Advanced Serverless Workshop

Advanced Serverless Workshop

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Speakers

Chad Green

09:00 to 10:30

Martine Dowden

11:00 to 12:30

Vadym Kazulkin

13:30 to 15:00

Speakers

Chad Green

09:00 to 10:30

Martine Dowden

11:00 to 12:30

Vadym Kazulkin

13:30 to 15:00

Panel Session

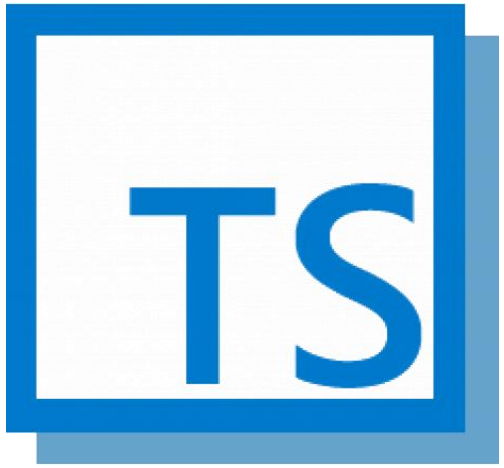



15:30 to 17:00

Who has a serverless project currently running in production?

Which cloud provider?

Which language(s)?



SERVERLESS ARCHITECTURE CONFERENCE

by devmio

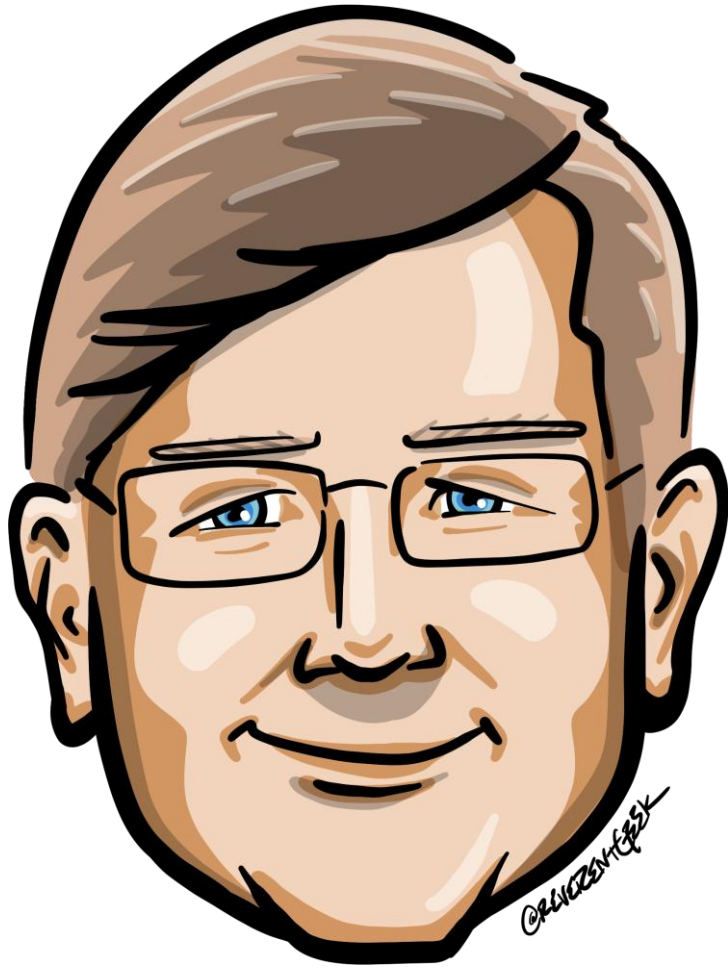
Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

Advanced Serverless Workshop

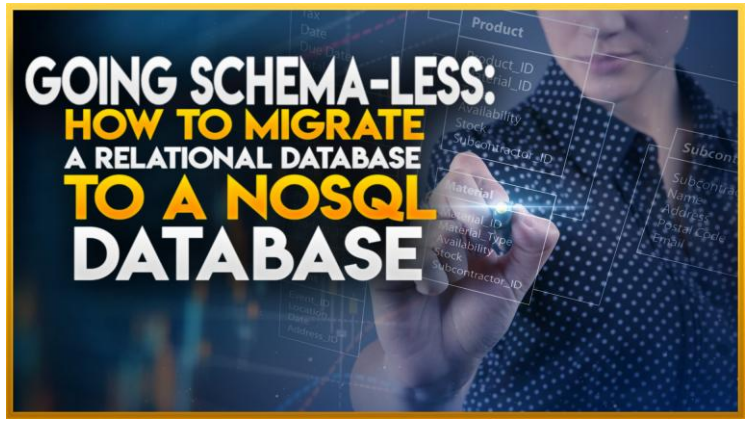
Who is Chad Green?

JASPER ENGINES & TRANSMISSIONS GO!

MVP Microsoft® Most Valuable Professional



Busy Week



Tuesday @ 11:30

Tuesday @ 15:45

API CONFERENCE Wednesday @ 17:00

Agenda

Serverless Architecture

- Introduction to Serverless Computing
- Serverless Architecture Styles
- Cloud Design Patterns
- Software Design Patterns

Agenda

Serverless Architecture

Azure Services Offerings

- Compute
- Workflow and Integration
- Data Processing and Analytics
- Messaging
- Data Storage

Agenda

Serverless Architecture

Azure Services Offerings

What's New and Coming

- Recent updates to Azure Container Apps
- Upcoming features coming to Azure Functions

