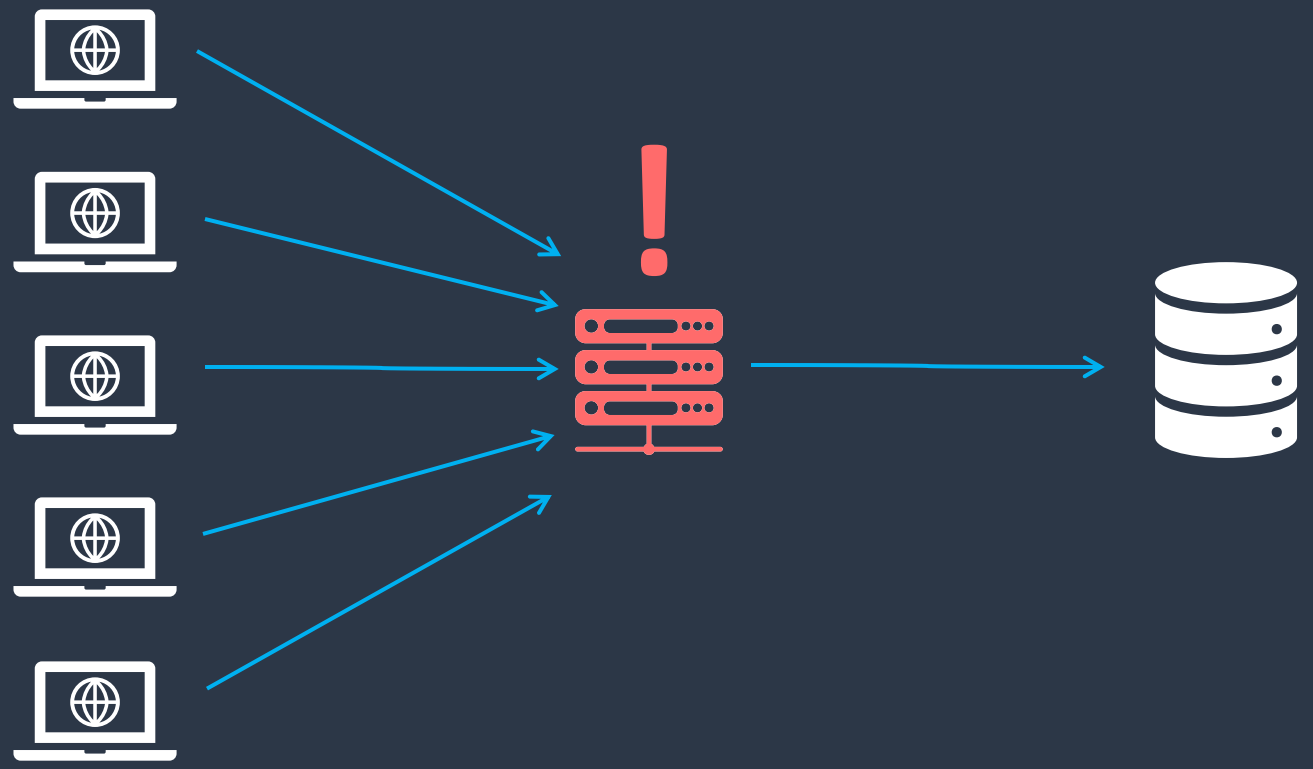
SQUER

# Building Event Driven Systems at Scale with Azure Cosmos DB

Cloud Native Linz

April 29th, 2025

# We‘re all good!



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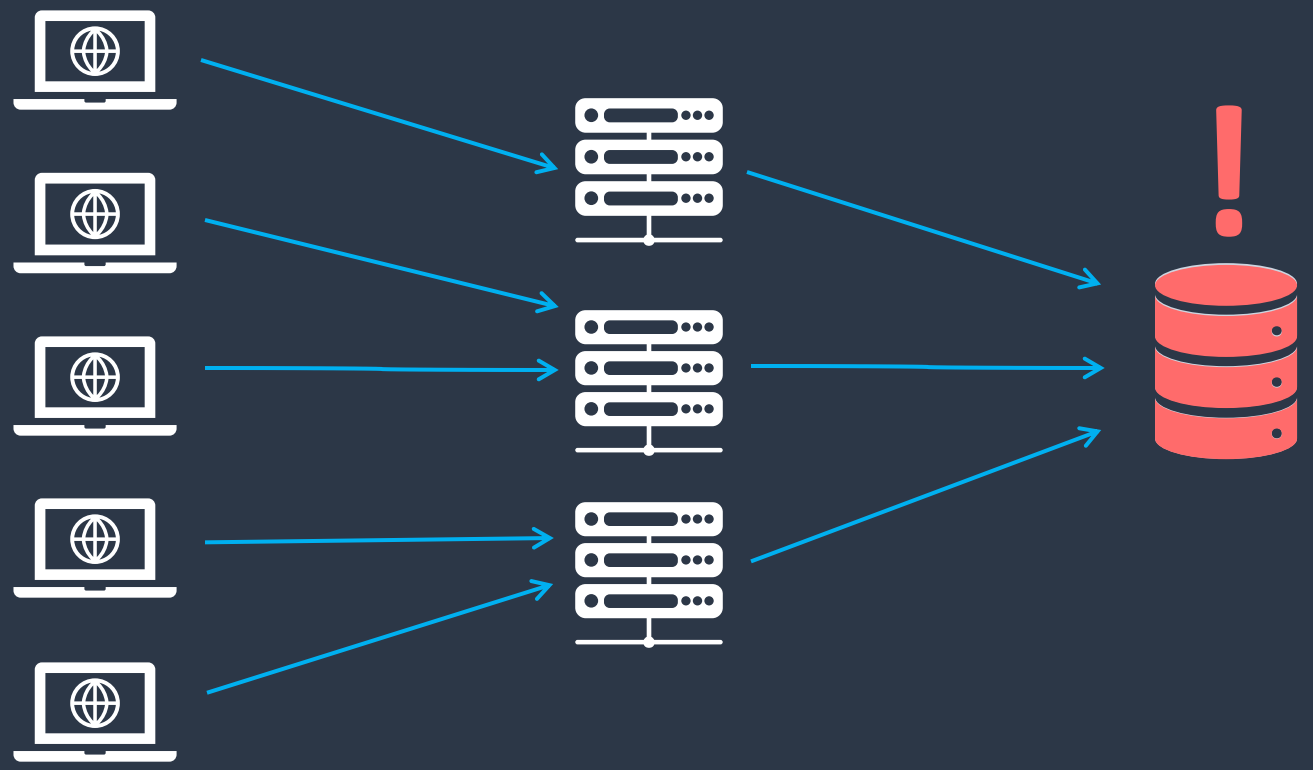

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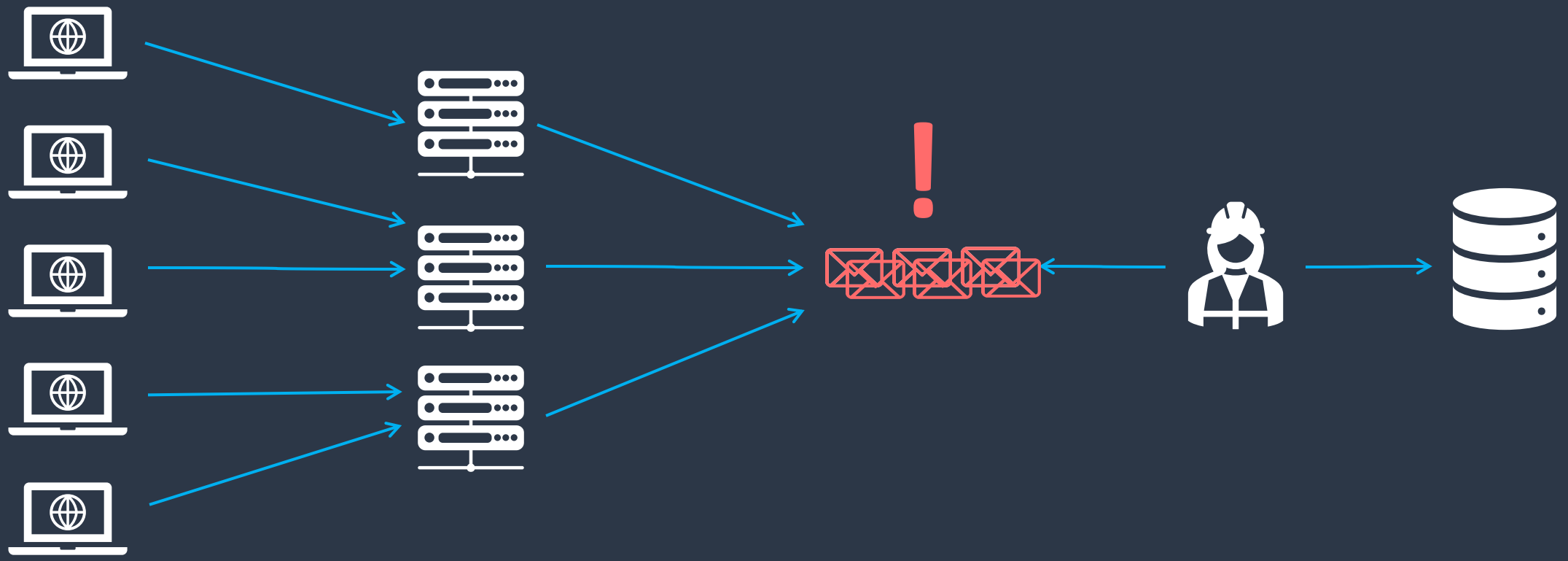

