CH-CH-CH-CHANGES:

TRACING CHANGES IN AZURE COSMOS DB

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QUEST ANALYTICS

MOONSHOT
INNOVATIONS

David Bowie - Changes

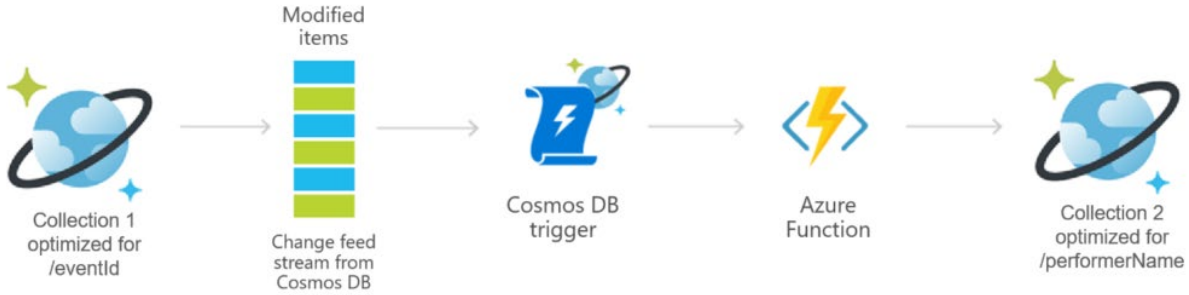
Ch-ch-ch-changes: Tracing Changes in Azure Cosmos DB