Introduction to Serverless Computing

Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

What is Serverless Computing

On-Prem

What is Serverless Computing

IaaS
Infrastructure as a Service

PaaS
Platform as a Service

FaaS
Function as a Service

What is Serverless Computing

IaaS
Infrastructure as a Service

PaaS
Platform as a Service

FaaS
Function as a Service

Serverless Benefits

Scalability

Serverless Benefits

Scalability

Cost-Efficiency

Serverless Benefits

Scalability

Cost-Efficiency

Developer Productivity

Serverless Benefits

Scalability

Cost-Efficiency

Developer Productivity

High Availability

Serverless Benefits

Scalability

Cost-Efficiency

Developer Productivity

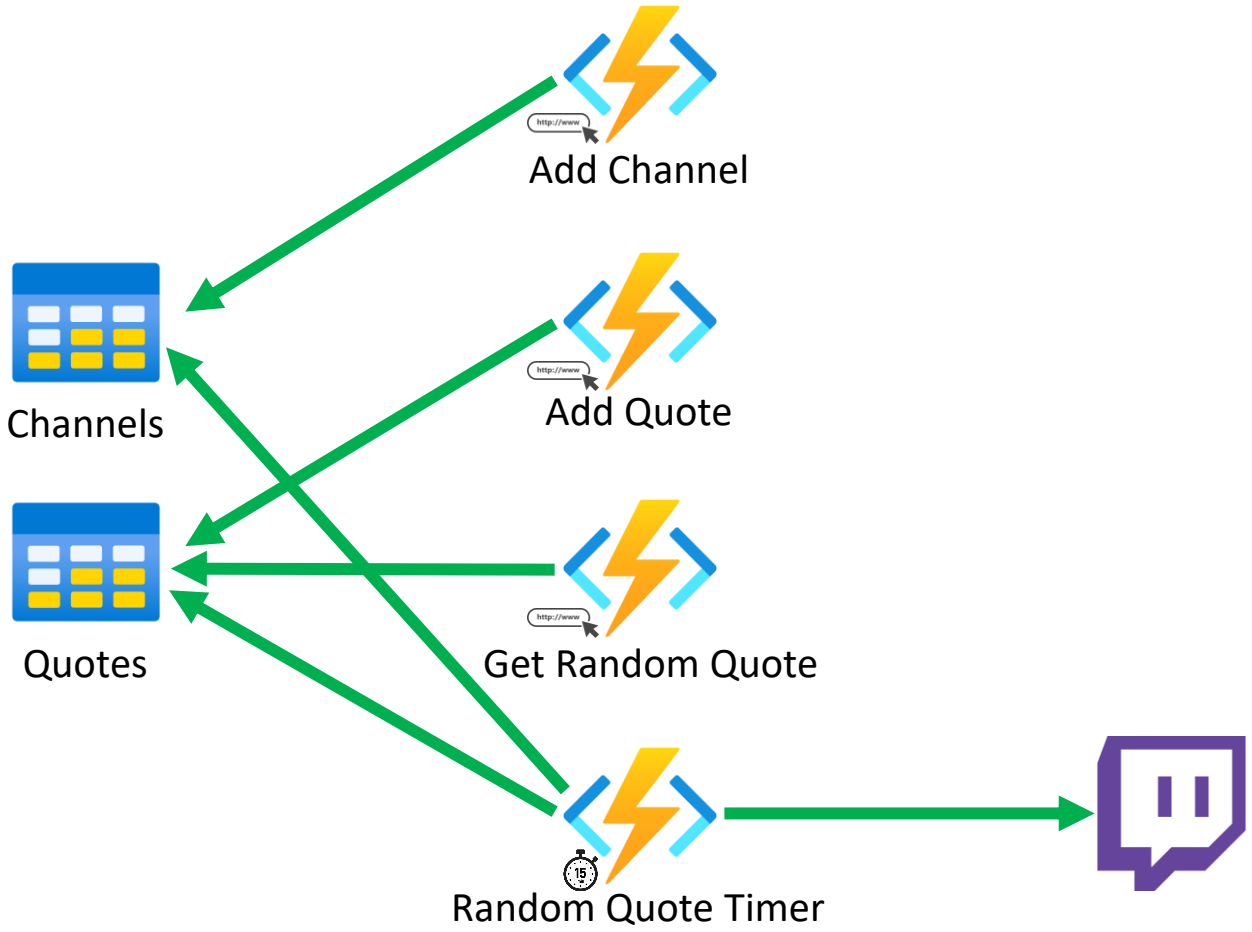
High Availability

Rapid Development

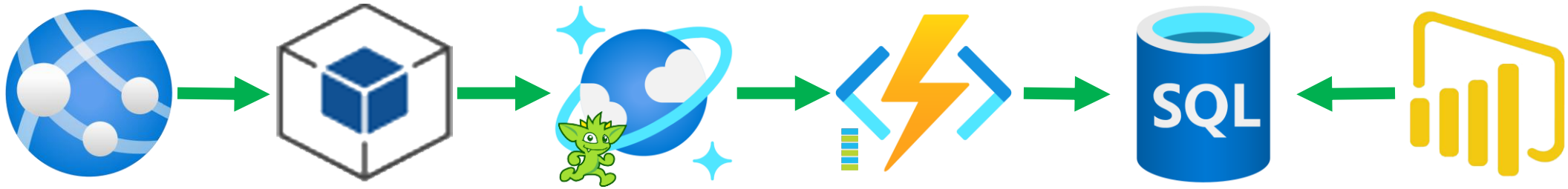
Implemented Azure Solutions

Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

Random Quote Generator



Replicating Data



Web Application

.NET Services Layer

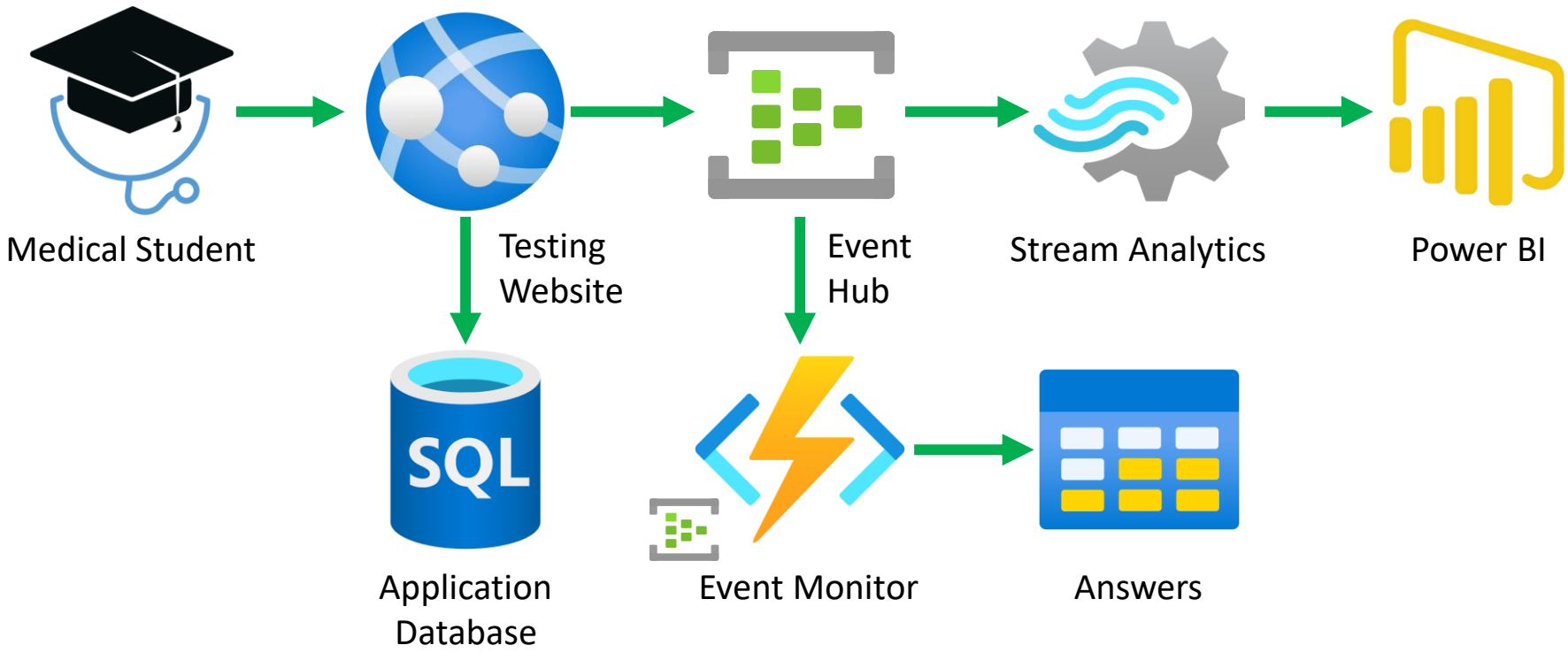
Primary Data Store

Change Feed Monitor

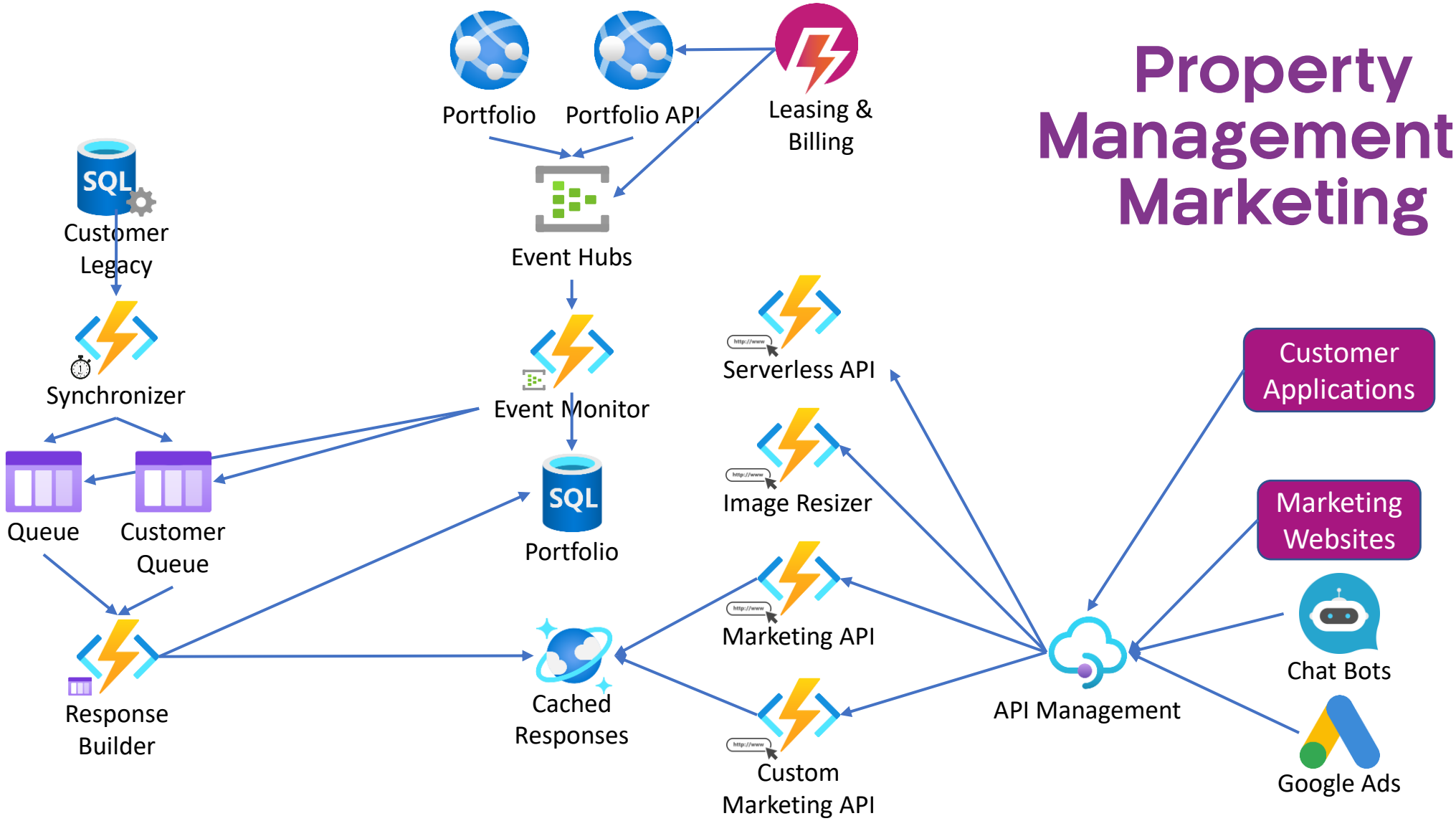
Reporting Database

Reporting Dashboard

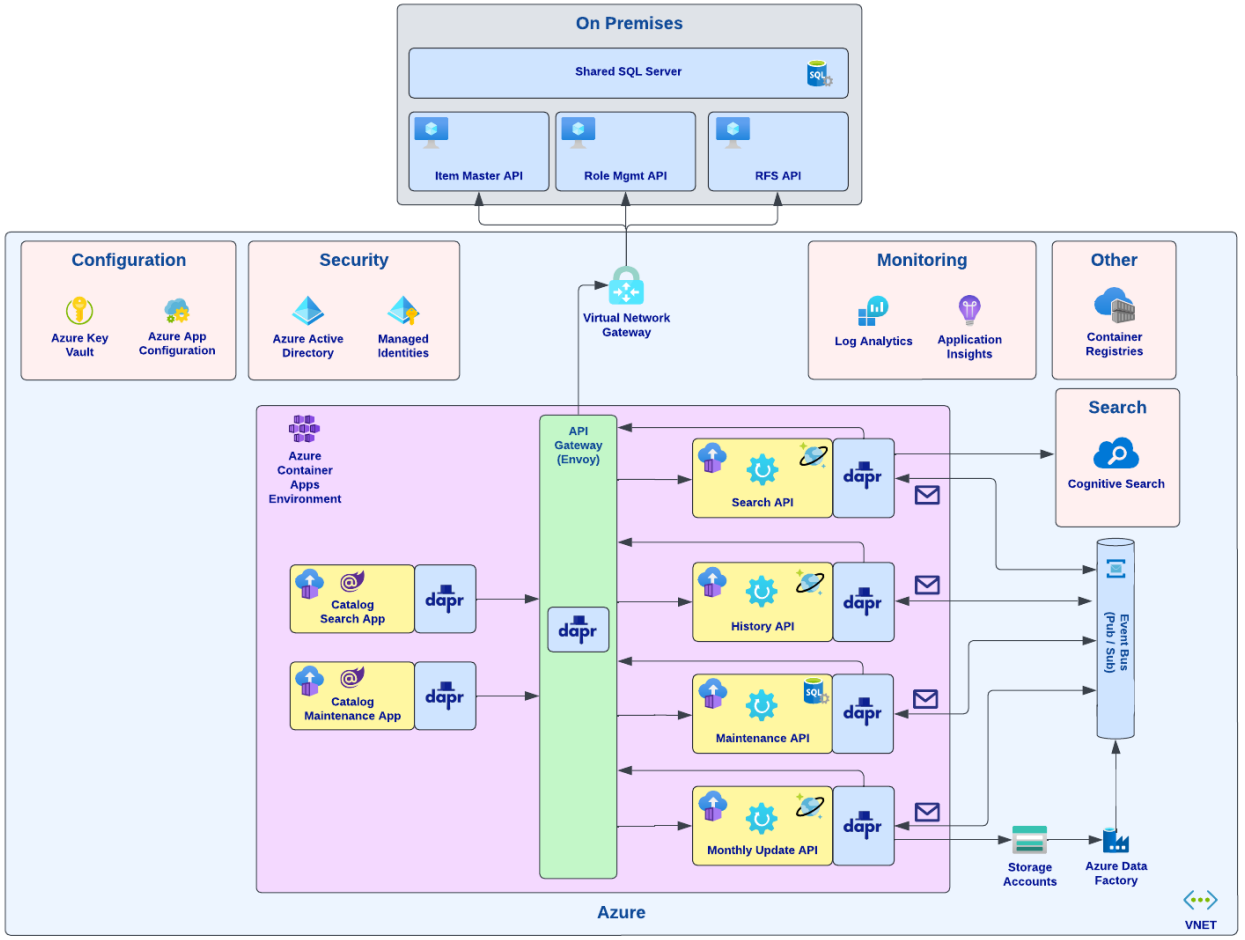
Real-Time Reporting



Property Management & Marketing



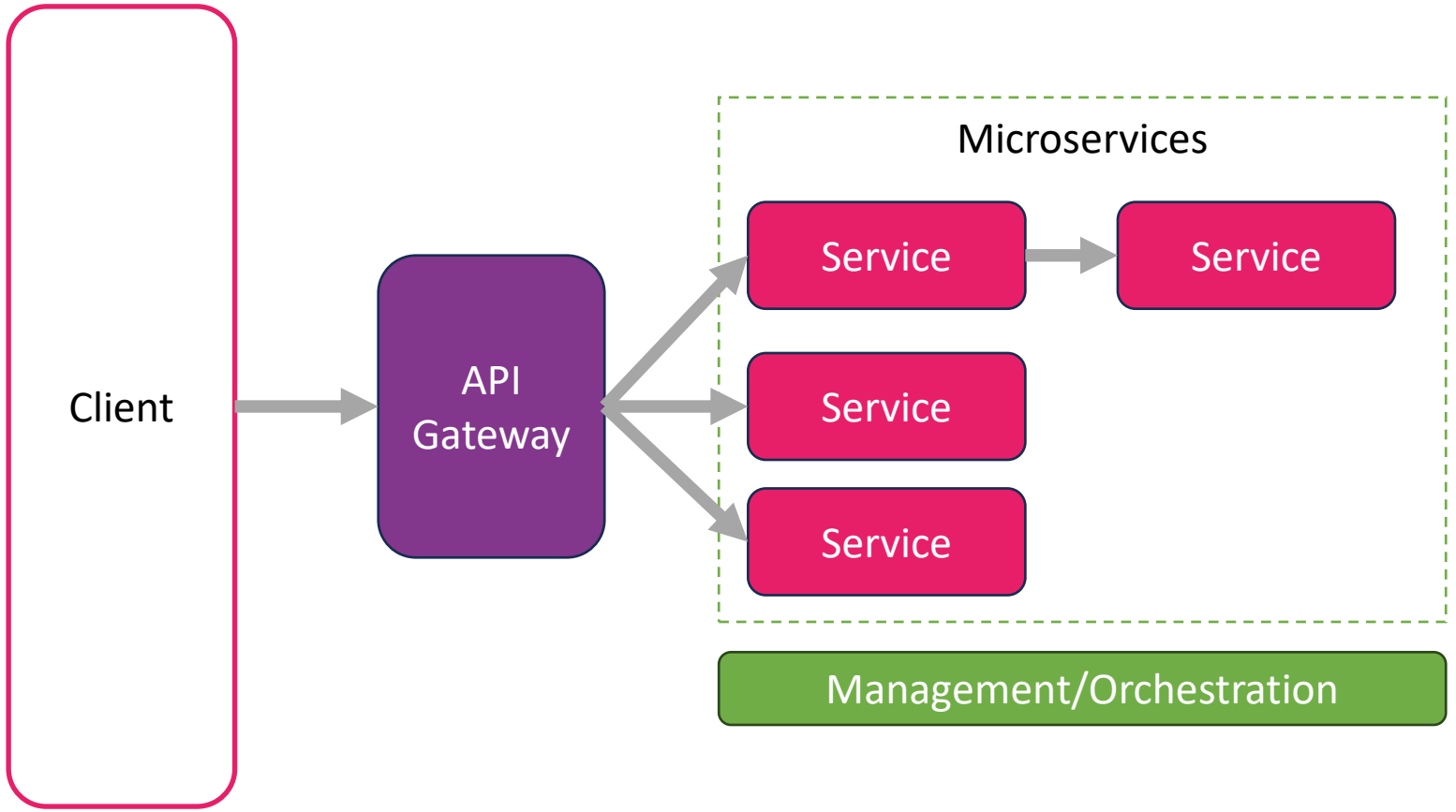
Catalog Maintenance



Serverless Architecture Styles

Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

Microservices



Benefits of Microservices

Flexibility

Benefits of Microservices

Flexibility

Scalability

Benefits of Microservices

Flexibility

Scalability

Resilience

Benefits of Microservices

- Flexibility
- Scalability
- Resilience
- Agility

Event-Driven Architecture

Benefits of Event-Driven Architecture

Scalability

Benefits of Event-Driven Architecture

Scalability

Flexibility

Benefits of Event-Driven Architecture

Scalability

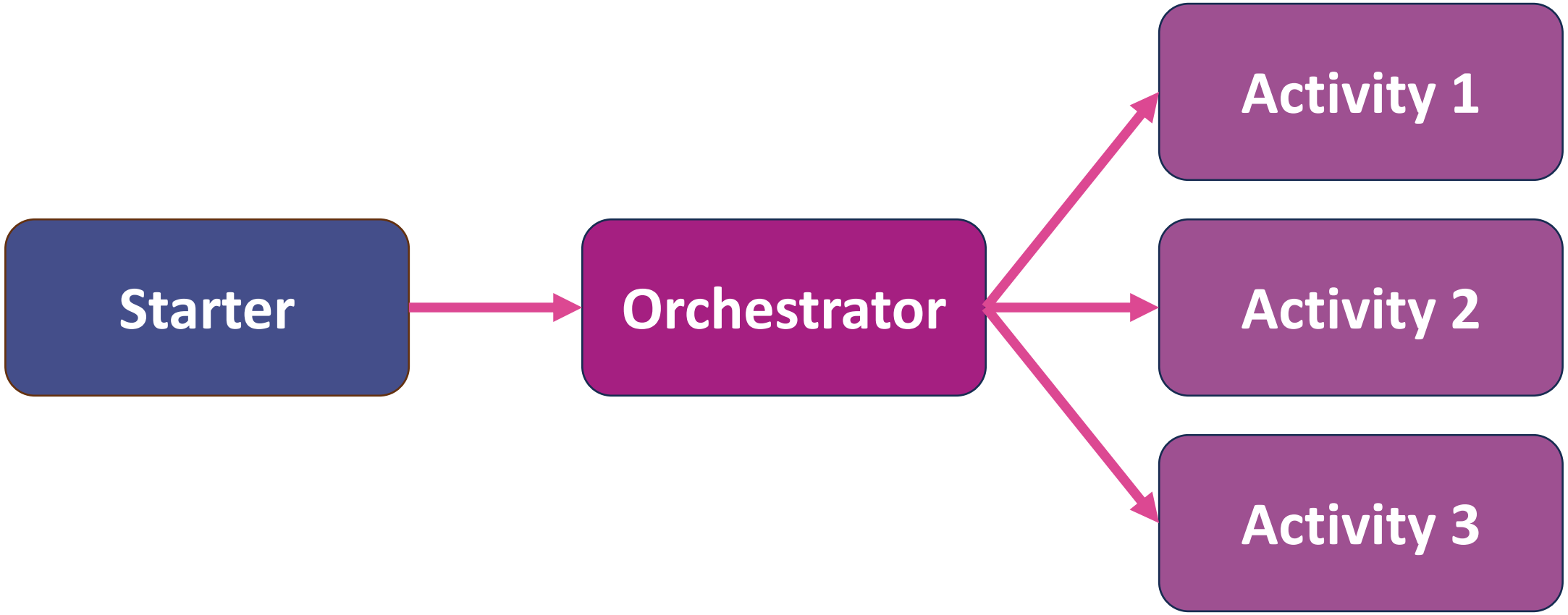
Flexibility

Resilience

Benefits of Event-Driven Architecture

- Scalability
