



Monitor Your Data in Real-time with Microsoft Power BI

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Presentation outline

1

What is
real-time?

2

Real-time
Power BI
dashboards

3

Real-time
Power BI
reports

4

Real-time
Power BI
paginated
reports

5

Summary

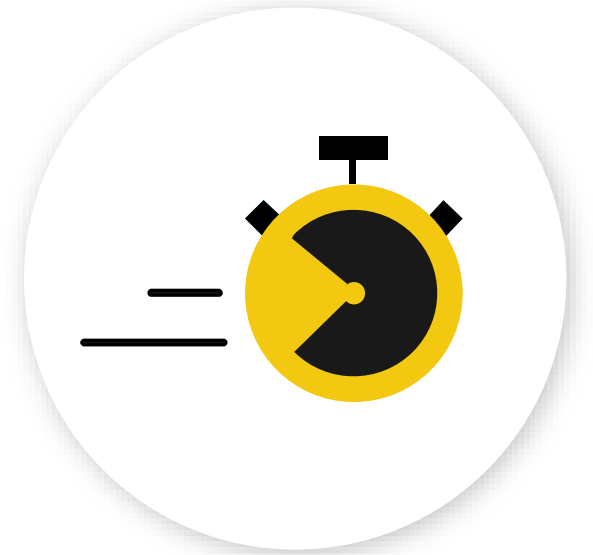
What is real-time?

What is real-time?

In data analytics, “real-time” means visualizing current data as it updates without requiring user interactivity

Typically, “real-time” applies to monitoring critical datasets that are updated frequently

- For example: Stock market prices, IOT telemetry, temperature observations

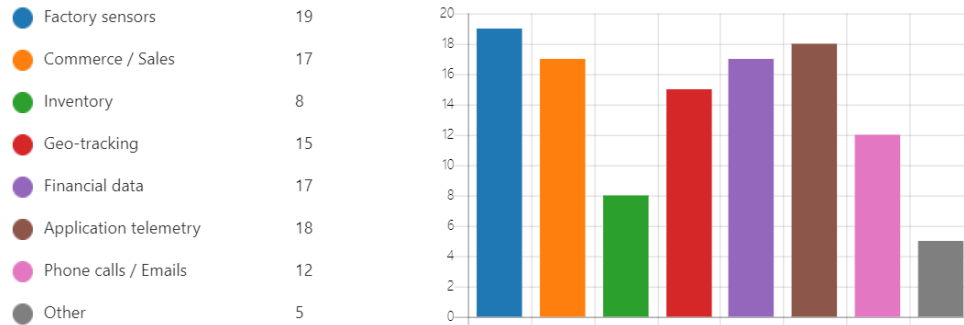


What is real-time?

Microsoft survey results

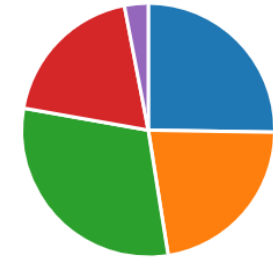
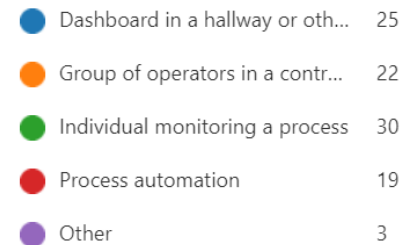
1. What real-time and streaming data scenarios do you have today? Please select all that apply

[More Details](#)



2. What scenarios best describe the way your real-time and streaming data is or will be consumed? Please select all that apply

[More Details](#)



4. What type of analysis do you perform or would like to perform with your real-time and streaming data? Please select all that apply

[More Details](#)



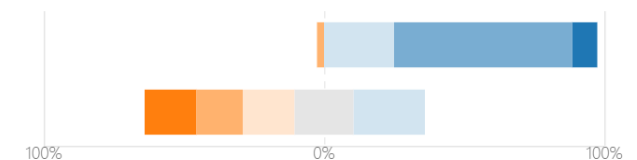
5. What refresh frequency do you consider to be batch vs real-time for your data? Please choose the closest one to your preference

[More Details](#)

> 1 hr. 1 hr. 30 min. 15 min. 5 min. 1 sec. < 1 sec.

Real-time / streaming

Batch



What is real-time?