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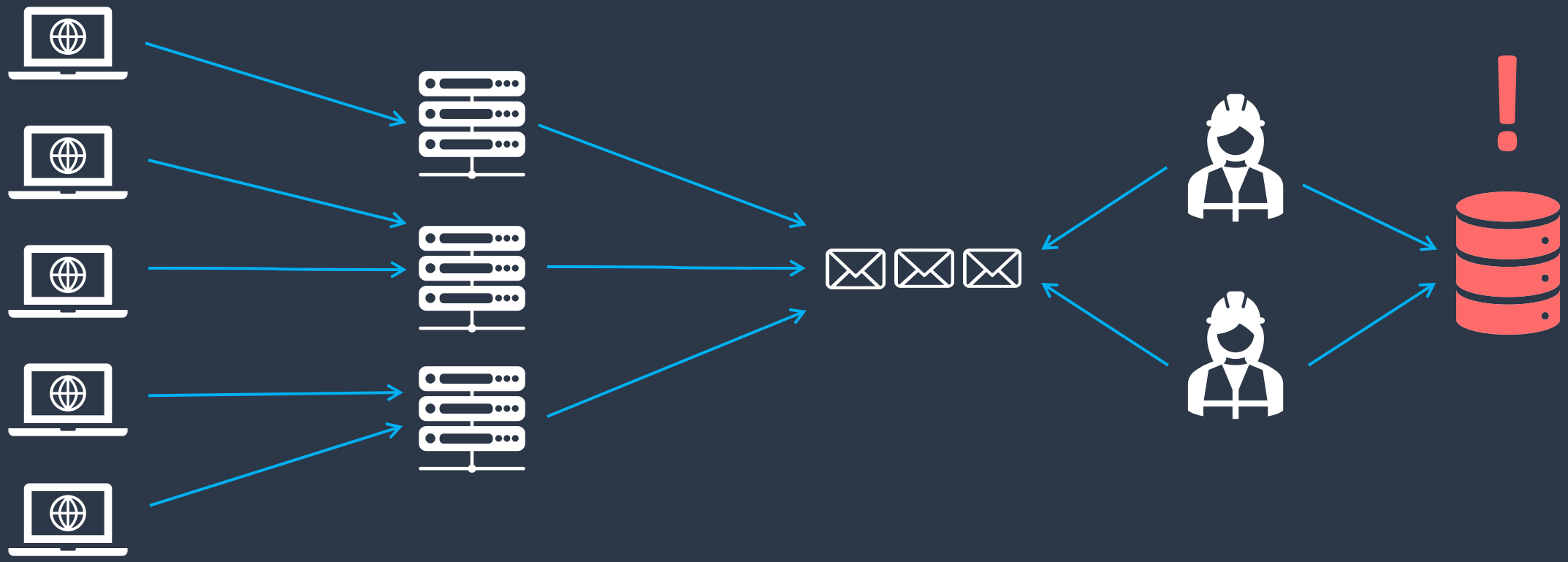


# In our hearts we are engineers.

*We believe in technology to make a difference, thinking outside the box to achieve highest impact and partnerships beyond project boundaries.*

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# > whoami

## Shahab Ganji

**Lead Coding Architect**

MAIN FOCUS ON

- Software Architecture
- Software Transformation
- .NET and C# enthusiast

TRIVIA

- Embracing Change
- Telling dad jokes (Proudly)
- Code Artisan

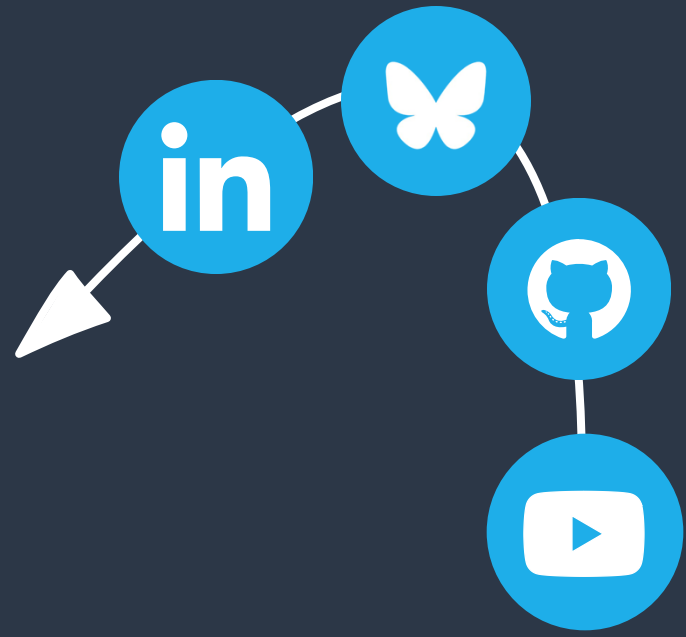
MORE SHAHAB

# Check my blog and get in touch:

Microsoft MSFarsi Community

Microsoft Zero To Hero

SHAHAB THE GUY




shahab-the-guy.dev

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INTRODUCTION

# What is an Event Driven Architecture?

- Has three main components
- Software components execute in response to events
- Uses events to communicate
- Promotes loose coupling

# Type of Events

## UNKEYED EVENT

- Describes an event as a singular statement of a fact


## ENTITY EVENT

- An entity is a unique thing and is keyed on the unique id of the thing
- Describes the properties and state of the entity at a given point in time

## KEYED EVENT

- Contains a key, but does not represent an entity
- Used for partitioning the stream of events to guarantee data locality within a single partition of an event stream

# Events vs Commands

## EVENTS

- It’s a fact, already happened
- It’s over publish-subscribe channel
- The sender owns the contract
- Zero or many consumers
- One sender
- Described in past tense

## COMMANDS

- Invokes a behavior
- It’s usually point-to-point
- The receiver owns the contract
- One consumer
- Many senders
- Describe as an imperative verb

# Related Patterns

## CQRS

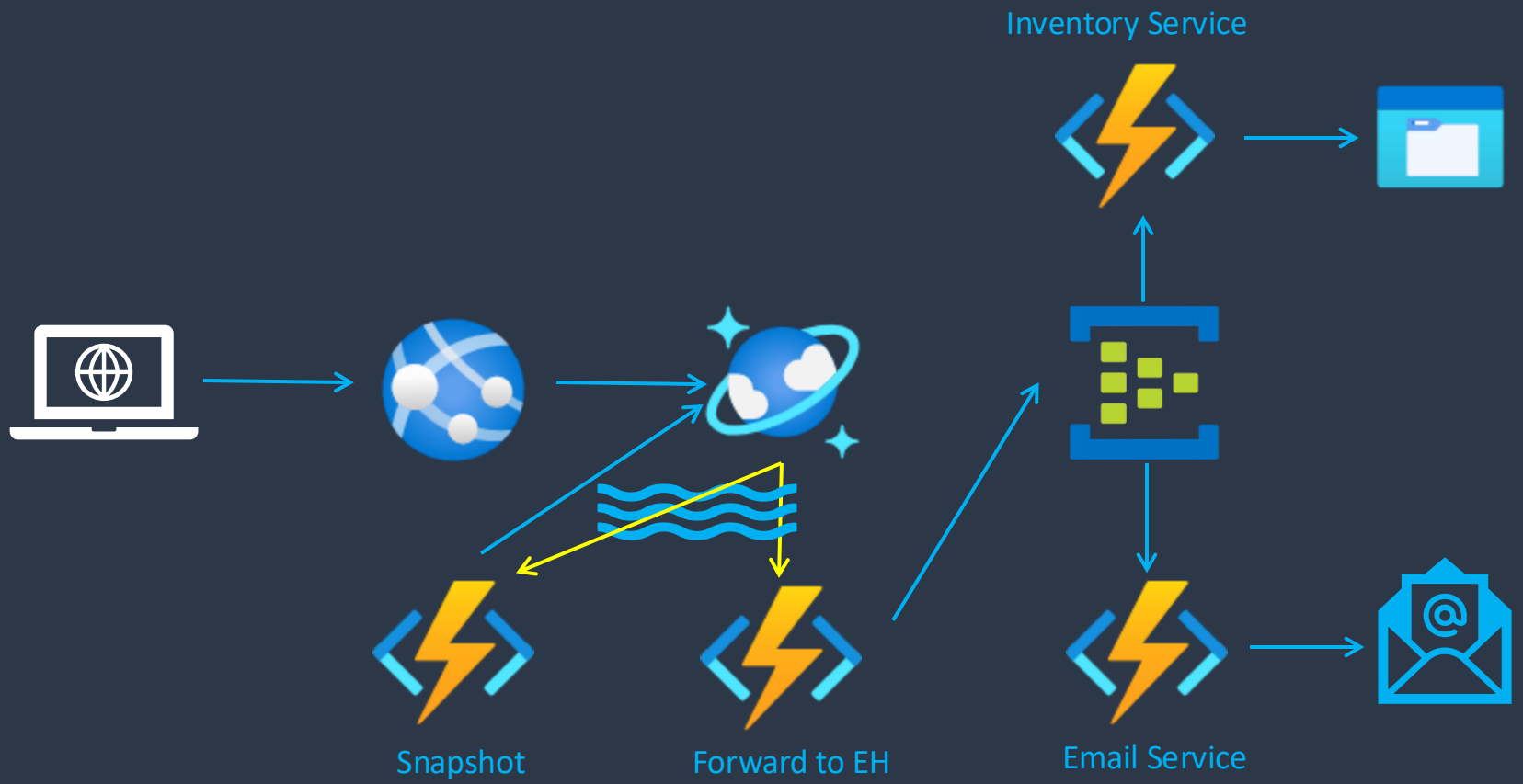
- Separate read and write models
- Enables optimized performance and scalability

## EVENT SOURCING

- Captures every change to the state
- Provides full audit trail
- Easier handling of complex transactions
- Replay what has happened in the system