- Flexibility
- Resilience
- Real-Time Processing

Workflow Orchestration



Benefits of Workflow Orchestration

Streamlined Business Processes

Benefits of Workflow Orchestration

Streamlined Business Processes

Scalability

Benefits of Workflow Orchestration

Streamlined Business Processes

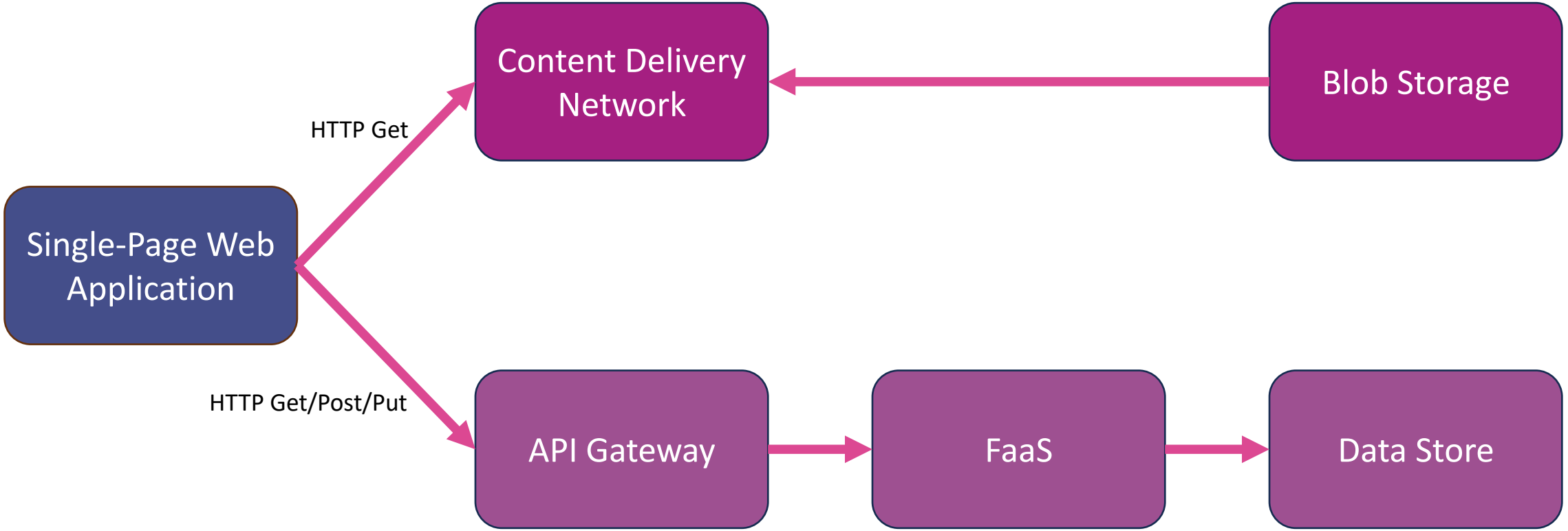
Scalability

Flexibility

Benefits of Workflow Orchestration

- Simplified Business Processes
- Scalability
- Flexibility
- Reliability

Scalable Web Applications



Benefits of Scalable Web Apps

Automatic Scaling

Benefits of Scalable Web Apps

Automatic Scaling

Global Reach

Benefits of Scalable Web Apps

Automatic Scaling

Global Reach

Simplified Operation

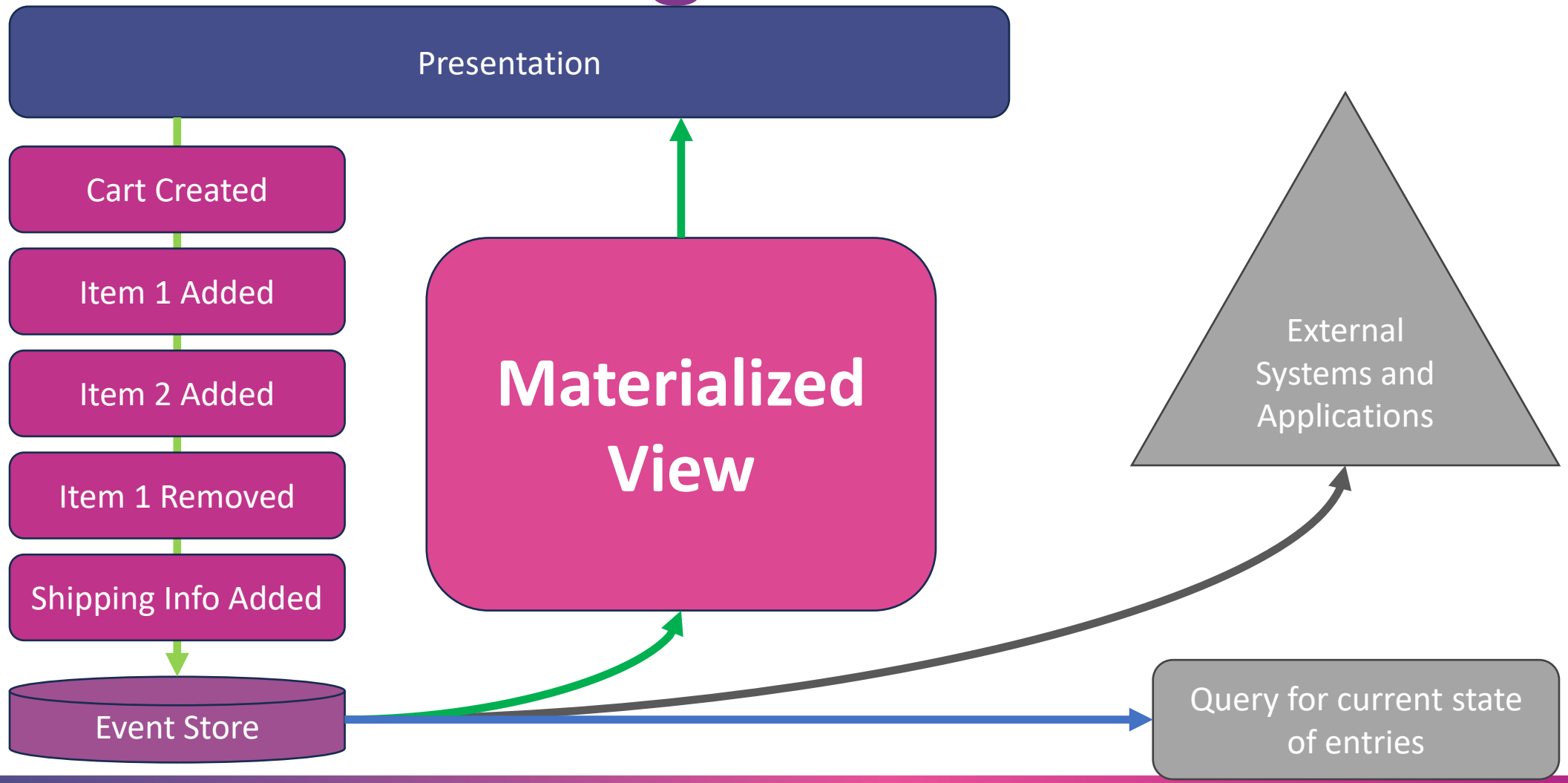
Benefits of Scalable Web Apps

- Automatic Scaling
- Global Reach
- Simplified Operation
- Cost Efficiency

Cloud Design Patterns

Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

Event Sourcing



Benefits of Event Sourcing

Immutable Audit Trail

Benefits of Event Sourcing

Immutable Audit Trail

Temporal Queries

Benefits of Event Sourcing

Immutable Audit Trail

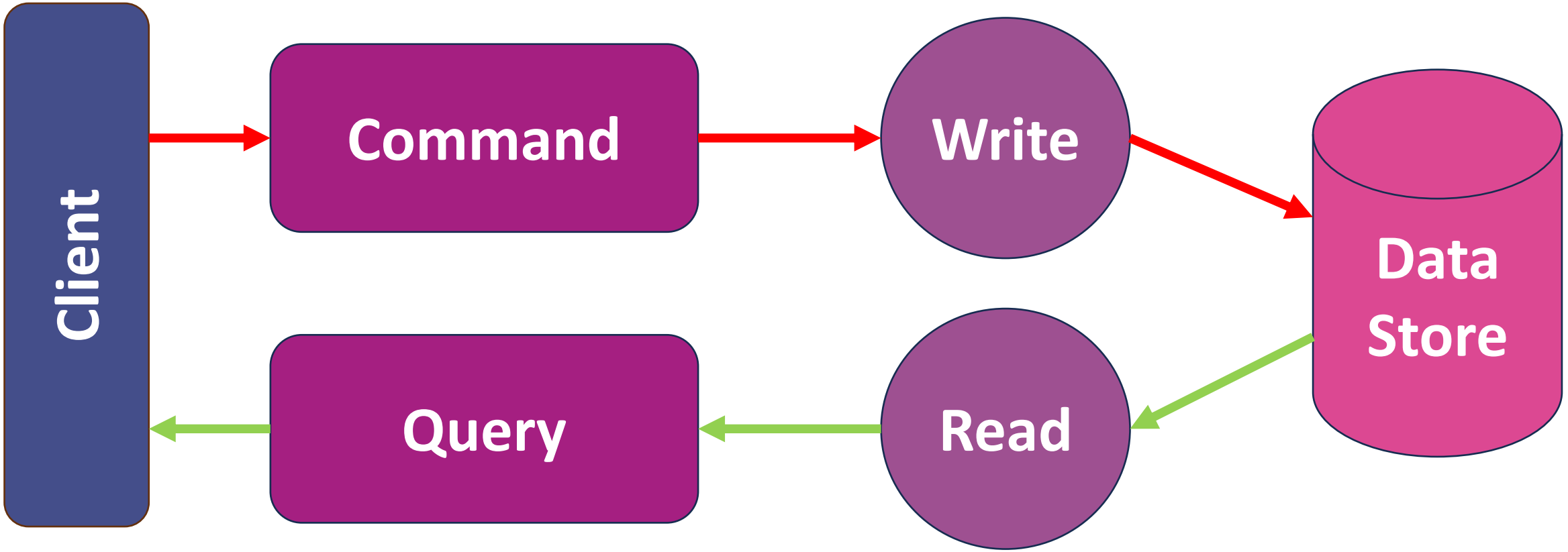
Temporal Queries

Scalability and Reliability

Benefits of Event Sourcing

- Immutable Audit Trail
- Temporal Queries
- Scalability and Reliability
- Flexibility and Extensibility

Command Query Responsibility Segregation (CQRS)



Benefits of CQRS

Scalability

Benefits of CQRS

Scalability

Performance

Benefits of CQRS

Scalability

Performance

Flexibility

Benefits of CQRS

- Scalability
- Performance
- Flexibility
- Maintainability

Retry

Benefits of Retry

Improved Reliability

Benefits of Retry

Improved Reliability

Fault Tolerance

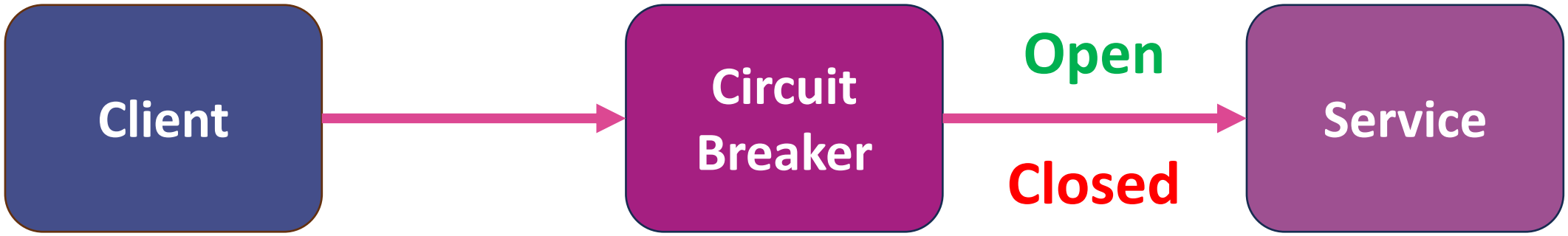
Benefits of Retry

- Improved Reliability
- Fault Tolerance
- Reduced Operational Overhead

Benefits of Retry

- Improved Reliability
- Fault Tolerance
- Reduced Operational Overhead
- Enhanced User Experience

