Microsoft® Azure™ SQL Database Step by Step

Leonard G. Lobel
Eric D. Boyd
To my partner of 20 years, Mark, and our children, Adam, Jacqueline, Joshua, and Sonny. With all my love, I thank you guys, for all of yours.

—Leonard Lobel

For my loving wife, Shelly, and our wonderful boys, Jaxon and Xander.

—Eric Boyd
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## Contents at a glance

*Introduction*  

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAPTER 1</td>
<td>Getting started with Microsoft Azure SQL Database</td>
<td>1</td>
</tr>
<tr>
<td>CHAPTER 2</td>
<td>Configuration and pricing</td>
<td>31</td>
</tr>
<tr>
<td>CHAPTER 3</td>
<td>Differences between SQL Server and Microsoft</td>
<td>57</td>
</tr>
<tr>
<td>CHAPTER 5</td>
<td>Security and backup</td>
<td>97</td>
</tr>
<tr>
<td>CHAPTER 6</td>
<td>Cloud reporting</td>
<td>123</td>
</tr>
<tr>
<td>CHAPTER 7</td>
<td>Microsoft Azure SQL Data Sync</td>
<td>173</td>
</tr>
<tr>
<td>CHAPTER 8</td>
<td>Designing and tuning for scalability and high performance</td>
<td>217</td>
</tr>
<tr>
<td>CHAPTER 9</td>
<td>Monitoring and management</td>
<td>261</td>
</tr>
<tr>
<td>CHAPTER 10</td>
<td>Building cloud solutions</td>
<td>289</td>
</tr>
</tbody>
</table>

*Index*  

357
This page intentionally left blank
## Contents

*Introduction* ................................................................. xiii

**Chapter 1  Getting started with Microsoft Azure SQL Database**  1

Cloud computing: The concept ........................................... 1
  Instant dynamic provisioning ........................................... 2
  The Microsoft Azure cloud ............................................ 2

Getting signed up for SQL Database .................................. 5
  Creating a Microsoft account .......................................... 5
  Creating a Microsoft Azure subscription ........................... 7

Creating a server ............................................................ 8

Creating a SQL Database instance .................................... 13
  Using the SQL Database management portal ..................... 15
  Designing tables and relationships ................................. 17
  Inserting data ............................................................ 21
  Querying the database .................................................. 24
  Exploring additional portal capabilities .......................... 27

Summary .......................................................... 30

**Chapter 2  Configuration and pricing**  31

Using the Microsoft Azure platform management portal .......... 31
  Creating a new database ............................................. 31
  Setting firewall rules ................................................ 35
  Obtaining connection strings ....................................... 38
  Deleting a database .................................................. 40

Using SQL Server Management Studio .............................. 40
  Connecting to SQL Database ....................................... 41
  Creating a new database ............................................. 43

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[Microsoft Learning Books Survey](microsoft.com/learning/booksurvey)
Changing the database edition and maximum size..................44
Deleting a database..................................................44
Using PowerShell..........................................................44
Installing the Microsoft Azure PowerShell cmdlets .................44
Using the PowerShell Integrated Scripting Environment ..........46
Configuring PowerShell for your Microsoft account ...............46
Creating a new server ...............................................47
Creating a new database.........................................48
Deleting a database.................................................50
Budgeting for SQL Database........................................50
SQL storage...........................................................50
Client bandwidth....................................................51
Backup storage space..............................................51
Backup storage bandwidth.......................................52
Support.................................................................53
Optimizing your costs...............................................54
Configuring the database edition and size .......................55
Summary.................................................................56

Chapter 3 Differences between SQL Server and
Microsoft Azure SQL Database 57
Size limitations.......................................................58
Connection limitations............................................58
Unsupported features..............................................59
Summary.................................................................62

Chapter 4 Migrating databases 63
Making the case for data migration......................63
Migrating data using Transact-SQL scripts................64
  Setting up a local SQL Server database........64
  Creating the T-SQL scripts..........................67
  Generating T-SQL scripts........................68
SQL Data-Tier Applications..............................70
  Creating a Microsoft Azure Storage account........71
  Exporting a BACPAC to Microsoft Azure Storage......74
  Importing a BACPAC to Microsoft Azure SQL Database...77
Chapter 5  Security and backup  97

Addressing major cloud concerns ........................................ 97
  Security responsibilities of the public cloud vendor ............... 98
  Shared security responsibilities ...................................... 98
  Security in Microsoft Azure .......................................... 99
Securing SQL Database .................................................... 100
  Creating a SQL Database ................................................ 100
  Configuring SQL Database Firewall .................................. 101
  Authenticating and authorizing users ................................ 105
Backing up SQL Database ................................................... 112
  Copying a database ........................................................ 112
  Monitoring the progress of a database copy operation ............ 113
  Exporting a BACPAC ...................................................... 115
  Importing a BACPAC .................................................... 117
  Scheduling BACPAC exports .......................................... 120
Summary ........................................................................ 122

Chapter 6  Cloud reporting  123

Creating a SQL Server Reporting services virtual machine ....... 125
  Creating the virtual machine from the image gallery ............. 126
  Configuring SSRS in the virtual machine ............................ 128
  Opening firewall access to the report server ....................... 130
Creating the sample database ............................................. 132
Using Report Builder ......................................................... 135
  Installing Report Builder ................................................. 135
  Creating a report using Report Builder ............................... 137
Adding an ADO.NET Web API controller ........................................ 230
Testing the Customer Web API .................................................. 233
Managing SQL Database connections .......................................... 234
  Opening late, closing early ...................................................... 234
  Pooling connections ............................................................ 234
  Recovering from connection faults .......................................... 234
  Adding the Transient Fault Handling Application Block ............ 235
  Using the Transient Fault Handling Application Block with ADO.NET .................................................. 237
  Using the Transient Fault Handling Application Block with Entity Framework ........................................ 239
Reducing network latency .......................................................... 243
  Keeping services close .......................................................... 243
  Minimizing round trips ......................................................... 243
Effectively using SQL Database .................................................. 244
  Using the best storage service ................................................ 244
Optimizing queries ................................................................. 245
Scaling up SQL Database .......................................................... 245
Partitioning data ...................................................................... 250
  Scaling out with functional partitions ...................................... 250
  Scaling out with shards ......................................................... 251
Summary ................................................................................. 260

Chapter 9 Monitoring and management ......................................... 261
Creating the sample database ....................................................... 261
Monitoring ................................................................................ 263
  Using the management portal ................................................ 264
  Microsoft Azure Service Dashboard ........................................ 269
  SQL Database management portal ........................................ 270
  Dynamic management views and functions .............................. 275
Programming the Service Management REST API ....................... 281
Summary ................................................................................. 288
# Chapter 10 Building cloud solutions

Creating the SQL Database ........................................ 292
Extending the SQL Database ........................................ 294
  Creating a new solution ........................................... 294
  Creating a SQL Server Database project ...................... 295
  Setting the target platform ..................................... 296
Importing from SQL Database into the project ............... 297
Adding a new column to the *Wine* table ....................... 300
Deploying the project to Microsoft Azure SQL Database .... 301
Creating the *Order* table ........................................... 305
Creating stored procedures for the *Order* table ............ 307
Creating the data access layer .................................... 312
  Introducing the Entity Data Model ......................... 313
  Creating the Data Access Layer project .................... 314
  Creating an Entity Data Model .......................... 315
Creating the website ................................................... 321
  Creating an ASP.NET web application project ............. 321
  Referencing the data access layer ....................... 323
  Creating the user interface .................................. 324
  Testing the website locally ................................. 328
  Deploying the website to Microsoft Azure .............. 331
Creating the ASP.NET Web API services ....................... 336
  Adding a Web API controller .......................... 337
  Testing the Web API .................................. 339
  Deploying the Web API .................................. 340
Creating the Windows Phone application .................... 341
  Installing the Windows Phone SDK 8.0 ................... 341
  Creating the Windows Phone Project .................... 343
  Adding Json.NET ...................................... 343
  Creating the App’s main page .......................... 344
  Testing the Windows Phone application ............ 353

*Index*

357

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Introduction

Microsoft Azure SQL Database is the cloud version of Microsoft SQL Server, which is Microsoft’s well-established on-premises relational database engine platform. Despite some noteworthy differences, SQL Database (the short name for Microsoft Azure SQL Database) is largely compatible with SQL Server, so for the most part, any experience you have working with SQL Server can be directly and immediately applied to SQL Database. If you are a software professional looking to consider the cloud as a platform for the database in your next application, SQL Database can be just the right tool for you. And if you want to get up to speed quickly with this emerging platform, with or without SQL Server experience, this is just the right book for you.

Microsoft Azure SQL Database Step by Step provides an organized walkthrough of the SQL Database platform. Our goal was to produce an end-to-end treatment of SQL Database that balances coverage and depth. In the first chapter, you will quickly create your first SQL Database on Microsoft Azure. By the last chapter, you will create a full multitiered solution in the cloud—including a website and a Windows Phone 8 app—all layered on top of SQL Database. And in every chapter in between, you will explore other facets of SQL Database and many of its orbiting technologies. SQL Database is a huge topic, but we carefully crafted each chapter to tackle one piece at a time, with easy-to-follow procedures that put digestible concepts to immediate applied use. Your knowledge will build in each chapter, as you learn about configuration, migration, security, backup, reporting, and more.

One big difference between on-premises software and cloud services is that the latter can be updated and enhanced much more frequently than the former, given that no installation or customer infrastructure is required in the cloud case. Cloud services are subject to frequent changes in pricing as well. As such, features, limitations, costs, the tooling user interface, or even the branding of Microsoft Azure SQL Database, as described in this book, may have evolved by the time you read it. For example, shortly before going to press, the platform formerly branded as Windows Azure was changed to Microsoft Azure. (Although the book title and textual references were updated accordingly, many screen shots still show the older name, Windows Azure.) Regardless of the potential for such changes, the principles and techniques covered throughout this book will help you achieve comfort with and mastery of Microsoft Azure SQL Database.
Note As Azure evolves, we evolve with it. Even as this first edition goes to press, we are busy planning the next edition with expanded coverage of the recently announced Basic, Standard, and Premium editions. These new service tiers (which have limited preview availability at the time of this writing) can support larger and more scalable databases than the current Web and Business editions offer. Our next edition will also be revised for the upcoming release of a new management portal currently being developed by Microsoft.

