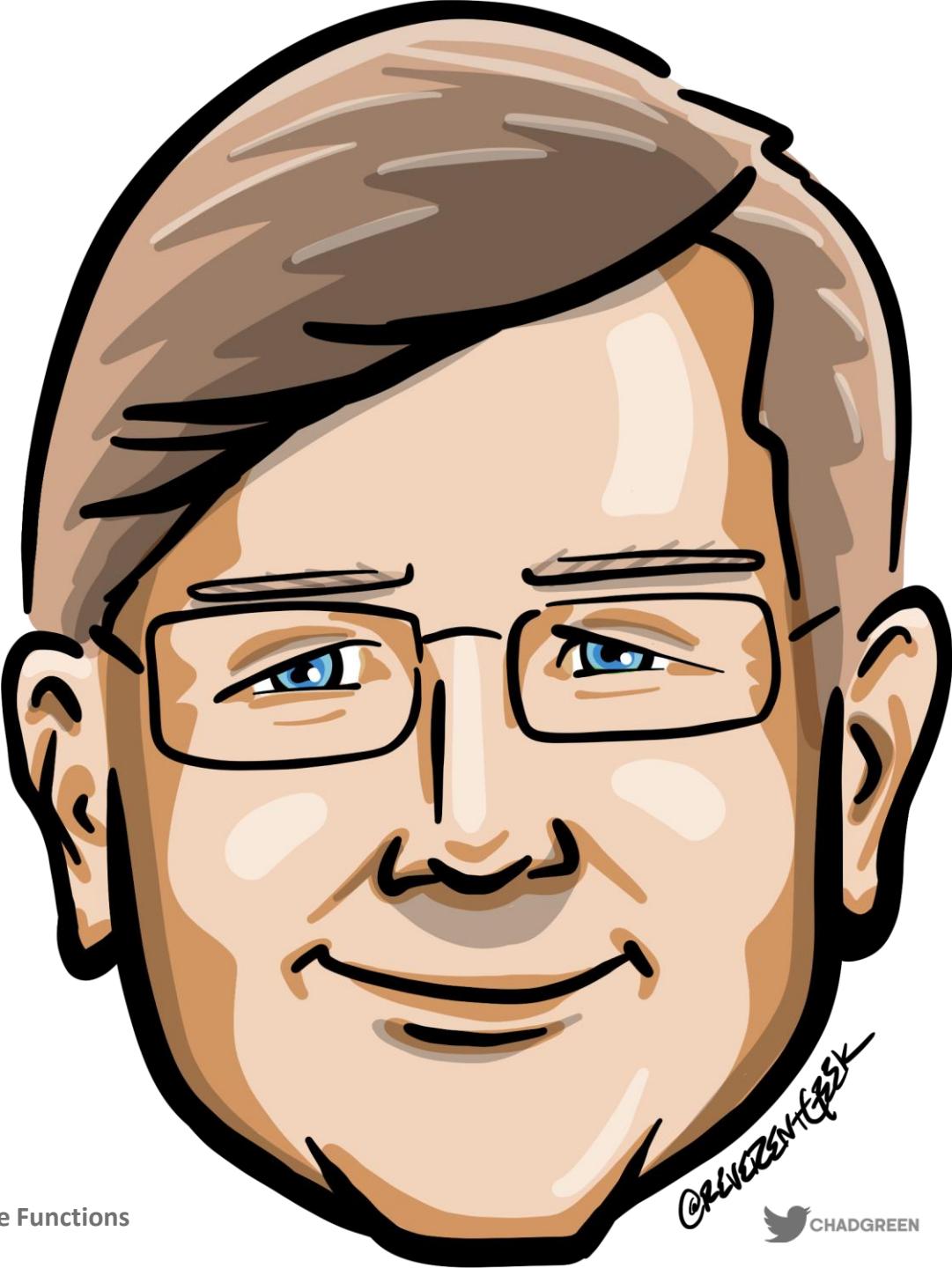




**UNLEASHING EXTREME SCALABILITY
WITH AZURE FUNCTIONS**

Who is Chad Green?

- ✉ chadgreen@chadgreen.com
- ✳ TaleLearnCode
- 🌐 ChadGreen.com
- 🐦 ChadGreen & TaleLearnCode
- linkedin ChadwickEGreen



Thanks



LOUISVILLE
AZURE MEETUP

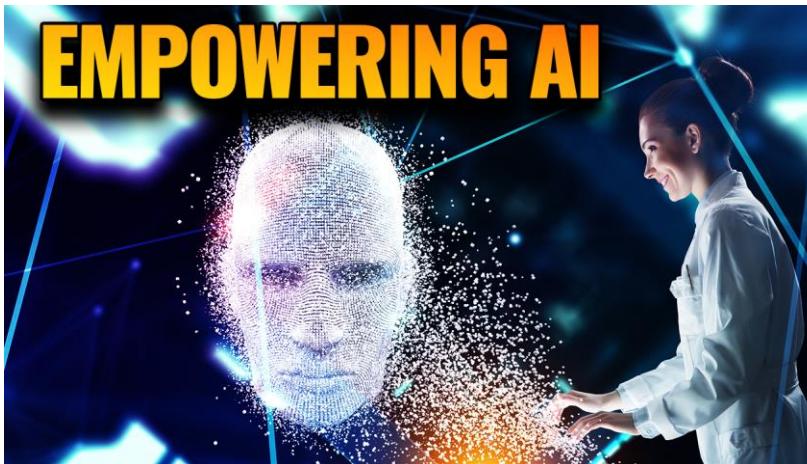


Unleashing Extreme Scalability with Azure Functions

Louisville .NET Meetup



June 20, 2024



July 18, 2024



August 22, 2024

Upcoming Events



Scenic City **Summit**

Scenic City Summit
Chattanooga, TN
June 28, 2024
\$99
sceniccitysummit.com

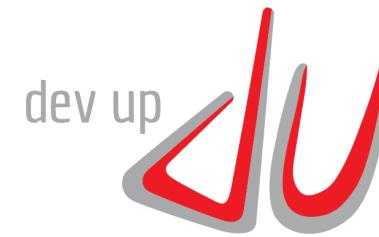
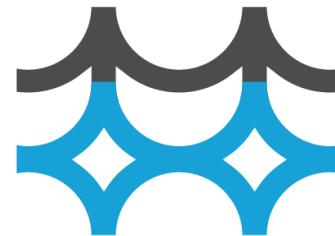
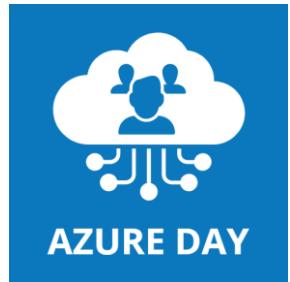


