Stream Processing Lab

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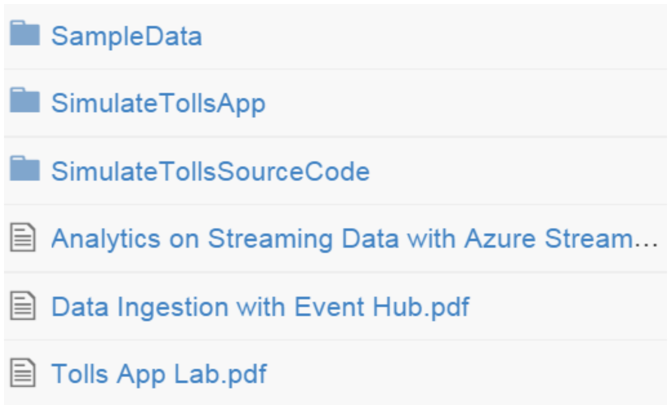
Lab Prerequisites

1) Windows Operating System (or .NET emulator)
    a) This lab will be simulating data into an Event Hub via a C# application, which requires .NET to execute
2) An Azure 30-day free trial account, or an Azure account with administrative access rights
    a) A free trial account can be found here: http://azure.microsoft.com/en-us/pricing/free-trial/
3) Text Editor (also called IDE; choose **ONE** of the following recommendations below)
    a) Notepad++: http://notepad-plus-plus.org/download/v6.7.5.html
    b) Sublime Text 2: http://www.sublimetext.com/2

File Descriptions


SampleData

SimulateTollsApp

SimulateTollsSourceCode

Analytics on Streaming Data with Azure Stream…

Data Ingestion with Event Hub.pdf

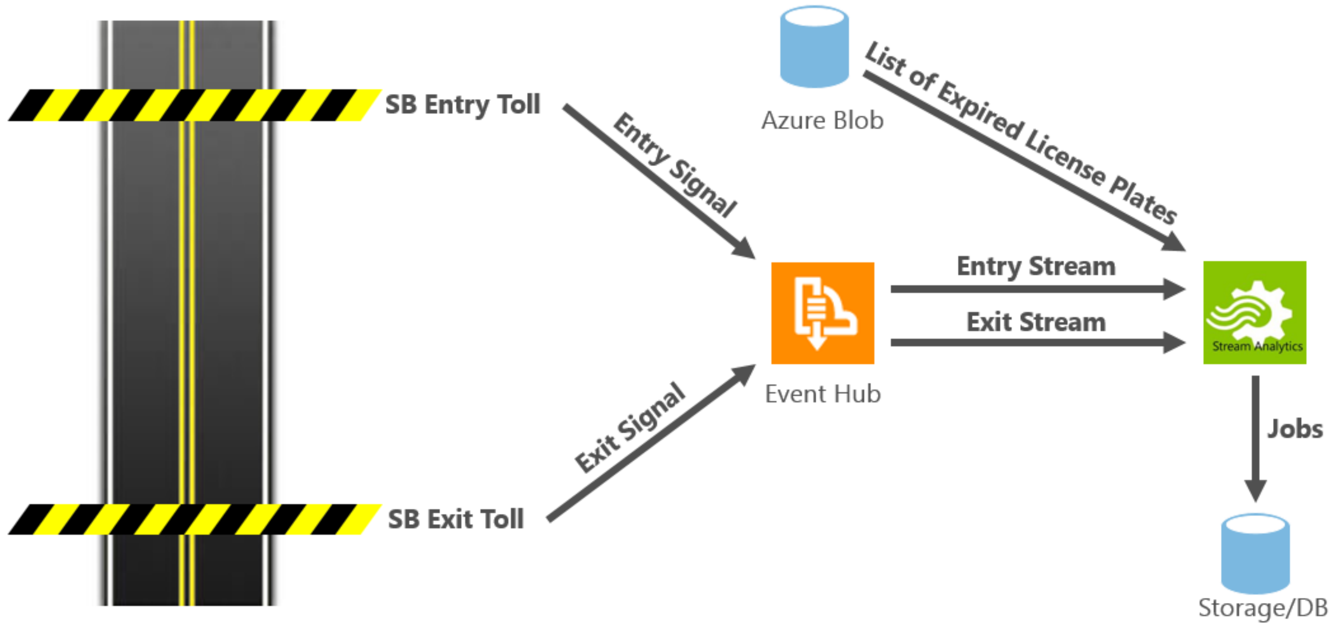
Tolls App Lab.pdf

1) <folder>SampleData: contains sample files to test stream query logic against.
2) <folder>SimulateTollsApp: a .NET app that generates toll data (cars going through a toll zone).
3) <folder>SimulateTollSourceCode: source code for the SimulateTollsApp.
4) <pdf>Analytics on Streaming Data with Azure Stream Analytics: the PowerPoint presentation pdf on stream analytics with Azure Stream Analytics, and Azure stream query language.
5) <pdf>Data Ingestion with Event Hubs: the PowerPoint presentation pdf on event ingestion using Azure Event Hubs.

Lab Overview: Simulating an Automated Toll Zone

A tolling station is a common phenomenon – we encounter them in many expressways, bridges, and tunnels across the world. Each toll station has multiple toll booths, which may be manual – meaning that you stop to pay the toll to an attendant, or automated – where a sensor placed on top of the booth scans an RFID card affixed to the windshield of your vehicle as you pass the toll booth. It is easy to visualize the passage of vehicles through these toll stations as an event stream over which interesting operations can be performed.

This lab is one example of a toll scenario. Data from these tolls will be generated by a .NET app and simulate cars going through a toll zone: a measurement when a car is going through an entry toll booth and another signal as a car goes through the exit toll booth and departs the toll zone. The measurements from both toll booths, called "signals", will be pushed and consolidated to the cloud, to an Azure Service Bus. From there, stream processors will be used to query, filter, and aggregate the data in real time.



Incoming Data

We will work with two streams of data, which are produced by sensors installed in the entrance and exit of the toll stations, and a static lookup dataset with vehicle registration data.

Entry Data Stream

Entry data stream contains information about cars entering toll stations.

Toll Id	EntryTime	LicensePlate	State	Make	Model	Vehicle Type	Vehicle Weight	Toll	Tag
1	2014-09-10 12:01:00.000	JNB 7001	NY	Honda	CRV	1	0	7	
1	2014-09-10 12:02:00.000	YXZ 1001	NY	Toyota	Camry	1	0	4	123456789
3	2014-09-10 12:02:00.000	ABC 1004	CT	Ford	Taurus	1	0	5	456789123
2	2014-09-10 12:03:00.000	XYZ 1003	CT	Toyota	Corolla	1	0	4	
1	2014-09-10 12:03:00.000	BNJ 1007	NY	Honda	CRV	1	0	5	789123456
2	2014-09-10 12:05:00.000	CDE 1007	NJ	Toyota	4x4	1	0	6	321987654
	…								

Here is a short description of the columns:

TollID	Toll booth ID uniquely identifying a toll booth
EntryTime	The date and time of entry of the vehicle to Toll Booth in UTC
LicensePlate	License Plate number of the vehicle
State	Is a State in United States
Make	The manufacturer of the automobile
Model	Model number of the automobile
VehicleType	1 for Passenger and 2 for Commercial vehicles
WeightType	Vehicle weight in tons; 0 for passenger vehicles
Toll	The toll value in USD
Tag	e-Tag on the automobile that automates payment, left blank where the payment was done manually

Exit Data Stream

Exit data stream contains information about cars leaving the toll station.

TollId	ExitTime	LicensePlate
1	2014-09-10T12:03:00.0000000Z	JNB 7001
1	2014-09-10T12:03:00.0000000Z	YXZ 1001
3	2014-09-10T12:04:00.0000000Z	ABC 1004
2	2014-09-10T12:07:00.0000000Z	XYZ 1003
1	2014-09-10T12:08:00.0000000Z	BNJ 1007
2	2014-09-10T12:07:00.0000000Z	CDE 1007
	…	

Column descriptions:

TollID	Toll booth ID uniquely identifying a toll booth
ExitTime	The date and time of exit of the vehicle from Toll Booth in UTC
LicensePlate	License Plate number of the vehicle

Commercial Vehicle Registration Data

We will use a static snapshot of the commercial vehicle registration database.

LicensePlate	RegistrationId	Expired
SVT 6023	285429838	1
XLZ 3463	362715656	0
BAC 1005	876133137	1
RIV 8632	992711956	0
SNY 7188	592133890	0
ELH 9896	678427724	1
…		

Column descriptions:

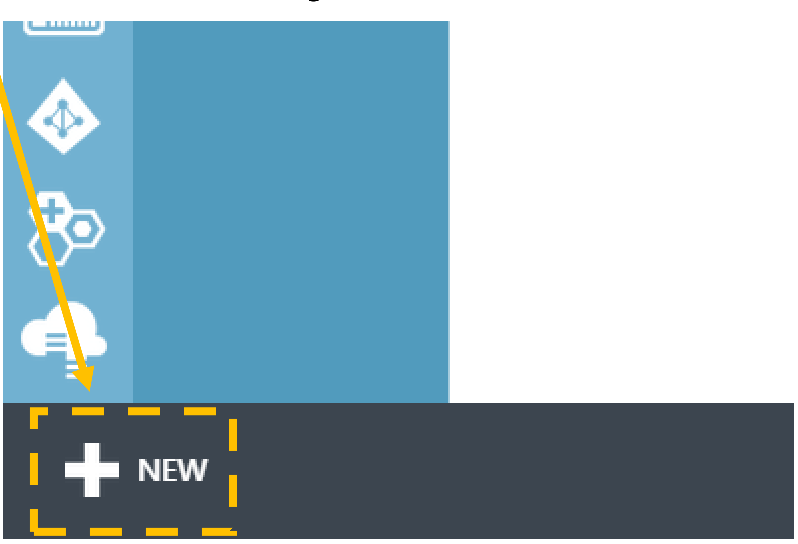
LicensePlate	License Plate number of the vehicle
RegistrationId	RegistrationId
Expired	0 if vehicle registration is active, 1 if registration is expired

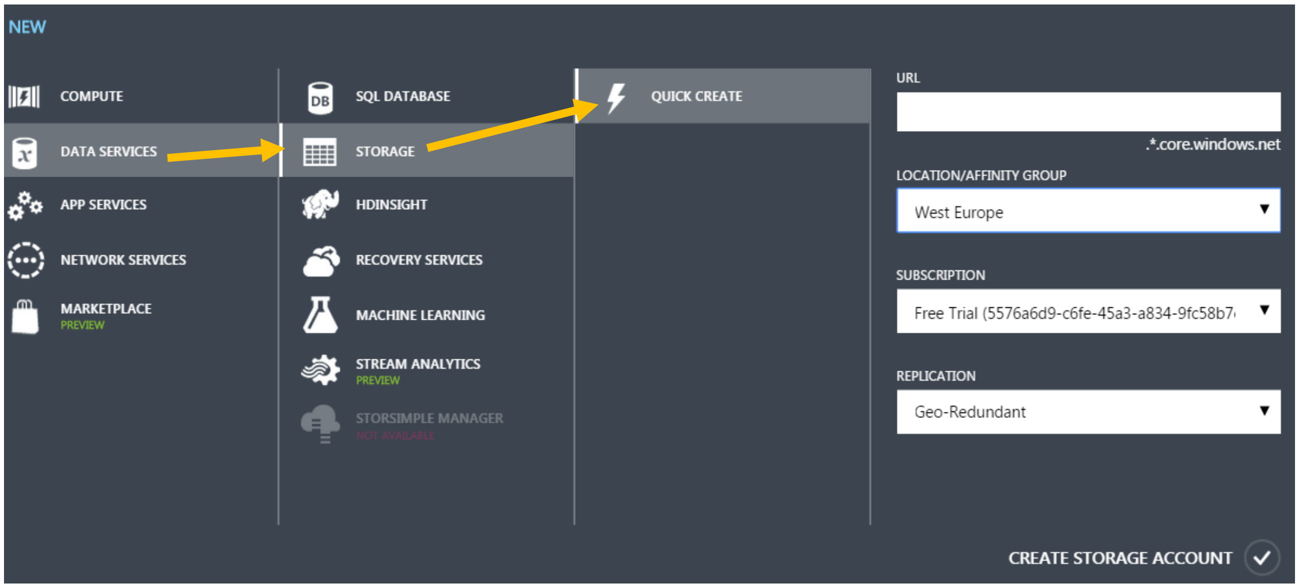
Creating a Storage Output

A stream processor takes in stream(s) and outputs a processed stream. The output can go to a variety of places such as: Blob storage, Event Hub, Power BI dashboard, SQL Database, or Table storage. For the purpose of this lab, a blob storage will be used as the stream's output.

