

Azure IoT Suit

- Azure Event Hubs
- Azure Storage
- Azure Stream Analytics
- Microsoft Power BI
- IoT Security consideration

Azure Event Hubs



- is a managed platform service
- provides a foundation for large-scale data intake
 - mobile apps traffic information from web farms
 - in-game event capture in console games
 - telemetry data collected from industrial machines
 - connected vehicles.
- "front door" event ingestor.

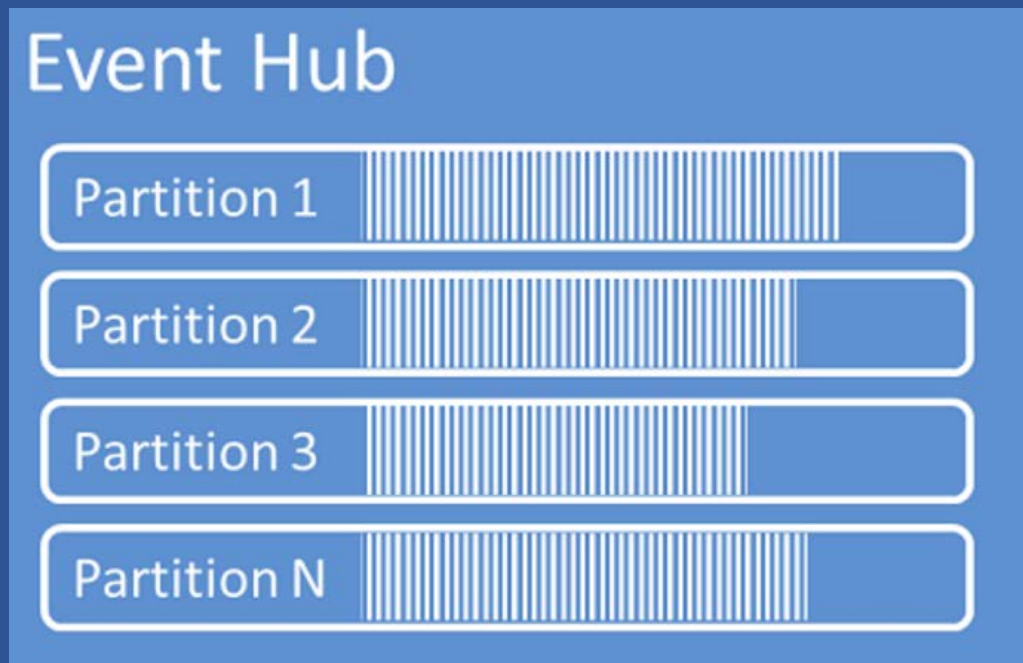
Partitions

- A partition is an ordered sequence of events that is held in an Event Hub.
- As newer events arrive, they are added to the end of this sequence.
- A partition can be thought of as a "commit log."

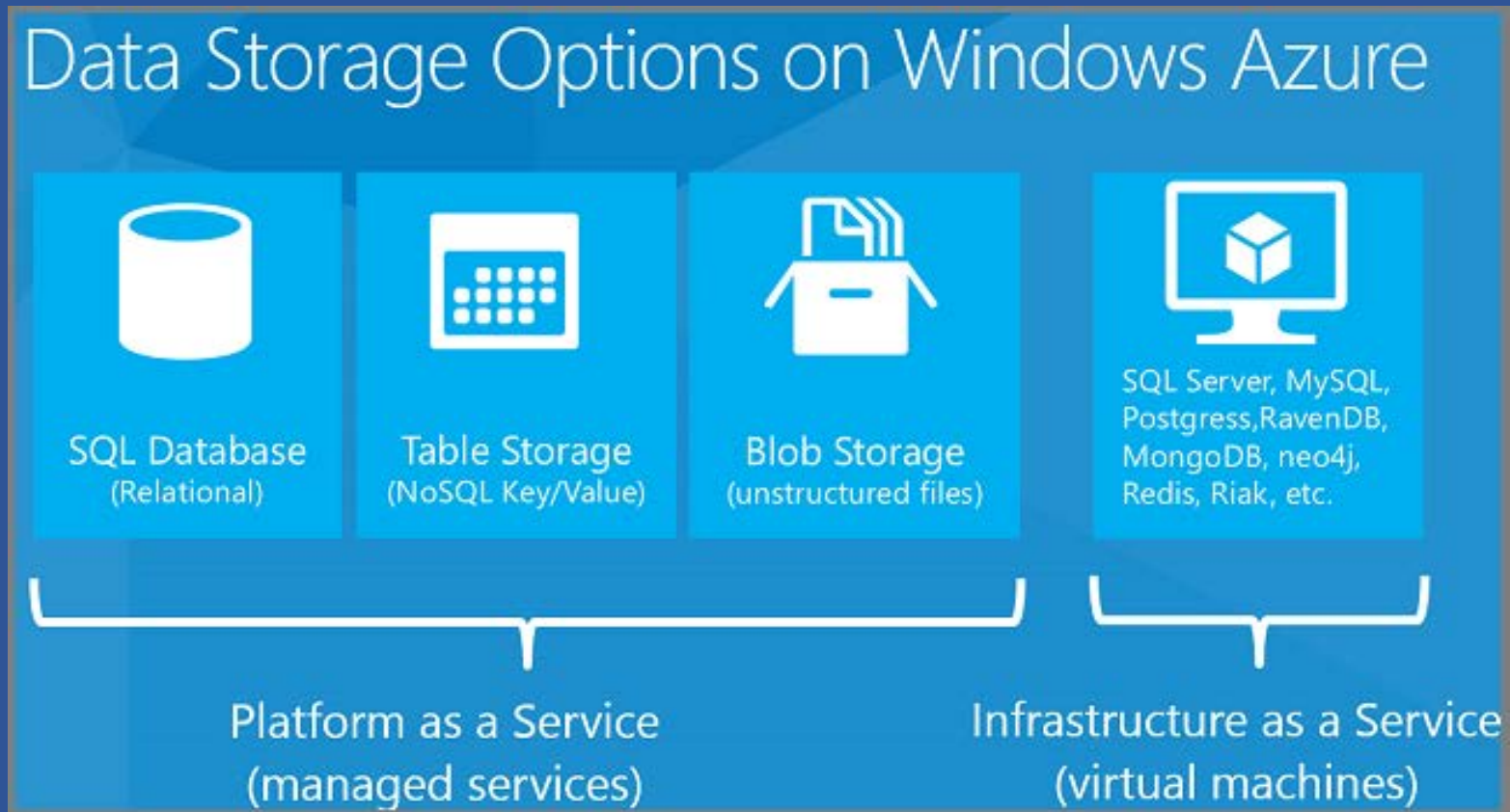


Event Hub / Partition

- Events expire on a time basis;
- you cannot explicitly delete them.
- An Event Hub contains multiple partitions.
- Each partition is independent and contains its own sequence of data.
- As a result, partitions often grow at different rates.



Azure Storage

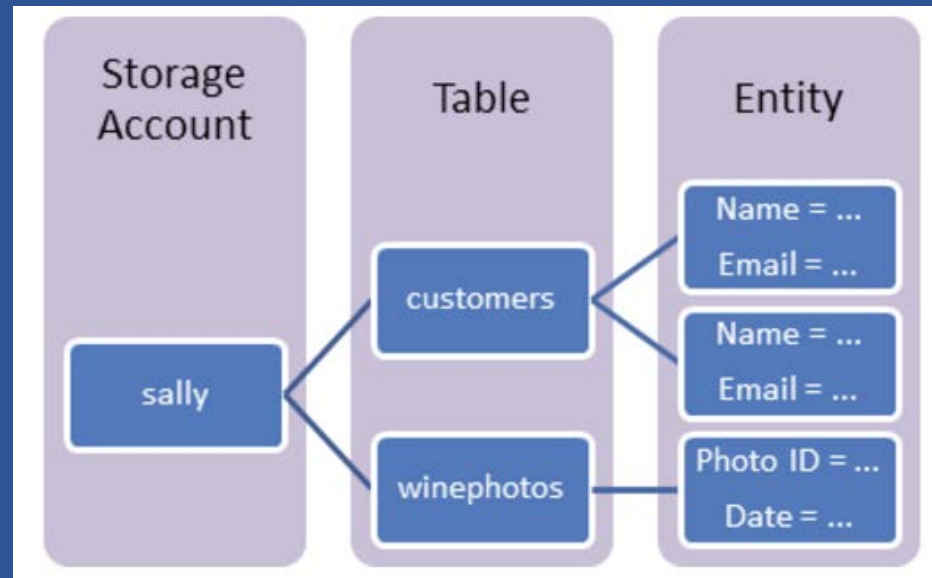


Azure Storage features

- Highly available
- Large-scale applications
- Storage foundation for Azure Virtual Machines
- Massively scalable
- Support the big data
- Support small business website
- Handles millions of requests per second
- Elastic, in terms of the amount of data stored and the number of request
- You pay only for what you use, and only when you use it.
- Automatically load-balances
- Accessible from anywhere in the world
- Supports Windows and Linux
- Support .NET, Java, Node.js, Python, Ruby, PHP and C++ and mobile programming languages)



Azure Table Service



- Large amounts of structured data
- NoSQL
- Accepts authenticated calls from inside and outside the Azure cloud
- Non-relational data
- Storing TBs of structured data
- Storing datasets that don't require complex joins, foreign keys, or stored procedures
- LINQ queries

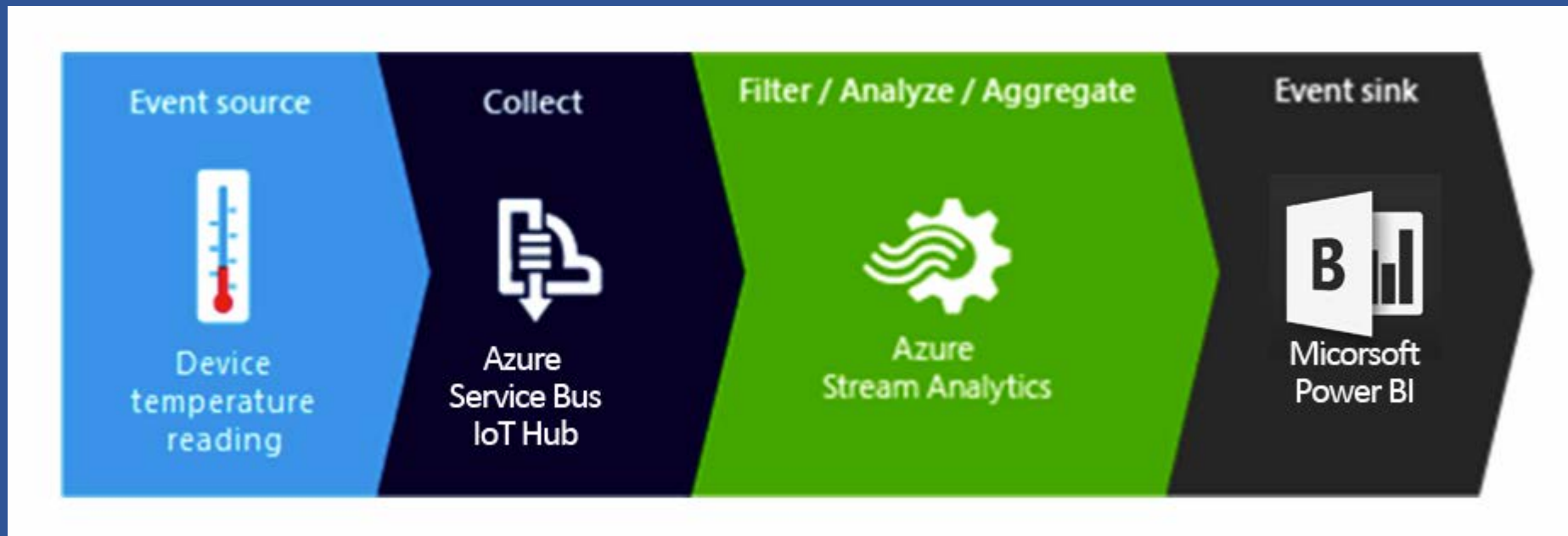
Azure Stream Analytics



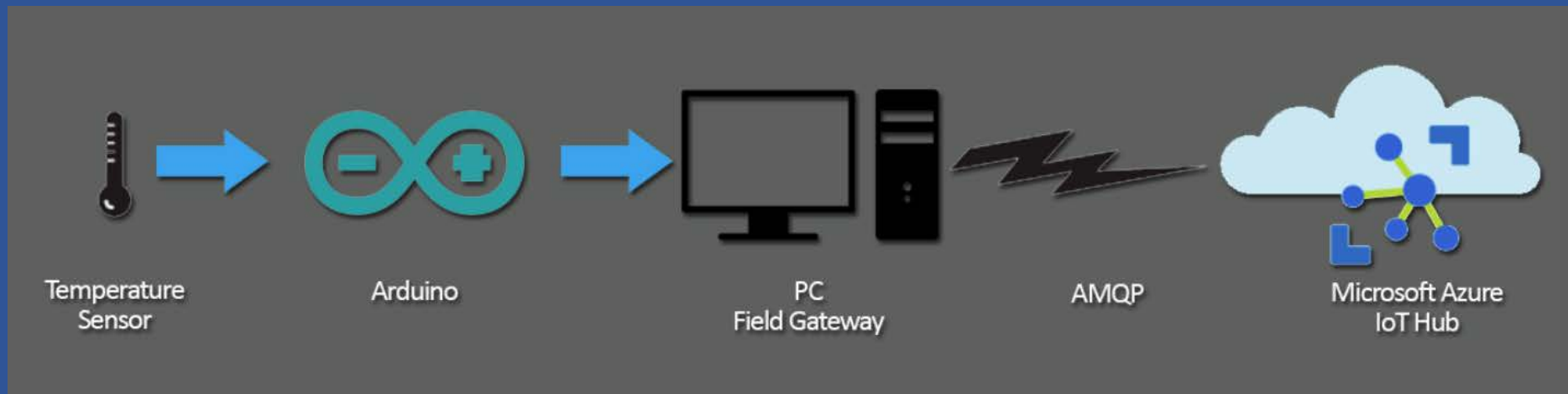
- Perform real-time analytics for your Internet of Things solutions
- Stream millions of events per second
- Get mission-critical reliability and performance with predictable results
- Create real-time dashboards and alerts over data from devices and applications
- Correlate across multiple streams of data
- Use familiar SQL-based language for rapid development