Power BI can visualize “real-time” updates in:

- The Power BI service (web browser)
- Mobile apps
- Custom apps, when Power BI content is embedded

Traditionally, Power BI dashboards were designed for real-time, but now reports can deliver real-time, too 😊

More accurately, Power BI supports real-time analytics, also referred to as “near real-time”

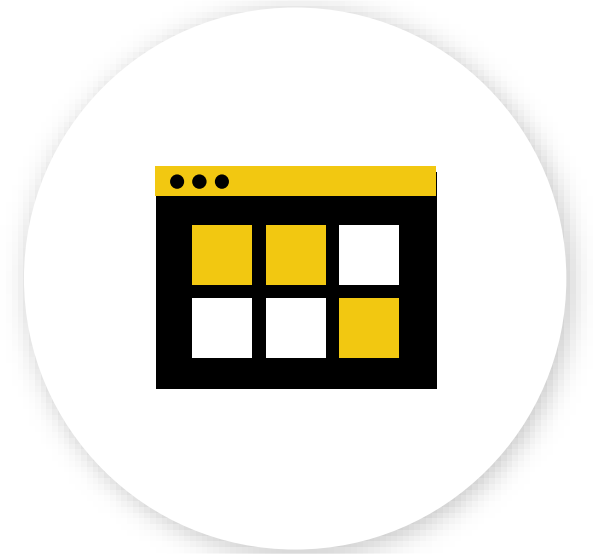
- Would you use Power BI to monitor a patient’s vital signs during open-heart surgery?



Real-time Power BI dashboards

Real-time Power BI dashboards

Power BI dashboard tiles are designed to always reflect the most current data **that the Power BI service is aware of**



Dashboard tiles can be based on:

- Datasets (pull datasets)
 - Import
 - Composite
 - Live connections
- Streaming datasets
- PubNub streaming datasets
- Push datasets

Real-time Power BI dashboards

When an import dataset refresh has completed, dashboard tile caches are instantly updated

Shared capacity:

- Maximum eight scheduled refreshes per day, at 15-minute intervals

Premium capacity:

- In the service: Maximum 48 scheduled refreshes per day, at 15-minute intervals
- XMLA endpoint: Unlimited, using TMSL or PowerShell
- The number of *parallel refresh operations* differs depending on product SKU, so refresh operations may queue
 - **P1** = 6, **P2** = 12, **P3** = 24
- Dataset query caching must be set to off

Using import
datasets

Real-time Power BI dashboards

Using composite + live connection datasets

Two types of datasets use scheduled cache refresh

- Composite, which contain at least one DirectQuery table
- Live connection, to Azure Analysis Services or SQL Server Analysis Services

Refresh frequency can be set to:

- 15 minutes
- 30 minutes
- 1 hour
- 2 hours
- 3 hours
- Daily, with multiple refresh times
- Weekly, with multiple refresh times

Be careful of excessive data source load if they apply dynamic RLS



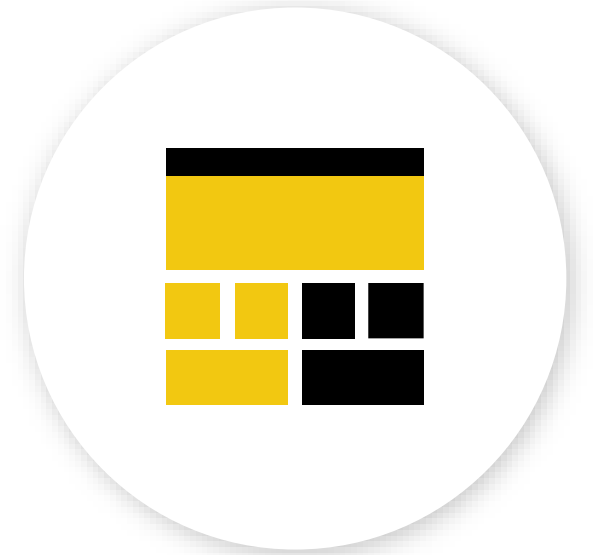
Real-time Power BI dashboards

Using streaming datasets

Streaming datasets are designed specifically for real-time dashboards

- Create them with the Power BI REST API, or in the Power BI service
- Stream data by sending JSON documents (representing rows) to an endpoint
 - The endpoint URL can include an authentication key
 - Packet size must not exceed 15 KB

