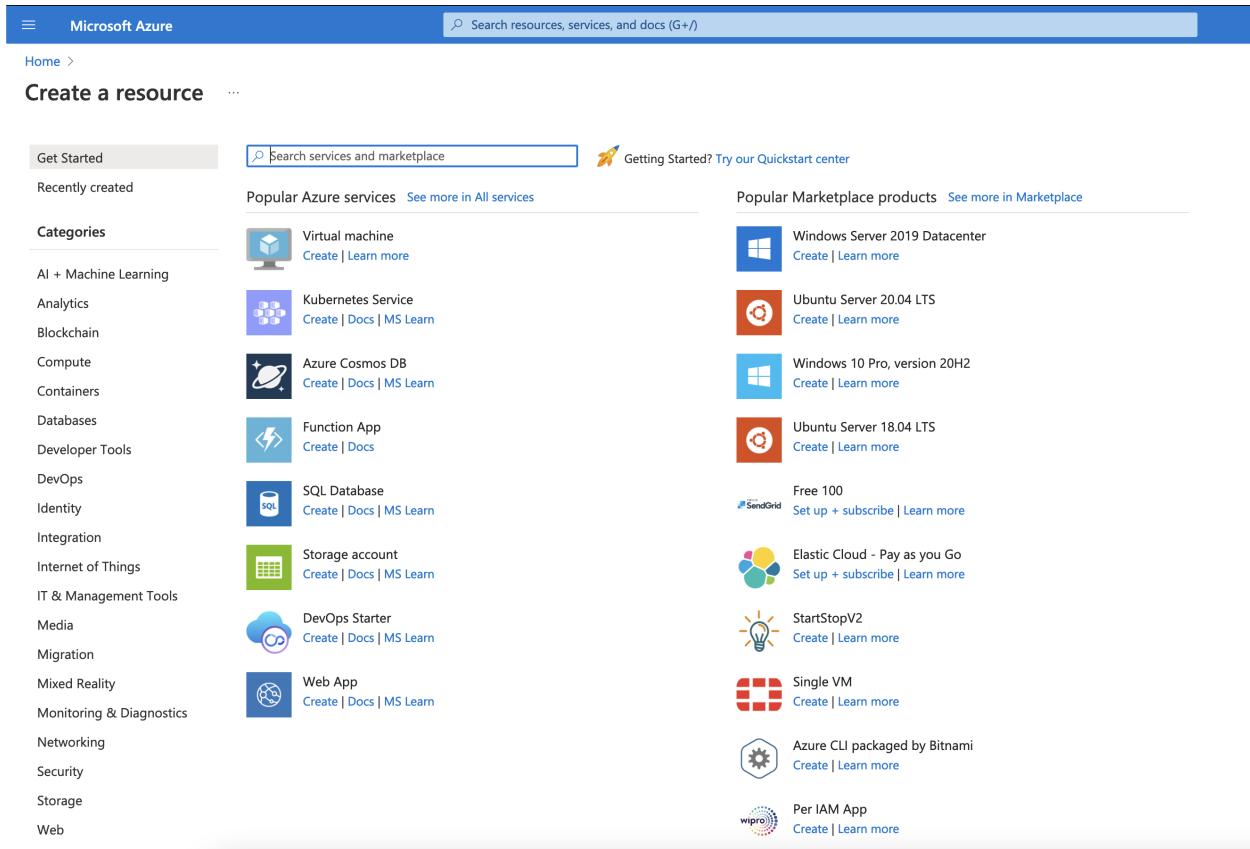


Azure Deployment guide

As Azure is an evergrowing service, some processes may change in the future. To keep this guide as accurate as possible, it will be referring to the official Microsoft docs. This guide assumes you already have a Microsoft/Azure account setup, with either a student or professional subscription (not tested on a free subscription). Head over to portal.azure.com.

The minimal Azure resources required for the system to function are: [Azure IoT Hub](#), [Azure SQL Database](#) and [Azure SQL Server](#) and [Azure Stream Analytics](#).

