

Patterns for Cloud Computing

Simon Guest
Senior Director, Technical Strategy
Microsoft Corporation



San Francisco 2009

Tutorials: Nov 16-17
Conference: Nov 18-20

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Patterns for Cloud Computing



Patterns for Cloud Computing



This is Jim

Patterns for Cloud Computing



Jim has many questions about cloud computing

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The more he reads, the more confused he gets

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Are SaaS & Cloud Computing Interchangeable Terms?

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Feb 16th, 2009, 10:24 am

A couple of weeks ago Alfresco CTO [John Newton](#) posted the following tweet on Twitter:
*"Does **Cloud** = **SaaS** [Software as a Service]? I don't think so. **Cloud** is **computing**, more like electricity."*

My gut reaction was that they were equal, and up until that moment I had used the terms interchangeably, but Newton's post got me thinking that perhaps they were different. **SaaS** applications use **cloud** platforms, but are not exactly **cloud computing**. The more I thought about it, however, the less clear it got, so I decided to do some research and also take my questions directly to some **cloud computing** experts and ask if the two terms were indeed synonymous or if they were as Newton opined, completely different.

"What is cloud computing?"

Patterns for Cloud Computing

August 19th, 2008

Piecing together Microsoft's cloud-computing vision

Posted by Mary Jo Foley @ 6:37 am

Categories: [.Net Framework](#), [Code names](#), [Corporate strategy](#), [Database](#), [Development tools...](#)

Tags: [Zurich](#), [Operating System](#), [Vision](#), [Microsoft Corp.](#), [Service...](#)



5 TalkBacks

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+3

WORTHWHILE?

7 VOTES

The term "cloud computing" has become almost meaningless — being used synonymously for everything from software-as-a-service (SaaS), to platform-as-a-service (PaaS).

But a new white paper, sponsored by Microsoft and written by the always entertaining consultant David Chappell, provides more clues about what the Softies are planning to unveil at this October's Professional Developers Conference. For anyone looking to understand how and where [Red Dog](#), [Zurich](#), [BizTalk Services](#) and [SQL Server Data Services \(SSDS\)](#) all fit together, the 13-pager is worth a read.

Chappell, who provided [an insightful talk at TechEd in June on Microsoft's "Oslo" initiative](#) (while managing to tread safely through a minefield of non-






"What are vendors doing in this space?"

Patterns for Cloud Computing

The myth of cloud computing

Virtualization can save money -- and open up new security issues

By Bill Brenner

 Comments (0)  Recommended (10)  Digg  Twitter  ShareThis

December 1, 2008 (CSO) Companies hungry for IT efficiency and cost savings absolutely love virtualization. The idea of reducing racks of servers into smaller and cheaper machine farms is simply irresistible in just about every enterprise.

[Security vendors](#) have seized on this with an array of products promising "[security in the cloud](#)." But the adopters often lack a basic understanding of what virtualization is about, and that's a problem, industry experts say.

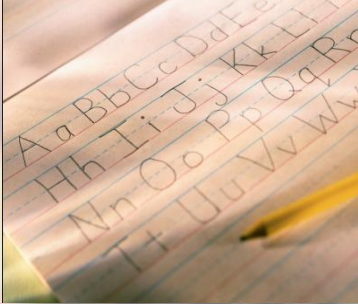
"When you look at how people think of virtualization and what it means, the definition of virtualization is either very narrow -- that it's about server

*"What **applications** make sense in the cloud?"*

Session Objectives



Session Objectives



Build on Stefan's introduction of
of cloud computing



Provide you with 5 patterns for
cloud-based applications



Show implementations of
these patterns

Defining Cloud Computing



Defining Cloud Computing

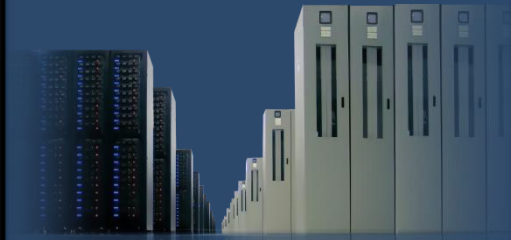
Application runs
on-premises



- Bring my own machines, connectivity, software, etc.
- Complete control and responsibility
- Upfront capital costs for the infrastructure

Defining Cloud Computing

Application runs **on-premises**



- Bring my own machines, connectivity, software, etc.
- Complete control and responsibility
- Upfront capital costs for the infrastructure

Application runs at a **hoster**



- Rent machines, connectivity, software
- Less control, but fewer responsibilities
- Lower capital costs, but pay for fixed capacity, even if idle

Defining Cloud Computing

Application runs **on-premises**



- Bring my own machines, connectivity, software, etc.
- Complete control and responsibility
- Upfront capital costs for the infrastructure

Application runs at a **hoster**



- Rent machines, connectivity, software
- Less control, but fewer responsibilities
- Lower capital costs, but pay for fixed capacity, even if idle

Application runs using **cloud** platform



- Shared, multi-tenant environment
- Offers pool of computing resources, abstracted from infrastructure
- Pay as you go

Defining Cloud Computing

Cloud “Variants”

Defining Cloud Computing

Public Cloud

Defining Cloud Computing

Pool of computing resources offered by a vendor, typically using a "pay as you go" model

Defining Cloud Computing

Private Cloud

Defining Cloud Computing

Pool of computing resources that lives within a **self managed datacenter**

Defining Cloud Computing

Pool of computing resources that lives within **a datacenter with no sharing**

Defining Cloud Computing



Compute: Virtualized compute based on Windows Server

Storage: Durable, scalable, & available storage

Management: Automated, management of the service



Database: Relational processing for structured/
unstructured data



Service Bus: General purpose application bus

Access Control: Rules-driven, claims-based access control

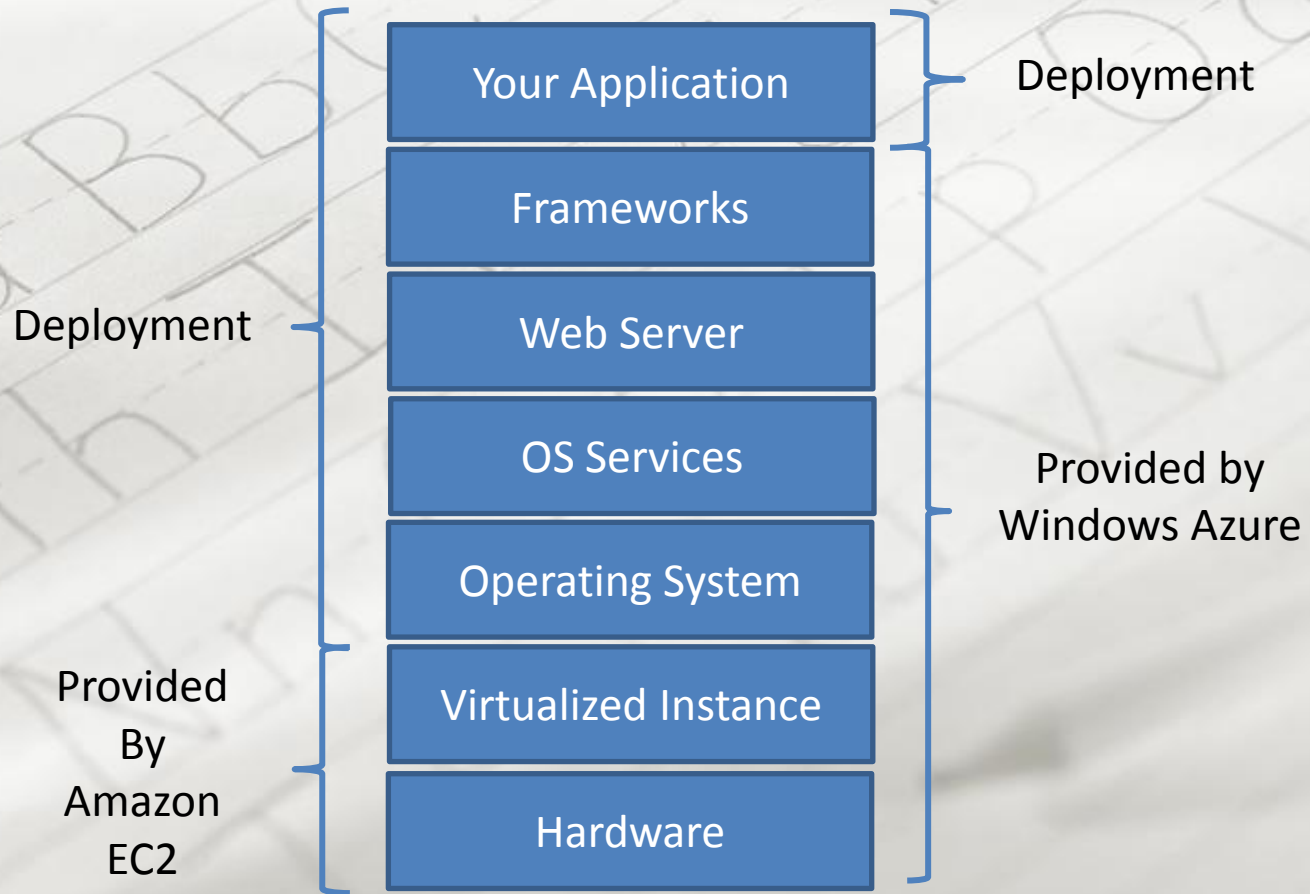
Different Models

Infrastructure as a Service (IaaS)

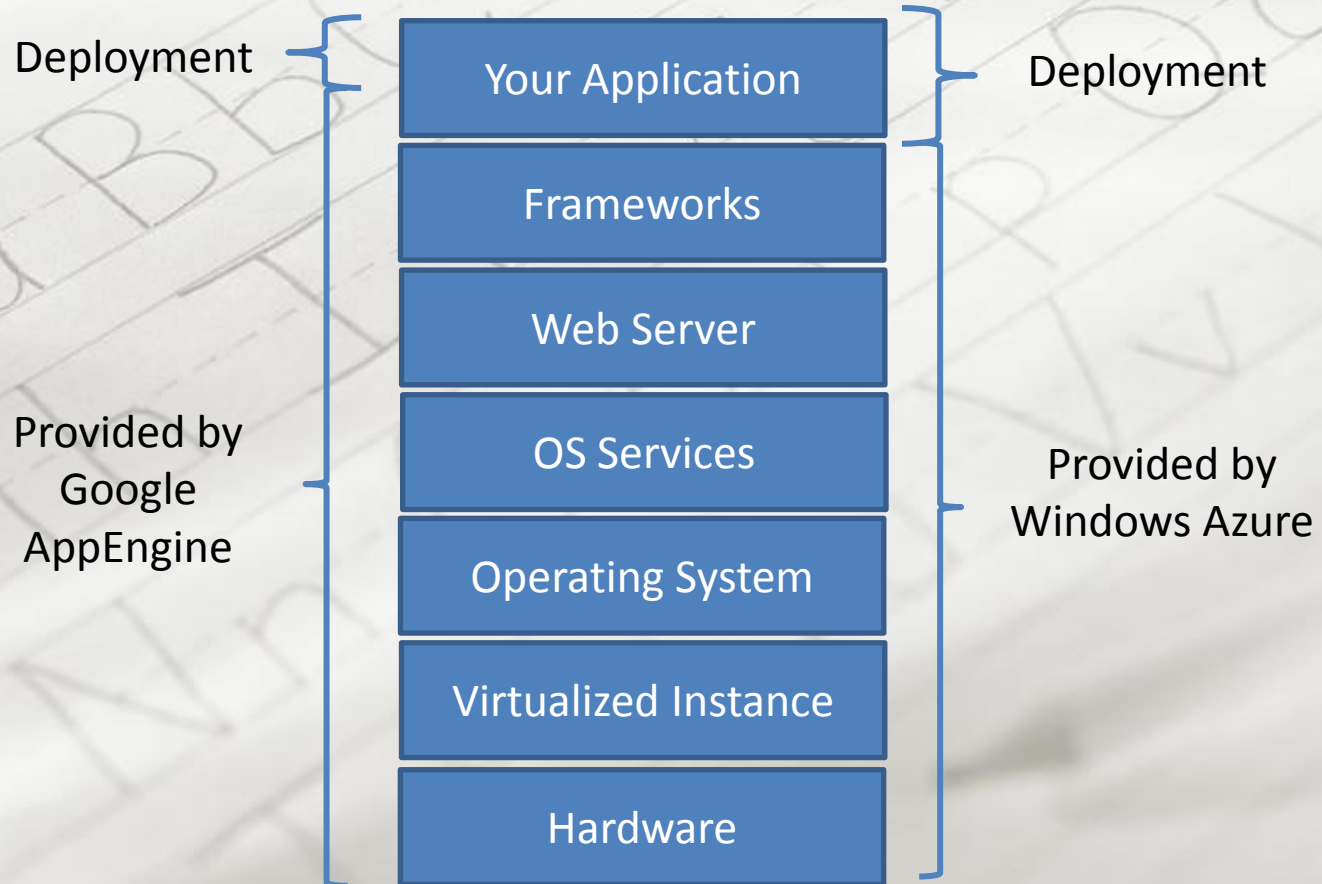
vs.

Platform as a Service (PaaS)

Defining Cloud Computing



Defining Cloud Computing



Patterns for Cloud Computing

#1 - Using the Cloud for **Scale**

Patterns for Cloud Computing



“Isn't the cloud good for applications that need to scale dynamically?”

Patterns for Cloud Computing



“For example, applications that have spikes or peak loads”

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“How does this work?”

Patterns for Cloud Computing

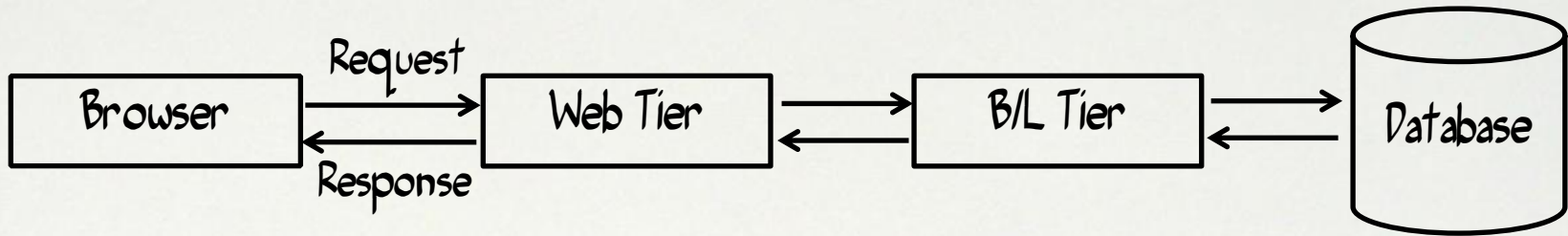
Let's do some white boarding for Jim...

...and when I say white boarding, I really mean it

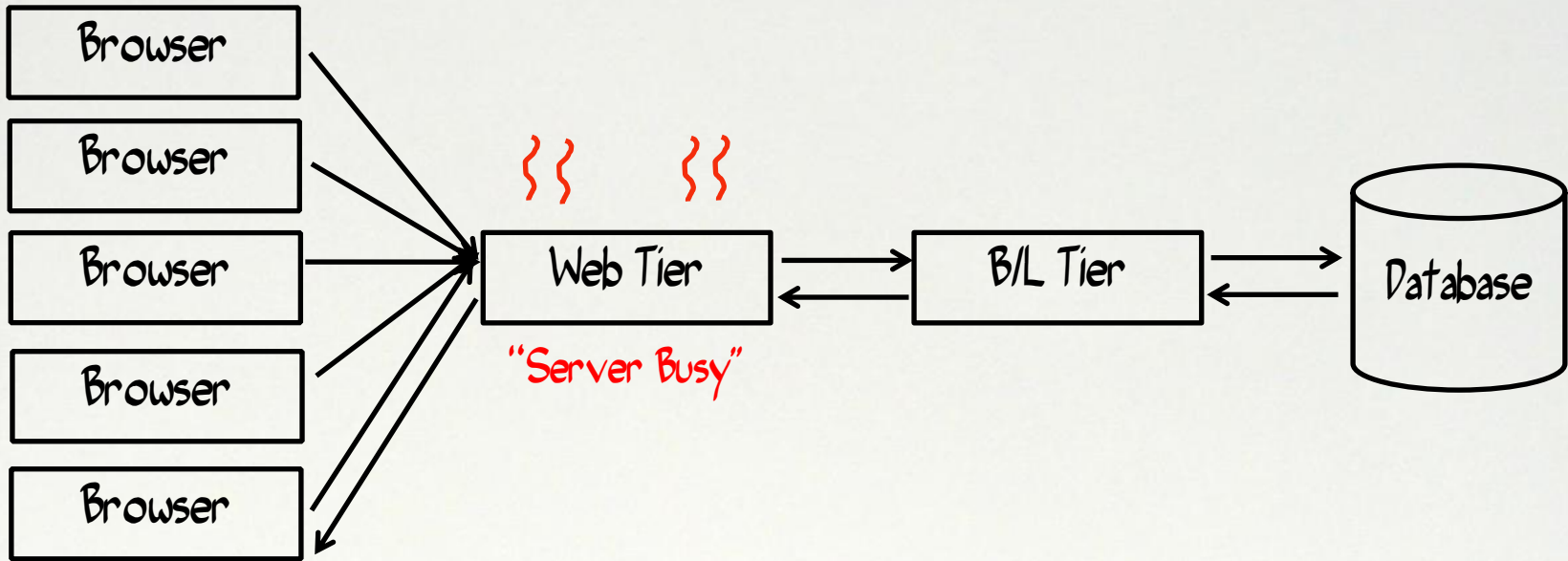
PARROT ATTENTION
Care & Use Instructions
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#1 - Using the Cloud for Scale

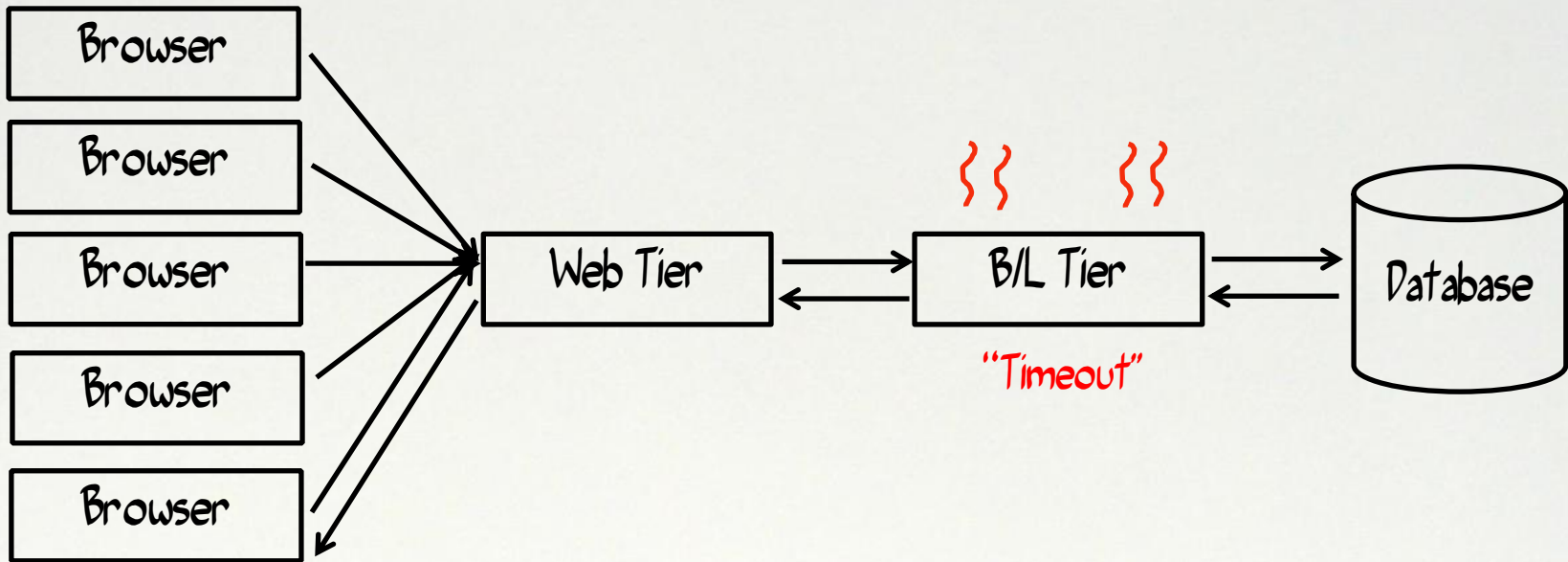
"Wow! What a great site!"



#1 - Using the Cloud for Scale



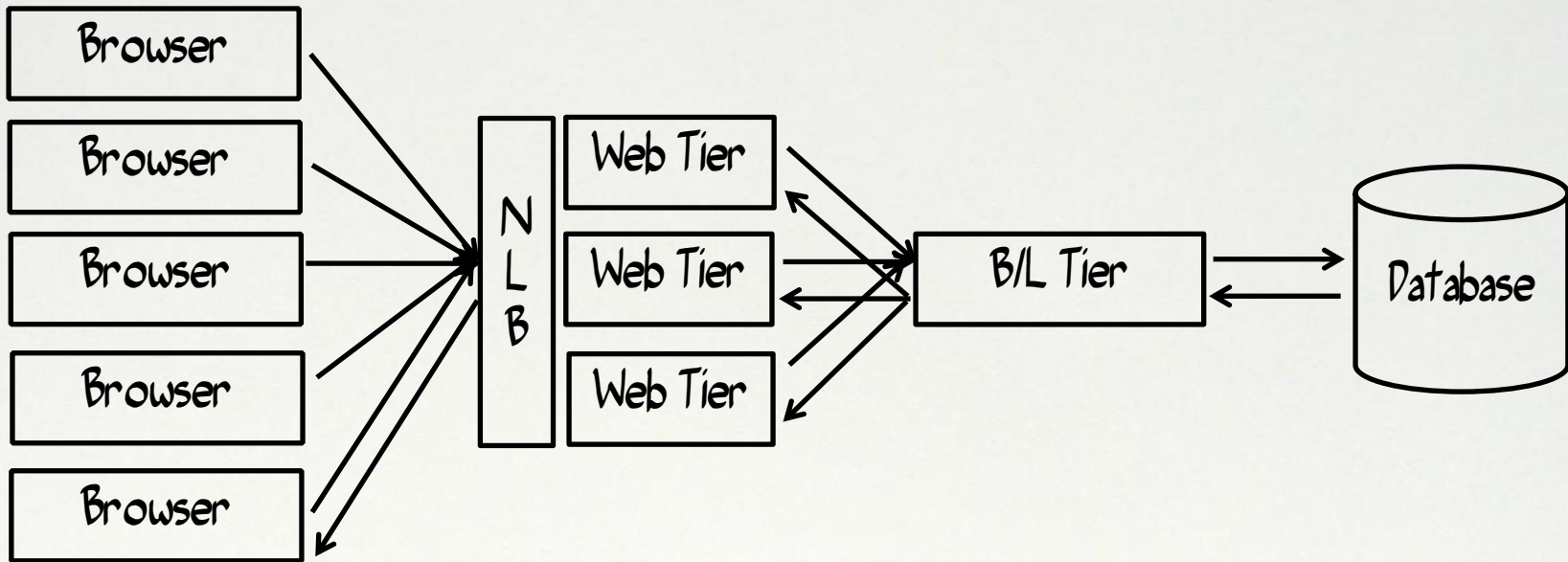
#1 - Using the Cloud for Scale



How would Jim do this today on premises?

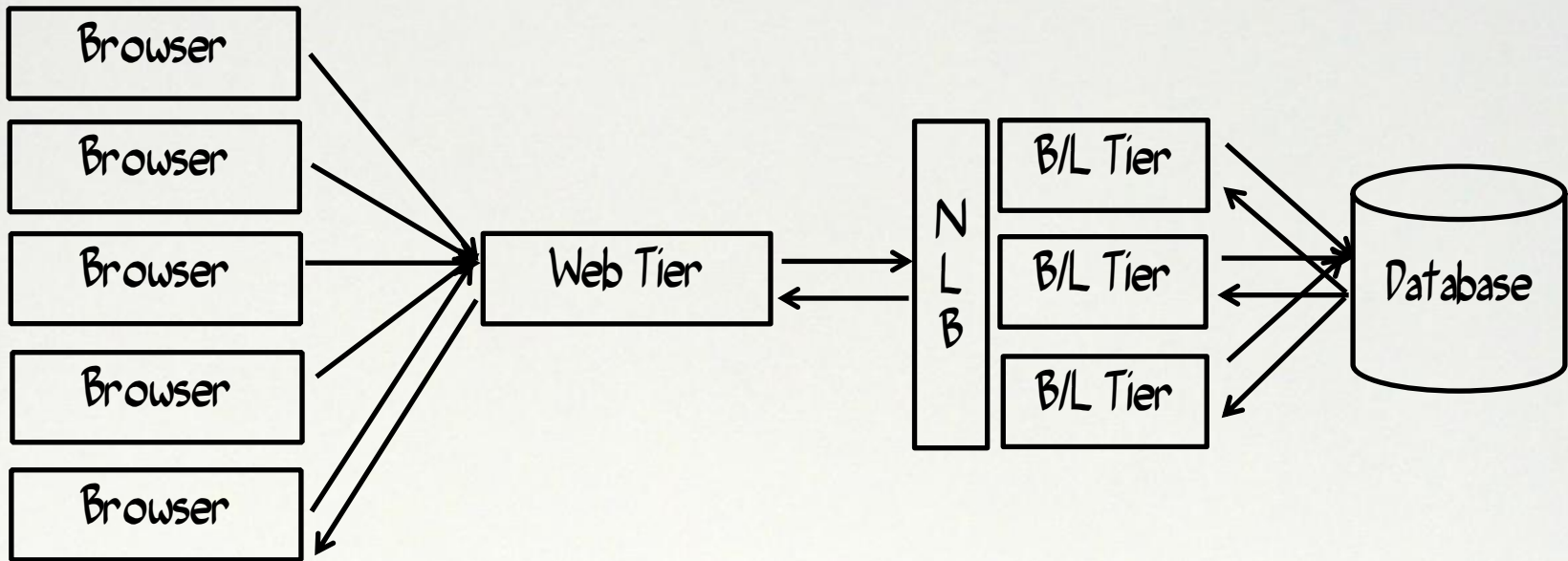
#1 - Using the Cloud for Scale

How would Jim do this today on premises?



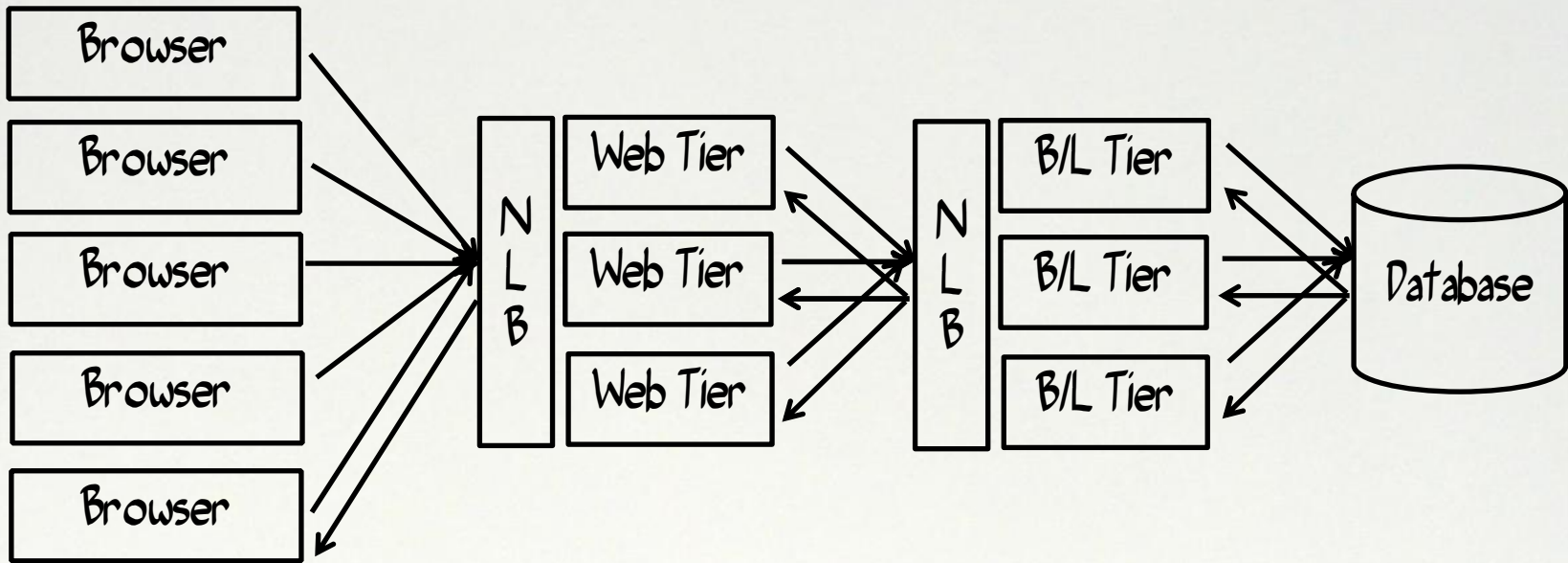
#1 - Using the Cloud for Scale

How would Jim do this today on premises?



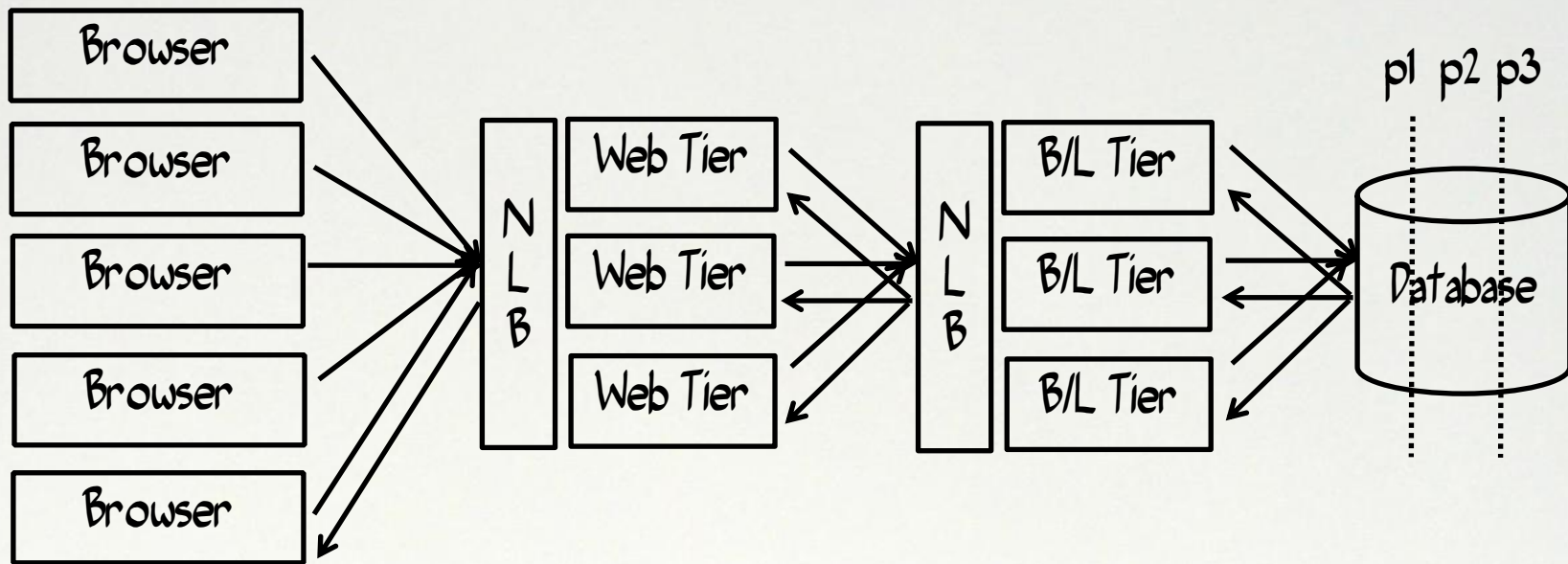
#1 - Using the Cloud for Scale

How would Jim do this today on premises?