Circuit Breaker



Benefits of Circuit Breaker

Fault Tolerance

Benefits of Circuit Breaker

Fault Tolerance

Load Management

Benefits of Circuit Breaker

Fault Tolerance

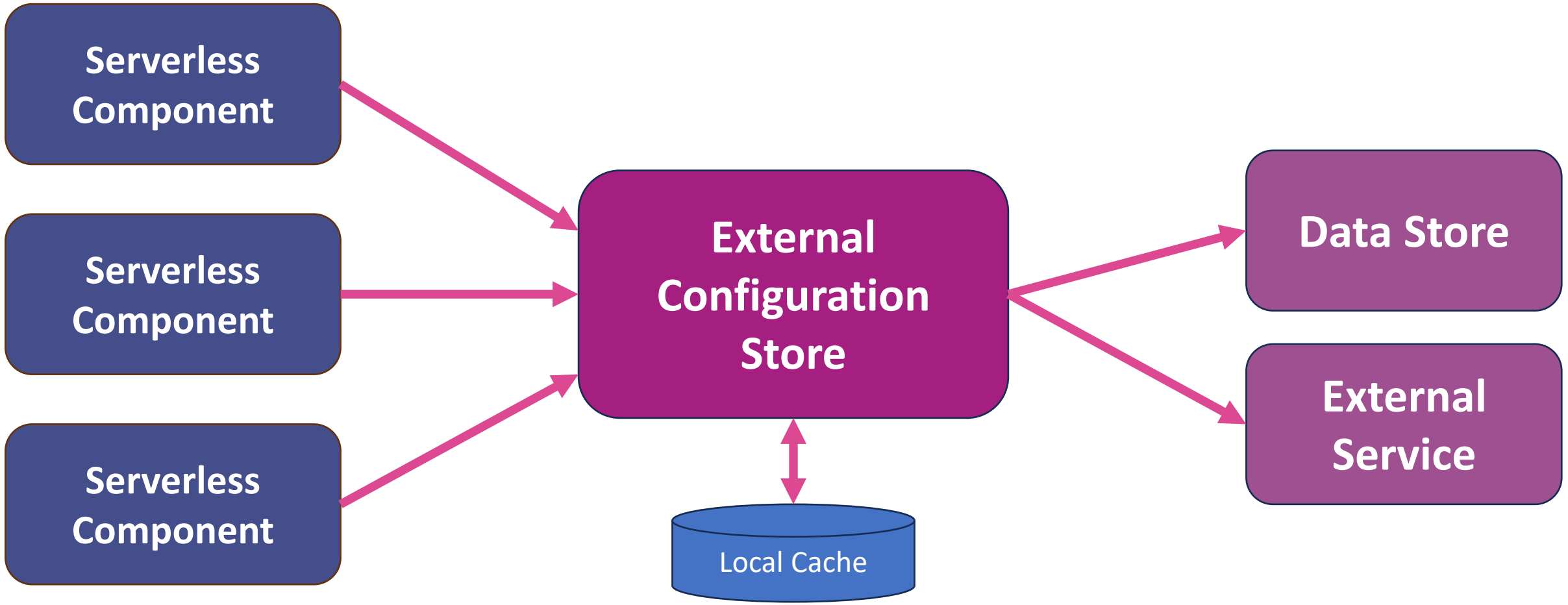
Load Management

Improved User Experience

Benefits of Circuit Breaker

- Fault Tolerance
- Load Management
- Improved User Experience
- Operational Insights

External Configuration



Benefits of External Configuration

Centralized Management

Benefits of External Configuration

Centralized Management

Dynamic Configuration Updates

Benefits of External Configuration

Centralized Management

Dynamic Configuration Updates

Enhanced Security

Benefits of External Configuration

- Centralized Management
- Dynamic Configuration Updates
- Enhanced Security
- Scalability and Performance

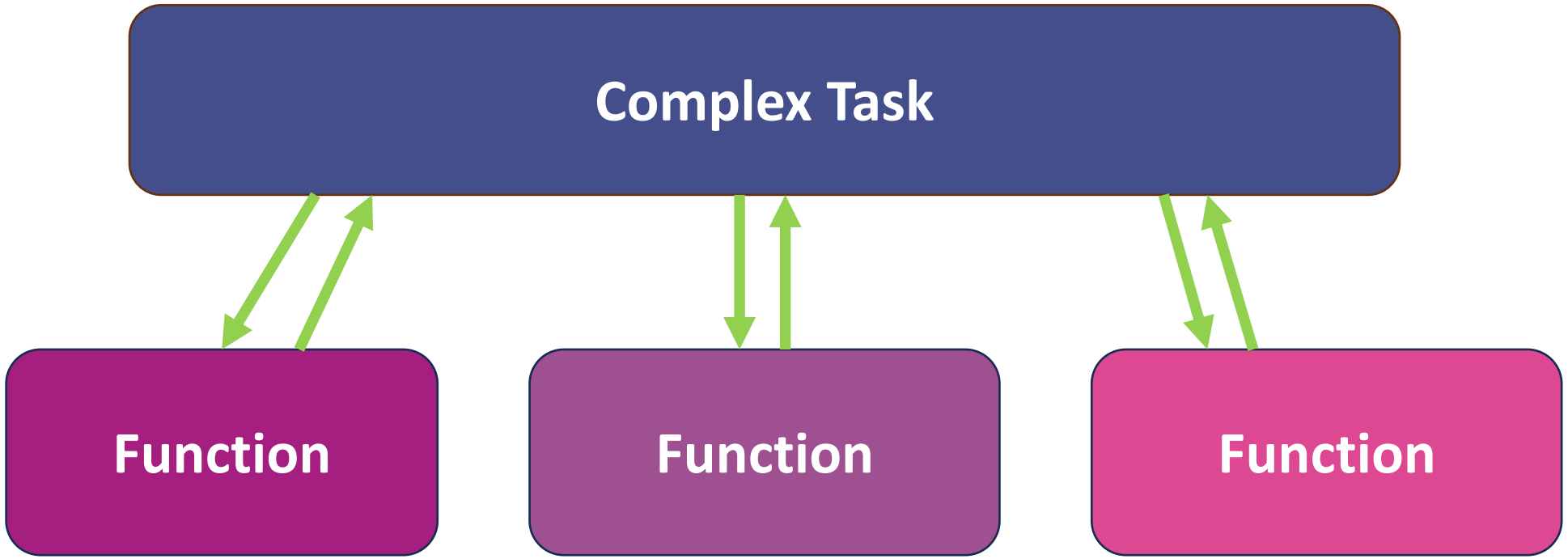
Other Cloud Design Patterns

- Ambassador
- Anti-Corruption Layer
- Asynchronous Request-Retry
- Backends for Frontends
- Bulkhead
- Cache-Aside
- Choreography
- Claim Check
- Compensating Transactions
- Competing Consumers
- Compute Resource Consolidation
- Deployment Stamps
- Edge Workload Configuration
- Federated Identity
- Gatekeeper
- Gateway Aggregation
- Gateway Offloading
- Gateway Routing
- Geode
- Health Endpoint Monitoring
- Index Table
- Leader Execution
- Materialized View
- Pipes and Filters
- Priority Queue
- Publisher/Subscriber
- Queue-Based Load Balancing
- Rate Limiting
- Saga
- Scheduler Agent Supervisor
- Sequential Convoy
- Sharding
- Static Content Hosting
- Stranger Fig
- Throttling
- Valet Key

Software Design Patterns

Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

Function Composition



Benefits of Function Composition

Modularity

Benefits of Function Composition

Modularity

Scalability

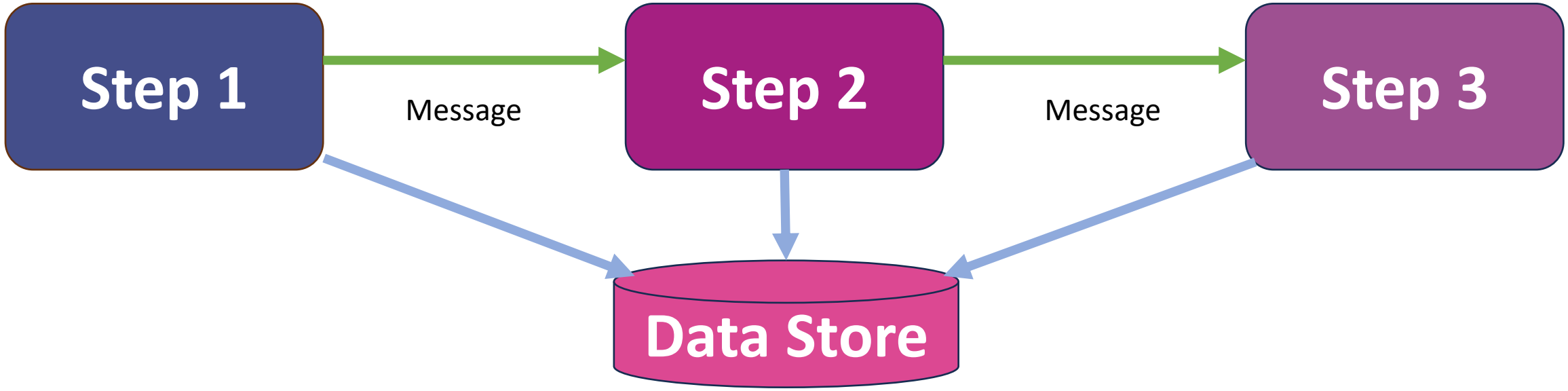
Benefits of Function Composition

- Modularity
- Scalability
- Flexibility

Benefits of Function Composition

- Modularity
- Scalability
- Flexibility
- Testability

Saga Pattern



Benefits of Saga Pattern

Transactional Integrity

Benefits of Saga Pattern

Transactional Integrity

Fault Tolerance

Benefits of Saga Pattern

Transactional Integrity

Fault Tolerance

Scalability

Benefits of Saga Pattern

- Transactional Integrity
- Fault Tolerance
- Scalability
- Flexibility

Event Driven Pattern

Benefits of Event-Driven Pattern

Loose Coupling

Benefits of Event-Driven Pattern

Loose Coupling

Scalability

Benefits of Event-Driven Pattern

- Loose Coupling
- Scalability
- Resilience

Benefits of Event-Driven Pattern

- Loose Coupling
- Scalability
- Resilience
- Flexibility

Asynchronous Messaging

Benefits of Asynchronous Messaging

Loose Coupling

Benefits of Asynchronous Messaging

Loose Coupling

Scalability

Benefits of Asynchronous Messaging

- Loose Coupling
- Scalability
- Reliability

Benefits of Asynchronous Messaging

- Loose Coupling
- Scalability
- Reliability
- Flexibility

Microsoft Azure Serverless Services

Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

Categories

Compute

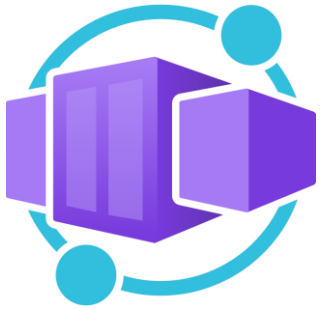
Workflow and Integration

Data Processing and Analytics

Messaging

Data Storage

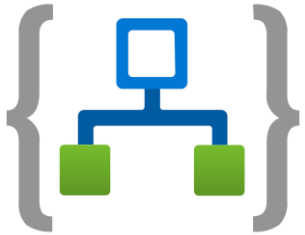
Compute



Azure Container Apps

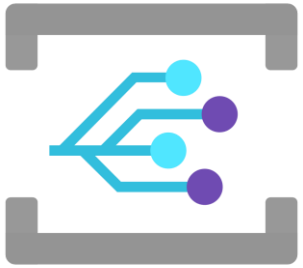
Azure Functions

Workflow and Integration



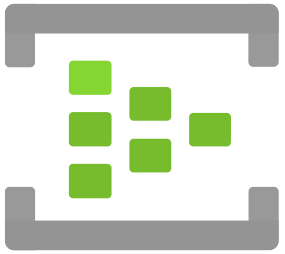
Azure Logic Apps

API Management



Azure Event Grid

Data Processing and Analytics



Azure Event Hubs

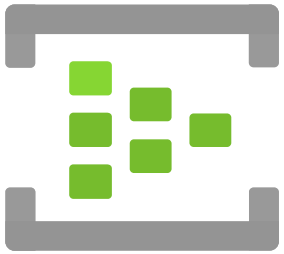
Azure Stream Analytics

Azure Synapse Analytics

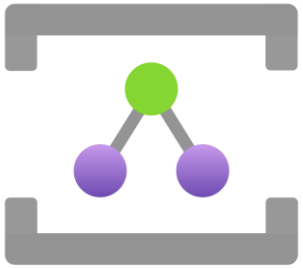
Azure Data Lake Analytics

Messaging

Azure Service Bus

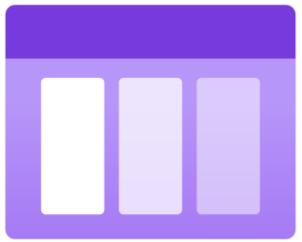


Azure Event Hubs



Azure Relays

Azure Event Grid



Azure Storage Queues

Data Storage

Azure SQL Database

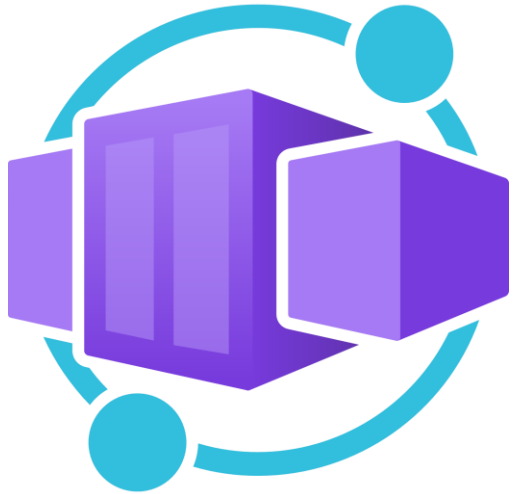
Azure Cosmos DB

Azure Storage

Azure Functions

- Asynchronous Request-Reply
- Backends for Frontends
- Compute Resource Consolidation
- Gatekeeper
- Messaging Bridge
- Pipes and Filters
- Publisher/Subscriber
- Queue-Based Load Balancing
- Retry
- Scheduler Agent Supervisor
- Throttling