In this session

1. Create Temperature sensing device
2. Sending telemetry data to Azure IoT Hub
3. Send data to Azure Stream Analytics
4. Sink event to BI
5. Create data visualization in Microsoft Power BI

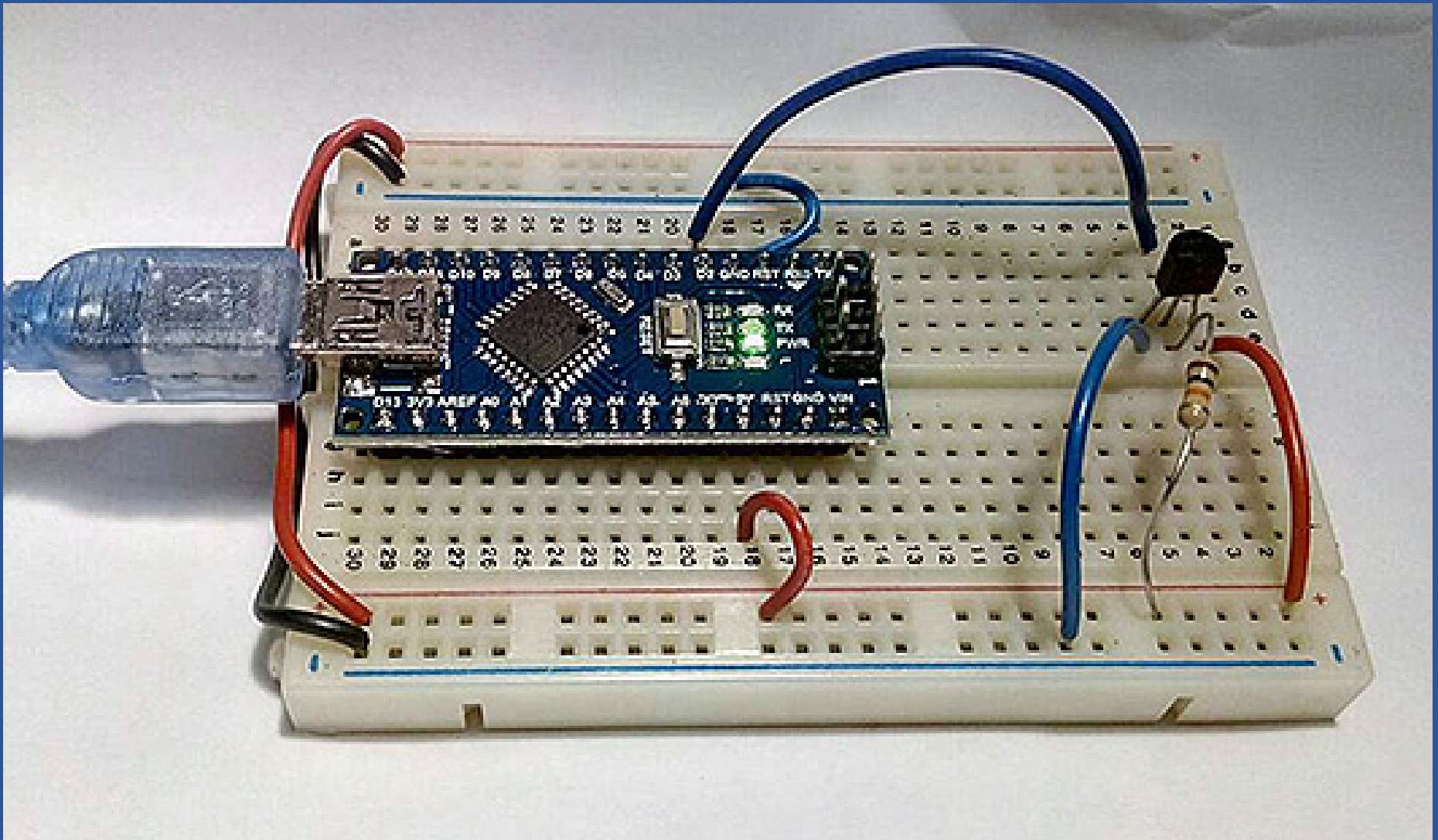


Sending telemetry data from device to Cloud

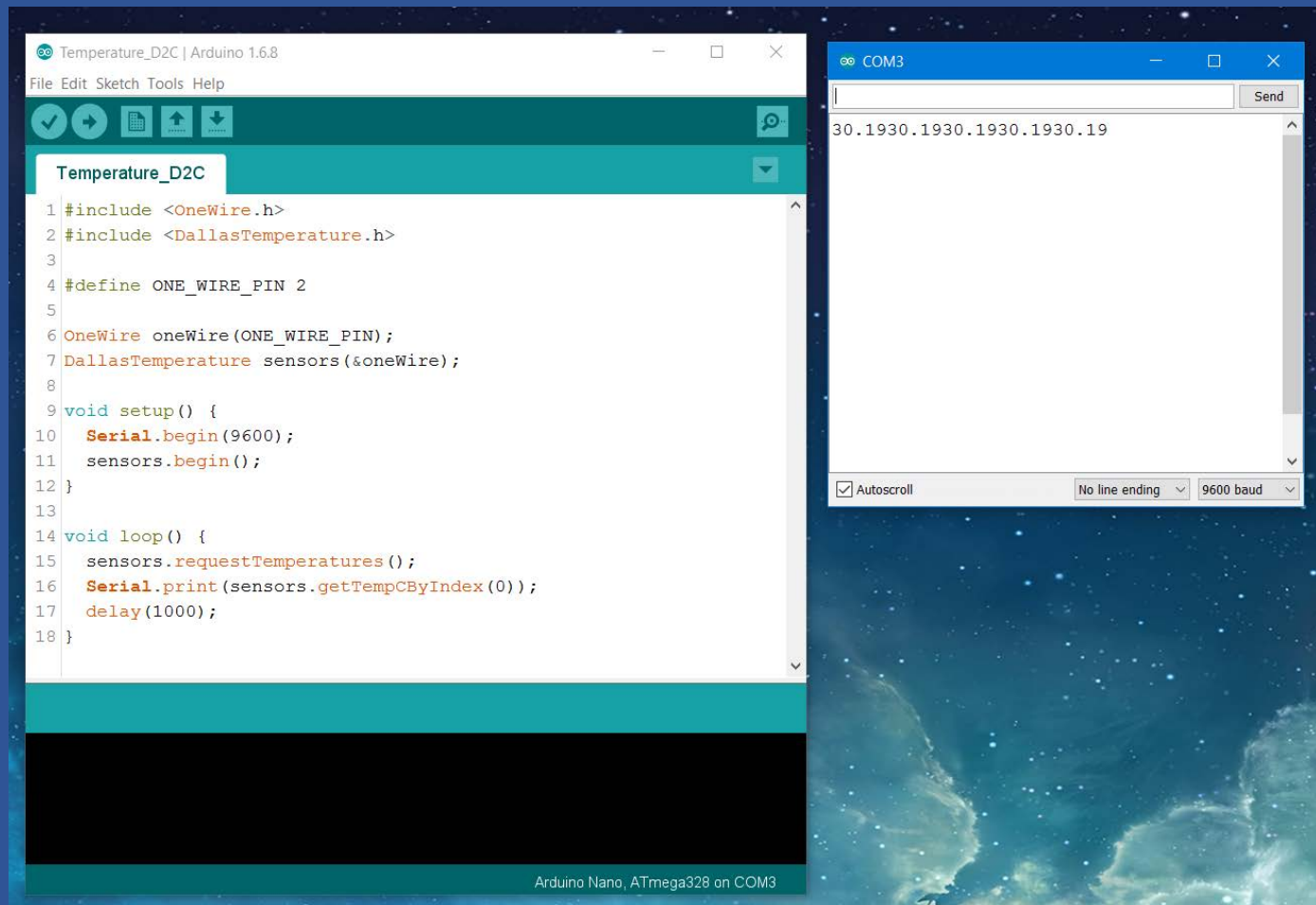


1. Make temperature circuit
2. Run Arduino Code and test
3. Run WinApp and test with Device Explorer

Make temperature circuit



Run Arduino Code and test



The image shows two windows from the Arduino IDE environment. The left window, titled "Temperature_D2C | Arduino 1.6.8", displays the source code for a sketch named "Temperature_D2C". The code includes the OneWire and DallasTemperature libraries, defines a pin, and sets up a serial connection at 9600 baud. The loop function requests temperatures and prints the first sensor's value every 1000 milliseconds. The right window, titled "COM3", is a serial monitor showing the output of the sketch: "30.1930.1930.1930.1930.19". The serial monitor settings at the bottom indicate "Autoscroll" is checked, "No line ending" is selected, and the baud rate is "9600 baud".

```
Temperature_D2C
1 #include <OneWire.h>
2 #include <DallasTemperature.h>
3
4 #define ONE_WIRE_PIN 2
5
6 OneWire oneWire(ONE_WIRE_PIN);
7 DallasTemperature sensors(&oneWire);
8
9 void setup() {
10   Serial.begin(9600);
11   sensors.begin();
12 }
13
14 void loop() {
15   sensors.requestTemperatures();
16   Serial.print(sensors.getTempCByIndex(0));
17   delay(1000);
18 }
```

30.1930.1930.1930.1930.19

Autoscroll No line ending 9600 baud

Arduino Nano, ATmega328 on COM3

Run WinApp and test with Device Explorer

The image shows two windows from the Microsoft Azure IoT suite. The 'Device Simulator 1' window on the left displays 'Device to Cloud Message' logs and 'Sensor Data' for a device named 'myFirstDevice'. The 'Device Explorer' window on the right shows the 'Monitoring' tab with configuration for an Event Hub named 'Loy01' and a list of received events.

Device Simulator 1 - Device to Cloud Message

```
7/15/2016 9:04:53 AM{"deviceId":"myFirstDevice","Temperature":30.19}
7/15/2016 9:04:54 AM{"deviceId":"myFirstDevice","Temperature":30.19}
7/15/2016 9:04:55 AM{"deviceId":"myFirstDevice","Temperature":30.19}
7/15/2016 9:04:57 AM{"deviceId":"myFirstDevice","Temperature":30.19}
7/15/2016 9:04:59 AM{"deviceId":"myFirstDevice","Temperature":30.25}
```

Device Simulator 1 - Sensor Data

```
30.19
30.19
30.19
30.19
30.25
```

Device Explorer - Monitoring Configuration

- Event Hub: Loy01
- Device ID: myFirstDevice
- Start Time: 07/15/2016 08:42:24
- Consumer Group: \$Default
- Enable: ☐

Device Explorer - Event Hub Data

Receiving events...