Who should read this book

This book exists to help software developers and database professionals understand the core concepts of Microsoft Azure SQL Database and its related technologies. Many readers will have little or no prior experience with either SQL Database or SQL Server, and that’s perfectly fine. This book starts with square one, and gets you off to a good start even if you have no prior knowledge of SQL Server or relational database concepts.

The book is also useful for those familiar with on-premises SQL Server and are interested in creating new applications to work with SQL Database, or those who would like to migrate existing applications that currently work with on-premises SQL Server to work with SQL Database as well.

Assumptions

No prior knowledge or experience with Microsoft Azure and cloud computing is assumed or required. Furthermore, although experience with Microsoft SQL Server is certainly useful, that too is not required.

Several chapters involve .NET programming. Here, too, prior experience with Microsoft Visual Studio and C# is helpful but not required. The procedures in these chapters include complete code listings, and clear explanations of the code are provided.
This book might not be for you if...

This book might not be for you if you already have extensive knowledge and experience with SQL Database, and are seeking to delve deeper into internals or other specialized focus areas not covered in this book. Still, this book contains useful information even for experienced users. Therefore, we recommend that you take a quick glance at the chapter descriptions in the next section. Doing so should help you quickly determine if there are specific areas of interest we cover that you would like to learn more about.

Organization of this book

This book is composed of ten chapters, each of which focuses on a different aspect of Microsoft Azure SQL Database. Most readers will probably benefit by starting with Chapter 1, but by no means does this book need to be read in any particular order. Read it from start to finish if you want, or jump right in to just those chapters that suit your needs or pique your interests. Either way, you’ll find practical guidance and walkthroughs to help get your job done with SQL Database.

- **Chapter 1—Getting started with Microsoft Azure SQL Database**  The opening chapter gets you acquainted with the SQL Database platform. After a brief overview of cloud computing with SQL Database, you’ll create a Microsoft account (if you don’t already have one) and a Microsoft Azure subscription. Then you will learn how to use the Microsoft Azure management portal to create servers and databases. You’ll move on to use the SQL Database management portal, where you’ll design tables, views, and stored procedures, and then populate and query tables in the database. Absolutely no local tools are required to follow along with the procedures in this chapter; all you need is a web browser and Internet access.

- **Chapter 2—Configuration and pricing**  With the basics covered, this chapter explains additional options for configuring SQL Database, beyond the browser-based portals introduced in Chapter 1. You will learn how to connect to SQL Database using familiar local tools, such as SQL Server Management Studio (SSMS) and SQL Server Data Tools (SSDT) inside Visual Studio. You will also learn how to configure and manage SQL Database using PowerShell, by downloading the Microsoft Azure PowerShell cmdlets. The chapter concludes with an explanation of how SQL Database pricing is structured on Microsoft Azure, and it provides tips to help you budget for a SQL Database solution.
Chapter 3—Differences between SQL Server and Microsoft Azure SQL Database

Readers with prior SQL Server experience will want to know about the important differences between the on-premises relational engine they are familiar with and the SQL Database implementation on Microsoft Azure. This brief chapter enumerates these differences and explains the rationale behind them. Where possible, we suggest workarounds for SQL Server features that are not supported in SQL Database.

Chapter 4—Migrating databases

When building systems on Microsoft Azure, there is often a need to migrate databases from existing on-premises SQL Servers to SQL Database. There are numerous techniques and tools you can use to migrate databases and data to SQL Database. In this chapter, you will learn about and use Transact-SQL scripts, SQL Data-Tier Applications, bulk copy, and the SQL Database Migration Wizard to migrate databases to SQL Database.

Chapter 5—Security and backup

Security, availability, and disaster recovery top the list of concerns when customers consider new data centers and public cloud providers. In this chapter, you will learn about security in Microsoft Azure and how to secure your SQL Database with firewall rules, as well as users and permissions. In addition to gaining knowledge about security, you will learn how to handle disaster recovery with SQL Database backup techniques.

Chapter 6—Cloud reporting

When you have data in a database, it’s only a matter of time before you also have reporting requirements related to that data. And when that database is hosted in the cloud on Microsoft Azure, it’s only natural to consider using the Azure cloud to host a reporting solution as well. In this chapter, you will learn how to create an Azure virtual machine (VM) to host SQL Server Reporting Services (SSRS) in the cloud. (No prior SSRS experience is needed.) Once the VM is configured, you will learn how to build SSRS reports using two report authoring tools: Report Builder and SSDT Business Intelligence for Visual Studio. After building and previewing reports locally, you will learn how to deploy them to the VM for a complete reporting solution in the cloud.

Chapter 7—Microsoft Azure SQL Data Sync

In this chapter, you will learn how to use the SQL Data Sync service available on Microsoft Azure to replicate data between multiple databases. You will learn about the hub-and-spoke architecture upon which the service is based, and see how SQL Data Sync can be used to implement solutions for a variety of scenarios, including one-way or bi-directional replication across a set of databases in multiple locations. The procedures in this chapter walk you through the process of configuring the SQL Data Sync service and creating sync groups that replicate between multiple databases.
hosted both in the cloud (on Microsoft Azure SQL Database) and on-premises (using SQL Server). You will also learn how to establish a conflict-resolution strategy and set up an automated synchronization schedule.

- **Chapter 8—Designing and tuning for scalability and high performance**  Applications and systems intended for real production use need to provide responsive experiences and good performance. In this chapter, you will optimize and tune database performance for SQL Database. Next, you will improve application reliability by managing database connections and connection errors using both ADO.NET and Entity Framework. Finally, you will explore how to scale databases in SQL Database using a special partitioning technique known as *sharding*.

- **Chapter 9—Monitoring and management**  Services used by production applications must provide monitoring and management capabilities. In this chapter, you will learn how to monitor the health of SQL Database using the management portal, the Service Dashboard, and dynamic management views and functions. You will also learn how to automate SQL Database operations programmatically, using the REST-based Service Management API.

- **Chapter 10—Building cloud solutions**  In the book’s closing chapter, you will learn how to build a complete solution in the cloud on top of Microsoft Azure SQL Database. Specifically, you will create a Visual Studio solution that includes a SQL Server Database project, an Entity Framework data-access layer, ASP.NET MVC, and ASP.NET Web API. The solution provides a website, web services, and a Windows Phone 8 app with functionality for users to retrieve and update data stored in SQL Database.

**Conventions and features in this book**

This book presents information using conventions designed to make the information readable and easy to follow:

- Each procedure consists of a series of tasks, presented as numbered steps (1, 2, and so on) listing each action you must take to complete the exercise.

- Boxed elements with labels such as “Note” provide additional information or alternative methods for completing a step successfully.

- Text that you type (apart from code blocks) appears in bold.
A plus sign (+) between two key names means that you must press those keys at the same time. For example, “Press Alt+Tab” means that you hold down the Alt key while you press the Tab key.

A vertical bar between two or more menu items (for example, File | Close) means that you should select the first menu or menu item, then the next, and so on.

**System requirements**

At a minimum, there are no special system requirements for working with SQL Database. The Microsoft Azure management portal requires only a web browser and Internet access. Similarly, the SQL Database management portal requires only a browser with the Silverlight plug-in.

Some chapters walk you through procedures that use local tools—typically, SQL Server Management Studio (SSMS) and Visual Studio 2013. To complete these procedures, you will need to have those tools installed as well, which requires the following:

- Visual Studio 2013, any edition. (Multiple downloads may be required if using Express Edition products.)
- SQL Server 2012 Express Edition or higher, with SQL Server Management Studio 2012 Express or higher. (Included with Visual Studio, Express Editions require separate download.)

Depending on your Windows configuration, you might require Local Administrator rights to install or configure Visual Studio 2013 and SQL Server 2012 products.

Chapter 4, "Migrating databases," and Chapter 7, "Microsoft Azure SQL Data Sync," include procedures that require a local SQL Server instance on which you have permissions to create a database. If you don’t have access to a local SQL Server instance, you can install SQL Server Express Edition (the free version of SQL Server) by following the instructions shown in the next section.

Finally, several individual chapters work with additional software that gets installed locally. These chapters include detailed procedures for downloading and installing the necessary software so that you can follow along with the rest of the chapter.
Downloads: SQL Server Express Edition

There are several SQL Server Express Edition downloads available on the Microsoft site, and they are available in both 32-bit and 64-bit versions. You can choose to install just the SQL Server Express database engine (and nothing else), or you can choose one of two other (larger) downloads: Express With Tools (which includes SQL Server Management Studio [SSMS]) or Express With Advanced Services (which includes SSMS, Full Text Search, and Reporting Services). There are also separate downloads for SSMS and LocalDB, but these do not include the SQL Server Express database engine needed to host local databases.

To install the SQL Server Express Edition database engine, follow these steps:

2. Click the large orange Download button.
3. Select the appropriate download for your system, as shown in Figure I-1:
   a. For 64-bit systems, choose ENU\x64\SQLEXPRESS_x64_ENU.exe.
   b. For 32-bit or 64-bit WoW systems, choose ENU\x86\SQLEXPRESS32_x86_ENU.exe.
   c. For 32-bit systems, choose ENU\x86\SQLEXPRESS_x86_ENU.exe.

**Note** If you need to download SQL Server Management Studio (SSMS) as well, choose the Express With Tools file instead, which is the one that includes WT in the filename.
4. Click Next.

