanel** and immediately calls the **BeginUpdate** method to stop updates until the new view has been completely defined. This is done to improve performance.

The code then sets the format of the "OrderDate" field to "yyyy" so sales are grouped by year and rebuilds view by clearing the engine's **RowFields**, **ColumnFields**, and **ValueFields** collections, then adding the fields that should be displayed. The "fieldName" parameter passed by the caller contains the name of the only field that changes between views in this example.

When all this is done, the code calls **EndUpdate** so the **C1OlapPanel** will update the output table.

Before running the application, let's look at the code that implements filtering. The event handlers look like this:

Visual Basic

```
Private Sub _btnExpensive_Click(sender As Object, e As RoutedEventArgs)
    SetPriceFilter("Expensive Products (price > $50)", 50, Double.MaxValue)
End Sub
Private Sub _btnModerate_Click(sender As Object, e As RoutedEventArgs)
    SetPriceFilter("Moderately Priced Products ($20 < price < $50)", 20, 50)
End Sub
Private Sub _btnInexpensive_Click(sender As Object, e As RoutedEventArgs)
    SetPriceFilter("Inexpensive Products (price < $20)", 0, 20)
End Sub
Private Sub _btnAllPrices_Click(sender As Object, e As RoutedEventArgs)
    SetPriceFilter("All Products", 0, Double.MaxValue)
End Sub
```

C#

```
void _btnExpensive_Click(object sender, RoutedEventArgs e)
{
    SetPriceFilter("Expensive Products (price > $50)", 50, double.MaxValue);
}
void _btnModerate_Click(object sender, RoutedEventArgs e)
{
    SetPriceFilter("Moderately Priced Products ($20 < price < $50)", 20, 50);
}
void _btnInexpensive_Click(object sender, RoutedEventArgs e)
{
    SetPriceFilter("Inexpensive Products (price < $20)", 0, 20);
}
void _btnAllPrices_Click(object sender, RoutedEventArgs e)
{
    SetPriceFilter("All Products", 0, double.MaxValue);
}
```

All handlers use a **SetPriceFilter** helper method given below:

Visual Basic

```
' apply a filter to the product pricevoid SetPriceFilter(string footerText, double
min, double max)
If True Then
    ' get olap engine    var olap = _olapPanel.OlapEngine;
    ' stop updating until done    olap.BeginUpdate();
    ' make sure unit price field is active in the view    var field =
olap.Fields["UnitPrice"];
    olap.FilterFields.Add(field)
    ' customize the filter    var filter = field.Filter;
    filter.Clear()
    filter.Condition1.[Operator] = C1.Olap.ConditionOperator.GreaterThanOrEqualTo
    filter.Condition1.Parameter = min
    filter.Condition2.[Operator] = C1.Olap.ConditionOperator.LessThanOrEqualTo
    filter.Condition2.Parameter = max
    ' restore updates    olap.EndUpdate();
```

```
End If
```

C#

```
// apply a filter to the product pricevoid SetPriceFilter(string footerText, double
min, double max)
{
    // get olap engine    var olap = _olapPanel.OlapEngine;
    // stop updating until done    olap.BeginUpdate();
    // make sure unit price field is active in the view    var field =
olap.Fields["UnitPrice"];
    olap.FilterFields.Add(field);
    // customize the filter    var filter = field.Filter;
    filter.Clear();
    filter.Condition1.Operator = C1.Olap.ConditionOperator.GreaterThanOrEqualTo;
    filter.Condition1.Parameter = min;
    filter.Condition2.Operator = C1.Olap.ConditionOperator.LessThanOrEqualTo;
    filter.Condition2.Parameter = max;
    // restore updates    olap.EndUpdate();
}
```

As before, the code gets a reference to the **C1OlapEngine** and immediately calls **BeginUpdate**.

It then gets a reference to the "UnitPrice" field that will be used for filtering the data. The "UnitPrice" field is added to the engine's **FilterFields** collection so the filter will be applied to the current view.

This is an important detail. If a field is not included in any of the view collections (**RowFields**, **ColumnFields**, **ValueFields**, **FilterFields**), then it is not included in the view at all, and its **Filter** property does not affect the view in any way.

The code proceeds to configure the **Filter** property of the "UnitPrice" field by setting two conditions that specify the range of values that should be included in the view. The range is defined by the "min" and "max" parameters. Instead of using conditions, you could provide a list of values that should be included. Conditions are usually more convenient when dealing with numeric values, and lists are better for string values and enumerations.

Finally, the code calls **EndUpdate**.

One last thing we'll do is update the **C1OlapChart** anytime the user sorts a column on the **C1OlapGrid**. This way the data values appear in the same order.

Visual Basic

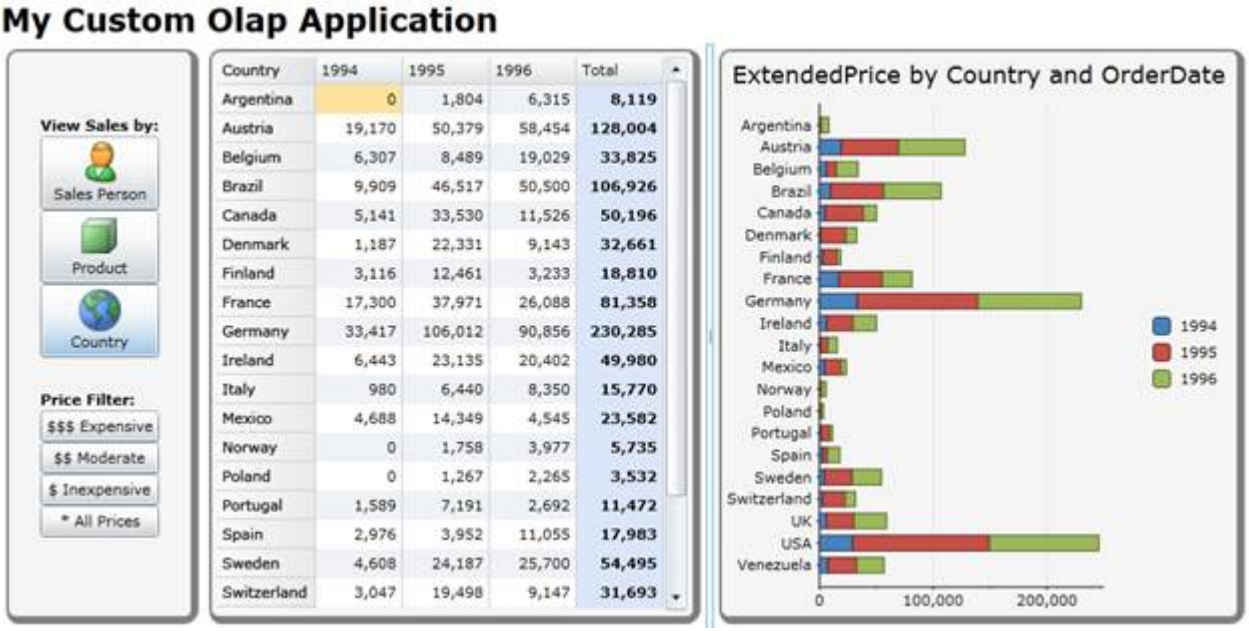
```
Private Sub _olapGrid_SortedColumn(sender As Object, e As
C1.Silverlight.FlexGrid.CellRangeEventArgs)
    _olapChart.UpdateChart()
End Sub
```

C#

```
void _olapGrid_SortedColumn(object sender, C1.Silverlight.FlexGrid.CellRangeEventArgs
e)
{
    _olapChart.UpdateChart();
}
```

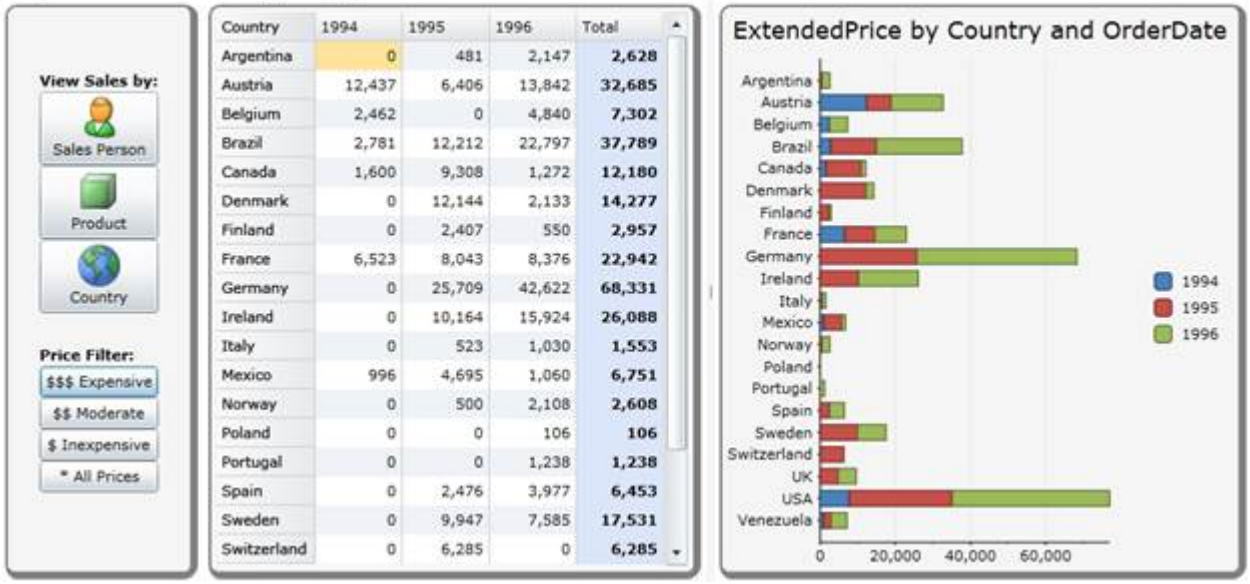
The application is now ready. You can run it and test the different views and filtering capabilities of the application, as

illustrated below:



This view shows sales for all products, grouped by year and country. Notice how the chart shows values approaching $300,000.