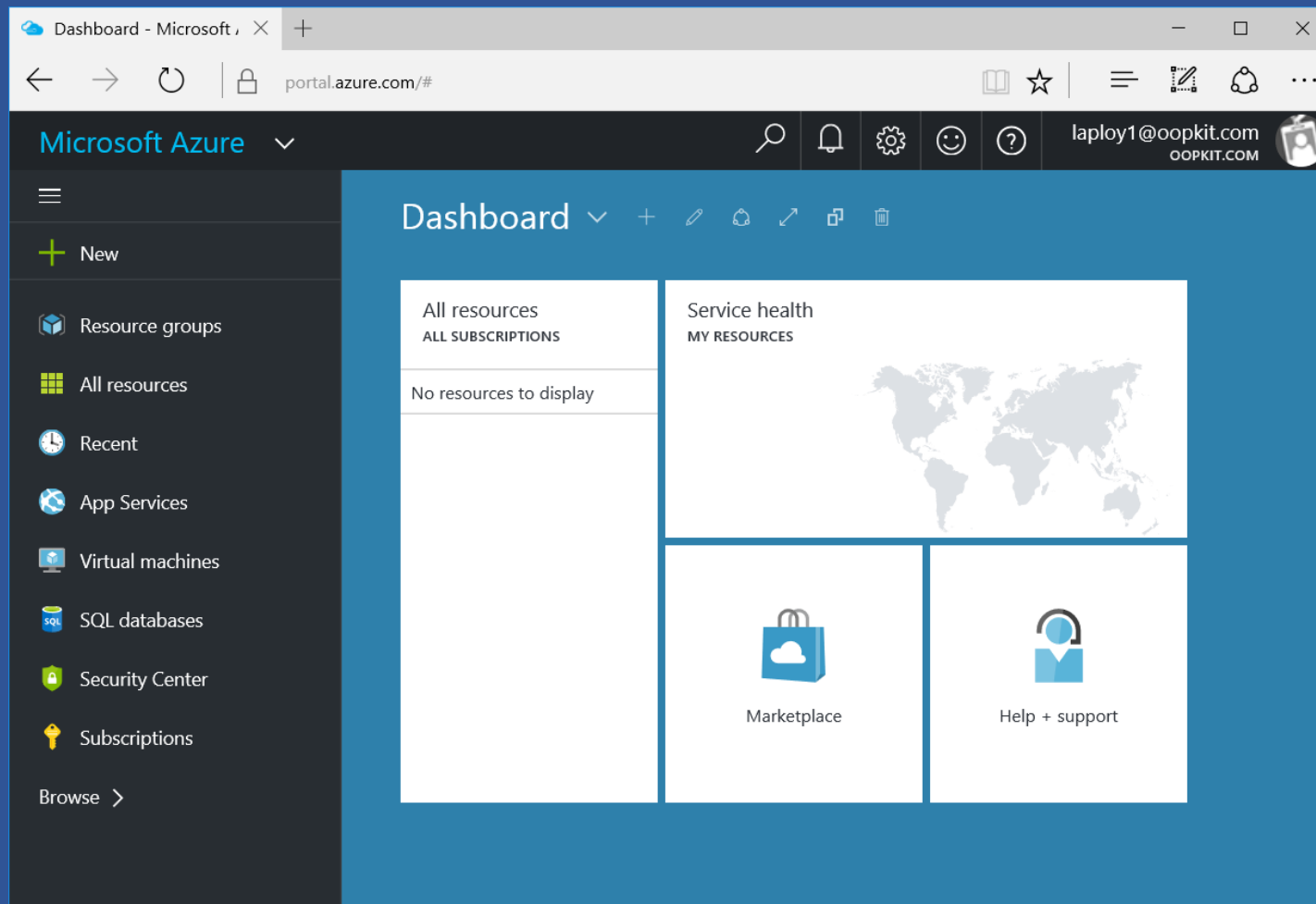
```
7/15/2016 8:42:24 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.12}]
7/15/2016 8:42:26 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:27 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:29 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.12}]
7/15/2016 8:42:31 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.12}]
7/15/2016 8:42:33 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:34 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.12}]
7/15/2016 8:42:36 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:38 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:40 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:42 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:43 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:45 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:47 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:49 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
7/15/2016 8:42:50 AM> Device: [myFirstDevice], Data:[{"deviceId":"myFirstDevice","Temperature":30.19}]
```

Create Azure Stream Analytics Job

1. Open Azure Dashboard
2. Create New Stream Analytics Job
3. Setup Input
4. Setup Output
5. Write query

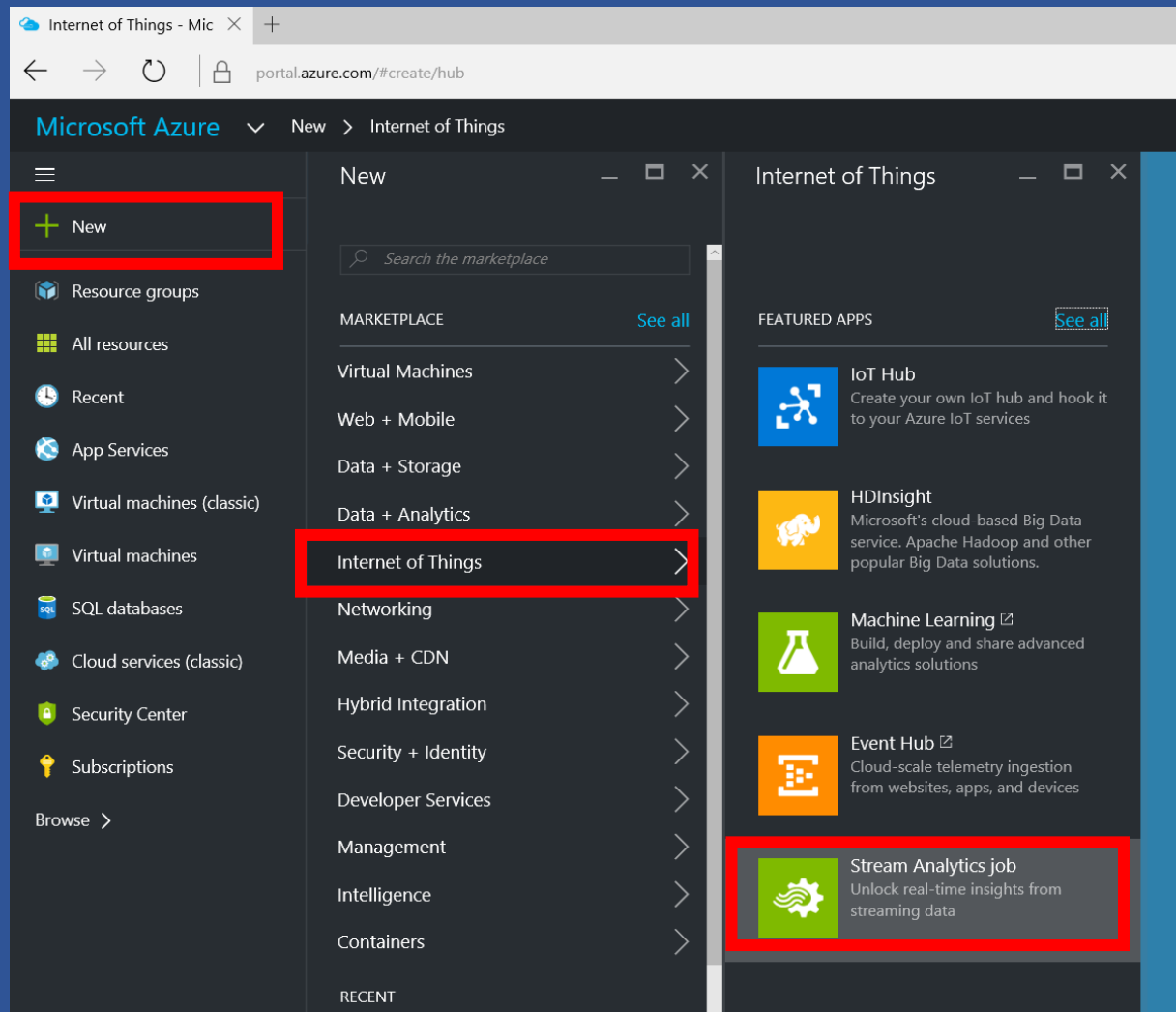
Go to Azure Dashboard

<https://portal.azure.com/>



Create new Stream Analytics Job

New / Internet of Things / Stream Analytics Job



Create New Stream Analytics Job

Provide name / Resource group / location

New Stream Anal...

* Job name

Stream1 ✓

* Subscription

Azure Pass ▼

* Resource group ⓘ

☐ Create new ☒ Use existing

rs01 ▼

* Location

Southeast Asia ▼

☒ Pin to dashboard

Create

Wait for Stream1 to be created

The screenshot displays the Azure portal dashboard with a blue header bar. The header contains the word "Dashboard" followed by a dropdown arrow, and several action buttons: "+ New dashboard", "Edit dashboard", "Share", "Fullscreen", "Clone", and "Delete".

The dashboard is divided into several sections:

- All resources ALL SUBSCRIPTIONS:** A list on the left showing "Stream1" (with a green gear icon) and "Loy01" (with a blue network icon).
- Service health MY RESOURCES:** A section featuring a world map with green checkmarks indicating service health across various regions.
- Loy01 AZURE IOT HUB:** A section on the right showing the status "Active" and a blue network icon.
- Stream1 STREAMING JOB:** A section at the bottom right, highlighted with a red border, showing a green gear icon.
- Marketplace:** A section at the bottom left with a blue shopping bag icon.
- Help + support:** A section at the bottom center with a blue headset icon.

A red arrow points from the "Stream1" resource in the "All resources" list to the "Stream1 STREAMING JOB" section, indicating the next step in the process.

Create Stream Analytics Job Input

Open Stream1

The screenshot shows the Azure Stream Analytics job 'Stream1' configuration page. The page has a dark header with the job name 'Stream1' and a 'Stream Analytics job' subtitle. Below the header is a toolbar with 'Settings', 'Start', 'Stop', and 'Delete' buttons. A blue banner indicates the job is 'Created'. The 'Essentials' section displays job details: Resource group 'rs01', Status 'Created', Location 'Southeast Asia', Subscription name 'Azure Pass', and Subscription ID 'bb51e644-fe87-4f6d-8793-f056f529d26c'. It also shows 'Created' on 'Friday, July 15, 2016 8:12:23 AM' and 'Last output' as '-'. A 'Send feedback' link is present. The 'Job Topology' section shows three empty boxes for 'Inputs', 'Query', and 'Outputs', each with a '0' and a 'No results.' message. An 'Add tiles' button is in the top right of the Job Topology section.

Stream1
Stream Analytics job

Settings Start Stop Delete

Created

Essentials ^

Resource group [rs01](#)

Status
Created

Location
Southeast Asia

Subscription name
[Azure Pass](#)

Subscription ID
bb51e644-fe87-4f6d-8793-f056f529d26c

Send feedback
[UserVoice](#)

Created
Friday, July 15, 2016 8:12:23 AM

Started
-

Last output
-

[All settings](#) →

Job Topology Add tiles +

Inputs

0 →

No results.

Query

< >

Outputs

0 →

No results.

Input / + Add

Stream1
Stream Analytics job

Settings Start Stop Delete

Created

Essentials ^

Resource group
rs01

Status
Created

Location
Southeast Asia

Subscription name
Azure Pass

Subscription ID
bb51e644-fe87-4f6d-8793-f056f529d26c

Send feedback
UserVoice

Created
Friday, July 15, 2016 8:12:23 AM

Started
-

Last output
-

All settings →

Job Topology

Inputs

0

No results.

Query

Outputs

0

No results.

Inputs

| NAME | SOURCE TYPE |
|-------|-------------|
| Empty | |

Set alias / source

The screenshot shows the 'New input' configuration window in Azure IoT Hub. The window has a dark header with the title 'New input' and standard window controls. The main area is white and contains several configuration fields, each with a red asterisk indicating it is required. The fields are: 'Input alias' (text input with 'input1' and a green checkmark), 'Source Type' (dropdown menu with 'Data stream' selected), 'Source' (dropdown menu with 'IoT hub' selected), 'Subscription' (dropdown menu with 'Use IoT hub from current subscription' selected), 'IoT hub' (dropdown menu with 'Loy01' selected), 'Endpoint' (dropdown menu with 'Messaging' selected), 'Shared access policy name' (dropdown menu with 'iothubowner' selected), 'Shared access policy key' (text input with masked characters), and 'Consumer group' (dropdown menu with '\$Default' selected). At the bottom is a blue 'Create' button. Five red arrows point to the 'Input alias', 'Source Type', 'Source', 'IoT hub', and 'Create' button fields.

New input

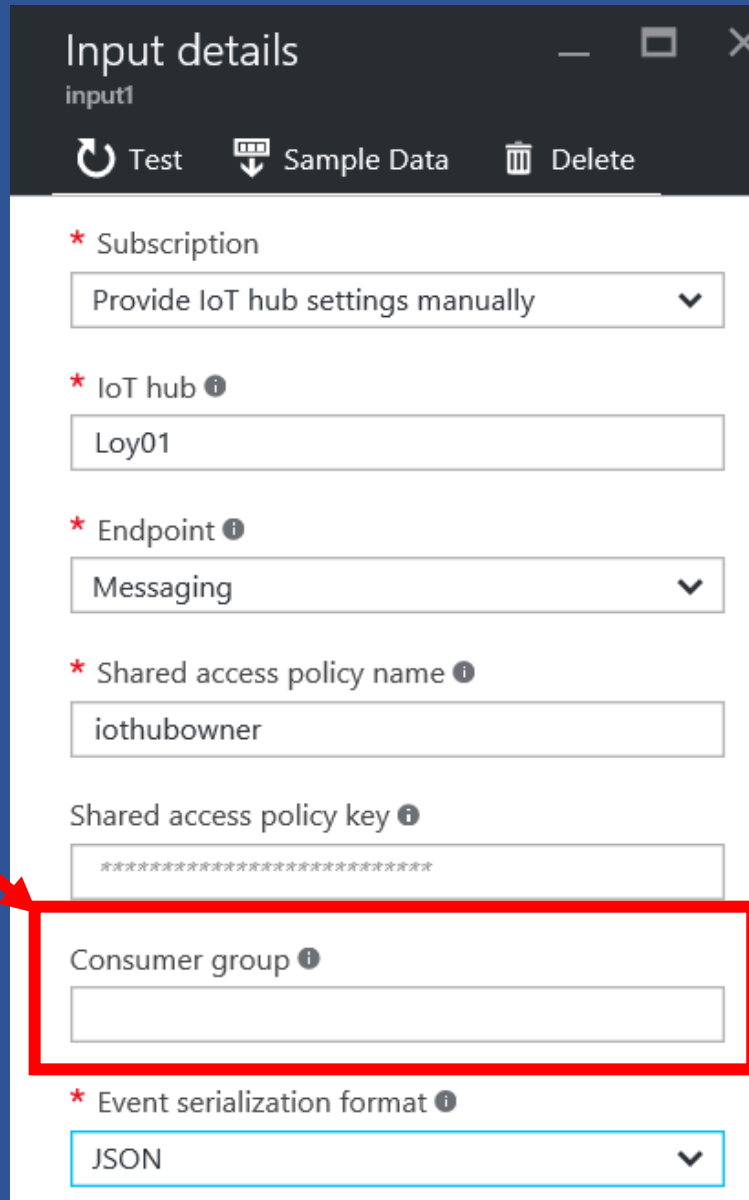
- * Input alias: input1 ✓
- * Source Type ⓘ: Data stream
- * Source ⓘ: IoT hub
- * Subscription: Use IoT hub from current subscription
- * IoT hub: Loy01
- * Endpoint ⓘ: Messaging
- * Shared access policy name: iothubowner
- Shared access policy key:
- * Consumer group: \$Default

