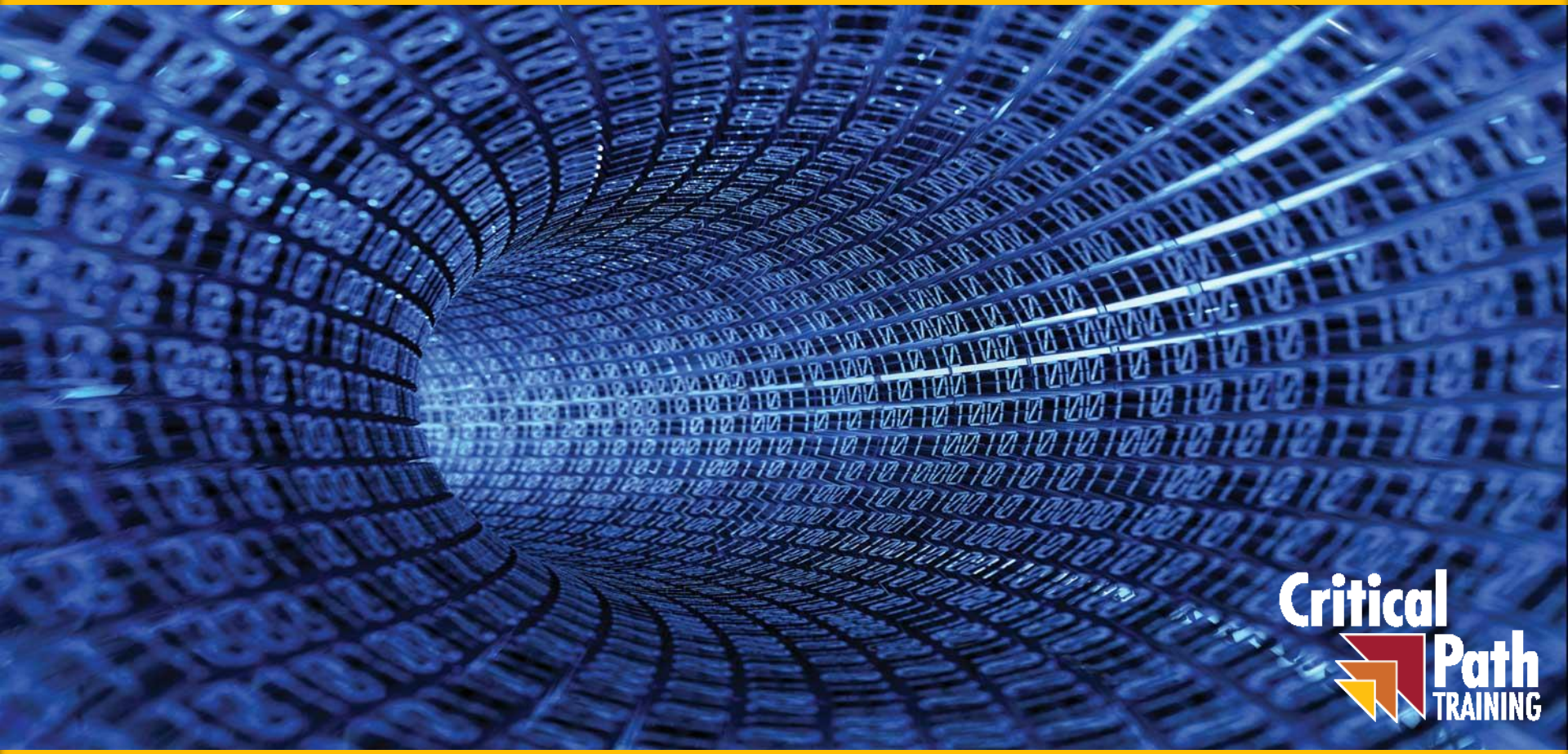
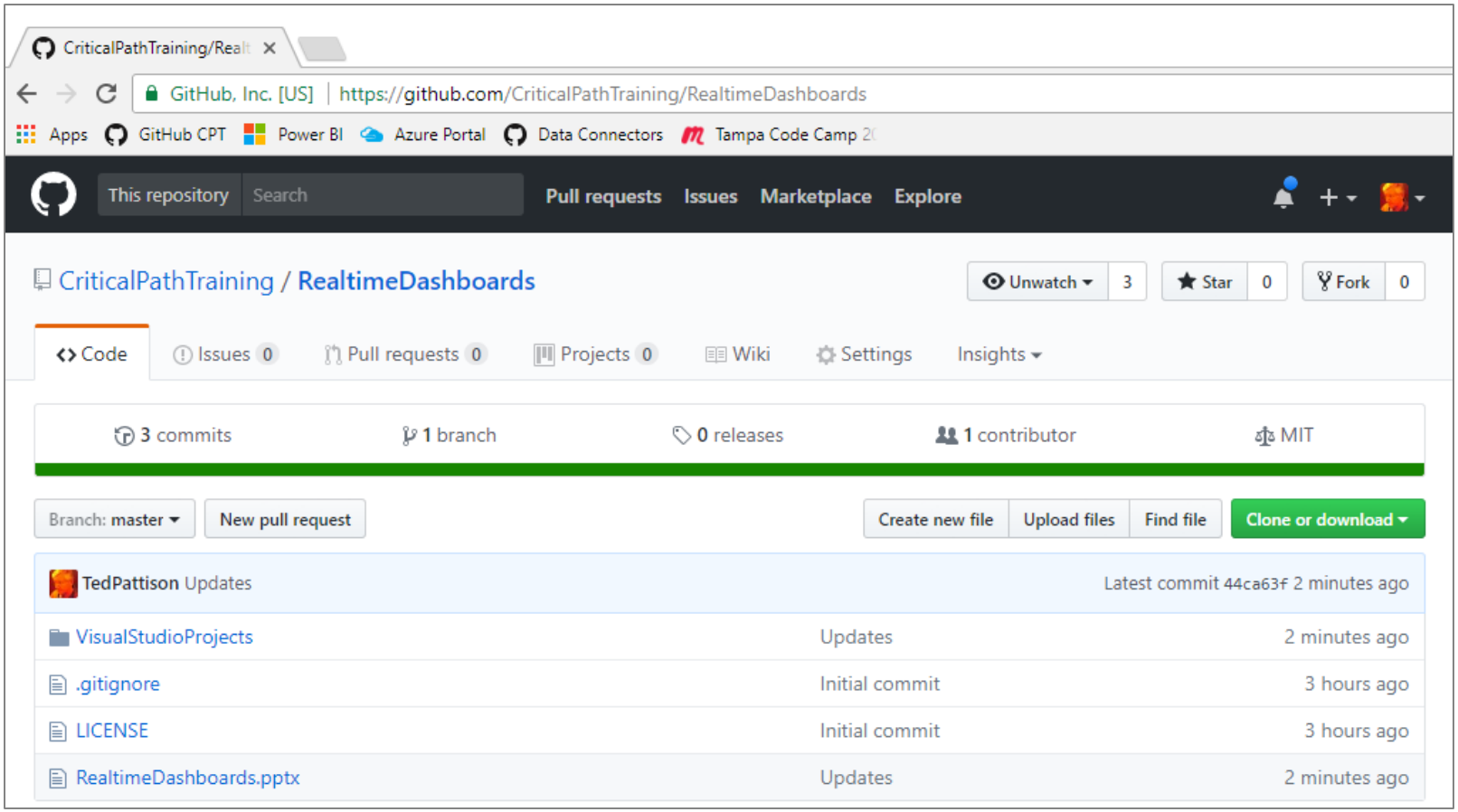
Developing in Power BI

with Streaming Datasets and Real-time Dashboards



Code and Slides for this Session

- **https://github.com/CriticalPathTraining/RealtimeDashboards**



Critical Path Training

https://www.CriticalPathTrainig.com

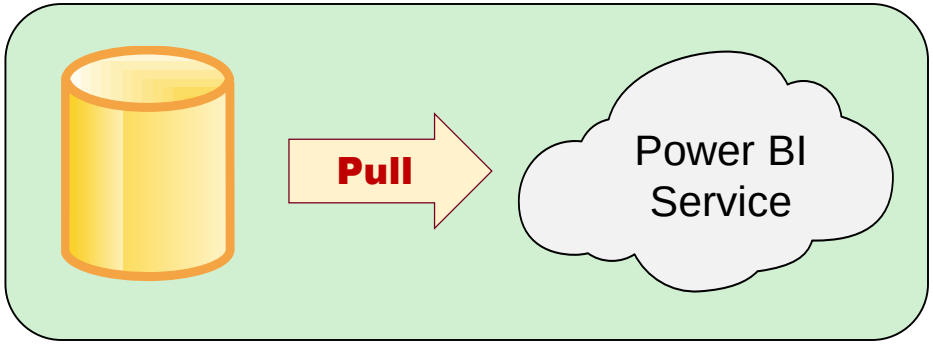
- **PBI365: Power BI Boot Camp** – 4 Days
  - Audience is Business Users, Analysts and Data Professionals
  - Provides hands-on introduction to the Power BI platform
  - Focuses on build solutions using Power BI Desktop
  - Query design, data modeling and report and dashboard design
  - Apps and App Workspaces
- **PBD365: Power BI Developer Boot Camp** – 4 Days
  - Audience is Professional Developers
  - Teaches developing custom visuals with TypeScript and D3
  - Teaches programming with the Power BI APIs
  - Teaches developing with Power BI Embedded
  - Teaches R programming and integrating R with Power BI
  - Teaches how to develop custom connector using M

