

Cloud Futures: Evolving Application Dev Trends on PaaS*

Rahul Chitale

Director – Cloud Services – Microsoft Public Sector

Rahulch@microsoft.com

**Some of the content represents my personal views and inferences and not a reflection of the Microsoft roadmap*

Agenda

Industry Trend: Convergence in Development Models

What is PaaS?

The Benefits of PaaS: A Closer Look

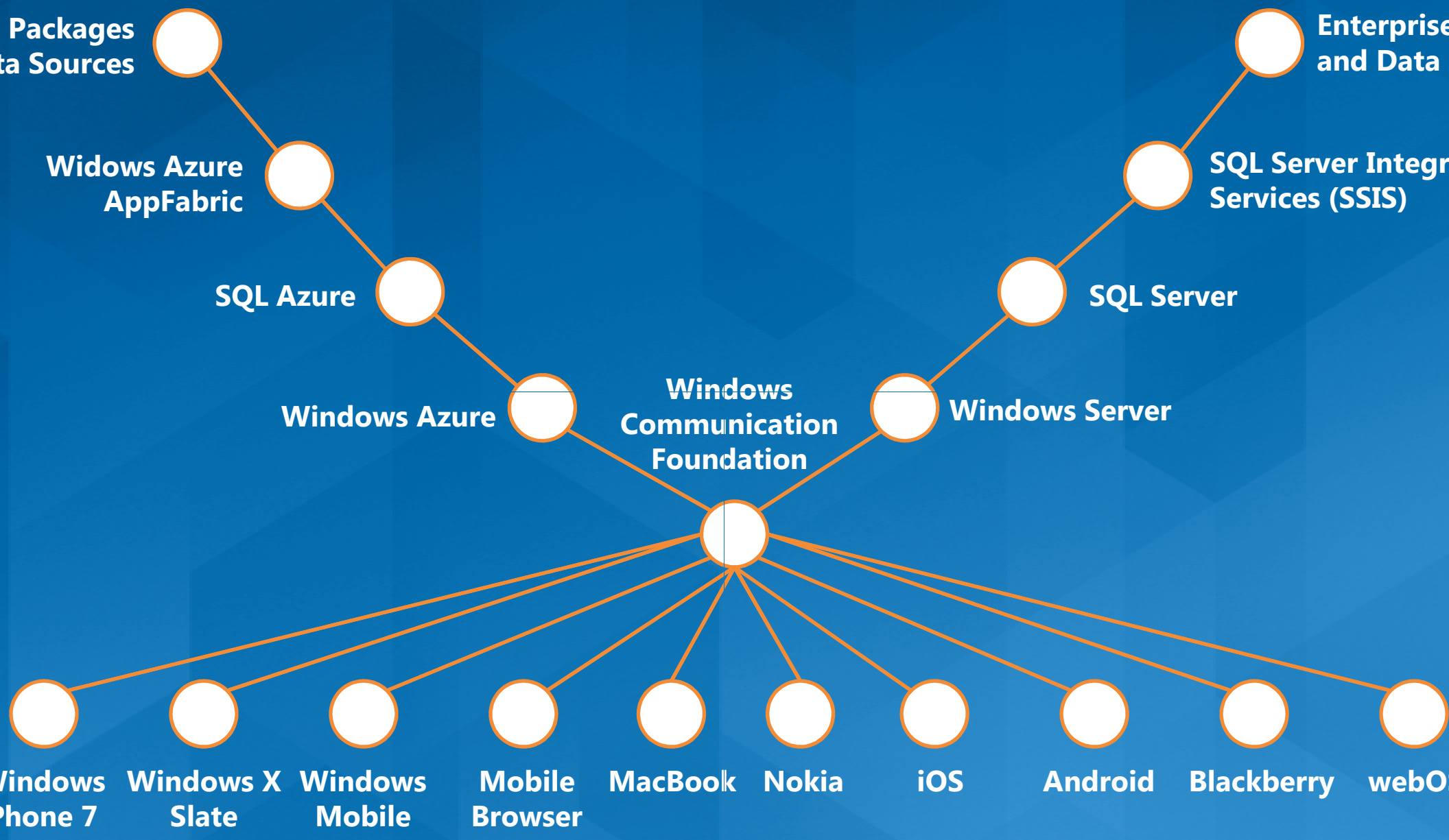
Applying PaaS to Compute: The Windows Azure
Programming Model

Applying PaaS in Other Areas: Storage and More

What can you expect from PaaS in the future ?

Cloud

On-Premise



What is PaaS?



IaaS and PaaS

Approaches for cloud platforms

Cloud platform technologies are commonly divided into two broad categories:

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)

IaaS appeared first

- Amazon Web Services (AWS) Elastic Compute Cloud (EC2) is IaaS

It's likely that PaaS will eventually dominate

- Although IaaS is more popular today

PaaS Examples

The Windows Azure platform takes a purely PaaS approach

- Compute: Windows Azure
- Storage: SQL Azure, Windows Azure tables and blobs
- Caching: Windows Azure AppFabric Caching
- Other services, including:
 - Windows Azure AppFabric Service Bus
 - Windows Azure App Fabric Access Control

Other public cloud platforms also offer PaaS

- Salesforce.com Force.com
- Google App Engine
- Amazon Web Services Elastic Beanstalk