If you click the "$$$ Expensive" button, the filter is applied and the view changes immediately. Notice how now the chart shows values approaching $80,000 instead. Expensive values are responsible for about one third of the sales:



XAML Quick Reference

This topic is dedicated to providing a quick overview of the XAML used to create a the **OLAP for WPF and Silverlight** controls.

To get started developing, add a **c1** namespace declaration in the root element tag:

```
xmlns:c1="http://schemas.componentone.com/winfx/2006/xaml"
```

Below is the XAML:

XAML

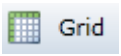
```
<!-- olap page -->
<c1:C1OlapPageHorizontalAlignment="Left"Margin="28,12,0,0"Name="c1OlapPage1"VerticalAlignment="Top"Height="426"Width="528"/>
<!-- olap panel -->
<c1:C1OlapPanelHorizontalAlignment="Left"Margin="26,11,0,0"Name="c1OlapPanel1"VerticalAlignment="Top"Height="307"Width="393"/>
<!-- olap grid -->
    <BorderStyle="{StaticResource_border}"Grid.Row="1"Grid.Column="1">
      <c1:C1OlapGridx:Name="_olapGrid"Margin="4"SortedColumn="_olapGrid_SortedColumn"/>
    </Border>
    <!-- olap chart -->
    <BorderStyle="{StaticResource_border}"Grid.Row="1"Grid.Column="3">
      <c1:C1OlapChartx:Name="_olapChart"Margin="4"/>
    </Border>
```

OLAP for WPF and Silverlight Design-Time Support

The following sections describe how to use the **OLAP for Silverlight and WPF** design-time environment to configure the controls.

Using the C1OlapPage ToolStrip

The C1OlapPage control provides a ToolStrip you can use to: load or save a C1OlapPage as an .xml file, display your data in a grid or chart, or setup and print a report. The following table describes the buttons in the ToolStrip.

Button		Description
Load		Allows you to load a previously saved **C1Olap** view definition file (*.olapx) into the C1OlapPage.
Save		Allows you to save a **C1Olap** view definition file (*.olapx).
Export		Allows you to export C1OlapGrid to different formats, such as .xlsx, .xls, .csv, and .txt.
Undo		Clicking the **Undo** button cancels the last action performed in C1OlapPage.
Redo		Clicking the **Redo** button performs the last action(s) cancelled using the **Undo** button.
Grid		Allows you to choose the columns and rows to display in the C1OlapGrid.
Chart		Allows you customize the chart used to display your data. You can determine: the chart type, the palette or theme, whether the title will appear, whether the chart is stacked, and whether gridlines appear.
Report		Allows you to: specify a header or footer for each page of the report; determine what to include in the report, the Olap grid, chart, or raw data grid; specify the page layout, including orientation, paper size, and margins; preview the report before printing; and print the report.

Using the Grid Menu

The **Grid** menu provides three options:

Total Rows	Allows you to choose from **Grand Totals**, **Subtotals**, or **None**.
Total Columns	Allows you to choose from **Grand Totals**, **Subtotals**, or **None**.
Show Zeros	If checked, shows any cells containing zero in the grid.

Simply uncheck any of these items to hide the total rows, total columns, or any zeros in the grid.

Using the Chart Menu

From the **Chart** menu, you can determine: the chart type, the palette, whether to show the chart title above the chart, whether to show chart gridlines, whether to show a stacked chart, and whether to show totals only.

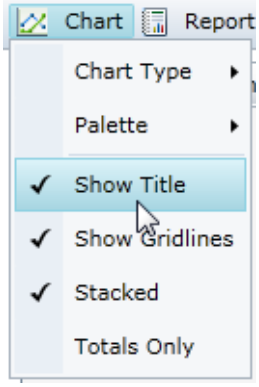
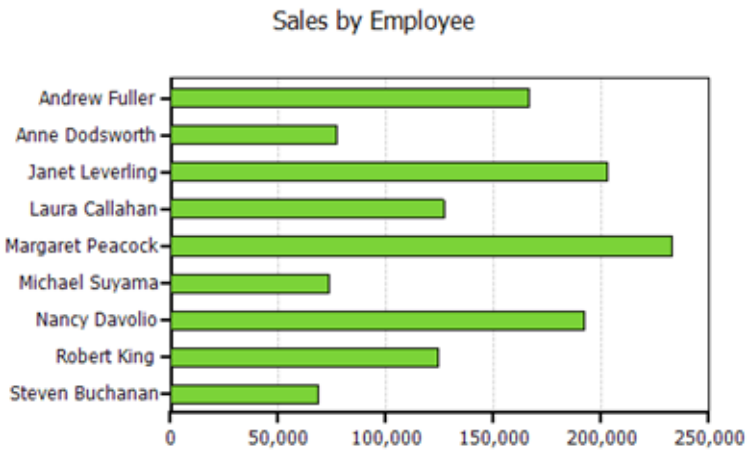
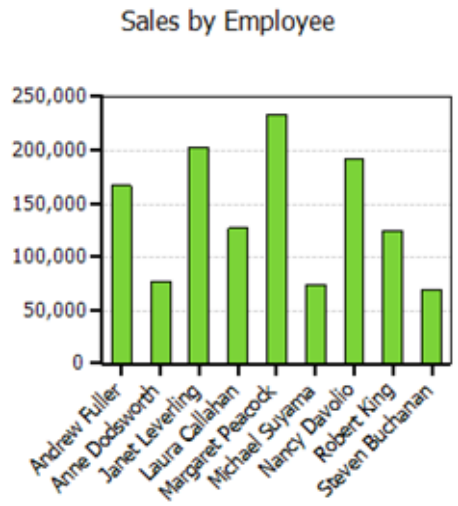
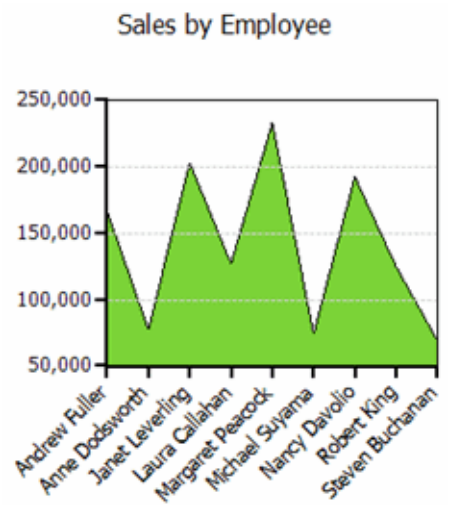
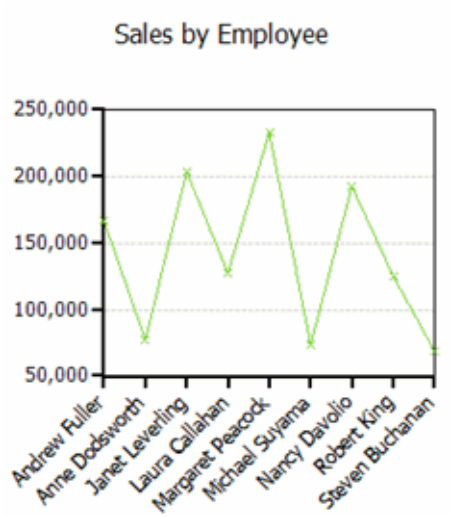


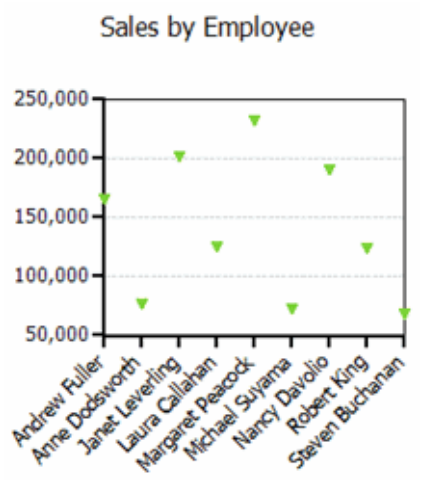
Chart Type	Click **Chart Type** to select from five common chart types shown below.
Palette	Click **Palette** to select from twenty-two palette options that define the colors of the chart and legend items. See the options in the **Palette** topic below.
Show Title	When selected, shows a title above the chart.
Stacked	When selected, creates a chart view where the data is stacked.
Show Gridlines	When selected, shows gridlines in the chart.
Totals Only	When selected, shows only totals as opposed to one series for each column in the data source.

Chart Types

OLAP for WPF and Silverlight offers five of the most common chart types. The following table shows an example of each type.

