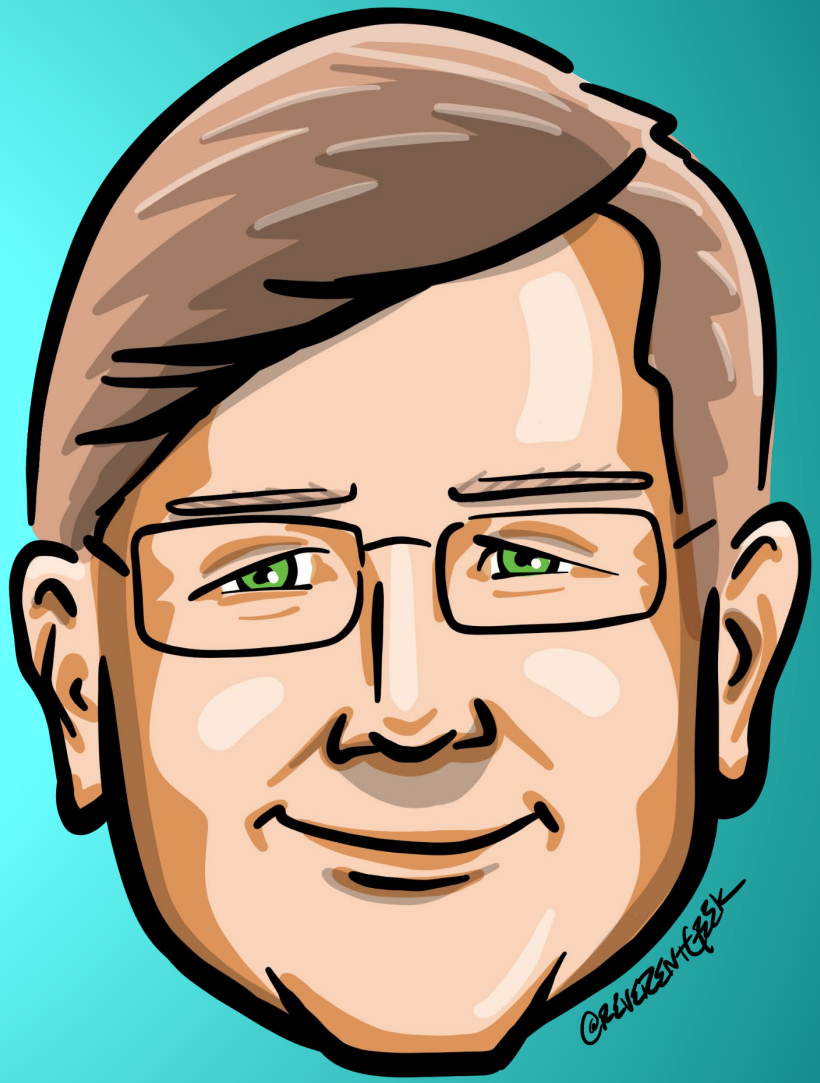
THE HITCHHIKER'S GUIDE TO THE COSMOS

MUSIC CITY TECH

Chad Green

Who is Chad Green

- chadgreen@chadgreen.com
- TaleLearnCode
- TaleLearnCode.com
- ChadGreen & TaleLearnCode
- ChadwickEGreen



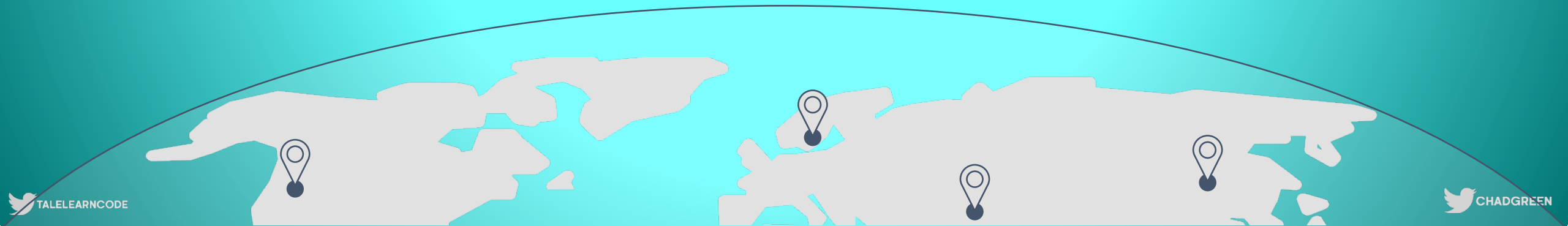
What is Cosmos DB

The Hitchhiker's Guide to the Cosmos

Azure Cosmos DB

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

Turnkey global distribution



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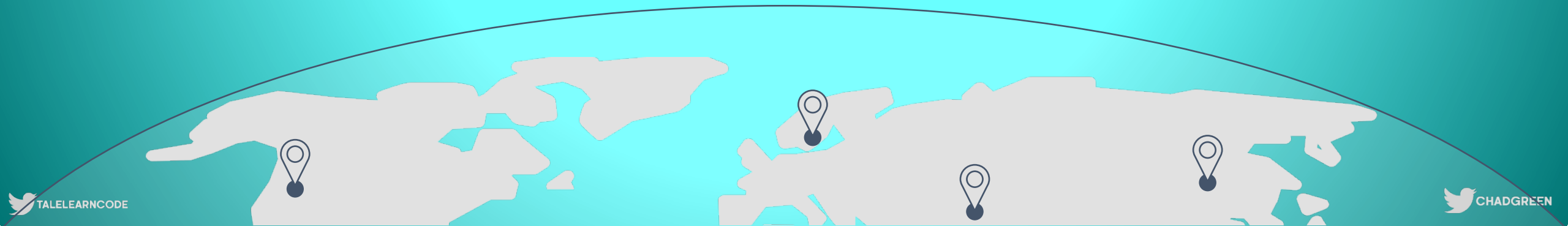

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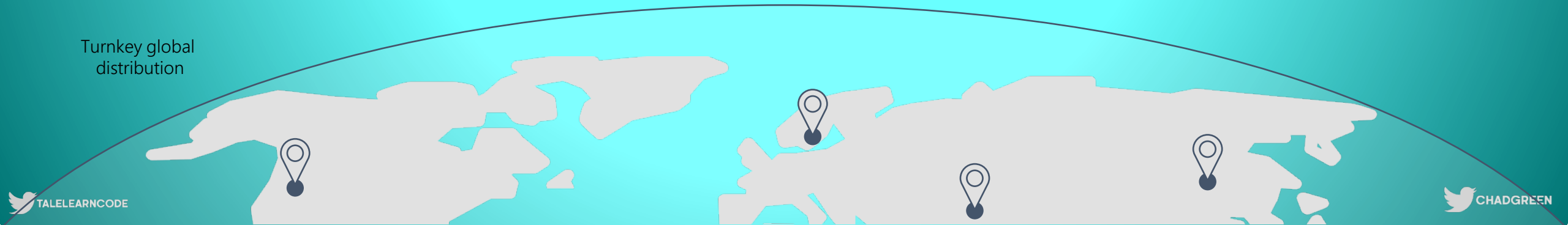

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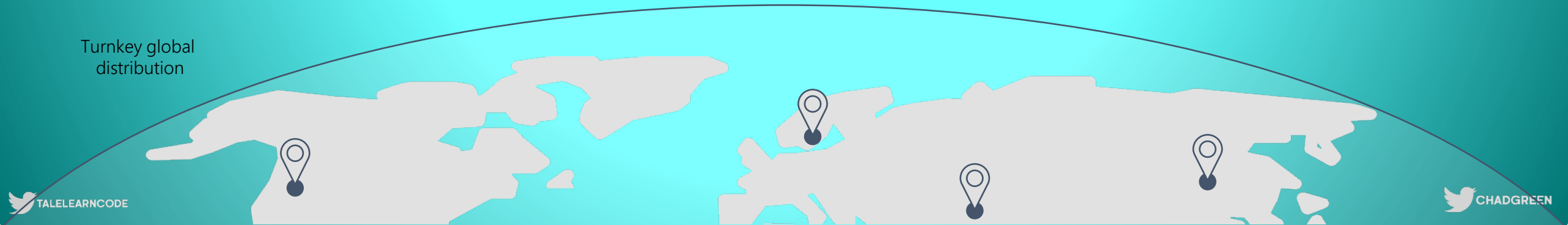

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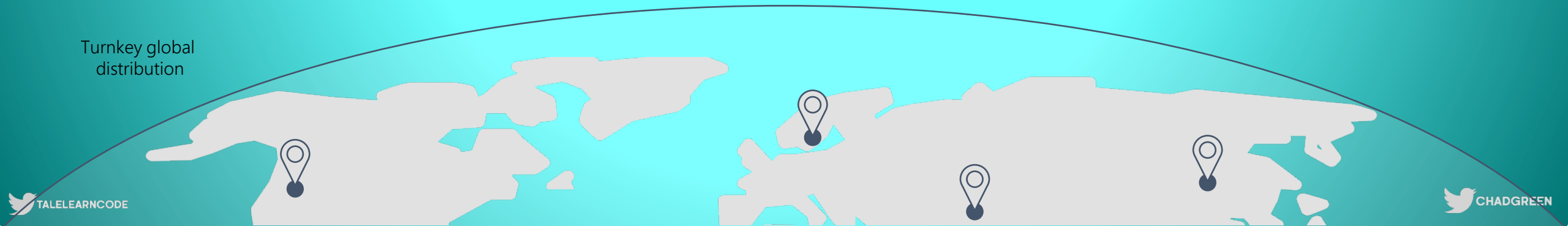

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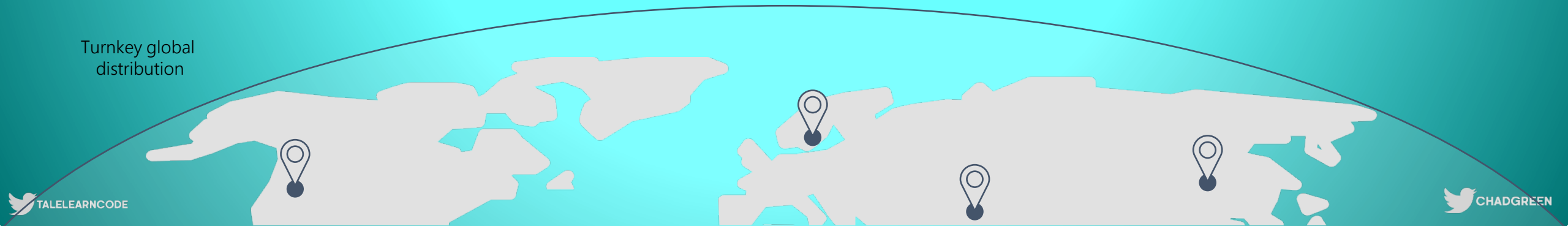

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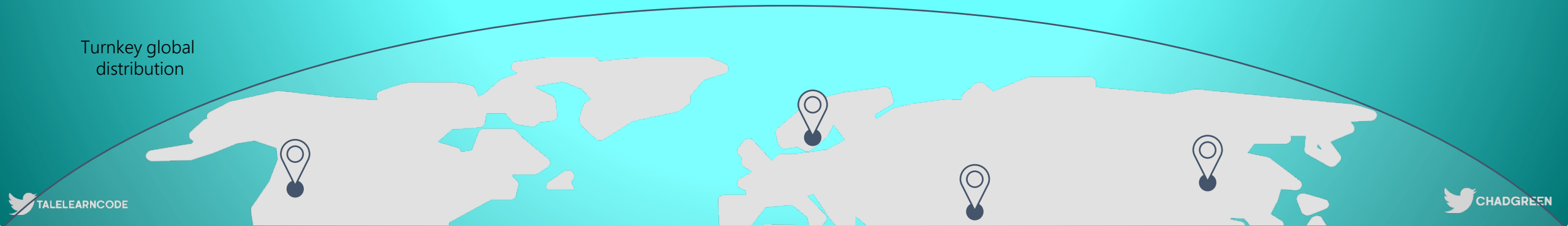

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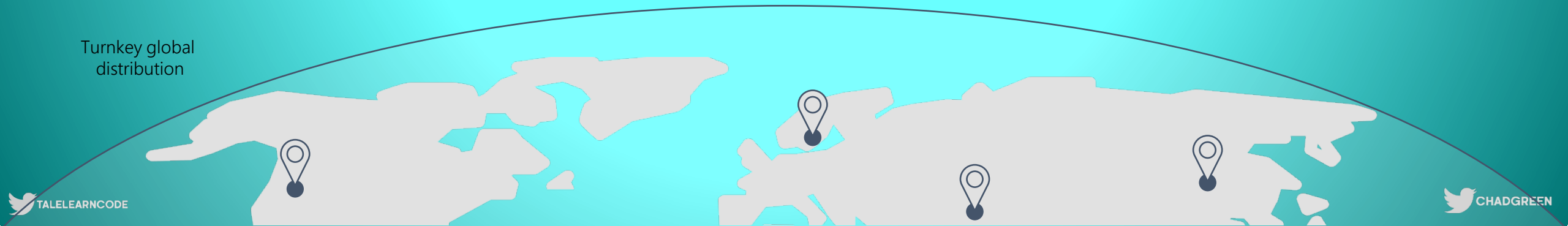

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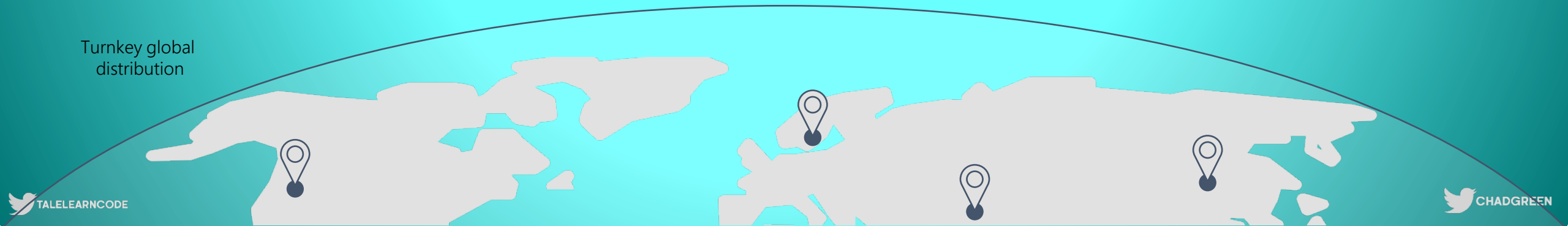