Azure has a nice and user friendly UI, and this guide will assume you will be using that for setup. For quicker setup, you can use [azure CLI](#) tool instead. The resource creation is all grouped in a single search box:



The screenshot shows the Microsoft Azure portal's 'Create a resource' interface. At the top, there's a blue header bar with the Microsoft Azure logo and a search bar labeled 'Search resources, services, and docs (G+/-)'. Below the header, the URL 'Home > Create a resource' is visible. On the left, a sidebar titled 'Get Started' lists various service categories like AI + Machine Learning, Analytics, Blockchain, Compute, Containers, Databases, Developer Tools, DevOps, Identity, Integration, Internet of Things, IT & Management Tools, Media, Migration, Mixed Reality, Monitoring & Diagnostics, Networking, Security, Storage, and Web. Each category has a corresponding icon and a 'Create' button. The main content area features a search bar 'Search services and marketplace' and a 'Getting Started? Try our Quickstart center' link. It displays a grid of popular Azure services and Marketplace products. The services include Virtual machine, Kubernetes Service, Azure Cosmos DB, Function App, SQL Database, Storage account, DevOps Starter, Web App, Windows Server 2019 Datacenter, Ubuntu Server 20.04 LTS, Windows 10 Pro, Ubuntu Server 18.04 LTS, Free 100, Elastic Cloud - Pay as you Go, StartStopV2, Single VM, Azure CLI packaged by Bitnami, and Per IAM App. Each item has a small icon, a name, and 'Create | Docs | MS Learn' links.

1. Create new resource group, fitting for your location. Follow the MS docs for detailed instruction: <https://docs.microsoft.com/en-us/azure/azure-resource-manager/management/manage-resource-groups-portal>

Setting up SQL Database

The screenshot shows the 'Create SQL Database' wizard in the Azure portal. The 'Basics' tab is selected. A callout box at the top left says: 'Did you know that new users in Azure can create a free Azure SQL Database and use it for 12 months using Azure free account? [Learn more](#)'.

Project details

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

Subscription * (dropdown menu) [REDACTED]
Resource group * (dropdown menu) [REDACTED] [Create new](#)

Database details

Enter required settings for this database, including picking a logical server and configuring the compute and storage resources.

Database name * (text input field) [Enter database name](#)
Server * (dropdown menu) [REDACTED] [Create new](#)

Want to use SQL elastic pool? * (radio buttons) Yes No

Compute + storage * (dropdown menu) [General Purpose](#) Gen5, 2 vCores, 32 GB storage, zone redundant, disabled
[Review + create](#) [Next : Networking >](#)

1. Create the SQL Database. Select the name of your choosing, but bear in mind you will use these data later on for establishing a connection with the GUI app. See detailed instruction here: https://docs.microsoft.com/en-gb/azure/azure-sql/database/single-database-create-quickstart?WT.mc_id=gallery&tabs=azure-portal
2. Select the subscription you are going to use, along with the created resource group.
3. Give the database a name, e.g. `iot-farmbeats`, and Select the option for new server creation.

Home > Create SQL Database >

Create SQL Database Server

Microsoft

Server details

Enter required settings for this server, including providing a name and location. This server will be created in the same subscription and resource group as your database.

Server name * .database.windows.net

Location *

Authentication

Select your preferred authentication methods for accessing this server. Create a server admin login and password to access your server with SQL authentication, select only Azure AD authentication [Learn more](#) using an existing Azure AD user, group, or application as Azure AD admin [Learn more](#), or select both SQL and Azure AD authentication.

Authentication method Use SQL authentication Use only Azure Active Directory (Azure AD) authentication Use both SQL and Azure AD authentication

Server admin login *

Password *

Confirm password *

4. In the server creation page, give it a name, select the most fitting region (if located in London, UK South is a good choice). For authentication method, select **Use SQL Authentication**. Add Admin Username and password. Note that down, as it will be used to enter any queries to the database and for GUI app connection.

