



بيانات الاتصال  
وتقنيات جيأ المعلومات



# Real-Time Traffic Analytics Using Azure Stream Analytics

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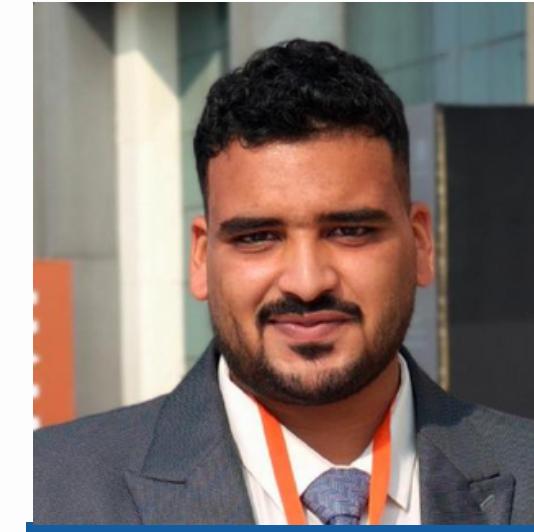




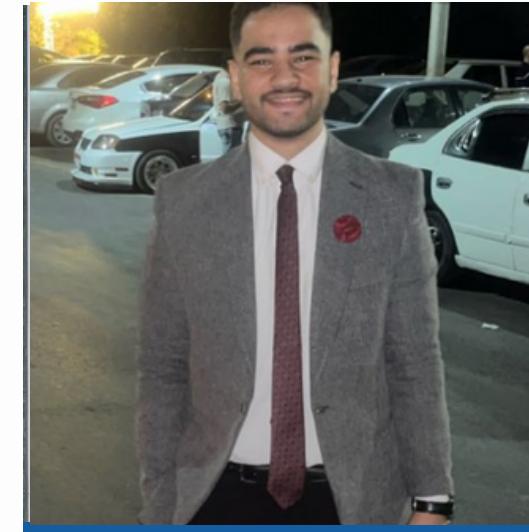
# Our Team



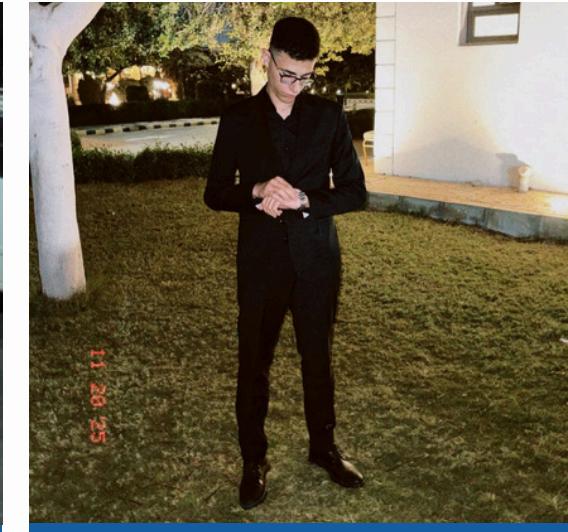
**Ali  
Ledar**



**Ibrahim**



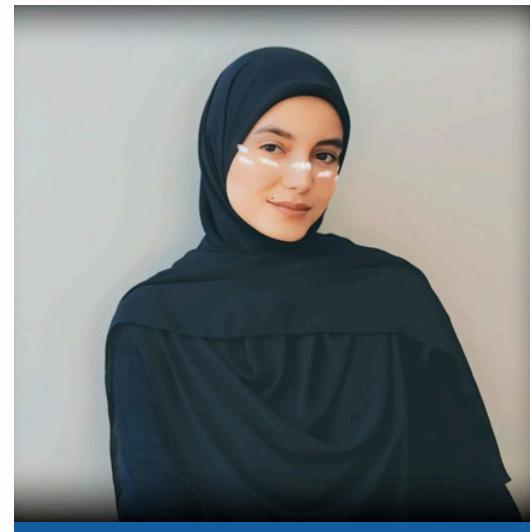
**Kareem**



**Mohamed**



**Esraa**



**Asmaa**



# Problem Statement

Cities suffer from heavy traffic congestion, slow incident detection, and lack of real-time monitoring.