Cincy Deliver
Mason, OH
July 26, 2024
\$65 through May; \$75
cincydeliver.org



dev up
St. Charles, MO
August 14 – 16, 2024
\$450 GA; \$225 Workshop
devupconf.org

Join Me



Unleashing Extreme Scalability with Azure Functions



Prelude

Unleashing Extreme Scalability
with Azure Functions

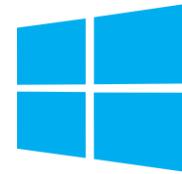
The evolution of application platforms

On-Premises

What media should I use to keep **backups**?

What **size of servers** should I **buy**?

How can I **scale** my app?

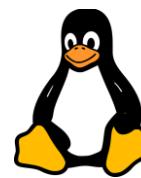


Do I need a secondary **Network connection**?

How **many** servers do I need?

It takes how long to **provision** a new server?

Which packages should be on my **server**?



Who has **physical** access my servers?

Who **monitors** my servers?

Do I need a **UPS**?



How often should I **patch** my servers?

What happens in case of server hardware **failure**?

How do I keep the **operating system** up to date?

What happens in case of server hardware **failure**?



How often should I **backup** my server?

How can I increase server utilization?

Are my servers in a **secure** location?

What storage do I need to use?

How can I dynamically configure my app?

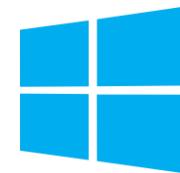
The evolution of application platforms

IaaS

What media should I use to keep **backups**?

What **size of servers** should I **buy**?

How can I **scale my app**?



Do I need a secondary **Network connection**?

How often should I **patch my servers**? Who has **physical access** to my servers?

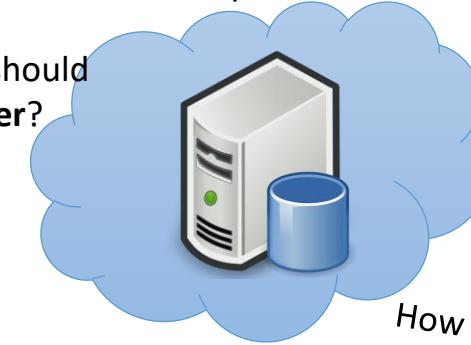
How often should I **backup my server**?

Which **servers** do I need?

Which **packages** should be on my **server**?

It takes how long to **provision a new server**?

What is the right **size of servers** for my **business needs** in case of **server hardware failure**?
How do I **deploy** my **code** to my **servers**? How many **servers** do I need? How can I **scale** my **application**? Who **monitors** my **apps**?

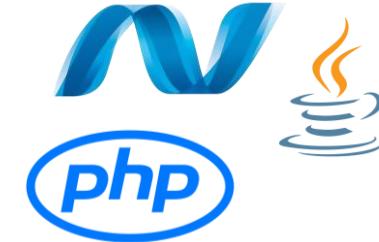


Who **monitors** my **servers**?

Do I need a **UPS**?

How often should I **patch my servers**?

What happens in case of **server hardware failure**? Who **monitors** my **application**? How do I **keep the operating system up to date**? How do I **keep the storage up to date**? What storage do I need to use?



How often should I **backup my server**?

Are my servers in a **secure location**?

How can I **increase server utilization**?

How can I dynamically **configure my app**?

The evolution of application platforms

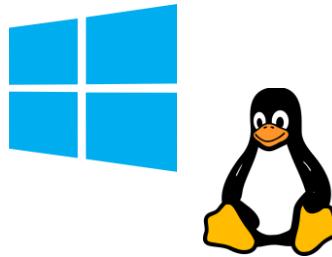
PaaS

What is the right **size of servers** for my business needs?

How can I increase **server utilization**?

How **many** servers do I need?

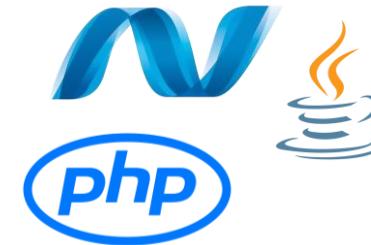
How can I **scale** my application?



How often should I **patch** my **servers**?

How often should I **backup** my **server**?

Which **packages** should be on my **server**?