Create

Wait for input1 to be created

| Inputs | | |
|---------|-------------|---------|
| Stream1 | | |
| + Add | | |
| NAME | SOURCE TYPE | SOURCE |
| input1 | Stream | IoT hub |

Clear Consumer group name



Input details
input1

Test Sample Data Delete

* Subscription
Provide IoT hub settings manually ▼

* IoT hub ⓘ
Loy01

* Endpoint ⓘ
Messaging ▼

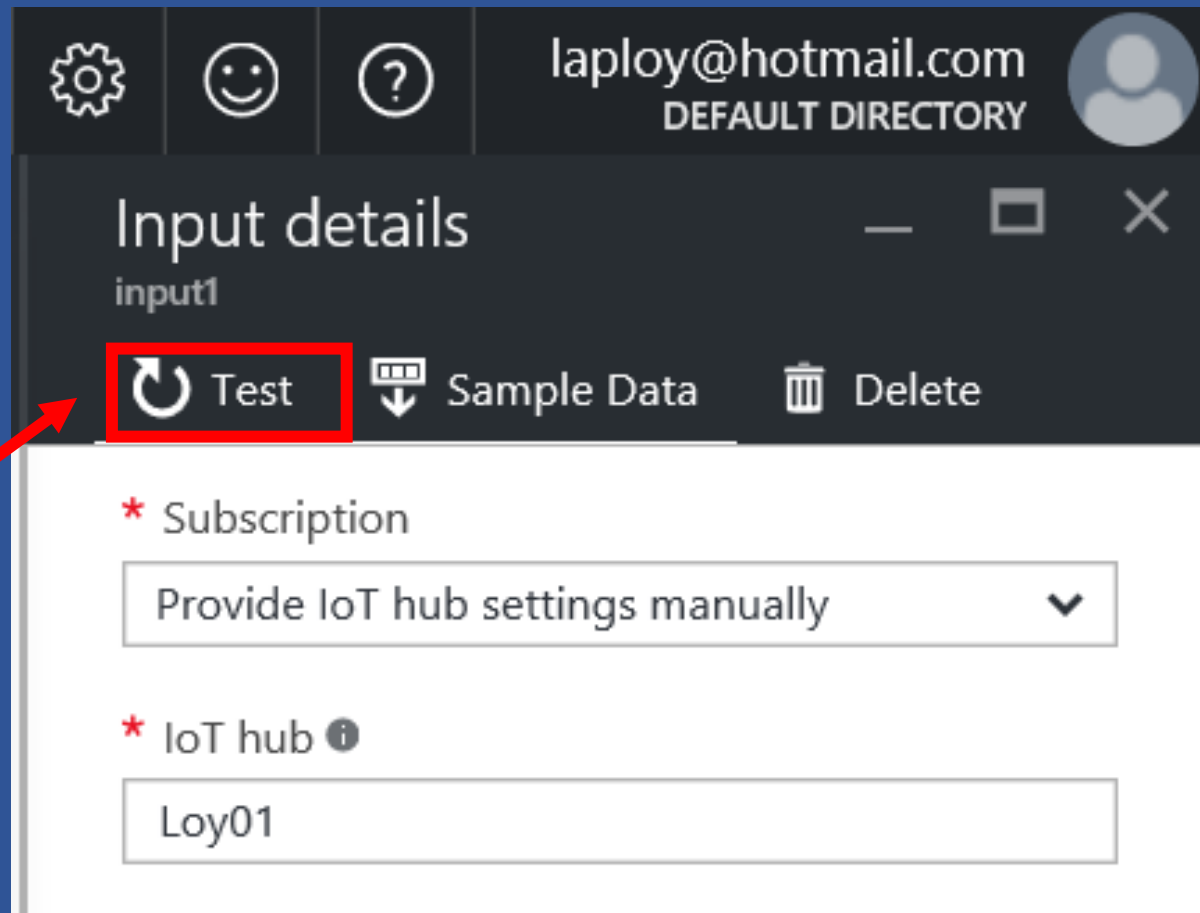
* Shared access policy name ⓘ
iothubowner

Shared access policy key ⓘ

Consumer group ⓘ

* Event serialization format ⓘ
JSON ▼

Click “Test” button to test connection



laploy@hotmail.com
DEFAULT DIRECTORY

Input details
input1

Test Sample Data Delete

* Subscription
Provide IoT hub settings manually

* IoT hub ⓘ
Loy01

In Sample Data box, click “OK”

Sample data

input1

* Start time ⓘ

2016-07-15

×

9:16:14 AM

Local Time (UTC+07:00)

* Duration ⓘ

Days

Hours

Minutes

Seconds

0

0

3

0

OK

Look for “Successful connection test” message

 Successful connection test
Connection to input 'input1' succeeded.

Download sample data

Click the message

The screenshot shows the Azure IoT Hub dashboard. A red arrow points from the 'Service health' section to a message in the right-hand pane. The message is titled 'Sample input 'input1' succeeded for Str...' and contains the text 'Sampled events are available to be downloaded. Click to download.' Below this message is a list of other events, including a failed sample input and several successful connection tests.

azure.com

Dashboard ▾ + New dashboard Edit dashboard Share

All resources
ALL SUBSCRIPTIONS

- Stream1
- Loy01

Service health
MY RESOURCES

Marketplace

Help + support

✓ Sample input 'input1' succeeded for Str... 8:43 AM
Sampled events are available to be downloaded. Click to download.

✗ Sample input 'input1' failed for Stream... 8:32 AM
Error code: BadArgument Error message: There was an error while reading sample input. Please check if the input source is configured correctly and data is in correct format.

✓ Successful connection test 8:31 AM
Connection to input 'input1' succeeded.

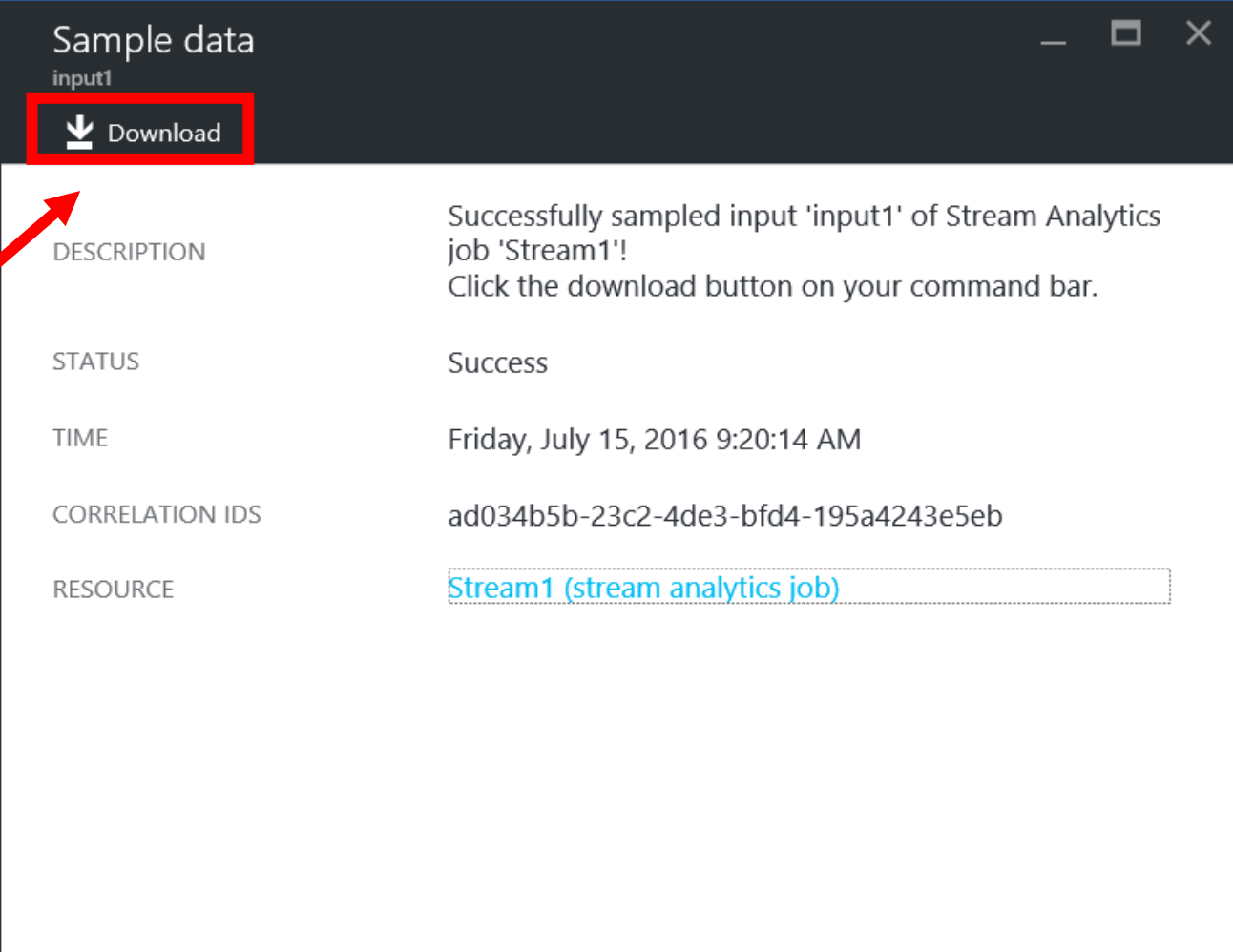
✓ Edited input 8:31 AM
Edited input 'input1' in Streaming Job 'Stream1'.

✓ Successful connection test 8:26 AM
Connection to input 'input1' succeeded.

✓ Edited input 8:26 AM
Edited input 'input1' in Streaming Job 'Stream1'.


✓ Successful connection test 8:26 AM
Connection to input 'input1' succeeded.

In sample data pane, click download button



Sample data

input1

 Download

| | |
|-----------------|--|
| DESCRIPTION | Successfully sampled input 'input1' of Stream Analytics job 'Stream1'! Click the download button on your command bar. |
| STATUS | Success |
| TIME | Friday, July 15, 2016 9:20:14 AM |
| CORRELATION IDS | ad034b5b-23c2-4de3-bfd4-195a4243e5eb |
| RESOURCE | Stream1 (stream analytics job) |

JSON message Analytics

```
1  "deviceId":"myFirstDevice",
2  "Temperature":30.31,
3  "EventProcessedUtcTime":"2016-07-15T02:20:07.9888477Z",
4  "PartitionId":1,
5  "EventEnqueuedUtcTime":"2016-07-15T02:16:15.0130000Z",
6  "IoTHub":
7  {
8      "MessageId":null,
9      "CorrelationId":null,
10     "ConnectionDeviceId":"myFirstDevice",
11     "ConnectionDeviceGenerationId":"636024695046666970",
12     "EnqueuedTime":"0001-01-01T00:00:00.0000000",
13     "StreamId":null
14 }
```

More on IoT hub message

- <https://azure.microsoft.com/en-us/documentation/articles/iot-hub-csharp-csharp-process-d2c/>
- <https://azure.microsoft.com/en-us/documentation/articles/iot-hub-devguide/>
- <https://azure.microsoft.com/en-us/documentation/articles/event-hubs-overview>

Create Stream Analytics Job Output

Click Output

The screenshot displays the Azure Stream Analytics job configuration interface for 'Stream1'. The top bar includes a settings gear, 'Start', 'Stop', and 'Delete' buttons. Below this is a 'Created' status bar. The 'Essentials' section provides job details: Resource group 'rs01', Status 'Created', Location 'Southeast Asia', Subscription name 'Azure Pass', and Subscription ID 'bb51e644-fe87-4f6d-8793-f056f52d26c'. It also shows 'Send feedback' via 'UserVoice', 'Created' on 'Friday, July 15, 2016 8:12:23 AM', and 'Last output' as '-'. A red arrow points from the 'Last output' field to the 'Outputs' tile in the 'Job Topology' section. The 'Job Topology' section has an 'Add tiles (+)' button and contains three tiles: 'Inputs' (1 input, 'input1'), 'Query' (code icon), and 'Outputs' (0 outputs, 'No results.'). The 'Outputs' tile is highlighted with a red box.

Click +Add

The screenshot shows the Azure Stream Analytics job 'Stream1' interface. The 'Outputs' panel on the right has a red box around the '+ Add' button. The 'Job Topology' section at the bottom has a red box around the 'Outputs' tile, which shows '0' results. A red arrow points from the '+ Add' button in the 'Outputs' panel to the 'Add tiles' button in the 'Job Topology' section.

Stream1
Stream Analytics job

Settings Start Stop Delete

Created

Essentials ^

Resource group
[rs01](#)

Status
Created

Location
Southeast Asia

Subscription name
[Azure Pass](#)

Subscription ID
bb51e644-fe87-4f6d-8793-f056f529d26c

Send feedback
[UserVoice](#)

Created
Friday, July 15, 2016 8:12:23 AM

Started
-

Last output
-

[All settings](#) →

Job Topology Add tiles (+)

Inputs
1

input1

Query
< >

Outputs
0

No results.