Illustrating IaaS

Deploying a multi-tier application

Developer



1) Choose image, then create VM for DBMS and configure DBMS

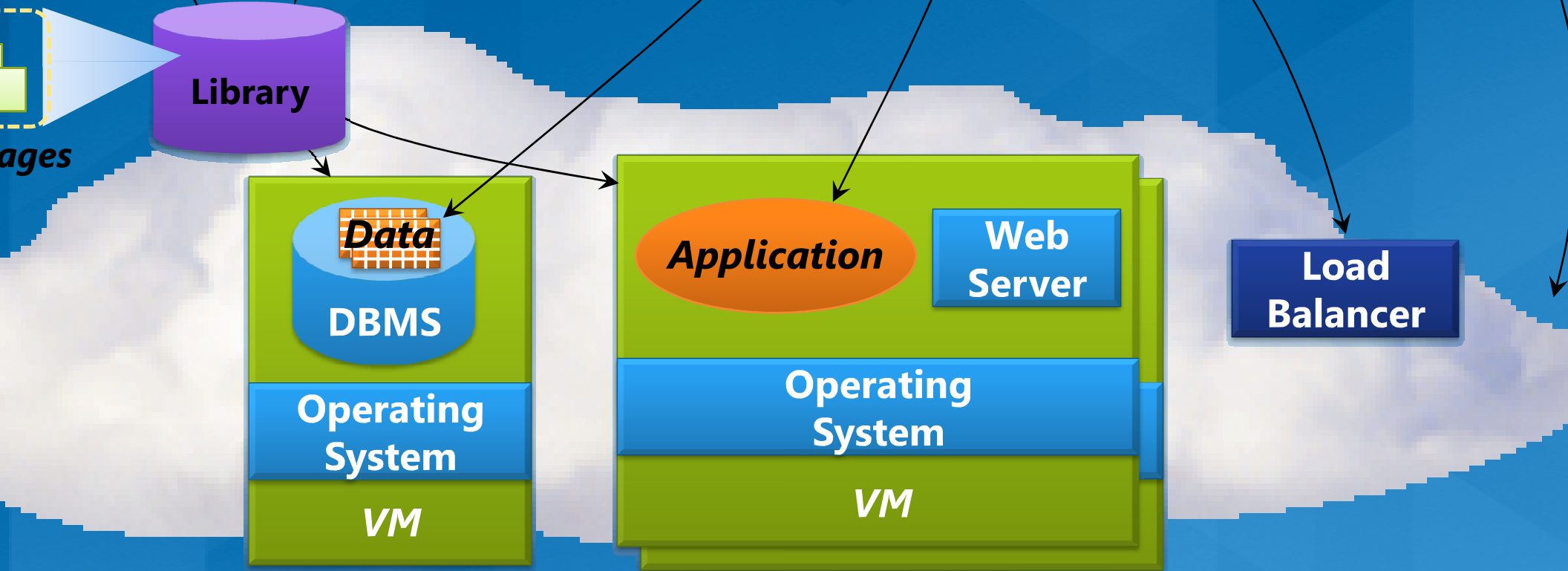
2) Choose image, then create and configure VM(s) for application

3) Provision database, then create tables and add data

4) Install application

5) Configure load balancer

6) Manage VMs and D... (e.g., deploying new images in VMs)



Illustrating PaaS

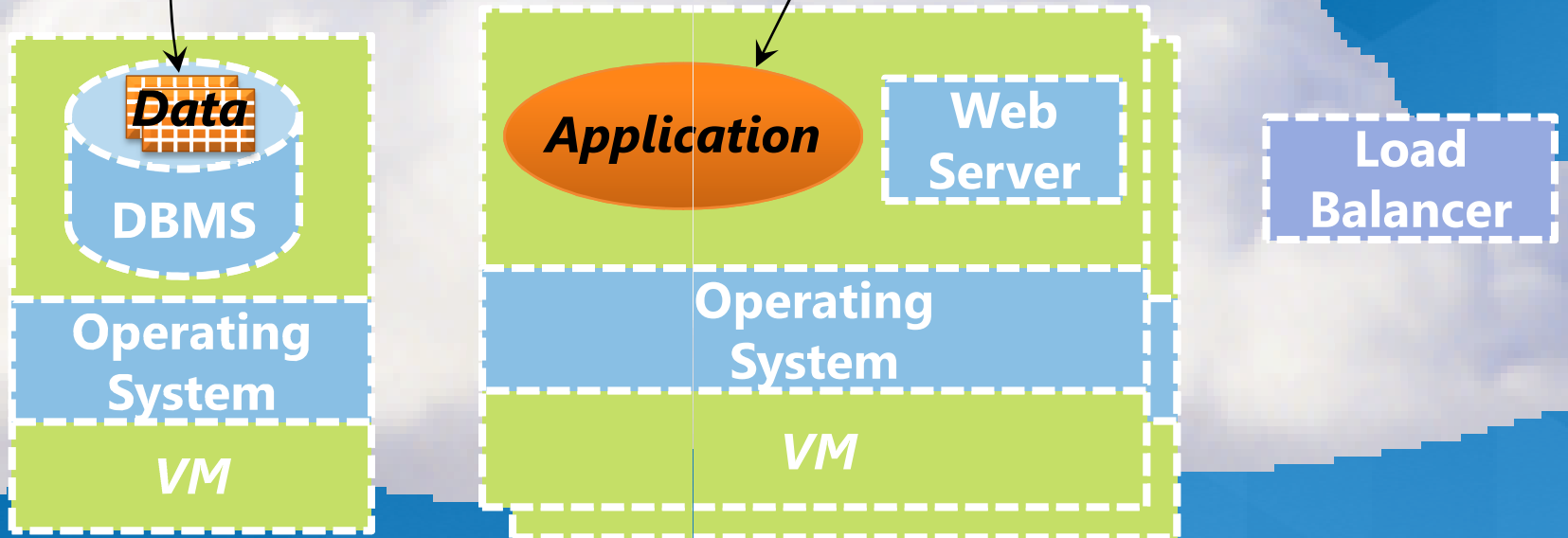
Running a multi-tier application

Developer



1) Provision database,
then create tables
and add data

2) Deploy
application



The Benefits of PaaS: A Closer Look



Categorizing the Benefits of PaaS

provided by the *Windows Azure* platform

Application design

Application development

Application test

Application deployment

Storage

Administration and management

Examining PaaS Benefits

Application design

What you're responsible for starts higher in the stack

- So there are fewer things to worry about

You can ignore many things:

- Choosing VM images
 - And ensuring that those images are secure
- Designing redundant VMs for scalability and high availability
- Designing for geo-distribution
 - With Windows Azure Traffic Manager

Examining PaaS Benefits

Application development

Because a PaaS platform provides more services than IaaS, there's less code to write

- Such as code that monitors and restarts failed VMs

Integration problems stemming from diverse environments are minimized

- Even distributed teams share the same execution platform

Examining PaaS Benefits

Application test

Because a PaaS platform provides more services than IaaS, there's less code to test

There's a consistent environment for development and test

- Test teams don't need their own test platform, e.g., a high-availability database cluster
- Test teams don't need to understand and track configuration changes in the environment

Examining PaaS Benefits

Application deployment

Deployment is automated: just submit the new app's code

- The PaaS platform deploys the code

Running applications can be updated in place

- Without downtime

You can use existing PaaS services without setup

- Such as storage and caching

Examining PaaS Benefits

Page

Data is replicated automatically

- Doing backups solely for recovery from hardware failures is less necessary

High availability is provided automatically

- Creating an HA database takes under a minute with SQL Azure

You don't need to administer storage

- No need to manually increase disk space, manage logs, etc.

Examining PaaS Benefits

Administration and management

You don't need administrators (or developers with administrative skills)

- A development group can create, test, and deploy apps themselves

You don't need to apply operating system updates

- The platform can update the operating system beneath a running application

Applying PaaS to Compute: The Windows Azure Programming Model



Why Create a New Programming Model?

Getting the benefits of PaaS requires writing applications to run differently

- The Windows Azure programming model isn't identical to the Windows Server programming model

The Windows Azure Programming Model

Summary in three rules

A Windows Azure application is built from one or more roles

A Windows Azure application runs multiple instances of each role

A Windows Azure application behaves correctly when any role instance fails

le 1

Windows Azure application is built from one or more roles

Windows Azure today supports three role types:

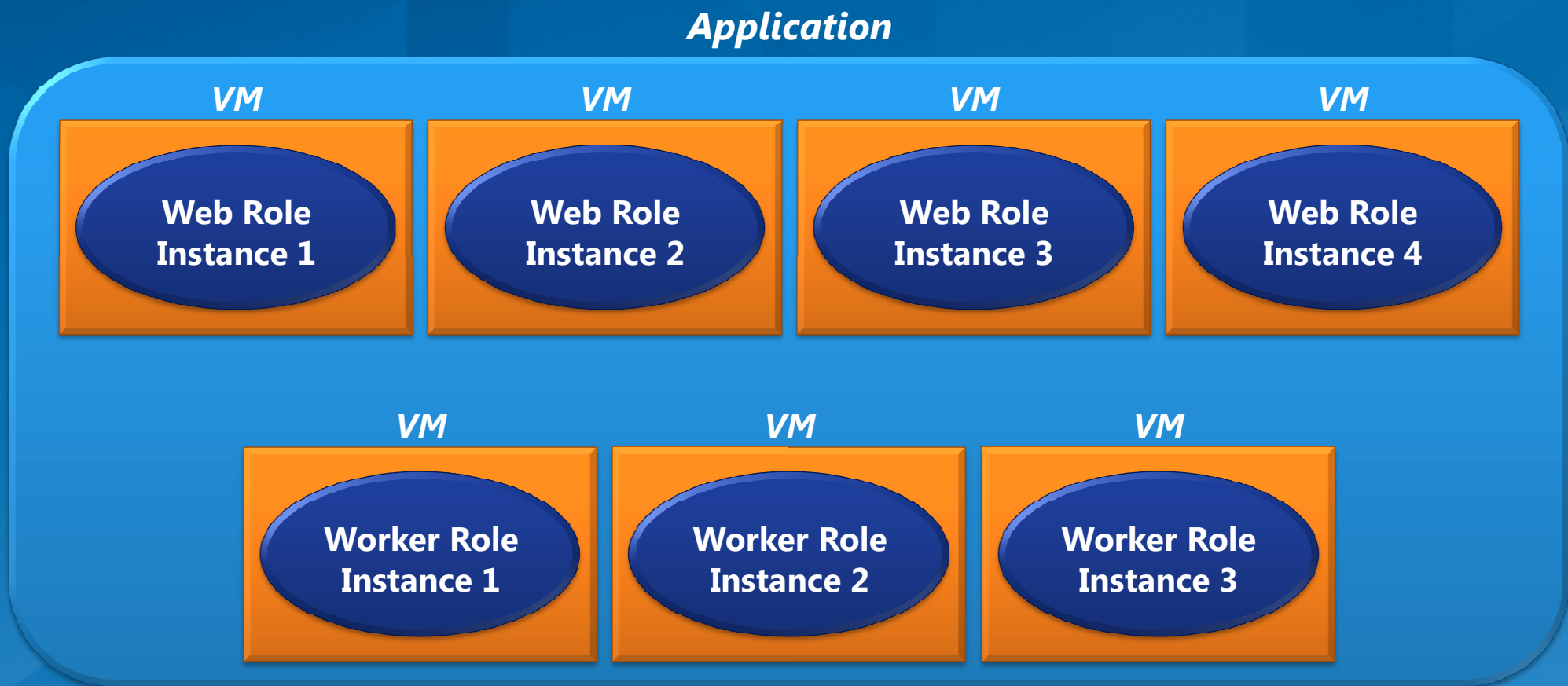
- Web role: Run IIS, intended for Web apps
- Worker role: Run arbitrary code
- VM role: Runs a customer-supplied Windows Server 2008 R2 V