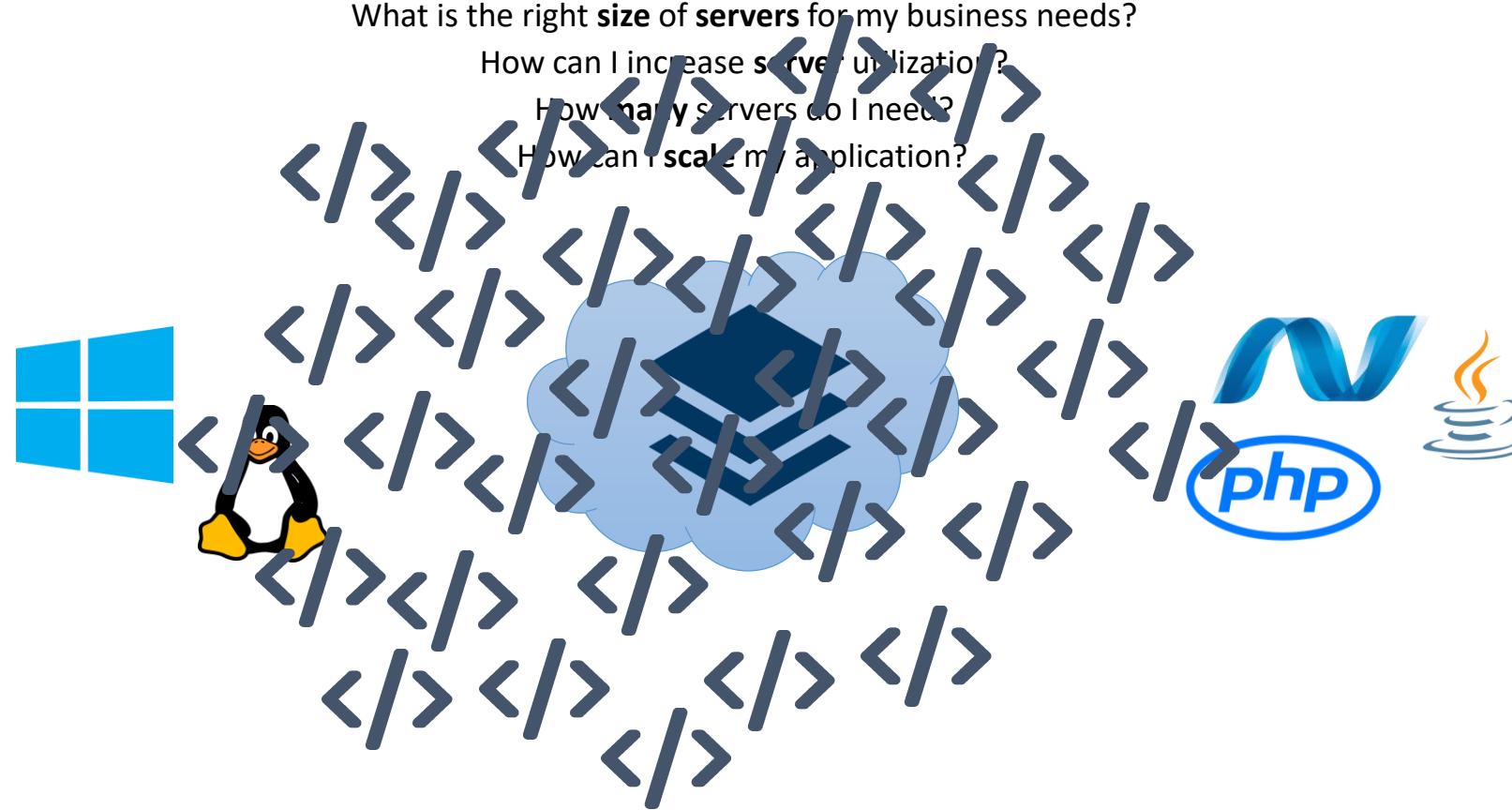
How do I **deploy** new **code** to my **server**?

How do I keep the **operating system** up to date?

Who **monitors** my application?