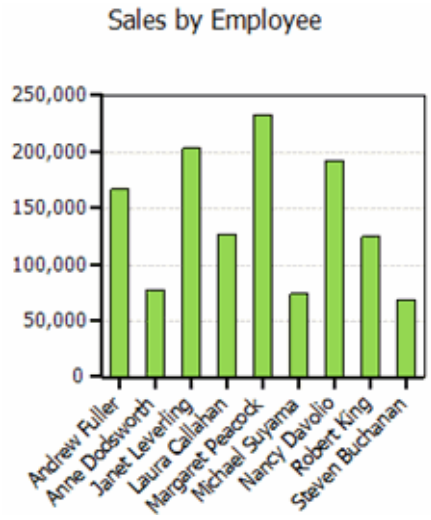
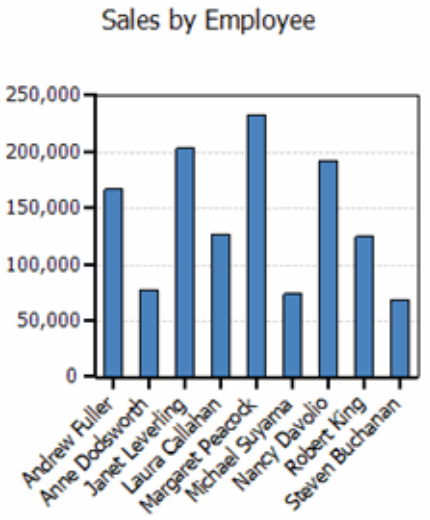
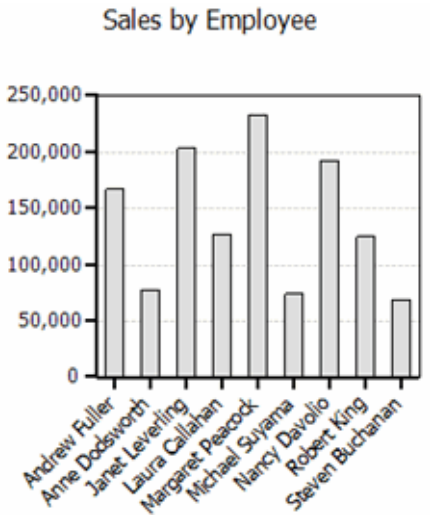
Bar	

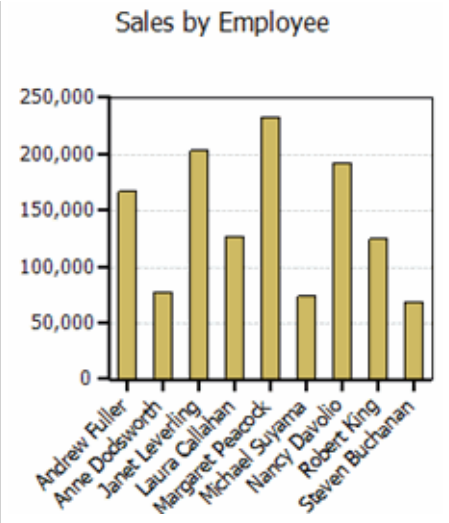
Column	
Area	
Line	

Scatter	

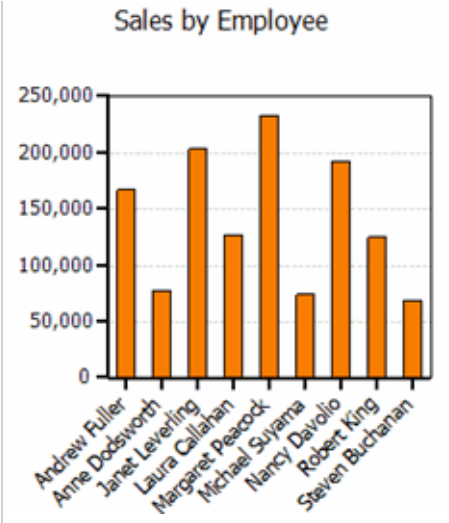
Palette

The C1OlapChart palette is made up of twenty-two options that define the colors of the chart and legend items. The following table shows the colors for each palette option.