They represent a single table, and store data for up to 60 minutes



Real-time Power BI dashboards

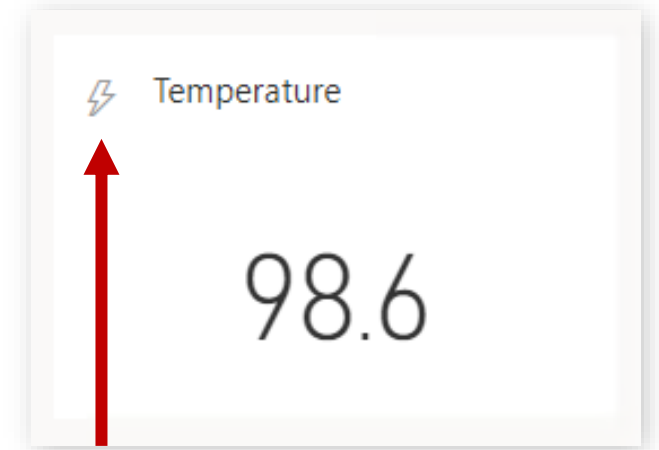
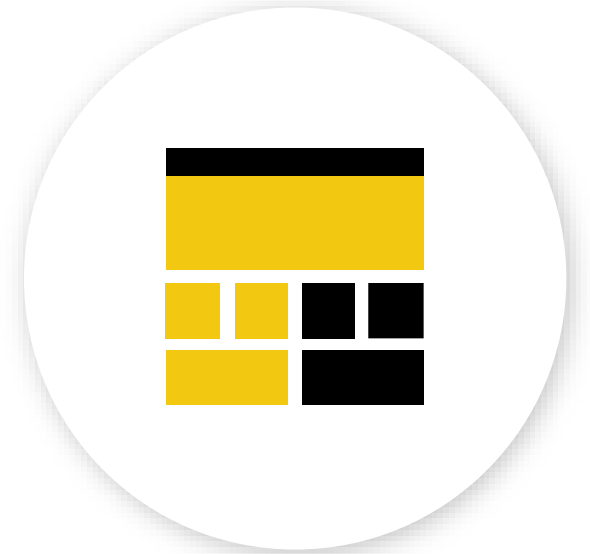
Using streaming datasets (continued)

For non-hybrid streaming datasets, add dashboard streaming tiles

- Limited set of visualization types, and it is not extensible
- Streaming tiles are identified by the lightning strike icon
- Real-time animations are very fluid

When created as hybrid, they are both a streaming and push dataset

- Using the Power BI REST API, set the dataset default mode to **PushStreaming**
- Or, in the Power BI service, enable **Historic data analysis**



Demo

Streaming datasets

Real-time Power BI dashboards

Push datasets are designed specifically for real-time dashboards

All operations are done programmatically with the Power BI REST API:

- Create datasets
 - Dataset = model, and can include multiple tables, relationships, and measures—but not RLS
- Enumerate datasets
- Push rows of data to dataset tables by:
 - Sending JSON documents (representing rows)
 - Using Azure Stream Analytics job outputs
- Remove data by clearing all table rows

Using push
datasets

Real-time Power BI dashboards

Using push datasets » Create dataset

-----> Request

```
POST https://api.powerbi.com/v1.0/myorg/datasets?defaultRetentionPolicy=basicFIFO HTTP/1.1
Authorization: Bearer {AAD Token}
Content-Type: application/json; charset=utf-8
```

```
{
  "name": "E-Commerce",
  "defaultMode": "Push",
  "tables": [
    {
      "name": "Browsing",
      "columns": [
        {
          "name": "Timestamp",
          "dataType": "DateTime"
        },
        {
          "name": "Product",
          "dataType": "String"
        },
        {
          "name": "Category",
          "dataType": "String"
        },
        {
          "name": "Country",
```

Push | PushStreaming | Streaming

Real-time Power BI dashboards

Using push datasets » Enumerate datasets

-----> Request

```
GET https://api.powerbi.com/v1.0/myorg/datasets HTTP/1.1  
Authorization: Bearer {AAD Token}  
Content-Type: application/json; charset=utf-8
```