Monitoring Add tiles (+)

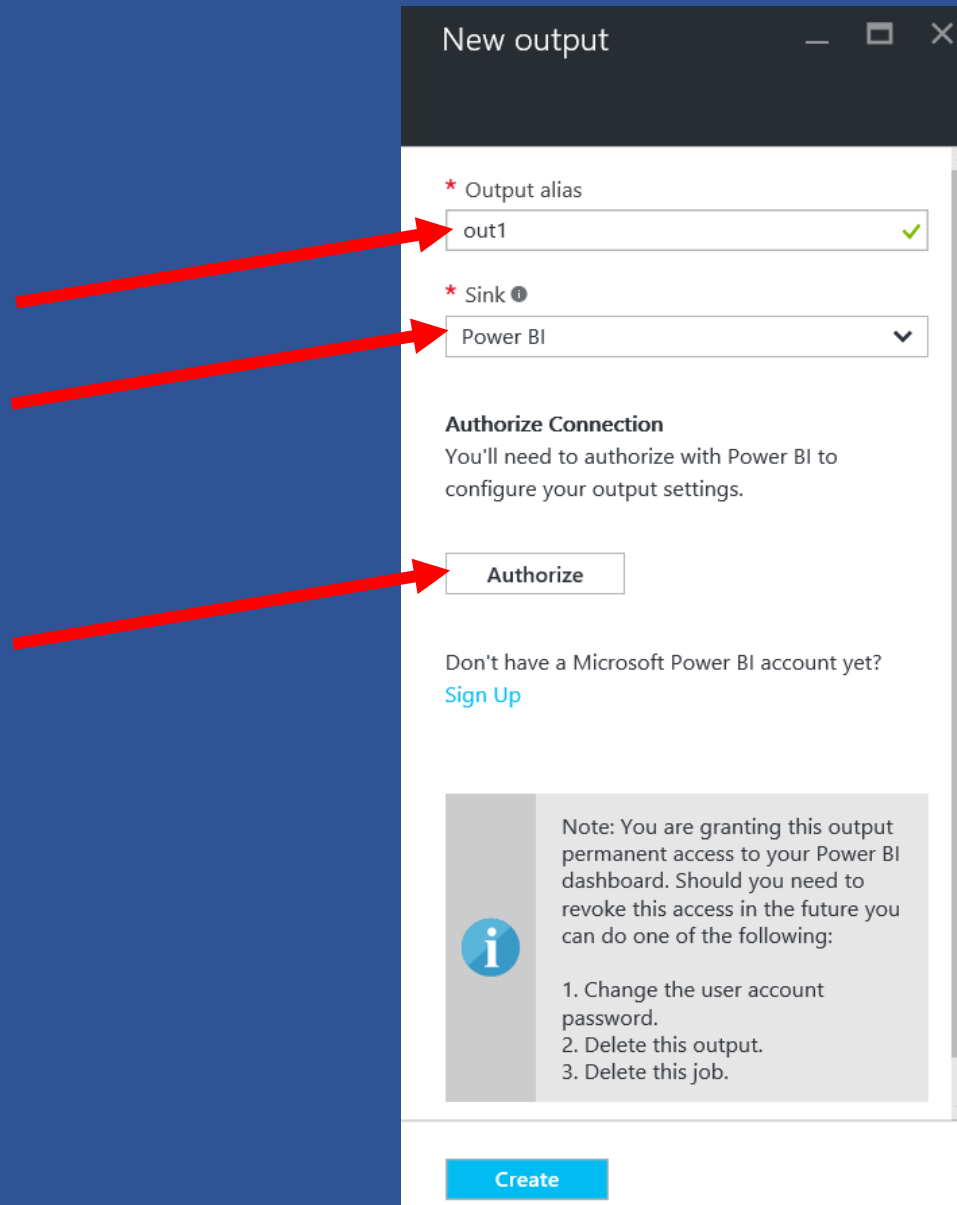
Outputs
Stream1

+ Add

NAME

Empty

Set Output alias / Sink Power BI / Authorize



New output

* Output alias
out1 ✓

* Sink ⓘ
Power BI ▼

Authorize Connection
You'll need to authorize with Power BI to configure your output settings.

Authorize

Don't have a Microsoft Power BI account yet?
[Sign Up](#)

Note: You are granting this output permanent access to your Power BI dashboard. Should you need to revoke this access in the future you can do one of the following:

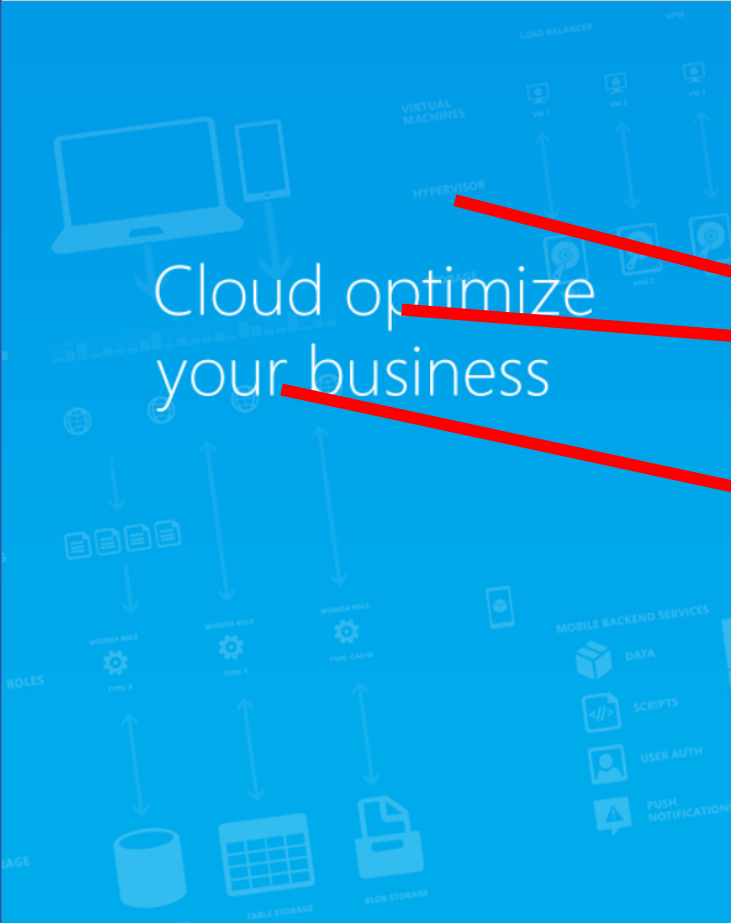
1. Change the user account password.
2. Delete this output.
3. Delete this job.

Create

Provide Power BI credential

Sign in to your account - Microsoft Edge

login.microsoftonline.com/common/oauth2/authorize?client_id=66f1e791-7bfb-4e18-aed8-1720056421c7&resource=https%3a%2f%2fanalysis.windows.net%2fpowerbi%2fapi8



Cloud optimize
your business

Microsoft Azure

Work or school account

laploy1@oopkit.com


••••••••

☐ Keep me signed in

Sign in

Can't access your account?

© 2016 Microsoft
[Terms of use](#) [Privacy & Cookies](#)



Enter Dataset Name / Table Name / Create

New output

* Output alias
out1 ✓

* Sink ⓘ
Power BI ▼

Group Workspace
My Workspace ▼

* Dataset Name
dn1 ✓

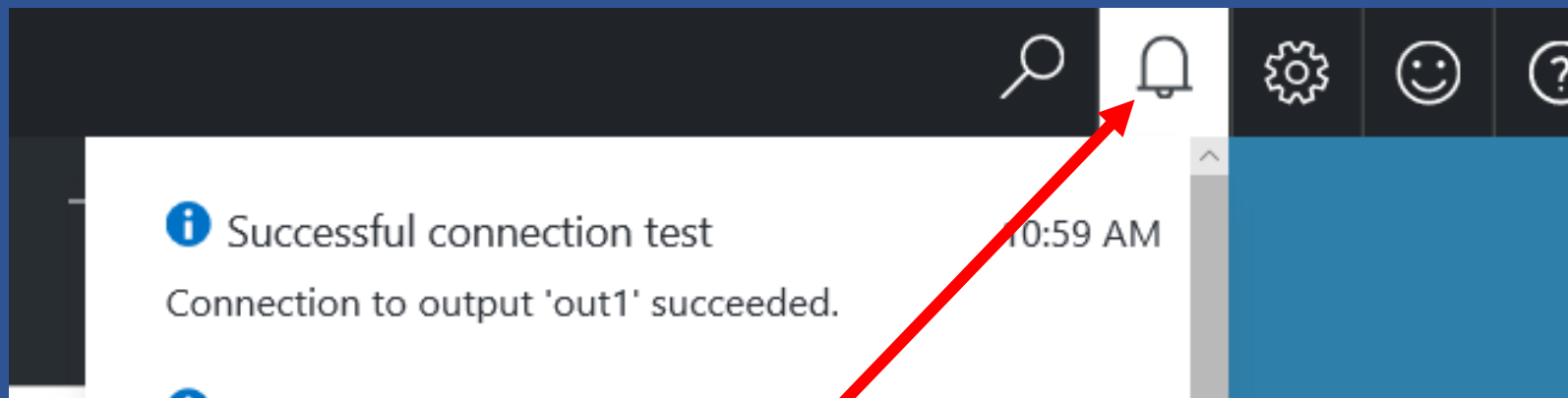
⚠ If the dataset or table already exists in your Microsoft Power BI subscription, it will be overwritten.

* Table Name
table1 ✕

Currently authorized as [loy vanich](#)
([laploy1@oopkit.com](#))

Create

Look for Successful message



Create Stream Analytics Job query

Click Query

The screenshot shows the Azure Stream Analytics Job 'Running' page. The 'Job Topology' section is highlighted with a red box, and a red arrow points to the 'Query' tile. The 'Query' tile is the central component for defining the stream analytics query.

Running

Essentials ^

Resource group **rs01**

Status **Running**

Location **Southeast Asia**

Subscription name **Azure Pass**

Subscription ID **bb51e644-fe87-4f6d-8793-f056f529d26c**

Send feedback **UserVoice**

Created **Friday, July 15, 2016 8:12:23 AM**

Started **Friday, July 15, 2016 11:20:53 AM**

Last output **Friday, July 15, 2016 11:58:03 AM**

[All settings →](#)