#1 - Using the Cloud for Scale

How would Jim do this today on premises?

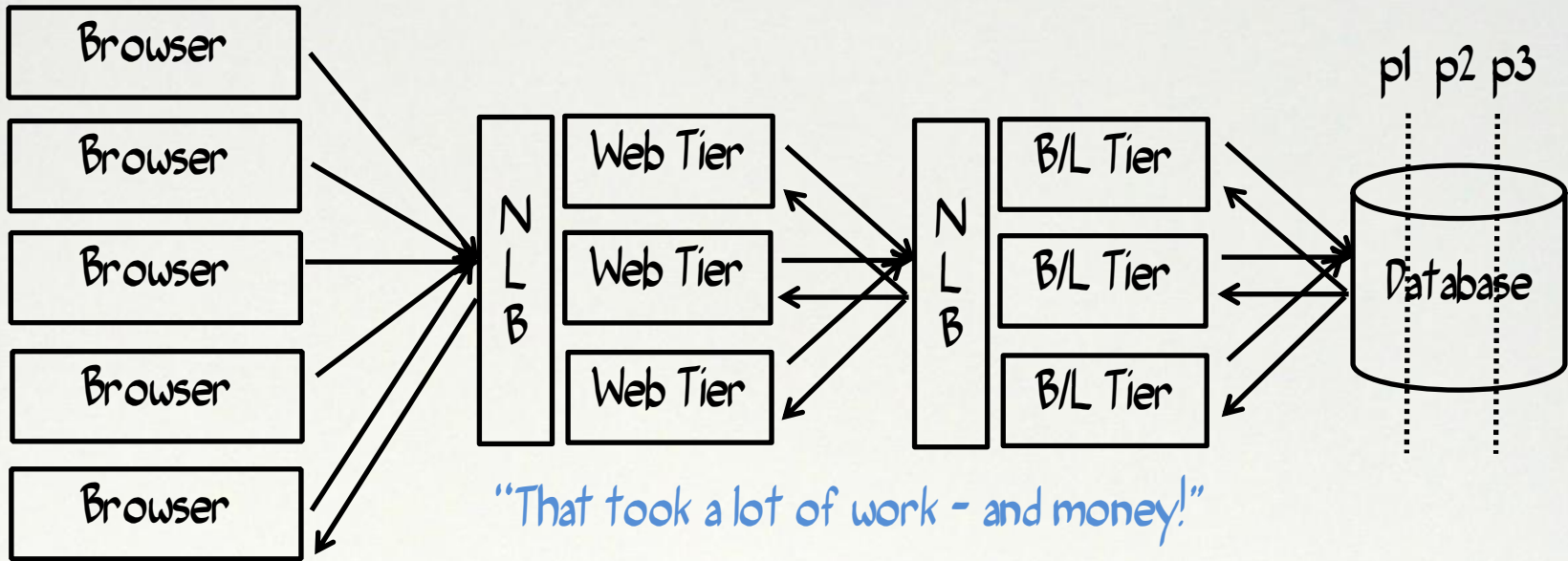


Not without consequences...

PARROT ATTENTION Care & Use Instructions
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#1 - Using the Cloud for Scale

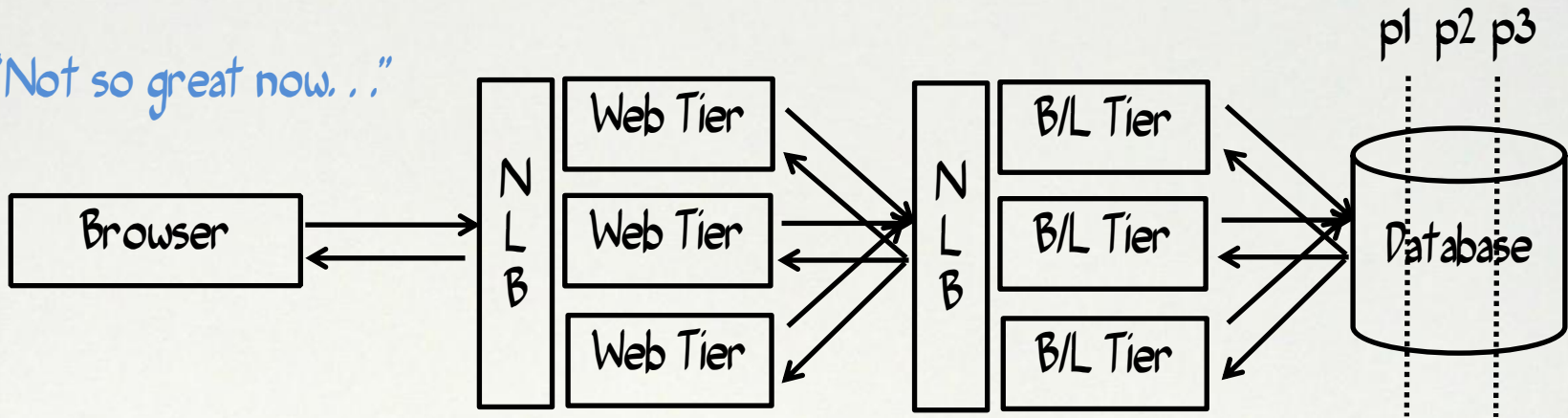
How would Jim do this today on premises?



#1 - Using the Cloud for Scale

How would Jim do this today on premises?

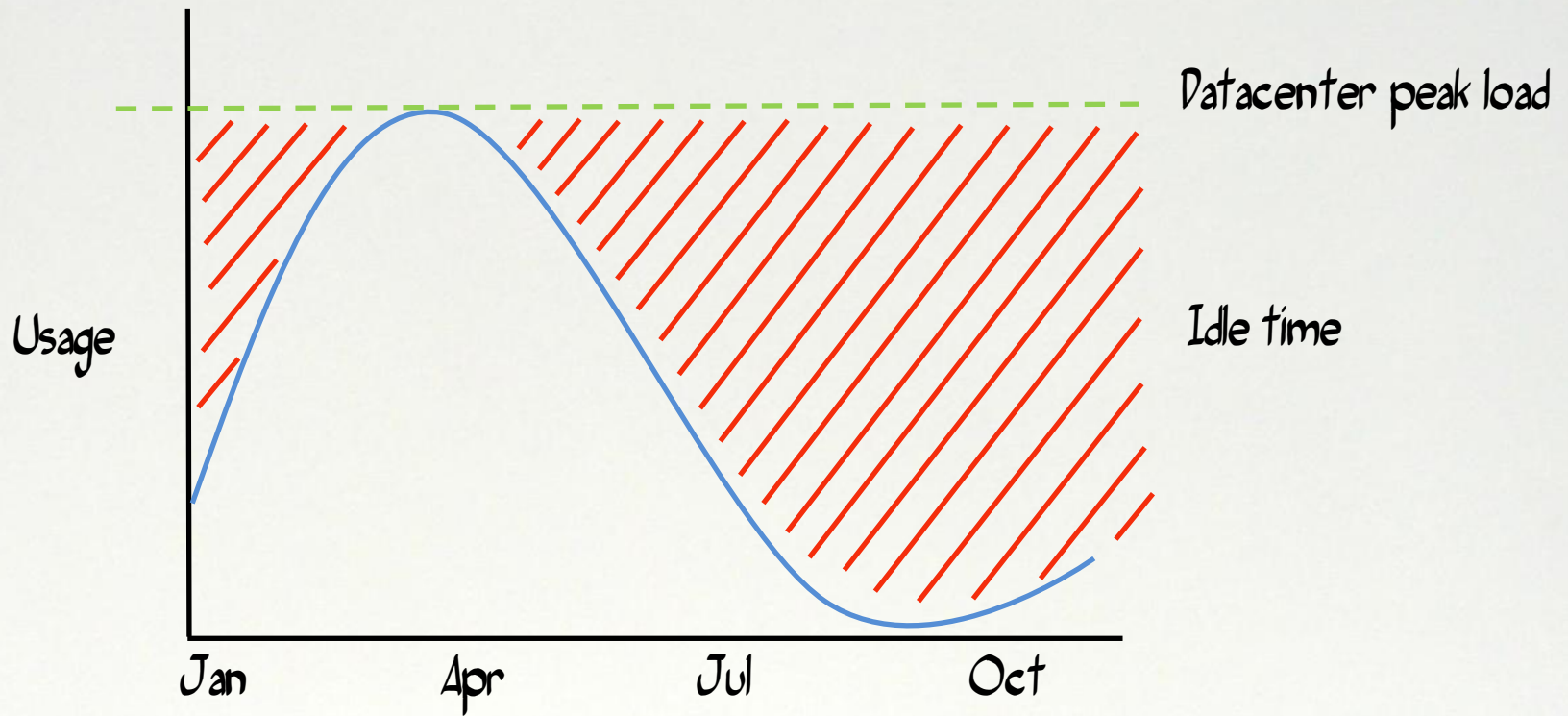
"Not so great now..."



"That took a lot of work - and money!"

"Hmmm... Most of this stuff is sitting idle..."

#1 - Using the Cloud for Scale

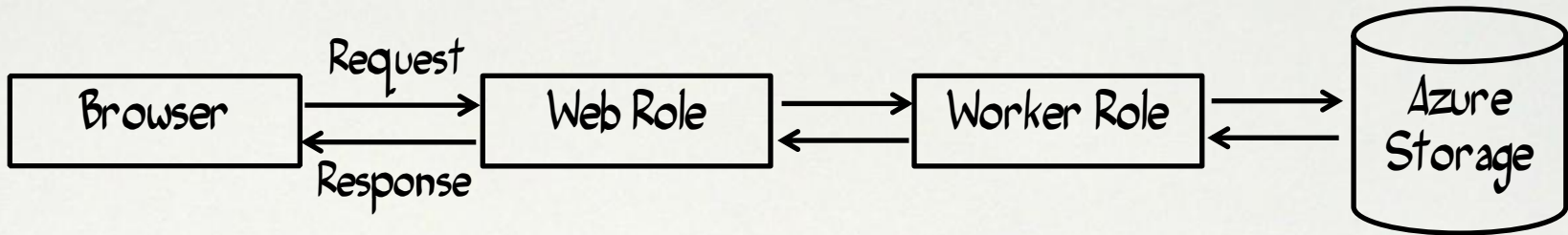


How can cloud computing help?

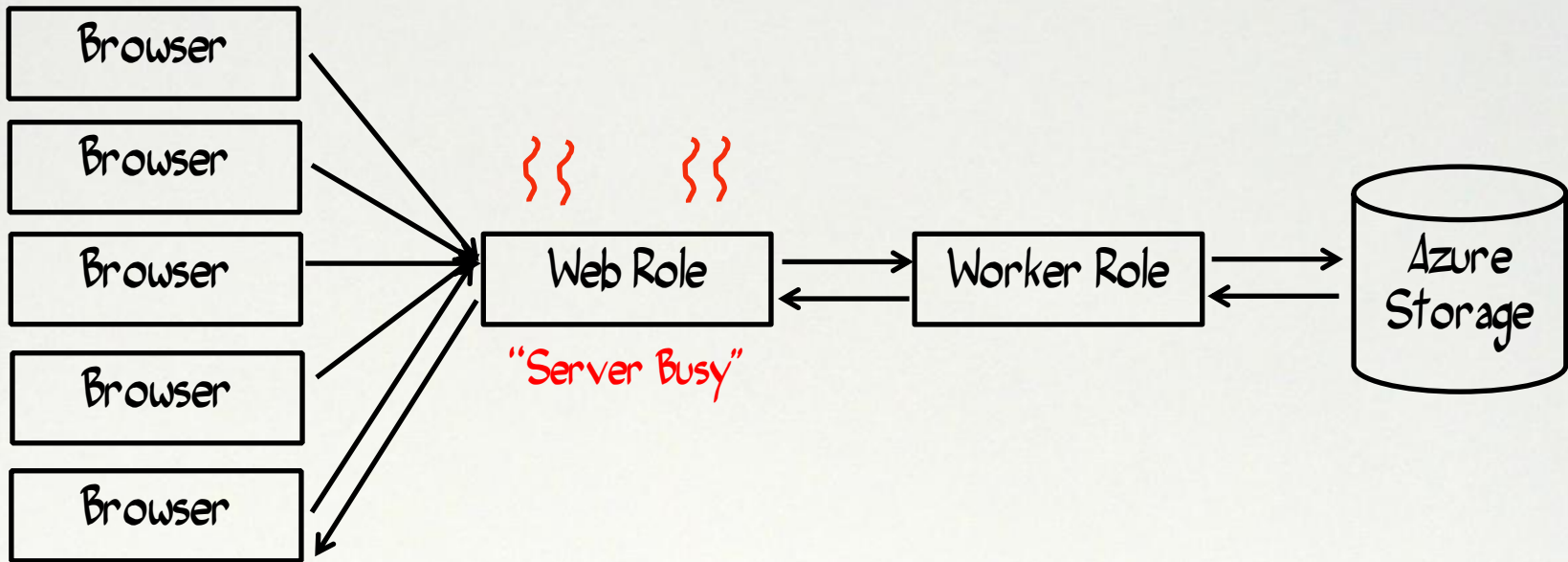
CAUTION ATTENTION
Consult the user manual for proper use and handling instructions.
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Do not use the board in a high-temperature environment.
Do not use the board in a high-voltage environment.
Do not use the board in a high-magnetic-field environment.
Do not use the board in a high-frequency electromagnetic field.
Do not use the board in a high-vibration environment.
Do not use the board in a high-impact environment.
Do not use the board in a high-pressure environment.
Do not use the board in a high-speed environment.
Do not use the board in a high-acceleration environment.
Do not use the board in a high-g environment.
Do not use the board in a high-gravity environment.
Do not use the board in a high-temperature, high-pressure, high-vibration, high-impact, high-speed, high-acceleration, high-g, high-gravity environment.

#1 - Using the Cloud for Scale

"Wow! What a great site!"



#1 - Using the Cloud for Scale



Service Tuning

Event Logs

Copy the event logs for this deployment to a storage account:

[Copy Logs](#)

Storage Account:

Container Name:

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/ServiceConfigura
tion">
  <Role name="WebRole1">
    <ConfigurationSettings />
    <Instances count="1" />
  </Role>
  <Role name="WorkerRole1">
    <ConfigurationSettings />
    <Instances count="1" />
  </Role>
</ServiceConfiguration>
```

Upload a new configuration file:

[Browse...](#)

[Upload](#)

Hosted Service

Production
v1.8




Upgrade...

Suspend

Configure...

Delete

WebRole:

 Ready

10

Web Site URL:

<http://primephp.cloudapp.net/>

Deployment ID:

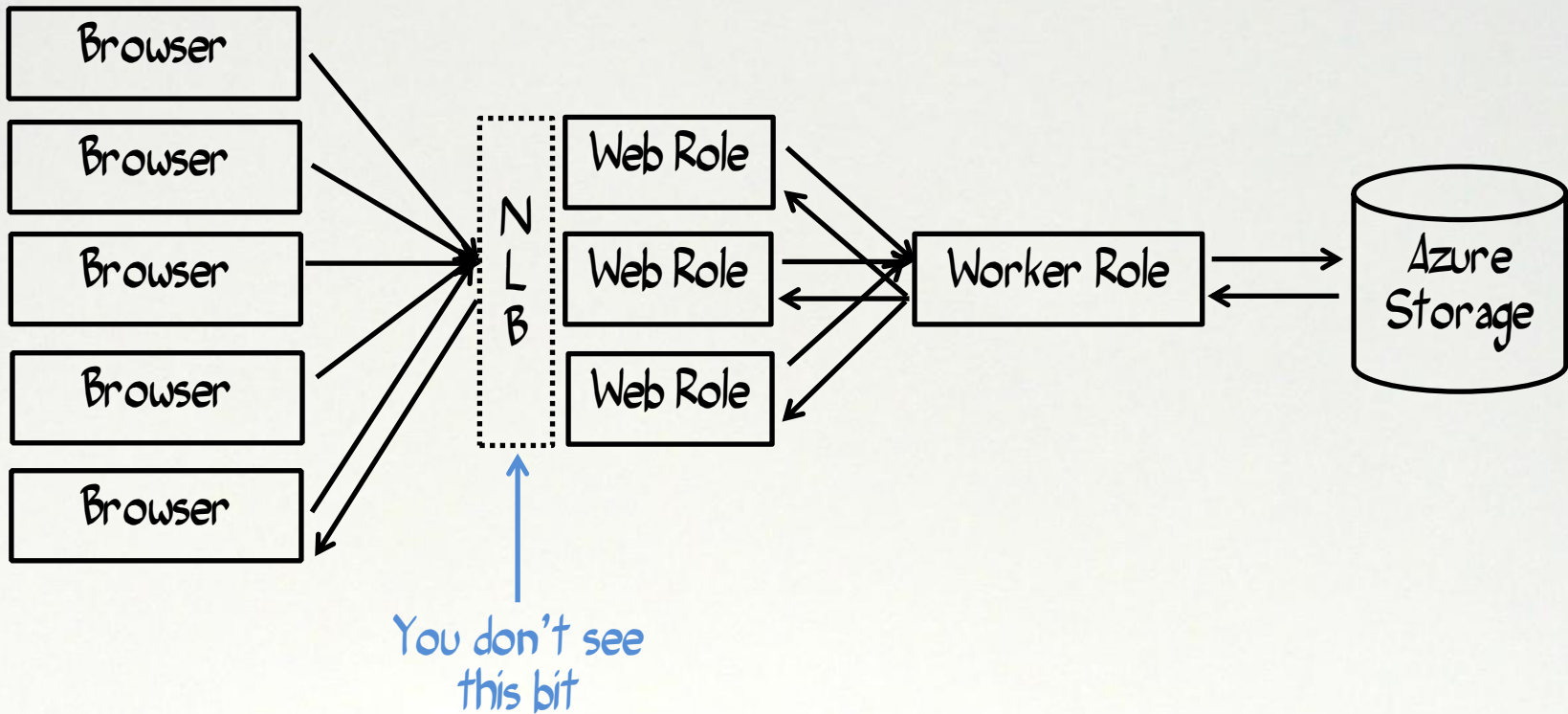
52d2a2a9133d4b2ea5d72ae8b563683a

Affinity Group

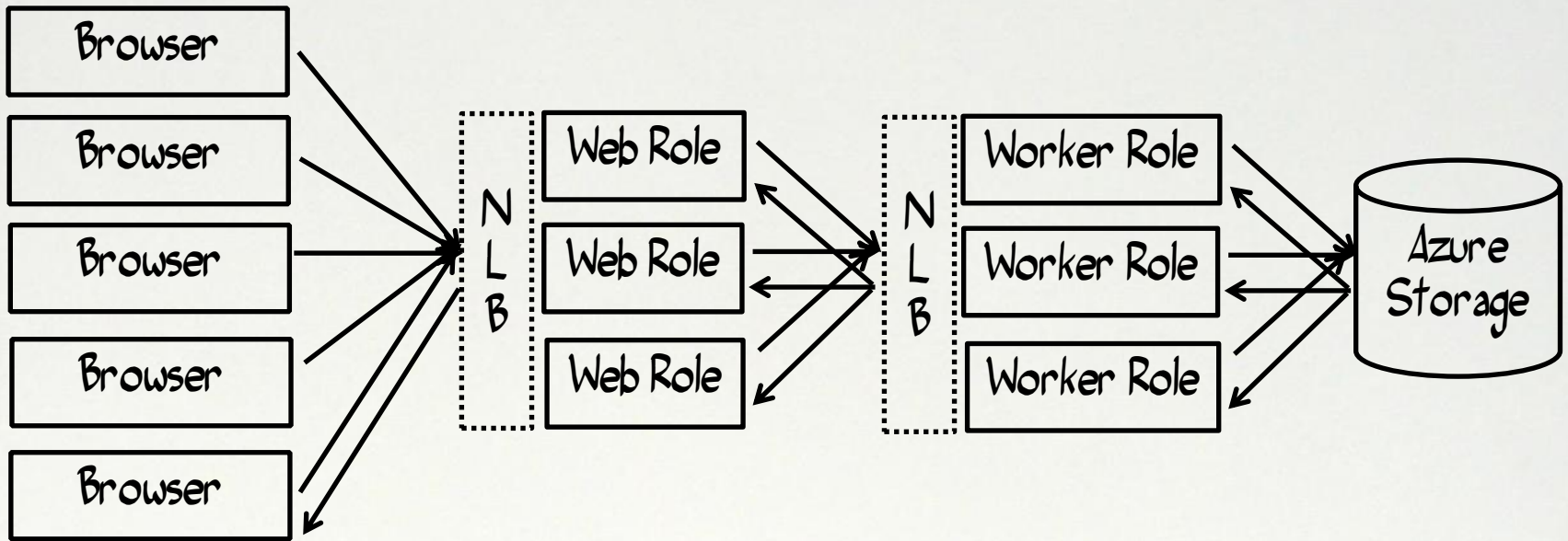
Affinity Group Name: Unaffinitized

Geographic Location: Anywhere US

#1 - Using the Cloud for Scale



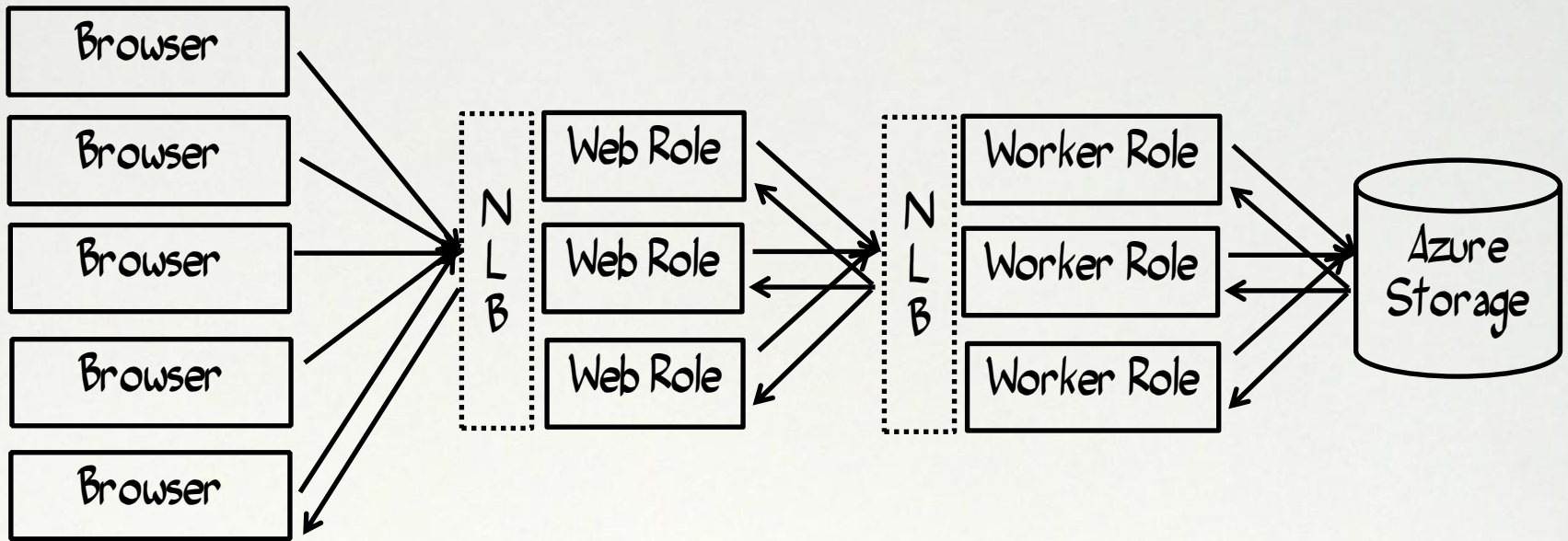
#1 - Using the Cloud for Scale



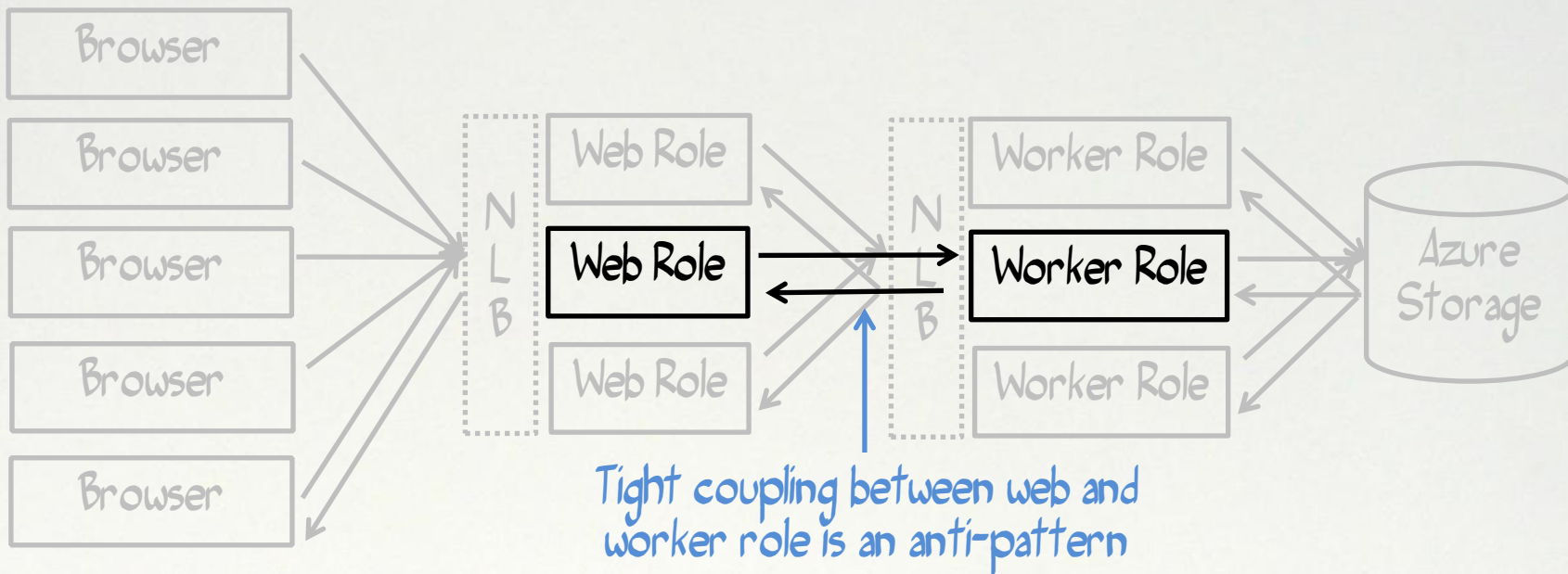
OK, so changing config is easy...

...but what else do I need to know?

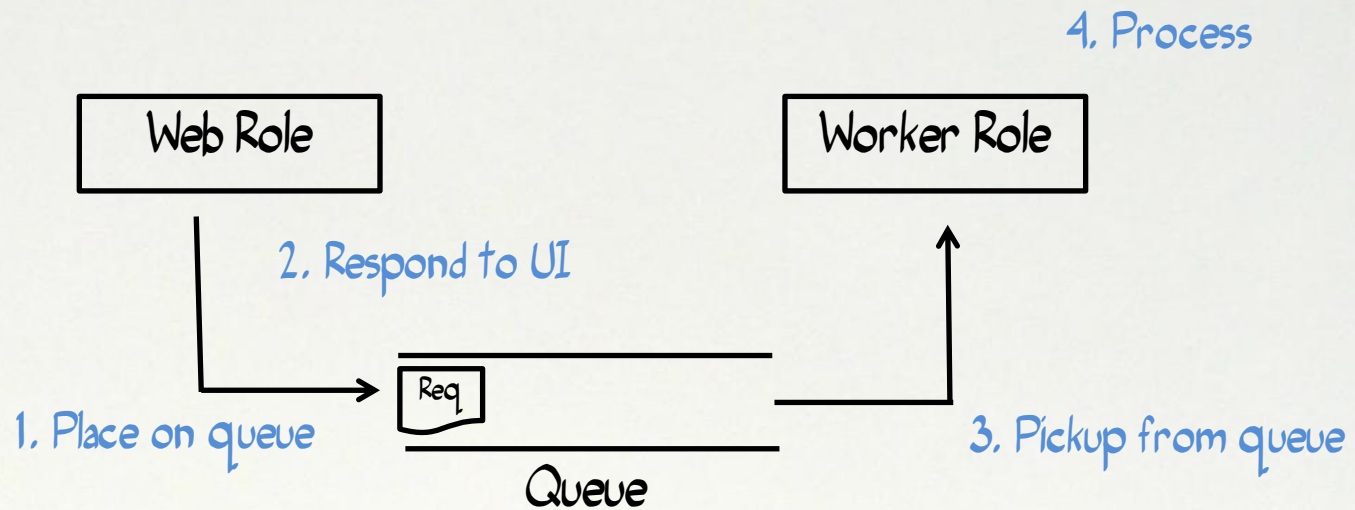
#1 - Using the Cloud for Scale



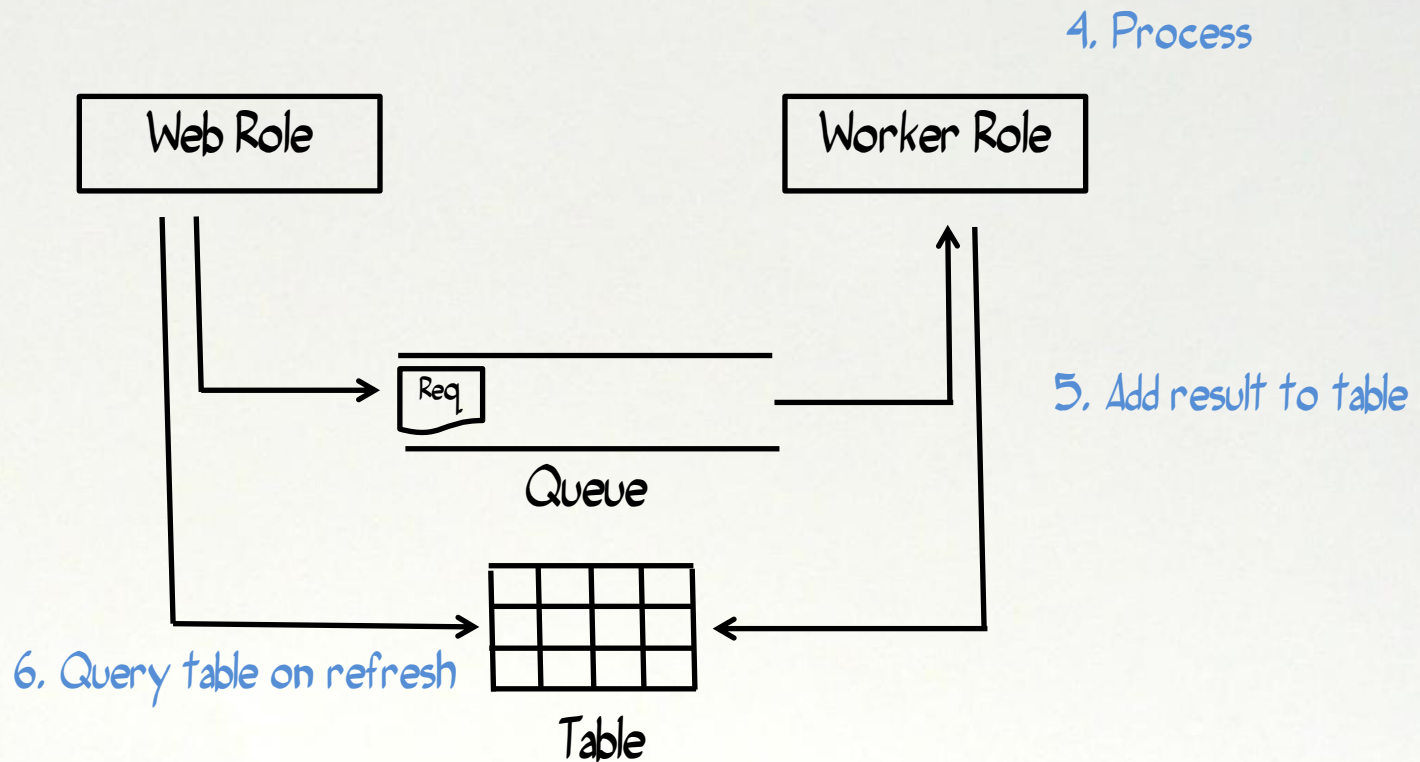
#1 - Using the Cloud for Scale



#1 - Using the Cloud for Scale



#1 - Using the Cloud for Scale

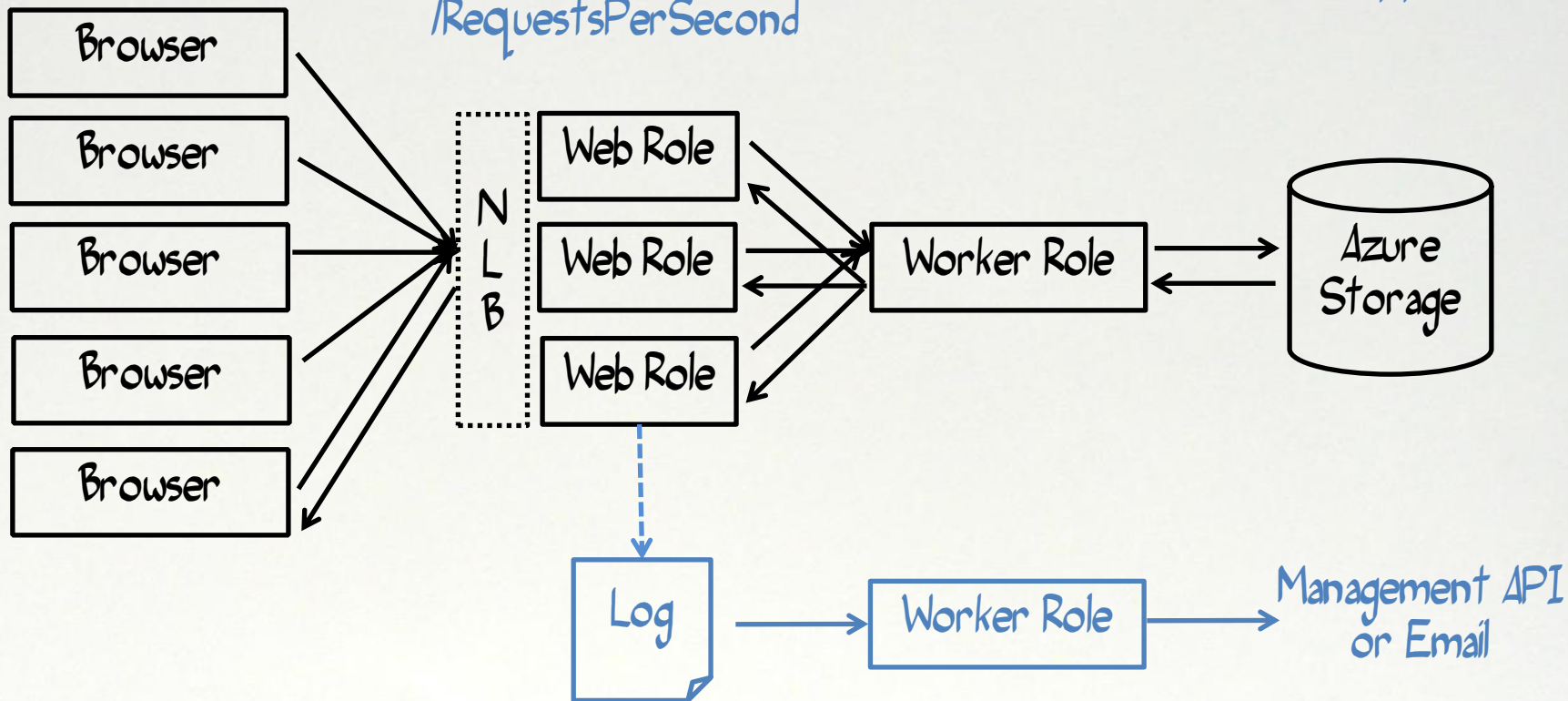


How many web and worker roles do you need?

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#1 - Using the Cloud for Scale

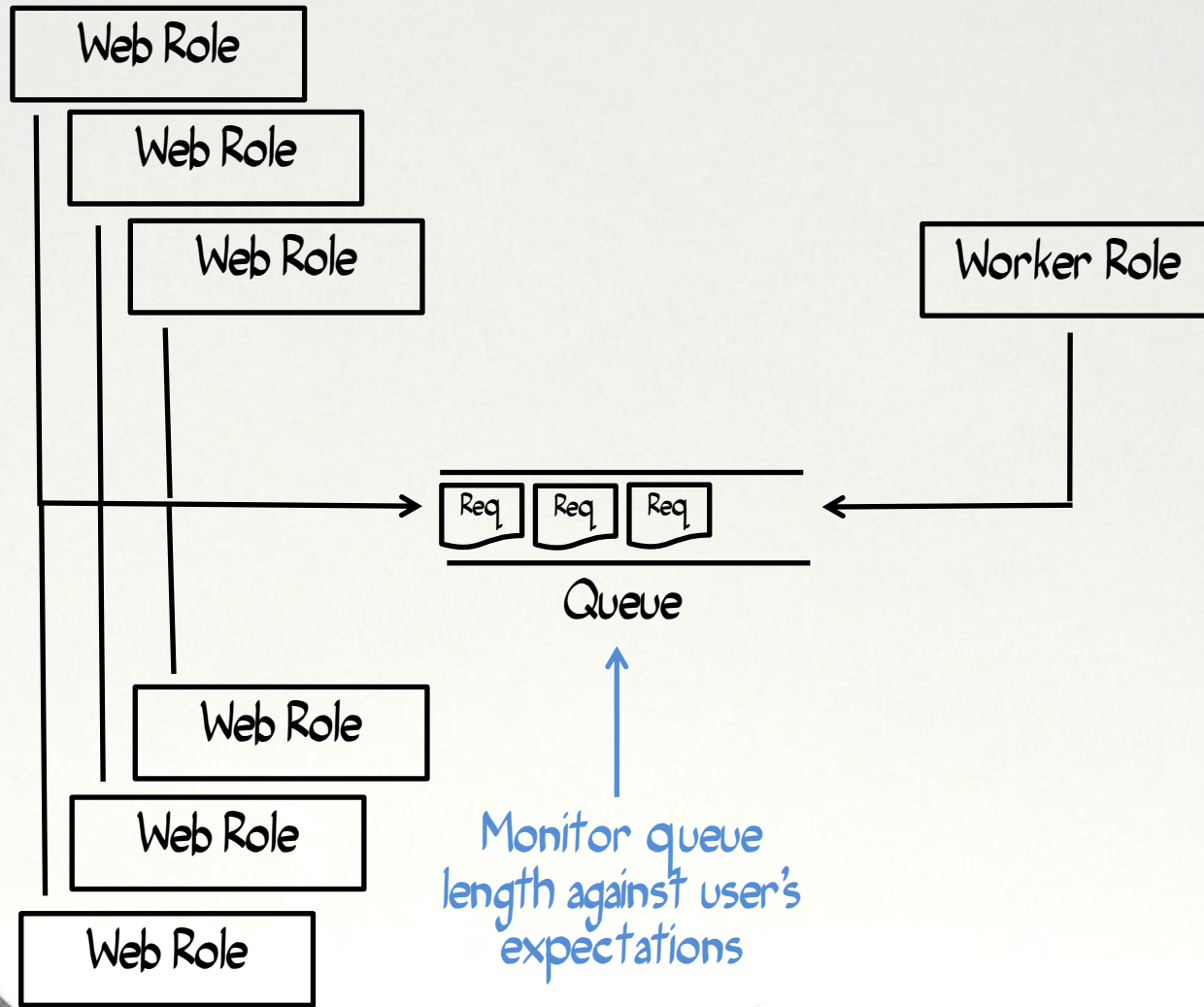
WMI_Win32_PerfFormattedData_ASPNET_ASPNETApplications
/RequestsPerSecond



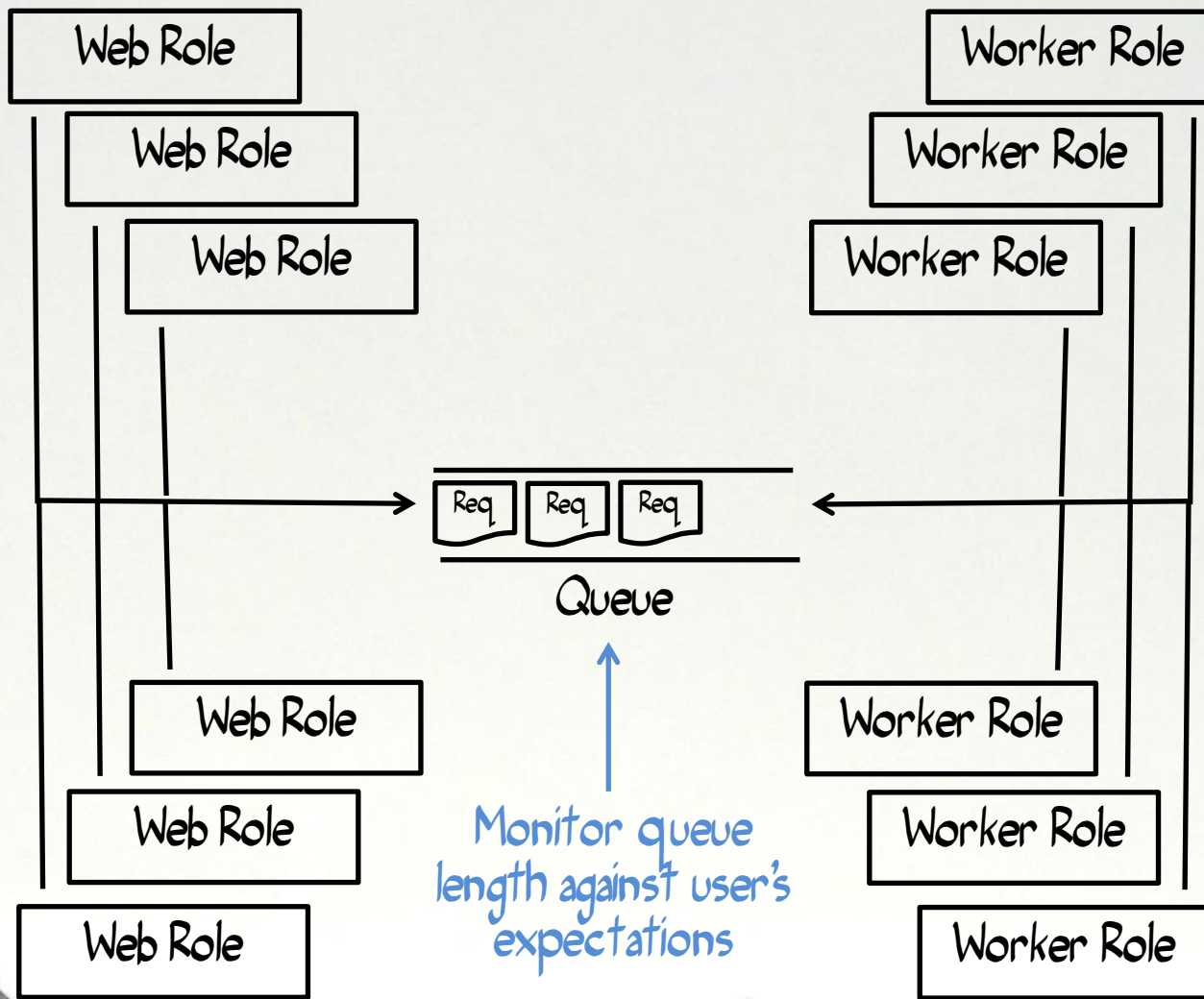
How many web and worker roles do you need?

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#1 - Using the Cloud for Scale



#1 - Using the Cloud for Scale



Patterns for Cloud Computing

Takeaways



A core tenet of cloud computing is the ability to scale up/down



Understand how to communicate between roles and nodes



Strategy on when to scale up/down roles in production



Patterns for Moving to the Cloud

#2 - Using the Cloud for **Multi Tenancy**

Patterns for Cloud Computing



“I like the idea of scaling Web roles...”

Patterns for Cloud Computing



“...but need to serve multiple customers”

Patterns for Cloud Computing

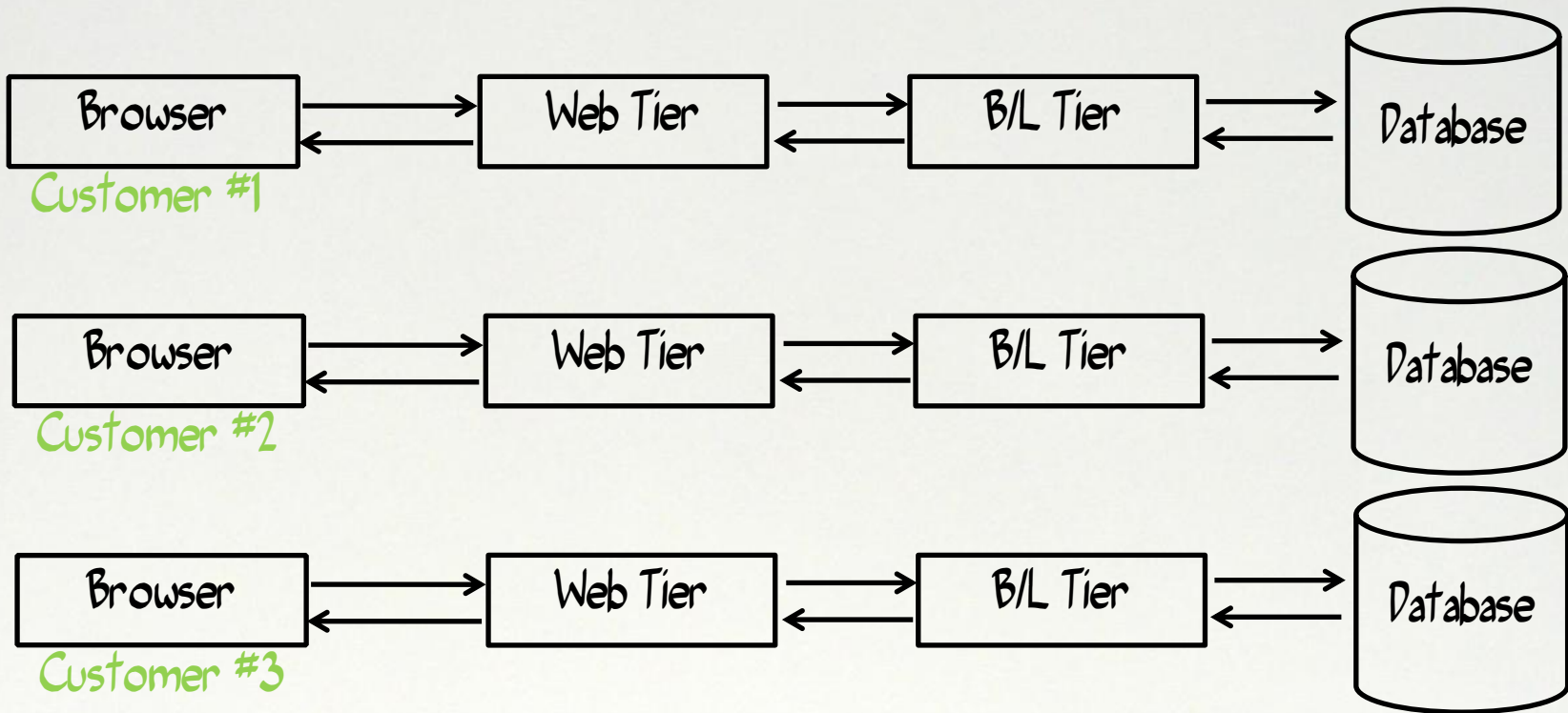


“Without creating separate codebases!”

How would Jim do this today on premises?

#2 - Using the Cloud for Multi Tenancy

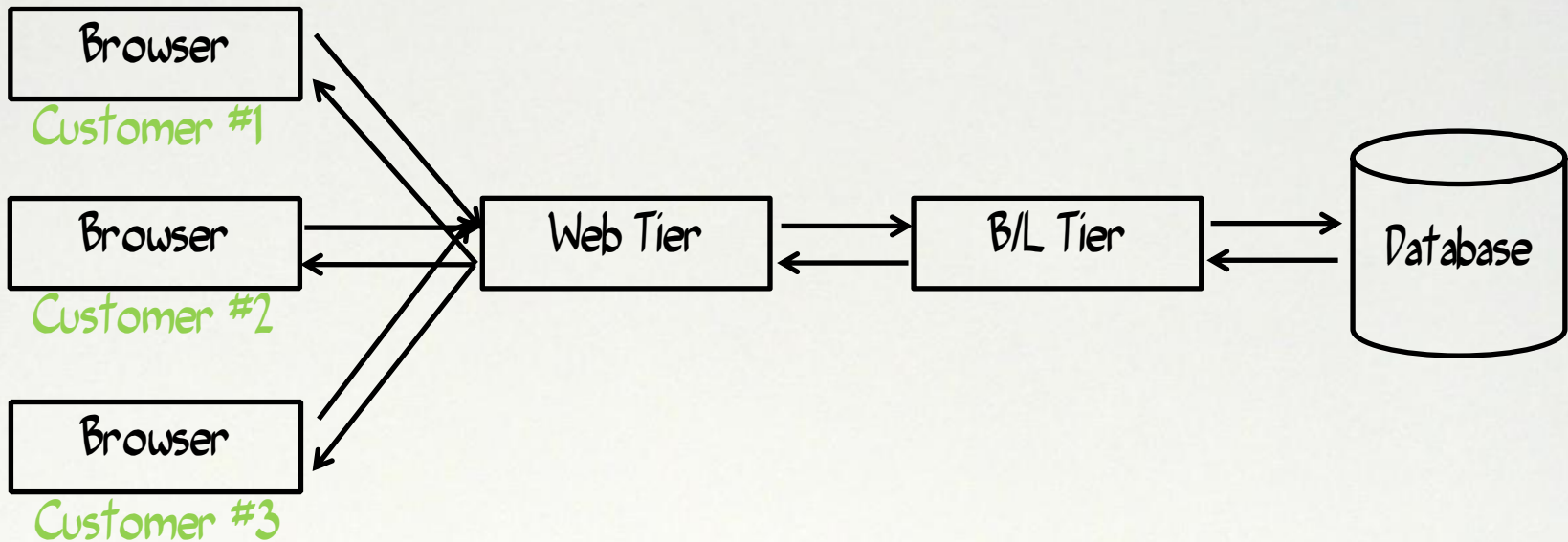
How would Jim do this today on premises?



Gets expensive pretty quickly

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#2 - Using the Cloud for Multi Tenancy



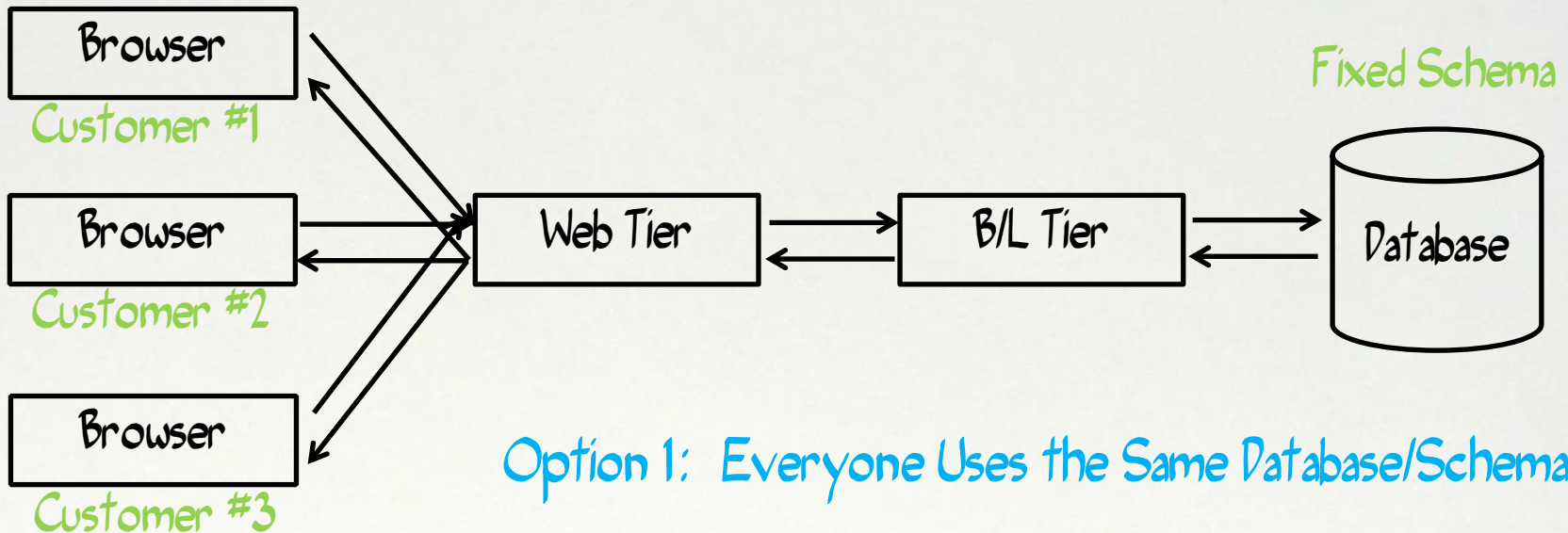
Schema Customizations

UI Customizations

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Care & Use Instructions
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3 options for data in multi tenant environment

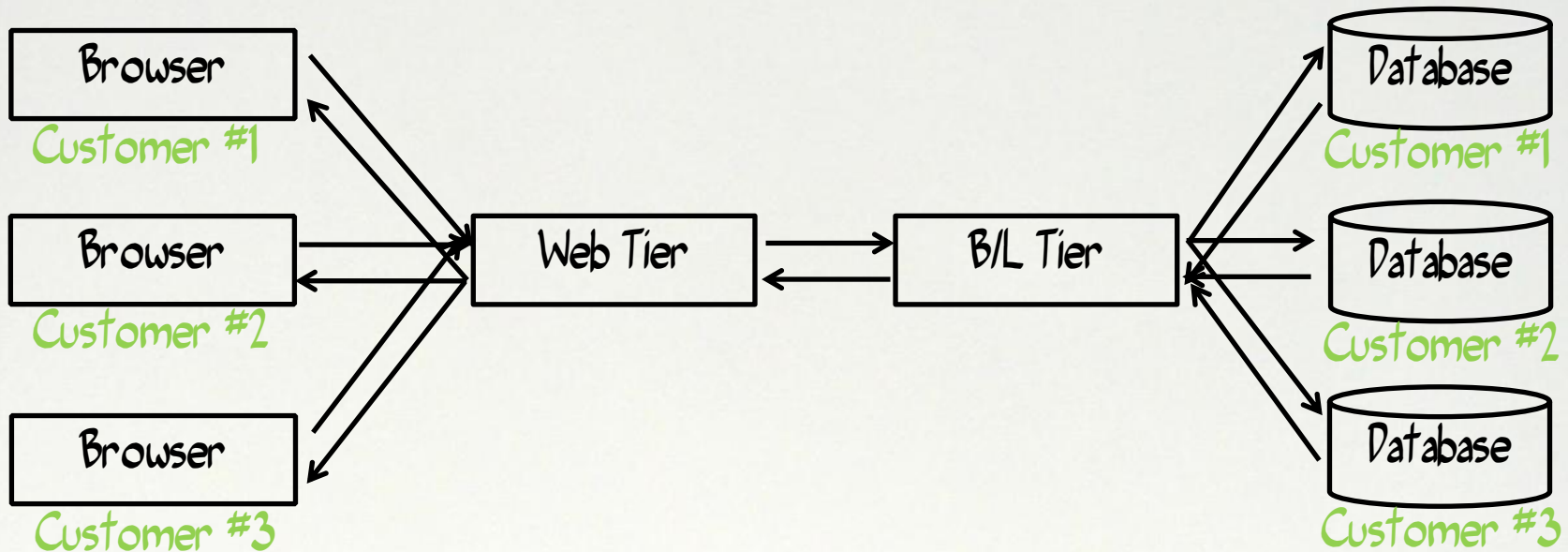
#2 - Using the Cloud for Multi Tenancy



Option 1: Everyone Uses the Same Database/Schema

Pros: Simplest approach, easy to maintain/upgrade.
Cons: No customizations. Restoring of tenant data.

#2 - Using the Cloud for Multi Tenancy

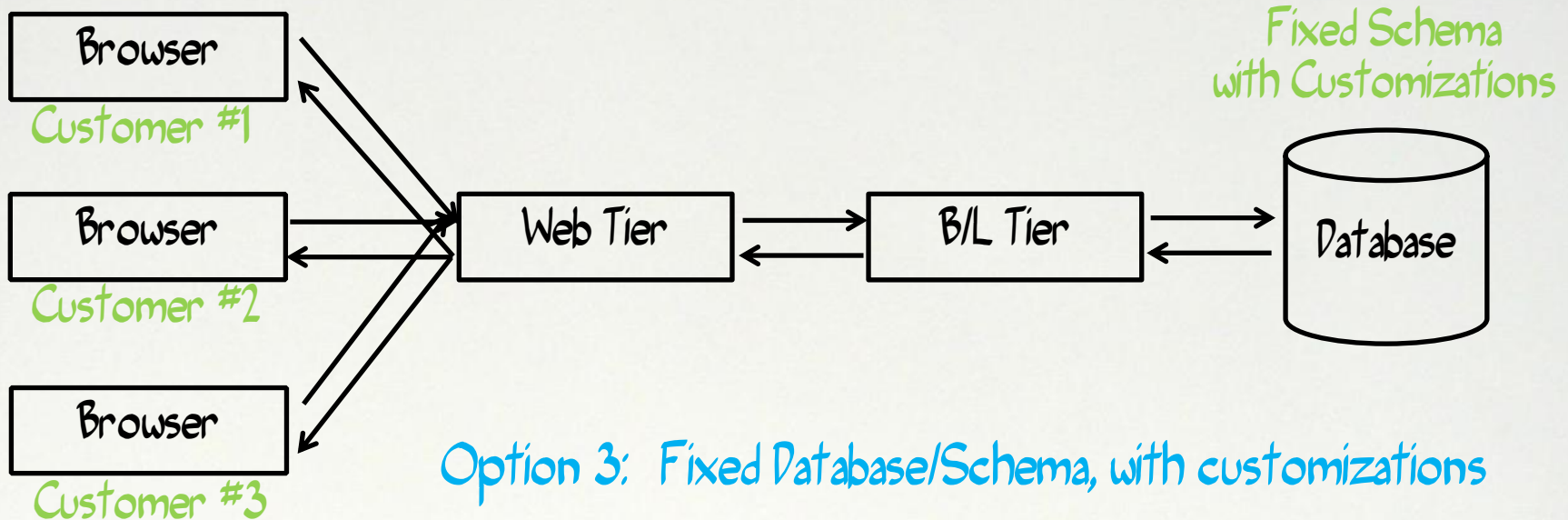


Option 2: Give Each Customer Their Own Database/Schema

Pros: Flexible. Tenant restore is easier. High Isolation.

Cons: Can be costly. Difficult to upgrade db schemas.

#2 - Using the Cloud for Multi Tenancy

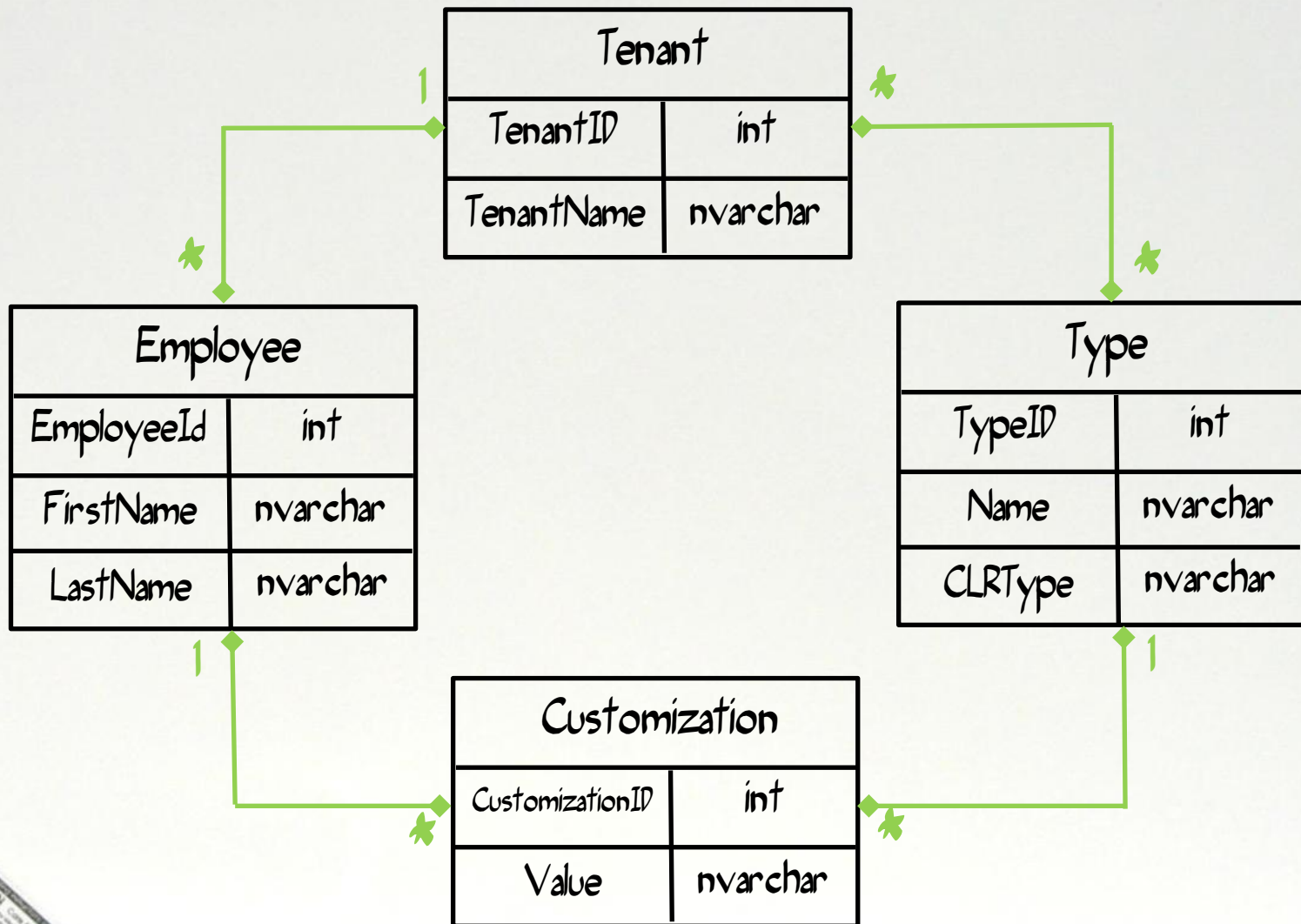


Option 3: Fixed Database/Schema, with customizations

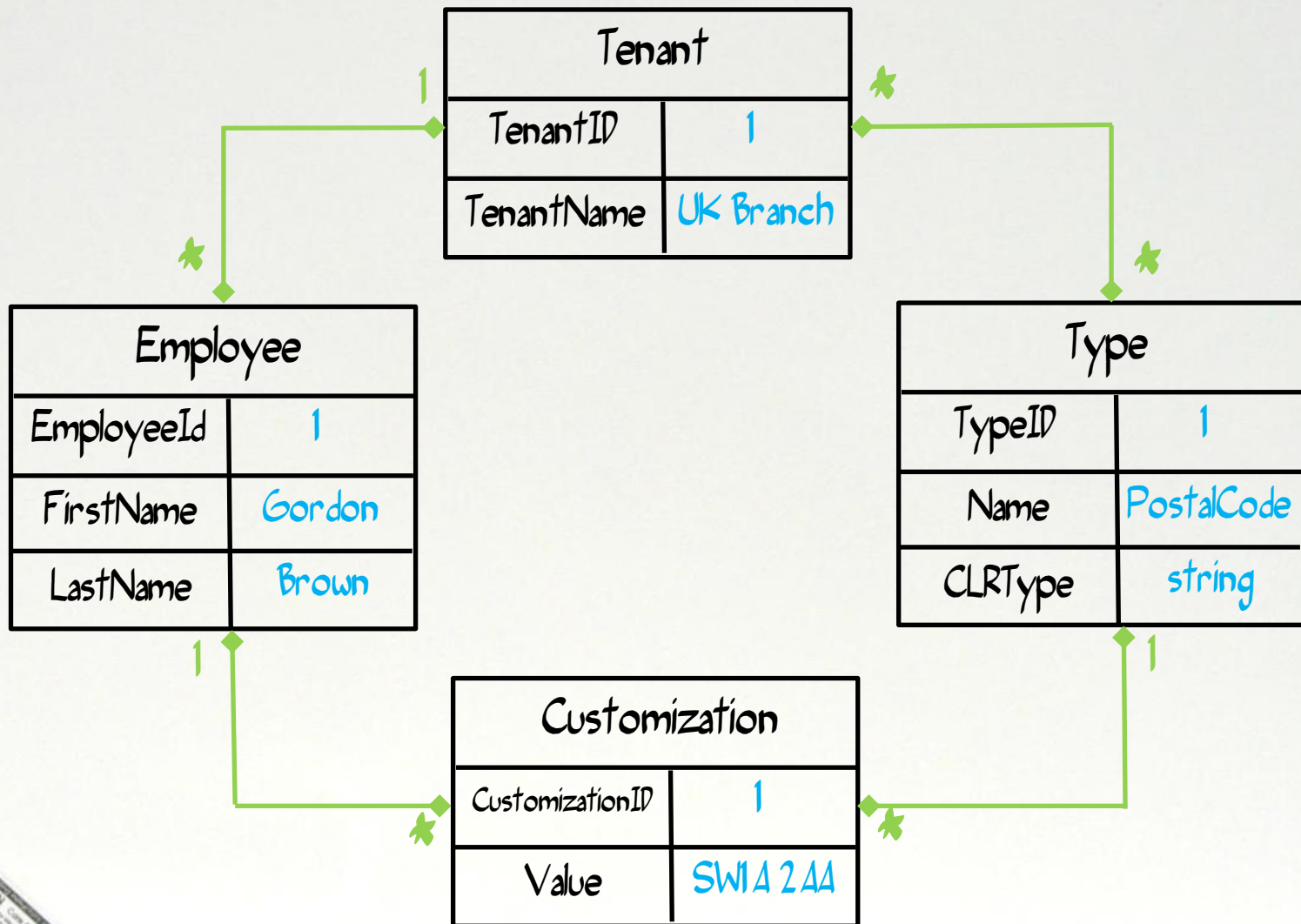
Pros: Customers can add their own custom fields

Cons: Non standard way of customizing the schema.
Tenant restore is difficult.

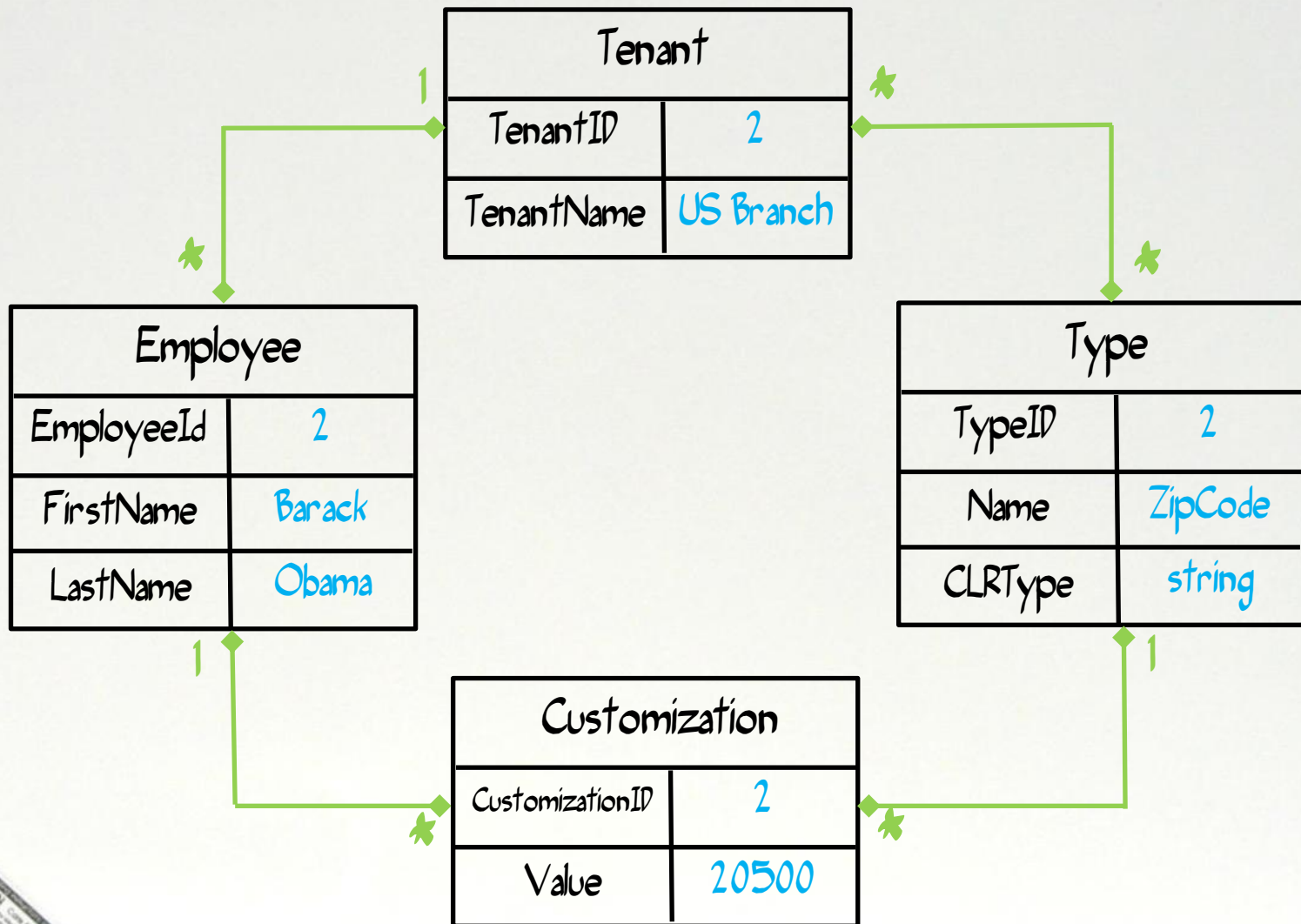
#2 - Using the Cloud for Multi Tenancy



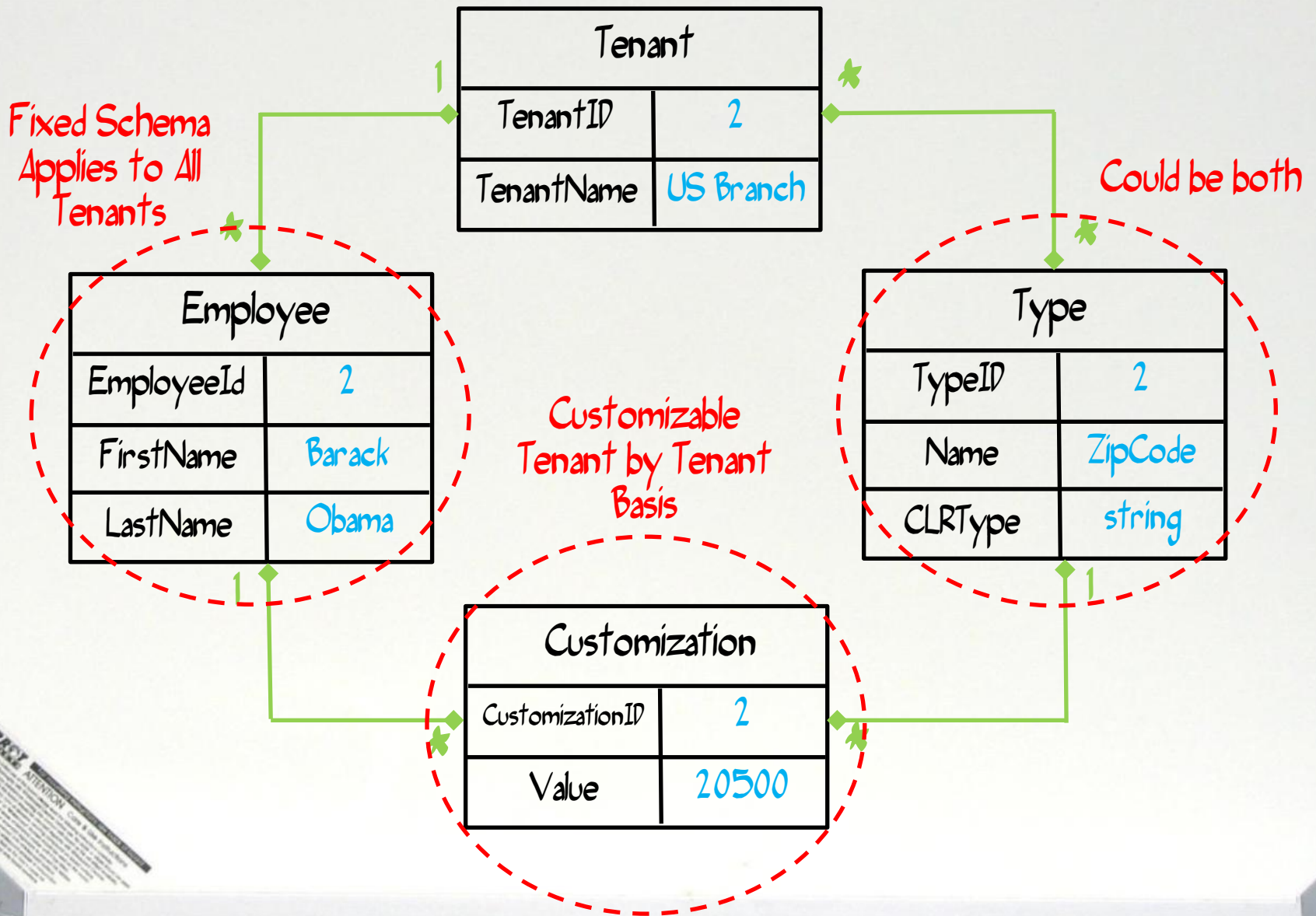
#2 - Using the Cloud for Multi Tenancy



#2 - Using the Cloud for Multi Tenancy



#2 - Using the Cloud for Multi Tenancy

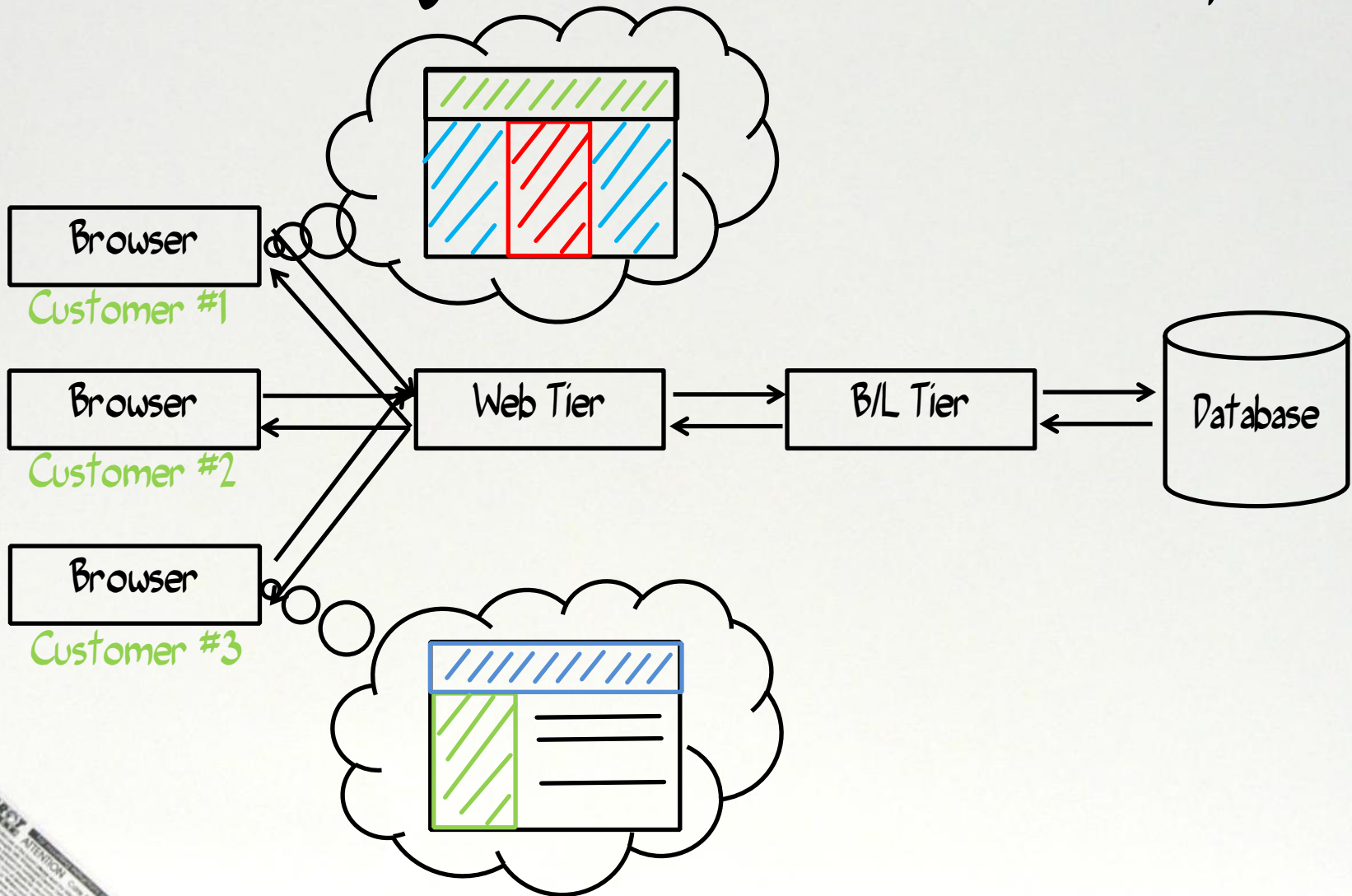


Schema Customizations

UI Customizations

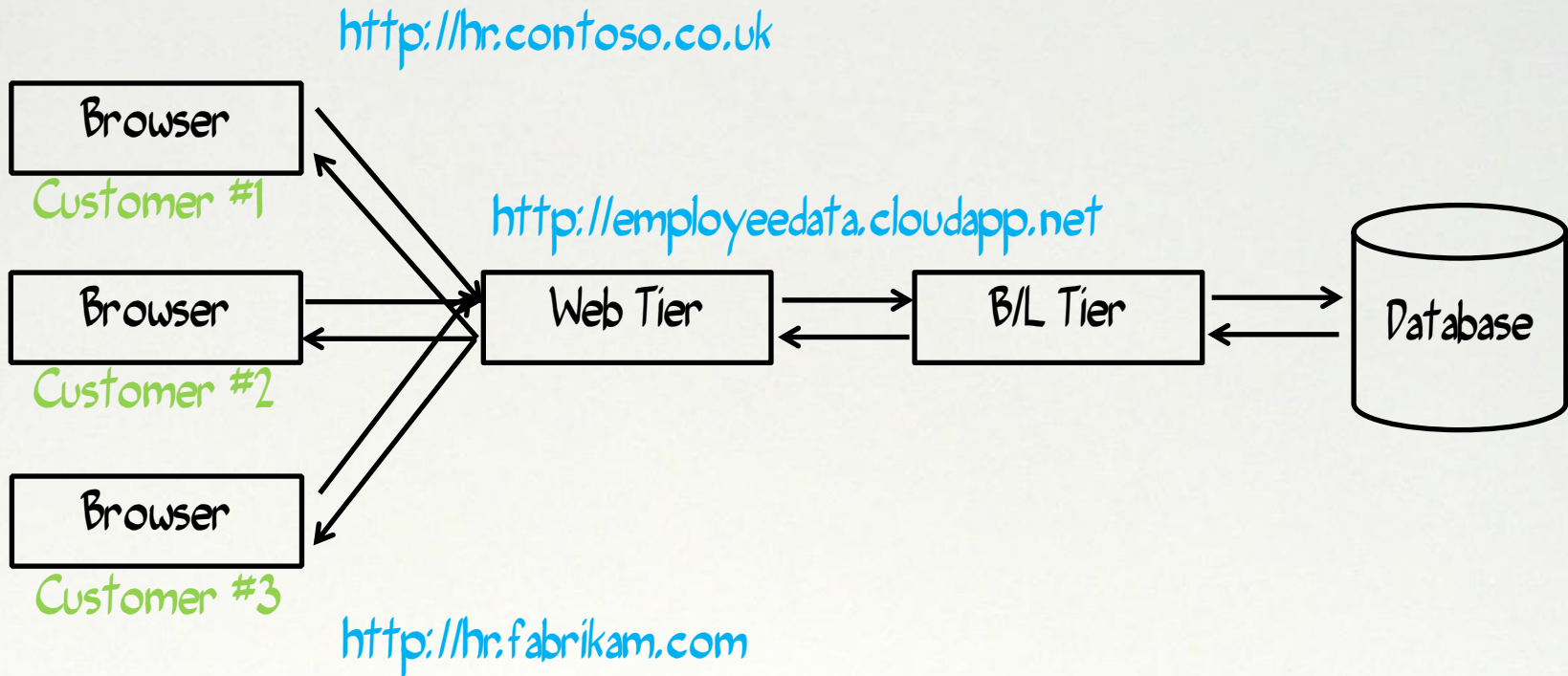
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#2 - Using the Cloud for Multi Tenancy



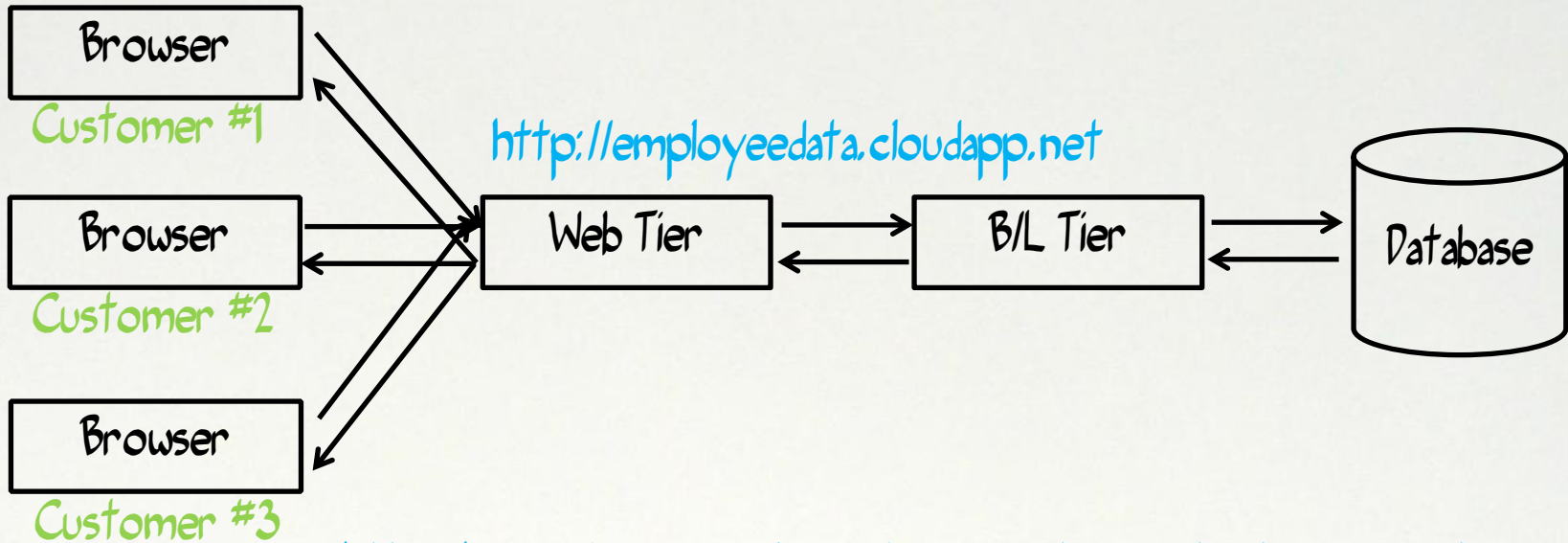
Routing using MVC approach

#2 - Using the Cloud for Multi Tenancy



#2 - Using the Cloud for Multi Tenancy

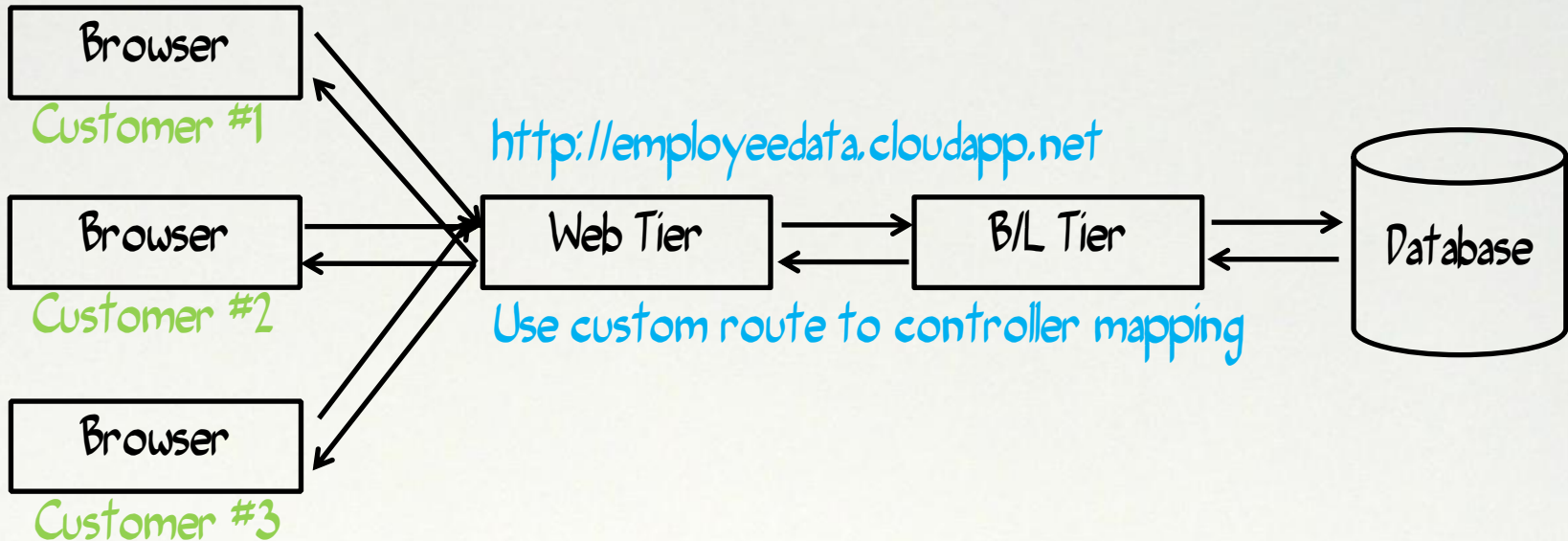
<http://hr.contoso.co.uk> -> CNAME (employeedata.cloudapp.net)



<http://hr.fabrikam.com> -> CNAME (employeedata.cloudapp.net)

#2 - Using the Cloud for Multi Tenancy

<http://hr.contoso.co.uk> -> CNAME (employeedata.cloudapp.net)



<http://hr.fabrikam.com> -> CNAME (employeedata.cloudapp.net)

Patterns for Cloud Computing

Takeaways



Always consider Multi Tenancy first, even if only one customer



Design considerations must include both data and UI



Many other considerations, such as identity – p&p guidance



Patterns for Moving to the Cloud

#3 - Using the Cloud for **Compute**

Patterns for Cloud Computing



Jim sees how cloud computing supports scaling up/down nodes

Patterns for Cloud Computing



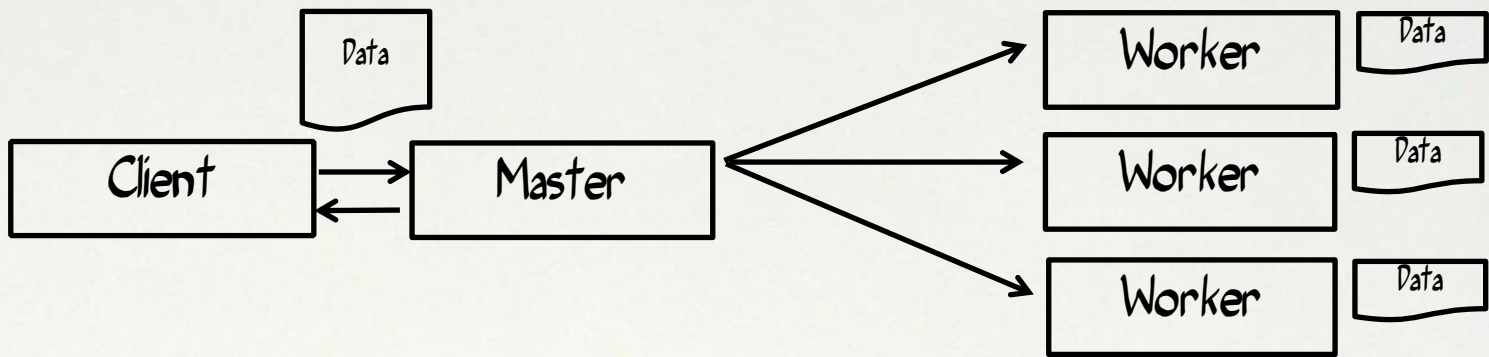
“Can I use all of these nodes in parallel?”

Patterns for Cloud Computing

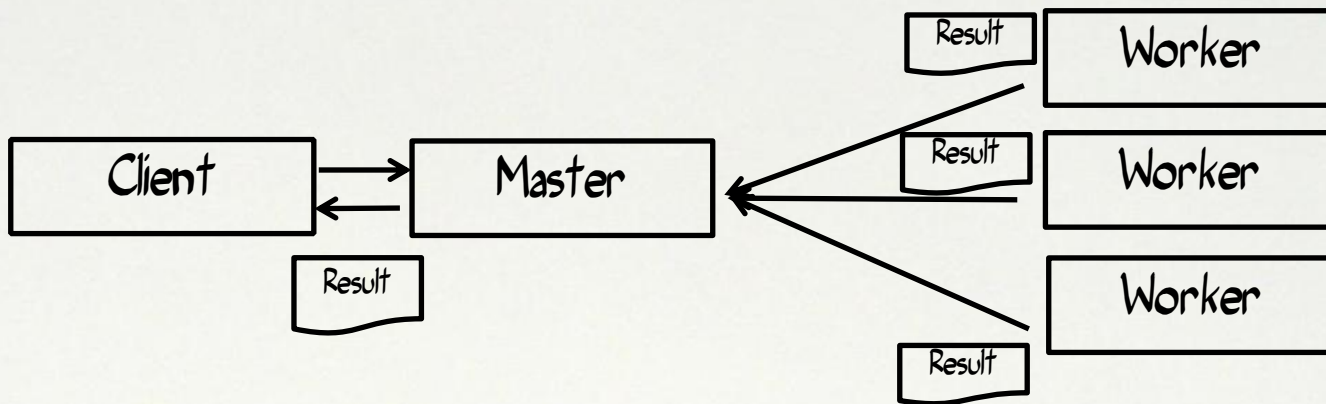


“I’ve got this complex calculation I would like to share across these multiple nodes...”

#3 - Using the Cloud for Compute



#3 - Using the Cloud for Compute

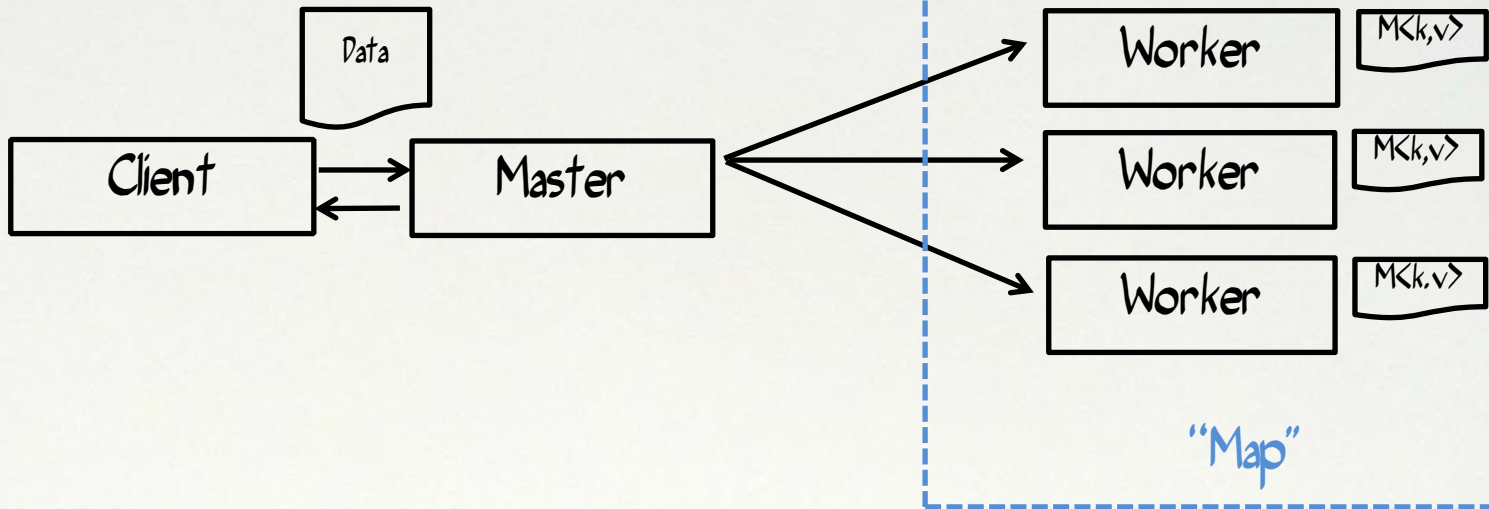