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Bounded Staleness

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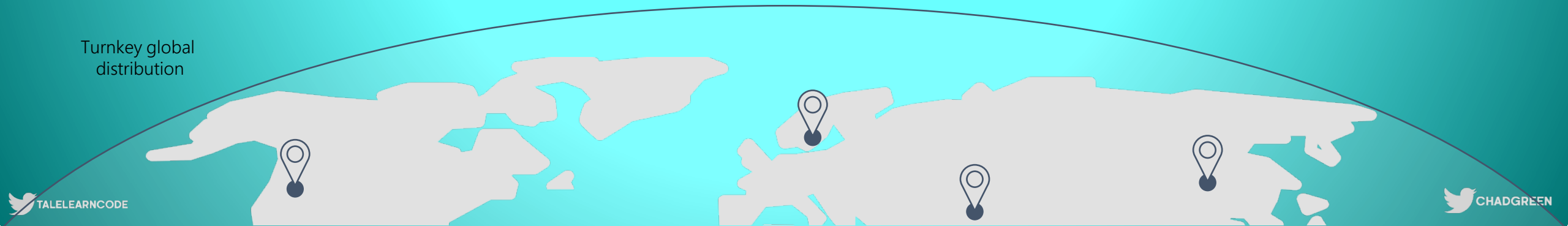

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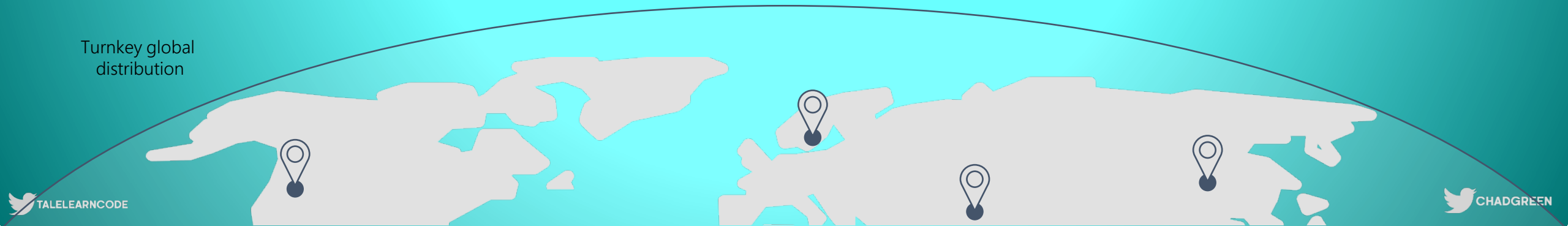

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Strong **Session** **Bounded Staleness**

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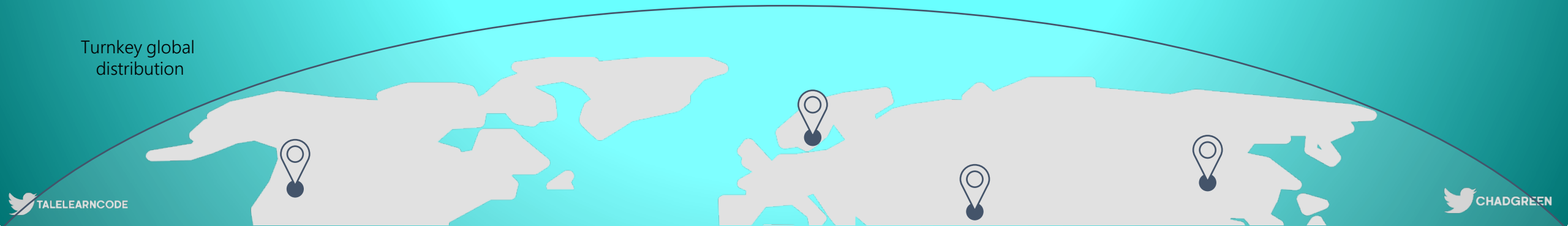

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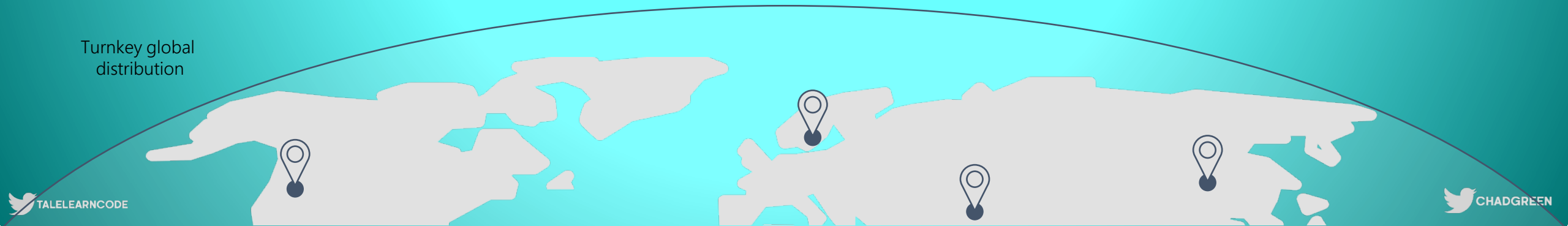

Azure Cosmos DB

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Consistent Prefix

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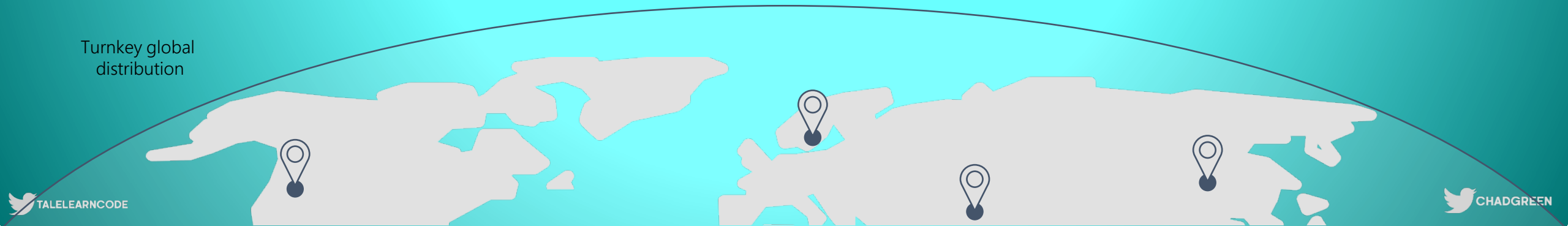

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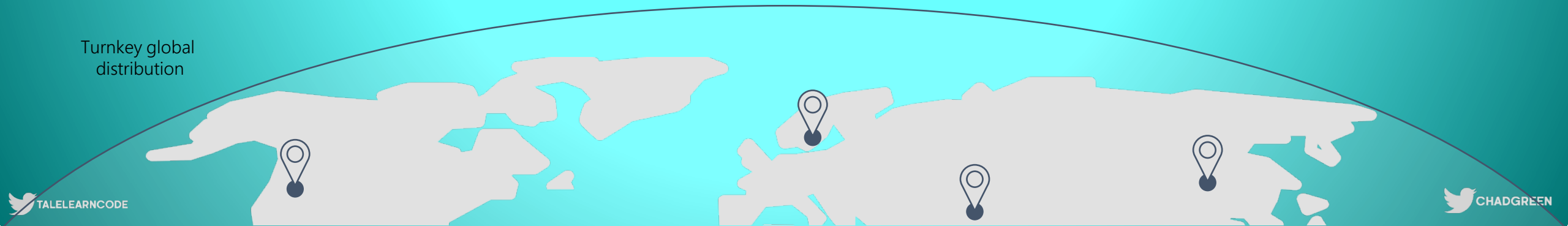

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Strong

Eventual

Bounded Staleness

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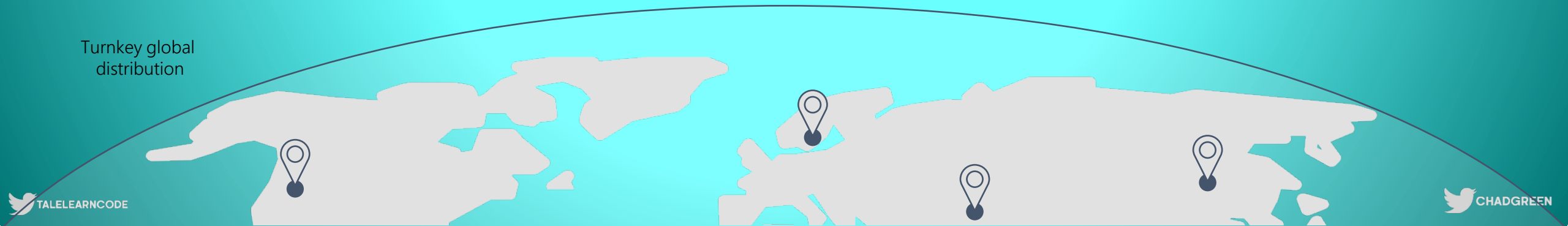

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Five well-defined consistency models

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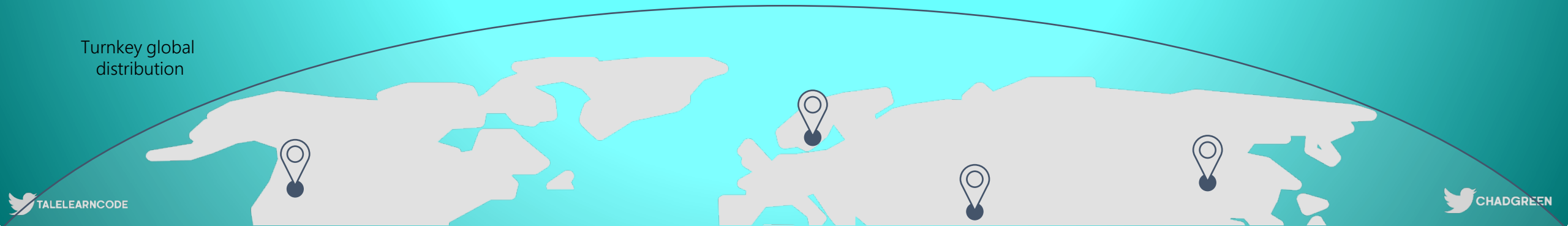

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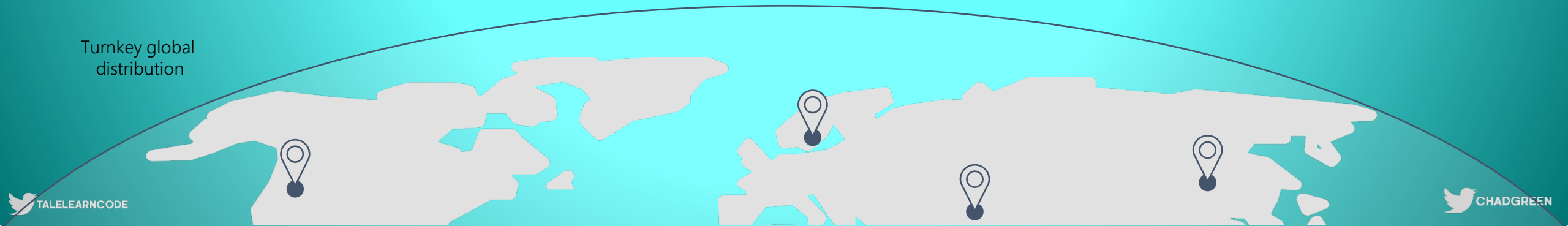

Azure Cosmos DB

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

Key-value

Column-family

Document

Graph

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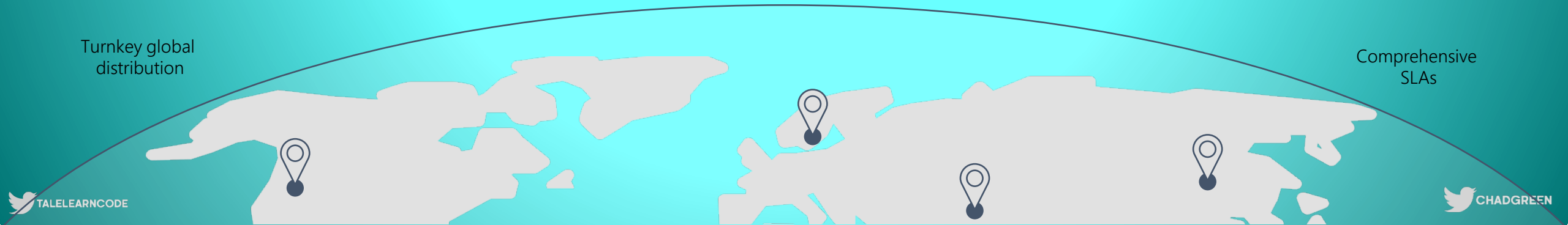

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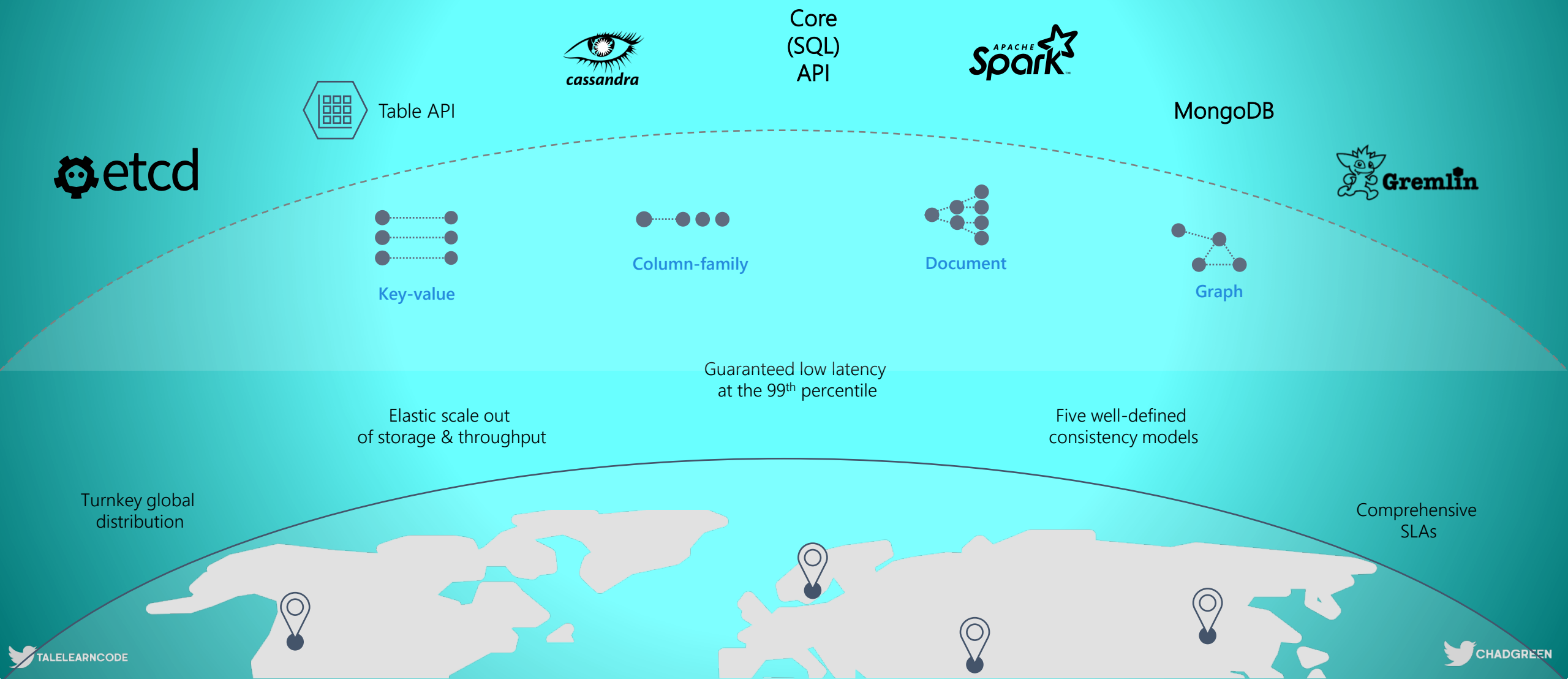

Azure Cosmos DB

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

What if we have REALLY large data requirements?