Job Topology Add tiles +

Inputs

1 ➡

input1

Query

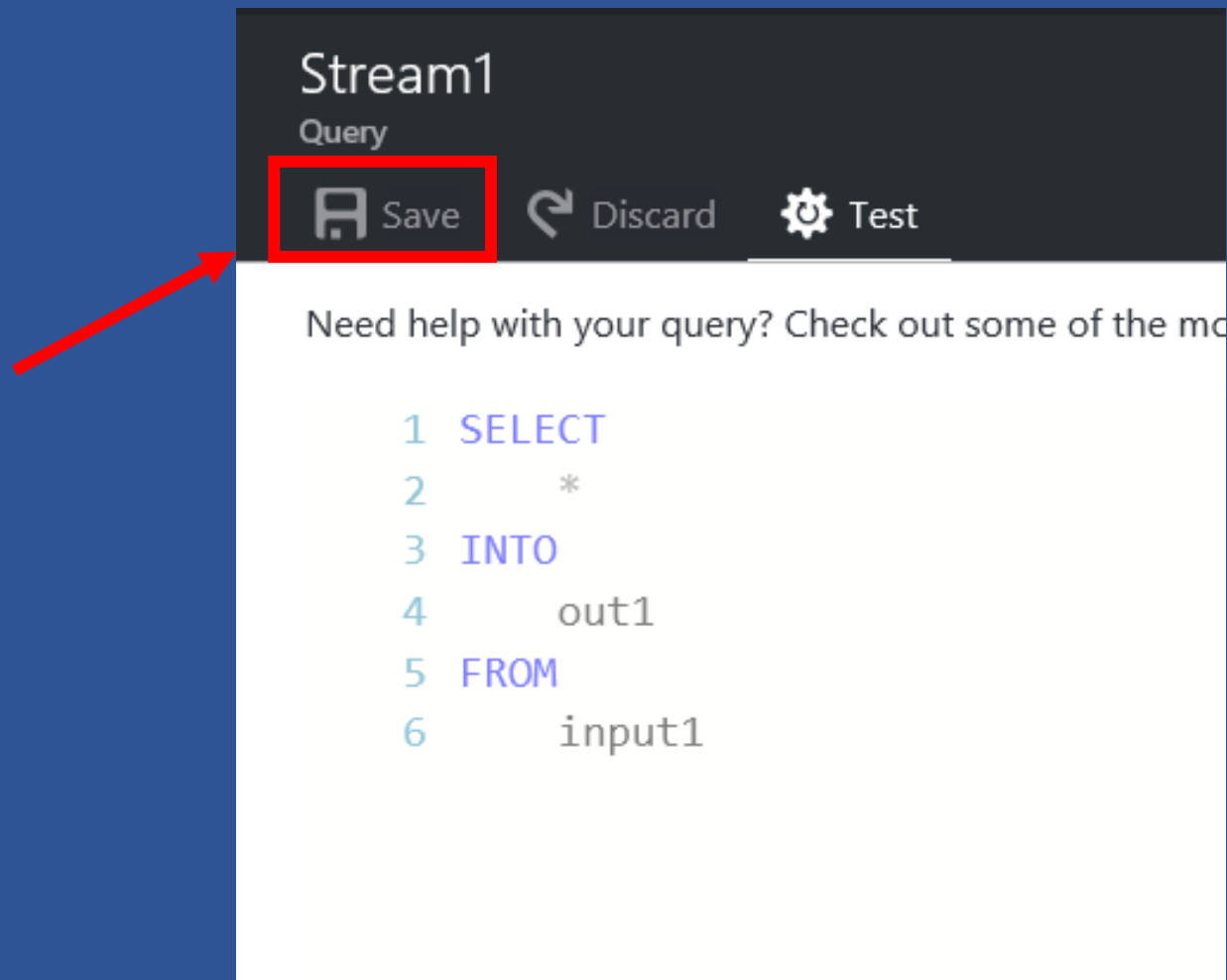
< >

Outputs

1 ➡

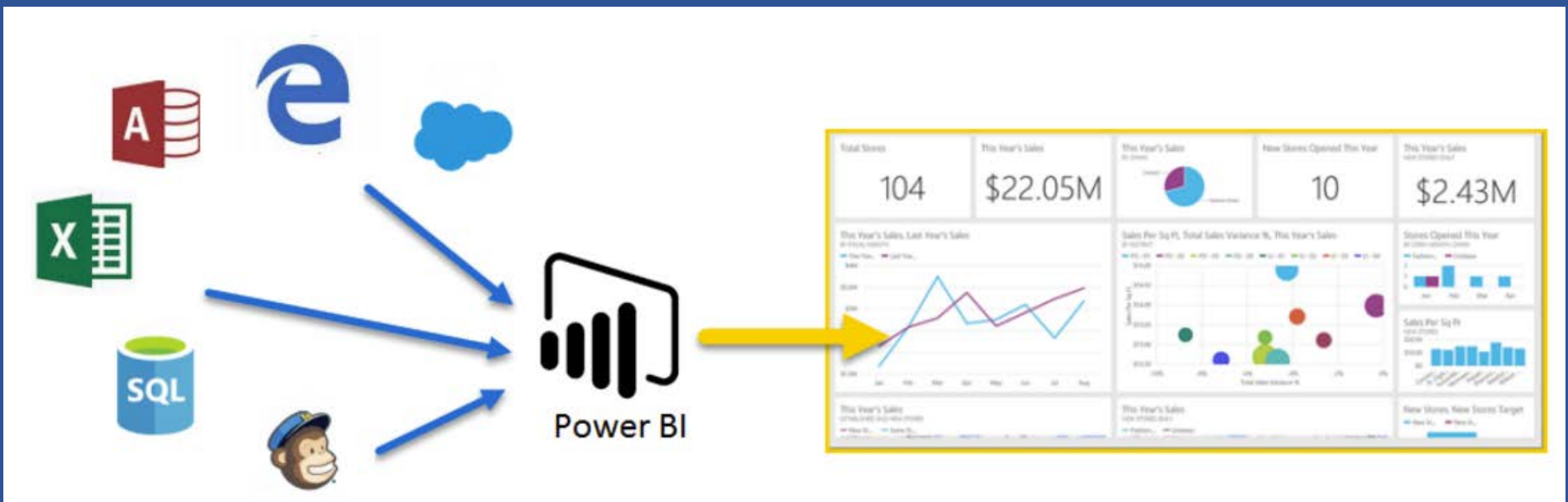
out1

Enter the Query and save



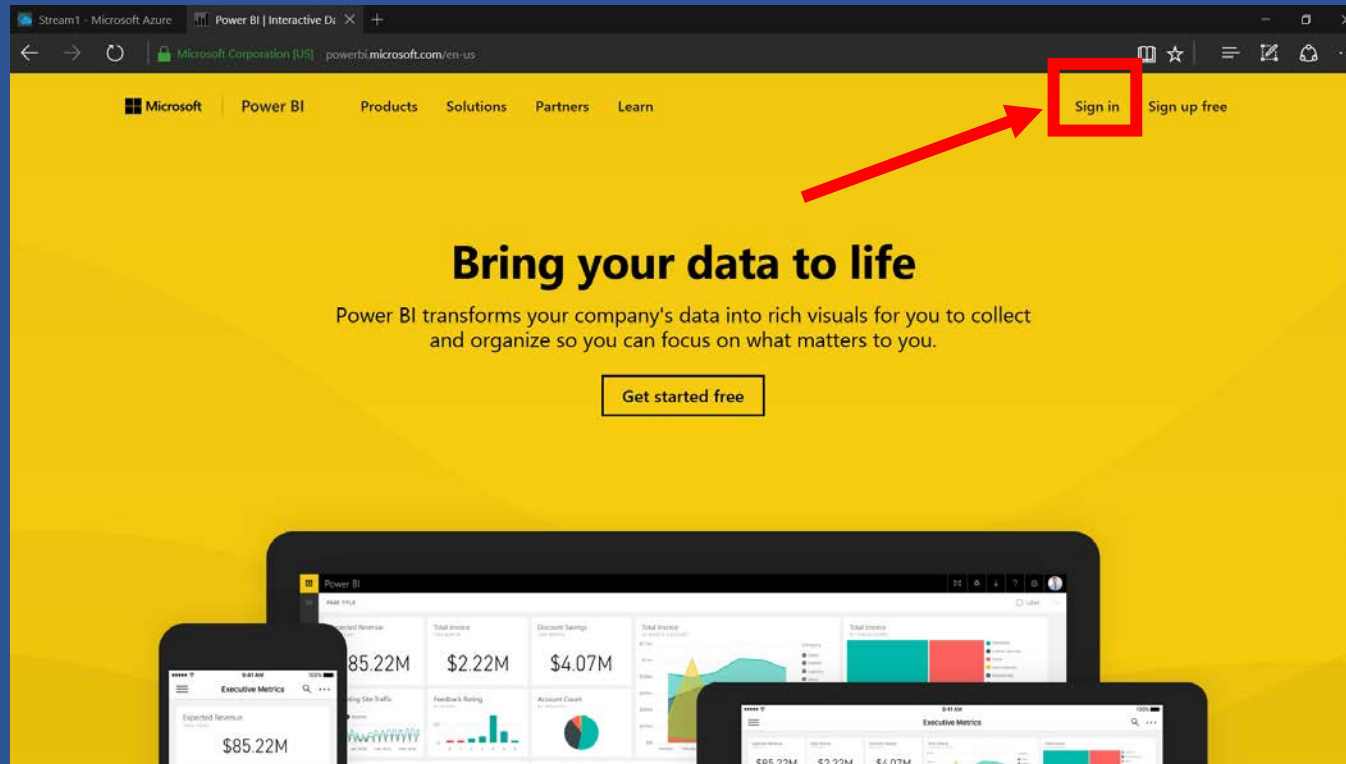
What is Microsoft Power BI?

- A collection of software services, apps, and connectors
- Turn unrelated sources of data into interactive insights.
- Easily connect to data sources
- Visualize
- Share with anyone
- Simple and fast
- Robust and enterprise-grade
- Real-time analytics

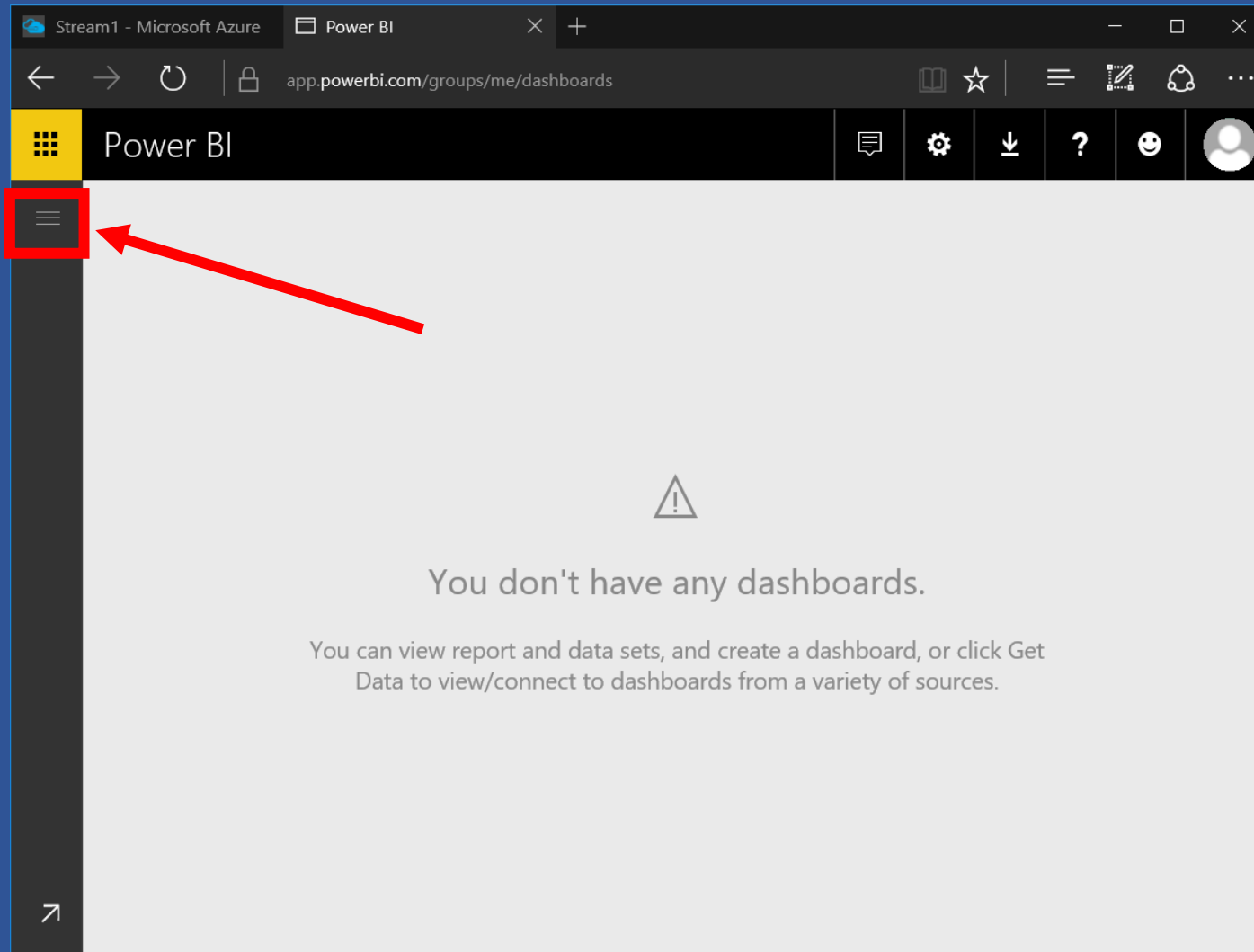


Create simple IoT data visualization in Power BI

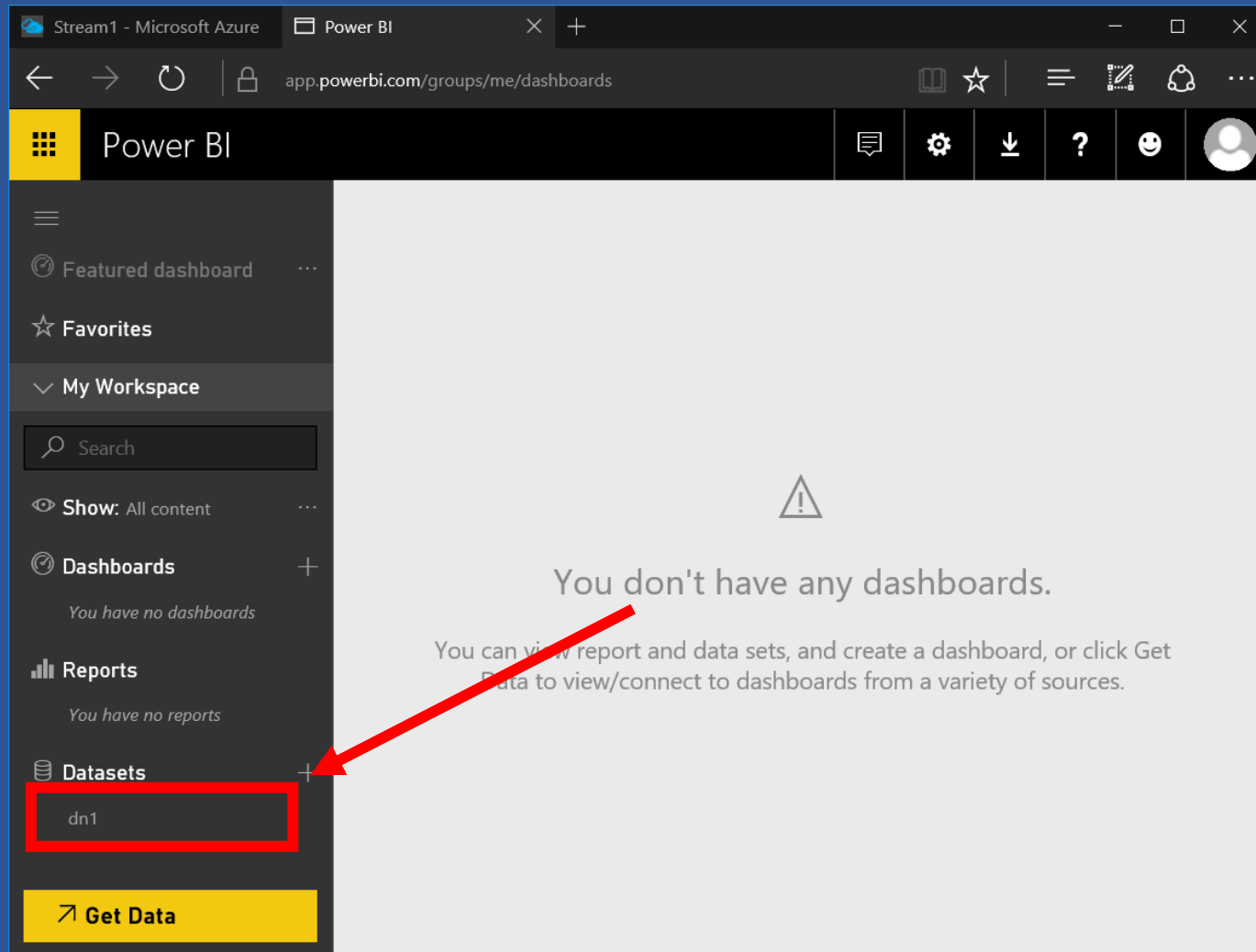
Go to Microsoft Power BI page <https://powerbi.microsoft.com/en-us/>