5. If you receive a pop-up warning, click Allow Once, as shown in Figure I-2.

6. When prompted to run or save the file, choose Run. This starts and runs the download.

7. If the User Account Control dialog appears after the download files are extracted, click Yes.

8. In the SQL Server Installation Center, click New SQL Server Stand-Alone Installation, as shown in Figure I-3.
In the SQL Server 2012 Setup wizard, do the following:

a. On the License Terms page, select I Accept The License Terms and click Next.

b. On the Product Updates page, allow the wizard to scan for updates, and then click Next.

c. On the Install Setup Files page, wait for the installation to proceed.

d. On the Feature Selection page, Click Next.

e. Continue clicking Next through all the remaining pages until the Installation Progress page, and wait for the installation to proceed.

f. On the Complete page indicating a successful setup (shown in Figure I-4), click Close.
Many chapters have procedures in which you will write actual code. In most cases, there is only a small amount of code, but you may still find it helpful to download the completed code listings from the book’s companion website. Doing so can help you work through the procedures, particularly those few procedures that have a bit more code than others. All the code found in this book can be downloaded at the following page:

http://aka.ms/AzureSQLDB_SBS

Installing and using the code samples
Simply download the zip file to your local machine and extract it. You will find one folder for the code in each chapter, although note that there is no code for Chapters 2 and 3. The code folders contain listing files that correspond to the listing numbers.
found in each of the chapters. Finally, the code folders for Chapters 6, 8, and 10 also include the completed Visual Studio solutions for the exercises found in those chapters.

Acknowledgments

I was first asked to write a book on SQL Azure—back when it was still called SQL Azure—nearly two years ago. It’s been a long road since then, and despite seismic shifts both in the Azure product platform and in the book publishing ecosystem (not to mention an unexpected curve ball or two), I am extremely delighted to finally publish!

This is my third technical book, and although each experience has been unique, I’ve learned the same lesson in each case: I could not have even contemplated the challenge without the aid of numerous other talented and caring individuals. These are folks who deserve special recognition—people who lent their generous support out in so many different ways that it’s impossible to mention names in any prescribed order.

So I’ll start with Andrew Brust. If not for Andrew (who himself is a well-established leader in the software industry), I would never have started down the book-writing path in the first place. I am grateful for our personal friendship, as well as our working relationship writing books and presenting workshops together. These experiences truly help me thrive and grow.

I’m also fortunate to have teamed up with my colleague and co-author Eric Boyd, who produced four excellent chapters on several advanced topics. Eric is an extremely talented software professional, whose expertise and passion for technology comes through clearly in his writing.

Russell Jones, my pal at O’Reilly Media, gets special mention of course, because he’s the one who asked me to write this book in the first place. I thank Russell, not only for offering me the opportunity, but for his expert guidance and assistance during the transition to Microsoft Press. More thanks go out to Roger LeBlanc for his copyediting review, and to Scott Klein for his technical review. Special thanks as well to Devon Musgrave and Rosemary Caperton at Microsoft Press, and Steve Sagman of Waypoint Press. Their guidance has been vital to the successful production of this book, and it has been an absolute pleasure working with each one of them.

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And greatest thanks of all go out to my dear Mom, bless her soul, for always encouraging me to write with “expression.”

—Leonard Lobel

I have been developing software professionally for almost 20 years and I am grateful for being blessed with deep interest and excitement for this industry, the ability learn and understand what are sometimes very complex concepts, and the support of my family, friends, mentors and peers throughout my career. Writing a book like this requires lots of guidance and help from many people, and I have many people to thank.

First and foremost, I want to thank God for everything: for life, salvation, family, friends, talents, abilities and everything.

Working on this project over the past year has been a lot of fun, but it has also been a lot of work. My family has been extremely supportive, even when I had to block off nights and weekends to write. I owe so much to my wife, Shelly, for everything that she does for our family. And I’m so thankful for our two wonderful boys who enjoy sitting next to me in my office and cuddling up next to me with my laptop in the living room, when my evenings and weekends get occupied with writing.

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—Eric Boyd
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CHAPTER 3

Differences between SQL Server and Microsoft Azure SQL Database

—Leonard Lobel

One of the most attractive aspects of Microsoft Azure SQL Database is that it shares virtually the same codebase and exposes the same tabular data stream (TDS) as on-premises Microsoft SQL Server. Thus, to a great extent, the same tools and applications that work with SQL Server work just the same and just as well with SQL Database. Notice that we said to a great extent, because despite their commonality, there are quite a few SQL Server features that SQL Database does not support. In this brief chapter, we discuss how and why these two platforms differ from one another, and we explain the SQL Database constraints you need to be aware of if you have previous experience with SQL Server.

SQL Server and SQL Database differ in several ways—most notably, in terms of size limitations, feature support, and T-SQL compatibility. In many cases, these constraints are simply the price you pay for enjoying a hassle-free, self-managing, self-healing, always-available database in the cloud. That is, Microsoft cannot responsibly support features that impair its ability to quickly replicate, relocate, and scale a SQL Database instance. This is why SQL Database places limits on database size and doesn’t support certain specialized features, such as FILESTREAM.

Another common reason why a particular feature or T-SQL syntax might not be supported in SQL Database is that it’s simply not applicable. With SQL Database, administrative responsibilities are split between Microsoft and you. Microsoft handles all the physical administration (such as disk drives and servers), while you manage only the logical administration (such as database design and security). This is why any and all T-SQL syntax that relates to physical resources (such as path names) are not supported in SQL Database. For example, you don’t control the location for primary and log file groups. This is why you can’t include an ON PRIMARY clause with a CREATE DATABASE statement, and indeed, why SQL Database does not permit a file group reference in any T-SQL statement. Plainly stated, everything pertaining to physical resources (that is, infrastructure) is abstracted away from you with SQL Database.

Yet still, in some cases, a certain SQL Server feature or behavior might be unsupported merely because Microsoft has just not gotten around to properly testing and porting it to SQL Database. Azure is constantly evolving, so you need to keep watch for updates and announcements. This small
chapter is a great starting point, but the best way to stay current is by reviewing the “Guidelines and Limitations” section of the SQL Database documentation on the MSDN website. (See http://msdn.microsoft.com/en-us/library/ff394102.aspx.)

Size limitations

With the exception of the free, lightweight Express edition of SQL Server, there is no practical upper limit on database size in any edition of SQL Server. A SQL Server database can grow as large as 524,272 terabytes. (For SQL Server Express edition, the limit is 10 gigabytes.)

In contrast, SQL Database has very particular size limitations. As explained in Chapter 2, “Configuration and pricing,” you can set the maximum size by choosing between the Web and Business editions. With a Web edition database, you can set the maximum database size to either 1 or 5 gigabytes (GB). With a Business edition database, the maximum database size can range from 10 to 150 GB. The absolute largest supported database size is 150 GB, although partitioning strategies can be leveraged for scenarios that require databases larger than 150 GB (as explained in Chapter 8, “Designing and tuning for scalability and high performance”).

Note At the time this book went to press, Microsoft announced the Preview availability of SQL Database Premium. This is a more costly option than the standard Web and Business editions of SQL Database (which have been rebranded as Basic and Standard), and it supports a maximum database size of 500 GB. As we explain in Chapter 8, SQL Database Premium also lets you scale up for performance using dedicated CPU and memory.

Connection limitations

SQL Database is far less flexible than SQL Server when it comes to establishing and maintaining connections. Keep the following in mind when you connect to SQL Database:

- SQL Server supports a variety of client protocols, such as TCP/IP, Shared Memory, and Named Pipes. Conversely, SQL Database allows connections only over TCP/IP.
- SQL Database does not support Windows authentication. Every connection string sent to SQL Database must always include a login user name and password.
- SQL Database often requires that @<server> is appended to the login user name in connection strings. SQL Server has no such requirement.
- SQL Database communicates only through port 1433, and it does not support static or dynamic port allocation like SQL Server does.
- SQL Database does fully support Multiple Active Result Sets (MARS), which allows multiple pending requests on a single connection.
Because of the unpredictable nature of the Internet, SQL Database connections can drop unexpectedly, and you need to account for this condition in your applications. Fortunately, several options are available to cope with this:

- The latest version of the Entity Framework (EF6, Microsoft’s recommended data access API for .NET) has a new Connection Resiliency feature, which automatically handles the retry logic for dropped connections.
- The Microsoft Enterprise Library Transient Fault Handling Application Block, covered in Chapter 4, lets you define and implement retry strategies to deal with dropped connections.
- The ADO.NET SqlConnection class has an OpenWithRetry extension method that handles the retry logic based on the default retry policy (which must be defined using the Microsoft Enterprise Library Transient Fault Handling Application Block).

Unsupported features

This section lists many SQL Server capabilities that are not supported in SQL Database, and here we suggest workarounds where possible. Again, because this content is subject to change, we recommend you check the MSDN website for the latest information. (See http://msdn.microsoft.com/en-us/library/ff394102.aspx.)

- **Agent Service**  You cannot use the SQL Server Agent service to schedule and run jobs on SQL Database.
- **Audit**  The SQL Server auditing feature records server and database events to either the Windows event log or the file system, and it is not supported in SQL Database.
- **Backup/Restore**  Conventional backups with the BACKUP and RESTORE commands are not supported with SQL Database. However, SQL Database supports an automated backup schedule that creates transactionally consistent backups in the form of BACPAC files created in Azure storage. You can also create BACPAC files manually; however, this does not provide transactional consistency for changes made during the export operation. To ensure transactional consistency for a manual backup, you can either set the database as read-only before exporting it to a BACPAC, use the Database Copy feature to create a copy of the database with transactional consistency and then export that copy to a BACPAC file. See Chapter 5, “Security and backup,” for more information.
- **Browser Service**  SQL Database listens only on port 1433. Therefore, the SQL Server Browser Service, which listens on various other ports, is unsupported.
- **Change Data Capture (CDC)**  This SQL Server feature monitors changes to a database, and it captures all activity related to change tables. CDC relies on a SQL Server Agent job to function and is unsupported in SQL Database.
- **Common Language Runtime (CLR)**  The SQL Server CLR features (often referred to simply as *SQL CLR*) allow you to write stored procedures, triggers, functions, and user-defined types in any .NET language (such as Microsoft C# or Visual Basic) as an alternative to using traditional T-SQL. In SQL Database, only T-SQL can be used; SQL CLR is not supported. Note, however, that this limitation does not apply to SQL Server data types implemented internally using the CLR (such as `xml`, `geography`, and `geometry`, all of which are supported in SQL Database).