Time may change me

But I can't trace time

I said that time may change me

But I can't trace time



Who is Chad Green

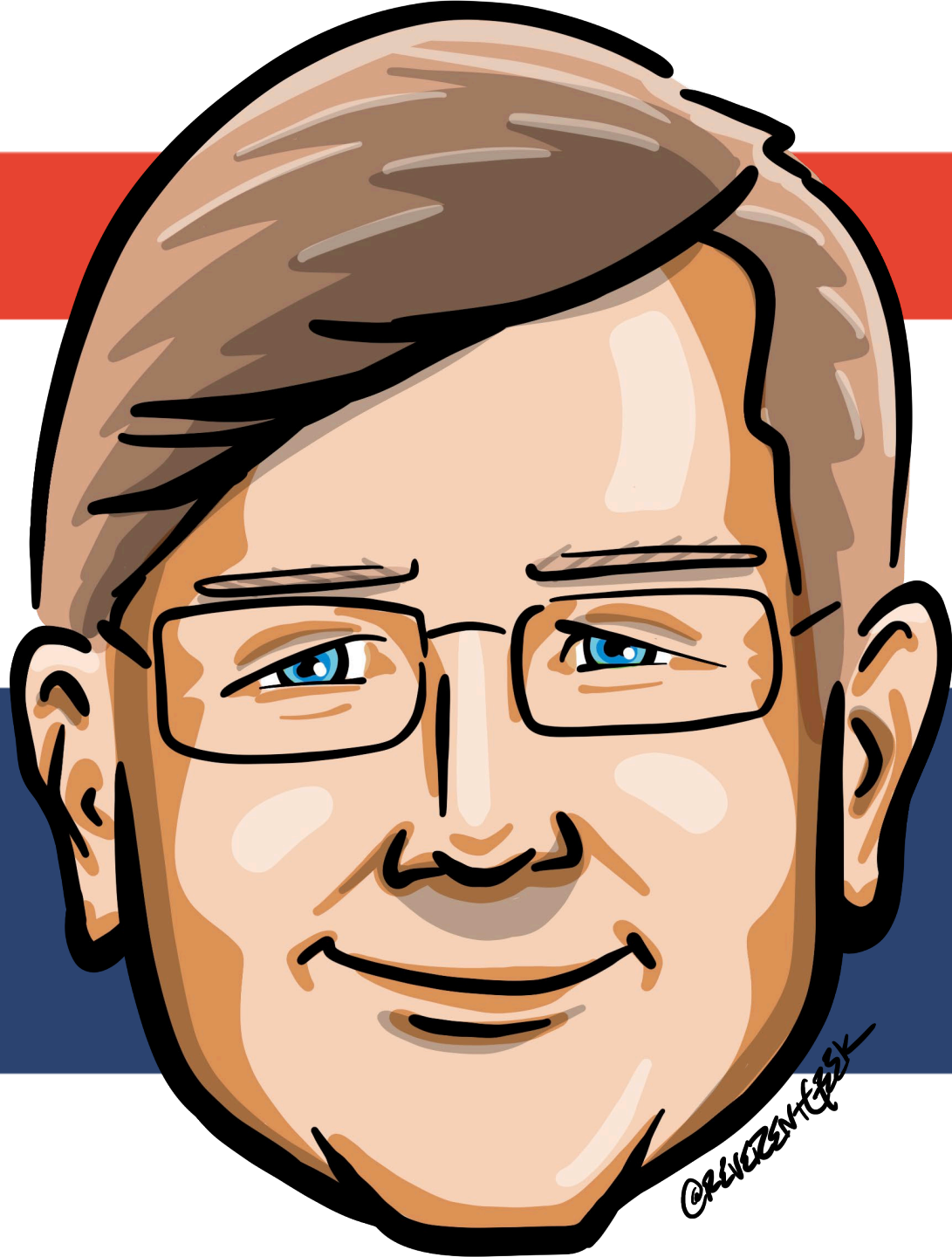
chadgreen@chadgreen.com

TaleLearnCode

ChadGreen.com

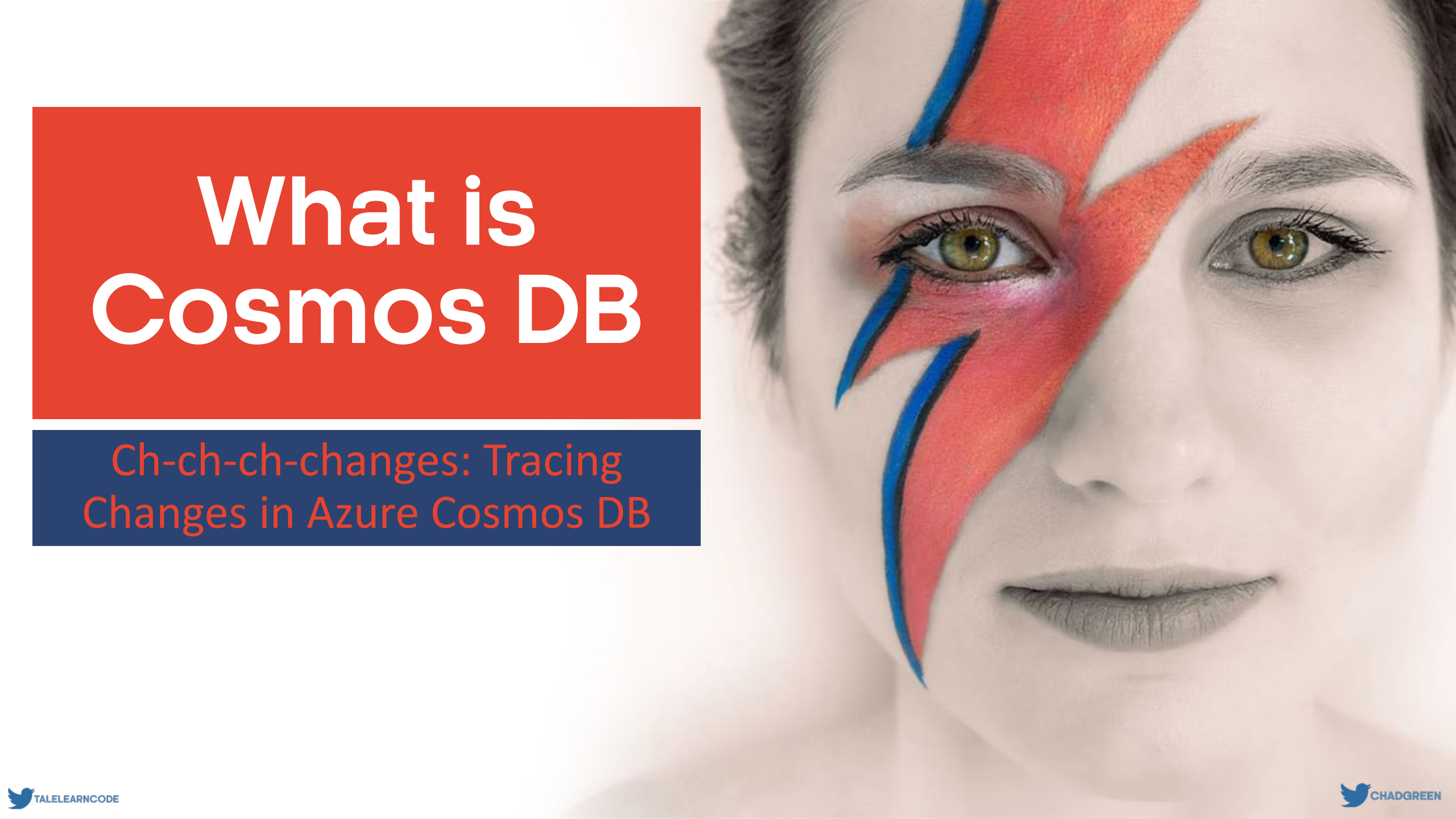
ChadGreen & TaleLearnCode

ChadwickEGreen



What is Cosmos DB

Ch-ch-ch-changes: Tracing Changes in Azure Cosmos DB

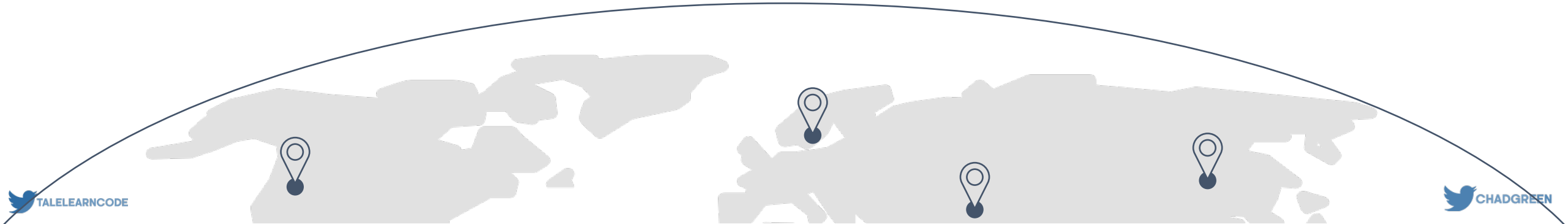


Azure Cosmos DB

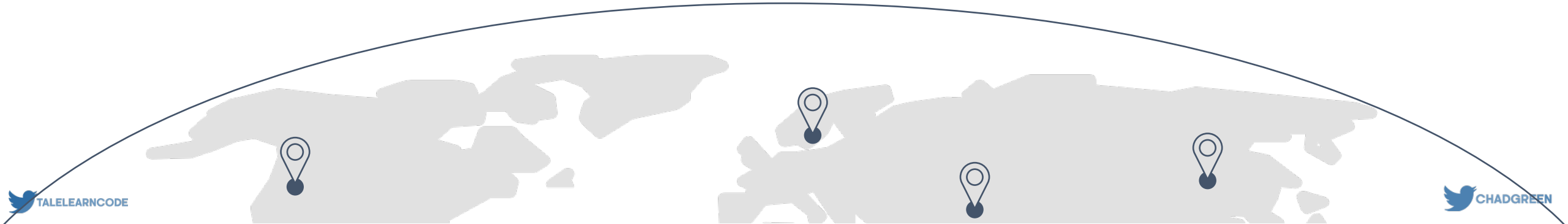
What is Cosmos DB

A globally distributed, massively scalable, multi-model database service

Turnkey global distribution



Turnkey global distribution



Azure Cosmos DB

A globally distributed, massively scalable, multi-model database service

Elastic scale out of storage & throughput

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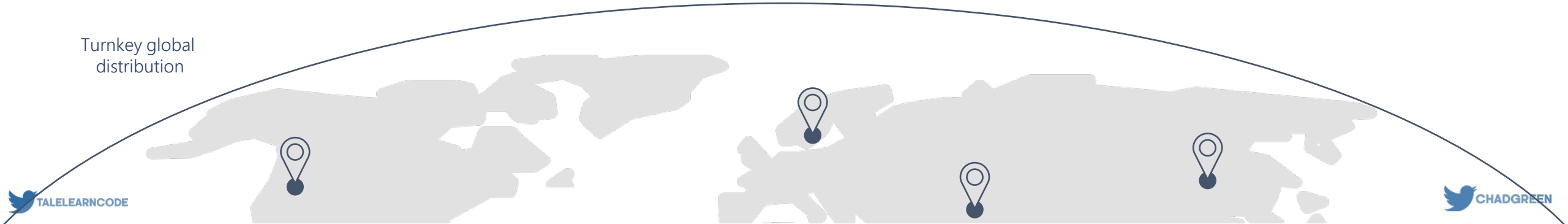

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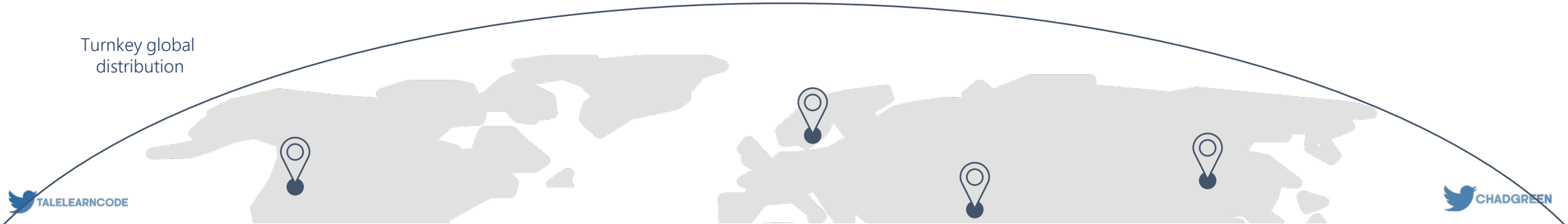

Azure Cosmos DB

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A globally distributed, massively scalable, multi-model database service

Five well-defined consistency models

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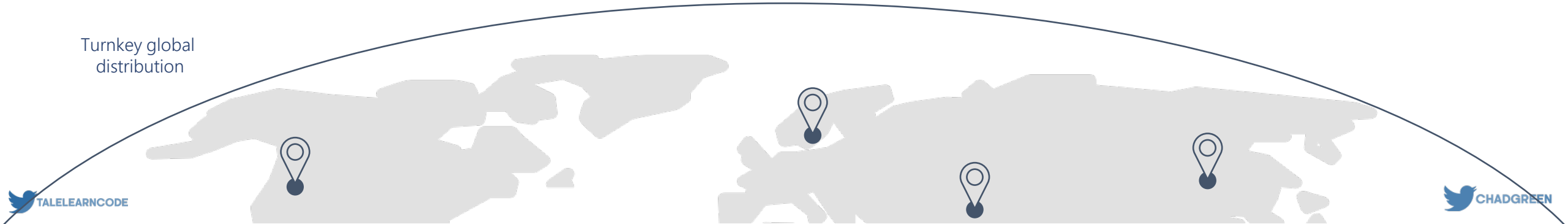

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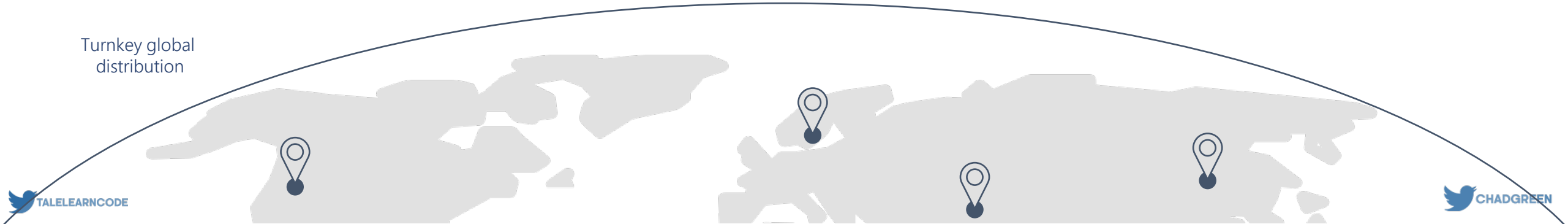

Azure Cosmos DB

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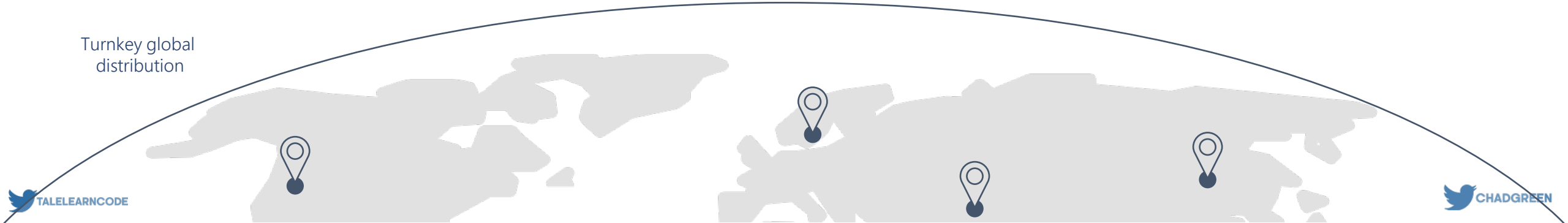