The evolution of application platforms

Serverless



Not there isn't servers

Just, you can think about the servers less

~~Server Configuration~~

~~Server Scaling~~

Function-as-a-Service

Event-Driven

Short-Lived

**Automatic
Scaling**

**Pay-Per-
Execution**

**Abstraction of
Infrastructure**

Azure Serverless

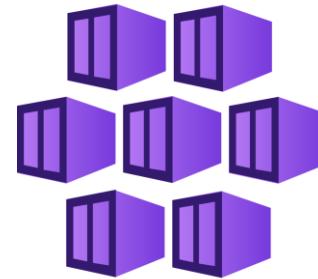


Unleashing Extreme Scalability with Azure Functions

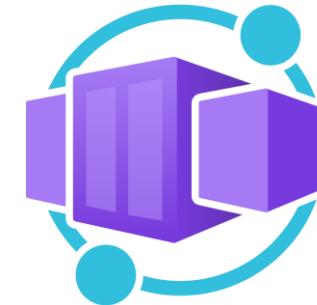
Azure Serverless



Compute



Azure Kubernetes Service



Azure Container Apps



Azure App Service

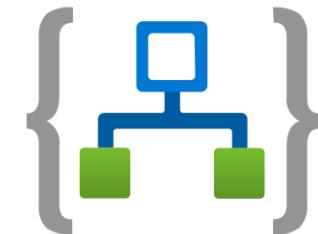


Azure Functions

Azure Serverless



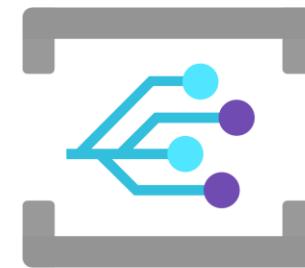
Workflow and Integration



Azure Logic Apps



API Management

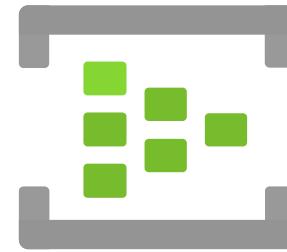


Azure Event Grid

Azure Serverless



**Data
Processing
and
Analytics**



Azure Event Hubs



Azure Stream
Analytics



Azure Synapse
Analytics



Azure Data Lake
Analytics

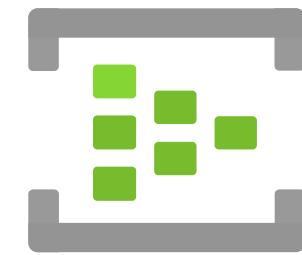
Azure Serverless



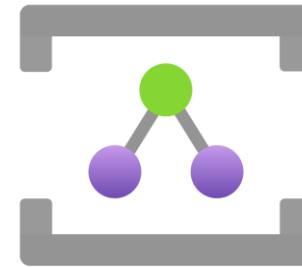
Messaging



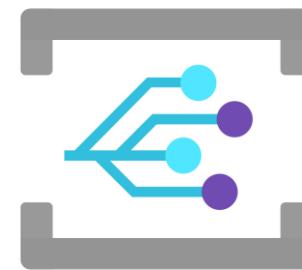
Azure Service Bus



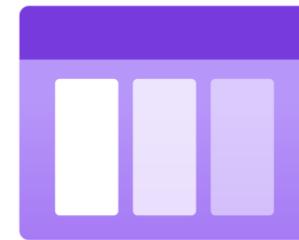
Azure Event Hubs



Azure Relays



Azure Event Grid



Azure Storage
Queues

Azure Serverless



**Data
Storage**



Azure SQL Database



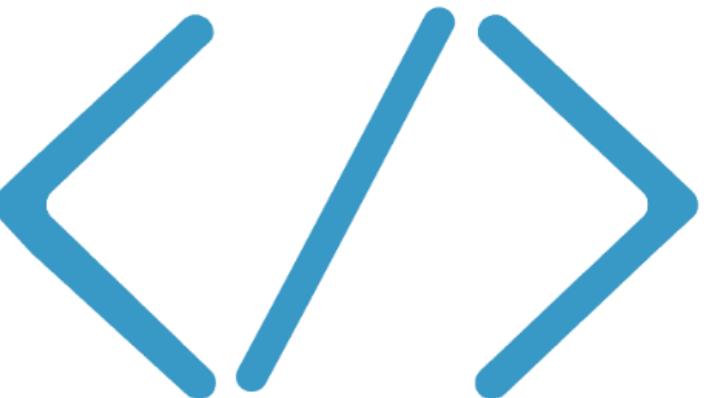
Azure Cosmos DB



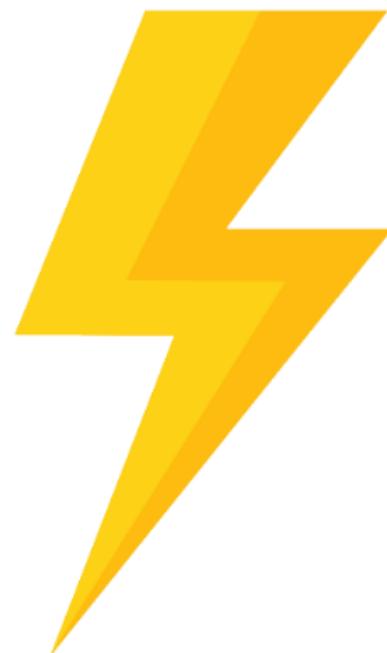
Azure Storage

Azure Functions

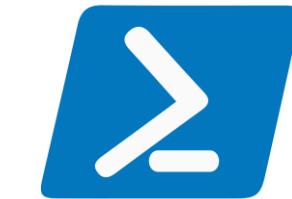
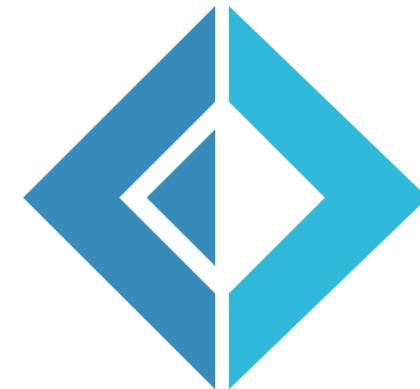
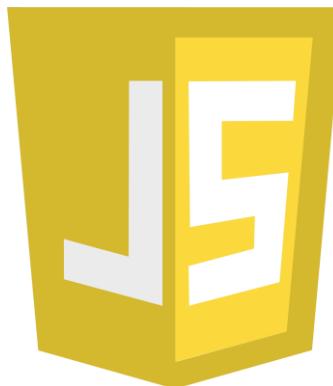
Code



Events + data



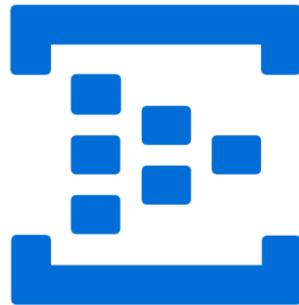
Choice of Language



Bring your own dependencies



Simplified Integration

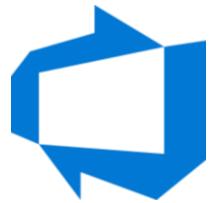
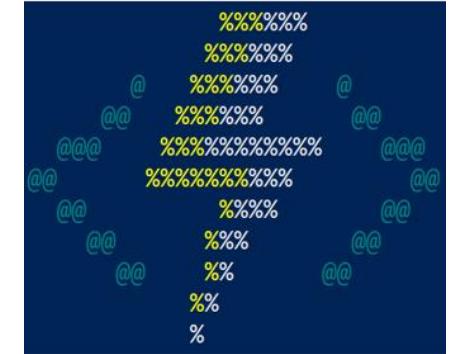
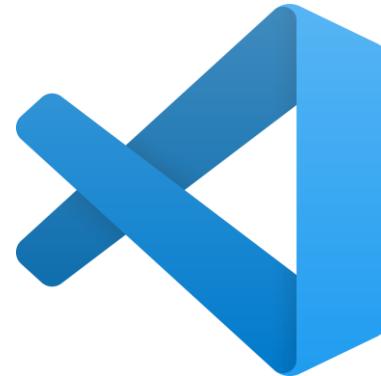
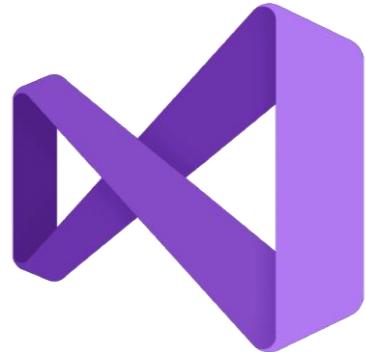