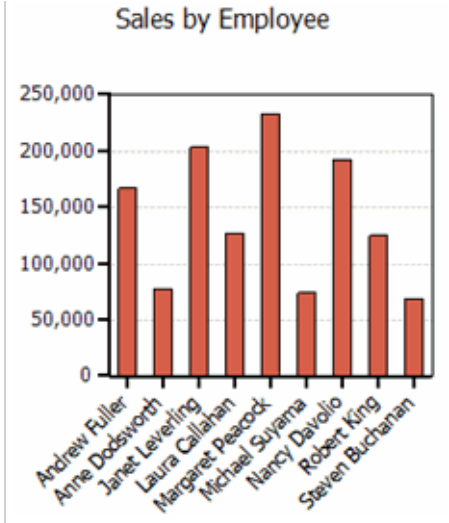
Standard	**Office**	**GrayScale**
		
Apex	**Aspect**	**Civic**



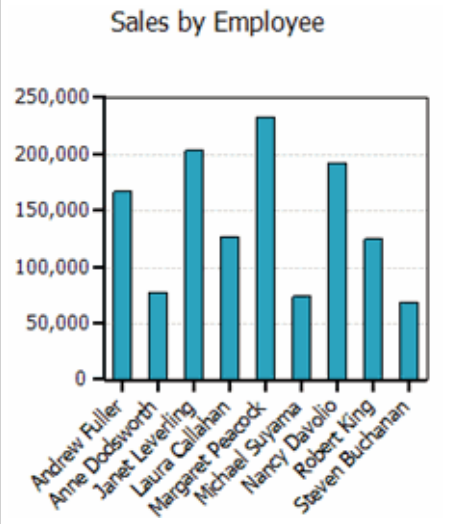
Concourse



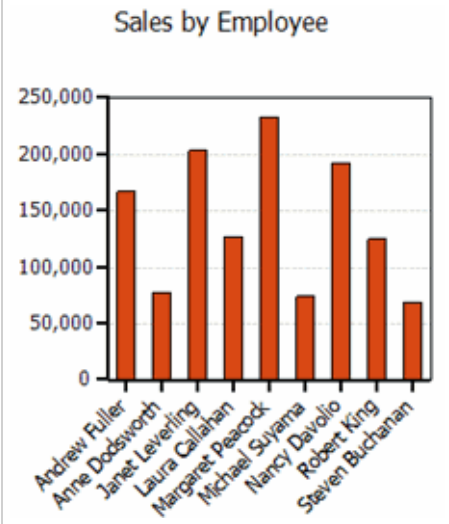
Equity



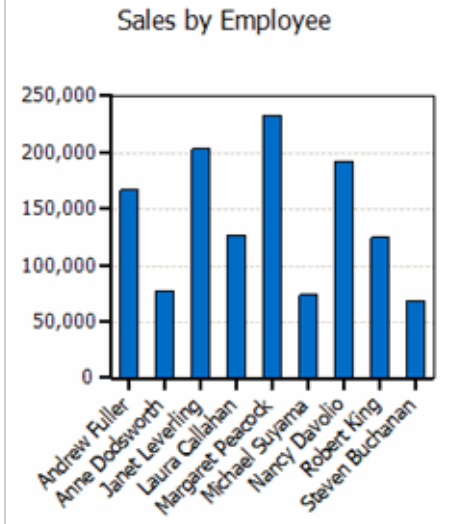
Flow



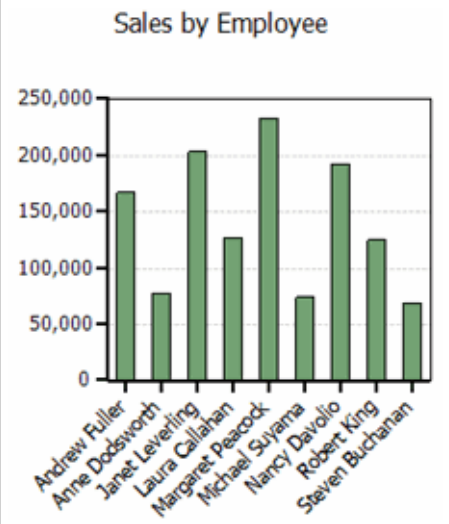
Foundry



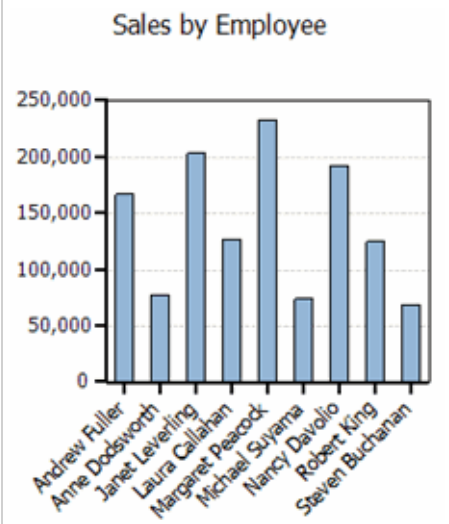
Median



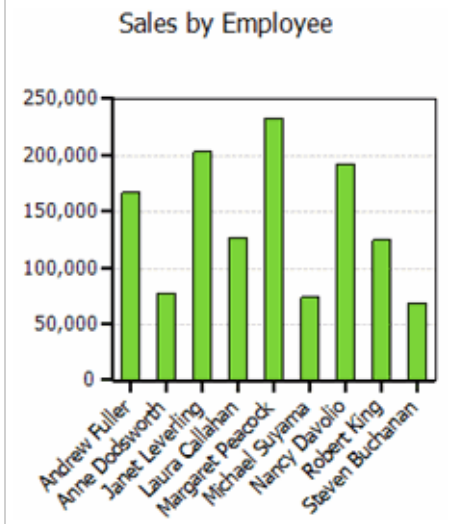
Metro



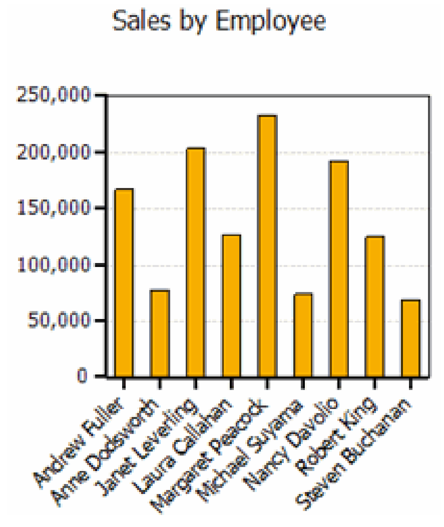
Module



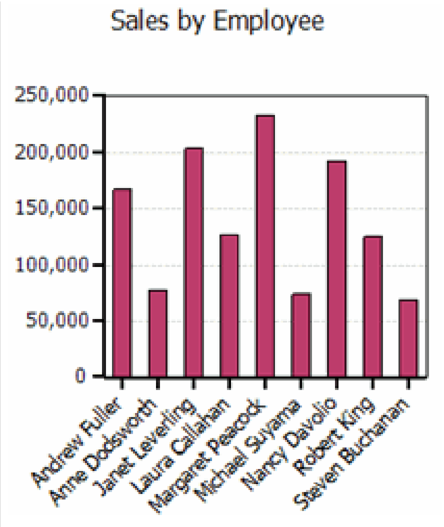
Opulent



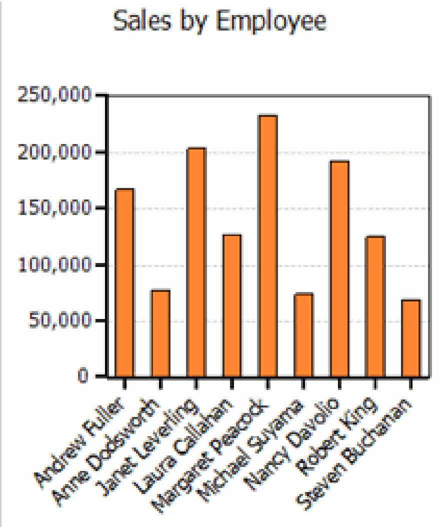
Oriel



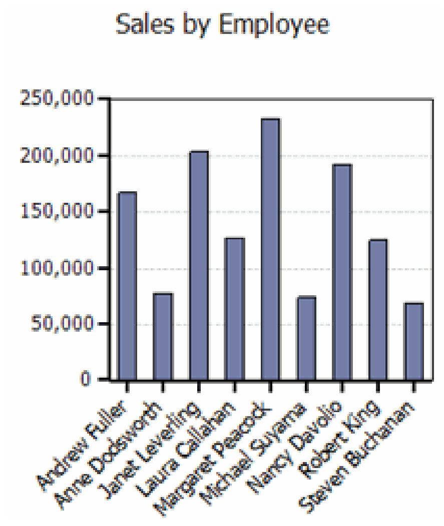
Origin



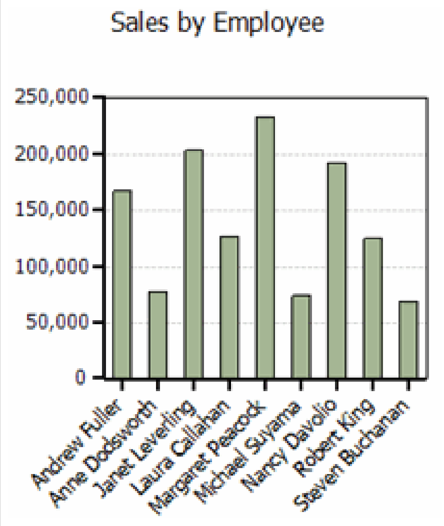
Paper



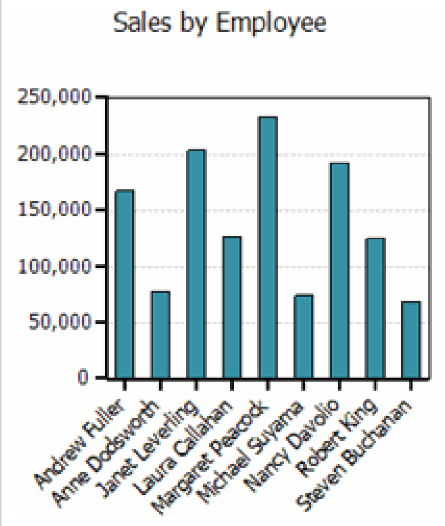
Solstice



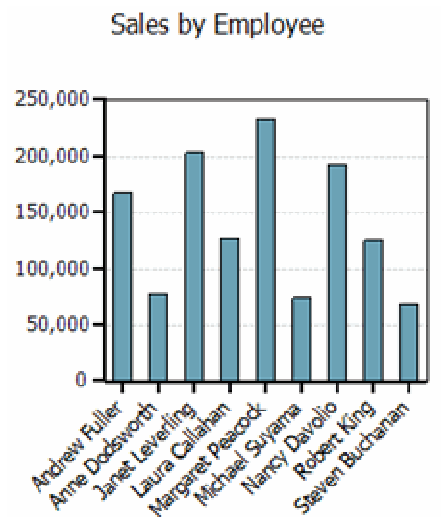
Technic



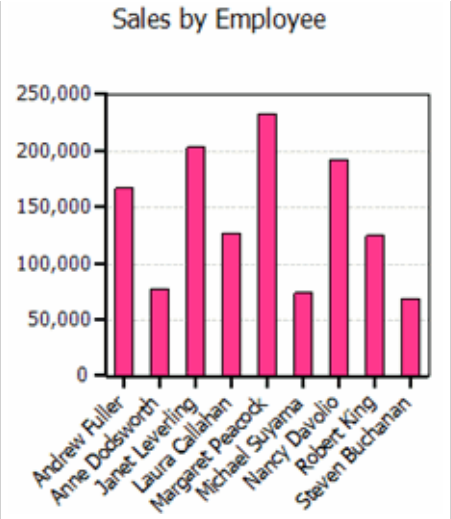
Trek



Urban

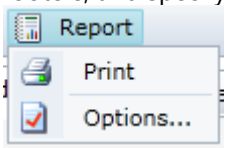


Verve



Using the Report Menu

From the **Report** menu, you can preview or print the report, set up the pages of the report, add header and/or footers, and specify which items to show in the report.

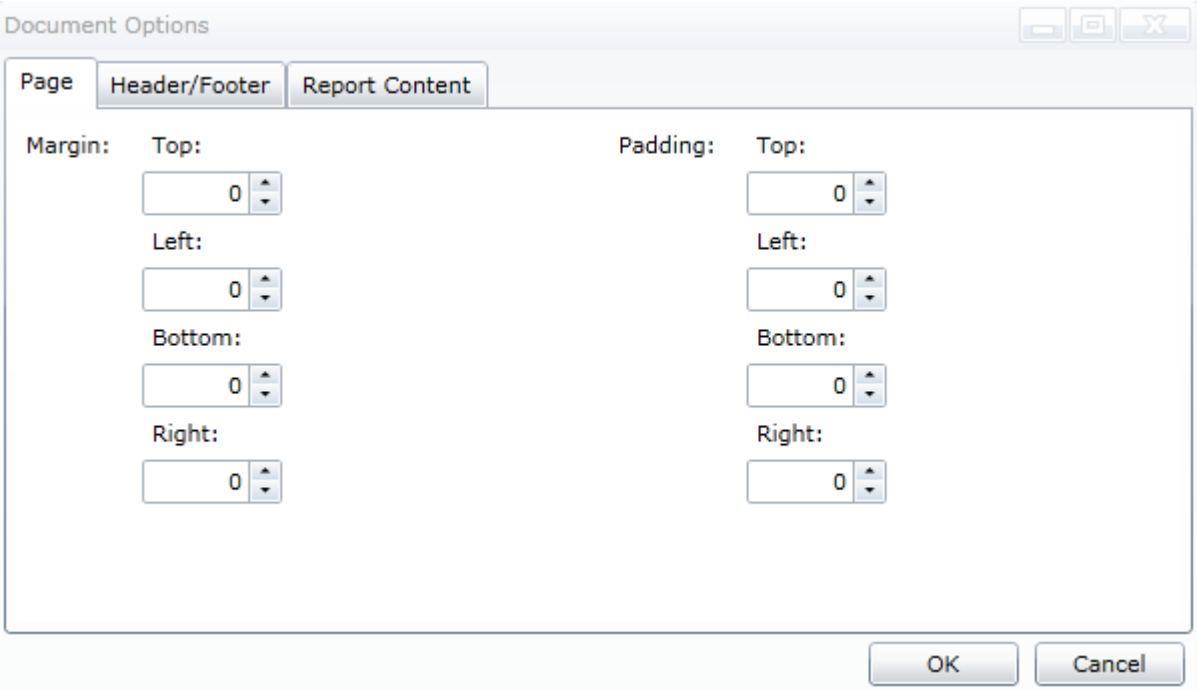


Print	Click **Print** to print the C1OlapGrid, C1OlapChart, or both.
Options	Click **Options** to open the **Document Options** dialog box for