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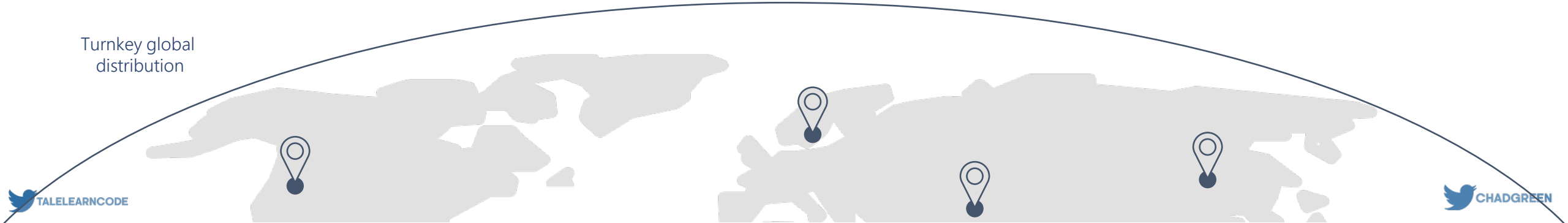

Azure Cosmos DB

A globally distributed, massively scalable, multi-model database service

Battle Tested

XBOX LIVE

Office 365

skype™

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at the 99th percentile

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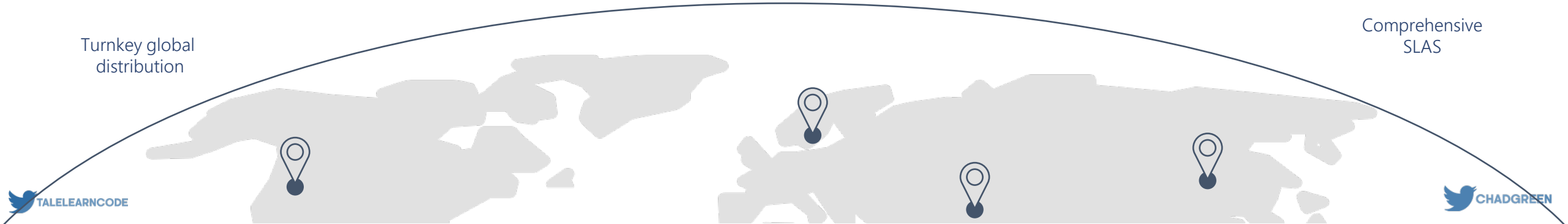
of storage & throughput

Five well-defined
consistency models

Turnkey global
distribution

Comprehensive
SLAS



Azure Cosmos DB

A globally distributed, massively scalable, multi-model database service

Battle Tested

Coca-Cola · AVEVA Schneider Electric · Albertsons SAFEWAY · Johnson Controls · SIEMENS Healthineers · BMI

Liberty Mutual INSURANCE · jet · Rolls-Royce · ExxonMobil · Cincinnati Children's

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Elastic scale out of storage & throughput

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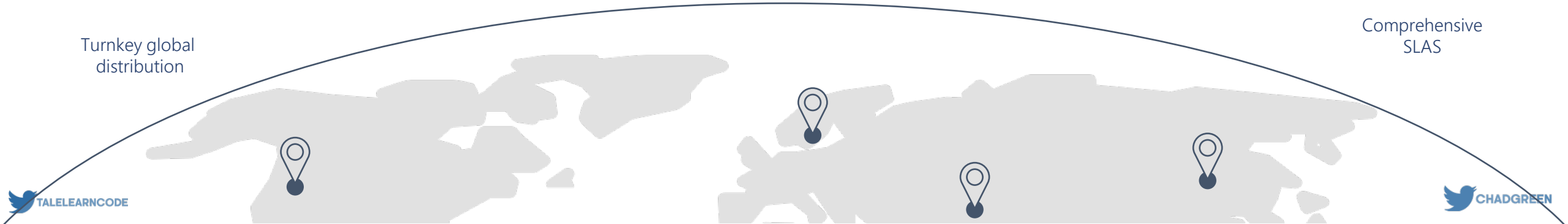
Turnkey global distribution

Comprehensive SLAS



Azure Cosmos DB

A globally distributed, massively scalable, multi-model database service

Ubiquitous Regional Presence

Turnkey gl
distribut

rehensive
SLAS

Azure Cosmos DB

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Secure by default and enterprise ready

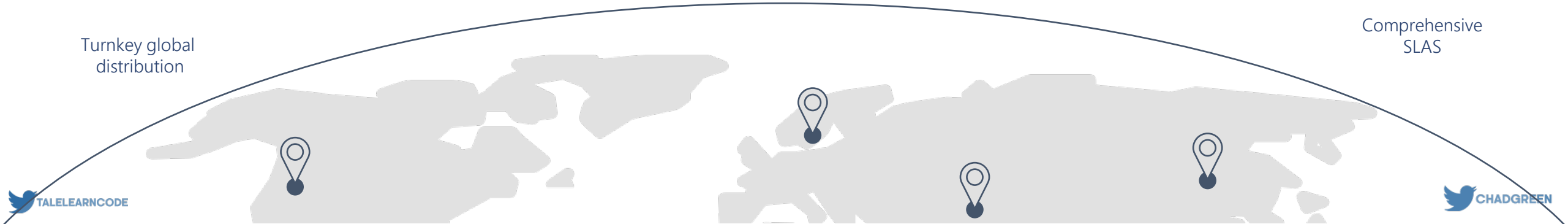
Guaranteed low latency at the 99th percentile

Elastic scale out of storage & throughput

Five well-defined consistency models

Turnkey global distribution

Comprehensive SLAS



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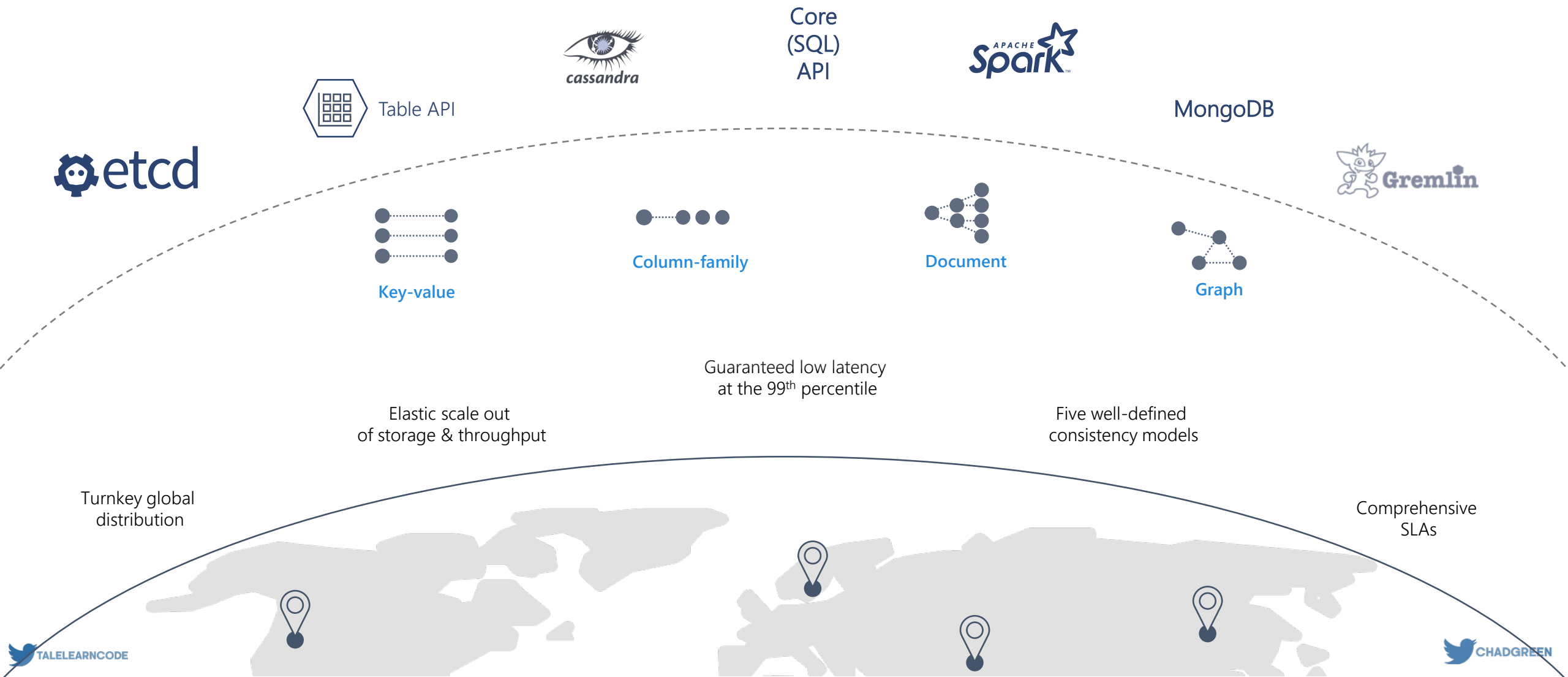