This project aims to build a solution that analyzes traffic in real time and provides instant insights

## Problem 01

Traffic conditions change rapidly, making manual monitoring unreliable and slow

## Problem 02

Decision-makers need real-time insights to optimize routes and reduce delays

## Problem 03

Existing systems lack automated anomaly detection for incidents and congestion spikes.





# Project Objectives

This project aims to build an end-to-end real-time traffic monitoring pipeline using Azure cloud services



## Objective 01

Improve decision-making by providing live traffic insights and automated alerts.



## Objective 02

Enable scalable data ingestion and processing for high-volume streaming events



## Objective 03

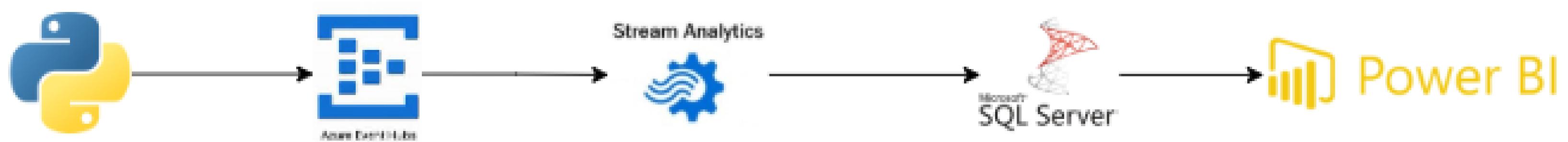
Deliver a unified dashboard for traffic visualization and operational monitoring





# System Architecture

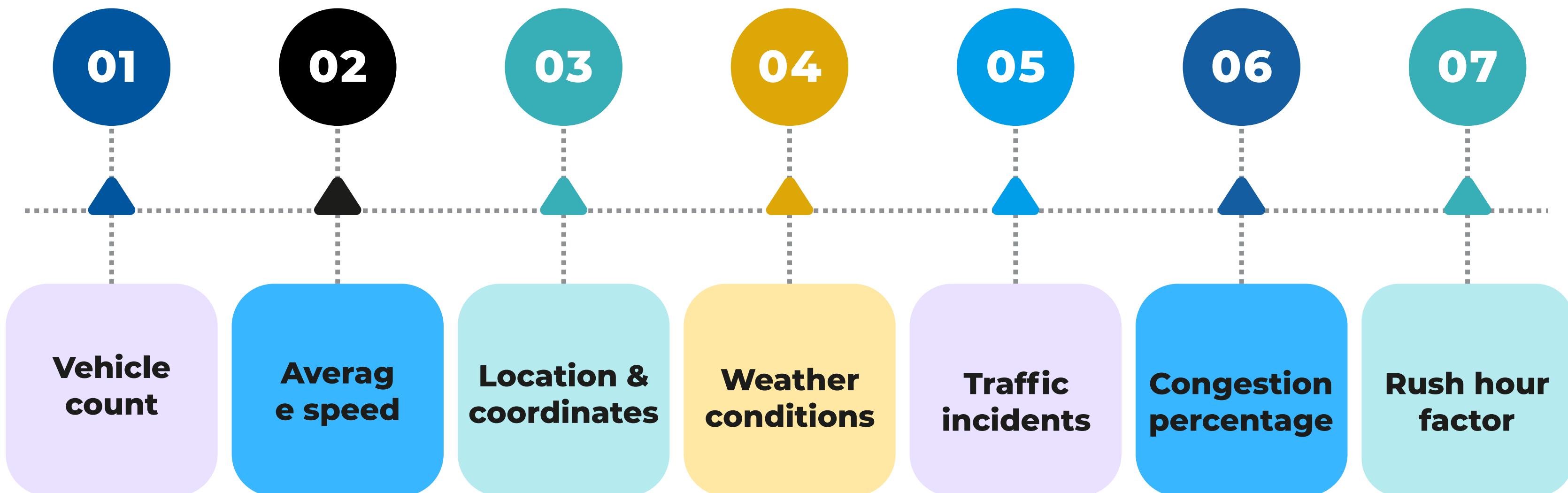
## High-Level Architecture Diagram





# Data Simulation Overview

Our Python simulator generates:





## Sample Generated Event

```
{  
  "timestamp": "2025-11-25 18:20:30",  
  "location": "Tahrir Square",  
  "vehicle_count": 95,  
  "average_speed": 34,  
  "weather": "Light Rain",  
  "incident": "Minor Accident",  
  "congestion_percentage": 85  
}
```





