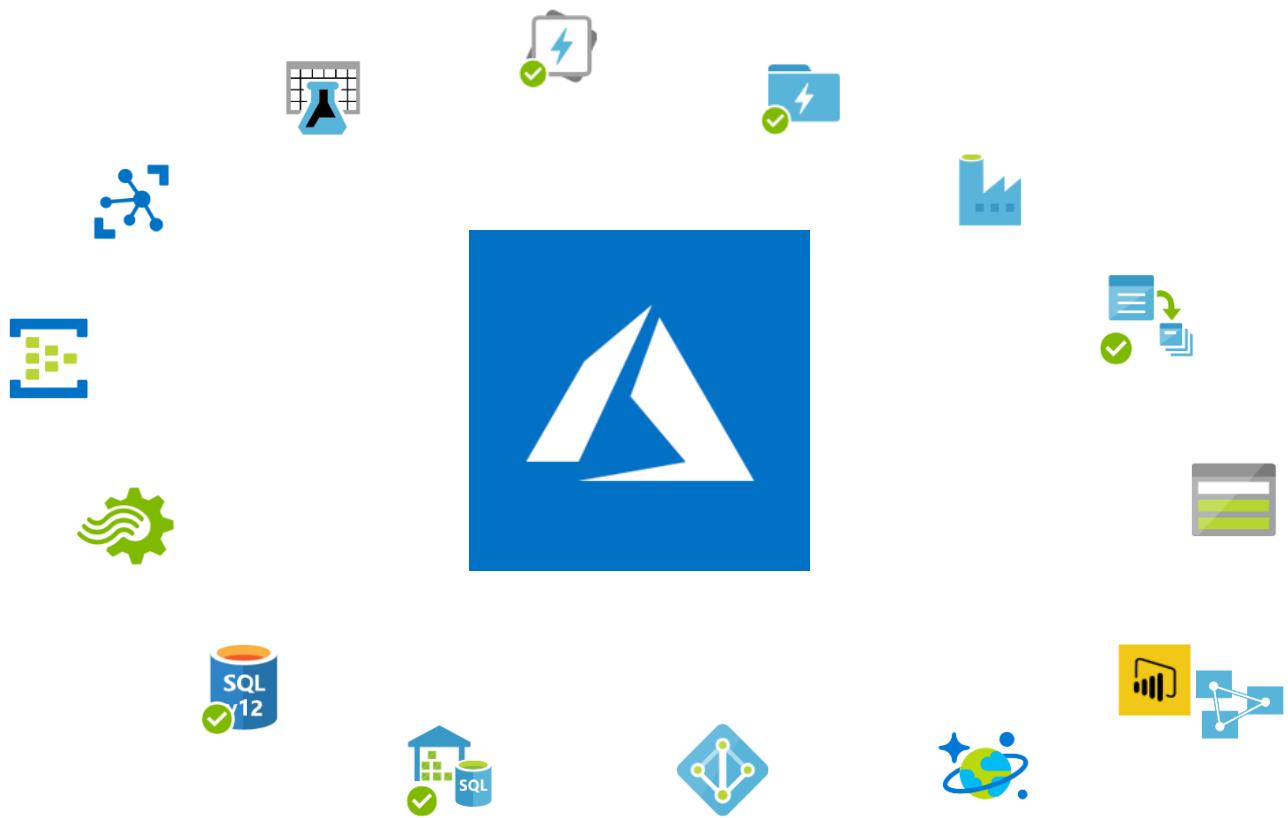


# Business Intelligence in Azure

with

Paul Andrew & Alex Whittles

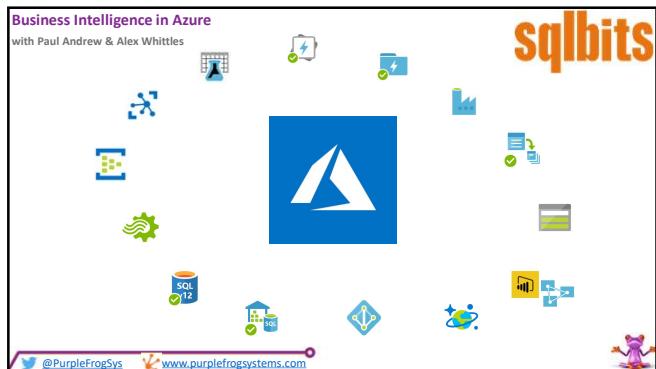
# sqlbits



February 2018

# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



### Paul Andrew

Microsoft Data Platform [MVP](#)  
Business Intelligence Consultant at [Purple Frog Systems](#)  
STEM Ambassador with [STEM Learning UK](#)  
PASS Chapter Leader for [Microsoft Data Platform Group](#)  
Speaker at the [PASS Summit 2017](#)  
Speaker & head of logistics for [SQL Relay](#)  
Speaker & helper at [SQL Bits](#)  
Speaker & helper at various [SQL Saturday's](#)  
[Stack Overflow](#) • Unsung Hero • Steward

[linkedin.com/in/mrpaulandrew](#) [paul@mrpaulandrew.com](#) [mrpaulandrew.com](#) [@mrpaulandrew](#)

**About Me**

Many years' experience working with the complete on-premises SQL Server stack in a variety of roles and industries. Now as Data Analytics Consultant has turned his keyboard to big data solutions in the Microsoft cloud. Specialising in Azure Data Lake Analytics, Azure Data Factory, Azure Stream Analytics, Event Hubs and IoT.

### Alex Whittles

- SQL Relay Committee
- SQL Bits Committee
- Birmingham SQL UG
- Birmingham Azure UG
- MSc in Business Intelligence, CEng, CITP, FBCS, FIOE, MIEI, MInstC
- Principal Consultant [purplefrog](#) BI Consultancy

[SQL Relay](#) [SQLBits.com](#) [SQLMidlands.com](#) [AzureBirmingham.uk](#)

**Business Intelligence Consultancy**

Data Modelling  
Data Warehousing  
OLAP Cubes

ETL Systems  
Reporting Systems  
Managed Service

**MVP**  
Microsoft Most Valuable Professional

# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

Module	Content	Full Agenda
1	Getting Started with Azure	
2	An Overview of BI in Azure (ETL, ELT, ECTL & Lambda)	
3	Databases in Azure (T-SQL, D-SQL)	
	Break (10:30)	
4	The Azure Machine are here to Learn	
5	Swimming in the Data Lake (U-SQL)	
	Lunch (12:30)	
6	IoT, Event Hubs and Azure Stream Analytics	
7	Power BI, Sematic layers and All Things to All People	
8	Orchestrate Your Services with Azure Data Factory	
	Break (15:30)	
9	Wrap Up & Questions	



**Microsoft Certification**

70-776 Perform Big Data Engineering on Microsoft Cloud Services  
<https://www.microsoft.com/en-us/learning/exam-70-776.aspx>

Exam 70-776

Microsoft

Published: July 5, 2017  
Languages: English  
Audience: Data engineers  
Technology: Microsoft Azure SQL Data Warehouse, Azure Data Lake Analytics, Azure Data Factory, Azure Stream Analytics  
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**Module 1 - Getting Started with Azure**

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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

### Module Agenda

IaaS vs PaaS vs SaaS  
What is Azure?  
Azure Portal Tour

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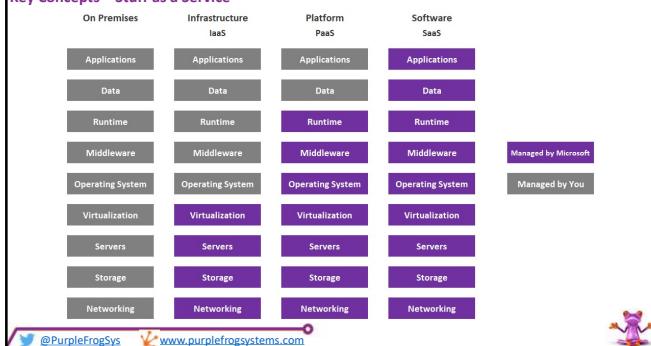
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### Key Concepts – Stuff as a Service



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### Module 1 - Getting Started with Azure

<https://azure.microsoft.com>

<https://azure.microsoft.com/en-gb/get-started/>

Yes, but what is it?

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# Business Intelligence in Azure

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**What is Azure?**

The screenshot shows the Wikipedia article for "Azure (color)". The page title is "Azure (color)" and it is described as a variation of blue. It includes a color swatch and a photograph of a clear sky. The sidebar contains links to related topics like Ethymology, History, and Variations of Azure.

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**What is Microsoft Azure?**

The screenshot shows the Wikipedia article for "Microsoft Azure". It describes Azure as a cloud computing service. The sidebar lists various services like Compute, Storage, and Media.

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**What is Microsoft Azure for us humans?**

The screenshot shows the Microsoft Azure sign-in page. It asks the user to pick an account, showing options for "Paul Andrew" and "paul@mrrpaulandrew.com".

# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

A Quick Tour of the Azure Portal

M1 - Getting Started

Subscriptions

Resource groups

All resources

Azure Terminology

- Portal
- Dashboard
- Blades
- Active AD
- Tenant
- Subscription
- Resource Groups
- Resources
- Services
- Marketplace

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Module 1 - Getting Started with Azure

Questions?

Service Progress

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Module 2 – An Overview of Business Intelligence in Azure

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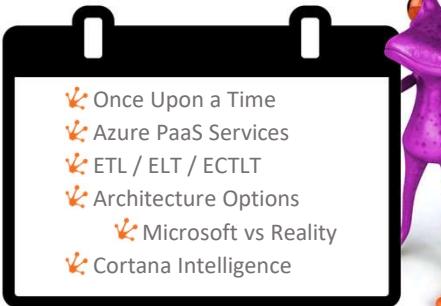
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

### Module Agenda



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### Module Agenda



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### A Day in the Life of a Business Intelligence Professional



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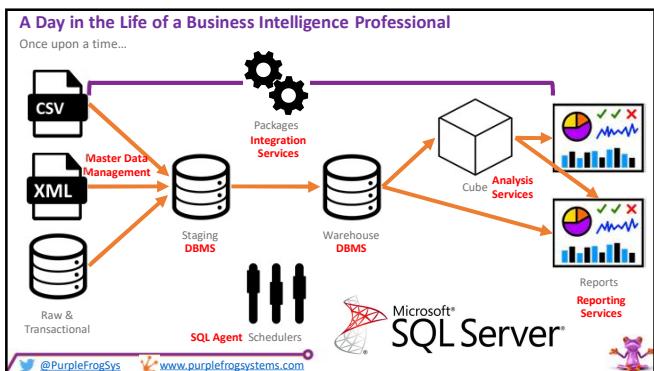
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles




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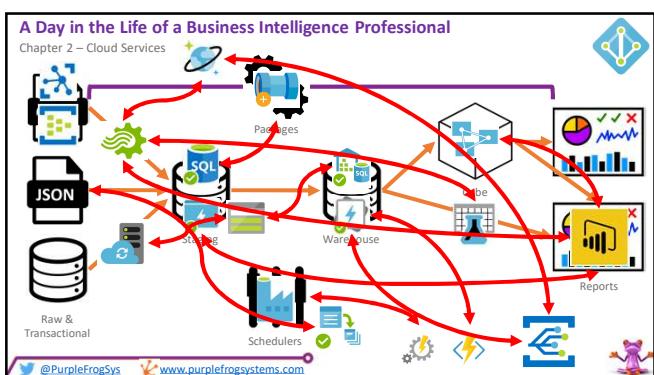
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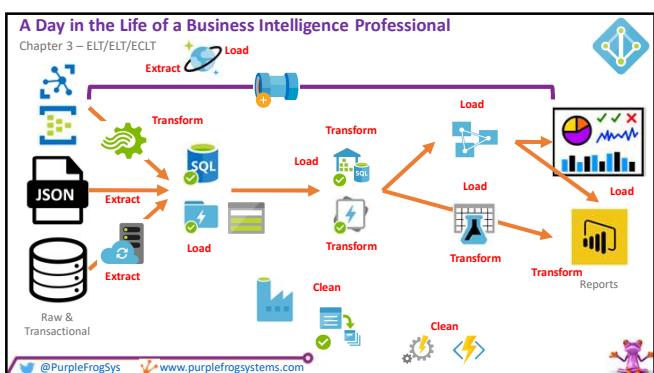
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

Module Agenda

Once Upon a Time  
Azure PaaS Services  
ETL / ELT / ECTLT  
Architecture Options  
Microsoft vs Reality  
Cortana Intelligence

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Business Intelligence in Azure  
Chapter 4 – Architecture Options

Raw & Transactional

Reports

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Business Intelligence in Azure  
Chapter 4 – Architecture Options

Raw & Transactional

Reports

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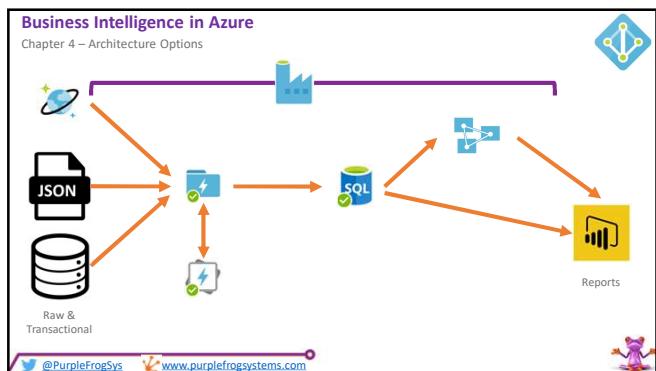
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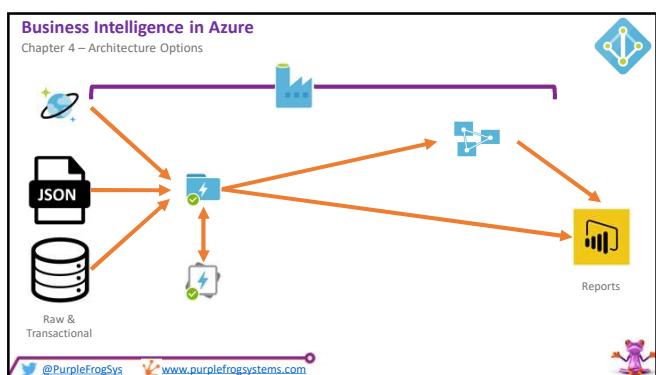
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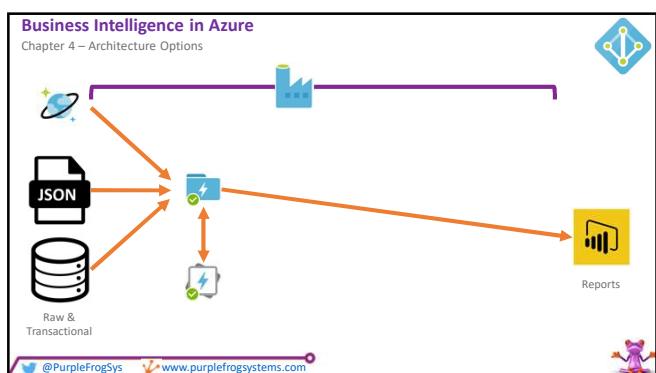
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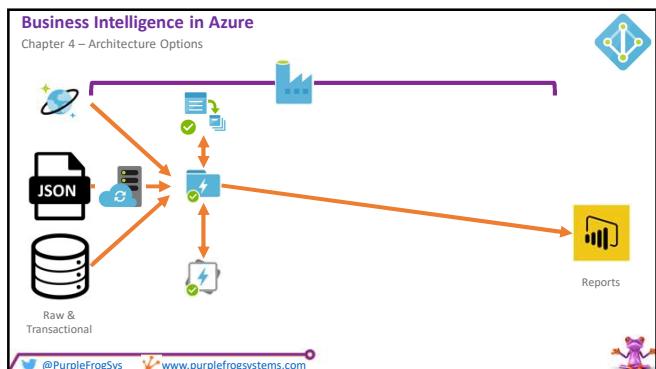
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