Azure Container Apps

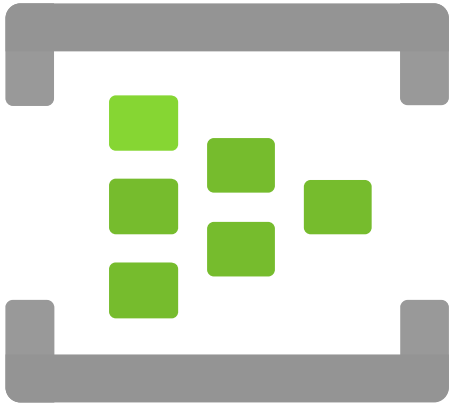


- Ambassador
- Backends for Frontends
- Bulkhead
- Circuit Breaker
- Gateway
- Gateway Aggregation
- Gateway Offloading
- Gateway Routing
- Pipes and Filters
- Sidecar
- Stranger Fig

Azure Service Bus

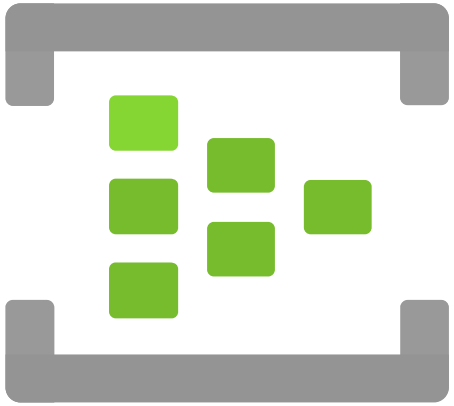
- Asynchronous Request-Reply
- Competing Consumers
- Event Sourcing
- Messaging Bridge
- Publisher/Subscriber
- Queue-Based Load Leveling
- Retry
- Saga
- Sequential Convoy

Azure Event Hubs



- Event Sourcing
- Messaging Bridge
- Publisher/Subscriber
- Queue-Based Load Leveling

Azure Event Grid



- Asynchronous Request-Reply
- Event Sourcing
- Messaging Bridge
- Publisher/Subscriber

Azure API Management

- Ambassador
- Anti-Corruption Layer
- Backends for Frontends
- Gatekeeper
- Gateway Aggregation
- Gateway Offloading
- Gateway Routing
- Pipe and Filters
- Static Content Hosting
- Valet Key

New and Upcoming Serverless Compute Enhancements

Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

Azure Functions on Azure Container Apps

Run Functions in Containers

Event-Driven Scaling

Open-Source Integration

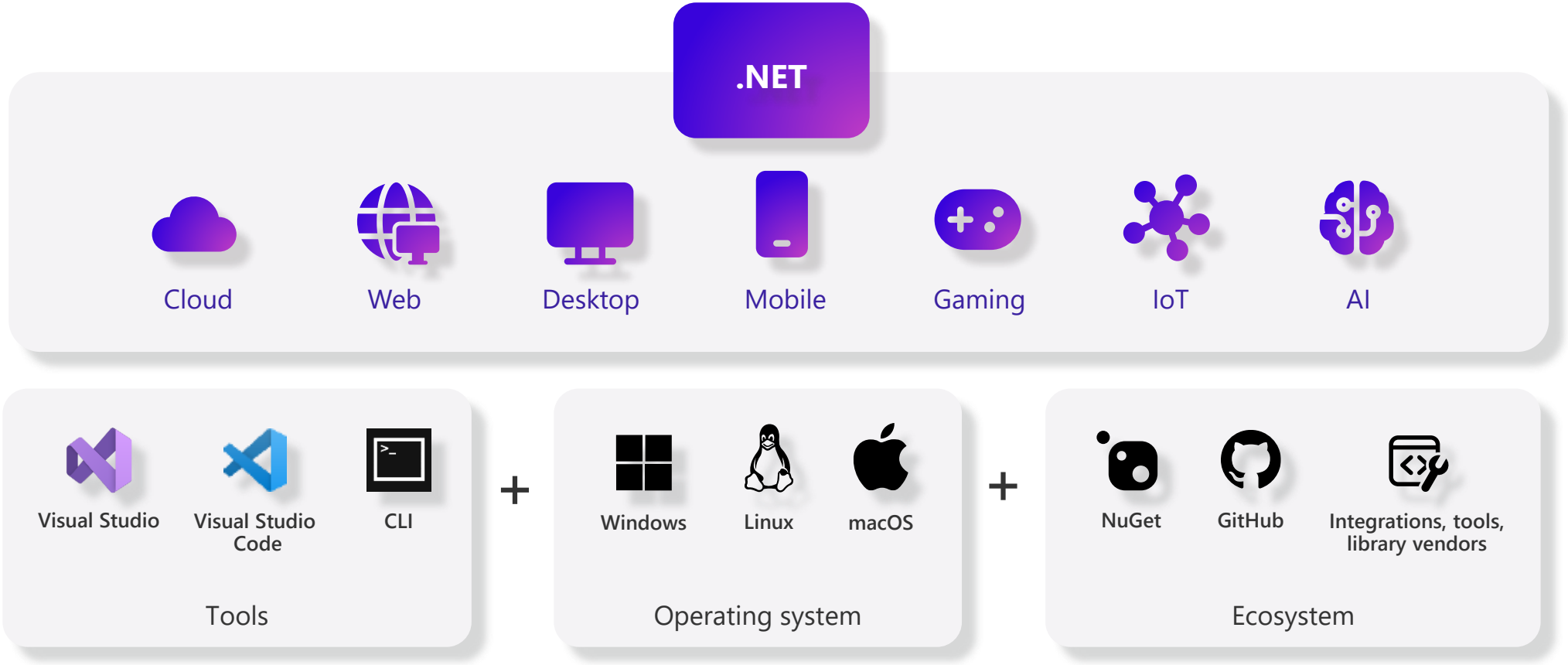
Flexible Deployment

Monitoring and Networking

Why Azure Functions on Azure Container Apps?

- Integration with Kubernetes
- Event-Driven Autoscaling
- Open-Source Tools
- Cost Efficiency
- Flexible Deployment

Building anything with a unified platform



What every app needs

Every App Needs

Observability

Resiliency

Scalability

Manageability

.NET 8 Includes

Observability

- **Built in metrics with dimensions**
- **DI integration for metrics**
- **Better Logging support** (faster, can object serialization)
- **Enrichment**
- **Redaction**
- **Testing fakes for Logging & Metrics**

Resiliency

- **New Polly based resiliency packages**
- **SignalR Stateful Reconnect**

Scalability

- **AOT** (increased density)
- **Performance**
- **Chiseled Ubuntu**

Manageability

- **Certificate auto-rotation support in Kestrel**

It’s still not easy

It’s Still Not Easy 😟

Complex

Getting Started

Choices

Paved Path

.NET Aspire

A cloud ready stack for building observable, production ready, distributed applications

.NET Aspire

A cloud ready stack for building observable, production ready, distributed applications

- Smart Defaults
- Developer Dashboard
- Orchestration
- Service Discovery
- Integrations
- Deployment

.NET Aspire

A cloud ready stack for building observable, production ready, distributed applications

- Smart Defaults
- Developer Dashboard
- Orchestration
- Service Discovery
- Integrations
- Deployment

.NET Aspire Service Defaults

Observability

Resiliency

Health Checks

.NET Aspire

A cloud ready stack for building observable, production ready, distributed applications

Smart Defaults

Developer Dashboard

Orchestration

Service Discovery

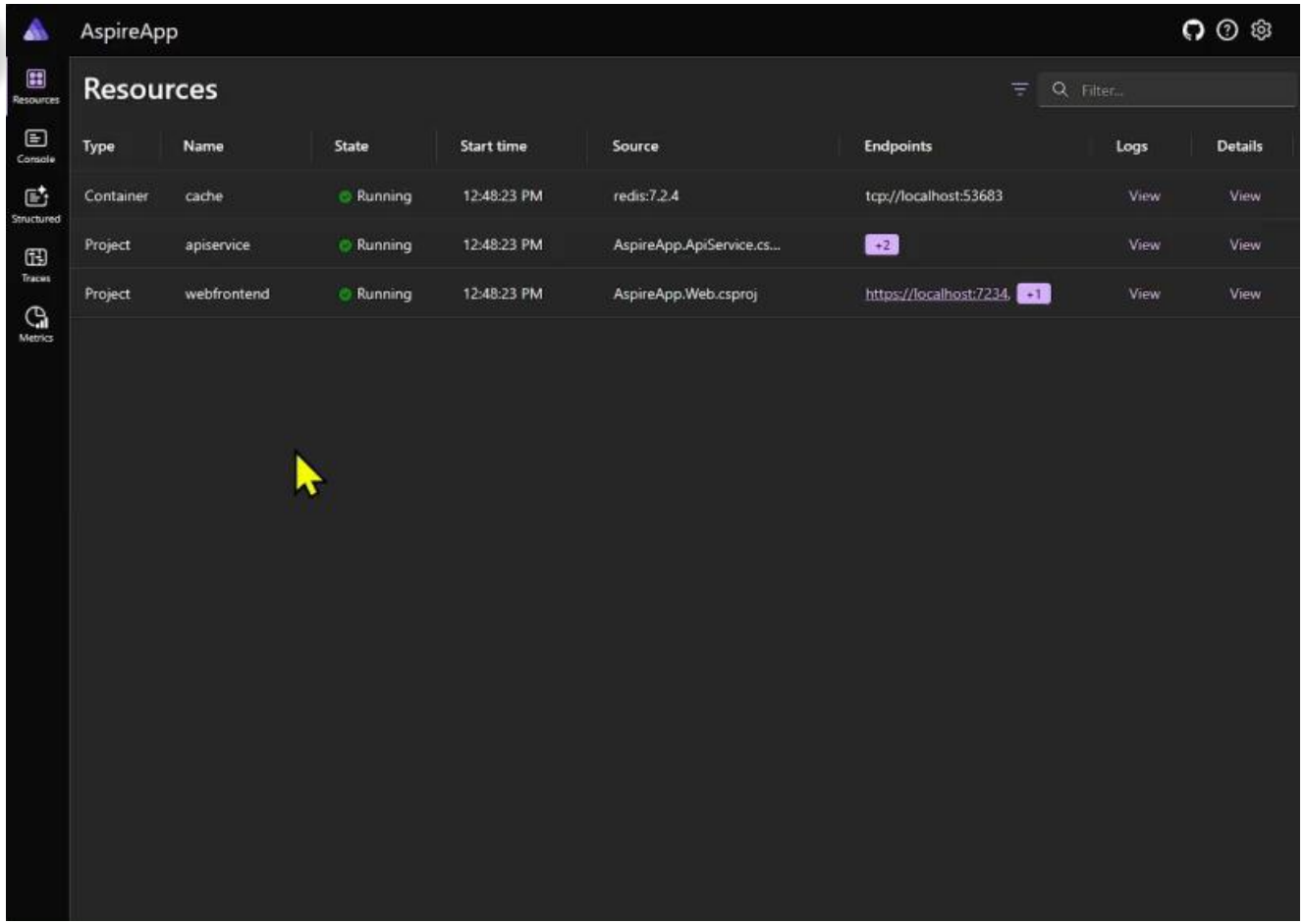
Integrations

Deployment

.NET Aspire

Developer Dashboard

- Structured Logs
- Metrics
- Distributed Traces
- Dependencies



.NET Aspire

A cloud ready stack for building observable, production ready, distributed applications

Smart Defaults

Developer Dashboard

Orchestration

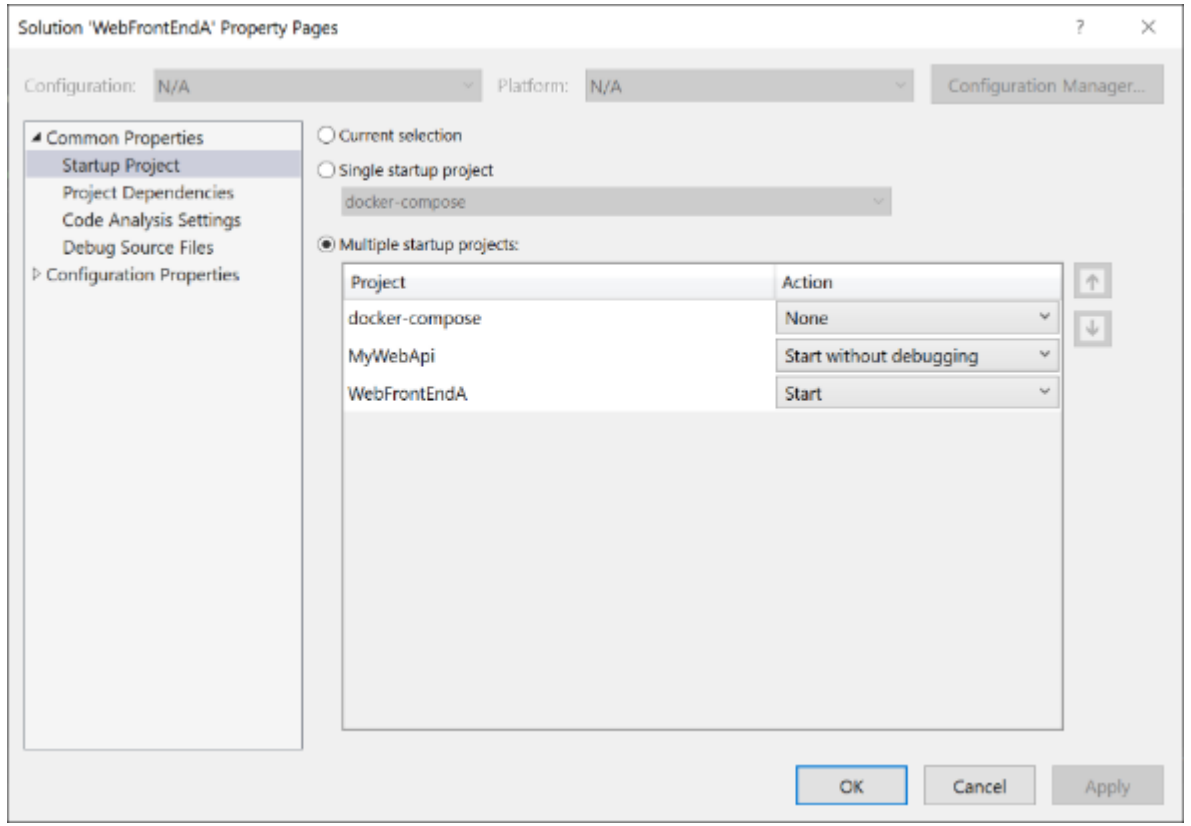
Service Discovery

Integrations

Deployment

Orchestration Before

```
{
    "version": "0.2.0",
    "compounds": [
        {
            "name": "Run all",
            "configurations": [
                "Run products",
                "Run store",
            ]
        }
    ],
    "configurations": [
        {
            "name": "Run products",
            "type": "dotnet",
            "request": "launch",
            "projectPath": "${workspaceFolder}\\Products\\Products.csproj"
        },
        {
            "name": "Run store",
            "type": "dotnet",
            "request": "launch",
            "projectPath": "${workspaceFolder}\\Store\\Store.csproj"
        }
    ]
}
```

