Introduction to Windows Azure and the Azure Service Platform

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Why?

What?

How?

Why cloud computing?

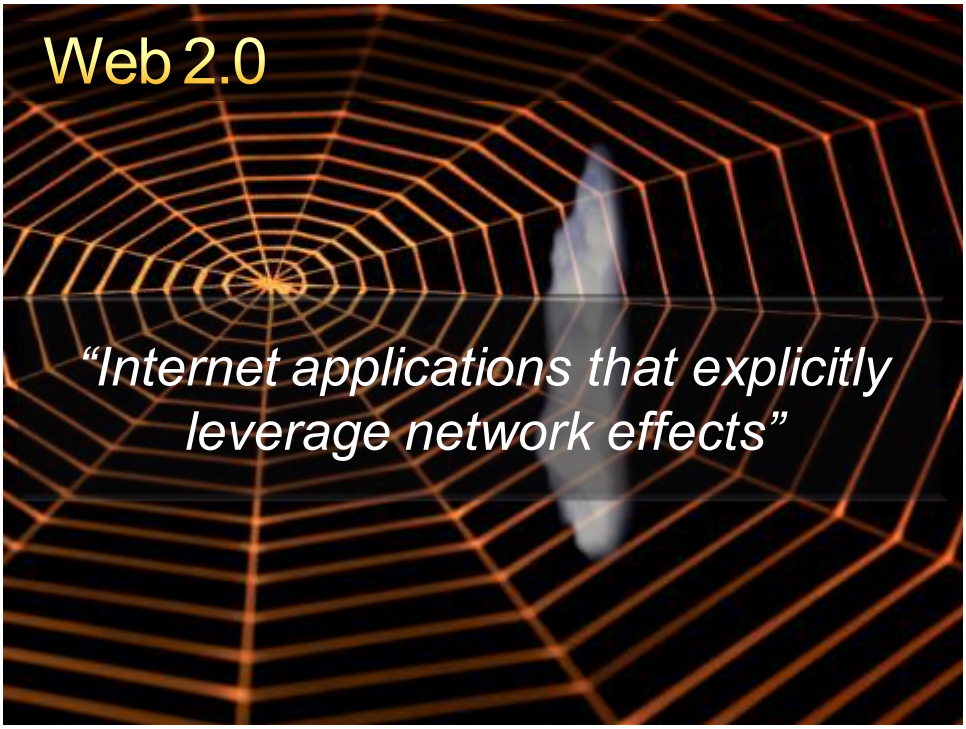
What is Azure?

How to develop for Azure?

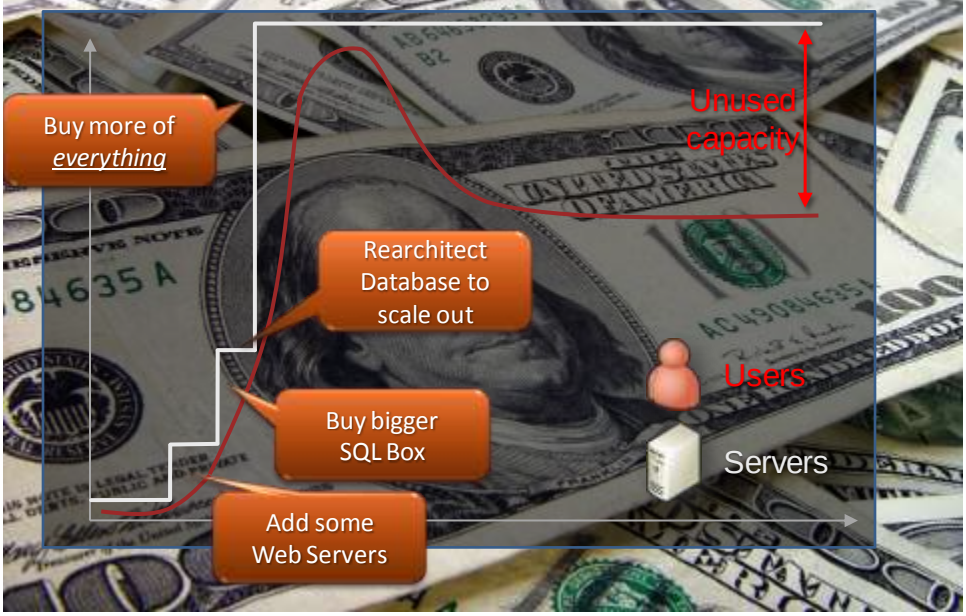
Business Drivers for IT Projects

- Increase market share and revenue
  - Investing in product development and customer facing interaction channels
- Increase efficiency and lower TCO
  - Investing in technologies and processes to drive efficiency and lower cost through optimization

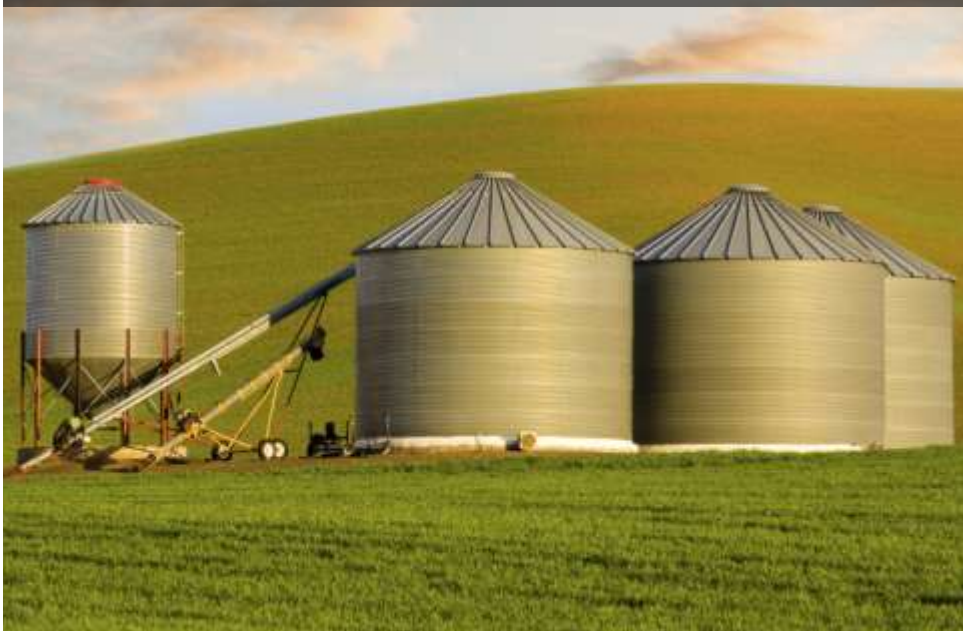
Some Impactful Trends in IT
• Socialization of IT
• Datacenters and Green IT
• Utility Computing and IT as a Service


Web 2.0
“Internet applications that explicitly leverage network effects”

What does Success 2.0 look like?

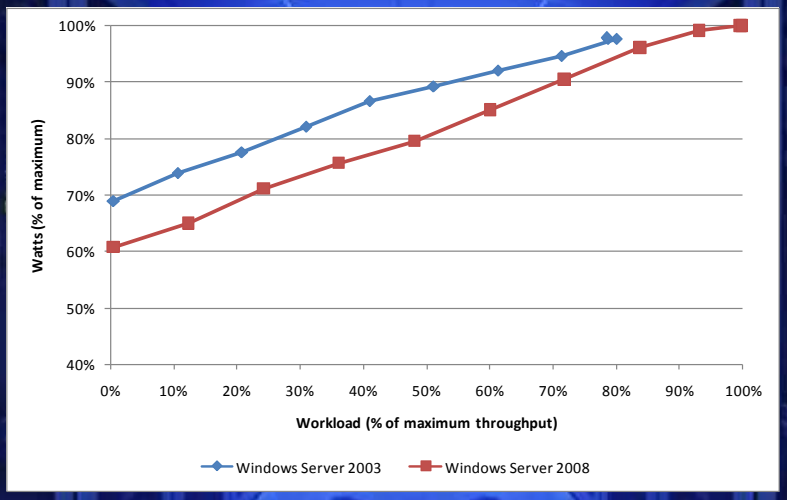


Datacenters and Green IT



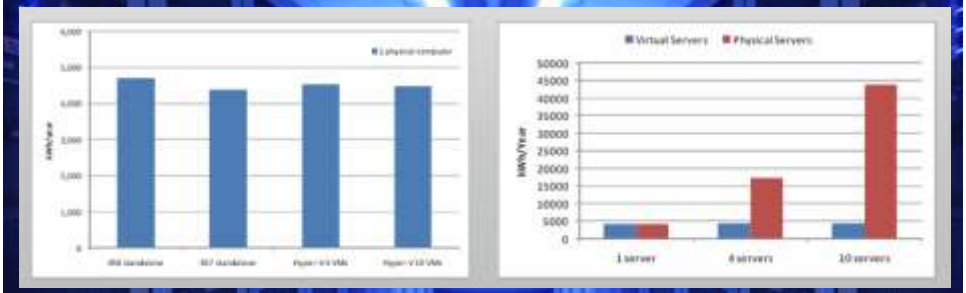
From Mega Hertz to Mega Watt

Optimizing Power Management



"….achieved power savings approx 10 percent or more over Windows Server 2003 OOB at comparable levels of throughput. "

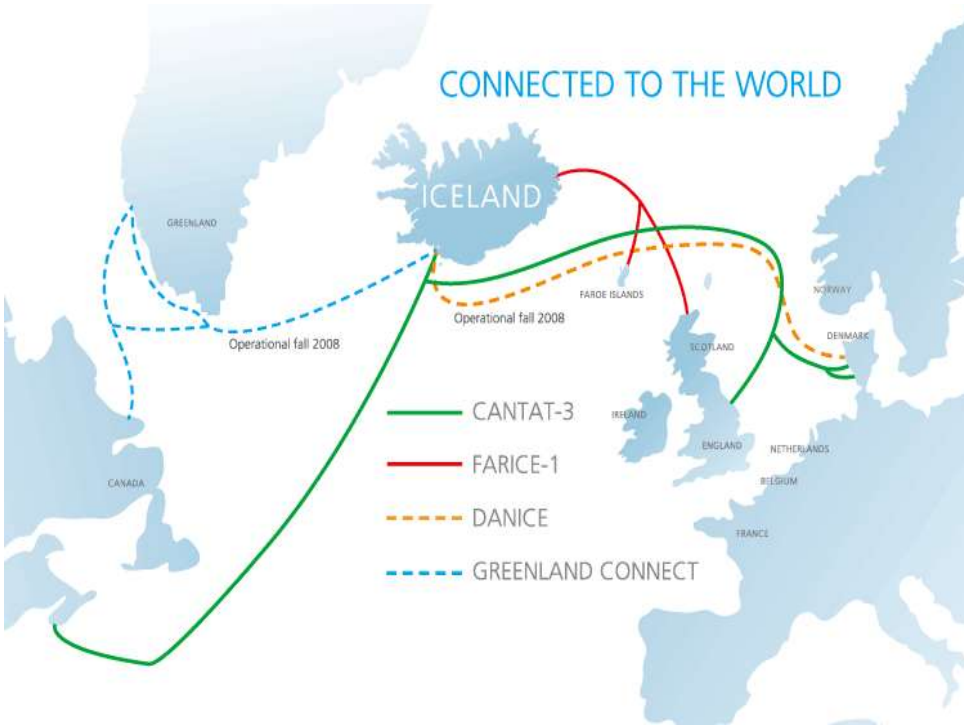
Saving Power through Virtualization



However …

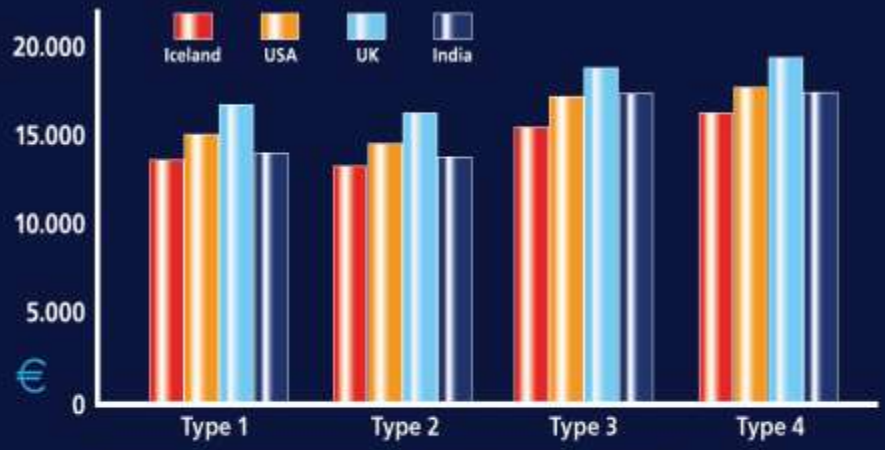
- Server power is small part of overall bill
- CPU $$ is less than 1% of total
  - Trend is towards more efficient CPU,
  - Lower rack power densities (amps/foot^3) on horizon
- Disk is more complicated
  - Mass storage consumes more than CPU, Fan, Memory, Face drives combined
  - Keeping DB on line all the time consumes more than all CPU's involved

The big power spend is cooling


CONNECTED TO THE WORLD
ICELAND
GREENLAND
FAROE ISLANDS
Operational fall 2008
Operational fall 2008
NORWAY
DENMARK
SCOTLAND
IRELAND
ENGLAND
NETHERLANDS
BELGIUM
FRANCE
CANADA
CANTAT-3
FARICE-1
DANICE
GREENLAND CONNECT

Cost components for the benchmark

The combination of the 4 detailed cost components results in a favourable position for Iceland, especially thanks to the power and rental cost.