## Azure Event Hub Setup

Azure Event Hubs was used as the main ingestion layer for streaming traffic events. Key features:

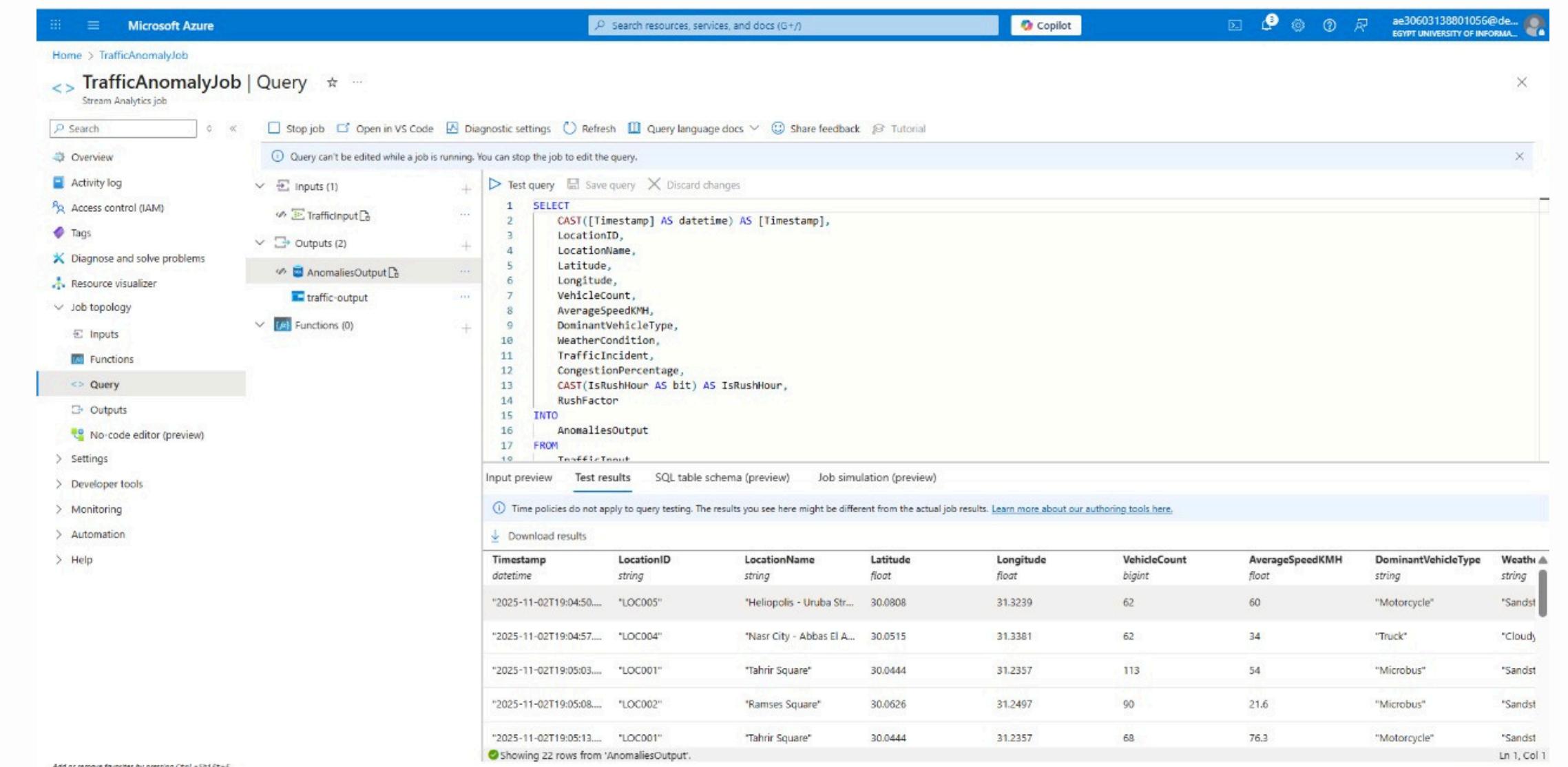
- **High-throughput message ingestion**
- **Supports thousands of events per second**
- **Partitioning to distribute traffic load**
- **Secure authentication via Shared Access Policies**
- **Integration with Stream Analytics in real time**

# Stream Analytics Job

Our Stream Analytics job was responsible for processing traffic events in real time.