Document Options

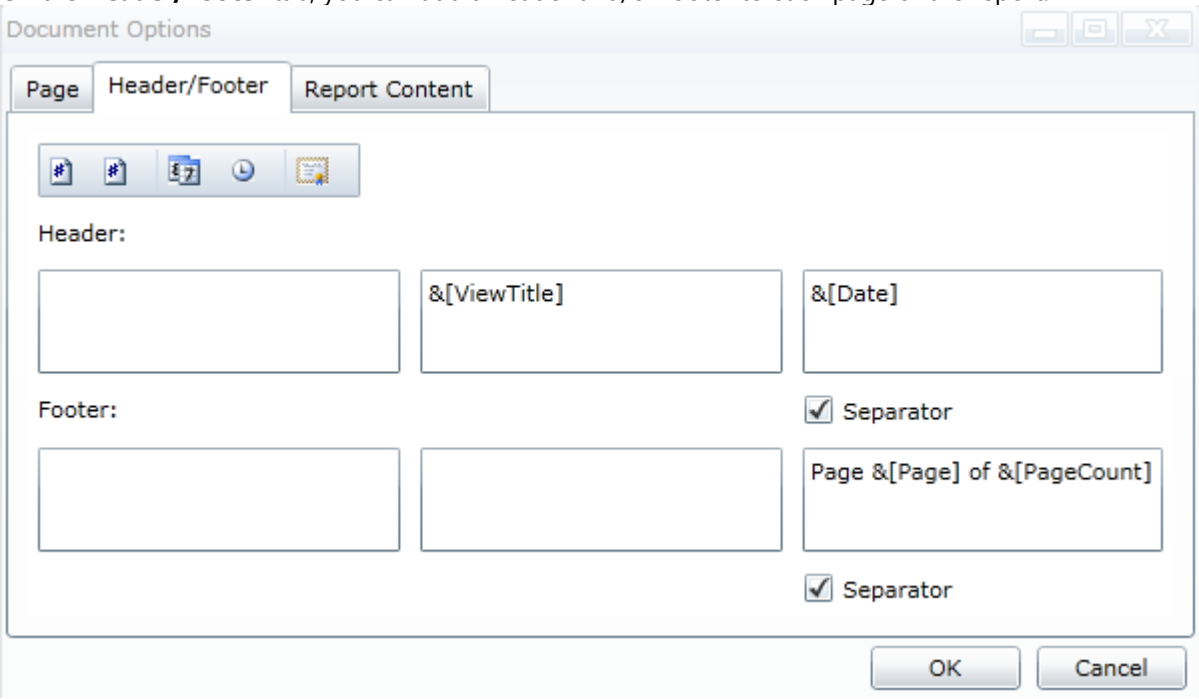
The Page Tab

On the **Page** tab you can specify the Margins and Padding.



The Header/Footer Tab

On the **Header/Footer** tab, you can add a header and/or footer to each page of the report.



Click one of the buttons on the toolbar to insert fields into the header or footer.

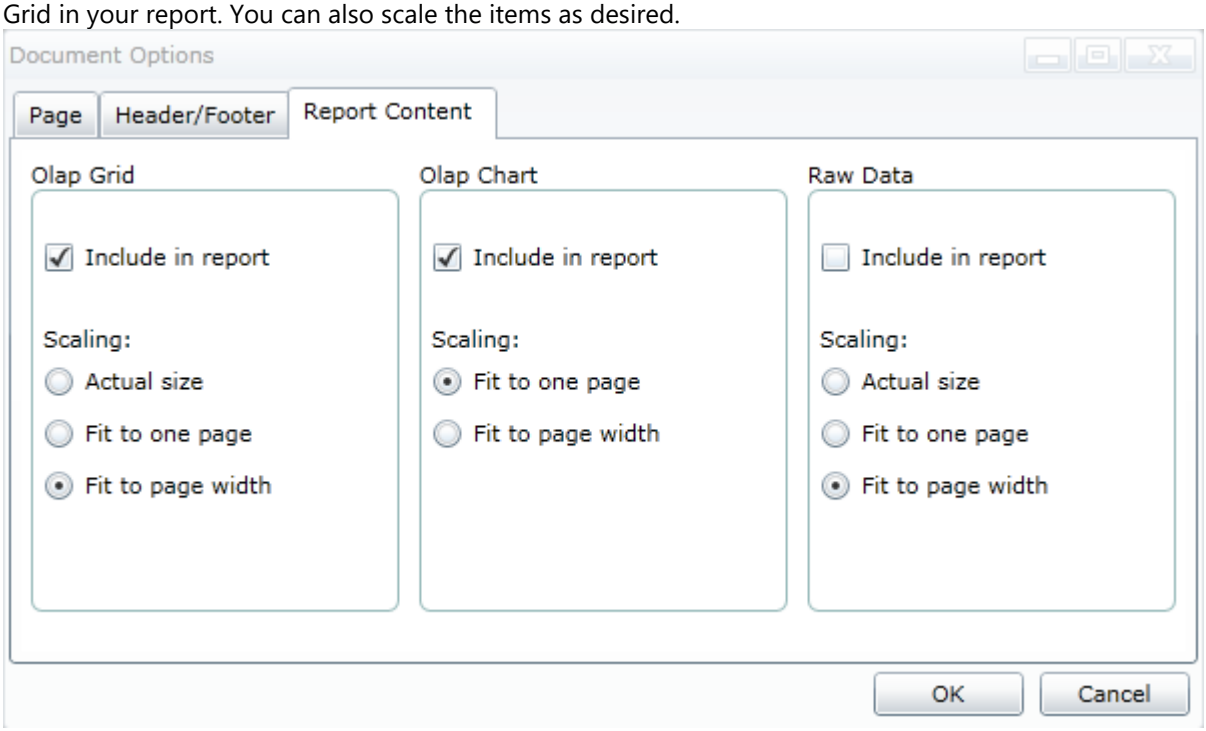
Button	**Field**
Page Number	&[Page]
Total Page Count	&[PageCount]
Current Date	&[Date]
Current Time	&[Time]

Title	&[ViewTitle]

Check the **Separator** box to show a separator line below the header or above the footer. Click the **Font** button to change the font, style, size, or effects.

The Report Content Tab

On the **Report Content** tab, you can determine whether to include the OLAP Grid, Olap Chart, and/or the Raw Data Grid in your report. You can also scale the items as desired.



OLAP Cubes

Olap for WPF allows you to connect to OLAP data sources like **Microsoft® SQL Server® Analysis Services (SSAS)**. You can connect to online cubes or attach a local cube at run time. **C1Olap** works with **Analysis Services** and **SQL Server 2008**, **2012** and **2014**.

> **Note:** Cube support is available for WPF only.

Connecting to an OLAP Cube

To connect with a cube, you should use the C1OlapPanel.ConnectCube method. This method accepts two parameters: the connection string to a SQL Server with Analysis Services installed, and the name of the cube. You can report errors to the user by catching an Exception at run-time. Here is a complete coded example of connecting to a cube.

Visual Basic

```
' connect to cube

stringconnectionString = "Data Source=myServerAddress;Catalog=myDataBase"

stringcubeName = "Adventure Works"

Try

    _c1OlapPage.OlapPanel.ConnectCube(cubeName, connectionString)

Catch generatedExceptionName As Exceptionex


    MessageBox.Show(ex.Message)
End Try
```

C#

```
// connect to cube
stringconnectionString = @"Data Source=myServerAddress;Catalog=myDataBase";
stringcubeName = "Adventure Works";

try
{
    _c1OlapPage.OlapPanel.ConnectCube(cubeName, connectionString);
}
catch(Exceptionex)
{
    MessageBox.Show(ex.Message);
}
```

The connection string should set the **Data Source** and the **Initial Catalog**. If you have more than one Microsoft OLE DB provider for OLAP installed, you may need to specify the version of the provider in the connection string. For example, setting the **Provider** to **MSOLAP** will use the latest version of **OLE DB for OLAP** installed on your system.

Example:

Visual Basic

```
Provider = MSOLAP
Dim Source As Data = myServerAddress
Dim Catalog As Initial = myDataBase
```

C#

```
Provider=MSOLAP;Data Source=myServerAddress;Initial Catalog=myDataBase;
```

Note: If you've created a custom UI or are not using the C1OlapPage control, you can use the C1OlapPanel control and its same C1OlapPanel.ConnectCube method.

Loading a Local Cube File

You can use **C1Olap** with local cube files (.cub). For instance, if you have placed a cube file in a directory within the project named **Data**, the connection string would look like the following.

Visual Basic

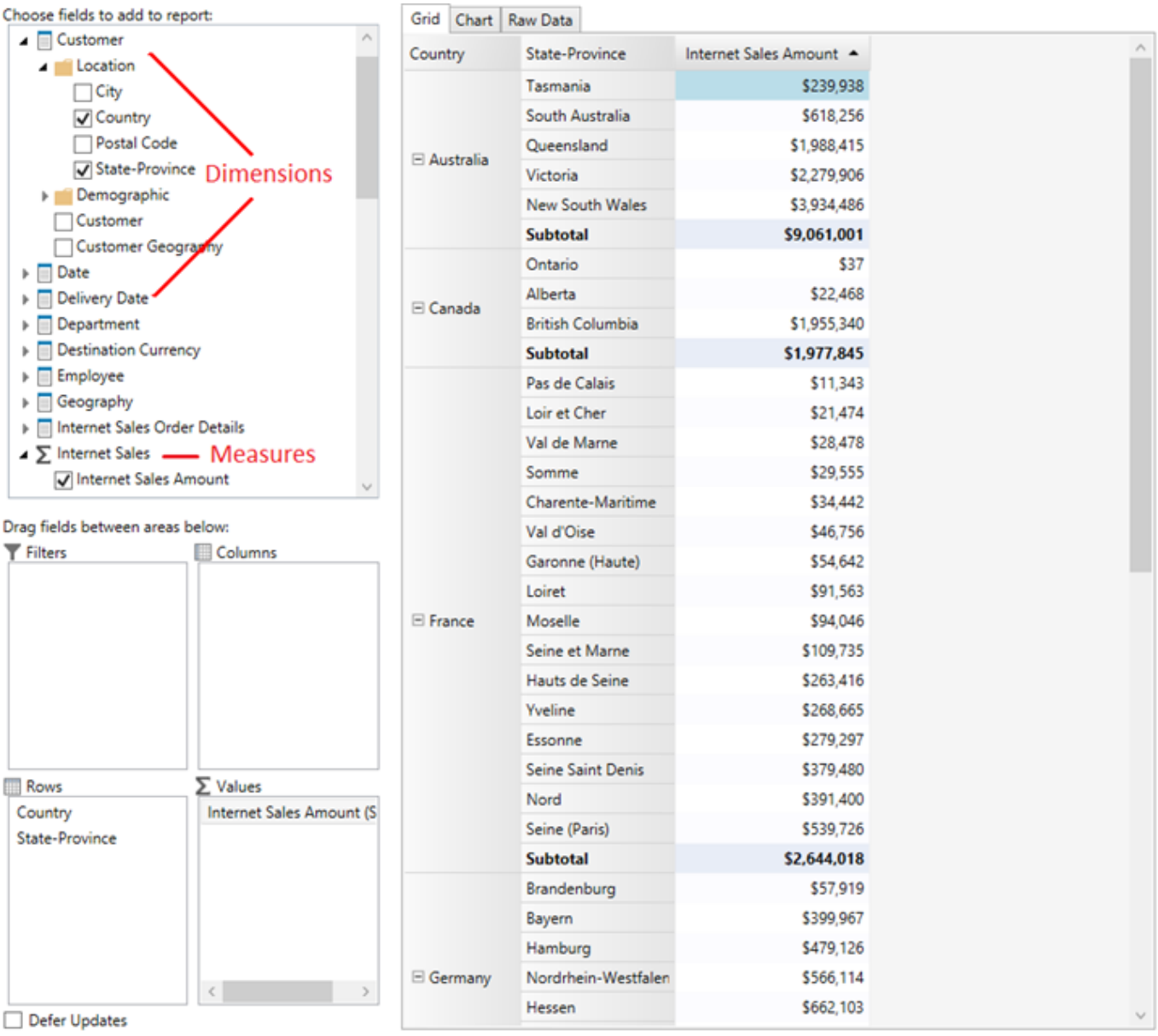
```
stringconnectionString = "Data Source=" +
System.AppDomain.CurrentDomain.BaseDirectory + "\Data\LocalCube.cub;Provider=msolap"

stringcubeName = "LocalCube"

c1OlapPage1.OlapPanel.ConnectCube(cubeName, connectionString)
```