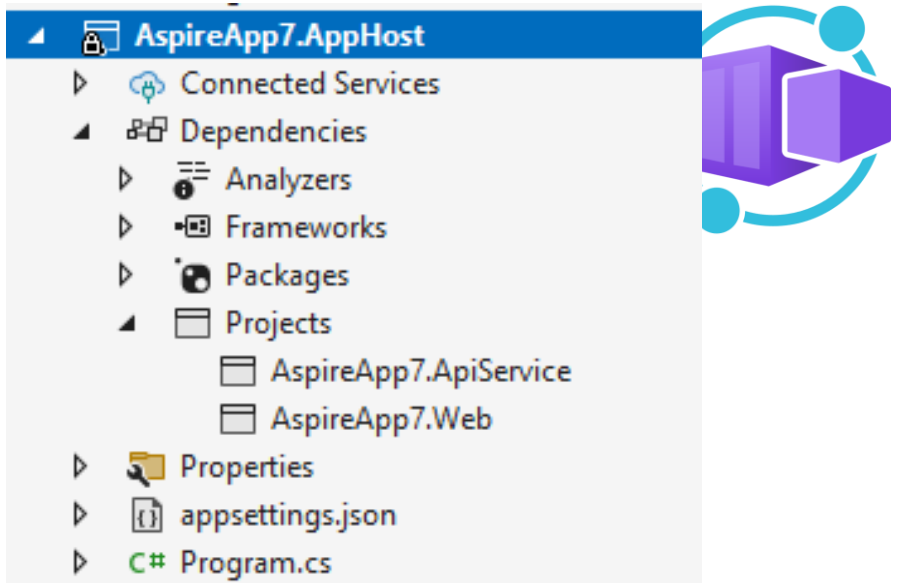


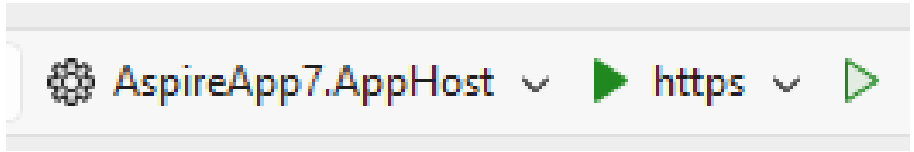
Orchestration with .NET Aspire

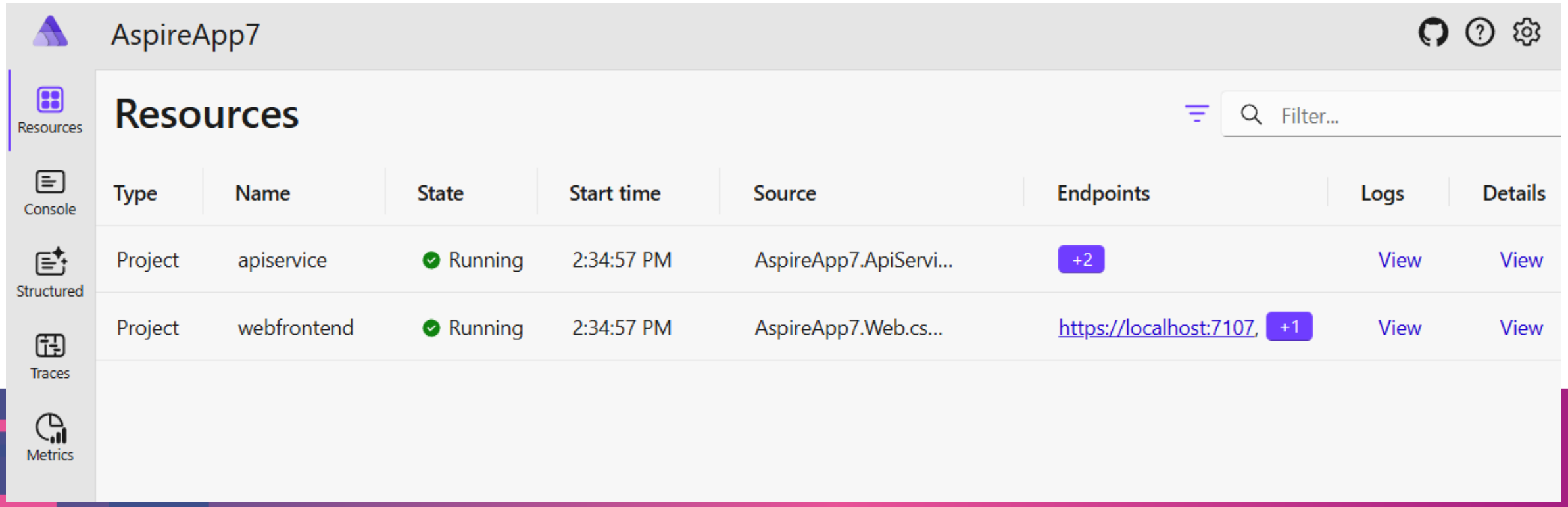
Orchestration

```
var builder = DistributedApplication.CreateBuilder(args);

builder.AddProject<Projects.ApiService>("apiservice");

builder.AddProject<Projects.Web>("webfrontend");

builder.Build().Run();
```

After with .NET Aspire







.NET Aspire

A cloud ready stack for building observable, production ready, distributed applications

Smart Defaults

Developer Dashboard

Orchestration

Service Discovery

Integrations

Deployment

Service Discovery Before

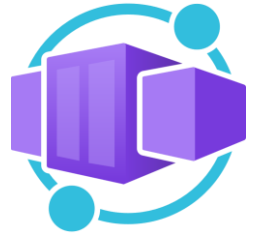
```
{
  "Logging": {
    "LogLevel": {
      "Default": "Information",
      "Microsoft.AspNetCore": "Warning"
    }
  },
  "AllowedHosts": "*",
  "ProductEndpoint": "http://localhost:5228",
  "ProductEndpointHttps": "https://localhost:7130"
}
```

```
builder.Services.AddHttpClient<ProductService>(c =>
{
    var url = builder.Configuration["ProductEndpoint"] ?? throw new
        InvalidOperationException("ProductEndpoint is not set");

    c.BaseAddress = new(url);
});
```

Service Discovery

```
var builder = DistributedApplication.CreateBuilder(args);


var apiService = builder.AddProject<Projects.ApiService>("apiservice");

builder.AddProject<Projects.Web>("webfrontend")
       .WithReference(apiService);

builder.Build().Run();
```

```
builder.Services.AddHttpClient<WeatherApiClient>(client =>
    {
        client.BaseAddress = new("https+http://apiservice");
    });
```



.NET Aspire

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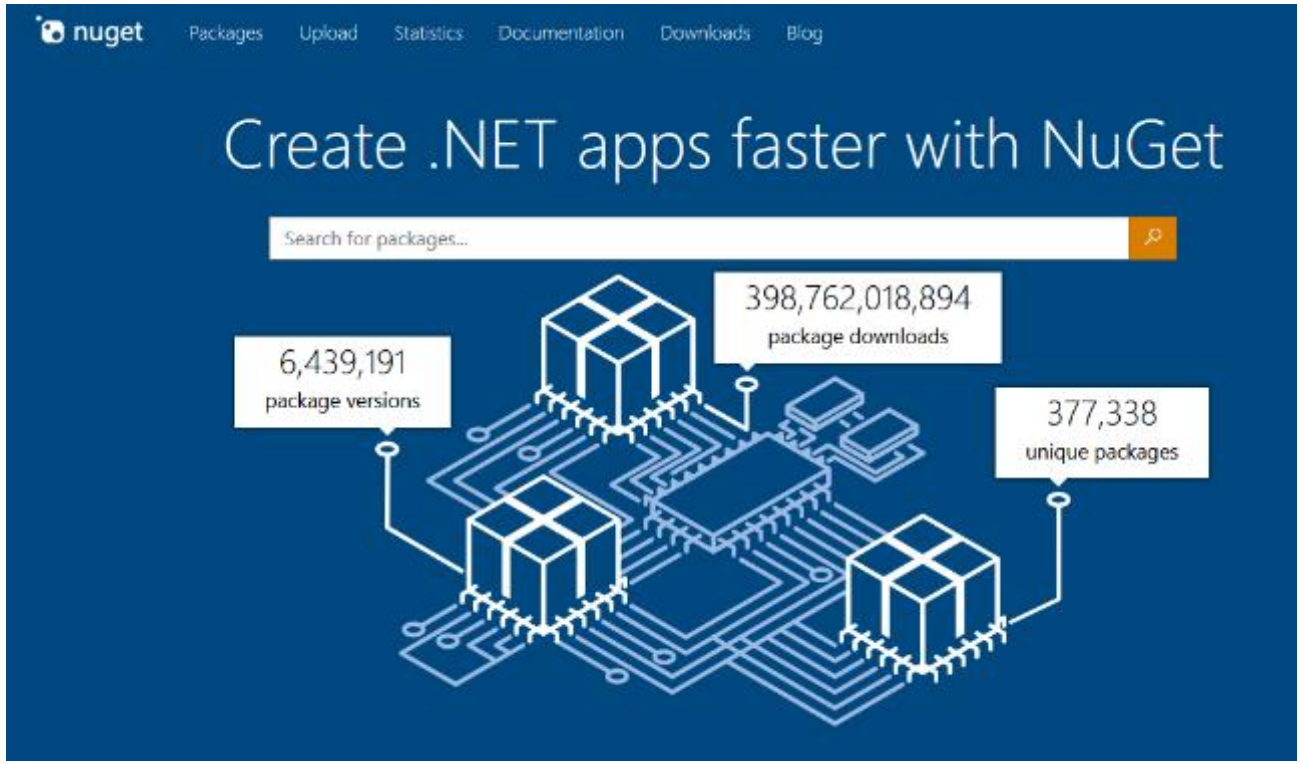
.NET Aspire

Integrations

redis

RabbitMQ



.NET Aspire

Hosting Integration

```
var builder = DistributedApplication.CreateBuilder(args);

var postgres = builder.AddPostgres("postgres").WithPgAdmin();
var db = postgres.AddDatabase("db");

var cache = builder.AddRedis("cache");

var apiService = builder.AddProject<Projects.ApiService>("apiservice")
                        .WithReference(db);

builder.AddProject<Projects.Web>("webfrontend")
       .WithReference(apiService)
       .WithReference(cache);

builder.Build().Run();
```

Automatically will pull down container image and start it in Docker or Podman!

.NET Aspire

Client Integration

```
var builder = WebApplication.CreateBuilder(args);

builder.AddServiceDefaults();
builder.AddRedisOutputCache("cache");

builder.Services.AddRazorComponents()
    .AddInteractiveServerComponents();

var app = builder.Build();

app.UseOutputCache();

app.MapRazorComponents<App>()
    .AddInteractiveServerRenderMode();

app.MapDefaultEndpoints();

app.Run();
```

Configures service with retries, corresponding health checks, logging, and telemetry!!!!

.NET Aspire

A cloud ready stack for building observable, production ready, distributed applications

Smart Defaults

Developer Dashboard

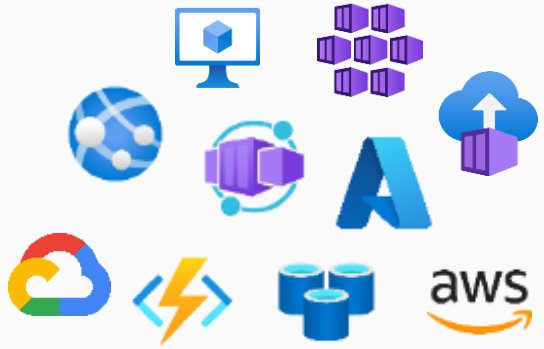
Orchestration

Service Discovery

Integrations

Deployment

Flexible Integrations & Deployment



How You Do It Today!

