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## SharePoint® 2010

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Connectivity  
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Brett Lonsdale, and Phill Duffy

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# SharePoint® 2010 Business Connectivity Services

Put your organization's data to work with Business Connectivity Services in SharePoint 2010—and build valuable business solutions. Led by a team of SharePoint experts, you'll learn how to integrate data from several systems—such as sales, accounting, and inventory—and then search, display, combine, and modify the information using code and no-code SharePoint solutions. This hands-on guide is ideal for SharePoint project managers, business analysts, architects, and administrators.

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SharePoint® 2010

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# Microsoft® SharePoint® 2010: Business Connectivity Services

Penelope Coventry  
Brett Lonsdale  
Phill Duffy

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*I would like to dedicate this book to my sisters, Pam, Bobby, and Paula.*

—PENNY COVENTRY

*I dedicate this book to Sara and Rio for putting up with me and supporting me while the book was authored.*

—BRETT LONSDALE

*To Pip and my family for their love and support.*

—PHILL DUFFY





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# Introduction

*Microsoft SharePoint 2010: Business Connectivity Services* helps small and medium-sized businesses as well as bigger organizations put their business data to work—and create valuable business solutions. Use Microsoft SharePoint Foundation 2010, Microsoft SharePoint Server 2010, or Microsoft SharePoint Online (part of Microsoft Office 365 cloud services) to unlock data and increase productivity.

## Who Should Read This Book

The book is aimed at business users, project managers, architects, administrators, and decision makers who want to create solutions that are required to create, use, share, and find information using Microsoft SharePoint 2010 websites, where the information is not stored in Microsoft SharePoint 2010 SQL Server content databases. Led by SharePoint experts, you'll learn hands-on strategies for deploying business solutions that integrate data from business applications and databases using BCS.

## Who Should Not Read This Book

The book is not aimed at developers; therefore, it does not cover in detail the creation of server-side code using Visual Studio. However, it does contain examples of client-side code (such as XSLT, JavaScript, and jQuery) that can be incorporated into business solutions using tools such as Microsoft SharePoint Designer 2010 to present and manipulate data exposed when using BCS.

## Assumptions

This book assumes that you have a working knowledge of SharePoint 2010 and Microsoft Office 2010 client applications. If you need to learn how to use SharePoint 2010, we recommend that you read the following two books:

- *Microsoft SharePoint Foundation 2010 Step by Step* by Olga Londer and Penelope Coventry (Microsoft Press, 2011)
- *Microsoft SharePoint 2010 Plain & Simple* by Johnathan Lightfoot and Chris Beckett (Microsoft Press, 2010)

## System Requirements

To use this book, you must have access to a server running SharePoint Foundation 2010, SharePoint Server 2010 or SharePoint Online. These products provide different Business Connectivity Service (BCS) capabilities that are explained in the book. Directions on how to install these products are outside the scope of the book. However, once you have access to one of these products, this book details how to configure and extend BCS.

The book uses the the Microsoft Adventure Works LT and AdventureWorks databases when creating a SQL Server external content type (ECT), external lists, and dashboards. You can download these databases from <http://msftdbprodsamples.codeplex.com>.

To use the companion content (sample files), you must have a development environment where Visual Studio and a SharePoint server product are installed on the same server. The requirements for developing SharePoint Solutions can be found at <http://msdn.microsoft.com/en-us/ee231582.aspx>.

## Organization of This Book

This book provides a comprehensive look at the various SharePoint features you will use. It is divided into three parts.

### Part I: Planning and Maintaining Business Connectivity Services

This part provides an introduction to Business Connectivity Services (BCS) and why you might want to use it. It details BCS terminology and the tasks that a SharePoint server administrator and business owner need to complete to enable users to present the external data within SharePoint websites.

Chapter 1, “Making SharePoint the Central Hub for Business,” reviews how organizations have changed over the last 20 years with regard to business data, and how these changes led to organizations having pockets of data throughout their business processes. The chapter then explains how BCS can provide a uniform method of accessing data for all stakeholders in an organization.

Chapter 2, “Introducing Business Connectivity Services,” introduces the types of solutions you can create with BCS and how you can plan and extend BCS. This chapter explores the BCS architecture and how it is divided into four layers: external system, connectivity, presentation, and tools.

Chapter 3, “Creating and Maintaining Business Data Connectivity Service Applications,” first explains the SharePoint service application architecture and its effect on the deployment of BCS. The chapter then breaks down the server administration tasks to create and configure a Business Data Connectivity (BDC) service application, explains the security options, outlines how to configure the Secure Store Service, discusses modifications to the BCS throttling settings, and details the administration of BCS in a tenant environment.

Chapter 4, “Defining External System Connections Using SharePoint Designer,” helps you hook up external data with SharePoint and Office applications with the creation of an external content type (ECT). The chapter explains that while you can use other tools to create an ECT, SharePoint Designer provides you with a wizard to easily define the BDC model, ECT, BDC objects, and operations that you are allowed to perform on the external system.

## **Part II: Presenting External Data**

In this part, you'll learn how to extend the user experience to display and manipulate content from an external system in Office 2010 client applications and websites built on top of SharePoint 2010.

Chapter 5, “Creating External Lists and Using External Data in Lists and Libraries,” explains that the preferred method of displaying data from external data sources is to use external lists. The chapter helps you use both the browser and SharePoint Designer to create external lists, and finishes by showing you how to use external columns in SharePoint lists and libraries.

Chapter 6, “Building Business Data Dashboards,” explores how to build business data dashboards using Business Data Web Parts and other Web Parts, and how to configure them in an effective way.

Chapter 7, “Using External Data with Office Client Applications,” helps you use external data within Microsoft Office applications, such as Microsoft Word, Microsoft Outlook, Microsoft SharePoint Workspace, and Microsoft Access, as well as how to modify external list forms with Microsoft InfoPath Designer 2010.

Chapter 8, “Finding Information from External Systems,” provides tools and strategies that allow organizations to provide their users with the ability to search for all relevant business data, whether it is stored within SharePoint SQL content databases or outside SharePoint. This chapter explains the search options available, depending on the version of SharePoint 2010 that you are using.

Chapter 9, “Using External Data in User Profiles,” explains how you can use BCS to populate user profile data that exists elsewhere within your organization, and explores how this benefits an organization when using SharePoint 2010 features such as people search and audience targeting. This chapter also explains how you can use Duet Enterprise to connect SharePoint 2010 and SAP solutions.

Chapter 10, “Exploring Office 365 and Connecting to External Data,” helps you to connect SharePoint Online, which is part of Office 365, to external data. It compares the use of BCS SharePoint Online with dedicated SharePoint Online and with an on-premises installation of SharePoint 2010. The chapter finishes by describing how to build a SharePoint Online BCS solution.

## Part III: Extending the Out-of-the-Box Business Connectivity Services Functionality

In this part, you’ll explore the options you can use to extend BCS.

Chapter 11, “Using Client-Side Code and External Data,” introduces the SharePoint 2010 Client Object Model and how you can leverage client-side code to create solutions to greatly extend how your organization works with line-of-business (LoB) data.

Chapter 12, “Building Server-Side BCS Solutions,” introduces the use of Visual Studio to build SharePoint solutions, how to use Visual Studio to build solutions that execute code on SharePoint servers, as well as how to use Visual Studio to create and deploy BDC models.

The Appendix, “BCS Model Infrastructure,” describes the BCS metadata object hierarchy and details the relationships among commonly used metadata objects.

## Conventions

The following conventions are used in this book:

- Boldface type is used to indicate text that you type.
- The first letters of the names of ribbon tabs, dialog boxes, dialog box elements, and commands are capitalized. For example, the Save As dialog box.
- Keyboard shortcuts are indicated by a plus sign (+) separating key names. For example, Ctrl+Alt+Delete means that you press the Ctrl, Alt, and Delete keys at the same time.

## About the Companion Content

We have included companion content to enrich your learning experience. The companion content for this book can be downloaded from the following page:

*[http://www.microsoftpressstore.com/title/ 9780735660182](http://www.microsoftpressstore.com/title/9780735660182)*

The companion content includes the following:

- The BDC model project used in Chapter 12, “Building Server-Side BCS Solutions.”
- The BDC model *.bdcm* file referenced in the Appendix, “BCS Model Infrastructure.”

## Acknowledgments

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Writing a book is never easy and it places a considerable amount of strain on personal and professional lives. On many occasions while writing this book, we ignored our families and loved ones, even when we were supposed to be on holiday with them. So it is with our greatest appreciation and admiration that we say thank you to them.

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## PART I

# Planning and Maintaining Business Connectivity Services

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# Making SharePoint the Central Hub for Business

In this chapter, you will:

- Review how organizations have changed their approach to business data over the last 20 years
- Understand why organizations have islands of data throughout their business processes
- Learn how a familiar application such as SharePoint can help resolve the problem of distributed data
- Learn how Business Connectivity Services can provide a uniform method of accessing data for all stakeholders in an organization

Before you learn how to use Business Connectivity Services (BCS) to make external data available to SharePoint, it is important to understand how and why the technology is so useful.

In this chapter, you will review a real-world company and how it changed in the early 1990s as a result of the evolution of email and the Internet, both of which made accessing data more efficient. You will then examine a real-world problem seen in many businesses today, where senior management and other business users often require business data to be available in a single location so that they can closely monitor all aspects of the organization. Having business data immediately available is important at any time, but especially so within a challenging economic climate.

Data is often spread across an organization in different systems and with different user interfaces, and accessing this data to provide business intelligence can be difficult. Getting the right data into the format you need can be challenging and time-consuming, especially when the data needs to come from several sources. It takes time to learn each system, and then additional time to take snapshots of data that soon becomes out of date. In the latter part of this chapter, you will explore how you can use BCS to bring business data into SharePoint to make business-critical and required information easily accessible. Finally, you will examine a realistic scenario using Adventure Works as an example of a modern-day business, and you will learn how BCS can be used to meet the needs of the Adventure Works business users.

# Reviewing How Businesses Store Data

---

Let's start by looking at a real-world company and the changes it underwent in the 1990s with respect to business data. A global distribution company in 1993 provided storage and distribution of electronic components. The electronic components were packed within the warehouse and shipped to customers throughout the world. Over four years, this company experienced a huge change in the way that it operated, purely due to the development of computer software and how that software was used within each department.

In 1993, the company mainly used Windows 3.0 as an operating system, with only a handful of computers using Windows 3.1, which incorporated networking capabilities. The networking capabilities back then were primarily used for some file sharing, but mainly printer sharing. Besides that, some data was available on dumb terminals from a mainframe system based in the United States.

Teams of people within the organization worked on each customer contract, processing the orders. The order process typically involved receiving faxes of required goods from a customer and then typing the contents of the faxes into a spreadsheet, which was then printed and hand-delivered to the warehouse for packing. The address details for the delivery were then hand-typed again into another software application to produce the shipping label. Tracking the status of the order was usually carried out by telephone.

