

Windows Azure – a Developer's Intro

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An Intertech Course ▶▶

Welcome to the Windows Azure UG

- Jim White – jwhite@intertech.com
- Intertech Instructor & Director of Training
- Practice lead for Cloud Computing at Intertech
 - Windows Azure Bootcamp Facilitator
 - Author of Windows® Azure™ Solutions with Microsoft® Visual Studio® 2010 – in Microsoft Courseware Library this October

Presentation available today.
See www.intertech.com/blog



Agenda

- Introduce Windows Azure
- Learn Why Windows Azure
- Explore what you need to work in Windows Azure
- Examine the Windows Azure Architecture
- See Windows Azure code (Web & Worker Roles)
- Look at Windows Azure data (Azure Storage & SQL Azure)
- Understand the costs of Windows Azure.

Available On Line

- After today, just follow the link provided on www.intertech.com/blog to download the slides.
- Send me an email if you really want the demo code.

Informal Survey

- How many of you...
 - Have .NET developer experience
 - Have been to the *Microsoft Windows Azure Web Site*
 - Have started looking at the *Windows Azure API*
 - Have created a small demo Azure application
 - Are working on an Azure application
 - Have Azure in production (or near production)

Hello World

- No technology would be complete without a hello world style demo.
- Let's do that to let you see Azure, but at the same time...
 - Compare a "normal" ASP.NET Web application to an Azure Web application.
 - See a bit of the Windows Azure SDK
 - See a bit of the Windows Azure Developer Portal
- We'll revisit each in more detail later.

Why Azure – Reasons for moving to Azure

■ Availability

- Azure is always up
- Its easy to set up (prototyping, rapid development, etc.)



■ Monetarily

- To save money – cheaper implementation
- To create money – faster to market
- Op Ex vs. Cap Ex

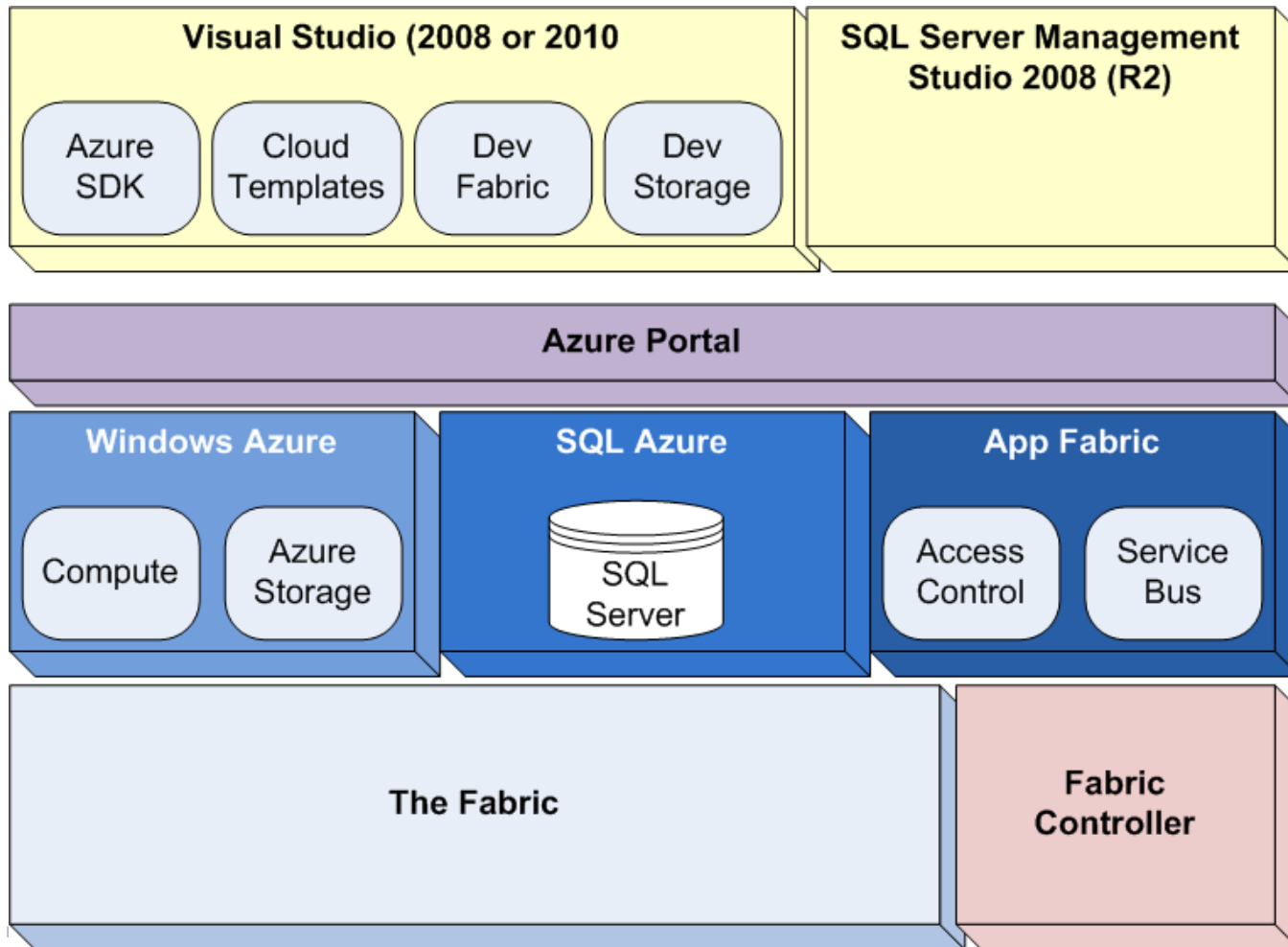
■ Scalability

- Scale up or down as your needs change
- Pay as you go model
- Pay for use not capacity

Why Azure (cont.)

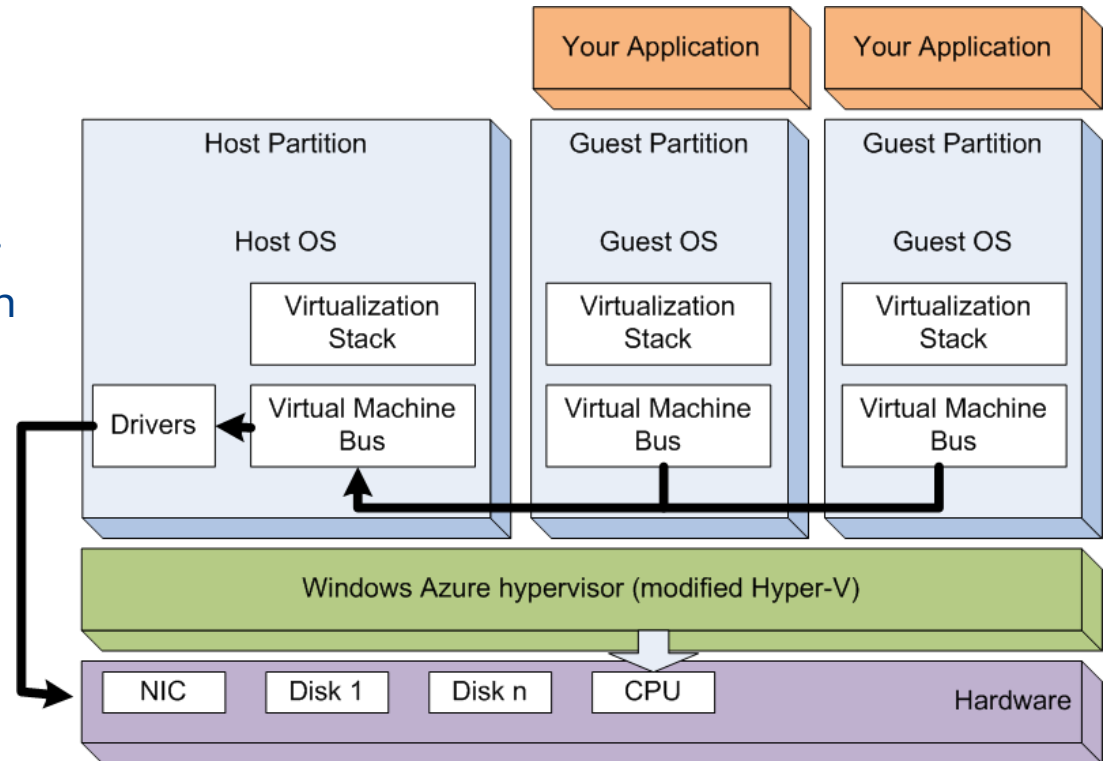
- Manageability
 - Let Microsoft wrestle with servers, networks, routers, OS, upgrades
 - Let Microsoft deal with outages, hardware replacement
 - Focus on what you do best
- Familiarity
 - Its based on Windows, .NET, SQL Server, etc.
 - You have a large investment in these technologies
 - You can migrate existing apps/data to the cloud easier
- Geographical Disbursement
 - Putting apps/data closer to customers (faster)
 - Adding to apps/data availability