Provisioning an Azure Storage Account

1) Once you are logged into your Azure portal (https://manage.windowsazure.com/), click **New>Data Services>Storage>Quick Create**





URL

.*.core.windows.net

LOCATION/AFFINITY GROUP: West Europe

SUBSCRIPTION: Free Trial (5576a6d9-c6fe-45a3-a834-9fc58b7

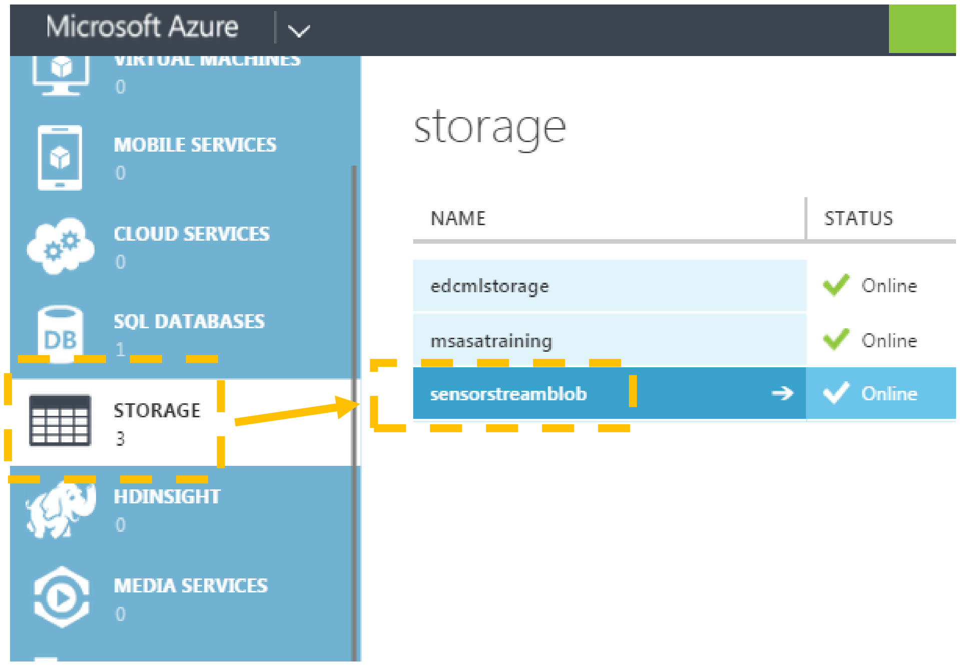
REPLICATION: Geo-Redundant

2) URL: The URL will be the name of your storage and serve as a pseudo primary key for your storage name. Assign a unique name to it. It's called a URL because the storage account can be referenced directly via HTTP, like this for example: https://mystorageaccount.blob.core.windows.net/
3) Location: For the purpose of this lab, select **West Europe**.
4) Replication: Geo-Redundant or Locally Redundant will suffice.

Provisioning a Storage Container

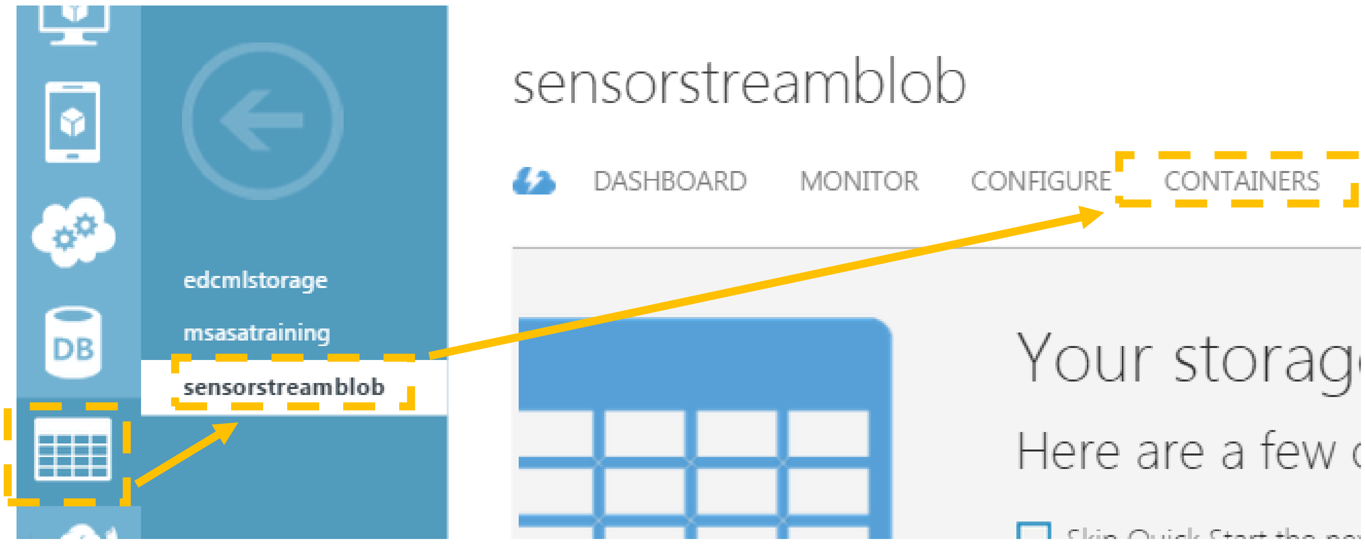
Files within an Azure Storage account are held within containers. Think of a container like a folder within a normal desktop environment. Create a container within the newly created Azure Storage account.

1) Within the Azure Management Portal (https://manage.windowsazure.com/)
   a) **Storage > YourStorage**
   b) Within the sample image below, the storage account is called "sensorstreamblob."

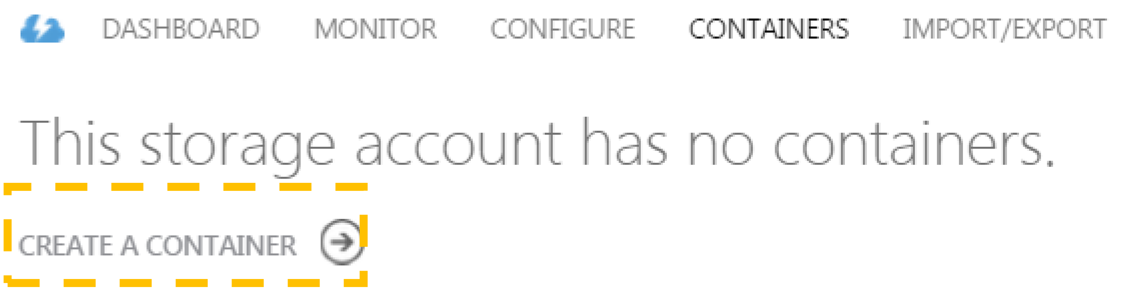


NAME	STATUS
edcmlstorage	✓ Online
msasatraining	✓ Online
sensorstreamblob	✓ Online

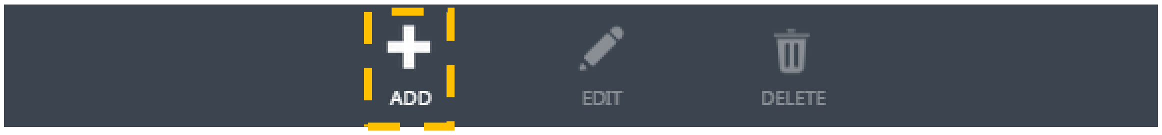
   c) Once inside the storage account's management dashboard, select containers.



d) Select either Create a Container or Add

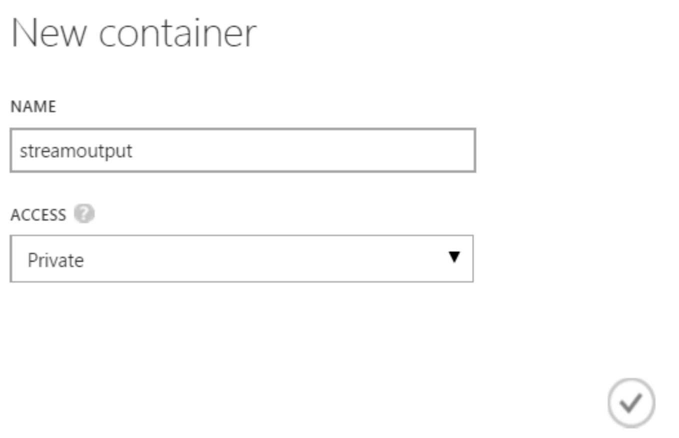


This storage account has no containers.



e) Name the Container (in all lower case)

f) Access: any access right



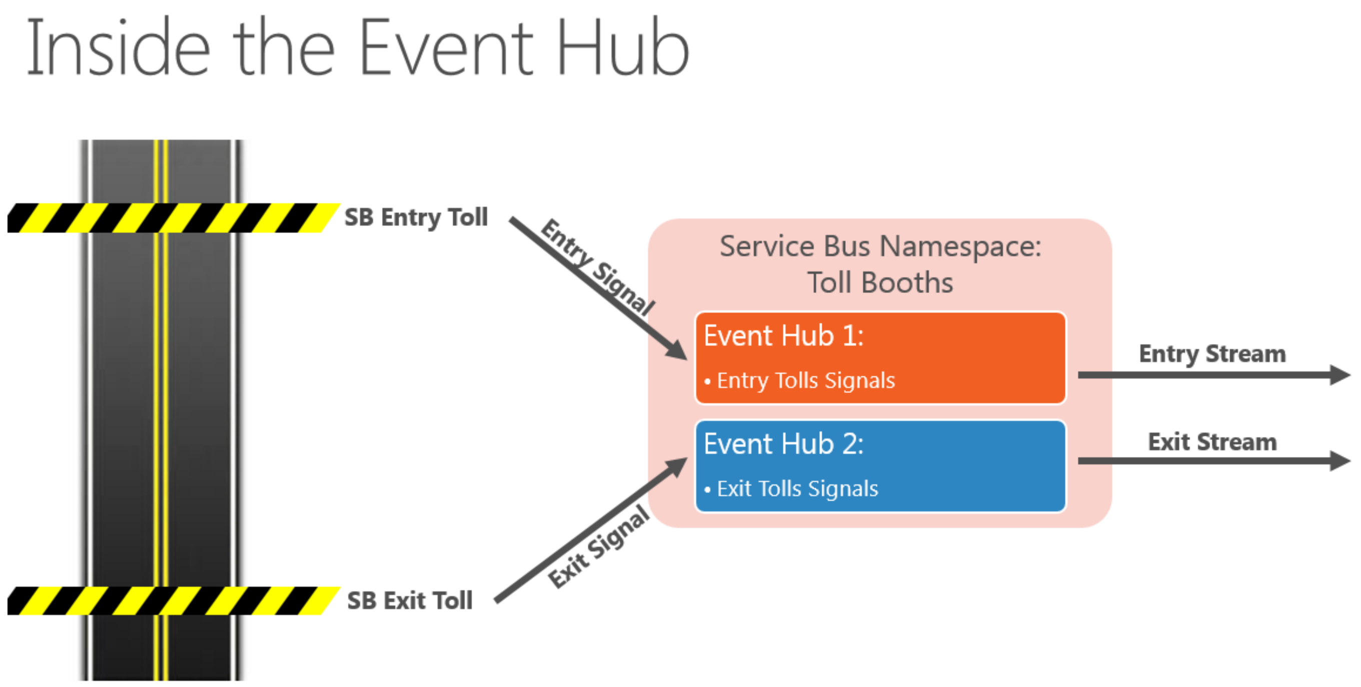
New container

NAME: streamoutput

ACCESS: Private

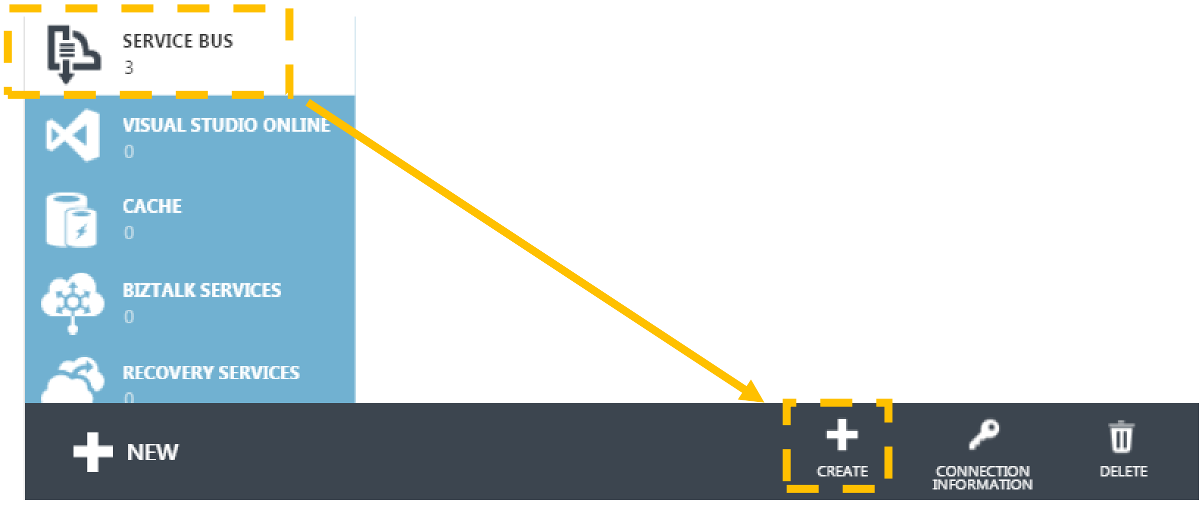
Provisioning an Event Ingestor Input

Signals from both the entry toll booths and the exit toll booths will be sent into the cloud. Specifically, the data will be sent into an Azure Service Bus Namespace, an event ingestor which will consolidate the streaming data into a central location for replication, stream management, and short-term retention. This Service Bus Namespace will contain two Event Hubs, one to facilitate streams related to the entry booths and one related to exit booth streams. Think of the Service Bus Namespace as a server which will house all the Event Hubs.