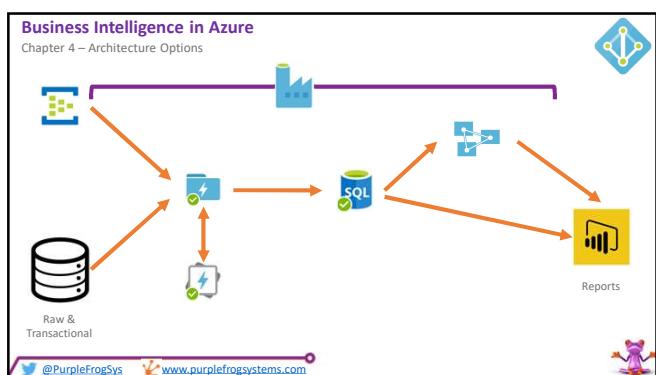
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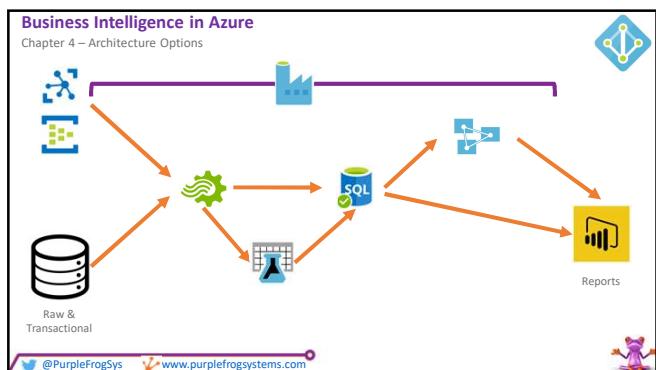
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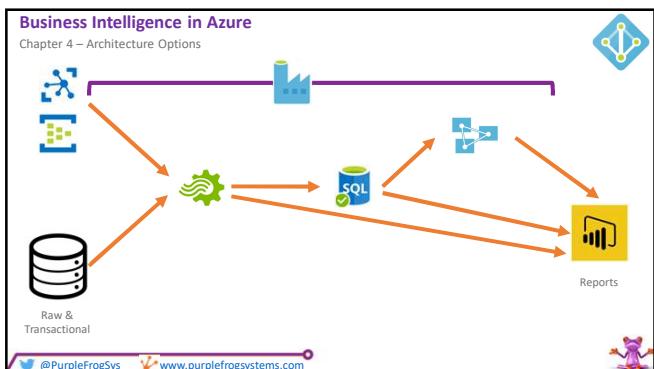
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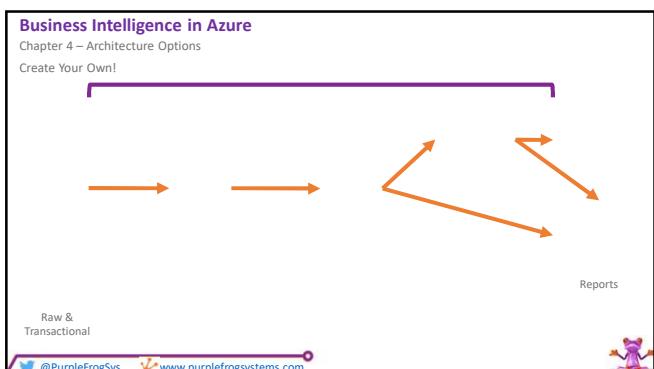
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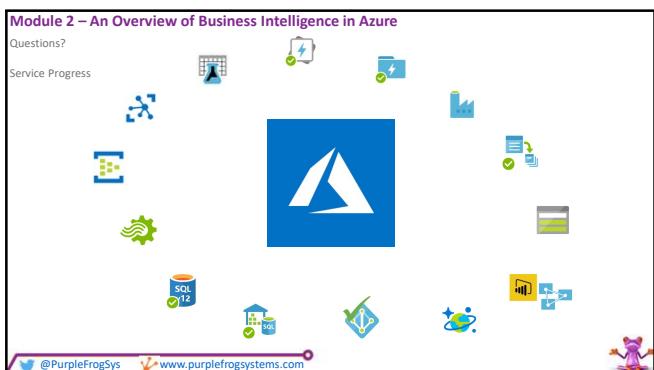
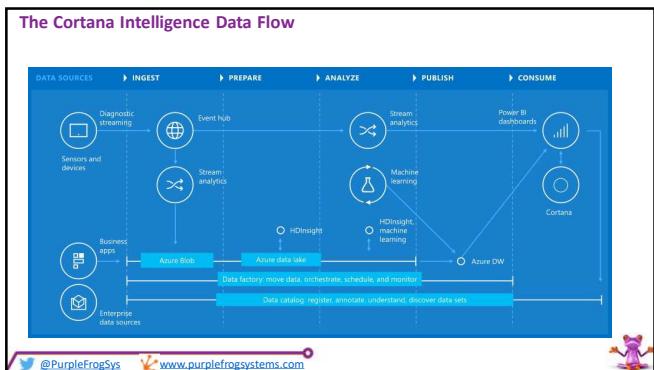
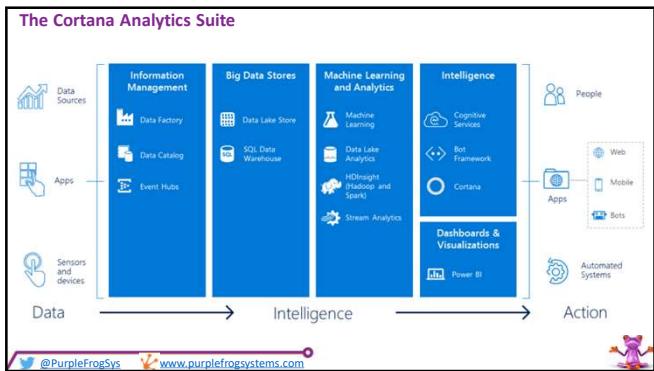
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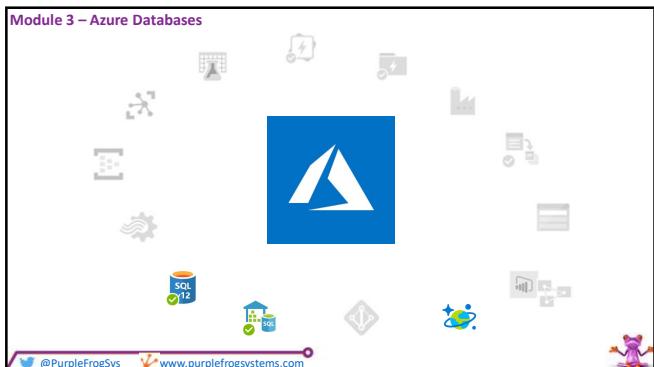
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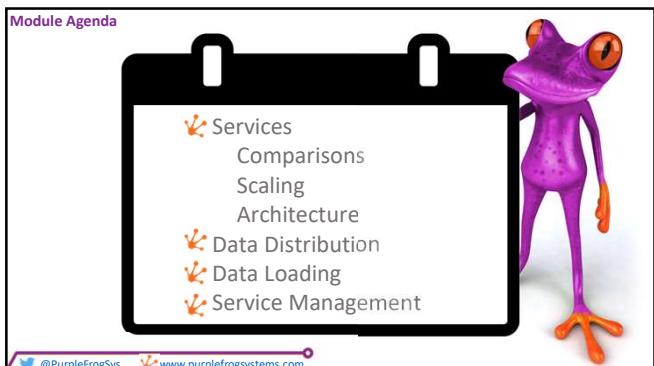
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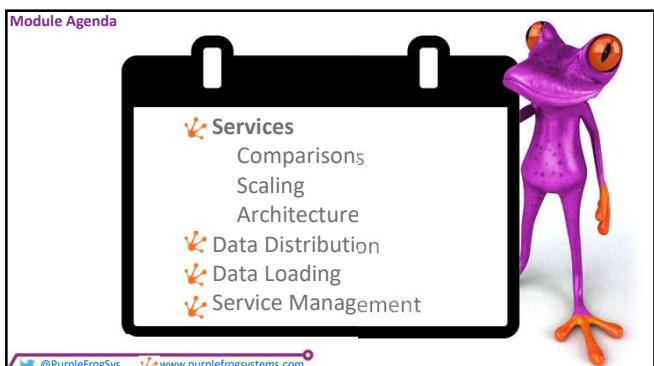
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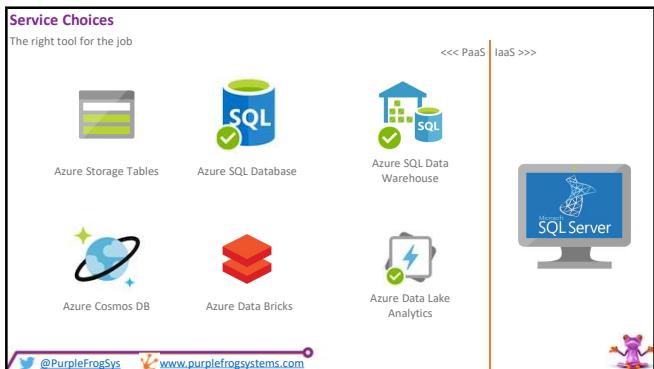
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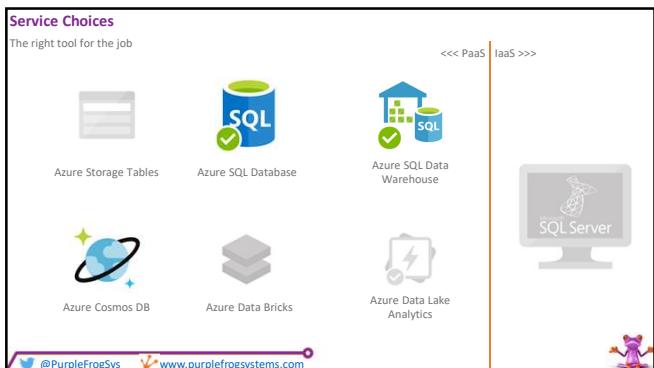
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**Cosmos DB** <https://docs.microsoft.com/en-us/azure/cosmos-db/introduction>

The right tool for the job

NoSQL  
Semi Structured Data

Feature	Cosmos DB
Max Size	10 GB or Unlimited (per collection)
Compute Pause/Resume	No
Concurrent Queries	Unlimited
Active Connections	Unlimited
Charging Units	Request Units (RUs)
PolyBase	No
Role	OLTP
Scalable	Yes
On Premises Equivalent	None

Other Features

- Choice of API's
  - SQL
  - MongoDB
  - Cassandra
  - Azure Table
  - Gremlin
- Global Replication (in 3 clicks)
- Graph Visualisations in Portal
- Always On Availability
- SLA's
  - Latency
  - Throughput
  - Consistency
  - Availability

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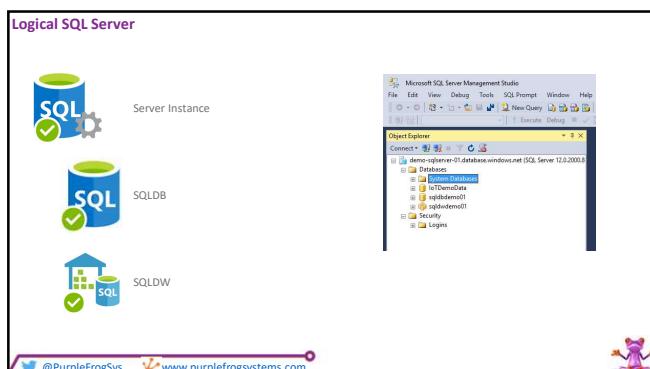
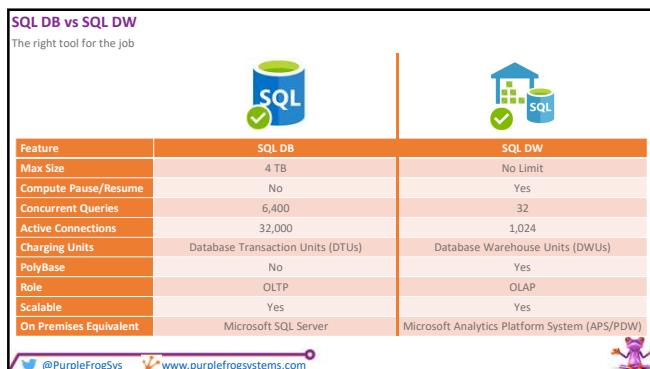
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**Azure SQLDB – Scaling**

Configure performance

Feedback

Basic

Standard

Premium

Premium RS

DTU

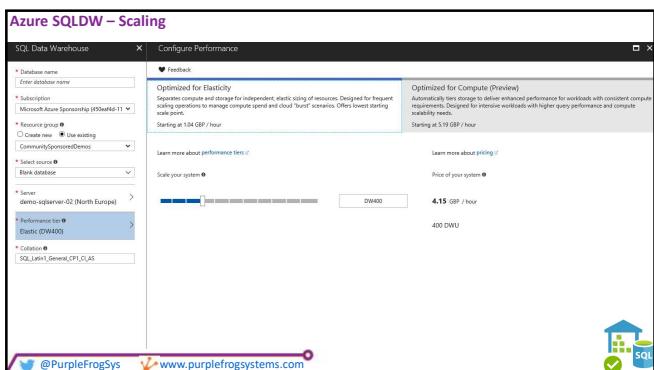
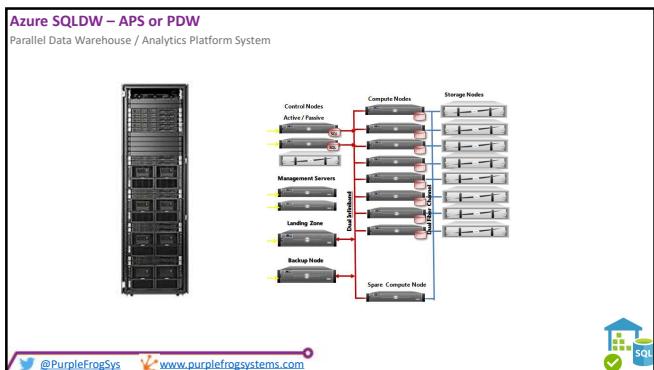
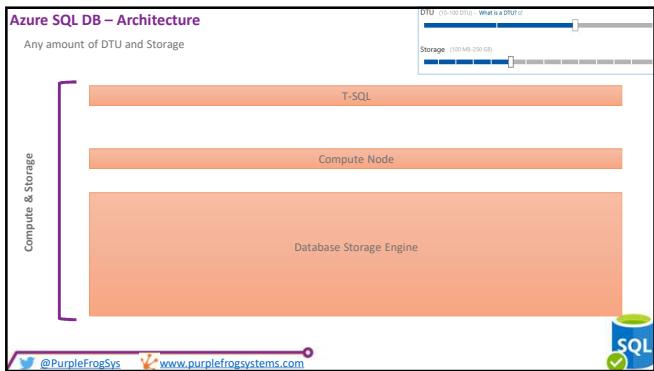
Storage