Agenda

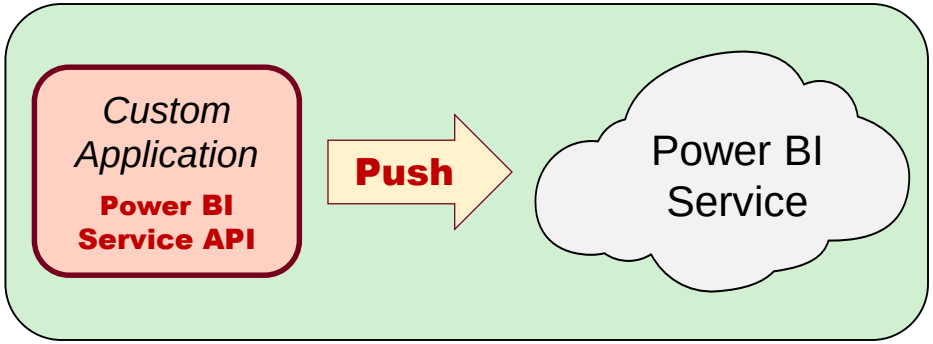
- Introduction to Real-time Datasets
- Creating a Streaming Dataset with the API
- Designing Dashboards with Streaming Data Tiles
- Creating a Push Dataset with Real-time Data
- Integrating Azure Streaming Analytics Jobs

Pull Datasets versus Real-time Datasets

- Pull Datasets
  - Imported Datasets
  - DirectQuery Datasets
  - Live Connect Datasets

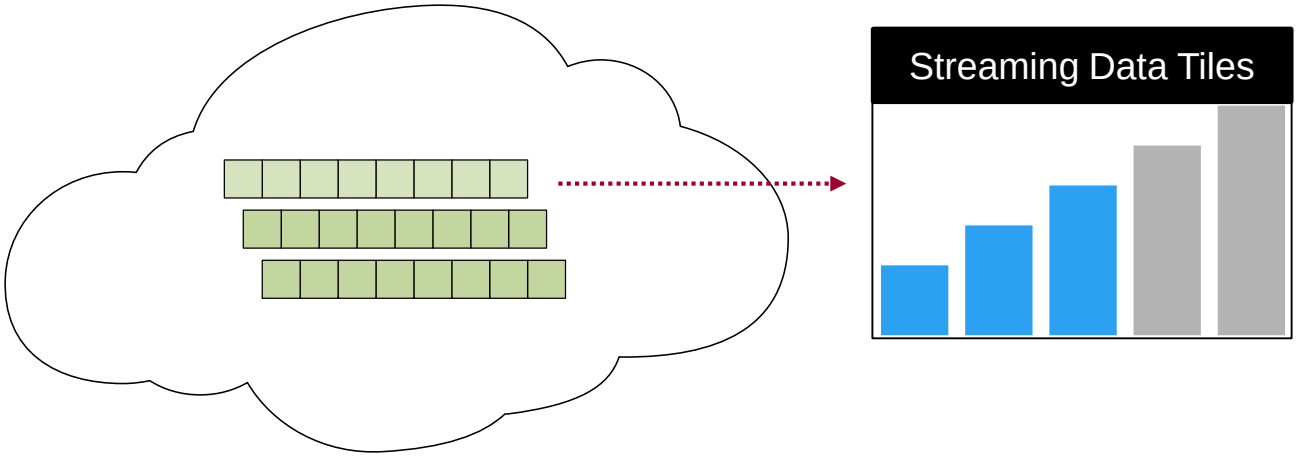


- Real-time Datasets
  - Streaming Datasets
  - Push Datasets
  - Hybrid Datasets



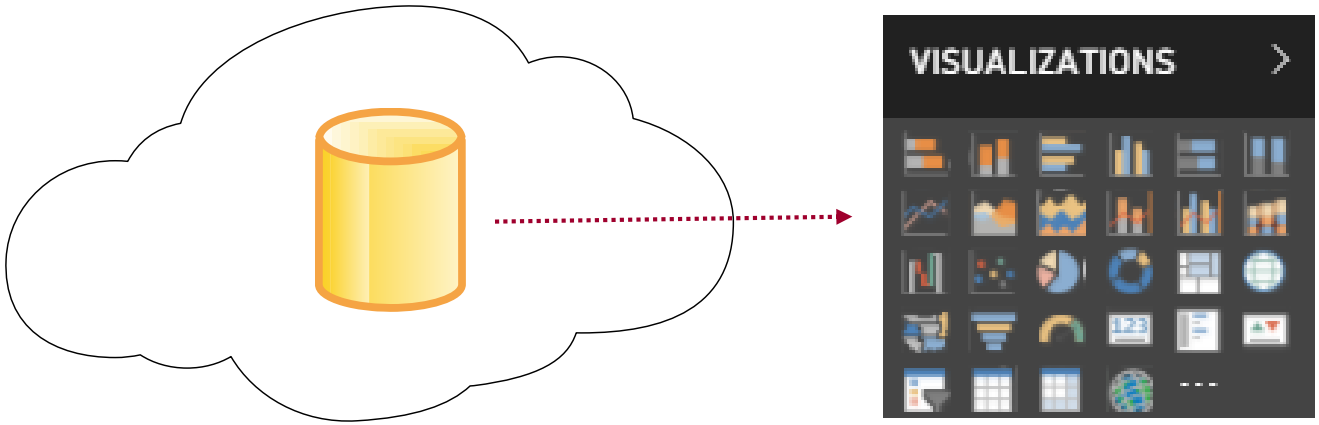
Streaming Datasets

- Data stored in cloud-based cache – not persisted in DB
- Restricted to single table - no rich data modeling
- Not supported by standard Power BI report designer
- Dashboard created using specialized streaming data tiles
- No support for DAX, aggregation or filtering



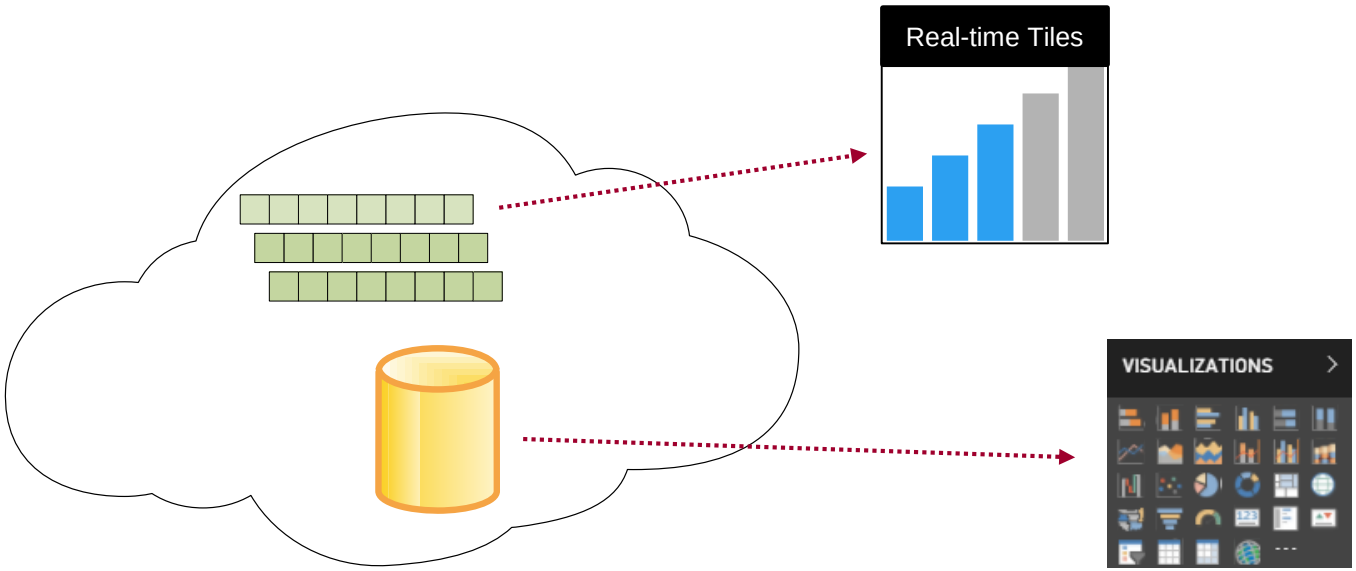
Push Datasets

- Data stored in Azure SQL DB – not in cache
- Supports multiple tables and table relationships
- Supported by standard Power BI report designer
- Supports DAX, measures, aggregation & filtering



Hybrid Datasets

- Data stored in cloud-based cache **AND** in Azure SQL DB
- Restricted to single table and no rich data modeling
- Supported by streaming data tiles
- Supported by Power BI report designer




DEMO
Creating a Hybrid Dataset by Hand

Agenda

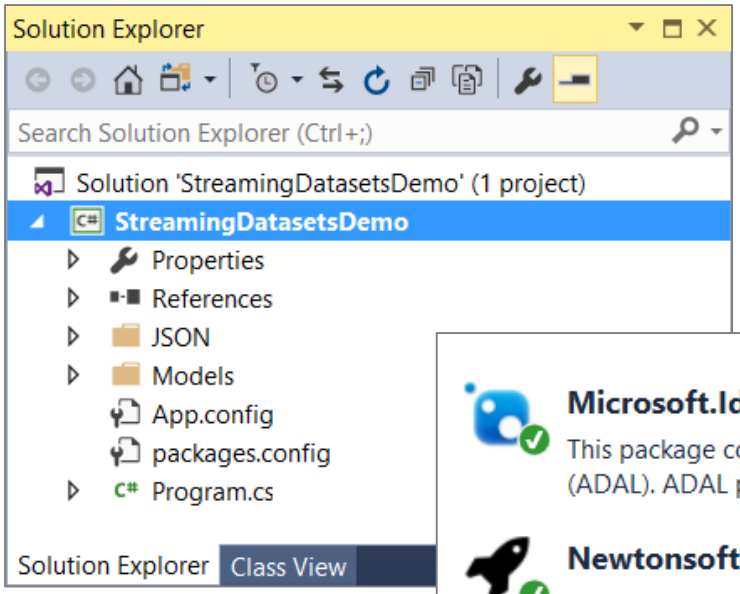
- ✓ Introduction to Real-time Datasets
- ➢ Creating a Streaming Dataset with the API
- Designing Dashboards with Streaming Data Tiles
- Creating a Push Dataset with Real-time Data
- Integrating Azure Streaming Analytics Jobs