Soon, technology moved on and the organization began receiving orders by Electronic Data Interchange (EDI), which involved using a single computer to dial up to another computer via modem, in order to receive an electronic file containing the orders to be shipped. This data was then imported into an application called Wisdom.

Within a couple of years, customers were placing their own orders via a website. They used a custom application for the orders and warehouse shipping, which was replicated via an ISDN line to a central server, allowing the rest of the company to report on the data. Customers could track an order using their order tracking number on the website.

Technology evolved very quickly back then, which meant that businesses went from storing physical documents and mailing them when required, to electronic storage and email—within just a few years. Through the use of networking, relational databases, and Internet technology, customers and business users had a much better experience.

However, one big problem existed then and often still exists today: islands of data. For example, say a given tracking system in an organization works exceptionally well, but you want to get a big-picture view of what is going on in the organization. What if you need to know your revenue and profit for the quarter, along with the number of successful deliveries, the number of days your staff were absent, and so on? In the past, obtaining all that information often meant involving other people and departments, and receiving numerous spreadsheets all formatted differently; or you had to track down the information yourself, which meant gaining access to and learning lots of dissimilar systems. The data is out there, but it is separated out on various "islands" spread across different departments, technologies, and systems.

Each department and sometimes each branch of an organization may use its own system for business processes. You will often also find these systems duplicated within an organization with different technologies—for example, Adventure Works in the United Kingdom may use Microsoft Dynamics CRM for customer relationship management, while Adventure Works in the United States might use Salesforce.com. In addition, the human resources group might be using an Oracle application for personnel data, the accounting department may be using Sage for invoicing, and so forth. Each part of the business could be using an application designed specifically for its departmental business processes. It is logical that when you design a system, you are not designing it for the entire organization; rather, you are designing it for a business process, and for that reason, your organization uses great applications for its individual business processes. One issue with this approach is that your organization's departments may use dissimilar technologies for data storage, and each software application has a different user interface, reinforcing the islands of data problem.

To resolve this issue, you certainly don't want to create an application that is generic enough to provide all of the required services across the entire organization. You'll just end up with a jack-of-all-trades application that has fewer capabilities and functionality than the software designed to solve a particular business process. The solution to this problem lies in using Microsoft SharePoint and Business Connectivity Services (BCS) to provide a central hub for all of the business information within the organization.



**Note** Sometimes the "islands of data" issue arises as the result of a company acquisition—for example, a merger of two large airlines. When a merger such as this occurs, you will have at least two of everything to deal with: two CRM systems, two booking systems, two intranets, and so forth. BCS and SharePoint can bring these two sets of data together for reporting purposes.

## Bringing Data Together in One Place with Business Connectivity Services

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Today's businesses thrive on business intelligence. Business people want to be able to troubleshoot problems before they occur (and result in cash-flow issues or even a lack of demand for a specific product). The ability to quickly obtain this business-critical information is of great importance.

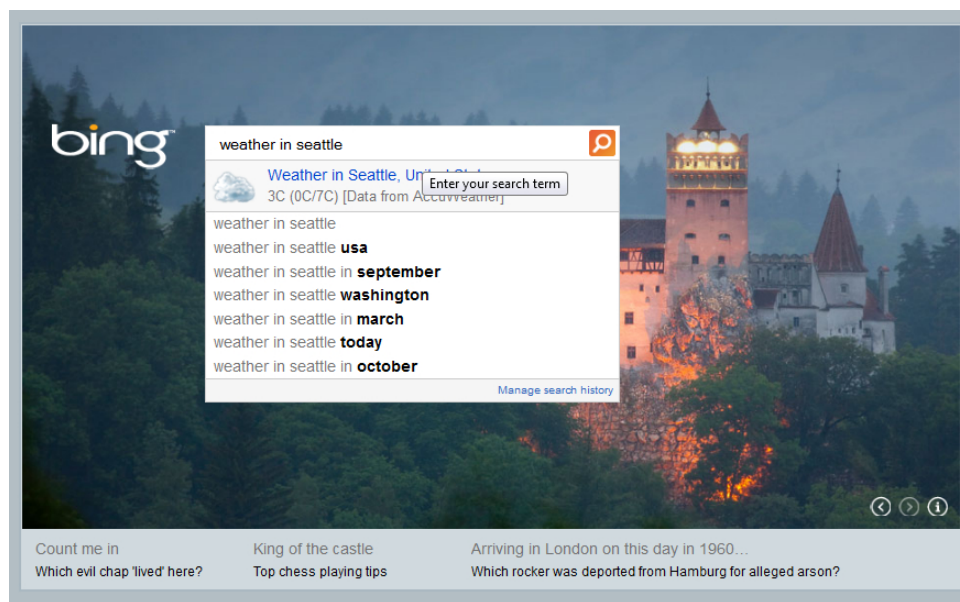
A good example of the use of business-critical information is illustrated in a story that comes from a member of the SharePoint community. This person is a business analyst whose job is to provide reporting capabilities for organizations. He was producing some charts based upon products and sales per store when his attention was immediately drawn to a line on a chart showing that sales of chewing gum in a particular store had suddenly stopped. Sales of this chewing gum brand went from hundreds of packages per day to zero per day. He thought this strange, as all of the other store branches were still selling the product successfully. He checked the stock levels at the store, which appeared to be fine, and the product was still current—yet this store had not sold a single pack of the chewing gum for three days. He called the store manager, who discovered that a poster had fallen from the

wall and was covering the box of chewing gum. Without business intelligence, this issue might have gone unnoticed for weeks.

SharePoint can be used to bring information together into an easy-to-use, easy-to-navigate central hub of business data. The central hub provides you with the ability to search, view, modify, and report on information across your organization's data and even beyond, to data outside of your organization.

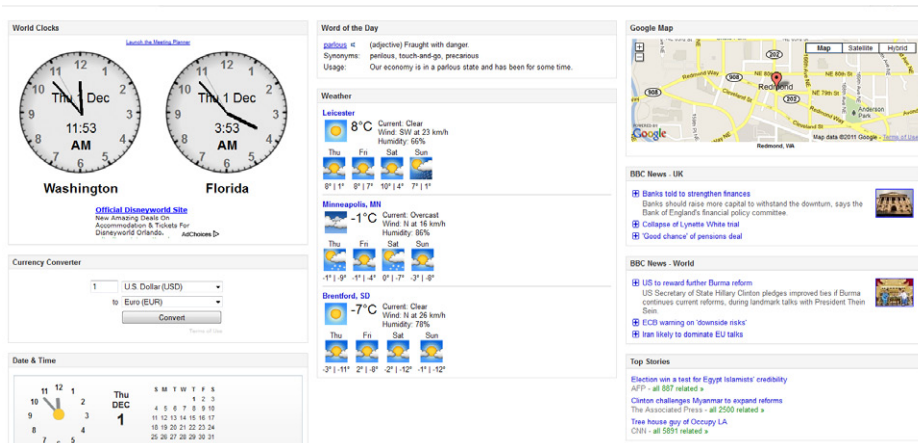
An Internet search engine is a good example of the central hub concept. You can use a single Internet search engine to search websites for data all over the world, regardless of where that data resides. As a user, you don't care what technology is used to store the data for Amazon or Expedia, for example, and you don't care what language was used to develop the website. All you care about is being able to see and retrieve the data quickly when you want it, via a familiar Internet search site.

Figure 1-1 shows how easy it is to get the information you want in a single place. From the Bing search engine, you can retrieve the weather report for your region without having to go to a specific website or television channel.



**FIGURE 1-1** You can easily find information through a single search box.

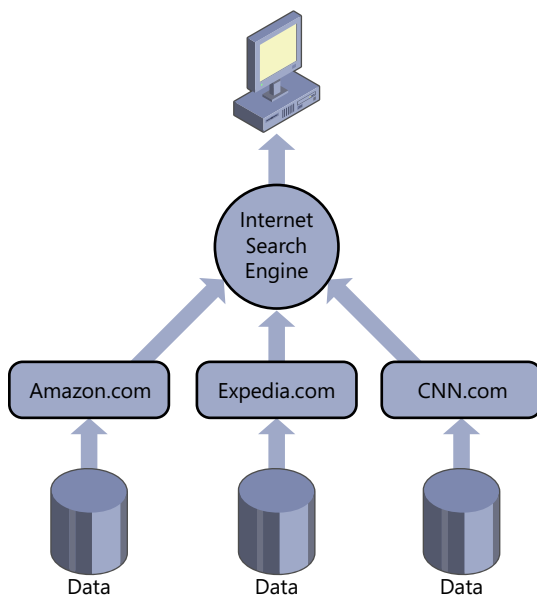
You can also create a dashboard of information in some search engines, as shown in Figure 1-2. You could spend a good part of your day going to individual websites to check the weather, read the news, find the latest currency exchange rates, and so on. Sometimes it is more useful to have a single page where you can view all of this information at a glance.



**FIGURE 1-2** A dashboard can help you view information and absorb it quickly.

Most of the information in the dashboard in Figure 1-2 is driven through other websites. The data is stored somewhere, but most of the time you don't know or care where it is stored. Have you ever wondered where websites you visit get weather reports from, for example? The National Climatic Data Center (NCDC) and the National Weather Service (NWS) are two examples of weather information providers. The information from these providers is made available for use by news agencies and other websites.

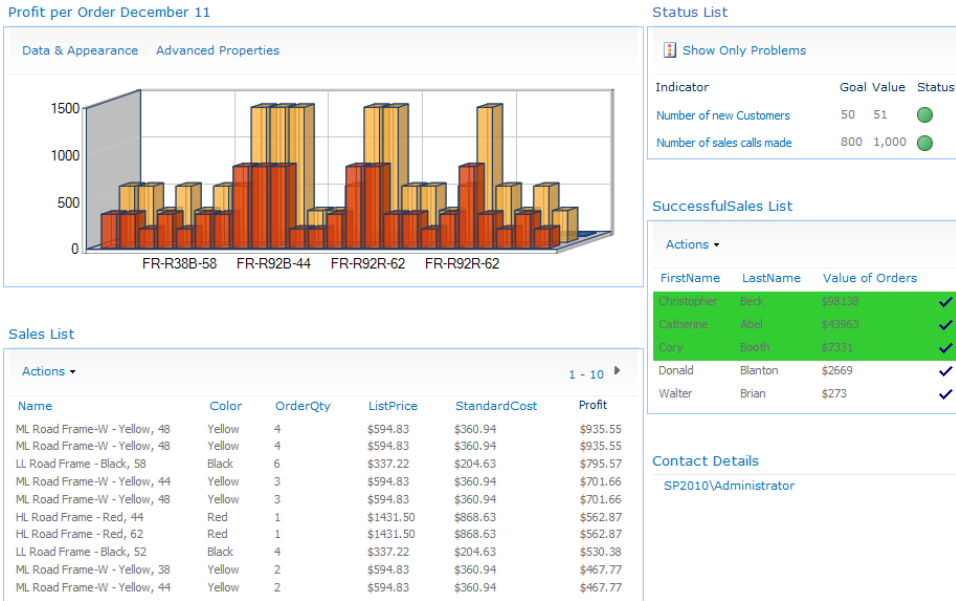
Figure 1-3 shows an example of information aggregated from multiple data sources, which makes it convenient for people to find and use.