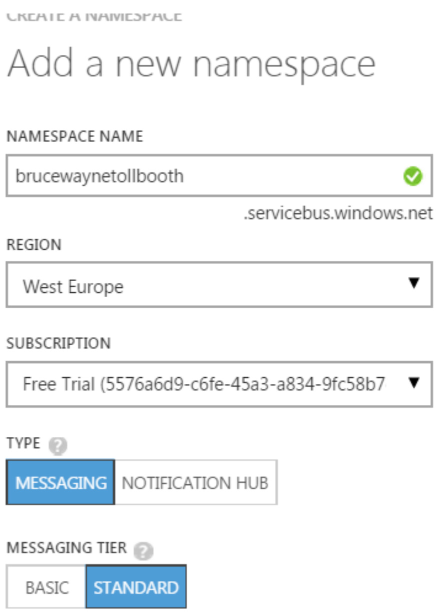


Creating a Service Bus Namespace

1) Within the Azure Management Portal (https://manage.windowsazure.com/)
    a) **Service Bus > Create**



2) Name the Service Bus Namespace
    a) Namespace Name: globally unique URL name.
    b) Region: for the purpose of this lab, select **West Europe**.
    c) Type: Messaging
    d) Massaging Tier: Standard



CREATE A NAMESPACE

Add a new namespace

NAMESPACE NAME

brucewaynetollbooth .servicebus.windows.net

REGION

West Europe

SUBSCRIPTION

Free Trial (5576a6d9-c6fe-45a3-a834-9fc58b7

TYPE

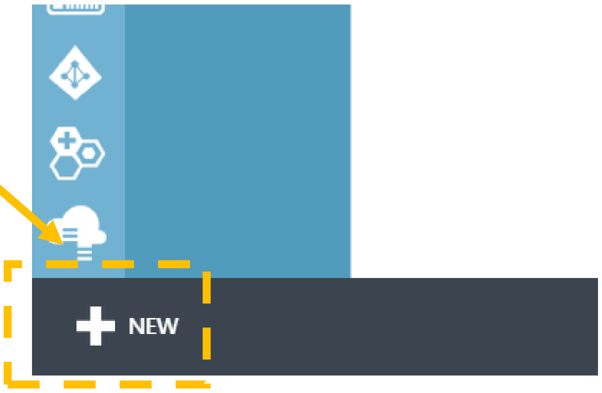
[✓ MESSAGING] NOTIFICATION HUB

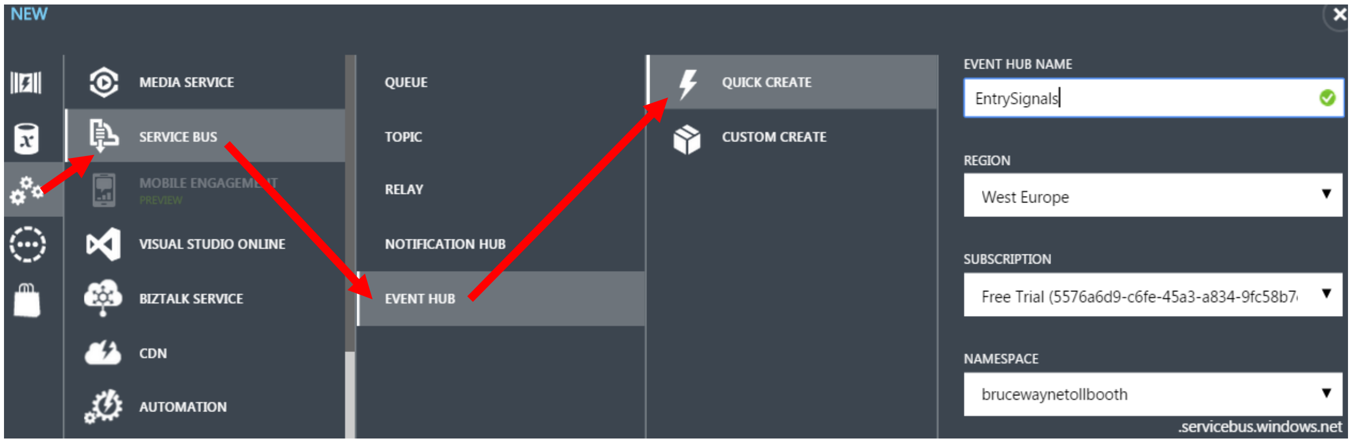
MESSAGING TIER

BASIC [✓ STANDARD]

Creating Event Hubs

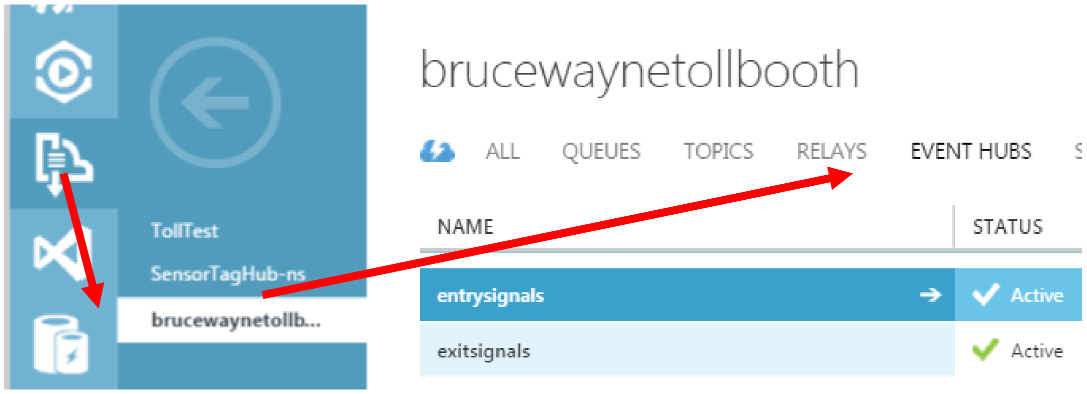
1) Within the Azure Management Portal (https://manage.windowsazure.com/)
   a) **New > App Services > Service Bus > Event Hub > Quick Create**





EVENT HUB NAME: EntrySignals
REGION: West Europe
SUBSCRIPTION: Free Trial (5576a6d9-c6fe-45a3-a834-9fc58b7
NAMESPACE: brucewaynetollbooth .servicebus.windows.net

   b) Create Event Hub #1, for entry signals.
      i) Event Hub Name: EntrySignals
      ii) Region: for the purpose of this lab, set **West Europe**.
      iii) Namespace: set the namespace that was created in the previous exercise.
   c) Create another Event Hub for exit signals.
   d) There should now be two Event Hubs within the same namespace, one for entry signals another for exit signals. Confirm their existence by selecting **Service Bus > My Service Bus > Event Hub**
      i) The example below has a namespace service bus called "brucewaynetollbooth" with two Event Hubs inside called "entrysignals" and "exitsignals".



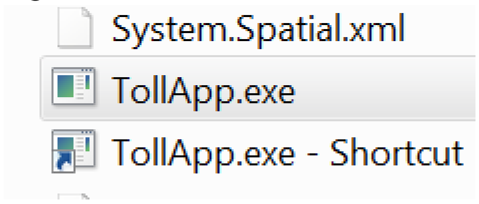
NAME	STATUS
entrysignals	✓ Active
exitsignals	✓ Active

Simulating Toll Data

Now that the data pipelines have been set up, it is time to fill the pipeline with data. This lab will use a .NET app to simulate cars going through a toll booth and output it into the Event Hubs setup in the prior exercise.

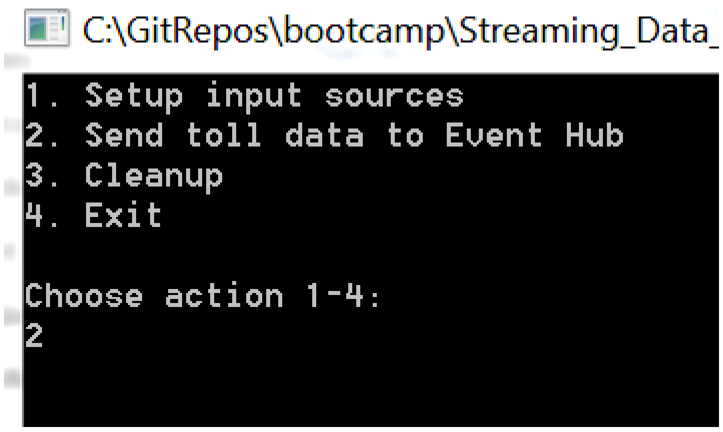
Launching the App

1) Go to the bootcamp folder under: bootcamp\Streaming_Data_and_Real-time_Analytics\SimulateTollsApp
2) Find a file called **TollApp.exe**
3) Right-click and run as administrator to launch the app.



System.Spatial.xml
TollApp.exe
TollApp.exe - Shortcut

4) Type '2' and hit enter to initiate input parameters.

