



# Azure Functions - Principles, Patterns and Practices

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# Azure

## Inteligência Artificial como serviço

Uma introdução aos Serviços Cognitivos  
da Microsoft Azure



 Casa do  
Código

THIAGO CUSTÓDIO

# Agenda



Security



Best Practices

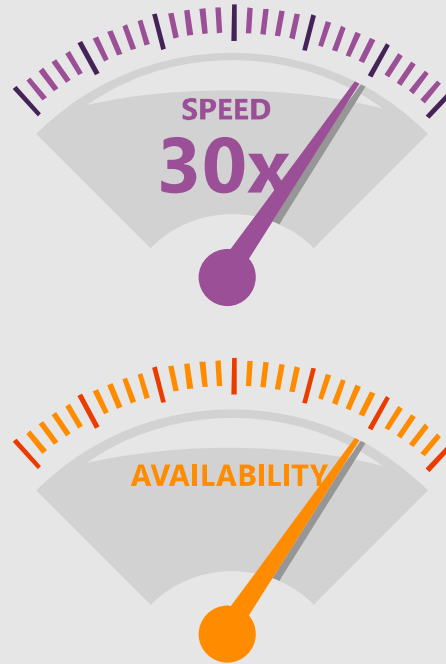


Performance

# What is serverless?



Abstraction  
of servers

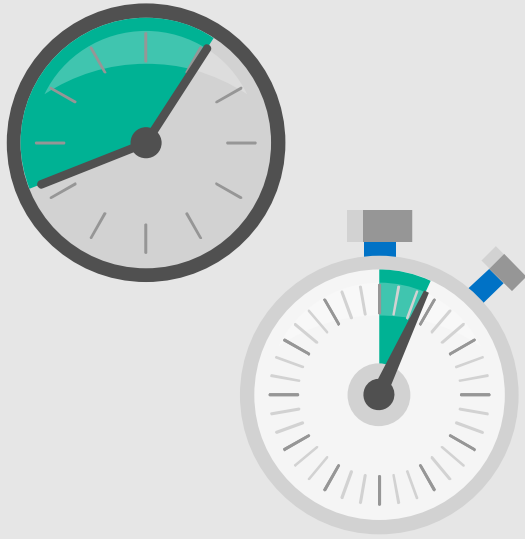


Event-  
driven scale

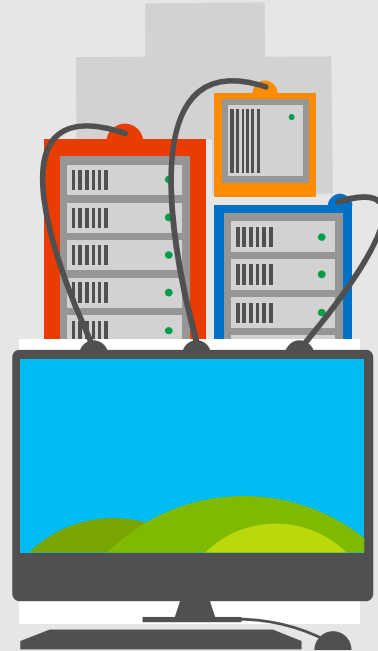


Sub-second  
billing

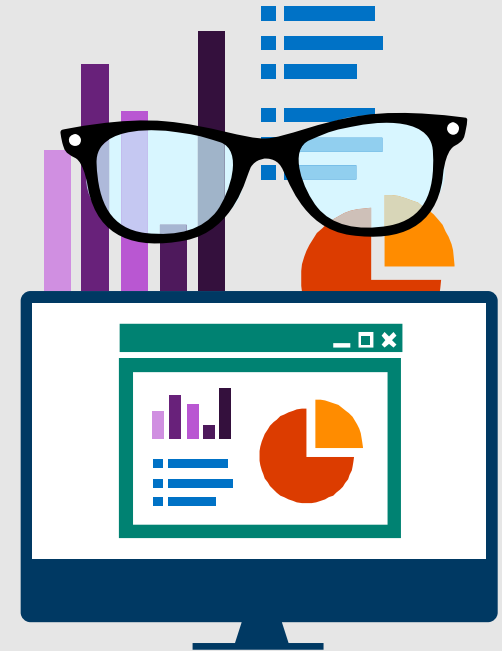
# Benefits



Micro-pricing

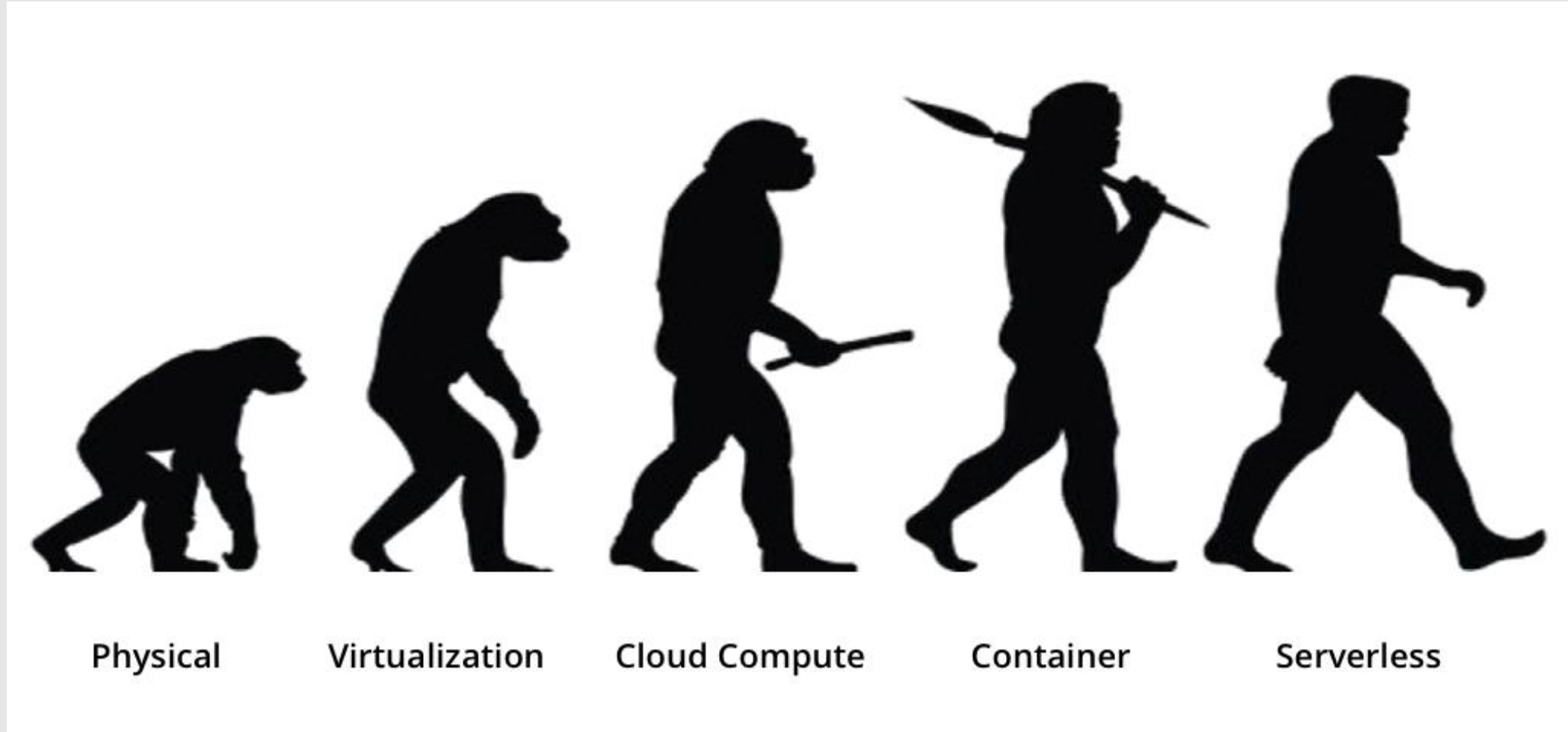


Ease of  
scale



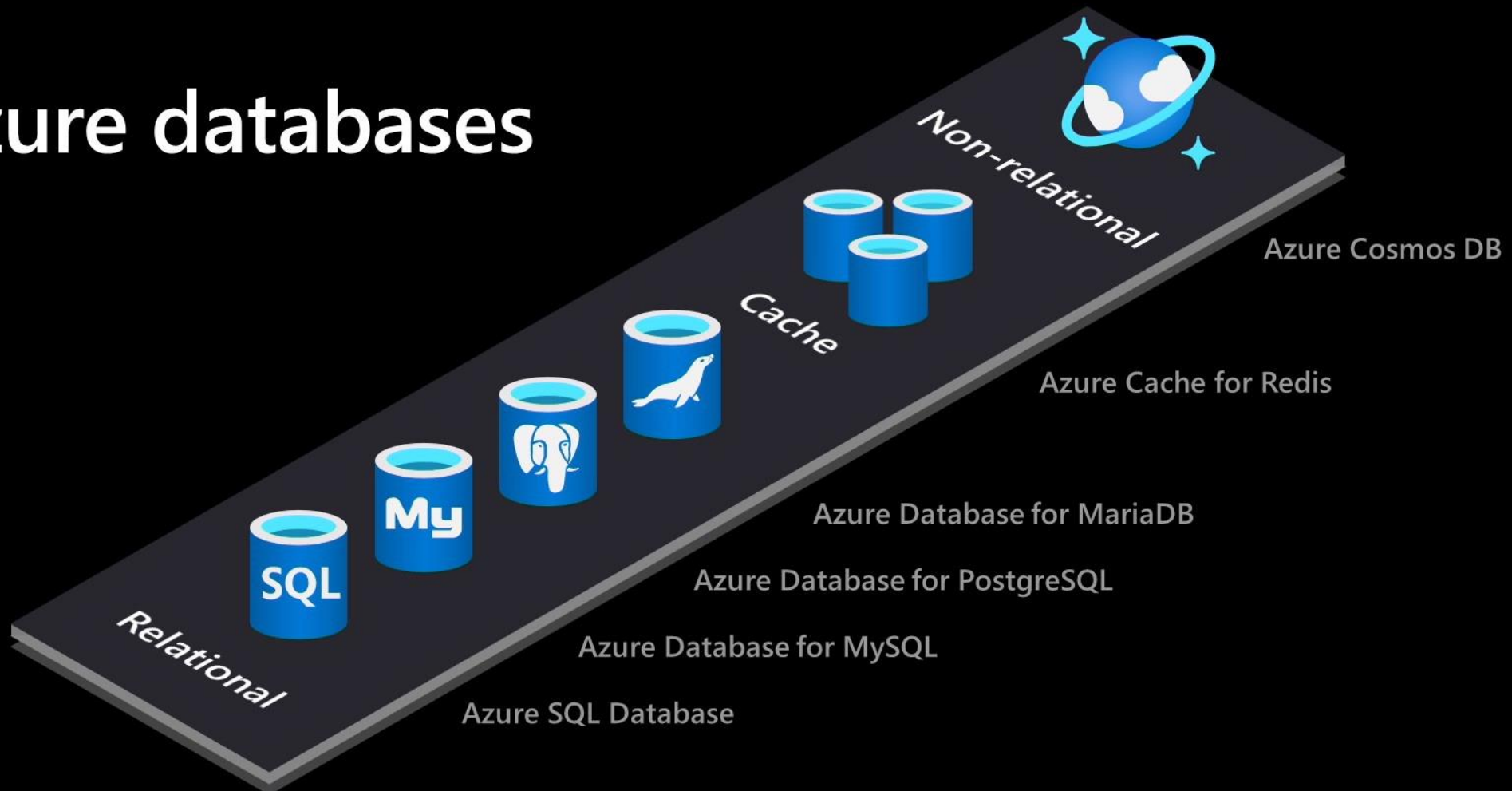
Business  
Focus

# Serverless is the natural evolution

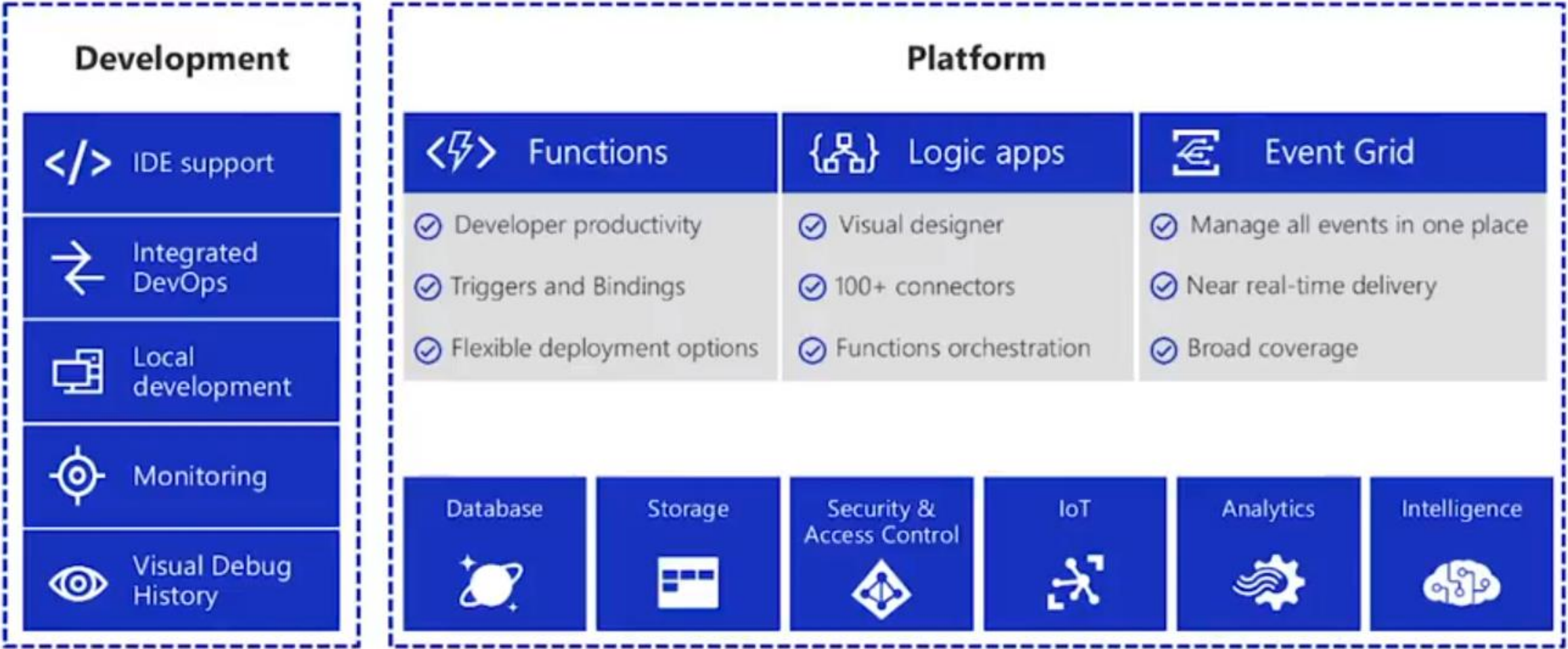


# PaaS / Serverless Databases

## Azure databases

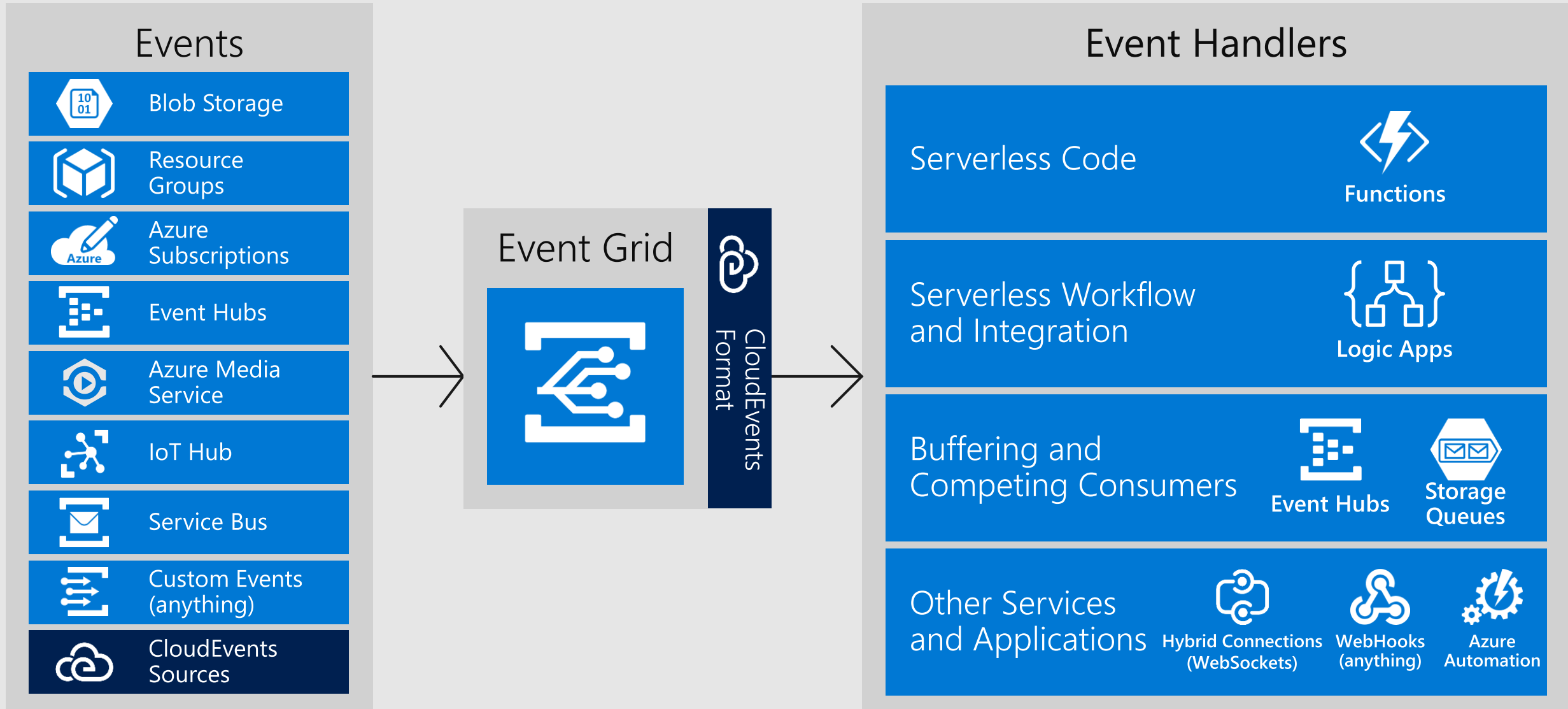