A simple example:



le 2

Windows Azure application runs multiple instances of each role



le 3

Windows Azure application behaves correctly when any role instance fails



Applications of Rule 3

Storage must be external to role instances

- An instance shouldn't store data locally

Interactions between instances should be generic

- In general, a role instance shouldn't care which instance of another role it interacts with

Some Background: The Fabric Controller

The fabric controller owns all of the machines in a particular Windows Azure data center

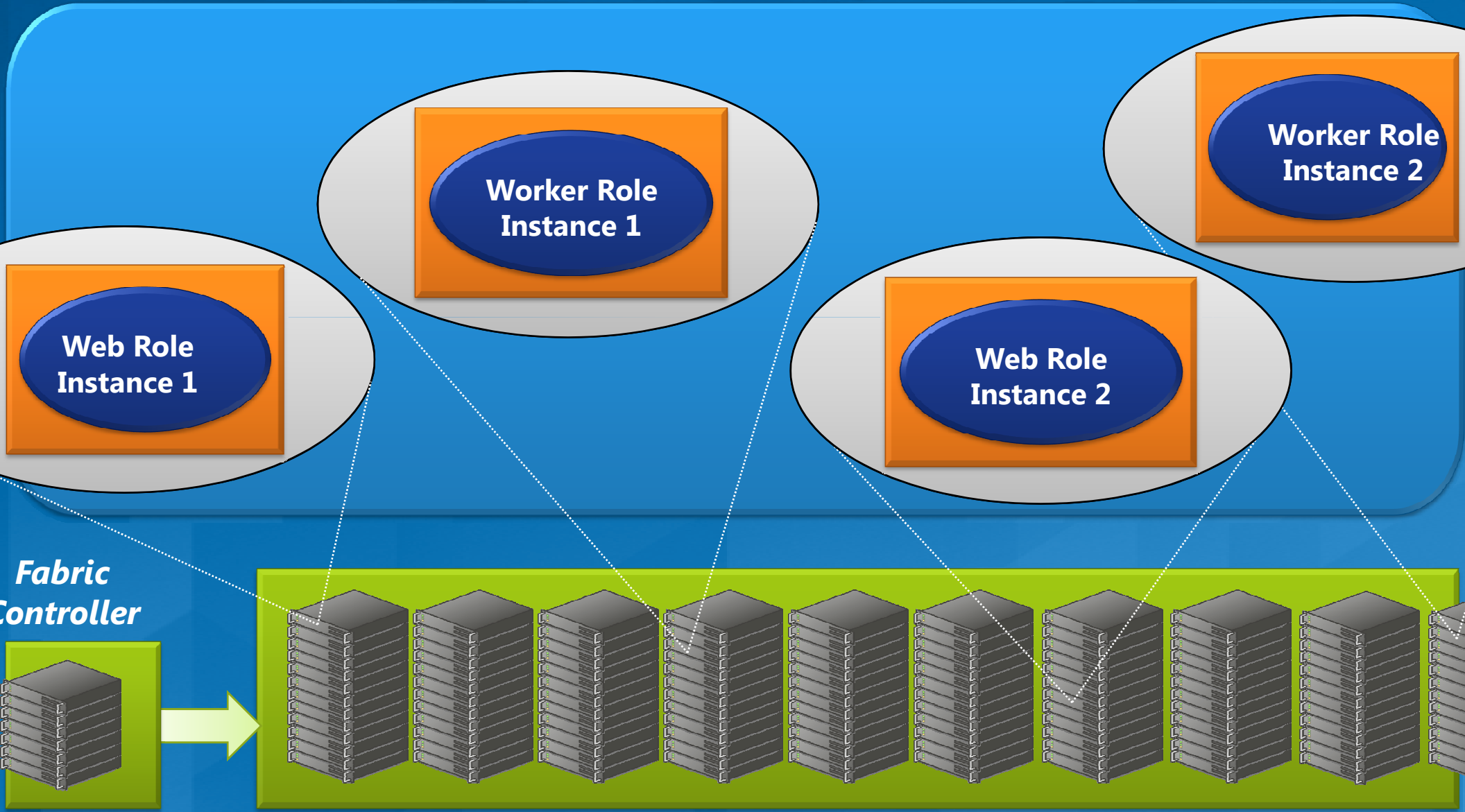
- It creates and monitors role instances on those machines

It starts new instances when:

- A new application is deployed
- An instance in a running application fails
- It needs to update system software in an instance virtual or physical machine
 - Such as Windows patches

Demonstrating the Fabric Controller

Application



What the Programming Model Provides

More easily scalable applications

- Role instances are created by the fabric controller
- The number of role instances can be changed dynamically

More available applications

- Protection against hardware failures
- Protection against software failures
- No-downtime application updates
 - With a single-step update, or
 - With a rolling update using *update domains*
- No-downtime system software updates
 - By shutting down some of a role's instances, updating their software, then restarting them

Interacting with the Operating System

For Web roles and Worker roles, the fabric controller owns the OS

- It updates each instance's OS when necessary
- Any changes you make must be applied again each time an instance starts

For VM roles, the customer owns the OS

- You must update it

For all roles, the fabric controller owns the OS of the underlying physical machine

- It patches it, then reboots when necessary

Moving Applications to Windows Azure

Examples (1)

An ASP.NET application with multiple load-balanced instances that share state stored in SQL Server

- An easy move
- It already matches the Windows Azure programming model

An ASP.NET application with multiple instances that maintains per-instance state and relies on sticky sessions

- Requires some work

Moving Applications to Windows Azure

Examples (2)