XBOX 360™

skype™

Office 365

Microsoft Azure

Azure Cosmos DB Capabilities

Resource	Default Limit
Maximum RUs per container	1,000,000
Maximum RUs per database	1,000,000
Maximum RUs per (logical) partition key	20-Gb
Maximum number of distinct (logical) partition keys	Unlimited
Maximum storage per container	Unlimited
Maximum storage per database	Unlimited
Maximum size of an item	2-Mb

Cosmos Use Cases

The Hitchhiker's Guide to the Cosmos

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IoT and Telematics

Azure Cosmos DB Use Cases

Ingest Bursts of Data

Process and Analyze Streaming Data

Archive Data to Cold Storage

IoT and Telematics

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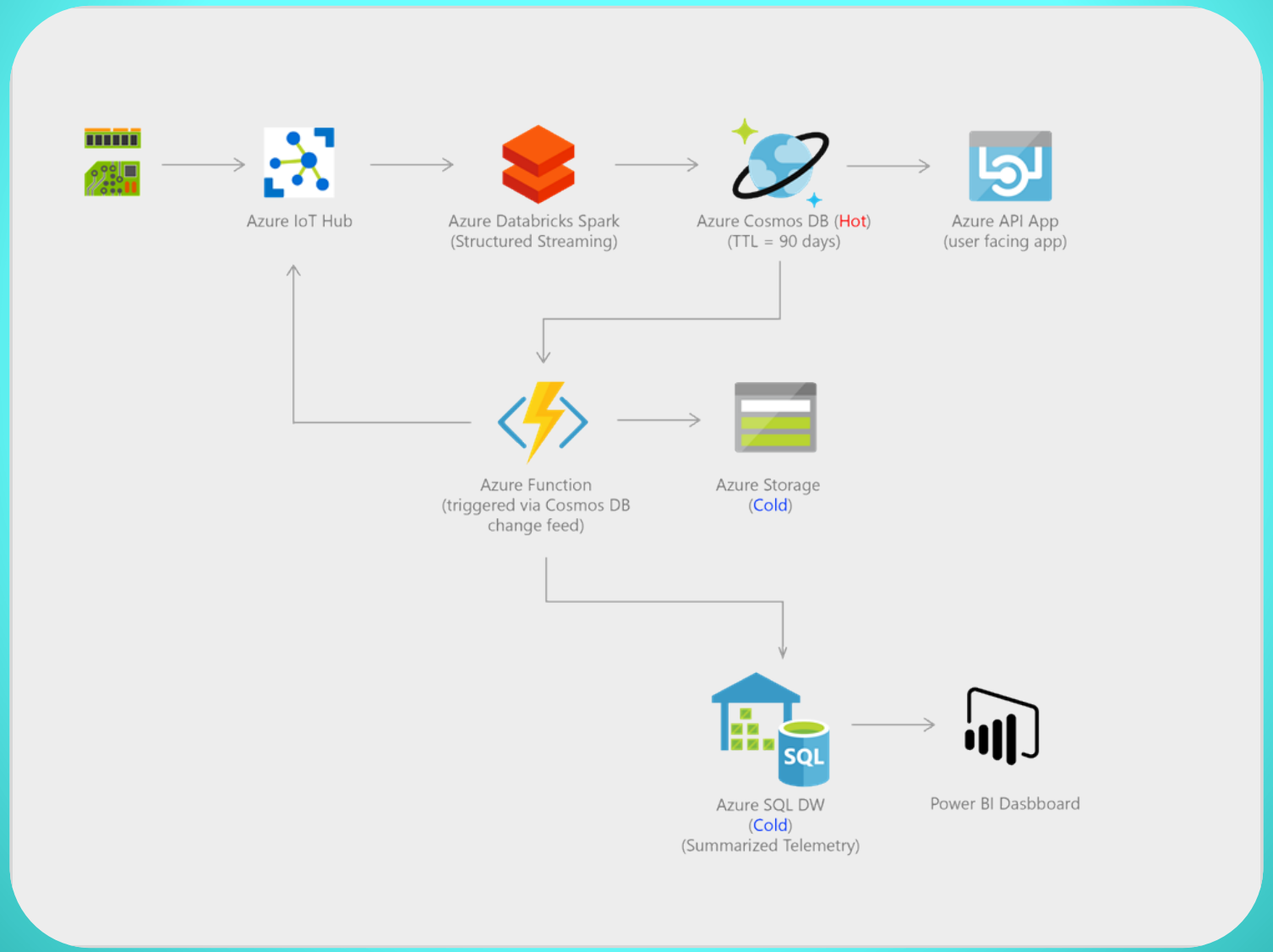

Retail Marketing

Azure Cosmos DB Use Cases

Storing and querying sets of attributes

User Accounts

Product Catalogs

IoT Device Registers

Retail Marketing

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User Accounts

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Retail and Marketing

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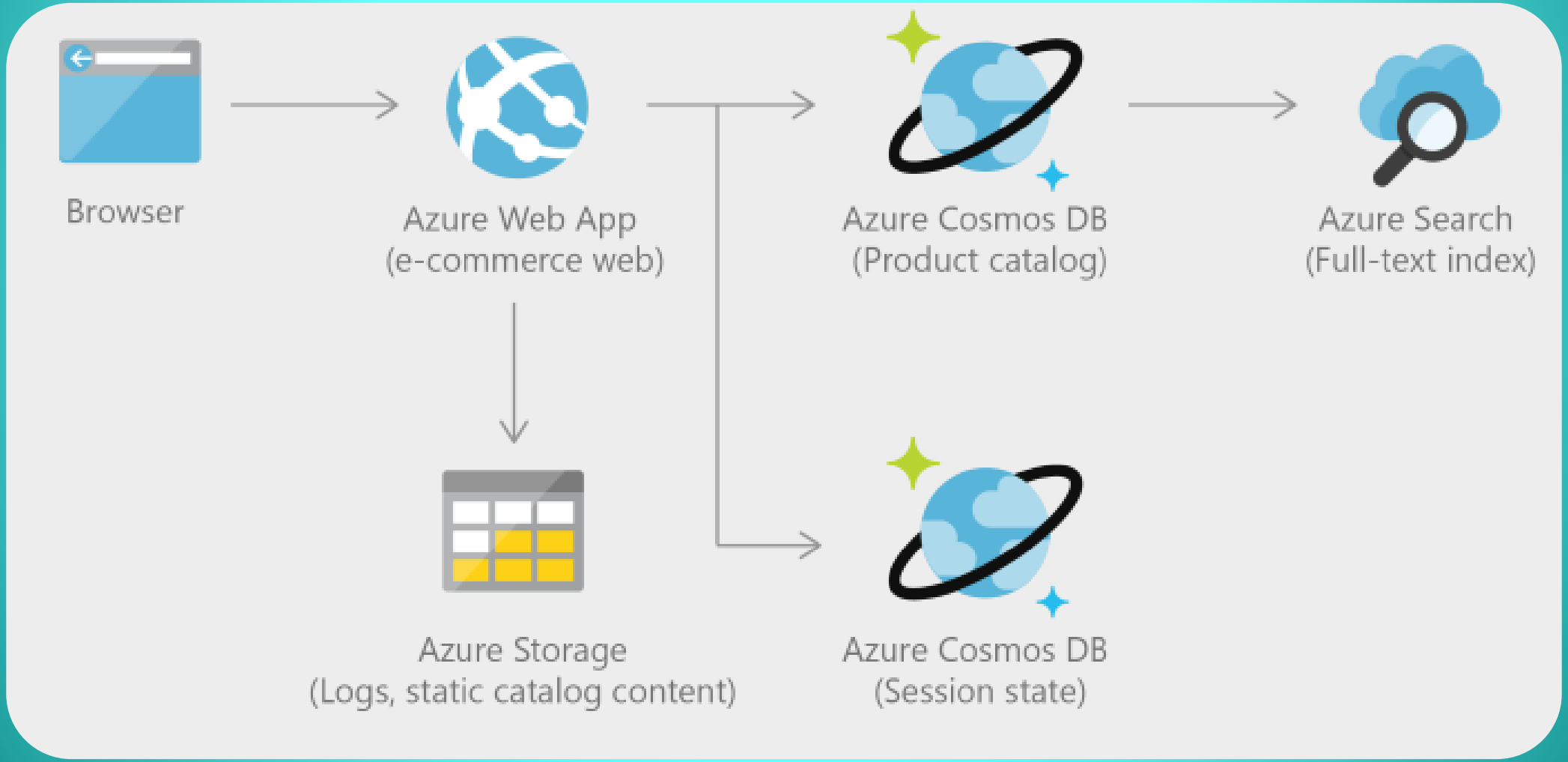

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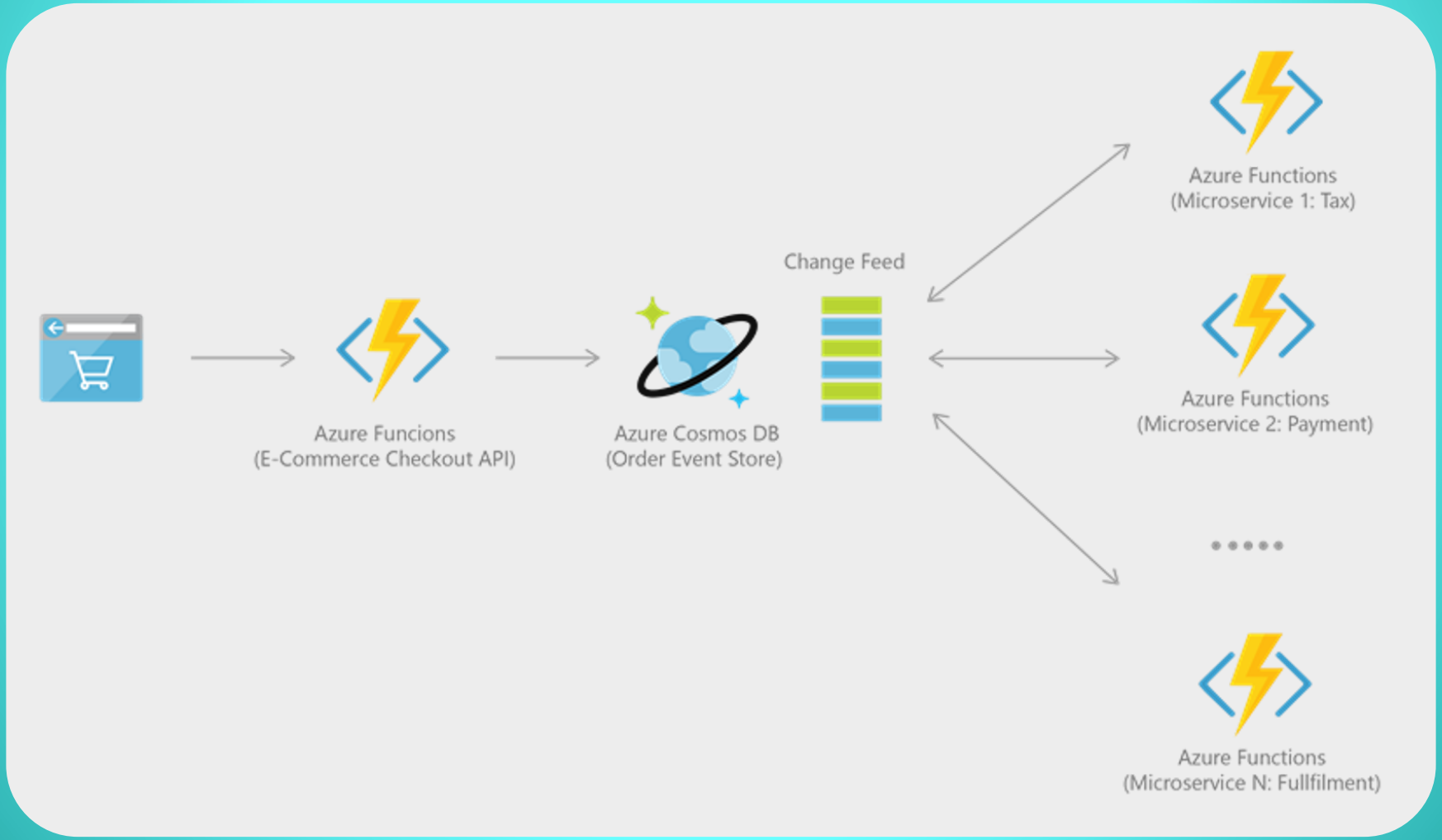