https://lostechies.com/jimmybogard/2012/08/22/busting-some-cqrs-myths

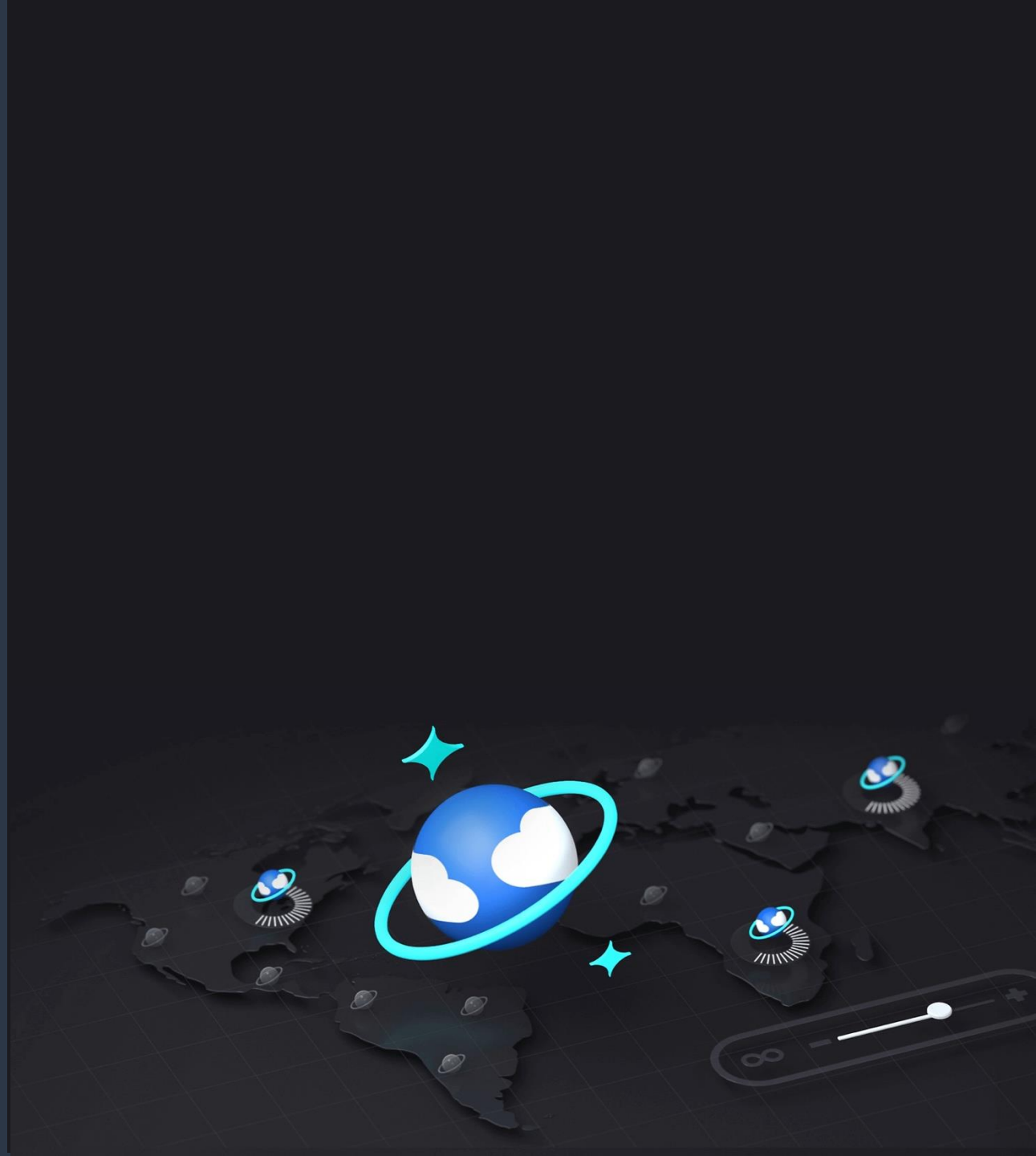
# Event Streams



AZURE COSMOS DB

# Schema free, NoSQL Cloud Solution

- Globally Distributed
- Horizontally Scalable
- Provisioned throughput
- Multi model database



SCALABILITY

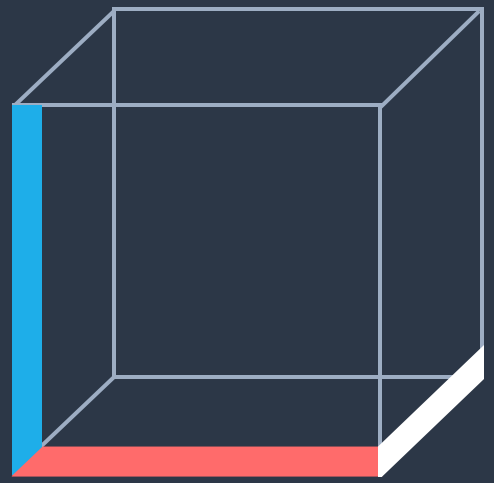
# 3 Dimensions of scaling

## 1

### DATABASE PER APPLICATION

Y axis – Functional Decomposition

Scale by splitting different things

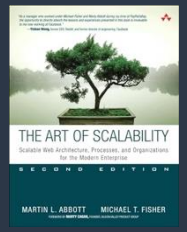


## 3

### SHARDING

z axis – data partitioning

Scale by splitting similar things




https://microservices.io/articles/scalecube.html

## 2

### REPLICATION

x axis – horizonal decomposition

Scale by cloning

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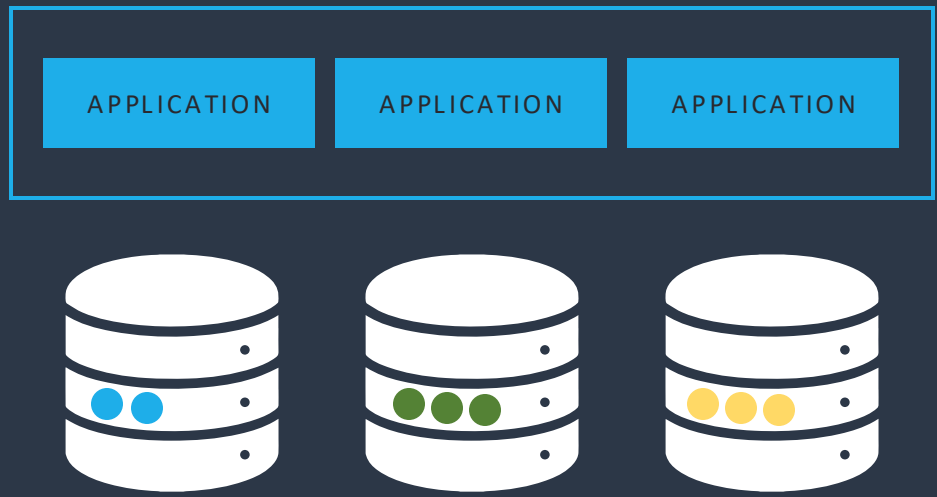
SCALABILITY

# Sharding

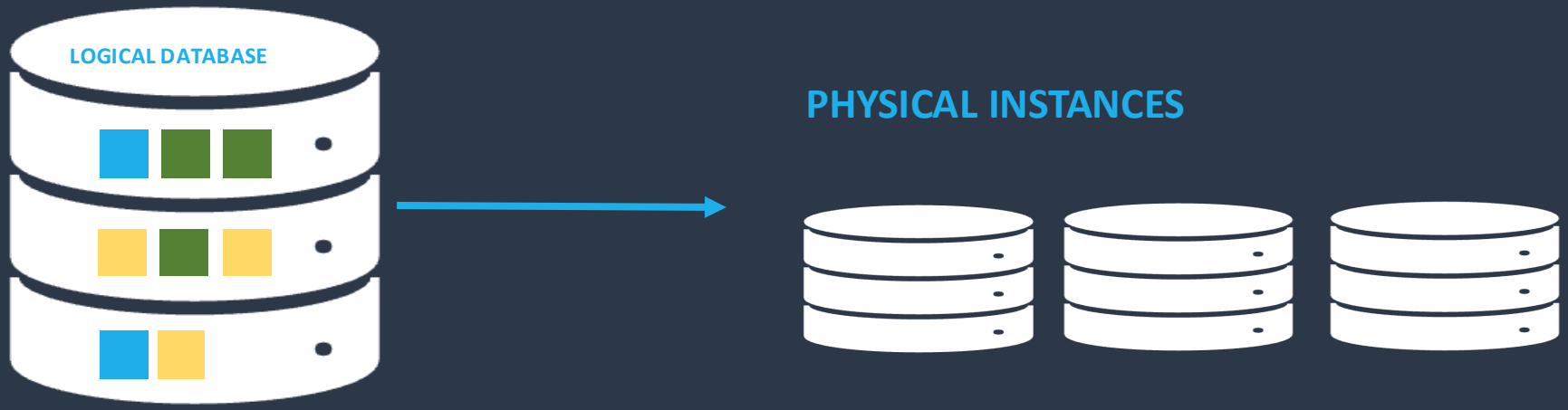
A single logical database

Cluster of databases

Nodes have different data



# Sharding – Database Level



# Sharding – Database Level

SCALABILITY

# Sharding – Database Level

LOGICAL DATABASE

PHYSICAL INSTANCES

SCALABILITY

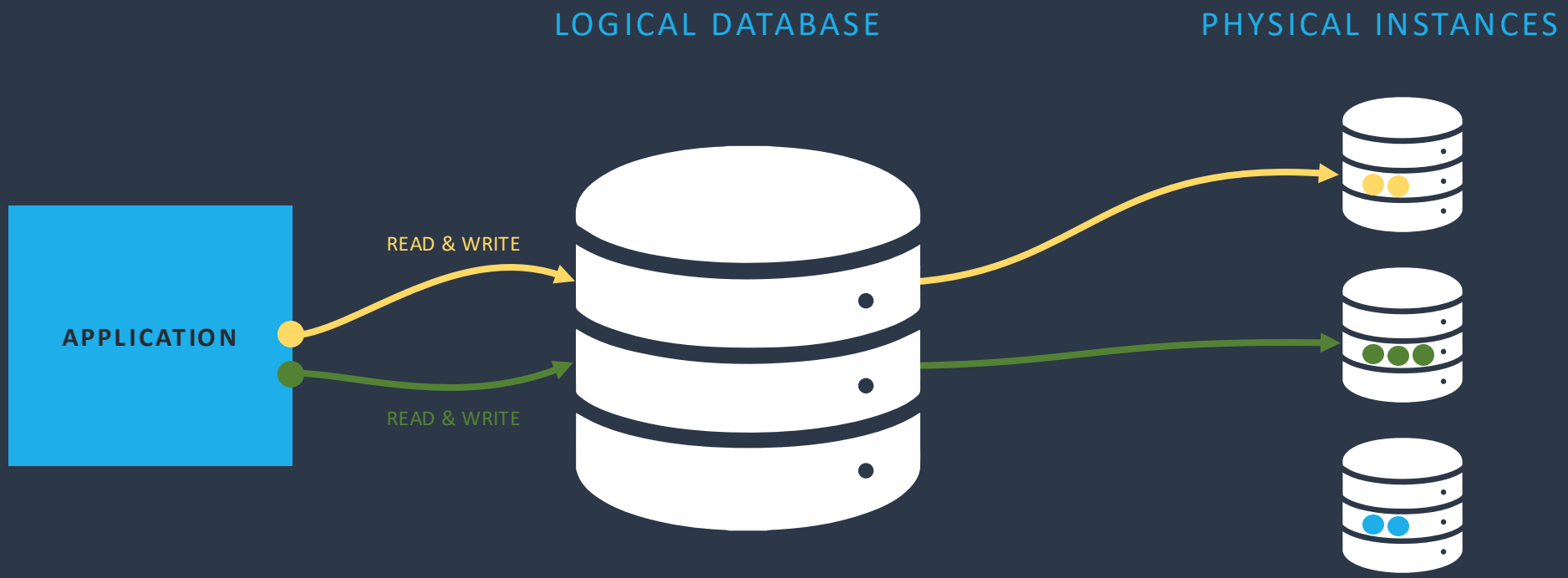
# Sharding – Database Level

LOGICAL DATABASE

PHYSICAL INSTANCES

SCALABILITY

# Sharding – Database Level

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SCALABILITY

# Advantages

- Each Server deals with a subset of data
- Improves transaction scalability
- Fault Isolation
- Cache Utilization
- Reduces Memory & I/O usage