Source: PricewaterhouseCoopers, Belguim - Benchmarking Study on Iceland as a Location for Data Centre Activity.

We're running scale services now

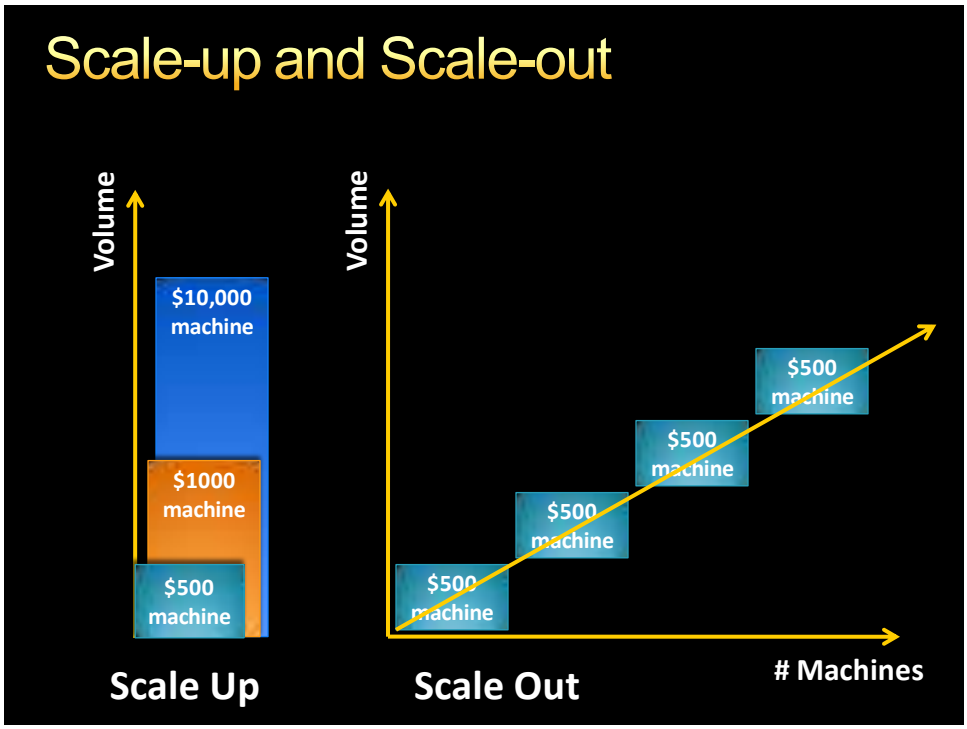
- 2 B Live Search queries/month
- 10 B MSN page views/month
- 30 B Live ID authentications/month
- 240 B Messenger messages/month

We're building to run your services

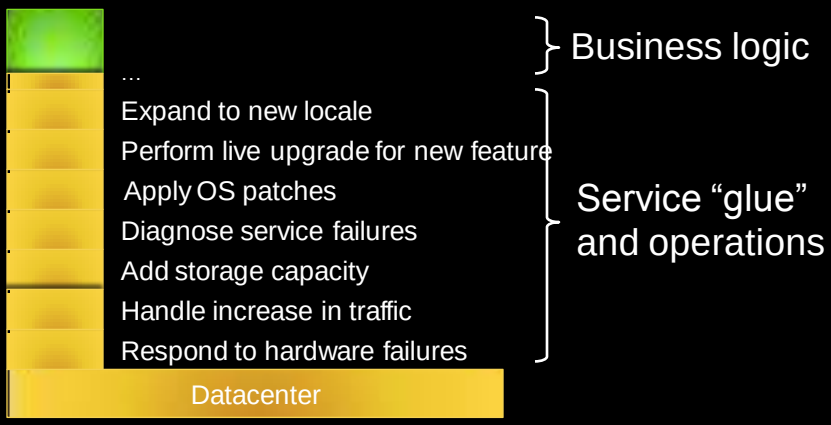
- $500 million per data center
- 10,000 servers/month
- $1 B spend/FY08

Utility Computing and IT as a Service

Scale-up and Scale-out

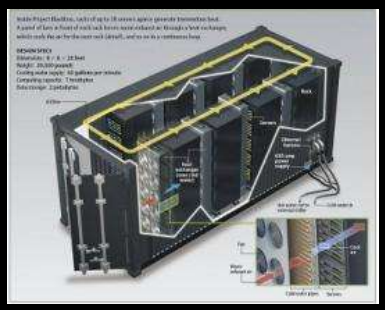


But this doesn't come for Free...



Microsoft Data Center

- Cost: $500 million each
- Size: 500,000 square foot facility (10 football fields) on average
- Container-based

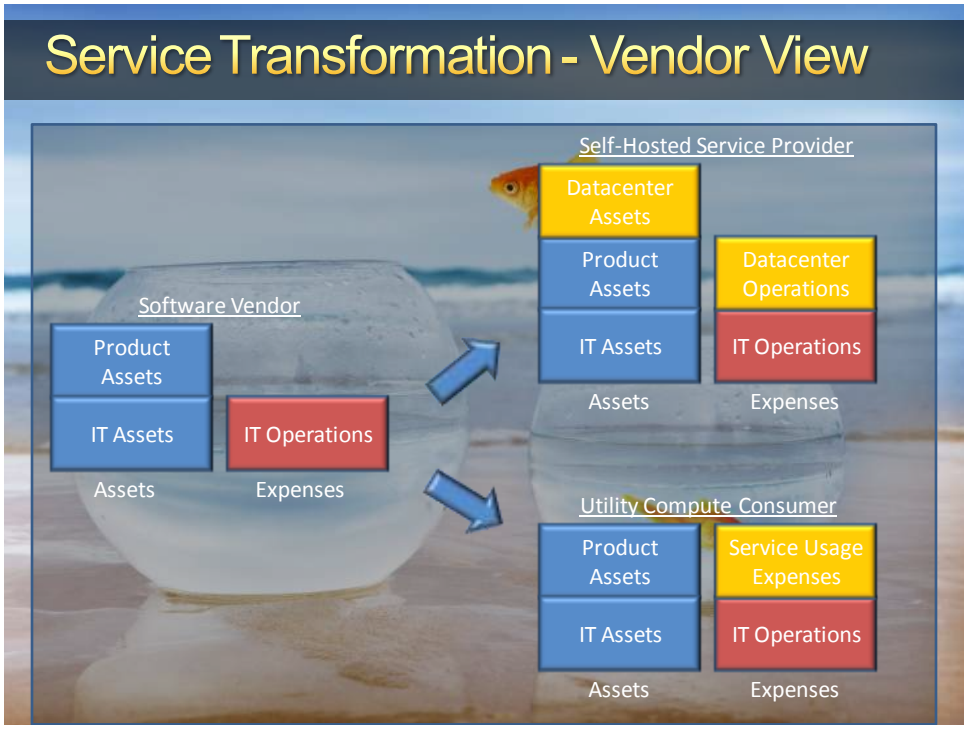


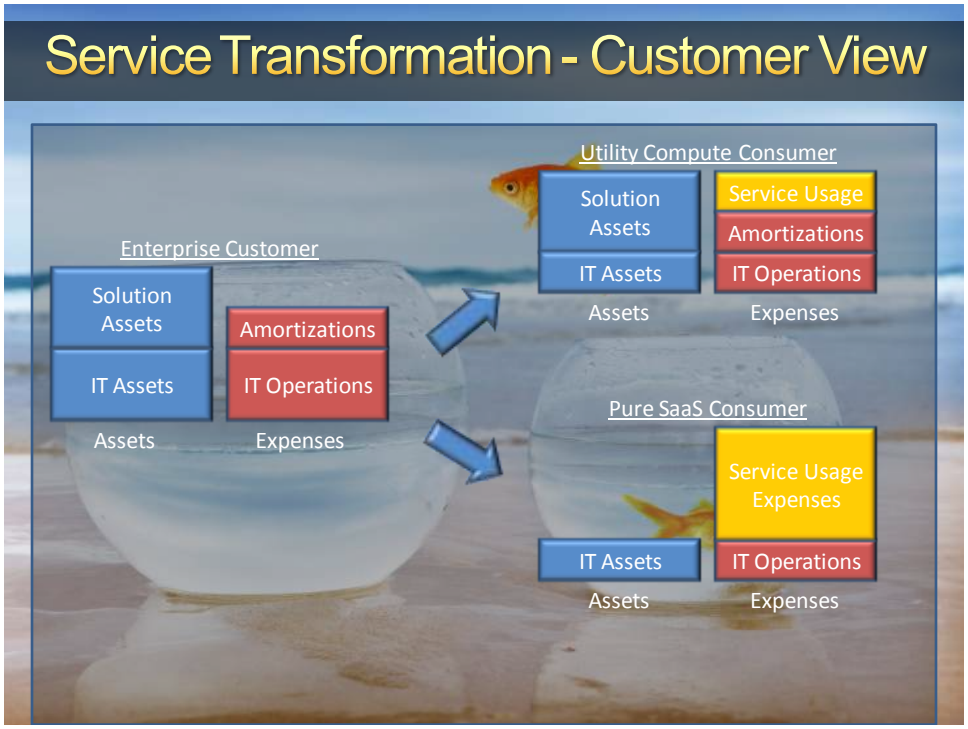
What about a Cloud OS?

- The same facilities as a desktop OS, but on a set of connected servers:
  - Abstract execution environment
  - Shared file system
  - Resource allocation
  - Programming environments
- And more: Utility computing
  - 24/7 operation
  - Pay for what you use
  - Simpler, transparent administration

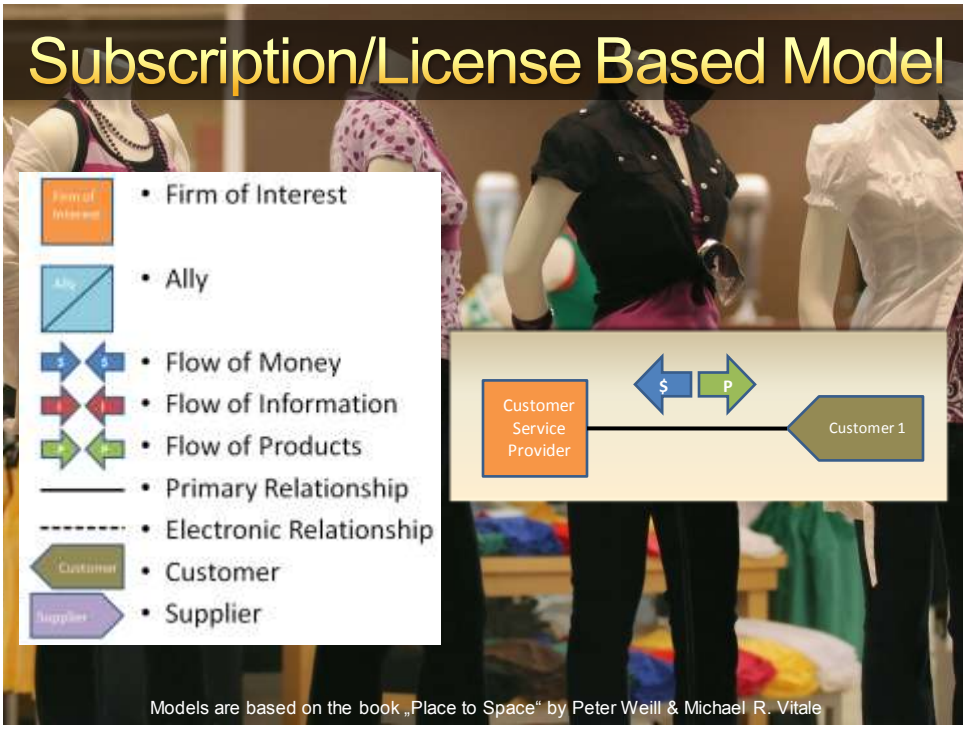
Implications

- Impacts CAPEX/OPEX spending
- May require "SOA in the large"
  - Governance
  - Identity
  - Business Processes
- New Business Model Emerge
- Introduces new Programming Models