AWS CDK

Azure Dev CLI

Visual Studio

New and Upcoming Serverless Compute Enhancements

Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

Many Hosting Options

Consumption

Serverless

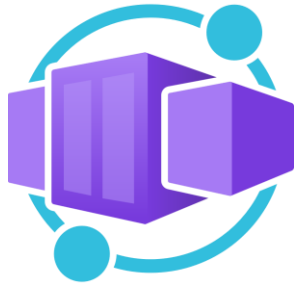
Premium

Sort of Serverless

Dedicated

App Service Plan

Container Apps



Consumption, Dedicated

App Service Environment

Network Isolation

Azure Stack

On Premises

Functions Runtime

Your Server

Azure IoT Edge

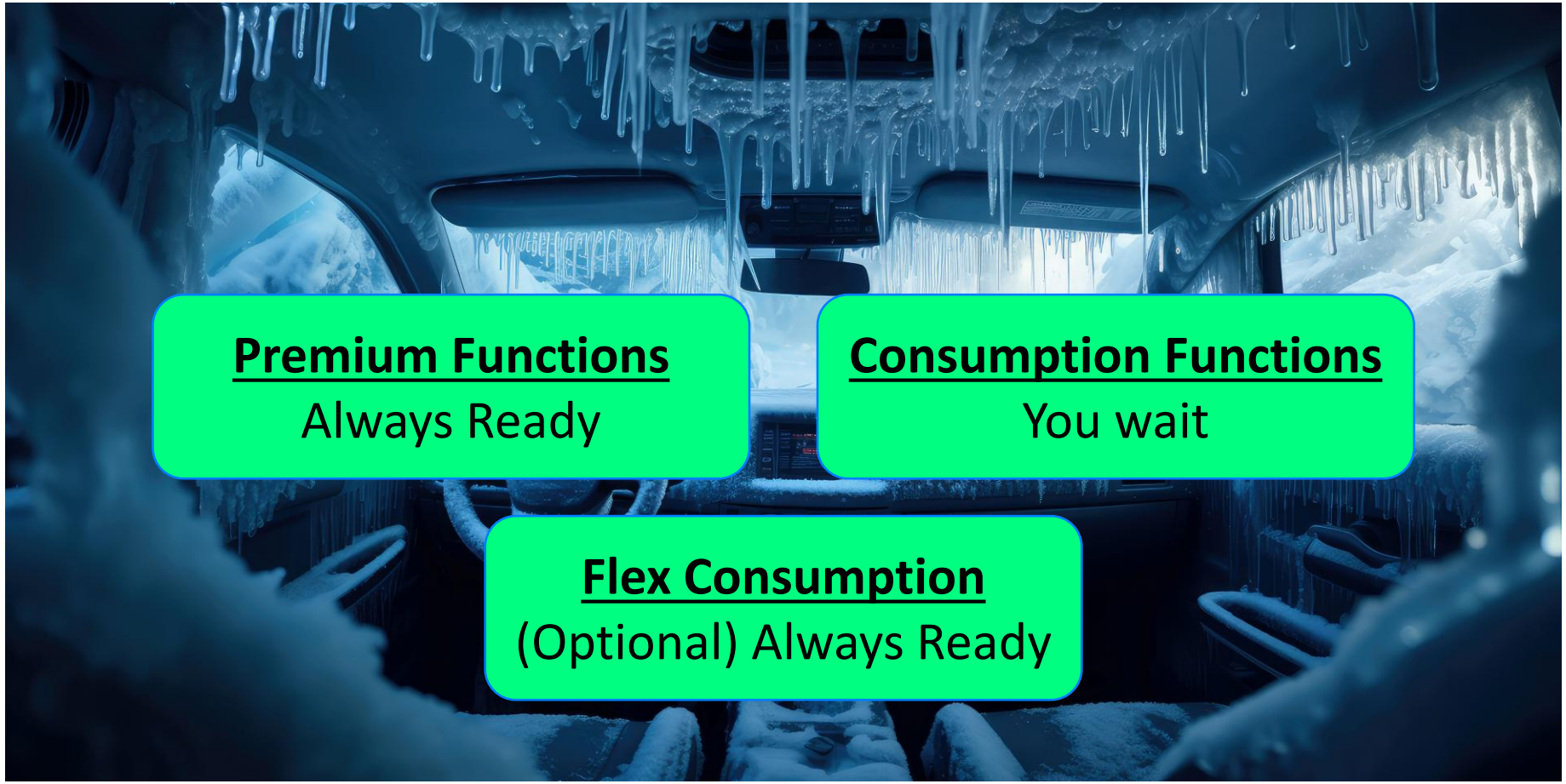
On Devices

Many Hosting Options

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

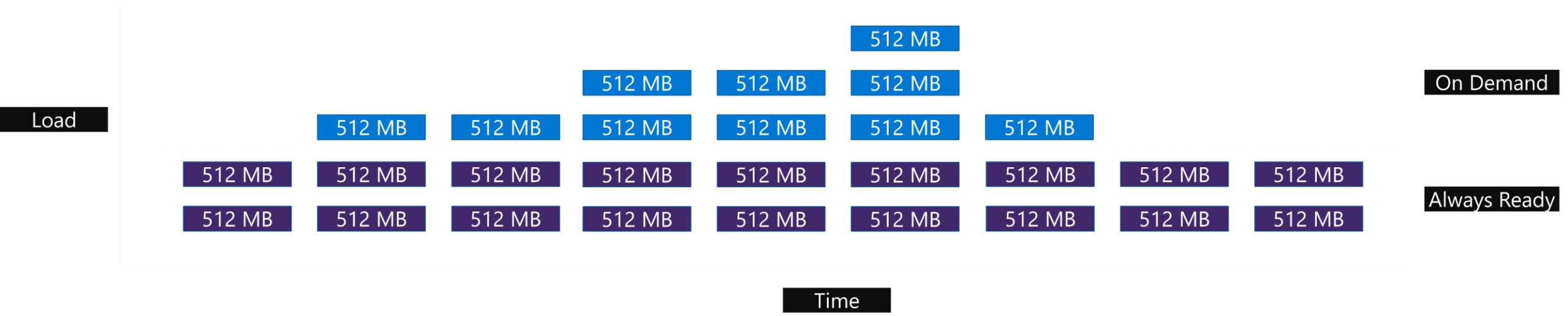
#1 Issue in Serverless: Cold Starts

#1 Issue in Serverless: Cold Starts

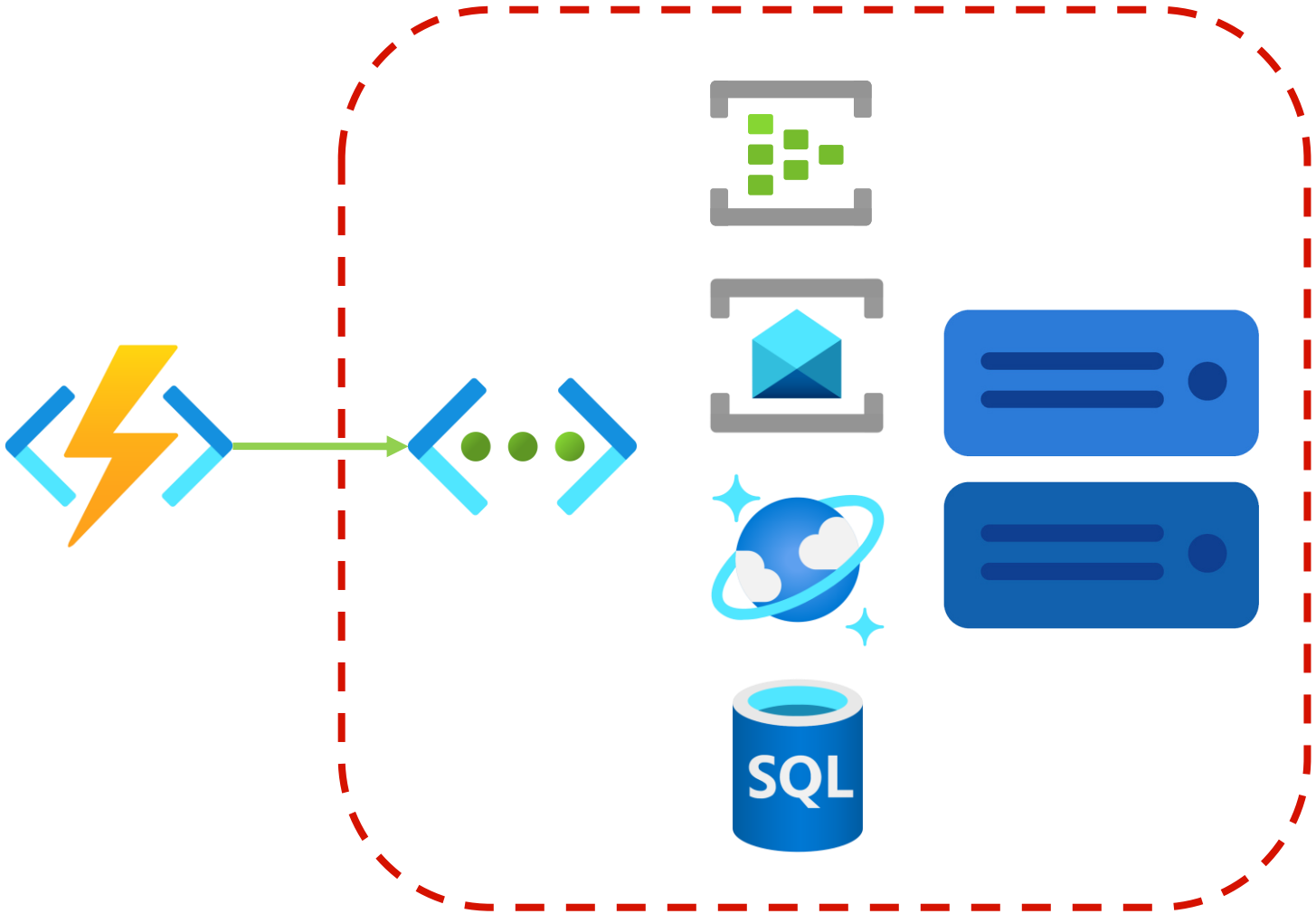


Always Ready Instances

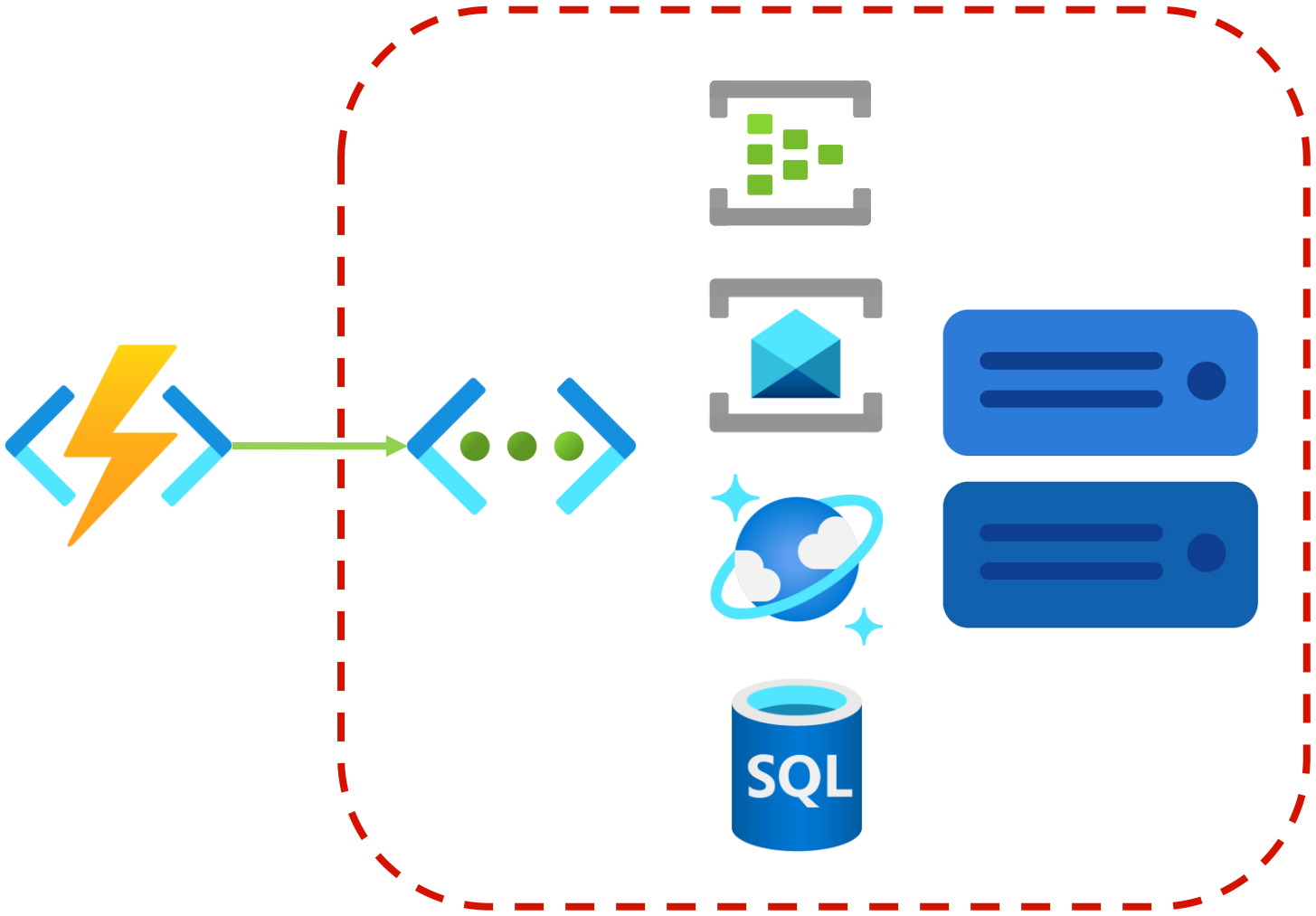
- Choose instances that are always running
- Set minimum number of instances always ready