# Serverless on Azure





# Event grid in action



# Azure Functions



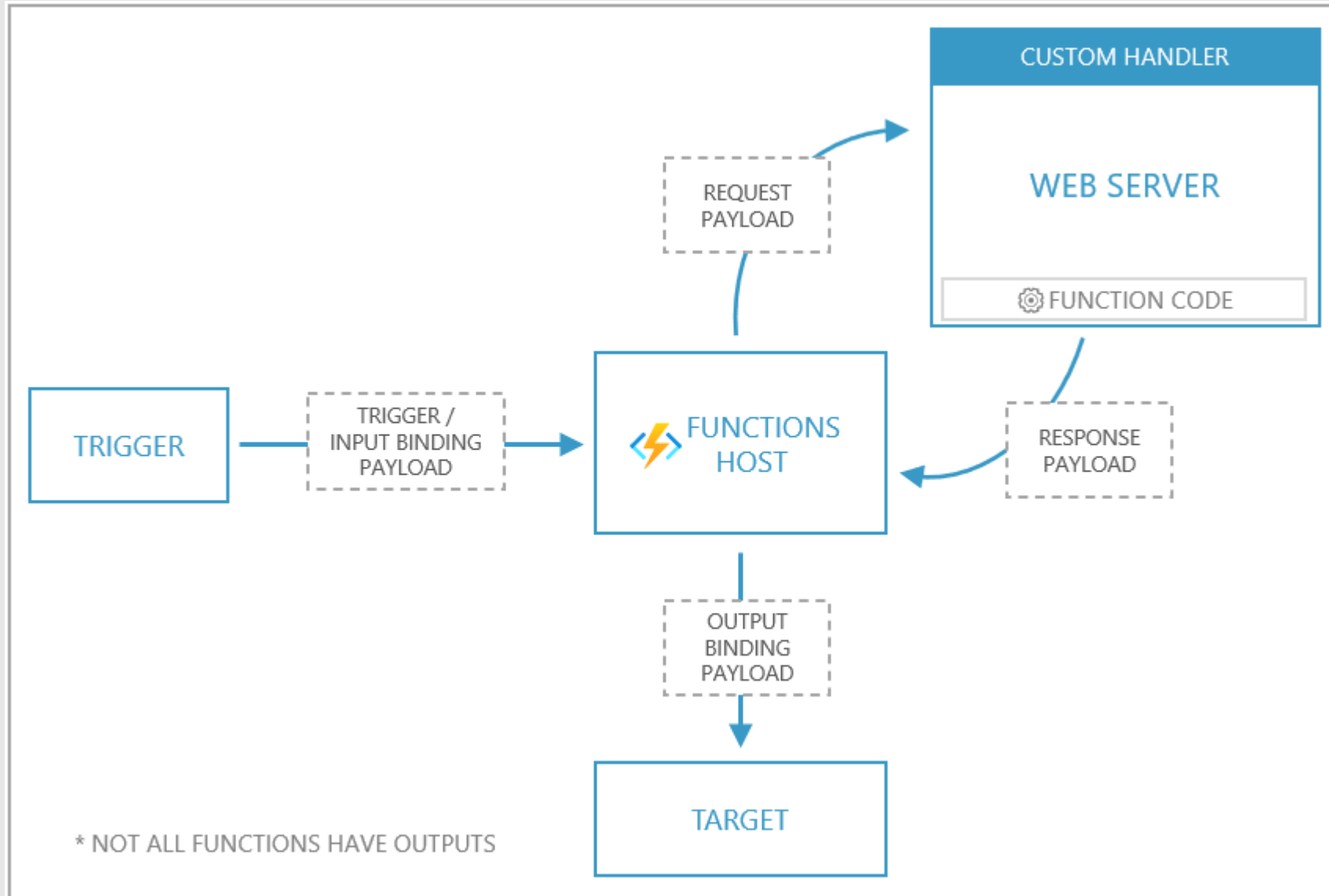
# Bindings and triggers

Type	1.x	2.x and higher <sup>1</sup>	Trigger	Input	Output
<a href="#">Blob storage</a>	✓	✓	✓	✓	✓
<a href="#">Cosmos DB</a>	✓	✓	✓	✓	✓
<a href="#">Event Grid</a>	✓	✓	✓		✓
<a href="#">Event Hubs</a>	✓	✓	✓		✓
<a href="#">HTTP &amp; webhooks</a>	✓	✓	✓		✓
<a href="#">IoT Hub</a>	✓	✓	✓		✓
<a href="#">Microsoft Graph Excel tables</a>		✓		✓	✓
<a href="#">Microsoft Graph OneDrive files</a>		✓		✓	✓
<a href="#">Microsoft Graph Outlook email</a>		✓			✓
<a href="#">Microsoft Graph events</a>		✓	✓	✓	✓
<a href="#">Microsoft Graph Auth tokens</a>		✓		✓	
<a href="#">Mobile Apps</a>	✓			✓	✓
<a href="#">Notification Hubs</a>	✓				✓
<a href="#">Queue storage</a>	✓	✓	✓		✓
<a href="#">SendGrid</a>	✓	✓			✓
<a href="#">Service Bus</a>	✓	✓	✓		✓

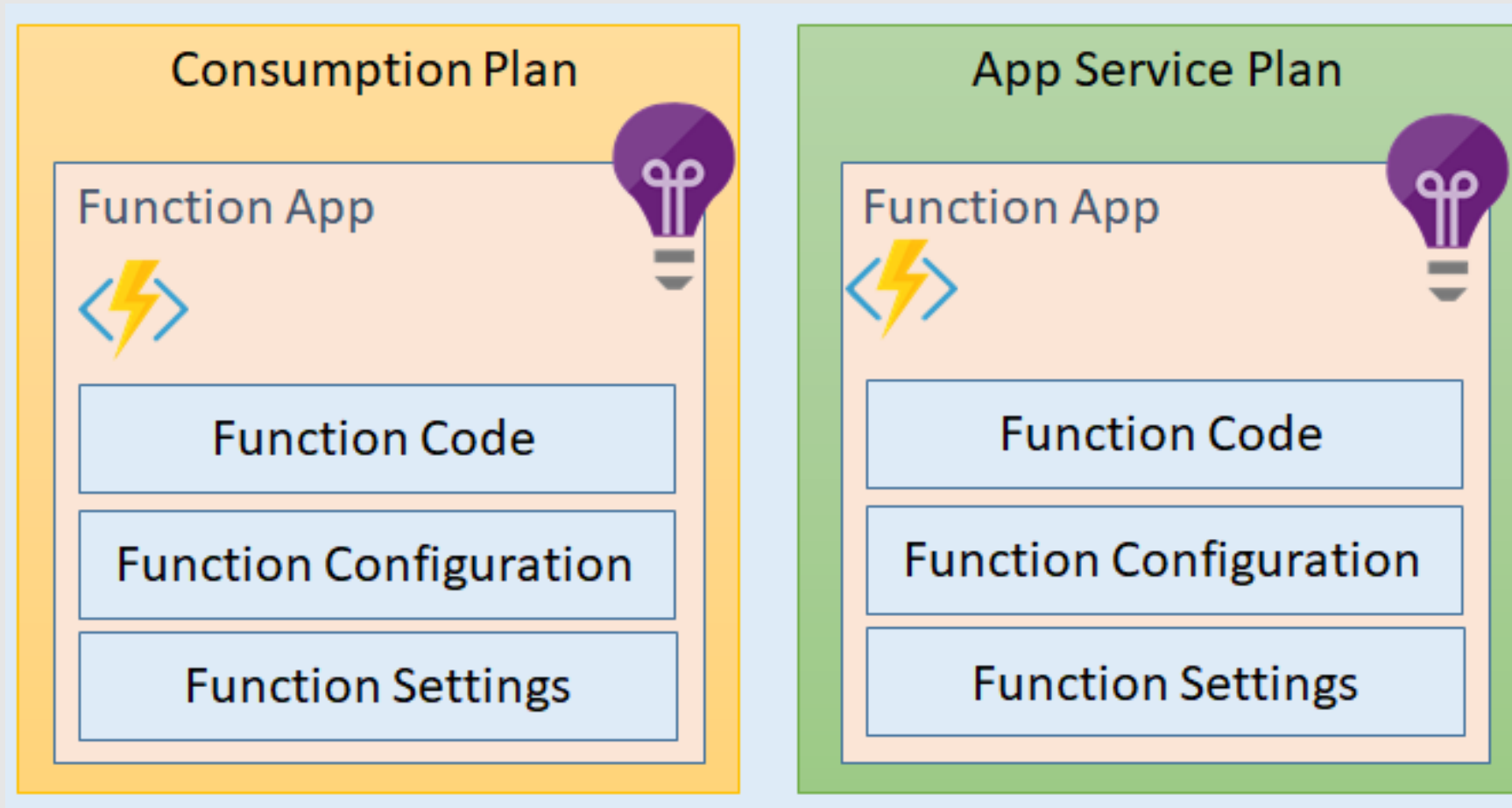
# Programming Languages

Language	1.x	2.x	3.x
C#	GA (.NET Framework 4.7)	GA (.NET Core 2.2)	GA (.NET Core 3.1)