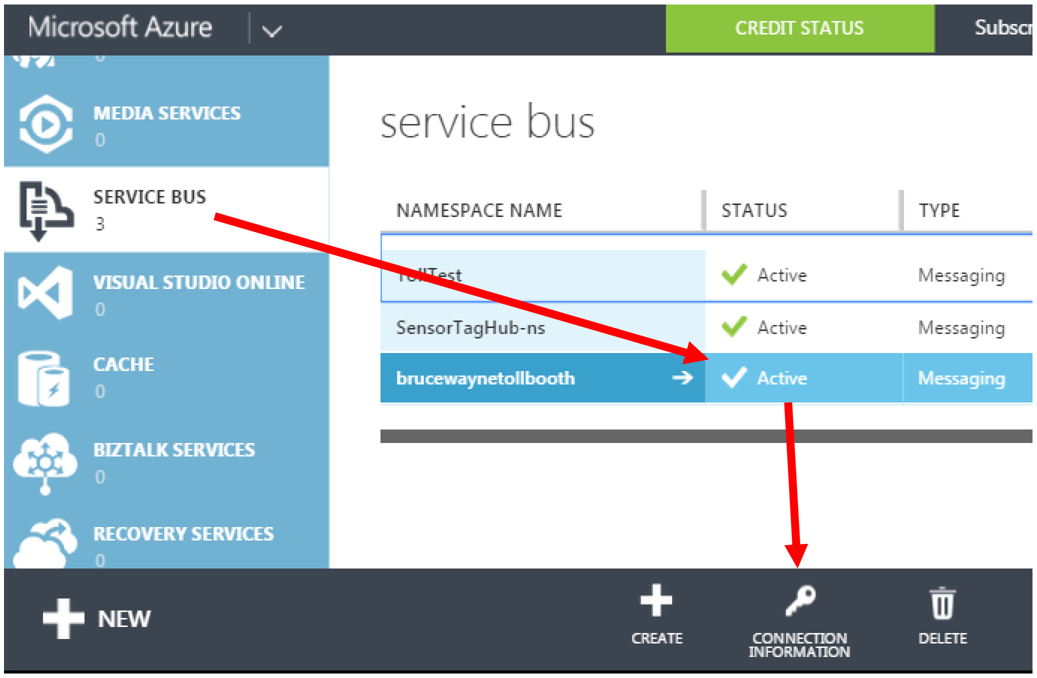


```
C:\GitRepos\bootcamp\Streaming_Data_

1. Setup input sources
2. Send toll data to Event Hub
3. Cleanup
4. Exit

Choose action 1-4:
2
```

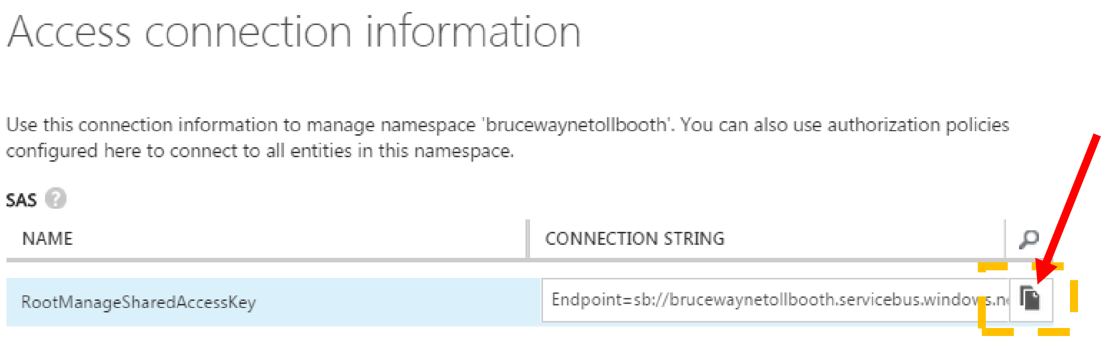
5) The app will now ask for a "Service Bus Connection String to Namespace with RootManageSharedAccessKey". Essentially, it is requesting the "god key" or the "master key" to access all the Event Hubs within the service bus namespace. In practice, this is bad style since each user should only be given as much access as necessary to perform their task (separation of listen/send rights at the Event Hub level or consumer group level). However, for the purpose of this lab, the "god key" will be used in order to minimize the amount of parameters that the user must enter (in this case there are 4 possible keys, two from each Event Hub).

Obtaining the Connection String

1) From the Azure management portal (https://manage.windowsazure.com/)
   a) **Service Bus > Select Your Service Bus Namespace (light blue area) > Connection Information**



2) Copy the connection string of the RootManageSharedAccessKey by hitting the copy button at the right of the connection string text box.

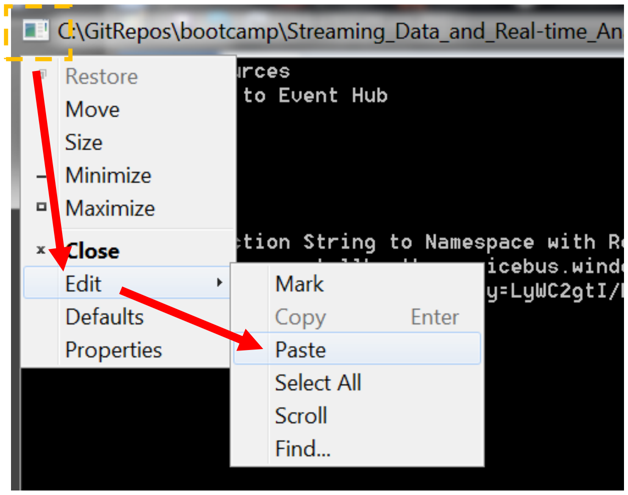

Access connection information

Use this connection information to manage namespace 'brucewaynetollbooth'. You can also use authorization policies configured here to connect to all entities in this namespace.

SAS

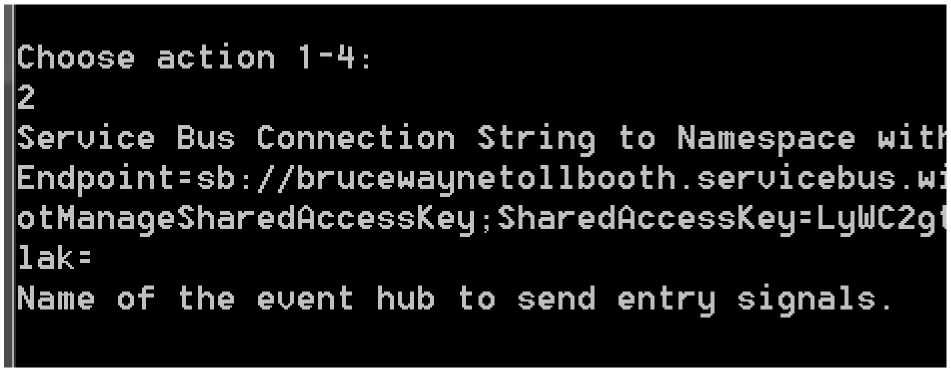
NAME	CONNECTION STRING
RootManageSharedAccessKey	Endpoint=sb://brucewaynetollbooth.servicebus.windows.n

3) Paste the connection string back into your app. Right-click the top left icon of the app to open up a menu. Go to Edit > Paste. Hit enter to be asked about the next parameter.


```
C:\GitRepos\bootcamp\Streaming_Data_and_Real-time_An
urces
 to Event Hub

ction String to Namespace with R
                       icebus.wind
                       y=LyWC2gtI/
```

Specifying Event Hubs to Push Data Into

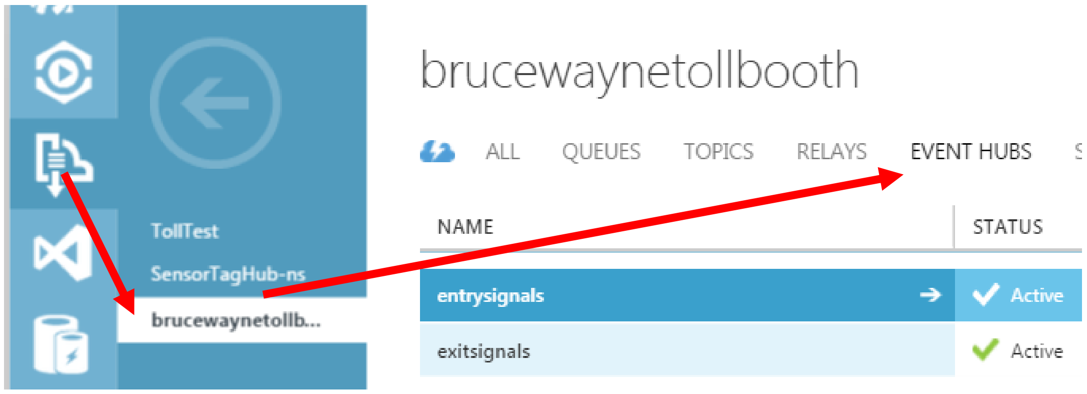
1) It will now ask for the name of the Event Hub in which to send the entry signals. Enter the name of the Event Hub that was created in the prior step.



```
Choose action 1-4:
2
Service Bus Connection String to Namespace with
Endpoint=sb://brucewaynetollbooth.servicebus.wi
otManageSharedAccessKey;SharedAccessKey=LyWC2gt
lak=
Name of the event hub to send entry signals.
```

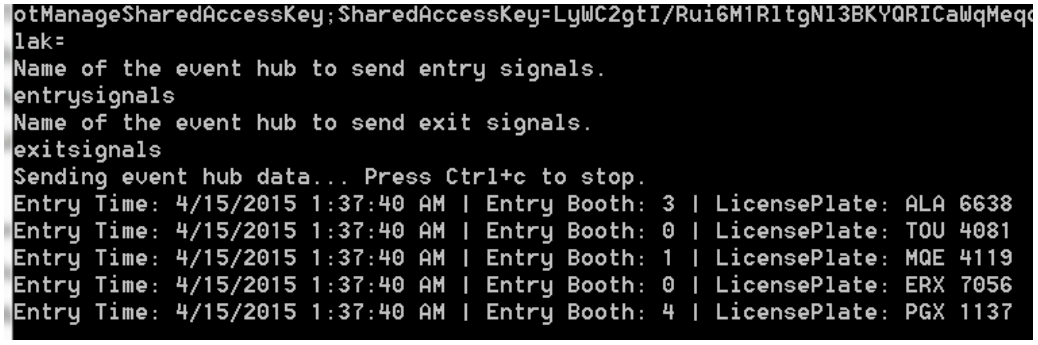
   a) **Service Bus > My Service Bus > Event Hubs**

      i) The example below has a namespace service bus called “brucewaynetollbooth” with two Event Hubs inside called “entrysignals” and “exitsignals”.



NAME	STATUS
entrysignals	✓ Active
exitsignals	✓ Active

2) Enter in the name of the Entry Hub.
3) Enter in the name of the Exit Hub.
4) The app will now proceed to send streams of data into the event hubs.



```
otManageSharedAccessKey;SharedAccessKey=LyWC2gtI/Rui6M1R1tgN13BKYQRICaWqMeq
lak=
Name of the event hub to send entry signals.
entrysignals
Name of the event hub to send exit signals.
exitsignals
Sending event hub data... Press Ctrl+c to stop.
Entry Time: 4/15/2015 1:37:40 AM | Entry Booth: 3 | LicensePlate: ALA 6638
Entry Time: 4/15/2015 1:37:40 AM | Entry Booth: 0 | LicensePlate: TOU 4081
Entry Time: 4/15/2015 1:37:40 AM | Entry Booth: 1 | LicensePlate: MQE 4119
Entry Time: 4/15/2015 1:37:40 AM | Entry Booth: 0 | LicensePlate: ERX 7056
Entry Time: 4/15/2015 1:37:40 AM | Entry Booth: 4 | LicensePlate: PGX 1137
```

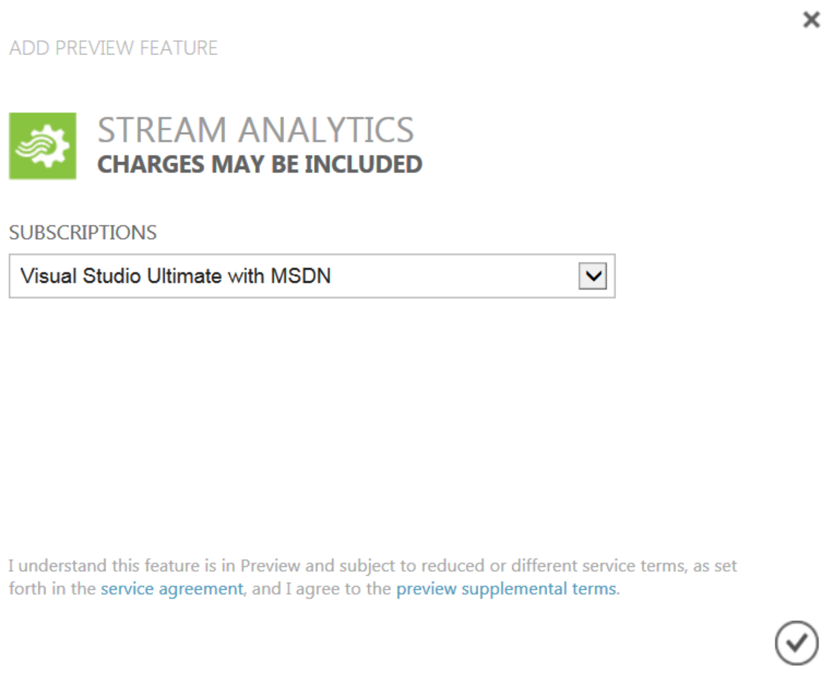
Provisioning Stream Processors

Stream Processors can now be created that will query, filter, and aggregate the streams in real time as it goes through the Event Hub. This lab will utilize the Azure Stream Analytics stream processor.

Enable the Azure Stream Analytics feature

Azure Stream Analytics is in the Preview program. Please open https://account.windowsazure.com/PreviewFeatures?fid=streamanalytics and click on the OK button in the lower right corner of the window to enable Azure Stream Analytics in the Azure Portal.

Please note that you need to be Administrator of the subscription to be able to enable Preview features in the Azure Portal.