Popularized by the term "MapReduce"*

* 2004 OSDI paper by Jeff Dean and Sanjay Ghemawat (Google)

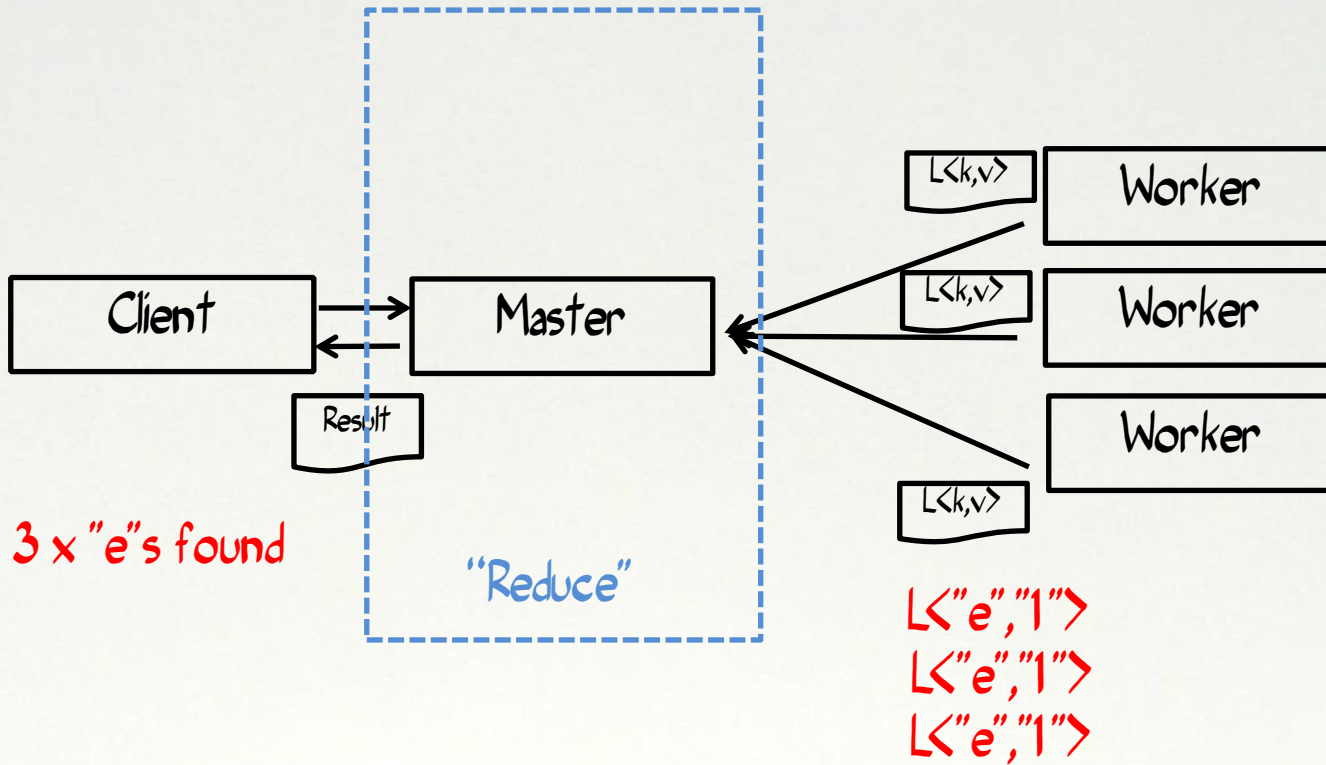
#3 - Using the Cloud for Compute

How many "e"s in
"The quick brown fox jumps over the lazy dog"?



M<"the quick brown","e">
M<"fox jumps over","e">
M<"the lazy dog","e">

#3 - Using the Cloud for Compute



#3 - Using the Cloud for Compute

Google

20pb of data analyzed every day using MapReduce

Yahoo!

10k+ cores, 4pb of data using MapReduce

Facebook

2500+ cores, 1pb of data using MapReduce

Frameworks

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#3 - Using the Cloud for Compute

Apache Hadoop

Open Source Java "Inspired by MapReduce"
(Core, HDFS, many more)

Cloudera

Consulting, training, distribution of Hadoop

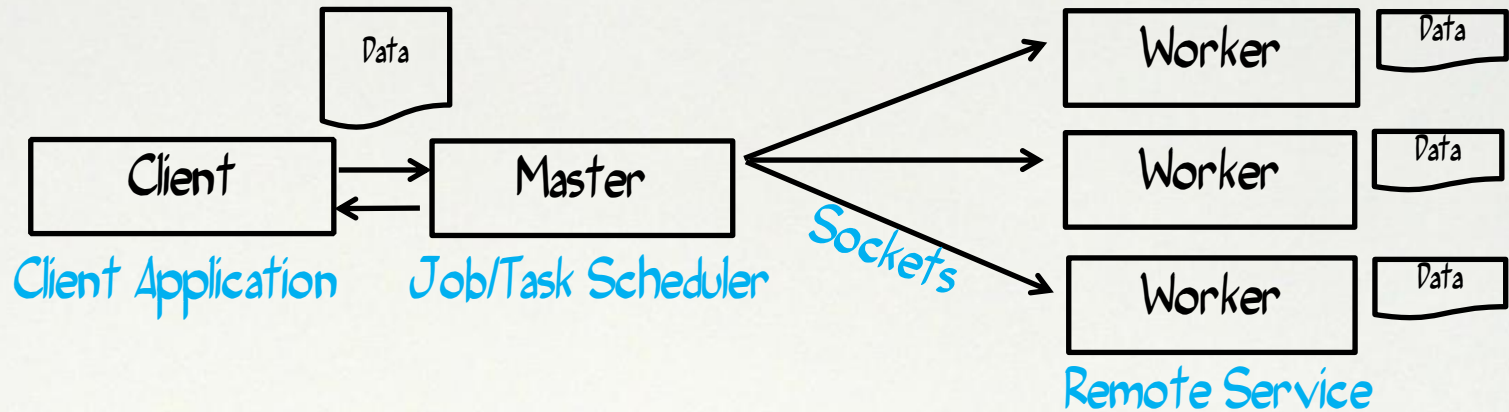
Amazon Elastic MapReduce

Hadoop implementation on EC2

How would Jim do this today on premises?

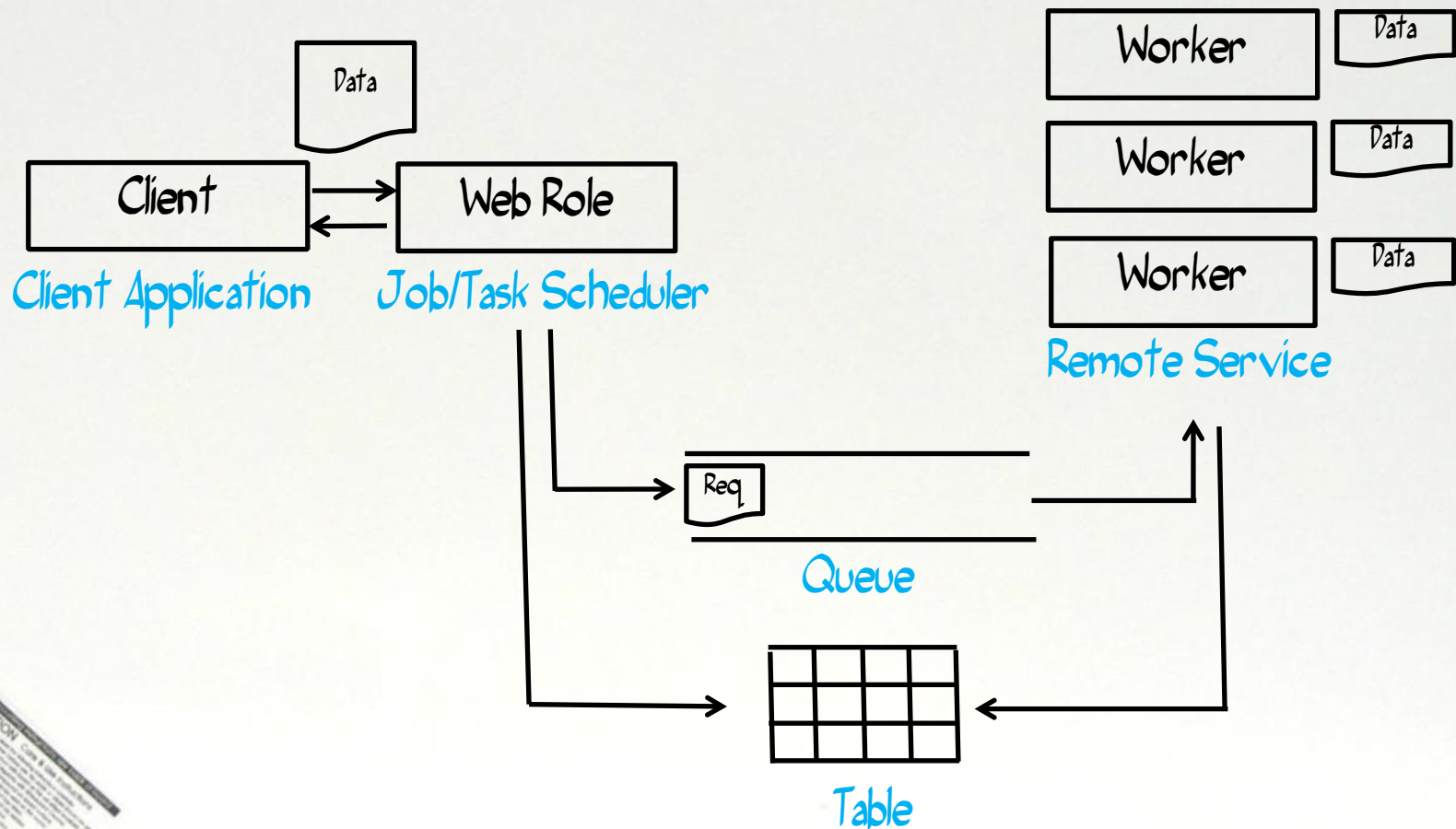
#3 - Using the Cloud for Compute

How would Jim do this today on premises?



How about implementing this on Windows Azure?

#3 - Using the Cloud for Compute



Patterns for Cloud Computing

Takeaways



MapReduce very visible, although can be difficult to initially grasp



Learn about existing frameworks, especially Apache Hadoop



Read up on Dryad (DryadLINQ) for future direction



Patterns for Moving to the Cloud

#4 - Using the Cloud for **Storage**

Patterns for Cloud Computing



“The cloud lets me store *infinite* data, right?”

Patterns for Cloud Computing



Lots of headaches with data management today

Patterns for Cloud Computing



“It sounds too good to be true...”

How does Jim do this today on premises?

PARROT ATTENTION Care & Use Instructions
This whiteboard is made of a special material that is easy to clean and write on. It is designed to be used in a classroom or office setting. To ensure the best performance, please follow the following instructions:
- Avoid using sharp objects or abrasive cleaners on the surface.
- Wipe the surface with a soft, damp cloth after use.
- Do not use water-based markers or permanent markers.
- The whiteboard is not intended for use in high-temperature environments.
- The whiteboard is not intended for use in high-humidity environments.
- The whiteboard is not intended for use in high-pressure environments.
- The whiteboard is not intended for use in high-voltage environments.
- The whiteboard is not intended for use in high-frequency environments.
- The whiteboard is not intended for use in high-speed environments.
- The whiteboard is not intended for use in high-acceleration environments.
- The whiteboard is not intended for use in high-g environments.
- The whiteboard is not intended for use in high-vibration environments.
- The whiteboard is not intended for use in high-noise environments.
- The whiteboard is not intended for use in high-light environments.
- The whiteboard is not intended for use in high-contrast environments.
- The whiteboard is not intended for use in high-resolution environments.
- The whiteboard is not intended for use in high-contrast environments.
- The whiteboard is not intended for use in high-resolution environments.

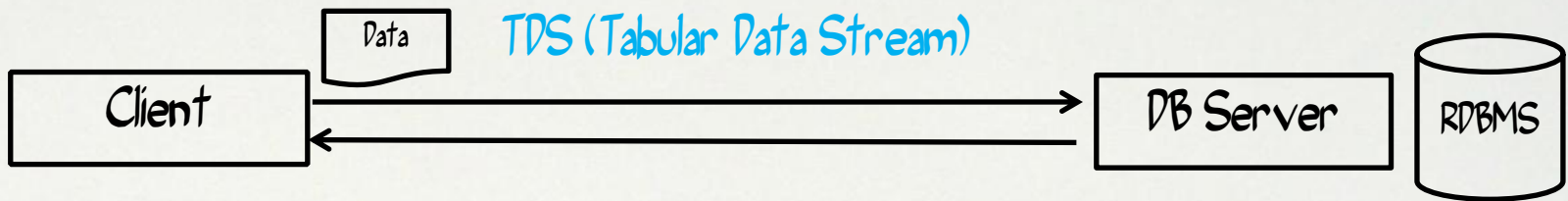
#4 - Using the Cloud for Storage

How would Jim do this today on premises?



#4 - Using the Cloud for Storage

How would Jim do this today on premises?

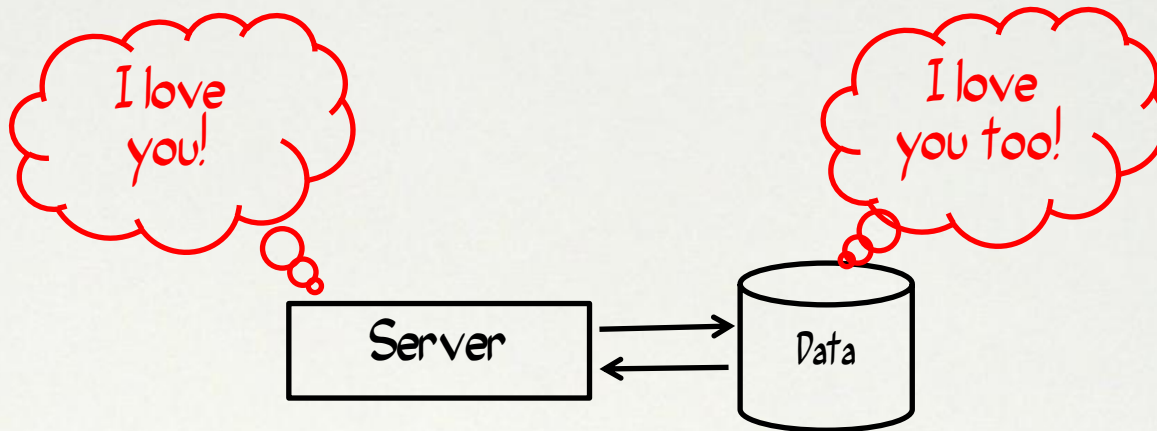


#4 - Using the Cloud for Storage

How would Jim do this today on premises?

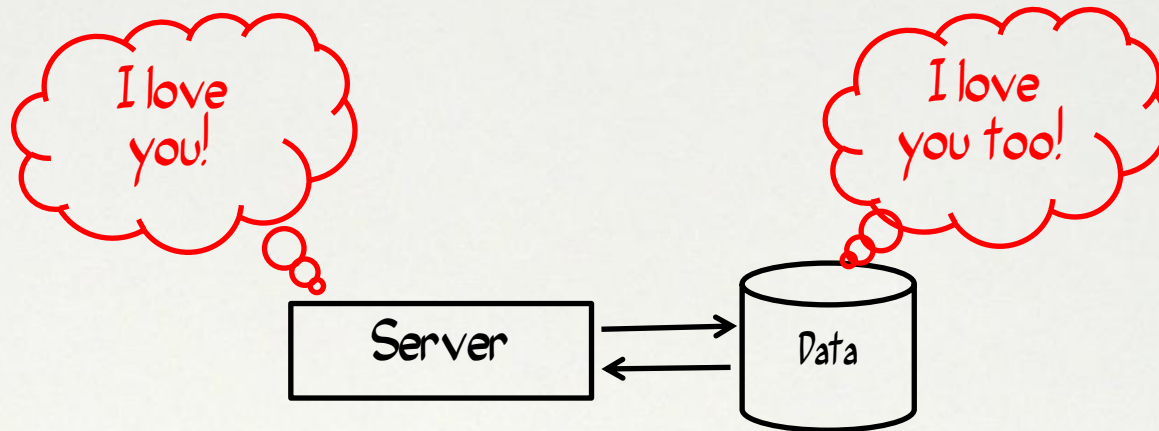


#4 - Using the Cloud for Storage



Affinity between your data and physical hardware that serves it

#4 - Using the Cloud for Storage



Symptoms:

Which RAID number was that again?

Tedious to backup exponentially growing data

Crap! I'm at 95% capacity - got to move to a bigger disk

Breaks the affinity between your data and hardware

CAREX ATTENTION
Care & Use Instructions
Please read these instructions carefully before using the product.
The product is designed for use in the following conditions:
- Temperature: 50°F to 100°F (10°C to 38°C)
- Humidity: 20% to 80%
- Air Quality: Clean, dry air
- Surface: Smooth, non-porous surfaces
- Use: For cleaning only
- Do not use on: Fabric, wood, stone, or other sensitive materials.
- Safety: Keep out of reach of children.
- Disposal: Recycle in accordance with local regulations.
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Blobs, Tables, Relational

PARROT ATTENTION: Care & Use Instructions
The Parrot brand of whiteboards is made of a special material that is designed to be used with dry-erase markers. It is not intended for use with liquid markers or other writing instruments. The whiteboard surface is not to be used for drawing or writing with sharp objects. The whiteboard should be cleaned regularly with a soft cloth and a mild detergent. Do not use abrasive cleaners or solvents. The whiteboard should be stored in a cool, dry place. For more information, please visit our website at www.parrotwhiteboards.com.

Blobs, Tables, Relational

PARROT ATTENTION: Care & Use Instructions
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#4 - Using the Cloud for Storage

PutBlob

PUT <http://account.blob.core.windows.net/containername/blobname>

Blob Container

Client

REST API

Azure
Blob Storage