Real-time Power BI dashboards

Using push datasets » Enumerate datasets

-----> Request

```
GET https://api.powerbi.com/v1.0/myorg/datasets HTTP/1.1
Authorization: Bearer {AAD Token}
Content-Type: application/json; charset=utf-8
```

<----- Response

```
{
  "datasets": [
    {
      "id": "2C0CCF12-A369-4985-A643-0995C249D5B9",
      "name": "E-Commerce"
    },
    {
      "id": "C446840B-94AD-4B23-8896-C276E69B8FAA",
      "name": "Finance"
    }
  ]
}
```

Real-time Power BI dashboards

Using push datasets » Push data

-----> Request

```
POST https://api.powerbi.com/v1.0/myorg/datasets/2C0CCF12-A369-4985-A643-0995C249D5B9
  /Tables/Browsing/Rows HTTP/1.1
Authorization: Bearer {AAD Token}
Content-Type: application/json; charset=utf-8
```

```
{
  "rows":
  [
    {
      "Timestamp": "2020-05-17T22:12:41.599Z",
      "Product": "4CAX-B Helicopter",
      "Category": "Co-Axial",
      "Country": "Australia",
    }
  ]
}
```

A maximum of
10K rows can be
pushed in a
single request

Real-time Power BI dashboards

Using push datasets » Delete table rows

-----> Request

```
DELETE https://api.powerbi.com/v1.0/myorg/datasets/2C0CCF12-A369-4985-A643-0995C249D5B9
  /Tables/Browsing/Rows HTTP/1.1
Authorization: Bearer {AAD Token}
Content-Type: application/json; charset=utf-8
```

It is not possible
to delete a
filtered subset
of rows

Real-time Power BI dashboards

Using push datasets » Limitations

Maximum:

Columns: 75

Tables: 75

Rows per table: 5M

- No retention policy: Rows will be collected to the limit
- **basicFIFO** retention policy: Stores up to 200K rows, replacing older rows with new rows

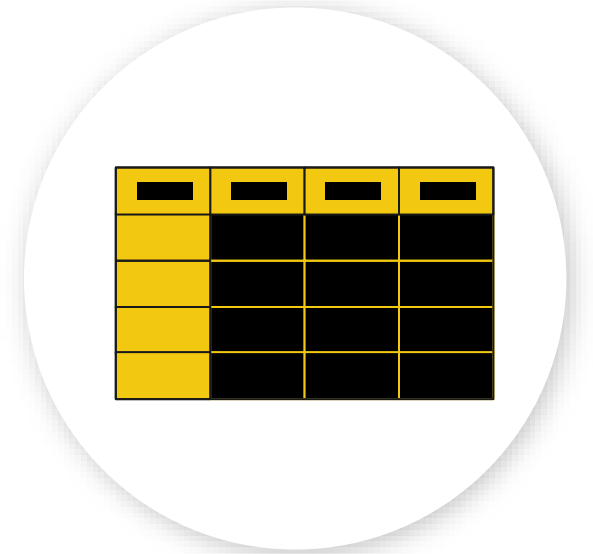
Rows per single push: 10K

Rows per hour per dataset: 1M

- Except when the table has more than 250K row, in which case it is 120

Characters per string column : 4K

Pending requests: 5



Real-time Power BI dashboards

Dashboard tiles can be created by:

- Pinning report visuals
- Pinning Q&A responses

Pinning live report pages will not reflect real-time results

Use relative time expressions to display recent results

- Relative date or time filters
- Q&A date/time-based expressions

**Using push datasets
» Dashboard tiles**

Demo

Push datasets

Real-time Power BI dashboards

Compare push + streaming datasets

| | Streaming dataset | Push dataset |
|-------------------------------|---|--|
| Technology used | Redis cache, polled by the Power BI service | DirectQuery over an Azure SQL database |
| Responsiveness | ~1 s | ~3-5 s |
| Data retention | 60 minutes | 5M rows per table, or 200K basic FIFO |
| Max ingestion rates | 5 requests/s 15 KB/request | 1 request/s 16 MB/request (10K rows) |
| Data throughput limits | None | 1M rows/h, but 120 rows/h if > 250K rows |
| Dataset structure | Single table—last values | Rich model—aggregation results |
| Visual types | Streaming tile visuals | Report visuals, including custom visuals |
| Animation updates | Fluid | A bit twitchy |
| Time zone | User's time zone | Coordinated Universal Time (UTC) |

