

# Data Engineering in the Cloud

## IoT with Azure Stream Analytics

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# Outline

- Internet of Things (IoT)
- Lab

# Internet of Things

- The Internet of Things (IoT) refers to the networked interconnection of everyday objects.
  - ▶ These objects are often equipped with intelligence and sensors.
- IoT is an evolution of the Internet, enhancing interconnectivity.
  - ▶ It allows for the exchange of services and goods between all connected elements.
- IoT Architecture: Internet-based information architecture enables communication between devices.
  - ▶ Devices share information and specific data with the world around them.

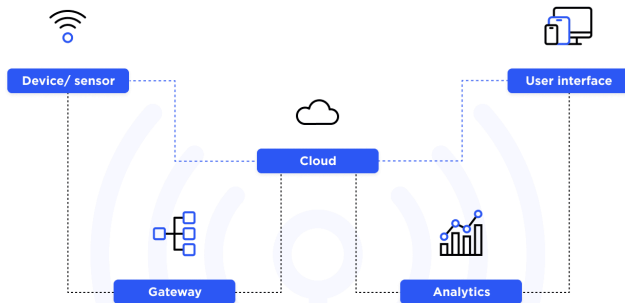
# Internet of Things

IoT history (<https://explodingtopics.com/blog/iot-stats>):

- The term Internet of Things was first used by Kevin Ashton in 1999 that was working in the field of networked RFID (radio frequency identification) and emerging sensing technologies.
- However, IoT was “born” sometime between 2008 and 2009 [2].
- There are well over 14 billion connected IoT devices around the globe.
  - ▶ IoT devices surpassed non-IoT devices in 2020
  - ▶ Video entertainment is the biggest spending category in IoT
  - ▶ The IoT industry is worth over \$1 trillion
- It's expected there will be 25.44 billion IoT devices by 2030

# Popular IoT applications

- The IoT can be seen as a combination of sensors and actuators providing and receiving information that is digitalized and placed into bidirectional networks able to transmit all data to be used by a lot of different services and final users



# Popular IoT applications

## Popular IoT applications

- IoT in Healthcare: Remote monitoring, smart medical devices, health data tracking.
- IoT & Smart Cities: Traffic management, parking, Waste, water, and electricity management, smart lighting, Management of disasters.
- IoT in Supply Chain Management: Real-time tracking, Smart routing, inventory management, logistics optimization.
- IoT in Agriculture: Smart greenhouses, Precision farming, livestock monitoring, smart irrigation.
- IoT in Energy: Smart grids, energy monitoring, efficient energy usage, Predictive maintenance.
- IoT in Manufacturing: Predictive maintenance, Real-time device monitoring, automation.
- IoT, Wearables, and Consumer Tech: Fitness trackers, smartwatches, Notifications and reminders, home automation.

# Lab

- The objectives of the lab:
  - ▶ Use online simulator to generate IoT data
  - ▶ Recieve IoT data with Azure IoT hub
  - ▶ Analysis of IoT data with Azure Stream Analytics and PowerBI

# Lab

- **Step 1.** Create a datalake (storage account with hierarchical namespace enabled)
  - ▶ To lower the cost, you may choose Redundancy as LRS
  - ▶ Create a container in the storage account

The screenshot displays the Microsoft Azure portal interface. At the top, there is a blue header bar with the Microsoft Azure logo, an 'Upgrade' button, a search bar, and a 'Copilot' button. Below the header, the 'Azure services' section features a row of icons for various services: 'Create a resource', 'Cost analysis', 'Stream Analytics jobs', 'Event Hubs', 'Azure Synapse Analytics', 'Azure Cosmos DB', 'Subscriptions', 'Data factories', 'Storage accounts', and 'More services'. The 'Resources' section is divided into 'Recent' and 'Favorite' tabs. The 'Recent' tab is active, showing a table of resources. The table has three columns: 'Name', 'Type', and 'Last Viewed'. It lists three resources: 'xzhang2storage1' (Storage account, viewed a few seconds ago), 'xzhang2' (Resource group, viewed a day ago), and 'AzureSubscription' (Subscription, viewed 5 days ago). A 'See all' link is provided below the table. The 'Navigate' section at the bottom shows four icons: 'Subscriptions', 'Resource groups', 'All resources', and 'Dashboard'.