- **Compression**  SQL Database does not support the data-compression features found in SQL Server, which you use to compress tables and indexes.

- **Database object naming convention**  In SQL Server, multipart names can be used to reference a database object in another schema (with the two-part name syntax `schema.object`), in another database (with the three-part name syntax `database.schema.object`), and (if you configure a linked server) on another server (with the four-part name syntax `server.database.schema.object`). In SQL Database, two-part names can also be used to reference objects in different schemas. However, three-part names are limited to reference only temporary objects in `tempdb` (that is, where the database name is `tempdb` and the object name starts with a `#` symbol); you cannot access other databases on the server. And you cannot reference other servers at all, so four-part names can never be used.

- **Extended events**  In SQL Server, you can create extended event sessions that help to troubleshoot a variety of problems, such as excessive CPU usage, memory pressure, and deadlocks. This feature is not supported in SQL Database.

- **Extended stored procedures**  You cannot execute your own extended stored procedures (which are typically custom-coded procedures written in C or C++) with SQL Database. Only conventional T-SQL stored procedures are supported.

- **File streaming**  SQL Server native file-streaming features, including FILESTREAM and FileTable, are not supported in SQL Database. Instead, you can consider using Azure Blob Storage containers for unstructured data files, but it will be your job at the application level to establish and maintain references between SQL Database and the files in blob storage, though note that there will be no transactional integrity between them using this approach.

- **Full-Text Searching (FTS)**  The FTS service in SQL Server that enables proximity searching and querying of unstructured documents is not supported in SQL Database. However, there is a third-party text search engine library available from Lucene that does work with SQL Database. For more information, visit [http://www.lucene.net](http://www.lucene.net).

- **Mirroring**  SQL Database does not support database mirroring, which is generally a non-issue because Microsoft is ensuring data redundancy with SQL Database, so you don’t need to worry about disaster recovery. This does also mean that you cannot use SQL Database as a location for mirroring a principal SQL Server database running on-premises. However, if you want to consider the cloud for this purpose, you can host SQL Server inside an Azure virtual machine (VM) against which you can mirror an on-premises principal database. This solution requires that you also implement a virtual private network (VPN) connection between
your local network and the Azure VM, although it will work even without the VPN if you use server certificates.

- **Partitioning**  With SQL Server, you can partition tables and indexes horizontally (by groups of rows) across multiple file groups within a database, which greatly improves the performance of very large databases. SQL Database has a maximum database size of 150 GB (or 500 GB, for the newly announced Premium edition) and gives you no control over file groups, thus it does not support table and index partitioning.

- **Replication**  SQL Server offers robust replication features for distributing and synchronizing data, including merge replication, snapshot replication, and transactional replication. None of these features are supported by SQL Database; however, SQL Data Sync can be used to effectively implement merge replication between a SQL Database and any number of other SQL Databases on Microsoft Azure and on-premises SQL Server databases. See Chapter 7, “Microsoft Azure SQL Data Sync,” for more information.

- **Resource Governor**  The Resource Governor feature in SQL Server lets you manage workloads and resources by specifying limits on the amount of CPU and memory that can be used to satisfy client requests. These are hardware concepts that do not apply to SQL Database, so the Resource Governor is unsupported.

- **Service Broker**  SQL Server Service Broker provides messaging and queuing features, and it is not supported in SQL Database.

- **System stored procedures**  SQL Database supports only a few of the system stored procedures provided by SQL Server. The unsupported ones are typically related to SQL Server features and behaviors not supported by SQL Database. At the same time, SQL Database provides a few new system stored procedures not found in SQL Server that are specific to SQL Database (for example, `sp_set_firewall_rule`).

- **Tables without a clustered index**  Every table in a SQL Database must define a clustered index. By default, SQL Database will create a clustered index over the table’s primary key column, but it won’t do so if you don’t define a primary key. Interestingly enough, SQL Database will actually let you create a table with no clustered index, but it will not allow any rows to be inserted until and unless a clustered index is defined for the table. This limitation does not exist in SQL Server.

- **Transparent Data Encryption (TDE)**  You cannot use TDE to encrypt a SQL Database like you can with SQL Server.

- **USE**  In SQL Database, the *USE* statement can refer only to the current database; it cannot be used to switch between databases as it can with SQL Server. Each SQL Database connection is tied to a single database, so to change databases, you must connect directly to the database.

- **XSD and XML indexing**  SQL Database fully supports the *xml* data type, as well as most of the rich XML support that SQL Server provides, including XML Query (XQuery), XML Path (XPath), and the *FOR XML* clause. However, XML schema definitions (XSD) and XML indexes are not supported in SQL Database.
Summary

In this brief chapter, you learned about the important differences between on-premises SQL Server and SQL Database on Microsoft Azure. We explained the SQL Database limitations on size, as compared to a virtually unlimited database size supported by SQL Server. We also discussed connection limitations, and important considerations to keep in mind with respect to dropped connections, which occur with relative frequency in SQL Database. The chapter concluded by enumerating the many SQL Server features that are either unsupported or have limited support in SQL Database, and offered workarounds where possible.

The information in this chapter will help you decide whether or not SQL Database is suitable for your particular scenario. Of course, if you determine that it is not, always remember that you can run on-premises SQL Server in an Azure VM (we show you how in Chapter 6). This IaaS approach provides you with full SQL Server functionality in the cloud, compared to the PaaS approach of going with SQL Database.
A

abstraction, 3–4, 217, 313
access control, 12, 35–38, 106–111, 170
  least privilege principle, 108–109, 111
  with stored procedures, 307–312
action methods, 321, 326–327, 338
Active Directory, adding users, 170
ADO.NET, 217
  connection pooling, 234
  data access layer, building, 312–313
  database connections, managing, 234
  Dataset objects and data adapters, 313
  encapsulating, 239
  raw objects, 312–313
  sharding with, 254–259
  SqlConnection class OpenWithRetry extension method, 59
  transient fault handling, 237–238
  Web API controllers, building, 230–233
AdventureWorks database, installing, 151–154
agent keys, 204
Agent service, 59
agents, 174
aging policies, 56
allowed IP addresses, 12
  See also firewall rules; SQL Database Firewall
ALTER DATABASE statement, 44
applications
  auditing, 99
  building, 289–354
  in the cloud, 2
  connection faults, recovering from, 235–243
  data synchronization, 179
  geographic locations, 179, 243
  hackers, protecting from, 99
  health, monitoring, 261
  load balancing, 179–180
  physical distance from databases, 55, 179, 243
  regulatory requirements, complying with, 99
  repository pattern, 314
  scaling, designing for, 218
  tables, indirect access to, 307–312
  volume purchase plan, 55
ASP.NET MVC websites, 321–335
ASP.NET Web APIs
  See Web API controllers; Web API services; Web APIs
attack surface, reducing, 108. See also security
  auditing, 59, 99
authentication
  with management certificates, 281, 283
  selecting type, 41
  SQL Database support for, 58
  of users, 105–111
  Windows Integrated authentication, 170
authorization of users, 105–111, 170
automated BACPAC export schedule, 120–121
automated data synchronization schedules, 200–202
Automated Export feature, 120–121
Azure
  See Microsoft Azure

B
backup storage, 51–53
backup-and-restore process, 59, 112–121
backups, 112–121
  automated, 59
  geo-replicated storage for, 55
  removal strategy, 55
  transactional consistency, 59
BACPAC files, 30
  for backups and restores, 112, 115–121
  creating, 34–35, 59
  data migration with, 70–80
  database objects for export, 75
BACPAC files

BACPAC files (continued)
  importing to SQL Database instance, 77–80
  transactional consistency of, 120–121
bandwidth-based fees, 9, 79
basic authentication, 170
bcp (SQL Server Bulk Copy), 80–86, 153
bi-directional binding, 350
bi-directional synchronization, 195–196
blob containers, 73–74
blob storage, 54, 60, 115, 244–245
block blobs, 115
Browser role, 170
Browser Service, 59
browsers
  content negotiation, 230
  MVC websites, running from, 335
  reports, running from, 149–150, 168–169
  Web APIs, testing, 228–230
Business Intelligence Developer Studio (BIDS), 151
Business Intelligence project templates, installing, 151, 154–156
Business (Standard) edition of SQL Database, 55, 58