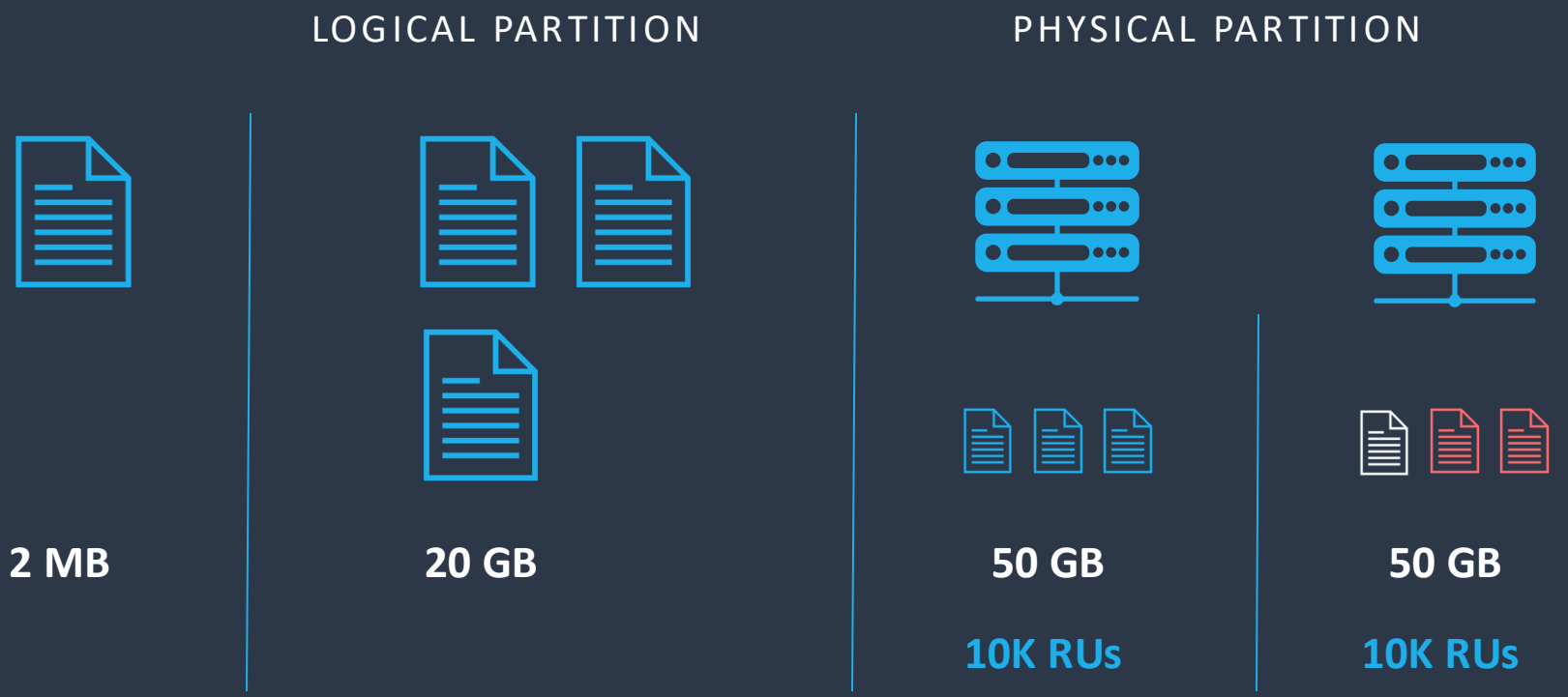
SCALABILITY

# Disadvantages

- Increased application complexity
- Design a Partition Schema
- Re-partitioning
- Improper Traffic Distribution
- Performance Issues with Queries – Cross Partition

AZURE COSMOS DB

# Containers, Partitions, Request Units

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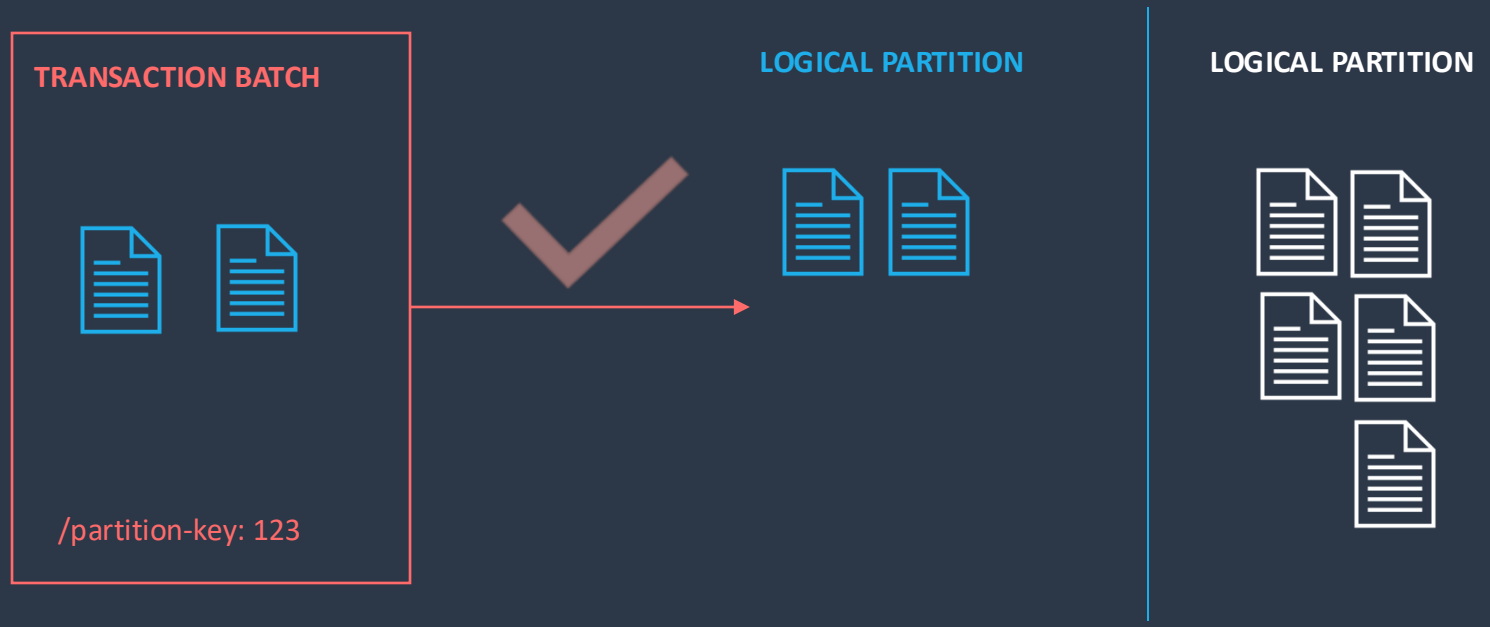
# Transaction Scope



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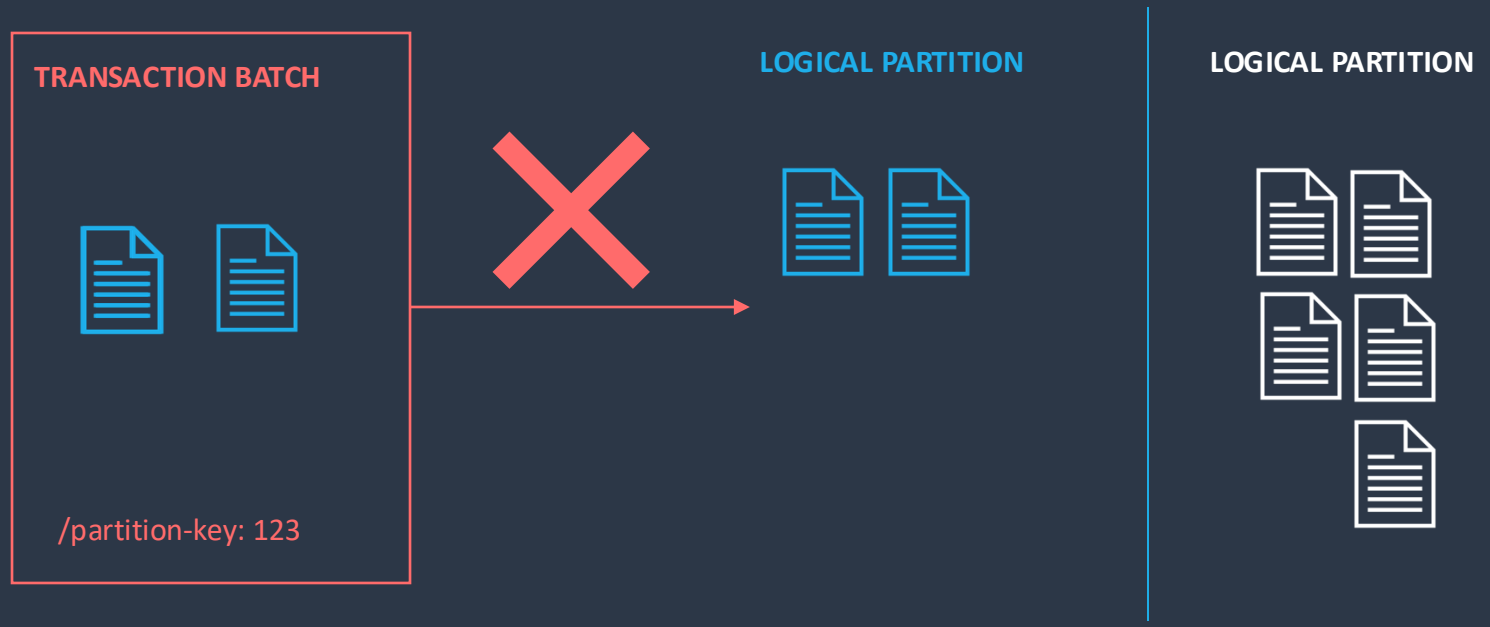
# Transaction Scope



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# Dual Write Problem – Zombie Records

```
public async Task<CreateOrderResult> Handle(CreateOrder request, CancellationToken cancellationToken)
{
    var order = new Order(request.ProductId, request.Quantity);

    await _repository.StoreAsync(order, cancellationToken);

    await _eventEmitter.Emit(order.DomainEvents);

    return new CreateOrderResult { OrderId = order.Id };
}
```

AZURE COSMOS DB

# Dual Write Problem – Ghost Messgaes

```
public async Task<CreateOrderResult> Handle(CreateOrder request, CancellationToken cancellationToken)
{
    var order = new Order(request.ProductId, request.Quantity);

    await _eventEmitter.Emit(order.DomainEvents);

    await _repository.StoreAsync(order, cancellationToken);

    return new CreateOrderResult { OrderId = order.Id };
}
```

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# Transactional Outbox

```
public async Task<CreateOrderResult> Handle(CreateOrder request, CancellationToken cancellationToken)
{
    var order = new Order(request.ProductId, request.Quantity);

    await _repository.StoreAsync(order, cancellationToken);

    await _eventEmitter.Emit(order.DomainEvents);

    await _unitOfWork.CommitAsync(cancellationToken);

    return new CreateOrderResult { OrderId = order.Id };
}
```