Windows Azure Platform



Inside the MSFT Cloud

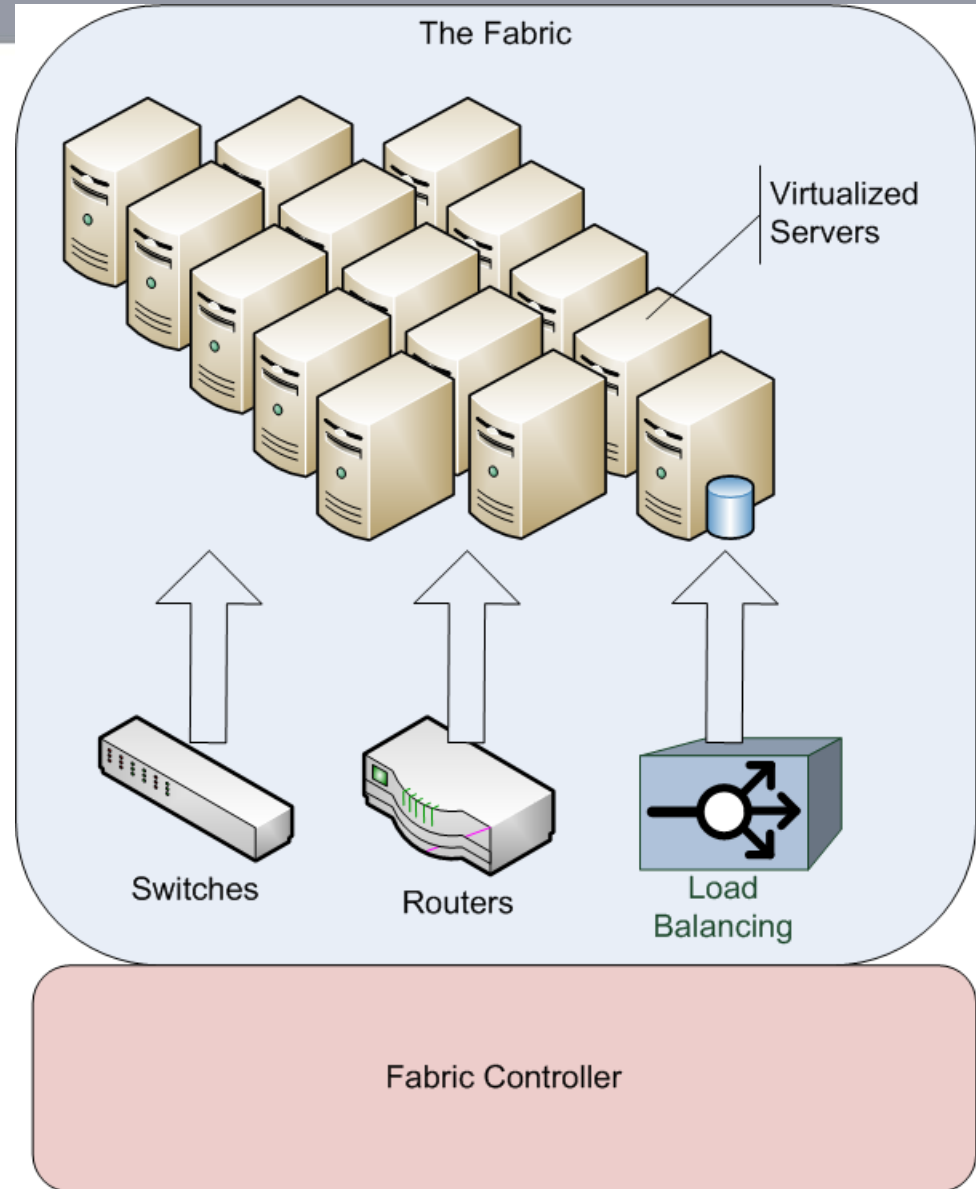
- Microsoft has > 12 data centers across the world.
 - Not all of them run Azure.
 - Exact number and location are not advertised.
- Chicago Data Center has ~360,000 servers.
 - On each server:
 - 1.5 to 1.7GHz CPU
 - ~1.7GB of RAM
 - Modified Hyper-V



Hypervisor allows machine resources in the data center to be shared. It manages and controls the virtual machine/partition running on the physical server.

The Fabric

- A lot of other hardware exists in the data centers.
 - Load balancers
 - Switches
 - Routers
 - ...
- Collectively ...
 - Physical and virtual servers
 - Supporting hardware
 - Supporting software
- ...are known as the *Azure Fabric*.



The Fabric Controller

- The Fabric Controller is *the “brains”* of Windows Azure.
 - Controls the hardware, software and just about everything in the Microsoft cloud.
 - Manages the physical deployment of your hosted services and data into the virtualized environment.
 - Monitors the hardware, software and your services and takes corrective action when any fail.



Developing Windows Azure Applications

- Most use Visual Studio (VS)
 - Visual Studio 2010 or 2008
 - Visual Web Developer Express 2010 or 2008
 - VS 2008 or Express 2008 requires upgrade to Service Pack 1.
- Additionally, you should have the Windows Azure Tools (WAT) for Microsoft Visual Studio.
 - Allows VS to create, configure, build, debug, test, package and deploy services in Windows Azure.
 - The current version of the WAT is 1.2.
 - WAT includes the Windows Azure SDK

Windows Azure SDK

- WAT for VS includes the Windows Azure SDK.
- The SDK is what really provides the APIs, tools, documentation, and samples needed to develop Windows Azure applications.
 - The SDK contains the Dev Fabric and Dev Storage
 - These allow you to test Windows Azure applications locally.
 - You can use the SDK independent of VS.

*There is even a
WAT for Eclipse*

Supported Azure Environments

- Windows Azure applications run in .NET 3.5 or .NET 4.0 environments
 - Your dev machine must also have .NET 3.5 or 4.0.
- Azure SDK (and WAT) are supported on...
 - Windows 7
 - Windows Server 2008
 - Windows Server 2008 R2
 - and Windows Vista
 - Some of the supported OS may need service pack upgrades or other software.