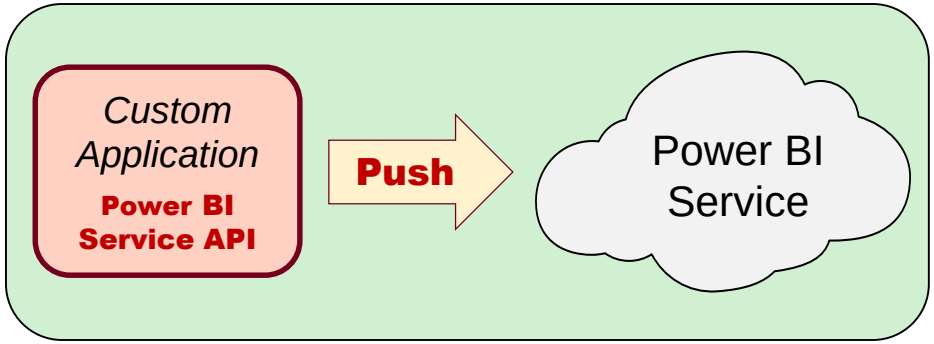
Real-time Scenario Being Simulated

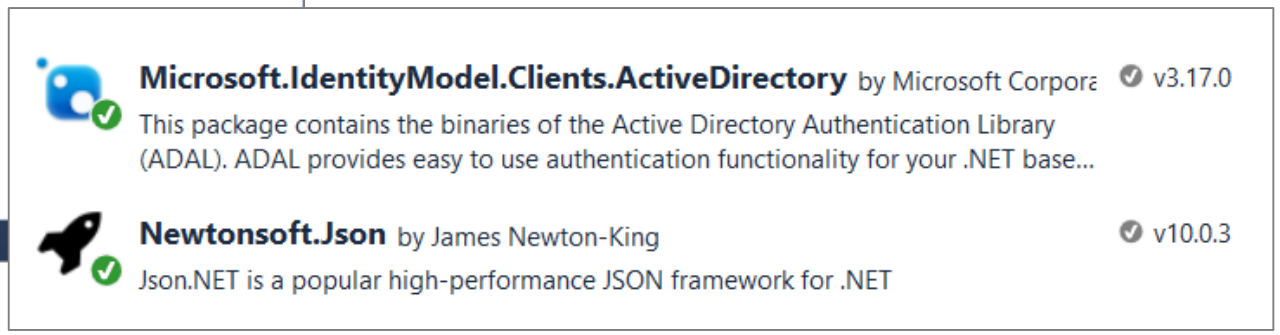
- Heisenberg labs processes chemicals
  - Required to monitor temperatures during processing
  - Temperature must be monitored on per-second basis
  - Send alerts if temperature exceeds preset threshold

The StreamingDatasetsDemo Project

- Console application project in Visual Studio 2017
  - Installed package for Azure AD Authentication library
  - Installed package to serialize .NET objects to JSON







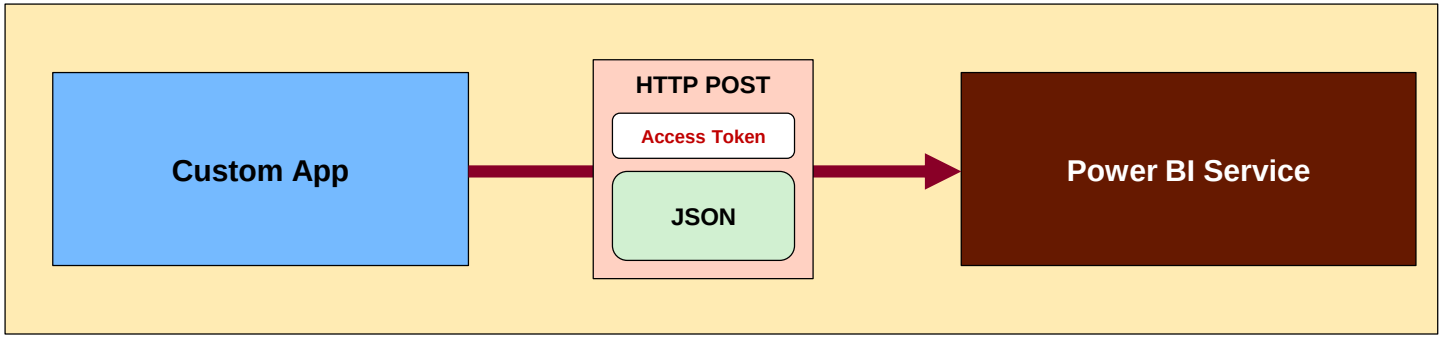
Executing Power BI Service API Calls

- Generic helper methods designed to execute HTTP operations

```
private void ExecutePostRequest(string restUri, string postBody) {
  // prepare REST call
  HttpContent body = new StringContent(postBody);
  body.Headers.ContentType = new MediaTypeWithQualityHeaderValue("application/json");
  HttpClient client = new HttpClient();
  client.DefaultRequestHeaders.Add("Accept", "application/json");
  client.DefaultRequestHeaders.Add("Authorization", "Bearer " + AccessToken);

  // execute REST call
  HttpResponseMessage response = client.PostAsync(restUri, body).Result;
}
```

1

2



Creating a Streaming Dataset

- Streaming dataset created using JSON schema definition
  - Streaming dataset limited to a single table
  - Columns defined using name and datatype
  - No support for any other column properties (e.g. formatting)

DemoStreamingDataset.json

```
{
  "name": "TemperatureReadings",
  "defaultMode": "Streaming",
  "tables": [
    { "name": "TemperatureReadings",
      "columns": [
        { "name": "Run", "dataType": "string" },
        { "name": "Time", "dataType": "Datetime" },
        { "name": "TimeWindow", "dataType": "string" },
        { "name": "TargetTemperature", "dataType": "Double" },
        { "name": "MinTemperature", "dataType": "Double" },
        { "name": "MaxTemperature", "dataType": "Double" },
        { "name": "BatchA", "dataType": "Double" },
        { "name": "BatchB", "dataType": "Double" },
        { "name": "BatchC", "dataType": "Double" }
      ]
    }
  ]
}
```

Creating a Custom Dataset

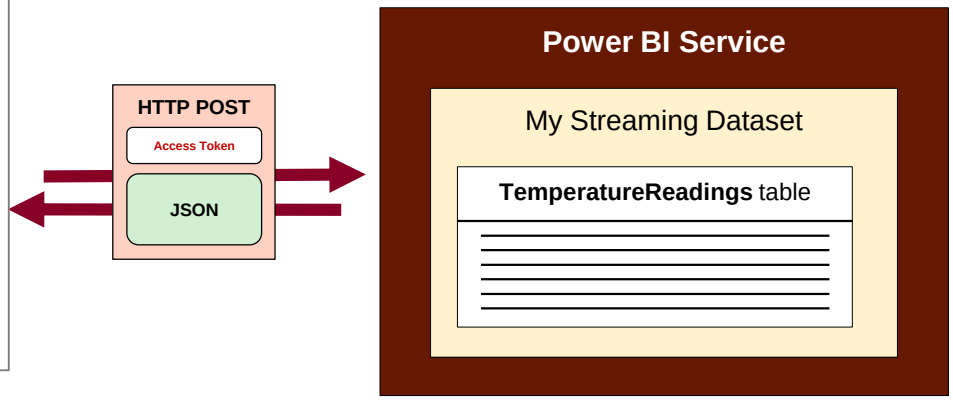
- Dataset created by executing HTTP POST operation
  - One-time operation done as application begins running

```
// prepare call to create new dataset
string restUrlDatasets = ProgramGlobalConstants.PowerBiServiceRootUrl + "datasets";
string jsonNewDataset = Properties.Resources.NewDataset_json;
// execute REST call to create new dataset
string json = ExecutePostRequest(restUrlDatasets, jsonNewDataset);
// retrieve Guid to track dataset ID
Dataset dataset = JsonConvert.DeserializeObject<Dataset>(json);
CustomDatasetId = dataset.id;
```

1
2
3

DemoStreamingDataset.json

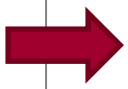
```
{
  "name": "TemperatureReadings",
  "defaultMode": "Streaming",
  "tables": [
    { "name": "TemperatureReadings",
      "columns": [
        { "name": "Run", "dataType": "string" },
        { "name": "Time", "dataType": "Datetime" },
        { "name": "TimeWindow", "dataType": "string" },
        { "name": "TargetTemperature", "dataType": "Double" },
        { "name": "MinTemperature", "dataType": "Double" },
        { "name": "MaxTemperature", "dataType": "Double" },
        { "name": "BatchA", "dataType": "Double" },
        { "name": "BatchB", "dataType": "Double" },
        { "name": "BatchC", "dataType": "Double" }
      ]
    }
  ]
}
```