JavaScript	GA (Node 6)	GA (Node 8 & 10)	GA (Node 10 & 12)
F#	GA (.NET Framework 4.7)	GA (.NET Core 2.2)	GA (.NET Core 3.1)
Java	N/A	GA (Java 8)	GA (Java 8)
PowerShell	N/A	GA (PowerShell Core 6)	GA (PowerShell Core 6)
Python#python-version	N/A	GA (Python 3.6 & 3.7)	GA (Python 3.6, 3.7, & 3.8)
TypeScript	N/A	GA <sup>1</sup>	GA <sup>1</sup>

# Custom handlers



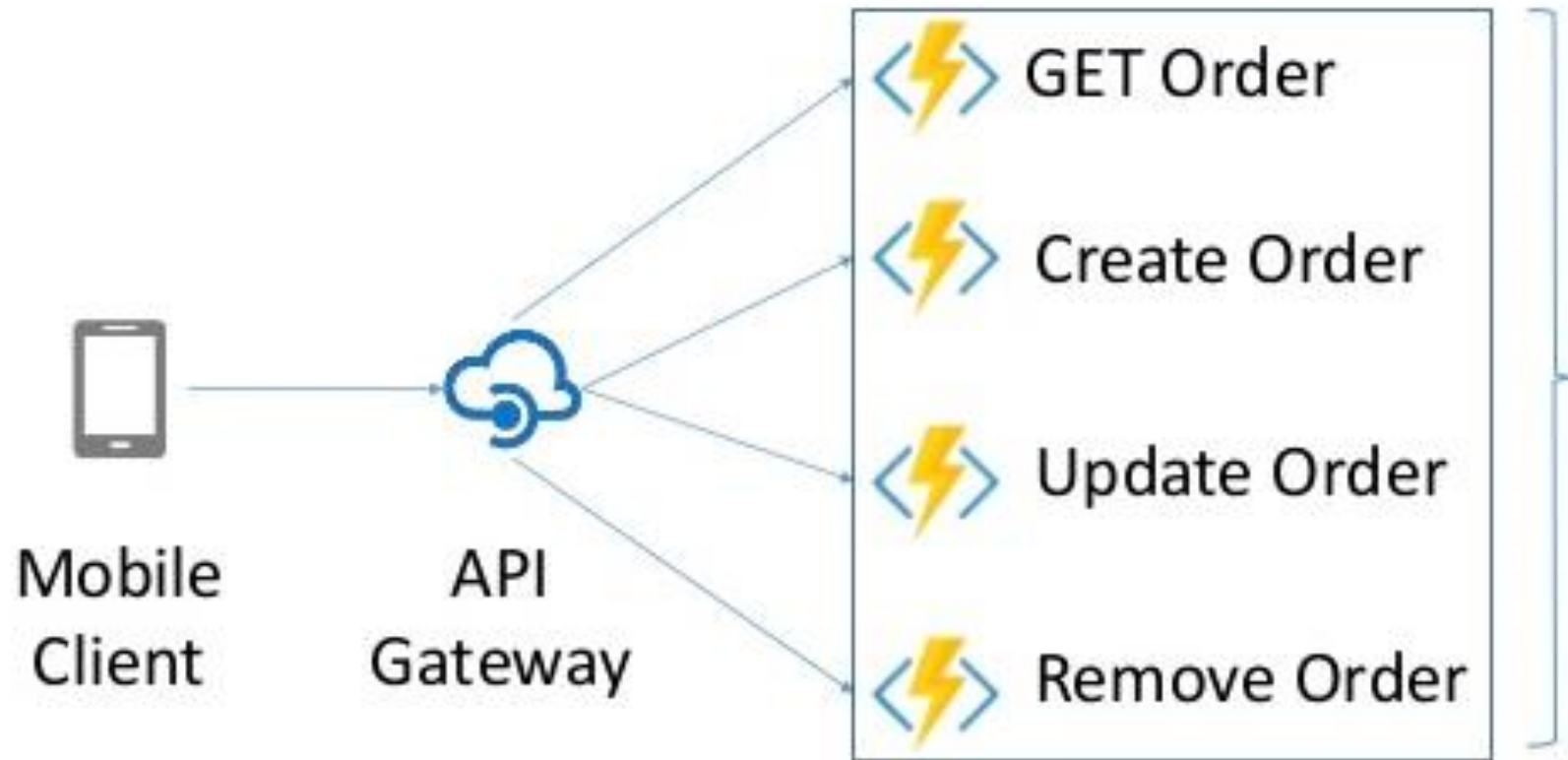
# Consumption / App Service Plan



# Security



# API Gateway





# API Gateway

- Block unauthorized requests
- Block requests based on IP-Address
- Logging / Audit
- Authentication / Authorization
- Encryption in-transit

# Versioning

[Home](#) > [APIManagerExperiment](#) > APIManagerExperiment - APIs



## APIManagerExperiment - APIs

API Management service



 [Publisher portal](#)

 [Developer portal](#)

 Search APIs

 *Filter by tags*

☐ Group by tag

+ Add API

## All APIs

- ✓ Sample API

v1 ...

v2 ...

v3 ...