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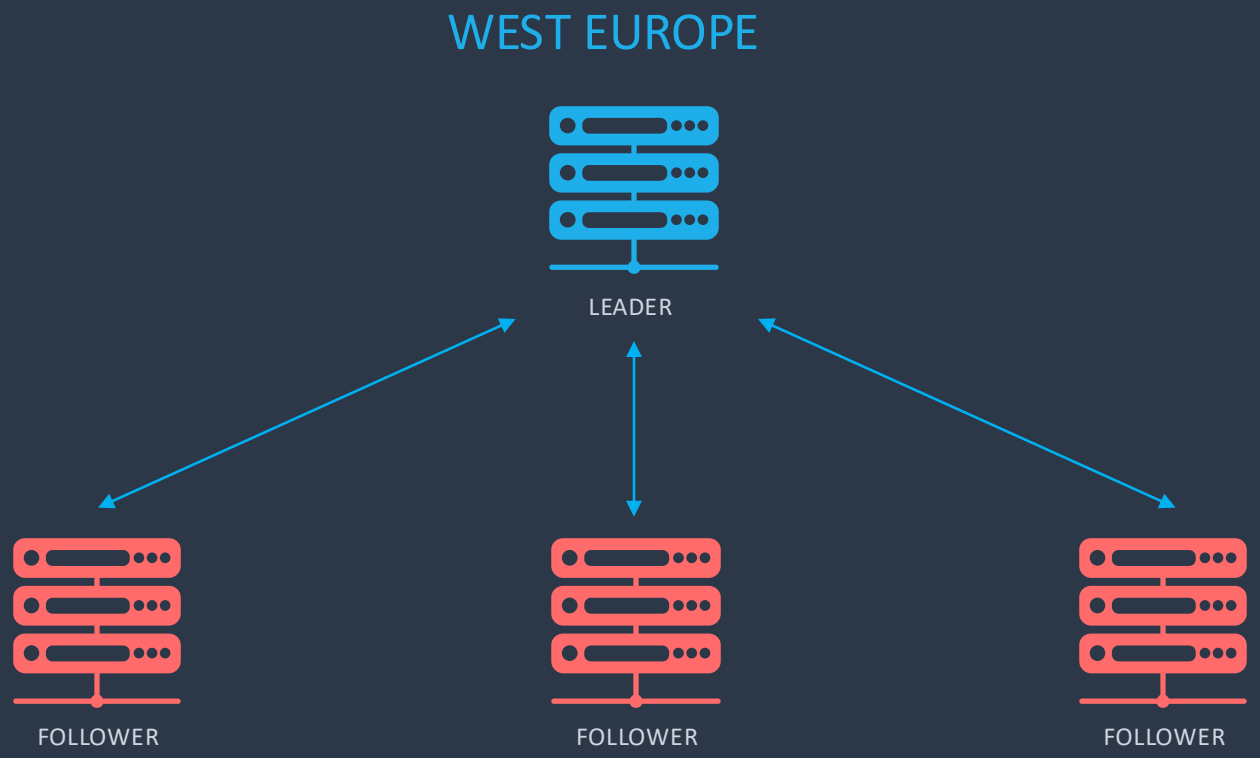
# Dig deeper!

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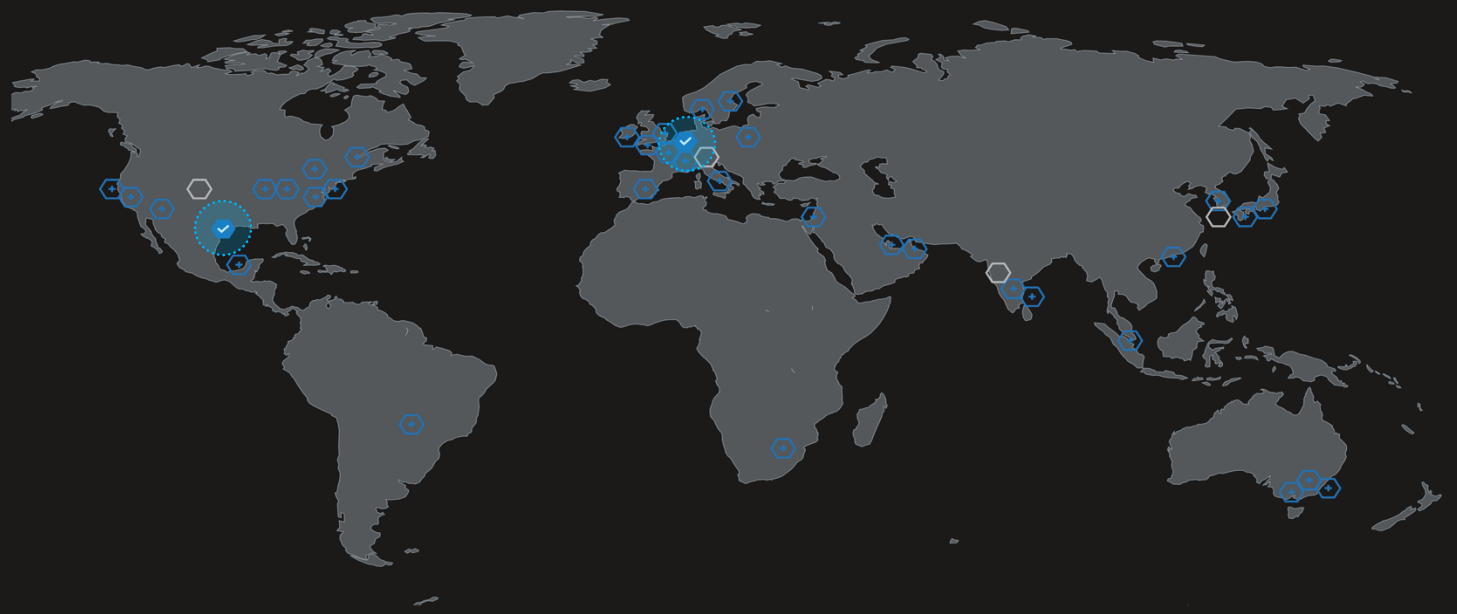
# Globally Distributed



Configure regions
Multi-region writes
Disable Enable

Configure the regions for reads, writes and availability zone (supported in selected regions and can only be configured when a new region is added).
+ Add region

| Regions | Reads Enabled | Writes Enabled | Availability zone | Action |
|---|---|---|---|---|
| West Europe | ✓ | ✓ | | |
| South Central US | ✓ | ✓ | | |

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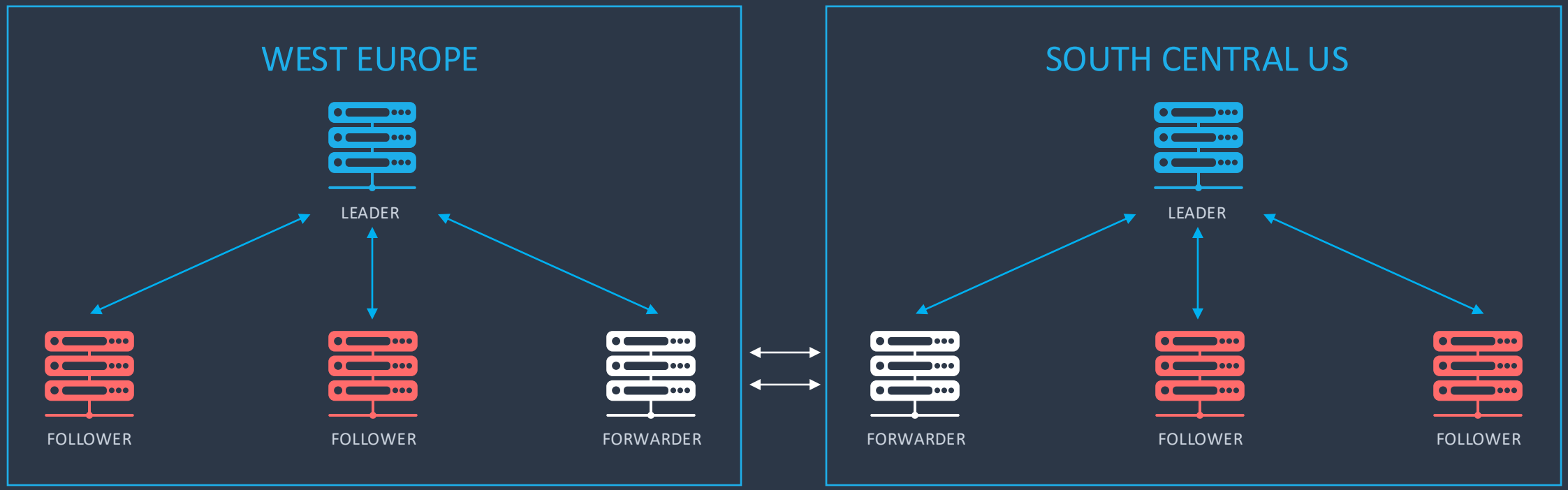
# Globally Distributed

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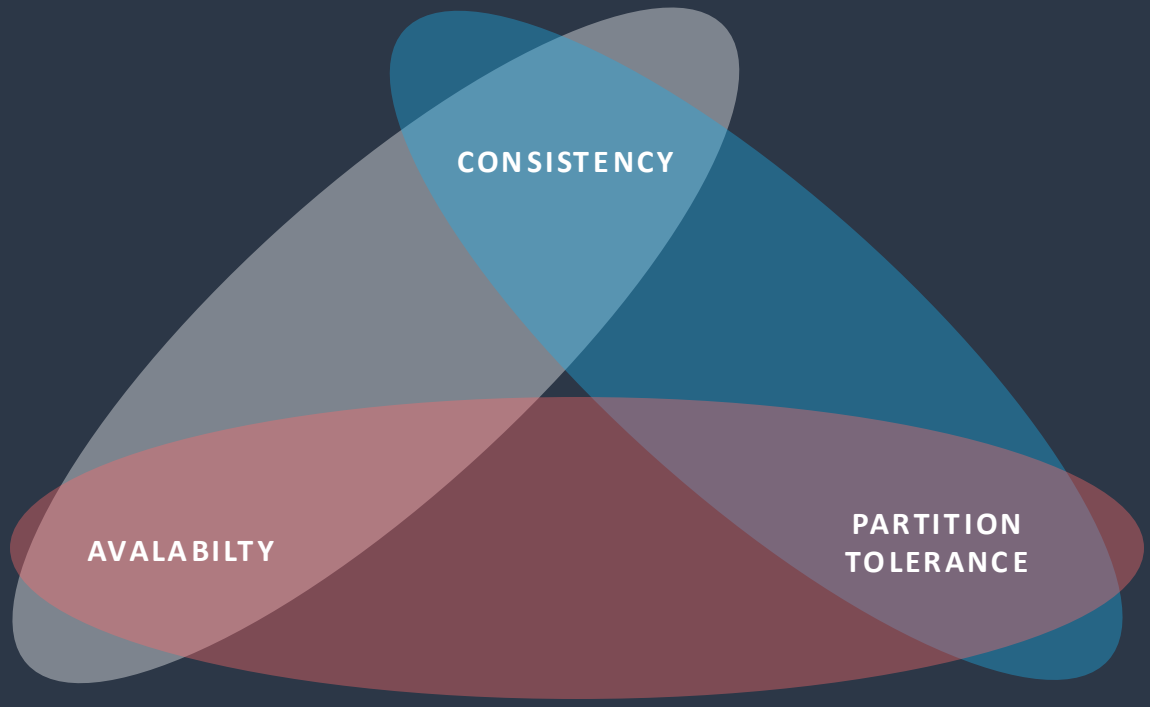
# CAP theorem