Monthly cost: 55.91 GBP

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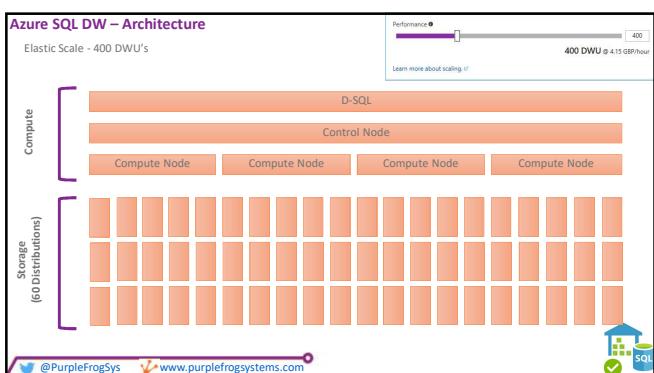
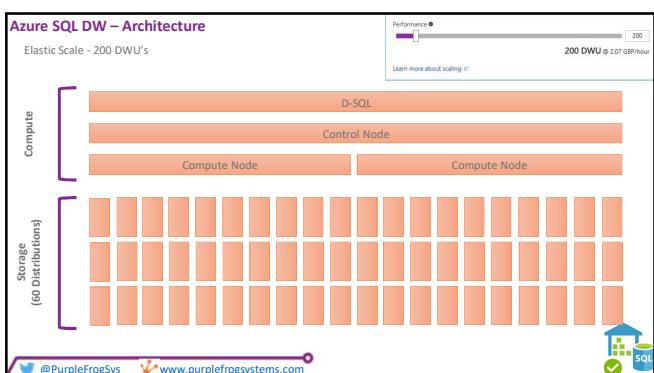
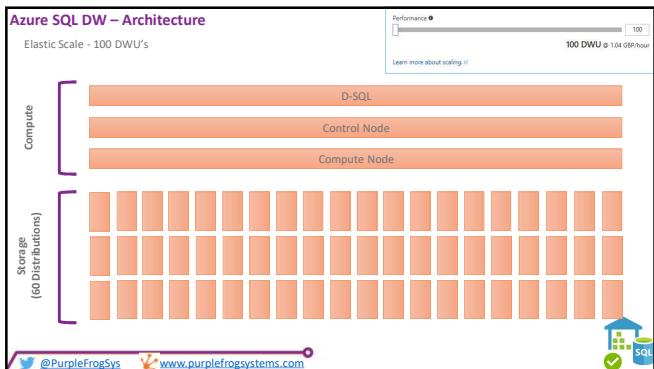
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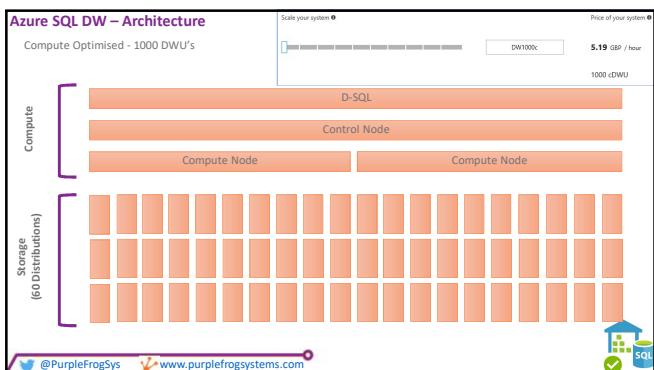
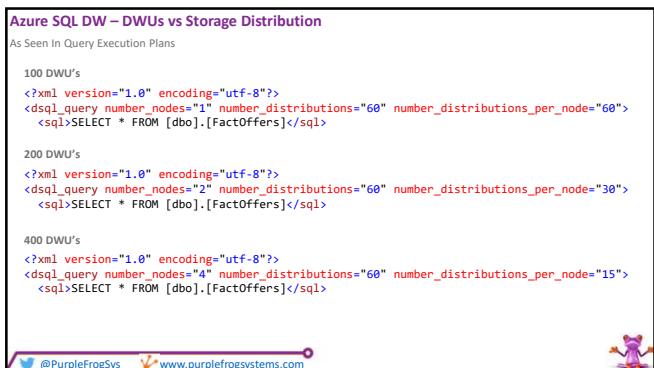
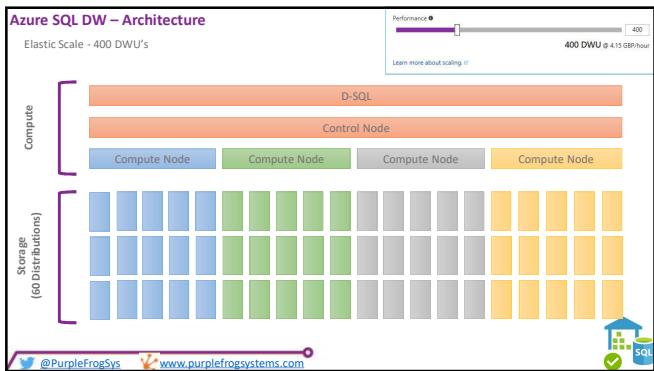
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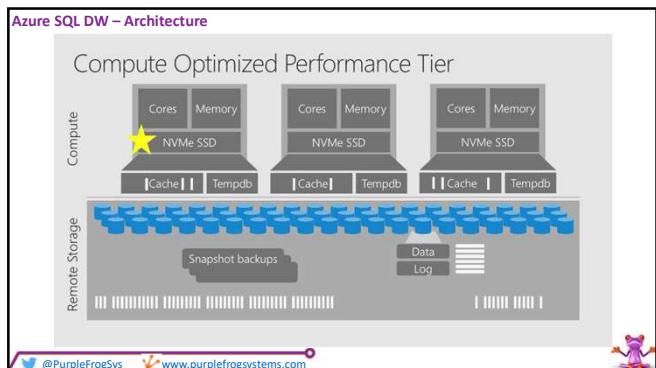
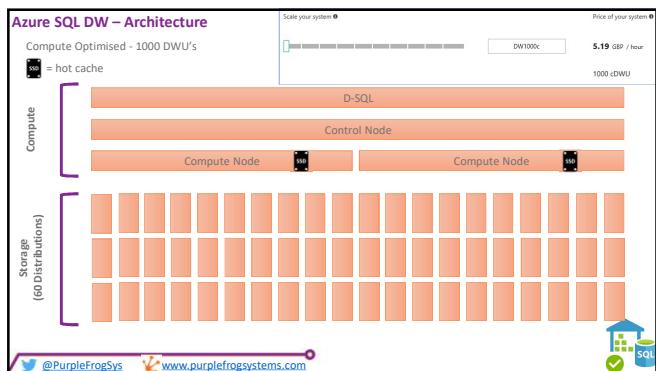
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**Azure SQL DW – Architecture**

Compute Translation Table

Elastic				Compute Optimised			
DWUs	Compute Nodes	Storage Per Node	Price Per Hour*	DW c	Compute Nodes	Storage Per Node	Price Per Hour*
100	1	60	£1.04	-	-	-	-
200	2	30	£2.07	1000	2	30	£5.19
300	3	20	£3.11	1500	3	20	£7.78
400	4	15	£4.15	2000	4	15	£10.37
500	5	12	£5.18	2500	5	12	£12.97
600	6	10	£6.22	3000	6	10	£15.56
1000	10	6	£10.37	5000	10	6	£25.94
1200	12	5	£12.44	6000	12	5	£31.12
1500	15	4	£15.55	7500	15	4	£38.91
2000	20	3	£20.74	10000	20	3	£51.87
3000	30	2	£31.11	15000	30	2	£77.81
6000	60	1	£62.21	30000	60	1	£155.62

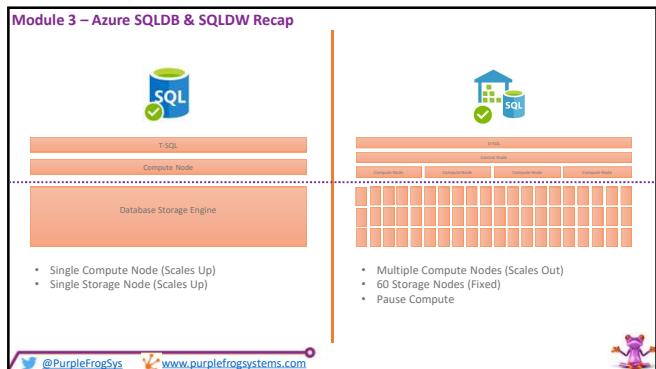
\* Prices updated 6<sup>th</sup> Feb 2018

Contact Microsoft

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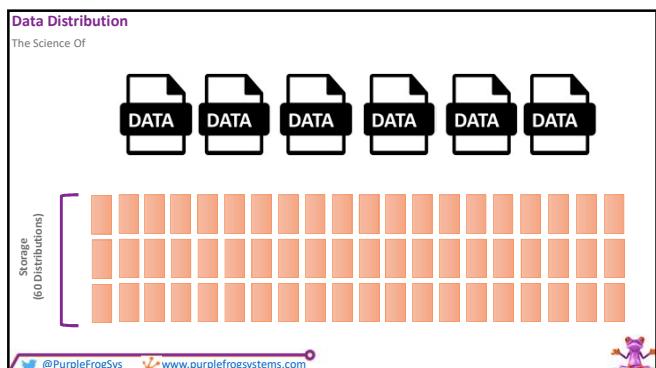
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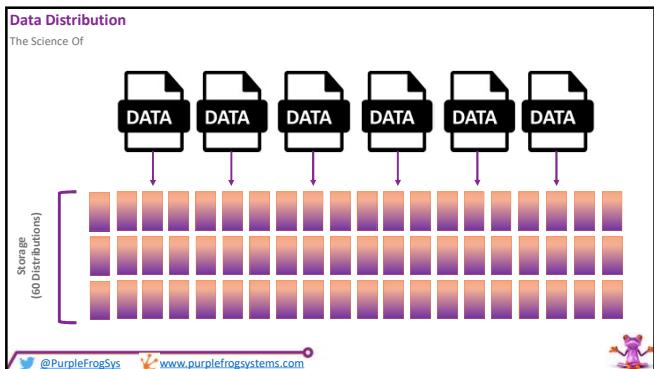
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# Business Intelligence in Azure

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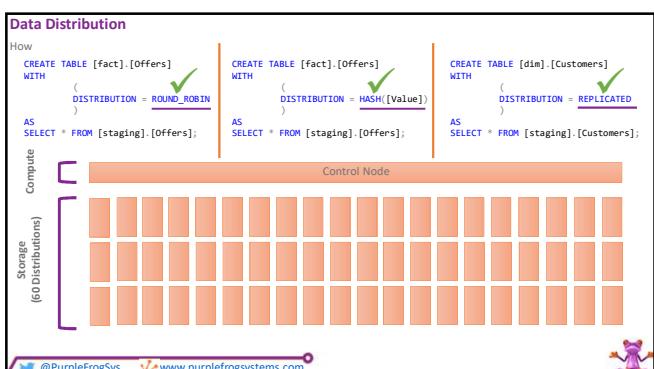
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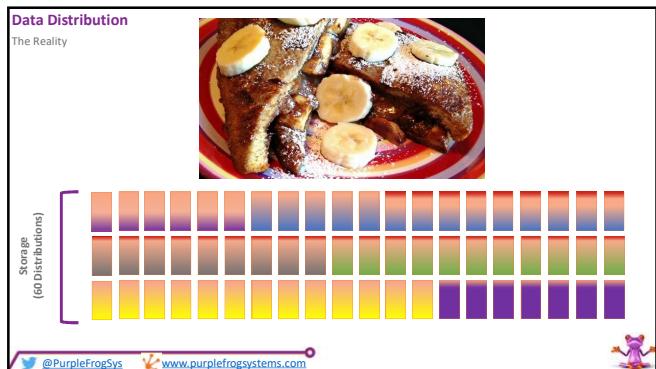
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# Business Intelligence in Azure

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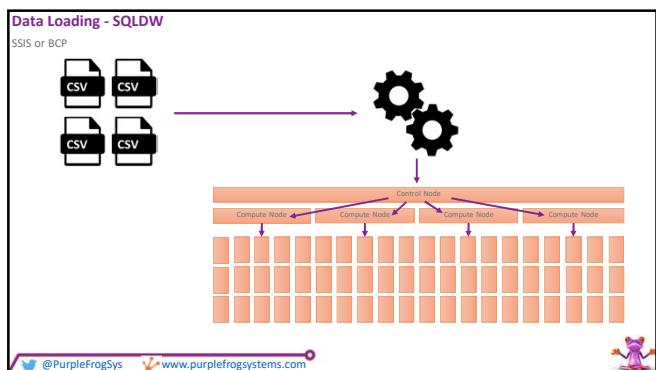
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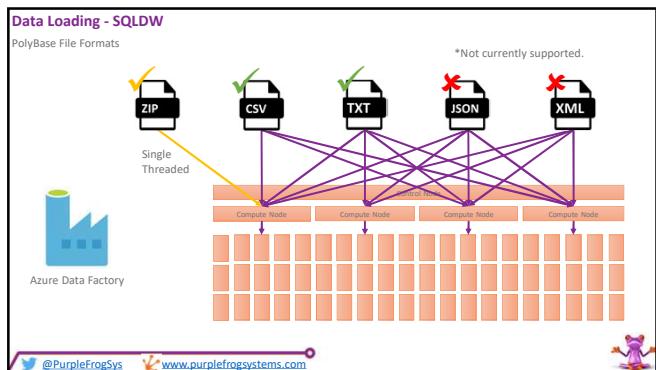
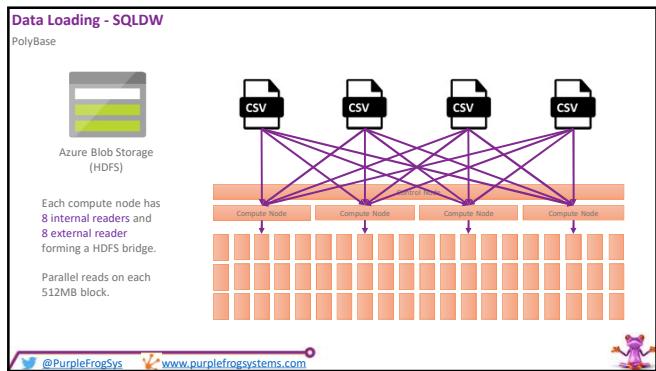
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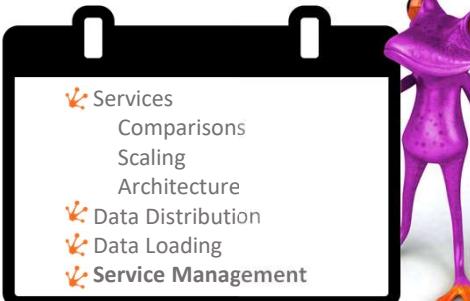
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# Business Intelligence in Azure

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### Module Agenda



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### Things to Poke the DBA About

Business Intelligence Developer Awareness



DB

- Elastic DTU Pools
- Scaling (DTUs)
  - Portal Blades
  - PowerShell
- Database Sync
- Performance Recommendations
- Query Performance Insights
- Alert Rules
- No SQL Agent Available
- Dynamic Data Masking
- Linked Server Connections
- Remote Query Execution



<https://docs.microsoft.com/en-us/azure/sql-data-warehouse/sql-data-warehouse-develop-concurrency>

- Resource Classes
  - Active Connections
  - Concurrent Queries
  - Queued Executions
- Scaling (DWUs or cDWUs)
  - Portal Blades
  - SQL
  - PowerShell
- Scaling Kills Queries
- Pausing the Compute
  - Azure Automation
  - Paying For File Footprint
- Create Statistics



Instance

- Database Restore Times
- Server Credentials
- Firewall Rules
- Failover Groups
- Long Term Backups
- Auto Tuning
- Threat Detection
- Geo Redundancy
- Data Encryption

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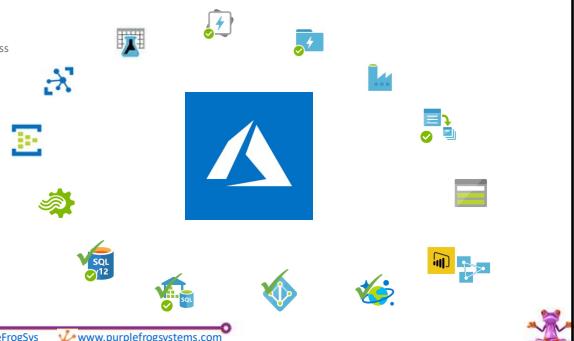
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### Module 3 – Azure Databases

Questions?