```
graph LR; Client[Client] -- REST API --> Azure[Azure Blob Storage]; Azure -- REST API --> Client;
```

<http://account.blob.core.windows.net/containername/blobname>

PutBlob = 64Mb MAX

Metadata = 8Kb per Blob

#4 - Using the Cloud for Storage



<http://account.blob.core.windows.net/containername/blobname>

#4 - Using the Cloud for Storage



<http://account.blob.core.windows.net/containername/blobname>

#4 - Using the Cloud for Storage

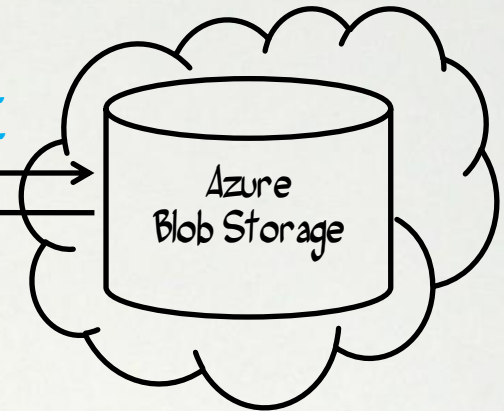
PutBlock(blobname, blockid, data)

PutBlockList(blobname, blockid1, . . . , blockidN)

Client

REST API

Blob Container



<http://account.blob.core.windows.net/containername/blobname>

PutBlock = 4Mb MAX to a maximum of 50Gb

BlockId = 64 bytes

Blobs, Tables, Relational

PARROT ATTENTION
Care & Use Instructions
The Parrot® Whiteboard is made of a special material that is resistant to most liquids and stains. It is easy to clean with a damp cloth. Do not use harsh chemicals or abrasive cleaners. For more information, visit www.parrot.com.

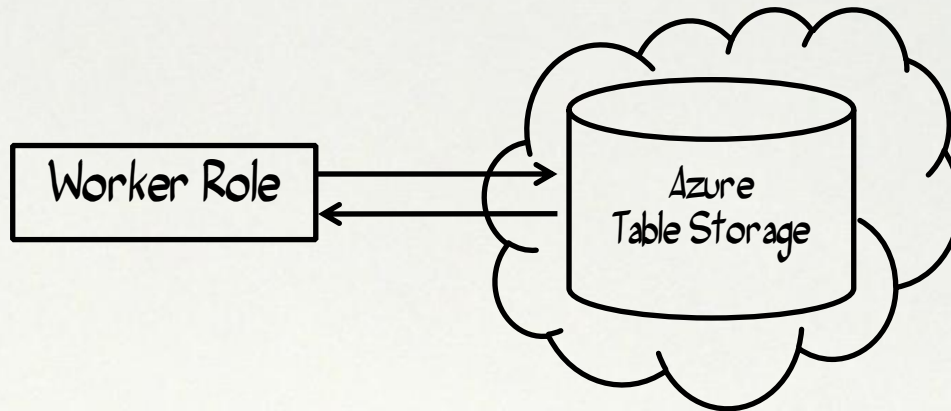
#4 - Using the Cloud for Storage

REST:

GET <http://account.table.core.windows.net/Customers?%3Bfilter=%20PartitionKey%20eq%20value>

LINQ:

```
var customers = from o in context.CreateQuery<customer>("Customers") where o.PartitionKey == value select o;
```



<http://account.table.core.windows.net>

Each Table:

PartitionKey (e.g. DocumentName) to ensure scalability

RowKey (e.g. version number)

[fields] for data

Blobs, Tables, Relational

PARROT ATTENTION
Care & Use Instructions
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Codename Sitka (early 2008)

BARRETT ATTENTION
Care & Use Instructions
The following information is provided for your reference. Please read this information carefully before using the product. For more information, please visit our website at www.barrett.com.
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SQL Server Data Services (MIX08)

PARROT ATTENTION: Check for any instructions.
Small text block in the bottom-left corner of the whiteboard, likely containing safety or usage instructions.

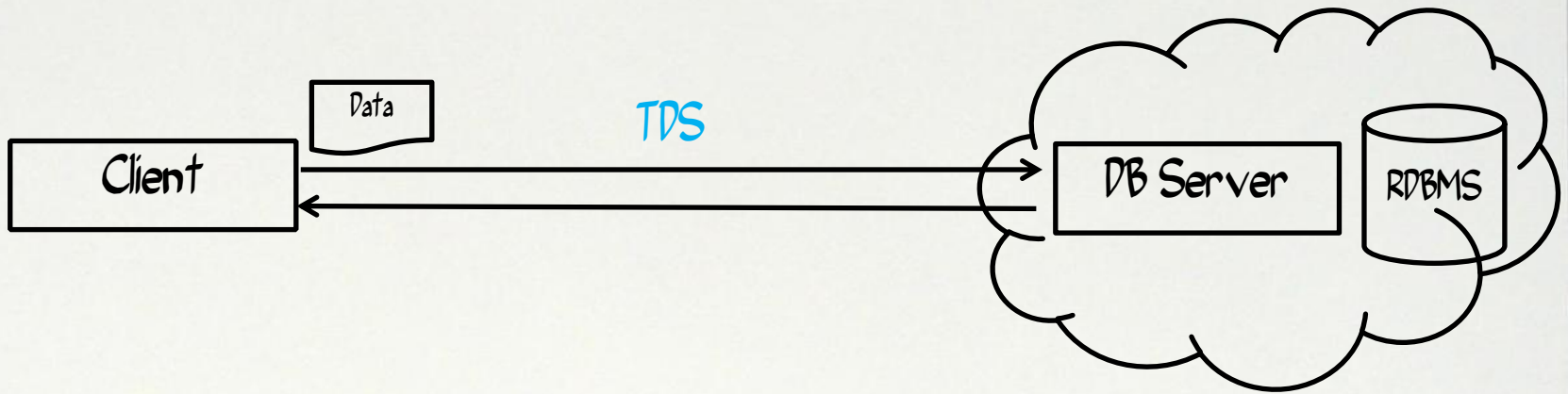
#4 - Using the Cloud for Storage

This is what I'm doing on premises...



#4 - Using the Cloud for Storage

So, this is what I would like to do in the cloud...

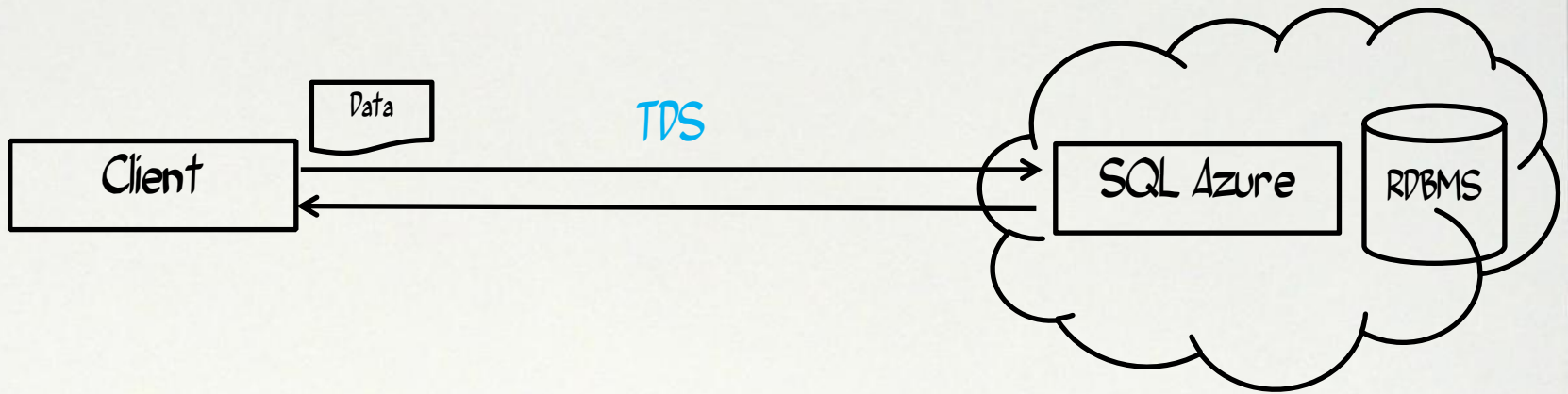


SQL Azure (July 2009)

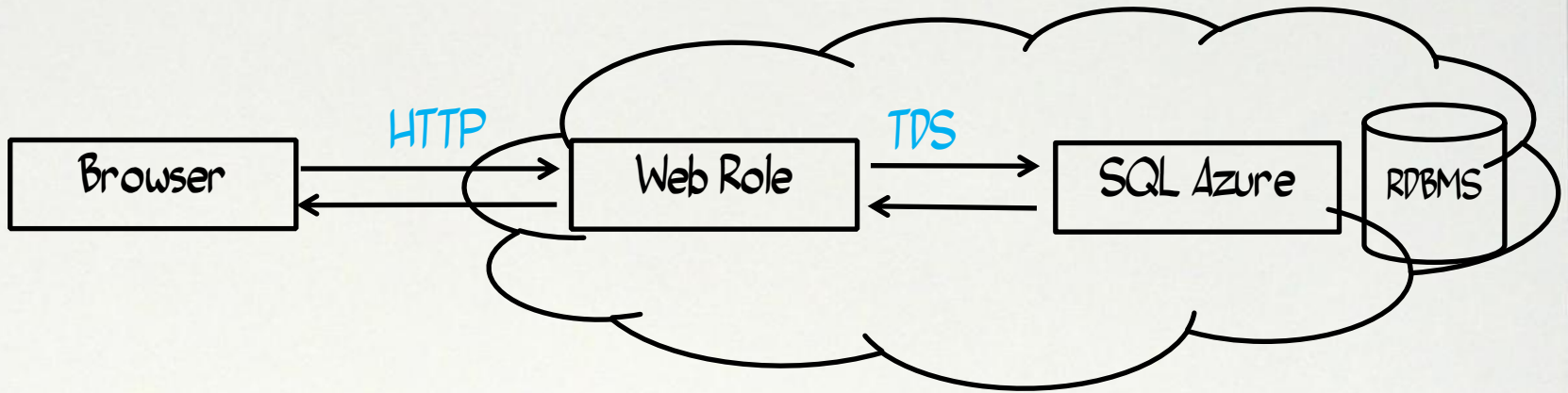
CAUTION ATTENTION
Consult the instructions for use and safety information.

#4 - Using the Cloud for Storage

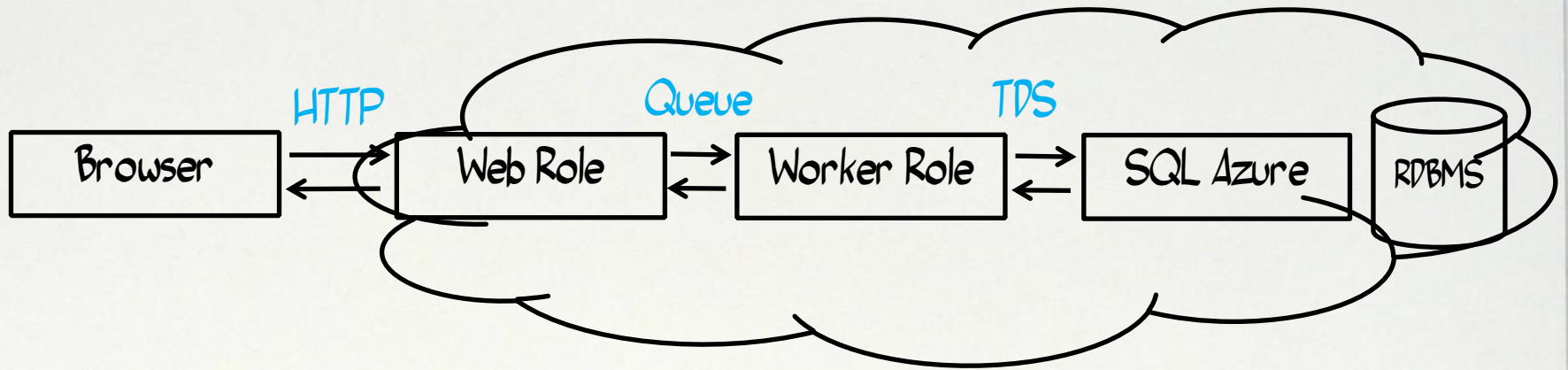
So, this is what I would like to do...



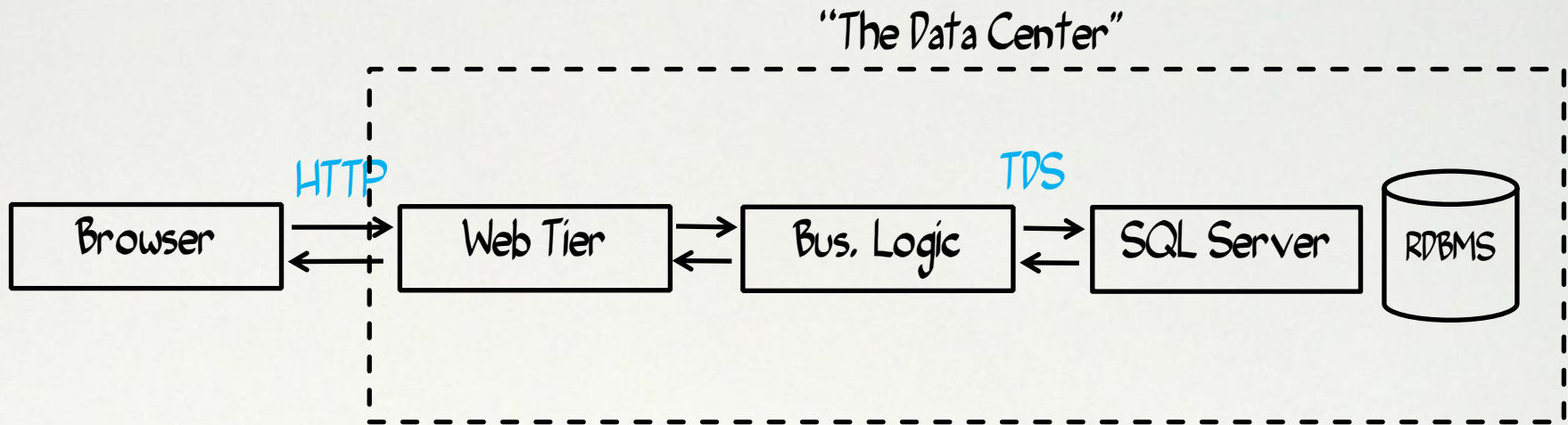
#4 - Using the Cloud for Storage



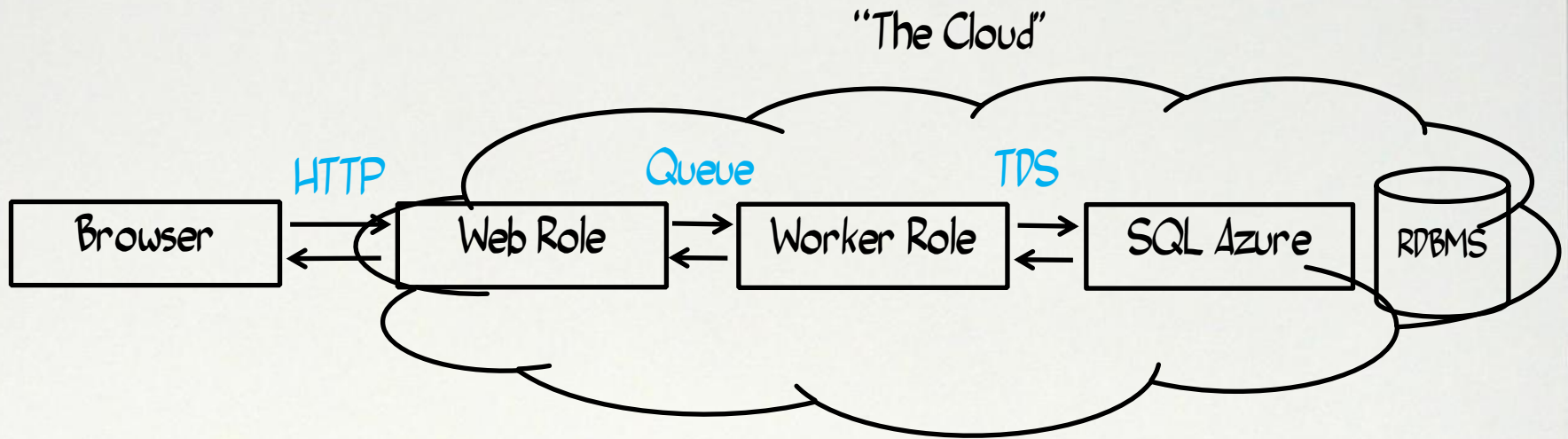
#4 - Using the Cloud for Storage



#4 - Using the Cloud for Storage



#4 - Using the Cloud for Storage



Demo: SQL Azure CTP

Patterns for Cloud Computing

Takeaways



Storage in the cloud may look the same, but breaks the affinity issue



Understand the pricing model for storage on-premises vs. cloud



SQL Azure as a factor for migration/move from on premises



Patterns for Moving to the Cloud

#5 - Using the Cloud for **Communications**

Patterns for Cloud Computing



Jim's organization needs to communicate with other organizations

Patterns for Cloud Computing