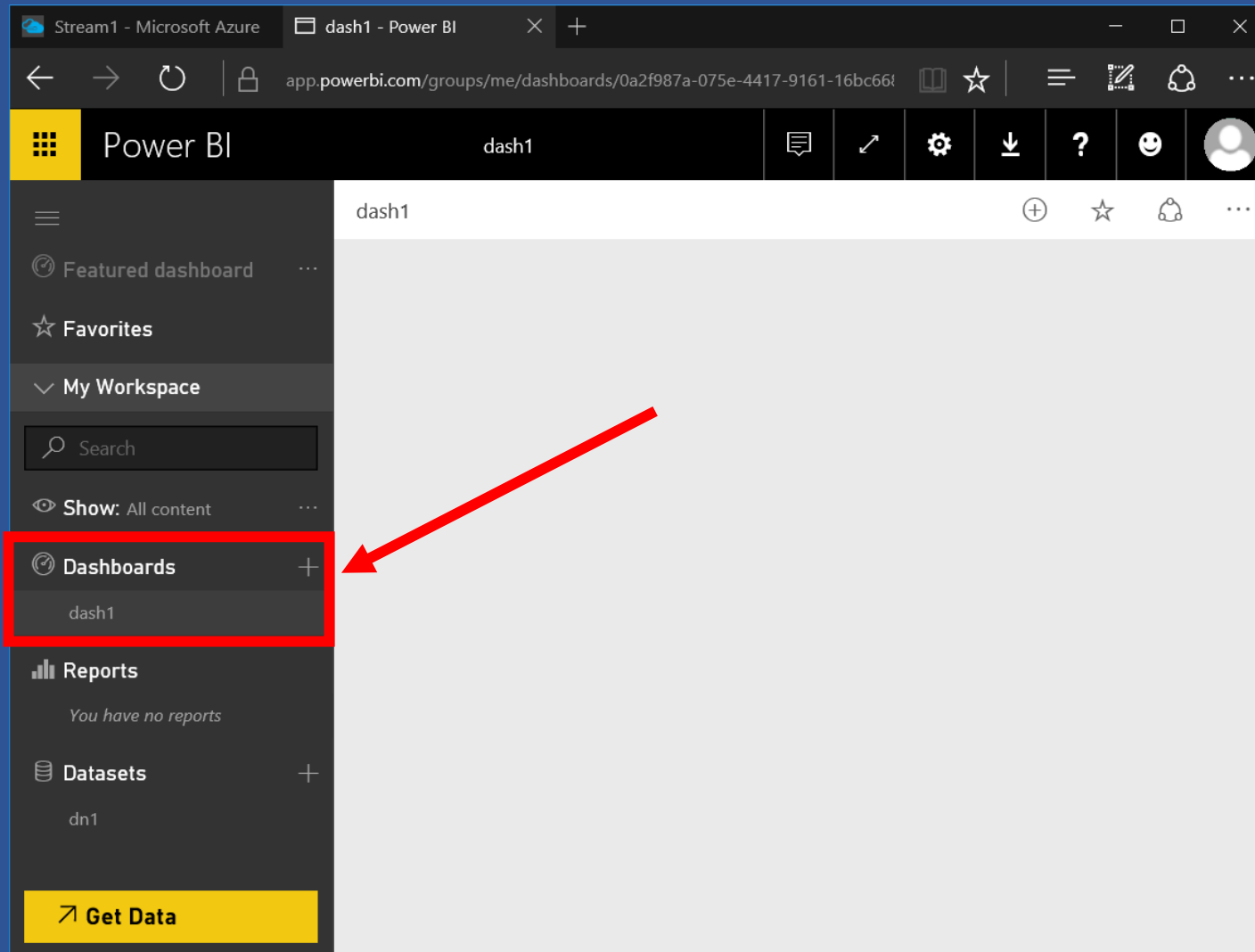
Click menu button to show Jumpbar



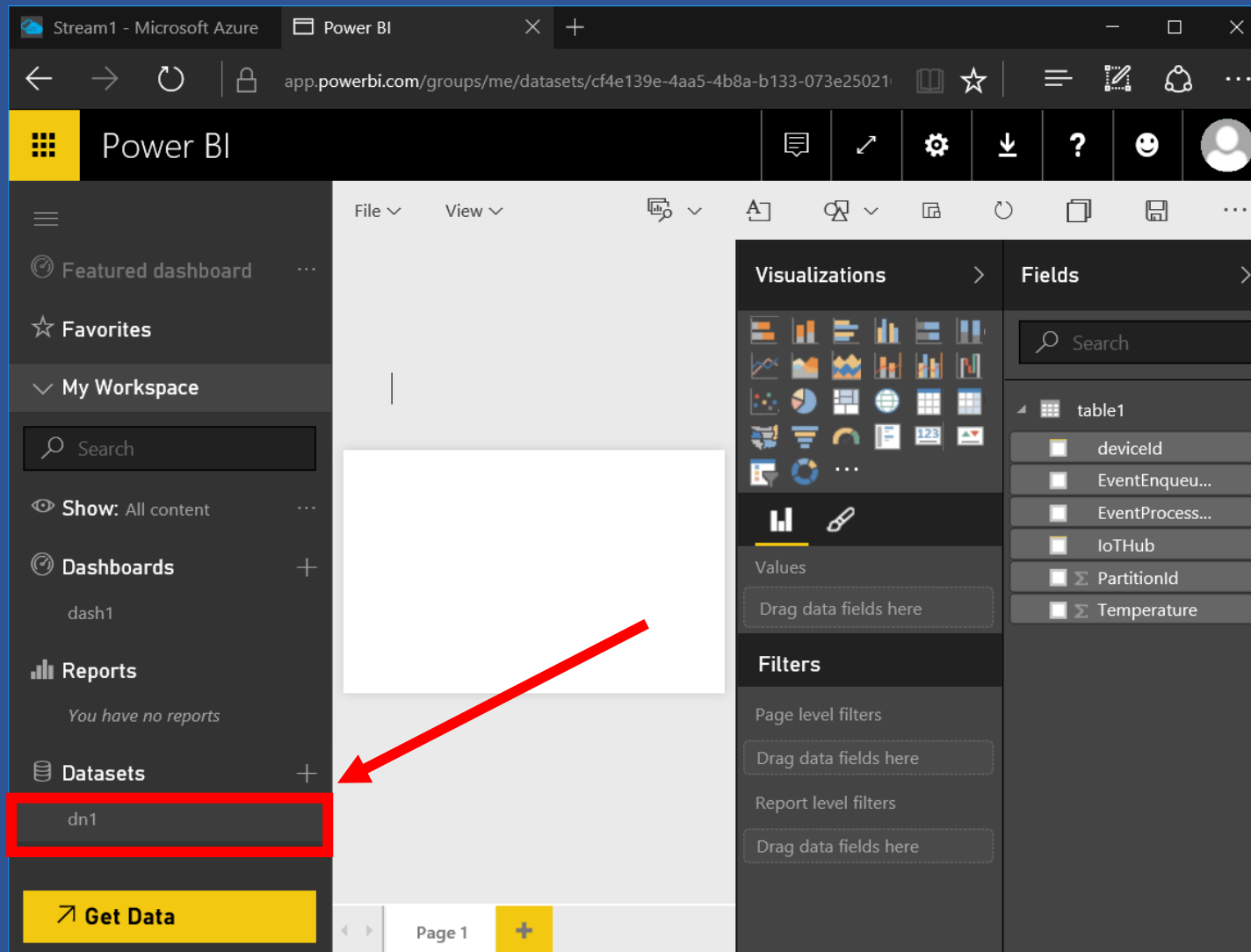
Note the Dataset



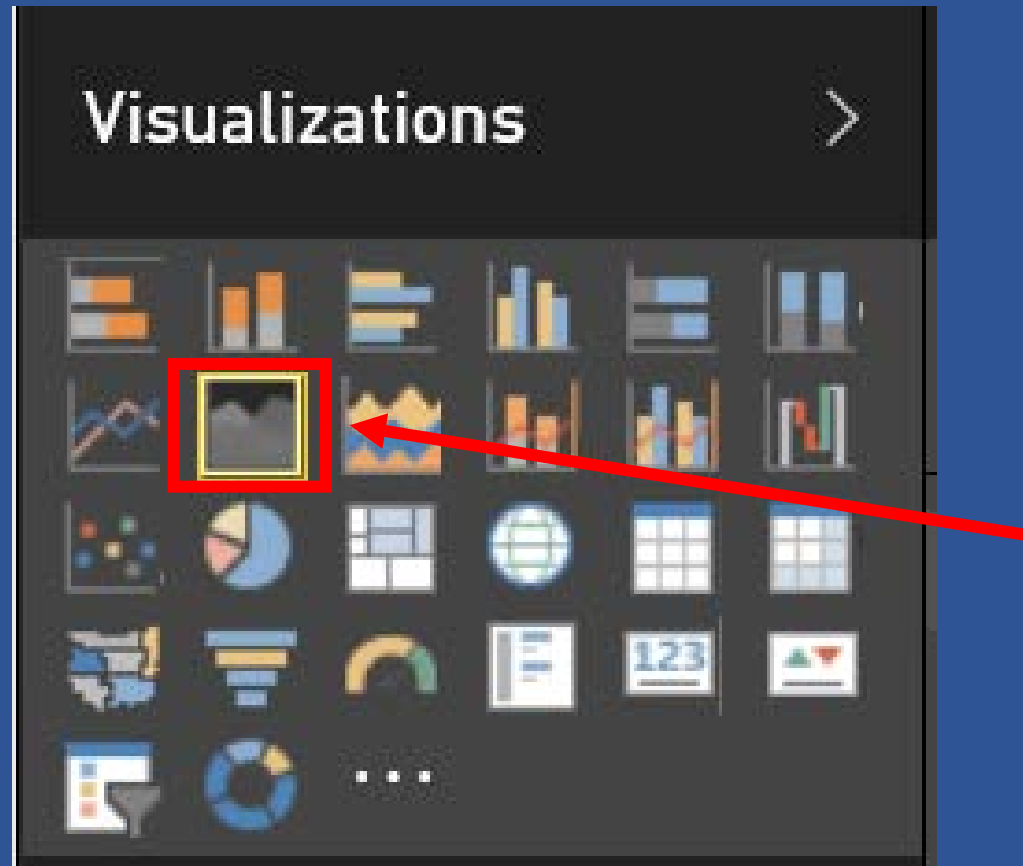
Create new Dashboard



Click Dataset Name



Select Area chart



Set Axis / Value

The screenshot displays the Microsoft Power BI interface with the Visualizations pane on the left and the Fields pane on the right. The Visualizations pane shows a bar chart selected. The Fields pane shows a table named 'table1' with fields: deviceId, EventEnqueue..., EventProcess..., IoTHub, PartitionId, and Temperature. The Temperature field is checked and summarized. The Visualizations pane shows the Axis set to 'EventProcessedUtcTime' and the Values set to 'Average of Temperat...'.

Visualizations

Axis: EventProcessedUtcTime

Legend: Drag data fields here

Values: Average of Temperat...

Fields

Search

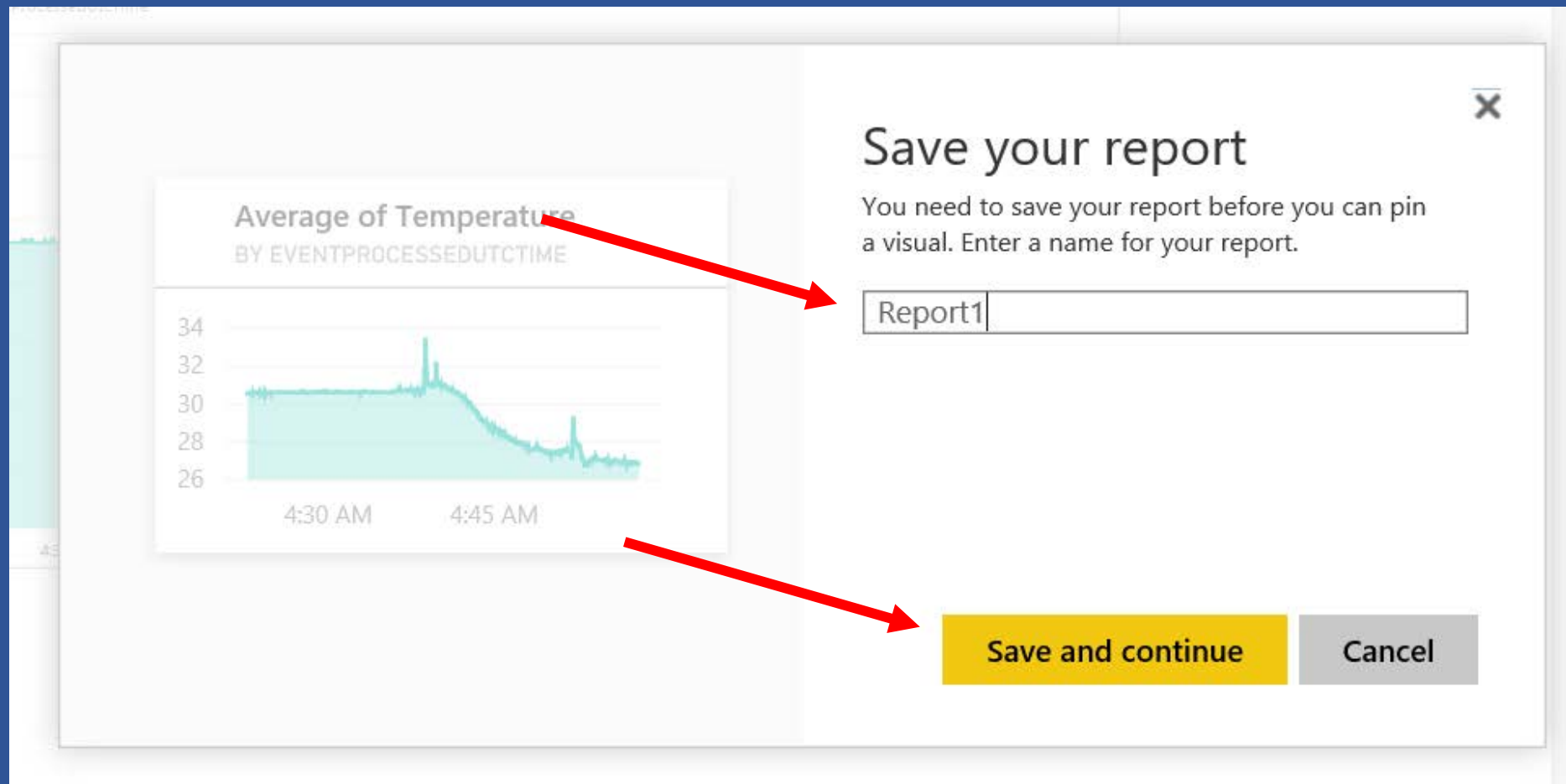
table1

- deviceId
- EventEnqueue...
- EventProcess...
- IoTHub
- PartitionId
- Temperature