Service Progress



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# Business Intelligence in Azure

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### Module 4 – The Azure Machines are here to Learn



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### Alex Whittles



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- SQL Bits Committee
- Birmingham SQL UG
- Birmingham Azure UG
- MSc in Business Intelligence, CEng, CITP, FBCS, FIOEE, MIET, MIOB
- Principal Consultant

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AzureBirmingham.uk



Most Valuable Professional

purple frog

BI Consultancy

Business Intelligence Consultancy

Data Modelling

Data Warehousing

OLAP Cubes

ETL Systems

Reporting Systems

Managed Service



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### Module Agenda



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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



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Machine Learning in Today's World  
Retail - Amazon



Customers who bought this item also bought:

Transformers Robots in Disguise Power Surge Command Head Order Toy - Red	50 Polka Dot Twist Ties For Craft Party Bags Calli Assorted Colors	Banana Boat Kids Banana Spray Sun Lotion SPF 50+ 100ml	SaltSmart Jr. Puzzle Ball Magnetic Intelligence Ball Game	Totes Limited Boy's Short Sleeve Graphic Tee Shirt	The Wishing-Chair Collection: Five Stories (The Wishing-Chair Magic) Puzzle 21 Pcs	The Magic Faraway Tree Collection: 3 Books in 1	Violin Star 1, Student's book, with CD (Violin Star)
£19.99 prime	£5.45 prime	£5.95 prime	£9.99 prime	£7.24 - £9.95	£7.24 - £13.77	£6.99 prime	£6.29 - prime

Total price: £25.11 [Add both to Basket](#)

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Machine Learning in Today's World

- Credit Scoring
- Customer Segmentation
- Post Office Image Recognition



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# Business Intelligence in Azure

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**Selecting a Model**  
(simplified!!!!)

Type	Scenario	Model
Unsupervised	Clustering	K-Means
	Outlier detection	K-Means
Supervised	Predict Yes/No	Two-class boosted decision tree Two-class logistic regression
	Predict Classification	Multi-class logistic regression Support Vector Machine Multi-class neural net
	Predict Value	Linear Regression
	Feature based detection / intelligence	Neural Net

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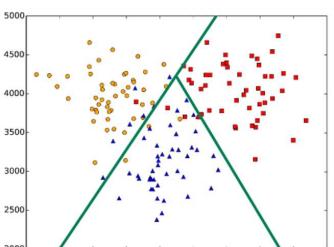
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**K-Means Clustering**



Credit: <https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice>

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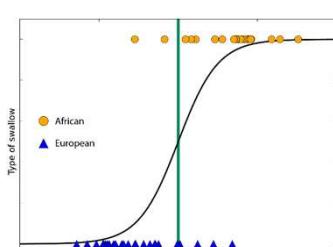
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**Logistic Regression**



Credit: <https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice>

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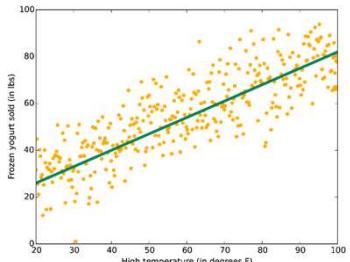
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# Business Intelligence in Azure

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### Linear Regression



Credit: <https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice>

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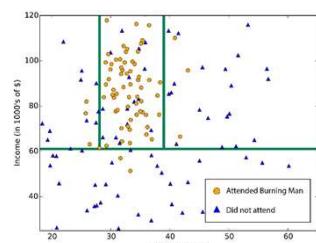
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### Decision Trees



Credit: <https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice>

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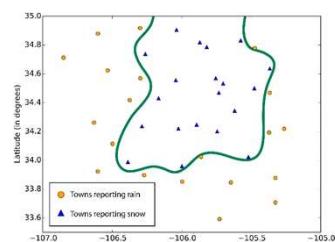
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### Neural Network



Credit: <https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice>

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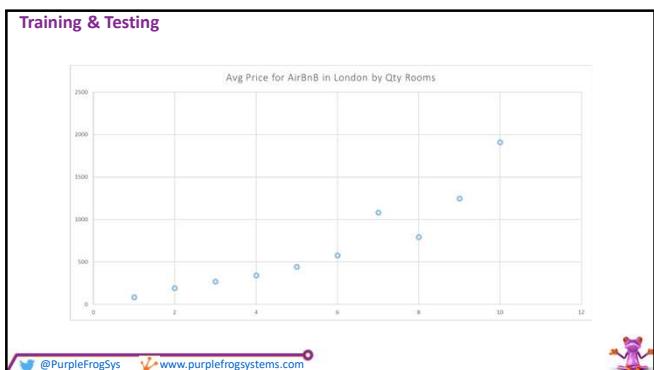
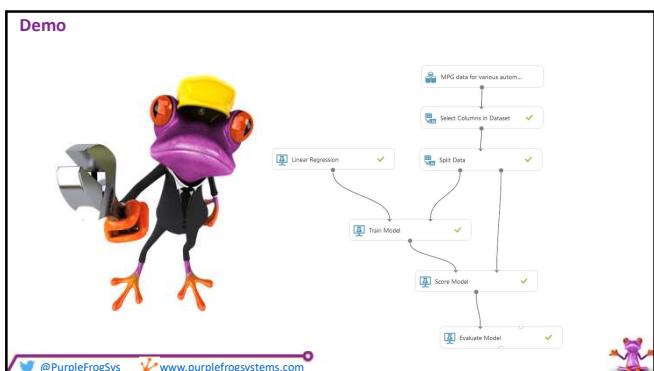
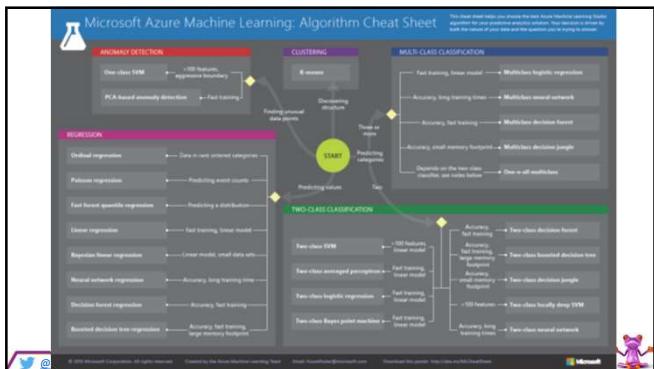
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



# Business Intelligence in Azure

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### Training & Testing

Over trained



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### Training & Testing

Generic model



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### Training & Testing

Generic model



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# Business Intelligence in Azure

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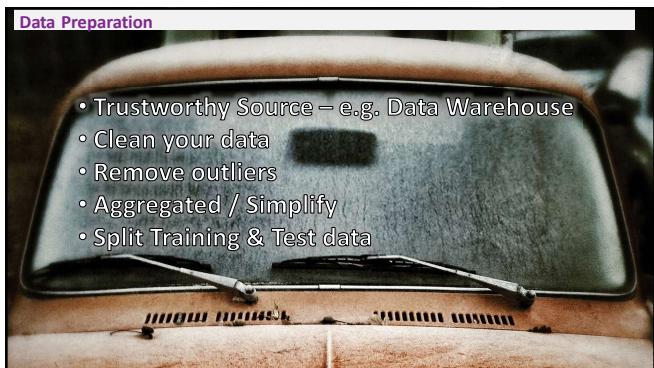
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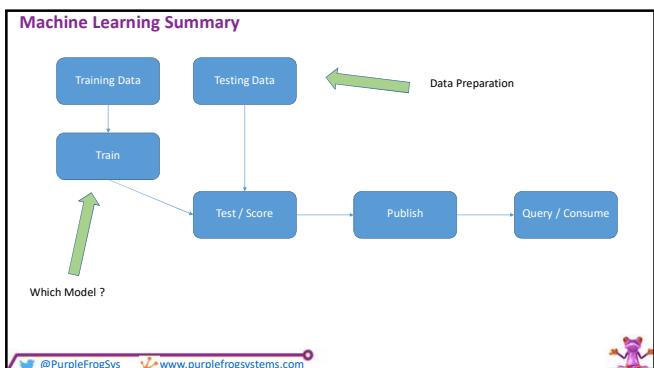
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

### I've got my model – now what?

- Batch Execution
  - Process prediction asynchronously for bulk data

- Web Service API
- Data Lake Analytics
- Excel

- Request-Response
  - One prediction at a time

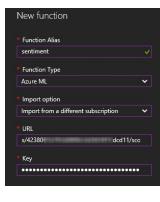
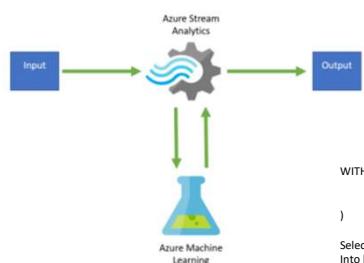
- Web Service API
- Stream Analytics



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### I've got my model – now what?

Real Time Data – Stream Analytics



```
WITH sentiment AS (
    SELECT text, sentiment(text) as result
    from [Input]
)
Select text, result.[Scored Labels]
Into [output]
From [sentiment]
```

<https://docs.microsoft.com/en-us/azure/stream-analytics/stream-analytics-machine-learning-integration-tutorial>

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### Machine Learning without Azure ML?

- Algorithms are generic, not Azure ML specific
- Other tools
  - SQL Server on Prem
    - 'R' in SQL Server 2016 'Machine Learning Services'
    - Python added in SQL Server 2017
  - R Studio
  - Python
  - SAS
  - Analysis Services Data mining
  - 'R' in Data Lake
  - Amazon Machine Learning

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# Business Intelligence in Azure

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**Module 4 – The Azure Machines are here to Learn**

Questions?

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**Module 5 – Diving into the Azure Data Lake with U-SQL**

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**Module Agenda**

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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

Module Agenda:



- What is Azure Data Lake?
  - Storage & compute
- Why use it?
  - Microsoft & in the real world
- How can we work with each service?
  - Developing, managing & consuming
- U-SQL
  - The language (T-SQL, C#)
  - Logical database & advanced capabilities

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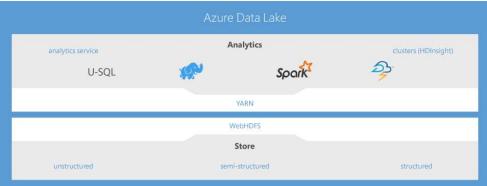
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What is Azure Data Lake?

The Microsoft version...



<https://azure.microsoft.com/en-gb/solutions/data-lake/>

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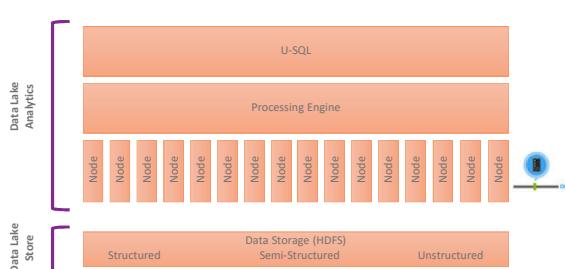
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What is Azure Data Lake?

The non product orientated version...



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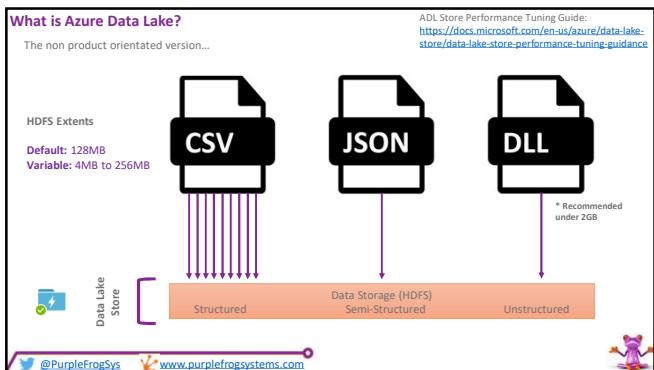
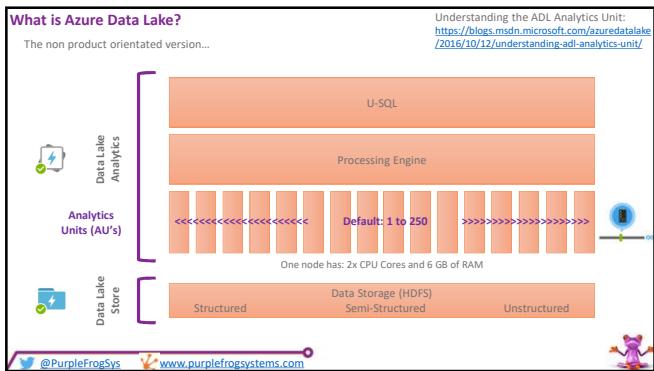
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



# Business Intelligence in Azure

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**Why Use Azure Data Lake?**

The Microsoft version...

**Microsoft Azure**

Why Azure? Solutions Products Documentation Pricing Partners Blog Resources Support FREE ACCOUNT >

**Data Lake**

A no-limits data lake to power intelligent action

- ✓ Store and analyse petabyte-size files and trillions of objects
- ✓ Develop massively parallel programs with simplicity
- ✓ Debug and optimise your big data programs with ease
- ✓ Enterprise-grade security, auditing and support
- ✓ Start in seconds, scale instantly and pay per job
- ✓ Built on YARN, designed for the cloud

Try it now >

<https://azure.microsoft.com/en-gb/solutions/data-lake/>

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**Why Use Azure Data Lake?**

The Microsoft version...

**Microsoft Azure**

Why Azure? Solutions Products Documentation Pricing Partners Blog Resources Support FREE ACCOUNT >

**Data Lake**

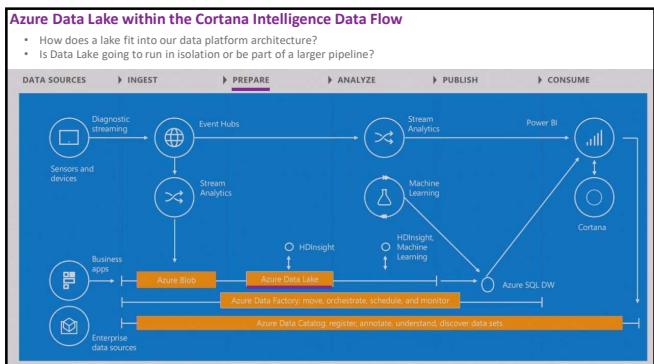
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- ✓ Store and analyse petabyte-size files and trillions of objects
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- ✓ Debug and optimise your big data programs with ease
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- ✓ Start in seconds, scale instantly and pay per job
- ✓ Built on YARN, designed for the cloud

Try it now >

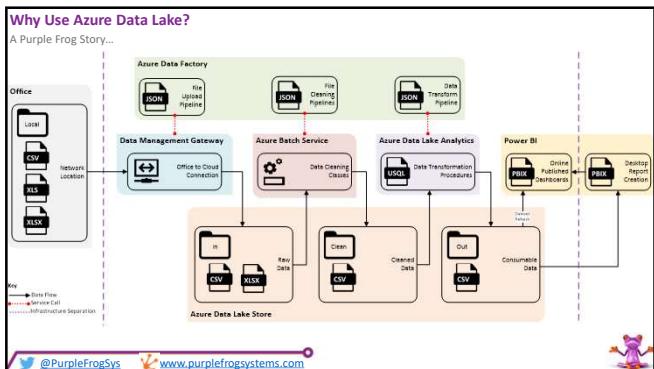
<https://azure.microsoft.com/en-gb/solutions/data-lake/>

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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



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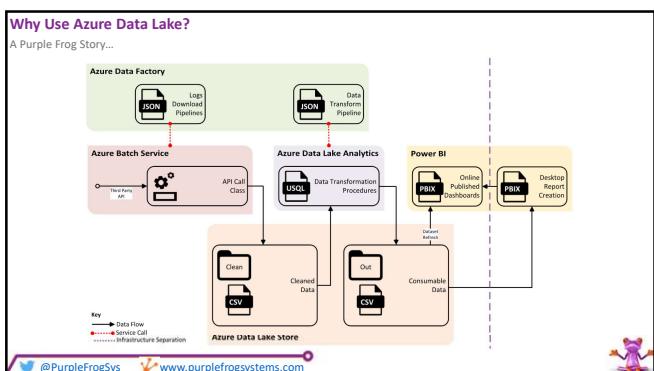
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