**FIGURE 1-3** You can search data from an Internet search engine regardless of the technology used for the website and data storage.

Aggregating data from multiple external data sources is exactly what you can achieve with business data through SharePoint. SharePoint is quickly becoming a familiar interface within organizations, just as Bing and Google are familiar among users for searching the Internet and finding information. You can view SharePoint as a central hub of information, just like an Internet search engine. When you need to see your organization's data, you don't have to learn how to use all of the dissimilar systems the departments in your company use—you simply navigate to SharePoint to see a dashboard of information.

Figure 1-4 shows an example of such a dashboard. The dashboard brings external data into SharePoint from more than one data source.



**FIGURE 1-4** This SharePoint report page shows sales-related information from the Adventure Works SQL database via BCS.

Notice that the Business Connectivity Services (BCS) Chart Web Part is used to display product sales from the current quarter in a 3D bar graph. The bar graph shows the standard cost versus the list price of each order. Below that graph is a Business Data List Web Part that has been customized using SharePoint Designer 2010, showing the products ordered this month along with the quantity, standard cost, and list price. A custom column has been created that shows the list price multiplied by the order quantity minus the standard cost, multiplied by the order quantity. The cost columns are set in currency format using SharePoint Designer 2010, and the sort order is set to the Profit column in descending order. Lastly, the Web Part is configured to show only the 10 most profitable orders that were taken within this quarter.



In the middle-right of the dashboard is another Business Data List Web Part that is obtaining its data from a custom view within the Adventure Works database. The custom view displays the top five salespeople this quarter. Using SharePoint Designer 2010, the rows are formatted with conditional formatting showing those salespeople who achieved at least \$5,000 worth of sales. The rows have a green background if that is the case.

Finally, in the top-right corner is a Status List Web Part displaying key performance indicators (KPIs). Unfortunately, the Key Performance List within SharePoint 2010 does not support external lists that contain external data. You can, however, configure SQL Analysis services to base your KPIs on. SQL Analysis Services is being used to determine the number of sales calls made and the number of new customers. This information is obtained from the Microsoft Dynamics CRM application, not the Adventure Works database. In this way, you can see that information from multiple external data sources can be mashed together or combined within a single dashboard to provide a useful view of live business information.

## Using SharePoint as the Central Hub for All Your External Data Sources

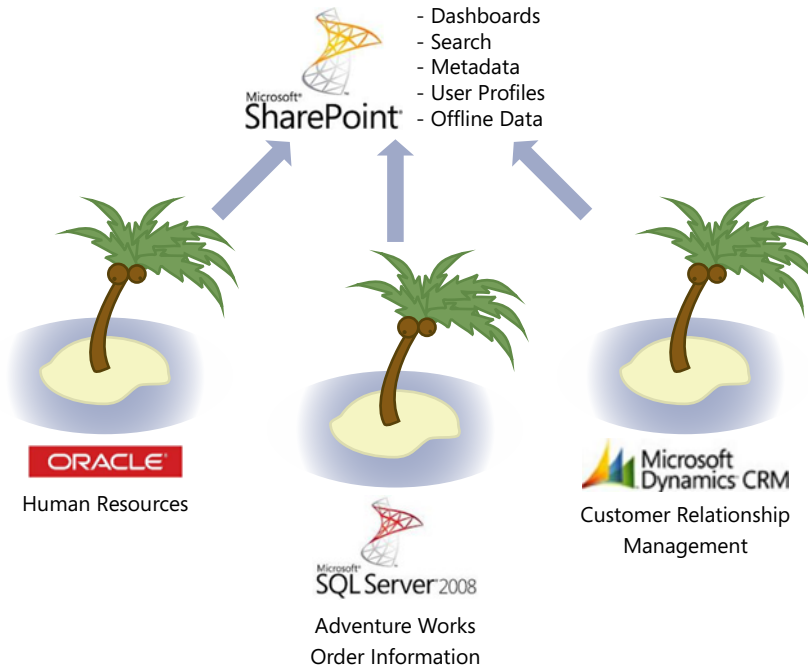
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To demonstrate how SharePoint can become the central hub for your organization's data, you'll work with a fictitious organization called Adventure Works Cycles throughout this book. Adventure Works Cycles is a large multinational company. The company manufactures and sells metal and composite bicycles to the North American, European, and Asian commercial markets. While its base operation is located in Bothell, Washington, with 290 employees, Adventure Works has several regional sales teams located throughout its market base.

Adventure Works uses a Microsoft SQL Server database to handle buying, manufacturing, and selling bicycles. Within the database, you will find all of the components that make up a bicycle, the cost of each part, and a list of the suppliers for each component. Members of the accounting department use the database primarily to work out the company's profit and loss based upon the sales of each product. The sales at each Adventure Works store are also recorded within the database so that sales information can be retrieved.

The Microsoft SQL Server database is not the only data store within the Adventure Works organization. Sales representatives use Microsoft Dynamics CRM to track and manage the relationship with each Adventure Works customer. In addition, the human resources group uses an Oracle solution to store information about each of the company's 290 employees. Within the Oracle solution is information about each employee, such as the employee's home address, next of kin, salary, skills, and résumé.

Figure 1-5 illustrates all the external data sources that Adventure Works would like to consolidate via SharePoint.



**FIGURE 1-5** Adventure Works wants to use these external data sources within SharePoint to provide a common, more intuitive view of the external data.

In addition to building dashboards with external data via Business Connectivity Services (BCS) in SharePoint, you can perform the following tasks on all business data within your organization:

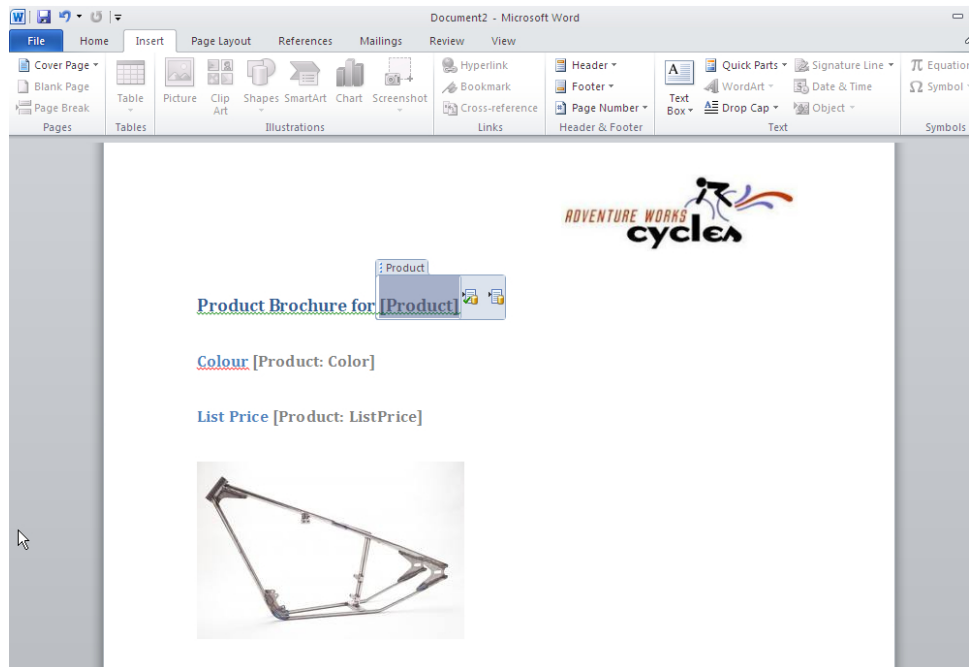
- Search external data.
- Browse external data.
- Use external data within Office documents and metadata.
- Update external data, including inserting, modifying, and deleting information.
- Display dashboards of data made up of charts and KPIs.
- Use external business data to populate SharePoint user profiles.

Through its investment in SharePoint, Adventure Works would like to make better use of the SharePoint product and use it as a central repository where users can obtain business information. Business information, in this case, is a broad category consisting of documents, spreadsheets, data-bases, websites, employee information, and much more.

You will focus on how you can make business data available to SharePoint throughout this book, but first you need to understand the company's requirements:

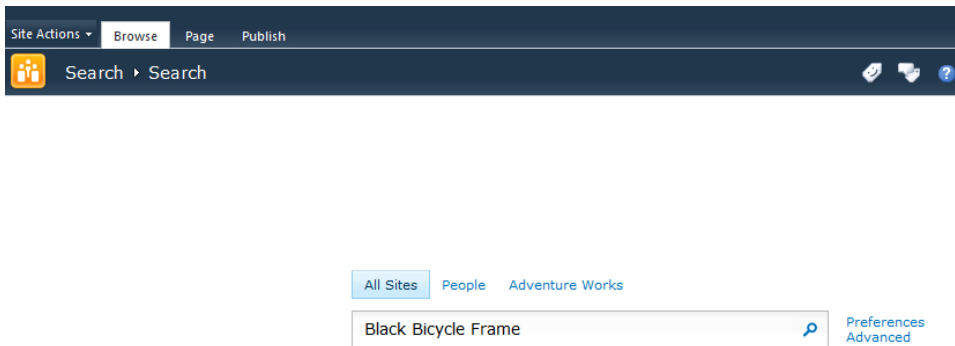
- Adventure Works has requested the ability to see who the top-performing salesperson is within the organization. Sales activity, such as the number of calls, is recorded within Microsoft Dynamics CRM, invoices and profit are stored within the Microsoft SQL Server database, and all of the employee information is stored within the Oracle solution. To determine the top-performing salesperson, you need to gather information from all three places. Using a Microsoft SharePoint site, you can connect to each data source and display a dashboard of information from all three data stores. The dashboard can show the highest sales activity within a chart, the largest single order from the Microsoft SQL Server database, and the location of each top-performing salesperson by using connections on the dashboard between the CRM and Oracle applications.
- Adventure Works wants to make business data available within client applications. Adventure Works uses Microsoft Office to produce letters to customers and order more stock from suppliers. The company performs further data analysis using Microsoft Excel. Using BCS, the external data from Microsoft Dynamics CRM, Microsoft SQL Server, and the Oracle application can be made available to Microsoft Office applications through the BCS Client Runtime. Chapter 6, “Building Business Data Dashboards,” covers how to use BCS in Office client applications.