Additional Requirements

- Additionally, your dev box must have:
 - IIS 7.0 (with ASP.NET, WCF HTTP Activation, Static Content, and optionally CGI).
 - SQL Server
 - Microsoft SQL Server Express 2008
 - Microsoft SQL Server Express 2005
 - Microsoft SQL Server 2008
 - Additional service packs or Hotfixes may be required depending on your environment.
 - See the WAT or SDK download pages for more details.

Dev Fabric and Dev Storage

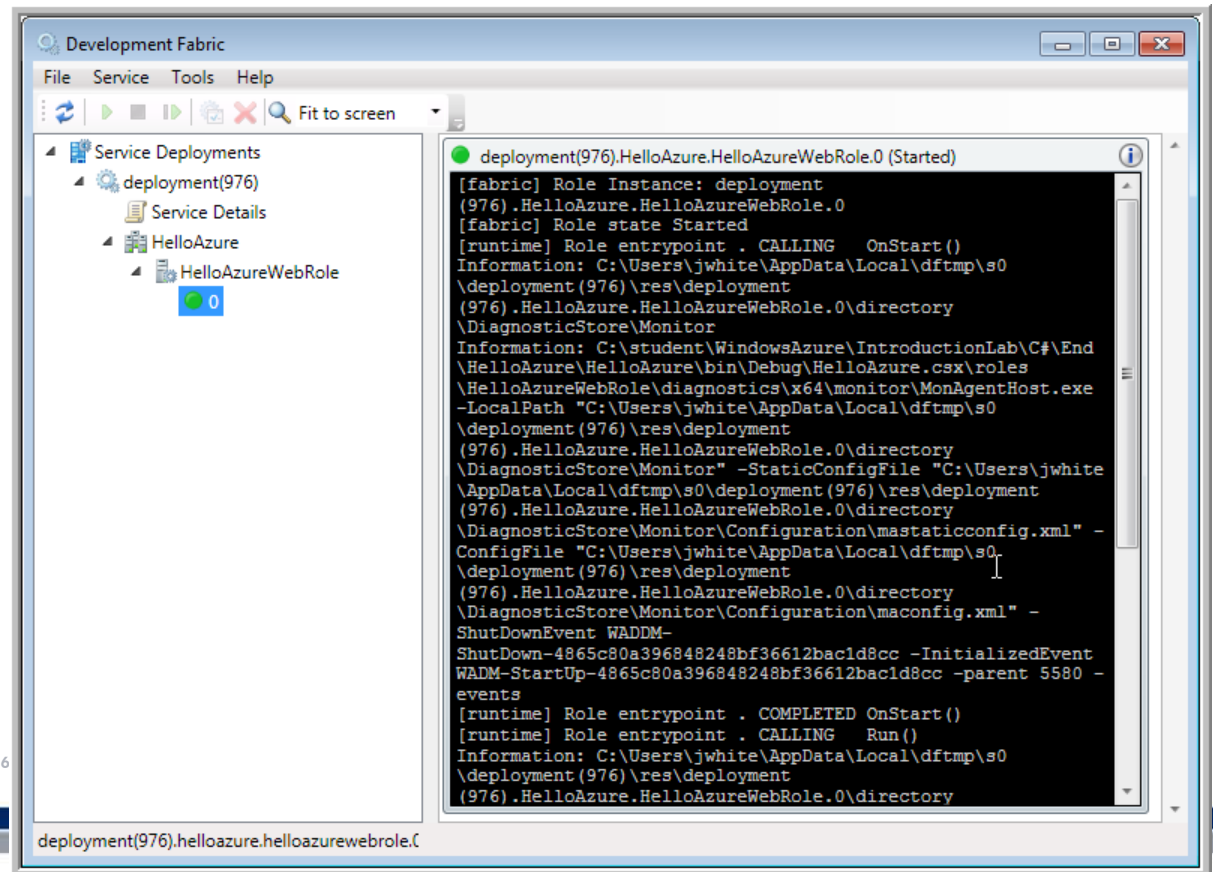
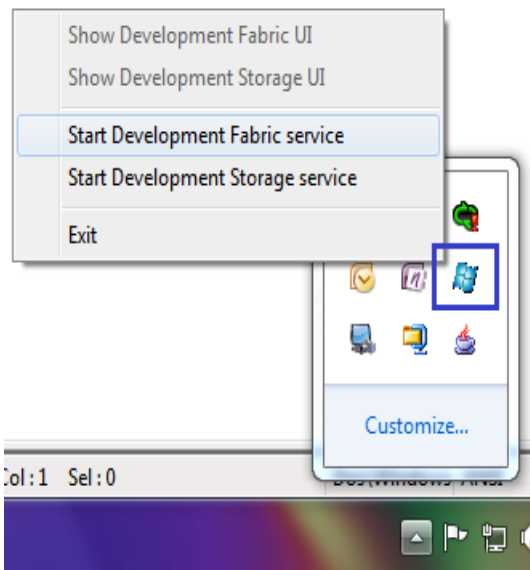
- You write Windows Azure code in a fashion similar to writing other .NET applications.
 - Ultimately, code runs on a virtual server in a Microsoft data center.
 - You don't run a hypervisor and virtualized environment on your development box.
 - Development Fabric and Storage provide a local cloud simulation environment for testing.
 - Dev Fabric and Dev Storage are part of the Windows Azure SDK (and so too WAT).

Dev Fabric/Storage – How's

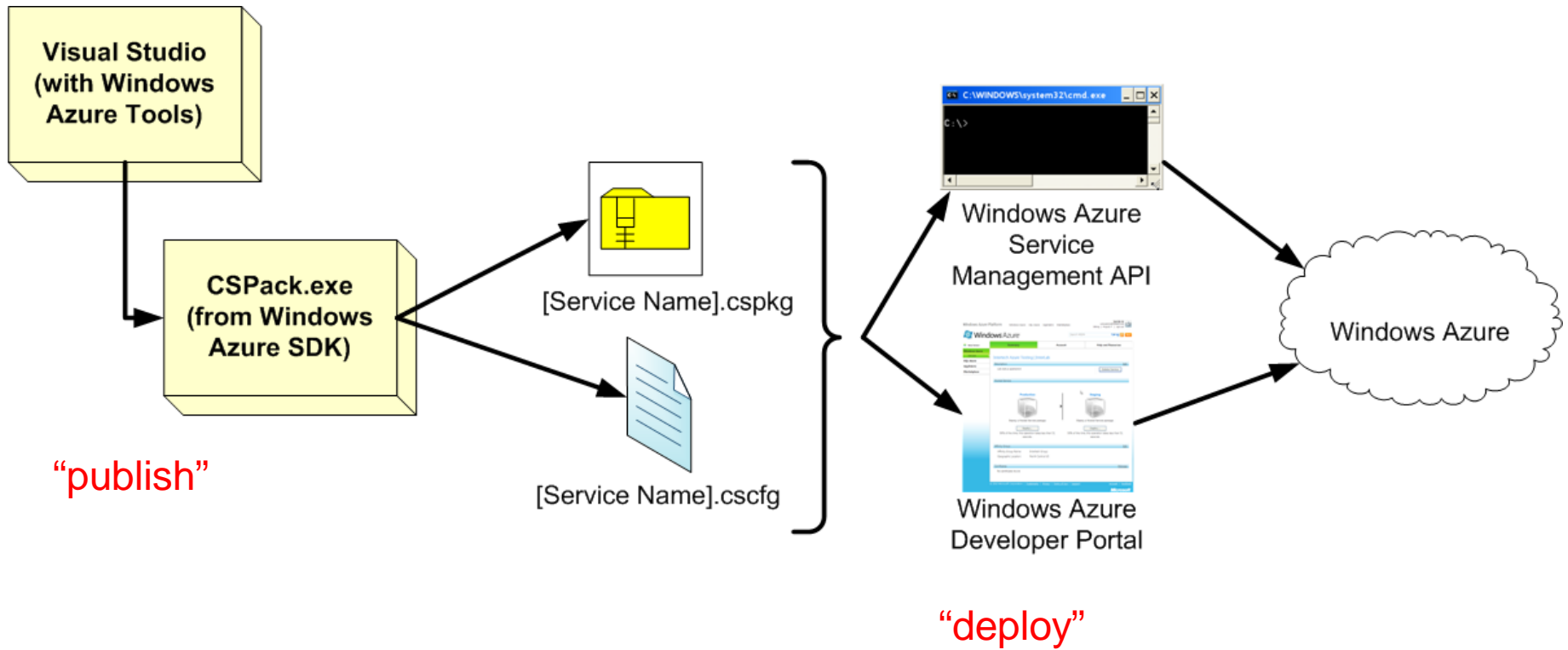
- Dev Fabric uses processes to simulate virtual machines.
 - The Dev Fabric is started when you create a Windows Azure project and Debug (press F5) in VS.
 - The Dev Fabric is based on 90% of the real Fabric.
 - Dev Fabric *does not check* whether code can run in the cloud.
 - In most cases, performance will also be better in the cloud.
- Dev Storage simulates the Azure Storage services using local SQL Server instance.