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# Strong


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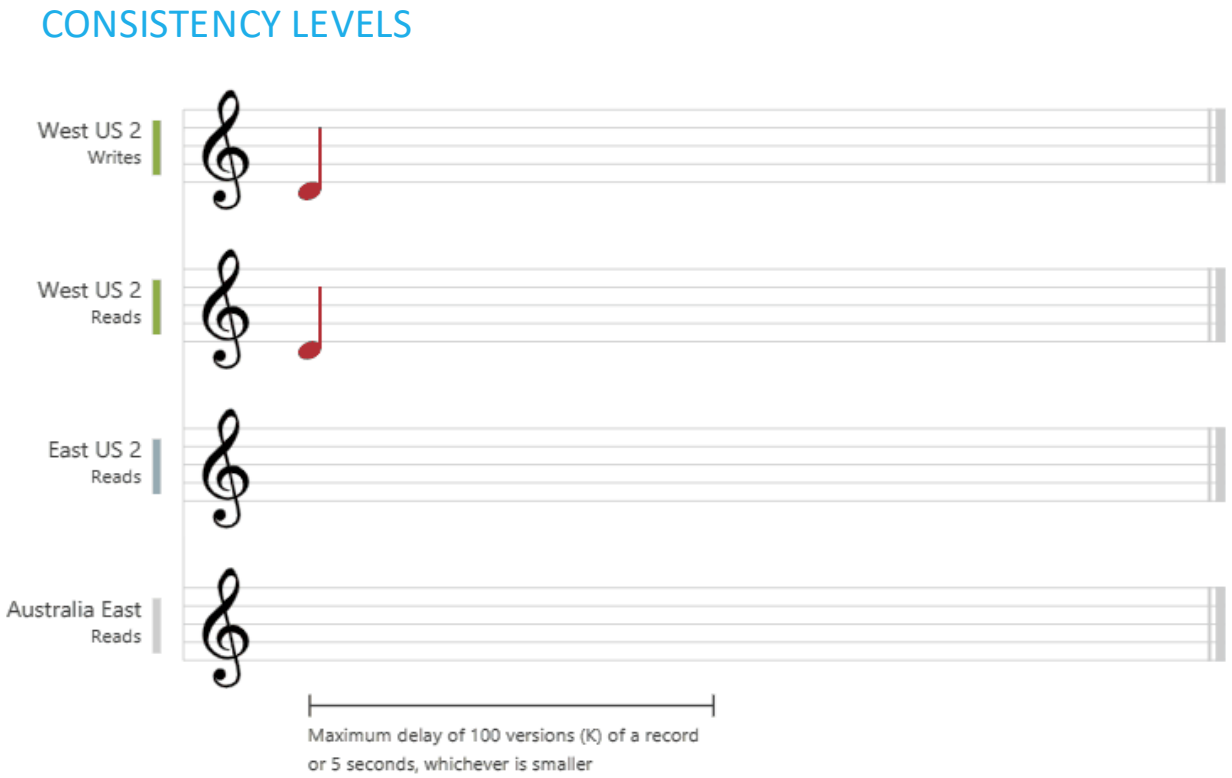
# Bounded Staleness

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# Session


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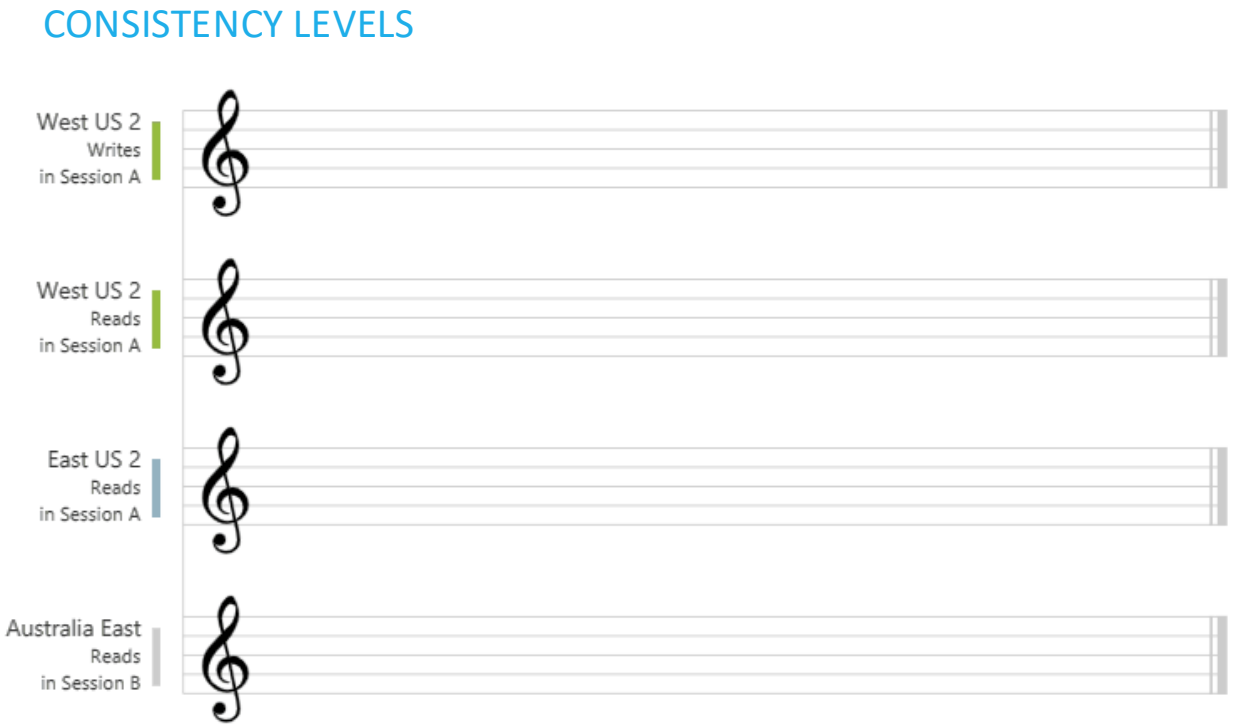
# Consistent Prefix

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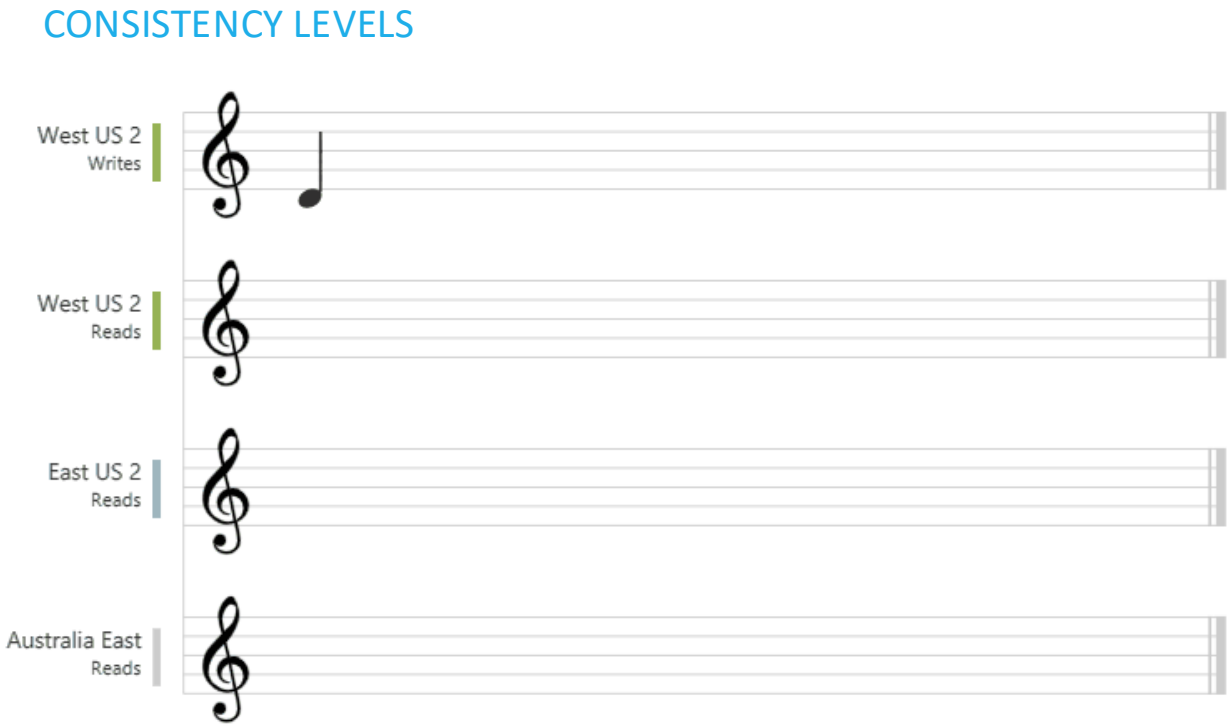
# Eventual