Microsoft Azure Upgrade Search resources, services, and docs (G+/I) Copilot

Azure services

Create a resource Cost analysis Stream Analytics jobs Event Hubs Azure Synapse Analytics Azure Cosmos DB Subscriptions Data factories Storage accounts More services

Resources

Recent Favorite

Name	Type	Last Viewed
xzhang2storage1	Storage account	a few seconds ago
xzhang2	Resource group	a day ago
AzureSubscription	Subscription	5 days ago

See all

Navigate

Subscriptions Resource groups All resources Dashboard



# Lab

- **Step 2.** Create an IoT hub.

- 1 Search for “IoT hub” in the search bar and create an IoT hub.

[Home](#) > [IoT Hub](#) >

## IoT hub

Microsoft

[Basics](#) [Networking](#) [Management](#) [Add-ons](#) [Tags](#) [Review + create](#)

Create an IoT hub to help you connect, monitor, and manage billions of your IoT assets. [Learn more](#)

### Project details

Choose the subscription you'll use to manage deployments and costs. Use resource groups like folders to help you organize and manage resources.

Subscription \*

AzureSubscription

Resource group \*

xzhang2

[Create new](#)

### Instance details

IoT hub name \*

xzhang2IoTHub

Region \*

East US

Tier \*

Free

**i** Free trial explores the app with live data. Trials cannot scale or be upgraded later.

[Compare tiers](#)

Daily message limit \*

8,000 (\$0/month)

[Review + create](#)

[< Previous](#)

[Next: Networking >](#)

# Lab

- Click on the “Review+Create” button.

[Home](#) > [IoT Hub](#) >

## IoT hub ...

Microsoft

[Basics](#) [Networking](#) [Management](#) [Add-ons](#) [Tags](#) [Review + create](#)

### Pricing

IoT hub

**\$0 USD**  
per month  
[Change basics](#)

Add-ons total

[Change add-ons](#)

### Basics

Subscription	AzureSubscription
Resource group	xzhang2
IoT hub name	xzhang2IoTHub
Region	East US
Disaster recovery enabled	Yes
Tier	Free
Daily message limit	8,000 (\$0/month)

### Networking

Connectivity configuration	Public access
Private endpoint connections	None
Allow public network access	Enabled
Minimum TLS Version	1.0

- Click on the “Create” button. The deployment process will take a few minutes.
- Then click on Go to resource

The screenshot shows the Azure portal interface for an IoT Hub deployment. At the top, the breadcrumb navigation shows 'Home >'. The main header displays the IoT Hub name 'xzhang2IoT Hub-73114858' followed by 'Overview' and a settings icon. Below the header is a search bar and a row of action buttons: 'Delete', 'Cancel', 'Redeploy', 'Download', and 'Refresh'. A left-hand sidebar contains a list of tabs: 'Overview' (selected), 'Inputs', 'Outputs', and 'Template'. The main content area features a large green checkmark icon and the text 'Your deployment is complete'. Below this, deployment details are listed: 'Deployment name: xzhang2IoT Hub-73114858', 'Subscription: AzureSubscription', and 'Resource group: xzhang2'. To the right, the 'Start time' is '7/31/2024, 2:08:57 PM' and the 'Correlation ID' is '3e89e559-fdf5-43b2-8ca9-e3d03df94016'. A section titled 'Deployment details' is expanded, showing 'Next steps' with two recommended actions: 'Add and configure IoT Devices' and 'Configure routing rules for device messaging'. A blue button labeled 'Go to resource' is positioned below the next steps. At the bottom, there is a 'Give feedback' section with a link to 'Tell us about your experience with deployment'.