Dev Fabric UI

- The Dev Fabric icon appears in the system tray of your system when the Dev Fabric is running.

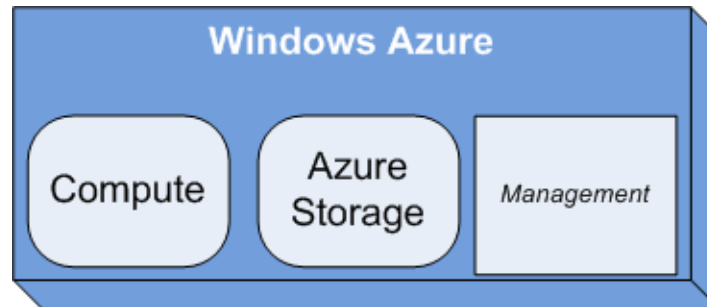


Publish/Deploying to the Cloud



Windows Azure

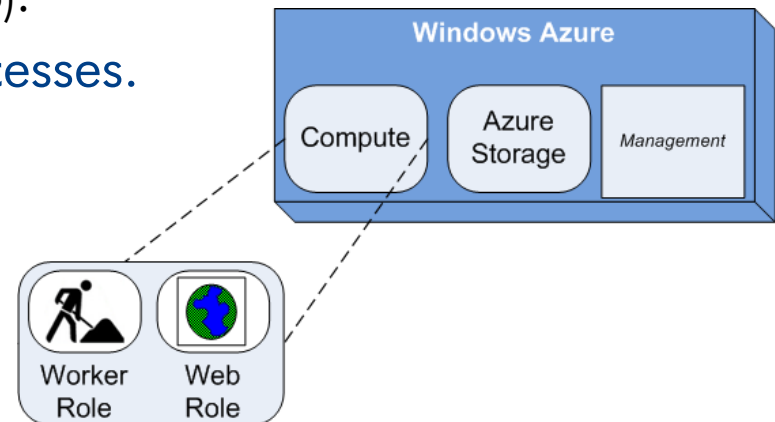
- Windows Azure is the core of the platform.
 - Microsoft calls Windows Azure the operating system for the cloud.
 - Windows Azure consists of three “services”: Compute, Storage and Management.



Windows Azure Compute

- Applications run in Windows Azure Compute
 - Consist of one or more components or services known as *Hosted Services*.
- Two types of components in Hosted Services.
 - *Web roles* and *worker roles*.
 - Web roles are Web applications.
 - Runtime includes a Web server (IIS).
 - Worker roles are background processes.

Hello World was
a Web Role

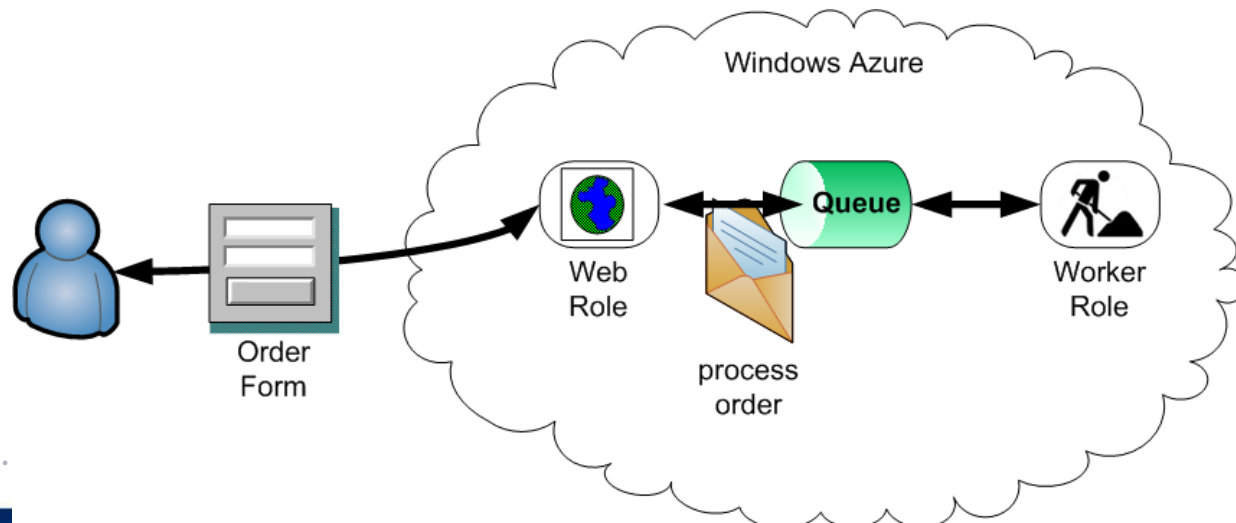


Roles and Role Instances

- When deployed, the Fabric Controller assigns each role its own guest partition (virtual machine).
 - Through configuration, you can request multiple instances of roles be created.
 - Each role instance gets its own guest partition in the Fabric.
 - If they fail, the Fabric Controller restarts them automatically (maybe on a different server).
- Multiple instances provide extra processing power and failover capability, but at additional cost.