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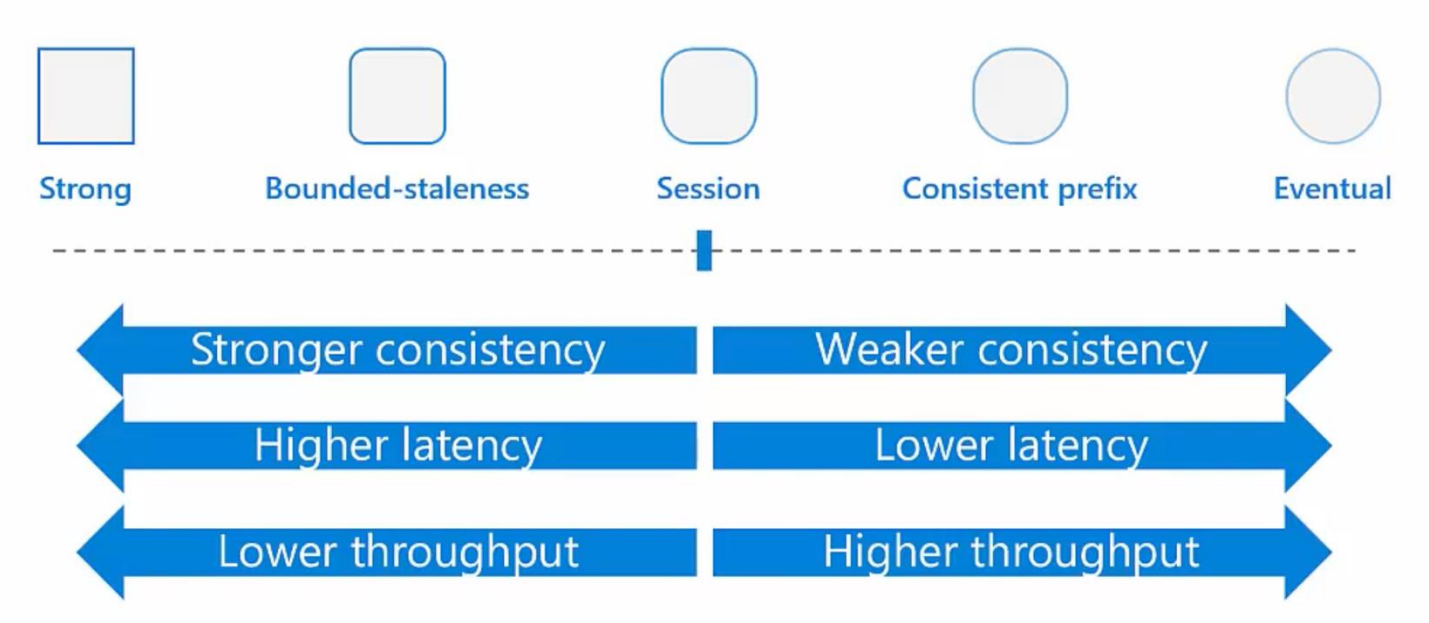
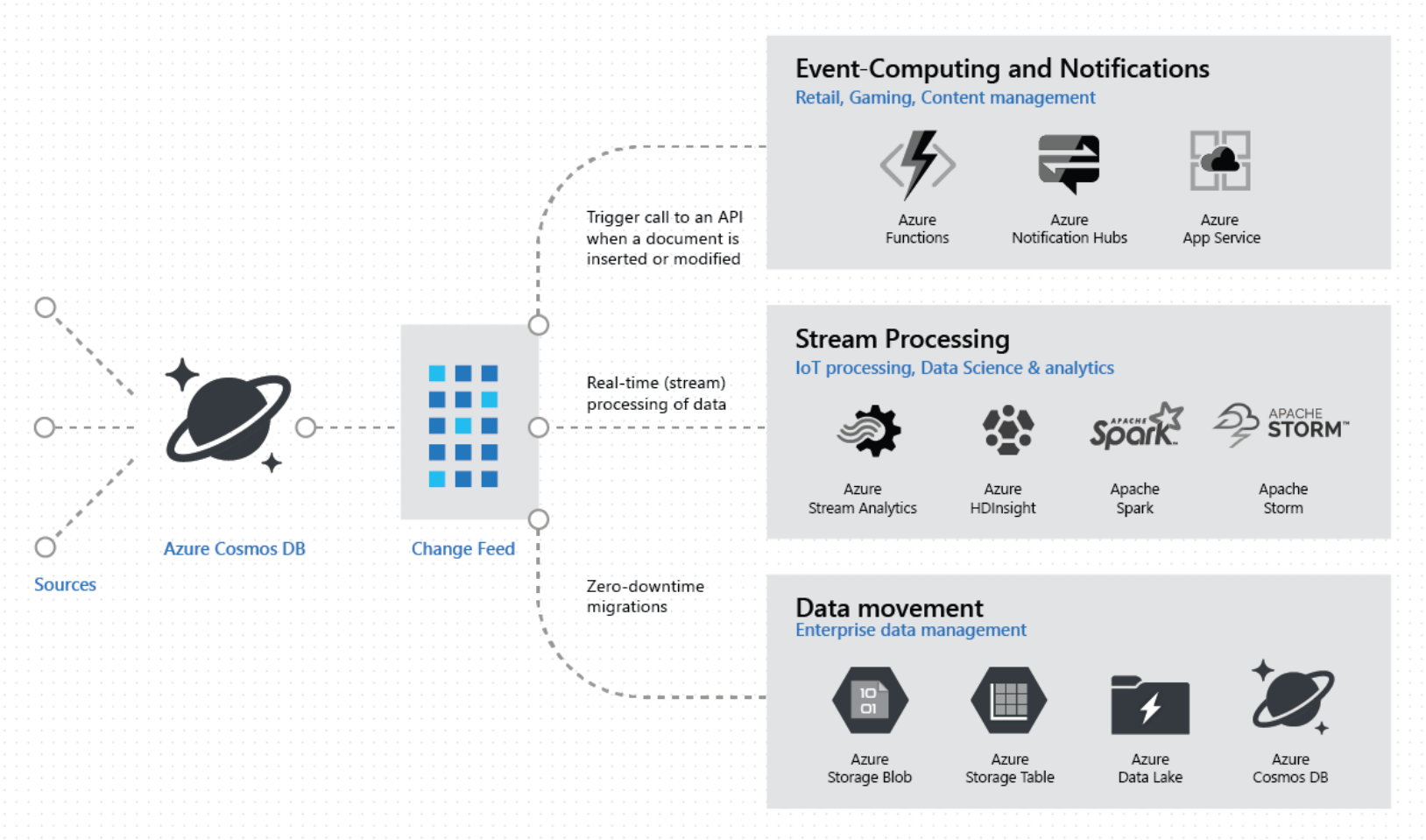
# Tradeoffs

CONSISTENCY LEVELS



# Change Feed


Sources
Azure Cosmos DB
Change Feed
Trigger call to an API when a document is inserted or modified
Real-time (stream) processing of data
Zero-downtime migrations
Event-Computing and Notifications
Retail, Gaming, Content management
Azure Functions
Azure Notification Hubs
Azure App Service
Stream Processing
IoT processing, Data Science & analytics
Azure Stream Analytics
Azure HDInsight
Apache Spark
Apache Storm
Data movement
Enterprise data management
Azure Storage Blob
Azure Storage Table
Azure Data Lake
Azure Cosmos DB

AZURE COSMOS DB

# Change Feed

LOGICAL DATABASE

1
1
1
2
2
1
3
2
2

PHYSICAL PARTITION 1

1
2
1
2

PHYSICAL PARTITION 2

1
1
2
3
2

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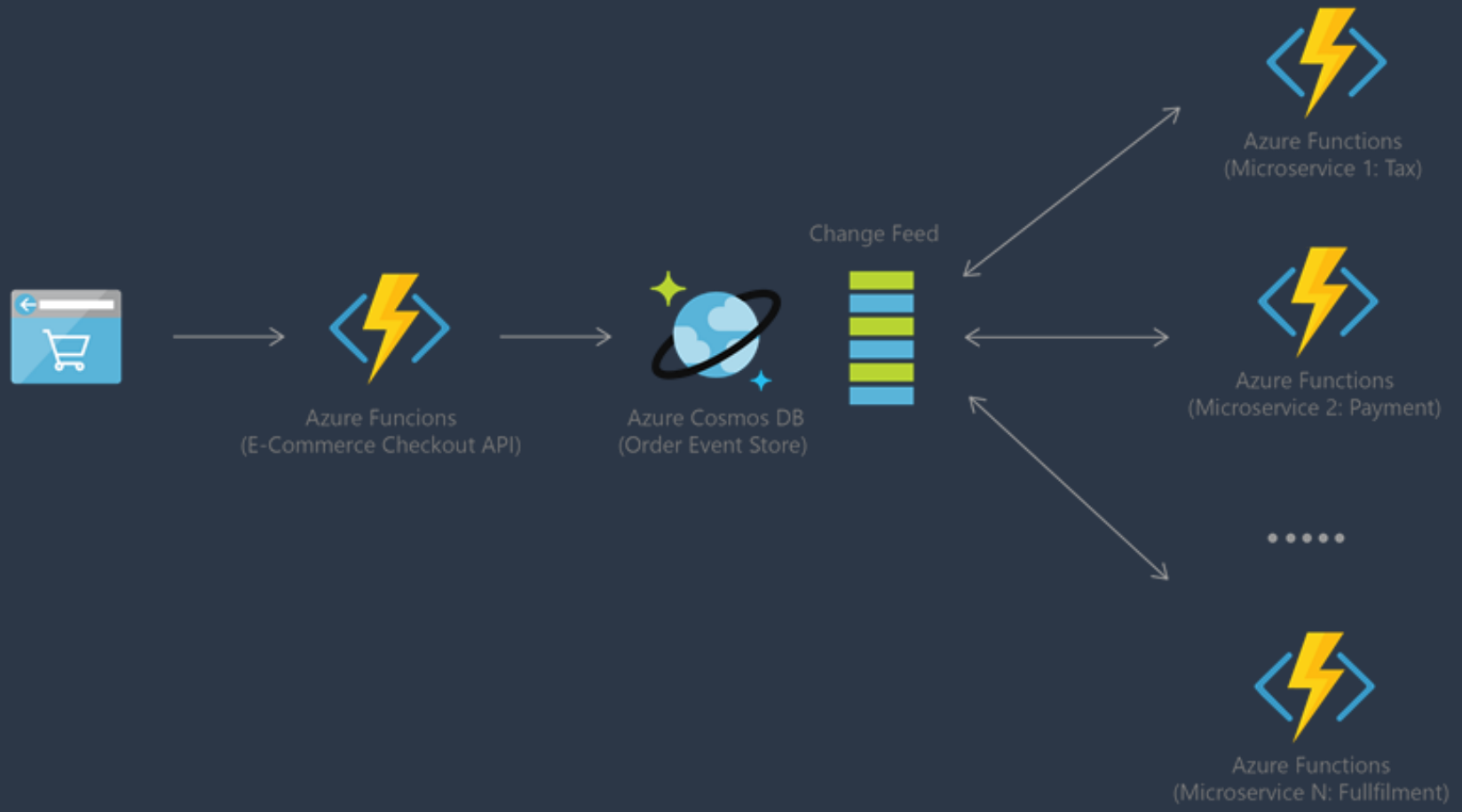
# Change Feed

```
FeedIterator<Customer> iteratorForPartitionKey = _container.GetChangeFeedIterator<Customer>(
    ChangeFeedStartFrom.Beginning(FeedRange.FromPartitionKey(new PartitionKey("stream-id"))),
    ChangeFeedMode.LatestVersion);
```