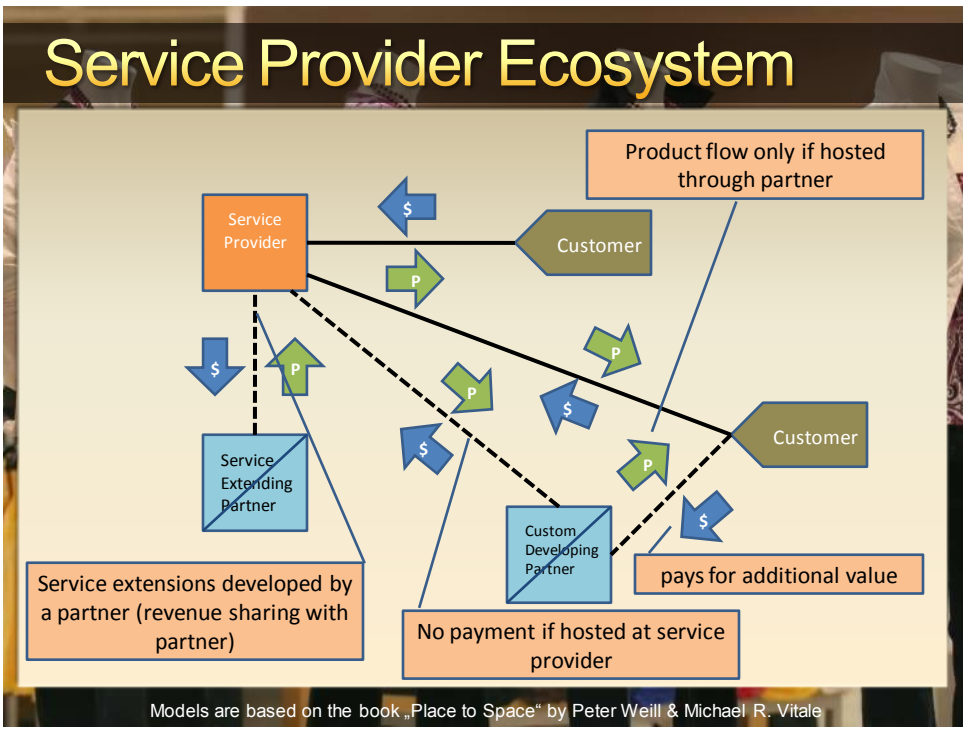

Service Transformation - Vendor View
Self-Hosted Service Provider
Datacenter Assets
Product Assets
IT Assets
Datacenter Operations
IT Operations
Assets
Expenses
Software Vendor
Product Assets
IT Assets
IT Operations
Assets
Expenses
Utility Compute Consumer
Product Assets
IT Assets
Service Usage Expenses
IT Operations
Assets
Expenses


Service Transformation - Customer View
Utility Compute Consumer
Solution Assets
IT Assets
Service Usage
Amortizations
IT Operations
Assets
Expenses
Enterprise Customer
Solution Assets
IT Assets
Amortizations
IT Operations
Assets
Expenses
Pure SaaS Consumer
Service Usage Expenses
IT Assets
IT Operations
Assets
Expenses

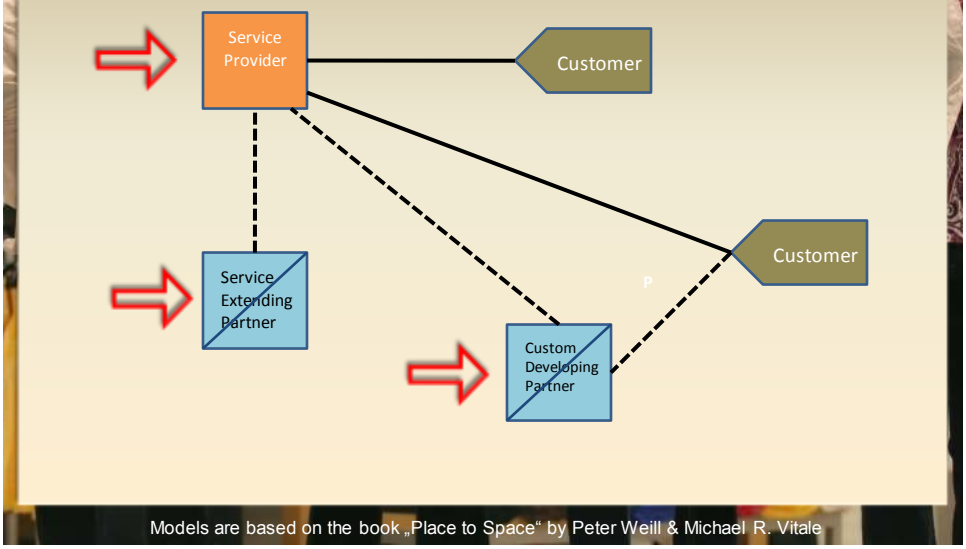
Subscription/License Based Model



Service Provider Ecosystem



Service Provider Ecosystem



Models are based on the book „Place to Space“ by Peter Weill & Michael R. Vitale

Programming Models for the Cloud

- Eric Brewer's **CAP** Theorem
  - **C**onsistency
  - **A**vailability
  - Tolerance to network **P**artitions

  One can only achieve a combination of two
- This leads to **BASE** semantic (vs. ACID)
  - **B**asically **A**vailable
  - **S**oft-state
  - **E**ventual consistency

Some Useful Definitions

Consistency Levels

Consistency Level	Changes are Visible	Example
Strong	Now	Missile Launch
Eventual	In the Future	Address Change
Optimistic	Maybe in the Future	Stock Ticker

Message Assurances

Assurance	Message Delivery	Example
Exactly Once	No loss, no duplicates	Bank Transfer
At Least Once	No loss, duplicates	Email
At Most Once	Loss, no duplicates	Streaming Video
Best Effort	Loss, duplicates	Stock Ticker

What does this mean for Developers?

Where did we start?	Where did we end up?
Shared State	Partitioned, Replicated State
ACID Transactions	Eventual Consistency
Exactly Once Messaging	Best Effort Messaging
Machine Loss is a Catastrophe	Machine Loss is Business As Usual
Keep Processes Running	Recovery-Oriented Computing

An internet-scale cloud services platform hosted in Microsoft data centers, which provides an operating system and a set of developer services that can be used individually or together.

Windows Azure

- Windows Azure is the foundation of Microsoft's Cloud Platform
- It is an "Operating System for the Cloud" and provides Essential Services for the Cloud
  - Virtualized Computation
  - Scalable Storage
  - Automatic Management
  - Developer SDK

The Backend – Physical

- Lots of racks, lots of servers, lots of wire.

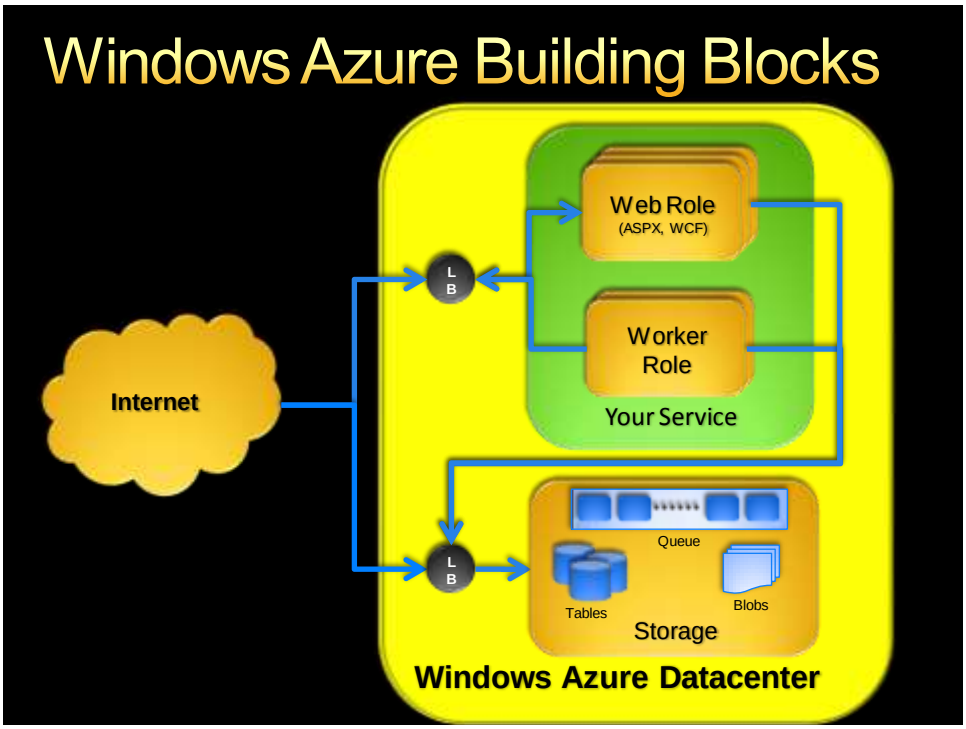
The Backend – Virtual

- 8+ cores per server
- 1,2,4 cores per VM

- "Lights out" model
  - VM reimaged on failure
  - Server retired on failure
- Quick deployment
  - 100 VMs in ~20 minutes
  - "Go" to "System Up"

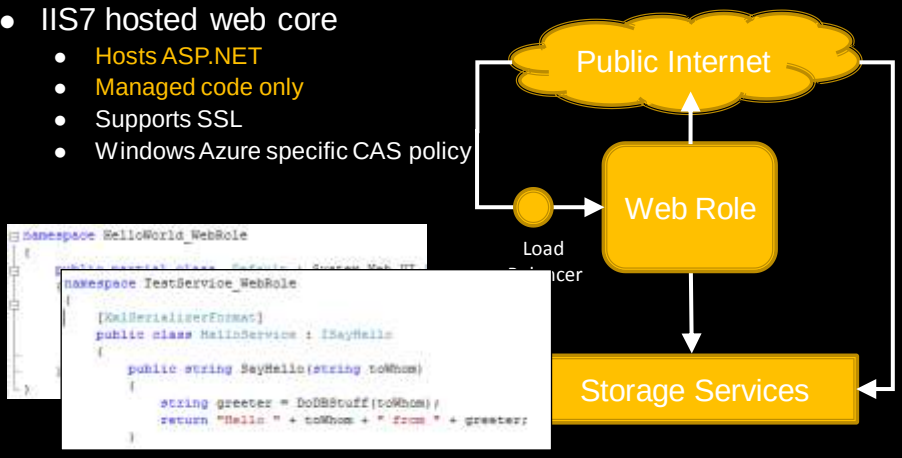
A Look Inside Azure

Windows Azure Building Blocks



Web Role

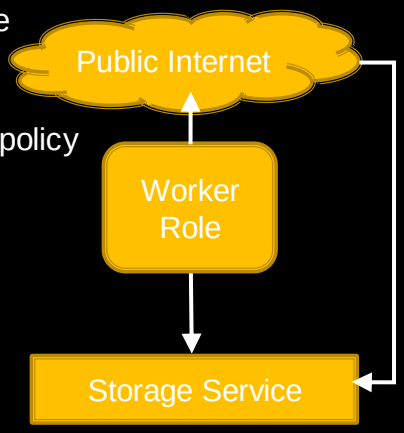
- Web farm that handles request from the Internet
- IIS7 hosted web core
  - Hosts ASP.NET
  - Managed code only
  - Supports SSL
  - Windows Azure specific CAS policy




```
namespace HelloWorld_WebRole
{
namespace TestService_WebRole
{
    [XmlSerializerFormat]
    public class HelloService : ISayHello
    {
        public string SayHello(string toWhom)
        {
            string greeter = DoDBStuff(toWhom);
            return "Hello " + toWhom + " from " + greeter;
        }
```