Figure 1-6 shows what using external data within a client application such as Microsoft Word looks like. After you complete a document, you can select the external data by clicking the relevant Quick Parts within the Word document.



**FIGURE 1-6** You can add the external data column to the body of a Microsoft Word 2010 document created from within a document library, allowing external data to be selected from the live external data source.

- Adventure Works would like users to be able to find product information using a search facility (see Figure 1-7). Rather than having the search functionality return product information from multiple sources, such as SharePoint lists, documents, and external data, Adventure Works requested a search page that shows results only from the external databases.



**FIGURE 1-7** A single search box in the SharePoint Enterprise Search Center allows you to search external data sources together with or separately from other data sources, such as documents or list items.

- Adventure Works would like to improve upon the findability of documents. Currently, documents are stored in folders within document libraries, and the libraries have taken on the same poor structure as the folders on the file server, including duplicate folders and subfolders created in the wrong locations. Adventure Works would like users to be able to find documents more easily, using metadata that is consistent with the external data sources.
- Each department of Adventure Works would like a team site with an announcements list. The announcements should be aggregated from each of the subsites and displayed in a single location. Some announcements are not of interest to everybody within Adventure Works, however, so the announcements should be targeted. To avoid duplicating the personnel information within the Oracle database, Adventure Works would like the SharePoint user profiles within SharePoint to be populated with the department users work in, who they report to, and what skills they have. This will allow audience targeting to be more effective.
- Adventure Works is considering the possibility of hosting SharePoint online with Office 365. The company would like to know how to make its business data available to SharePoint in the future, even if the data resides on the premises and SharePoint is hosted in the cloud.

Throughout this book, you will learn how to fulfill the Adventure Works requirements, along with how to connect to the external data systems and administer BCS to ensure that security and performance requirements are also met.

# Building New Solutions

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SharePoint is a big investment within an organization due to the need to purchase hardware, software licenses, training, and consultancy. It is therefore sometimes incorrectly assumed that SharePoint should be able to provide everything the organization needs going forward. SharePoint becomes the automatic solution to every problem.

As powerful as it is, SharePoint cannot do everything. It does not replace relational database technology, spreadsheets, or file systems. It often happens that after adopting SharePoint, companies move all their files from the file system into SharePoint, and SharePoint lists are used for data storage. File systems still have their place, as many organizations have extremely large files (such as video files) that are just too big to upload and download on a daily basis. Although SharePoint is not necessarily the place to store such files, it can make your file shares available, helping to make SharePoint the central hub for business information.

This book focuses on new business solutions. After your organization has made a big investment in SharePoint, if you require a new business solution such as a help desk application, the answer that you hear might be to use SharePoint. Is SharePoint the right tool for a help desk application? Maybe. But you still need to analyze all of the help desk applications available and consider them against developing a custom solution versus using existing technology within your company. You might find that SharePoint lists, InfoPath forms, and Workflow provide you with the solution that you require. That said, you might also find that the type of data you want to gather is more suitable for storage in a relational database than in SharePoint lists, or that the chosen help desk solution already uses a relational database back end.

The point is that if you decide to use SharePoint to build all your future solutions, you are likely to be disappointed. SharePoint cannot replace Microsoft Excel or Microsoft SQL Server, but it makes for an excellent tool to expose Microsoft Excel spreadsheets and Microsoft SQL Server databases to users. While SharePoint now offers IDs for documents and list items, it cannot reproduce the relationships required in a relational database management system and, for that matter, it cannot match the performance.

Your organization should still carefully consider its software choices, but keep in mind that even if you opt for an off-the-shelf application that uses a relational database back end, you can make that data available to SharePoint. For example, the help desk team will use the help desk application on a daily basis to receive trouble tickets, escalate tickets, and report bugs. SharePoint can be used to display dashboards showing how many tickets were resolved successfully last month, how many times the service-level agreements were broken, and which employee handled the most tickets.

Although you can't use SharePoint to resolve every business problem that exists today, you can often use it as part of a new system. SharePoint is many things to many people, and it is a difficult product to describe. Using SharePoint as a central hub of information for existing systems as well as future systems will at least make information more accessible.

## Summary

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This chapter presented an overview of the business problems that Business Connectivity Services (BCS) resolves. These business problems include the fact that organizations often contain lots of data that is stored in dissimilar systems and databases throughout different departments. You learned that by using BCS, you are able to aggregate these external data sources into one familiar application, such as Microsoft SharePoint.

In this chapter, you learned how the problem of isolated data sources came about and also how it can be resolved. The chapter introduced the fictitious company called Adventure Works that you will be working with throughout the book. Some of the business problems that Adventure Works would like to resolve with BCS were highlighted.

This chapter has provided a foundation for subsequent chapters to build on, to show how some of the services BCS has to offer can help a real-world organization.

# Introducing Business Connectivity Services

In this chapter, you will:

- Learn what Business Connectivity Services is and the types of solutions you can create with it
- Explore the Business Connectivity Services architecture
- Learn how Business Connectivity Services connects to external systems
- Overview how to extend Business Connectivity Services
- Plan for a Business Connectivity Services solution

Chapter 1, “Making SharePoint the Central Hub for Business,” discussed the frequent problems enterprises have when integrating disparate business data. Many organizations see Microsoft SharePoint as yet another silo of information that can only exploit data stored in lists and libraries. However, by using Microsoft Business Connectivity Services (BCS), an organization does not need to move all its data into SharePoint to build integrated business solutions, bringing together the business processes and the business data in a familiar user experience.

BCS—the evolution of the Business Data Catalog, which was shipped with Microsoft Office SharePoint Server 2007—is a key feature of SharePoint 2010. First introduced in the Enterprise edition of Microsoft Office SharePoint Server 2007, Business Data Catalog enabled you to integrate data stored in SharePoint with data from line-of-business (LoB) applications and other enterprise and Web 2.0 data sources. It allowed you to connect to business data from back-end systems and then, by using prebuilt Web Parts, you could display information from these external data sources on dashboards without the need for coding.

With Microsoft SharePoint Server 2010, these features have been enhanced. BCS is now available in the base product, Microsoft SharePoint Foundation 2010, and SharePoint Online, which is part of Microsoft Office 365.

This chapter introduces some key elements of BCS and forms the foundation of the rest of the book. You’ll learn about BCS, look at its architecture and how it connects to the external system, and consider its security implications. This chapter also introduces the integration of BCS with Microsoft Office client applications and examines how you can use BCS features to build composite solutions and dashboard pages, making SharePoint and Office a simpler and more cost-effective platform to

integrate with your business data. The rest of the book explores each of these areas in detail, showing how BCS can help you mitigate the frequent problems enterprises have when integrating disparate business data, as discussed in Chapter 1.

### **What Is Office 365?**

Office 365 is Microsoft's cloud-based software as a service (SaaS) offering that consists of Microsoft Office Professional Plus, Microsoft SharePoint Online, Microsoft Exchange Online, Microsoft Lync Online, and Microsoft Office Web Apps. Office 365 allows you to collaborate and access email, web conferencing, documents, and calendars from anywhere you have access to the Internet. There are two versions of Office 365: Standard and Dedicated. The Standard version is hosted on shared (multitenant) servers and consists of a number of plans. Plan P is aimed at small businesses with fewer than 50 employees, and Plan E accounts are for larger organizations, as well as educational organizations. The Dedicated version of Office 365 is hosted on server hardware that is dedicated to a particular customer and is intended for organizations with at least 20,000 users. You can find more information about BCS with SharePoint Online in Chapter 10, "Exploring Office 365 and Connecting to External Data."

## **What Is Business Connectivity Services?**

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Business Connectivity Services (BCS) in SharePoint 2010 enables integration with line-of-business (LoB) applications and other external data sources. As mentioned previously, BCS is built on the SharePoint Server 2007 Business Data Catalog technology. It bridges the gap between the various applications that an enterprise uses for surfacing key business data, from platforms such as Siebel, CRM, and SAP or data stored in a mainframe such as an AS/400 system, to SharePoint sites, lists, search functions, user profiles, and Microsoft Office applications.

As noted in Chapter 1, many companies have invested a lot of time and money into the LoB systems that manage their business, with each LoB system having its own specialist and set of management tools. The data from the external system is typically business critical, yet it cannot be used by the end users who need it. Those end users who can access the LoB system data have to contend with multiple different user interfaces (UIs) with an array of terminology. Typically these end users have undergone training in each UI and have developed their own cheat sheets to translate terms in the UIs into their everyday business speech.

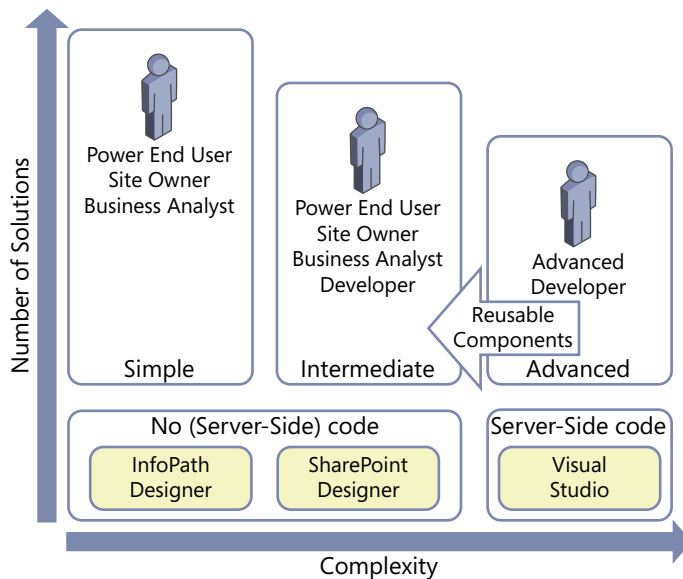
The aim of BCS (and any solutions you build with BCS) is to simply streamline the access to external data for end users who need to use it. That is, BCS connects with the external systems and exposes the external data either in SharePoint or in Office applications, such as Outlook 2010, Access 2010, and SharePoint Workspace 2010.



When using BCS, organizations no longer have to train their developers and end users in multiple systems. Professional developers need to learn only one method of developing against the external systems: the BCS application programming interfaces (APIs). End users can exploit their knowledge of SharePoint and Office applications to use LoB data in their business decisions.

## Types of BCS Solutions

Solutions that bring together data from a number of systems to assist in the automation of a business process are known as *composites* in SharePoint. BCS is a key component in building composites. BCS solutions can be divided into three types, as shown in Figure 2-1.



**FIGURE 2-1** The three types of BCS solutions are simple, intermediate, and advanced.

- **Simple** Built using the out-of-the-box capabilities within SharePoint. Connecting Office applications to external lists exposes the external data, such as when you use a Quick Part in Word 2010. Many of these simple solutions require that the definition of how to connect to the external system is already in existence. The solution is built almost entirely using the ribbon in the browser or Office applications.
- **Intermediate** Built by power end users, site owners, or business analysts. Such users, termed “citizen developers” by Gartner, Inc., operate outside the scope of IT, work in the business domain, and can use the WYSIWYG tools to create new business applications for consumption by others.