A client accessing WCF services running in a middle tier

- If the services don't maintain per-client state between calls, an easy move
- Otherwise, some redesign will be required

An application with a single instance running on Windows Server that maintains state on its own machine

- Some redesign needed
- Running the app in a VM role will likely make customers unhappy
 - Don't confuse VM roles with IaaS

Applying PaaS to Other Services: Storage and More



aS Storage

olutions on the IaaS/PaaS continuum

Running SQL Server in an AWS EC2 VM

AWS Relational Database Service (RDS)

SQL Azure

Windows Azure table and blob



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PaaS Storage

What the Windows Azure platform provides

SQL Azure provides:

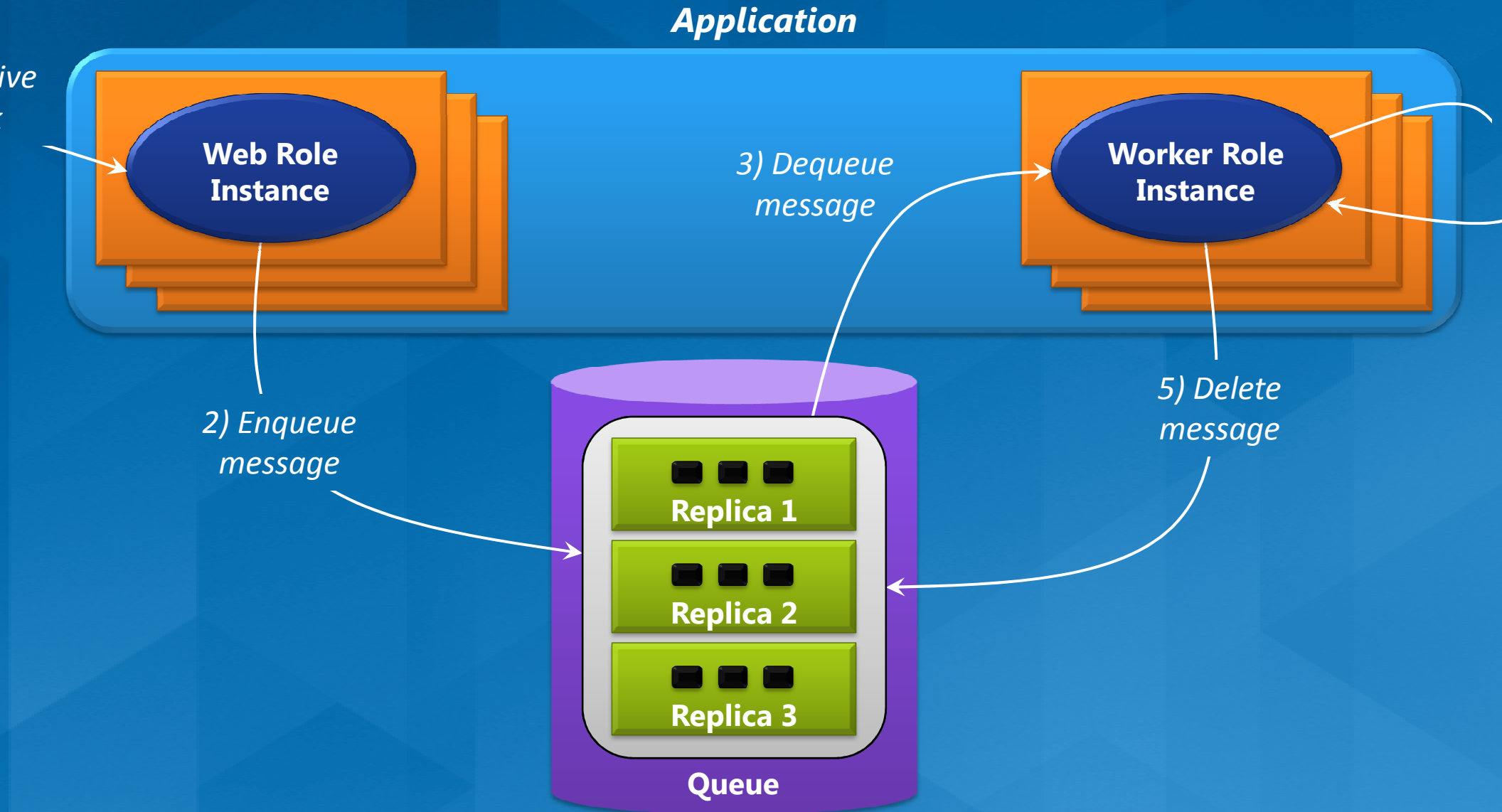
- PaaS relational storage with SQL Azure Database
- PaaS reporting services with SQL Azure Reporting
- PaaS data synchronization SQL Azure Data Sync

Windows Azure provides:

- PaaS scale-out storage with tables
- PaaS blob storage with blobs

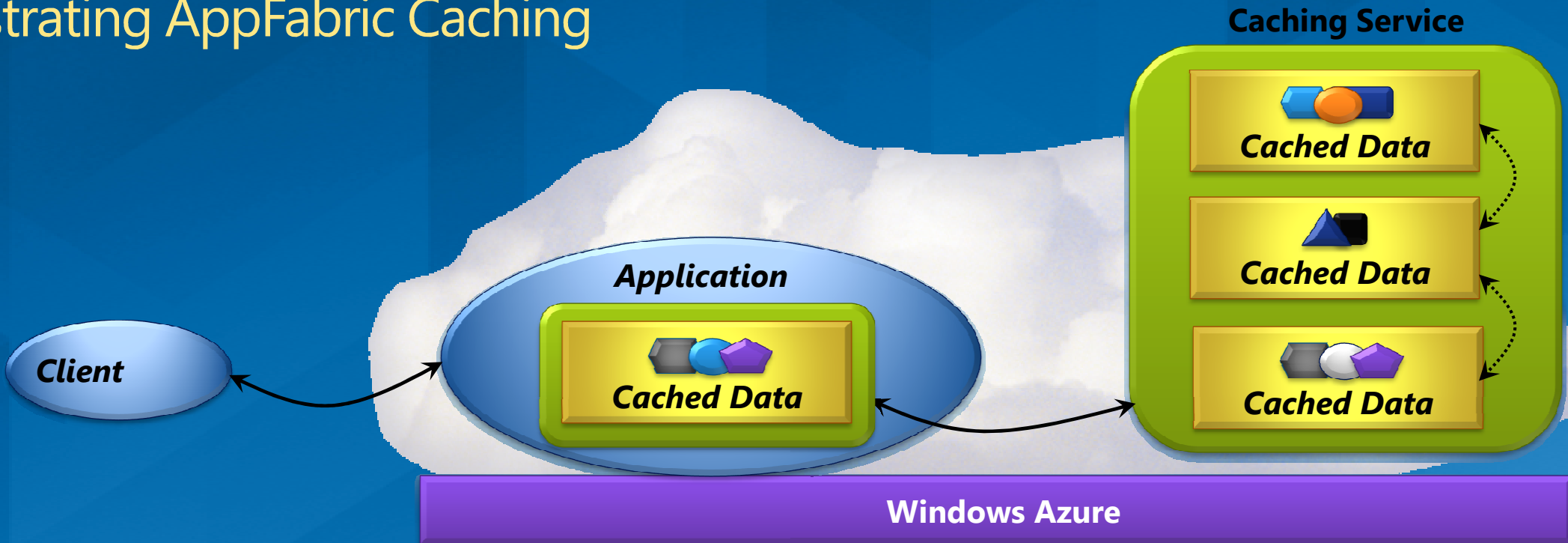
aaS Queuing

Illustrating Windows Azure Queues



aaS Caching

Illustrating AppFabric Caching



Provides data caching for Windows Azure apps

It's a PaaS service

- The customer doesn't instantiate or manage the service

The Future of PaaS: Everywhere !



Looking Ahead

7 Scenarios

Marketplaces: Apps & Data, Public & Private

Big Data

StreamInsight

Identity

Integration

HPC in the Cloud

Scenario: HPC in the Cloud

Digital Image Pathology

- Acquire, manage, interpret, and share pathology cases from digitized glass slides

Usage

- Determining clinical trial eligibility
- Probability of changed diagnoses impacting trial outcome (Clinical Trial Development)
- Supporting advanced translational research initiatives (biomarker identification ~ DNA)

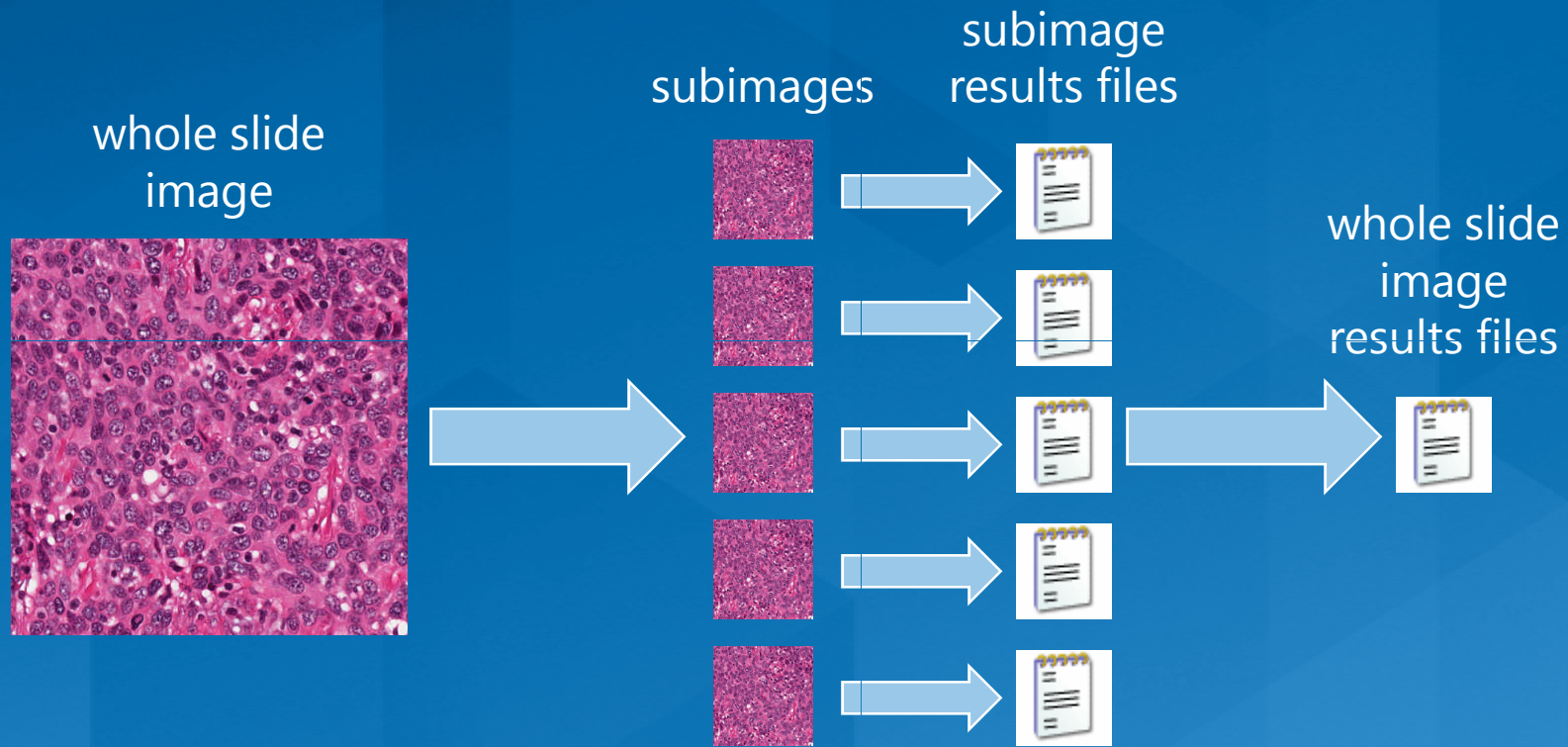
No private health information concerns – only image analysis