Change Feed

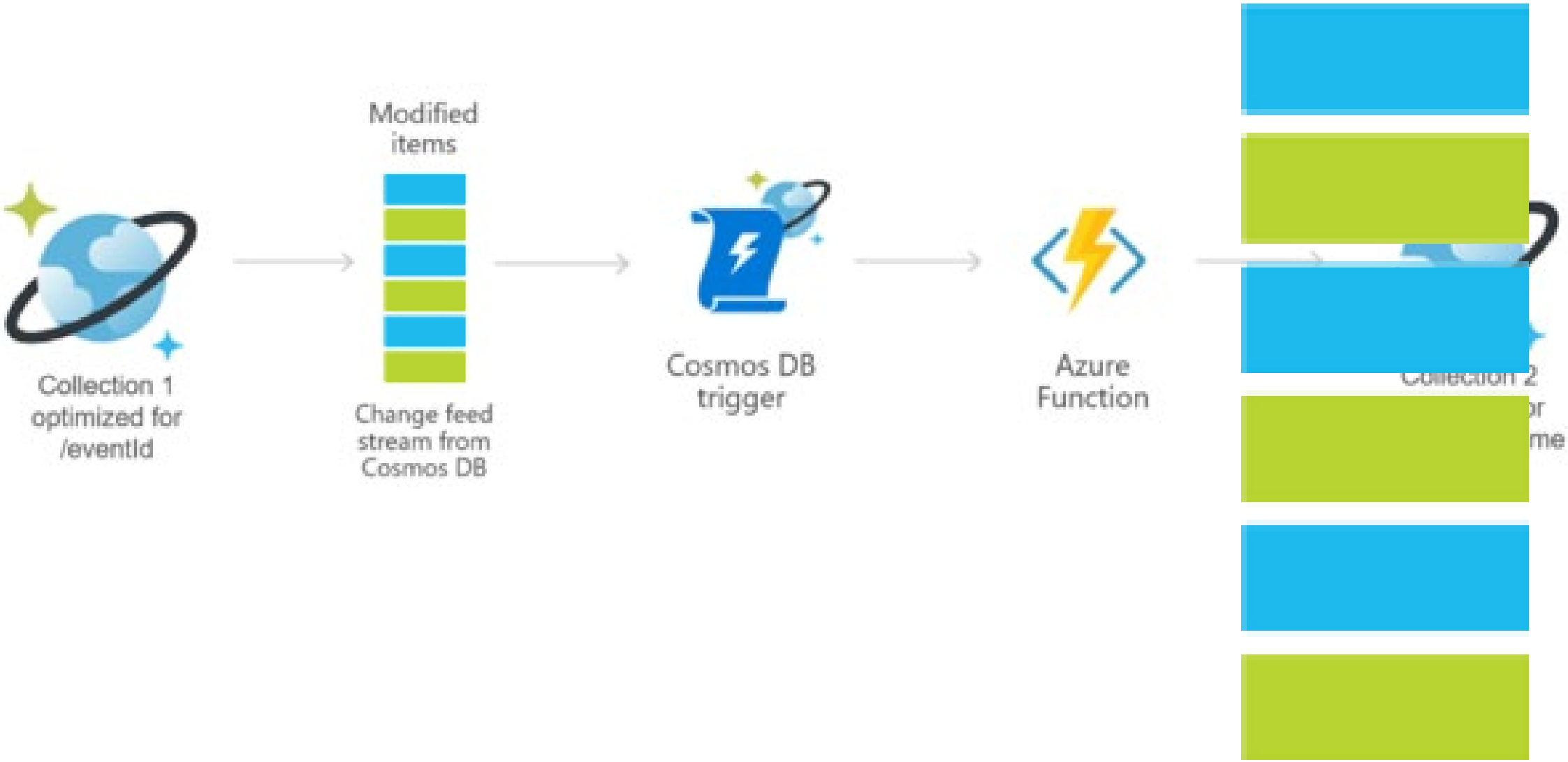
Ch-ch-ch-changes: Tracing Changes in Azure Cosmos DB

Overview

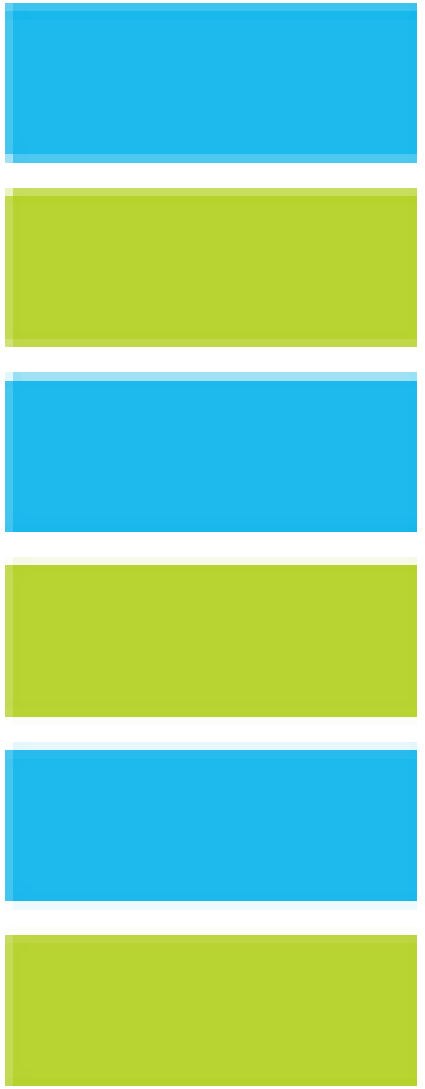
Change Feed

Overview

Change Feed



Unsung Hero of Azure Cosmos DB



Overview

Change Feed

Enabled by default

Overview

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Enabled by default

Enabled by default

Overview

Change Feed

Enabled by default

Includes insert and update operations

Overview

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Change Feed

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Each change appears exactly once

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Overview

Change Feed

Enabled by default

Includes insert and update operations

Each change appears exactly once

Clients manage checkpointing logic

Overview

Change Feed

Enabled by default

Includes insert and update operations

Each change appears exactly once

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Enabled by default

Includes insert and update operations

Each change appears exactly once

Clients manage checkpointing logic

Sorted by order of modification

Overview

Change Feed

Enabled by default

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Clients manage checkpointing logic

Sorted by order of modification

Sorted by order of modification

Overview

Change Feed

Enabled by default

Includes insert and update operations

Each change appears exactly once

No guaranteed order logical partitions

Clients manage checkpointing logic

Sorted by order of modification

Overview

Change Feed

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Includes insert and update operations

Each change appears exactly once

Clients manage checkpointing logic

No guaranteed order logical partitions

Sorted by order of modification

No guaranteed order logical partitions

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Change Feed

Enabled by default

Includes insert and update operations

Each change appears exactly once

Synchronized from any point-in-time

Clients manage checkpointing logic

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Change Feed

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Each change appears exactly once

Changes available in parallel for logical partitions

Clients manage checkpointing logic

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Changes available in parallel for logical partitions