Citizen developers use a combination of technologies, such as InfoPath forms, webpages, workflows, and integration into Office applications, such as Outlook task panes or Word documents. Citizen developers know what they want to achieve, they understand their business needs, and with a bit of SharePoint knowledge, they can wire together the business processes or sets of tasks.

Intermediate solutions are more complex than simple solutions, and they may involve the use of Office application macros or the manipulation of XSLT using the code view of Microsoft SharePoint Designer 2010. Therefore, citizen developers may initially need some training or help from the organization's central SharePoint team, particularly if they have never used SharePoint Designer or InfoPath Designer before.



**Note** Gartner, Inc. reports that citizen developers will build at least 25 percent of new business applications by 2014 (see [www.gartner.com/it/page.jsp?id=1744514](http://www.gartner.com/it/page.jsp?id=1744514)) and warns that IT departments that fail to capitalize on the opportunities that citizen development presents will find themselves unable to respond to rapidly changing market forces and customer preferences.

- **Advanced** Built by the IT department and professional developers, involving the development of reusable components to augment simple and intermediate solutions or solutions that require a deep knowledge of architectural concerns and a formal code, test, deploy, and support management process. Such reusable components could include .NET assembly connectors to connect, aggregate, and transform data from external systems, custom Web Parts, custom workflow actions that can be used from within SharePoint Designer, code for InfoPath forms, or extensions to the browser UI. Many of these components can only be developed with the use of Visual Studio.

IT departments will need to differentiate between the types of solutions citizen developers can create and those that the IT department should develop. When this identification process is completed successfully, it should free up IT resources for more complex problems.

Although many business users will have developed complex solutions with, say, Excel, that involved thousands of rows of data, the simple and intermediate types of BCS solutions will be based around forms or business processes. While many users in an organization may not have the specific data skills to build solutions in Excel or Access, they may have the SharePoint skills to create SharePoint solutions in which BCS defines data from multiple external systems. Because users will see little difference in creating solutions where data lives within SharePoint databases and solutions where data is stored in external systems, they are likely to promote the use of BCS related solutions throughout the organization.

The increased use of citizen developers to create business solutions may be new to an organization and will instigate a user adoption strategy as well as an education program. This education program will be focused more on introducing and managing the changes in the way the business will work going forward than enhancing skill sets. Other organizations may assimilate the use of SharePoint and

its tools into their formal/informal reengineering process. Whichever way an organization chooses to introduce SharePoint and BCS, it should not be seen by end users as another task for them to complete in their already busy day; rather, end users should be encouraged to view the use of these technologies as a new way of working, so they can accomplish more in the same amount of time.

Many of the most successful SharePoint solutions are built by the users who use them: the citizen developers. The solutions are successful because the citizen developers know what they want to achieve, they are using the solutions as they develop them, and they can resolve any problems, including issues that can only be uncovered by using the solution. Citizen developers find that there is no need to provide feedback to others or raise incidents with their organization's help desk. These citizen developers are probably very passionate about their own SharePoint solutions. Therefore, when an organization encourages citizen developers to instigate the business reengineering process, it is more likely that other users in the organization will adopt the solution, as one of their own developed it, and that person knew the business requirements and experienced firsthand the issues of the solution.

Key to the success of this paradigm shift is that organizations need to take the citizen development strategy into consideration with any development process. That is, any SharePoint-related development project needs to add to the list of citizen developer tools, continuing the SharePoint philosophy of self-service for end users, content owners, business owners, and site owners.

By using the different types of BCS solutions, an organization can accomplish the following objectives:

- Reduce or eliminate the code required to access LoB systems.
- Achieve deeper integration of data into places where an end user works.
- Centralize deployment of data source definitions for use by both BCS and Office applications.
- Reduce latency to access and manipulate data. After a data source is defined in the BCS repository, it will be immediately available to the web applications associated with that particular BCS service application.
- Centralize data security auditing and connections.
- Perform structured data searches.

## The Structure of a BCS Solution

Both SharePoint Designer and Microsoft Visual Studio 2010 enable users to model how to connect with external business systems. Once a BCS model is created, the data from the external system can be surfaced within the browser or Office application. Then, depending on the operations defined within the model, the end user can manipulate the external system data with full create, read, update, and delete (CRUD) operation support. The definitions within the BCS model enable full integration into SharePoint Server 2010, such as surfacing data from an external system within search or a user's profile.

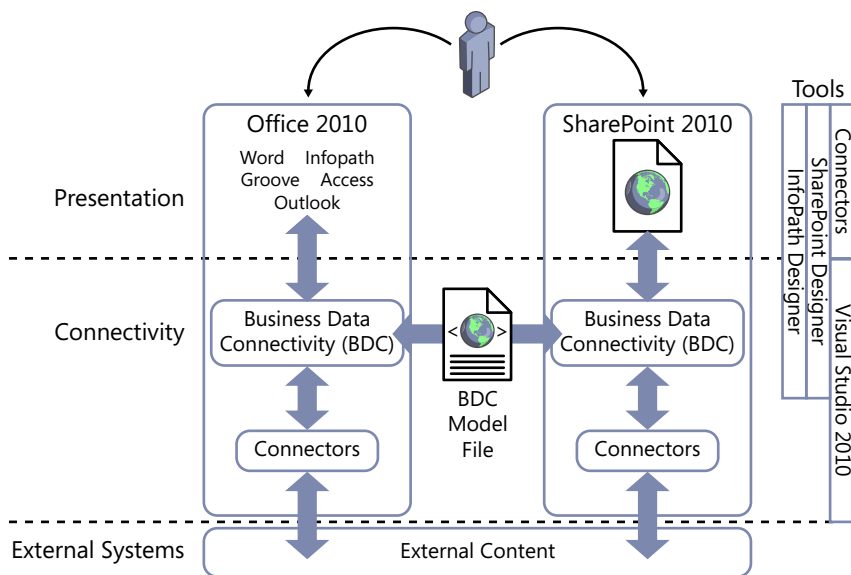


**Note** One feature often cited as new for BCS in SharePoint 2010 is the ability to write back to external systems. You could create SharePoint Server 2007 Business Data Catalog data source definitions that allowed you to update or insert data into the external data sources; however, none of the out-of-the-box Web Parts exposed this feature. You needed a developer to create a custom Web Part to match the data source definition.

A BCS solution can be divided into four layers:

- **External System** Layer that contains the external content.
- **Connectivity** Layer that connects the presentation layer with the external system. It uses different types of connectors depending on the interfaces supported by the external systems, together with information defined in an XML file, known as the Business Data Connectivity (BDC) model, to read and write data to and from the external system.
- **Presentation** Layer that extends the user experience (UX) to display and manipulate content from external systems in Office 2010 client applications and websites built on top of SharePoint 2010.
- **Tools** Layer used to develop solutions and create the BDC model.

Figure 2-2 shows the high-level interaction among the four layers, SharePoint 2010, and Office applications.



**FIGURE 2-2** The high-level architecture of BCS.

## External System

This layer contains the external data. Before using BCS, you should work with the owners of the external system to evaluate the best method to connect to it. There may be more than one method—for example, you may obtain the data from the external system by directly interrogating the database or by using a web services interface. If your external system does not have a compatible interface, you can develop your own BCS connector or expose the content as a web service.

## Connectivity

This layer of BCS connects to the external systems and is referred to as Business Data Connectivity (BDC). (Note that this acronym was used in the previous version of SharePoint, where it represented the Business Data Catalog.) To connect to the external system, you need to define the location of the external system, the protocol to use, and the credentials. Once connected, you need to define the operations on the data that are allowed and the format of the data that will be returned. The operations that can be used on the external data and its format are defined in an external content type (ECT). The definition of the location of the external system together with the ECT is known as the *BDC model*.

The BDC model consists of XML declarations that describe the external system you want to access as well as the operations you want to perform on the external data. For example, you might want to read a data record, update one data record, or delete one data record. You can create the BDC model on a development or test SharePoint installation, and from there download and import it into the SharePoint production farm, a SharePoint installation that is installed on one or more servers that share the same SharePoint configuration database.

**See Also** *You can find detailed information on the BDC model XML schema in Appendix A, “BCS Model Infrastructure.”*

All BDC models to be used within SharePoint are stored in a Microsoft SQL Server database created especially for the use of BCS, known as the metadata store or ECT repository.

Microsoft Office 2010 client applications can also use the BDC model. Office 2010 client applications only contain components to upload a BDC model, so Office 2010 client applications do not provide any management or configuration interface. With SharePoint 2010, however, you can use the SharePoint 2010 Central Administration website or Windows PowerShell to manage and configure the BDC model.

**See Also** *For more information about creating a BDC model, see Chapter 4, “Defining External System Connections Using SharePoint Designer.”*

## Presentation

BCS enables you to bring external data into SharePoint and Office and allows end users to gain insight into the underlying data in a reusable way. SharePoint uses the information in the BDC model to present the external data using external lists, the Business Data Web Part, external data columns, and

external data search, as well as by using SharePoint Designer to create Data Form Web Parts (DFWPs) to display the data. Other Web Parts, such as the Chart Web Part, can also present external data.

Your professional developers could create new Web Parts to present the data, but typically your citizen developers will use tools such as the browser, InfoPath Designer, or SharePoint Designer. For example, in SharePoint 2010, you can display data from external systems on publishing pages, Web Part pages, and wiki pages. No matter which page you are working with, external data is exposed by using Web Parts. For example, external lists use Web Part pages to create views of the external data. These pages contain the XSLT List View (XLV) Web Part, or you can choose to use an InfoPath form or the DFWP. The XLV Web Part and the DFWP use XSLT, and you can use SharePoint Designer's WYSIWYG editing pane as well as its code view to amend the code for these Web Parts.



**Note** External data can also be exposed when you use SharePoint search or in a user's profile. Some of the search Web Parts also use XSLT to present a user-friendly view of the data.

External data can also be presented in Office 2010 client applications by connecting through SharePoint to the external systems or by using the BDC model to connect directly with the external systems.

**See Also** *You can find more information about how to present external data in SharePoint and in Office applications in Part II of this book.*

## Tools

Both SharePoint and Office client applications provide programming interfaces that use BCS and allow professional developers to create solutions. SharePoint 2010 also provides tools for the power user, site owners, and business analysts—the citizen developer tools, such as SharePoint Designer and Microsoft InfoPath Designer.

You can use Visual Studio 2010 to create the BDC model, interact with the BCS program interfaces, and manipulate BDC objects. Third-party tools are also available for you to work with, and you can even use an XML editor, such as XML Notepad 2007 or Notepad, to create a BDC model.