Home >

xzhang2IoT Hub-73114858 | Overview

Deployment

Search x «

Delete Cancel Redeploy Download Refresh

Overview

Inputs

Outputs

Template

Your deployment is complete

Deployment name: xzhang2IoT Hub-73114858  
Subscription: AzureSubscription  
Resource group: xzhang2

Start time: 7/31/2024, 2:08:57 PM  
Correlation ID: 3e89e559-fdf5-43b2-8ca9-e3d03df94016

Deployment details

Next steps

Add and configure IoT Devices Recommended

Configure routing rules for device messaging Recommended

Go to resource

Give feedback

Tell us about your experience with deployment

# Lab

- 4 Click on Add Device to add a device

Microsoft Azure Upgrade Search resources, services, and docs (G+/)

Home > xzhang2IoT Hub-73114858 | Overview > xzhang2IoT Hub

## xzhang2IoT Hub | Devices

IoT Hub

Search View, create, delete, and update devices in your IoT Hub. [Learn more](#)

Overview Add Device Edit columns Refresh Assign tags Delete

Activity log enter device ID Types: All Add filter

Access control (IAM)

Tags

Diagnose and solve problems

Events

Device management

Devices

IoT Edge

Configurations + Deployments

Updates

Queries

Hub settings

Security settings

Defender for IoT

Monitoring


Automation

Help

Device ID	Type	Status	Last status update
There are no devices to display.			

## 5 Click on Save

[Home](#) > [xzhang2loThub-73114858 | Overview](#) > [xzhang2loThub | Devices](#) >


 **Create a device** ...

 Find Certified for Azure IoT devices in the Device Catalog


Device ID 

RaspberryPi


☐ IoT Edge Device

Authentication type 

**Symmetric key** X.509 Self-Signed X.509 CA Signed

Auto-generate keys 



Connect this device to an IoT hub 

**Enable** Disable

Parent device 

**No parent device**

[Set a parent device](#)

**Save**

## 6 Click on the Device ID

Home > xzhang2IoT Hub


### xzhang2IoT Hub | Devices

IoT Hub

Search View, create, delete, and update devices in your IoT Hub. [Learn more](#)

+ Add Device Edit columns Refresh Assign tags Delete

enter device ID Types: All + Add filter

Device ID	Type	Status	Last status update	Authentication type
 RaspberryPi	IoT Device	Enabled	--	Shared Access Signature

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Events

Device management

Devices

IoT Edge

Configurations + Deployments

Updates

Queries

## 7 Copy the primary connection string

Home > xzhang2IoTHub | Devices >

### RaspberryPi

xzhang2IoTHub

Save Message to Device Direct method Add Module Identity Device twin Refresh

Device ID RaspberryPi

Primary key SvFdr41GDceoJedJD5PKo9seEDDmBawYCAIoTPeU8OM=

Secondary key NUWdJYEtmebF1Gn9kt6ZaQlKjWTaF0GZAloTAijuLi=

Primary connection string **HostName=xzhang2IoTHub.azure-devices.net;DeviceId=RaspberryPi;SharedAccessKey=SvFdr41GDceoJe...**

Secondary connection string HostName=xzhang2IoTHub.azure-devices.net;DeviceId=RaspberryPi;SharedAccessKey=NUWdJYEtmebFL...

Tags [\(edit\)](#) No tags

Enable connection to IoT Hub ☒ Enable ☐ Disable

Parent device No parent device

Module Identities Configurations

Module ID	Connection State	Connection State Last Updated ...	Last Activity Time (UTC)
-----------	------------------	-----------------------------------	--------------------------