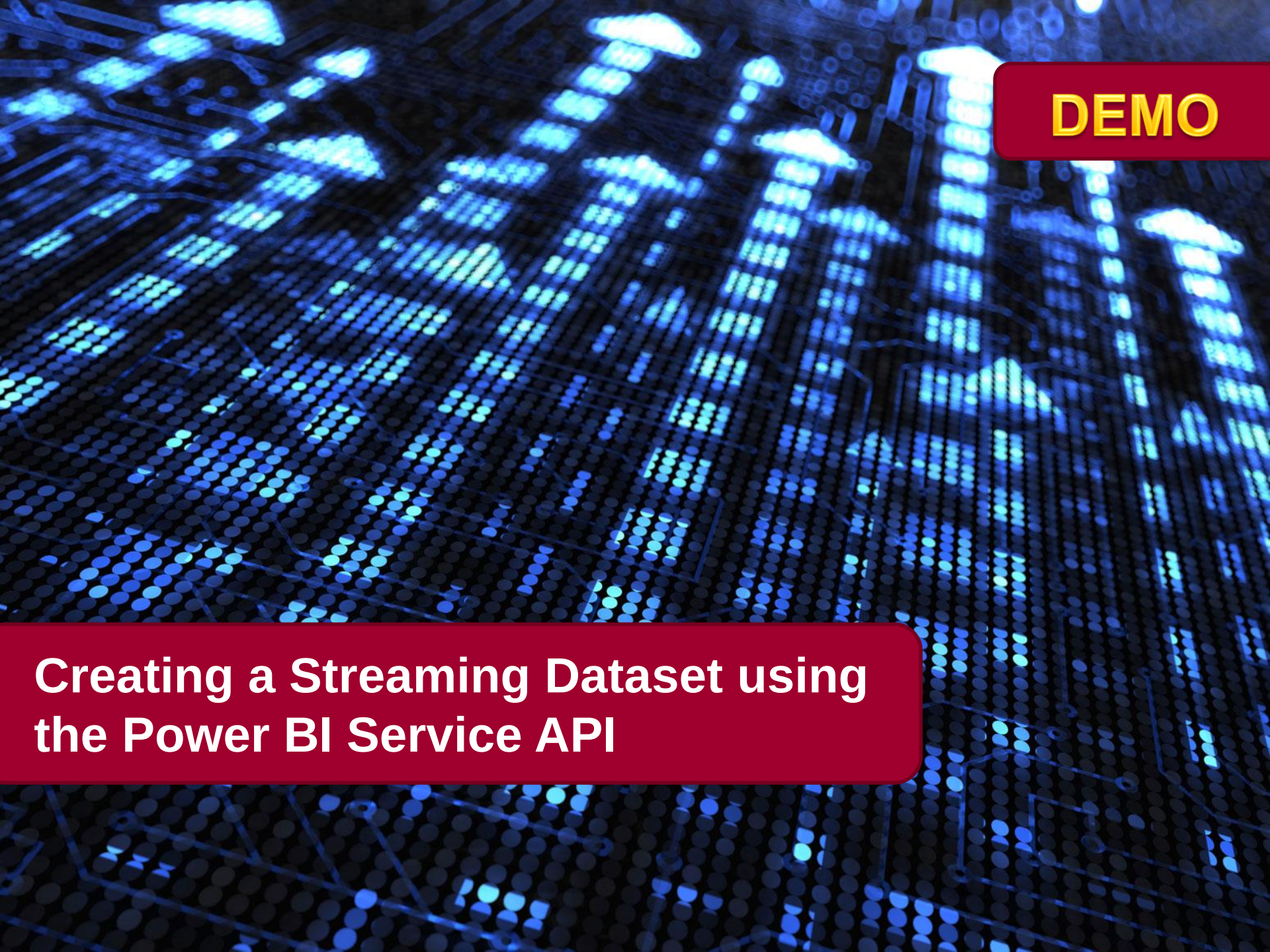
Adding Rows by Converting C# to JSON

```
TemperatureReadingsRow row = new TemperatureReadingsRow {
  Run = RunName,
  Time = DateTime.Now,
  TimeWindow = currentTimeWindow,
  TargetTemperature = 212,
  MinTemperature = 100,
  MaxTemperature = 250,
  BatchA = temperatureBatchA,
  BatchB = temperatureBatchB,
  BatchC = temperatureBatchC,
};

TemperatureReadingsRow[] rows = { row };
TemperatureReadingsRows temperatureReadingsRows = new TemperatureReadingsRows { rows = rows };
string jsonNewRows = JsonConvert.SerializeObject(temperatureReadingsRows);
string restUrlTargetTableRows = string.Format("{0}/{1}/tables/TemperatureReadings/rows", restUrlDatasets, DatasetId);
string jsonResultAddExpenseRows = ExecutePostRequest(restUrlTargetTableRows, jsonNewRows);
```

```
public class TemperatureReadingsRow {
  public string Run { get; set; }
  public DateTime Time { get; set; }
  public string TimeWindow { get; set; }
  public double TargetTemperature { get; set; }
  public double MinTemperature { get; set; }
  public double MaxTemperature { get; set; }
  public double BatchA { get; set; }
  public double BatchB { get; set; }
  public double BatchC { get; set; }
}

class TemperatureReadingsRows {
  public TemperatureReadingsRow[] rows { get; set; }
}
```



```
{
  "rows": [
    {
      "Run": "Run 06",
      "Time": "2017-10-05T22:43:40.364569-04:00",
      "TimeWindow": "22:43:30",
      "TargetTemperature": 212.0,
      "MinTemperature": 100.0,
      "MaxTemperature": 250.0,
      "BatchA": 152.73999999999995,
      "BatchB": 152.78,
      "BatchC": 152.25
    }
  ]
}
```


DEMO
Creating a Streaming Dataset using the Power BI Service API

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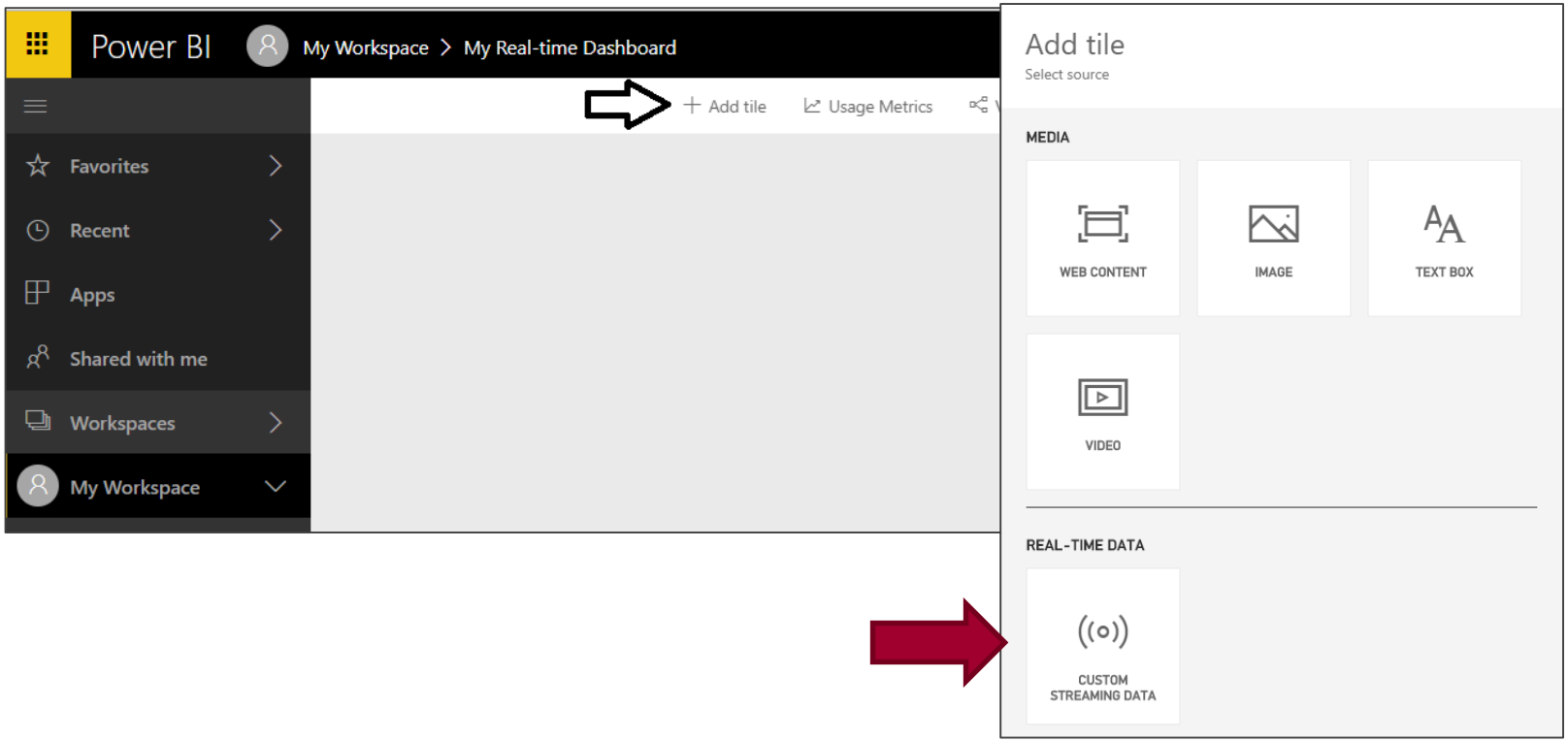
Streaming Data Tiles

- Streaming Data surfaced using Streaming Data Tiles
  - Used to surface data values from streaming dataset cache
  - Optimized to provide smooth animations for real-time data

- Available set of streaming titles as of today
  - Card
  - Gauge
  - Line chart
  - Cluster Bar Chart
  - Cluster Column Chart

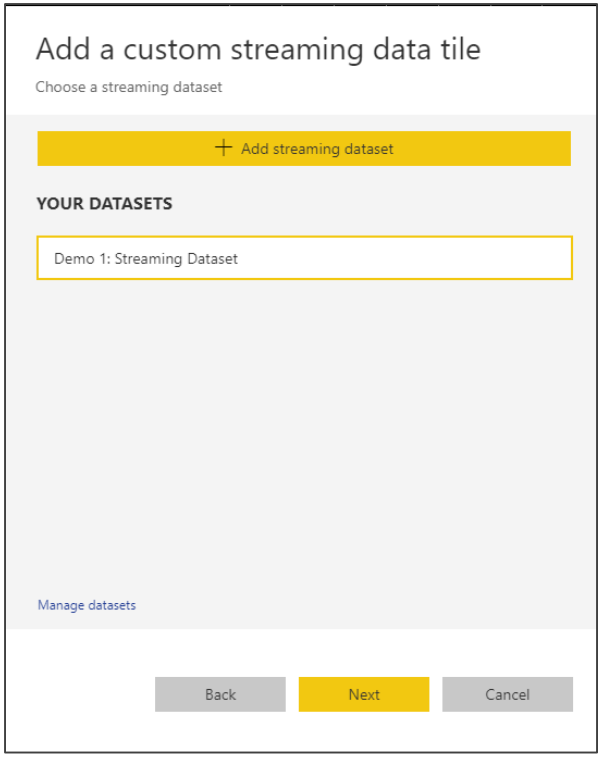
Creating Dashboards with Streaming Datasets