RabbitMQ



twilio

Flexible Development



Maven™



Many Hosting Options

Consumption



Serverless

App Service Environment



Network
Isolation

Premium



Sort of Serverless

Azure Stack



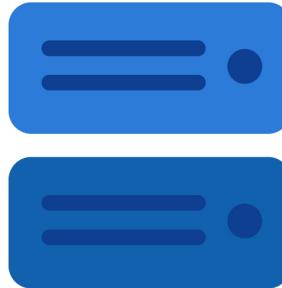
On Premises

Dedicated



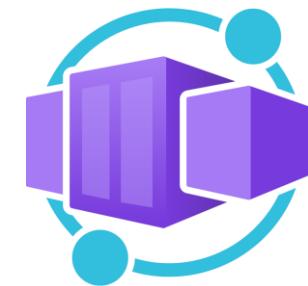
App Service Plan

Functions Runtime



Your Server

Container Apps



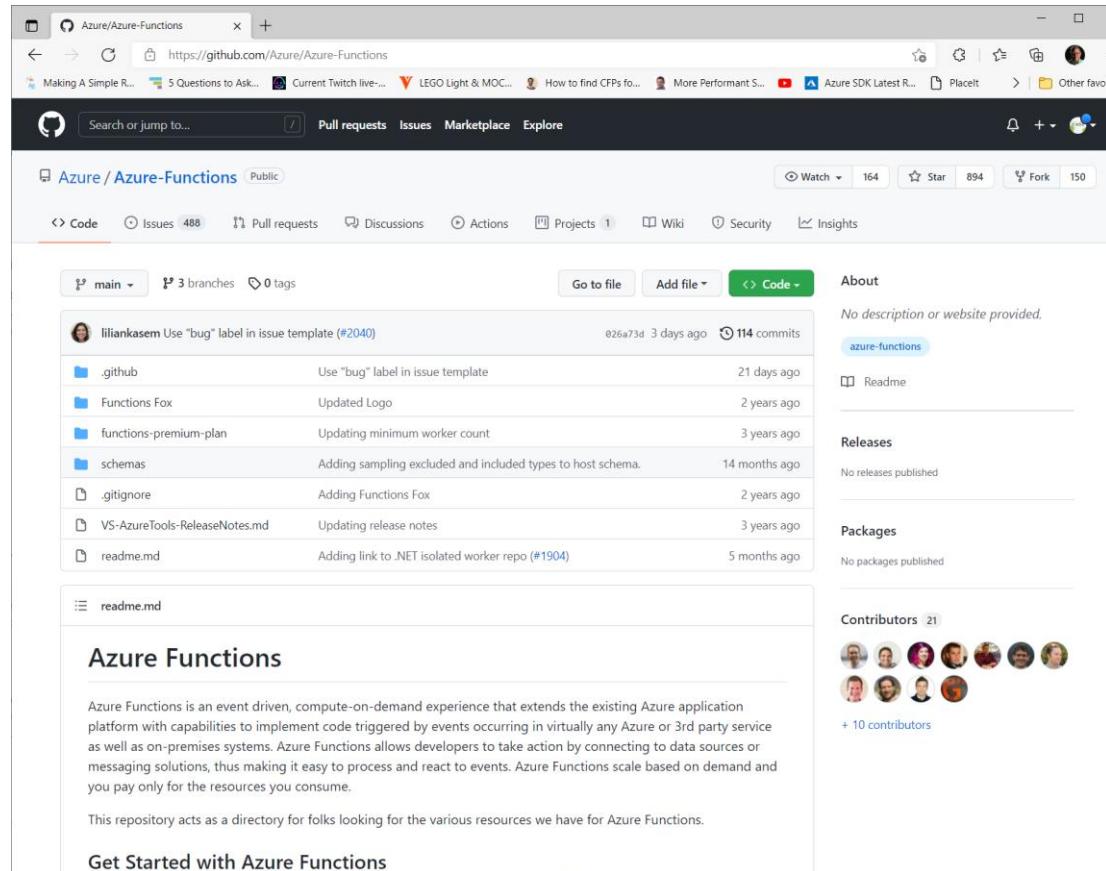
Consumption,
Dedicated

Azure IoT Edge



On Devices

Open Source



Azure Functions

- Choice of Language
- Bring Your Own Dependencies
- Simplified Integration
- Flexible Development
- Many Hosting Options
- Open Source

Many Hosting Options

Consumption



Serverless

App Service Environment



Network
Isolation

Premium



Sort of Serverless

Azure Stack



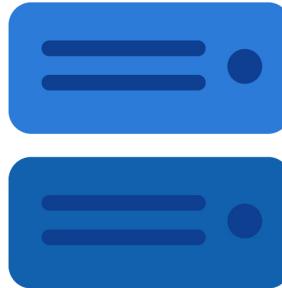
On Premises

Dedicated



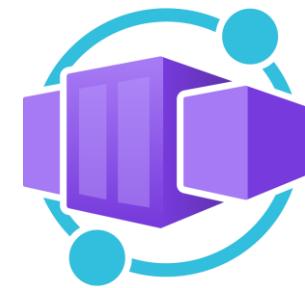
App Service Plan

Functions Runtime



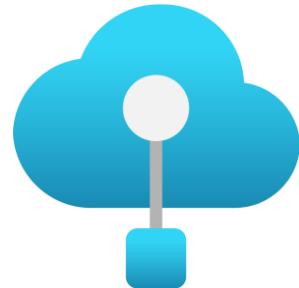
Your Server

Container Apps



Consumption,
Dedicated

Azure IoT Edge



On Devices

Many Hosting Options

- Consumption
- Premium
- Dedicated
- Container Apps
- App Service Plan
- Azure Stack
- Functions Runtime
- Azure IoT Edge





Project Legion

Unleashing Extreme Scalability
with Azure Functions

Legion Design Principles

- Must be secured with Hyper-V isolation boundary
- Must burst to scale to 1000s of instances with VNET injection
- Use latest Azure Security standards and reliability standards with Azure Zones support
- Close feature parity with Kubernetes Pod API specification
- Operate at a growing scale
- Automate/optimize operational workstreams

How Legion Works

Azure Services Being Used

- Cosmos DB
- App Service Environment v3
- Nested Virtualization enabled VMSS

How Legion Works

Azure Services Being Used

- Cosmos DB
- App Service Environment v3
- Nested Virtualization enabled VMSS

Notable APIs

- Kubernetes Pod API object CRUD operations
- Pool Group CRUD operations

How Legion Works

Azure Services Being Used

- Cosmos DB
- App Service Environment v3
- Nested Virtualization enabled VMSS

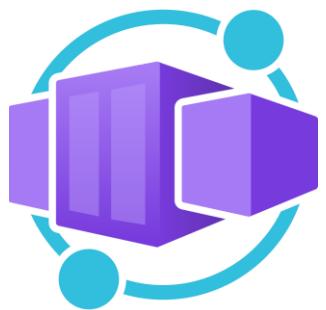
Notable APIs

- Kubernetes Pod API object CRUD operations
- Pool Group CRUD operations

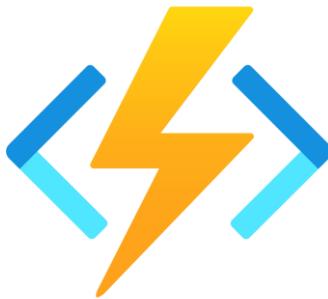
Other Features of Legion

- Startup boost for Functions
- Over provisioning of CPU resources
- Managing infrastructure updates in automated fashion