Overview

Change Feed

Enabled by default

Includes insert and update operations

Each change appears exactly once

Applications can request multiple change feeds

Clients manage checkpointing logic

Sorted by order of modification

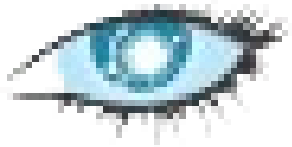
No guaranteed order logical partitions

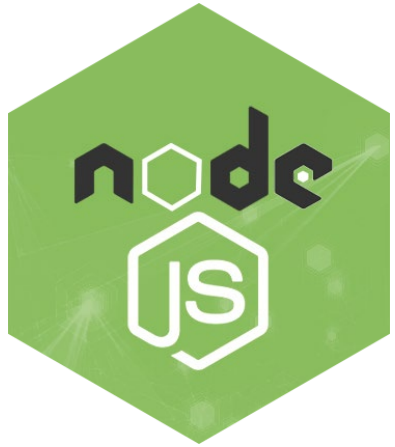
Synchronized from any point-in-time

Changes available in parallel for logical partitions

Supported APIs and Client SDKs

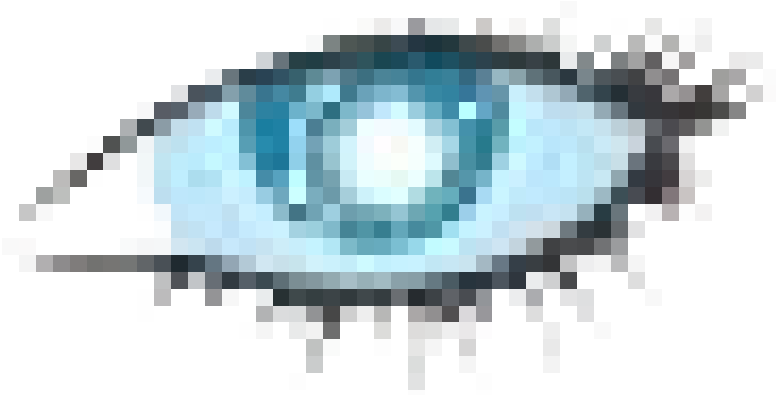
Change Feed





Supported APIs and Client SDKs

Change Feed



Current Limitations

Change Feed

Intermediate Updates

Current Limitations

Change Feed

Intermediate Updates

Current Limitations

Change Feed

Intermediate Updates

Guaranteed Order

Current Limitations

Change Feed

Intermediate Updates

Guaranteed Order

Current Limitations

Change Feed

Intermediate Updates

Deletes

Guaranteed Order

Change Feed Processor

Ch-ch-ch-changes: Tracing Changes in Azure Cosmos DB

Change Feed Processor Components

Reading the Change Feed

Monitored Container

Change Feed Processor Components

Reading the Change Feed

Monitored Container

Leased Container

Change Feed Processor Components

Reading the Change Feed

Monitored Container

Leased Container

Host

Change Feed Processor Components

Reading the Change Feed

Monitored Container

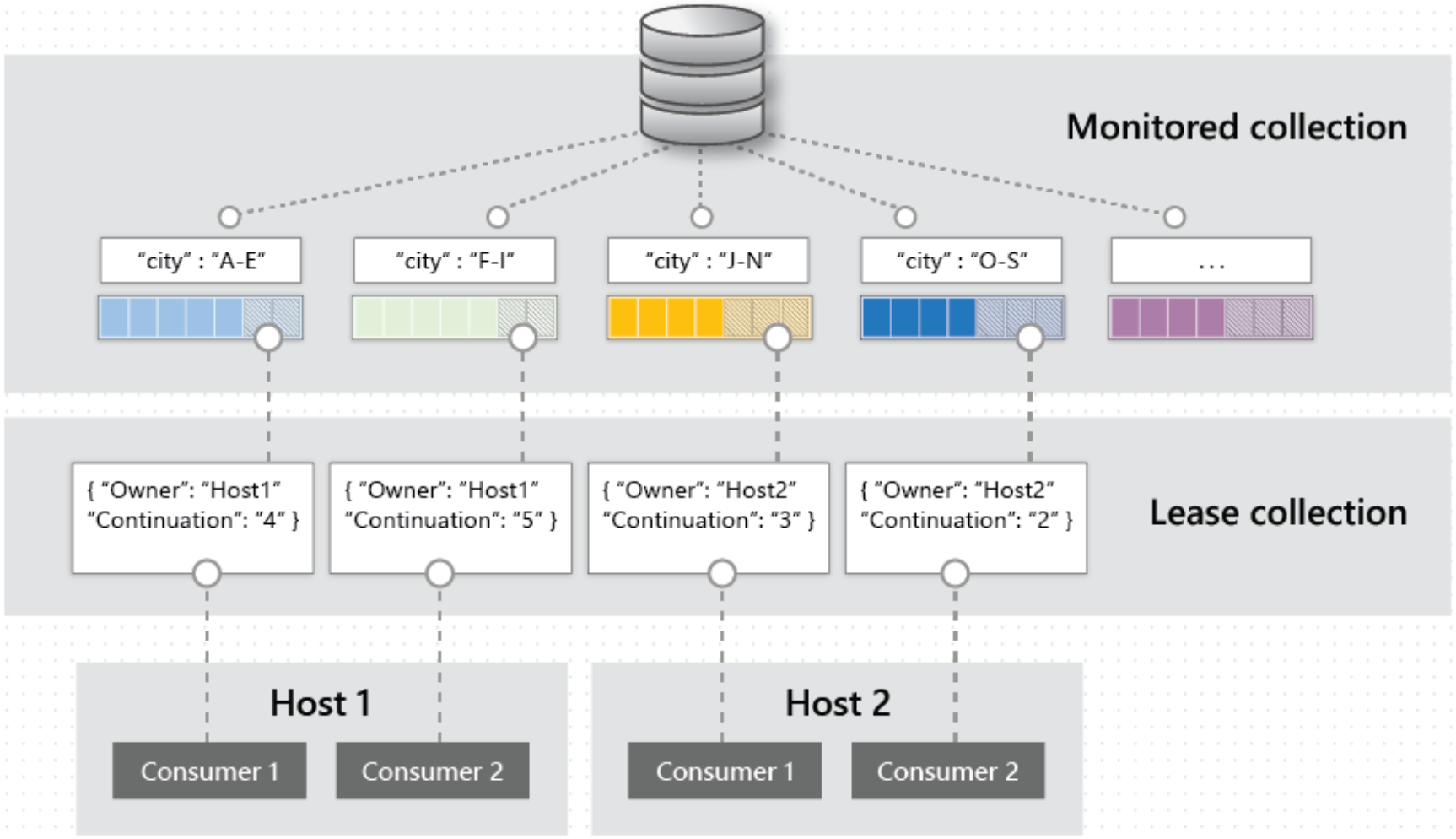
Leased Container

Host

Delegate

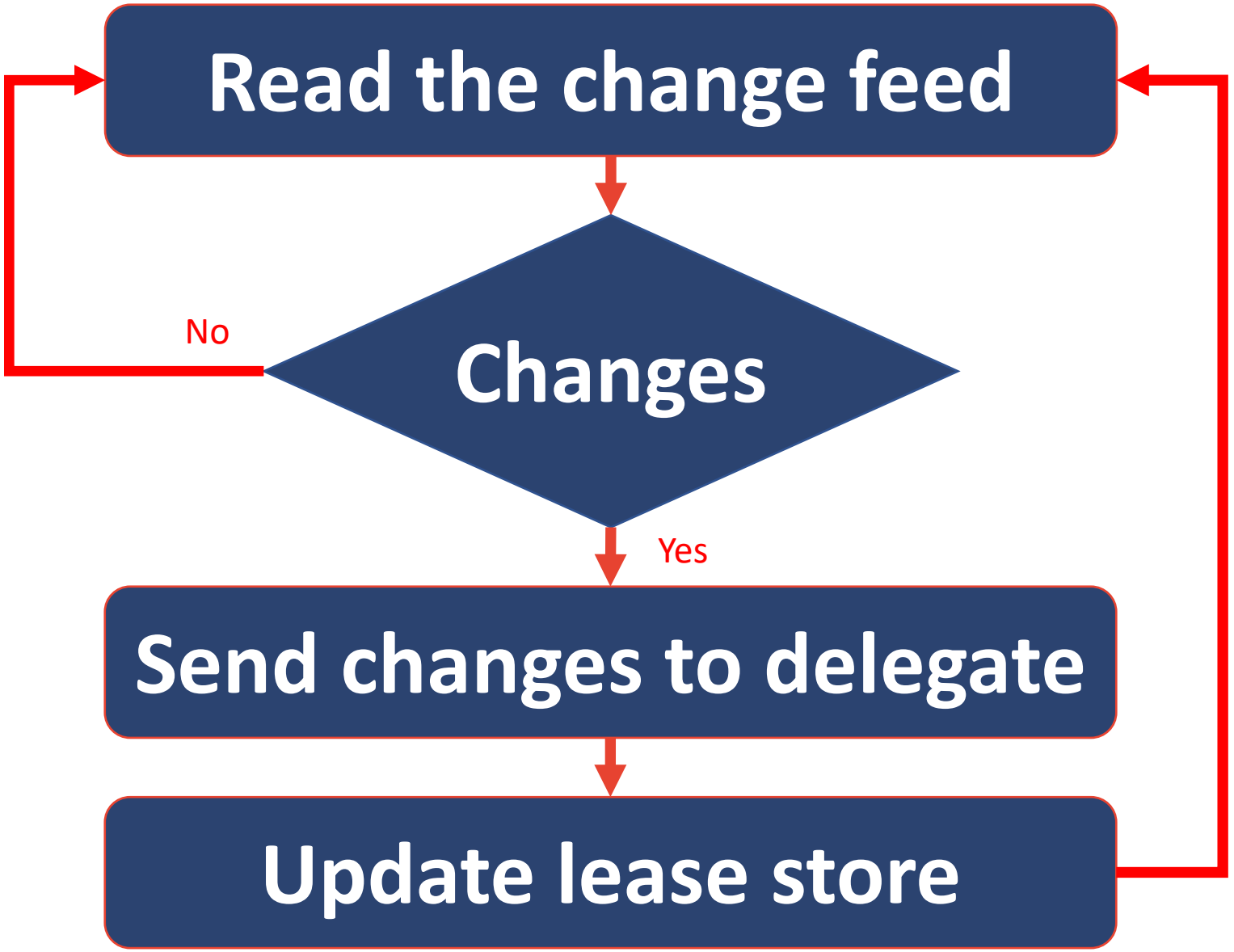
Change Feed Processor Components

Reading the Change Feed



Processing Life Cycle

Reading the Change Feed



Hosting the Change Feed Processor

Reading the Change Feed

- Azure WebJob
- Azure Virtual Machine
- Azure Kubernetes Service
- ASP.NET Hosted Service

Serverless Event-Based Architectures

Ch-ch-ch-changes: Tracing Changes in Azure Cosmos DB

Azure Functions

Serverless Event-Based Archictures

Azure Functions

Serverless Event-Based Architectures

Serverless

Azure Functions

Serverless Event-Based Architectures

Serverless

Language Choice

Azure Functions

Serverless Event-Based Architectures

Serverless

Language Choice

Pay-Per-Use

Azure Functions

Serverless Event-Based Architectures

Serverless

Language Choice

Pay-Per-Use

BYOD

Azure Functions

Serverless Event-Based Architectures

Serverless

Language Choice

Pay-Per-Use

BYOD

Security

Azure Functions

Serverless Event-Based Architectures

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Language Choice

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Security

Integration

Azure Functions

Serverless Event-Based Architectures

Serverless

Language Choice

Pay-Per-Use

BYOD

Security

Integration

Flexible Dev

Azure Functions

Serverless Event-Based Architectures

Serverless

Language Choice

Pay-Per-Use

BYOD

Security

Integration

Flexible Dev

Stateful

Azure Functions

Serverless Event-Based Architectures

Serverless	Language Choice	Pay-Per-Use
BYOD	Security	Integration
Flexible Dev	Stateful	**Open-Source**

What can you do with Azure Functions?