Gaming

Azure Cosmos DB Use Cases

Single-Millisecond Latencies

Handle Massive Spikes

Gaming

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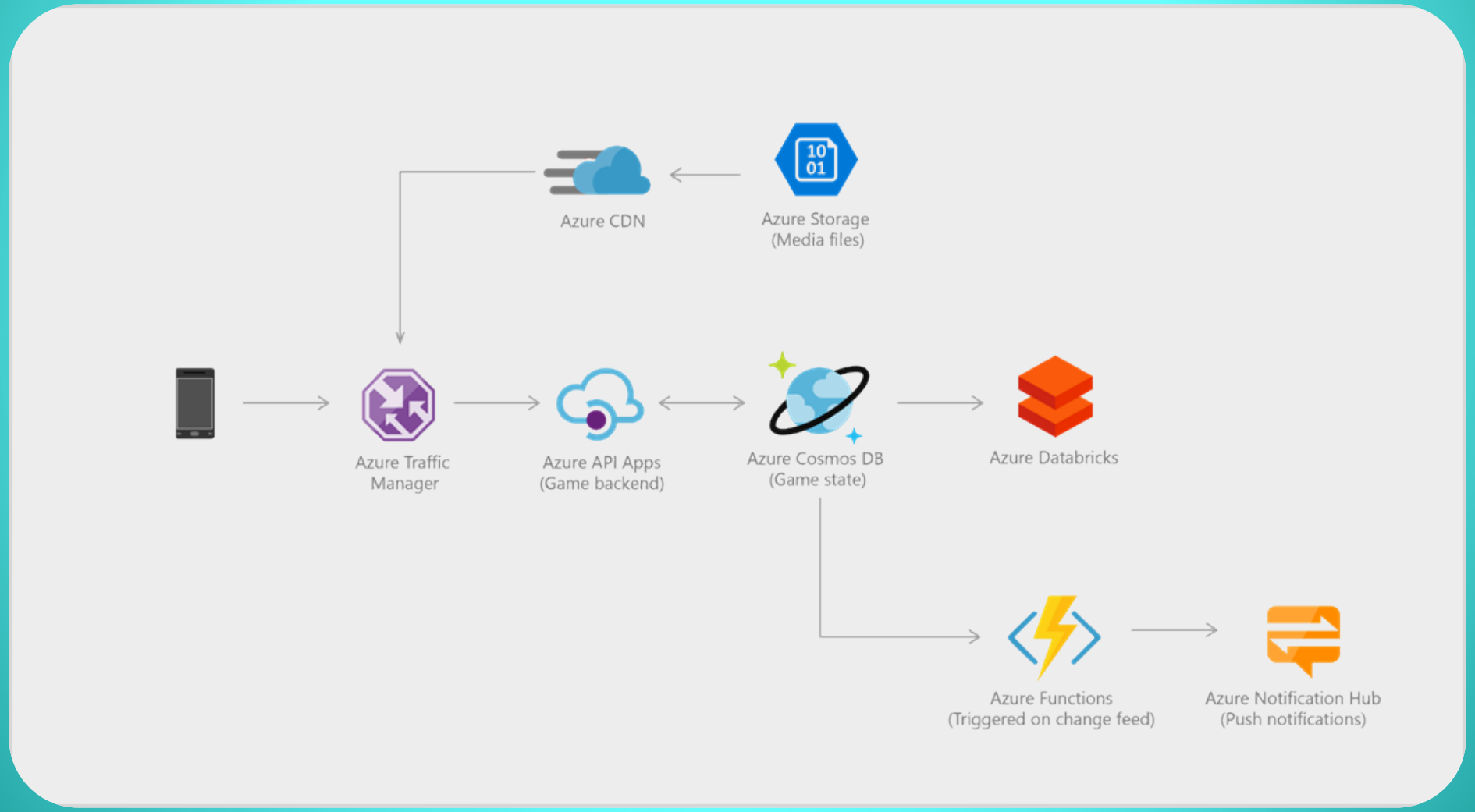

Web & Mobile Applications

Azure Cosmos DB Use Cases

- Modeling Social Interactions
- Integrating with Third-Party Services
- Building Rich Personalized Experiences

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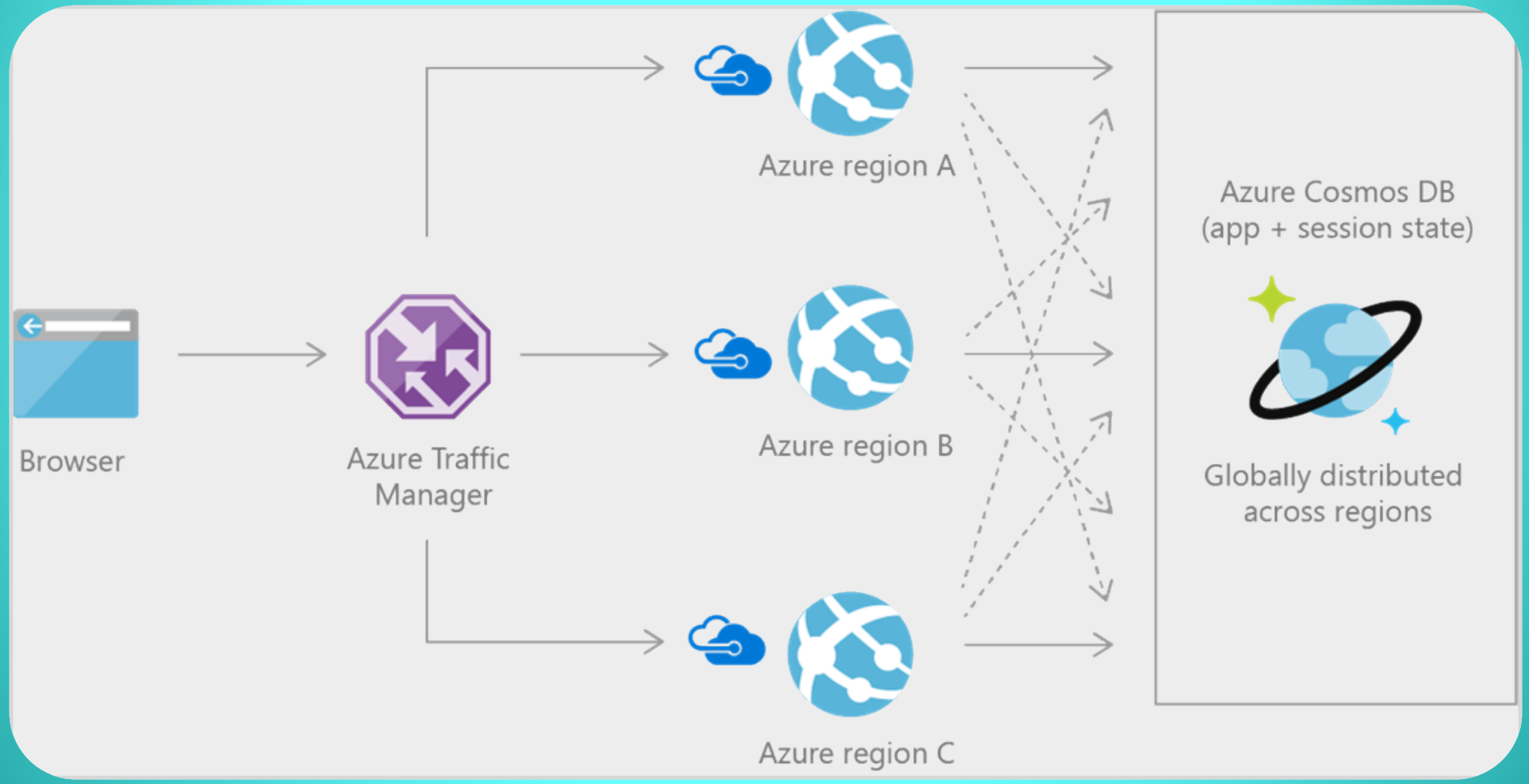

Integrations

The Hitchhiker's Guide to the Cosmos

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Cosmos DB Integrations

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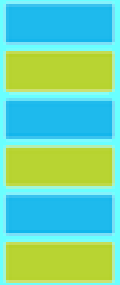

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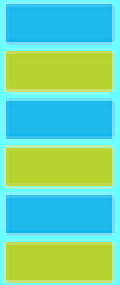

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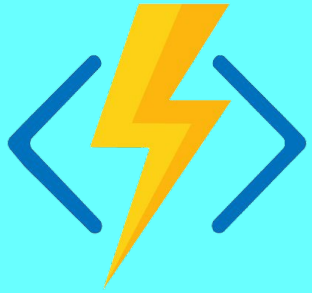

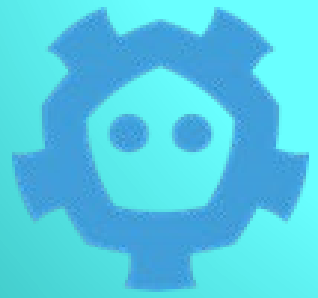

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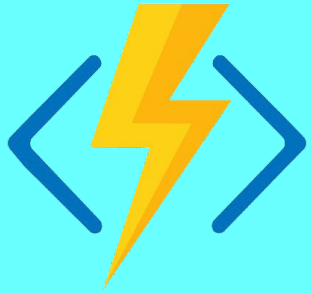

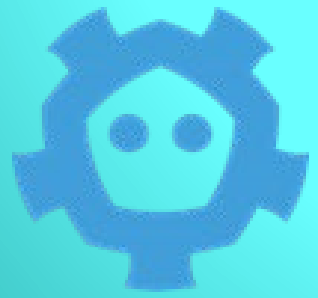

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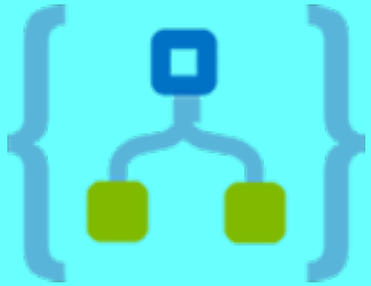

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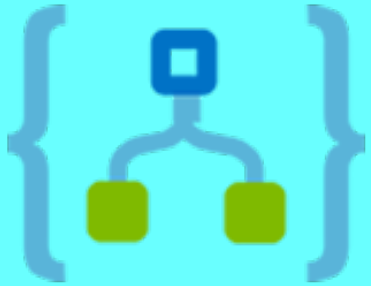

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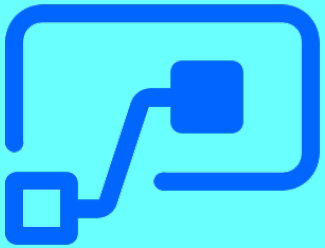
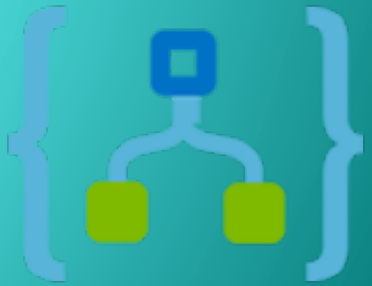