**Uploading Data Into Azure Data Lake Store**

**Manual**

**Azure Data Factory**

```
{
  "name": "DataLakeUploads",
  "properties": {
    "activities": [
      {
        "type": "Copy",
        "inputs": [
          {
            "name": "OnPremFileServer"
          }
        ],
        "outputs": [
          {
            "name": "DataLakeStore"
          }
        ]
      }
    ],
    "parameters": {}
  }
}
```

**Power Shell**

```
Import-AzureRmDataLakeStoreItem
-AccountName $dataLakeStoreName
-Path "C:\Temp\SampleData.txt"
-Destination $myDataDir\Samples\Data.txt
```

**.Net SDK**

```
var parameters = new UploadParameters(
    srcFilePath,
    destFilePath,
    acName,
    isOverwrite: force);

var frontend = new DataLakeStoreFrontEndAdapter(
    acName,
    adlsClient);

var uploader = new DataLakeStoreUploader(parameters,
    frontend);
uploader.Execute();
```

**Automatic**

**Azure Data Factory**

```
{
  "name": "DataLakeUploads",
  "properties": {
    "activities": [
      {
        "type": "Copy",
        "inputs": [
          {
            "name": "OnPremFileServer"
          }
        ],
        "outputs": [
          {
            "name": "DataLakeStore"
          }
        ]
      }
    ],
    "parameters": {}
  }
}
```

**Power Shell**

```
Import-AzureRmDataLakeStoreItem
-AccountName $dataLakeStoreName
-Path "C:\Temp\SampleData.txt"
-Destination $myDataDir\Samples\Data.txt
```

**.Net SDK**

```
var parameters = new UploadParameters(
    srcFilePath,
    destFilePath,
    acName,
    isOverwrite: force);

var frontend = new DataLakeStoreFrontEndAdapter(
    acName,
    adlsClient);

var uploader = new DataLakeStoreUploader(parameters,
    frontend);
uploader.Execute();
```

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**Writing and Submitting Azure Data Lake Analytics U-SQL Jobs**

**Manual**

**Azure Data Factory**

```
{
  "name": "DataLakeProcessing",
  "properties": {
    "activities": [
      {
        "type": "DataLakeAnalyticsU-SQL",
        "typeProperties": {
          "script": "#Data = SELECT * FROM @CSVfile",
          "scriptType": "T-SQL"
        }
      }
    ],
    "parameters": {}
  }
}
```

**Power Shell**

```
Submit-Job -JobName $jobName
-ProcessorName $processorName
-AccountName $dataLakeAnalyticsName
-ScriptPath $usqlScript
```

**.Net SDK**

```
var script = File.ReadAllText(scriptPath);
var jobId = Guid.NewGuid();
var properties = new JobProperties(script);
var parameters = new JobInformation($jobName, jobType.Usql, properties, priority: 1, degreeOfParallelism: 1, jobId: jobId);

var jobInfo = await JobClient.CreateJobAsync(jobName, jobId, parameters);
return jobId;
```

**Automatic**

**Azure Data Factory**

```
{
  "name": "DataLakeProcessing",
  "properties": {
    "activities": [
      {
        "type": "DataLakeAnalyticsU-SQL",
        "typeProperties": {
          "script": "#Data = SELECT * FROM @CSVfile",
          "scriptType": "T-SQL"
        }
      }
    ],
    "parameters": {}
  }
}
```

**Power Shell**

```
Submit-Job -JobName $jobName
-ProcessorName $processorName
-AccountName $dataLakeAnalyticsName
-ScriptPath $usqlScript
```

**.Net SDK**

```
var script = File.ReadAllText(scriptPath);
var jobId = Guid.NewGuid();
var properties = new JobProperties(script);
var parameters = new JobInformation($jobName, jobType.Usql, properties, priority: 1, degreeOfParallelism: 1, jobId: jobId);

var jobInfo = await JobClient.CreateJobAsync(jobName, jobId, parameters);
return jobId;
```

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**Developing U-SQL for Azure Data Lake Analytics**

- Visual Studio 2013
  - Azure SDK – ADL Tools
- Visual Studio 2015
  - Azure SDK – ADL Tools
- Visual Studio 2017
  - Out of the box extensions
- Azure Portal
  - Directly with blades
- Visual Studio Code
  - Extension now GA

**Manual**

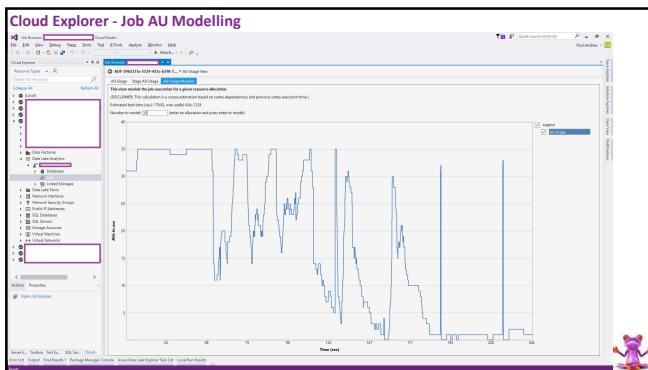
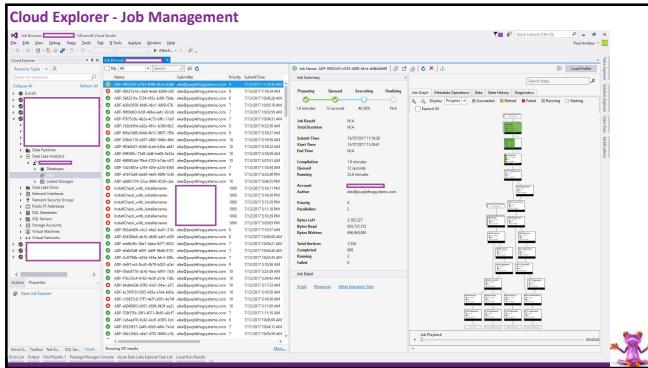
**Azure Data Lake**

**Automatic**

**Azure Data Lake**

# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



This screenshot shows the Microsoft Azure Job Management interface. It includes a table for job details, a 'Change Your Plan' dialog for selecting a pay-as-you-go or monthly subscription plan, and a 'Bulk buy your compute!' chart showing usage costs. The configuration section allows setting maximum AU-Hours, running jobs, and days to retain job queues.

# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

### Module Agenda

What is Azure Data Lake?  
Storage & compute

Why use it?  
Microsoft & in the real world

How can we work with each service?  
Developing, managing & consuming

U-SQL  
The language (T-SQL, C#)  
Logical database & advanced capabilities

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### What is U-SQL?

- Hybrid of T-SQL and C#

Created by Microsoft's Michael Rys

```
@fileSummary = SELECT CountryCode,
    COUNT(*) AS RecordCount,
    SUM(SHSIn) AS SHSIn,
    SUM(SHSOut) AS SHSOut,
    SUM(CallIn) AS CallIn,
    SUM(CallOut) AS CallOut,
    SUM(Data) AS Data
FROM @RawData
GROUP BY CountryCode;
```

```
@DataRegion =
SELECT *
    , DateTime.Parse("1970-01-01").AddSeconds(TimeMS/1000) AS StartWindowDT
    , DateTime.Parse("1970-01-01").AddSeconds(TimeMS/1000).AddMinutes(18) AS EndWindowDT
FROM @RawData;
```



@MikeDoesBigData #USQL

### Why 'U'?

- Unifies T-SQL and C#
- Dive into the data lake like a U-Boat.
- U is the next letter after T-SQL.

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### U-SQL, like T-SQL

- Based on T-SQL
- SELECT
- DISTINCT
- SUM()
- FROM
- GROUP BY
- ORDER BY
- Windowing Functions – ROW\_NUMBER() etc.

Microsoft Azure

Why Azure? Solutions Products Documentation Pricing Partners Blog Resource

## Data Lake

A no-limits data lake to power intelligent action

- Store and analyse petabytes-size files and trillions of objects
- Develop massively parallel programs with simplicity
- Debug and optimise your big data programs with ease

Try it now >

### U-SQL, but with C#

- Uses .Net Data Types
  - bool
  - decimal
  - int
  - short
  - ushort
  - string – (128KB per row)
- Embeds C# functions
  - DateTimes.Parse("1970-01-01").AddSeconds(TimeMS/1000) AS
- Access C# Assemblies
  - USqlApplication.udfs.validateDate(@CustomerUDOB) AS CustomerUDOB

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<http://feedback.azure.com/forums/327234-data-lake/suggestions>



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# Business Intelligence in Azure

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**T-SQL vs U-SQL**

T-SQL	U-SQL
CASE WHEN Gender IN ('M', 'F') THEN Gender ELSE '-' END	(Gender=="M"    Gender=="F") ? Gender : "-" AS Gender
SubString(Field,0,10)	Field.SubString(0,10)
CharIndex('?',Field)	Field.IndexOf("?")
IsNull(Field,'Unknown')	String.IsEmptyOrNull(Field) ? Field : "Unknown"
Convert(Varchar, OrderDateTime, 112)	OrderDateTime.ToString("yyyyMMdd")
Replace(Field,'?','Unknown')	Field.Replace("?", "Unknown")



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**A Couple of Limitations**

T-SQL	U-SQL
MERGE/UPDATE	<a href="https://www.purplefrogsystems.com/paul/2016/12/writing-a-u-sql-merge-statement/">https://www.purplefrogsystems.com/paul/2016/12/writing-a-u-sql-merge-statement/</a>
WHILE	<a href="https://www.purplefrogsystems.com/paul/2017/05/recursive-u-sql-with-powershell-u-sql-looping/">https://www.purplefrogsystems.com/paul/2017/05/recursive-u-sql-with-powershell-u-sql-looping/</a>
SELECT @Check = COUNT(0) FROM [SomeWhere]	<a href="https://www.purplefrogsystems.com/paul/2017/02/creating-a-u-sql-date-dimension-numbers-table-in-azure-data-lake/">https://www.purplefrogsystems.com/paul/2017/02/creating-a-u-sql-date-dimension-numbers-table-in-azure-data-lake/</a>
IF @Check > 5	
Date Dimension	



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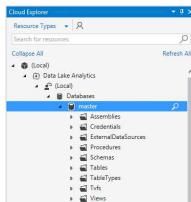
**Azure Data Lake Analytics Database Object (DDL and DML)**

- Assemblies
- Stored Procedures
- Schemas
- Tables
- Functions
- Live in the '\_catalog\_' directory of your storage.

```

CREATE DATABASE IF NOT EXISTS [Demo];
CREATE SCHEMA IF NOT EXISTS [fact];
DROP TABLE IF EXISTS [fact].[Sales];
CREATE TABLE IF NOT EXISTS [fact].[Sales];
DROP PROCEDURE IF EXISTS [Demo].[fact].[usp_LoadSales];
CREATE PROCEDURE [Demo].[fact].[usp_LoadSales](@TimeSliceStart string)
AS
BEGIN /* do stuff */ END;

```





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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

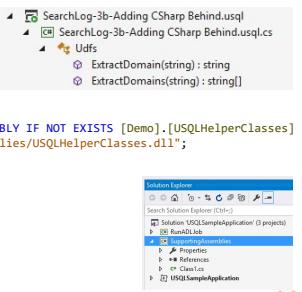
**C# Code Behind**

- Handled by Visual Studio when submitting jobs.
- U-SQL file does not carry C# around with it.
- Calling from other services it needs help compiling the C#.
- Calling U-SQL Stored procedures needs help.
- Assemblies are your friend ☺

```
CREATE ASSEMBLY IF NOT EXISTS [Demo].[USQLHelperClasses]
FROM "Assemblies/USQLHelperClasses.dll";
```

**Compiled C# Code in Assemblies**

- Inline binary in U-SQL.
- Create the assembly from Azure Data Lake Store.
- Create the assembly from Azure Blob Storage.



<https://www.purplefrogsystems.com/paul/2017/04/using-csharp-in-u-sql-with-code-behind/>

**Demo Time!**



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**U-SQL Further Reading**

Microsoft Blog – An Introduction to U-SQL in Azure Data Lake  
<https://blogs.msdn.microsoft.com/robinlester/2016/01/04/an-introduction-to-u-sql-in-azure-data-lake/>

Microsoft Documentation – U-SQL Programmability Guide  
<https://docs.microsoft.com/en-us/azure/data-lake-analytics/data-lake-analytics-u-sql-programmability-guide>

Microsoft MSDN – U-SQL Language Reference  
<https://msdn.microsoft.com/en-US/library/azure/microsoft%2fazuredatalakeudf%2flanguage.aspx>

SQL Server Central – Stairway to U-SQL  
<http://www.sqlservercentral.com/stairway/142480/>

Purple Frog Blog  
<https://www.purplefrogsystems.com/>

Stack Overflow – U-SQL Tag  
<http://stackoverflow.com/questions/tagged/u-sql>



# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

Module 5 – Diving into the Azure Data Lake with USQL

Questions? \_\_\_\_\_  
Service Progress \_\_\_\_\_

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Module 6 – IoT, Event Hubs and Azure Stream Analytics

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Module Agenda

- ↳ Concepts
- ↳ Services
  - ↳ IoT Hub
  - ↳ Event Hub
  - ↳ Stream Analytics
- ↳ Use Cases
- ↳ IoT Options

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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

### Module Agenda



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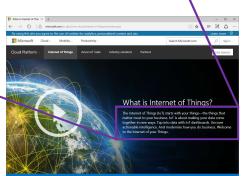
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### What is the Internet of Things?

<https://www.microsoft.com/en-gb/server-cloud/internet-of-things/overview.aspx>

"The Internet of Things (IoT) starts with your things—the things that matter most to your business. IoT is about making your data come together in new ways. Tap into data with IoT dashboards. Uncover actionable intelligence. And modernise how you do business. Welcome to the Internet of your Things."

By Microsoft



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### What is the Internet of Things?