Home >

Create SQL Database

Microsoft

Basics Networking Security Additional settings Tags Review + create

Configure network access and connectivity for your server. The configuration selected below will apply to the selected server 'deployment-test-farmbeats' and all databases it manages. [Learn more](#)

Network connectivity

Choose an option for configuring connectivity to your server via public endpoint or private endpoint. Choosing no access creates with defaults and you can configure connection method after server creation. [Learn more](#)

- No access
- Public endpoint
- Private endpoint

Connectivity method * ⓘ

Firewall rules

Setting 'Allow Azure services and resources to access this server' to Yes allows communications from all resources inside the Azure boundary, that may or may not be part of your subscription. [Learn more](#)

Setting 'Add current client IP address' to Yes will add an entry for your client IP address to the server firewall.

No Yes

Allow Azure services and resources to access this server *

No Yes

Add current client IP address *

Connection policy

Configure how clients communicate with your SQL database server. [Learn more](#)

Connection policy ⓘ

- Default - Uses Redirect policy for all client connections originating inside of Azure and Proxy for all client connections originating outside Azure
- Proxy - All connections are proxied via the Azure SQL Database gateways
- Redirect - Clients establish connections directly to the node hosting the database

[Review + create](#)

[< Previous](#)

[Next : Security >](#)

5. Click the button at the bottom: [Next: Networking](#) and fill out the fields to match the screenshot:

- a. Set Network Connectivity to Public endpoint.
- b. In Firewall rules: by default [Allow Azure services and resources to access this server](#) is switched off, and since Avanade's policy doesn't allow this option we could not use it. For testing purposes, you can turn it on as it will make the next steps easier (the guide will assume however you selected No).

Select **Yes** for the Option Add current client IP address (this will allow your PC to connect to the Database).

- c. For connection policy, select **Default**.

The screenshot shows the 'Create SQL Database' wizard on the 'Security' tab. At the top, there are tabs for Basics, Networking, Security (which is selected), Additional settings, Tags, and Review + create. Below the tabs, a section titled 'Microsoft Defender for SQL' is shown with a note about protecting data. A radio button for 'Not now' is selected for enabling Microsoft Defender. The 'Ledger (preview)' section shows 'Not configured' and a 'Configure ledger' link. The 'Identity' section shows 'Not enabled' and a 'Configure Identities' link. The 'Transparent data encryption' section shows 'Service-managed key selected' and a 'Configure transparent data encryption' link. At the bottom, there are buttons for 'Review + create', '< Previous', and 'Next : Additional settings >'.

6. Click the button on the bottom: **Next: Security**
 - a. For the **Enable Microsoft Defender for SQL** option, select **Not now**.
7. Click **Review + create**, check all information was inputted correctly, and confirm creation.
8. After deployment, depending how you set up your firewall rules, you may need to add the Ip address range for Stream Analytics Job in your region. If you do not want to do that, edit the Firewall settings for SQL Server (found under Security - Firewall)

and virtual networks), and set `Allow Azure services and resources to access this server` to `Yes`. Otherwise, you will need to find your IP address ranges for the StreamAnalytics Job and add them to the IoT Hub. Current range for UK South is: `20.68.187.0` to `20.68.187.255`.

The screenshot shows the Azure portal interface for a SQL database named 'test-deployment-db'. On the left, there's a navigation sidebar with various options like Overview, Activity log, Tags, and Query editor (preview). The 'Query editor (preview)' option is selected. The main area is titled 'Query 1' and contains a SQL script:

```

1 IF OBJECT_ID('dbo.SensorData', 'U') IS NULL
2     CREATE TABLE dbo.SensorData
3 (
4     [Timestamp] DATETIME NOT NULL,
5     [SensorID] INT NOT NULL,
6     [SensorType] VARCHAR(256) NOT NULL,
7     [Value] REAL NOT NULL,
8     [ActuatorValue] REAL,
9     CONSTRAINT SensorData_pk PRIMARY KEY (Timestamp, SensorID,
10    SensorType)
11 );
12
13
14

```

Below the code, there are 'Results' and 'Messages' tabs. The 'Messages' tab shows the message: 'Query succeeded: Affected rows: 0'.