## Capabilities:

- Running continuous SQL queries
- Detecting congestion and abnormal patterns
- Filtering irrelevant events
- Joining live data with reference data (if needed)
- Routing processed output to SQL / Blob / Power BI



The screenshot shows the Microsoft Azure Stream Analytics Query editor. On the left, the job navigation pane displays 'TrafficAnomalyJob' with sections like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Resource visualizer, Job topology, Inputs, Functions, and a highlighted 'Query'. The main area shows a 'Test query' window containing a continuous SQL query:

```
1 SELECT
2     CAST([Timestamp] AS datetime) AS [Timestamp],
3     LocationID,
4     LocationName,
5     Latitude,
6     Longitude,
7     VehicleCount,
8     AverageSpeedKMH,
9     DominantVehicleType,
10    WeatherCondition,
11    TrafficIncident,
12    CongestionPercentage,
13    CAST(IsRushHour AS bit) AS IsRushHour,
14    RushFactor
15 INTO
16    AnomaliesOutput
17 FROM
18    TrafficInput
```

Below the query, there are tabs for 'Input preview', 'Test results', 'SQL table schema (preview)', and 'Job simulation (preview)'. The 'Test results' tab shows a table with 22 rows of simulated traffic data:

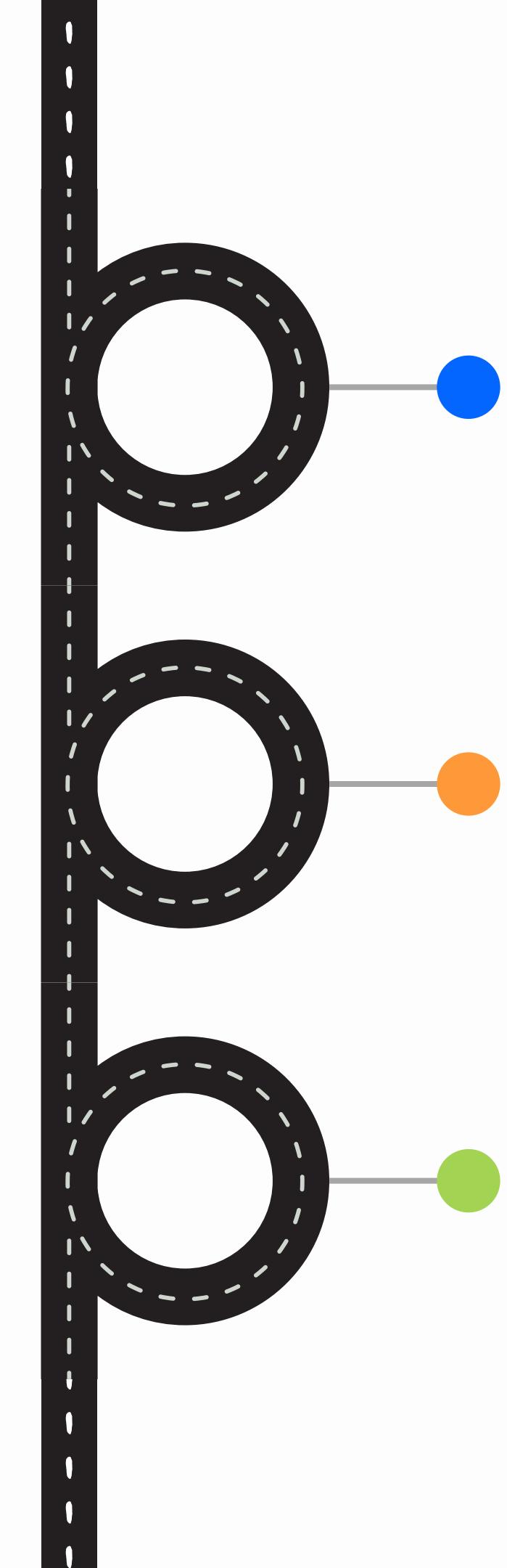
Timestamp	LocationID	LocationName	Latitude	Longitude	VehicleCount	AverageSpeedKMH	DominantVehicleType	WeatherCondition
2025-11-02T19:04:50...	"LOC005"	"Helipolis - Uruba Str..."	30.0808	31.3239	62	60	"Motorcycle"	*Sandst
2025-11-02T19:04:57...	"LOC004"	"Nasr City - Abbas El A..."	30.0515	31.3381	62	34	"Truck"	*Cloudy
2025-11-02T19:05:03...	"LOC001"	"Tahrir Square"	30.0444	31.2357	113	54	"Microbus"	*Sandst
2025-11-02T19:05:08...	"LOC002"	"Ramses Square"	30.0626	31.2497	90	21.6	"Microbus"	*Sandst
2025-11-02T19:05:13...	"LOC001"	"Tahrir Square"	30.0444	31.2357	68	76.3	"Motorcycle"	*Sandst