ADD PREVIEW FEATURE

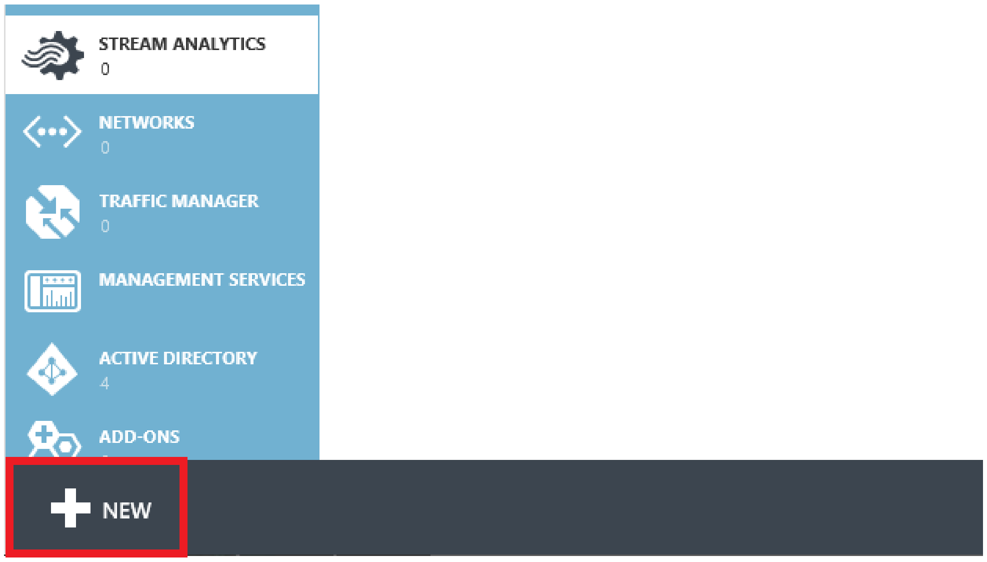
STREAM ANALYTICS
CHARGES MAY BE INCLUDED

SUBSCRIPTIONS
Visual Studio Ultimate with MSDN

I understand this feature is in Preview and subject to reduced or different service terms, as set forth in the service agreement, and I agree to the preview supplemental terms.

Create a Stream Analytics Job

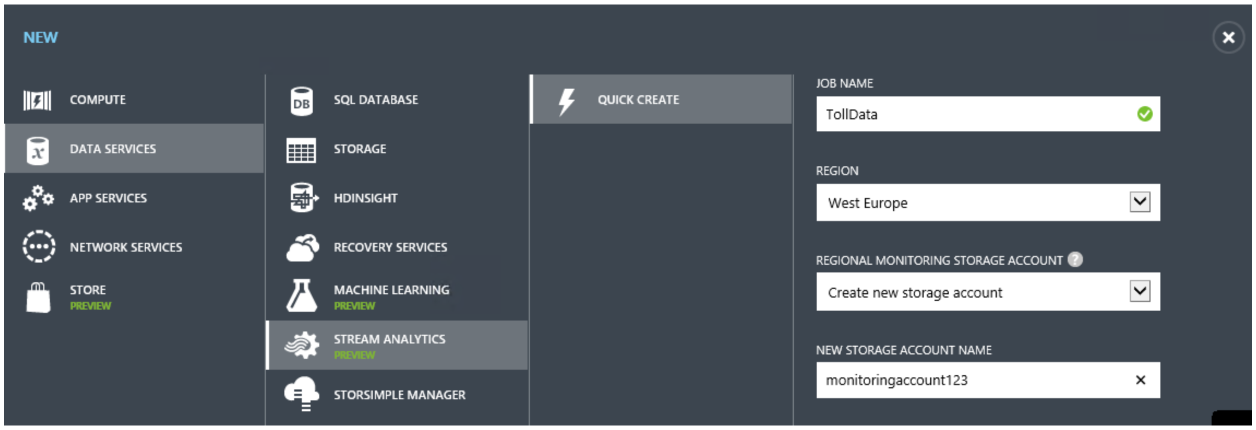
In the Azure portal, open Stream Analytics and click "New" in the bottom left-hand corner of the page to create a new analytics job.



Click "Quick Create". Select either "West Europe" or "Central US" as the region.

For the "Regional Monitoring Storage Account" setting, select "Create new storage account" and give it any unique name. Azure Stream Analytics will use this account to store monitoring information for all your future jobs.

Click "Create Stream Analytics Job" at the bottom of the page.



JOB NAME: TollData

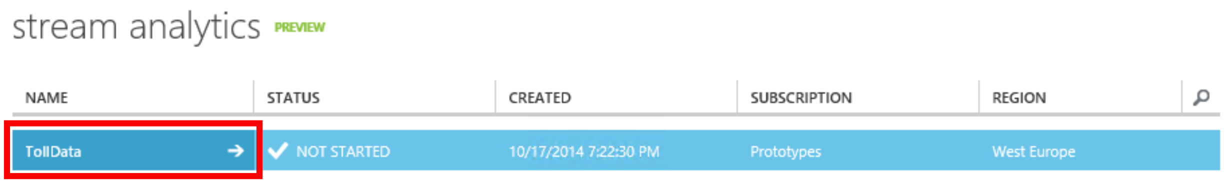
REGION: West Europe

REGIONAL MONITORING STORAGE ACCOUNT: Create new storage account

NEW STORAGE ACCOUNT NAME: monitoringaccount123

Define Input Sources

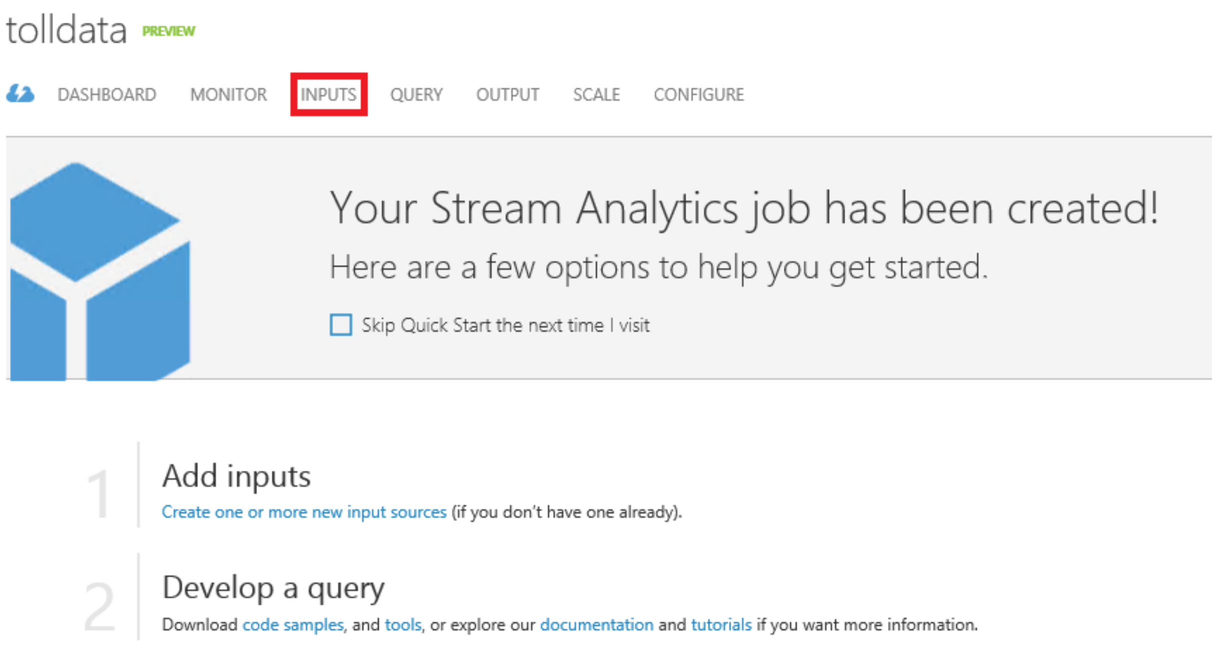
Click on the created analytics job in the portal.



stream analytics

NAME	STATUS	CREATED	SUBSCRIPTION	REGION
TollData	NOT STARTED	10/17/2014 7:22:30 PM	Prototypes	West Europe

Open the "Inputs" tab to define the source data.



tolldata

Your Stream Analytics job has been created!

Here are a few options to help you get started.

☐ Skip Quick Start the next time I visit

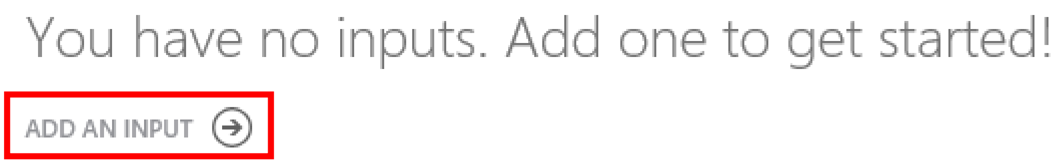
1 Add inputs

Create one or more new input sources (if you don't have one already).

2 Develop a query

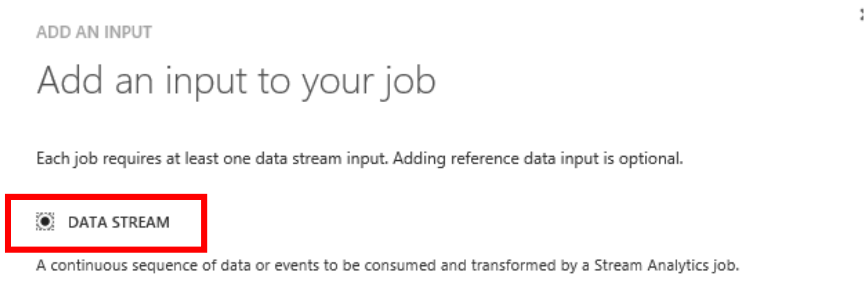
Download code samples, and tools, or explore our documentation and tutorials if you want more information.

Click "Add an Input"



You have no inputs. Add one to get started!

Select "Data Stream" on the first page



ADD AN INPUT

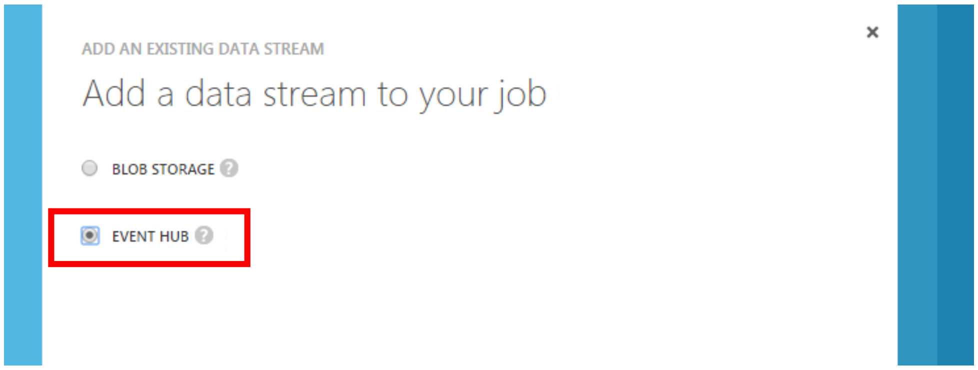
Add an input to your job

Each job requires at least one data stream input. Adding reference data input is optional.

[✓ DATA STREAM]

A continuous sequence of data or events to be consumed and transformed by a Stream Analytics job.

Select “Event Hub” on the second page of the wizard.