9. Next, go to the `Query editor (preview)` for the SQL database, as shown on the picture above. Login with your credentials and run this query: (It will create an empty table which will be used later on):

```

IF OBJECT_ID('dbo.SensorData', 'U') IS NULL
CREATE TABLE dbo.SensorData
(
    [Timestamp] DATETIME NOT NULL,
    [SensorID] INT NOT NULL,
    [SensorType] VARCHAR(256) NOT NULL,
    [Value] REAL NOT NULL,
    [ActuatorValue] REAL,
    CONSTRAINT SensorData_pk PRIMARY KEY (Timestamp, SensorID,
    SensorType)

);

```

IoT Hub setup

1. While the SQL server and database are deploying, we can move onto IoT Hub deployment. In the search box at the top of Azure portal. For an up to date guide, see the official MS docs: <https://docs.microsoft.com/en-gb/azure/iot-hub/iot-hub-create-through-portal>.

Home > Create a resource > IoT Hub >

IoT hub

Microsoft

Basics Networking Management 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 * ⓘ [Redacted] ▾

Resource group * ⓘ [Redacted] ▾ [Create new](#)

Instance details

IoT hub name * ⓘ My-new-hub ▾

Region * ⓘ UK South ▾

[Review + create](#) [< Previous](#) [Next: Networking >](#)

2. Select your subscription and resource group, give your IoT Hub a name, e.g. `My-new-hub` (will be used later for connection), and select the most fitting region (ideally same region as the one selected for the SQL Database and server).

Home > Create a resource > IoT Hub >

IoT hub

Microsoft

Basics Networking Management Tags Review + create

You can connect to your IoT hub either publicly via its public hostname or privately using a private endpoint.
[Learn more](#)

Connectivity configuration *

Public access
 Private access (Recommended)

i You can change this or configure another connectivity method after this resource has been created.
[Learn more](#)

[Review + create](#) [< Previous: Basics](#) [Next: Management >](#)

3. Click on `Next: Networking`. Select the default Public access (we want all IoT devices across the globe to be able to connect for the demo).

IoT hub

Microsoft

Each IoT hub is provisioned with a certain number of units in a specific tier. The tier and number of units determine the maximum daily quota of messages that you can send. [Learn more](#)

Scale tier and units

Pricing and scale tier * ⓘ

B3: Basic tier



S1: Standard tier

S2: Standard tier

S3: Standard tier

B1: Basic tier

B2: Basic tier

B3: Basic tier

F1: Free tier

Number of B3 IoT hub units ⓘ

Determines

Defender for IoT

Microsoft [Defender for IoT](#) is a separate service that protects your IoT Edge devices, your IoT Edge, and your devices. You will be charged within a different geographic location than your IoT hub.

Pricing and scale tier ⓘ

B3

Device-to-cloud-messages ⓘ

Enabled

Messages per day ⓘ

300,000,000

Message routing ⓘ

Enabled

Cost per month

499.72 USD

Cloud-to-device commands ⓘ

Only available in Free/Standard tiers

Defender for IoT ⓘ

Disabled

IoT Edge ⓘ

Only available in Free/Standard tiers

Device management ⓘ

Only available in Free/Standard tiers

[Review + create](#)

[< Previous: Networking](#)

[Next: Tags >](#)

4. Click [Next: Management](#). Here, if available select the free tier (this demo does not use IoT Edge nor Cloud-to-device commands). All other options should be left as default.
5. Click [Review + create](#), double check all information and confirm creation.

My-new-hub | Devices

IoT Hub

Search (Cmd+/)

View, create, delete, and update devices in your IoT Hub.