## Interaction Between the Layers

There is a close symmetry between the BCS architecture of a SharePoint installation and Office 2010 applications. The Office 2010 client applications do not have a BDC metadata store, but they have a BDC client-side cache that is used to store the BDC model when data from an external list is taken offline. If amendments are made while the client is offline, they are stored in the client data cache and committed to the external system when the client is next online.

The offline data from the external list is also stored in the client-side cache, within a SQL Compact Edition client database. When the user's computer is turned off, the BDC model and the offline external data is persisted.

Also, note in Figure 2-2 that Office 2010 client applications have their own connectors. When you switch from offline mode to online mode, the Office application connects directly to the external system without connecting through SharePoint. Access 2010 can import a client-side version of the BDC model, therefore it does not need to connect to SharePoint at all—it connects directly to the external system.

## Alternative Methods of Connecting SharePoint 2010 with External Systems

---

SharePoint 2010 provides the following methods of integrating with data that is not stored in SharePoint:

- **Access Services** This service application is available in the Enterprise edition of SharePoint Server 2010 and the P1, E3, and P4 plans of SharePoint Online. You can also create a Web Database by publishing a Microsoft Access 2010 database, where data held in Access tables is moved to SharePoint lists and forms and reports are created as webpages. You can then access the web database using the browser or the Access client application. You can find more information about using Access Services in the Microsoft paper “Improving the Reach and Manageability of Microsoft Access 2010 Database Applications with Microsoft Access Services” at [www.microsoft.com/download/en/details.aspx?id=19061](http://www.microsoft.com/download/en/details.aspx?id=19061).
- **Visio Services** This service application is available in the Enterprise edition of SharePoint Server 2010 and the E3 and E4 plans of SharePoint Online. It allows you to share and view Microsoft Visio 2010 web drawings (.vdw files) in the browser without the Visio client application or the Visio viewer installed on your local computer. The Visio web drawings can contain visuals that are linked to data from an external data source. Visio Services can fetch the data from these linked data sources and update the visuals of a Visio web drawing. Only Microsoft Visio Professional 2010 and Microsoft Visio Premium 2010 can publish Visio web diagrams to a SharePoint Server 2010 site. You can find more information about using Visio Services at <http://technet.microsoft.com/en-us/library/ee663482.aspx>.
- **Excel Services** With this service application, you can publish Microsoft Excel 2010 workbooks to SharePoint 2010, which allows users to view and interact with the workbooks in their browser. First introduced in the Enterprise edition of SharePoint Server 2007, Excel Services is now implemented as a service application available in the Enterprise edition of SharePoint Server 2010. It consists of Excel Calculation Services, the Microsoft Excel Web Access Web Part, and Excel Web Services for programmatic access. Excel workbooks hosted in Excel Services can connect to external data using embedded connection definitions, or connection definitions can be stored in a data connection library. Excel Services is available in all plans of SharePoint Online, where it can connect only to data stored within SharePoint Online. You can find more information about Excel Services at <http://technet.microsoft.com/en-us/library/ee424405.aspx>.

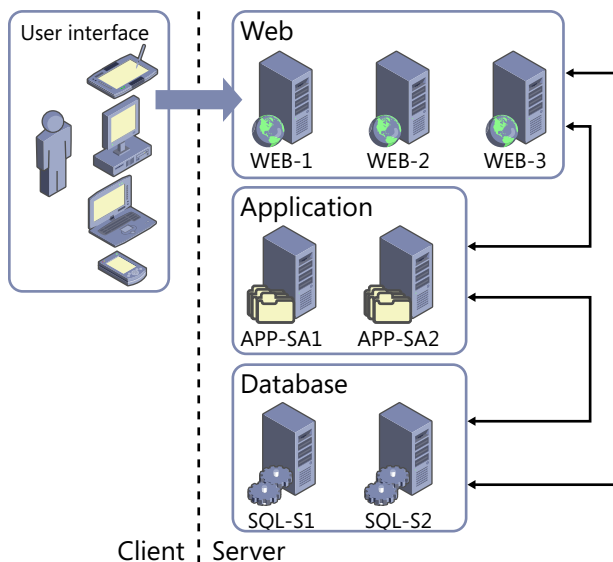
- **PerformancePoint Services** PerformancePoint is available in the Enterprise edition of SharePoint Server 2010 as a service application. At the time of this writing, it is not available in any SharePoint Online plan. PerformancePoint Services allows you to monitor and analyze business information by providing tools to build dashboards, reports, scorecards, and key performance indicators (KPIs). All data used in PerformancePoint is classified as external data, including data stored in SharePoint lists or Excel files published to Excel Services. However, data stored within SharePoint can only be used in PerformancePoint in read-only mode. You can use PerformancePoint to connect to tabular data in SQL Server tables, Excel workbooks, and multidimensional (Analysis Services) data sources, and you can use a PowerPivot model built using the PowerPivot add-in for Excel as a data source. You can find more information about PerformancePoint Services at <http://technet.microsoft.com/en-us/library/ee681486.aspx>.
- **InfoPath forms** With InfoPath, you can create both forms and browser-based forms. Users entering data into forms require Microsoft InfoPath Filler 2010. For browser-based forms, users need only a browser and InfoPath Form Services. Form templates for both types of forms can be created using Microsoft InfoPath Designer 2010. Forms created using InfoPath can connect to data sources such as SharePoint lists or web services. Forms or browser-based forms can be saved in a SharePoint Form library. The ASPX pages in external lists that allow you to create, read, update, and modify data from an external system can be replaced with InfoPath browser-based forms.
- **InfoPath Form Services (IFS)** This service application enables InfoPath browser-based forms to be rendered in SharePoint 2010. This service is available only in the Enterprise edition of SharePoint Server 2010 and the E3 and E4 plans of SharePoint Online. However, in the Standard edition of SharePoint Server, a version of IFS is activated that allows you to use InfoPath workflow association and initiation forms. IFS is not a SharePoint 2010 service application, but it is configured at the farm level using the SharePoint 2010 Central Administration website. For more information about IFS, see <http://technet.microsoft.com/en-us/library/cc262498.aspx>.
- **Microsoft SQL Server 2008 R2 Reporting Services (SSRS)** When installed, this free add-in for SharePoint Technologies 2010 allows you to run SSRS Report Server within SharePoint 2010, where the SSRS reports, items, and properties are stored in SharePoint. Users can browse to SharePoint libraries to find the reports, and if they have sufficient permissions to use the Report Builder, they can create reports. You can find an overview of SSRS and SharePoint integration at <http://msdn.microsoft.com/en-us/library/bb326356.aspx>.
- **Data Sources gallery using SharePoint Designer** Using Microsoft FrontPage 2003, and then later Microsoft Office SharePoint Designer 2007, you could connect, present, and modify data from several types of external data sources using the Data Source Library and Data Source Details task panes. This method is still available with SharePoint Designer 2010 with the Data Sources gallery, which you can access through the Navigation pane. The Data Sources gallery replaces the Data Source Library task pane in SharePoint Designer 2007. The advantage of using BCS as opposed to the Data Source gallery in SharePoint Designer is that you define the external system and external content type (ECT) only once, and you can then use



that ECT on many sites across all web applications that are associated with the BDC service application. The disadvantage is that ECT designers must be given edit permissions to the metadata store, which is a high level of security, whereas with the Data Source gallery you only need to be, for example, a site owner. In addition, you need to set other BCS security settings to allow users to access the external content. You can implement these settings using the SharePoint 2010 Central Administration website or Windows PowerShell. Setting the correct level of BCS security requires a level of collaboration between the ECT designer and the SharePoint farm administrator, which in a large organization are typically two different people.

## Introducing the BCS Architecture

A SharePoint 2010 installation can consist of one or more servers, depending on the number of concurrent users to the SharePoint sites and the functionality they use. Such a collection of servers is called a SharePoint *farm*, and it uses a client/server architecture, as shown in Figure 2-3.



**FIGURE 2-3** SharePoint 2010 is installed as a client/server architecture.

The server architecture consists of four tiers:

- **User interface** Hosts the applications that access the data from the external system. The UI applications run on the user's computer, laptop, tablet, or mobile device. These applications could be a browser; one of the Office client applications, such as Word 2010 or InfoPath Filler; a third-party application; or an application that your organization created.

- **Web** Hosts the IIS Web Server Infrastructure and ASP.NET Framework that SharePoint websites use. The first part of a SharePoint website—for example, *http://www.adventure-works.com* or *http://intranet*—maps to an IIS website, which in turn maps to what in SharePoint is known as a *web application*. This tier responds to requests from the user interface, and directs requests to the appropriate application server and obtains data from the database server. This tier, like the other two tiers, could consist of more than one server for resiliency and load reasons:
  - **Resiliency** If one server is lost, there is still at least one server that can respond to user requests.
  - **Load** If the requests from users cannot be serviced by one server, another server should be added to make the solution scalable. When this tier consists of more than one server, the load is balanced across the servers, and it appears to the world as if it is a single URL.
- **Application** Hosts services associated with SharePoint 2010 service applications. Service applications are a separate SharePoint 2010 functionality that allows you to manage and deploy a SharePoint installation in a service-orientated approach. In SharePoint Server 2007, these services were all grouped into Shared Service Providers (SSPs), which had severe limitations when trying to scale or deploy complex solutions.

The web and application tiers can reside on the same server or servers; however, in larger deployments these two tiers may be installed on their own servers, where each application server may host one or more service applications. Before installing a multiserver SharePoint farm, a basic understanding of the service application architecture is necessary, as this will affect nearly every aspect of a SharePoint installation.

SharePoint 2010 service applications include Business Connectivity Services (BCS), Managed Metadata Service (MMS), PerformancePoint Services (PPS), Office Web Apps, SharePoint Server Search Service, Secure Store Service (SSS), User Profile Service (UPS), and Web Analytics Service, as well as the client-related services, such as Access Services, Excel Services, and Visio Services.

After the Business Data Connectivity (BDC) model is imported into the server running the BCS service application, the external data is made available to any web applications associated with that BCS service application.

**See Also** *For more information about BCS service applications, see Chapter 3, "Creating and Maintaining Business Data Connectivity Service Applications."*

- **Database** Stores the data required by the application and web tiers.

The server architecture can reside on one or more servers. The number of servers will vary from organization to organization and depend on a number of factors, such as the number of concurrent users, scalability, redundancy, resiliency, and the number of service applications used.

For example, when deploying SharePoint 2010 for evaluation or development purposes for a small number of users (for example, fewer than 100 users), the implementation could consist of one server. The single server, known as a single-server farm, would host the web, application, and database tiers. For between 100 and 1,000 users, where redundancy and resiliency are considerations, a four-server farm could be implemented, where two servers would host the web and application tiers and the other two servers would host a clustered or mirrored database server configuration—the database tier.