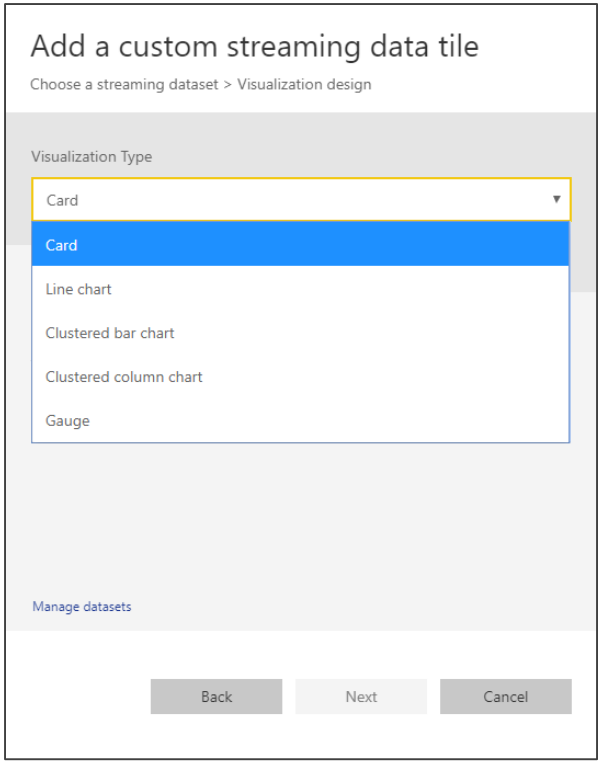
- You cannot use the Power BI report designer
  - Instead, you add real-time data tiles directly to a dashboard
  - Real-time data tiles different from standard set of Power BI visuals



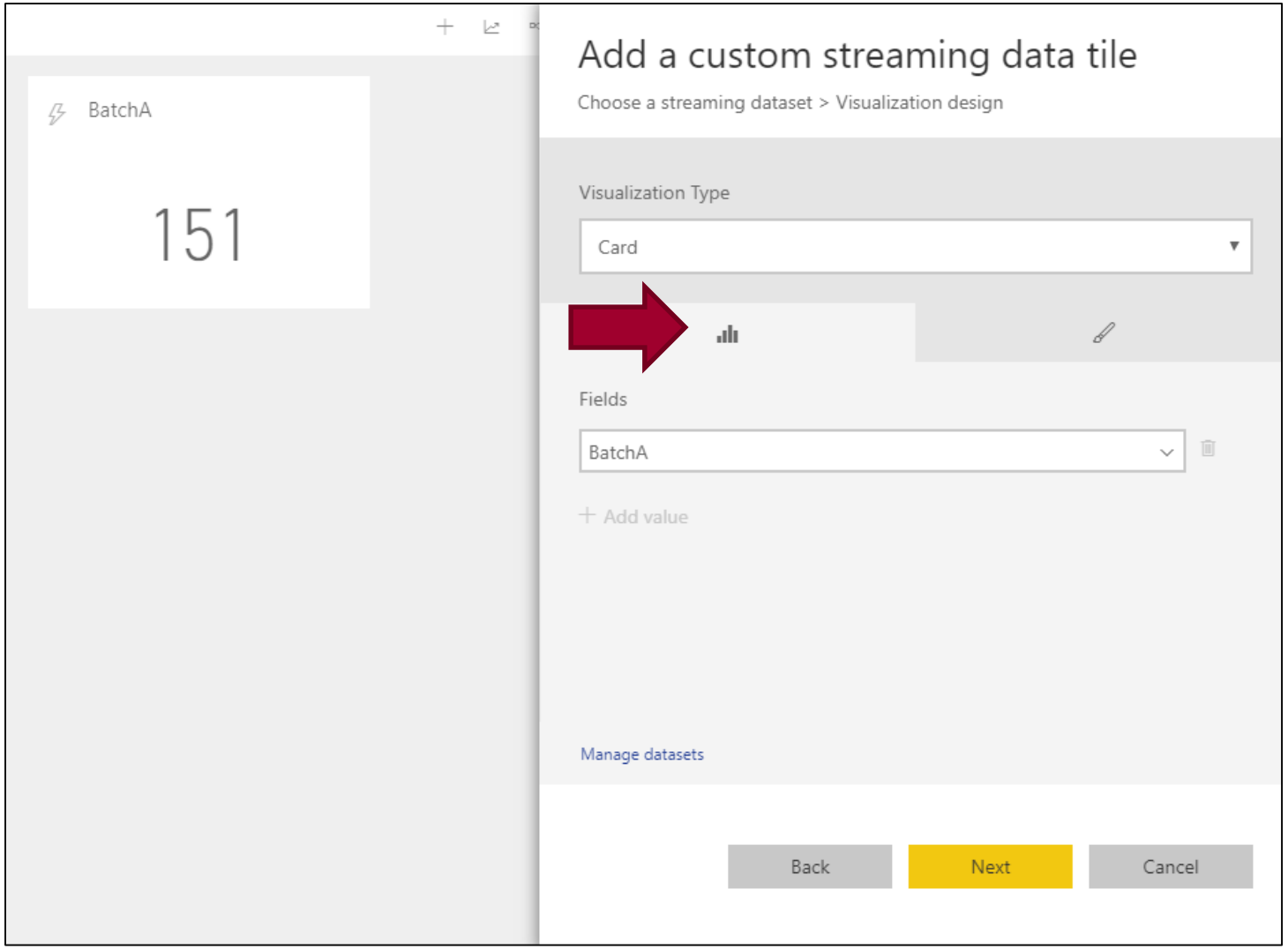
Creating a New Streaming Data Tile

- When creating a streaming data tile…
  - Select dataset that is a streaming dataset or a hybrid dataset
  - Choose the type of data streaming tile