Worker Role

- No inbound network connections
- Can read requests from queue in storage
- Managed code only
- Windows Azure specific CAS policy

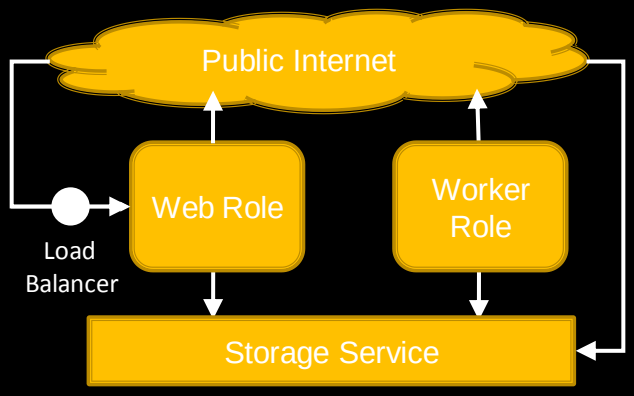



```
public class WorkerRole : RoleEntryPoint
{
    public override void Start()
    {
        RoleManager.WriteToLog("Information", "Wor
        while (true)
        {
            Thread.Sleep(10000);
            RoleManager.WriteToLog("Information",
        }
    }
```

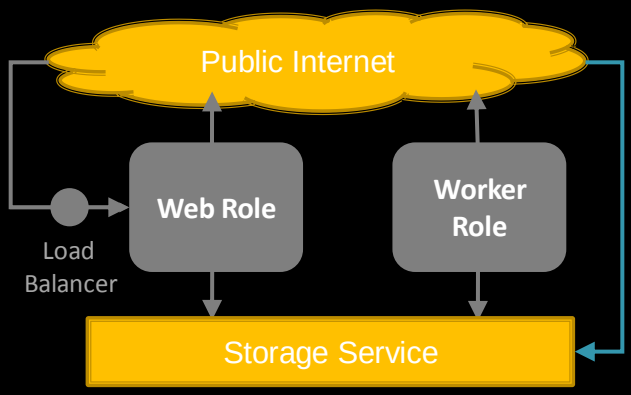
Azure Compute Instance (Worker/Web)

- **Tech Preview** offers one type of VM
  - Platform: 64-bit Windows Server 2008
  - CPU: 1.5-1.7 GHz x64 equivalent
  - Memory: 1.7 GB
  - Network: 100 Mbps
  - Transient local storage: 250 GB
  - Azure storage also available: 50 GB
- Full service model will support more options

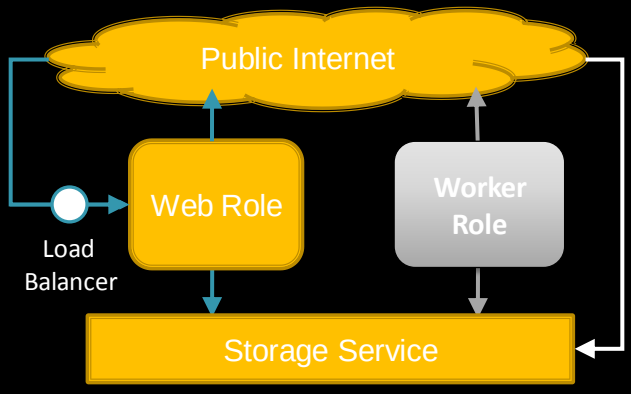
Example Service Architecture



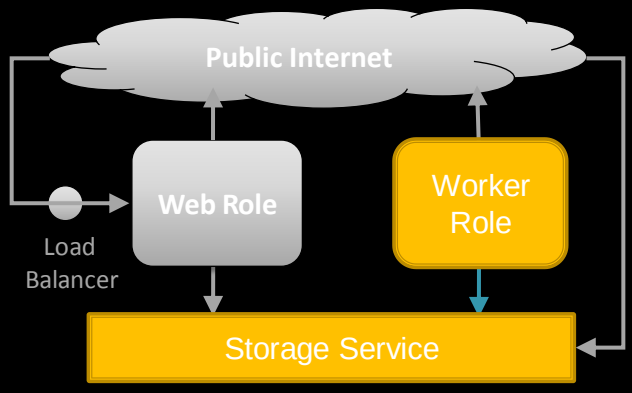
Uploading Static Content



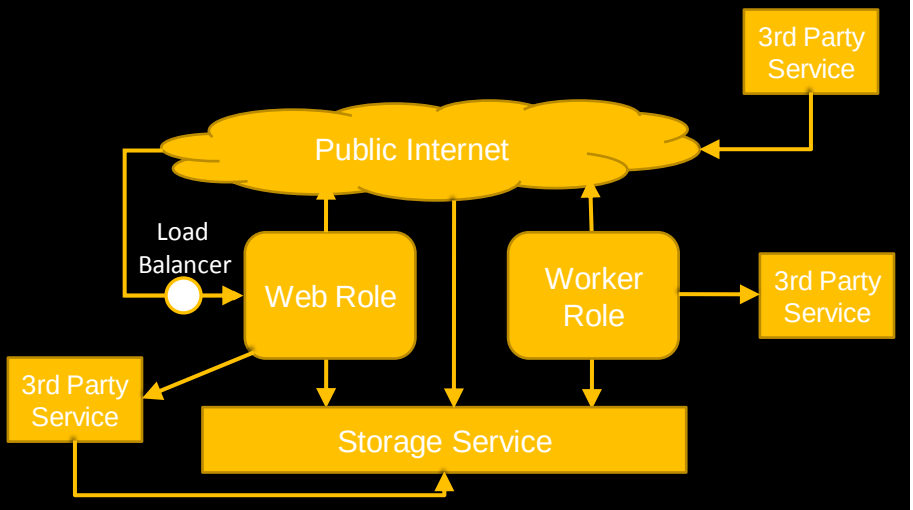
Serving Dynamic Content



Background Tasks



Architecture with additional Services



Fundamental Data Abstractions

- Blobs – Provide a simple interface for storing named files along with metadata for the file
- Tables – Provide structured storage. A Table is a set of entities, which contain a set of properties
- Queues – Provide reliable storage and delivery of messages for an application

Tables - Capabilities

Data Model

- Data stored in Tables
  - A Table is a set of Entities (rows)
  - An Entity is a set of Properties (columns)
- Entity has:
  - PartitionKey – enables scalability
  - RowKey – unique id within the partition
    the only indexed property
  - Timestamp – for optimistic concurrency
  - 255 properties for your data
  - Max size of 1MB

Working with Tables

Vessel Position Reporting System – **SQL Server**

VesselId	Time	Latitude	Longitude	Speed
xxx-xx1	10:15 14 Nov	01.23	53.24	0
xxx-xx1	10:05 14 Nov	04.45	54.32	5
xxx-xx1	09:55 14 Nov	02.32	52.34	4
xxx-xx2	10:15 14 Nov	01.23	51.23	10

To find last pos report for vessel in SQL:

```
select TOP(1) * from PosRpts
order by [Time] DESC
where VesselId = ???
```

Working with Tables

Solving this the **Azure way**

PartitionKey

VesselId	Time	Latitude	Longitude	Speed
xxx-xx1	10:15 14 Nov	01.23	53.24	0
xxx-xx1	10:05 14 Nov	04.45	54.32	5
xxx-xx1	09:55 14 Nov	02.32	52.34	4
xxx-xx2	10:15 14 Nov	01.23	51.23	10

PartitionKey

Stored in-order: Just need to do a top on the partition

RowKey needs to be a string

nKey | xxx-xx1

owKey	Latitude	Longitude	Speed
2521756430999999999	01.23	53.24	0
2521756436999999999	04.45	54.32	5
999	02.32		

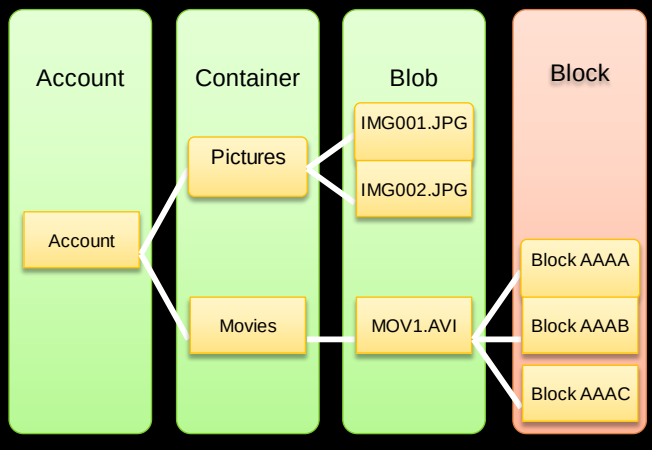
Makes it descending

100 nanoseconds!

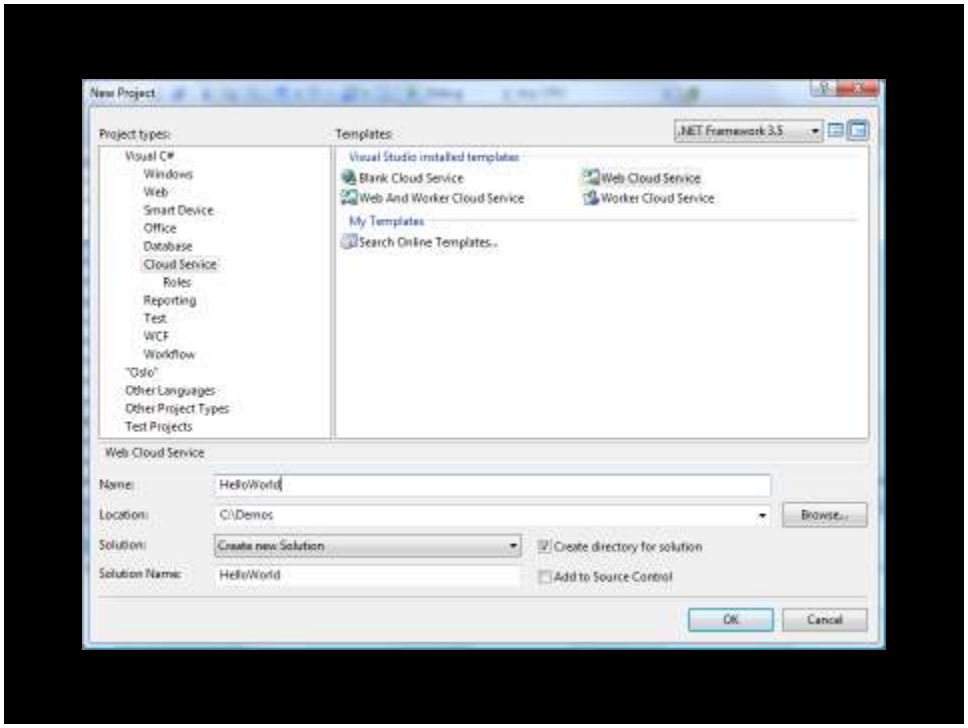
```
time.Ticks.ToString ()
```

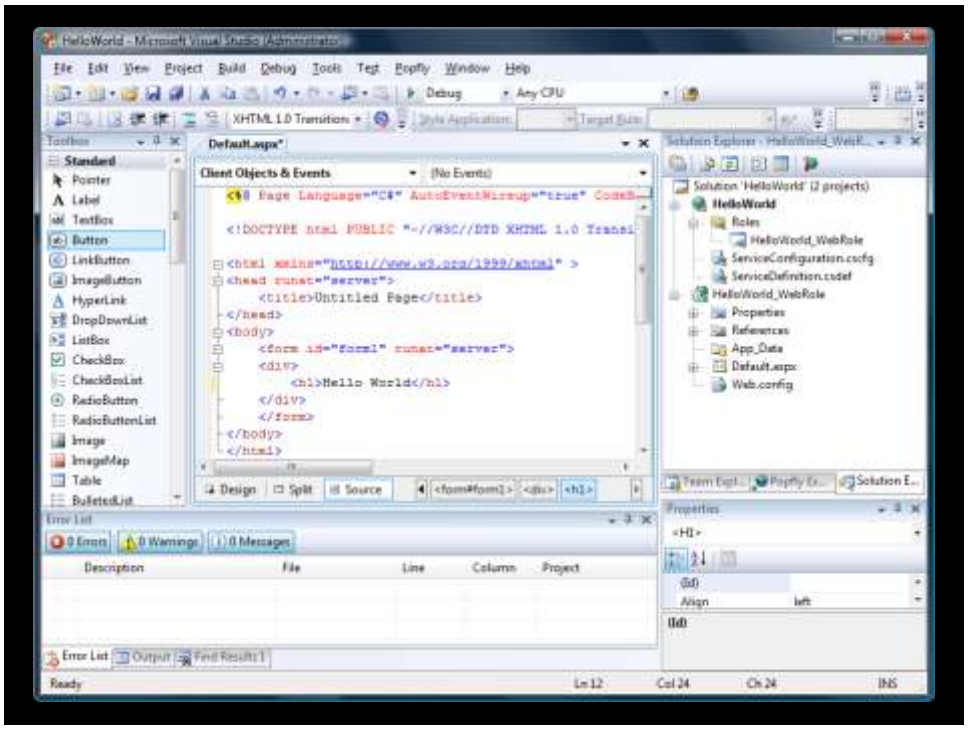
Blobs

- Store Large Objects (up to 50 GB each)
- Standard REST PUT/GET/DELETE Interface
  http://<Account>.blob.core.windows.net/<Container>/<BlobName>