**See Also** *You can learn more about common ways to build and scale farm topologies, including planning which servers to start services on, at [www.microsoft.com/download/en/details.aspx?id=6096](http://www.microsoft.com/download/en/details.aspx?id=6096).*

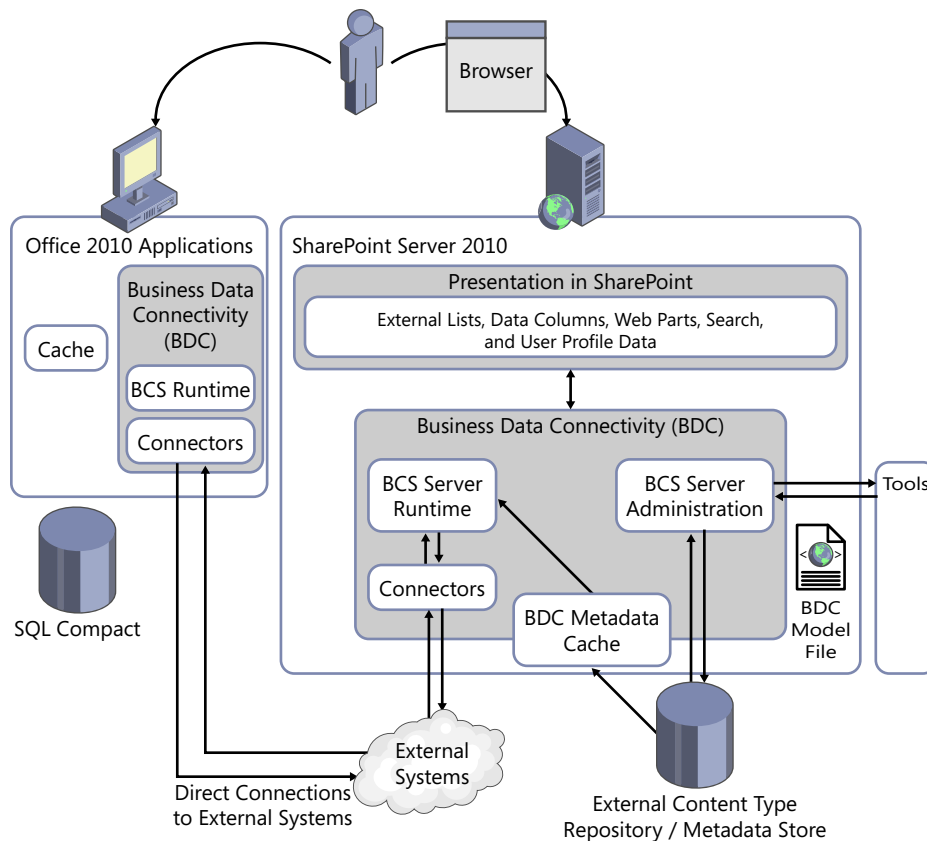
## Connecting to Business Applications

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The Business Connectivity Services (BCS) data connectivity layer, known as the Business Data Connectivity (BDC), uses connectors to access the external systems. The built-in connectors allow you to connect to databases, cloud-based services, Windows Communication Foundation (WCF) endpoints, and web services, as well as provide you with the ability to create new connectors, such as .NET assembly and custom connectors. These two connectors are created using Visual Studio. The .NET assembly connector is typically developed internally in an organization and allows a developer complete control over the operations with the external system with the code the developer writes. Custom connectors are typically developed by third-party companies so that the purchasers of the third-party solution can integrate the solution with a SharePoint installation.

Once SharePoint knows how to connect to an external system, then depending on the operations SharePoint is allowed, it can retrieve, modify, and create external data. An improvement in SharePoint 2010 is the introduction of batch and bulk operations for retrieving external data. When multiple documents are retrieved, it is also possible to retrieve the documents in chunks, which reduces the number of round-trips to retrieve the data.

The connection and data operation details are stored in the BDC metadata store, also known as the BCS database. In this database, SharePoint stores and secures external content type (ECT) and related objects defined in the BDC model, so this database is also known as the ECT repository. This database does not contain external data; it contains only information about the external system. The metadata store is accessed by the Administration and Runtime interfaces, as shown in Figure 2-4, which are discussed in more detail in the following sections.



**FIGURE 2-4** External data can be accessed either from an Office client application or using SharePoint.

## BDC Administration

The Business Data Connectivity (BDC) interface creates, reads, updates, and deletes objects within the metadata store. All of the SharePoint 2010 built-in features use this interface. For example, when you use the SharePoint 2010 Central Administration website, the BCS administration webpages use the BDC interface to import the model, as does the external data picker in any of the business data Web Parts.

On a server hosting the BDC service application, the BDC layer stores in memory (caches) all the BDC model information, so most of the time a call to the administration interface will result in manipulating objects from the cache instead of making round trips to the SQL Server to access the ECT repository. If the BDC sees a change to one of the BDC model objects, it clears and then loads the cache.



**Important** A SharePoint 2010 timer runs once every minute on each server to look for any changes to the BDC metadata objects. If the logic within the timer job sees a change, it clears the cache and then reloads it. Therefore, after you change metadata, you must wait up to a minute for changes to propagate to all the servers in the farm. The changes take effect immediately on the computer on which you make them.

## BDC Runtime

This layer is used to create, update, display, and edit the external content. External content is not saved in the ECT repository but is retrieved by the BDC server runtime using bulk load routines when the content is needed.

For example, if a user clicks a link for an external list, the BDC runtime is used to populate the default view of the external list. However, before the BDC runtime can populate the default view, it must first call the BDC Administration interface to find the location and format of the data from the BDC model, so that it can call the appropriate connector, which is the component that obtains the external data. This process causes network traffic between the web server and the servers that host the BDC service application. Examples of the built-in features that use the BDC runtime are external lists, business data Web Parts, the Retrieve data link, and the refresh icon in the external data column of a list or library.

The Office applications include a symmetrical BDC runtime to the BDC runtime that runs on the server. The BDC runtime, whether it is on the client or SharePoint 2010, uses the same connectors, so the client does not need to connect back to SharePoint to access the external data.

The BDC runtime provides an intuitive, “stereotypical,” consistent object model, independent of the external system. Developers need to understand only the BDC Object Model to extract data from the external systems, whether they are developing code for the client or the server.

The BDC runtime consists of an infrastructure component to provide runtime connection management and shared security services to the external systems. Access to the external systems is the responsibility of the BDC connectors.

## External Content Types

External content types (ECTs) are a new concept in SharePoint 2010 and are the building blocks of BCS, similar to the entity object in SharePoint Server 2007. ECTs refer to external data objects and define the fields, methods, and behavior of the data in SharePoint and Office client applications. Both read and write capabilities are included, along with batch and bulk operation support. ECTs are defined in the BDC model. The data objects defined by the ECTs can be displayed on SharePoint 2010 sites using Web Parts, external columns in lists, and libraries. Also, as the data objects are similar to content types, you can use them to create a specialized list, such as an external list, or in Office 2010 applications where ECTs are the framework for creating Office Business Applications (OBAs).

## BCS Security

To create, modify, or delete the BDC model, or to access the data from the external systems, you will need to plan and consider security requirements. The security requirements of the external systems will usually be outside your control. Many of the external systems will have been installed in your organization before the installation of SharePoint, probably many years before SharePoint was even considered by your organization. You will need to work closely with the external system owners, and with your organization's security experts if you are in a highly regulated industry, as you develop SharePoint composite solutions.

Security requirements can be divided into two types: authentication and authorization. Authentication involves some type of system that provides a mechanism such that users can prove their identity. An authentication mechanism commonly used by large organizations is Windows authentication, where users are provided with a user name and a password. This approach could be augmented with advanced techniques, such as smart cards or fingerprint recognition. Windows authentication involves the installation of Active Directory (AD) within your organization and servers (domain controllers) whose role is to take requests from other servers in your organization to check that a user's credentials are valid. Once the requesting servers have received positive notification from a domain controller concerning the user's credentials, then the requesting server can authorize the user to perform actions based on the permissions granted to the user (authorization).

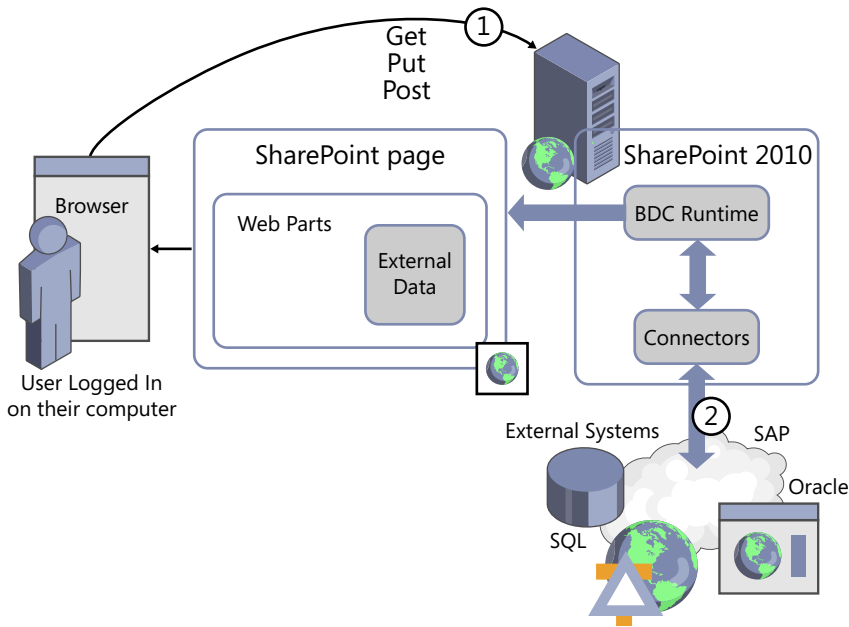
### Authentication

A BCS solution involves a number of systems and each system has its own authentication method. A solution typically involves an end-user device, such as a laptop, desktop computer, mobile phone, or tablet, and on that device an application will run, such as a mobile phone application, an Office application, or a browser. A BCS SharePoint solution involves a SharePoint farm as well as the external system. Each one of these systems—end-user device, SharePoint, and the external system—will be able to use a number of authentication methods, such as Windows authentication, SAML token, or Windows Live ID.

In an ideal world, once a user has signed on to their device, there should be no need to have the user authenticate again. Such an environment, in which a user need only authenticate once no matter how many systems the user's application has to request information from, is known as single sign-on. Although over the years the authentication process has become increasingly transparent to the end user, it still doesn't happen by magic. In most BCS solutions, you will have work to do. If not you, then someone in your organization will need to understand the authentication methods.