ADD AN EXISTING DATA STREAM

Add a data stream to your job

BLOB STORAGE [✓ EVENT HUB]

Input Alias: “EntryStream”

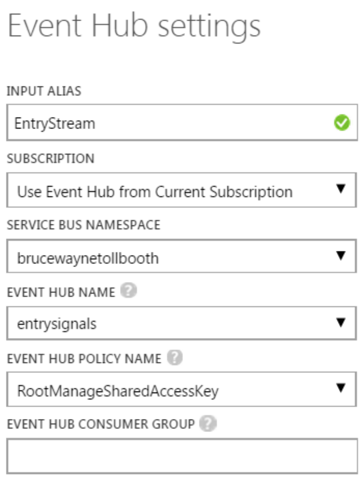
Subscription: Use Event Hub from Current Subscription

Service Bus Namespace: Your Service Bus Namespace

Event Hub Name: Your Entry Signal Event Hub

Policy Name: RootManageSharedAccessKey

Consumer Group: Leave Blank


Event Hub settings

INPUT ALIAS: EntryStream

SUBSCRIPTION: Use Event Hub from Current Subscription

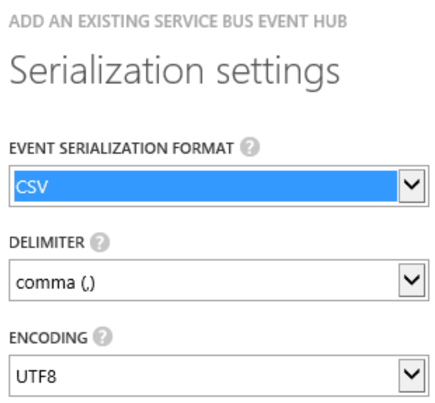
SERVICE BUS NAMESPACE: brucewaynetollbooth

EVENT HUB NAME: entrysignals

EVENT HUB POLICY NAME: RootManageSharedAccessKey

EVENT HUB CONSUMER GROUP:

Move to the next page. Leave default values (CSV, comma delimited, UTF8 encoding)


ADD AN EXISTING SERVICE BUS EVENT HUB

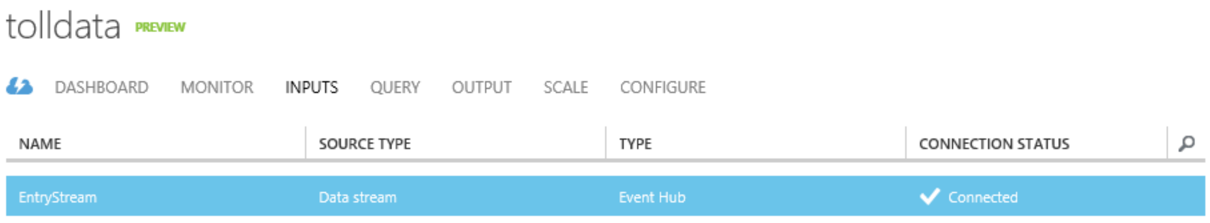
Serialization settings

EVENT SERIALIZATION FORMAT: CSV

DELIMITER: comma (,)

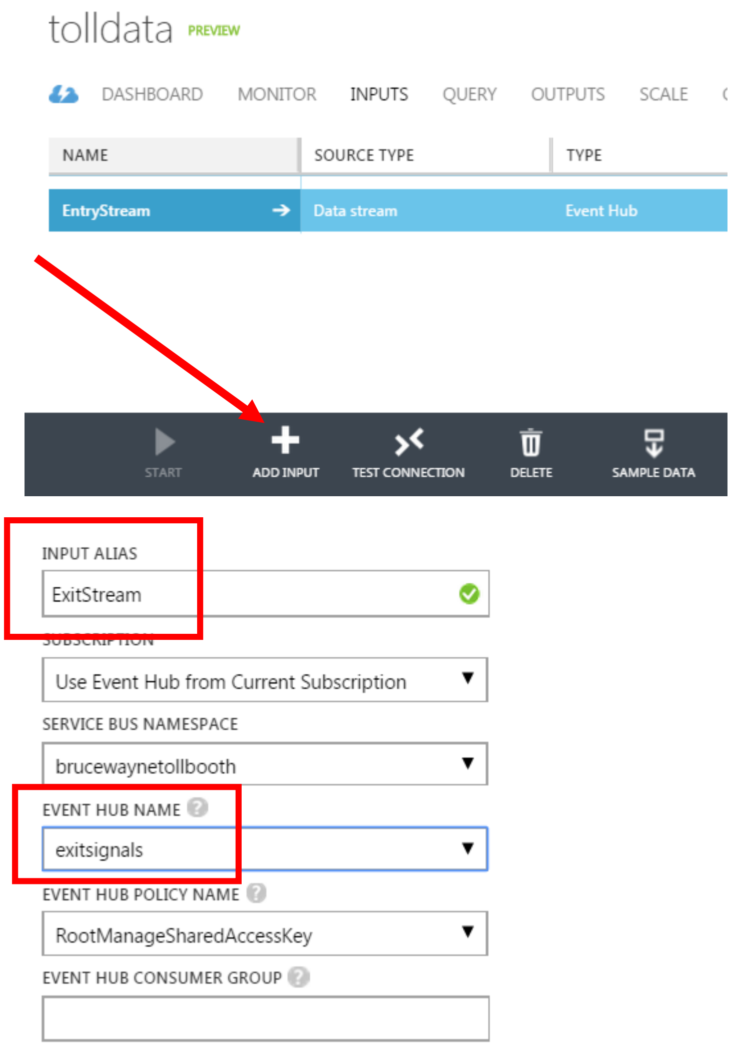
ENCODING: UTF8

Click OK at the bottom of the dialog to finish the wizard.



NAME	SOURCE TYPE	TYPE	CONNECTION STATUS
EntryStream	Data stream	Event Hub	✓ Connected

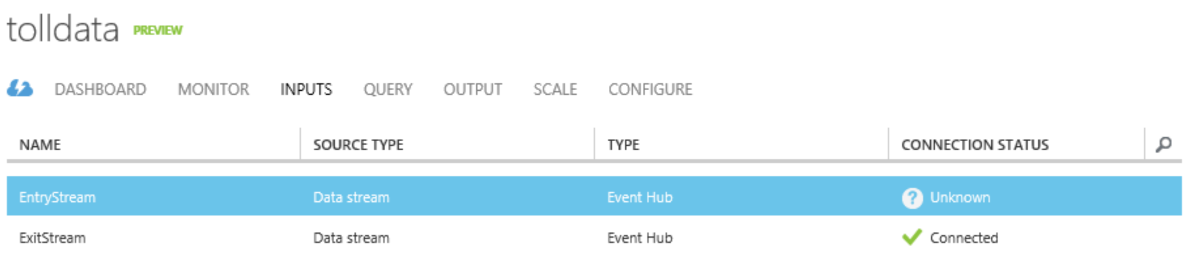
You will need to follow the same sequence of steps to create the second Event Hub input for the stream with Exit events. Make sure on the 3rd page you enter values as on the screenshot bellow.



NAME	SOURCE TYPE	TYPE
EntryStream	Data stream	Event Hub

INPUT ALIAS: ExitStream
SUBSCRIPTION: Use Event Hub from Current Subscription
SERVICE BUS NAMESPACE: brucewaynetollbooth
EVENT HUB NAME: exitsignals
EVENT HUB POLICY NAME: RootManageSharedAccessKey
EVENT HUB CONSUMER GROUP:

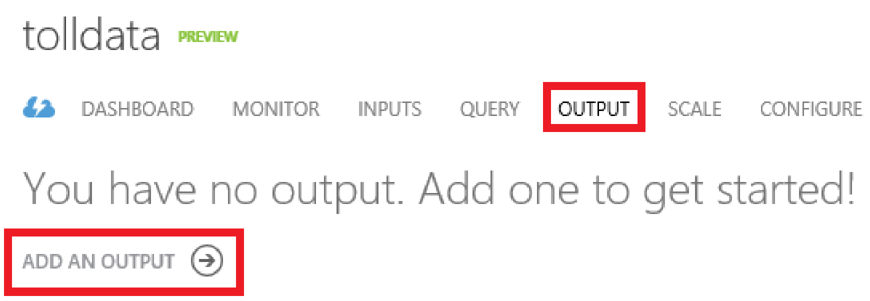
You now have two input streams defined:



NAME	SOURCE TYPE	TYPE	CONNECTION STATUS
EntryStream	Data stream	Event Hub	? Unknown
ExitStream	Data stream	Event Hub	✓ Connected

Define Output

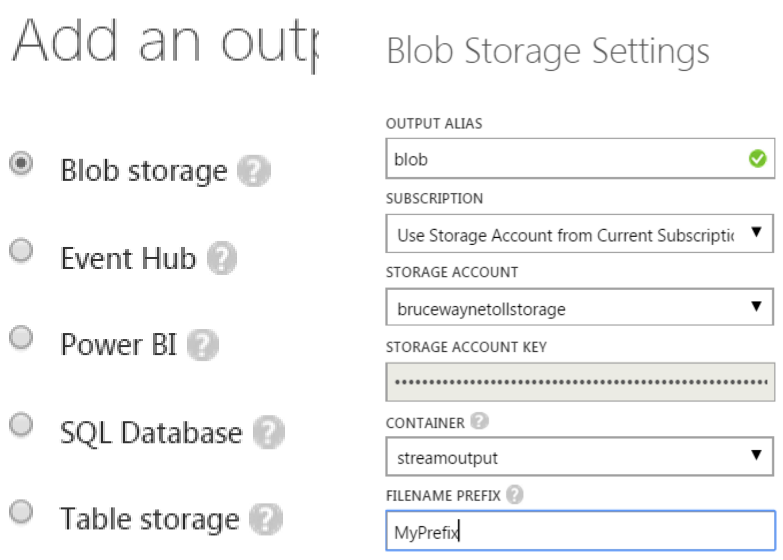
Go to the “Output” tab and click “Add an output”.



You have no output. Add one to get started!

ADD AN OUTPUT

Select Blob Storage.



Blob Storage Settings

OUTPUT ALIAS	blob
SUBSCRIPTION	Use Storage Account from Current Subscriptic
STORAGE ACCOUNT	brucewaynetollstorage
STORAGE ACCOUNT KEY	••
CONTAINER	streamoutput
FILENAME PREFIX	MyPrefix

Output Alias: this is where the user gets to define what their output will be called for the purpose of the query.

Subscription: “Use Storage Account from Current Subscription”

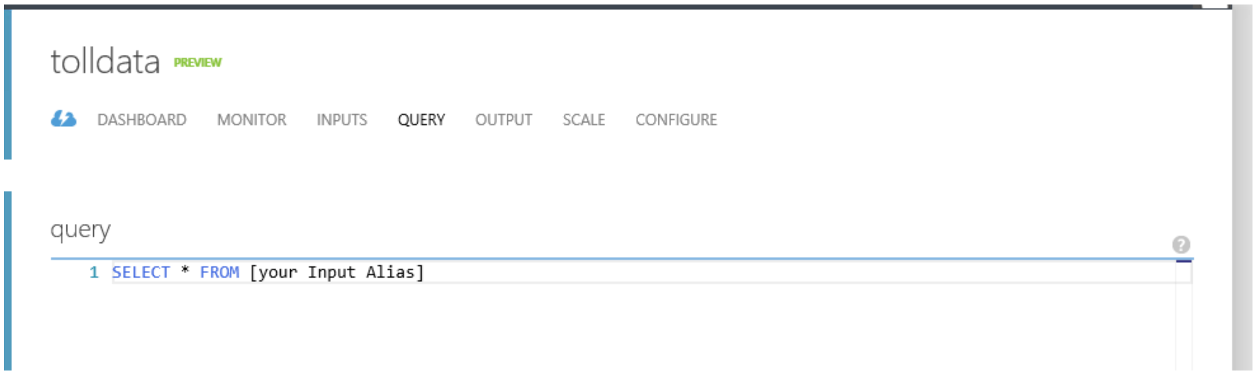
Storage Account: The storage account that was provisioned in the first exercise.

Container: The container within that storage account that was provisioned in the previous exercise.

FilenamePrefix: The output from this stream will have a unique identifier set by the user. As multiple stream processors can output to the same blob, it can get confusing as to which file within the blob is related to which stream processor. Think of this like customerID or employeeID but for the job output file.

Azure Stream Analytics Query

The Query tab contains a SQL query that performs the transformation over the incoming data.



```
SELECT * FROM [your Input Alias]
```

Through this lab we will attempt to answer several business questions related to Toll data and construct Stream Analytics queries that can be used in Azure Stream Analytics to provide a relevant answer.

Before we start our first Azure Stream Analytics job, let's explore few scenarios and query syntax.

Let's say we need to count the number of vehicles that enter a toll booth. Since this is a continuous stream of events, it is essential that we define a "period of time". We need to modify our question to be "Number of vehicles entering a toll booth every 3 minutes". This is commonly referred to as the Tumbling Count.

Let's look at the Azure Stream Analytics query answering this question:

```
SELECT TollId, System.Timestamp AS WindowEnd, COUNT(*)AS Count
FROM EntryStream TIMESTAMP BY EntryTime
GROUP BY TUMBLINGWINDOW(minute,3), TollId
```

As you can see, Azure Stream Analytics is using a SQL-like query language with a few additional extensions to enable specifying time-related aspects of the query.

The next sections will describe Timestamp and TumblingWindow constructs used in the query in detail.