AZURE COSMOS DB

# Change Feed

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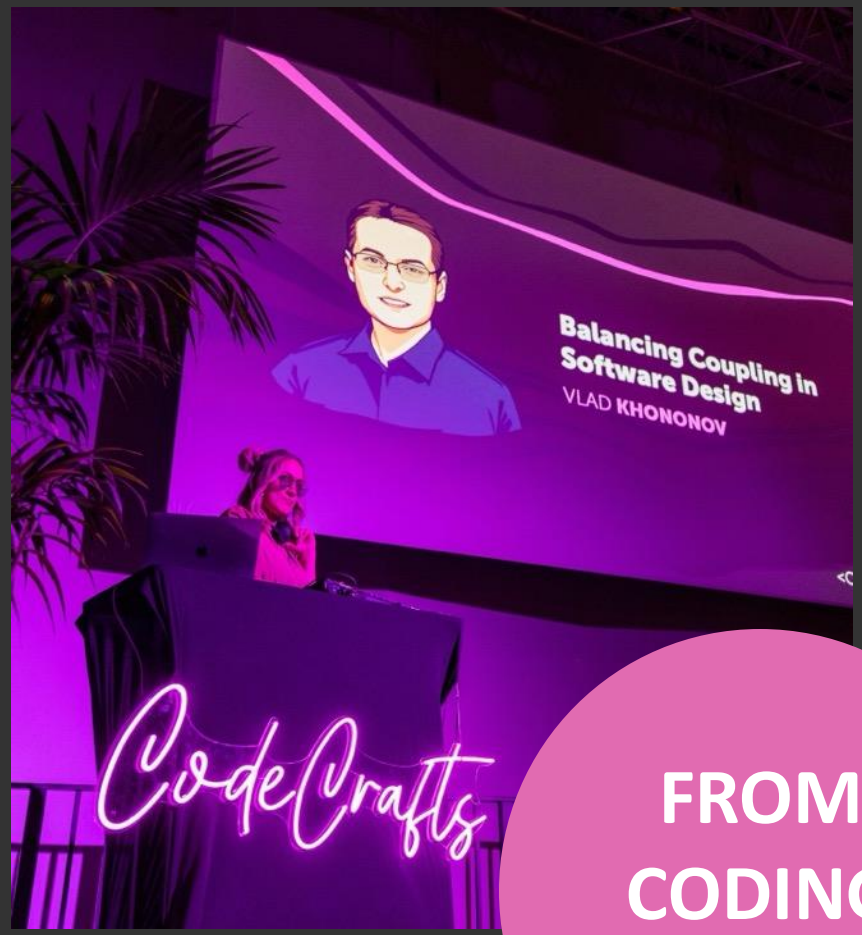
SHOW ME
THE CODE

REGISTER YOUR TICKET

# CodeCrafts on May 22nd

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EXPEDIT HALLE VIENNA

CODE/CRAFTS

# Listen to Renowned Speakers from Coding to Agile:

KENT BECK

SUSANNE KAISER

NEAL FORD

MARK RICHARDS

ADAM TORNHILL

AVRAHAM POUPKO

SHAHAB GANJI

CODECRAFTS

**Write an email to us before 6th May and we will raffle two winners among all replies.**

**WIN A TICKET!**

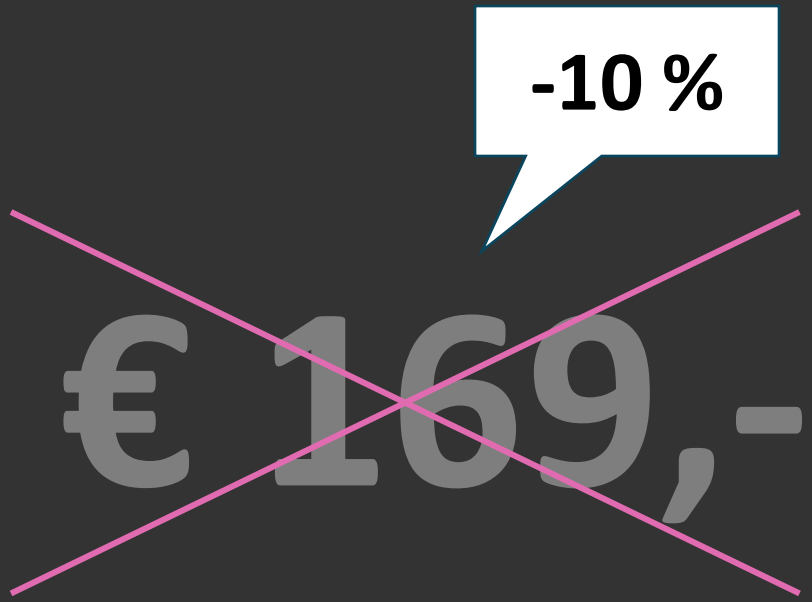
# marketing@squer.io

**Subject:** Cloud Native Linz & CodeCrafts

Submission deadline: 6. Mai

CODECRAFTS

# Or: Use our discount code and save your seat directly:




~~€ 169,-~~ **€ 152,-**

DISCOUNT CODE → meetup-discount-4dsa

CODE/CRAFTS

# Check out our workshops at the 21st of May

KENO DRESSEL &
ALFRED FELDMEYER

## Hands-On GPT: From Training to Deployment

Explore GPT model training, transformer architecture, and deployment strategies to help you build and integrate AI-driven applications.

PAUL ROHORZKA &
MARTIN TAMME

## DDD Workshop from Strategy to Tactics

Learn more about key DDD concepts, strategic and tactical design, and collaborative modeling techniques to help you build software that aligns with business needs.

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# Check out our workshops at the 23rd of May

## NEAL FORD

### Software Architecture Fundamentals

In this hands-on workshop, you'll explore key architectural patterns, trade-offs, and leadership skills to help you build software that truly fits business needs.

## MARK RICHARDS

### Software Architecture – The Hard Parts

Discover real-world strategies for tackling complex architectural decisions, particularly in microservices-based systems, where no two problems are the same.

CODE/CRAFTS

# Tickets and more info via...

CODE-CRAFTS.COM

# Summary

### EDA

- High volume of events
- Real-time processing
- Scalability is a primary concern
- Requires immediate reaction

### CQRS EVENT SOURCING

- Separate read and write models
- Audit log
- Tracking state changes are critical

### AZURE COSMOS DB

- Global distribution
- Guaranteed Performance and SLAs
- Change Feed
- Automatic Indexing
- Multi-model and Multi-API support

WE ARE HIRING

# Check our open positions – we are hiring!

BECOME A SQUERY

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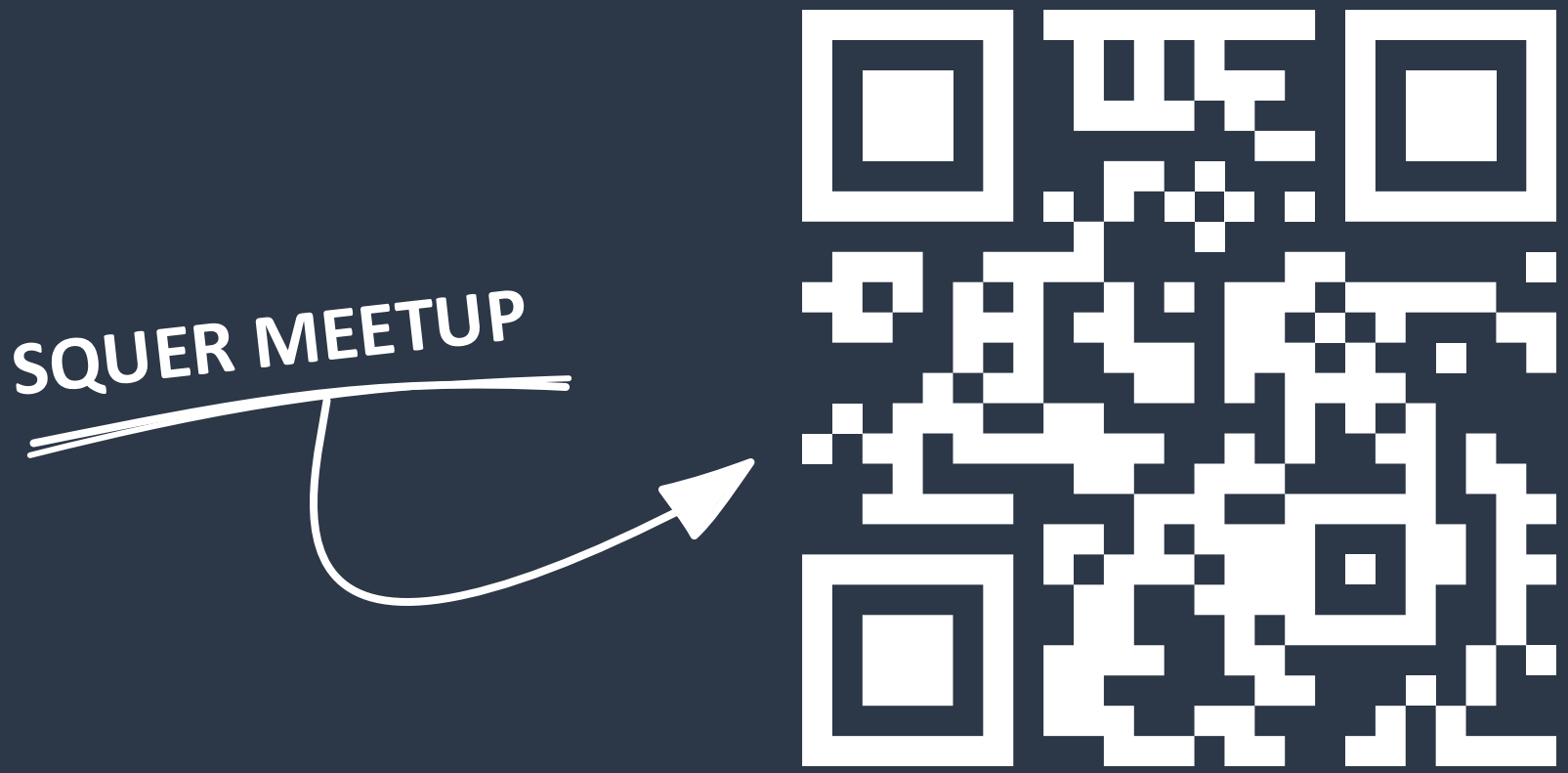
SEE YOU SOON

# Did you enjoy your time? Follow our Meetup Group and come back soon!

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# Get in touch

**Shahab Ganji**
aka. Saeed

Code Artisan!

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# Q&A

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