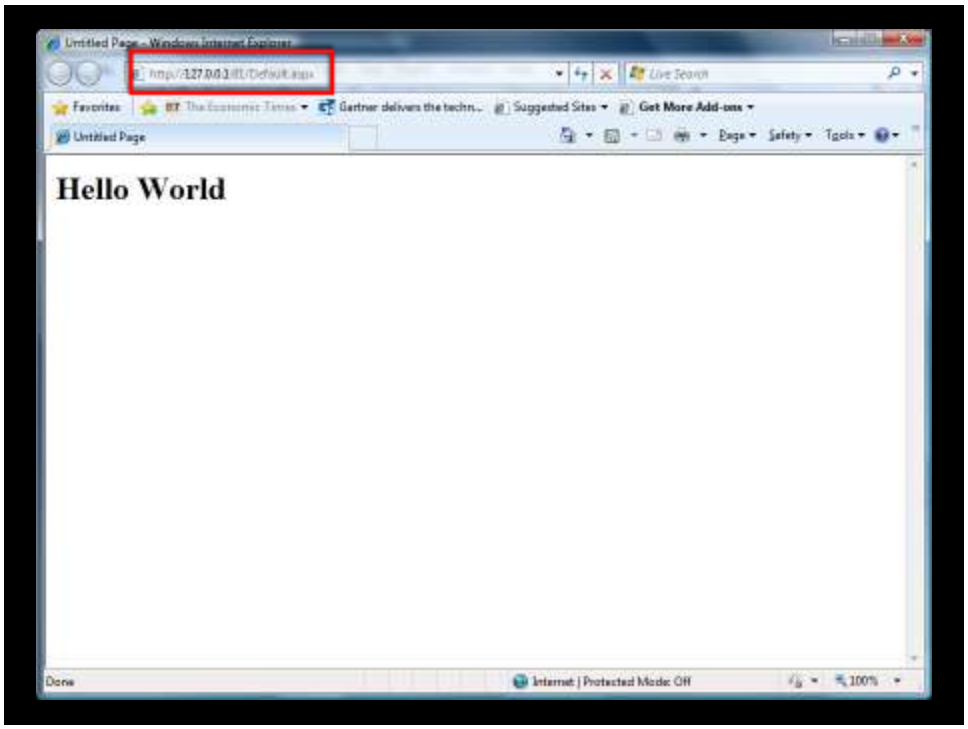


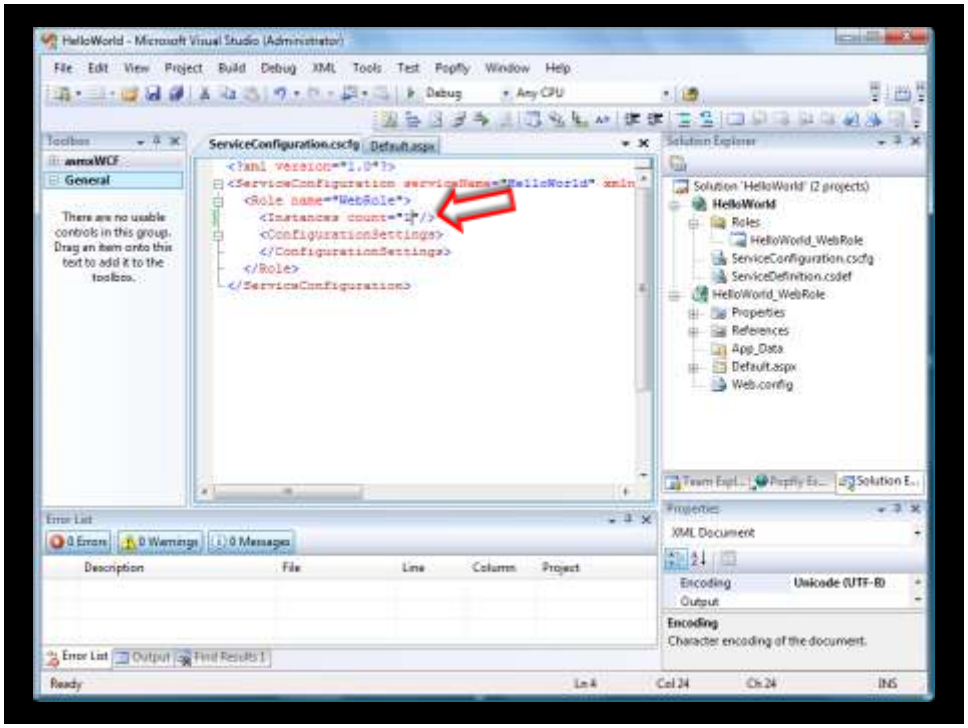
Hello World on Azure


New Project
Project types:
Templates:
.NET Framework 3.5
Visual C#
Windows
Web
Smart Device
Office
Database
Cloud Service
Roles
Reporting
Test
WCF
Workflow
"Oslo"
Other Languages
Other Project Types
Test Projects
Visual Studio installed templates
Blank Cloud Service
Web Cloud Service
Web And Worker Cloud Service
Worker Cloud Service
My Templates
Search Online Templates...
Web Cloud Service
Name:
HelloWorld
Location:
C:\Demos
Browse...
Solution:
Create new Solution
Create directory for solution
Solution Name:
HelloWorld
Add to Source Control
OK
Cancel


File Edit View Project Build Debug Tools Test Popfly Window Help
Debug
Any CPU
XHTML 1.0 Transition
Toolbox
Standard
Pointer
Label
TextBox
Button
LinkButton
ImageButton
HyperLink
DropDownList
ListBox
CheckBox
CheckBoxList
RadioButton
RadioButtonList
Image
ImageMap
Table
BulletedList
Default.aspx*
Client Objects & Events
(No Events)
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transi
<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
<title>Untitled Page</title>
</head>
<body>
<form id="form1" runat="server">
<div>
<h1>Hello World</h1>
</div>
</form>
</body>
</html>
Design
Split
Source
Solution Explorer - HelloWorld_WebR...
Solution 'HelloWorld' (2 projects)
HelloWorld
Roles
HelloWorld_WebRole
ServiceConfiguration.cscfg
ServiceDefinition.csdef
HelloWorld_WebRole
Properties
References
App_Data
Default.aspx
Web.config
Error List
0 Errors
0 Warnings
0 Messages
Description
File
Line
Column
Project
Properties
<H1>
(Id)
Align
left
Error List
Output
Find Results 1
Ready
Ln 12
Col 24
Ch 24
INS

Development Storage
Development storage services are starting up.


Hello World


HelloWorld - Microsoft Visual Studio (Administrator)
File Edit View Project Build Debug XML Tools Test Popfly Window Help
ServiceConfiguration.cscfg
Default.aspx
<?xml version="1.0"?>
<ServiceConfiguration serviceName="HelloWorld" xmln
<Role name="WebRole">
<Instances count="2" />
<ConfigurationSettings>
</ConfigurationSettings>
</Role>
</ServiceConfiguration>
Solution 'HelloWorld' (2 projects)
HelloWorld
Roles
HelloWorld_WebRole
ServiceConfiguration.cscfg
ServiceDefinition.csdef
HelloWorld_WebRole
Properties
References
App_Data
Default.aspx
Web.config
Error List
0 Errors
0 Warnings
0 Messages
Description
File
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Project
XML Document
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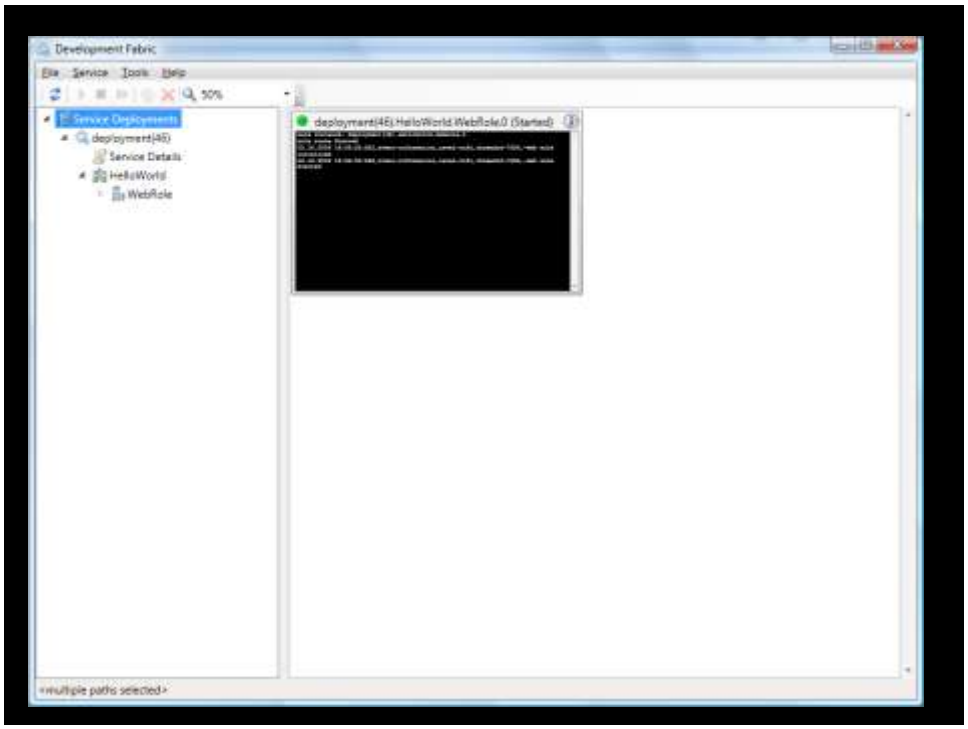
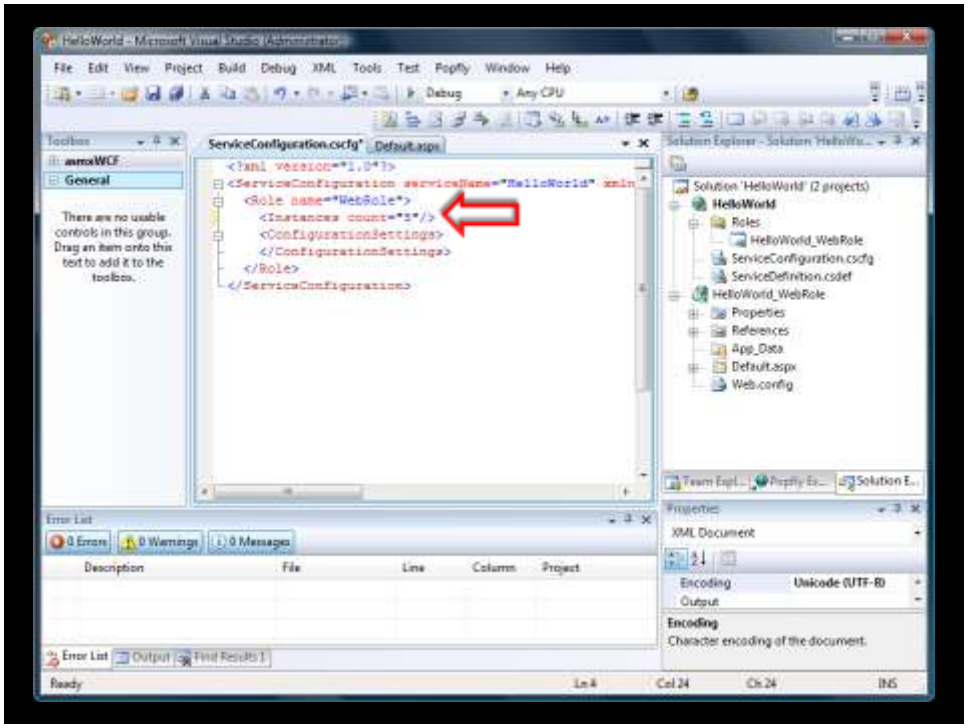
Unicode (UTF-8)
Output
Encoding
Character encoding of the document.
Ready
Ln 4
Col 24
Ch 24
INS