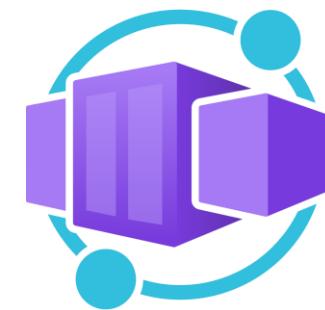
Legion in Action



Azure Container Apps



Azure Functions



Azure Container Apps
Dynamic Sessions



Microsoft
CoPilot



Flex Consumption

Unleashing Extreme Scalability
with Azure Functions

#1 Issue in Serverless: Cold Starts



Cold Start Solutions



Premium Functions

Always Ready

Consumption Functions

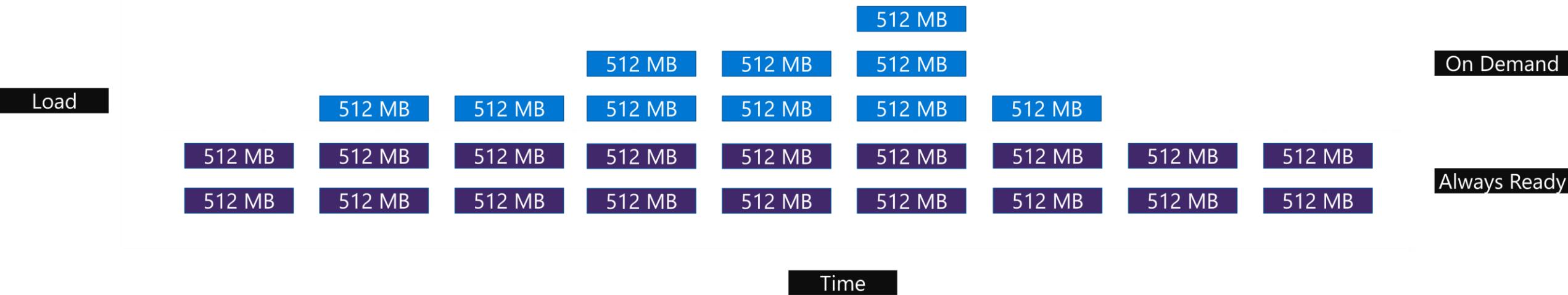
You wait

Flex Consumption

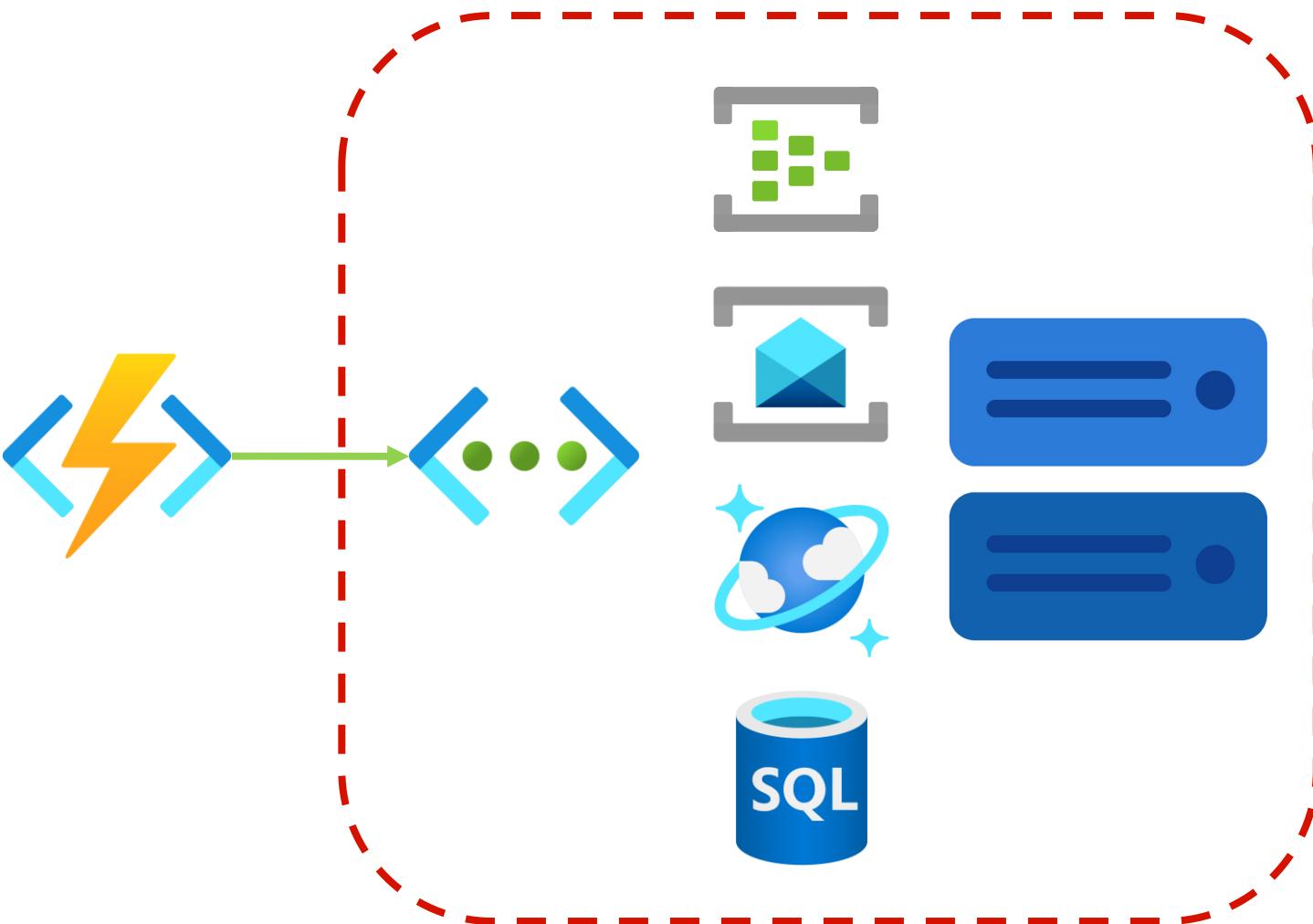
(Optional) Always Ready

Always Ready Instances

- Choose instances that are always running
- Set minimum number of instances always ready