# Lab

- **Step 3.** Connect the IoT hub to the [Raspberry Pi Azure IoT Online Simulator](https://azure-samples.github.io/raspberry-pi-web-simulator/) <https://azure-samples.github.io/raspberry-pi-web-simulator/>
- Replace the connectionstring in line 15 of the Raspberry Pi Azure IoT Online Simulator <https://azure-samples.github.io/raspberry-pi-web-simulator/>
- Run the simulator for a minute and stop it



```
1 /*
2  * IoT Hub Raspberry Pi NodeJS - Microsoft Sample Code - Copyright (c) 2017 - Licensed MIT
3  */
4 const wpi = require('wiring-pi');
5 const Client = require('azure-iot-device').Client;
6 const Message = require('azure-iot-device').Message;
7 const Protocol = require('azure-iot-device-mqtt').Mqtt;
8 const BME280 = require('bme280-sensor');
9
10 const BME280_OPTION = {
11   i2cBusNo: 1, // defaults to 1
12   i2cAddress: BME280.BME280_DEFAULT_I2C_ADDRESS() // defaults to 0x77
13 };
14
15 const connectionString = 'HostName=xzhang2IoThub.azure-devices.net;DeviceId=RaspberryPi;SharedAccessKey=...';
16 const LEDPin = 4;
17
18 var sendingMessage = false;
19 var messageId = 0;
20 var client, sensor;
21 var blinkLEDTIMEOUT = null;
22
23 function getMessage(cb) {
24   messageId++;
25   sensor.readSensorData()
26     .then(function (data) {
27
```

Run Reset

Click "Run" button to run the sample code(When sample is running, code is read-only).  
Click "Stop" button to stop the sample code running.  
Click "Reset" to reset the code.We keep your changes to the editor even you refresh the page.



- 9 Scroll down to line 23 and you will see that the simulator generates 4 variables
  - messageld
  - deviceId: always 'Raspberry Pi Web Client'
  - temperature
  - humidity

- **Step 4. Create an Azure Data Explorer Cluster**
- 10 Search for Data explorer in the search bar and create an Azure Data Explorer Cluster
- Click on Review+create

Home > Azure Data Explorer Clusters >

## Create an Azure Data Explorer Cluster

[Basics](#) [Scale](#) [Configurations](#) [Security](#) [Network](#) [Diagnostic settings](#) [Tags](#) [Review + create](#)

**PROJECT DETAILS**  
Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription \*

Resource group \*  [Create new](#)

**CLUSTER DETAILS**

Cluster name \*

Region \*

**COMPUTE SPECIFICATION**  
Select a VM size to support the workload you want to run. The VM size determines factors such as processing power, memory, and storage capacity. Azure charges an hourly price based on the VM's size and operating system. [Learn more about Compute specifications](#)

Workload \*

Size

Compute specifications  [Select other](#)

Availability zones ☐ ☒ All available zones

[Review + create](#) [Next : Scale >](#) [Download a template for automation](#)

[Home](#) > [Azure Data Explorer Clusters](#) >

## Create an Azure Data Explorer Cluster ...

[\\* Basics](#) [Scale](#) [Configurations](#) [Security](#) [Network](#) [Diagnostic settings](#) [Tags](#) [Review + create](#)

### Basics

Subscription	AzureSubscription
Resource group	xzhang2
Region	East US 2
Availability zones	On
Cluster name	xzhang2explorer

### Compute specifications

Workload	Dev/test
Size	Extra Small
Compute	Dev(No SLA)_Standard_E2a_v4

### Scale

Scaling method	Manual scale
Instance count	1

### Configurations

Streaming ingestion	Off
Enable purge	Off
Auto-Stop cluster	On

### Security

System-assigned identity	On
--------------------------	----

[Create](#)[← Previous : Tags](#)[Download a template for automation](#)

- 12 The deployment process will take a few minutes. Click on Go to resource

The screenshot shows the Azure Data Explorer web interface. At the top, the cluster name 'xzhang2explorer' is displayed with a star icon. Below it, a search bar and a toolbar with icons for adding databases, stopping, refreshing, moving, deleting, and feedback are visible. A left-hand navigation menu includes links for Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Data, Settings, Security + networking, Monitoring, Automation, and Help. The main content area features a blue banner with the instruction 'To use Azure Data Explorer, create at least one database.' followed by a right arrow. Below this, an 'Essentials' section displays a table of cluster details:

Resource group	: xzhang2	State	: Running
Location	: East US 2	URI	: <a href="https://xzhang2explorer.azuredataexplorer.com">https://xzhang2explorer.azuredataexplorer.com</a>
Subscription	: AzureSubscription	Data ingestion URI	: <a href="https://ingest-xzhang2explorer.azuredataexplorer.com">https://ingest-xzhang2explorer.azuredataexplorer.com</a>
Subscription ID	: c375af05-a27a-41f9-ba5e-20eabf6b29c5	Compute specifications	: Dev(No SLA)_Standard_E2a_v4
Availability zones	: 1, 2, 3	Instance count	: 1

Below the table, there are tabs for 'Getting started', 'Overview', 'Tutorials & Demos', and 'Data'. The 'Getting started' tab is active, showing a section titled 'Get started with Azure Data Explorer' with the text 'Use the Azure Data Explorer web app to manage your data easily.' and a 'Learn more' link. At the bottom, there are two cards: 'Database creation' with a 'Create' button, and 'Data Ingestion' with 'Ingest' and 'Create data connection' options.

## 13 We need to create a database

### Azure Data Explorer Database

Create new database

Database name \*

database1 ✓

Retention period (in days) \* ⓘ

365

☐ Unlimited days for retention period

Cache period (in days) \* ⓘ

31

☐ Unlimited days for cache period

Create

14 Click on Databases under Data, you will see the database

Home > xzhang2explorer

**xzhang2explorer** | Databases ☆ ...  
Azure Data Explorer Cluster

Search  ◦ ◀ + Add Database ↻ Refresh 🗑 Delete 🗨 Feedback

Overview  Search by name...

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

▼ Data

🗄 **Databases** ☆

🔍 Query

> Settings

> Security + networking

> Monitoring

> Automation

> Help

<input type="checkbox"/>	Database T	Size	Retention period	Cache period	Database kind	Shared with others	Relationship
<input type="checkbox"/>	database1	0 Bytes	365 days	31 days	Read-Write	No	None

## 15 Click on the database to open it

Home > xzhang2explorer | Databases >

### database1 (xzhang2explorer/database1)

Azure Data Explorer Database

Search Query Edit Refresh Delete Feedback Share

- Overview
- Settings
- Automation

#### Essentials

Resource group	: <a href="#">xzhang2</a>	Retention period (in days)	: 365 days
Location	: <a href="#">East US 2</a>	Cache period (in days)	: 31 days
Subscription	: <a href="#">AzureSubscription</a>	Database kind	: Read-Write
Subscription ID	: c3754f05-a27a-4119-ba5e-20eebfeb29c6	Shared with others	: No
Cluster	: <a href="#">xzhang2explorer</a>		

#### Data connections

Cosmos DB 0	Event Hub 0	IoT Hub 0	Event Grid 0
----------------	----------------	--------------	-----------------

# Lab

- 16 Use the following Kusto Query Language (KQL) command to create a table

```
.create table MyIoTData  
(  
    messageId: int,  
    deviceId: string,  
    temperature: real,  
    humidity: real,  
    EventTime: datetime  
)
```



- **Step 5.** Create a Stream Analytics job
- 17 Add your storage account

Home >

## StreamAnalyticsJob | Overview

Deployment

Search


Overview

Inputs

Outputs

Template

Delete Cancel Redeploy Download Refresh

 Your deployment is complete

Deployment name : StreamAnalyticsJob  
Subscription : AzureSubscription  
Resource group : xzhang2

Start time  
Correlation ID

> Deployment details

Next steps

Go to resource

Give feedback

Tell us about your experience with deployment

## 16 Now add an Iot hub input under Job Topology

Home > StreamAnalyticsJob | Overview >

**stream1** ☆ ...  
Stream Analytics job

Search 0 <<

▶ Start job 🗑 Delete → Move ↻ Refresh 🗨 Share feedback

Overview

Activity log

Access control (IAM)