At the bottom, a note says 'Showing 22 rows from 'AnomaliesOutput''. The status bar at the bottom of the browser window shows 'ae30603130801056@de... EGYPT UNIVERSITY OF INFORMAT...'.





## Real-Time Query Examples



### High Congestion Detection

```
SELECT *\nFROM InputStream\nWHERE congestion_percentage > 80
```

### High Speed Detection

```
SELECT *\nFROM InputStream\nWHERE average_speed > 80
```

### Incident Filtering

```
SELECT *\nFROM InputStream\nWHERE incident <> "None"
```



# Output Storage

Our processed results were stored using multiple Azure storage options



Azure SQL Database

Structured insights for queries



Azure Blob Storage

Raw and historical events



Azure Data Lake

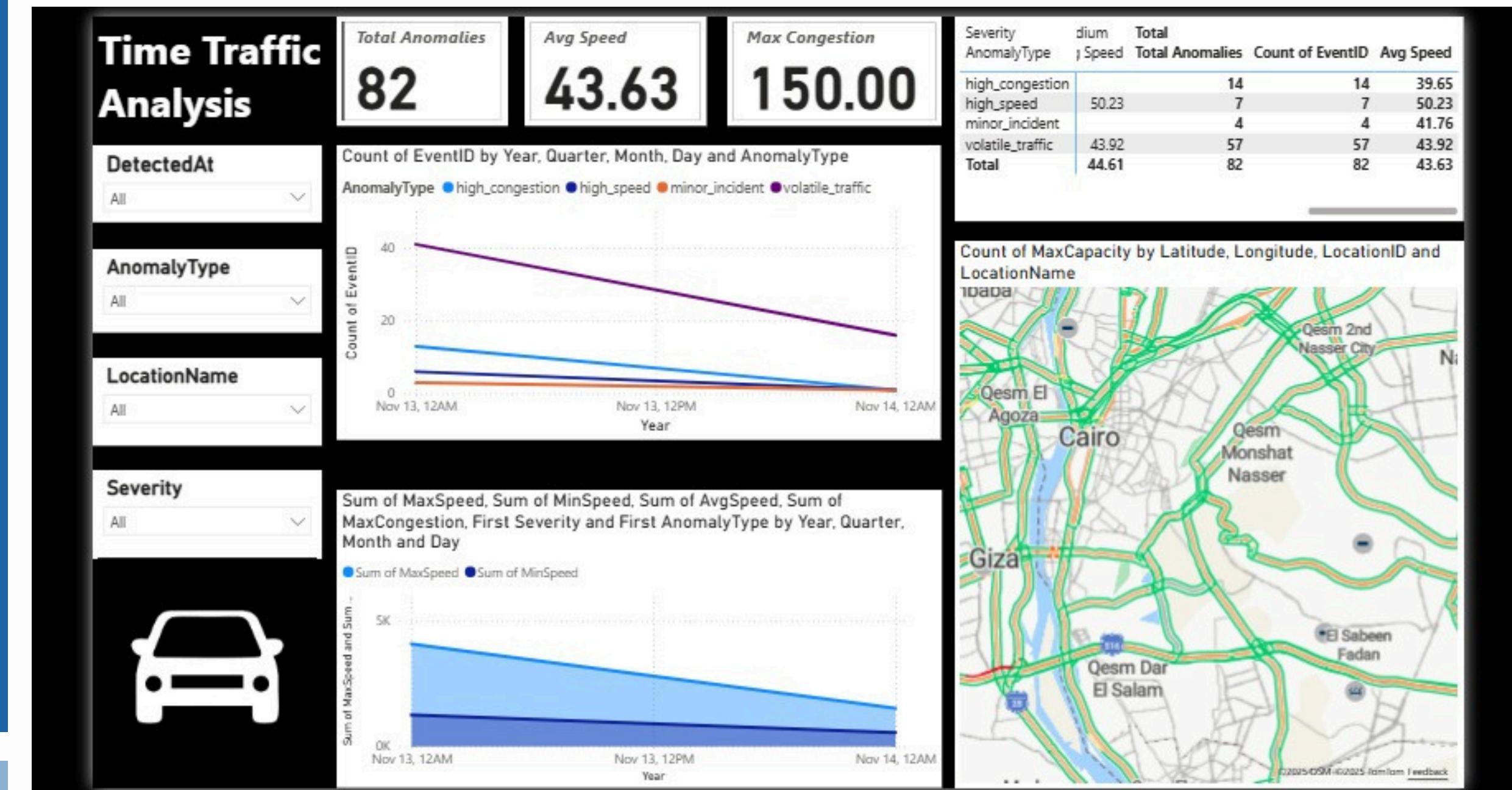
Future ML and large-scale analytics

# Power BI Dashboard

Our Power BI dashboard visualized the real-time traffic stream.

Dashboard includes:

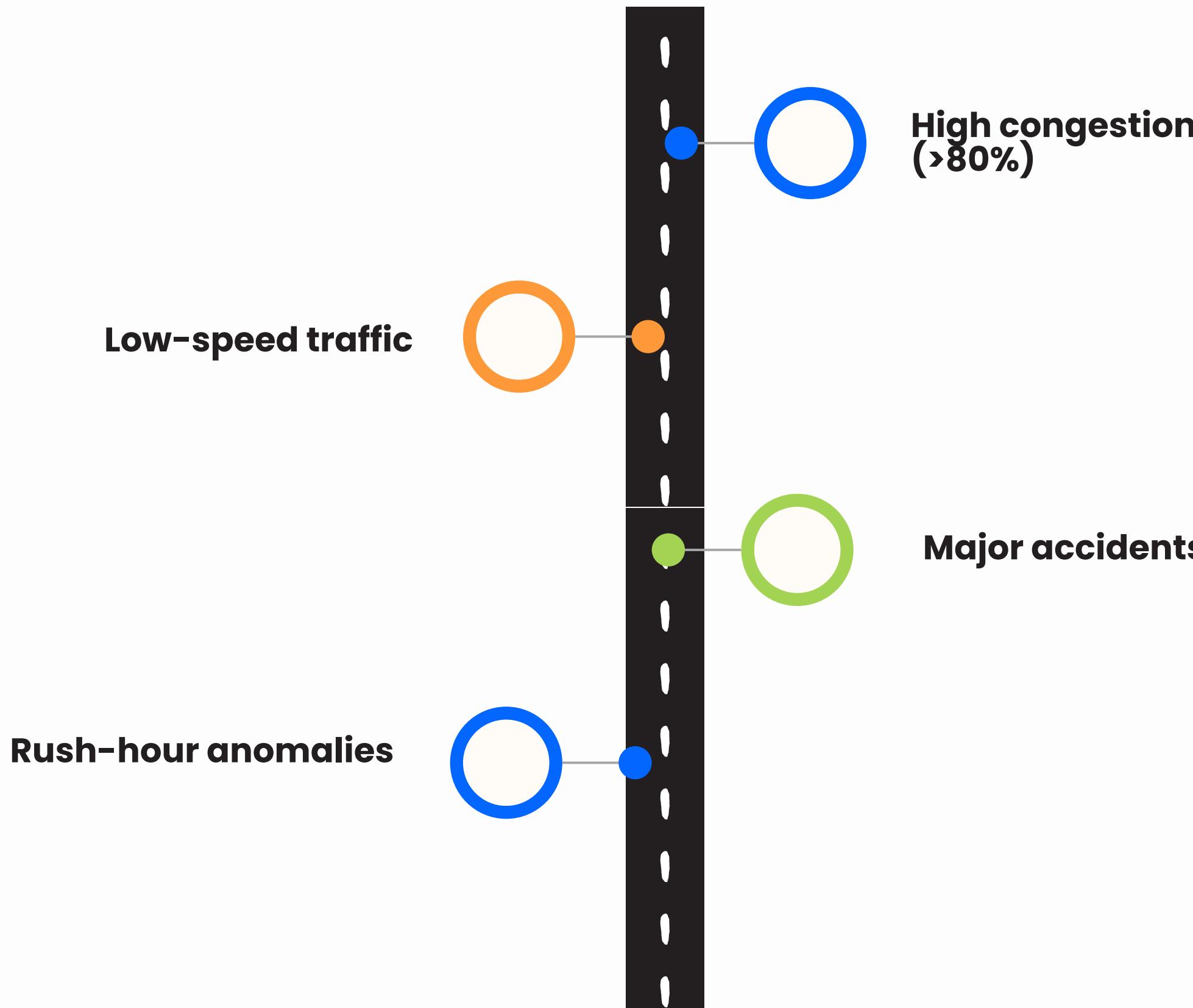
- Vehicle count trends
- Congestion levels & heatmaps
- Current weather vs congestion
- Real-time incident notifications
- Speed distribution charts