Virtual Network Support



Virtual Network Support



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

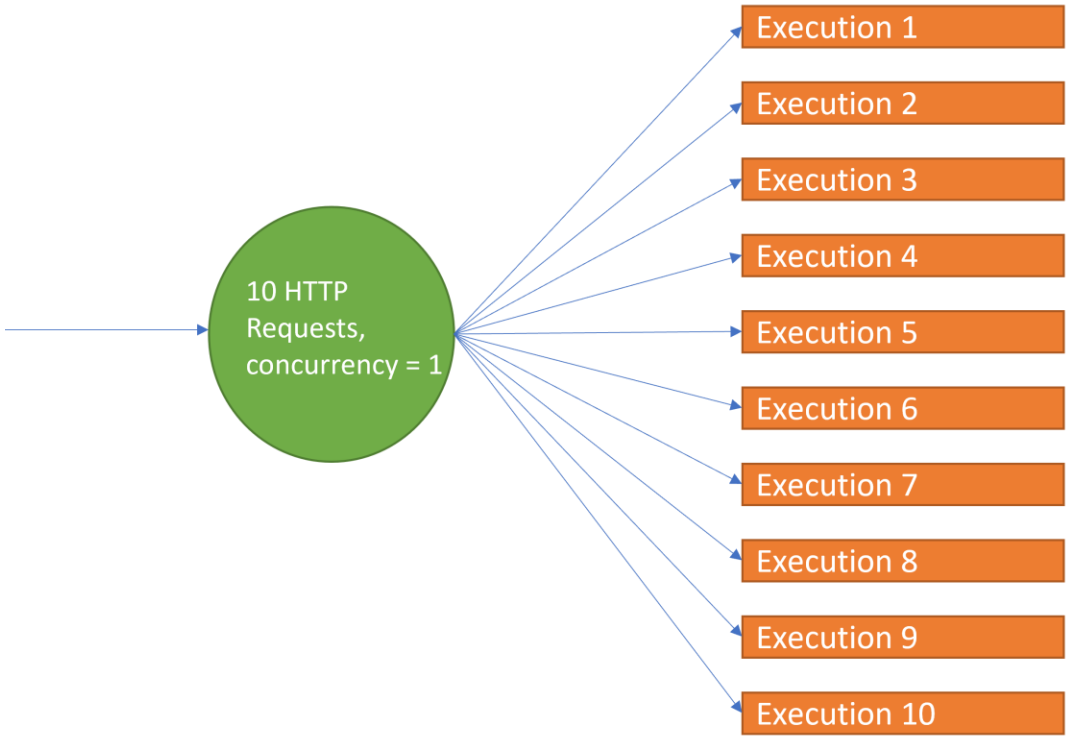
Instance Memory Choice

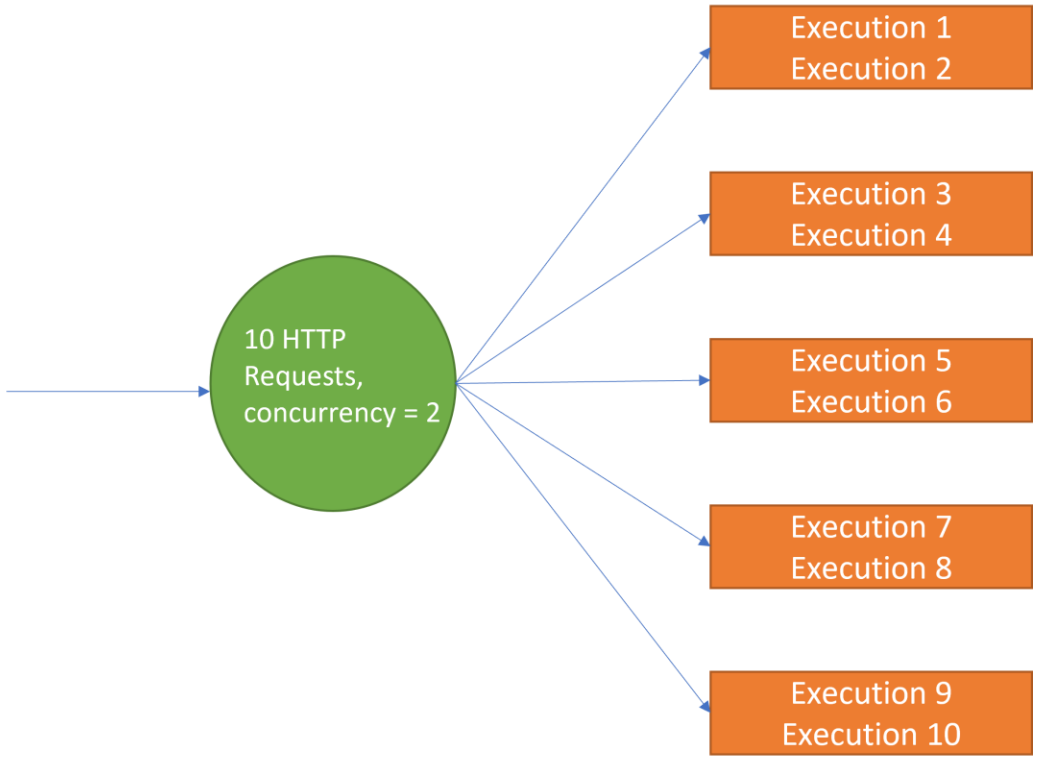
- 2048-Mb and 4096-Mb (more options coming)
- Default is 2048-Mb
- Change instance memory size at any time
- More memory means more can be done

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-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

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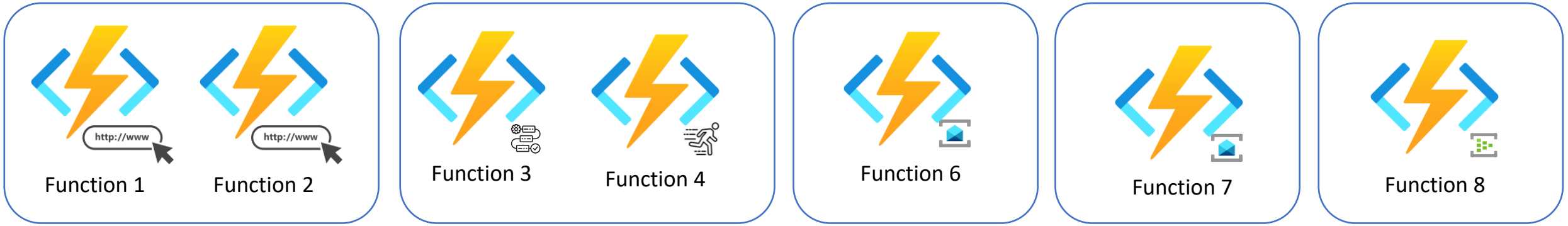
- No code changes
- Special cases: HTTP, Blob (Event Grid), and Durable trigger



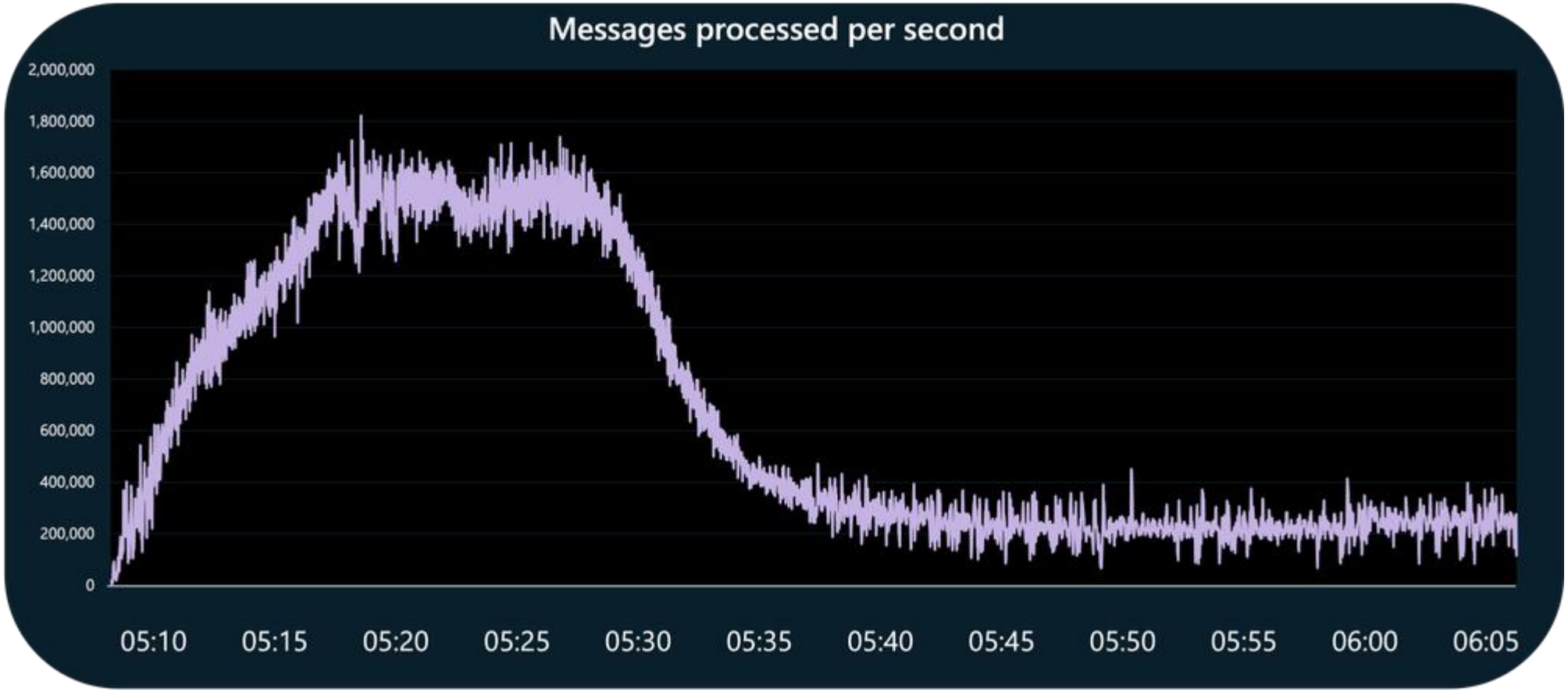
Scale Out Further

- Default is 100 instances
- Highest is 1000 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

Demonstration of Extreme Scalability using Azure Functions Flex Consumption

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

Pricing

My Standard Scenario

3 million executions per month; each execution using 512 Mb and running for 1 second

Consumption: $18.00

Pricing

Azure Function Scenario

3 million executions per month; each execution using 512 MB and running for 1 second

Consumption: $18.00

Premium: $155.27

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

Pricing

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

Pricing

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

Recap

Serverless Unleashed: From Design Patterns to Azure Solutions and Beyond

Recap

Serverless Architecture

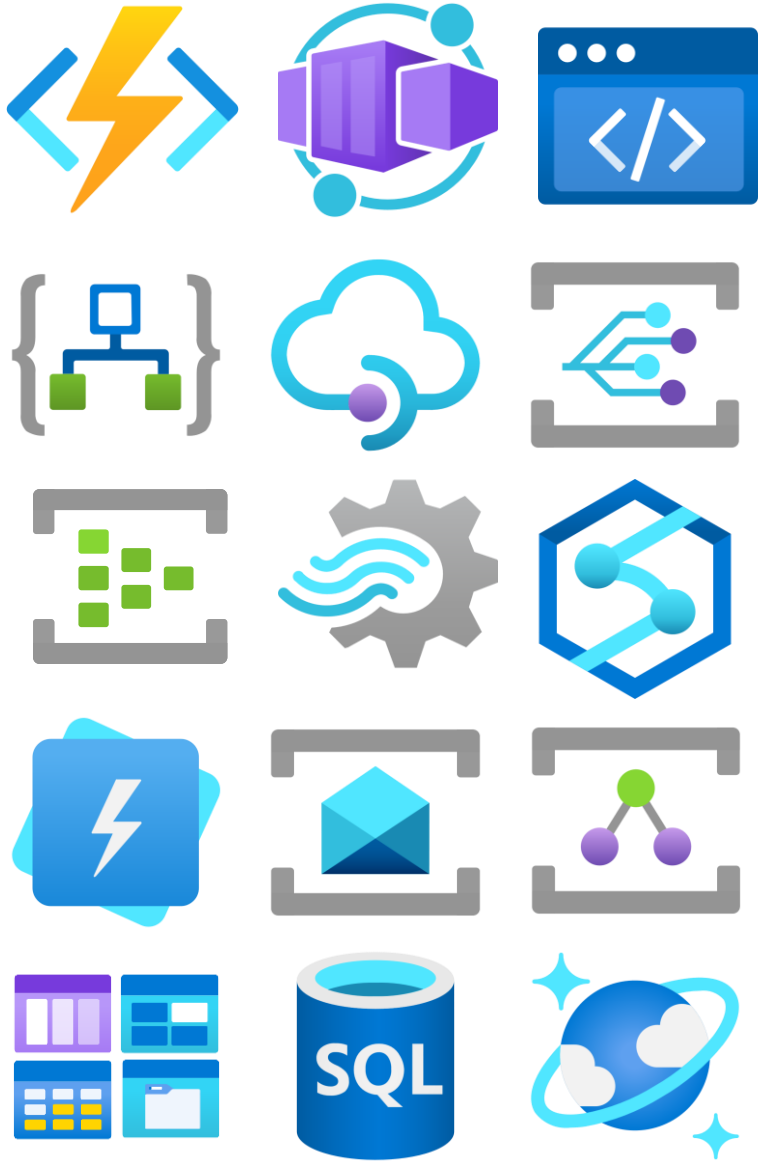
- Introduction to Serverless Computing
- Serverless Architecture Styles
- Cloud Design Patterns
- Software Design Patterns

Recap

Serverless Architecture

Azure Services Offerings

- Compute
- Workflow and Integration
- Data Processing and Analytics
- Messaging
- Data Storage



Recap

Serverless Architecture

Azure Services Offerings

What's New and Coming

- Azure Functions on Azure Container Apps
- .NET Aspire
- Azure Functions Flex Consumption

Thank You

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