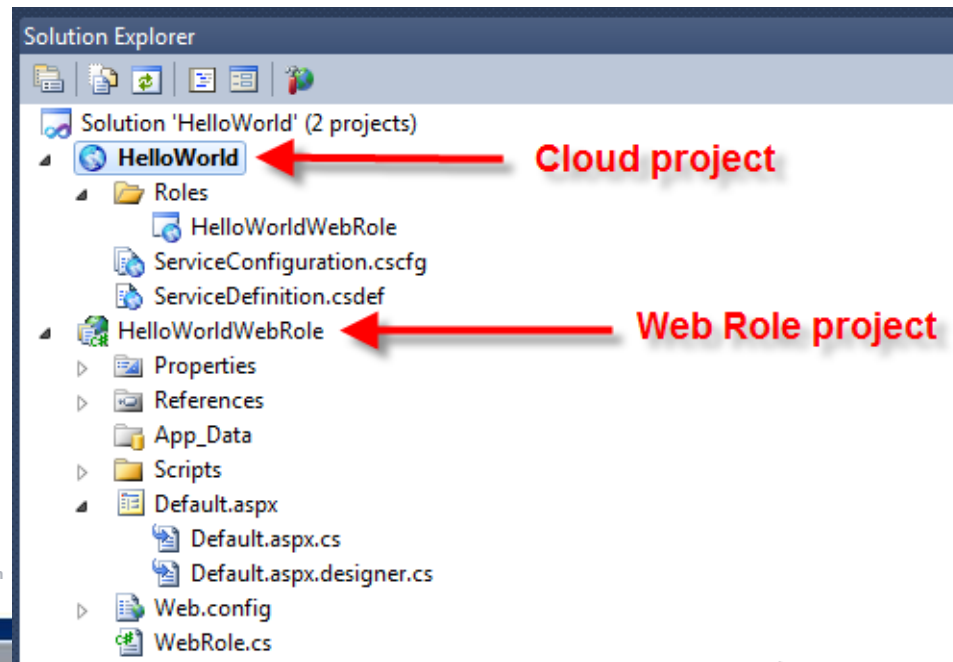
Many Roles make up an “Application”

- Many applications use both types of roles.
 - Users interact with a Web role.
 - Web roles then request worker roles to provide batch processing on the data provided by users.
 - Roles can communicate directly with each other
 - Or can communicate via messages using Azure Storage Queues.



Cloud Projects

- Once you create a new cloud project, VS creates a solution that includes
 - A cloud project
 - A project for each role you request



Cloud Project Configuration

- The cloud service project is a container for roles (role projects).
- Each cloud service project also has two very important files.
 - service definition file (ServiceDefinition.csdef)
 - service configuration file (ServiceConfiguration.cscfg)
 - These XML files define the configuration for all the roles in the cloud service.
 - The Fabric Controller uses the information in these files to determine how to deploy and operate your application in the Fabric.

Service Definition

- The service definition file defines the roles and overall structure of your service (static at runtime).
 - Defines the size of the virtual machine to support each role
 - Whether a role requires native code execution
 - Ports roles listen on
 - Defines configuration settings (i.e. config parameters or environmental variables) used by the application.

```
<?xml version="1.0" encoding="utf-8"?>
<ServiceDefinition name="HelloWorld" xmlns="http://schemas.microsoft.com/ServiceHosting/2008/10/ServiceDefinition">
  <WebRole name="HelloWorldWebRole" vmsize="Large">
    <InputEndpoints>
      <InputEndpoint name="HttpIn" protocol="http" port="80" />
    </InputEndpoints>
    <ConfigurationSettings>
      <Setting name="DiagnosticsConnectionString" />
    </ConfigurationSettings>
  </WebRole>
</ServiceDefinition>
```

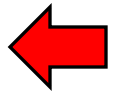
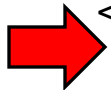
Service Configuration

- The service configuration file defines
 - Values for configuration that can change at runtime.
 - The number of instances (i.e. the number of virtual machines) required for each role.

```

<?xml version="1.0"?>
<ServiceConfiguration serviceName="HelloWorld"
xmlns="http://schemas.microsoft.com/ServiceHosting/2008/10/ServiceConfiguration">
  <Role name="HelloWorldWebRole">
    <Instances count="3" />
    <ConfigurationSettings>
      <Setting name="DiagnosticsConnectionString" value="UseDevelopmentStorage=true" />
    </ConfigurationSettings>
  </Role>
</ServiceConfiguration>

```



Creating a Web Role

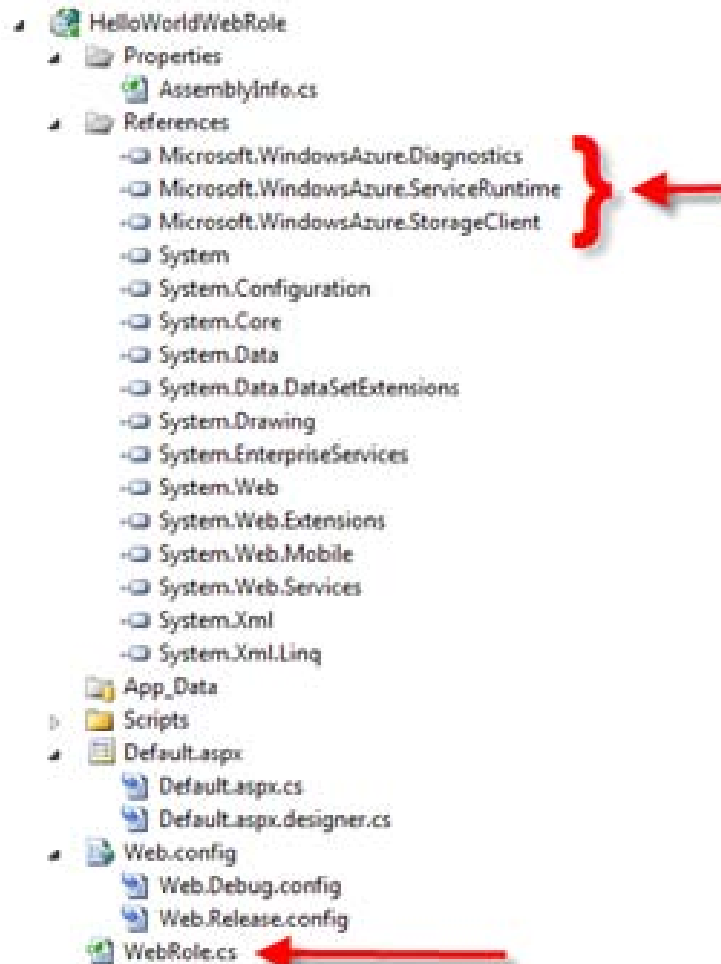
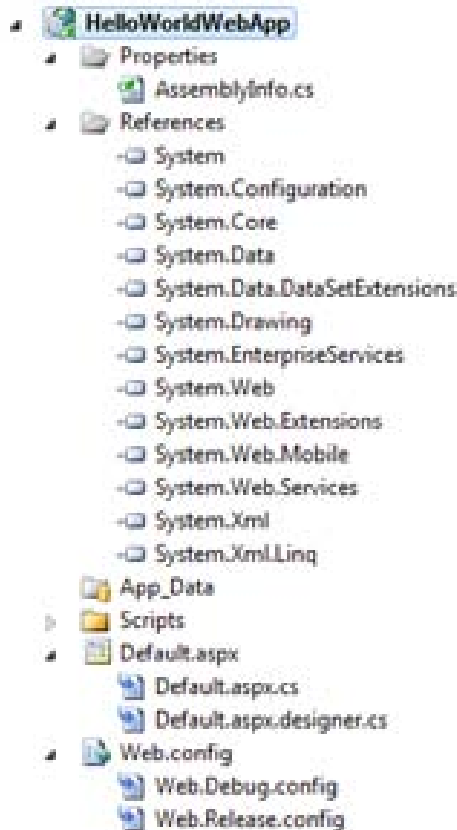
- WAT provides four Web role templates in VS.

Web Role Type	Description
ASP.NET Web Role	General Web application that talks HTTP/HTTPS, runs on IIS 7, and the ASP.NET stack. Essentially the same as an ASP.NET Web Application template, but built to run in the Azure cloud.
ASP.NET MVC 2 Web Role	A Web application that talks HTTP/HTTPS, runs on IIS 7, but is prewired to support the MVC 2 Framework. Essentially the same as an ASP.NET MVC 2 Web Application, but built to run in the Azure cloud.
WCF Service Web Role	A Windows Communication Foundation (WCF) service hosted in IIS with HTTP or HTTPS endpoints. Essentially the same as WCF Service Application template, but built to run in the Azure cloud.
CGI Web Role	Host a FastCGI protocol project. This allows Web sites written in languages such as PHP or Python to run in Azure.