# Alerting System

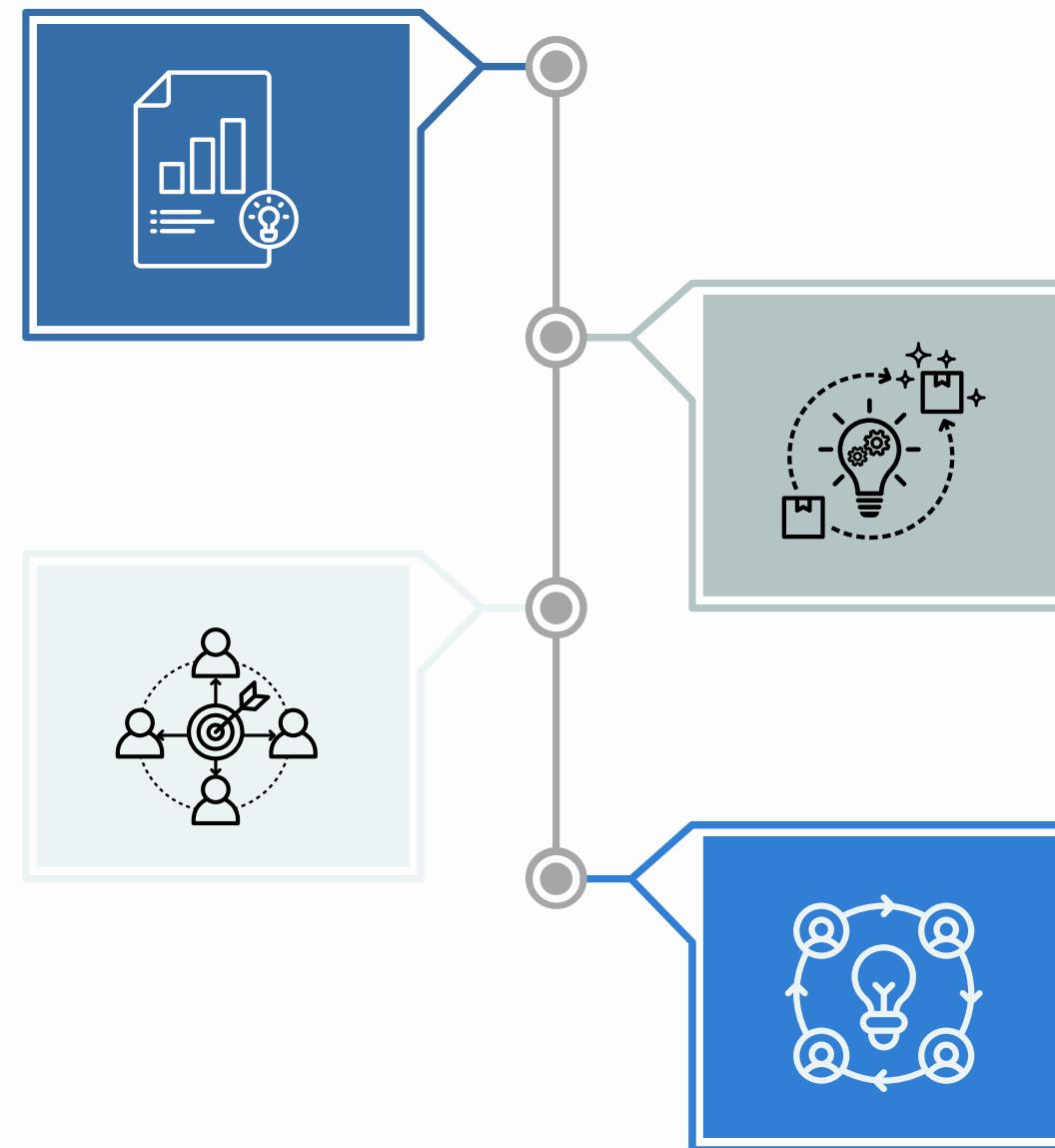
We implemented an alerting mechanism triggered by Stream Analytics outputs  
Alerts triggered for