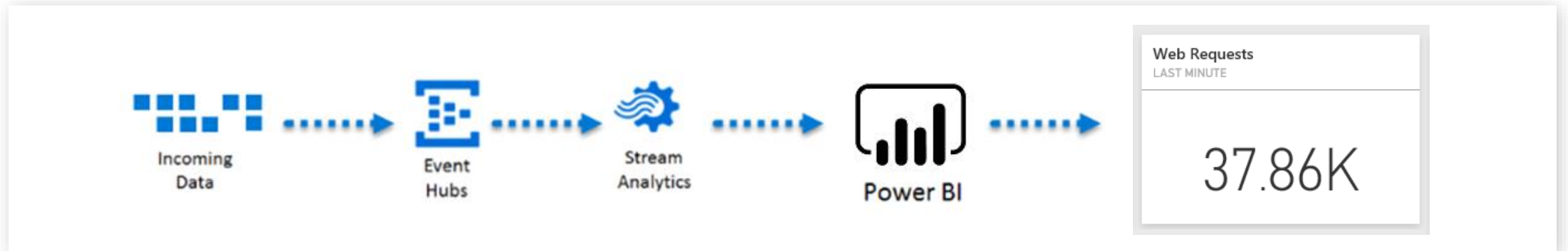


Real-time Power BI dashboards

Azure Stream Analytics

Use Azure Stream Analytics (ASA) to push job outputs to Power BI datasets

- Enables real-time dashboards at scale, over data from devices and applications
- Can stream millions of events per second
- Can perform aggregation over time windows
- Can integrate Azure Machine Learning predictions

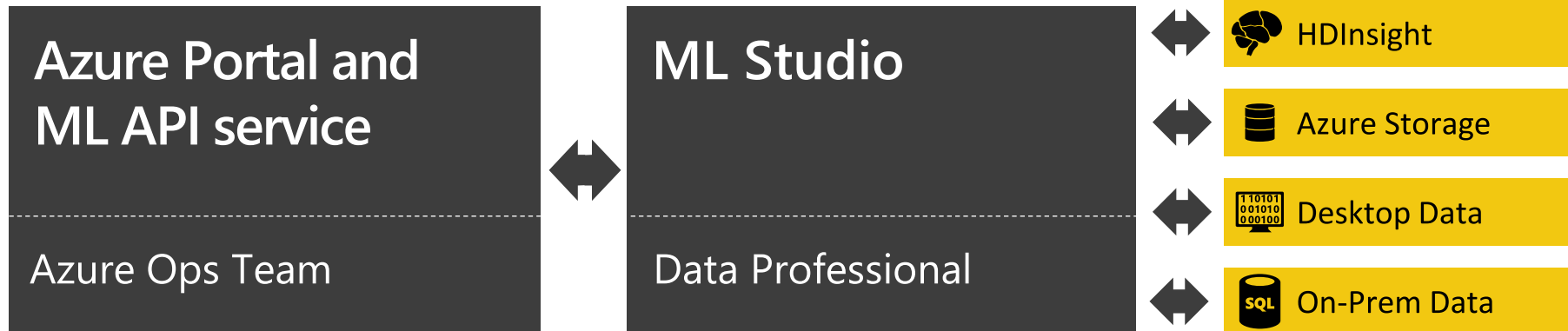


Real-time Power BI dashboards

Azure Stream Analytics (continued)



Business users easily access results from anywhere, on any device



Real-time Power BI dashboards

Azure Stream Analytics (continued)

If the dataset does not exist (by match of name), ASA will create a basic FIFO hybrid dataset before the first output is sent

If you create the dataset before starting the ASA job, you can:

- Set the default mode as Push
- Set the basic FIFO retention policy
- Create additional tables
- Define relationships, and measures

If you use a hybrid dataset, be sure that the ASA output applies data reduction to keep the packet size small (< 15 KB)

- Consider WHERE, GROUP BY clauses, and frequent tumbling/hopping windows



Demo

Azure Stream Analytics and Power BI

Real-time Power BI reports

Real-time Power BI reports

By default, Power BI reports do not reflect updates to underlying data

Now, non-interactive refresh can be achieved using automatic page refresh (APR) (* in preview)