otivation

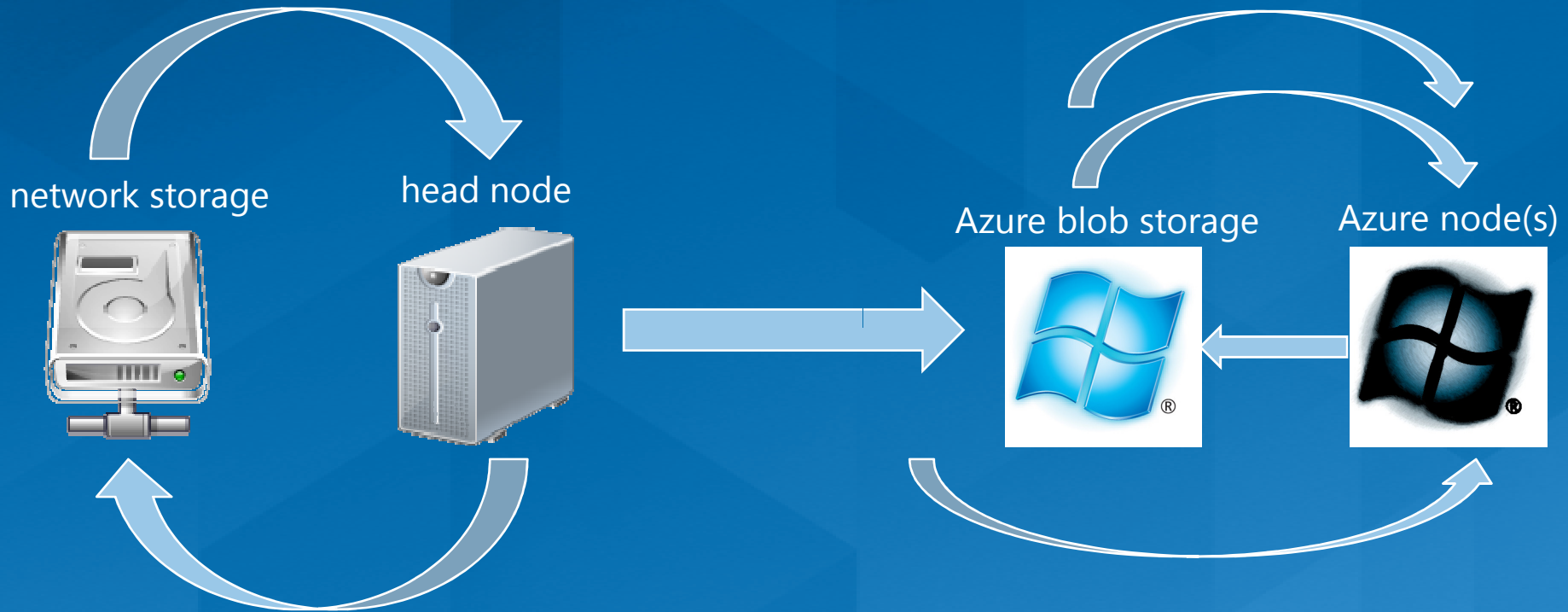
Digital Image Pathology

- Average image size:
 - 32,500 x 59,000 pixels
 - 300 MB
- Quality assurance currently performed by imaging technicians
- Automated detection of poor quality images would save time, manpower and speed acceptance into clinical trial

ur Detection Algorithm

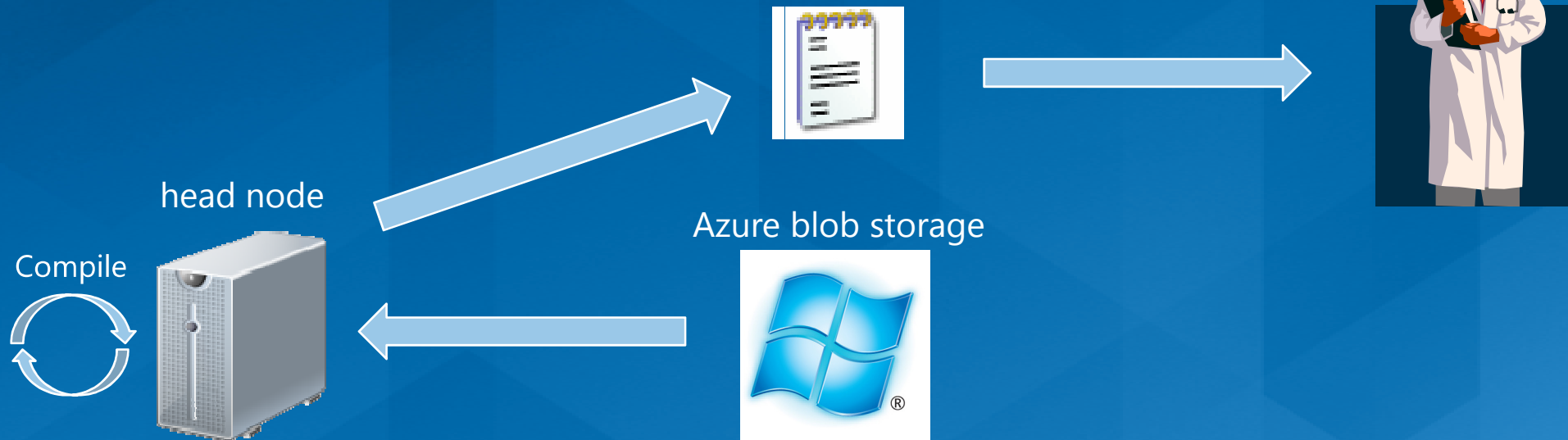


Start Process



- Executable transferred to Azure nodes via hpcpack and hpcsync
- Sub-images transferred to Azure blob storage via C# wrapper
- Job submitted via C# wrapper and executed on Azure node(s)
- Azure nodes return analysis to storage