## Results

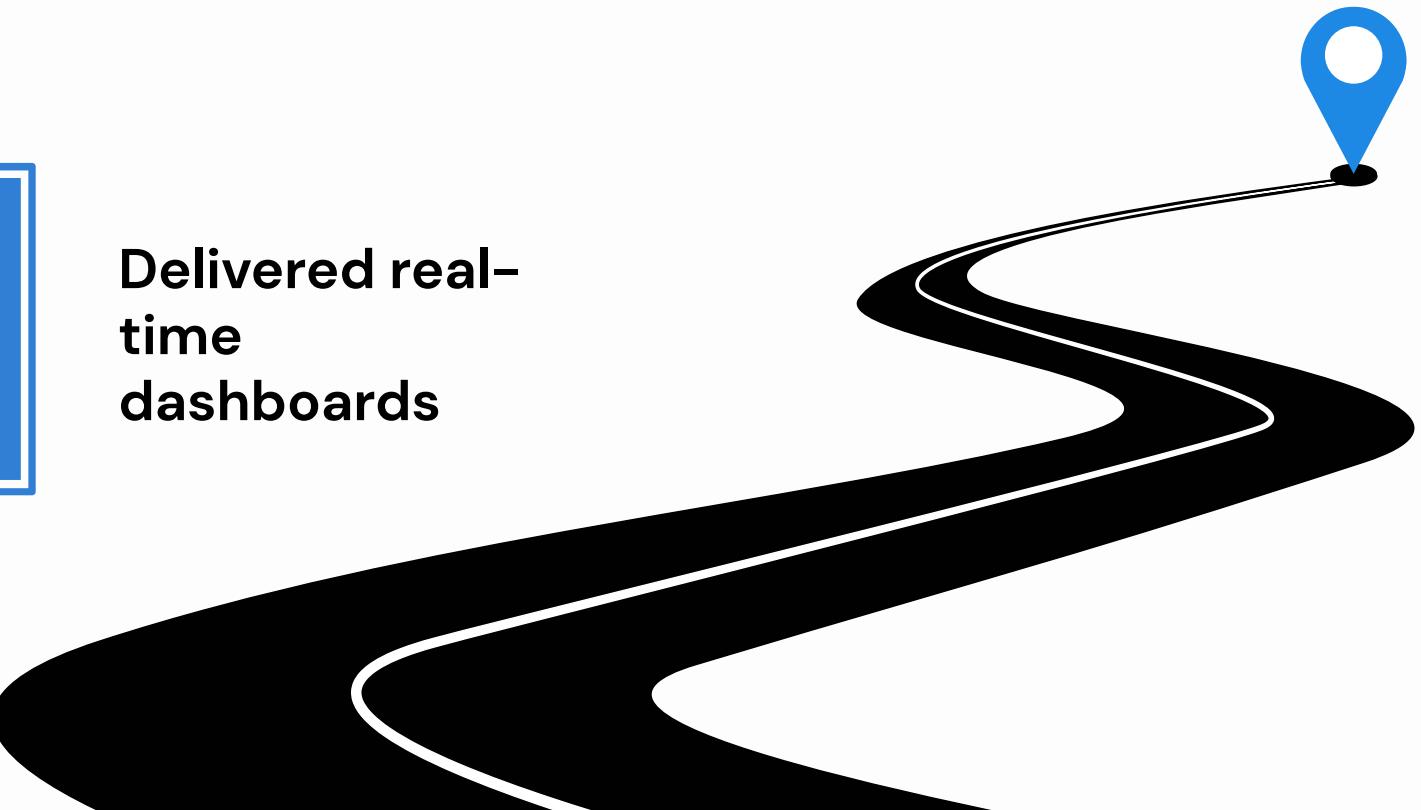
Streamed live traffic data into the cloud



Showed weather impact on traffic flow

Detected congestion and unusual events

Delivered real-time dashboards





# THANK YOU!