Adjust chart size and pin to Dashboard



Specify report name and save



Average of Temperature
BY EVENTPROCESSEDUTCTIME

34
32
30
28
26

4:30 AM 4:45 AM

Save your report

You need to save your report before you can pin a visual. Enter a name for your report.

Report1

Save and continue **Cancel**

Select dashboard to pin

Average of Temperature
BY EVENTPROCESSEDUTCTIME

34
32
30
28
26

4:30 AM 4:45 AM

Pin to dashboard

Select an existing dashboard or create a new one.

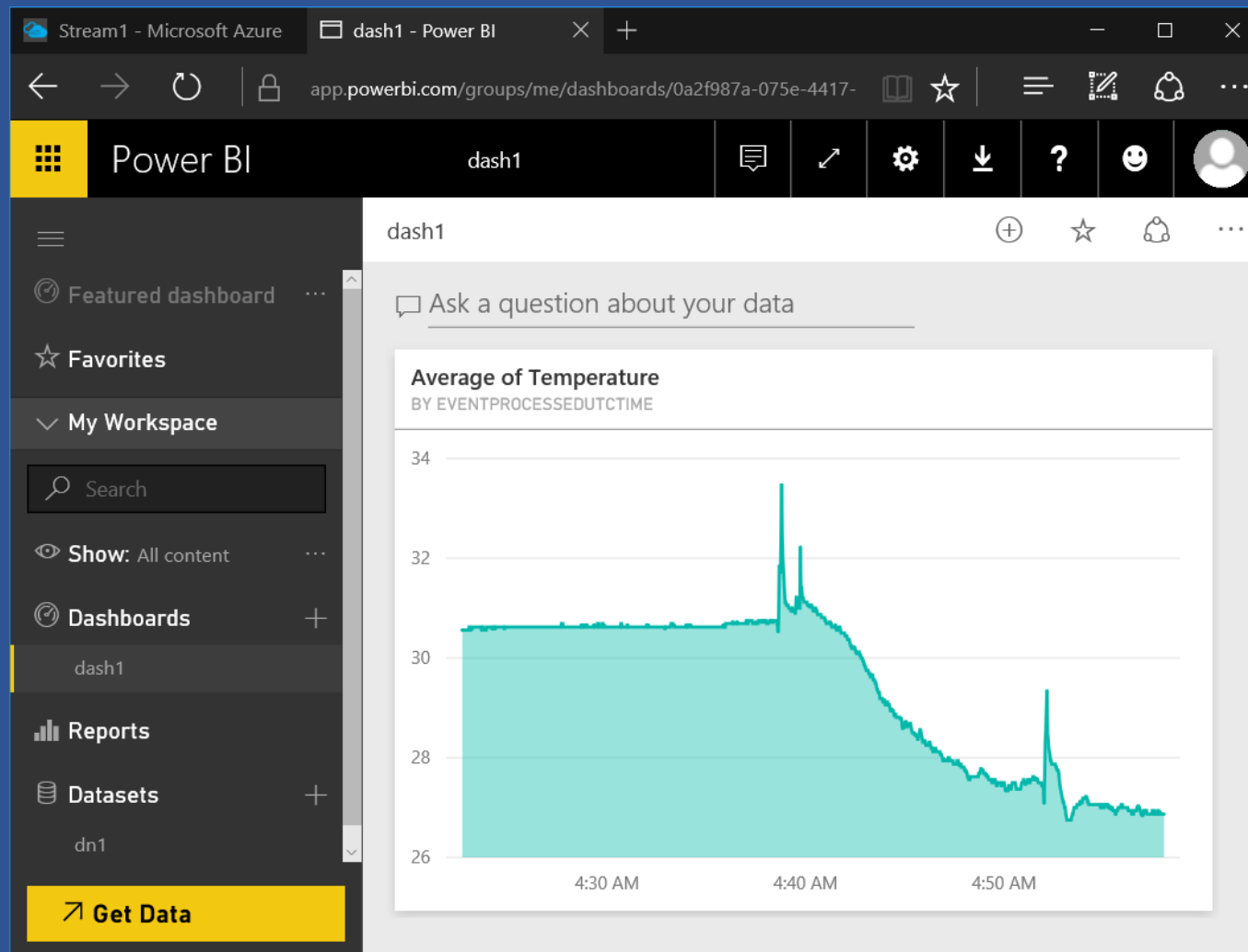
Where would you like to pin to?

☒ Existing dashboard
☐ New dashboard

dash1

Pin **Cancel**

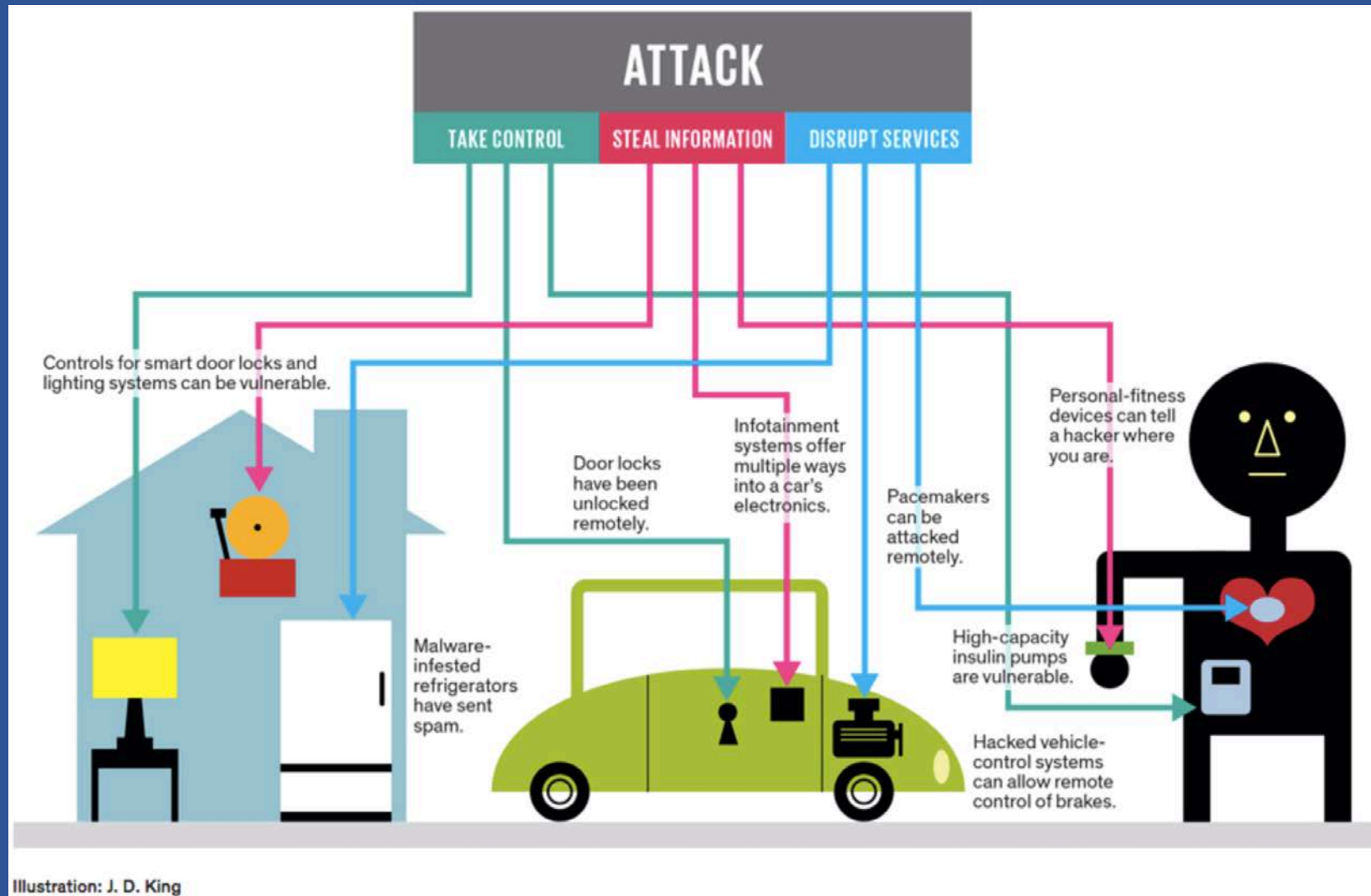
View dashboard



More on Stream Data Analytics

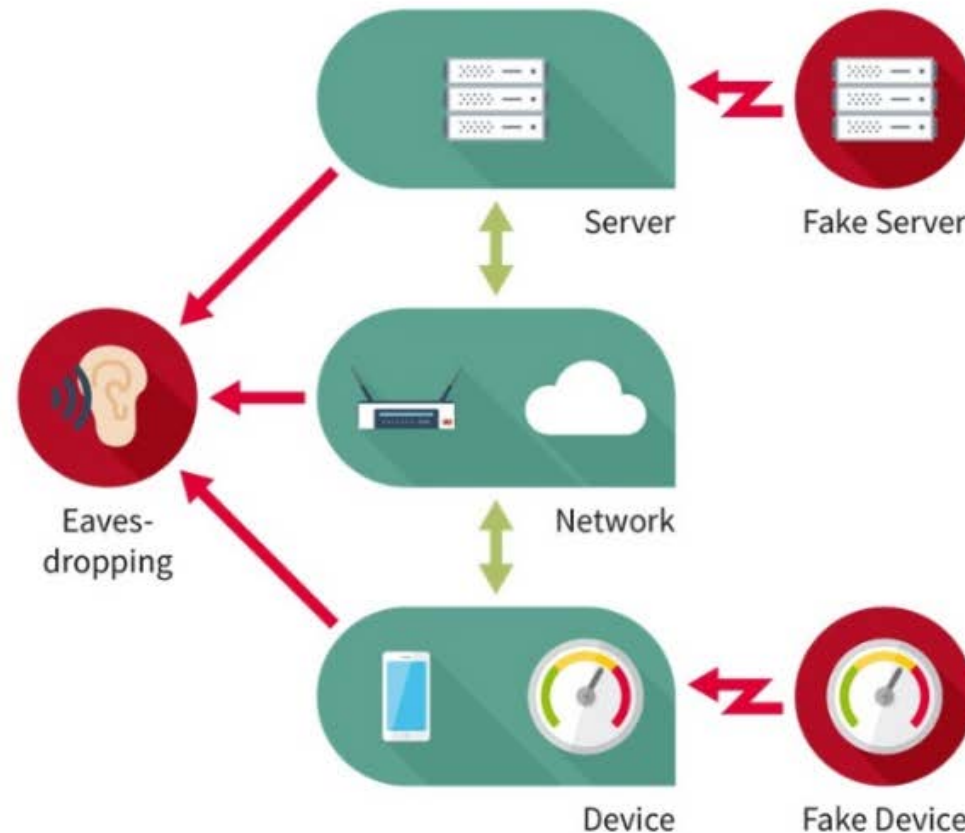
- <https://powerbi.microsoft.com/en-us/guided-learning/>
- <https://azure.microsoft.com/en-us/services/stream-analytics/>
- <https://azure.microsoft.com/en-us/documentation/articles/stream-analytics-power-bi-dashboard/>
- <https://azure.microsoft.com/en-us/documentation/articles/iot-hub-csharp-csharp-process-d2c/>

IoT Security consideration



IoT Attack area

An **Eavesdropper** listening in on data or commands can reveal confidential information about the operation of the infrastructure.



A **Fake Server** sending incorrect commands can be used to trigger unplanned events, to send some physical resource (water, oil, electricity, etc.) to an unplanned destination, and so forth.

A **Fake Device** injecting fake measurements can disrupt the control processes and cause them to react inappropriately or dangerously, or can be used to mask physical attacks.*

Azure IoT Suite security features