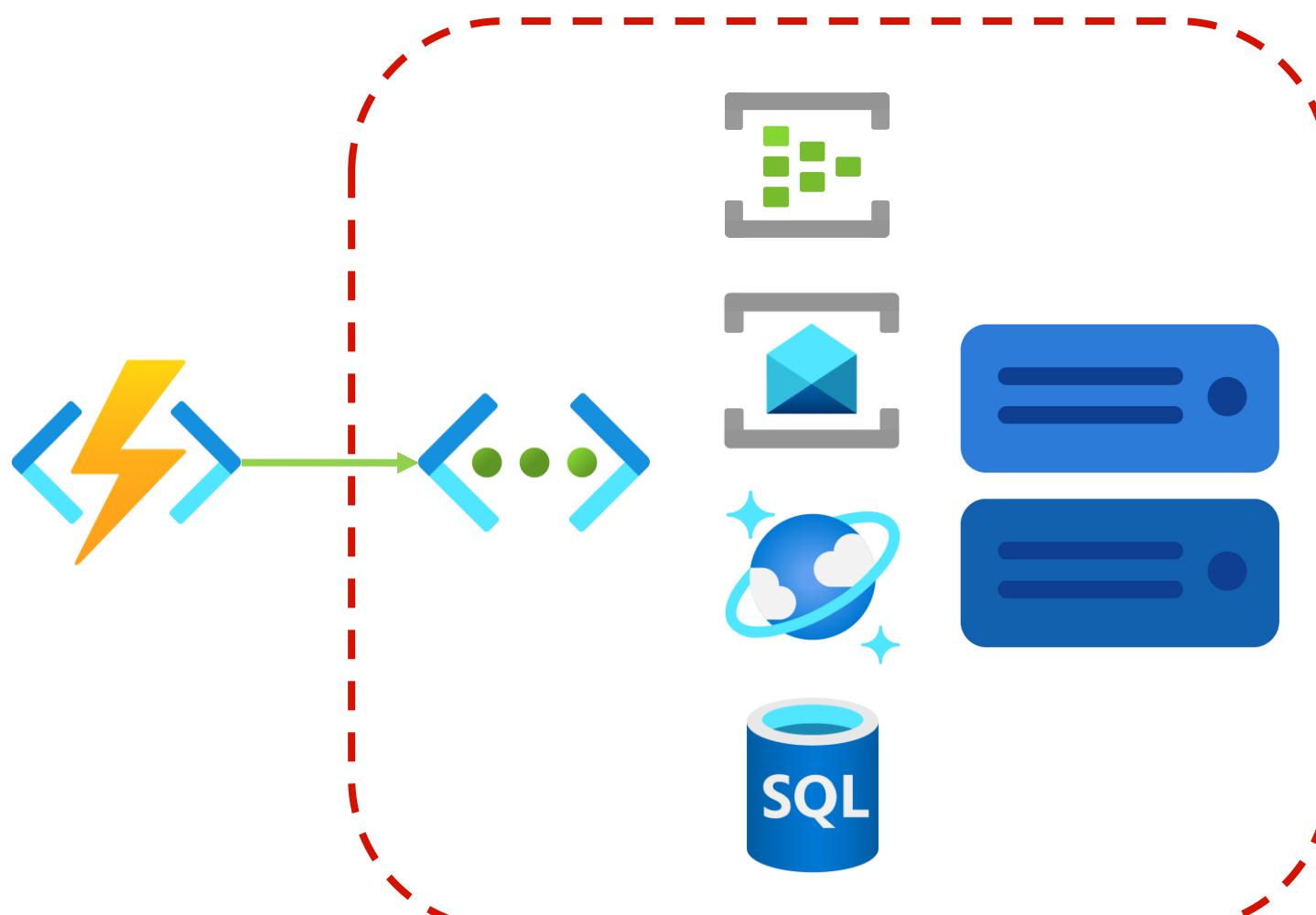


Virtual Network Support



Unleashing Extreme Scalability with Azure Functions

Virtual Network Support



- Inbound Private Endpoints
- Virtual Network Integration
- Virtual Network Triggers (non-HTTP)
- Hybrid connections (Windows only)

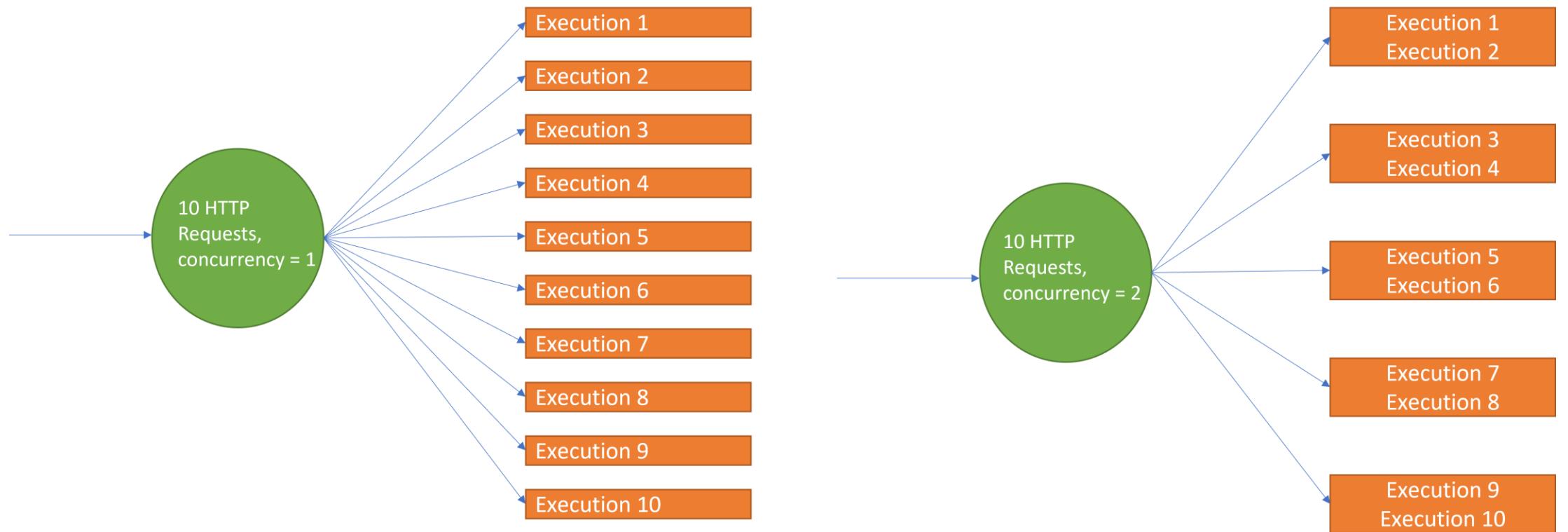
Instance Memory Choice

- 2048-Mb and 4096-Mb (more options coming)
- Default is 2048-Mb
- Change instance memory size at any time
- More memory means more can be done