C

Cache service, 244–245
caching, client-side, 244
catalog views, 280
Change Data Capture (CDC), 59
change scripts, 301, 303
check constraints, 310
circular references, 338–339
class library projects, 314–315, 323, 324
client agent service, 204
client bandwidth pricing, 51
client connections, allowing through firewall, 101–105
client protocols, SQL Database support for, 58
clients, pushing data changes to, 174
client-side storage and caching, 244
cloud computing, 1–4, 218
cloud databases. See also databases; SQL Database
  location of, 215
  synchronizing, 182–202
cloud reporting, 3, 123–171
Cloud Service Fundamentals in Windows Azure, 259
cloud solutions, 289–354
  ASP.NET Web API services, creating, 336–341
  data access layer, creating, 312–321
  delivery of, 3
  deploying to SQL Database, 301–304, 312
  importing into SQL Database, 297–300
  iterative development cycle, 305
  layered architecture, 289–292
  sample database, building, 292–293
  sample solution stack, 289–291
  scaling, 2–3
  SQL Server Database project, creating, 295–296
  stored procedures, creating, 307–312
  table columns, adding, 300–301
  tables, creating, 305–307
  target platform, setting, 296–297
  website, creating, 321–335
  Windows Phone application, creating, 341–354
cloud storage
  browsing, 78
  Microsoft Azure Storage Account for, 35
cloud-based Microsoft Azure SQL Database. See SQL Database
CLR (Common Language Runtime), 60
clustered indexes, 61
code in the cloud, 2
codebases, 57, 63–64
collations, 31–34
columns, table
  adding, 300–301
  check constraints on, 310
  null values, 300–301
command prompt, opening, 46, 83
Common Language Runtime (CLR), 60
compatibility issues, 88–94
collations, 31–99
compatibility, 98–99
compression, 60
compute resources, 218, 234
  load distribution across, 251–259
  partitioning, 250–259
  reserving, 245
conflict resolution in data synchronization procedures, 196–200, 214–215
Connect To Server dialog, 41–42
  advanced version, 110–111
Connect to Server errors, 109–110
connected development, 294
connection pooling, 234
connection strings
  @server requirement, 58
  entity, locating, 324
  passwords in, 316
  quick-start link to, 38–39
  viewing, 38–39
connections
  dropped, 59
  faults, recovering from, 234–236
  limitations on, 58–59, 234
  managing, 234–243
connections (continued)
  monitoring with DMVs and DMFs, 277–280
  multiple pending, 58
  opening late, closing early, 234
  pooling, 234
  prevention of, 102  See also  firewall rules
  specifying database, 110–111
  throttling, 235
  Transient Fault Handling Application Block, 235–243
  transient faults, 234–243 viewing, 278, 280
  console applications, creating, 283–287
  constraints, disabling during import operations, 85
  Content Manager role, 170
  content negotiation, 230
  controllers, MVC, 321
    action methods, 326–327
    extending, 327
    Home controller, 321, 325–326
    scaffolding, 325–326
    URLs, mapping to, 321
  copy database operation, 112–115
  COUNT function, 141
  CREATE DATABASE statement, 43, 57
  CREATE DATABASE...AS COPY OF statement, 113–114
  credentials, user, 99
  CRUD actions, 336–337
  custom authentication, 170
  custom code in reports, 124
  Custom Create database creation option, 31, 33–34
  customers of cloud vendors, security responsibilities, 98–99
  CustomerShard class, 254, 256
  cyber attacks, preventing, 98

D

DACPAC (Data-tier Application Component Package)
  files, 30, 70, 80
DAL.  See data access layer (DAL)
  data
    check constraints, 310
    in cloud, 2
    formatting in reports, 162–163
    geo-replication, 71
    incremental changes and updates, 63
    referential integrity, 19
    regulatory compliance, 99
    scripting, 69
    service layer over, 27
    summarizing at database and report levels, 157
    validation rules, 307–312
  data access, 106–111, 170
    encapsulating in stored procedures, 243–244, 307–312
    with Entity Framework, 313
    over HTTP, 336
    performance, 217
    securing, 98
  data access layer (DAL)
    ADO.NET, building with, 312–313
    class library projects, creating, 314–315
    creating, 290–291, 312–321
    referencing, 323–324
    repository pattern, 314
  data aggregation with SQL Data Sync, 177
  data compression, 60
  data entry, 21–24
  data importing  See importing
  data migration, 63–86, 88–94
  data partitioning, 13, 58, 61, 250–259, 276
  data redundancy, 60–61
  data sources, report, 125, 135, 138
    creating, 139–140, 158–159
  data stores, maintaining, 63–64
  data synchronization  See SQL Data Sync; sync groups; synchronizing data
  data validation, 307–312
  database access, 12, 35–38, 106–111, 170, 307–312
  database administration, 30
    See also  SQL Database management portal
  database collations, 31–34
  database connections  See connections
  Database Copy feature, 59, 112–113
  database dynamic management views (DMVs), 275–278
  database objects
    developing, deploying, and managing, 70
    mapping to .NET objects, 217
    naming conventions, 60
    scripting, 68
    T-SQL scripts, generating for, 91–92, 94
  database queries  See queries
  database-level permissions, 108–109
  databases.  See also  on-premises SQL Server databases;
    SQL Database
    changes, discovering and replicating, 173
    changing between, 61
    configuring, 44
    connection strings  See connection strings
    copying, 112–113
    creating, 13–15, 184
    creating in Microsoft Azure portal, 31–35
    creating in PowerShell, 48–49
    creating in SSMS, 43
databases
creating with Service Management API, 283–287
current number, 265
deleting, 40, 44, 50, 77
delivery, 33–34, 44, 55–56
exporting, 115–117
firewall rules See firewall rules
fragmentation information, 276
free space, 56, 270
importing, 31, 34–35, 297–300
incremental changes and updates, 63, 191
index statistics, 276
I/O, locking, latching, and access method activity, 276
load distribution across, 251–259
local, 64–66 See also on-premises SQL Server databases
migrating to SQL Database, 63–94
mirroring, 60–61
monitoring, 263–280
new query window, 43, 65, 106–107, 109
offline management, 300
operational metrics, 265–269
page and row-count information, 276
partitioning, 13, 250–259
physical distance from applications, 243
populating, 21–24
querying, 24–26 See also queries
reporting See reporting; reports
saving data to, 22
scripting, 68 See also Transact-SQL (T-SQL)
service layer over, 307
sharding, 13, 252–254
size, 31, 33, 44, 55–58, 270, 276–278
synchronizing, 173–174 See also SQL Data Sync;
synchronizing data
transactional consistency, 112
updating, 194–195
upgrading to SQL Database Premium, 249–250
usage metrics, 265–269
varbinary(max) or image file storage, 54
waits statistics, 276
Dataset objects and data adapters, 313
datasets, data synchronization, 188–191, 215
datasets, report, 135, 138, 140–143
Data-tier Application Component Package (DACPAC) files, 30, 70, 80
Data-Tier Applications (DACs), 70, 74–77, 80
data-transfer pricing, 51
dbmanager security role, 107
deleting
data in Windows Phone 8 apps, 352
databases, 40, 44, 50, 77, 113
firewall rules, 104
tables, 81
Developer Command Prompt, 281
disaster recovery, 60–61, 97, 112–121
DMFs See dynamic management functions (DMFs)
DMVs See dynamic management views (DMVs)
DROP DATABASE statement, 44, 113
DROP TABLE statement, 81
dropped connections, 59
dynamic management functions (DMFs), 275–280
dynamic management views (DMVs), 275–280

E
EDM See Entity Data Model (EDM)
EDMX files, 223, 313
EF See Entity Framework (EF)
endpoints, VM, 131–132
entities, 318–320, 325
entity connection string, 324
Entity Data Model (EDM), 313–314
class library projects, creating, 314–315
conceptual schema, 313
creating, 315–321
data connection, 315
data source, 316
.edmx files, 313
entity classes, 318
mapping, 313, 320
metadata, 313
model contents, 315
as model in MVC applications, 323–324
navigation properties of entities, 318–319
result bindings, 319
storage schema, 313
stored procedures, 317, 319–320
tables, selecting, 317
version setting, 317
Entity Data Model (EDM) designer, 223
Entity Framework (EF), 217
Code First feature, 223–228, 313
Connection Resiliency feature, 59
conventions, 224
data access layer, building, 312–321
data context, 226–227
database first approach, 313
database initialization strategy, 224, 228
database resource consumption, 234
Entity Data Model, 313–314
performance overhead, 217
pluralization naming strategy, 224–225, 227
POCO (Plain Old CLR Object) classes, 223
Entity Framework (continued)
RESTful Web APIs, building, 218–228
schemas, mapping between, 314
sharding, 259
Transient Fault Handling Application Block and,
239–243
Visual Studio scaffolding feature and, 321
Web API controllers, adding, 226–227
Web APIs, creating, 225–228
entity models, 223–224, 230
error code 40544, 276
errors, 109–110, 235, 276, 329–330
event tables, 280
exception handling, 329–331
ExecuteAction method, 239–243
execution dynamic management views (DMVs), 278–280
execution performance, monitoring, 277–280
execution speed, optimizing, 217
Export Database feature, 115–117
Export Data-Tier Application wizard, 74–77
exporting, 35, 83–84
Automated Export feature, 120–121
BACPAC files, 115–117
export files, 120–121
extended events, 60
extended stored procedures, 60
Extensible Application Markup Language (XAML)
  binding features, 345

F
F5 key, 43
fan-out queries, 256, 259
file streaming, 60
firewall rules, 9, 12, 35–38, 48, 102–105
  See also SQL Database Firewall
  for local network access, 35–36
  quick-start link, 36
  for remote IP address access, 35–36
  report server access, 130–132
foreign-key table relationships, 65, 306, 318–319
forms-based authentication, 170
FROM clause, 140–141
Full-Text Searching (FTS), 60
fully qualified names, 134
functional partitions, 250–251

G
Generate And Publish Scripts wizard, 68–69
geographic region, 8–9
of applications, 179, 243
of cloud databases, 215
of Microsoft Azure Storage account, 71
pricing and, 51
synchronization and, 176–179
geo-replication, 52–53, 55, 71
GET requests, 326
GROUP BY clause, 140–141
GUI management tools, 261. See also Microsoft Azure
  management portal; SQL Database management
  portal; SQL Server Data Tools (SSDT); SQL Server
  Management Studio (SSMS)

H
hackers, protecting against, 99
hardware, hypervisor virtualization technology on, 2–3
high availability, 112
horizontal partitioning, 251–259
HTTP data access over, 336
HTTP requests and responses, 223, 230, 283–287, 326,
  351–352
hub databases, 174, 186
Huey, George, 86
hypervisor virtualization technology, 2–3