Development Fabric
File Service Tools Help
Service Deployments
deployment(46)
Service Details
HelloWorld
WebRole
deployment(46) HelloWorld.WebRole.0 (Started)
<multiple paths selected>


HelloWorld - Microsoft Visual Studio (Administrator)
File Edit View Project Build Debug XML Tools Test Popfly Window Help
ServiceConfiguration.cscfg*
Default.aspx
<?xml version="1.0"?>
<ServiceConfiguration serviceName="HelloWorld" xmln
<Role name="WebRole">
<Instances count="1" />
<ConfigurationSettings>
</ConfigurationSettings>
</Role>
</ServiceConfiguration>
There are no usable controls in this group. Drag an item onto this text to add it to the toolbox.
Solution 'HelloWorld' (2 projects)
HelloWorld
Roles
HelloWorld_WebRole
ServiceConfiguration.cscfg
ServiceDefinition.csdef
HelloWorld_WebRole
Properties
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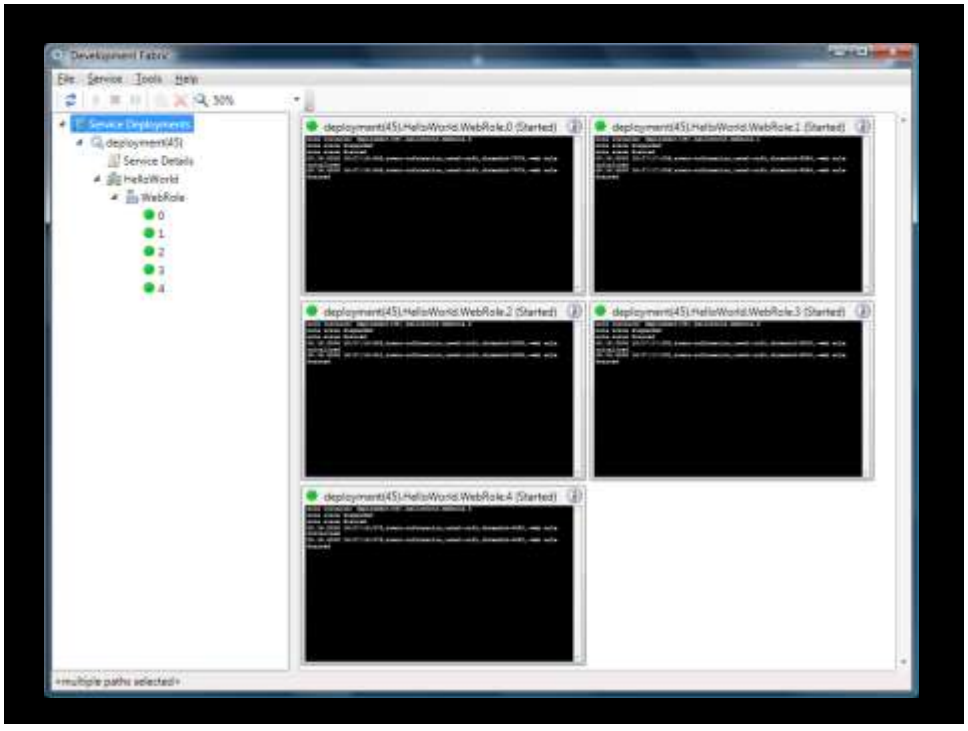
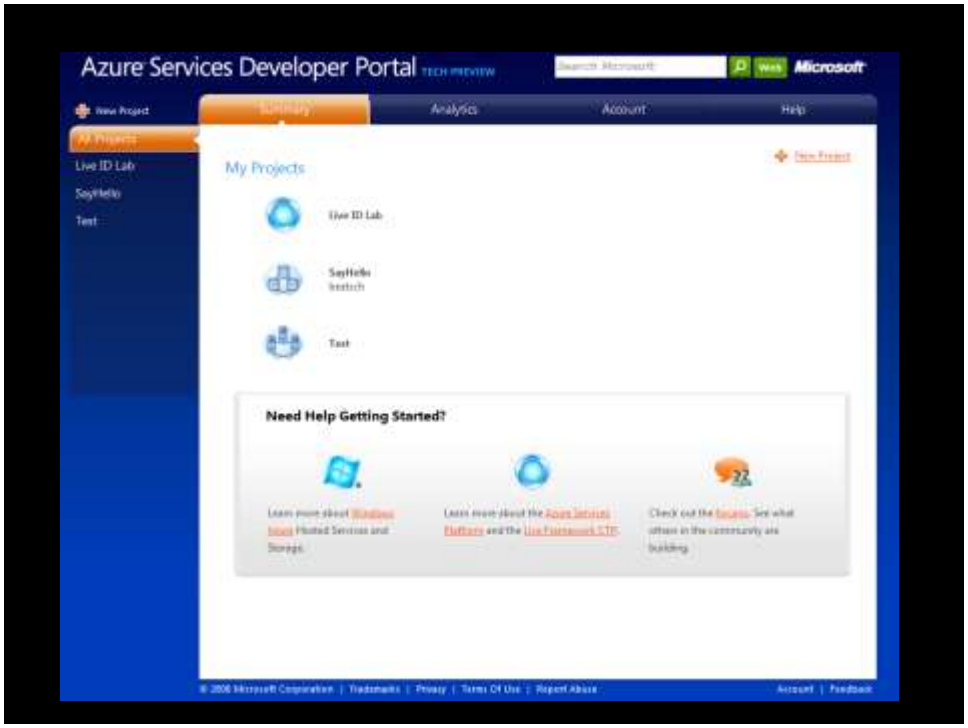
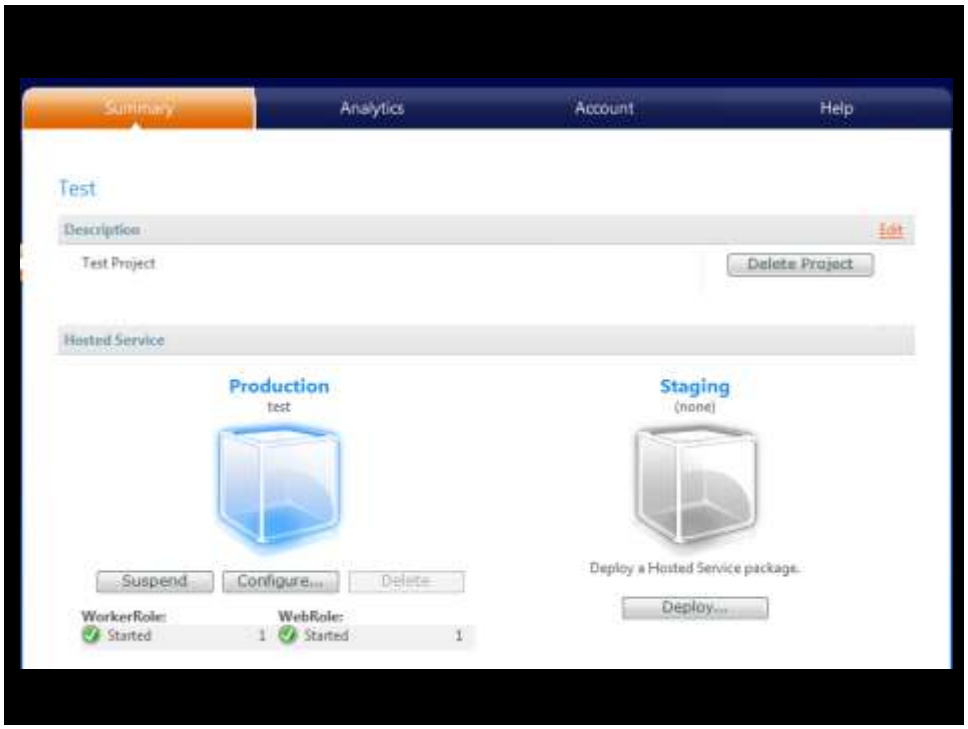
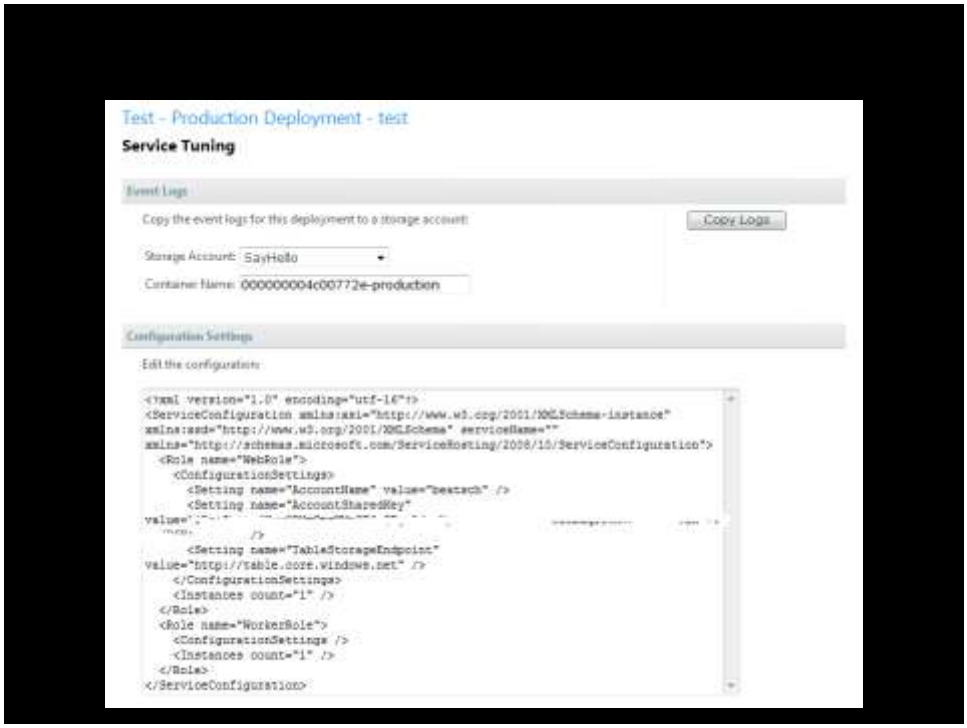
App_Data
Default.aspx
Web.config
Error List
0 Errors
0 Warnings
0 Messages
Description
File
Line
Column
Project
XML Document
Encoding
Unicode (UTF-8)
Output
Encoding
Character encoding of the document.
Ready
Ln 4
Col 24
Ch 24
INS


Development Fabric
File Service Tools Help
Service Deployments
deployment(45)
Service Details
HelloWorld
WebRole
0
1
2
3
4
deployment(45)\HelloWorld.WebRole.0 (Started)
deployment(45)\HelloWorld.WebRole.1 (Started)
deployment(45)\HelloWorld.WebRole.2 (Started)
deployment(45)\HelloWorld.WebRole.3 (Started)
deployment(45)\HelloWorld.WebRole.4 (Started)
<multiple paths selected>

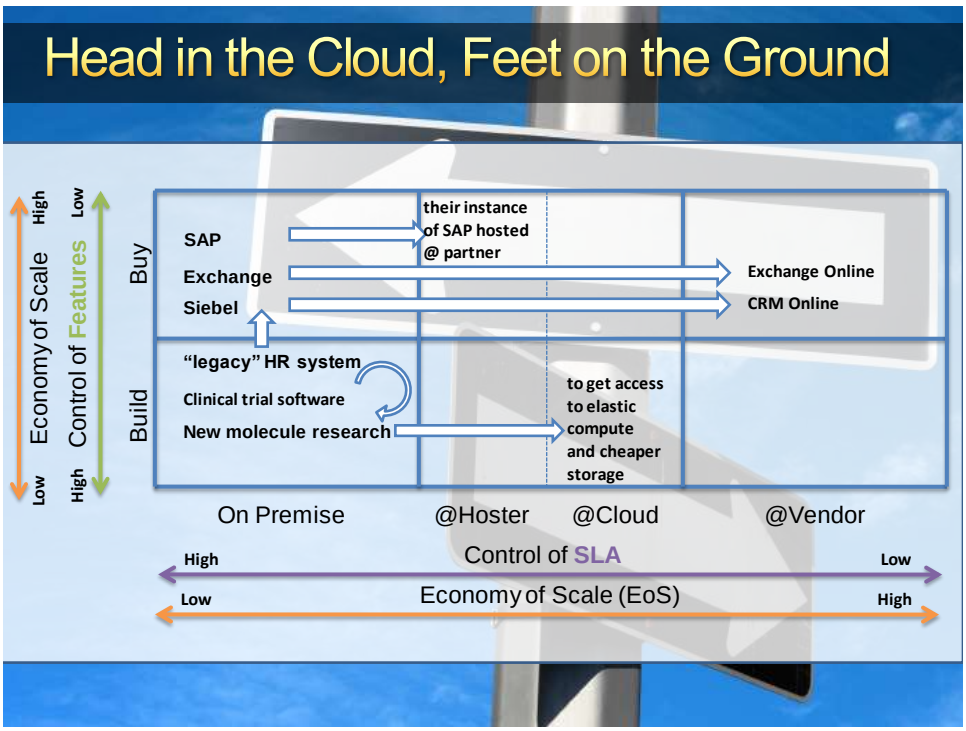

Azure Services Developer Portal
TECH PREVIEW
Microsoft
Summary
Analytics
Account
Help
My Projects
Live ID Lab
Test
Need Help Getting Started?