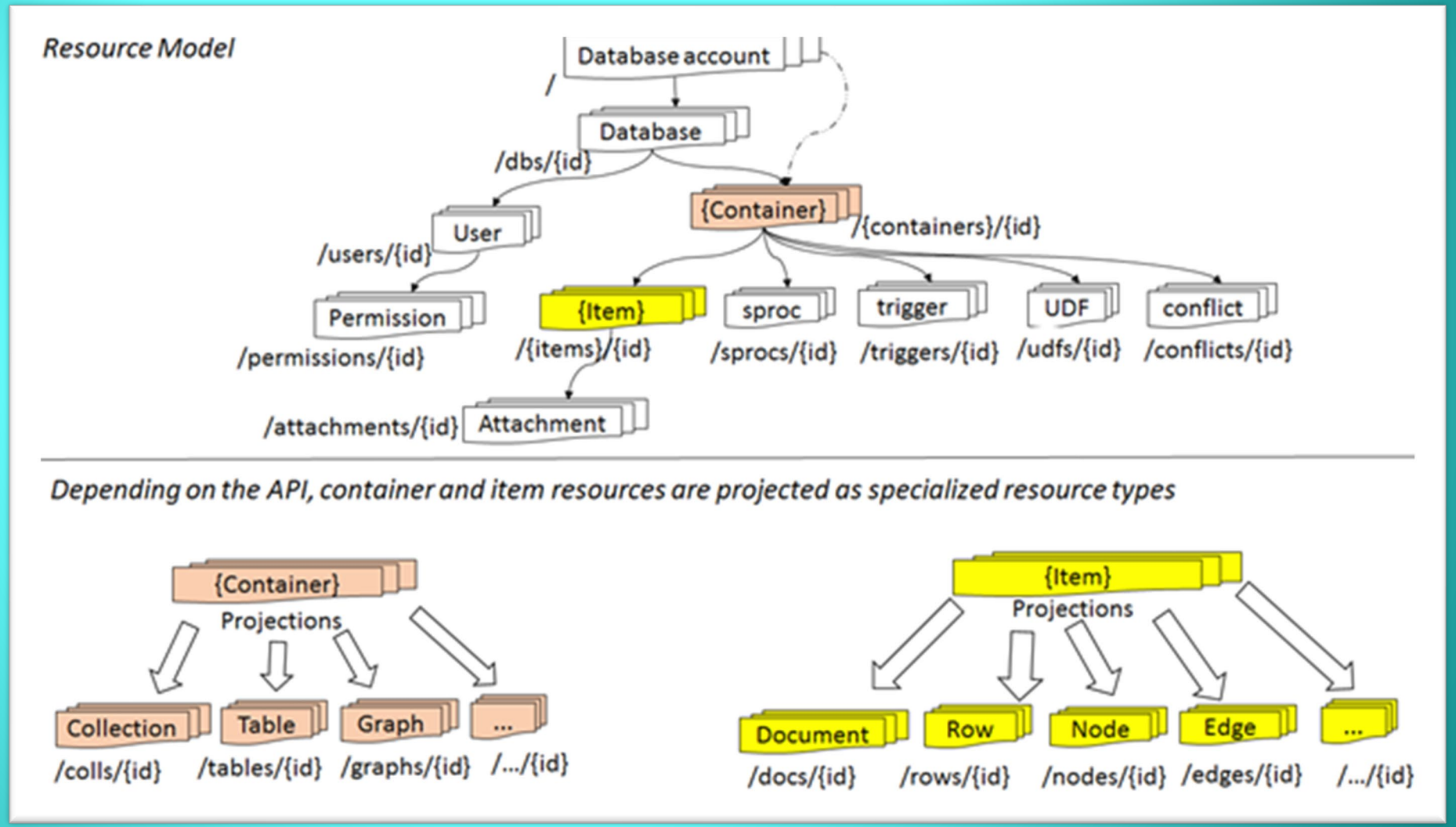


Wide-Range of Data APIs

The Hitchhiker's Guide to the Cosmos

Atom Resource Sequence

Wide-Range of Data APIs



SQL API

Document Database

SQL API – What

Wide-Range of Data APIs

Document Database

SQL to Query JSON Documents

JavaScript Programming Model

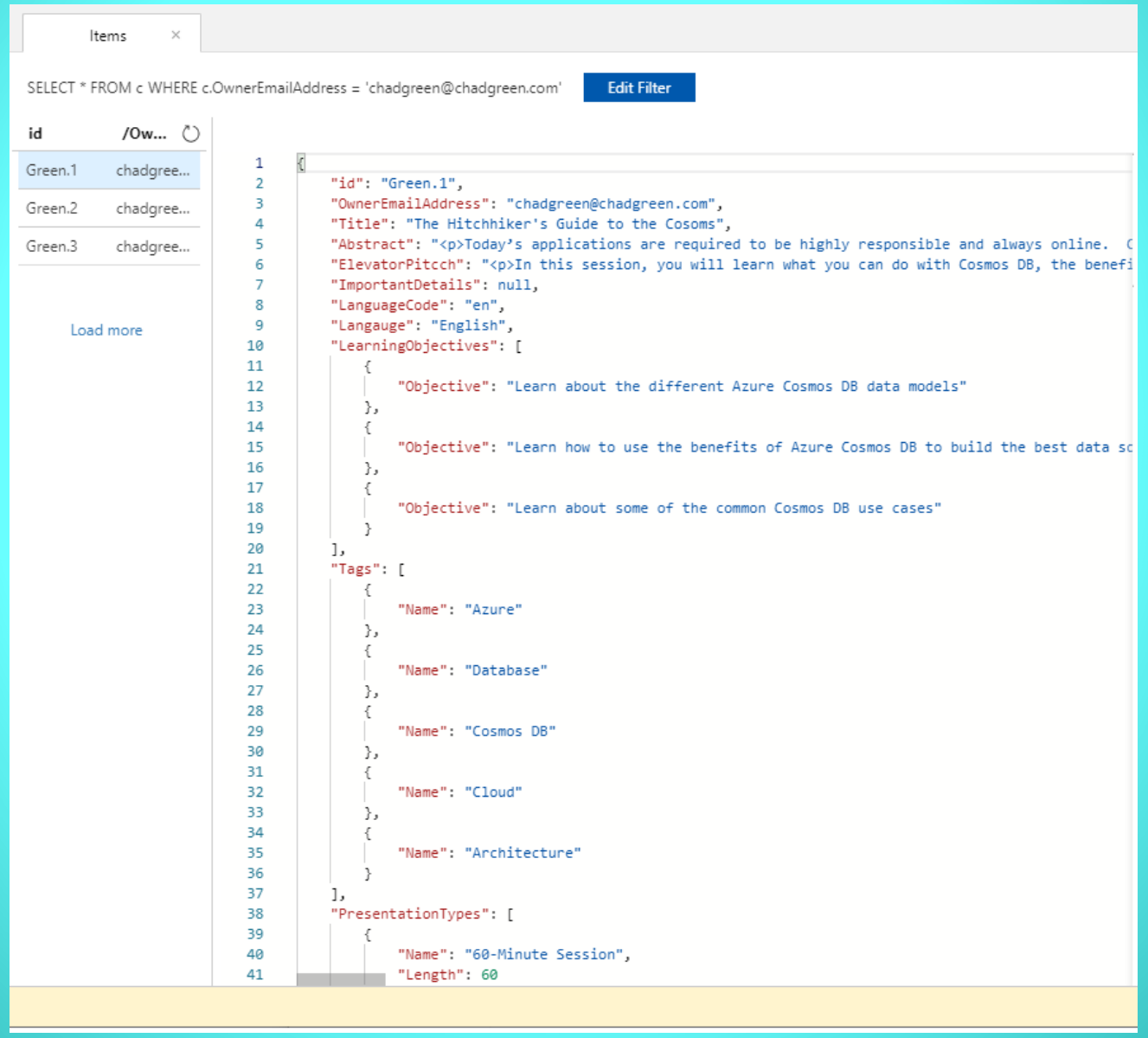
SQL API – When

Wide-Range of Data APIs

Building a new non-relational document database and want to query using SQL

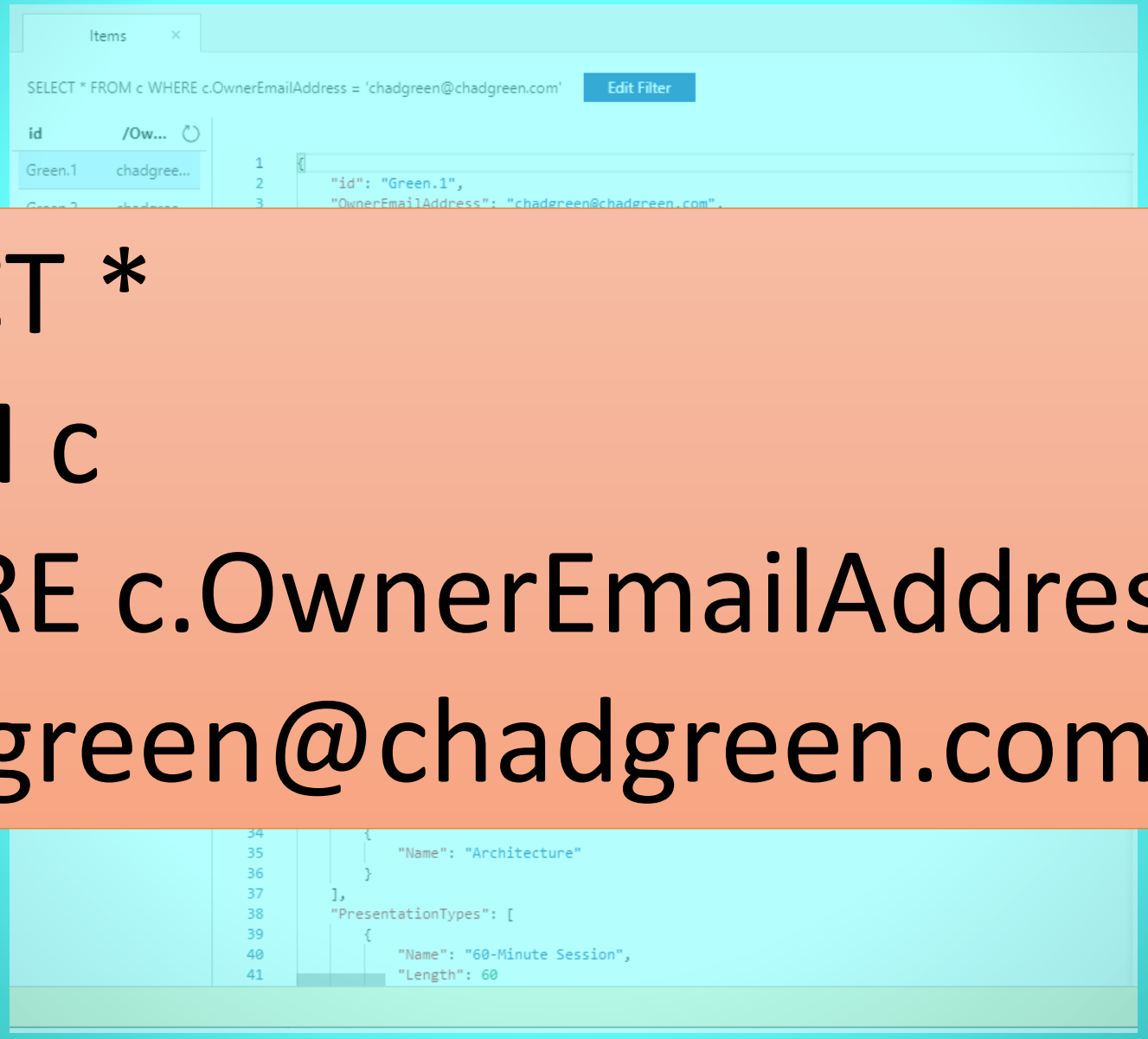
SQL API – How: Data Model

Wide-Range of Data APIs



SQL API – How: Data Model

Wide-Range of Data APIs




```
SELECT *
FROM c
WHERE c.OwnerEmailAddress =
'chadgreen@chadgreen.com'
```

SQL API – How: Insert

Wide-Range of Data APIs

```
public class Presentation
{
  [JsonProperty(PropertyName = "id")]
  public string Id { get; set; }

  public string OwnerEmailAddress { get; set; }
  public string Title { get; set; }
  public string Abstract { get; set; }
  public string ElevatorPitcch { get; set; }
  public string ImportantDetails { get; set; }
  public string LanguageCode { get; set; }
  public string Langauge { get; set; }
  public LearningObjective[] LearningObjectives { get; set; }
  public Tag[] Tags { get; set; }
  public PresentationType[] PresentationTypes { get; set; }
}
```

SQL API – How: Insert

Wide-Range of Data APIs

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  public PresentationType[] PresentationTypes { get; set; }
}
```

SQL API – How: Insert

Wide-Range of Data APIs

```
private async Task AddPresentation(ExistingPresentation existingPresentation)
{
  Presentation presentation = Generate.Presentation(existingPresentation);
  try
  {
    ItemResponse<Presentation> presentationResponse =
        await this.container.ReadItemAsync<Presentation>(presentation.Id,
        new PartitionKey(presentation.OwnerEmailAddress));
    Console.WriteLine("Item in database with id: {0} already exists\n",
        presentationResponse.Resource.Id);
  }
  catch
  (
    CosmosException ex) when (ex.StatusCode == HttpStatusCode.NotFound)
    {
      ItemResponse<Presentation> presentationResponse =
          await this.container.CreateItemAsync<Presentation>(presentation,
          new PartitionKey(presentation.OwnerEmailAddress));
      Console.WriteLine("Created item with id: {0} Using {1} RUs.\n",
      presentationResponse.Resource.Id, presentationResponse.RequestCharge);
    }
  }
}
```

SQL API – How: Insert

Wide-Range of Data APIs

```
private async Task AddPresentation(ExistingPresentation existingPresentation)
{
  Presentation presentation = Generate.Presentation(existingPresentation);
   try
   {
     ItemResponse<Presentation> presentationResponse =
         await this.container.ReadItemAsync<Presentation>(presentation.Id,
         new PartitionKey(presentation.OwnerEmailAddress));
     Console.WriteLine("Item in database with id: {0} already exists\n",
         presentationResponse.Resource.Id);
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SQL API – How: Insert

Wide-Range of Data APIs

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           new PartitionKey(presentation.OwnerEmailAddress));
       Console.WriteLine("Created item with id: {0} Using {1} RUs.\n",
       presentationResponse.Resource.Id, presentationResponse.RequestCharge);
     }
  }
}
```

SQL API – How: Query

Wide-Range of Data APIs

```
private async Task QueryPresentationsAsync()
{
  var sqlQueryText = "SELECT * FROM c WHERE c.OwnerEmailAddress = 'chadgreen@chadgreen.com'";
  Console.WriteLine("Running query: {0}\n", sqlQueryText);

  QueryDefinition queryDefinition = new QueryDefinition(sqlQueryText);
  FeedIterator<Presentation> queryResultSetIterator
      = this.container.GetItemQueryIterator<Presentation>(queryDefinition);

  List<Presentation> presentations = new List<Presentation>();
  while (queryResultSetIterator.HasMoreResults)
  {
    FeedResponse<Presentation> currentResultSet = await queryResultSetIterator.ReadNextAsync();
    foreach (Presentation presentation in currentResultSet)
    {
      presentations.Add(presentation);
      Console.WriteLine($"\t{presentation.Title}");
    }
  }
}
```

SQL API – How: Query

Wide-Range of Data APIs

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SQL API – How: Query

Wide-Range of Data APIs

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SQL API – How: Query

Wide-Range of Data APIs

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  {
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    foreach (Presentation presentation in currentResultSet)
    {
      presentations.Add(presentation);
      Console.WriteLine($"\t{presentation.Title}");
    }
  }
}
```