Per-Instance Concurrency

- Number of parallel executions
- Can set concurrency level per instance
- Has a direct effect on how your app scales

Per-Instance Concurrency



Per-Instance Concurrency Defaults

- Python – 1
- Other languages
 - 512-Mb: 4
 - 2048-Mb: 16
 - 4096-Mb: 32

Per-Function Scaling

- Deterministic way of scaling your app on a per-function basis
- No code changes
- Special cases: HTTP, Blob (Event Grid), and Durable trigger



Function 1



Function 2



Function 3



Function 4



Function 6



Function 7



Function 8

Scale Out Further

- Default is 100 instances
- Highest is 1000 instances
- Lowest is 40 instances

Region Subscription Memory Quota

512,000 MB per region per subscription

Extreme Scalability



Even More Benefits

- Azure Load Testing Integration
- Open Telemetry Opt-In
- Long Execution Times

Flex Consumption Features and Benefits

- Always Ready
- Virtual Network Support
- Instance Memory Choice
- Per-Instance Concurrency
- Per-Function Scaling
- Scale-Out Further
- Extreme Scalability
- Azure Load Testing Integration
- Open Telemetry Opt-In
- Long Execution Times

Pricing

Pricing

On-Demand

Always Ready

Meter	Free Grant (per month)	Pay as you go
On Demand Execution Time	100,000 GB-s	\$0.000016/GB-s
On Demand Total Executions	250,000 executions	\$0.20 per million executions
Always Ready Baseline		\$0.000004/GB-s
Always Ready Execution Time		\$0.000009/GB-s
Always Ready Total Executions		\$0.20 per million executions

Billing

Flex Consumption with Always Ready Scenario

3 million executions per month; each execution using 512 MB and running for 1 second; 1% of executions performed while idle

Consumption: \$18.00

Premium: \$155.27

Flex Consumption (w/o Always Ready): \$20.60

Flex Consumption (with Always Ready): \$33.70

Billing

Actual Scenario

434k executions per month; each execution using 2048 MB and running for 400 milliseconds; VNet connectivity needed no Always Ready (cold starts acceptable)

Consumption: N/A

Premium: \$155.27

Flex Consumption: \$4.16



Demonstrations

Unleashing Extreme Scalability
with Azure Functions

Demonstrations

- Deploying your first Flex Consumption Azure Function
- High-Scale HTTP Function App to Event Hubs via VNet



Considerations

Unleashing Extreme Scalability
with Azure Functions

Considerations

- Not all triggers fully supported (yet)

Unsupported Triggers

Kafka

Azure SQL

SignalR

Not-Fully Supported

Blob (only supports the Event Grid source)

Considerations

- Not all triggers fully supported (yet)
- Not all regions are supported (yet)

Flex Consumption Regions

- East US
- North Europe
- Southeast Asia
- East Asia
- East US 2
- South Central US
- Australia East
- North Central US
- West US 2
- UK South
- West US 3
- Sweden Central

Considerations

- Not all triggers fully supported (yet)
- Not all regions are supported (yet)
- Deployment options limited (currently)

Unsupported Deployment Methods

- Azure DevOps Task (AzureFunctionApp@2)
- GitHub Actions (function-action@v1)
- Deployment Slots

Considerations

- Not all triggers fully supported (yet)
- Not all regions are supported (yet)
- Deployment options limited (currently)
- Scaling limitations (currently)

Scaling Limitations

- Lowest maximum scale is 40
- Highest maximum scale is 1000

Considerations

- Not all triggers fully supported (yet)
- Not all regions are supported (yet)
- Deployment options limited (currently)
- Scaling limitations (currently)
- Limited Support – Preview Functionality





Decisions

Unleashing Extreme Scalability
with Azure Functions

Hosting Decisions

Consumption

Flex Consumption

Premium

Dedicated

Container Apps

Hosting Decisions

Consumption

Flex Consumption

Premium

Dedicated

Container Apps

Benefits

- Pay only when your functions are running (pay-as-you-go)
- True serverless hosting
- Automatic scaling during high load

Use case

Ideal for sporadic workloads with varying demand

Hosting Decisions

Consumption

Flex Consumption

Premium

Dedicated

Container Apps

Benefits

- High scalability with compute choices
- Support virtual networking for added security
- Specify pre-provisioned instances to reduce cold starts
- Connects to virtual networks

Use case

- When you need more control over concurrency and what to pay-as-you-go
- When you need VNet support for sporadic workloads

Hosting Decisions

Consumption

Flex Consumption

Premium

Dedicated

Container Apps

Benefits

- Automatically scales based on demand using prewarmed workers
- Suitable for continuous or nearly continuous workloads
- Connects to virtual networks

Use case

- Multiple functions apps on the same plan with event-driven scaling
- Need for more compute power
- When you need VNet support for high-use workloads

Hosting Decisions

Consumption

Flex Consumption

Premium

Dedicated

Container Apps

Benefits

- Dedicated compute resources for your app
- Ideal for complex applications with customization needs
- Fully utilize existing App Service Plans

Use case

- Get full utilization of an existing App Service Plan
- Long-running scenarios where Durable Functions cannot be used

Hosting Decisions

Consumption

Flex Consumption

Premium

Dedicated

Container Apps

Benefits

- Run your function app in a container
- Fully managed environment
- Dapr Support

Use case

- Mixing with other Container Apps and/or need Dapr support
- Migrating code execution from on-premises or legacy apps



Summary

Unleashing Extreme Scalability
with Azure Functions

Azure Functions Flex Consumption

- Instance Memory Choice
- Per-Instance Concurrency
- Per-Function Scaling
- Always Ready Instances
- Scale Out Further
- Virtual Network Support
- Azure Load Testing Integration
- Open Telemetry Opt-In
- Serverless Billing

Thank You

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🐦 ChadGreen & TaleLearnCode

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