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Events

Pricing and scale

Device management

Devices

IoT Edge

Configurations

Updates

Queries

Hub settings

Built-in endpoints

Message routing

File upload

Failover

Properties

Locks

Security settings

Identity

Device name

enter device ID

Find devices

Add Device Refresh Delete

Device ID	Status
-----------	--------

There are no IoT devices to display.

6. After the IoT Hub is deployed, open its main portal and scroll to **Device Management** and select **Devices**.
7. Create a new IoT device, by pressing **Add Device**. You can now follow this guide in case ours becomes out-dated: <https://docs.microsoft.com/en-gb/azure/iot-hub/quickstart-send-telemetry-cli>

Home > My-new-hub >

Create a device

Find Certified for Azure IoT devices in the Device Catalog

Device ID *

Authentication type Symmetric key X.509 Self-Signed X.509 CA Signed

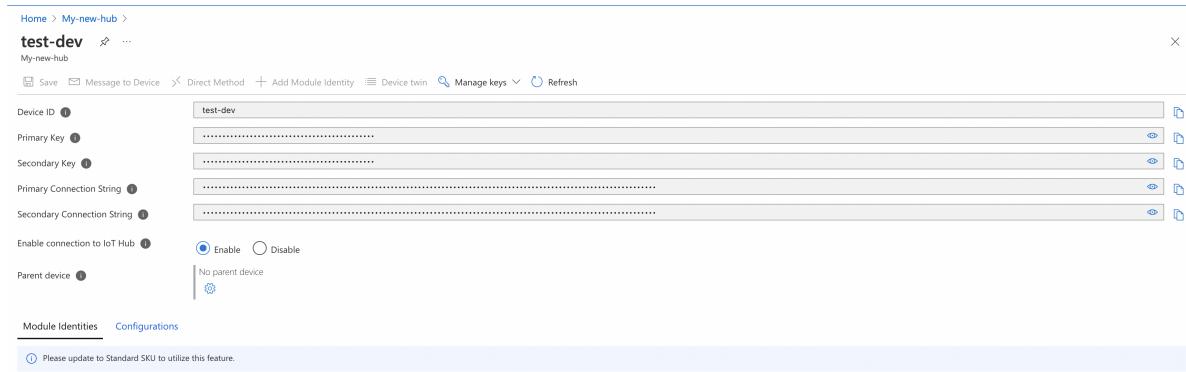
Auto-generate keys

Connect this device to an IoT hub Enable Disable

Parent device
No parent device [Set a parent device](#)

Save

8. Give the device an ID, select **Symmetric key** for Authentication Type, and **Enable** connection of this device to IoT Hub.



9. Now the device should appear in the list of available IoT devices. Select it, and copy the Primary Connection String. This will be used in the Raspberry Pi `.env` file, for authenticating with the IoT Hub.

Stream Analytics Job

1. Next we create the Stream Analytics Job. Once again, Look for it in the resources above, select the creation of a new Stream Analytics Job.

Home > Stream Analytics jobs >

New Stream Analytics job

This will create a new Stream Analytics job. You will be charged accordingly.

Job name *

Subscription *

Resource group *

 [Create new](#)

Location *

 UK South

Hosting environment

Cloud Edge

Streaming units (1 to 192)

3

Secure all private data assets needed by this job in my Storage account.

Create

2. Add the Job's name, select your subscription and resource group (same as IoT Hub and SQL Database). Choose the same Location as well. Click **Create**.
3. After the resource is deployed, click **Go to resource**.

The screenshot shows the Azure Stream Analytics job configuration interface. At the top, the path is 'Home > StreamAnalyticsJob > test-deployment-job'. The main title is 'test-deployment-job | Inputs'. Below the title, there's a search bar and two buttons: '+ Add stream input' and '+ Add raw data'. On the left, a sidebar lists several sections: Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Settings (Properties, Locks), Job topology (Inputs, Functions, Query, Outputs), Configure (Environment, Storage account settings, Scale, Locale, Event ordering, Error policy, Compatibility level, Managed Identity). The 'Inputs' section under 'Job topology' is currently selected. A dropdown menu on the right shows options: Blob storage/ADLS Gen2, Event Hub, IoT Hub, and IoT Hub is highlighted.