C#

```
stringconnectionString = @"Data Source="+
System.AppDomain.CurrentDomain.BaseDirectory +
@"\Data\LocalCube.cub;Provider=msolap";
stringcubeName = "LocalCube";
c1OlapPage1.OlapPanel.ConnectCube(cubeName, connectionString);
```

Using Cube Data Sources

At run-time users can build reports from cube data much like they would from regular data sets. The key difference is that cube data sets are represented by a tree in the C1OlapPanel control with each node representing a dimensional entity or an object for measure. All fields that can be added to the report are displayed with a checkbox. Objects represented by the summation symbol (∑) are measures and can be added to the **Values** collection. Fields of entities can be added to the **Rows** or **Columns** collections.



OLAP for WPF and Silverlight Task-Based Help

The task-based help assumes that you are familiar with programming in Visual Studio and know how to use bound and unbound controls in general. Each topic provides a solution for specific tasks using the **OLAP for WPF and Silverlight** product. By following the steps outlined in the help, you will be able to create projects demonstrating a variety of **OLAP for WPF and Silverlight** features.

Each task-based help topic also assumes that you have created a new WPF or Silverlight project.

Binding C1OlapPage or C1OlapPanel a Data Source

You can easily bind C1OlapPage or **C1Olap** to a data source using the **C1OlapPage.DataSource** or **C1OlapPanel.DataSource** property. For this example, we load Northwind product data from an XML data schema file. Note that the **nwind.zip** is installed with the **OlapQuickStart** sample. We use **ComponentOne Data**, which provides us the familiar DataSet and DataTable objects to read the data in. We also use **ComponentOne Zip** to unpackage the zipped XML file on the client.

To bind the C1OlapPage control, follow these steps:

1. Add the following code:

Visual Baisc

```
' load data from embedded zip resourcevar ds = new DataSet();
Dim asm = Assembly.GetExecutingAssembly()
Using s = asm.GetManifestResourceStream("OlapQuickStart.nwind.zip")
    Dim zip = New C1ZipFile(s)
    Using zr = zip.Entries(0).OpenReader()
        ' load data
        ds.ReadXml(zr)
    End Using
End Using
```

C#

```
// load data from embedded zip resourcevar ds = new DataSet();
var asm = Assembly.GetExecutingAssembly();
using (var s = asm.GetManifestResourceStream("OlapQuickStart.nwind.zip"))
{
     var zip = new C1ZipFile(s);
     using (var zr = zip.Entries[0].OpenReader())
     {
           // load data
           ds.ReadXml(zr);
     }
}
```

2. Set the **C1OlapPage.**DataSource property on the C1OlapPage control. We could use any data binding method with this control.

Visual Basic

```
// bind olap page to data
_c1OlapPage.DataSource = ds.Tables[0].DefaultView;
```

C#

```
// bind olap page to data
_c1OlapPage.DataSource = ds.Tables[0].DefaultView;
```

Binding C1OlapChart to a C1OlapPanel

You can populate a C1OlapChart control by binding it to a C1OlapPanel that is bound to a data source. Note that this topic assumes you have a bound C1OlapPanel control on your form.

Set the C1OlapChart.DataSource property on the C1OlapChart to the C1OlapPanel that provides the Olap data.

Binding C1OlapGrid to a C1OlapPanel

You can populate a C1OlapGrid control by binding it to a C1OlapPanel that is bound to a data source. Note that this topic assumes you have a bound C1OlapPanel control on your form.

Set the C1OlapGrid.DataSource property on the C1OlapGrid to the C1OlapPanel that provides the OLAP data.

Removing a Field from a Data View

In the C1OlapPanel control or the C1OlapPanel area of the C1OlapPage control, you can filter out an entire field so that it doesn't appear in your C1OlapGrid or C1OlapChart data view. This can be done at run time.

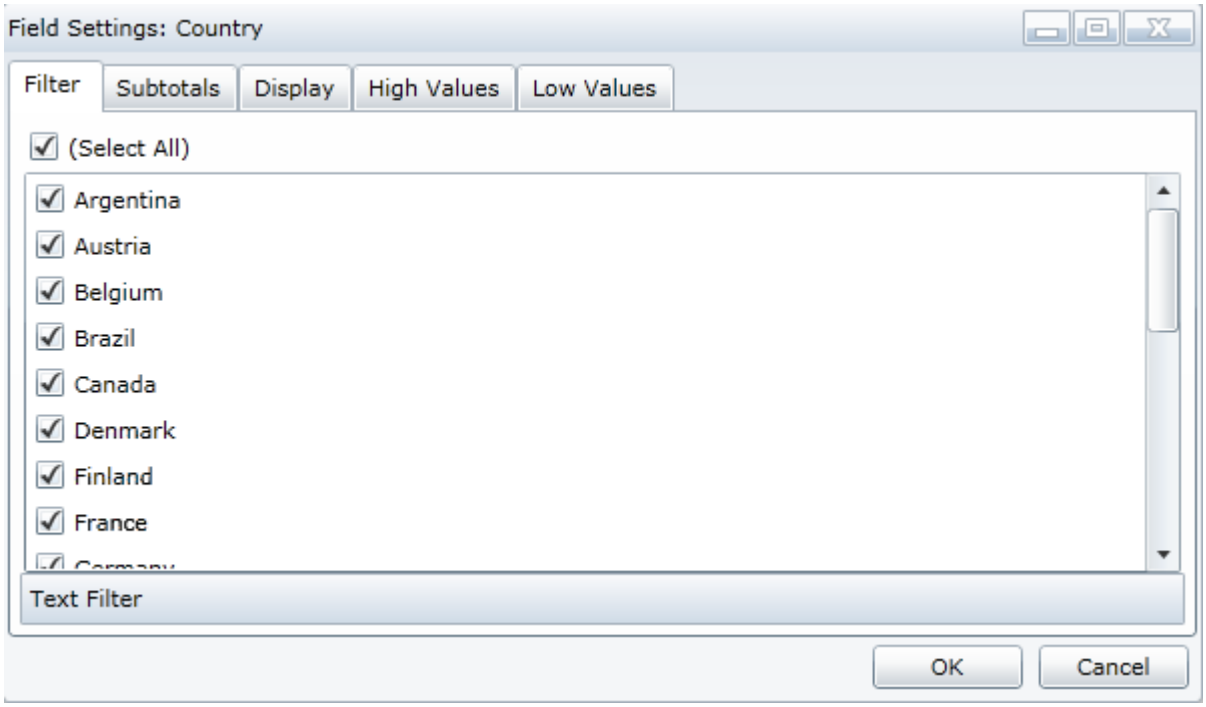
1. In the **Drag fields between areas below** section of the panel, select the field to filter out of the view.
2. Drag it to the **Filter** area of the panel. The data in this field will be removed from the C1OlapGrid or C1OlapChart data view.

Filtering Data in a Field

In the C1OlapPanel control or the C1OlapPanel area of the C1OlapPage control, you can filter the data in a field from the **Drag fields between areas below** section of the panel at run time. Each field has two filters: the value filter, which allows you to check specific values in a list, and the range filter, which allows you to specify one or two criteria. The two filters are independent, and values must pass both filters in order to be included in the OLAP table.

Using the Value Filter

1. Right-click a field in the **Filter**, **Column Fields**, **Row Fields**, or **Values** area.
2. Click **Field Settings** in the context menu. The **Field Settings** dialog box opens.
3. Click the **Filter** tab. This is the value filter. You can clear the selection for any of the fields that you do not want to appear in the OLAP table.



Once you have selected the fields to appear in the table, you can specify a range filter by clicking the **Text Filter** or **Numeric Filter** button at the bottom of the window.