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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

**Hot and Cold Data Paths**  
Previously Stream Insights On-Premises

[Main page](#) [Contents](#) [Featured content](#) [Current events](#) [Random article](#) [Donate to Wikipedia](#) [Wikipedia store](#)

[Article](#) [Talk](#)

Lambda architecture

From Wikipedia, the free encyclopedia

**Lambda architecture** is a data-processing architecture designed to handle massive quantities of data by taking advantage of both batch- and stream-processing methods. This approach to architecture attempts to balance latency, throughput, and fault-tolerance by using batch processing to provide comprehensive and accurate views of batch data, while simultaneously using real-time stream processing to provide views of online data. The two view outputs may be joined before presentation. The rise of lambda architecture is correlated with the growth of big data, real-time analytics, and the drive to mitigate the latencies of map-reduce.<sup>[1]</sup>

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**Module Agenda**

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**IoT Hub vs Event Hub**  
The right tool for the job

Feature	IoT Hub	Event Hub
Message Direction	2 Way	1 Way
Protocol Support	MQTT, AMQP, HTTP	AMQP, HTTP
Scaling	Configured	Automatic
Message Routing	Yes	No
Security	Device Level	Hub Level
Device State Support	Yes	No
Message Capturing	No	Yes
Multiple Hubs	No	Yes
Tiers	F1/S1/S2/S3	Basic/Standard

<https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-compare-event-hubs>

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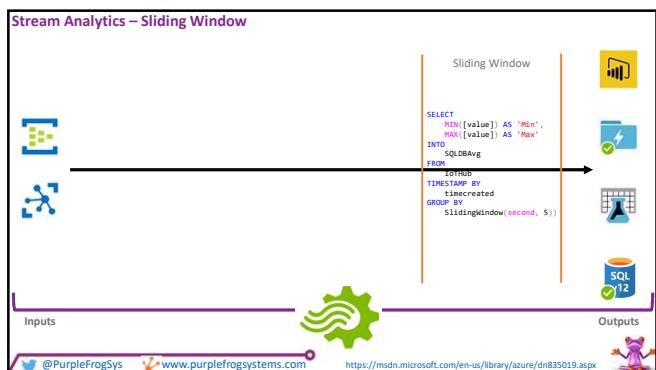
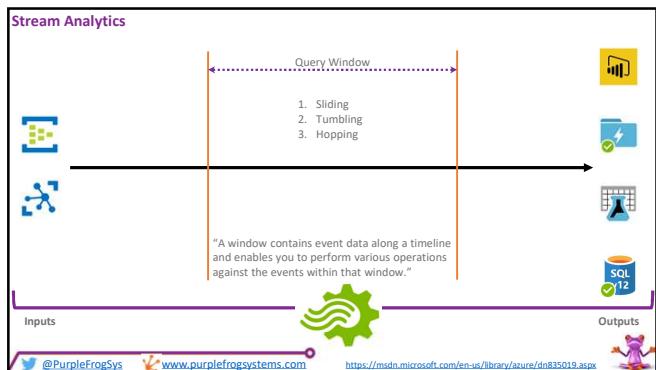
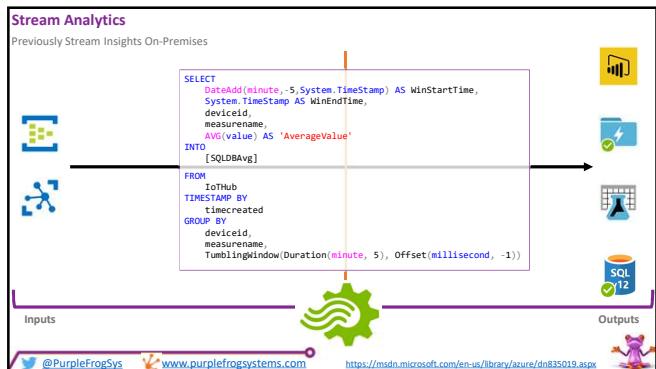
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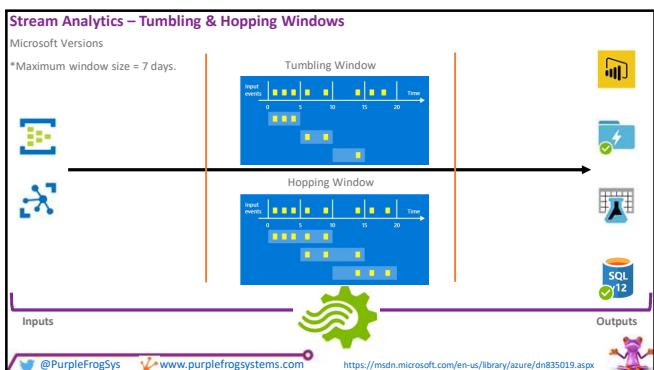
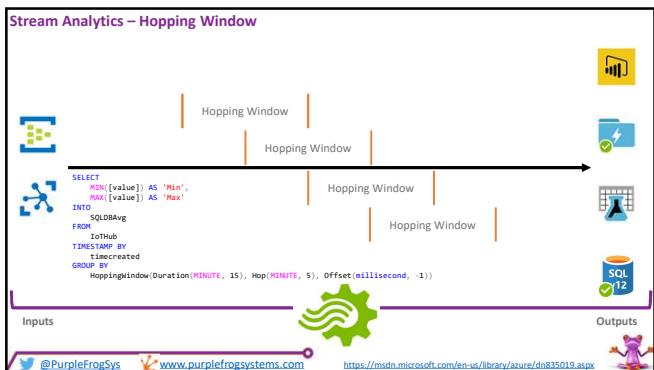
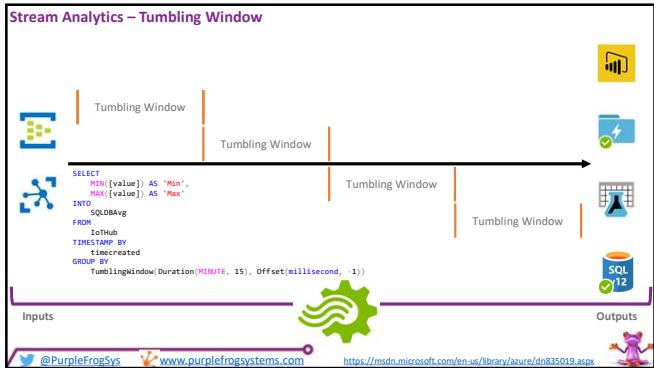
# Business Intelligence in Azure

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# Business Intelligence in Azure

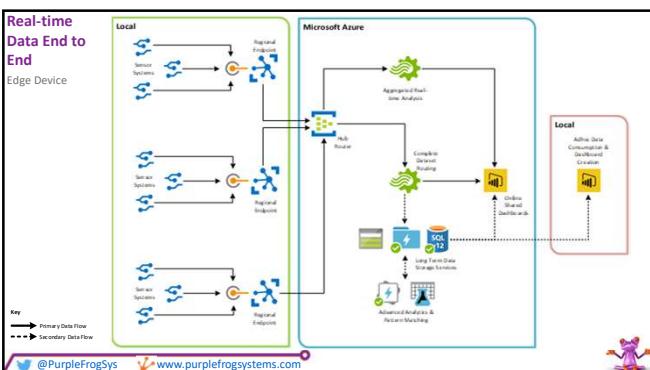
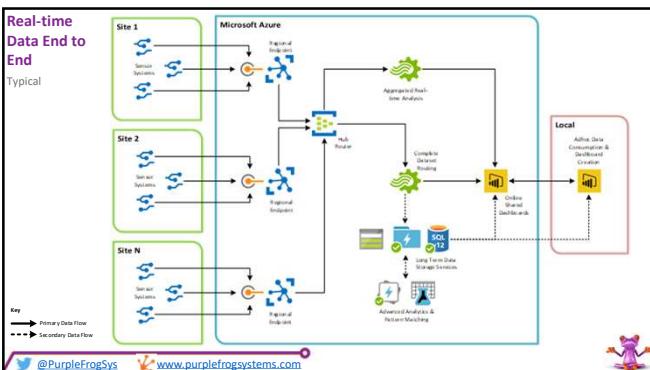
## with Paul Andrew & Alex Whittles



# Business Intelligence in Azure

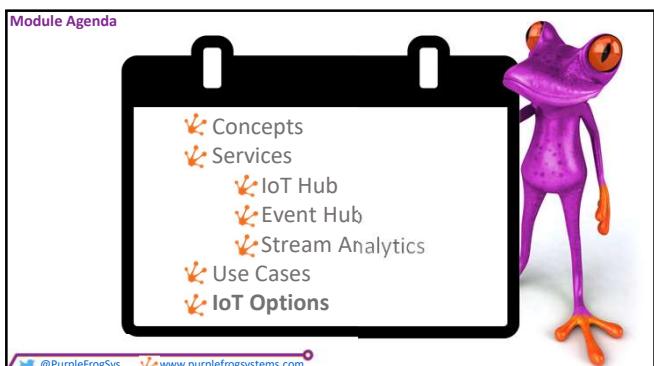
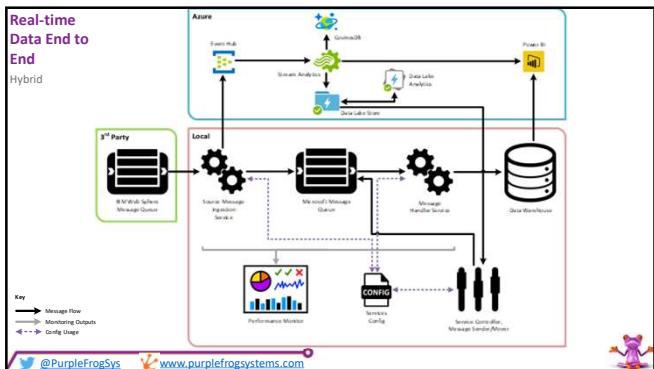
## with Paul Andrew & Alex Whittles

### Module Agenda



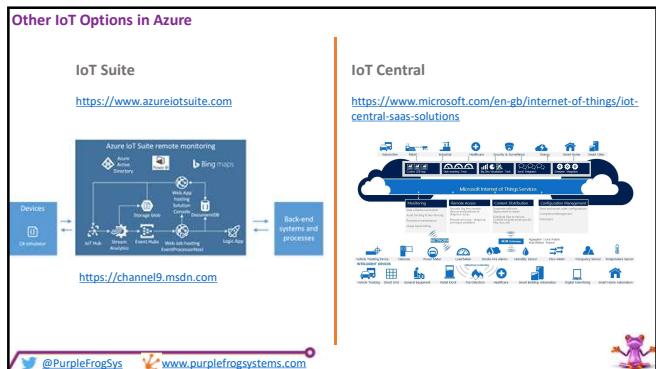
# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



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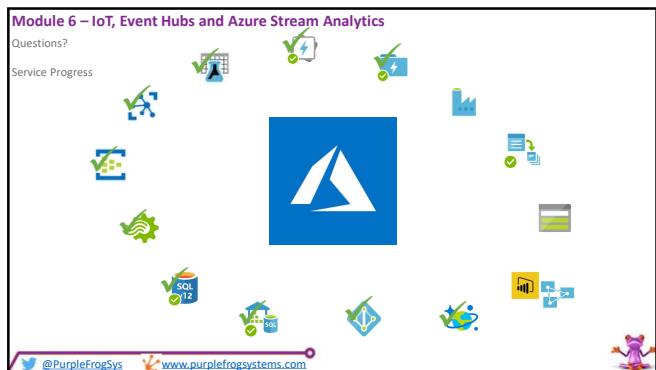
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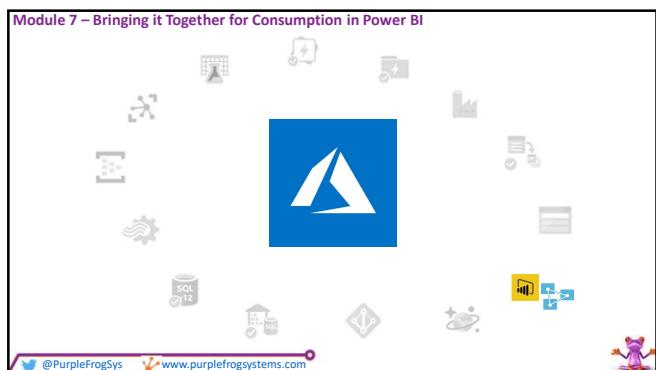
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

**Power BI – Get It From The Windows Store**  
Auto Updates

The diagram illustrates the availability of Power BI through the Windows Store. A central Microsoft Store icon has two arrows pointing to it from below, each leading to a separate icon: 'Power BI Desktop' on the left and 'Power BI Mobile' on the right. The entire graphic is contained within a white rectangular frame.

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**Module Agenda**

A slide titled 'Module Agenda' featuring a purple frog standing next to a black calendar icon. The calendar icon contains a list of topics: 'What is Power BI', 'Power BI in Production', 'Azure Analysis Services', 'Limitations & Considerations', 'Power BI Extensibility', and 'Versions & Pricing'. The entire slide is contained within a white rectangular frame.

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**Module Agenda**

A slide titled 'Module Agenda' featuring a purple frog standing next to a black calendar icon. The calendar icon contains a list of topics: 'What is Power BI', 'Power BI in Production', 'Azure Analysis Services', 'Limitations & Considerations', 'Power BI Extensibility', and 'Versions & Pricing'. The entire slide is contained within a white rectangular frame.

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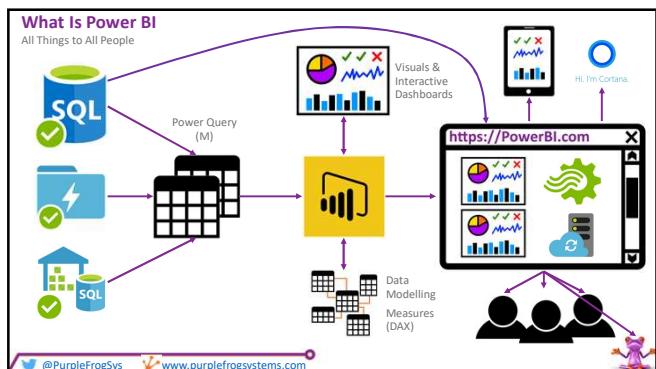
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



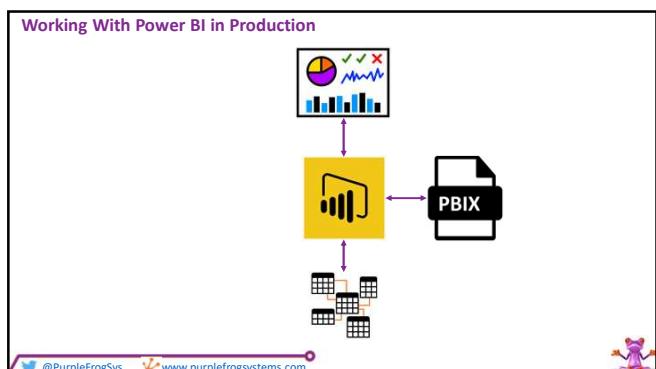
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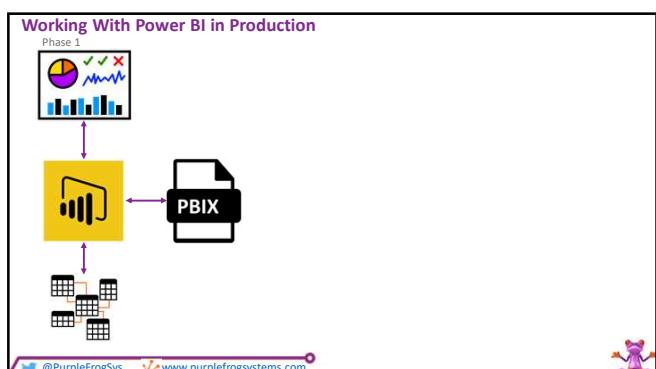
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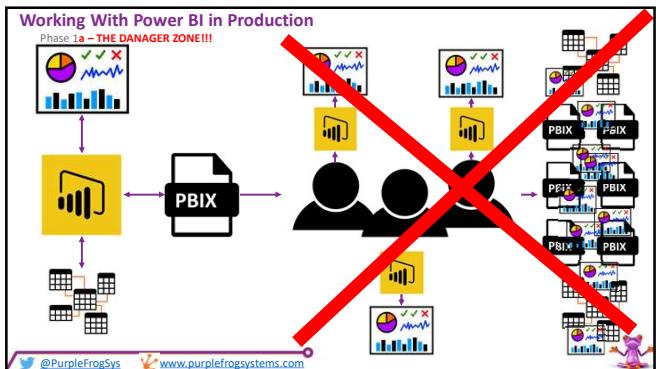
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



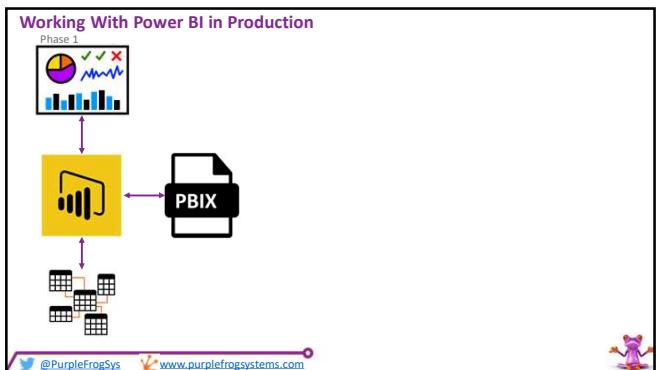
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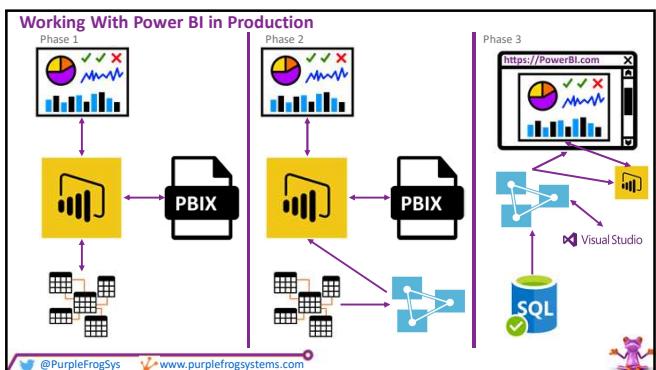
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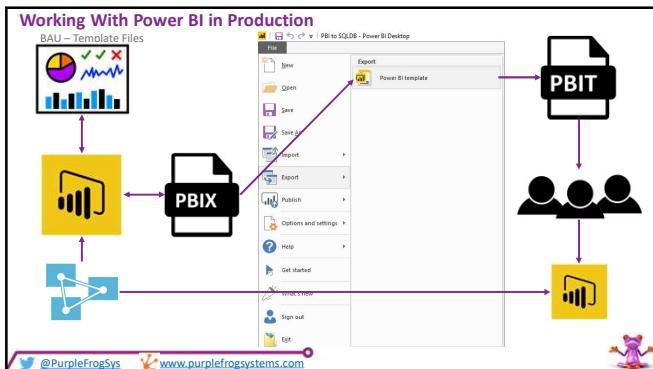
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

**Limitations: Refreshing Azure Data in Power BI.com**

The screenshot shows the 'Get Data' dialog in Power BI Desktop. The 'Azure' category is selected under 'Database'. In the top right, there's a 'Workspaces' dropdown with a link to 'Workspaces'. On the right, the 'Settings' sidebar is open, specifically the 'PBI to SQLDB' section. It shows a scheduled refresh set for daily at 10:00 UTC.