Serverless Event-Based Architectures

HTTP

What can you do with Azure Functions?

Serverless Event-Based Architectures

HTTP

Timer

What can you do with Azure Functions?

Serverless Event-Based Architectures

HTTP

Timer

Blob storage

What can you do with Azure Functions?

Serverless Event-Based Architectures

HTTP

Timer

Blob storage

Queue storage

What can you do with Azure Functions?

Serverless Event-Based Architectures

HTTP

Timer

Blob storage

Queue storage

Event Grid

What can you do with Azure Functions?

Serverless Event-Based Architectures

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Timer

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What can you do with Azure Functions?

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Timer

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Service Bus Queue

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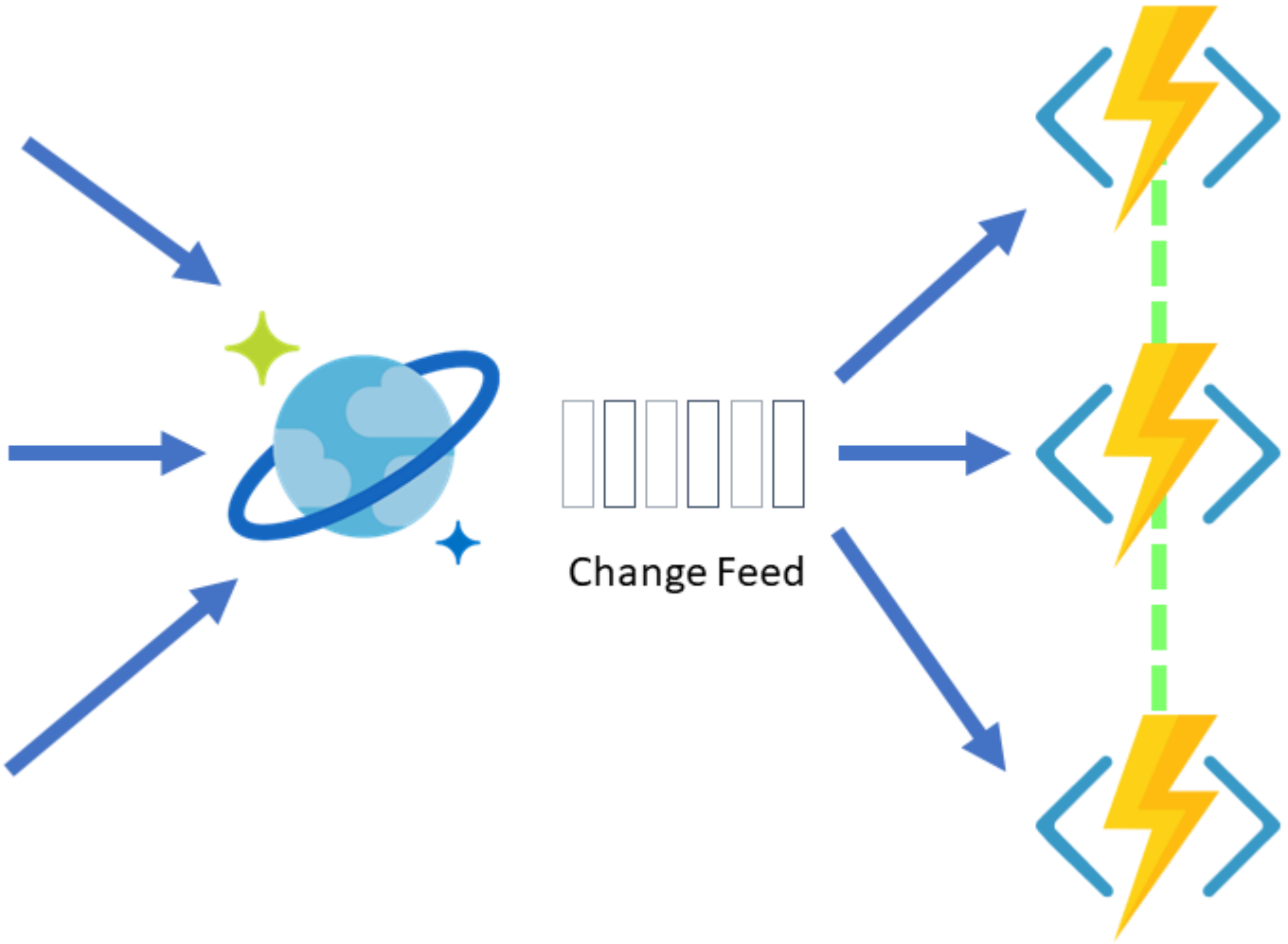
Cosmos DB