d Process



- Results files transferred from blob storage to head node via C# wrapper
- Results files compiled into summary numeric result file on head node
- Technician reviews results to determine if further scans are necessary

PaaS Everywhere

Microsoft provides PaaS in its own public cloud today with the Windows Azure platform

- Microsoft will also provide Windows Azure-based PaaS for non-Microsoft public clouds and for private clouds

PaaS outside Microsoft's public cloud will be provided via the *Windows Azure Platform Appliance (WAPA)*

- WAPA is a preconfigured hardware/software solution
 - Currently in limited production release with Dell, eBay, Fujitsu, and HP
 - Each deploying ~1,000 servers
- WAPA isn't yet broadly available
 - It won't be mainstream for at least a few years

Conclusion

PaaS will likely be the dominant cloud platform style in the future

- Although IaaS has a role to play

Especially for new public cloud applications, PaaS is generally the best choice:

- It makes application development and deployment faster
- It makes application management cheaper
- It lowers risk

Further Reading

The Windows Azure Programming Model

<https://profile.microsoft.com/RegSysProfileCenter/wizard.aspx?wizid=1a934602-5005-4b9ec-220bc5ae6a95&lcid=1033>

IT as a Service: Transforming IT with the Windows Azure Platform

<http://download.microsoft.com/download/C/D/A/CDAE9B95-F03A-4C80-AC07-3B03AF42817B/ITasaService-v1.pdf>

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Examining PaaS Benefits

Administration and management

Automated, Consistent Application Updates	<ul style="list-style-type: none">➤ Automated updates resulting in consistent instances➤ Local storage and OS are left untouched during application updates
Automated, Consistent Configuration Changes	<ul style="list-style-type: none">➤ Automated configuration changes➤ Local storage and OS are left untouched
Scale-out	<ul style="list-style-type: none">➤ Automated scale-out and initial deployment➤ Model-driven scaling control
Multi-Instance Management	<ul style="list-style-type: none">➤ Identical instances deployed across the service, guaranteeing consistency➤ No configuration drift across multiple instances
High Availability	<ul style="list-style-type: none">➤ No application downtime during updates➤ Resilient to hardware and application failures
Automated, Consistent OS Servicing	<ul style="list-style-type: none">➤ Image-based OS patching➤ Consistent and automated OS security updates
Reliability	Benefits

Admin/Management 2

Windows Azure diagnostics: they're part of Microsoft.com, and they were the first Azure app to be onboarded to Microsoft.com. Doing this added no tool and no people—there was no cost to them. Level 1 and level 2 support people don't even know that it's Azure. On Amazon, you'd need to connect System Center to your VMs, then monitor this. With Azure, the app writes events to Windows Azure diagnostics, then use some code available for System Center that connects these diagnostics with System Center. This code is the Windows Azure Management Pack for System Center, which shipped a few months ago. This thing connects to the Windows Azure diagnostics. You don't need to manage the conventional things that an MP manages, since Azure does this and you don't need to write an MP for your app—you can just use this. This is another example of PaaS benefits – You can look at all of this as handcuffs being enabling—look at it as enabling.

The Benefits of PaaS

Summary

PaaS is faster

- Reason: There's less work for developers to do
- Benefit: Applications can go from idea to availability more quickly

PaaS is cheaper

- Reason: There's less admin and management work to do
- Benefit: Organizations spend less supporting applications

PaaS lowers risk

- Reason: The platform does more, leaving fewer opportunities for error
- Benefit: Creating and running applications gets more reliable

The Drawbacks of PaaS

Summary

It's unfamiliar to developers

- It's harder to adopt because they must learn the PaaS platform

Developers have less control

- They must work within the constraints of the PaaS technology

PaaS can raise fears of vendor lock-in

- Because it's not identical to an existing on-premises environment

Moving existing applications to PaaS can be hard

- It's easier to make an IaaS platform look just like an existing on-premises environment

More Affordable Platform Access

Ultra Small Instances

Designed for small scale web applications

Mix and match with larger VM Instances

Instance Size	CPU	Memory	Instance Storage	I/O Performance	Price
Small	1.0 GHz	768 MB	20 GB	Low	\$.05 per hour
Medium	1.6 GHz	1.7 GB	225 GB	Moderate	\$.12 per hour
Large	2 x 1.6 GHz	3.5 GB	490 GB	High	\$.24 per hour
X-Large	4 x 1.6 GHz	7 GB	1000 GB	High	\$.48 per hour
XX-Large	8 x 1.6 GHz	14 GB	2040 GB	High	\$.96 per hour

SQL and NoSQL

Relational	Key Value	Document	Wide Column	Graph
SQL Azure Oracle MySQL Amazon RDS	SQL Azure WA Table Storage Project Voldemort Amazon SimpleDB Amazon Dynamo	SQL Azure* CouchDB MongoDB	SQL Azure* BigTable Cassandra Hbase	FlockD Neo4 Graph