I
IaaS (Infrastructure as a Service), 3–4
image file storage, 54
Import Database feature, 31, 77–80, 117–119
importing
  BACPAC files, 117–119
databases, 34–35, 77–80
  nonclustered indexes, triggers, constraints, 85
  into SQL Database instance, 84–86
  with SQL Server Integration Services, 63
incremental changes and updates, 63
index partitioning, 61
index statistics, 276
Infrastructure as a Service (IaaS), 3–4
instance names of local SQL Server database, 64
instance objects, 70
Internet Explorer, 150
  See also browsers
Internet hosting, cloud computing service level, 1
IP addresses
  allowed, 12, 35
current client IP address, 104
  firewall rules for, 101–104
  learning remote addresses, 37
JavaScript Object Notation (JSON)

J

JavaScript Object Notation (JSON), 336, 338–339
Json.NET, 343–344

L

language settings, customizing, 31
latency, 9, 215, 243–244
least privilege principle, 108–109, 111
legacy systems, data migration from, 63–94
local machines, 2, 12
See also servers
local networks, enabling database access, 35–36
local SQL Server databases, 64–68, 83–84
local sync agent, 204–211
locks, monitoring, 280
logical administration, 57
login user names @server requirement, 58
loginmanager security role, 107
lookup data, client-side storage of, 244
Lucene text search engine library, 60

M

maintenance, 4, 63–64
malicious attack prevention, 98
management, 99, 261, 275–287
GUI tools for, 261 See also Microsoft Azure management portal; SQL Database management portal; SQL Server Data Tools (SSDT); SQL Server Management Studio (SSMS)
management certificates, 281–283
manual syncs, 191–196
mapping
objects, 217
between schemas, 314
stored procedures to entities, 319–320
URLs to controllers and actions, 321
master database, 102, 106–110, 134–135, 280
matrixes, report, 157, 160–161
metadata, 244, 278
Microsoft account, 5–7, 46–47
Microsoft Azure, 1–4
ASP.NET Web Application projects, deploying to, 331–333
authentication for, 281, 283
compute resources, scaling up, 218
free trial subscription, 7–8
management certificates, 281–283
preview services, 120–121, 174, 246
pricing, 7, 9, 50–54, 79
Queue storage, 244–245
scaling, 3 See also scalability
security, 99
SQL Reporting, 123–124
staying current with, 57–58
storage services for nonrelational data, 244–245
subscribing to, 7–8
Table storage, 244–245
volume purchase plan, 55
Microsoft Azure Blob Storage, 35, 54, 60, 115, 244–245
Microsoft Azure Cache, 244–245
Microsoft Azure cloud, 2–4
See also cloud computing; cloud solutions
Microsoft Azure Customer Advisory Team, 235, 259
Microsoft Azure datacenters, 2, 51, 55
Microsoft Azure Management Application Programming Interface (API), 261
Microsoft Azure management portal, 9, 31–40
BROWSE CLOUD STORAGE dialog box, 78
CONFIGURE link, 37
connection strings, obtaining, 38–39
copy database operation, monitoring, 114–115
CREATE A SQL DATABASE SERVER link, 9–10
CREATE SERVER dialog, 10–11
Custom Create database option, 33–34
database usage metrics, 265–266
databases, creating, 31–35
databases, deleting, 40, 77
databases, importing, 77–80
Export Database Settings dialog, 115–117
firewall rules, managing, 35–38, 102
IMPORT DATABASE dialog, 77–79
local agent service, configuring, 207–208
logging in, 9
main portal page, 9
MANAGE URL link, 15–16
management certificates, 281–283
Microsoft Azure Storage account, creating, 71–74
monitoring with, 264–269
publish profile for websites, 333–334
Quick Create database option, 31–33
quick-start links for databases, 36
server usage overview, 264–265
servers, creating, 9–11
SQL Data Sync configuration, 174
SQL Database management portal, accessing, 15, 192–193
SQL Database Monitor page, 267–269
SQL Database Premium, signing up for, 246–247
SQL Database Premium quota, requesting, 248
SQL Database Premium quota request status, 248–249
Microsoft Azure management portal (continued)

- SQL Database servers, list of, 102–103
- SSRS, configuring in VM, 128–130
- storage access keys, generating, 71
- SYNC link, 188
- VM endpoints, creating, 131–132
- VMs, creating, 126–128
- websites, creating, 331–334

Microsoft Azure PowerShell cmdlets, installing, 44–45

Microsoft Azure Service Dashboard, 269–270

Microsoft Azure Service Management API, 71, 281–288

Microsoft Azure services

- See services

Microsoft Azure SQL Data Sync, 173–216

Microsoft Azure SQL Database

- See SQL Database

Microsoft Azure Storage, 35, 71–80
  - browsing, 78, 117–118
  - geo-replication, 52
  - pricing, 51–52

Microsoft Azure Traffic Manager, 179–180

Microsoft Azure Trust Center, 99

Microsoft Silverlight, 15–16, 82, 183, 341, 343, 351

Microsoft Visual Studio

- See Visual Studio


migrating data, 63–94

migration wizard, 86–94

mirroring, 60–61

models, entity, 223–224, 230

Model-View-Controller (MVC) applications, 222–223, 323–331

Model-View-Controller (MVC) framework, 291–292

Model-View-Controller (MVC) websites, 321–335

Model-View-ViewModel (MVVM) pattern, 344

monitoring, 261, 263–280
  - database operations, 265–266
  - database size, 276–278
  - database usage, 265
  - dynamic management views and functions, 275–280
  - metrics, displaying, 267–269
  - with Microsoft Azure management portal, 264–269
  - Microsoft Azure Service Dashboard, 269–270
  - query performance, 271–275
  - sample database, creating, 261–263
  - server usage, 264–265
  - services health, 269–270
  - with SQL Database management portal, 270–275

MSDN subscribers, Azure pricing for, 7

multipart names for database objects, 60

nonclustered indexes, 85

nondeterministic behavior, 310

nonrelational data, 244–245

NuGet Package Manager, 235–236

  - Json.NET, downloading and adding, 344
  - numeric data, formatting in reports, 162–163

Object Explorer, 40, 42

object relational mapping (ORM), 217, 312

- See also Entity Framework (EF)

objects

- developing, deploying, and managing, 70
- mapping to .NET objects, 217
- naming conventions, 60

packing as DACPAC files, 70

T-SQL scripts, generating for, 91–92, 94

offline projects, 294

online transactional processing (OLTP), 178–179

on-premises SQL Server databases, 64–66. See also databases

- abstraction levels, 3
  - BACPAC files, creating, 34–35
- instances, 1
- latency, 243

migrating to SQL Database, 63–94

mirroring, 60–61

nonrelational and binary data in, 244

size, calculating, 51

sync agent, registering with, 209–211

sync group, adding to, 211–214

synchronizing, 174–176, 202–215. See also synchronizing data

on-premises SQL Server servers, 2

- See also servers

ORM (object relational mapping), 217, 312

N

naming conventions for database objects, 60

navigation properties of entities, 318–319

.NET Framework 3.5, 153

network bandwidth fees, 9, 51–53, 79

network latency, reducing, 243–244

network round trips, minimizing, 243–244

network traffic, reducing, 244

new query window, 43, 65, 106–107, 109

Newtonsoft.Json assembly, 336, 343–344

  - importing namespace for, 350–351

nonclustered indexes, 85

nondeterministic behavior, 310

nonrelational data, 244–245

ORM (object relational mapping), 217, 312

O

Object Explorer, 40, 42

object relational mapping (ORM), 217, 312

- See also Entity Framework (EF)

objects

- developing, deploying, and managing, 70
- mapping to .NET objects, 217
- naming conventions, 60

packing as DACPAC files, 70

T-SQL scripts, generating for, 91–92, 94

offline projects, 294

online transactional processing (OLTP), 178–179

on-premises SQL Server databases, 64–66. See also databases

- abstraction levels, 3
  - BACPAC files, creating, 34–35
- instances, 1
- latency, 243

migrating to SQL Database, 63–94

mirroring, 60–61

nonrelational and binary data in, 244

size, calculating, 51

sync agent, registering with, 209–211

sync group, adding to, 211–214

synchronizing, 174–176, 202–215. See also synchronizing data

on-premises SQL Server servers, 2

- See also servers

ORM (object relational mapping), 217, 312

N
PaaS (Platform as a Service)