## Settings

## Version set

View and manage settings for your Version set. The Name and Description of your set are visible on the developer portal.

- \* Display name

Sample API

### Description

- \* Versioning scheme

Path

# Managed Identity

Function Apps

Search

Visual Studio Professional with MSDN

Function Apps

⚡ [Placeholder] ↺ »

▼ Functions (Read Only) ↺

▼ *f* Function1

⚡ Integrate

⚙ Manage

🔍 Monitor

Overview

Platform features

Search features

General Settings

⚡ Function app settings

⚙ Configuration

⚙ Properties

☁ Backups

🌐 All settings

Networking

↔ Networking

🔒 SSL

🌐 Custom domains


🔑 Authentication / Authorization

🔑 Identity

📢 Push notifications




# Managed Identity


 **Identity**


System assigned

User assigned

A system assigned managed identity enables Az access-control. The lifecycle of this type of managed identities.

 Save

 Discard

 Refresh

Status ⓘ

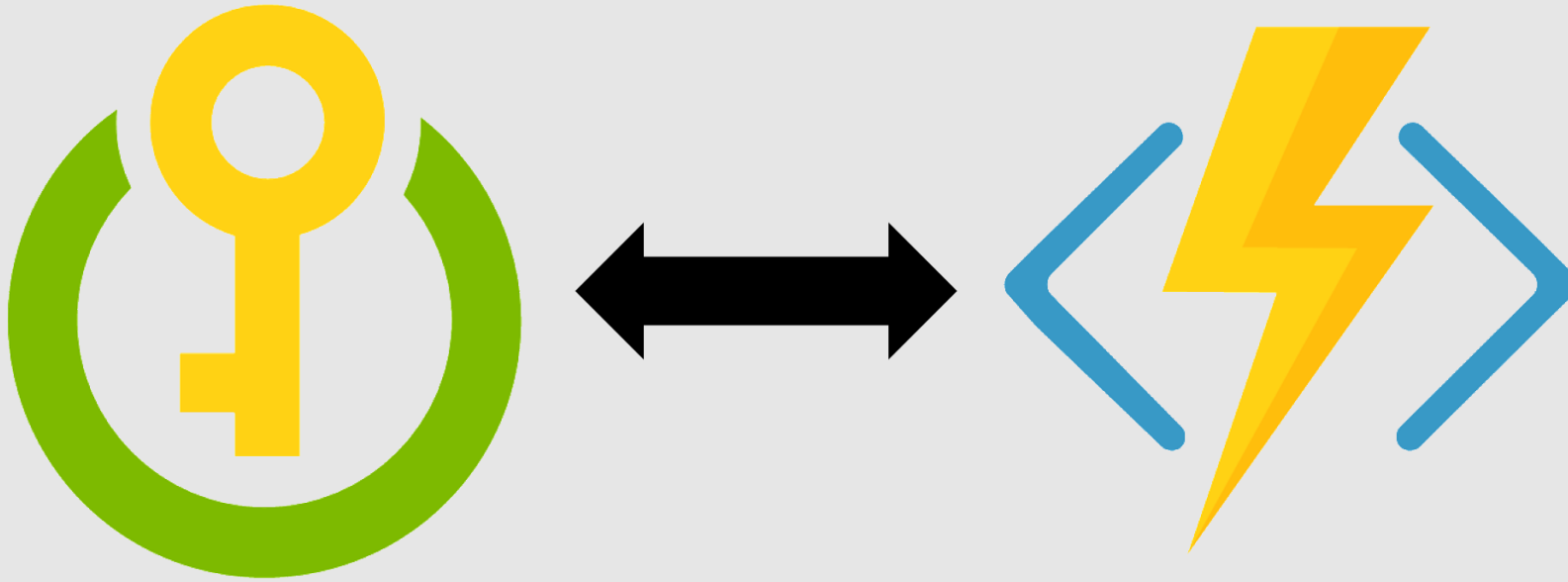
Off

On

Object ID ⓘ

9e483eef-b0ae-4ed6-a672-e84b35b419bd



# Key Vault



























# Read from Key Vault

 Refresh  Save  Discard

























Application settings are encrypted at rest and transmitted over an encrypted channel. You can choose to display them in plain text in your browser by using the controls below. Application Settings are exposed as environment variables for access by your application at runtime. [Learn more](#)

 New application setting  Show values  Advanced edit  Filter

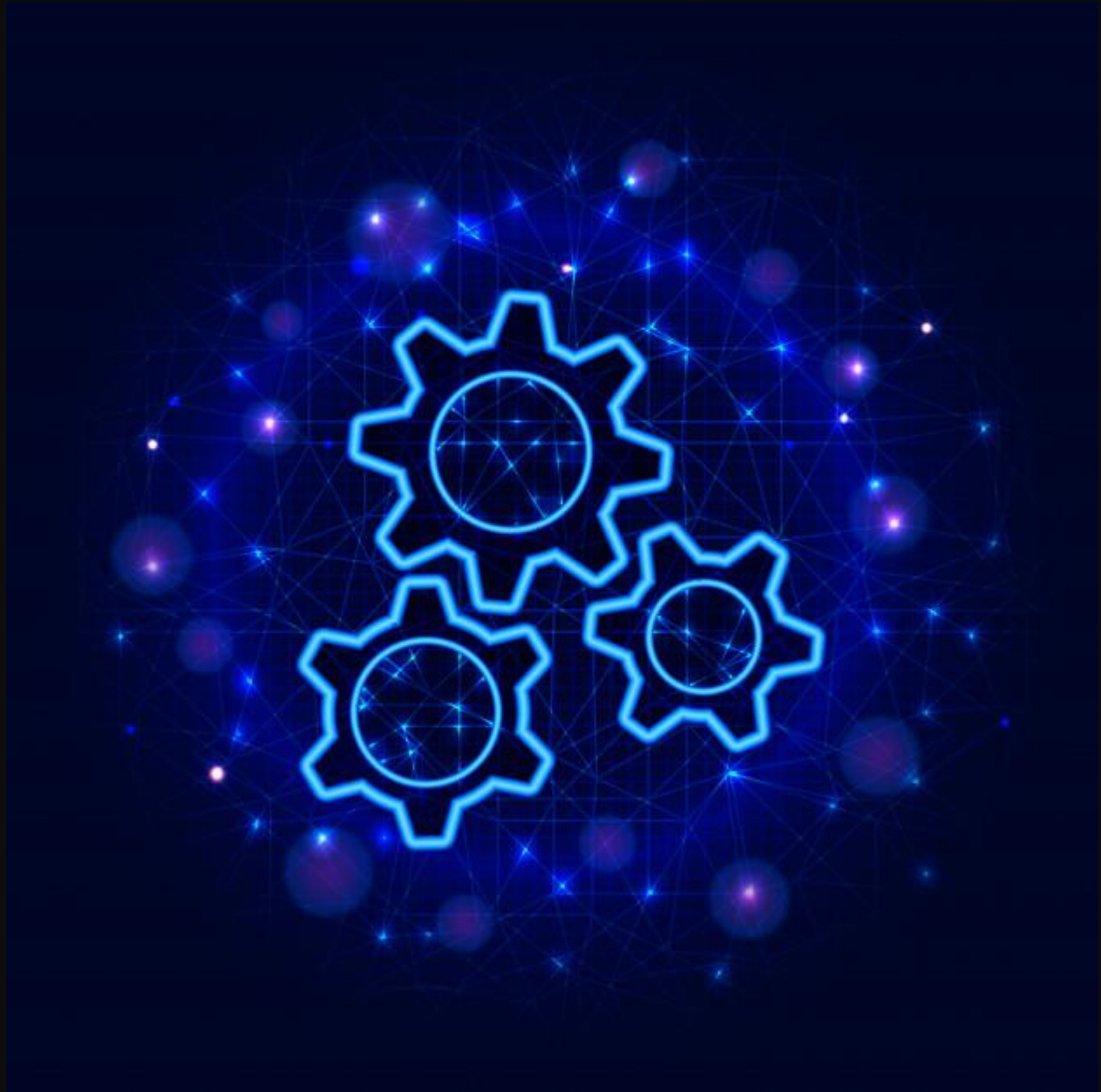
Name	Value	Source	Deployment slot setting	Delete	Edit
APPINSIGHTS_INSTRUMENTATIONKEY	 Hidden value. Click show values button above to view	App Config			
APPLICATIONINSIGHTS_CONNECTION_STRING	 Hidden value. Click show values button above to view	App Config			
AzureWebJobsStorage	 Hidden value. Click show values button above to view	App Config			
FUNCTIONS_EXTENSION_VERSION	 Hidden value. Click show values button above to view	App Config			
FUNCTIONS_WORKER_RUNTIME	 Hidden value. Click show values button above to view	App Config			
SuperSecret	 1234@asdf	App Config			
WEBSITE_CONTENTAZUREFILECONNECTIONSTRING	 Hidden value. Click show values button above to view	App Config			
WEBSITE_CONTENTSHARE	 Hidden value. Click show values button above to view	App Config			

# Read from Key Vault

@Microsoft.KeyVault(SecretUri={SECRET\_URL})