Application Time - TimeStamp

In any temporal system like Azure Stream Analytics, it’s essential to understand the progression of time. Every event that flows through the system comes with a timestamp. In other words, every event in the system depicts a point in time.

This timestamp can be defined by the Application (e.g. specific field in the event). The user can specify it in the query using the “*TIMESTAMP BY*” clause (e.g. EntryTime column in our example).

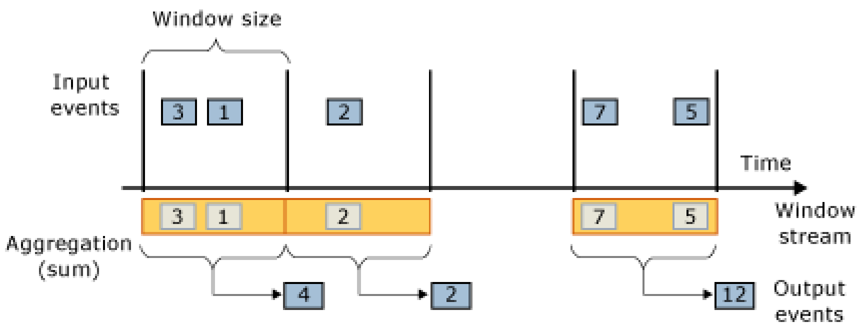
Alternatively, the system can assign the timestamp based on the event arrival time. Please note that in this case the value of the timestamp is potentially subject to certain factors such as network latencies. This can negatively affect accuracy of the analysis.

You can access the *timestamp* of any event using the *System.Timestamp* property which needs to be used with an alias. For any aggregate event like Sum(), Avg(), etc., produced as output from a window operation, it will also have a *timestamp* property like any other input event entering into the system. This timestamp of the output event aligns to the end time of the window.

Time Windows – Tumbling Window

In applications that process real-time events, a common requirement is to perform some set-based computation (aggregation) or other operations over subsets of events that fall within some period of time. In Azure Stream Analytics, these subsets of events are defined through windows.

A window contains event data along a timeline and enables you to perform various operations against the events within that window. For example, you may want to sum the values of payload fields in a given window as shown in the following illustration.



Azure Stream Analytics supports several functions to define window aggregates (Tumbling, Hopping, Sliding windows). Please refer to the Query Language Reference Guide in MSDN for more details.

Our sample query uses the TumblingWindow function to specify the size of the window:

GROUP BY TUMBLINGWINDOW(minute,3)

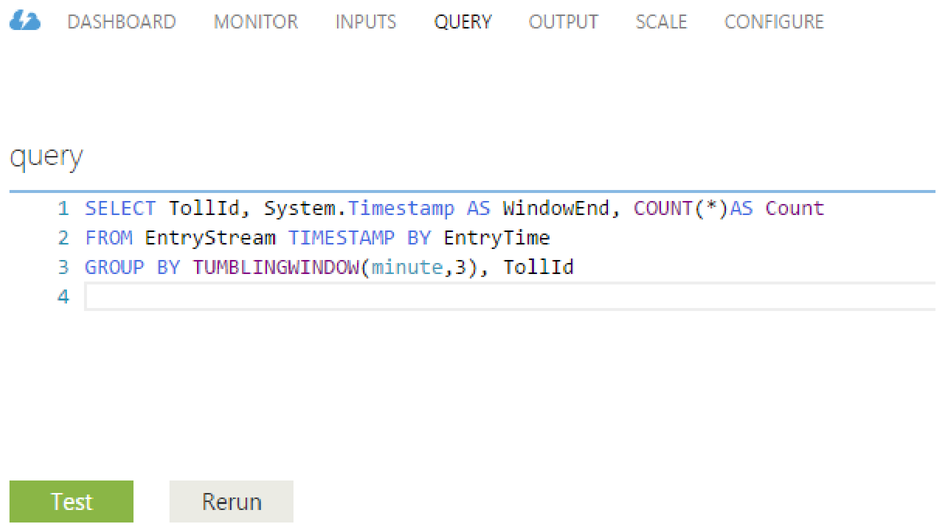
Testing Queries

Within the folder: bootcamp\Streaming_Data_and_Real-time_Analytics\SampleData, the following 3 files can be used to test the stream query logic before the job is fired:

1. Entry.json
2. Exit.json
3. Registration.json

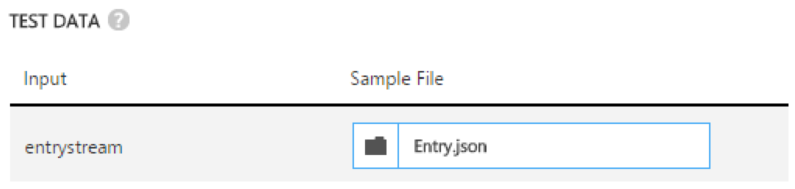
Question 1 - Number of Vehicles Entering a Toll Booth

Open the Azure Management portal and navigate to your created Azure Stream Analytics job. Open the Query tab and copy & paste the Query from the previous section.



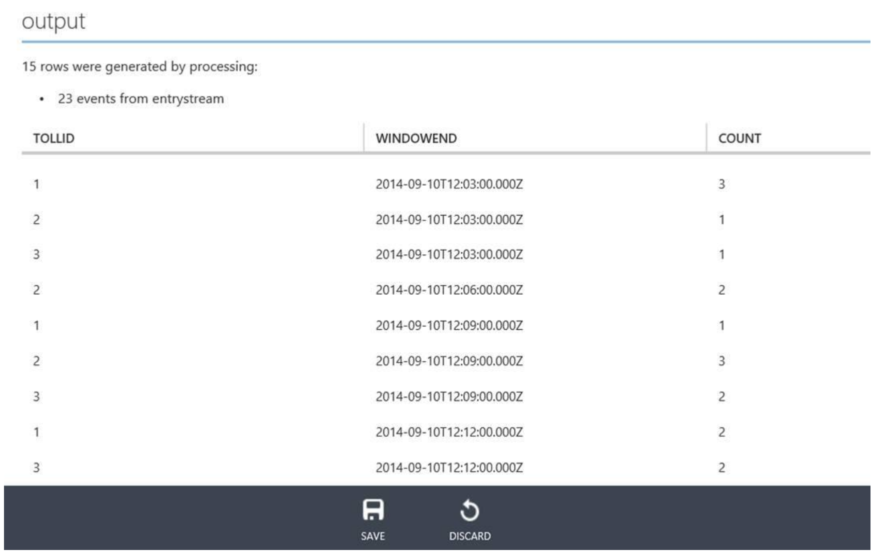
```
SELECT TollId, System.Timestamp AS WindowEnd, COUNT(*)AS Count
FROM EntryStream TIMESTAMP BY EntryTime
GROUP BY TUMBLINGWINDOW(minute,3), TollId
```

To validate this query against sample data, click the Test button. In the dialog box that opens, navigate to Entry.json, a file with sample data from the EntryTime event stream.



Input	Sample File
entrystream	Entry.json

Validate that the output of the query is as expected:



15 rows were generated by processing:

- 23 events from entrystream

TOLLID	WINDOWEND	COUNT
1	2014-09-10T12:03:00.000Z	3
2	2014-09-10T12:03:00.000Z	1
3	2014-09-10T12:03:00.000Z	1
2	2014-09-10T12:06:00.000Z	2
1	2014-09-10T12:09:00.000Z	1
2	2014-09-10T12:09:00.000Z	3
3	2014-09-10T12:09:00.000Z	2
1	2014-09-10T12:12:00.000Z	2
3	2014-09-10T12:12:00.000Z	2

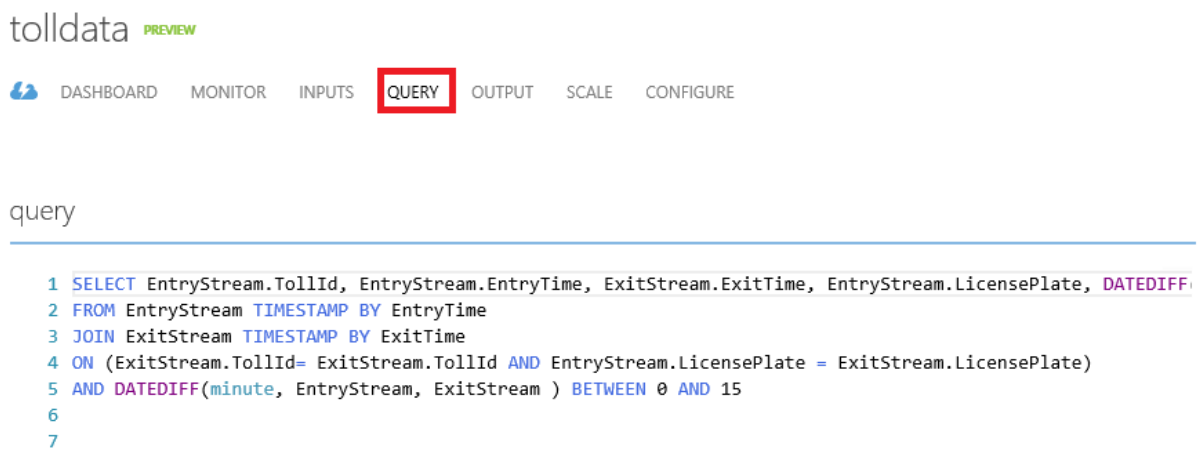
Question 2 - Report Total Time for Each Car to Pass Through the Toll Booth

We want to find the average time required for the car to pass through the toll booth to assess efficiency and customer experience.

For this, we need to join the stream containing EntryTime with the stream containing ExitTime. We will join the streams on TollId and LicencePlate columns. JOIN operator requires specifying a temporal wiggle room describing acceptable time difference between the joined events. We will use the DATEDIFF function to specify that events should be no more than 15 minutes from each other. We will also apply the DATEDIFF function to Exit and Entry times to compute the actual time a car spends in the toll. Note the difference of the use of DATEDIFF when used in a SELECT statement compared to a JOIN condition.

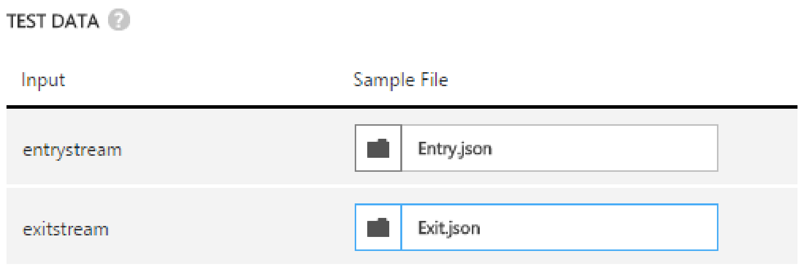
```
SELECT EntryStream.TollId, EntryStream.EntryTime,
ExitStream.ExitTime, EntryStream.LicensePlate, DATEDIFF(minute,
EntryStream.EntryTime, ExitStream .ExitTime) AS
DurationInMinutes
FROM EntryStream TIMESTAMP BY EntryTime
JOIN ExitStream TIMESTAMP BY ExitTime
ON (EntryStream.TollId= ExitStream.TollId AND
EntryStream.LicensePlate = ExitStream.LicensePlate)
AND DATEDIFF(minute, EntryStream, ExitStream ) BETWEEN 0 AND 15
```

To test this query, update the query on the Query tab of your job:



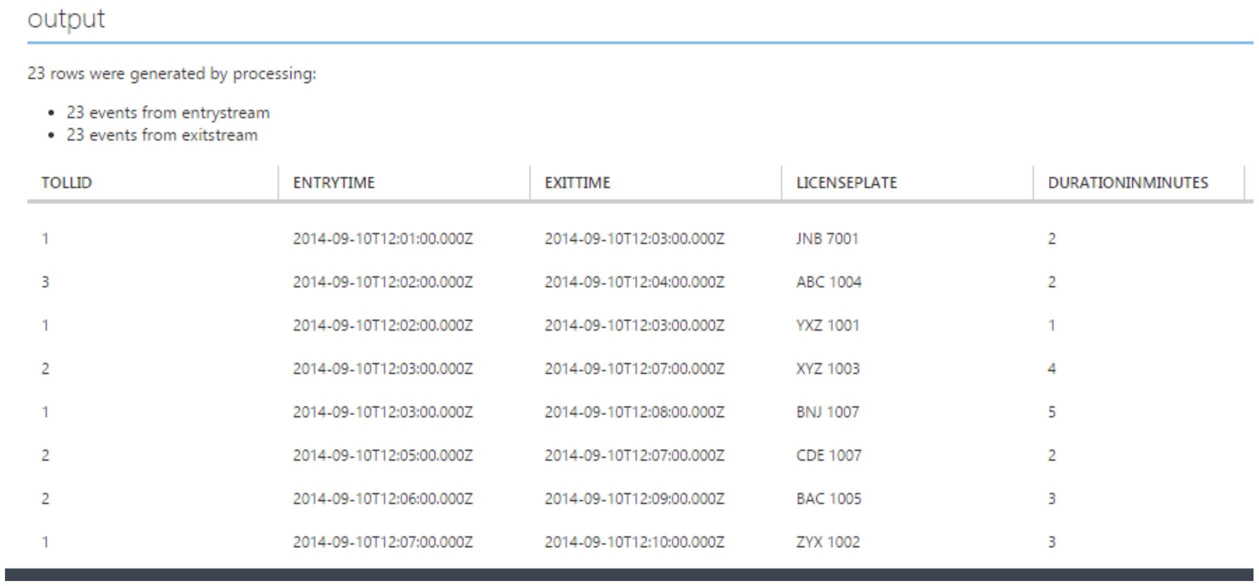
```
SELECT EntryStream.TollId, EntryStream.EntryTime, ExitStream.ExitTime, EntryStream.LicensePlate, DATEDIFF
FROM EntryStream TIMESTAMP BY EntryTime
JOIN ExitStream TIMESTAMP BY ExitTime
ON (ExitStream.TollId= ExitStream.TollId AND EntryStream.LicensePlate = ExitStream.LicensePlate)
AND DATEDIFF(minute, EntryStream, ExitStream ) BETWEEN 0 AND 15
```

Click test, and specify sample input files for EntryTime and ExitTime.