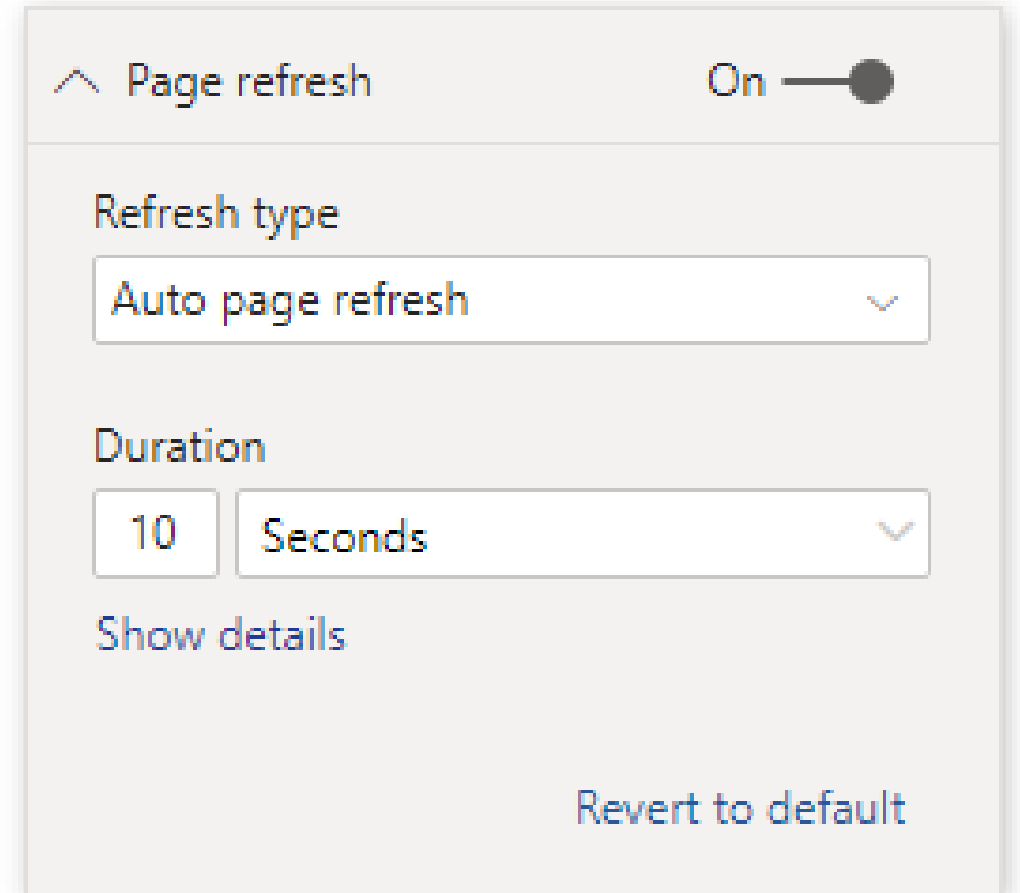
Real-time Power BI reports

Automatic page refresh

In Power BI Desktop, you must enable APR as a preview feature

When the report is based on a composite dataset, turn on the **Page refresh** report property, then:

- Set page refresh interval value and unit
- Default interval is 30 minutes
- Minimum interval is one second



Real-time Power BI reports

Automatic page refresh (continued)

Only visuals based on DirectQuery tables will auto refresh

Be careful of excessive data source load

- Refresh takes place at page level
- Each DirectQuery-based visual results in at least one query to the data source