Web Role Project

- A Web role project looks nearly identical to non-Azure Web project.
 - In other words, an ASP.NET Web role project looks almost identical to an ASP.NET Web Application project.
 - A WCF Service Application looks almost identical to a WCF Service Web role.
 - Etc.
- In fact, the only difference is that the Web role adds 3 Windows Azure references and the WebRole.cs file.

A closer look at the Web Role project



Some Web Role Code

- WebRole.cs
 - Acts like a Global.asax in a traditional ASP.NET app.
 - Azure platform calls the OnStart() after loading the Web role.

```
public override bool OnStart()
{
    DiagnosticMonitor.Start(
        "DiagnosticsConnectionString");
    RoleEnvironment.Changing +=
        RoleEnvironmentChanging;
    // your own code to initialize a Web
    // Role goes here
    return base.OnStart();
}
```

Some Azure API

- From the `ServiceRuntime` namespace
 - Determine if you are running in the cloud or not
 - Get a configuration value

- From `Diagnostics` namespace
 - Write to Azure trace logs

```

if RoleEnvironment.IsAvailable)
{
    //do stuff in Azure
} else
{
    //not in Azure – do other stuff
}
    
```

```

WelcomeLabel.Text = RoleEnvironment.
    GetConfigurationSettingValue(
        "HelloWorldGreeting");
    
```

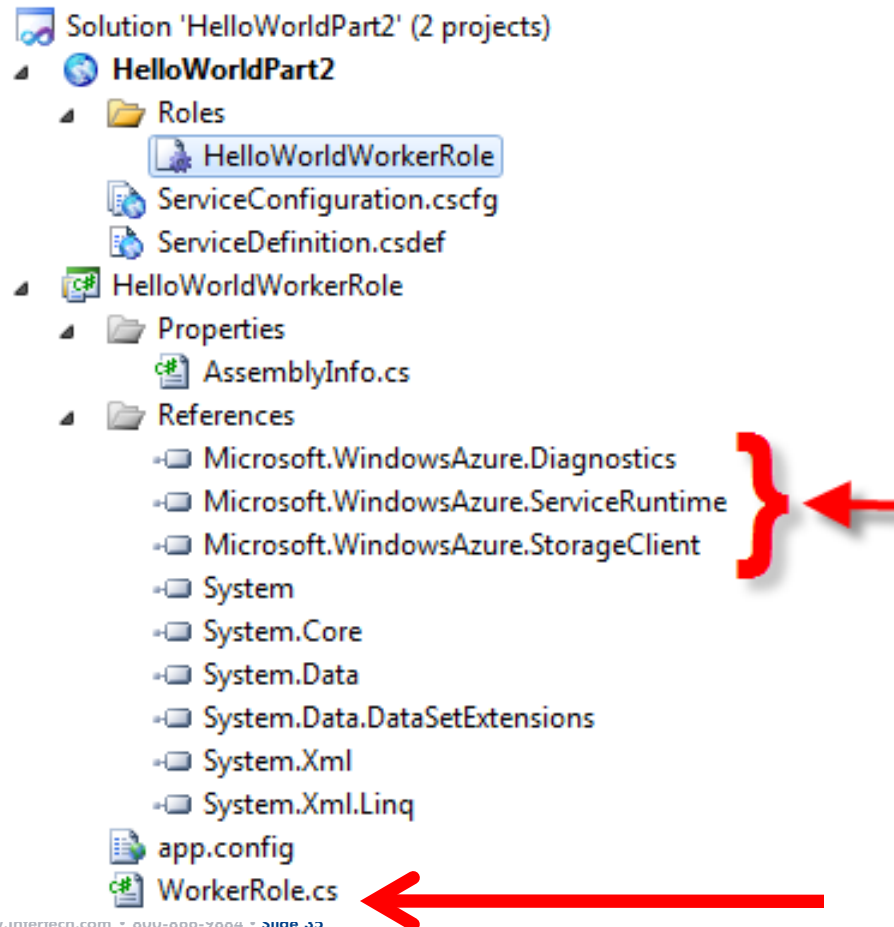
```

Trace.WriteLine("log entry", "category");
    
```

Worker Role Projects

- Worker roles provide background processing.
 - Think of a worker role as a Windows service.
 - Use worker roles for ...
 - batch processing
 - queue processing
 - non-HTTP WCF service hosting
 - just plain old “number crunching” activities.
- Unlike Web roles, WAT for VS provides just one worker role template.

A closer look at a worker role project



Some Worker Role Code

- WorkerRole.cs is the kick-off/entry point for a worker role
 - Has an OnStart method like WebRole.cs
 - Run() method is where the worker role performs its work.

```
public override void Run()
{
    Trace.WriteLine(
        "HelloWorldWorkerRole entry
        point called", "Information");
    while (true)
    {
        //do work here
        Thread.Sleep(10000);
        Trace.WriteLine(
            "Working", "Information");
    }
}
```

Azure Compute by the numbers

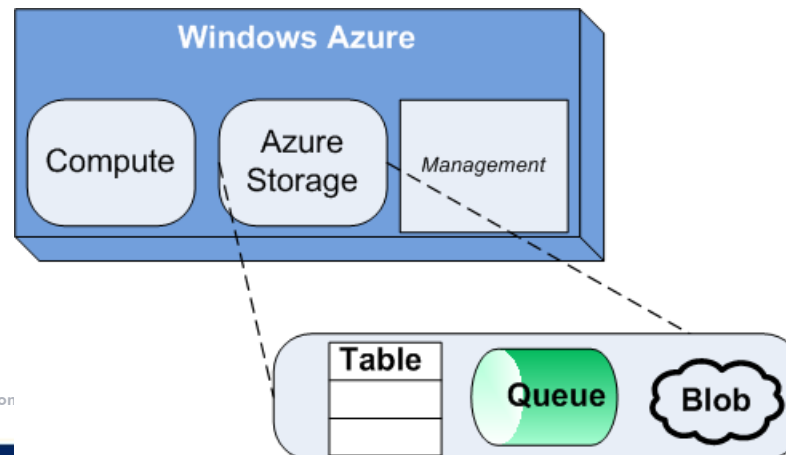
- Web and Worker Role Instance Charges

VM Size	Cost	CPU cores	Available Memory	Allotted Local Disk Space
Small	\$0.12/hr	1	1.75 GB	225 GB
Medium	\$0.24/hr	2	3.5 GB	490 GB
Large	\$0.48/hr	4	7.0 GB	1,000 GB
Extra Large	\$0.96/hr	8	14 GB	2,040 GB