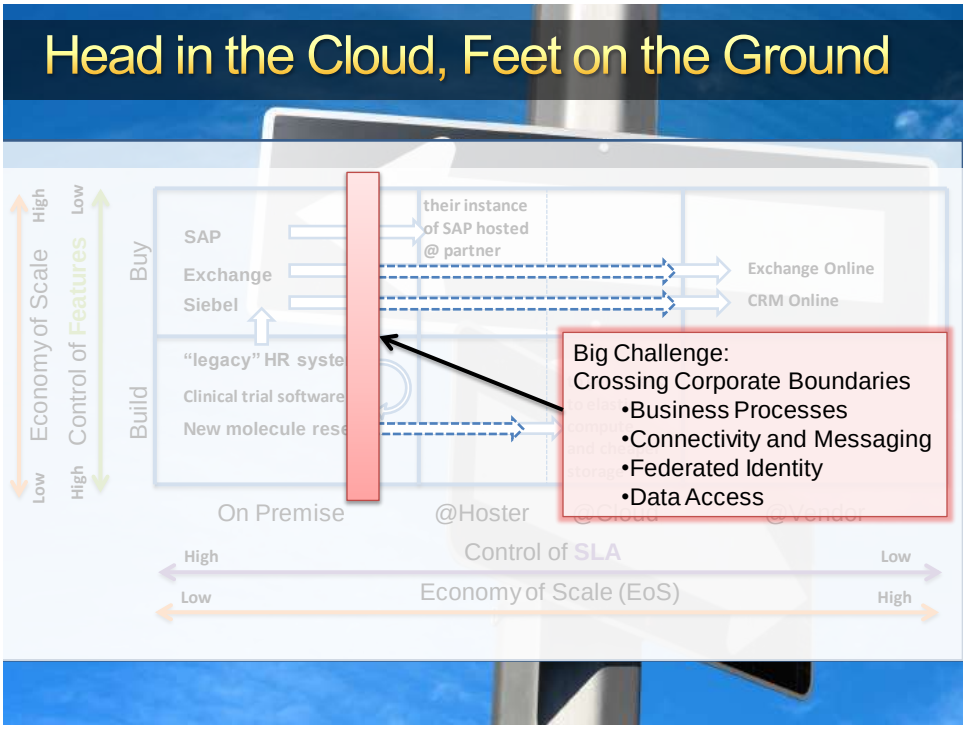

Summary
Analytics
Account
Help
Test
Description
Edit
Test Project
Delete Project
Hosted Service
Production
test
Staging
(none)
Suspend
Configure...
Delete
Deploy a Hosted Service package.
Deploy...
WorkerRole:
Started 1
WebRole:
Started 1


Test - Production Deployment - test
Service Tuning
Event Logs
Copy the event logs for this deployment to a storage account
Copy Logs
Storage Account: SayHello
Container Name: 000000004c00772e-production
Configuration Settings
Edit the configuration
<?xml version="1.0" encoding="utf-16"?>
<ServiceConfiguration xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" serviceName=""
xmlns="http://schemas.microsoft.com/ServiceHosting/2008/10/ServiceConfiguration">
<Role name="WebRole">
<ConfigurationSettings>
<Setting name="AccountName" value="beatech" />
<Setting name="AccountSharedKey"
<Setting name="TableStorageEndpoint"
value="http://table.core.windows.net" />
</ConfigurationSettings>
<Instances count="1" />
</Role>
<Role name="WorkerRole">
<ConfigurationSettings />
<Instances count="1" />
</Role>
</ServiceConfiguration>

A Look Inside Azure

Head in the Cloud, Feet on the Ground





.NET Services

- Extension of .NET capabilities to the cloud
- Leverage what you know to do things that are otherwise pretty hard
- 3 Services today, more to follow
  - .NET Service Bus
    connectivity and fan-out messaging necessary for many integrations
  - .NET Workflow Service
    reliably run workflows at scale
  - .NET Access Control Service
    authorization based on federated identities

Service Bus

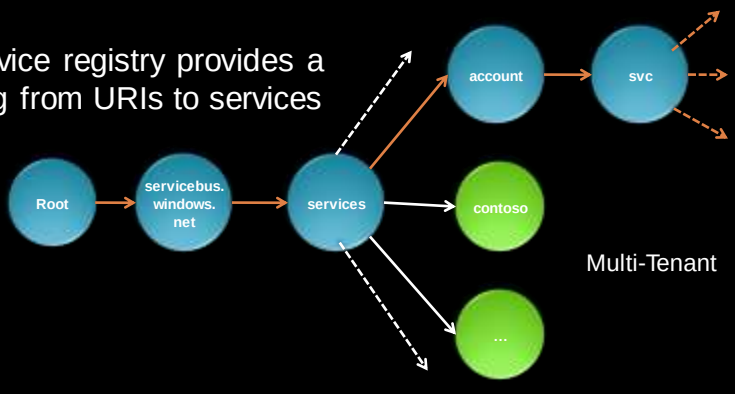
- Service Registry
- Relay and direct connect connectivity
- Publish/Subscribe
- Integrated with Access Control services

Service Registry

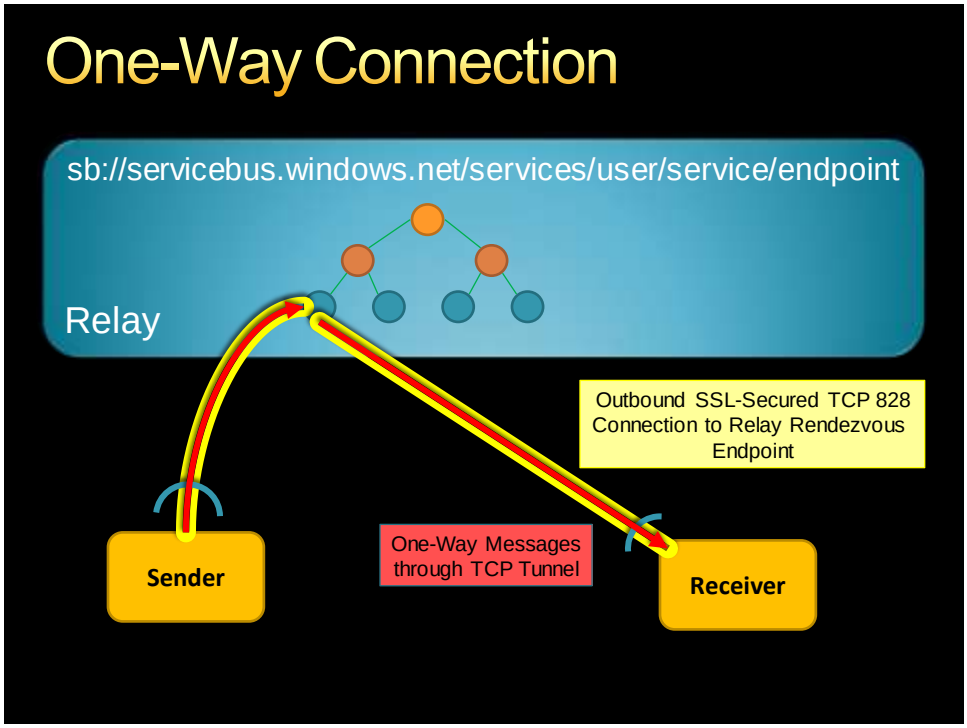
[http|sb]://servicebus.windows.net/services/account/svc/…

Service Registry Root

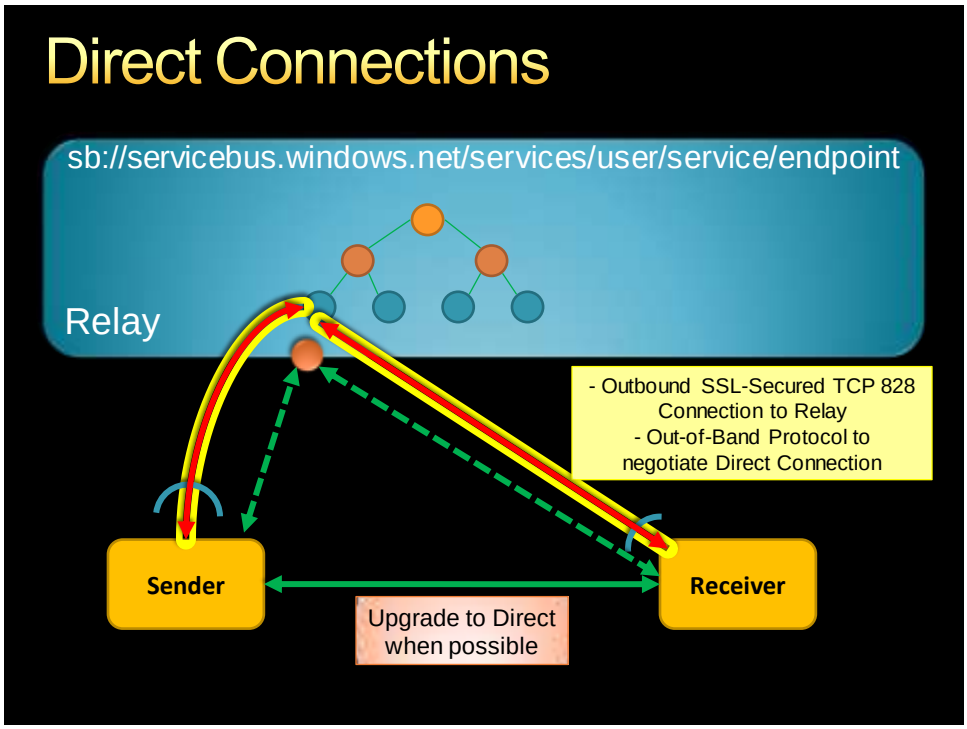
The service registry provides a mapping from URIs to services