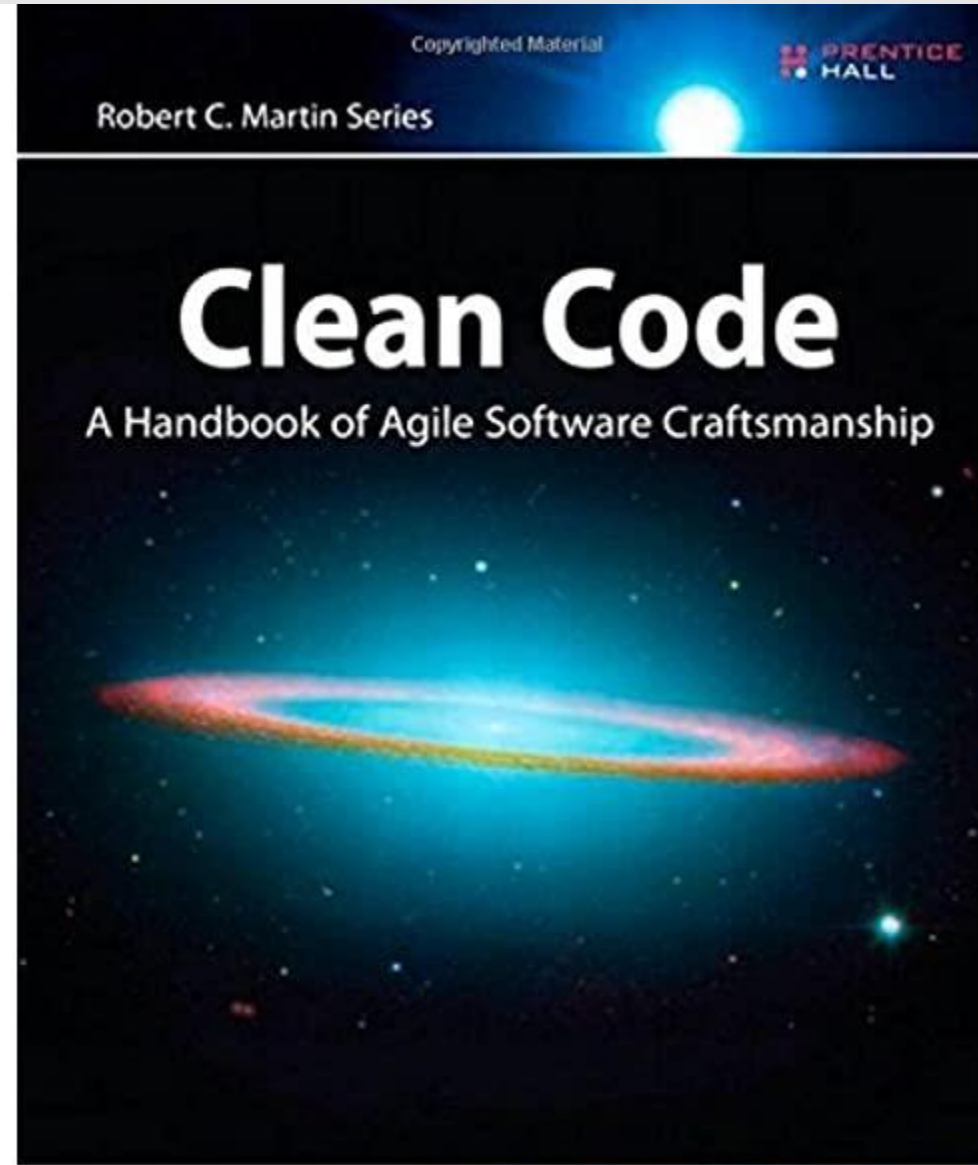
Name	Value	Source	Deployment slot setting	Delete	Edit
APPINSIGHTS_INSTRUMENTATIONKEY	 Hidden value. Click show values button above to view	App Config			
APPLICATIONINSIGHTS_CONNECTION_STRING	 Hidden value. Click show values button above to view	App Config			
AzureWebJobsStorage	 Hidden value. Click show values button above to view	App Config			
FUNCTIONS_EXTENSION_VERSION	 Hidden value. Click show values button above to view	App Config			
FUNCTIONS_WORKER_RUNTIME	 Hidden value. Click show values button above to view	App Config			
SuperSecret	 @Microsoft.KeyVault(SecretUri=https://keyvaultdemoserverless.vai	App Config			
WEBSITE_CONTENTAZUREFILECONNECTIONSTRING	 Hidden value. Click show values button above to view	App Config			
WEBSITE_CONTENTSHARE	 Hidden value. Click show values button above to view	App Config			

# Best Practices





# S.O.L.I.D

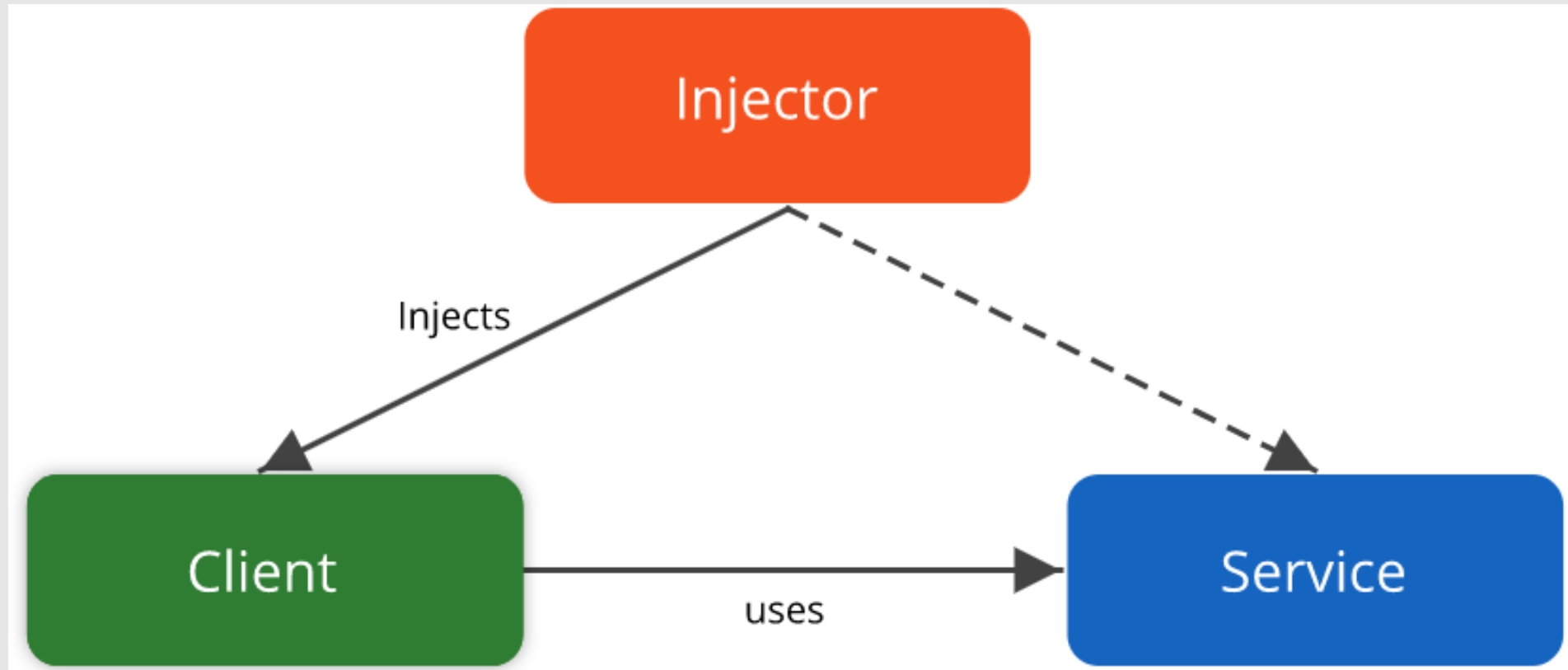


# Functions

"Functions should do something, or answer something, but not both."

"One way to know that a function is doing more than 'one thing' is if you can extract another function from it with a name that is not merely a restatement of its implementation."

# Dependency Injection

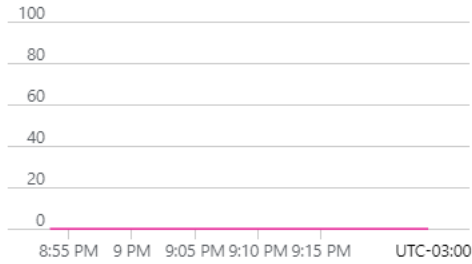


Performance



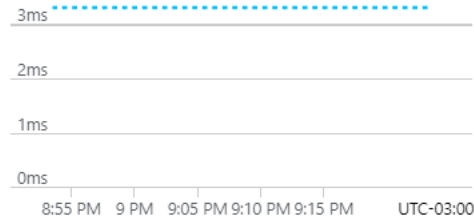
# Application Insights

## Failed requests



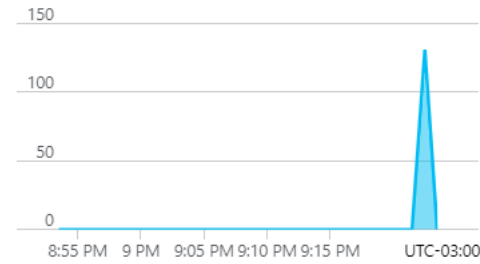
0

## Server response time



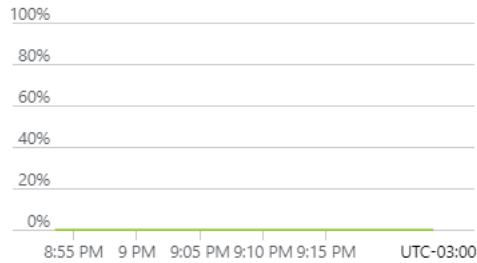
3.32 ms

## Server requests



131

## Availability



--

# Application Insights



demo-serverless-mundo-real | Live Metrics

Application Insights

Search (Ctrl+/)

- Overview
- Activity log
- Access control (IAM)
- Tags
- Diagnose and solve problems

## Investigate

- Application map
- Smart Detection

## Live Metrics

- Search
- Availability
- Failures
- Performance
- Troubleshooting guides (prev...

## Monitoring

- Alerts
- Metrics
- Logs
- Workbooks

Pause Reset Learn more View in Logs Open Live Metrics (Classic) Feedback

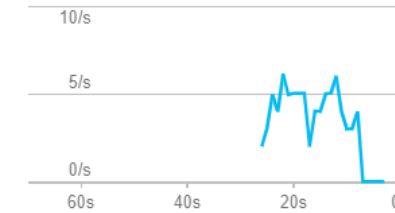
Welcome to the new Live Metrics experience. If you prefer the old experience, click "Open Live Metrics (Classic)" above to return to it.

Last 60 seconds (Live)

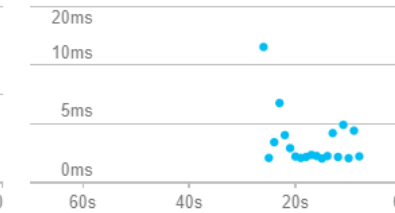
2 servers online

### Incoming Requests

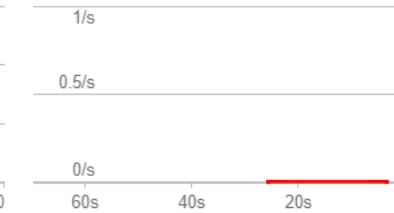
Request Rate



Request Duration

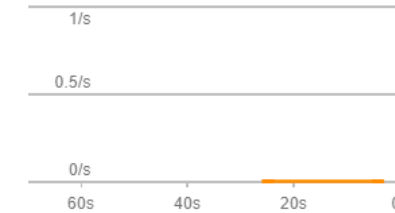


Request Failure Rate

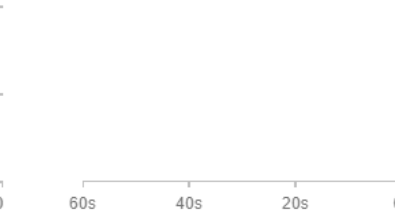


### Outgoing Requests

Dependency Call Rate



Dependency Call Duration

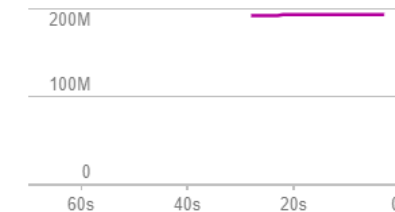


Dependency Call Failure Rate

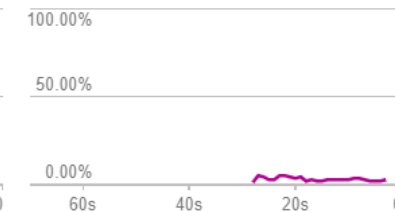


### Overall Health

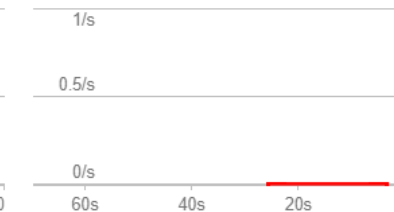
Committed Memory



CPU Total (%)



Exception Rate



## Sample telemetry

9:22:51 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Request successfully matched the route wit...me 'Function1' and template 'api/Function1'

9:22:49 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Request successfully matched the route wit...me 'Function1' and template 'api/Function1'

9:22:47 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Request successfully matched the route wit...me 'Function1' and template 'api/Function1'

9:22:45 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Request successfully matched the route wit...me 'Function1' and template 'api/Function1'

9:22:43 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Request successfully matched the route wit...me 'Function1' and template 'api/Function1'

9:22:41 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Request successfully matched the route wit...me 'Function1' and template 'api/Function1'

9:22:39 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Request successfully matched the route wit...me 'Function1' and template 'api/Function1'

9:22:37 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Request successfully matched the route wit...me 'Function1' and template 'api/Function1'

9:22:36 PM | **Trace** @8450785612f59e5...e55703cf2b27e  
Skipping breaking change analysis.