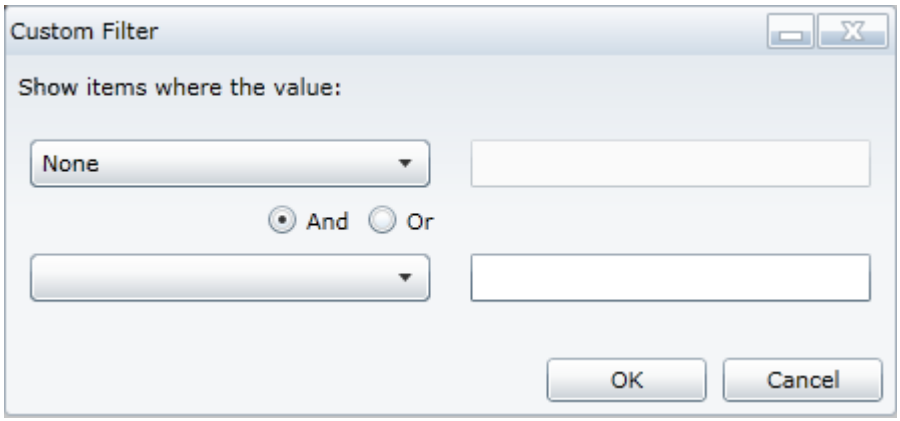
	Note: If the field you are filtering contains numeric data, **Numeric Filter** appears instead of **Text Filter**.

Using the Range Filter

1. Right-click a field in the **Filter**, **Column Fields**, **Row Fields**, or **Values** area.
2. Click **Field Settings** in the context menu. The **Field Settings** dialog box opens.
3. Click the **Filter** tab and specify the value filter, if desired. You can clear the selection for any of the fields that you do not want to appear in the OLAP table.
4. Click the **Text Filter** or **Numeric Filter** button to set the range filter.
5. Select one of the following items.

Clear Filter	Clears all filter settings.
Equals	Opens the **Custom Filter** dialog box so you can create a filter where items equal to the specified value are shown.
Does Not Equal	Opens the **Custom Filter** dialog box so you can create a filter where items that are not the same as the specified value are shown.
Begins With	Opens the **Custom Filter** dialog box so you can create a filter where items that begin with the specified value are shown.
Ends With	Opens the **Custom Filter** dialog box so you can create a filter where items that end with the specified value are shown.
Contains	Opens the **Custom Filter** dialog box so you can create a filter where items that contain the specified value are shown.
Does Not Contain	Opens the **Custom Filter** dialog box so you can create a filter where items that do not contain the specified value are shown.
Custom Filter	Opens the **Custom Filter** dialog box so you can create a filter with your own conditions.

6. Add an item to filter on in the first blank text box.



7. Select **And** or **Or**.
8. Add a second filter condition, if necessary. If you select an option other than **None**, the second text box becomes active and you can enter an item.
9. Click **OK** to close the **Custom Filter** dialog box and click **OK** again to close the **Field Settings** dialog box.

Specifying a Subtotal Function

When creating custom views of data, you may want to perform a different aggregate function other than "Sum" on your column or row. For example, you may want to find the average or maximum values in your data. This can easily be done through the **Field Settings** dialog box or in code.

To specify the function performed on data at run time:

1. Right-click a field in the **Values** area of the C1OlapPanel.
2. Click **Field Settings** in the context menu. The **Field Settings** dialog box opens.
3. Click the **Subtotals** tab.
4. Select one of the following options:

Sum	Gets the sum of a group.
Count	Gets the number of values in a group.
Average	Gets the average of a group.
Maximum	Gets the maximum value in a group.
Minimum	Gets the minimum value in a group.
First	Gets the first value in a group.
Last	Gets the last value in a group.
Variance	Gets the sample variance of a group.
Standard Deviation	Gets the sample standard deviation of a group.
Variance Population	Gets the population variance of a group.
Standard Deviation Population	Gets the population standard deviation of a group.

5. Click **OK** to close the **Field Settings** dialog box. Notice how the values in the summary table change.

To specify the function performed on data in code:

Use the C1OlapField.Subtotal property of the field to specify the function. In this example code, first the view is created, and then the average unit price is calculated for each product.

Visual Basic

```
' build viewvar olap = this.c1OlapPage1.OlapEngine;
olap.ValueFields.Add("UnitPrice")
olap.RowFields.Add("OrderDate", "ProductName")
' format unit price and calculate averagevar field = olap.Fields["UnitPrice"];
field.Subtotal = Subtotal.Average
field.Format = "c"
```

C#

```
// build viewvar olap = this.c1OlapPage1.OlapEngine;
olap.ValueFields.Add("UnitPrice");
olap.RowFields.Add("OrderDate", "ProductName");
// format unit price and calculate averagevar field = olap.Fields["UnitPrice"];
field.Subtotal = Subtotal.Average;
field.Format = "c";
```

Formatting Numeric Data

You can format numeric data as currency, as a percentage, and so on or create your own custom format.

To format numeric data at run time:

1. Right-click a field in the **Values** area of the C1OlapPanel.
2. Click **Field Settings** in the context menu. The **Field Settings** dialog box opens.
3. Click the **Format** tab.
4. Select one of the following options:

Numeric	Formats the data as a number like this: 1,235. You can specify the number of decimal places and whether to use a 1000 separator (,).
Currency	Formats the data as currency. You can specify the number of decimal places.
Percentage	Formats the data as a percentage. You can specify the number of decimal places.
Scientific	Formats the data in scientific notation. You can specify the number of decimal places.
Custom	Enter your own custom format for the data.

5. Click **OK** to close the **Field Settings** dialog box. Notice how the values in the summary table change.

To format numeric data in code:

Use the C1OlapField.Format property of the field and Microsoft standard numeric format strings to specify the format.

Accepted format strings include:

"N" or "n"	**Numeric**	Formats the data as a number like this: 1,235. You can specify the number of decimal places and whether to use a 1000 separator (,).
"C" or "c"	**Currency**	Formats the data as currency. You can specify the number of decimal places.
"P" or "p"	**Percentage**	Formats the data as a percentage. You can specify the number of decimal places.
"E" or "e"	**Scientific**	Formats the data in scientific notation. You can specify the number of decimal places.
Any non-standard numeric format string	**Custom**	Enter your own custom format for the data.

In this example code, first the view is created, and then the average unit price is calculated in currency format.

Visual Basic

```
' build view   var olap = this.c1OlapPage1.OlapEngine;
olap.ValueFields.Add("UnitPrice")
olap.RowFields.Add("OrderDate", "ProductName")

' format unit price and calculate average   var field = olap.Fields["UnitPrice"];
field.Subtotal = Subtotal.Average
field.Format = "c"
```

C#

```
// build view   var olap = this.c1OlapPage1.OlapEngine;
   olap.ValueFields.Add("UnitPrice");
   olap.RowFields.Add("OrderDate", "ProductName");
// format unit price and calculate average   var field = olap.Fields["UnitPrice"];
   field.Subtotal = Subtotal.Average;
   field.Format = "c";
```

Calculating Weighted Averages and Sums

There may be cases where it is necessary to find the weighted average or sum of your data. In a weighted average or sum, some data points contribute more to the subtotal than others.

Suppose you have a bound list of products and you want to find the average price for the group of products, taking into account the quantity of each product purchased. You can weight the price average by the number of units purchased. This can be done at run time by the user or in code.

To add weight to a calculation at run time:

1. Right-click the field in the **Values** area of the C1OlapPanel and select **Field Settings**.
2. Click the **Subtotals** tab and select the type of subtotal you want to calculate.
3. In the **Weigh by** drop-down list, select the field from your data table that will be used as a weight.
4. Click **OK** to close the **Field Settings** dialog box.

To add weight to a calculation in code:

Use the C1OlapField.WeightField property to specify the field to be used as the weight. In this example, the **Quantity** field is the weight.

Visual Basic

```
Dim olap = Me.C1OlapPage1.OlapEngine
Dim field = olap.Fields("Quantity")
field.WeightField = olap.Fields(“Quantity”)
```

C#

```
var olap = this.c1OlapPage1.OlapEngine;
var field = olap.Fields["Quantity"];
field.WeightField = olap.Fields["Quantity"];
```

Exporting a Grid

OLAP for WPF and Silverlight allows you to export a C1OlapGrid to any of the following formats: .xlsx, .xls, .csv, and .txt. Just click the **Export** button on the **ToolStrip** to begin exporting.

1. In the C1OlapPage on your form, click the **Export** button  in the ToolStrip.
2. In the **Save As** dialog box, enter a **File name**, select one of the file formats, and click **OK**.