**Limitations: Refreshing Azure Data in Power BI.com**

The screenshot shows a Power BI desktop interface connected to an 'Azure Subscription' tenant. It includes icons for Azure, Office 365, and Power BI. A message box displays the error: "Failed to update data source credentials: The credentials provided for the DataLake source are invalid." Below the message, there's a link to a blog post: <https://www.purplefrogsystems.com/paul/2017/06/connecting-power-bi-to-azure-data-lake-store-across-tenants/>.

**Limitations: Queries vs Visuals vs Connections**

SQLDW Concurrency

The screenshot shows a Power BI desktop interface. On the left is a 'SQLDW Connections...\_paulandrew (127)' query editor with some SQL code. On the right is a report page with various visualizations like a bar chart, pie chart, and line chart. Arrows point from the query editor towards the report.

# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

**Limitations: Connecting Live vs Data Imports**

Azure Source	Data Access	Model Editing	Visuals
SSAS	✗	✗	✓
SQLDB	✗	✓	✓
SQLDW	✗	✓	✓
ADLS	✓	✓	✓
Blob	✓	✓	✓

When in direct query mode:

Azure Source	Data Access	Model Editing	Visuals
SSAS	✗	✗	✓
SQLDB	✗	✓	✓
SQLDW	✗	✓	✓
ADLS	✓	✓	✓
Blob	✓	✓	✓

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**Limitations: Consuming Azure Data Lake with Power BI**

File Type	CSV	TXT	DATA
Success	✓	✓	✓
Error	✗	✗	✗

Only storage connector available at present.

adl://SwimmingArea02.azuredata湖store.net

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**Limitations: Files Loaded Into Local SSAS Instance & RAM**

Name	CPU	Memory	Disk	Network
Microsoft Power BI Desktop (1)	1.1%	1,074 MB	0.7 MB/s	5.4 Mbps
Microsoft Mashup Evaluation Container	0%	253 MB	0.7 MB/s	5.4 Mbps
Microsoft Power BI Desktop Analytics Services	0.6%	237 MB	0.7 MB/s	0 Mbps
Microsoft Power BI Desktop	0%	183 MB	0.7 MB/s	0 Mbps
CarSharp BrowserSubprocess	0.5%	102.5 MB	0 MB/s	0 Mbps
Microsoft Mashup Evaluation Container	0%	61.6 MB	0 MB/s	0 Mbps
Microsoft Mashup Evaluation Container	0%	59.1 MB	0 MB/s	0 Mbps
CarSharp BrowserSubprocess	0%	31.9 MB	0 MB/s	0 Mbps
CarSharp BrowserSubprocess	0%	24.2 MB	0 MB/s	0 Mbps
Console Window Host	0%	4.7 MB	0 MB/s	0 Mbps
CarSharp BrowserSubprocess	0%	3.8 MB	0 MB/s	0 Mbps

Full Compressed When Saved

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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

### Module Agenda

The slide features a purple frog standing next to a clipboard. The clipboard has a white background with a black border and contains a bulleted list of topics:

- What is Power BI
- Power BI in Production
- Azure Analysis Services
- Limitations & Considerations
- Power BI Extensibility
- Versions & Pricing

At the bottom left of the clipboard are two small icons: a Twitter bird and a website link. At the bottom right is a small purple frog icon.

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The slide shows a screenshot of the Power BI Custom Visuals Marketplace. On the left, there's a sidebar with options like 'Import from file', 'Import from marketplace', and 'Delete a custom visual'. The main area is titled 'Power BI Visuals' and shows a list of available visual types with small preview icons and descriptions. Examples include 'Histogram Chart', 'Bullet Chart', 'Dual KPI', and 'Dell-down column chart for time based data'. Each item has an 'Add' button to the right. A small purple frog icon is at the bottom right.

<https://docs.microsoft.com/en-us/power-bi/power-bi-custom-visuals>

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The slide shows a screenshot of the 'Power BI Custom Visuals' GitHub repository. It features the same sidebar as the previous slide. In the center, there's a large icon of a document labeled 'PBIVIZ'. To the right, there's a 'node.js' logo and a command line prompt: 'npm install -g powerbi-visuals-tools'. Below this is a section titled 'Building Bar Chart' with a numbered list of 11 steps. At the bottom left is a GitHub link, and at the bottom right is a small purple frog icon.

<https://github.com/Microsoft/PowerBI-visuals>

<https://docs.microsoft.com/en-us/power-bi/service-custom-visuals-getting-started-with-developer-tools>

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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

**Power BI Community**

Help

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**Module Agenda**

- ↳ What is Power BI
- ↳ Power BI in Production
- ↳ Azure Analysis Services
- ↳ Limitations & Considerations
- ↳ Power BI Extensibility
- ↳ Versions & Pricing

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**Power BI Versions**

No Longer About Data Size

**Pricing**  
Flexible pricing to fit your budget

Author	Share and collaborate	Scale large deployments
Power BI Desktop Free	Power BI Pro £7.50 per user per month	Power BI Premium Capacity pricing per node per month
<a href="#">DOWNLOAD FREE</a>	<a href="#">TRY FREE</a>	<a href="#">PLAN YOUR COSTS</a>

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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

**Power BI Calculator**  
For The Bill Payer

**Power BI Premium calculator**

Tell us about your organization and users  
Total users: 50  CALCULATE

How will your users interact with your reports and dashboards?  
Total users: 50

Cost estimate  
Total: £3,842 per month

Power BI Pro licenses  
Units: 10  Monthly fee: £7.00 / user / month   
 Total fees: £70 / month

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<https://powerbi.microsoft.com/en-us/calculator/>

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**Module 7 – Bringing it Together for Consumption in Power BI**

Questions? 

Service Progress 

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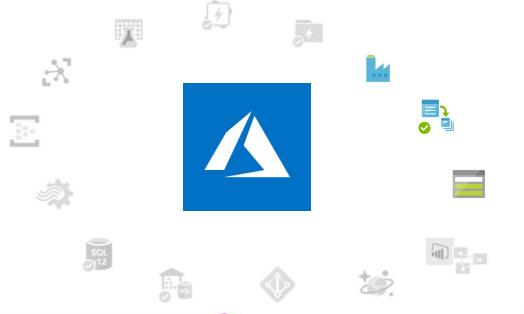
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**Module 8 – Orchestrate Your Services with Azure Data Factory**



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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles

Module Agenda

What is Azure Data Factory (ADF)?  
↳ Components & Concepts  
↳ Version 1 vs Version 2

↳ The Integration Runtime

↳ Developing and Monitoring

↳ ADF Extensibility  
↳ SSIS, REST API, Custom Activities

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Module Agenda

What is Azure Data Factory (ADF)?  
↳ Components & Concepts  
↳ Version 1 vs Version 2

↳ The Integration Runtime

↳ Developing and Monitoring

↳ ADF Extensibility  
↳ SSIS, REST API, Custom Activities

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What is Azure Data Factory (ADF)?

<https://azure.microsoft.com/en-gb/services/data-factory/>

Microsoft Azure

Why Azure? Solutions Products Documentation Pricing Training Marketplace Partners Support Blog More FREE ACCOUNT >

Data Factory

Hybrid data integration at scale, made easy

✓ Create, schedule and manage data pipelines  
✓ Fully managed ETL/ELT service in the cloud  
✓ Run your SQL Server Integration Service packages directly in the cloud

✓ Accelerate your data integration with multiple native data connectors  
✓ Modernise your data warehouse with big data integration  
✓ Orchestrate your data integration workflows wherever your data lives

Getting started >

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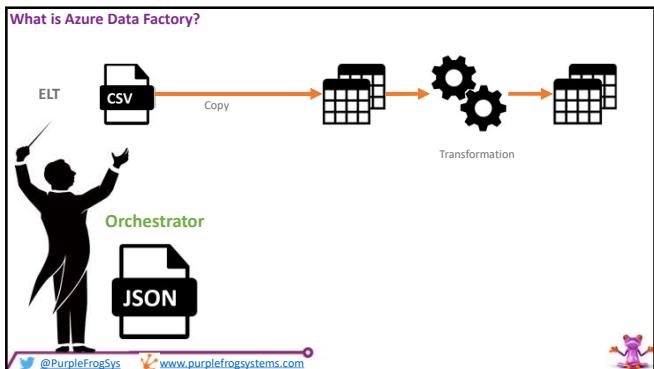
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



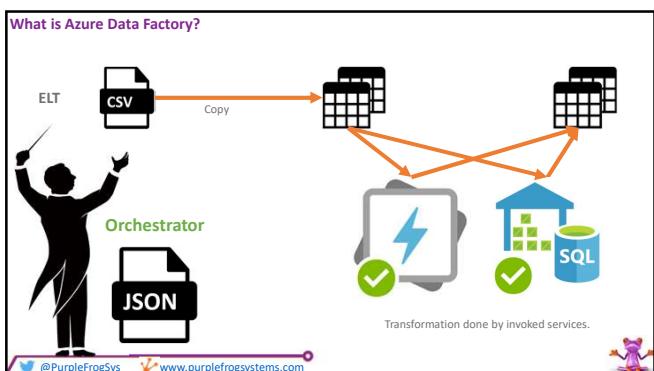
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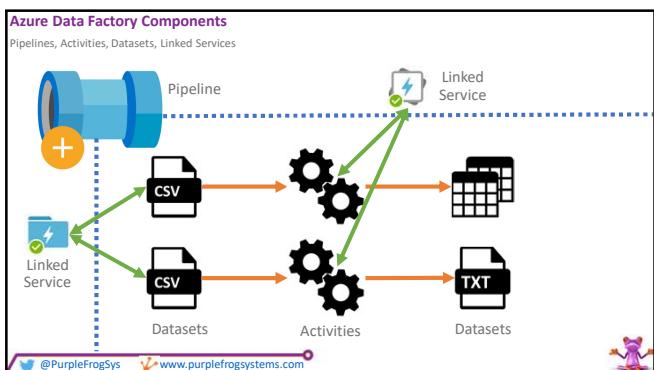
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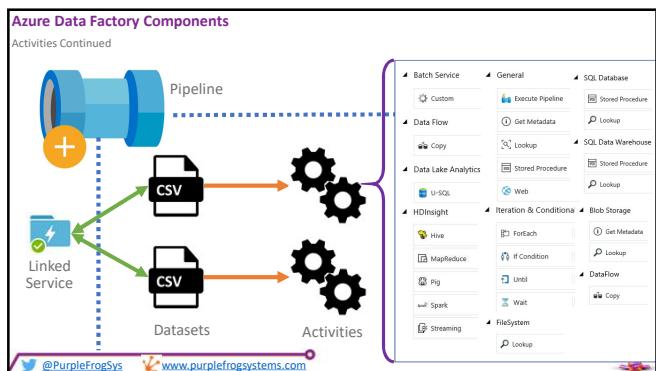
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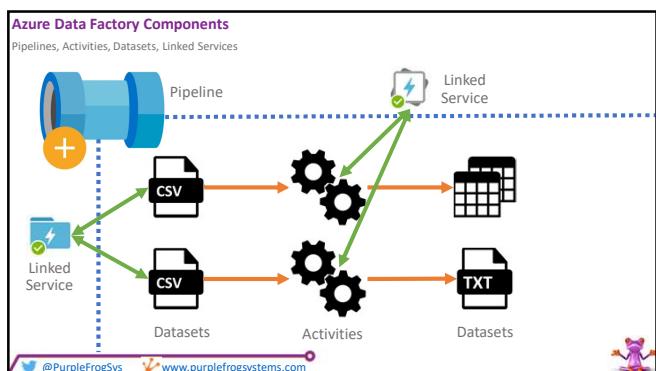
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# Business Intelligence in Azure

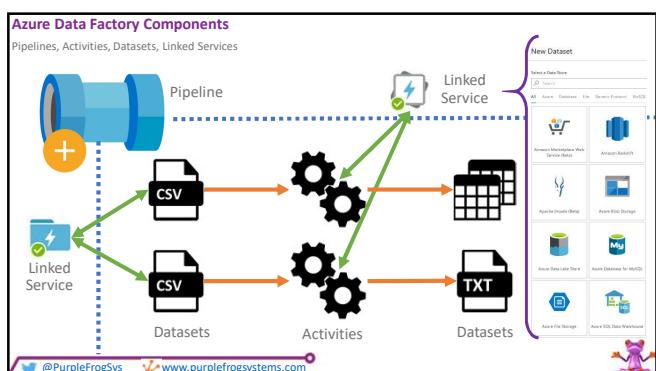
## with Paul Andrew & Alex Whittles



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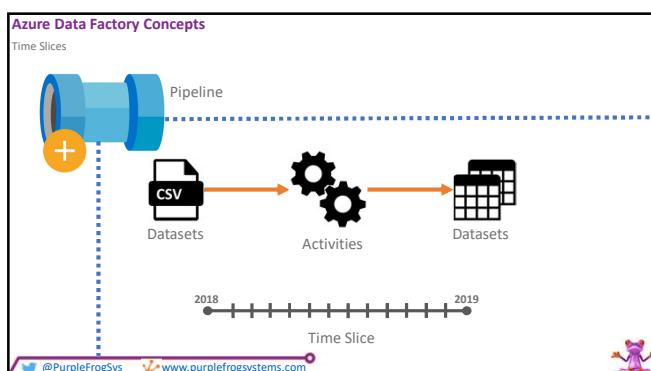
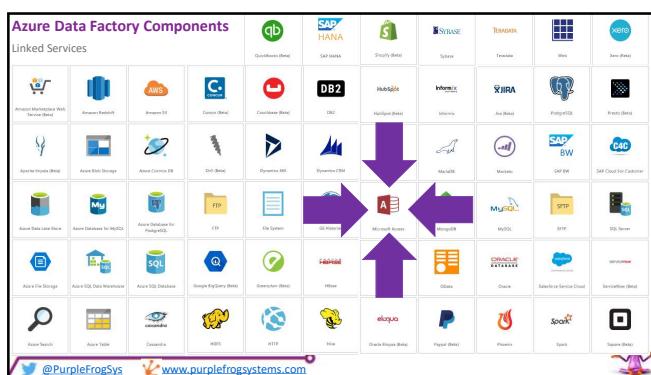
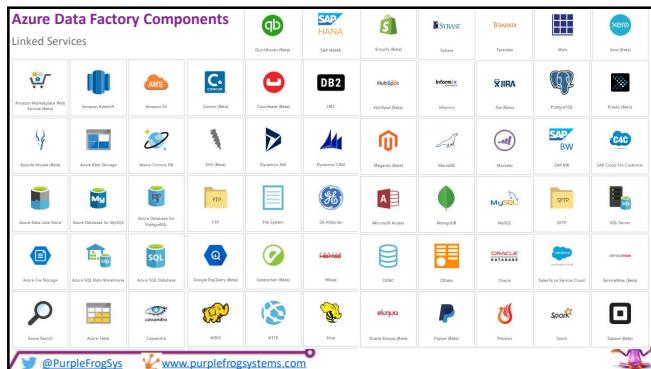
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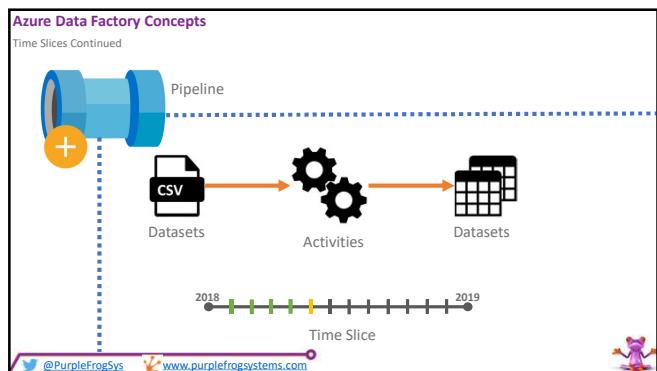
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## with Paul Andrew & Alex Whittles



# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



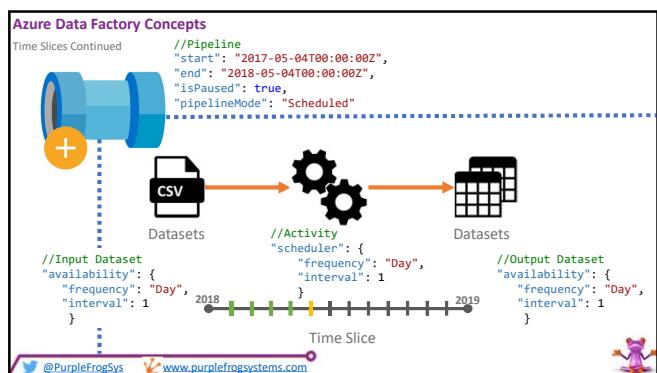
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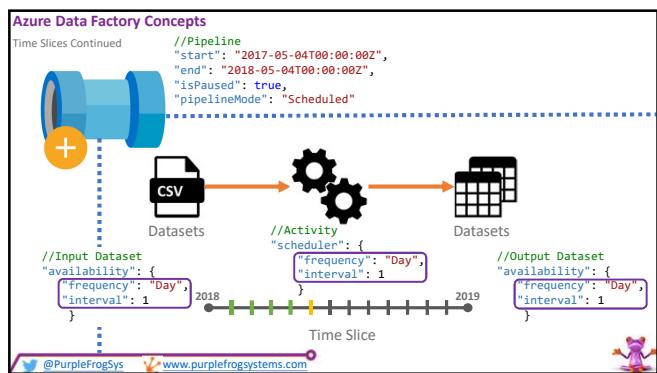
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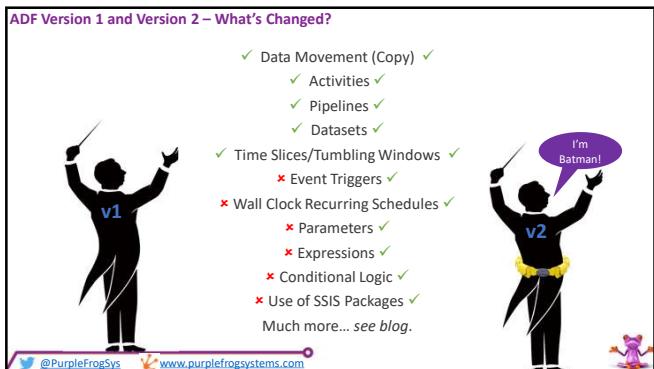
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



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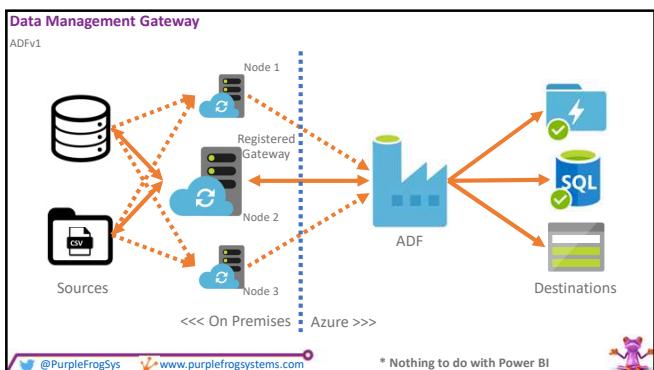
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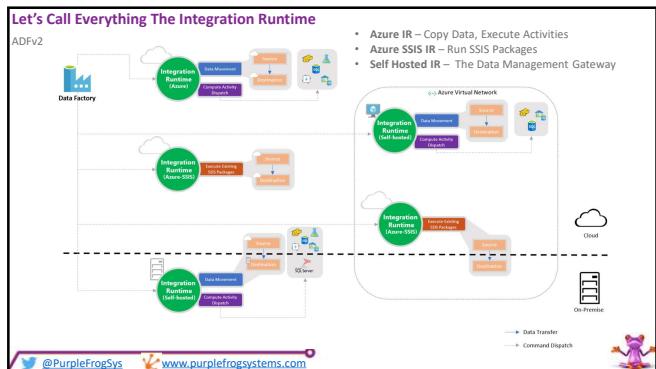
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# Business Intelligence in Azure

## with Paul Andrew & Alex Whittles



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**Developer Tools – ADFv2 Portal Author & Deploy Screens**

The screenshot shows the Azure Data Factory V2 developer tools interface. On the left, there's a sidebar with 'CommunityDemos' and 'RunFactory02'. The main area shows a pipeline named 'CopyData' with three activities: 'U-SQL', 'U-SQL1', and 'U-SQL2', followed by a 'Web' activity. The pipeline is triggered by a 'Sync' activity from 'VSTS GIT'. The pipeline is currently in 'Sync' mode. The pipeline details pane shows 'Name: CopyData' and 'Description:'. The bottom of the screen has social media links for @PurpleFrogSys and www.purplefrogsystems.com.



**ADFv1 and ADFv2 Monitoring**

Version 1

- Minimal Azure portal screens.
- Time slice bound.
- Pass or fail states.

The screenshot shows the Azure portal's monitoring interface for ADFv1. It displays a table of pipeline runs. One run is listed: 'Run01SPackage' with a status of 'Succeeded'. The table includes columns for Pipeline Name, Actions, Run Start, Duration, Triggered By, Status, Parameters, and Error. The bottom of the screen has social media links for @PurpleFrogSys and www.purplefrogsystems.com.

Version 2

- Part of the ADF developer tool.
- Pipeline execution and trigger focused.
- Activity drill down.
- Parameter inspection.

The screenshot shows the Azure Data Factory developer tools' monitoring interface for ADFv2. It displays a table of pipeline runs, showing the same 'Run01SPackage' entry with a 'Succeeded' status. The interface is more detailed than the ADFv1 version. The bottom of the screen has social media links for @PurpleFrogSys and www.purplefrogsystems.com.



**PowerShell**

<https://docs.microsoft.com/en-us/powershell/resourcemanager/azurerm.datafactories/v2.5.0/azurerm.datafactories>

The screenshot shows a Windows PowerShell session with a script named 'Untitled.ps1' running. The script uses the 'Azurerm' module to perform several actions: creating a resource group, setting context for a subscription, creating a data factory, and creating a pipeline. The right side of the screen shows a list of available PowerShell cmdlets for the 'Azurerm' module. The bottom of the screen has social media links for @PurpleFrogSys and www.purplefrogsystems.com.



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### Module Agenda

The agenda includes:

- What is Azure Data Factory (ADF)?
  - Components & Concepts
  - Version 1 vs Version 2
- The Integration Runtime
- Developing and Monitoring
- ADF Extensibility
  - SSIS, REST API, Custom Activities

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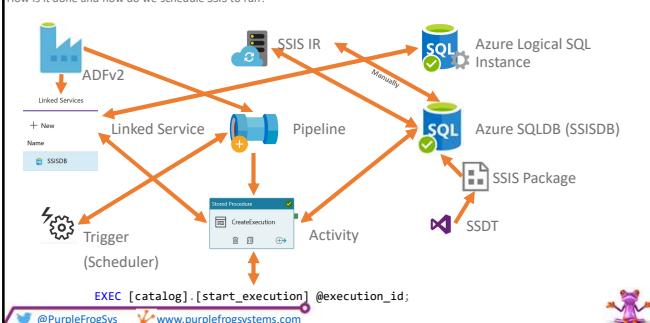
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### Running SSIS Packages in Azure

How is it done and how do we schedule SSIS to run?



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### Scheduling Stuff in Azure



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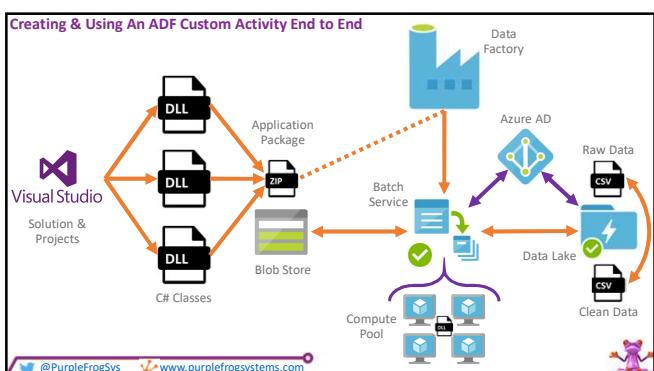
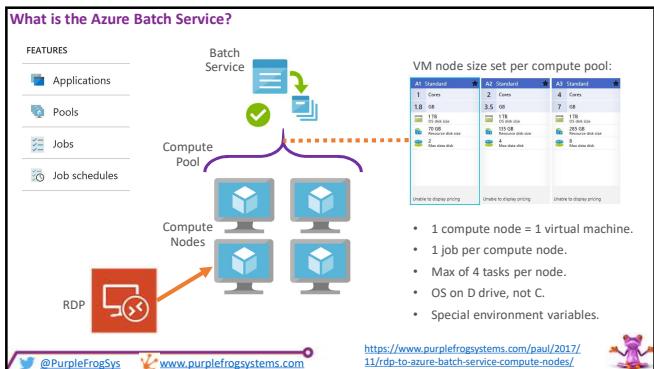
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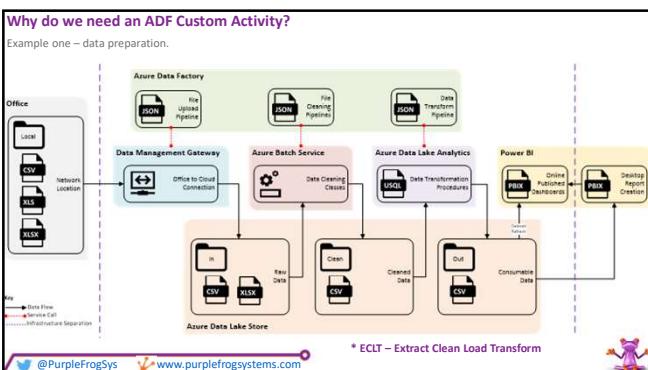
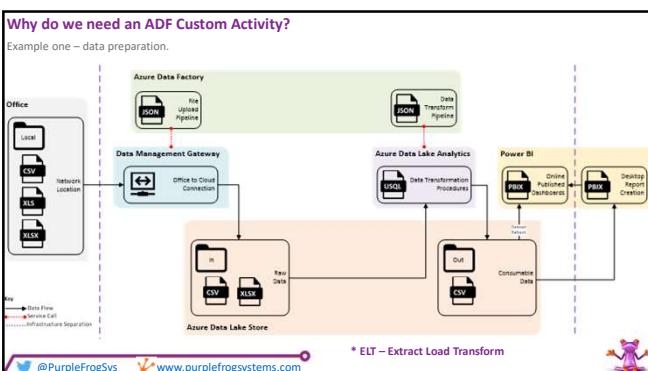
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**ADF Custom Activity vs SSIS Control Flow Script Task**

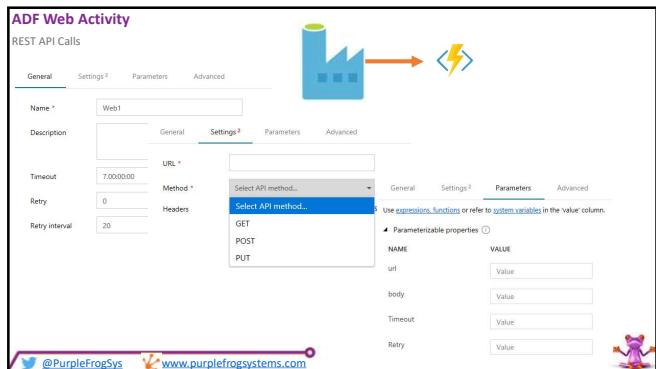
The screenshot shows two windows side-by-side. On the left is the 'PaulAndrewfactory - Microsoft Visual Studio' window, which displays the ADF Custom Activity (Data Flow Task) in the center. On the right is the 'Visual Studio - Microsoft Visual Studio' window, which displays the SSIS Control Flow Script Task code in the center. Arrows point from the ADF Custom Activity icon in the ADF window to the SSIS code, and from the SSIS code back to the ADF Custom Activity icon.

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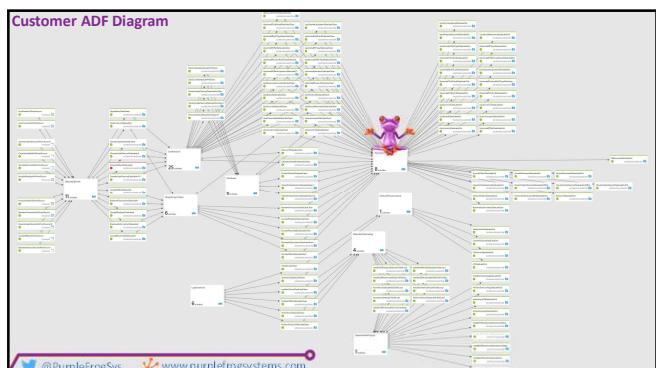
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### ADF Take Away Points

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|---|--|
| 1. What is Azure Data Factory (ADF)? <ul style="list-style-type: none"><li>• What is an ADF Pipeline?</li><li>• What is an ADF Dataset?</li></ul> | Orchestration tool.<br>Logical container of work.<br>Input/output.   |
| 2. What is an ADF Activity?   | Instructions for the service(s) invoked.   |
| 3. What is an ADF Time Slice?   | Way we control executions.<br>Equal across the time line. Bread!   |
| 4. What is a ADF Custom Activity?   | Extensibility. Call .Net class library.<br>Compute provided by batch service.  |
| 5. What is the Integration Runtime?   | ADF's way of executing activities.<br>A small bit of compute for data copying.<br>The wrapper for SSIS package execution.<br>An on premises gateway (VPN). |

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### Module 8 – Orchestrate Your Services with Azure Data Factory

Questions?

Service Progress



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