Tags

⚡ Diagnose and solve problems

Job topology

Inputs

Functions

>> Query

Outputs

No-code editor (preview)

Settings

Environment

Storage account settings

Scale

Locale

Event ordering

←> Nahumkinn (in preview)

Created

Essentials

Resource group ( <a href="#">move</a> )	: <a href="#">xzhang2</a>	Created	: Wednesday
Location	: East US	Started	:
Status	: Created	Output watermark	:
Subscription ( <a href="#">move</a> )	: <a href="#">AzureSubscription</a>	Cluster	: Shared
Subscription ID	: c375ef05-a27a-41f9-ba5e-20eebfef29c6	Hosting environment	: Cloud
Pricing plan	: StandardV2 ( <a href="#">manage</a> )	Virtual Network	: Disabled
Tags ( <a href="#">edit</a> )	: <a href="#">Add tags</a>		

Get started

Properties

Monitoring

Tutorials

Which best describes your needs?

I want to build my job using a query



Query editor

Build your job using Azure Stream Analytics Query Language to transform or analyze your real-time data.

I want to build my job



OR

No-code editor

Use Azure Stream Analytics no-code job without a single line of code

Microsoft Azure Upgrade Search results

Home > StreamAnalyticsJob | Overview > stream1

## stream1 | Inputs ☆ ...

Stream Analytics job

Search

+ Add input ▼ Refresh

- Stream input
  - Blob storage/ADLS Gen2
  - Event Hub
  - IoT Hub**
  - Kafka (preview)
- Reference input
  - Blob storage/ADLS Gen2
  - SQL Database

- Overview
- Activity log
- Access control (IAM)
- Tags
- Diagnose and solve problems
- Job topology
- Inputs**
- Functions
- Query
- Outputs
- No-code editor (preview)
- Settings
  - Environment
  - Storage account settings
  - Scale

# Lab

19 Kee all the default settings and click **Save**

- The input connection will be tested

**IoT Hub** ×  
New input

Input alias \*  ✓

☐ Provide IoT Hub settings manually  
☒ Select IoT Hub from your subscriptions

Subscription

IoT Hub \* ⓘ

Consumer group \* ⓘ

Shared access policy name \* ⓘ

Shared access policy key ⓘ

Endpoint ⓘ

Partition key ⓘ

Event serialization format \* ⓘ

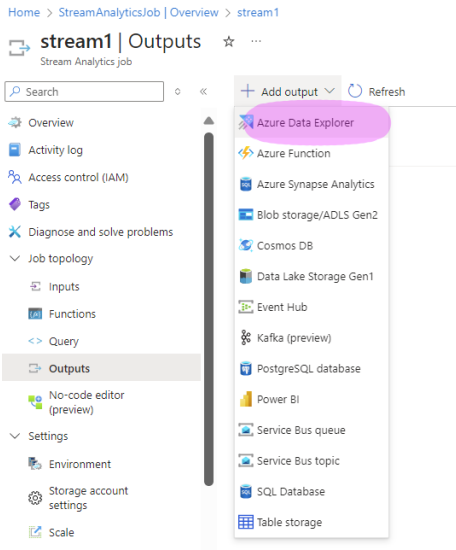
Encoding ⓘ

Event compression type ⓘ

**Save**

# Lab

- 20 Add an output under Job Topology with output to Azure Data Explorer to visualize the data



# Lab

- 21 Keep the default settings, enter the table name created in the Data explorer and Click Save

### Azure Data Explorer

New output

Output alias \*

database1

☐ Provide Azure Data Explorer settings manually

☒ Select Azure Data Explorer from your subscriptions

Subscription

AzureSubscription

Cluster \*

https://xzhang2explorer.eastus2.kusto.windows.net

Database \*

database1

Authentication mode

Managed Identity: System assigned

The Monitor and Ingestor role will be granted to the Managed Identity for this Stream Analytics job when you click Save. If grant fails follow the manual grant steps [here](#).