4. Now Set up the inputs for the job. Click on inputs and, `Add stream input`, and select `IoTHub`.

IoT Hub ×

New input

Input alias * my-input ✓

Provide IoT Hub settings manually
 Select IoT Hub from your subscriptions

Subscription [REDACTED] ▾

IoT Hub * ⓘ My-new-hub ▾

Consumer group * ⓘ \$Default ▾

Shared access policy name * ⓘ iothubowner ▾

Shared access policy key ⓘ

Endpoint ⓘ Messaging ▾

Partition key ⓘ

Event serialization format * ⓘ JSON ▾

Encoding ⓘ UTF-8 ▾

Save

5. Give the input a name, and select your subscription and the IoT Hub you have just created. Click Save.
6. Automatically a connection test will begin, and should complete successfully.

The screenshot shows the Azure Stream Analytics job interface for 'test-deployment-job'. The left sidebar contains links for Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Properties, Locks, Inputs, Functions, Query, and Outputs. The 'Outputs' link is highlighted. On the right, a list of destination services is shown in a dropdown menu, with 'SQL Database' selected.

- Azure Data Explorer (Preview)
- Azure Function
- Azure PostgreSQL (preview)
- Azure Synapse Analytics
- Blob storage/ADLS Gen2
- Cosmos DB
- Data Lake Storage Gen1
- Event Hub
- Power BI
- Service Bus queue
- Service Bus topic
- SQL Database
- Table storage

7. Just below inputs, select outputs, click **Add** and select SQL Database.

SQL Database

New output

Output alias * ✓

Provide SQL Database settings manually
 Select SQL Database from your subscriptions

Subscription ▾

Database * ⓘ ▾

Authentication mode ▾

Username * ✓

Password ✓

Server name

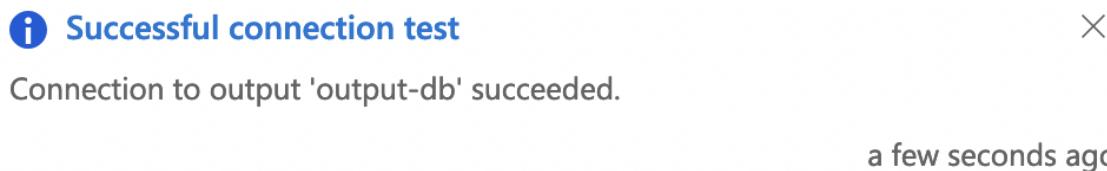
Table * ▾

Merge all input partitions into a single writer
 Inherit partition scheme of previous query step or input

Max batch count ⓘ

Save

- Fill in Output alias, select your subscription and the newly created database. For Authentication mode select `Connection string` and input your `username` and `password` for the SQL server. for the Table, put `dbo.SensorData` which is the table we created when setting up the SQL server and DB resources. Click `Save`.



- The connection to the DB will be tested. if you have correctly recreated all steps so far, you will be met with a Successful connection test message. Congratulations! You

are almost there.

10. Now, go to **Query** section (just above **output**). Paste in this query, replacing **output-db** for your output alias and **my-input** for your input alias:

```
SELECT
    Timestamp,
    SensorID,
    SensorType,
    Value,
    ActuatorValue
INTO
    [output-db]
FROM
    [my-input]
```

[Home](#) > [StreamAnalyticsJob](#) >

test-deployment-job

Stream Analytics job



 Search (Cmd+/)



 Start  Stop

 Overview

 Created

 Activity log

^ Essentials

 Access control (IAM)

Resource group ([move](#))

 Tags

Status

 Diagnose and solve problems

Location

 Settings

Subscription ([move](#))

... 

Subscription ID

11. Next, go back to main page of the Stream Analytics Job and click **Start**. This step is now complete!