- Partial compute instance hours are billed as full compute hours

Azure Storage

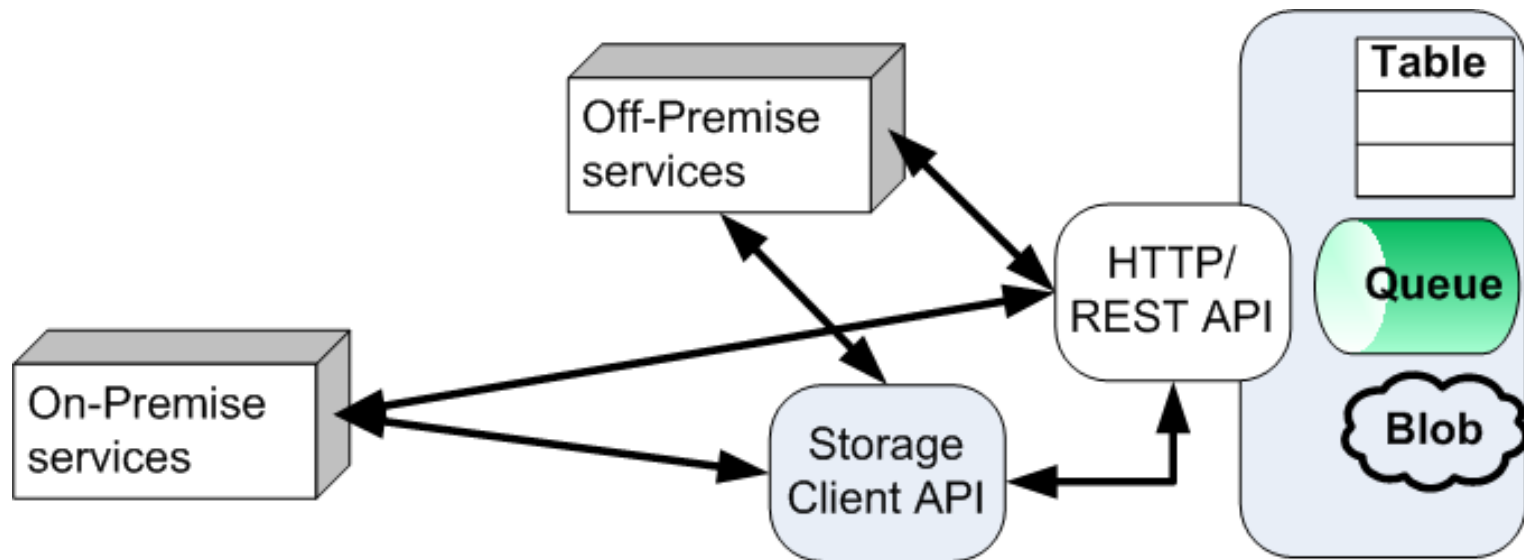
- Azure Storage consists of three types of data storage in the cloud: tables, blobs and queues.
 - Storage is not relational database storage.
 - SQL Azure is the relational database in the cloud.
 - Azure replicates all of storage 3 times.
 - Azure Storage is scalable and typically cheaper than storing data in relational form in the cloud.



Accessing Azure Storage

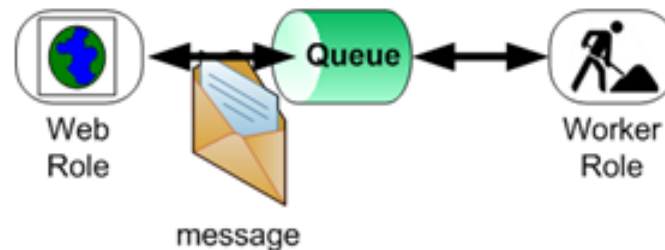
- Access Azure Storage (any of the 3 types) through REST over HTTP.
 - Allows you to access the data from applications running in and out of the cloud (off or on-premise).
 - Doesn't even have to be a .NET application.
- To simplify access to storage from managed code, the Azure SDK contains the *Storage Client API*.
 - The Storage Client API abstracts away the details of the REST API.
 - The Storage Client API still uses the REST API under the covers.

REST vs Storage Client API



Queue Storage

- Queue storage provides reliable and durable message stores.
 - Queues allow cross service communications in a loosely coupled fashion.
 - Think of queue storage as a kind of MSMQ or WebSphere MQ Series in the cloud.
 - Obviously, the implementation is quite different.



Queue Code example

```
public override void Run()
{
    Trace.WriteLine("HelloWorldWorkerRole entry point called", "Information");
    CloudStorageAccount storageAccount = CloudStorageAccount.Parse(RoleEnvironment.
    GetConfigurationSettingValue("DataConnectionString"));
    CloudQueueClient queueClient = storageAccount.CreateCloudQueueClient();
    CloudQueue queue = queueClient.GetQueueReference("helloqueue");
    while (true)
    {
        CloudQueueMessage workMessage = queue.GetMessage();
        if (workMessage != null)
        {
            //extract the contents of the message and do your work here
            queue.DeleteMessage(workMessage);
        }
        Thread.Sleep(5000);
        Trace.WriteLine("Working", "Information");
    }
}
```

Table Storage

- Table storage offers structured tables similar to what you would find in a relational database.
 - But without custom indexes and relationships to other tables.
 - Think of table storage like a set of fancy spreadsheets.
 - Don't view table storage as a replacement for an RDBMS.
 - Table storage provides another alternative to an RDMS for certain application situations.
 - Data is stored in row-column form, but relationships between rows and columns are limited.

Table Storage Entities

- Table storage keeps entity data.
 - Simple domain objects represent entities in an application.
 - Domain objects are often called data transfer objects (DTO) or plain ordinary CLR objects (POCO).

```
public class Customer
{
    public int ID { get; set; }
    public String firstname { get; set; }
    public String lastname { get; set; }
}
```

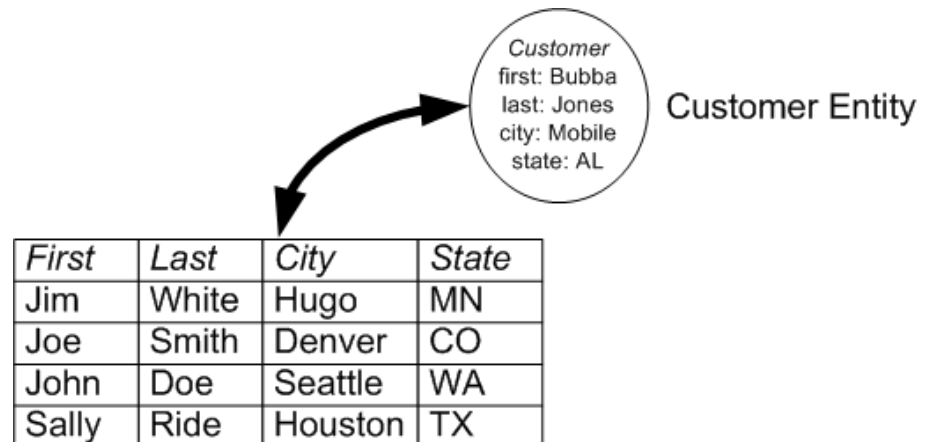
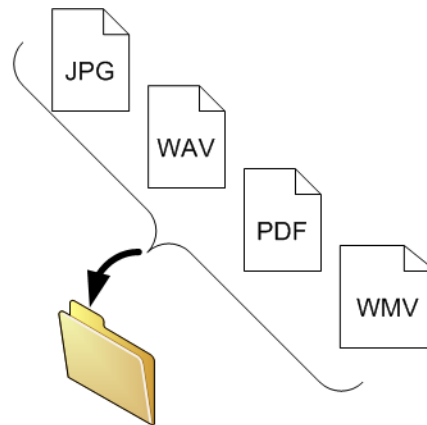


Table Code example

```
CloudStorageAccount storageAccount =  
    CloudStorageAccount.FromConfigurationSetting("DataConnectionString");  
CloudTableClient tableClient = storageAccount.CreateCloudTableClient();  
tableClient.CreateTableIfNotExist("customers");  
CustomerContext customerContext = new CustomerContext(storageAccount.TableEndpoint.AbsoluteUri,  
    storageAccount.Credentials);  
var aCustomer = new Customer  
{  
    PartitionKey = "East",  
    RowKey = Guid.NewGuid().ToString(),  
    firstName = "Joe",  
    lastName = "Smith",  
    dateOfBirth = new DateTime(1964, 1, 20),  
    phone = "612-999-9999"  
};  
customerContext.AddObject("customers", aCustomer);  
customerContext.SaveChanges();
```

BLOB Storage

- Binary Large Object (BLOB) storage houses large binary data.
 - Examples: images, videos, music, documents, etc in an organized file system.
 - Allows for just about anything that you need stored.
 - Think of BLOB storage as a file system replacement.