“This has always been a very tricky and expensive process to get working”

Patterns for Cloud Computing

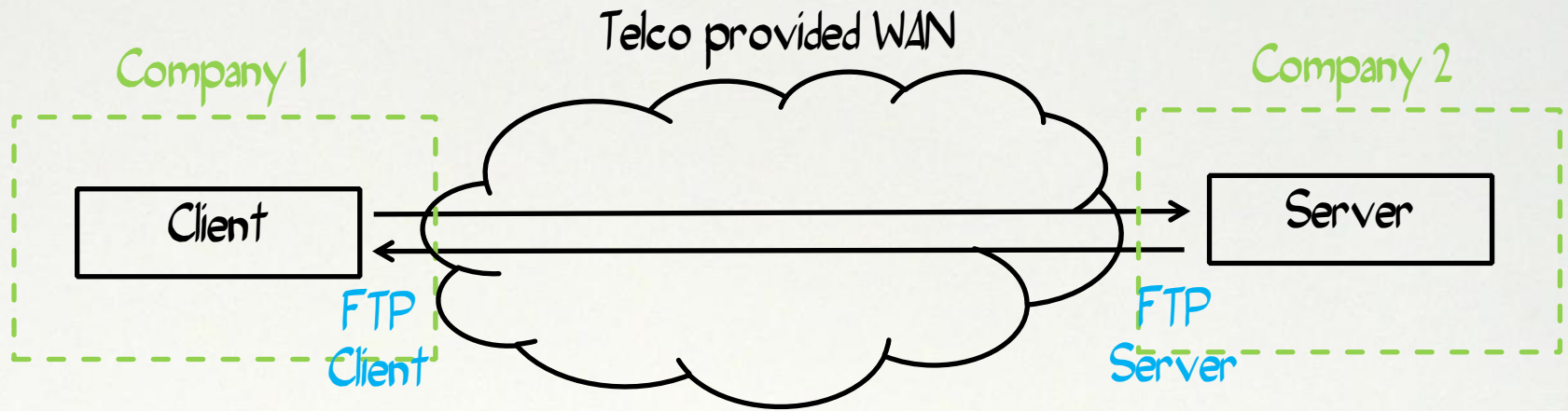


“Does the cloud offer anything to help?”

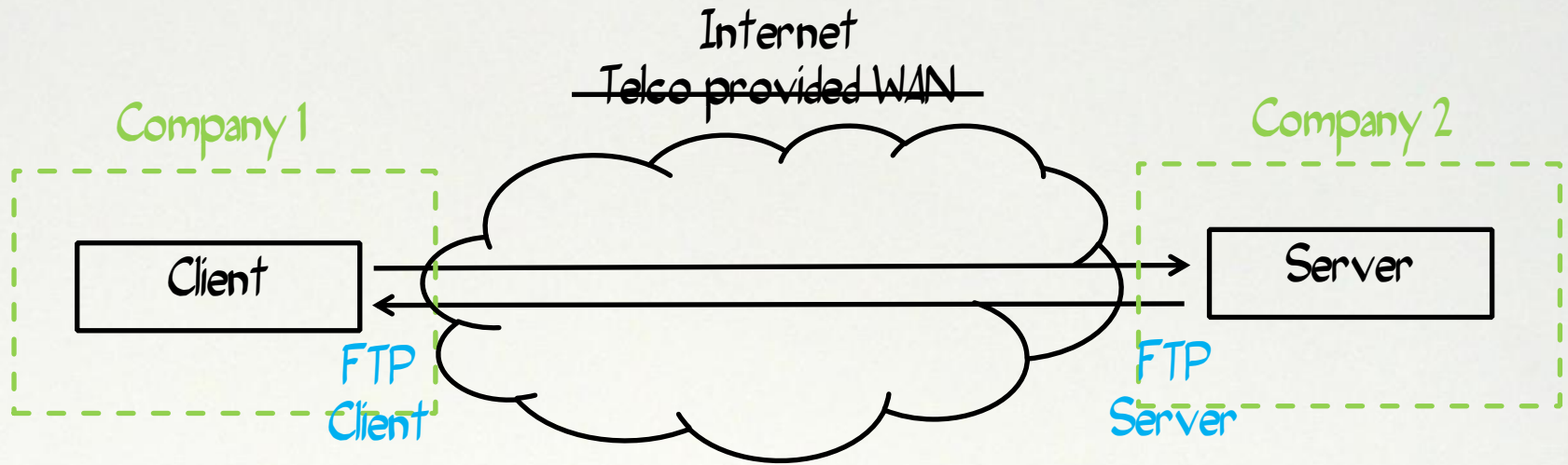
How would Jim have done this before?

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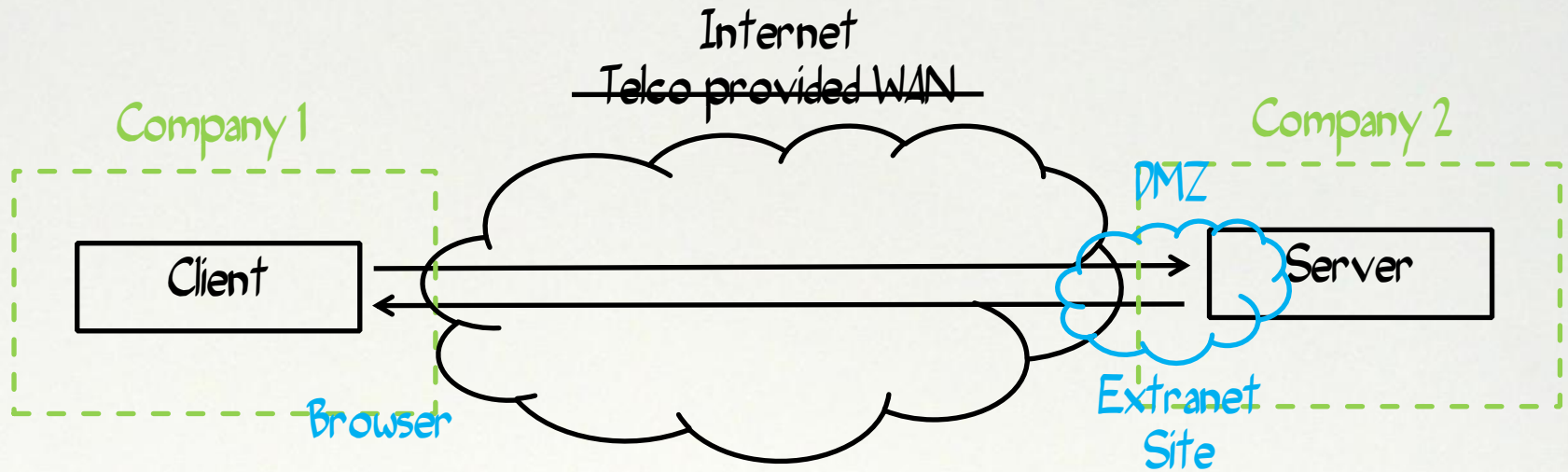
#5 - Using the Cloud for Communications



#5 - Using the Cloud for Communications



#5 - Using the Cloud for Communications

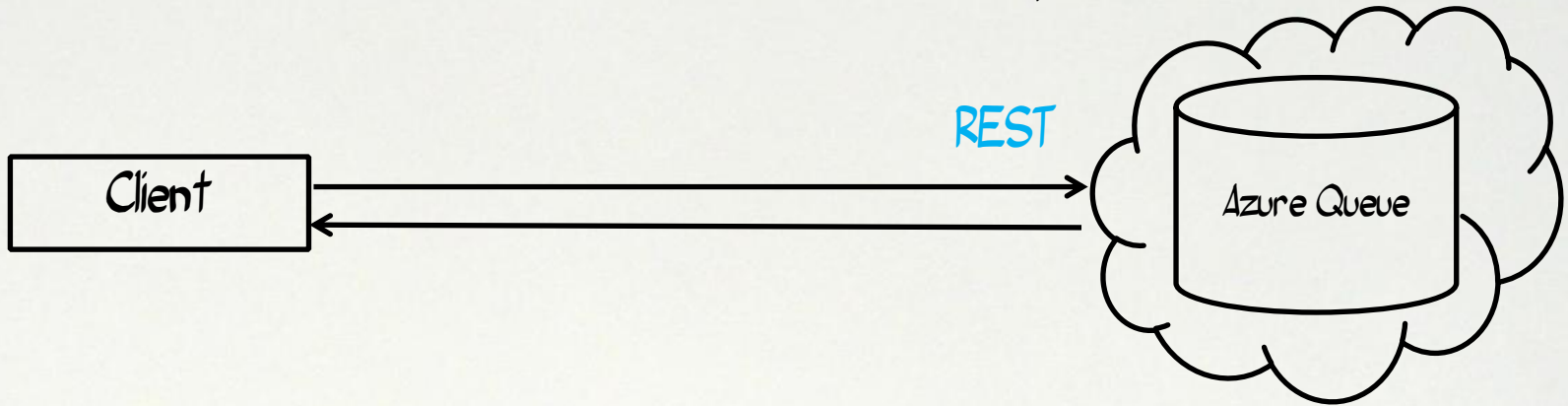


What does the cloud provide?

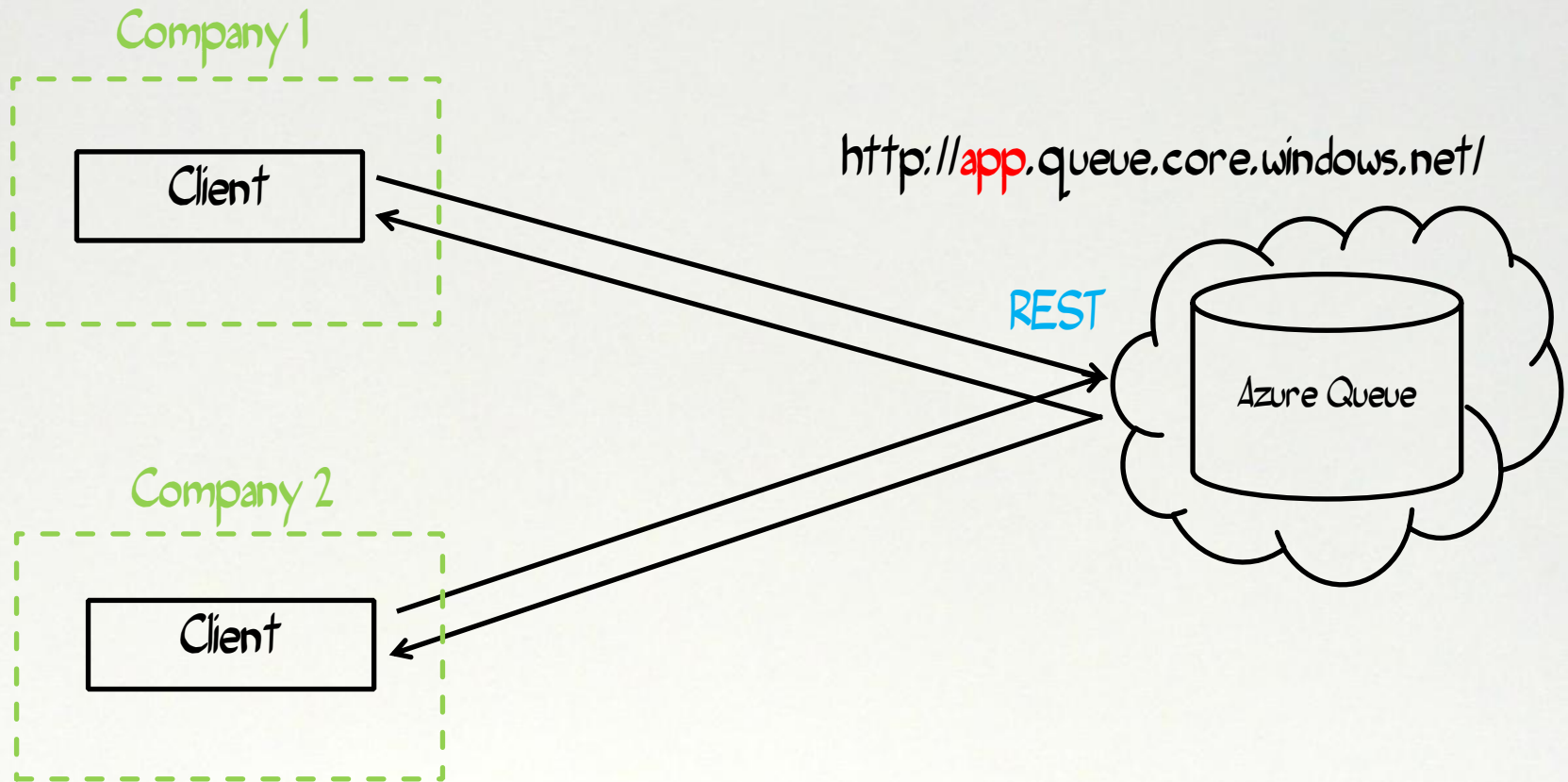
PARROT ATTENTION: Care & Use Instructions
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#5 - Using the Cloud for Communications

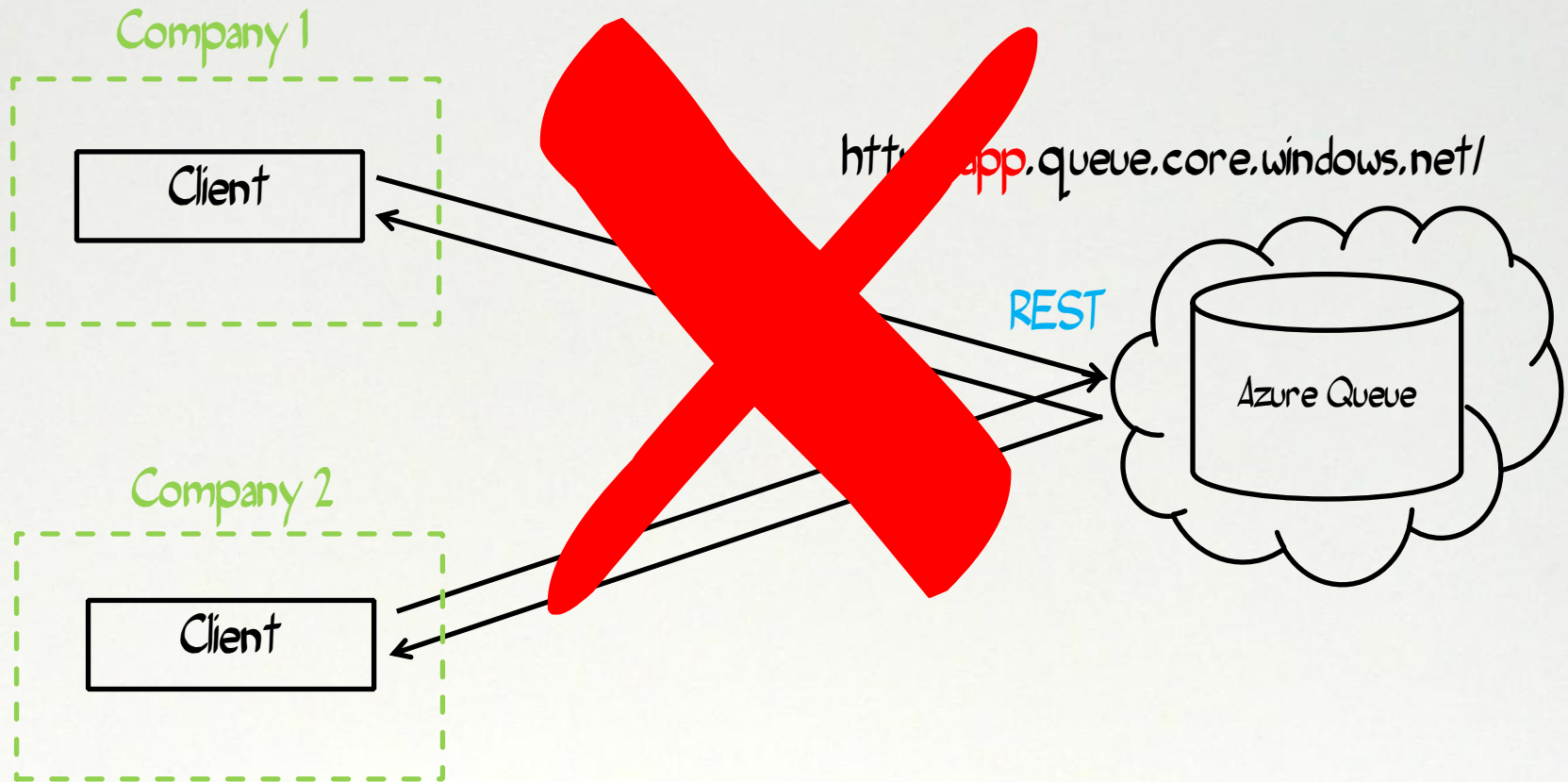
<http://app.queue.core.windows.net/>



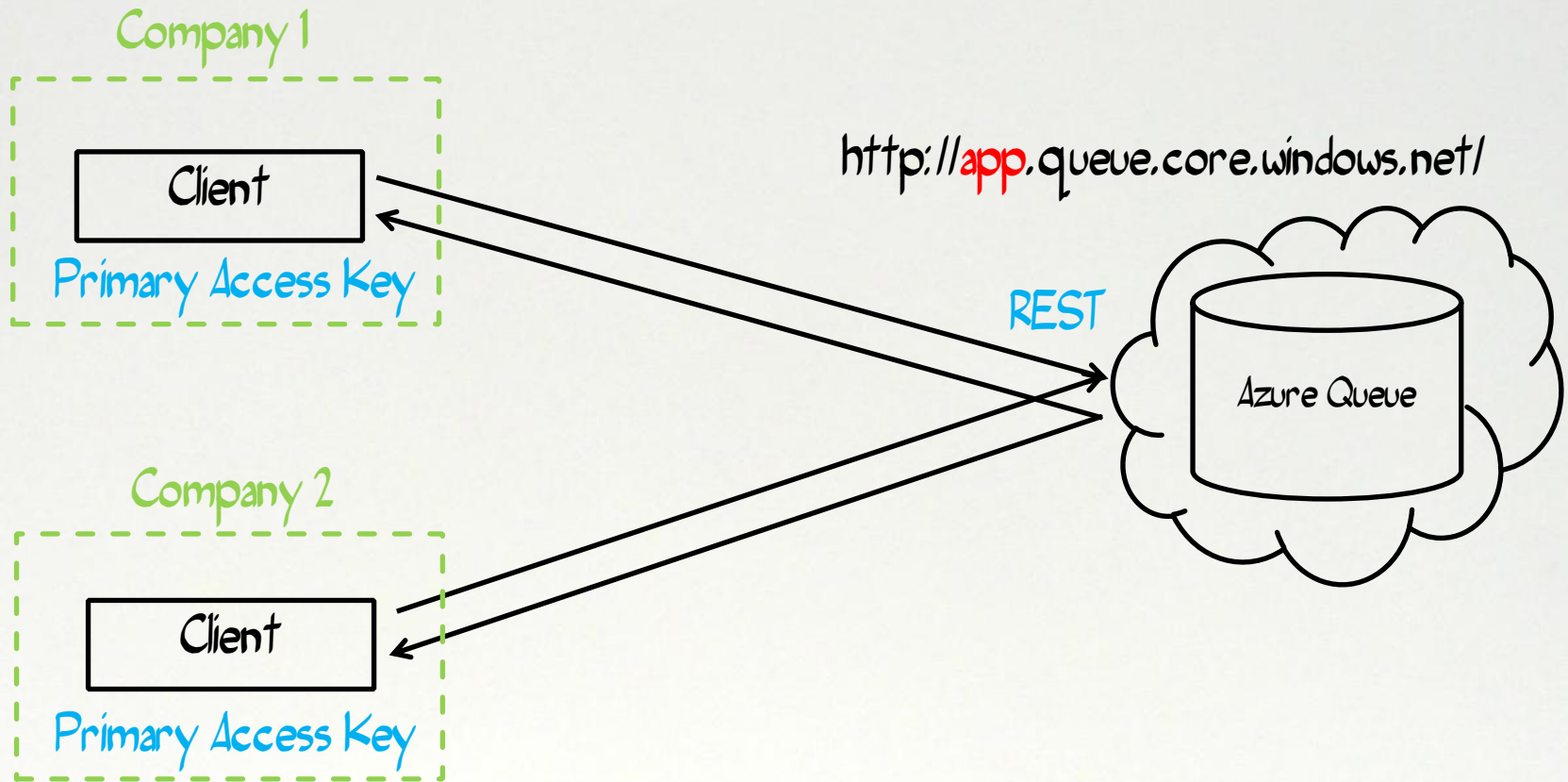
#5 - Using the Cloud for Communications



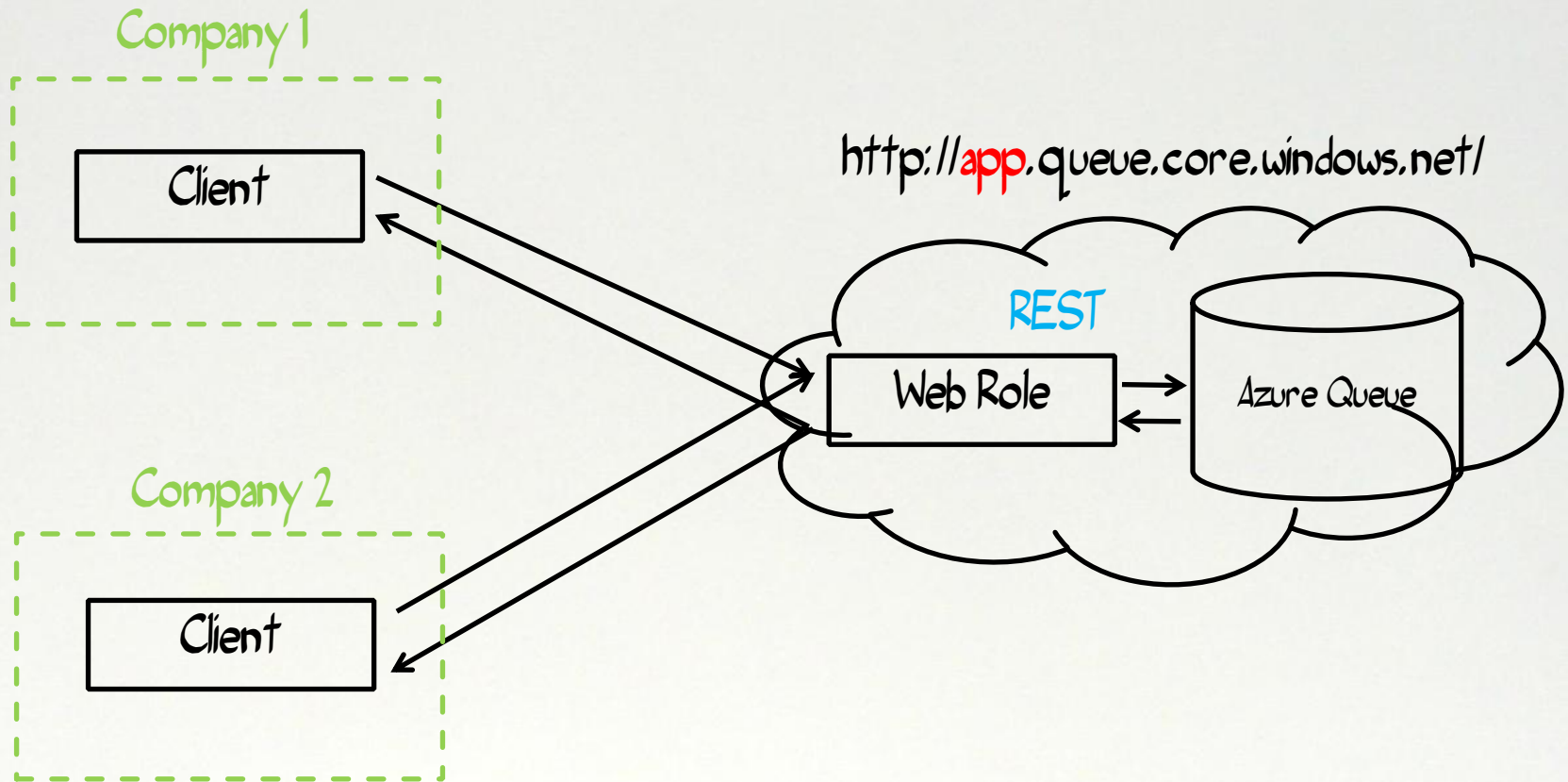
#5 - Using the Cloud for Communications



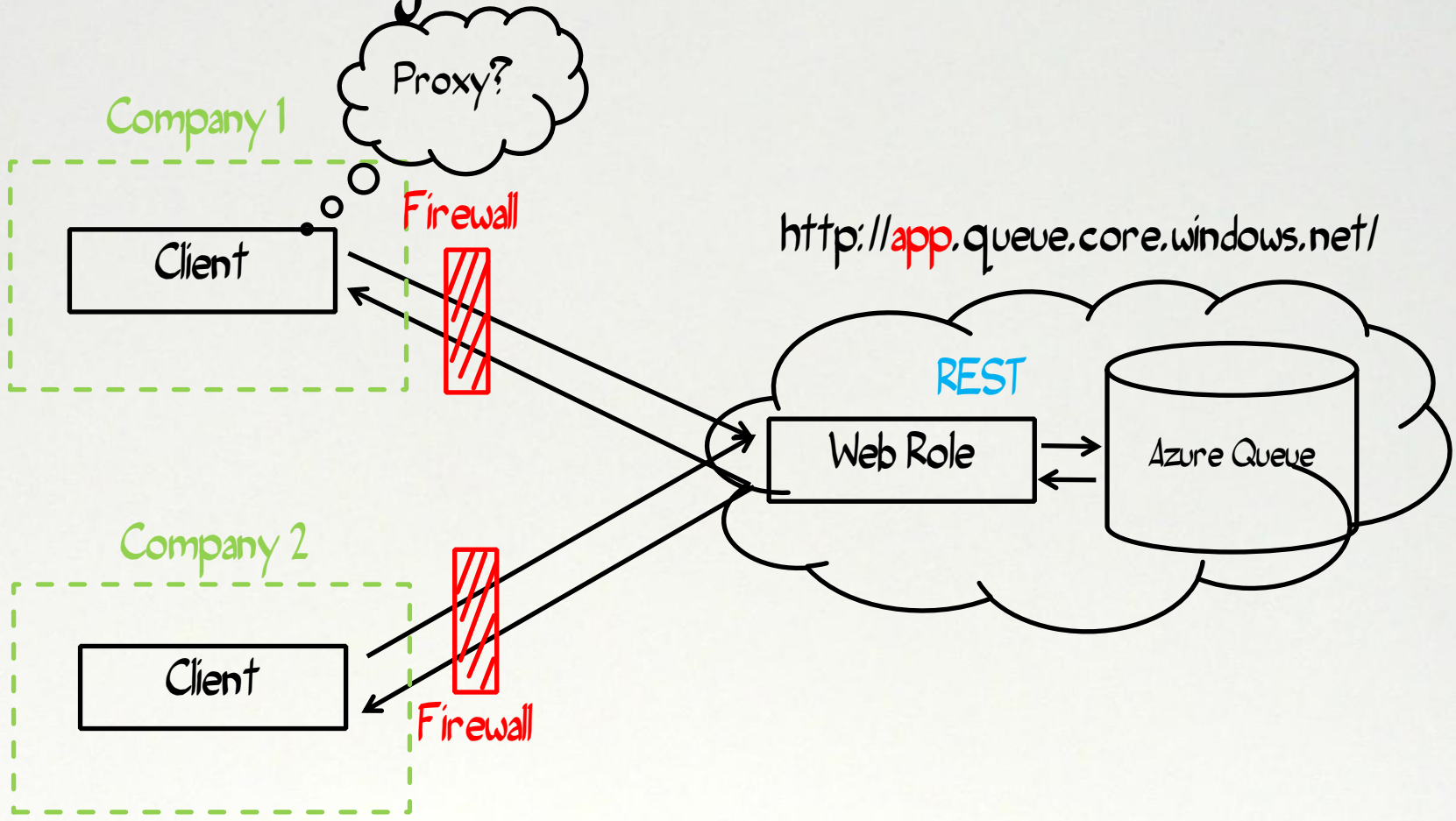
#5 - Using the Cloud for Communications



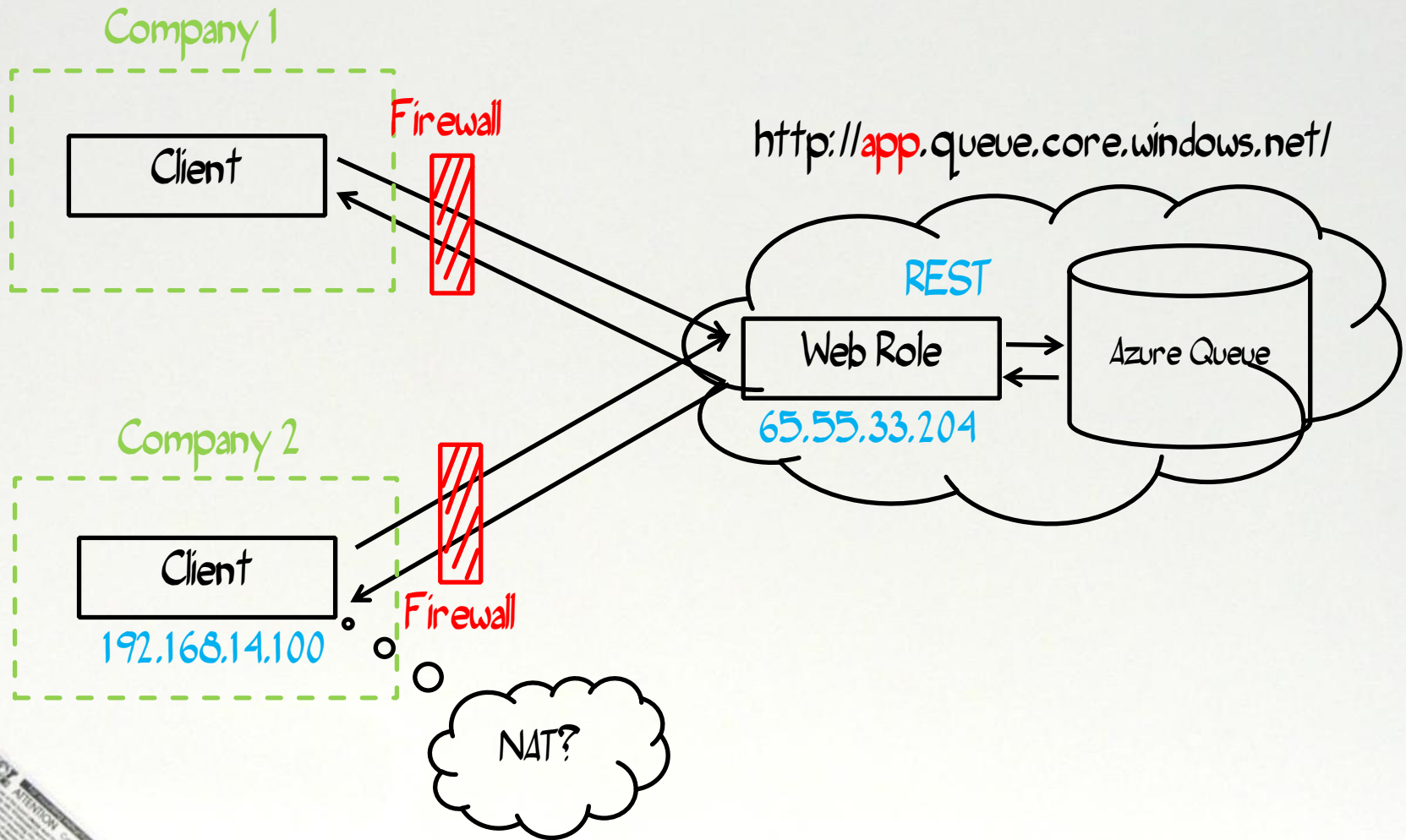
#5 - Using the Cloud for Communications



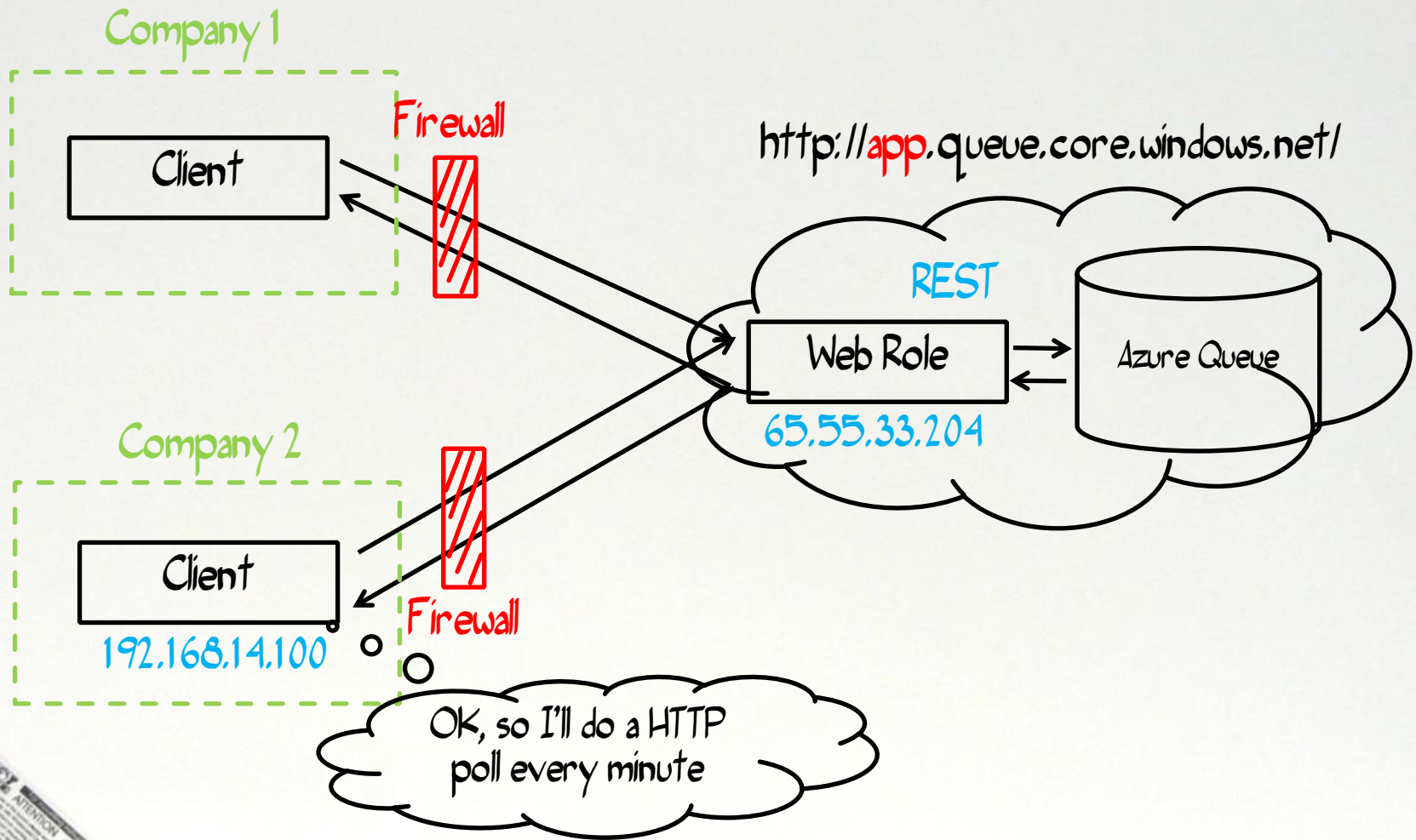
#5 - Using the Cloud for Communications



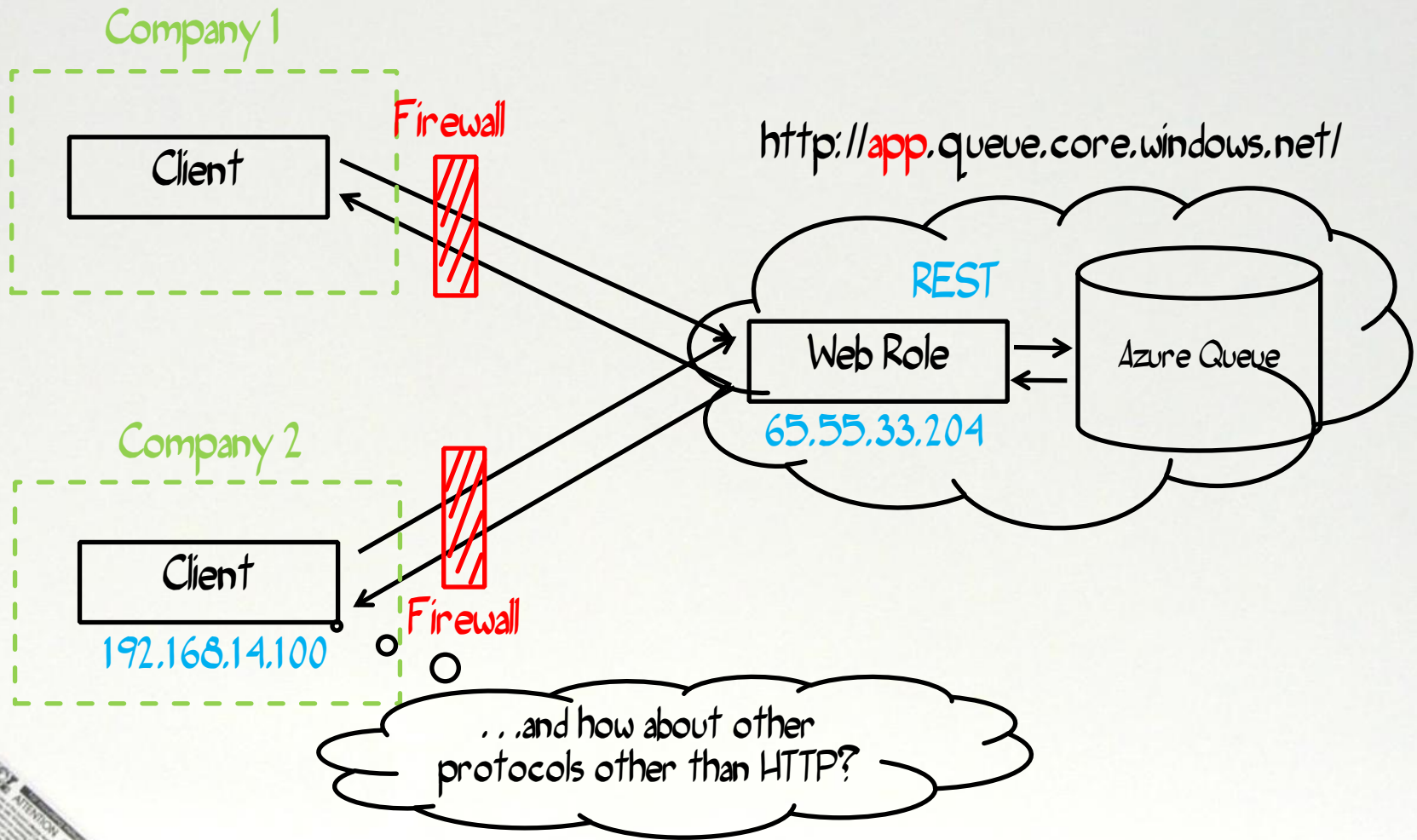
#5 - Using the Cloud for Communications



#5 - Using the Cloud for Communications



#5 - Using the Cloud for Communications



How does the .NET Service Bus help?

#5 - Using the Cloud for Communications

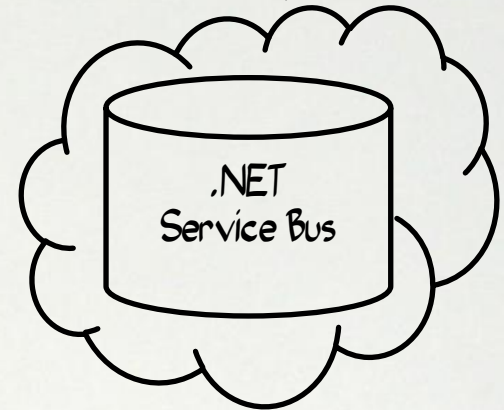
Company 1



Company 2



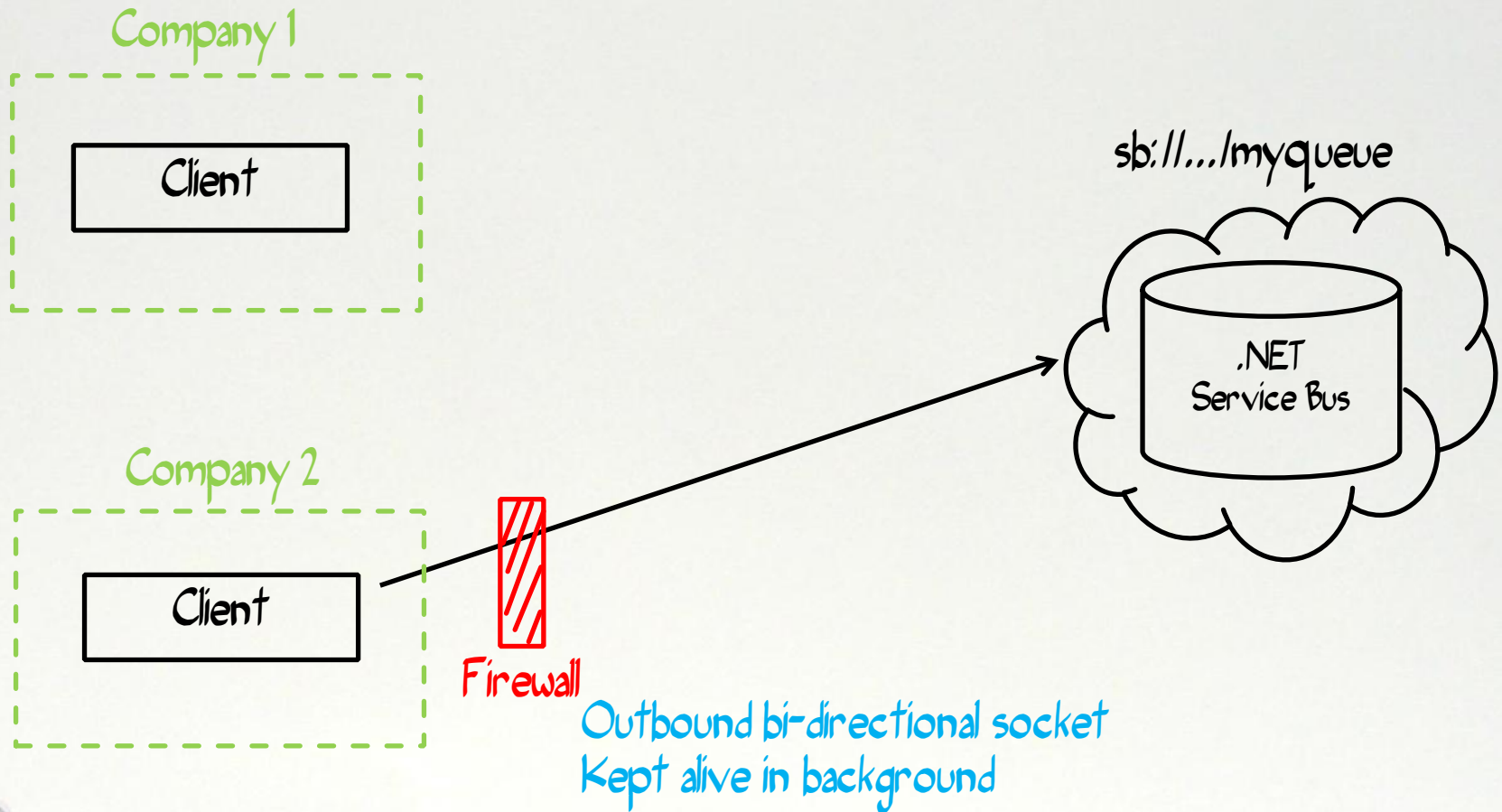
sb://.../myqueue



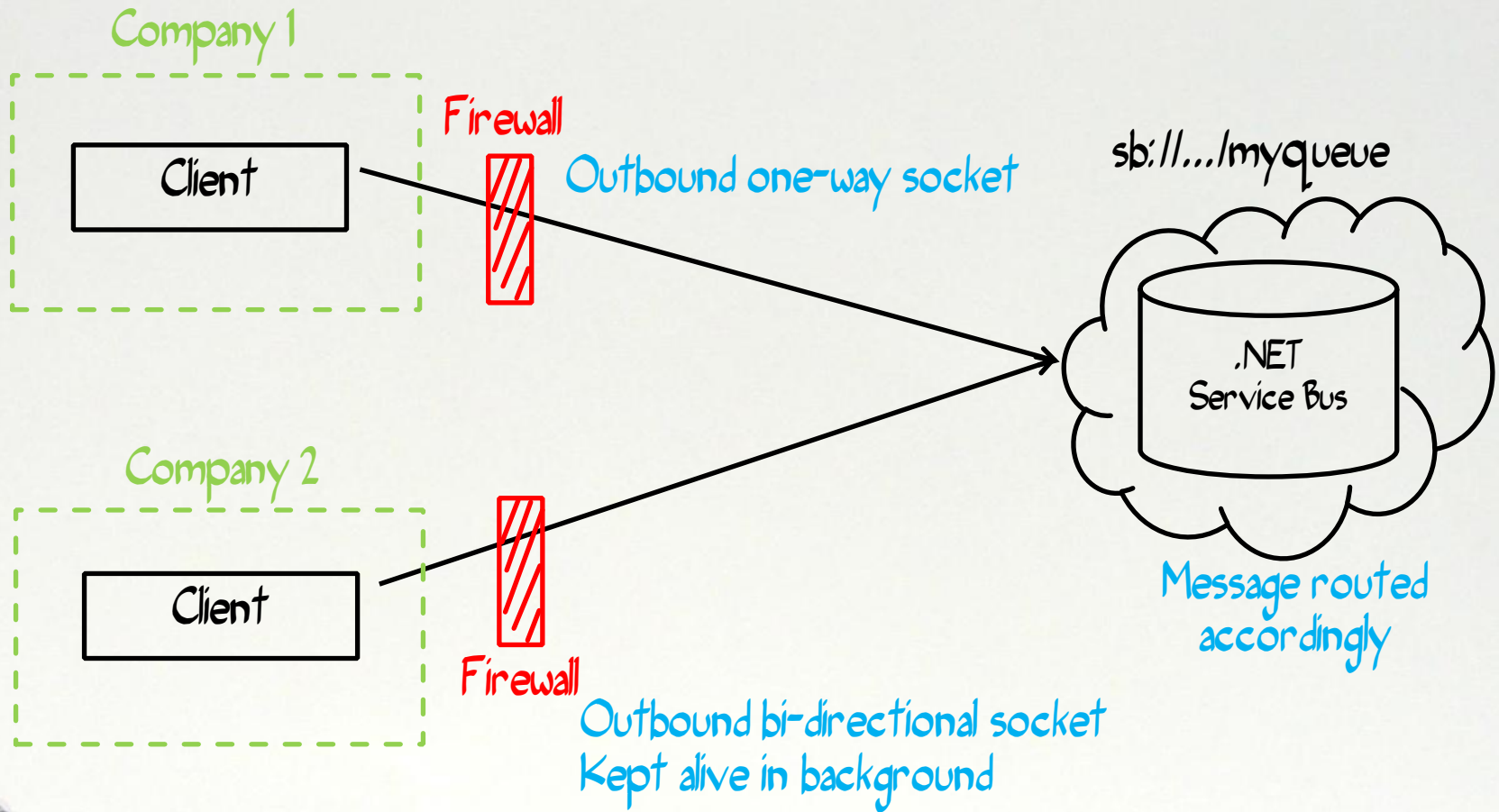
Two modes: TCP Relay and Message Buffer

Two modes: TCP Relay and Message Buffer

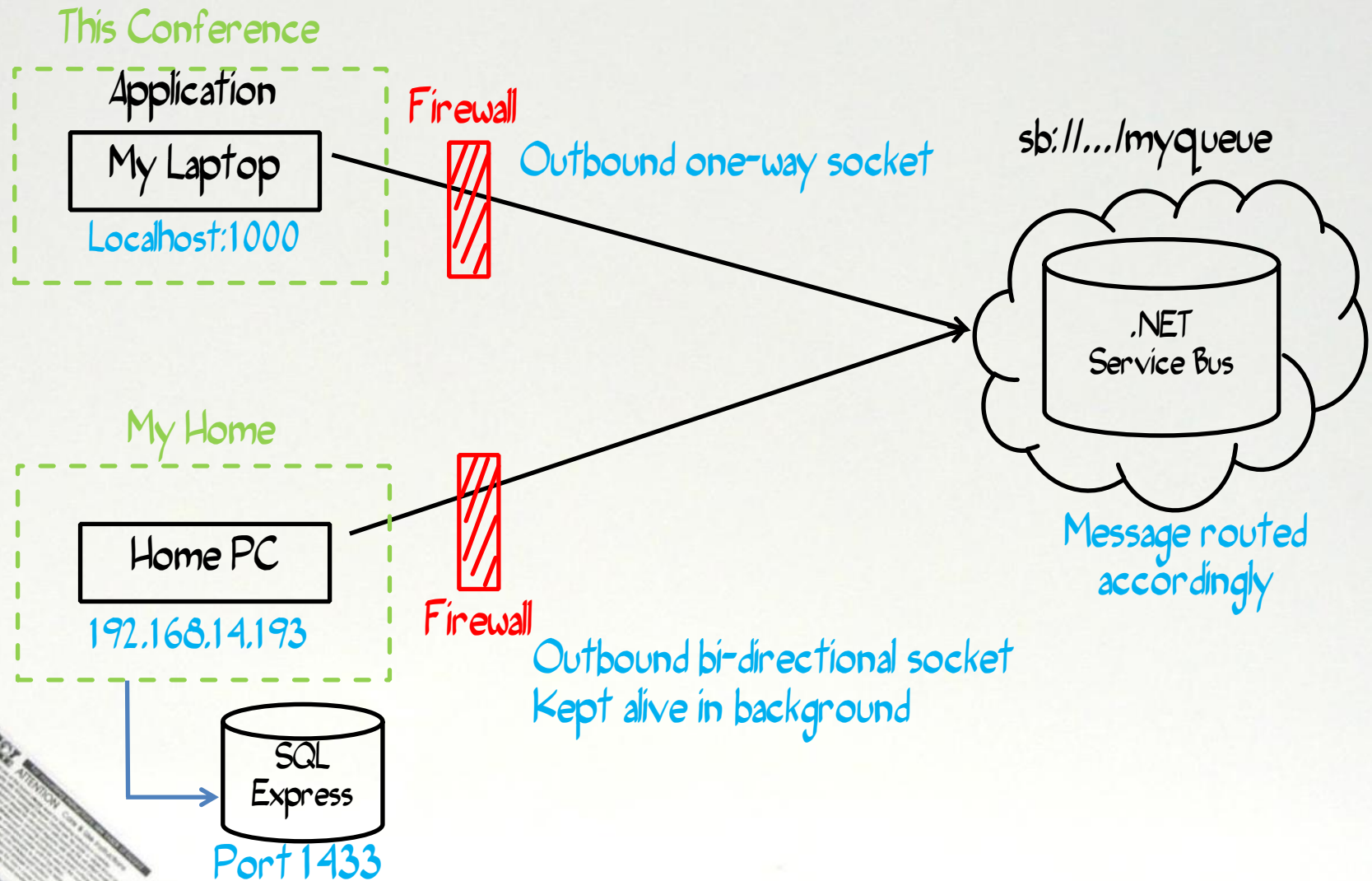
#5 - Using the Cloud for Communications



#5 - Using the Cloud for Communications

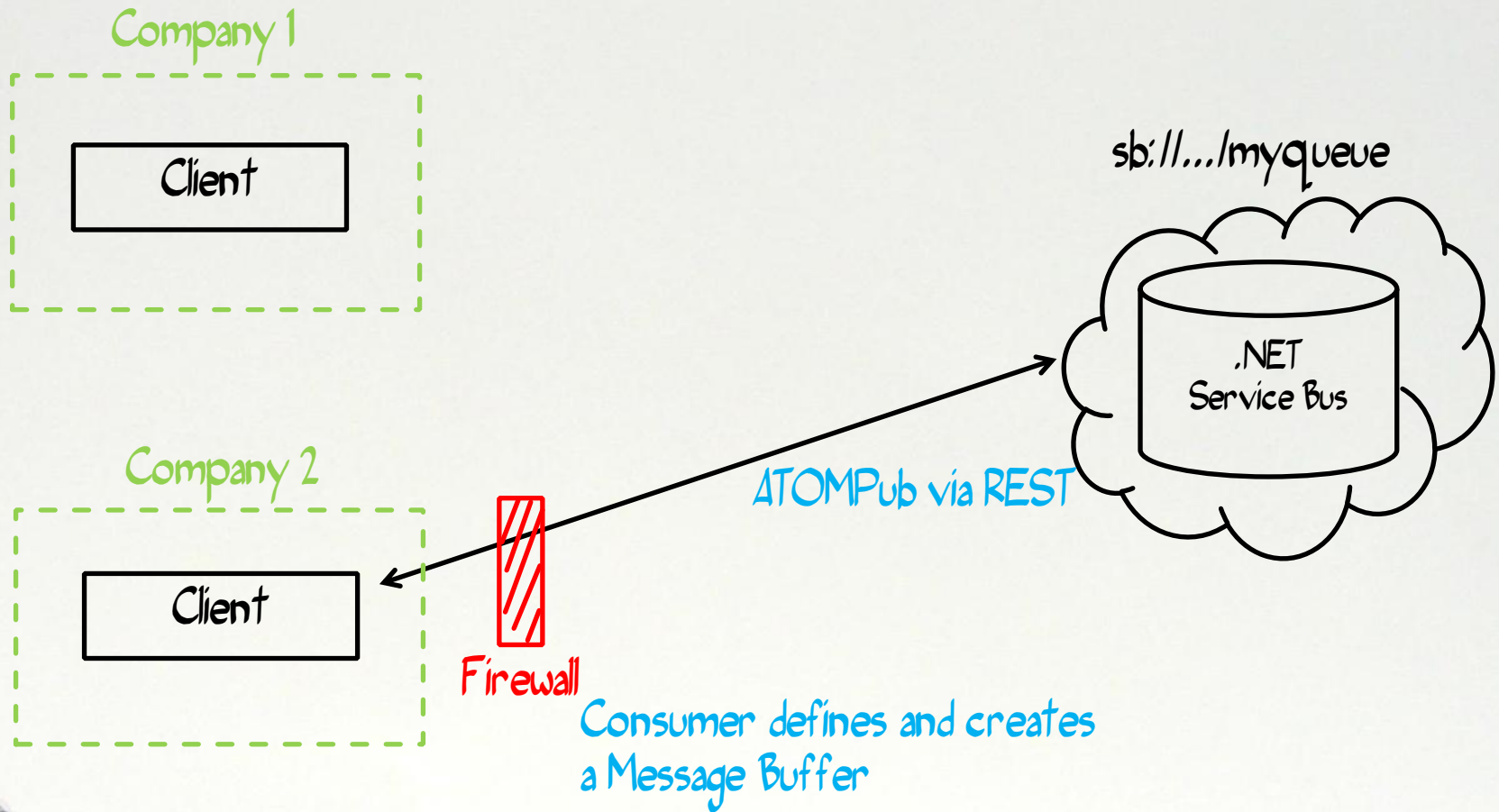


#5 - Using the Cloud for Communications

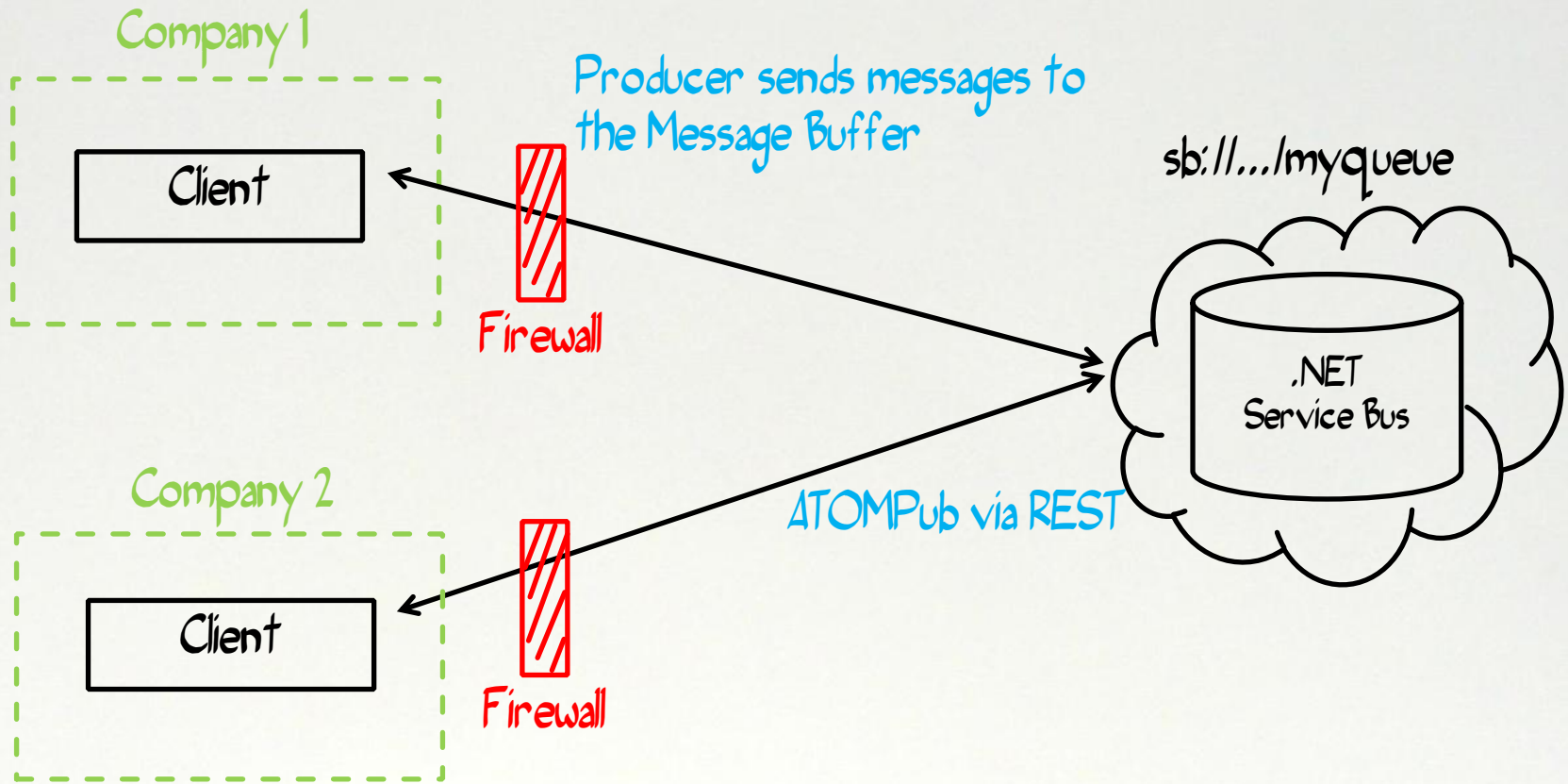


Two modes: TCP Relay and Message Buffer

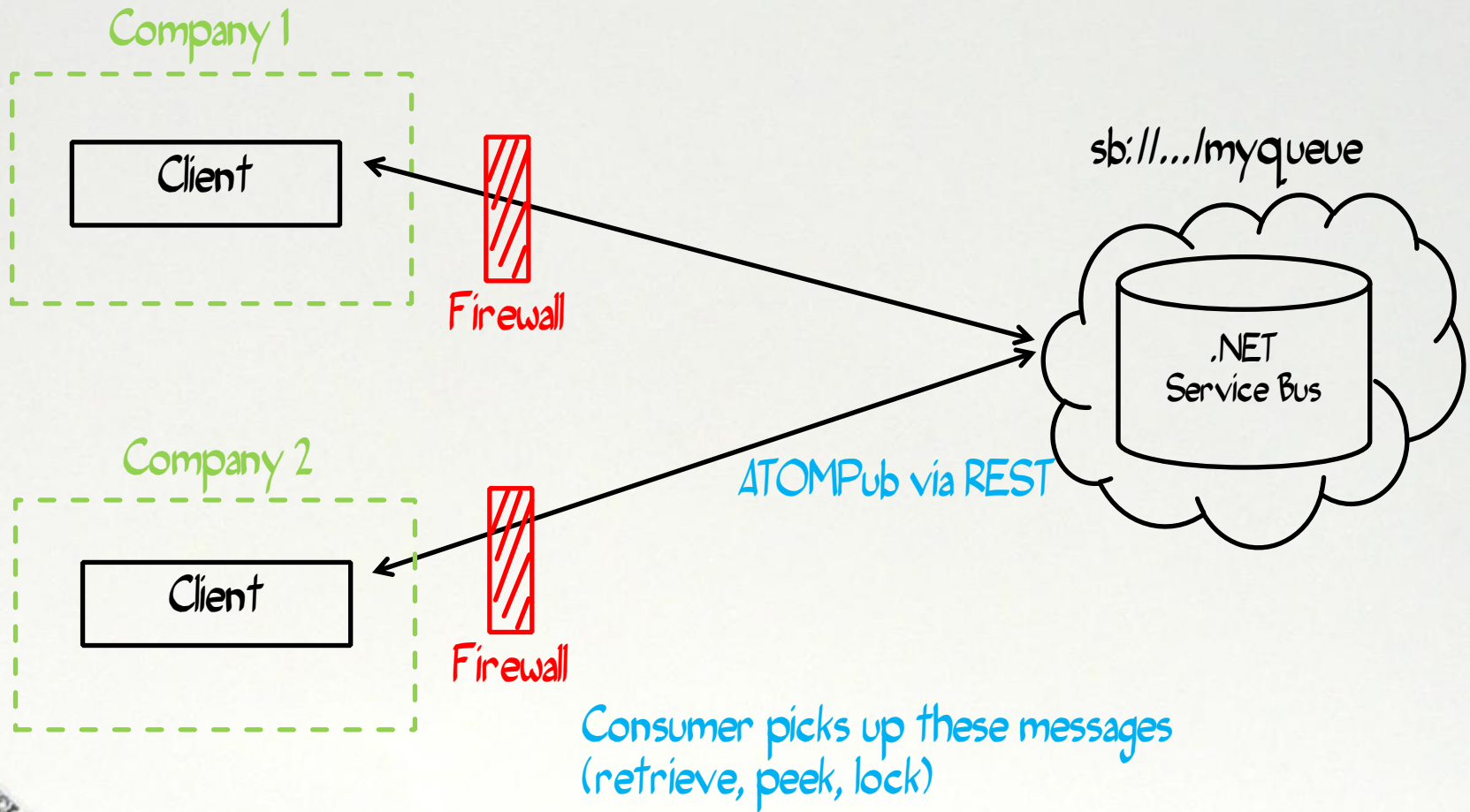
#5 - Using the Cloud for Communications