SQL API – Querying Options

Wide-Range of Data APIs

API

LINQ to SQL

JavaScript

Entity Framework

MongoDB

Document Database

{ LEAF }

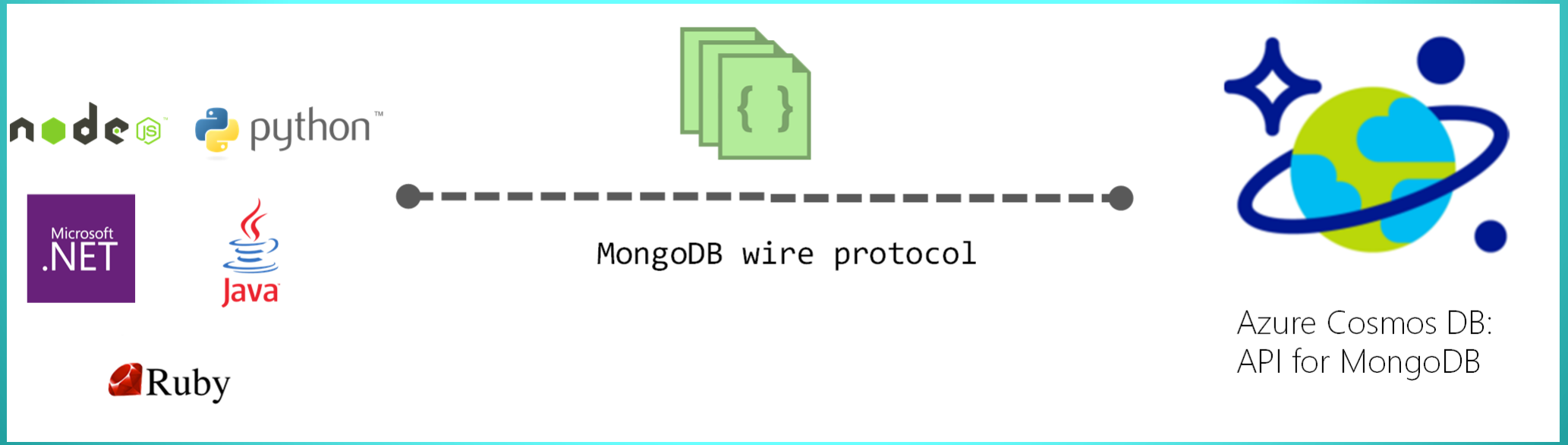
MongoDB – What

Wide-Range of Data APIs

Native Implementation

Interact Transparently

V3.6 Compatibility



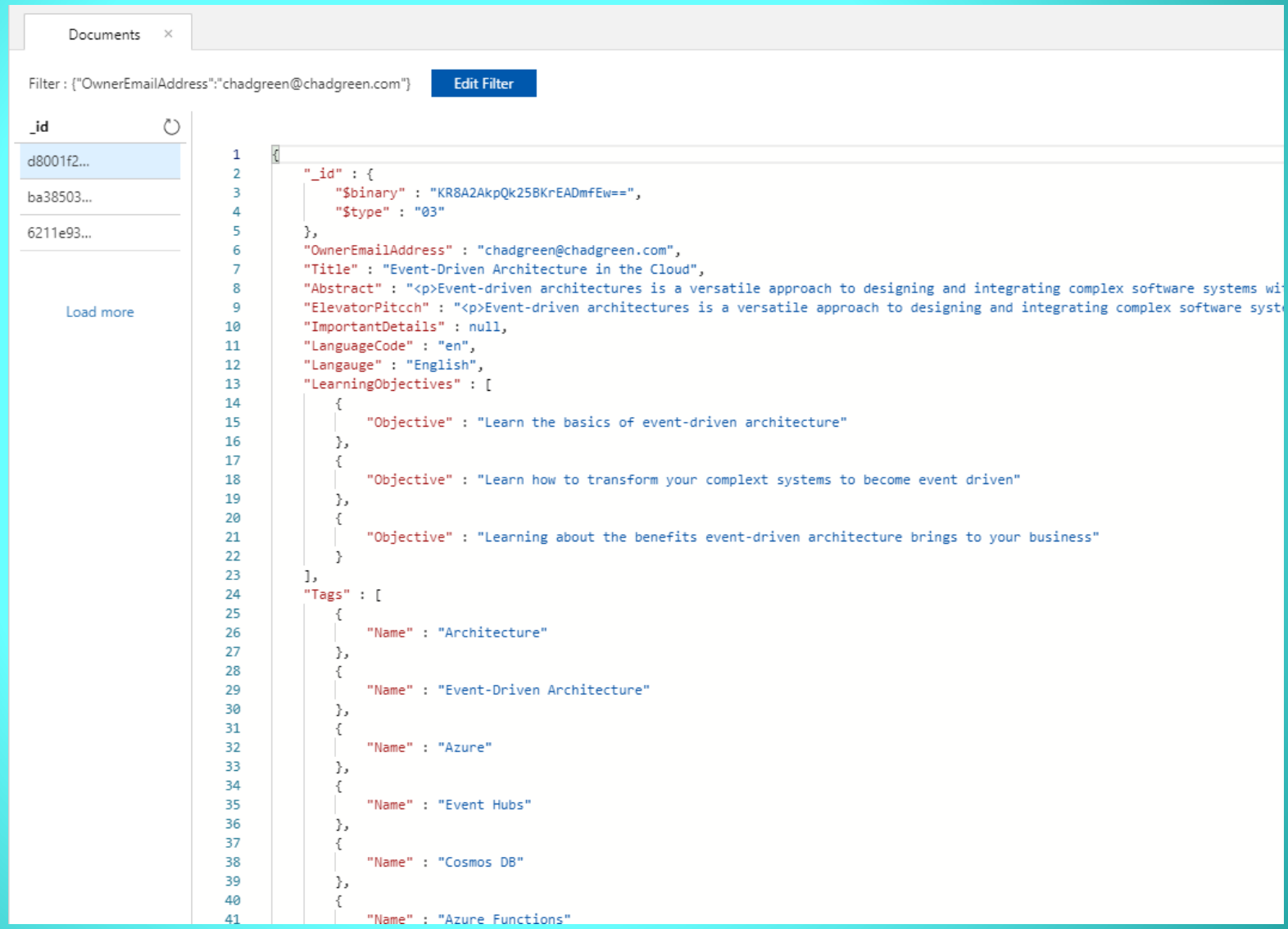
MongoDB – When

Wide-Range of Data APIs

Migrating data from a MongoDB database to Azure Cosmos DB's fully managed service

MongoDB – How: Data Model

Wide-Range of Data APIs



MongoDB – How: Data Model

Wide-Range of Data APIs

Filter: {"OwnerEmailAddress": "chadgreen@chadgreen.com"}

MongoDB – How: Insert

Wide-Range of Data APIs

```
public class Presentation
{
  [BsonId(IdGenerator =typeof(CombGuidGenerator))] public Guid Id { get; set; }

  [BsonElement("OwnerEmailAddress")] public string OwnerEmailAddress { get; set; }

  [BsonElement("Title")] public string Title { get; set; }

  [BsonElement("Abstract")] public string Abstract { get; set; }

  [BsonElement("ElevatorPitcch")] public string ElevatorPitcch { get; set; }

  [BsonElement("ImportantDetails")] public string ImportantDetails { get; set; }

  [BsonElement("LanguageCode")] public string LanguageCode { get; set; }

  [BsonElement("Langauge")] public string Langauge { get; set; }

  [BsonElement("LearningObjectives")] public LearningObjective[] LearningObjectives { get; set; }

  [BsonElement("Tags")] public Tag[] Tags { get; set; }

  [BsonElement("PresentationTypes")] public PresentationType[] PresentationTypes { get; set; }
}
```

MongoDB – How: Insert

Wide-Range of Data APIs

```
public void CreatePresentation(Presentation presentation)
{
  var collection = GetPresentationsCollection();
  try
  {
    collection.InsertOne(presentation);
  }
  catch (MongoCommandException ex)
  {
    string msg = ex.Message;
  }
}
```

MongoDB – How: Insert

Wide-Range of Data APIs

```
private IMongoCollection<Presentation> GetPresentationsCollection()
{
  MongoClientSettings settings = new MongoClientSettings();
  settings.Server = new MongoServerAddress(host, 10255);
  settings.UseTls = true;
  settings.SslSettings = new SslSettings();
  settings.SslSettings.EnabledSslProtocols = SslProtocols.Tls12;

  MongoIdentity identity = new MongoInternalIdentity(dbName, userName);
  MongoIdentityEvidence evidence = new PasswordEvidence(password);

  settings.Credential = new MongoCredential("SCRAM-SHA-1", identity, evidence);

  MongoClient client = new MongoClient(settings);
  var database = client.GetDatabase(dbName);
  var presetationCollection = database.GetCollection<Presentation>(collectionName);
  return presetationCollection;
}
```

MongoDB – How: Query

Wide-Range of Data APIs

```
public List<Presentation> GetAllPresentations()
{
  try { var collection = GetPresentationsCollection();
  return collection.Find(new BsonDocument()).ToList();
}
  catch (MongoConnectionException)
  {
    return new List<Presentation>();
  }
}
```

MongoDB – Cosmos or Atlas

Wide-Range of Data APIs

Cosmos DB

- Small documents – the smaller the cheaper
- Read more often than write
- Like idea to start small and pay-as-you-go
- Support included in Azure subscription
- Need a guaranteed latency despite usage

MongoDB Atlas

- Any size documents (only choice for documents over 2-Mb)
- Like to have a fixed budget for storage
- Use Mongo-API features that are not covered by Cosmos DB
- Freedom to create unique indexes
- Write data more often than read
- Want to decide backup policy

https://blog.chudinov.net/azure-cosmosdb-vs-mongodb-atlas/

Graph API

Graph Database

Graph API – What

Wide-Range of Data APIs

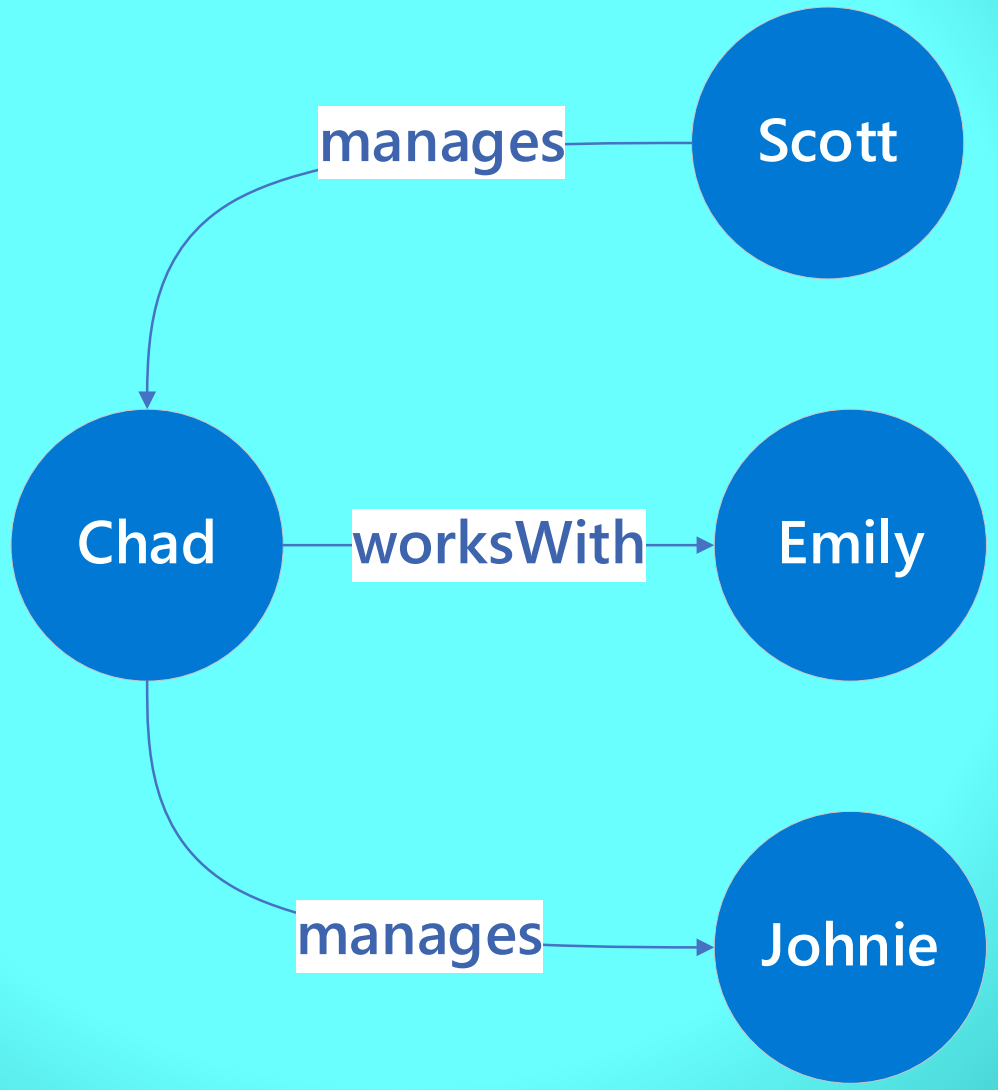
Vertices and Edges

Natural Data Representation

Model All Kinds of Scenarios

What is a Graph

Wide-Range of Data APIs



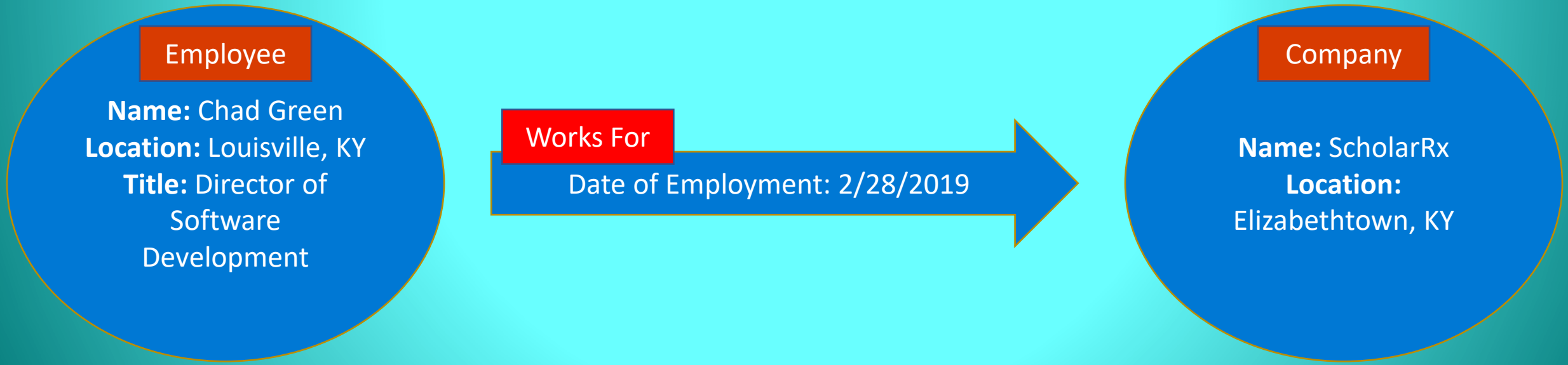
Property Graph Model

Wide-Range of Data APIs

Contains **nodes** (vertices) and **relationships** (edges)

Nodes and relationships contain **properties**

Relationships are **named** and **directed** with a **start** and **end** node



The Power of Graph Databases

Wide-Range of Data APIs

Performance

The Power of Graph Databases

Wide-Range of Data APIs

Performance

Flexibility

The Power of Graph Databases

Wide-Range of Data APIs

Performance

Flexibility

Agility

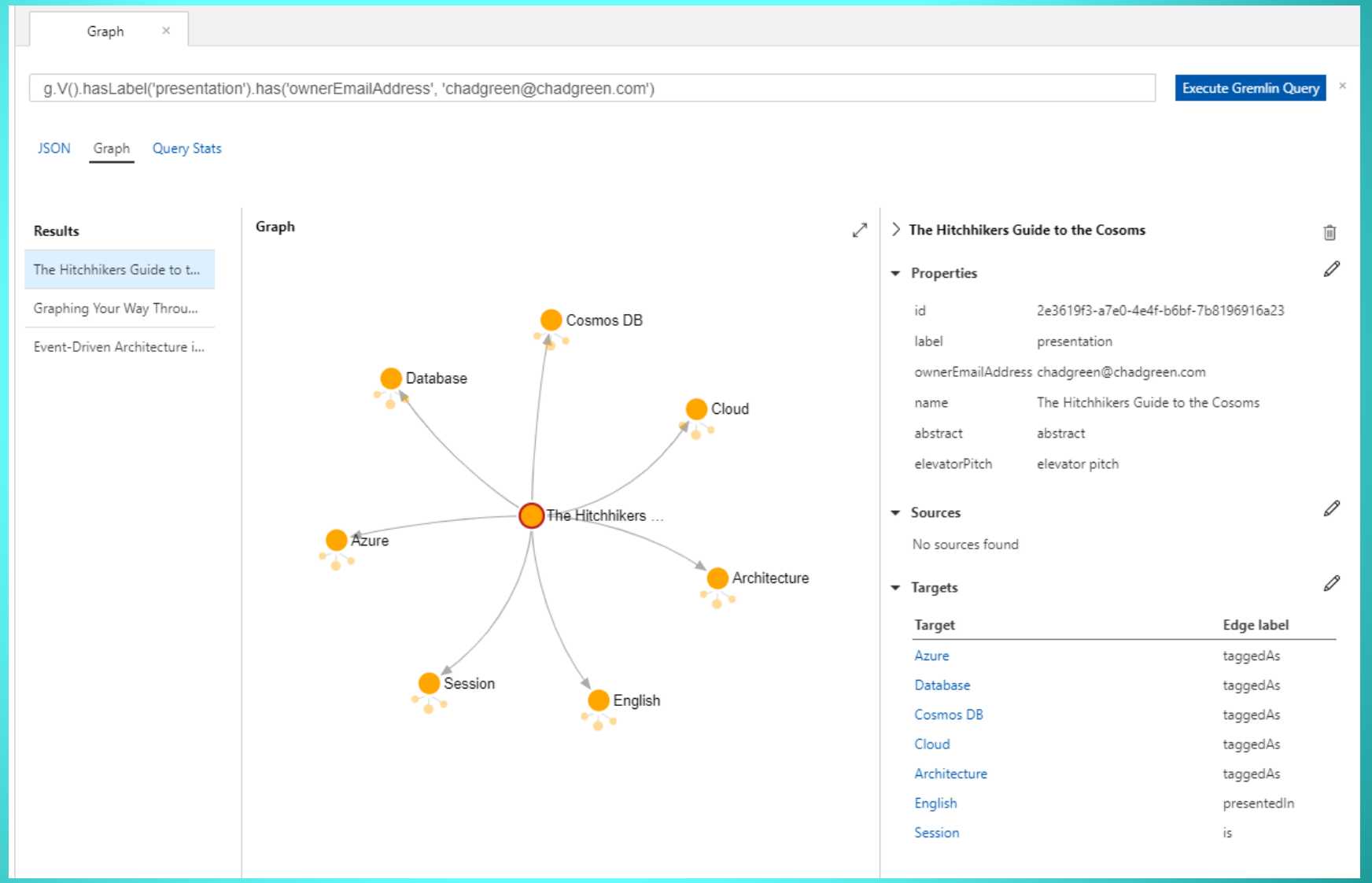
Graph API – When

Wide-Range of Data APIs

Building a graph database to model and traverse relationships among entities

Graph API – How: Data Model

Wide-Range of Data APIs



Graph API – How: Data Model

Wide-Range of Data APIs


```
g.V().hasLabel
('presentation')
.has('ownerEmailAddress',
'chadgreen@chadgreen.com')
```