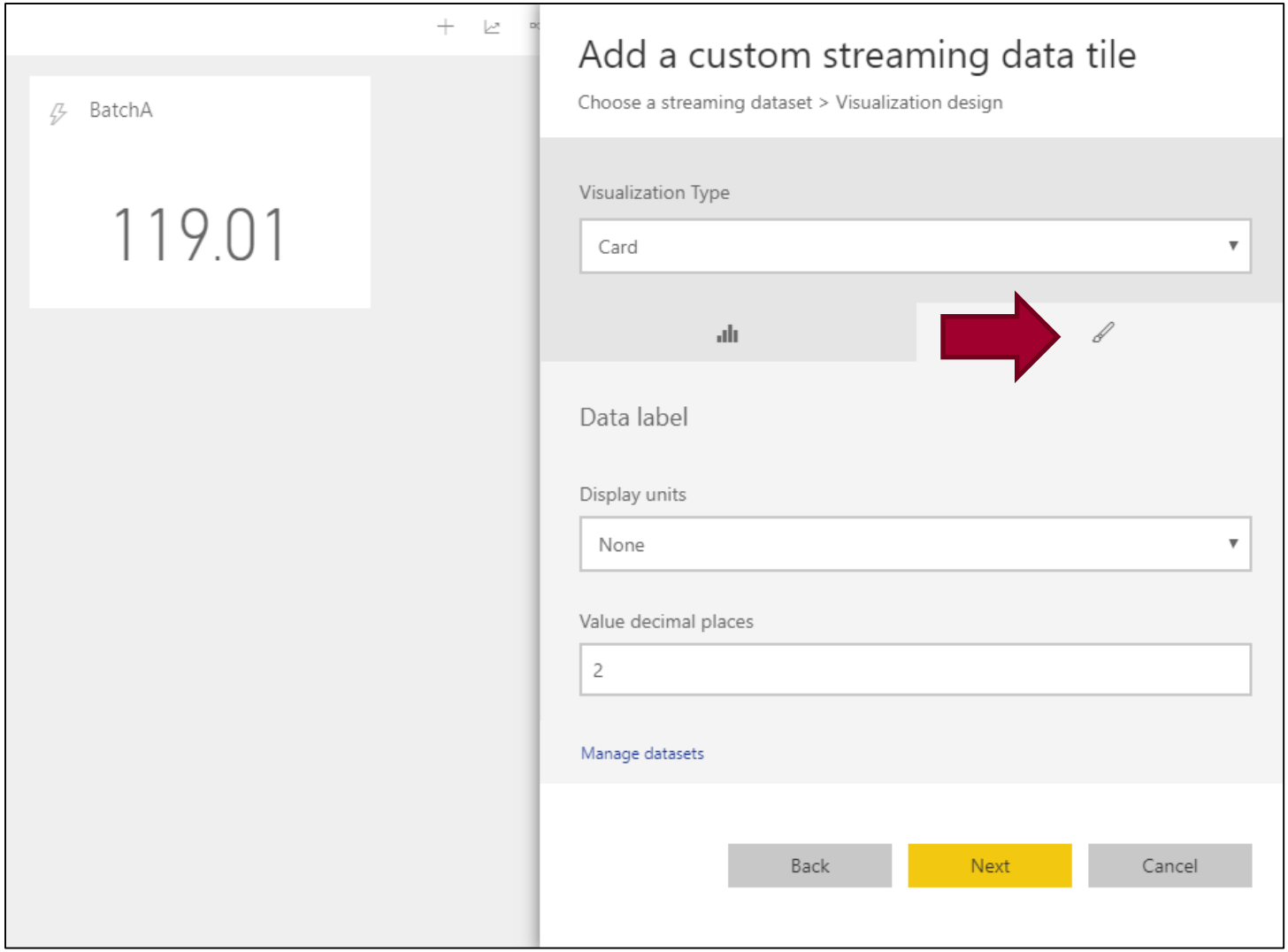




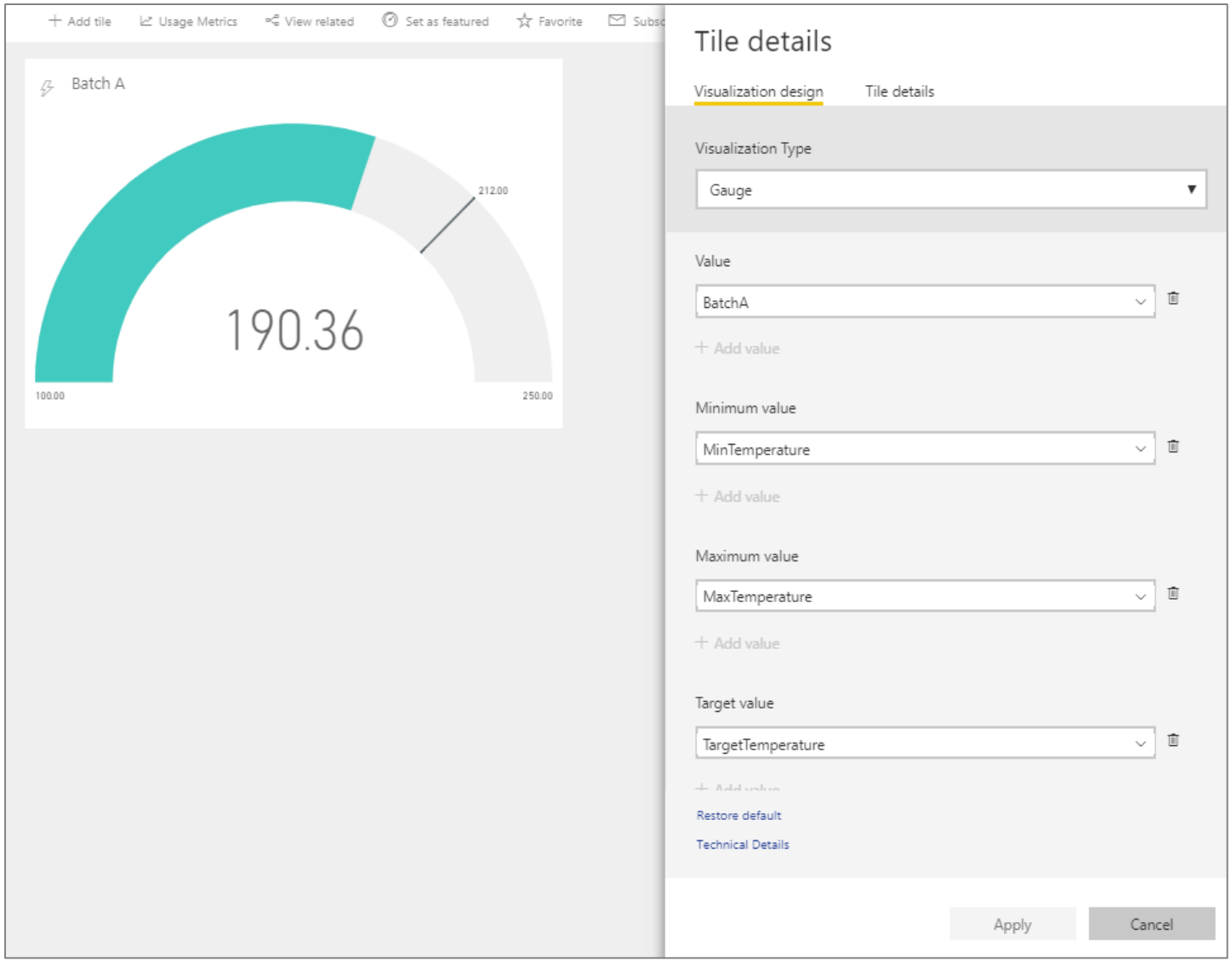
Real-time Data Tile Field Pane



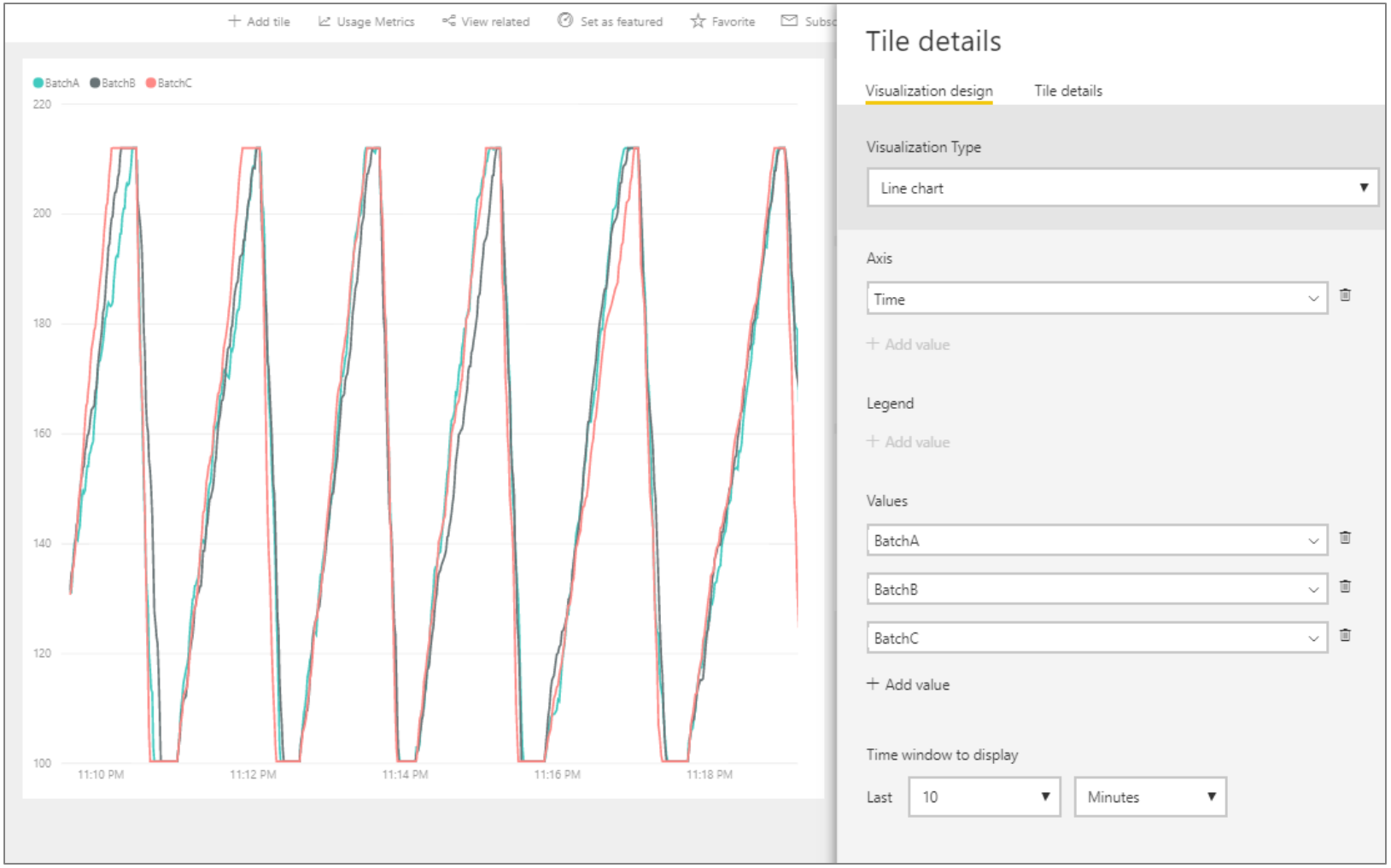
Real-time Data Tile Format Pane



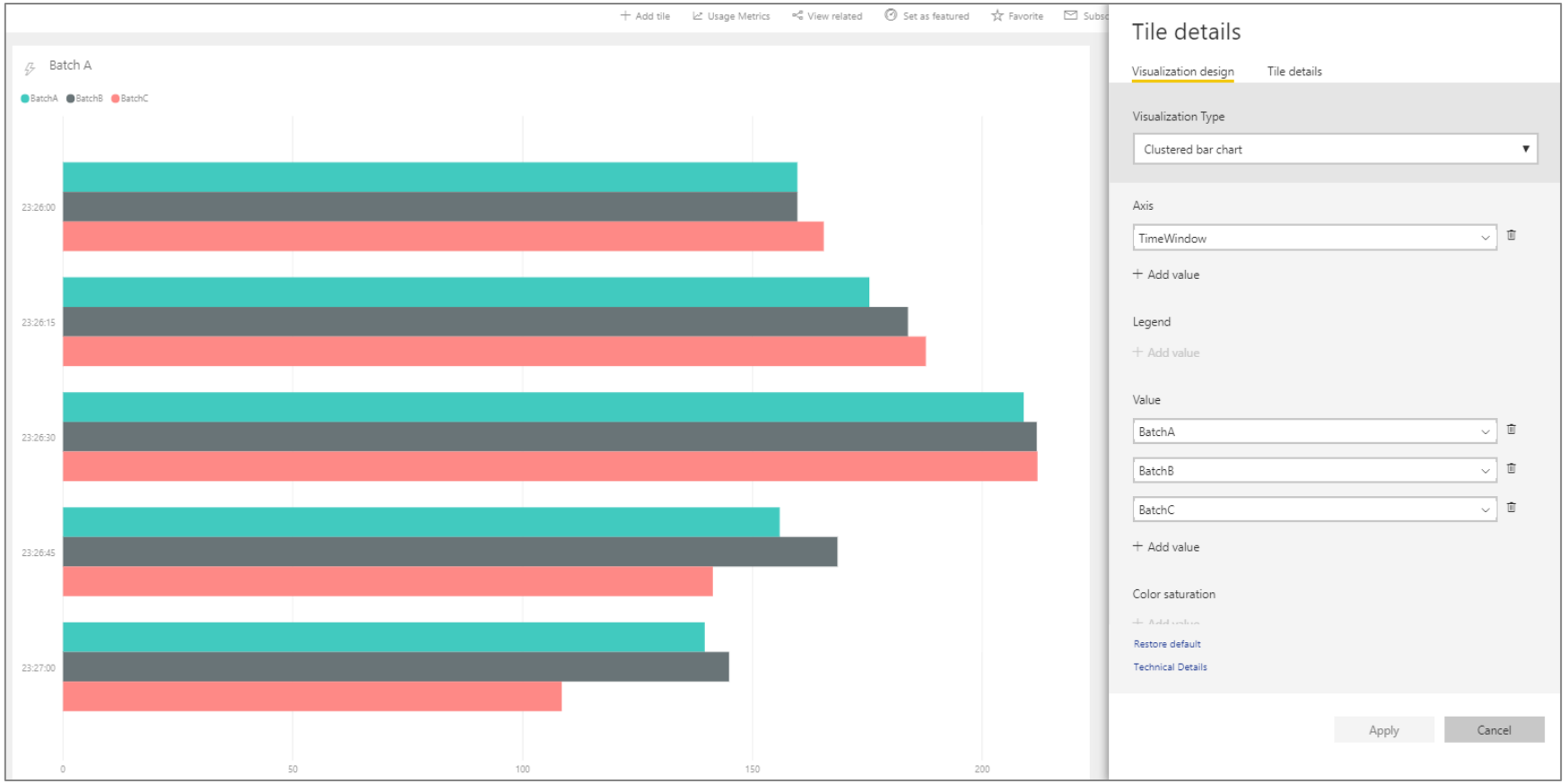
Streaming Gauge Tile



Streaming Line Chart Tile



Streaming Clustered Bar Chart Tile



Agenda

- ✓ Introduction to Real-time Datasets
- ✓ Creating a Streaming Dataset with the API
- ✓ Designing Dashboards with Streaming Data Tiles
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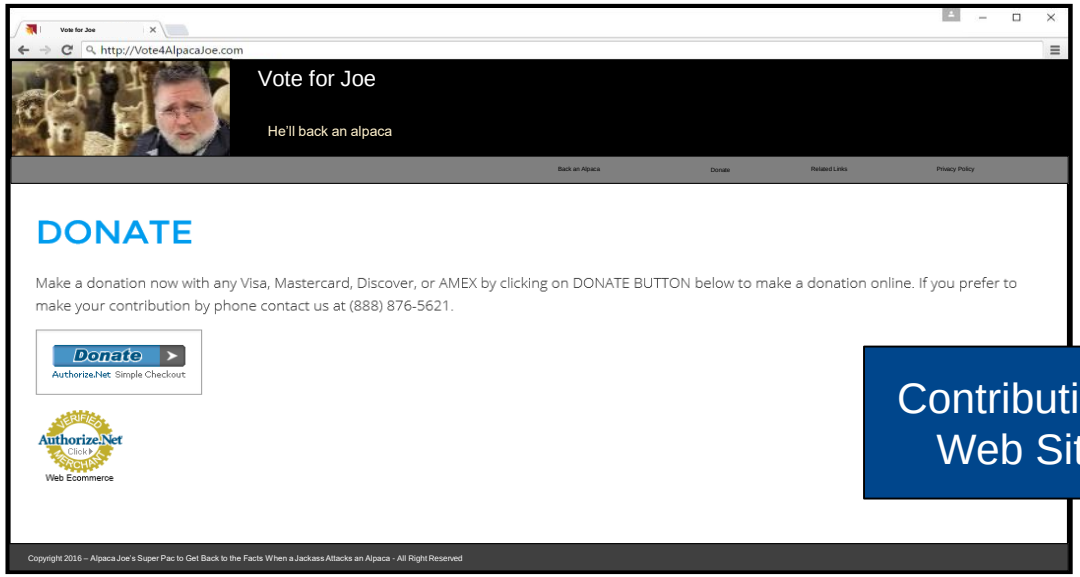
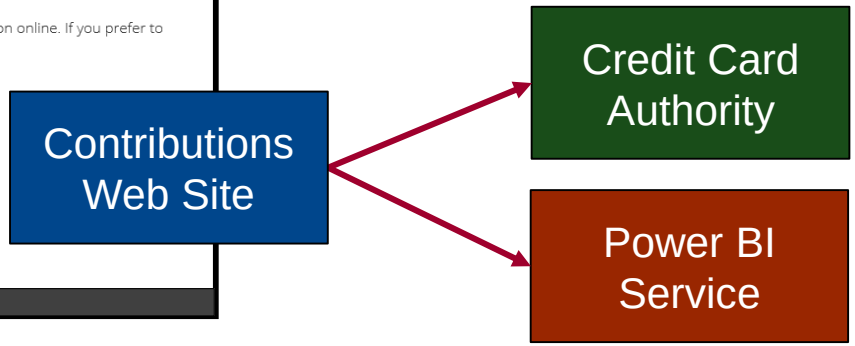
Real-time Scenario Being Simulated

- Contribution website accepts contributions from donors
  - Website calls web service to process credit card transaction
  - Website calls to Power BI REST API to create & update dataset





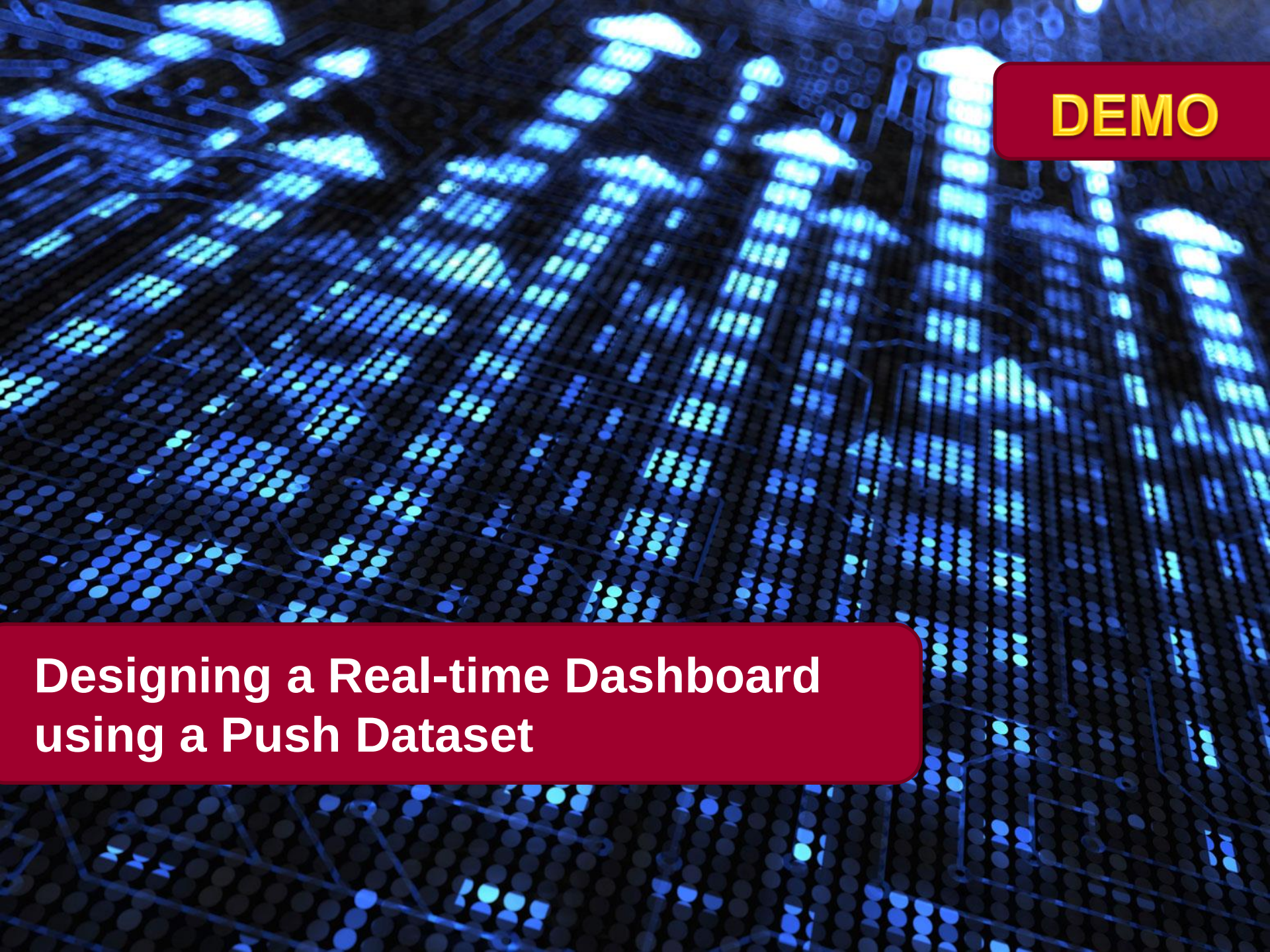
Creating a Push Dataset

- Push dataset created using JSON schema definition
  - Push dataset can contain multiple tables and table relationships
  - Tables can contains measures as well as columns
  - Columns & measures can be defined with formatString & dataCategory

```
{
  "name": "@DatasetName",
  "defaultMode": "Push",
  "tables": [
    {
      "name": "Contributions",
      "columns": [
        { "name": "ContributionID", "dataType": "Int64" },
        { "name": "Contributor", "dataType": "string" },
        { "name": "State", "dataType": "string", "dataCategory": "StateOrProvince" },
        { "name": "City", "dataType": "string", "dataCategory": "Place" },
        { "name": "Zipcode", "dataType": "Int64", "dataCategory": "PostalCode" },
        { "name": "Gender", "dataType": "string" },
        { "name": "Time", "dataType": "Datetime", "formatString": "hh:mm:ss" },
        { "name": "TimeWindow", "dataType": "string" },
        { "name": "Amount", "dataType": "Double", "formatString": "$#,##0" }
      ],
      "measures": [
        { "name": "Total Contributions", "expression": "SUM(Contributions[Amount])", "formatString": "$#,##0" },
        { "name": "Contribution Count", "expression": "COUNTROWS(Contributions)", "formatString": "#,##0" },
        { "name": "Max Contribution", "expression": "MAX(Contributions[Amount])", "formatString": "$#,##0" },
        { "name": "Average Contribution", "expression": "AVERAGE(Contributions[Amount])", "formatString": "$#,##0.00" }
      ]
    },
```