Grouping Data

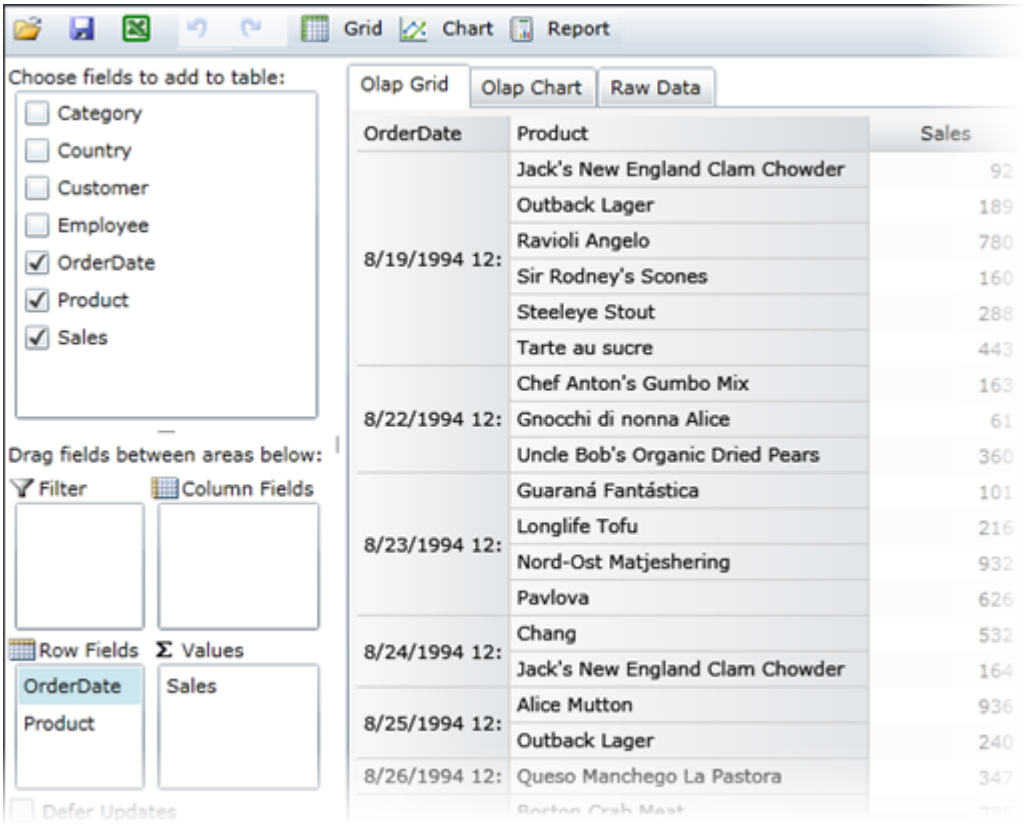
You can use field formatting to group data. Suppose you have a bound list of products and you want to group all the items ordered within a year together. You can use the **Field Settings** dialog box at run time or code. In this example, we'll use a C1OlapPage control bound to the C1Nwind.mdb installed with the product.

To group data by the year at run time:

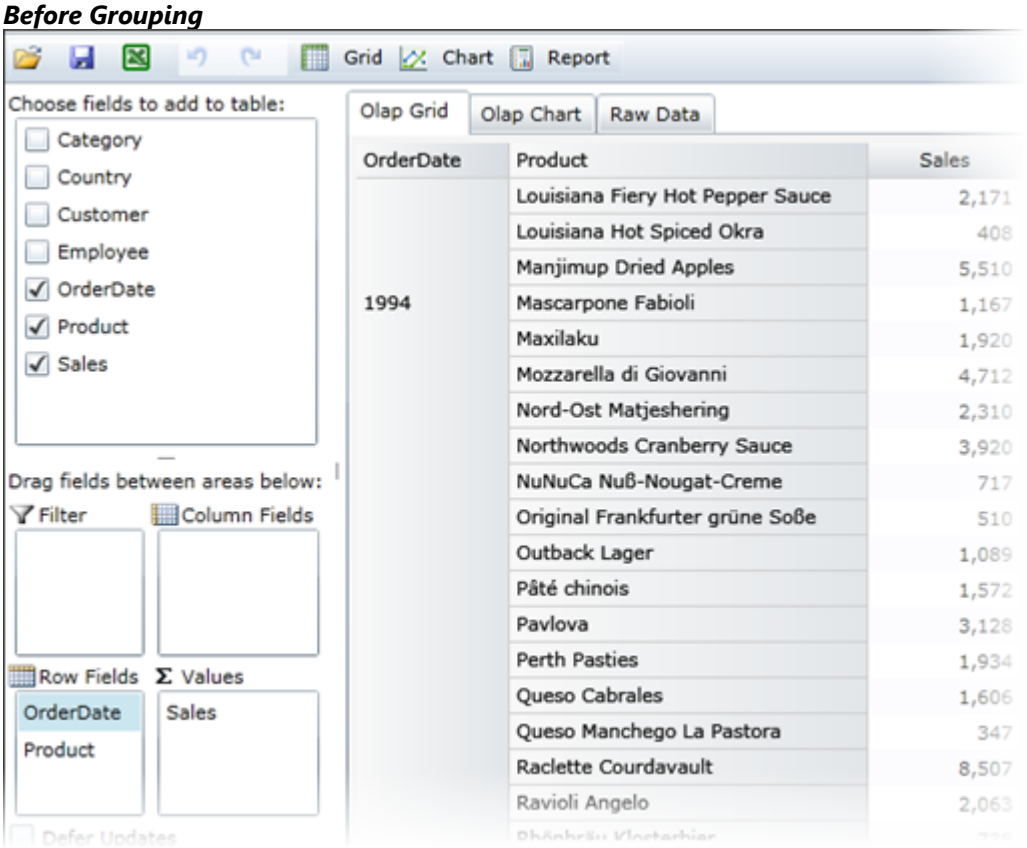
1. Add the following fields to the grid view by selecting them in the C1OlapPanel area of the C1OlapPage: *OrderDate*, *Product*, and *Sales*. Click the **Olap Grid** tab, if necessary, to view the grid.
2. Right-click the **Order Date** field under **Row Fields** and select **Field Settings**. The **Field Settings** dialog box appears.
3. Make sure **Select All** is selected on the **Filter** tab.
4. Click the **Format** tab and select **Custom**.
5. Enter "yyyy" in the **Custom Format** text box and click **OK**.

The following images show the grid before grouping and after grouping.

The *Before Grouping* image displays data that is not grouped. The *After Grouping* image displays data where products are grouped by the year they were purchased.



Before Grouping



After Grouping

To group data in code:

You can also group data in code. Here is the code that would be used for the example above:

Visual Basic

```
Imports C1.Olap
Imports System.Data.OleDb
Namespace WindowsFormsApplication1
    Public Partial Class Form1
        Inherits Form
        Public Sub New()
            InitializeComponent()

            ' get data

            Dim da = New OleDbDataAdapter("select * from invoices",
GetConnectionString())
            Dim dt = New DataTable()
            da.Fill(dt)

            ' bind to olap page

            Me.c1OlapPage1.DataSource = dt

            ' build view

            Dim olap = Me.c1OlapPage1.OlapEngine
            olap.ValueFields.Add("UnitPrice")
            olap.RowFields.Add("OrderDate", "ProductName")

            ' format order date to group data

            Dim field = olap.Fields("OrderDate")
            field.Format = "yyyy"
        End Sub
        Private Shared Function GetConnectionString() As String
            Dim path As String =
Environment.GetFolderPath(Environment.SpecialFolder.Personal) + "\ComponentOne
Samples\Common"
            Dim conn As String = "provider=microsoft.jet.oledb.4.0;data source=
{0}\c1nwind.mdb;"
            Return String.Format(conn, path)
        End Function
    End Class
End Namespace
```

C#

```
using C1.Olap;
using System.Data.OleDb;
namespace WindowsFormsApplication1
{
    public partial class Form1 : Form
    {
        public Form1()
```

```
        {
            InitializeComponent();
            // get data
            var da = new OleDbDataAdapter("select * from invoices",
GetConnectionString());
            var dt = new DataTable();
            da.Fill(dt);

            // bind to olap page
            this.c1OlapPage1.DataSource = dt;

            // build view
            var olap = this.c1OlapPage1.OlapEngine;
            olap.ValueFields.Add("UnitPrice");
            olap.RowFields.Add("OrderDate", "ProductName");

            // format order date to group data
            var field = olap.Fields["OrderDate"];
            field.Format = "yyyy";
        }
        static string GetConnectionString()
        {
            string path =
Environment.GetFolderPath(Environment.SpecialFolder.Personal) + @"\ComponentOne
Samples\Common";
            string conn = @"provider=microsoft.jet.oledb.4.0;data source=
{0}\c1nwind.mdb;";
            return string.Format(conn, path);
        }
    }
}
```

Collapse and Expand Groups

C1OlapGrid also provides users the functionality to display only summary or detail data in a group through code, by using following methods:

- CollapseAllRows: This method is used to collapse group of rows when there are many levels of data in a group of rows. For example, using **CollapseAllRows**, you can view year-wise total sales as shown below:

OrderDate	Product	Sales
⊞ 1994	**Subtotal**	162,744
⊞ 1995	**Subtotal**	590,927
⊞ 1996	**Subtotal**	512,022

- CollapseAllCols: This method is used to collapse group of columns when only summary data is required to be viewed from many levels of data in a group of columns.
- ExpandAllRows: This method is used to expand group of rows to view the detailed data in the collapsed rows. Alternatively, you can click '+' button at runtime.
- ExpandAllCols: This method is used to expand group of columns to view the detailed data in the collapsed

columns. Alternatively, you can click '**+**' button at runtime.

The following codes illustrates how to set these properties:

- To collapse group of rows

```
VB
c1OlapPage1.OlapGrid.CollapseAllRows()
```

```
C#
c1OlapPage1.OlapGrid.CollapseAllRows();
```

- To expand group of rows

```
VB
c1OlapPage1.OlapGrid.ExpandAllRows()
```

```
C#
c1OlapPage1.OlapGrid.ExpandAllRows();
```

Similarly, properties for collapsing and expanding of group of columns can be set.

Creating a Report

In the C1OlapPage control, you can set up and print a report using the **Report** menu at run time.

To create the report, follow these steps:

1. Click the drop-down arrow next to **Report** on the C1OlapPage ToolStrip.
2. Select **Options**. The **Document Options** dialog box appears.
3. On the **Page** tab, select a page **Orientation**, **Paper size**, and set the **Margins** as desired.
4. Click the **Header/Footer** tab.
5. Place the cursor in the header or footer text box where you want to add text or a predefined header/footer item.
6. Click one of the buttons on the toolbar to insert the desired field.
7. Click the **Report Content** tab.
8. Check the check box next to the items you want included in the report. You can also select a radio button to change the scaling of the grid or chart.
9. Click **OK** to close the **Document Options** dialog box.