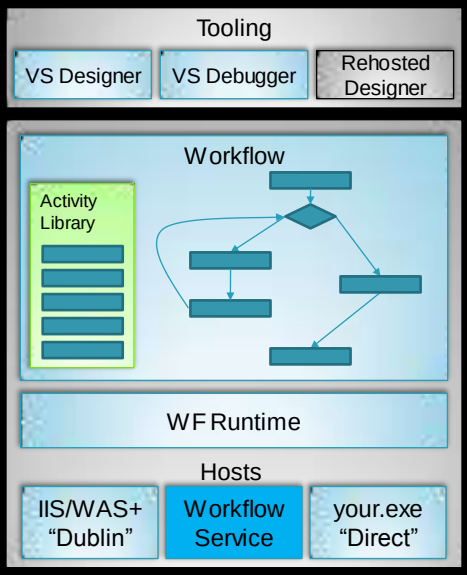
One-Way Connection



Direct Connections



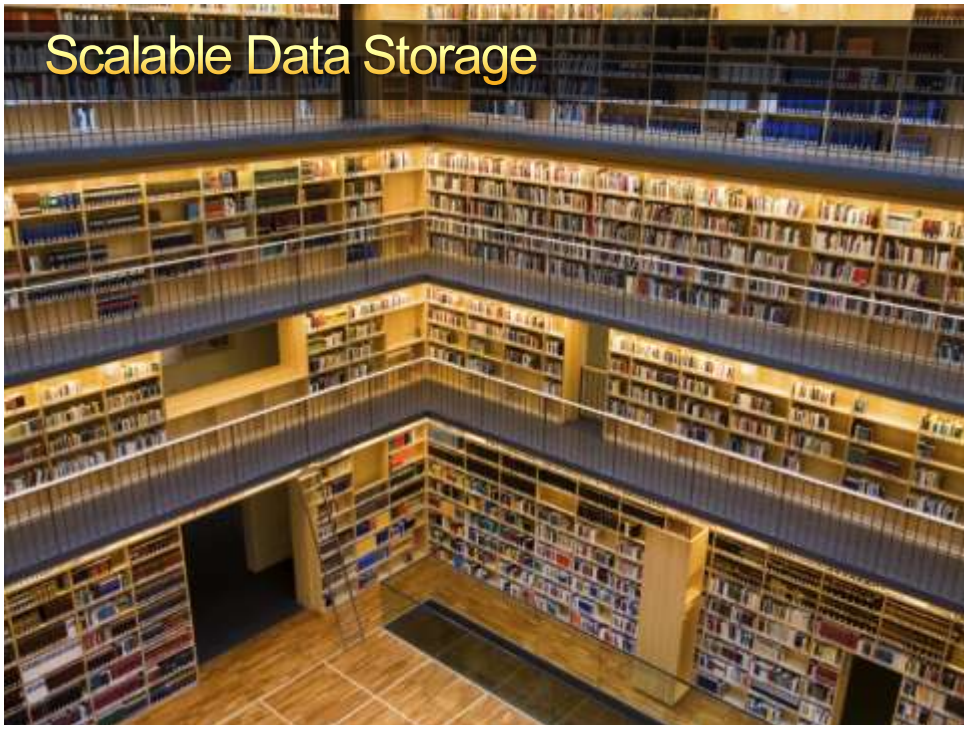
Windows Workflow Foundation



Workflow Service – Overview

A reliable, scalable off-premises host for workflows

- A portal at workflow.ex.azure.microsoft.com
- New activities for the Azure Services Platform
- APIs that allow you to deploy, manage, and run your workflows on the cloud
- Enables you to orchestrate services

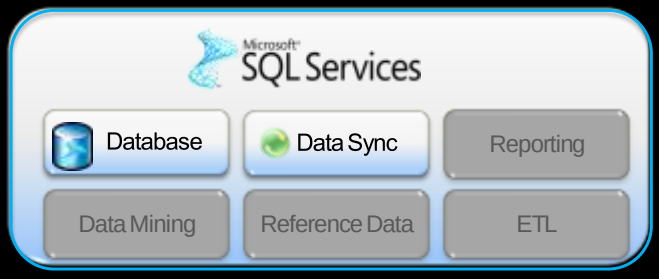


Scalable, Available Data Services

- Windows Azure Storage
  - "Essential storage service in the cloud"
  - Provides a core set of non-relational storage and retrieval abstractions at massive scale
- SQL Services
  - "Premium database service in the cloud"
  - Extends the rich capabilities of the SQL data platform to the cloud at scale
    - Relational data processing over structured and unstructured data
    - Integrate with key data platform capabilities – e.g. Data Analytics, Reporting, ETL

SQL Services Futures

Extending the SQL Data Platform to the cloud



- Data services tier of the Azure Services Platform
- Built on SQL Server foundation
- Broad data platform capabilities as a service
  - Friction-free provisioning, scaling
  - Significant investments in scale, HA, lights-out operation and TCO

Data Model And ACE Concepts

Authority

- Unit of geo-location and billing
- Tied to DNS name
- Collection of Containers

Container

- Unit of Consistency
- Scope for Query and Update
- Collection of Entities

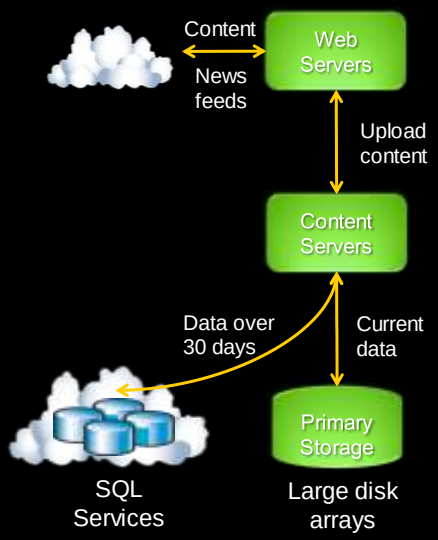
Entity

- Unit of Storage
- Property Bag of Name/ Value pairs
- No Schema required

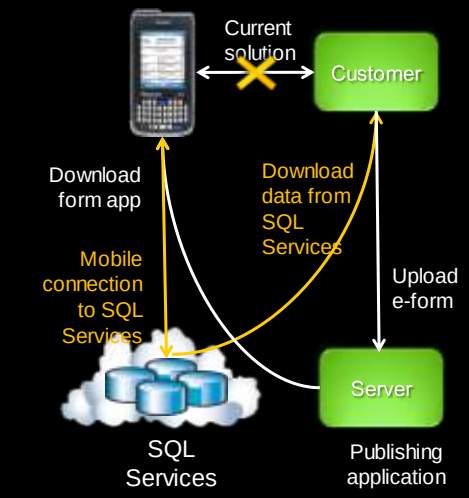
SQL Services supports Tabular Data Stream

- Tables
- Stored Procedures
- Triggers
- Views
- Indexes
- Visual Studio Compatibility
- ADO.Net Compatibility
- ODBC Compatibility

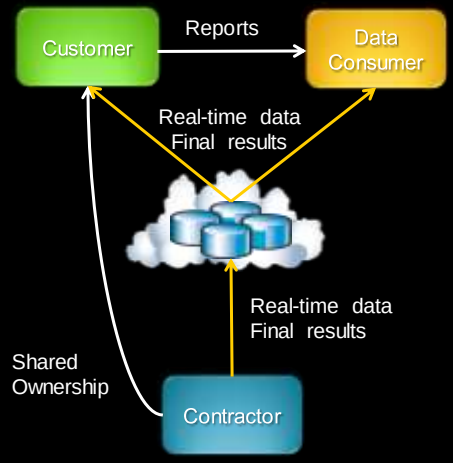
Scenario - Archival of Syndicated Content



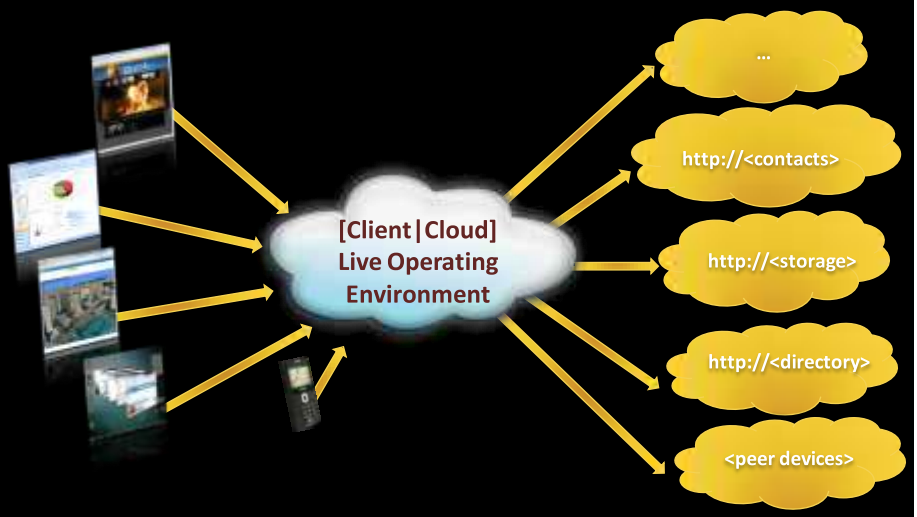
Scenario - Mobile Forms



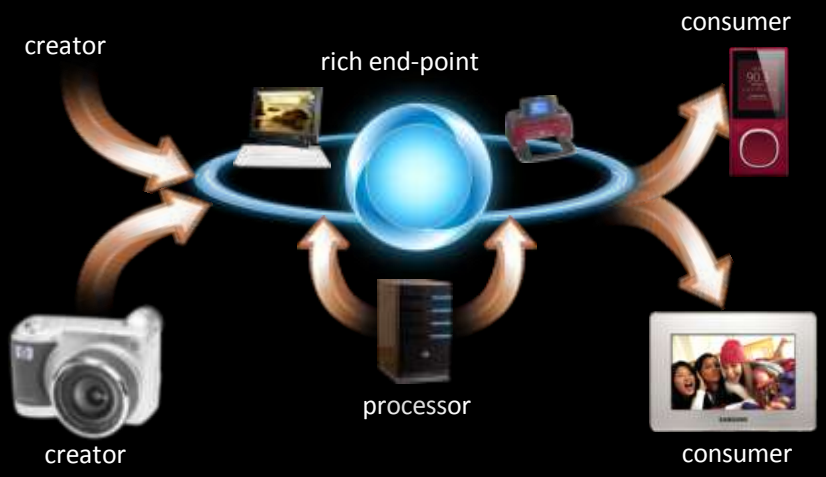
Scenario - B2B Data Sharing



Live Operating Environment

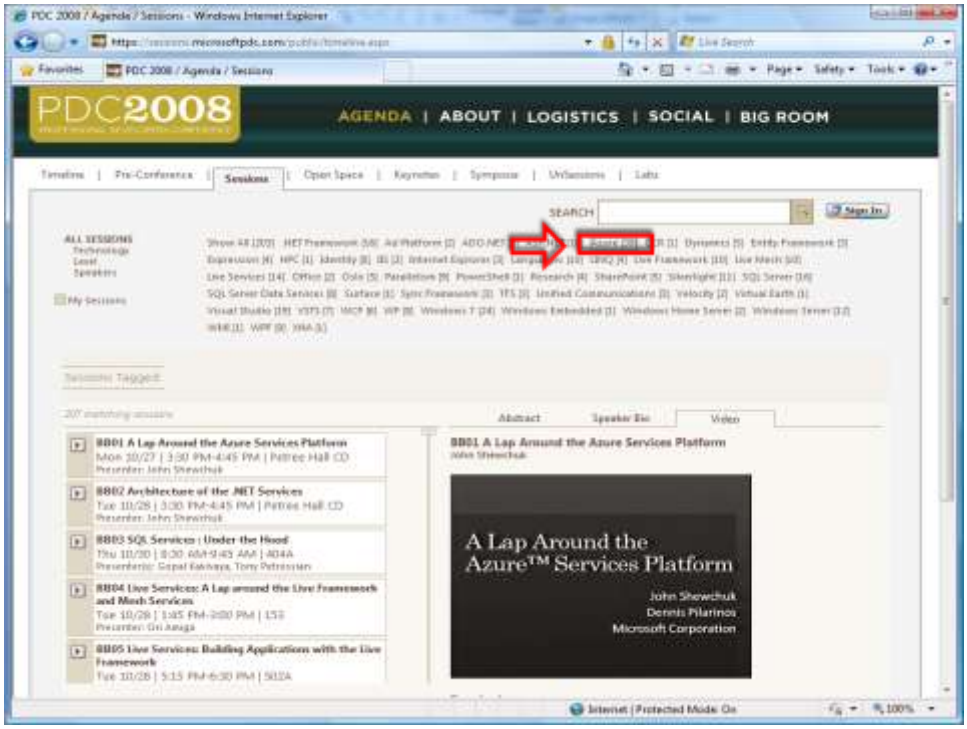


Device Scenarios



A Look Inside Azure

PDC2008
AGENDA | ABOUT | LOGISTICS | SOCIAL | BIG ROOM
Day 1 2 3 4
Cloud Computing Takes Center Stage
EVENT PHOTOS
TOP SESSION RECORDINGS
watch PDC session RECORDINGS
view PDC Hard Drive warranty infomation.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SEARCH
A Lap Around the Azure™ Services Platform
John Shewchuk
Dennis Pilarinos
Microsoft Corporation

Closing Thoughts

The Web-Tier provides tremendous opportunities

Windows Azure – An OS in the cloud for developing and running applications in the Web-Tier

Azure Service Platform – S+S building blocks