P

PaaS (Platform as a Service), 4, 218
partitioning data, 58, 61, 250–259
  page and row-count information, 276
sharding, 13, 251–259
password policy, 107
passwords in connection strings, 316
performance
  in the cloud, 218
  of cloud reporting, 124
  of data access, 217
database connections overhead, 234
latency, reducing, 243–244
optimizing and tuning, 217, 244–245
of queries, 245, 271–275
permissions, 108–111, 170
physical administration, 57
physical data centers, 98, 99
physical storage with PaaS, 4
Plain Old CLR Object (POCO) classes, 223–224, 230
Platform as a Service (PaaS), 4, 218
port 80, 130–132
port 1433, 58
port allocation, 58
POST requests, 326, 352
PowerShell, 44–50
  administrator credentials, 48
  -Collation switch, 49
configuring for Microsoft account, 46–47
context associated with server and credentials, 48
database collation, changing, 49
database edition, changing, 49
database size, changing, 49
databases, creating, 48–49
databases, deleting, 50
databases, viewing, 49
-Edition switch, 49
firewall rules, creating, 48
-Force switch, 50
management, automating, 281
master databases, 49
-MaxSizeGb switch, 49
server access, 47–48
servers, creating, 47–48
PowerShell Integrated Scripting Environment (ISE), 46
PowerShell Microsoft Azure cmdlets, 44–45, 48, 49
Premium edition of SQL Database, 58, 245–250
preview release software, 120–121, 174, 246
pricing for Microsoft Azure
  bandwidth, 9, 51–53, 79
  Blob Storage, 54
data transfer, 51
file storage, 54
geographic location and bandwidth pricing, 51
online pricing calculator, 50
pricing structures, 7
storage, 50–51
storage space, 51–52
support plans, 53–54
primary keys, 67
primary transactional database, replicating, 178–179
privacy, 98–99
public cloud platforms See Microsoft Azure
public cloud vendors
  auditing services, 99
  compliance certifications, 99
  hackers, protecting against, 99
  malicious attack prevention, 98
  multitenancy management, 98
  security responsibilities, 98–99
publish process, 301–303, 312
.Publishsettings file, 47
PUT requests, 352
Q
queries, 24–26
  editing, 273
  encapsulating, 27, 243–244
error code 40544, 276
  execution plans, 273–275
  fan-out, 256, 259
  memory grants, 278
  optimizing, 245
  performance, 271–275
  query plan details, 272–273
  query plans, cached, 278
  query plans, showing, 278
  running, 193–194
  in stored procedures, 141, 243–244
query code, 140–141, 157
query filters, 25–26
Queue storage, 244–245
Quick Create database creation option, 31–33
quick-start links, 36, 38–39
R
RDL authoring tools, 125
.rd1 files, 169
.rdp files, 128
read-only permissions, 108–111
records, aging policies, 56
Red-Gate Data Compare, 63
Red-Gate SQL Compare, 63
redundancy, data, 60–61
reference databases, 174, 184, 186–187
referential integrity of data, 19
regulatory requirements, complying with, 99
relational data, storage in SQL Database, 244–245
relational databases, 250
   See also databases; SQL Database
reliability, 217, 234–244
Remote Desktop sessions, 128
remote IP addresses, enabling database access, 37–38
replication, 61
Report Builder, 123, 125
   browser, running report from, 149–150, 168–169
data sources for reports, 138–140
datasets for reports, 138, 140–143
date and time of report execution, 138
Getting Started dialog, 137
images, adding to reports, 139
installing, 135–137
launching, 137
layout of report, 143–145
matrix control, 138–139
previewing reports, 135, 145–147
Report Data pane, 138–139
report parameters, defining, 139
reports, creating, 137–150
reports, saving and running locally, 145–147
Row Groups and Column Groups panes, 139
SSRS, deploying reports to, 147–149
table control, 138–139
user interface, 138
Report Definition Language (RDL), 123
Report Designer, formatting data, 162–163
Report Manager, 130, 149, 170
report server, 124, 130–132
Report Server Database Configuration Wizard, 129–130
Report Server Project Wizard, 158–162
Report Server projects, 150–169
reporting, 123–171
   Report Builder, 135–150
   requests, performance impact of, 179
   sample database, creating, 132–135
   security of reports, 170
   service URL, 149
   virtual directory, creating, 129
   Visual Studio Report Server projects, 150–169
   VM, creating, 125–132
   VM, shutting down, 171
Reporting Services. See SQL Server Reporting Services (SSRS)
reports
   bar charts, 164–166
   creating with Report Builder, 137–150
   creating with Visual Studio, 156–162
data source, 125, 135, 138–140, 158–159
dataset, 125, 135, 138, 140–143
date and time of execution, 138
deploying to SSRS, 135, 147–149, 166–168
   drill-down capabilities, 163
   executing, 146
   formatting, 162–163
   layout, 125, 135, 143–145
   matrixes in, 157, 160
   previewing, 145–147, 163
   queries, defining, 159–160
   RDL format, 125
   running from browser, 149–150, 168–169
   running locally, 145–146
   saving, 145
   security, 170
   summarizing data in, 157
title, 143
   user role assignment, 170
repository pattern, 314
requests. See HTTP requests and responses
   monitoring with DMVs and DMFs, 277–280
Resource Governor, 61
REST services, 336
RESTful Web APIs, 218–228
restore database operations, 117–119
RetryPolicy class ExecuteAction method, 239–243
round trips, minimizing, 243–244
routings, 179
   in MVC applications, 321
S
SaaS (Software as a Service), 4, 289
scalability, 2–4, 218, 245–250
   functional partitions, 250–251
   OLTP activity, separating from reporting activity, 184
   partitioning for, 58
   sharding, 251–259
   synchronizing between multiple locations, 178–179
SCC (source code control), 294–295
schemas, 156, 313
   changing before migration, 80
   compare operations, 301–303
   deploying to SQL Database, 91, 94
   mapping, 313–314
schemas (continued)
migrating, 77–83
referencing objects in, 60
scripting, 69
storage, 313
searching, 60
security, 97–121, 170, 216
firewall, 101–105 See also SQL Database Firewall
users, authenticating and authorizing, 99, 105–111
server certificates, 61
server logins, 105–107
server-level permissions, 107–108
server-level principals, 106–107
server-level security roles, 107–108
servers, 2, 8–12, 47–49, 183
accessibility to cloud services, 10
authentication method, 41
firewall settings, 12, 35–38, 102, 103 See also firewall rules; SQL Database Firewall
fully qualified names, 41
geographic region, 8–9
health, monitoring, 263–280
instance names, 64
physical access, securing, 98
PowerShell access, 47–48
usage, viewing, 264–265
Service Broker, 61
service levels, 3
Service Management API, 281–288
service outages, 269
services, 2–4
Agent service, 59
Allowed Services list, 105
asynchronous service calls, 351
auditing, 99
Browser Service, 59
Cache service, 244–245
client agent service, 204
data center regions, 243
geographic region, 8–9
health, monitoring, 261, 269–270
local agent service, 207–208
Microsoft Azure services, 105, 120–121, 174, 244–246
multitenant, 98
outages, 269
reporting See SQL Server Reporting Services (SSRS)
REST services, 336
Service Broker, 61
Service Management API, 281–288
SQL Server Integration Services, 63
Web API services, 336–341
sessions, monitoring with DMVs and DMFs, 277–280
Shard class, 254–256
sharding, 13, 251–259
ShardRoot class, 254
Software as a Service (SaaS), 4, 289
source code control (SCC), 294–295
spoke databases, 174
SQL Data Sync, 61, 173–216
automated sync schedules, 200–202
best practices, 215–216
clients, 174
conflict resolution, 196–200
direction settings, 187
exporting data from SQL Server to SQL Database, 175
importing data from SQL Database to SQL Server, 175–176
incremental change tracking, 191
manual syncs, 191–196
multiple cloud databases, synchronizing, 178–180
multiple locations, sharing data between, 176–177
one-way and two-way synchronization, 174
performance, 215
reference databases, 174
sample database, creating, 180–182
security measures, 216
SQL Server on-premises database, creating, 202–203
sync agents, 204–215
sync groups, 174, 182–188
sync rules, 188–191
Traffic Manager and, 179–180
SQL Database, 1
applications, co-locating with, 55
Automated Export feature, 120–121
backing up, 112–121
Business edition, 55, 58
communication port, 58
cost-related items, 50–56
database connections, managing, 234–243
distributions, switching between, 13
exporting data See exporting firewall rules See firewall rules Generally Available features, 120
high-availability features, 112
importing, 297–300 See also importing Microsoft account, 5–7
Microsoft Azure subscription, 7–8
migrating databases to, 63–94
SQL Database (continued)
monitoring health and usage, 263–280
monthly charges, 56
networking requirements, 101
online pricing calculator, 50
as PaaS solution, 4
performance, 244–245 See also performance
port number, 42
Premium edition, 55, 58, 249–250
Preview features, 120–121
pricing, 50–56, 215
SaaS solutions, 4
scaling up, 245–250
scripts compatible with, 69
securing, 100–111 See also security
signing up for, 5–8
size limitations, 57–58
sizes, switching between, 13
SQL Service Database projects, deploying to,
301–304, 312
synchronization See SQL Data Sync; synchronizing
data
unsupported features, 59–61
upgrading to SQL Database Premium, 249–250
Web edition, 31, 55, 58
SQL Database APIs, 281
SQL Database Firewall, 101–105, 184
See also firewall rules
SQL Database instances, 13–30, 100–101
BACPAC files, importing, 77–80
importing data into, 84–86
naming, 79
server for hosting, 79
SQL Database management portal, 15–17
accessing from Microsoft Azure portal, 192–193
ad-hoc query window, 24–25
connections and sessions, monitoring, 279–280
data entry, 21–24
database administration features, 30
database size, checking, 277–278
database summary page, 270–271
dropping and re-creating databases, 82
foreign-key designer, 20
logging in, 16, 82
monitoring performance and usage with, 270–275
Query Performance page, 271–272
Query Plan Details area, 272–273
stored procedures, creating, 27–29
Summary view, 17
table designer, 18–20
T-SQL scripts, executing, 70
views, creating, 27
SQL Database Management REST API, 105
SQL Database Migration Wizard, 87–94
See also migrating data
SQL Database servers
See also servers
AdventureWorks database, deploying to, 153
Allow Windows Azure Services To Access The Server
option, 11, 105
connecting to using SQL Database Migration
Wizard, 91–92
databases, deleting from, 77
master database, 106
permissions, 107–109
SQL Database Premium quota, adding, 248
SQL Database Service Dashboard, 270
SQL Data-Tier Applications, 70, 74–77, 80
SQL Server, 1
See also on-premises SQL Server databases
exporting data, 175
Express edition, 58, 64
Express With Advanced Services edition, 126
hosting in Azure virtual machines, 3, 60–61
importing data, 175–176
vs. SQL Database, 3–4, 57–62
synchronization service, 174 See also SQL Data Sync
SQL Server Authentication, 41, 105
SQL Server Bulk Copy (bcp), 80–86, 153
SQL Server Data Tools For Visual Studio 2012, 158
SQL Server Data Tools (SSDT), 41, 151
BACPAC file import restrictions, 80
bi-directional editing, 300–301
Business Intelligence add-in for Visual Studio, 123
Business Intelligence project templates, installing,
151, 154–156
connected development, 294
DACPAC files, defining and deploying, 30
dACPAC files, importing into, 80
database projects, testing, 295
databases, creating, 180–182, 292–293
disconnected development, 294
table designer, 300–301
T-SQL scripts, building and running, 64
SQL Server Database projects
creating, 295–296
database definition, 295
dbo folder, 300
deploying, 301–305, 312
importing from SQL Database, 297–300
offline changes, 305
target platform, setting, 296–297
SQL Server instances, 65–66, 202–203
SQL Server Integration Services (SSIS), 63
SQL Server Integration Services (SSIS)
SQL Server Management Objects (SMO)