9:22:36 PM | **Trace** @8450785612f59e5...e55703cf2b27e  
Last analysis flag value '2020-04-02T00:05:08.9332234+00:00'.

9:22:35 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Request successfully matched the route wit...me 'Function1' and template 'api/Function1'

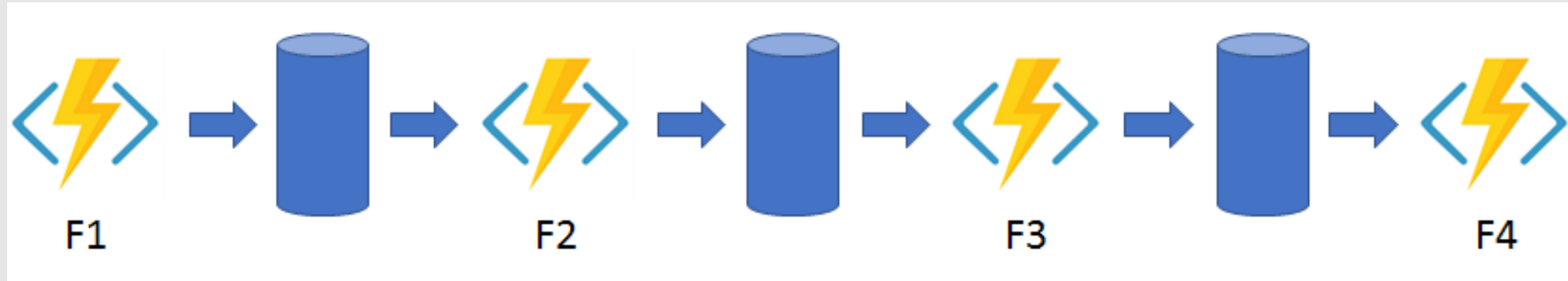
9:22:33 PM | **Trace** @939444cb8f601e1...681b7a297241a  
Executed 'Function1' (Succeeded, Id=32b876e3-84f3-4972-954c-15670949031a)

9:22:33 PM | **Trace** @939444cb8f601e1...681b7a297241a

To view details please select a document from the above list

# Durable Functions

# Durable Functions (Function chain)





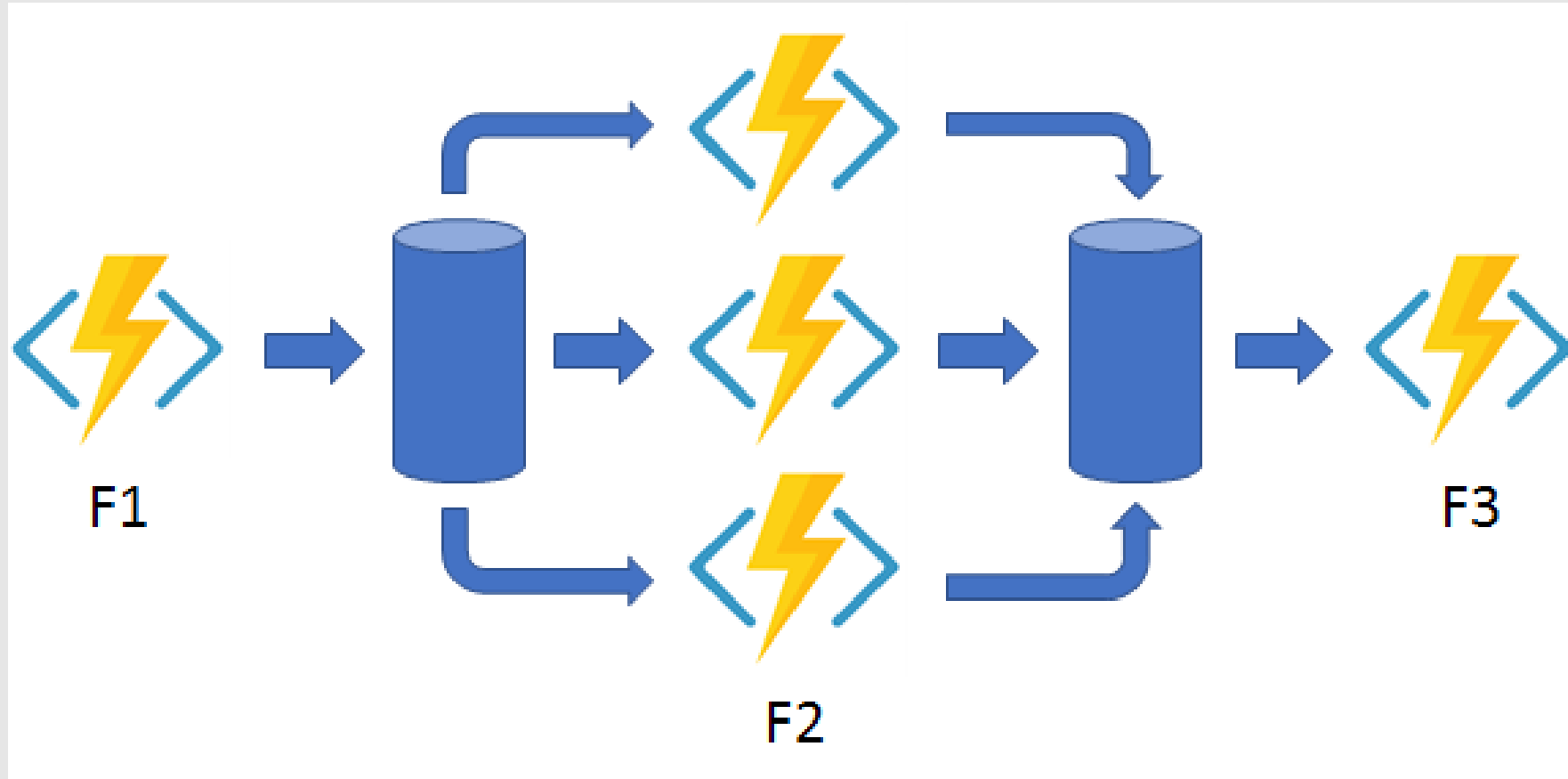
# Durable Functions (function chain)

C#

 Copy

```
[FunctionName("Chaining")]
public static async Task<object> Run(
    [OrchestrationTrigger] IDurableOrchestrationContext context)
{
    try
    {
        var x = await context.CallActivityAsync<object>("F1", null)
        var y = await context.CallActivityAsync<object>("F2", x);
        var z = await context.CallActivityAsync<object>("F3", y);
        return await context.CallActivityAsync<object>("F4", z);
    }
    catch (Exception)
    {
        // Error handling or compensation goes here.
    }
}
```