Azure Cosmos DB and Azure Functions

Serverless Event-Based Architectures

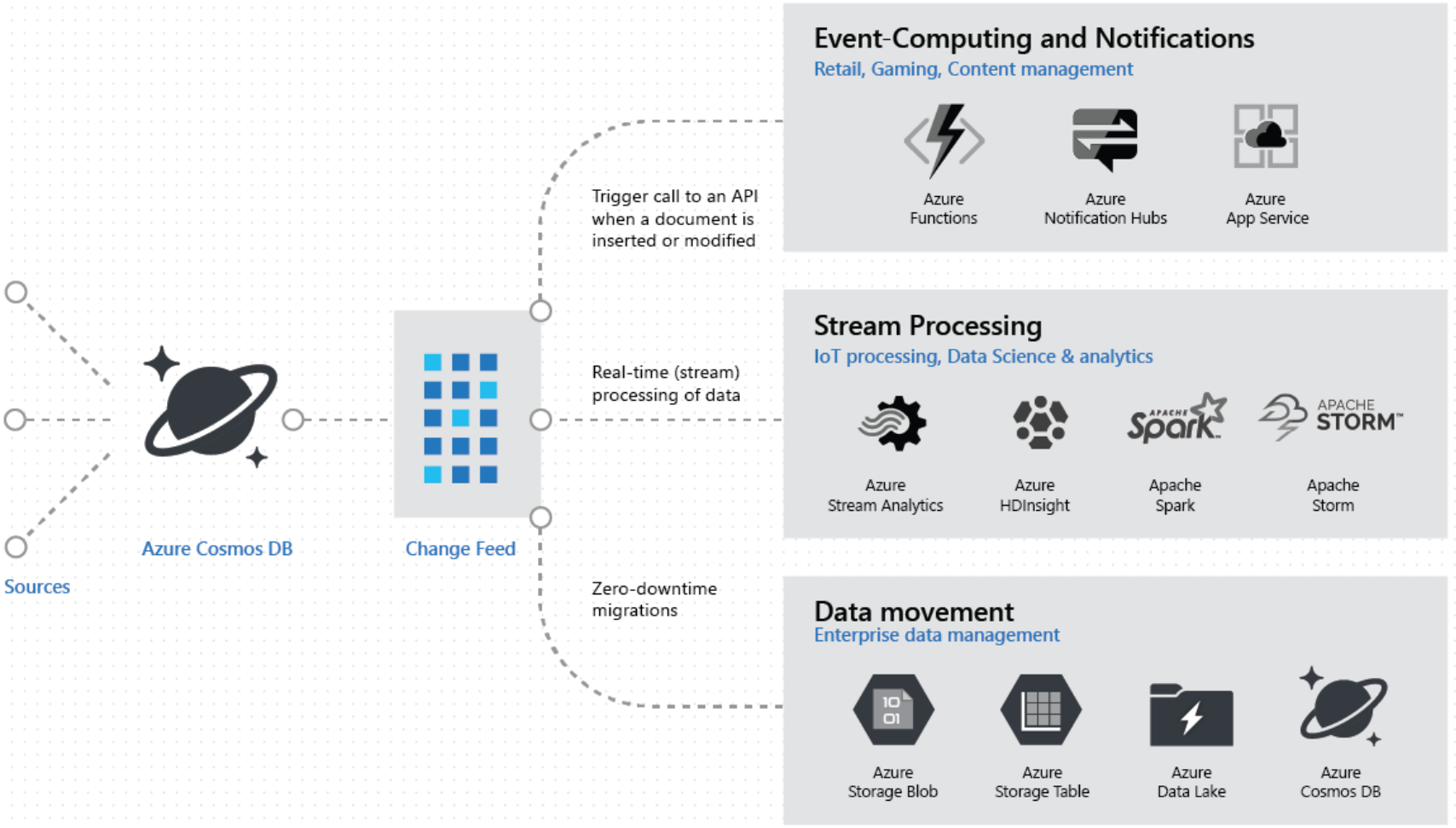


Change Feed Design Patterns

Ch-ch-ch-changes: Tracing Changes in Azure Cosmos DB

Common Uses of the Change Feed

Change Feed Design Patterns



Common Uses of the Change Feed

Change Feed Design Patterns

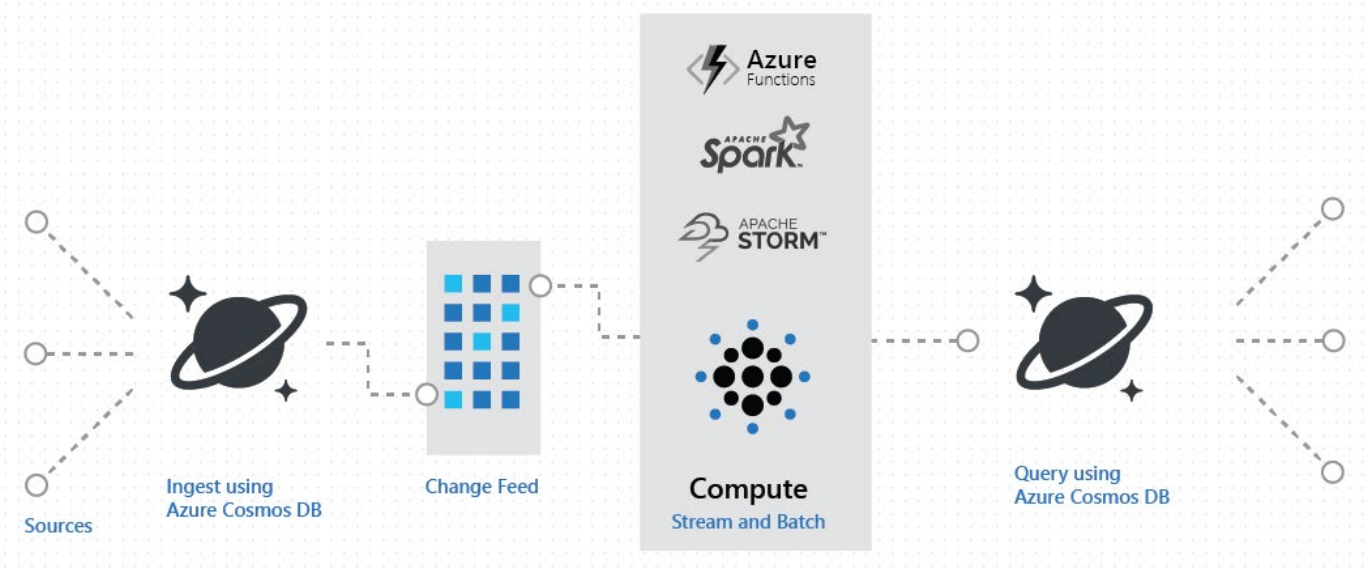
Event Computing and Notifications

Common Uses of the Change Feed

Change Feed Design Patterns

Event Computing and Notifications

Real-Time Stream Processing



Common Uses of the Change Feed

Change Feed Design Patterns

Event Computing and Notifications

Real-Time Stream Processing

Data Movement

Common Uses of the Change Feed

Change Feed Design Patterns

Event Computing and Notifications

Real-Time Stream Processing

Data Movement

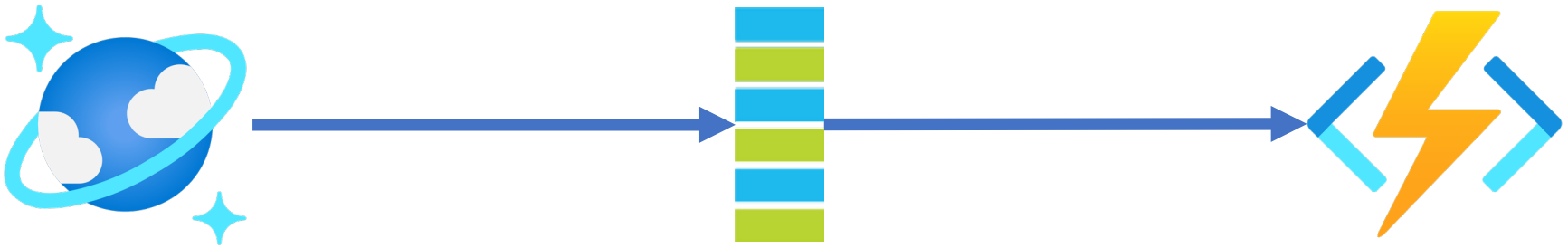
Event Sourcing

Demos

Ch-ch-ch-changes: Tracing Changes in Azure Cosmos DB

Basic Change Feed Demo

Change Feed Demos



Data written to Cosmos DB

Insert/Update recorded in the Change Feed

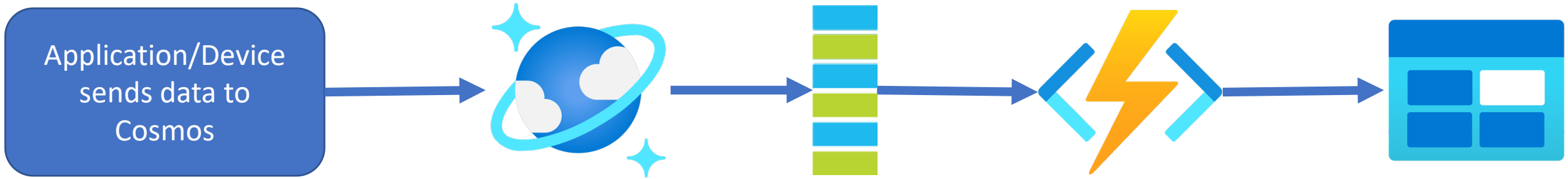
Azure Function is triggered by the item being added to the change feed

Scenario

- Practice test application
- Data is useful for active queries within 30 days (2,592,000 seconds)
- Need to keep archive for historical, compliance reasons
- Demo will process 428k records over 24-hour period
- Real data that has been autonomized

Data Archival

Change Feed Demos

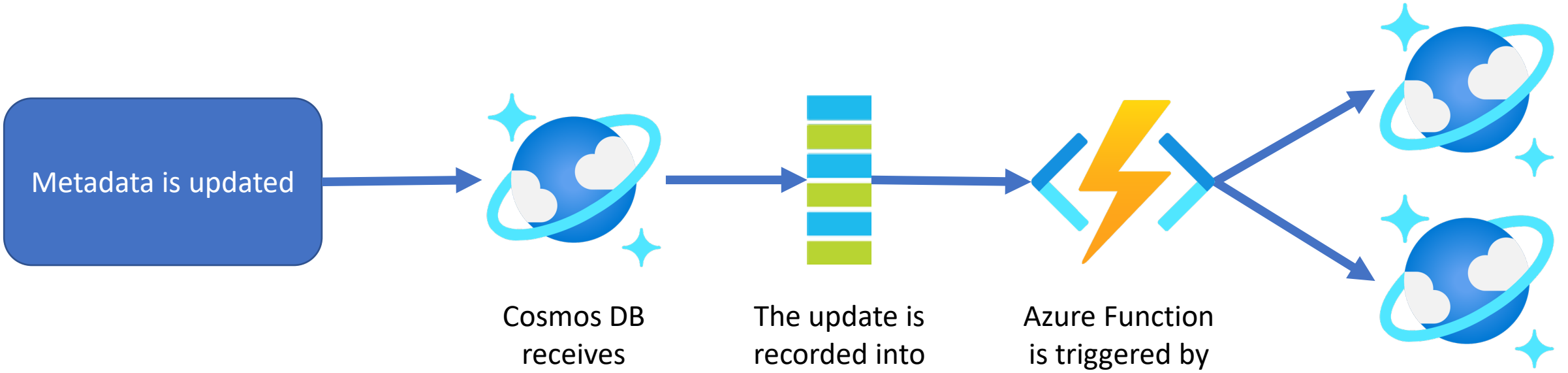


Scenario

- Shindig Manager
- Manages presentations for different shindigs (events)
- Metadata maintained in its own container
- Need way to update denormalized data in shindig (event) partitions

Denormalization

Change Feed Demos



Scenario

- Shindig Manager
- Manages presentations for different shindigs (events)
- Presentations partitioned by shindig
- Want to improve query performance when searching across tags (original partitioning would require cross-partition querying)