SQL Server Management Objects (SMO), 40–41
SQL Server Management Studio (SSMS), 40–44
advanced Connect to Server dialog, 110–111
Connect To Server dialog, 41–42, 64–65
database, 41–42, 64–65
Database Engine, connecting to, 110
databases, configuring, 44
databases, creating, 43
databases, deleting, 44
downloading, 40
exporting Data-Tier Applications, 74–77
fully qualified server names, 38, 41
Generate And Publish Scripts wizard, 68
graphical designers and dialogs support, 40–41
launching, 41, 65, 134
new query window, 43, 65
Object Explorer, 40
server logins, creating, 106–107
sharded databases, creating, 252–254
SQL Database, connecting to, 41–42
t-SQL scripts, generating automatically, 68–70
t-SQL scripts, running, 65
t-SQL scripts, viewing, 69–70
SQL Server Object Explorer, 304
SQL Server Reporting Services (SSRS), 3, 123–124
authentication of users and applications, 170
Configuration Manager, 128–129
configuring in virtual machine, 128–130
database, creating, 129–130
deploying reports to, 147–149
formatting capabilities, 150
free version, 126
Report Manager, running reports from, 149–150
Report Manager virtual directory, 129–130
security in, 170
Visual Studio as authoring tool, 151
VM SSRS service URL, 166–167
VM to host, creating, 125–132
.sqlexpress instance name, 64
SSDT See SQL Server Data Tools (SSDT)
SSMS See SQL Server Management Studio (SSMS)
SSRS See SQL Server Reporting Services (SSRS)
SSRS-in-a-VM solutions, 124
statements result set metadata, 278
storage, 50–51, 244
See also Microsoft Azure Storage
stored procedures, 27–29, 60, 243–244, 307–312
mapping to entities, 319–320
performance statistics, 278
queries in, 141
system, 61
testing, 29–30
strong password policy, 107
sync agents, 204–215
sync groups, 174, 182–189, 192
conflict resolution behavior, 174, 196–200, 214–215
on-premises SQL Server databases, adding, 211–214
ready status, 187, 191
scheduling syncs, 200–202, 215
sync loops, 215
sync rules, 188–191
sync rules, 188–191
synchronizing data, 215
automated schedules, 200–202
conflict resolution, 196–200
costs, 179
dataset, defining, 188–191
direction settings, 187
exporting data from SQL Server to SQL Database, 175
importing data from SQL Database to SQL Server, 175–176
manual, 191–196
multiple locations, sharing data between, 176–177
one-way and two-way, 174–177
with SQL Data Sync, 61, 173 See also SQL Data Sync
sync agents, creating, 204–215
sync groups, creating, 182–188
sync rules, creating, 188–191
testing, 195–196
sys.database_connection_stats view, 80
sys.dm_database_copies view, 114
sys.event_log view, 280
system stored procedures, 61

T

table partitioning  See partitioning data
table storage, 244–245
tables, 17–19, 30, 305–307
access control, 307–312
aggregating rows, 141
aliasing, 140–141
change tracking, 191
check constraints on, 310
clustering indexes, 61
columns, adding, 18, 300–301
data, inserting, 21–24, 67–68
deleting, 81–82
foreign keys, 19, 22–23, 306
ID primary key column, 18
Is Identity? option, 18, 21
joining, 24–26, 140–141
migrating data into and out of, 83–86
tables (continued)
  NULL values, 22
  partitioning, 251–259
  populating using T-SQL script, 67–68
  primary keys, 21–22
  relationships between, defining, 19–20
  scripting, 68
  service layer over, 307
  updating, 304
  validation rules, 307–312
  table-valued parameters, batching, 244
  tabular data stream (TDS), 57
  Task Parallel Library, 256, 259
  TCP port 80, 130–132
  TCP port 1433, 58
  tenants of cloud vendors, privacy from, 98
  text search engine library, 60
  throttling, 235
  Traffic Manager, 179–180
  transaction dynamic management views (DMVs), 280
  transactional consistency, 59, 112, 120–121
Transact-SQL (T-SQL)
  change scripts, 301, 303
  FROM clause, 24, 26
  CREATE DATABASE statement, 43
  data migration with, 64–70
  database engine type property, 69
  for database queries, 24
  databases, creating, 180–181, 219–221, 292
  DROP TABLE statement, 81
  editing, 300–301
  EXEC statements, 29
  executing, 43
  foreign-key table relationships, 65
  generating automatically, 68–70
  IDENTITY_INSERT setting, 67
  left outer joins, 24, 26, 28
  local SQL Server database, creating, 65
  populating local databases, 67–68
  query filters, 25–26
  Remove-AzureSqlDatabase cmdlet, 50
  reporting, preparing databases for, 133
  role assignment management, 107–108
  server logins, creating, 107
  sharded databases, 252
  SQL Database support, 57
  SQL Database use of, 60
  types of data property, 69
  user management, 107–108
  WHERE clause, 25–26
  transient connection faults, 234–235, 237–243
  transient error conditions, 239–243
  Transient Fault Handling Application Block, 59, 235–243
  Transparent Data Encryption (TDE), 61
  triggers, 85, 278, 310
  tuning queries, 245
  two-part names for database objects, 60
  two-way synchronization, 176–177

U
unstructured data, 60, 244–245
UPDATE statement, 194–195
URLs
  managing, 15–16
  mapping to controllers and actions, 321
  usage, monitoring, 263–280
  USE statement, 61, 135
users
  authenticating and authorizing, 105–111
  Browser role, 170
  Content Manager role, 170
  creating, 108
  routing to closest data center, 179–180
  security credentials, 99

V
validation, data, 307–312
varbinary(max) file storage, 54
vendors, security responsibilities, 98–99
views, database, 27
views, dynamic management (DMVs), 275–280
views (in MVC applications), 321, 327–328
virtual machines (VMs), 60–61, 126–132
  globally unique name, 147
  with IaaS, 3
  saving reports to, 148
  shutting down, 128, 171
  SSRS service URL, 166–167
virtual private networks (VPNs), 60–61
virtualization layer, 2–3
Visual Studio
  Add Scaffold dialog, 325
  ASP.NET Web Application project type, 222–223
  bi-directional editing, 300–301
  Business Intelligence Developer Studio version, 151
  console applications, creating, 286–287
  Data Tools Operations window, 303
  database definitions, maintaining in, 295
  databases, creating, 180–182
  Dataset designer, 313
  EDM designer, 223, 313, 318
Visual Studio (continued)

Entity Data Model, creating, 315–321
importing databases into database projects, 297–300
Mapping Details window, 320
NuGet package manager, 235–236
publishing databases, 301–303
references, adding, 323
scaffolding feature, 321, 325, 336–337
Solution Explorer, viewing, 222
solutions, building, 226, 228
solutions, creating, 221–222, 294–295
source code control, 294–295
SQL Server Database projects, creating, 295–296
SQL Server Object Explorer, 304
SSDT Business Intelligence add-in, 123
SSDT Business Intelligence project templates, installing, 151, 154–156
stored procedures, creating, 310–312
tables, creating, 30
target platform for database projects, setting, 296–297
Views folder, 327
Web API projects, creating, 222–223
Web API projects, deploying, 334–335, 340–341
Windows Phone apps, creating, 343
Windows Phone apps, testing, 353–354
Windows Phone SDK, 341–342
Visual Studio Report Server projects, 150–169
See also reporting; reports
AdventureWorks database, installing, 151–154
bar charts, adding to reports, 164–166
creating reports, 156–162
data sources, creating, 158–159
deploying, 150–169
designing, 150–169
formatting reports, 162–163
previewing reports, 163
project properties, 166–167
queries, defining, 159–160
Report Manager home page, 168
Report Server Project Wizard, 158–162
running reports from browser, 168–169
with SSDT Business Intelligence add-in, 125
SSDT Business Intelligence project templates, installing, 151, 154–156
VM SSRS service URL, 166–167

W

waits statistics, 276
Web API services, 336–341
Web APIs
  connection strings, setting, 227
  content negotiation, 230
  controllers, adding, 226–227, 230–233
  creating, 222–223, 225–228, 321–323
  data access layer, referencing, 323–324
  deploying from Visual Studio, 334–335
  deploying to Microsoft Azure, 331–335
  entity connection string, 324
  exception handling, 329–331
  model class, adding, 225
  referencing data access layer project, 323
  referencing MVC and Web API assemblies, 322–323
  RESTful Web APIs, building, 218–228
  sample database, creating, 219–221
  scaffolds, 226
  services, defining in, 336
  sharding with, 254–259
  testing, 228–230, 233, 328–331
  Transient Fault Handling Application Block, adding, 235–236
  user interface, creating, 324–328
Web (Basic) edition of SQL Database, 31, 55, 58
web services, creating, 336–341
Web.config file, copying into entity connection string, 324
websites, 4, 321–335
whatismyipaddress.com, 37
Windows authentication, 58, 105
Windows Azure, 2
Windows Firewall With Advanced Security, 130
Windows Integrated authentication, 170
Windows Live ID, 5
Windows Phone 8 apps, 341–345
Windows Phone Databound App template, 344
Windows Phone SDK, installing, 341–342
Windows PowerShell See PowerShell

X

X.509 v3 certificates, creating, 281
XAML binding features, 345
XML, SQL Database support, 61
xml data type, 61