# Durable Functions (fan out / fan in)



# Durable functions (fan out / fan in)

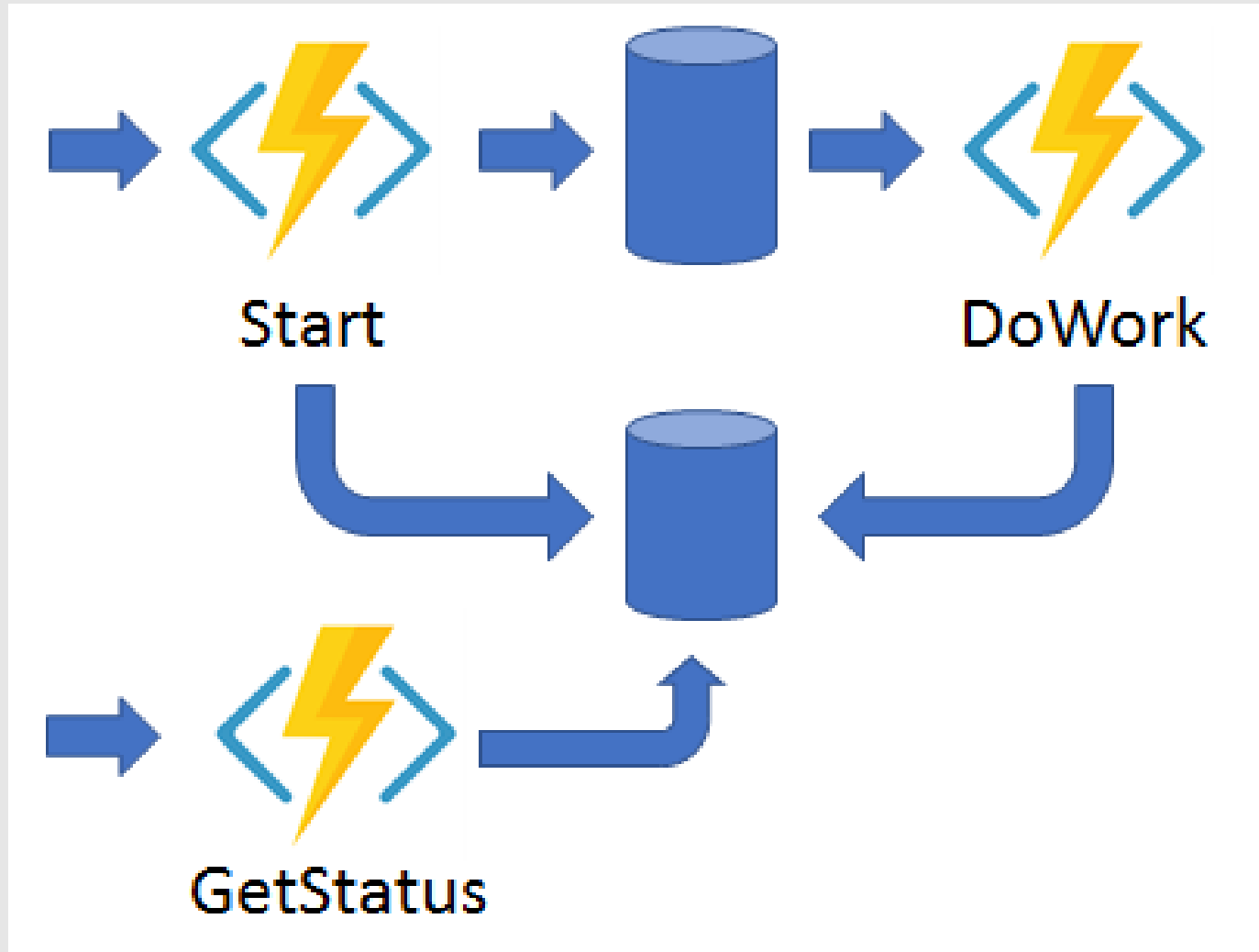
```
[FunctionName("FanOutFanIn")]
public static async Task Run(
    [OrchestrationTrigger] IDurableOrchestrationContext context)
{
    var parallelTasks = new List<Task<int>>();

    // Get a list of N work items to process in parallel.
    object[] workBatch = await context.CallActivityAsync<object[]>("F1", null);
    for (int i = 0; i < workBatch.Length; i++)
    {
        Task<int> task = context.CallActivityAsync<int>("F2", workBatch[i]);
        parallelTasks.Add(task);
    }

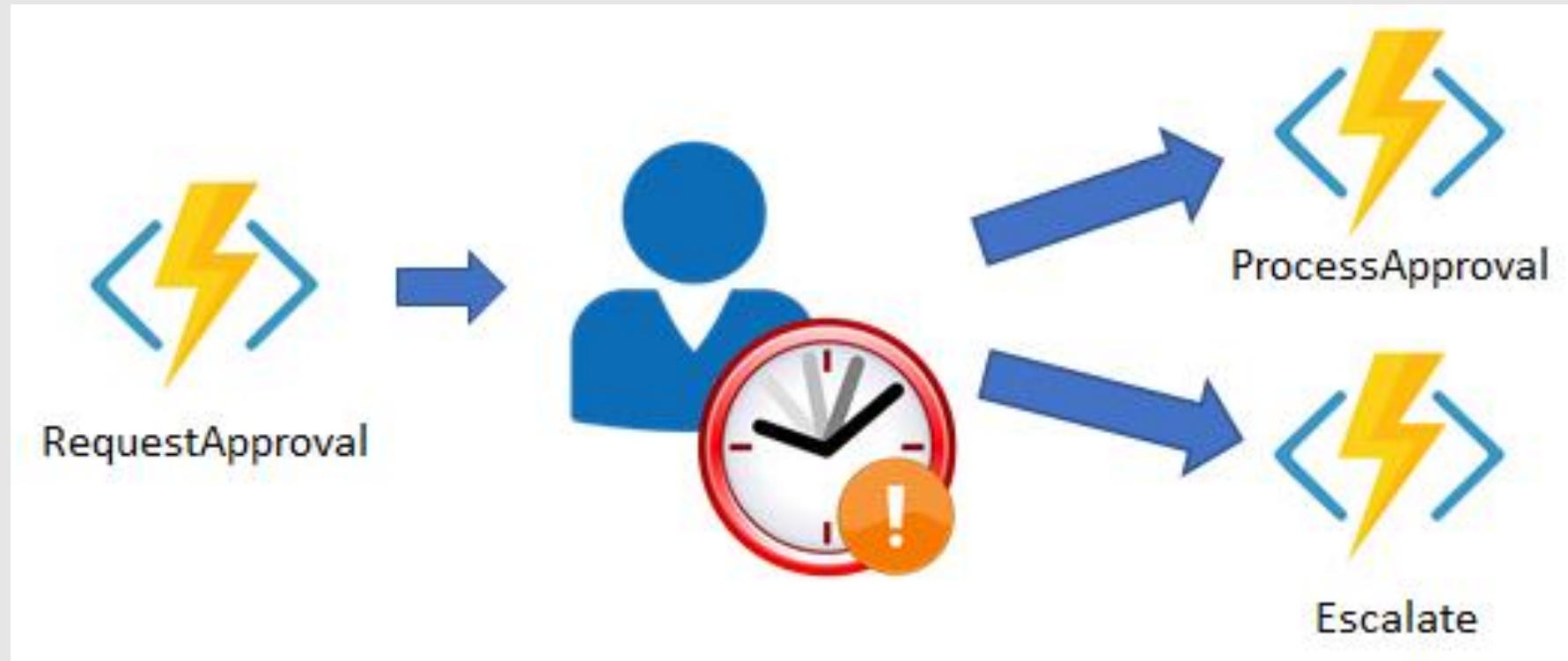
    await Task.WhenAll(parallelTasks);

    // Aggregate all N outputs and send the result to F3.
    int sum = parallelTasks.Sum(t => t.Result);
    await context.CallActivityAsync("F3", sum);
}
```