Table \*

MyIoTData

Save

22 I got a message

## Notifications



More events in the activity log →

Dismiss all ▾



### Added output




Added output 'database1' to Stream Analytics job 'stream1'.

a few seconds ago



### Failed to setup permissions



Please manually set up Managed Identity permissions for the added Azure Data Explorer. Follow the steps documented [here](#)  to complete setup.

a few seconds ago

Home > StreamAnalyticsJob | Overview > stream1



## stream1 | Managed Identity ☆ ...

Stream Analytics job

▼ rays

⚡ Diagnose and solve problems

➤ Job topology

▼ Settings

🏠 Environment

⚙️ Storage account settings

📊 Scale

🌐 Locale

🔄 Event ordering

🔗 Networking (preview)

🛑 Error policy

⚙️ Compatibility level

🔑 **Managed Identity**

📄 Schema registry (preview)

📑 Properties

🔒 Locks

▼ Developer tools

🖱️ Visual Studio Code

↔️ Switch identity

Identity

Endpoint management

After switching your job's Managed Identity, use Endpoint management to grant the Managed Identity

Identity type

System assigned

Principal ID

3797a089-8aff-4d51-a6ac-813f33e04ee3

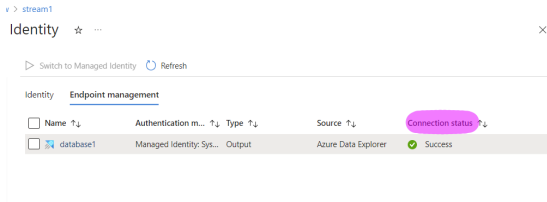
Principal name

stream1

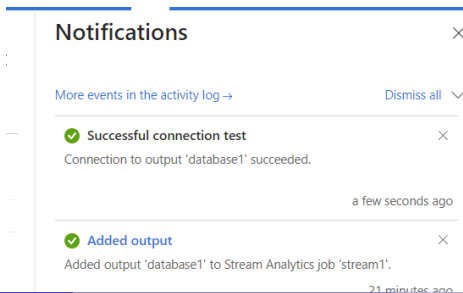


# Lab

## 23 Grant access to Azure Data Explorer (I did not screen shot the refresh button)



## • Test connection again



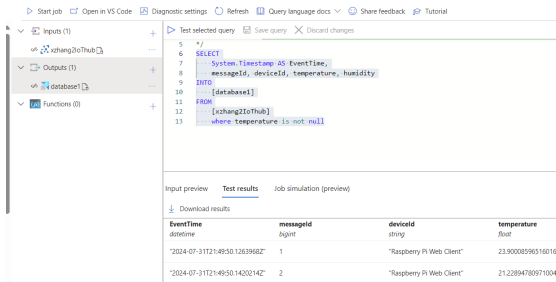
# Lab

- 24 Write the query below

```
SELECT
    System.Timestamp AS EventTime,
    messageId, deviceId, temperature, humidity
INTO
    [database1]
FROM
    [xzhang2IoThub]
where temperature is not null
```

- **Step 6.** Start the Stream Analytics job

- 25 Run the Raspberry Pi Azure IoT Online Simulator and then test the query



The screenshot shows the Azure Stream Analytics interface. On the left, the 'Inputs' section is expanded, showing 'xzhang2IoTHub'. The 'Outputs' section is also expanded, showing 'database1'. The 'Functions' section is empty. The main area displays a SQL query:

```

5  /*
6  SELECT
7    System.Timestamp AS EventTime,
8    messageId, deviceId, temperature, humidity
9  INTO
10   [database1]
11  FROM
12   [xzhang2IoTHub]
13   where temperature is not null
  
```

Below the query, the 'Test results' tab is selected, showing a table with the following data:

EventTime datetime	messageId bigint	deviceId string	temperature float
"2024-07-31T21:49:50.1263968Z"	1	"Raspberry Pi Web Client"	23.9008596516016
"2024-07-31T21:49:50.1420214Z"	2	"Raspberry Pi Web Client"	21.22894780971004

- 26 Start the Stream Analytics job.