Graph API – How: Insert

Wide-Range of Data APIs

```
g.addV('presentation')
.property('ownerEmailAddress', 'chadgreen@chadgreen.com')
.property('name', 'The Hitchhikers Guide to the Cosmos')
.property('abstract', 'This is a really cool talk!')
.property('elevatorPitch', 'Cool talk!')
```

Graph API – How: Insert

Wide-Range of Data APIs

```
private static Task<ResultSet<dynamic>> SubmitRequest(GremlinClient gremlinClient,
    KeyValuePair<string, string> query)
{
  try
  {
    return gremlinClient.SubmitAsync<dynamic>(query.Value);
  }
  catch (ResponseException e)
  {
    Console.WriteLine("\tRequest Error!");
    Console.WriteLine($"\tStatusCode: {e.StatusCode}");
    PrintStatusAttributes(e.StatusAttributes);
    Console.WriteLine($"\t[\"x-ms-retry-after-ms\"] :
        { GetValueAsString(e.StatusAttributes, "x-ms-retry-after-ms")}");
    Console.WriteLine($"\t[\"x-ms-activity-id\"] :
        { GetValueAsString(e.StatusAttributes, "x-ms-activity-id")}");

    throw;
  }
}
```

Graph API – How: Insert

Wide-Range of Data APIs

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Graph API – How: Insert

Wide-Range of Data APIs

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    Console.WriteLine($"\t[\"x-ms-activity-id\"] :
        { GetValueAsString(e.StatusAttributes, "x-ms-activity-id")}");

    throw;
  }
}
```

Graph API – How: Query

Wide-Range of Data APIs

```
g.V()
.hasLabel('tag’)
.has('name’, 'Azure’)
.in('taggedAs’)
.hasLabel('presentation')
```

Gremlin API – Querying Options

Wide-Range of Data APIs

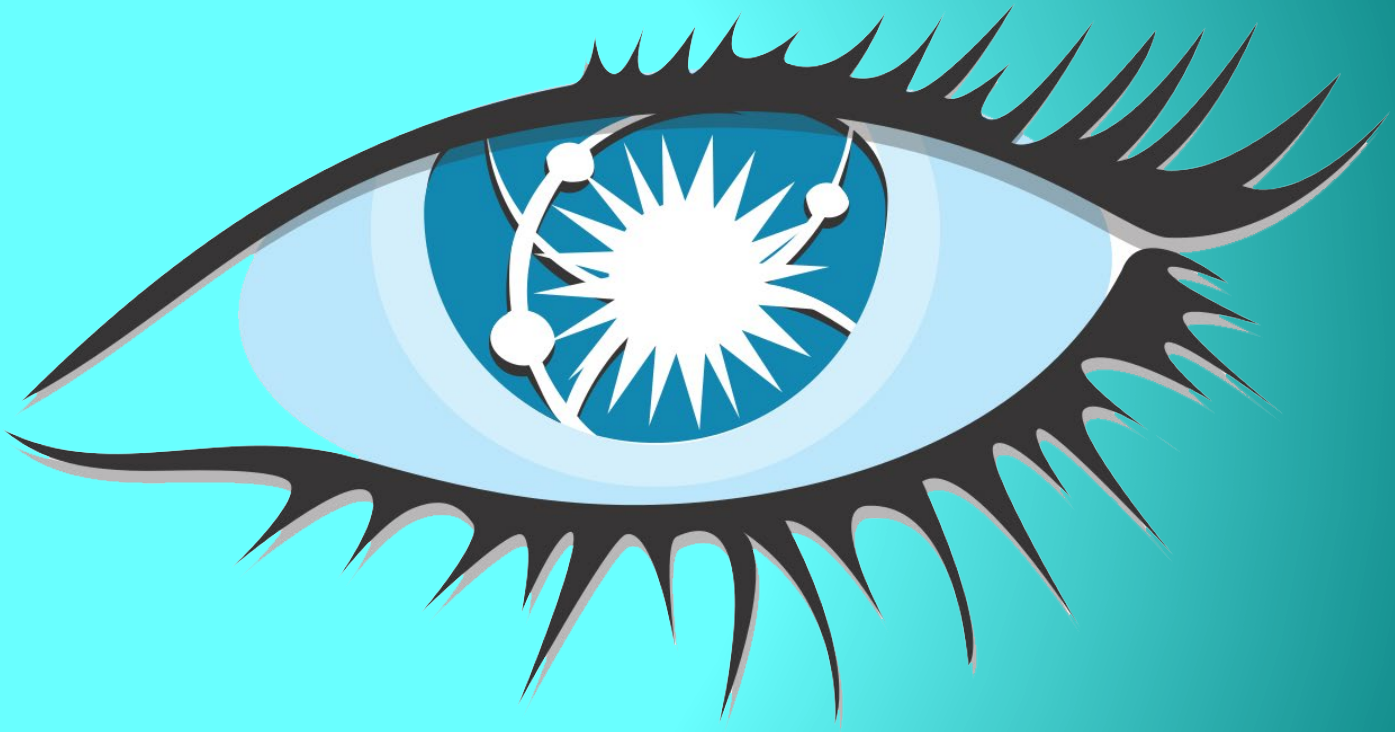
API

JavaScript

SQL API

Cassandra API

Wide Column Store



Cassandra API – What

Wide-Range of Data APIs

Handle Large Amounts of Data

Uses Commodity Servers

Developed by Facebook

Graph API – When

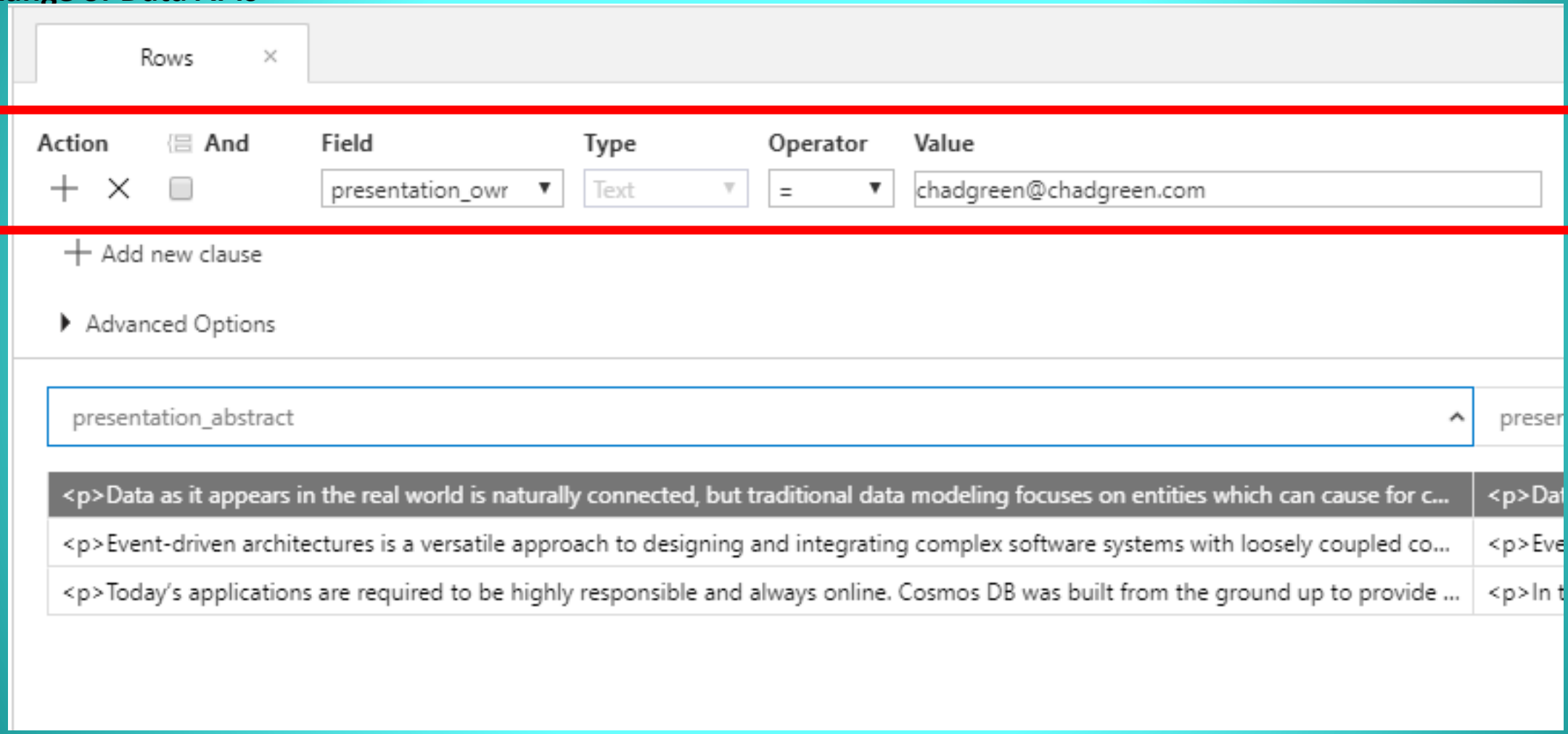
Wide-Range of Data APIs

Migrating data from Cassandra to

Azure Cosmos DB

Cassandra API – How: Data Model

Wide-Range of Data APIs



Cassandra API – How: Insert

Wide-Range of Data APIs

```
public class Presentation
{
  public string presentation_id { get; set; }
  public string presentation_owneremailaddress { get; set; }
  public string presentation_title { get; set; }
  public string presentation_abstract { get; set; }
  public string presentation_elevatorpitch { get; set; }
  public string presentation_importantinformation { get; set; }
  public string presentation_languagecode { get; set; }
  public string presentation_language { get; set; }
}
```

Cassandra API – How: Insert

Wide-Range of Data APIs

```
var options = new Cassandra.SSLOptions(SslProtocols.Tls12,
    true, ValidateServerCertificate);

options.SetHostNameResolver((ipAddress) => CassandraContactPoint);

Cluster cluster = Cluster.Builder()
    .WithCredentials(UserName, Password)
    .WithPort(CassandraPort)
    .AddContactPoint(CassandraContactPoint).WithSSL(options).Build();

ISession session = cluster.Connect();

session = cluster.Connect("speakingengagements");
IMapper mapper = new Mapper(session);

// Inserting Data into presentation table
mapper.Insert<Presentation>(Generate.Presentation(
    ExistingPresentation.EventDrivenArchitectureInTheCloud));
```

Cassandra API – How: Query

Wide-Range of Data APIs