Replicating Containers

Change Feed Demos

Presentation data is sent to Cosmos by the application

Cosmos DB receives data

The insert/update is recorded into the change feed

Azure Function is triggered by the item being added/updated to the change feed

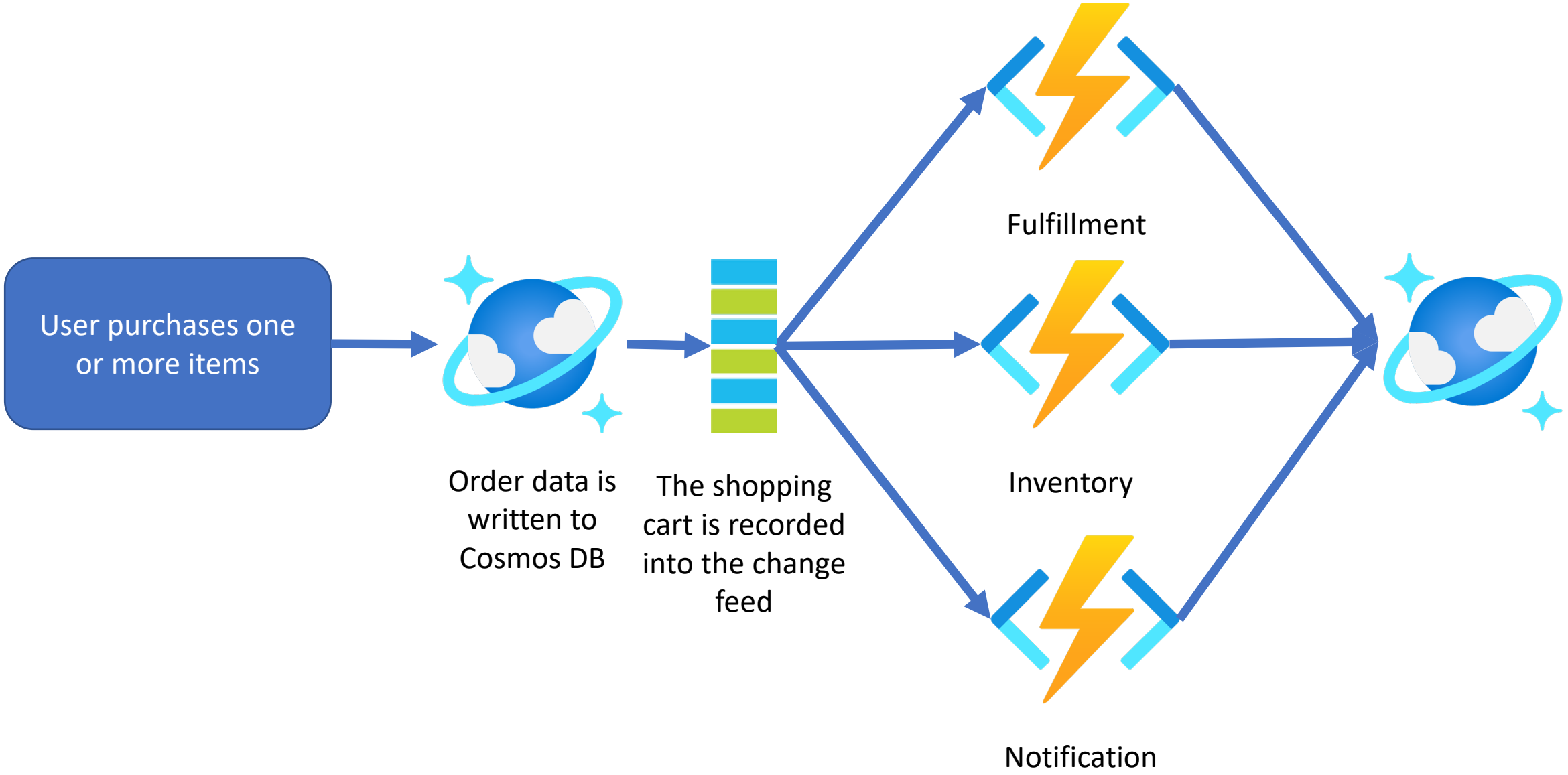
Document is sent to replicated Cosmos container(s)

Scenario

- Shopping cart implementation – Lego store
- Implementing an event-driven architecture to allow for asynchronous processing of an order
- Note: functions are only simulating doing actions

Triggering Event-Driven Architecture

Change Feed Demos



Wrap-Up

Ch-ch-ch-changes: Tracing Changes in Azure Cosmos

Wrap-Up

Ch-ch-ch-changes: Tracing Changes in Azure Cosmos DB

- Azure Cosmos DB

Wrap-Up

- Azure Cosmos DB
- Change feed is the unsung here of Cosmos DB

Wrap-Up

- Azure Cosmos DB
- Change feed is the unsung here of Cosmos DB
- Supported APIs and client SDKs

Wrap-Up

- Azure Cosmos DB
- Change feed is the unsung here of Cosmos DB
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- Current limitations
  - Intermediate Updates
  - Guaranteed Order
  - Deletes

Wrap-Up

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- Supported APIs and client SDKs
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  - Deletes
- Three processes for reading the change feed

Wrap-Up

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- Supported APIs and client SDKs
- Current limitations
  - Intermediate Updates
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  - Deletes
- Three processes for reading the change feed
- Common patterns

Wrap-Up

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- Change feed is the unsung here of Cosmos DB
- Supported APIs and client SDKs
- Current limitations
  - Intermediate Updates
  - Guaranteed Order
  - Deletes
- Three processes for reading the change feed
- Common patterns
- Demos

Thank You!

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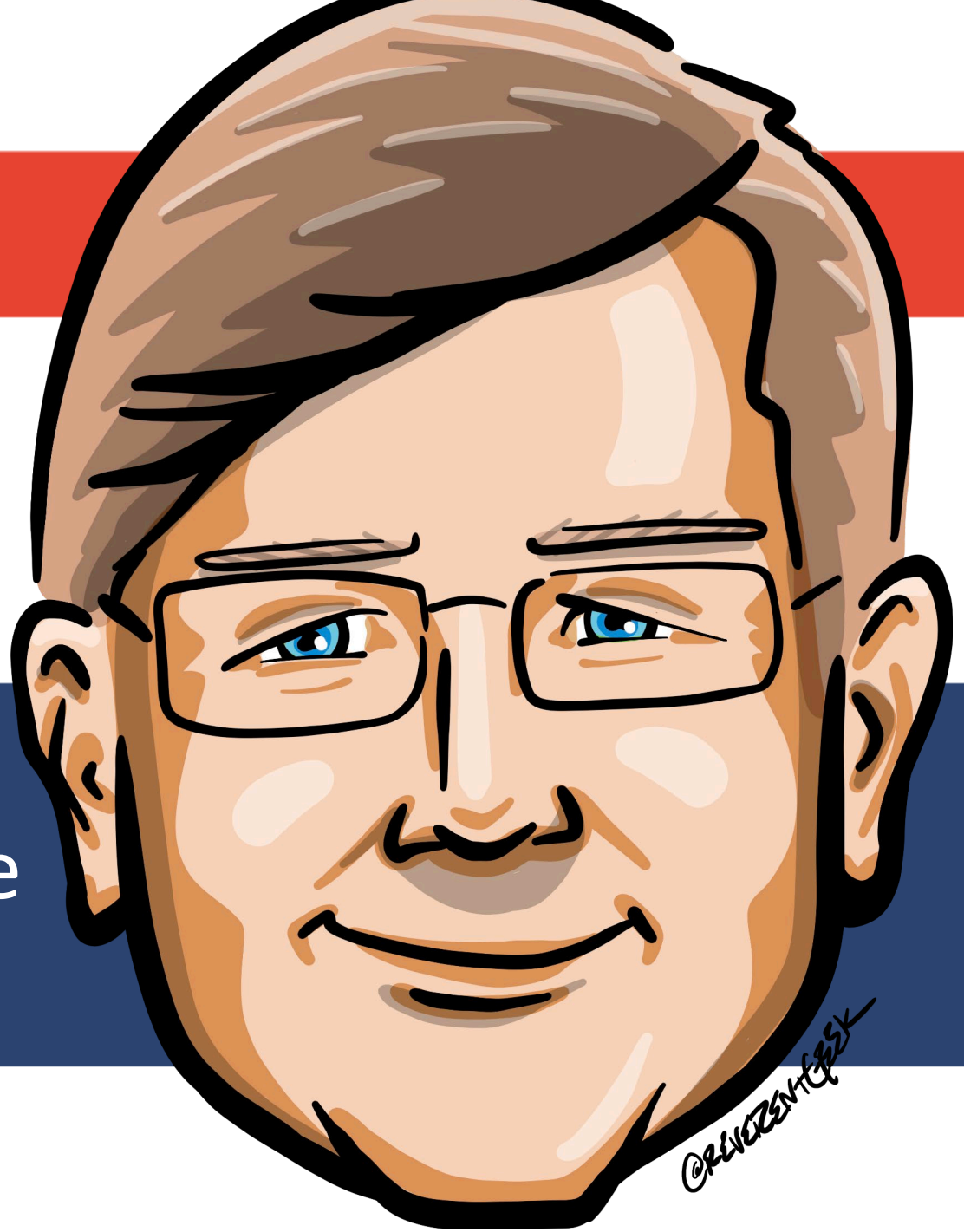
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