Blob Code example

```
CloudStorageAccount storageAccount =  
    CloudStorageAccount.FromConfigurationSetting("DataConnectionString");  
CloudBlobClient blobClient = storageAccount.CreateCloudBlobClient();  
CloudBlobContainer container =  
    blobClient.GetContainerReference("containername");  
container.CreateIfNotExist();  
CloudBlob blob = container.GetBlobReference("myfile.txt");  
blob.UploadText("This is a test. It is only a test. If this had...");
```

Azure Storage by the numbers

- Costs: \$0.15 per GB per month.
 - 10,000 storage transactions cost \$0.01.
 - Data transferred in cost \$0.10 per GB
 - In Asia Pacific regions \$0.30
 - Data transferred out costs \$0.15 per GB
 - In Asia Pacific regions \$0.45
- Per Azure Storage account: up to 100 TB of data
 - Queue message can be up to 8 KB
 - Table entity limited to 1 MB (255 fields)
 - Block Blobs limited to 200 GB; Page Blobs to 1 TB

SQL Azure

- SQL Azure is the relational database in the Windows Azure platform.
 - It is SQL Server 2008 R2 at its core.
 - But not a full-blown SQL Server.
 - This is SQL Server with a number of limitations.
- List of limitations is long.
 - “If your application works today against SQL Express edition and does not make use of some of the more advanced features of SQL Server, then your application should work in the cloud with little or no modification”

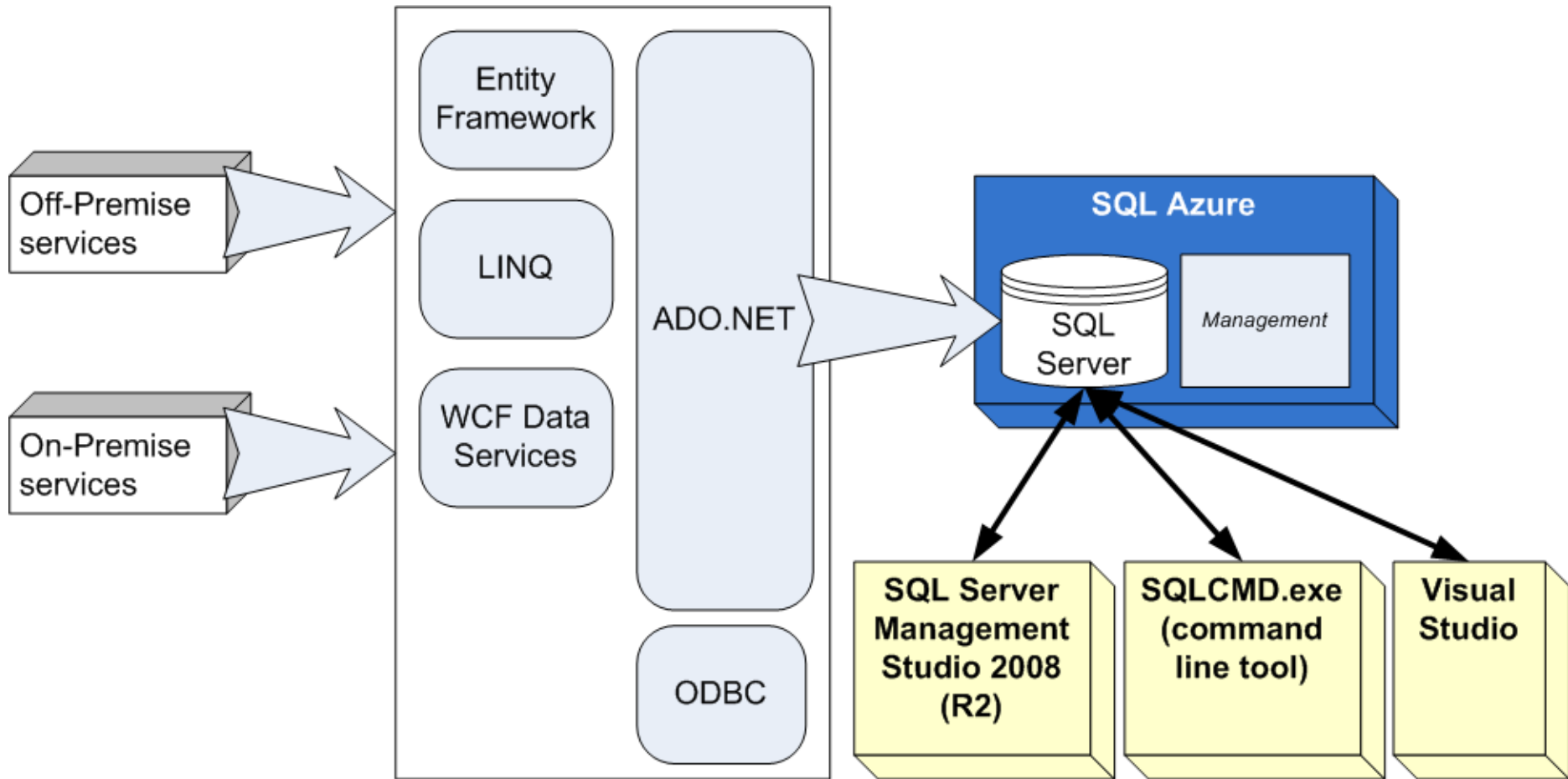
SQL Azure Management

- Create a SQL Azure database server through the Azure Developer Portal.
 - Access and manage through common SQL Server tools.
 - SQL Server Management Studio (SSMS)
 - SSMS 2008 R2 or better is required
 - SQLCMD.exe
 - Visual Studio
- Data Migration Wizard helps migrate data in and out of the cloud

SQL Azure From Applications

- You access SQL Azure in your application code in the same way you access SQL Server from your applications.
 - Use ODBC or ADO.NET (to include use of LINQ, Entity Framework, or WCF Data Services).
 - Like Azure Storage, SQL Azure is available to applications running both inside and outside the cloud.
 - In fact, one way to start to slide into the cloud is to consider moving your data first.

SQL Azure – Developers Perspective



SQL Azure by the numbers

- Cost: ~ \$10/GB per month
- Plus bandwidth costs
 - Data transferred in cost \$0.10 per GB
 - In Asia Pacific regions \$0.30
 - Data transferred out costs \$0.15 per GB
 - In Asia Pacific regions \$0.45
 - No transaction costs for SQL Azure.
- Limited to 1, 5, 10, 20, 30, 40 or 50 GB databases
 - Must Partition the database past 50GB.

Resource List

- Getting Started
 - www.microsoft.com/windowsazure/
- Tools info and downloads
 - msdn.microsoft.com/en-us/windowsazure/cc974146.aspx
- SQL Azure limitations
 - msdn.microsoft.com/en-us/library/ee336245.aspx
- Windows Azure Developer Portal
 - windows.azure.com
- Complete Windows Azure course at Intertech
 - www.intertech.com

What you have learned today

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Q & A

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jwhite@intertech.com
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