TEST DATA

Input	Sample File
entrystream	Entry.json
exitstream	Exit.json

Click the checkbox to test the query and view the output:


output

23 rows were generated by processing:

- 23 events from entrystream
- 23 events from exitstream

TOLLID	ENTRYTIME	EXITTIME	LICENSEPLATE	DURATIONINMINUTES
1	2014-09-10T12:01:00.000Z	2014-09-10T12:03:00.000Z	JNB 7001	2
3	2014-09-10T12:02:00.000Z	2014-09-10T12:04:00.000Z	ABC 1004	2
1	2014-09-10T12:02:00.000Z	2014-09-10T12:03:00.000Z	YXZ 1001	1
2	2014-09-10T12:03:00.000Z	2014-09-10T12:07:00.000Z	XYZ 1003	4
1	2014-09-10T12:03:00.000Z	2014-09-10T12:08:00.000Z	BNJ 1007	5
2	2014-09-10T12:05:00.000Z	2014-09-10T12:07:00.000Z	CDE 1007	2
2	2014-09-10T12:06:00.000Z	2014-09-10T12:09:00.000Z	BAC 1005	3
1	2014-09-10T12:07:00.000Z	2014-09-10T12:10:00.000Z	ZYX 1002	3

Question 3 – Report All Commercial Vehicles with Expired Registration

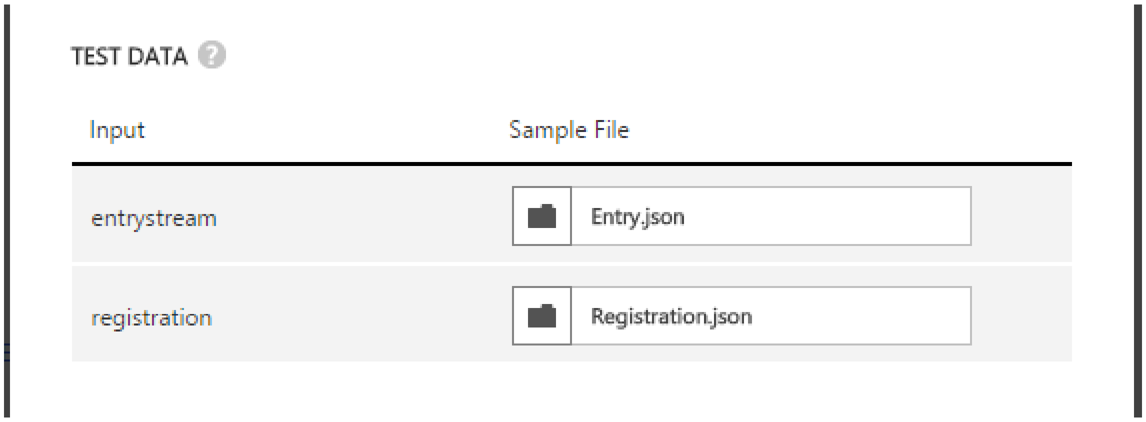
Azure Stream Analytics can use static snapshots of data to join with temporal data streams. To demonstrate this capability, we will use the following sample question.

If a commercial vehicle is registered with the Toll Company, they can pass through the toll booth without being stopped for inspection. We will use Commercial Vehicle Registration lookup table to identify all commercial vehicles with expired registration.

```
SELECT EntryStream.EntryTime, EntryStream.LicensePlate,
EntryStream.TollId, Registration.RegistrationId
FROM EntryStream TIMESTAMP BY EntryTime
JOIN Registration
ON EntryStream.LicensePlate = Registration.LicensePlate
WHERE Registration.Expired = '1'
```

Note that testing a query with Reference Data requires that an input source for the Reference Data is defined, which we have done in Step 5.

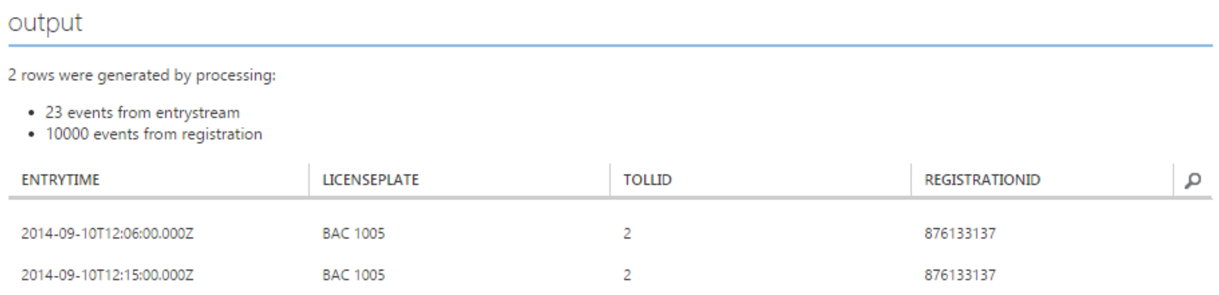
To test this query, paste the query into the Query tab, click Test, and specify the two input sources:



TEST DATA

Input	Sample File
entrystream	Entry.json
registration	Registration.json

View the output of the query:



output

2 rows were generated by processing:

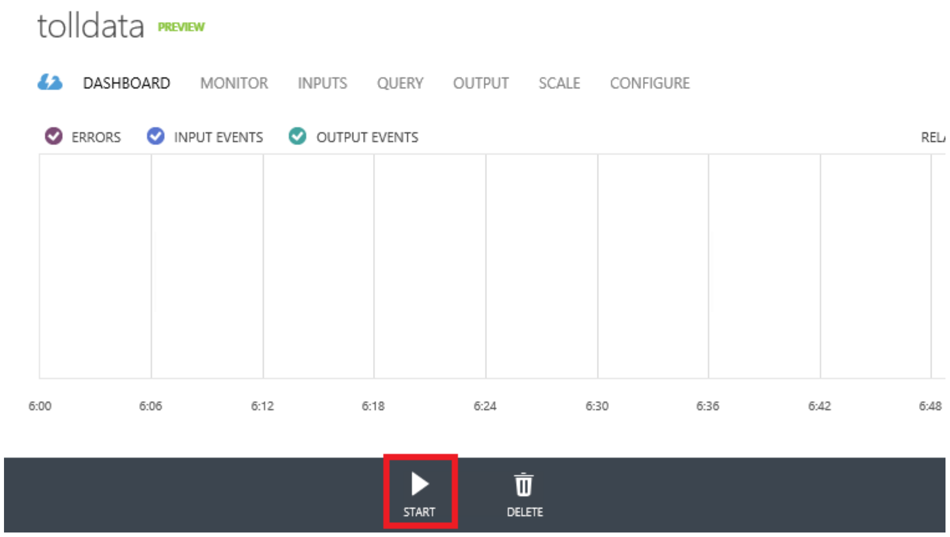
- 23 events from entrystream
- 10000 events from registration

ENTRYTIME	LICENSEPLATE	TOLLID	REGISTRATIONID
2014-09-10T12:06:00.000Z	BAC 1005	2	876133137
2014-09-10T12:15:00.000Z	BAC 1005	2	876133137

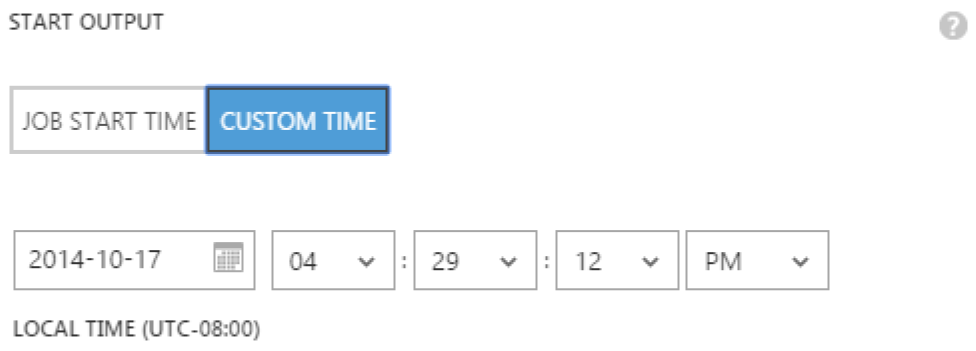
Start the Stream Analytics Job

We have written our first Azure Stream Analytics query, and now it is time to finish the configuration and start the job. Save the query from Question 3, which will produce an output that matches the schema of our output table TollDataRefJoin.

Navigate to the job dashboard and click Start.



In the dialog box that appears, change the Start Output time to Custom Time. Edit the Hour and set it an hour back. This will ensure that we process all events from the Event Hub since the moment we started generating the events in the beginning of the lab. Click the check mark to start the job.



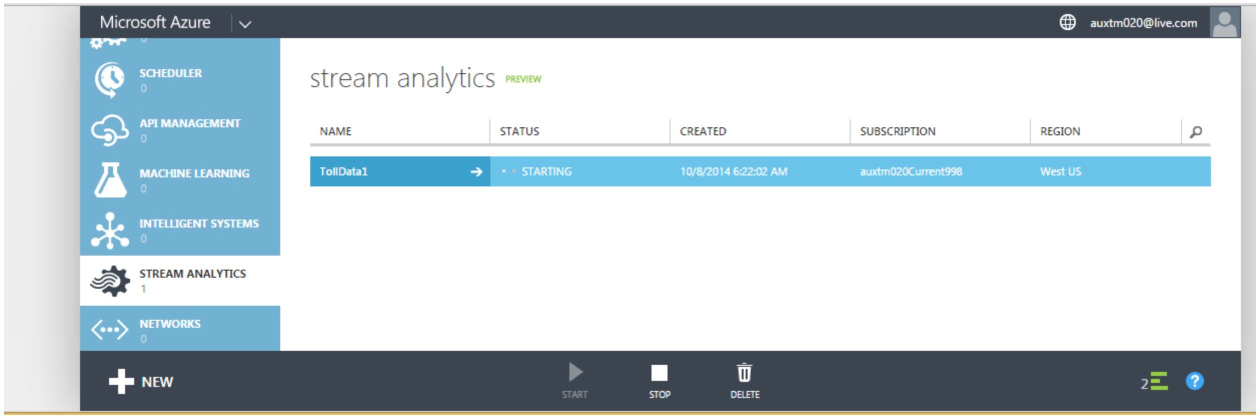
START OUTPUT

JOB START TIME [✓ CUSTOM TIME]

2014-10-17 04 : 29 : 12 PM

LOCAL TIME (UTC-08:00)

Starting the job can take a few minutes. You will be able to see the status on the top-level page for Stream Analytics.



NAME	STATUS	CREATED	SUBSCRIPTION	REGION
TollData1	STARTING	10/8/2014 6:22:02 AM	auxtm020Current998	West US