# Durable Functions (Async HTTP APIs)



# Durable Functions (External Event)



# Cases

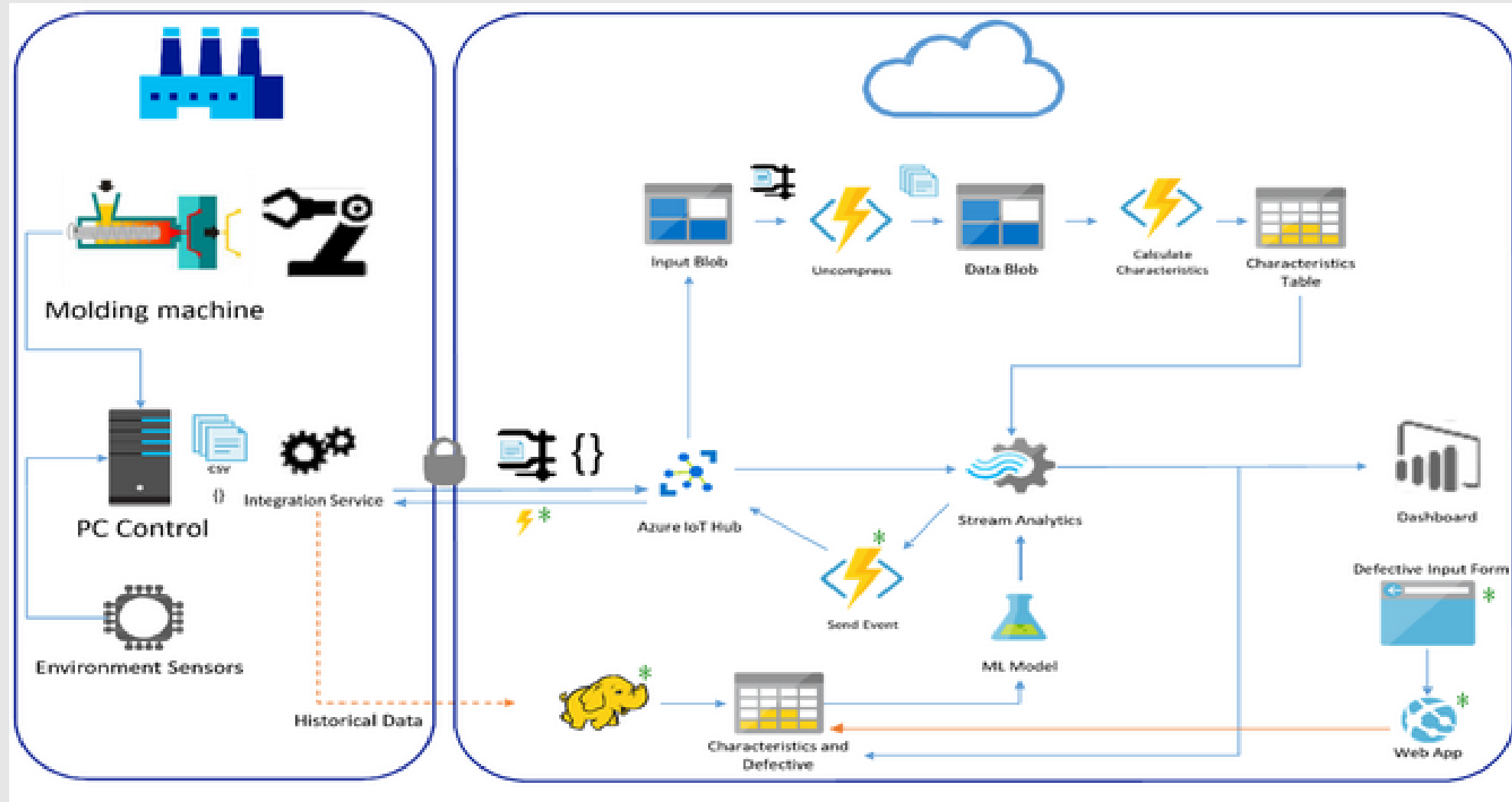


# #1 Fagor Ederlan





# #1 Fagor Ederlan





# #2 Fuji Film

<IMAGE WORKS Screen>



Samples where faces cannot be identified



Samples where numbers cannot be identified



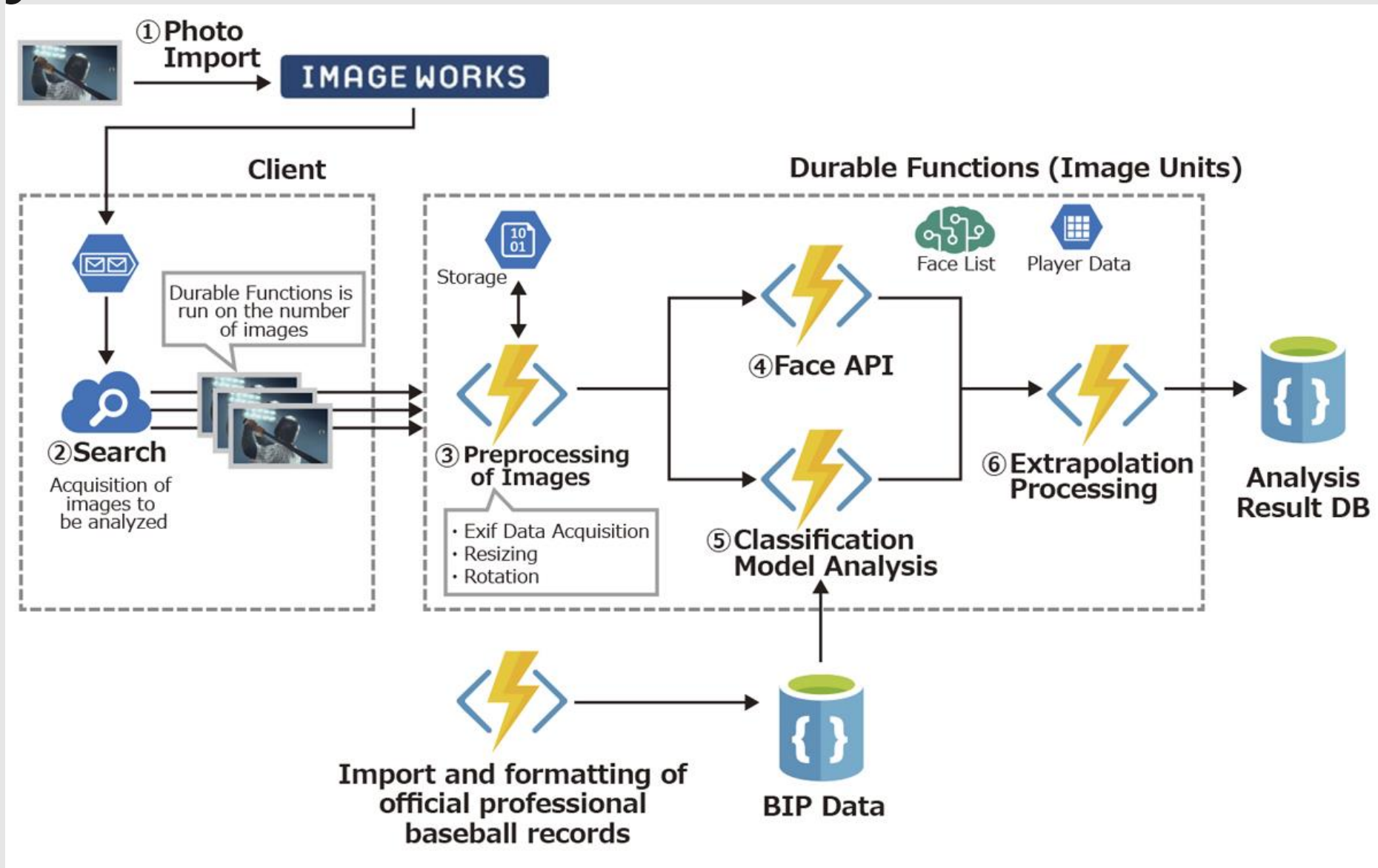
Samples where positions can be inverted



Samples where handedness can be determined

※ This pictures is for sample image. Actual product may vary.

## #2 Fuji Film



# #3 HIBP

## \$1,200

### is all you are worth on the dark web

Hacked accounts of these popular brands and stolen personal info are for sale on the dark web. The Dark Web Market Price Index tracks their average sale price, showing fraudsters can buy up someone's entire online identity for just \$1,200.

#### Online Shopping



Subtotal \$164.65

#### Travel



Subtotal \$45.53

#### Entertainment



Subtotal \$28.59

#### Personal Finance



Subtotal \$710.65

#### Social Media



Subtotal \$10.21

#### Proof of Identity



Subtotal \$92.20

#### Communication



Subtotal \$72.17

#### Delivery



#### Food Delivery



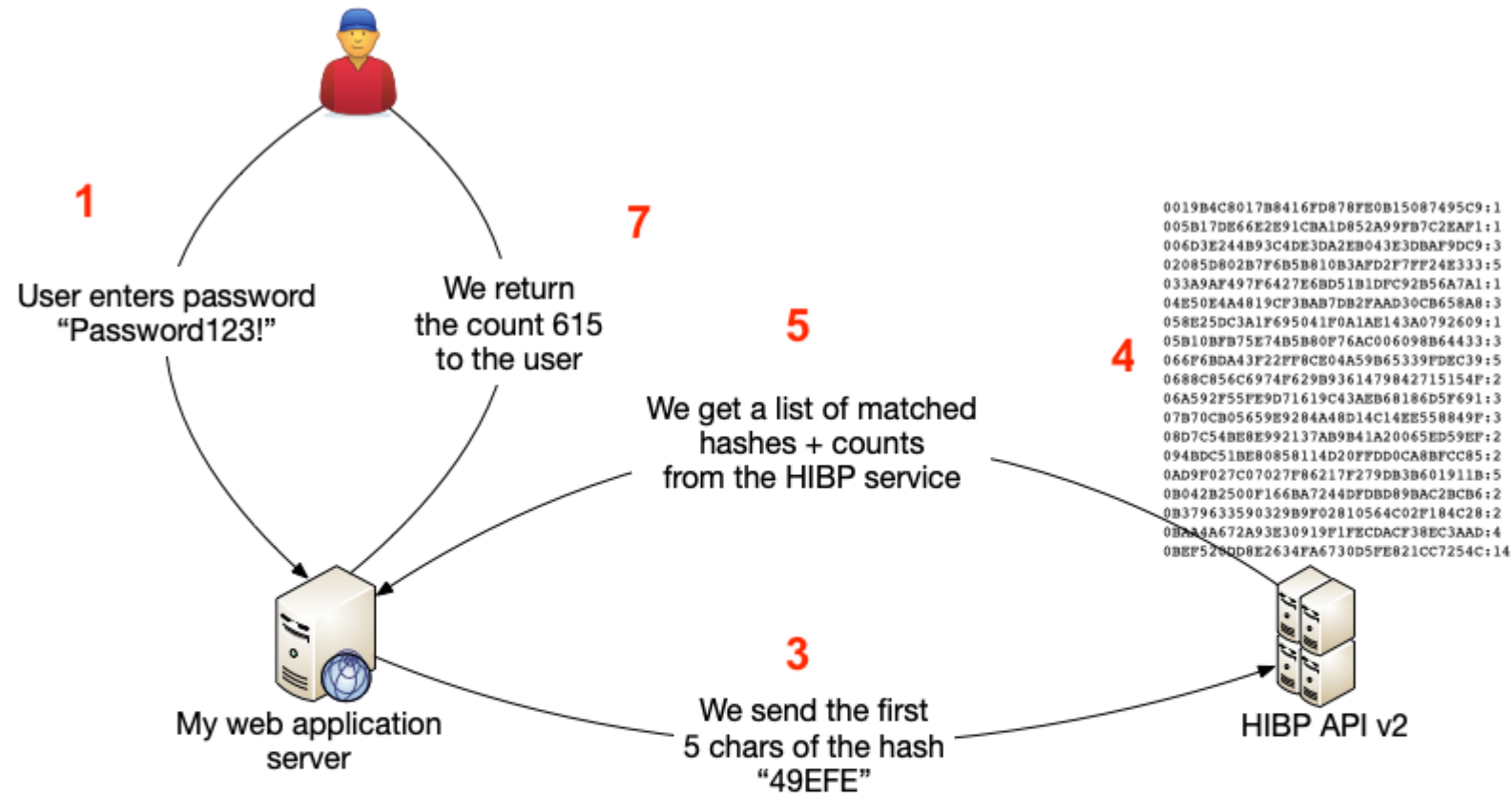
#### Email



#### Dating



# #3 HIBP



**2** On the server we create a SHA1 hash of the password "49EFEF5F70D47ADC2DB2EB397FBEF5F7BC560E29"

**6** Once we have the list back from HIBP we lookup the hash value to see if we have a match.

49EFEF5F70D47ADC2DB2EB397FBEF5F7BC560E29

```
F2581F2892ED179E9CBDC5D42BD7F1ECC9:1
F3B159ACCC13505A17923457D1B4AA1119E:1
F482BB09FBE873B1D24554833F8D4FA6595:2
F4F61F6BAA08552D99B98773D163A6B3F4D:2
F5F70D47ADC2DB2EB397FBEF5F7BC560E29:615
F67B09423AE6557E49AFD51079DFB64C302:2
F6D03E7956D362931D70E84872D5AC08921:1
F747A72EBB213BE28D0DE605E5F879DE522:1
F7F97B78BE747234928A166C2E46EC68F31:1
F96587BC01D40E8BF8DC34F0462D97794AE:4
```

# #3 HIBP

METER	PRICE	FREE GRANT (PER MONTH)
Execution Time*	\$0.000016/GB-s	400,000 GB-s
Total Executions*	\$0.20 per million executions	1 million executions

# #3 HIBP - Cost

	A	B	C	D	E	F
1	<b>Function Execution Units</b>				<b>Function Execution Count</b>	
2	Per week	1,660,000,000	MB-ms		Per week	114,710
3		1,621	GB-s		Per month	508,001
4	Per month	7,179	GB-s		Free grant per month	1,000,000
5	Free grant per month	400,000	GB-s		Billable units	0
6	Billable units	0	GB-s		Price per million	\$0.20
7	Cost per GB/s	\$0.000016			<b>Total</b>	<b>\$0.00</b>
8	<b>Total</b>	<b>\$0.00</b>				
9						
10	<b>Blob Storage</b>				<b>Blob Reads</b>	
11	Total	19.27	GB		Count	508,001
12	Cost per GB	\$0.0208			Cost per 10,000	\$0.0044
13	<b>Total</b>	<b>\$0.40</b>			<b>Total</b>	<b>\$0.22</b>
14						
15	<b>Bandwidth</b>					
16	Average response size	14	KB			
17	Responses per month	508,001				
18	Total bandwidth	7,112,020	KB			
19		7	GB			
20	Free grant per month	5	GB			
21	Billable units	2				
22	Cost per GB	\$0.087				
23	<b>Total</b>	<b>\$0.16</b>				
24						
25	<b>Grand Total</b>	<b>\$0.779</b>	<b>per month</b>			
26		<b>\$0.179</b>	<b>per week</b>			
27		<b>\$0.026</b>	<b>per day</b>			



# #3 HIBP - Cost

	A	B	C	D	E	F
1	<b>Function Execution Units</b>				<b>Function Execution Count</b>	
2	Per week	468,995,439,805	MB-ms		Per week	32,408,715
3		458,003	GB-s		Per month	140,920,038
4	Per month	2,028,301	GB-s		Free grant per month	1,000,000
5	Free grant per month	400,000	GB-s		Billable units	139,920,038
6	Billable units	1,628,301	GB-s		Price per million	\$0.20
7	Cost per GB/s	\$0.000016			<b>Total</b>	<b>\$27.98</b>
8	<b>Total</b>	<b>\$26.05</b>				
9						
10	<b>Blob Storage</b>				<b>Blob Reads</b>	
11	Total	19.27	GB		Count	140,920,038
12	Cost per GB	\$0.0208			Cost per 10,000	\$0.0044
13	<b>Total</b>	<b>\$0.40</b>			<b>Total</b>	<b>\$62.00</b>
14						
15	<b>Bandwidth</b>					
16	Average response size	14	KB			
17	Responses per month	140,920,038				
18	Total bandwidth	1,972,880,526	KB			
19		1,881	GB			
20	Free grant per month	5	GB			
21	Billable units	1,876				
22	Cost per GB	\$0.087				
23	<b>Total</b>	<b>\$163.25</b>				
24						
25	<b>Grand Total</b>	<b>\$279.697</b>	<b>per month</b>			
26		<b>\$64.324</b>	<b>per week</b>			

Q&A





# Links

<https://docs.microsoft.com>

<https://bit.ly/AzureFunctionsYoutube>

<https://twitter.com/thdotnet>

<https://linkedin.com/in/thdotnet>

<https://microsoft.github.io/techcasestudies>



# That's all folks!

<https://linkedin.com/in/thdotnet>

<https://twitter.com/thdotnet>

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