For example, in an organization that hosts its own AD and SharePoint farm, the credentials that a user logs on to their computer with are used to authenticate with the web server—this is called *Windows authentication*. SharePoint, using the authorization settings for the user (for example, the site permission settings), allows the user to complete certain operations. In this scenario, the two systems involved—the user's computer and the SharePoint web server—share the same authentication method, and there is just one hop from the user's computer to the SharePoint server.

With a BCS solution, in the same scenario three systems are involved, as shown in Figure 2-5: the user's computer, the SharePoint web server, and the external system.



**FIGURE 2-5** Displaying data from an external system requires two-hop authentication.

Even if the external system shares the same authentication method as the end-user device and SharePoint, when you try to pass a user's Windows authentication identification on to the external system, doing so will always incur a double hop: one hop from the client's computer to the SharePoint server, and a second hop from the SharePoint server to the external system. Unless SharePoint 2010 and the external system are installed on the same server, the user's credentials will not be successfully passed on to the external system. This is known as the *double-hop issue*.



**Note** SharePoint 2010 and the external system are usually installed on the same server only in small organizations, or in larger organizations in a development, prototyping, or demonstration environment.

The workaround to the double-hop issue, where you want to use Windows authentication both for the SharePoint site and the external system, is to use Kerberos or an SSS service application.

The SSS service application is available with SharePoint Server 2010 and can be used with BCS to authenticate users with external systems. It supports access to external data by allowing you to map the credentials of SharePoint users or groups to external system credentials. The SSS application has its own database where the user credentials are encrypted.



**Note** Microsoft recommends using Secure Sockets Layer (SSL) when connecting end-user devices and SharePoint web servers, as well as SSL or Internet Protocol Security (IPsec) between servers running SharePoint and external systems, to ensure that sensitive data is not compromised.

## Authorization

There are at least three levels of authorization with a SharePoint-based BCS solution:

- **SharePoint permissions** Sites are organized into site collections, and a site collection is a security boundary—that is, the top-level site of a site collection starts with its own unique security settings. When you create sites, by default they inherit the permissions of their parent site, which then percolates down to all lists, libraries, list items, and files within that site. When you create a page to display external data or when you create an external list, SharePoint permissions are used to control who can see that page or list. You can break the inheritance on your site so that pages and lists can have their own unique permission settings.



**Note** When you create an external list from an ECT, you cannot have unique permissions on items within the external list. You can have only per-item level permissions when the data resides within SharePoint. An external list presenting data held in the external system and only the external system can apply permissions on a per-item level.

- **BCS service application permissions** Since any BDC model could be extensively used through your SharePoint installation and could be a critical component to the day-to-day working of your organization, there is a mechanism to guard against accidental or malicious modifications to the model. The BDC service application also allows you to specify who can use the definitions to access the external data that the BDC model describes.
- **External system authorization** Most external systems have their own authorization settings determining who can see the data as well as who can view, create, manipulate, or delete the data.

When you create a SharePoint page to display or modify external data, the user experience will be a combination of these three levels of authorization. The user must have SharePoint permissions to the library where the page is stored. The user must have BCS model permissions for SharePoint to read the external system connection details and ECT information. Then the external system must allow the data to be retrieved for that user.

Also, once a BDC model is created, then the visibility of the external data is not limited to a single site. You can set permissions on the BDC model so that only a subset of users can see it, and those users may be site owners or list owners on other sites. However, without a full understanding of how you set up the authorization permissions, the users may decide to create solutions to use the data on



their sites or within their lists with unexpected results. Other users on these sites may not have permissions to see the external data because of authorization settings at the BCS service application level or within the external system. These users on other sites may be presented with an error message, and then they might phone the help desk for support. Therefore, it is important to understand the security implications of your solution, not just on the site where you plan to create external lists and business dashboards, but also throughout all the web applications associated with the BCS service application where your model is stored.

**See Also** *For more information about configuring BCS security, see Chapter 3, “Creating and Maintaining Business Data Connectivity Service Applications.”*

## Taking External Data Offline

When connecting an external list to Outlook 2010 and SharePoint Workspace 2010, you may notice that you can take the external data offline. However, to take the external data offline, additional logic is required. This logic is provided by a Visual Studio Tools for Office (VSTO) ClickOnce deployment package, which is provided only in the Enterprise edition of SharePoint Server 2010. In SharePoint Foundation or the Standard version of SharePoint Server 2010, you cannot take external list data offline in Outlook 2010 or SharePoint Workspace 2010 unless you write your own code.

**See Also** *For more information about using VSTO with external data, see Chapter 11, “Using Client-Side Code and External Data.”*

## Extending Solutions

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As previously explained in this chapter, Business Connectivity Services (BCS) allows you to connect to external data through SharePoint Server 2010 and surface the data in Office 2010 client applications, but that is just the beginning. By further extending the Office 2010 client that exposes the external data, you can create very rich, user-friendly, intuitive solutions. Once you’ve established the BCS connection, you can do a great deal more in the client applications to enhance the user experience.

For example, Microsoft Access 2010 makes connecting to external data easier than ever before. Access has always been a great landing pad for data. With Access 2010, Microsoft has built a new cached mode to dramatically improve the performance of connections to SharePoint lists. Additionally, Access can now slice, dice, and report on BCS data, just like any other linked table.

Although you can develop your own BCS connectors, most BCS development within an organization will concentrate on the presentation and manipulation of the data. With a web-based solution, you have the choice of developing logic that will run on the server, server-side code, or code that runs within the browser, client-side code:

- Server-side code is developed using languages such as C# and is available on web servers as precompiled dynamic-link libraries (DLLs). You can expose such code as controls that you can place on pages or activate as features at the farm, web application, site collection, or site (web scope) level.

- Client-side code is developed using interpretive languages, such as JavaScript, JQuery, and CSS, that are either embedded into HTML or sent to the browser in separate files. The advantage of using client-side code is that it allows the browser to respond to certain user actions, such as clicking a button, without the need to communicate with the server, providing a faster response and improved user experience. You can also add client-side code to pages using tools such as InfoPath Designer and SharePoint Designer.

**See Also** *You can find more information about how to extend the out-of-the-box BCS functionality in Part III.*

## Planning to Use BCS

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Whenever a solution is created that should be easily used by many people, whether it is a SharePoint-related solution or any other type of solution, the ease of use will come only if the architect of the solution has a deep understanding of the types of business scenarios it will be used for, information about the systems that store the business data, and knowledge of the skill set of the users. This is true for a Business Connectivity Services (BCS) solution as well. The person who architects the solution could be a business analyst, a citizen developer, a power end user, or a representative from the IT department, such as a developer.

A BCS solution consists of many components, and with good planning you can create an effective solution. The key to successfully using BCS is to create a Business Data Connectivity (BDC) model file that contains meaningfully named definitions that users can then use to expose the external data on their sites.

During the planning stages, you will need to liaise with a number of people, depending on your knowledge, the scope of the solution, and the number of external systems the solution will use. The solution can be very complex or simple. You need to give consideration to security, ensuring that users who should be allowed to use the data can use the data and that those users are not presented with permission-related error messages.

A BCS solution is not like a solution that can be created using the Data Sources gallery in SharePoint Designer. Such solutions tend to be created on a per-site basis, for a small set of users, by a person who knows the external system and knows the users who will use the solution. The creator of such a solution tends to also be a user of the solution and can tweak and readily extend the solution, creating other Data Source definitions as required using naming conventions that only the creator needs to understand.

If you plan to make heavy use of BCS within your organization, you will need a thorough understanding of BCS, which is the aim of this book. The project/program manager will have to create a communication plan so that end users adopt the solution. For example, the project/program manager will have to obtain the backing of the business owner; train the relevant citizen developers and help desk staff in the use of external lists, SharePoint Designer, and InfoPath Designer; and create electronic help or additional text on pages, such as any new pages you plan for the search center to inform users of the new search capabilities.

You may have to build a prototype that enables you to create the necessary business plan so you can identify whether the BCS solution is a SharePoint-related solution and/or an Office client application solution, whether users want to connect to the data using Outlook, and whether they want to take the data offline. You will need to identify if you can create the solution with only the out-of-the-box functionality or if you will need professional developer assistance.

In reading this chapter, you most likely have already identified some of the technical decisions and tasks you will need to complete when creating a BCS solution, including the following infrastructure and security-related tasks:

■ Infrastructure

- Determine which SharePoint servers will run BCS service application(s).
- Consider whether you need more than one BCS service application.
- Plan to include capacity and performance testing for solutions that will be used extensively. The BCS solutions you develop could result in a large amount of data being transferred from the external systems to the SharePoint servers. These solutions could increase workload on the external systems and SharePoint servers.
- Add SQL database backup and monitoring processes and procedures for all new BCS and SSS databases.
- For an Office client application solution, identify whether the functionality you plan to use requires the Enterprise edition of SharePoint Server 2010 and Office Professional Plus 2010.

■ Security

- Identify the authentication methods used by SharePoint and the external systems.
- Determine whether the BCS solution will need to use the SSS.
- Consider the need to secure communication between user devices and SharePoint servers and external systems for SharePoint-based solutions, or between user devices and external systems for Office client application solutions.
- Plan permissions for the SharePoint site, BDC service application, and external system.

**See Also** *If you have not upgraded to SharePoint 2010, but you are planning to do so and you are currently using the Business Data Catalog in the Enterprise edition of Microsoft Office SharePoint Server 2007, refer to <http://technet.microsoft.com/en-us/library/ff607947.aspx> for more information about upgrading.*

## Summary

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Business Connectivity Services (BCS) allows you to hook up external data with SharePoint and Office applications, enabling either professional developers or citizen developers in your organization to quickly develop composite solutions. BCS is implemented as a SharePoint service application, which allows you to create an external system definition once, known as a Business Data Connectivity (BDC)

model, and share these definitions with many sites. In addition, a SharePoint farm can host more than one BCS, and each one can be configured independently by different sets of administrators.

The BDC model consists of XML declarations that describe the external system you want to access as well as the external content type (ECT) that defines the operations you might like to use on this external data and its format. Once an ECT is defined, then using the browser or SharePoint Designer, you can manipulate the data from the external system as you do other SharePoint objects, such as lists and Web Parts, by using the external list, a new list type in SharePoint 2010.

You can extend the out-of-the-box BCS functionality using either client-side or server-side code. Client-side code can be developed using tools such as the browser, InfoPath Designer, or SharePoint Designer, whereas server-side code is developed using Visual Studio and deployed as precompiled dynamic-link libraries (DLLs).

SharePoint 2010 has tighter integration with Office client applications than in Microsoft SharePoint Server 2007 had with the Office client applications. You can use the BDC model to reveal external data in Microsoft Office 2010 applications, including Microsoft Outlook 2010, Microsoft Access 2010, Microsoft Workspace 2010, Microsoft Word 2010 and Microsoft InfoPath 2010.

Whether you create a SharePoint-related or Office client application BCS solution, you should consider the infrastructure and security implications, and plan the solution accordingly.

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