```
Presentation presentationId3 = mapper.FirstOrDefault<Presentation>
    ("Select * from presentation where presentation_owneremailaddress = ?",
    "chadgreen@chadgreen.com");
Console.WriteLine(presentationId3.presentation_title);
```

Cassandra API – Query Options

Wide-Range of Data APIs

API

CQL

Cassandra-Based Tools

Table API

Table Storage

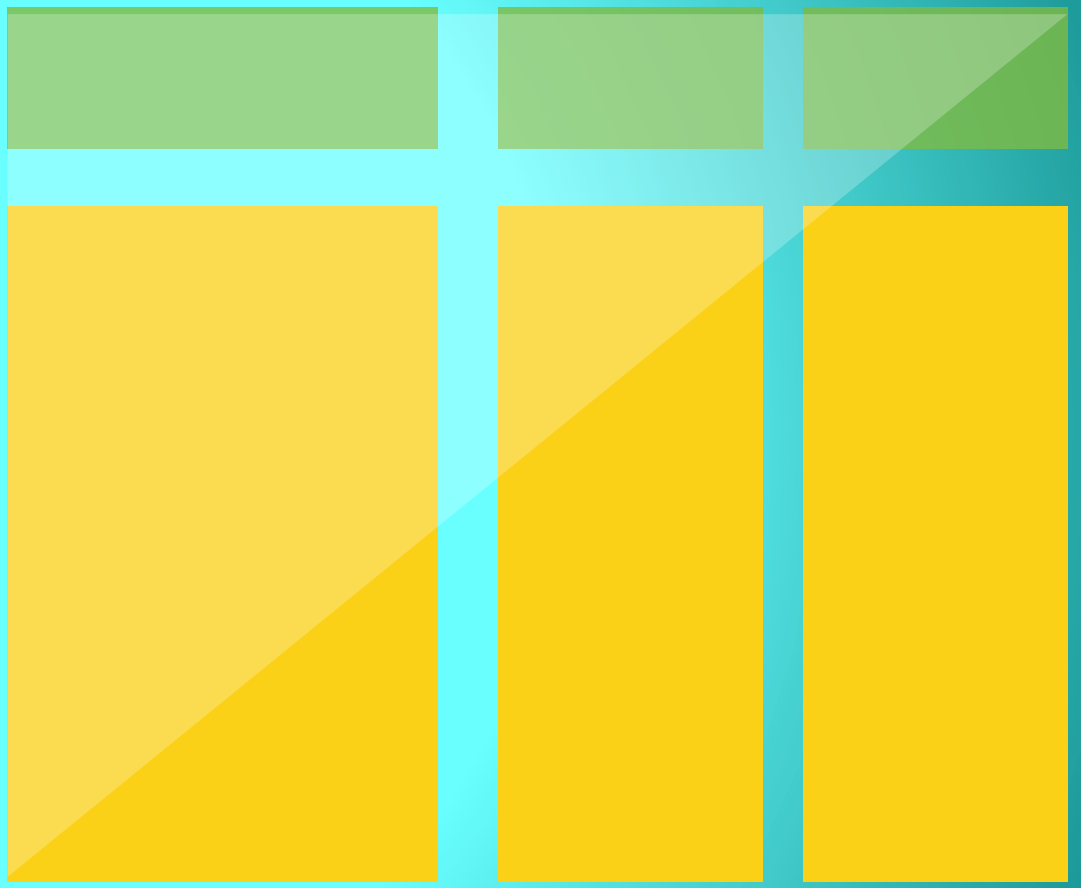


Table API – What

Wide-Range of Data APIs

Store Large Amounts of Data

Storing Structured Non-Related Data

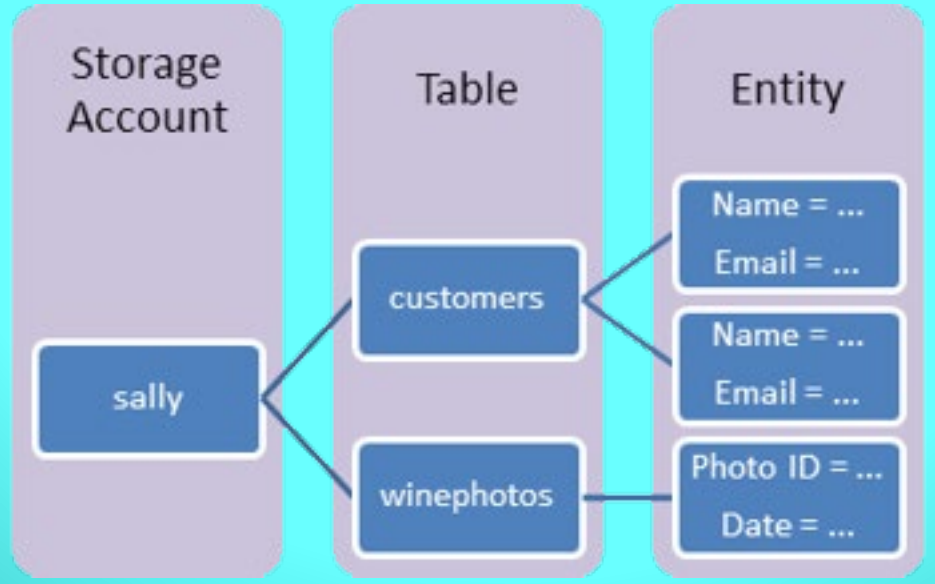


Table API – When

Wide-Range of Data APIs

Migrating data from Azure Table storage to Cosmos DB

Table API – How: Data Model

Wide-Range of Data APIs

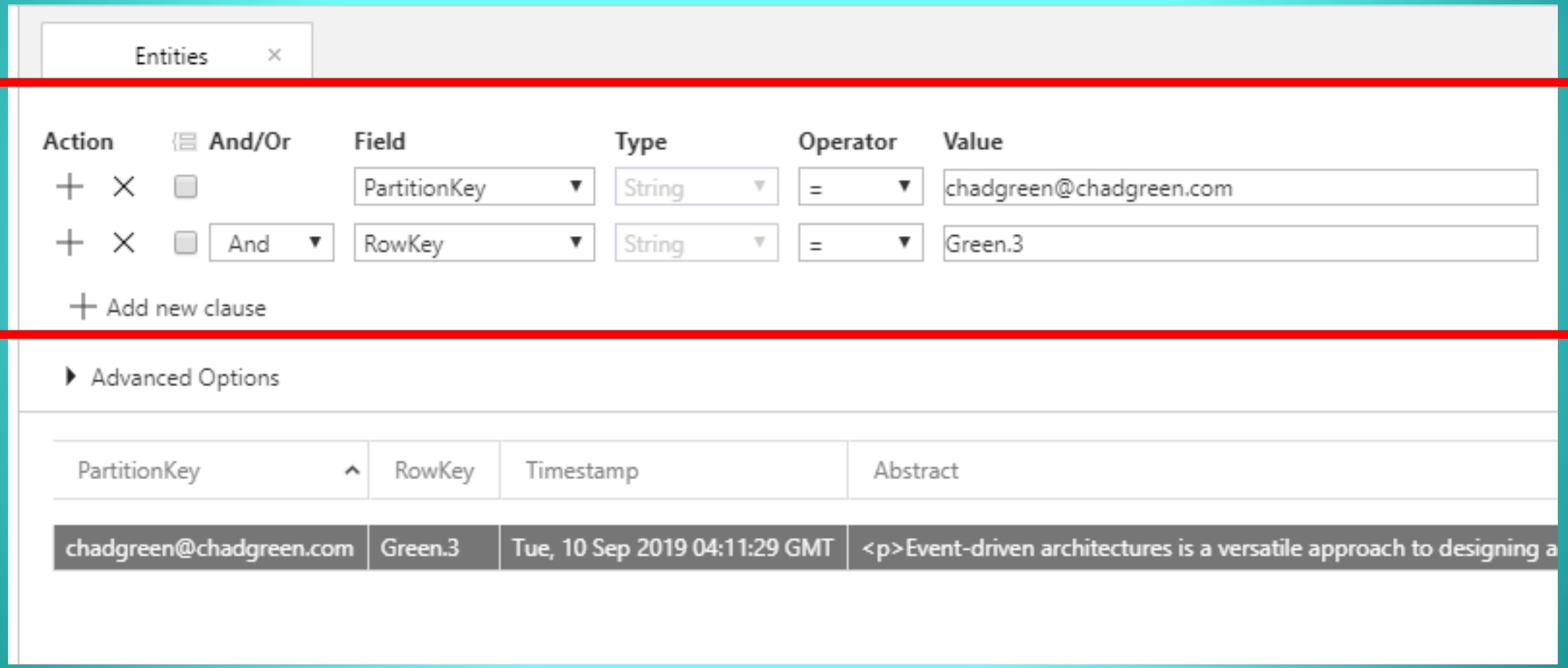


Table API – How: Insert

Wide-Range of Data APIs

```
public class Presentation : TableEntity
{
  public Presentation() { }

  public Presentation(string id, string ownerEmailAddress)
  {
    PartitionKey = ownerEmailAddress;
    RowKey = id;
  }

  public string Title { get; set; }
  public string Abstract { get; set; }
  public string ElevatorPitcch { get; set; }
  public string ImportantDetails { get; set; }
  public string LanguageCode { get; set; }
  public string Langauge { get; set; }
}
```

Table API – How: Insert

Wide-Range of Data APIs

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  public string ElevatorPitcch { get; set; }
  public string ImportantDetails { get; set; }
  public string LanguageCode { get; set; }
  public string Langauge { get; set; }
}
```

Table API – How: Insert

Wid

```
public static async Task<Presentation> InsertOrMergeEntityAsync(CloudTable table, Presentation entity)
{
  if (entity == null)
  {
    throw new ArgumentNullException("entity");
  }

  try
  {
    // Create the InsertOrReplace table operation
    TableOperation insertOrMergeOperation = TableOperation.InsertOrMerge(entity);

    // Execute the operation.
    TableResult result = await table.ExecuteAsync(insertOrMergeOperation);
    Presentation insertedCustomer = result.Result as Presentation;

    if (result.RequestCharge.HasValue)
    {
      Console.WriteLine("Request Charge of InsertOrMerge Operation: " + result.RequestCharge);
    }

    return insertedCustomer;
  }
  catch (StorageException e)
  {
    Console.WriteLine(e.Message);
    Console.ReadLine();
    throw;
  }
}
```

Table API – How: Insert

Wid

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    }

    return insertedCustomer;
  }
  catch (StorageException e)
  {
    Console.WriteLine(e.Message);
    Console.ReadLine();
    throw;
  }
}
```

Table API – How: Query

Wi

```
public static async Task<Presentation> RetrieveEntityUsingPointQueryAsync(CloudTable table,
    string partitionKey, string rowKey)
{
  try
  {
    TableOperation retrieveOperation
        = TableOperation.Retrieve<Presentation>(partitionKey, rowKey);
    TableResult result = await table.ExecuteAsync(retrieveOperation);
    Presentation presentation = result.Result as Presentation;
    if (presentation != null)
    {
      Console.WriteLine("\t{0}\t{1}\t{2}", presentation.PartitionKey,
          presentation.RowKey, presentation.Title);
    }

    if (result.RequestCharge.HasValue)
    {
      Console.WriteLine("Request Charge of Retrieve Operation: " + result.RequestCharge);
    }

    return presentation;
  }
  catch (StorageException e)
  {
    Console.WriteLine(e.Message);
    Console.ReadLine();
    throw;
  }
}
```

Table API – How: Query

Wide Range of Data APIs

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      Presentation presentation = result.Result as Presentation;
    if (presentation != null)
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          presentation.RowKey, presentation.Title);
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    {
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    }

    return presentation;
  }
  catch (StorageException e)
  {
    Console.WriteLine(e.Message);
    Console.ReadLine();
    throw;
  }
}
```

etcd API

Key-Value Storge

etcd

etcd API – What

Wide-Range of Data APIs

Simple

Secure

kubernetes

Fast

Reliable

etcd API – Why

Wide-Range of Data APIs

No etcd Operations Management

etcd API – Why

Wide-Range of Data APIs

No etcd Operations Management

etcd API – Why

Wide-Range of Data APIs

No etcd Operations Management

Global distribution & high availability

etcd API – Why

Wide-Range of Data APIs

No etcd Operations Management

Global distribution & high availability

etcd API – Why

Wide-Range of Data APIs

No etcd Operations Management

Elastic scalability

Global distribution & high availability

etcd API – Why

Wide-Range of Data APIs

No etcd Operations Management

Elastic scalability

Global distribution & high availability

etcd API – Why

Wide-Range of Data APIs

No etcd Operations Management

Elastic scalability

Security & enterprise readiness

Global distribution & high availability

etcd API – When

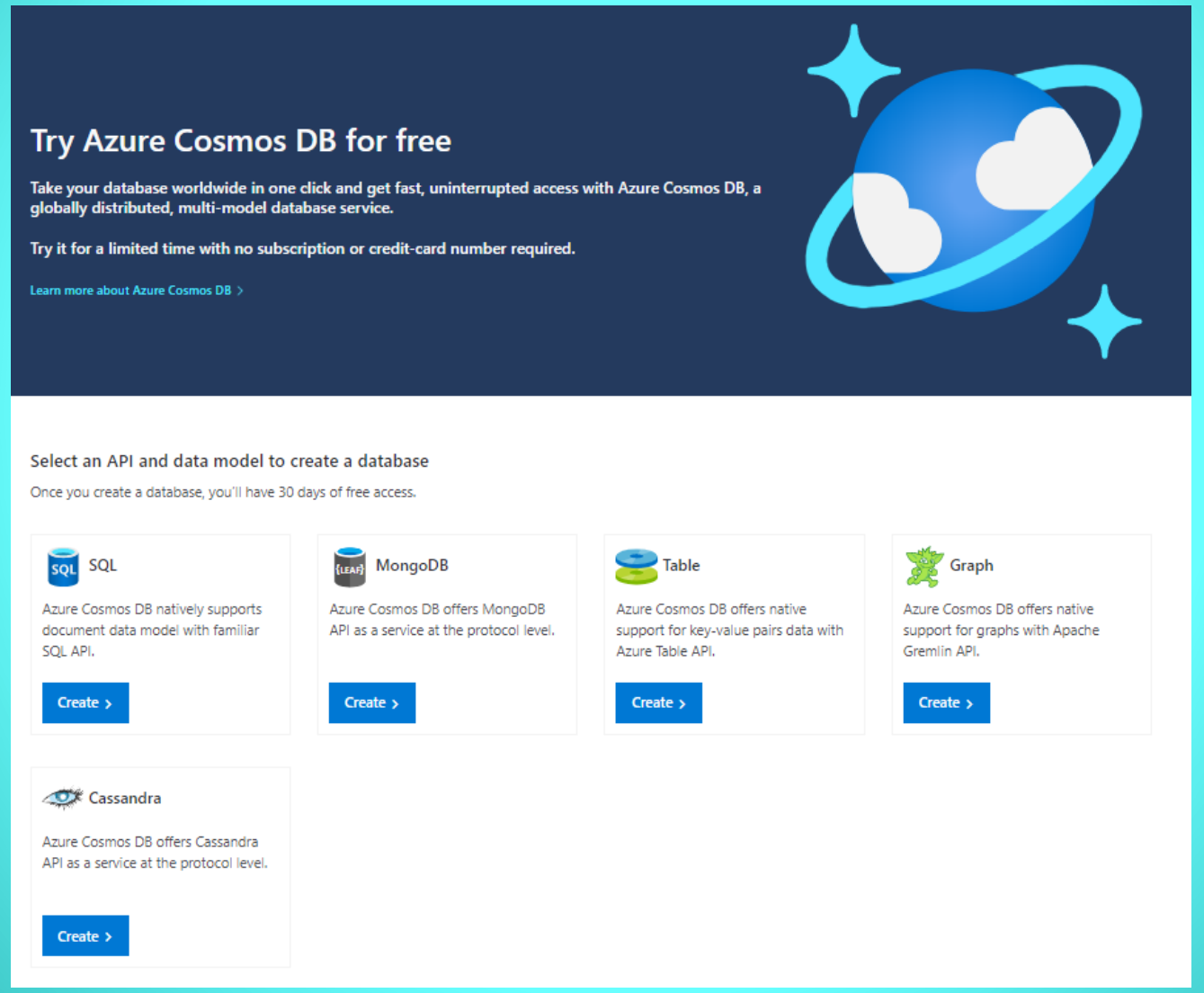
Wide-Range of Data APIs

Allows developers to scale Kubernetes state management on a fully managed cloud native PaaS service

Call to Action

The Hitchhiker's Guide to the Cosmos

azure.Microsoft.com/en-us/try/cosmosdb



Free Database

Free Database

Free Database

1000 RU/s

25-Gb

Serverless

Thank You!

chadgreen@chadgreen.com

TaleLearnCode

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