Creating a Tumbling Time Window

ContributionID	Contributor	City	Zipcode	Gender	Time	Amount
1	Travis Solomon	Lutz, FL	33559	Female	12:03:00	50.00
2	Rudolph Harris	Tarpon Springs, FL	34688	Female	12:03:00	100.00
3	Josh Franco	Davis Island, FL	33606	Male	12:03:00	250.00
4	Tim Duffy	Largo, FL	33774	Female	12:03:00	200.00
5	Napoleon Frye	Lutz, FL	33558	Male	12:03:30	50.00
6	Rodrigo Hart	Largo, FL	33774	Female	12:03:30	100.00
7	Will Levine	Tarpon Springs, FL	34688	Female	12:03:30	75.00
8	Eddie McCullough	Lutz, FL	33558	Male	12:03:30	100.00
9	Kirk Herrera	Lutz, FL	33558	Male	12:03:30	150.00
10	Antonia Bridges	Lutz, FL	33558	Female	12:03:30	100.00
11	Preston Cote	Davis Island, FL	33606	Female	12:03:30	1,000.00
12	Lonnie McCarty	Largo, FL	33774	Female	12:03:30	50.00
13	Humberto Parsons	Lutz, FL	33558	Female	12:03:30	50.00
14	Abel Perkins	Odessa, FL	33556	Female	12:03:30	1,000.00
15	Ernesto McLaughlin	Odessa, FL	33556	Female	12:03:30	150.00
16	Elbert Kinney	Macdill Air Force Base, Port Tampa, FL	33621	Male	12:03:30	50.00
17	Coleman Petersen	Lutz, FL	33558	Male	12:03:30	125.00
18	Nicky Roberson	Odessa, FL	33556	Female	12:03:30	100.00
19	Fritz Parrish	Lutz, FL	33558	Female	12:03:30	50.00
20	Freddie Sparks	Largo, FL	33774	Male	12:03:30	50.00


DEMO
Designing a Real-time Dashboard using a Push Dataset

Real-time Dataset Matrix

Feature	Streaming	Hybrid	Push
Updates in real-time	Yes	Yes	Yes
Smooth animations	Yes	Yes	No
Backed by Azure SQL DB	No	Yes	Yes
Report Designer Support	No	Yes	Yes
Allow Rich Data Modeling	No	No	Yes
Ingestion Rate	5 request/sec 15KB/request		1 request/second 16MB/request

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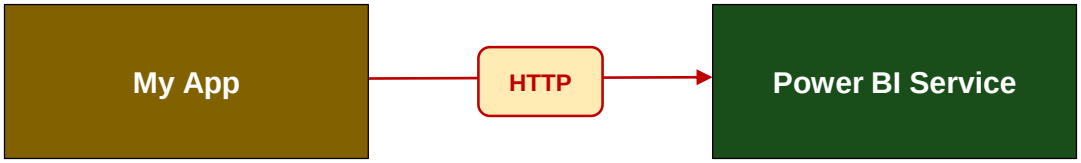
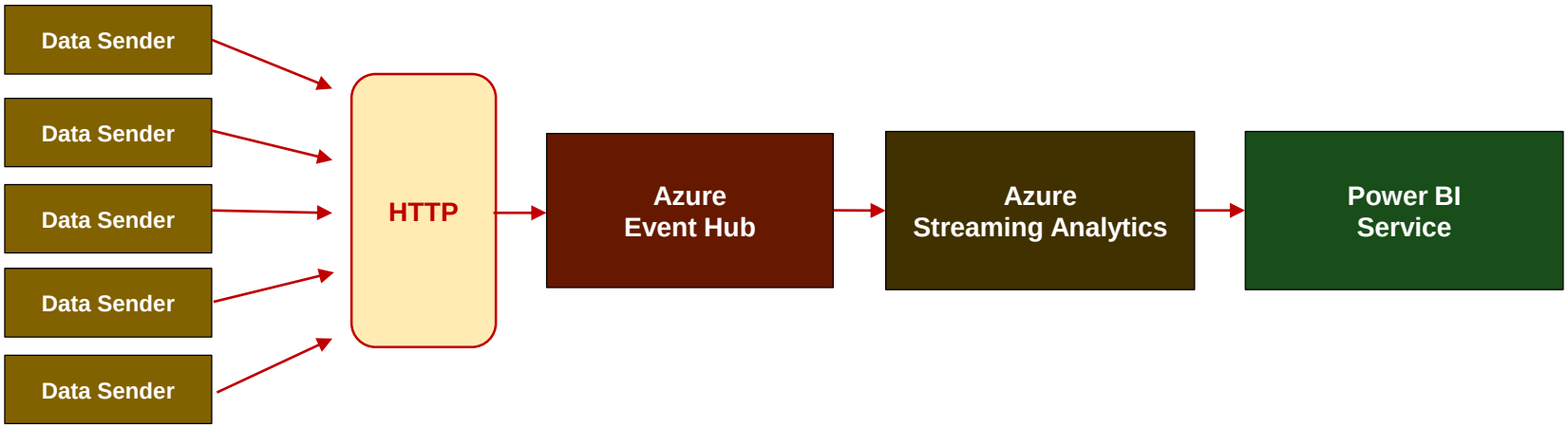
Scaling a Real-time Dashboard

- Low velocity data scenario

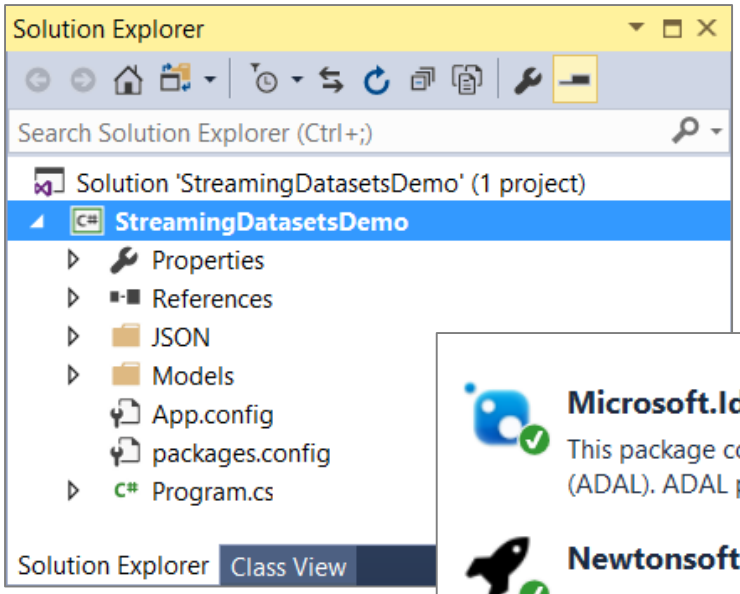


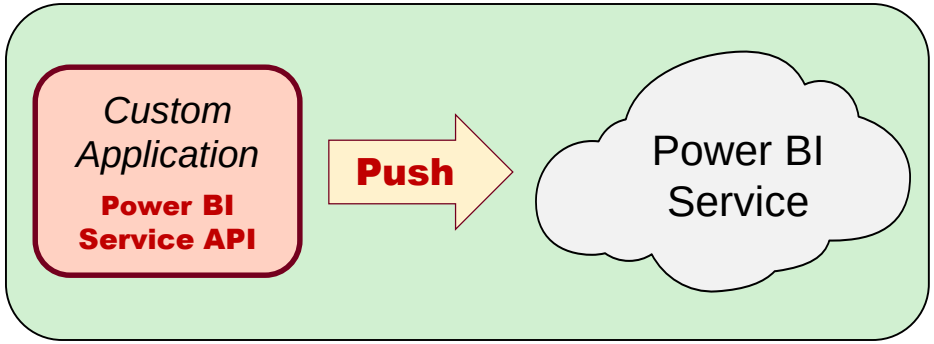
- High velocity data scenario

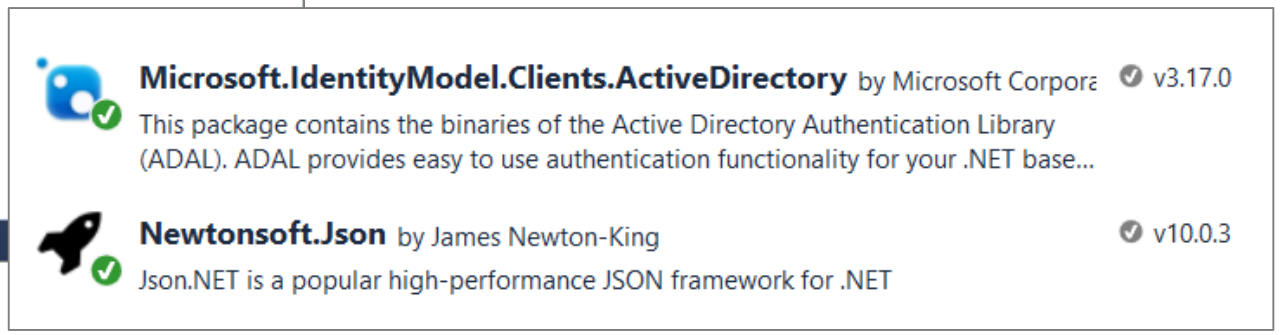


The StreamingDatasetsDemo Project

- Console application project in Visual Studio 2017
  - Installed package for Azure AD Authentication library
  - Installed package to serialize .NET objects to JSON








DEMO
Creating Streaming Datasets using
Azure Streaming Analytics Jobs

Summary

- ✓ Introduction to Real-time Datasets
- ✓ Creating a Streaming Dataset with the API
- ✓ Designing Dashboards with Streaming Data Tiles
- ✓ Creating a Push Dataset with Real-time Data
- ✓ Integrating Azure Streaming Analytics Jobs

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  - Audience is Business Users, Analysts and Data Professionals
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  - Query design, data modeling and report and dashboard design
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  - Teaches programming with the Power BI APIs
  - Teaches developing with Power BI Embedded
  - Teaches R programming and integrating R with Power BI
  - Teaches how to develop custom connector using M