#5 - Using the Cloud for Communications



#5 - Using the Cloud for Communications



Patterns for Cloud Computing

Takeaways



Be careful consuming REST based queues using shared secret



Firewalls/NATs can add additional trouble (especially non-HTTP)



Learn how .NET Service Bus traverses in these scenarios



Patterns for Moving to the Cloud

Putting the Patterns **Together**

Patterns for Cloud Computing



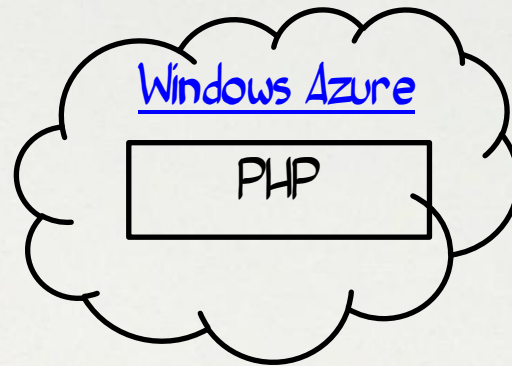
We've covered 5 patterns, but Jim has one last question...

Patterns for Cloud Computing



Are there cases where these patterns work together?

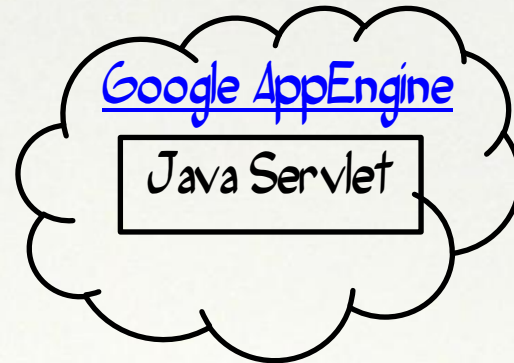
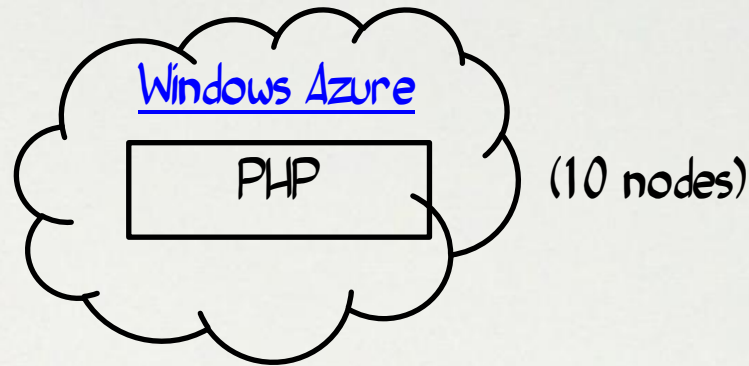
Putting the Patterns Together



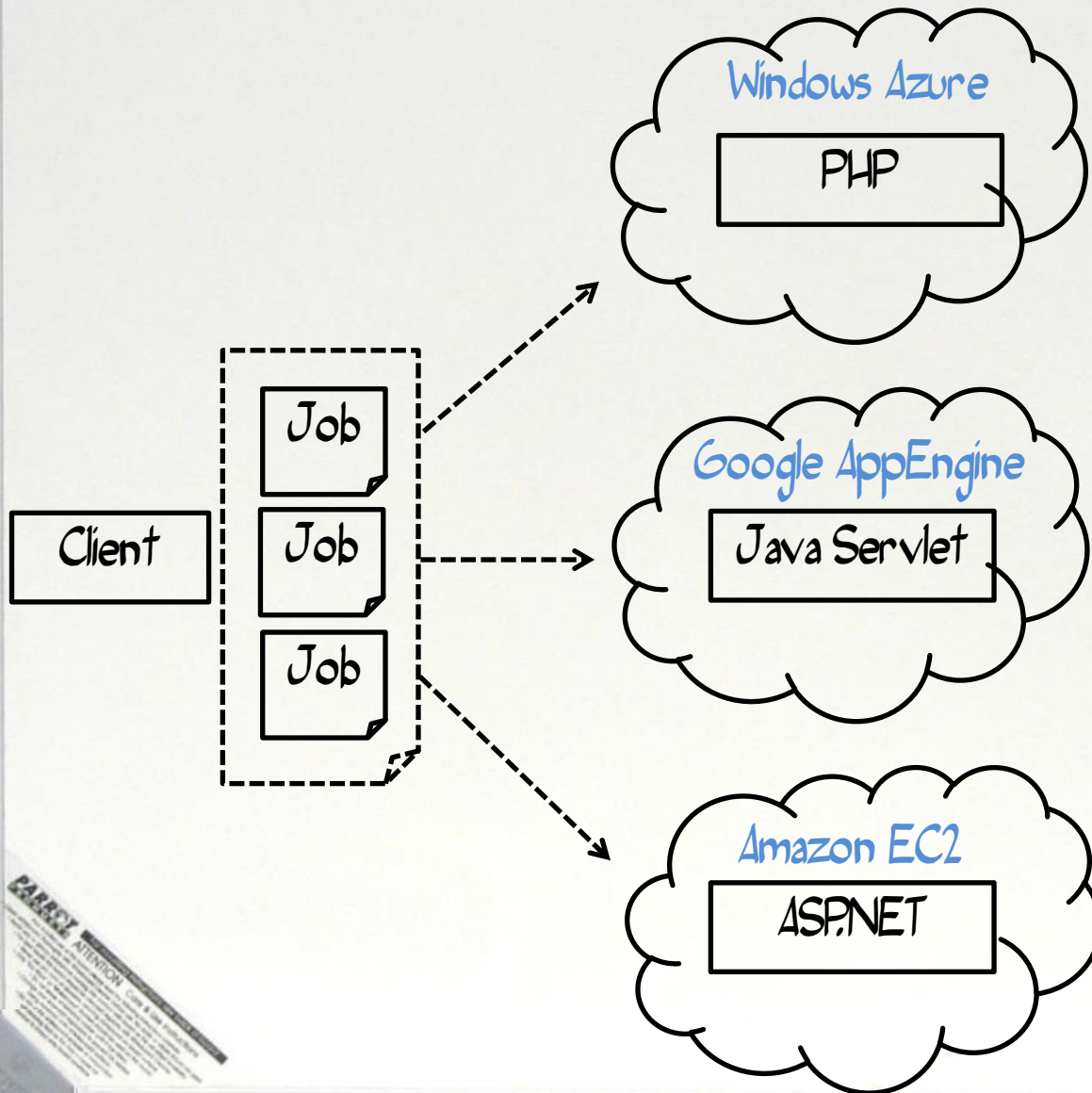
Let's build an
application in PHP
that scales to many
nodes. . .

Putting the Patterns Together

Use the principles of multi tenancy to create a version of the application across multiple vendors



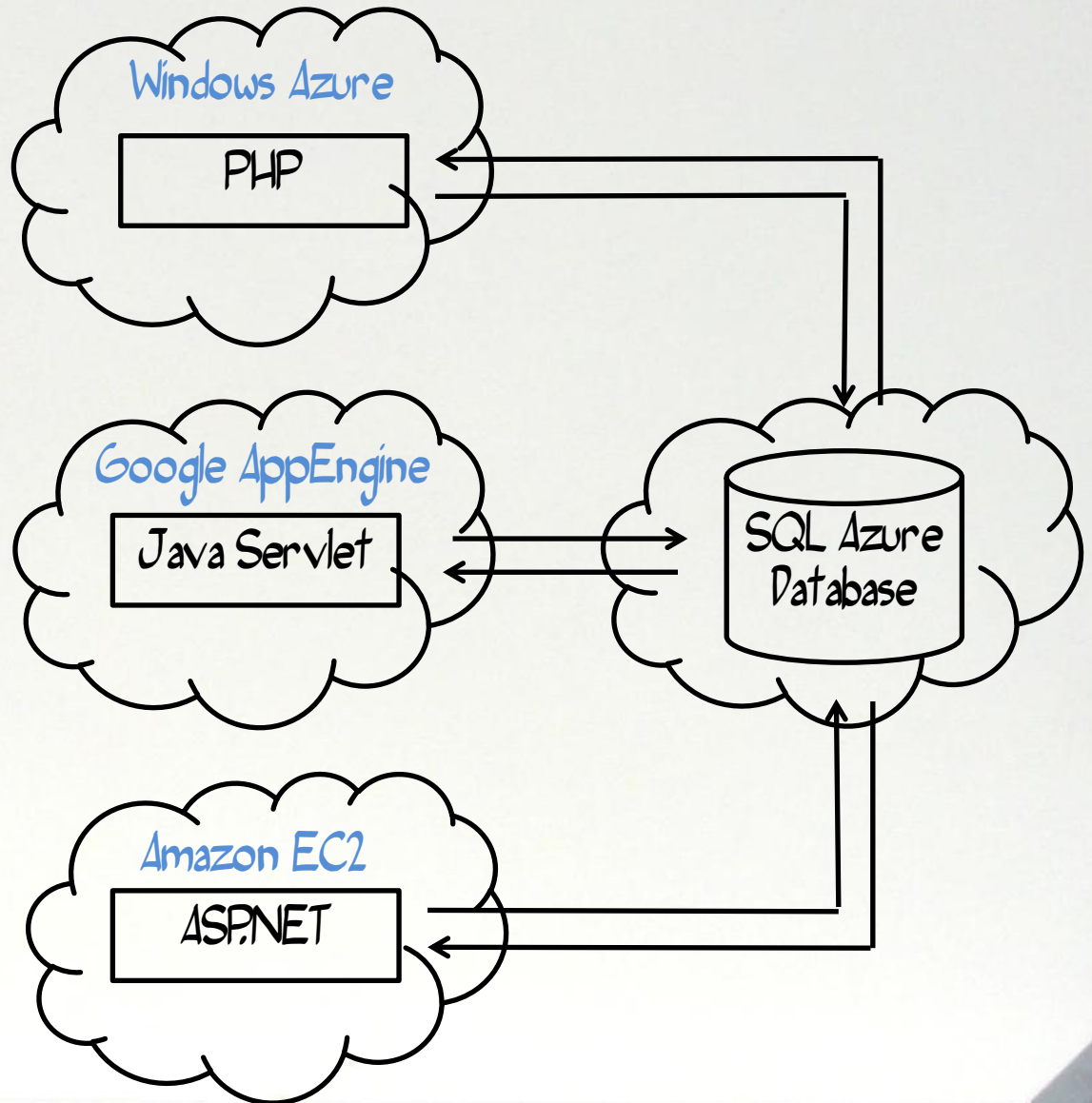
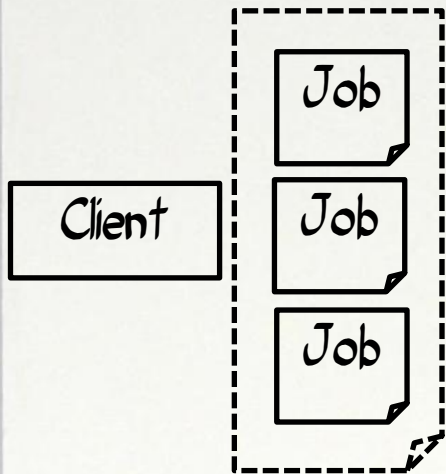
Putting the Patterns Together



Compute results with a MapReduce-like way of distributing work across all of these applications

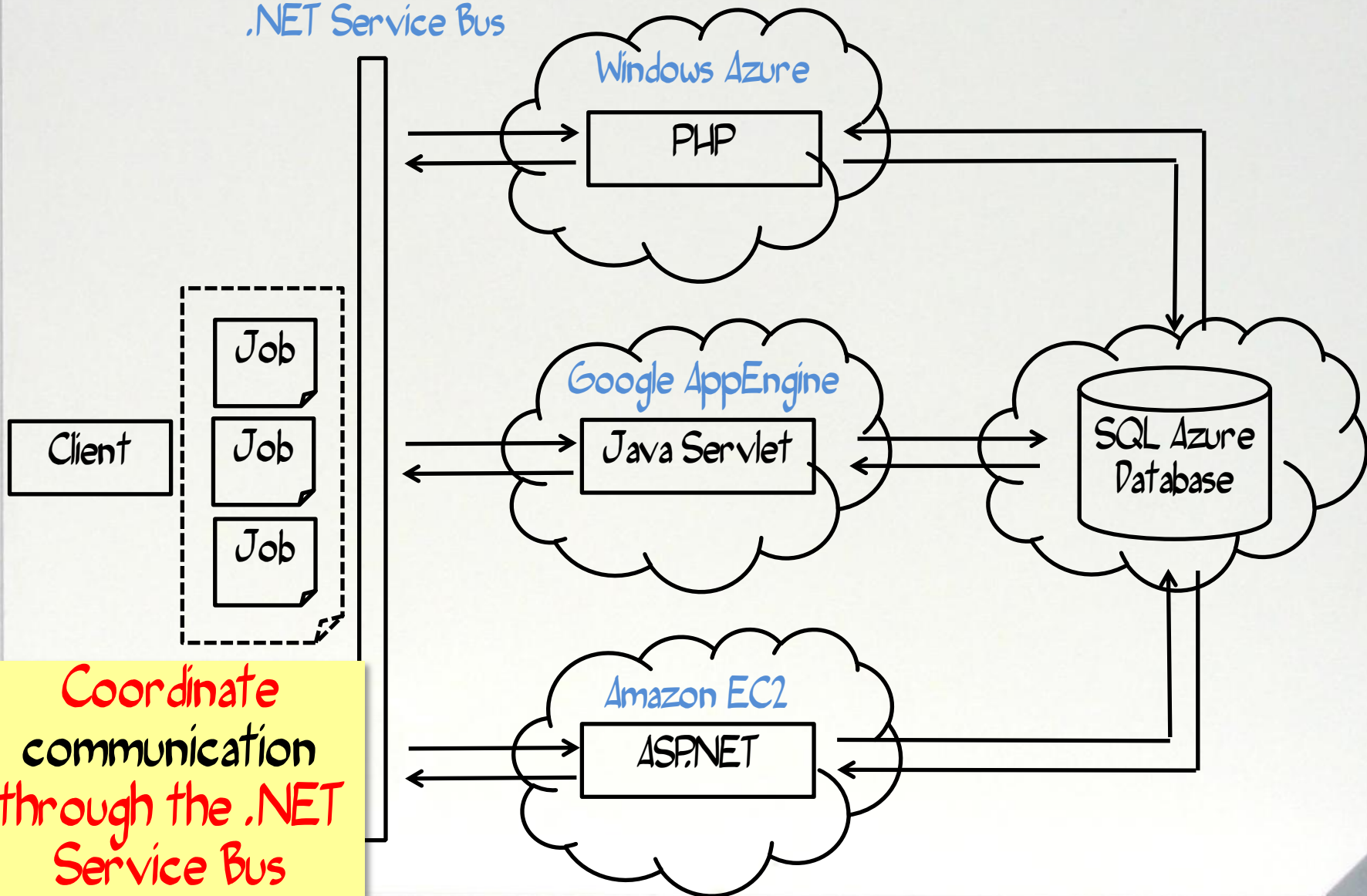
Putting the Patterns Together

Store the results
in a SQL Azure
database



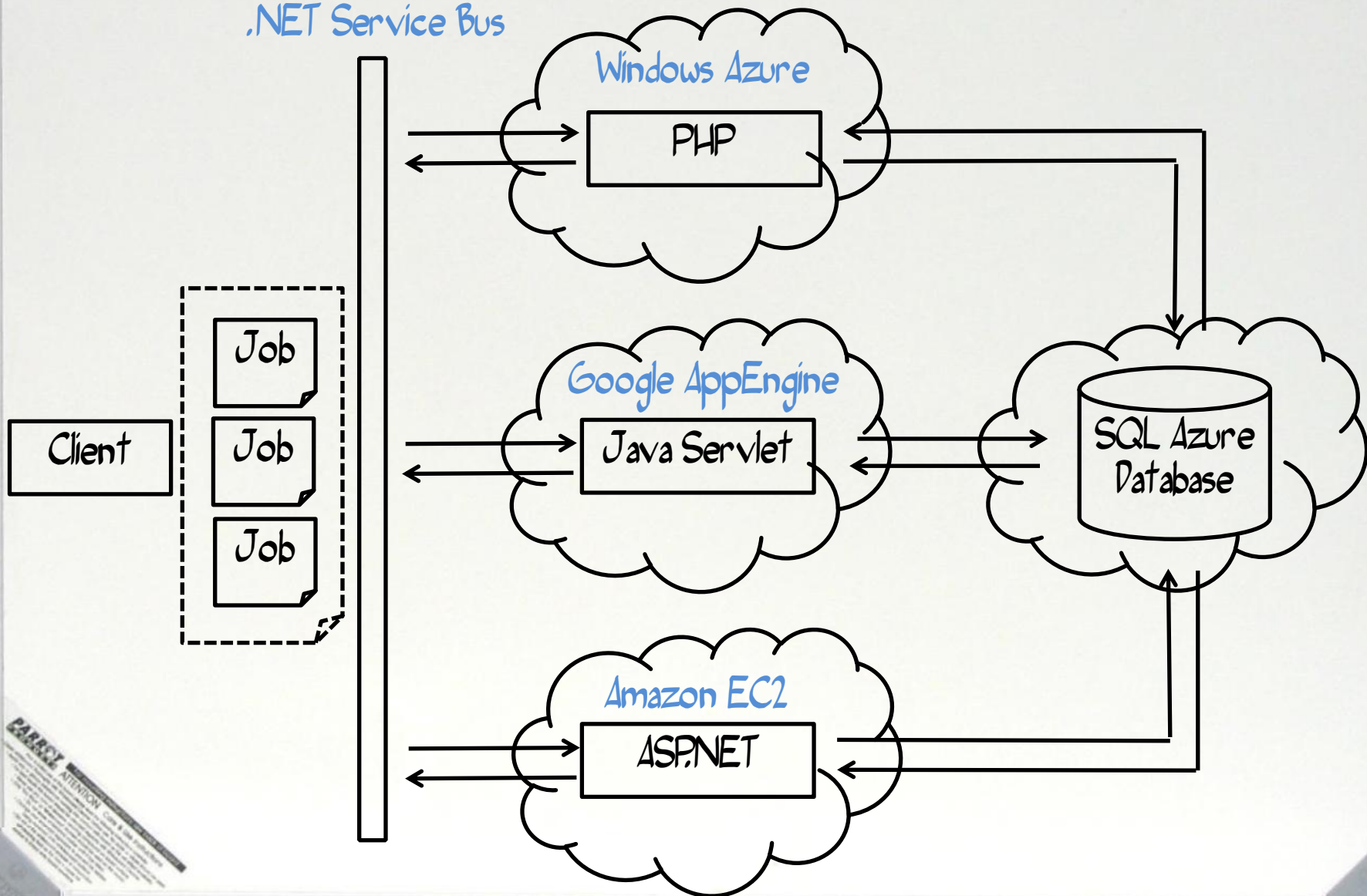
Putting the Patterns Together

.NET Service Bus



Putting the Patterns Together

.NET Service Bus



Putting the Patterns Together

.NET Service Bus

How many prime numbers between 1 and 10,000,000?

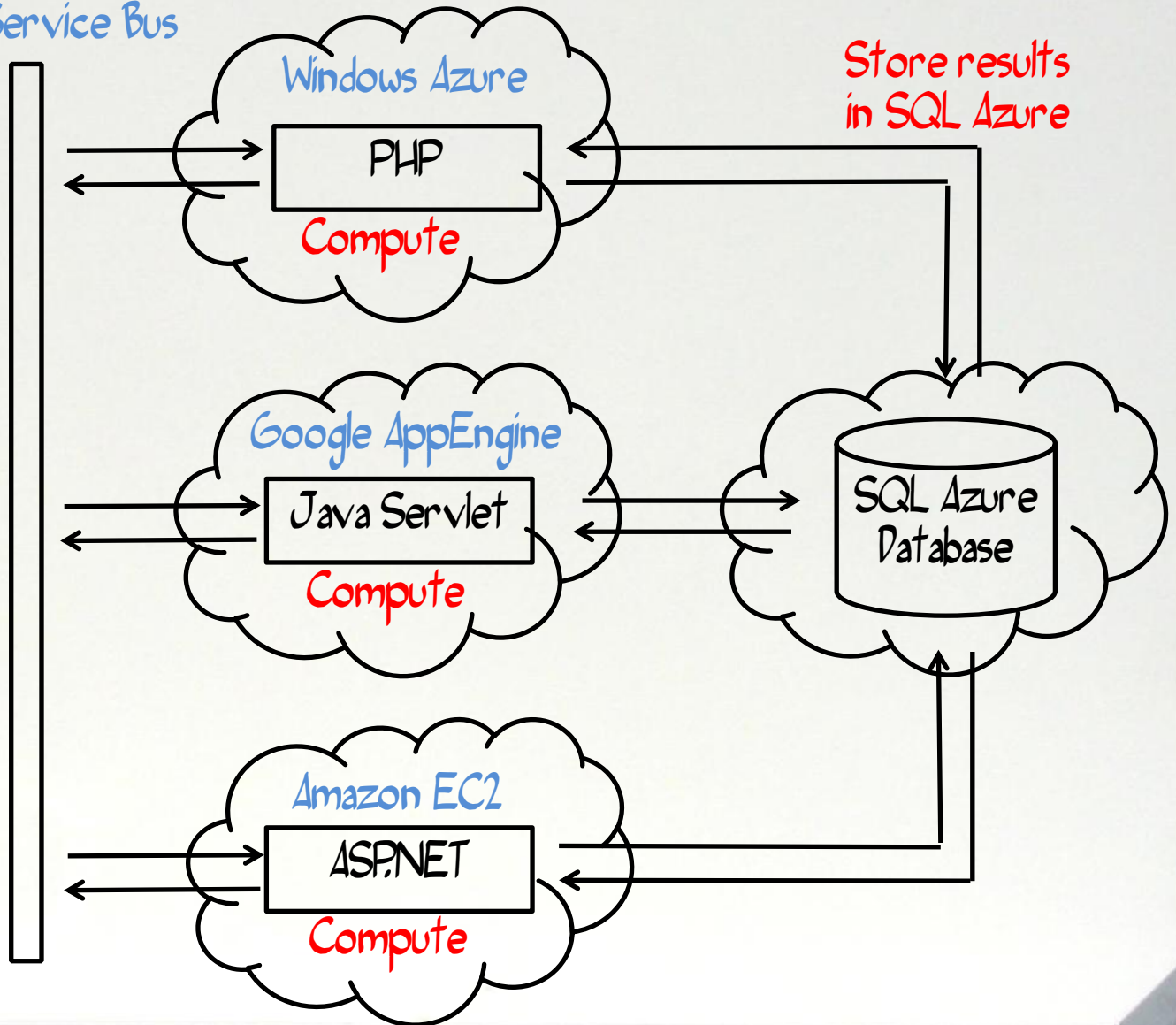
Client

Job

Job

Job

40 jobs of 250,000 numbers



Next Steps

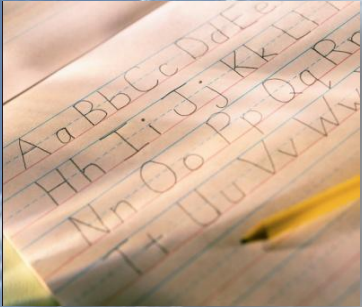


Next Steps



Obviously, our friend Jim, is **fake**...

Next Steps



Make sure you have a clear definition of Cloud Computing



Explore the 5 usage patterns for your scenarios today



Think about the next steps for implementation and migration

Microsoft®

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<http://simonguest.com>



San Francisco 2009

Tutorials: Nov 16-17
Conference: Nov 18-20

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