Real-time Power BI reports

Automatic page refresh » Change detection

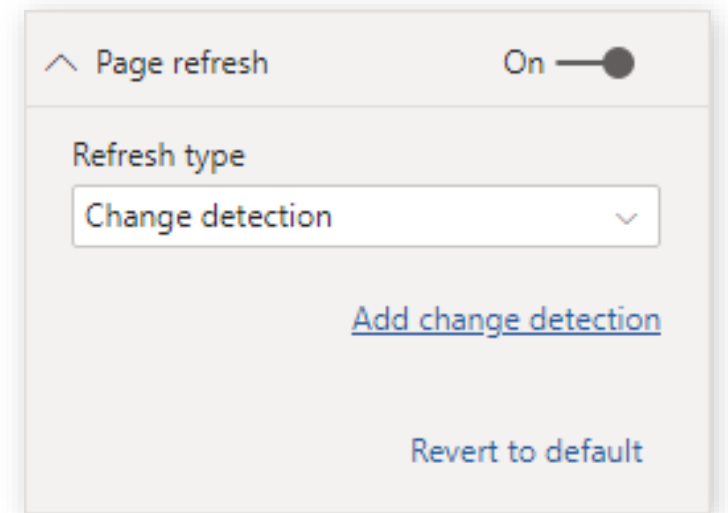
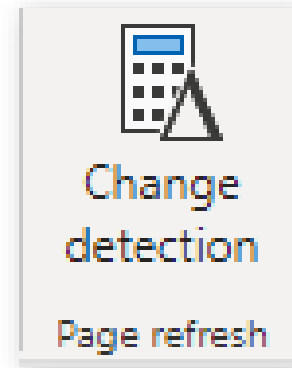
Use [change detection](#) to reduce source system load

Define a [change detection measure](#), which results in a lightweight query sent in the background on a regular interval to determine whether data has changed

When changed data is detected, it triggers a page refresh

Use a dialog window to create the measure or choose your own

Premium only feature



Real-time Power BI reports

Automatic page refresh » Restrictions

Page refresh intervals can be restricted:

Power BI Desktop:

- No constraints—pages will refresh according to the report setting

Shared capacity:

- Minimum interval is 30 minutes

Premium capacity:

- Capacity admin can disable APR
- Capacity admin can set minimum refresh interval (default 5 minutes), separately for automatic page refresh and change detection



Demo

Automatic page refresh

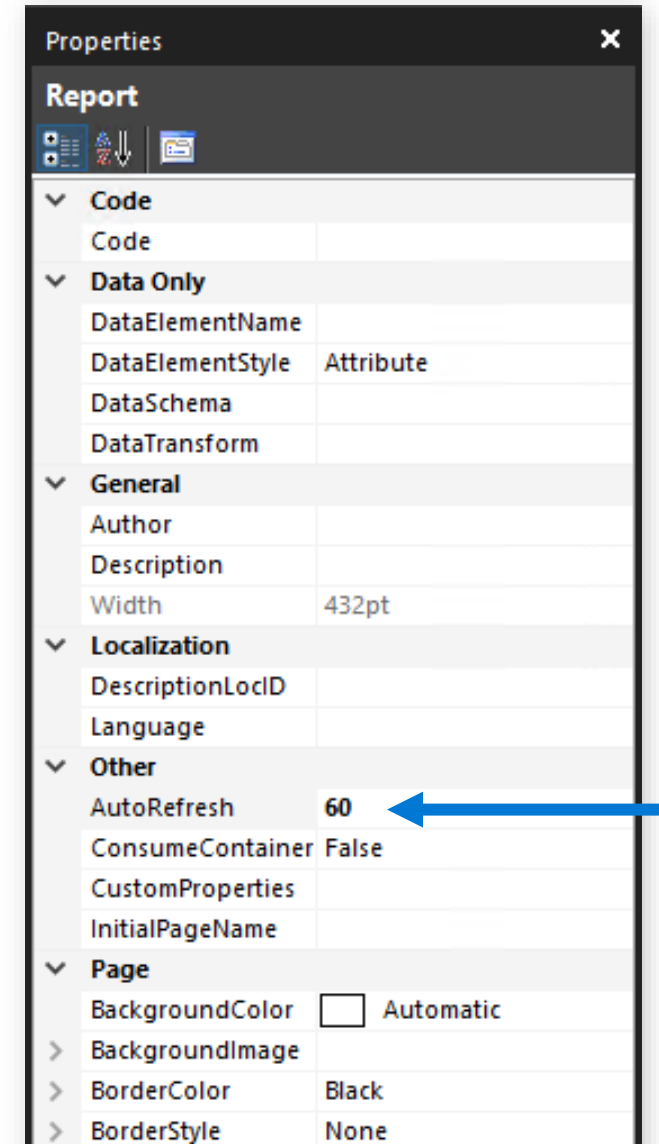
Real-time Power BI paginated reports

Real-time Power BI paginated reports

Power BI paginated reports are designed to deliver real-time results when rendered in HTML