# Lab

- 27 Go to Azure Data Explorer, run the queries

```
.create table MyIoTData
(
  messageId: int,
  deviceId: string,
  temperature: real,
  humidity: real,
  EventTime: datetime
)
```

```
.create table MyIoTData
(
  messageId: int,
  deviceId: string,
  temperature: real,
  humidity: real,
  EventTime: datetime
)
```

```
select count(*) from MyIoTData
```

MyIoTData

```
| where EventTime > ago(1h)
| summarize AvgTemperature = avg(temperature),
  AvgHumidity = avg(humidity) by bin(EventTime, 5m)
| render timechart
```

# Lab

- `where EventTime > ago(1h)`: Filters the data to include only records from the last 1 hour.
- `summarize AvgTemperature = avg(temperature) by bin(EventTime, 5m)`: Aggregates the data by computing the average temperature for each 15-minute interval.
- `render timechart`: Visualizes the results as a time chart.
- For more information, see [Time chart](https://learn.microsoft.com/en-us/azure/data-explorer/kusto/query/visualization-timechart?pivots=azuredatexplorer)  
<https://learn.microsoft.com/en-us/azure/data-explorer/kusto/query/visualization-timechart?pivots=azuredatexplorer>

# Lab

27 After a while run the queries again

xzhang2explorer.eastus... +

Open in Web UI

Filter...


xzhang2explorer.east...  
database1

Run xzhang2explorer.eastus2/database1

```
1 .create table MyIoTData
2 (
3   messageId: int,
4   deviceId: string,
5   temperature: real,
6   humidity: real,
7   EventTime: datetime
8 )
9
10
11 select count(*) from MyIoTData
12
13
```


Table 1 Stats Search

NoColumnName1
> 316

xzhang2explorer.eastus...  +

 1 ? 

 Open in Web UI

«  Run  xzhang2explorer.eastus2/database1  

Filter...  

▼  xzhang2explorer.east...

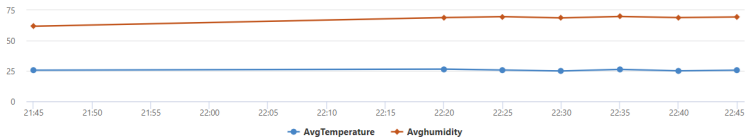
>  database1


```

7  EventTime: datetime
8  )
9
10
11 select count(*) from MyIoTData
12
13
14 MyIoTData
15 | where EventTime > ago(1h)
16 | summarize AvgTemperature = avg(temperature), Avghumidity = avg(humidity) by bin(EventTime, 5m)
17 | render timechart
    
```

 Graph  Table 1  Stats

 Done (0.073 s)  7 records  



xzhang2explorer.eastus...  +

 1 ? 

 Open in Web UI

Filter...  

▼  xzhang2explorer.east...

>  database1

<<

 Run

xzhang2explorer.eastus2/database1

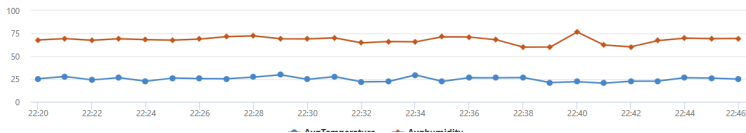
 ▼ ...

```

7  EventTime: datetime
8  )
9
10
11 select count(*) from MyIoTData
12
13
14 MyIoTData
15 | where EventTime > ago(1h)
16 | summarize AvgTemperature = avg(temperature), AvgHumidity = avg(humidity) by bin(EventTime, 1m)
17 | render timechart
    
```

 Graph  Table 1  Stats

 Done (0.074 s)  27 records 





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