- Set the **AutoRefresh** report property to a value > 0 seconds

It works in Power BI Report Builder (in preview mode) and in the Power BI service



The screenshot shows the 'Properties' pane in Power BI Report Builder, specifically the 'Report' section. The 'AutoRefresh' property is highlighted with a blue arrow and is set to the value '60'. Other properties visible include 'Code', 'Data Only', 'General', 'Localization', 'Other', and 'Page'.

| Property | Value |
|------------------|------------------------------------|
| Code | |
| Data Only | |
| DataElementName | |
| DataElementStyle | Attribute |
| DataSchema | |
| DataTransform | |
| General | |
| Author | |
| Description | |
| Width | 432pt |
| Localization | |
| DescriptionLocID | |
| Language | |
| Other | |
| AutoRefresh | 60 |
| ConsumeContainer | False |
| CustomProperties | |
| InitialPageName | |
| Page | |
| BackgroundColor | <input type="checkbox"/> Automatic |
| BackgroundImage | |
| BorderColor | Black |
| BorderStyle | None |

Demo

Power BI paginated report auto refresh

Resources

Power BI

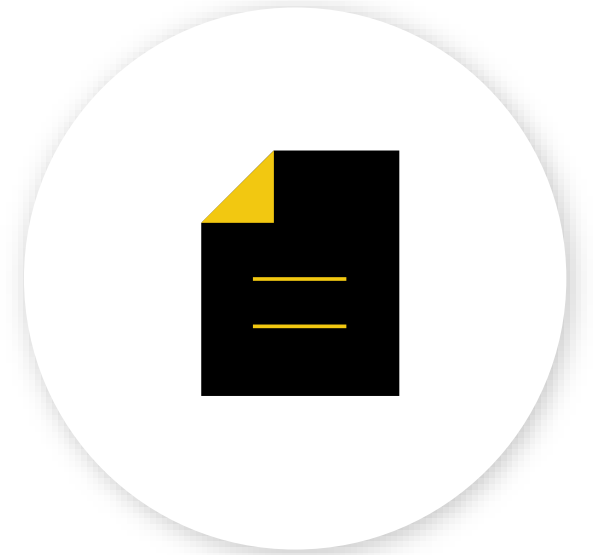
Power BI site | powerbi.com

Power BI community | community.powerbi.com/

Power BI ideas | ideas.powerbi.com/

Power BI blog | blog.powerbi.com/

Power BI Developer Center | powerbi.microsoft.com/developers/



Resources

Power BI real-time

Real-time streaming in Power BI |

docs.microsoft.com/power-bi/connect-data/service-real-time-streaming

Power BI REST API |

docs.microsoft.com/rest/api/power-bi/

Power BI REST API limitations (POST to push datasets) |

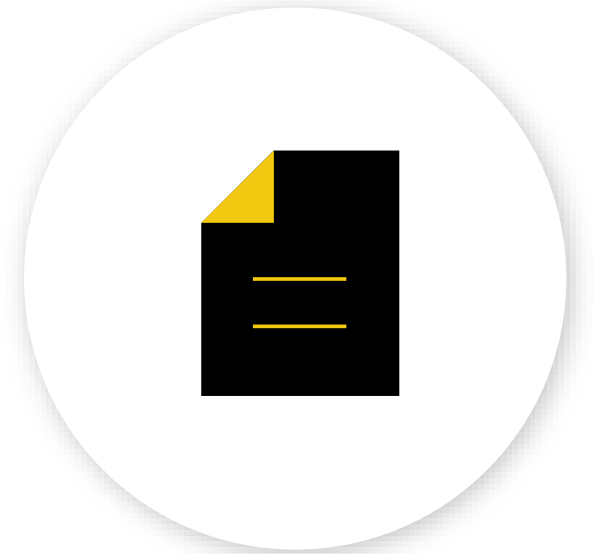
docs.microsoft.com/power-bi/developer/automation/api-rest-api-limitations

Stream Analytics and Power BI |

docs.microsoft.com/azure/stream-analytics/stream-analytics-power-bi-dashboard

Automatic page refresh in Power BI Desktop |

docs.microsoft.com/power-bi/create-reports/desktop-automatic-page-refresh



Thank you!

Peter Myers

Miguel Martinez

