Bus Route Analysis Project

Tools: MySQL · Power BI · DAX

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Project Objective

The primary objective of this project is to analyze public transportation performance by focusing on **bus routes, schedules, and delay patterns**.
Using structured SQL queries and an interactive Power BI dashboard, the goal is to:
Track and understand **trip delays** across different bus routes and timeframes
Identify **high-delay buses and routes** that require optimization
Monitor **operational KPIs** such as average delay, total trips, and percentage of delayed trips
Enable **data-driven decision-making** for transport managers and city planners
By simulating real-world data and building an integrated SQL-Power BI pipeline, this project demonstrates how data analytics can drive **transportation efficiency**, reduce **customer dissatisfaction**, and improve **fleet scheduling**.

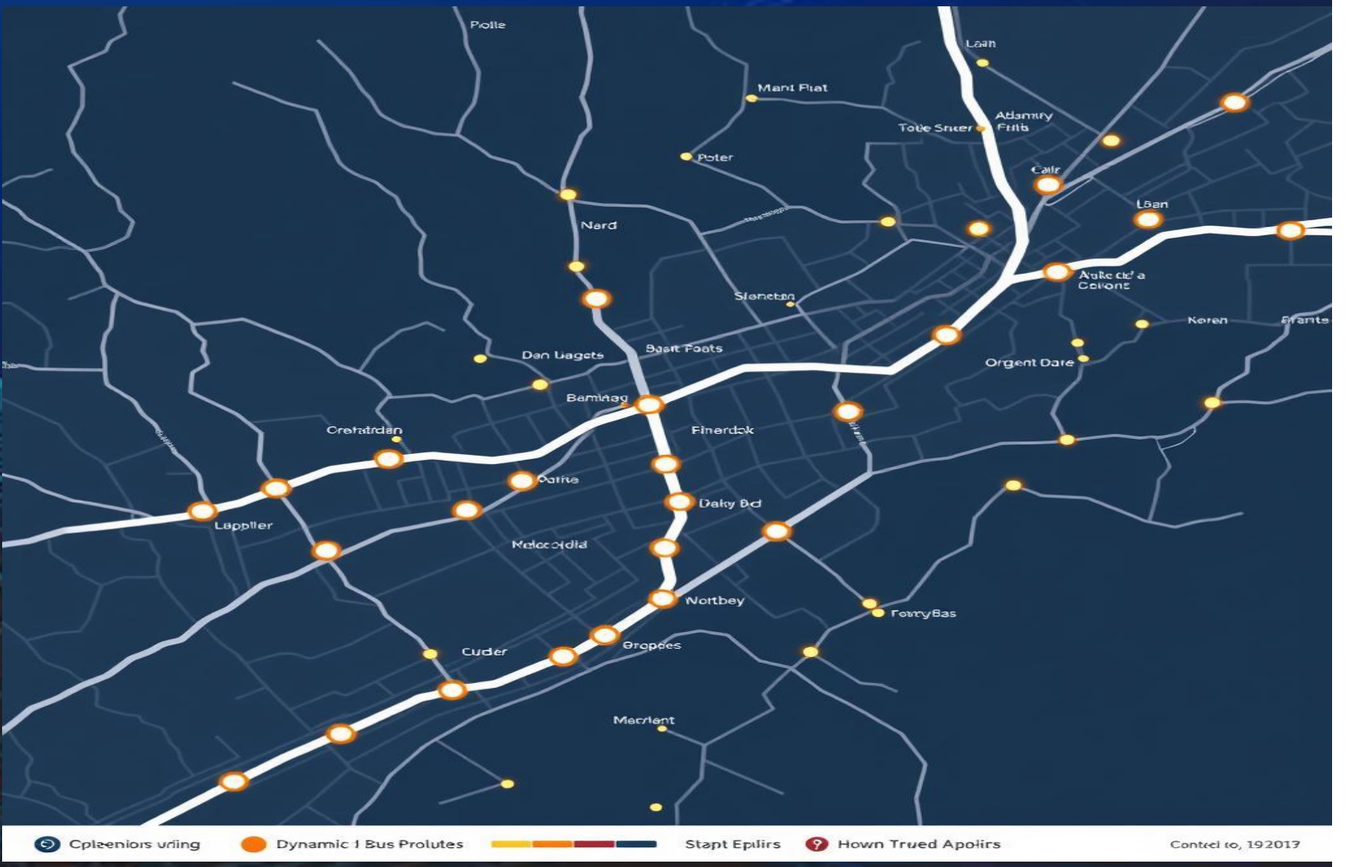
Total Number of Trips per Route

```sql
-- 1.  Total Number of Trips per Route

SELECT
    route_id,
    COUNT(*) AS total_trips
FROM
    trip_logs
GROUP BY
    route_id;
```

Result Grid | Filter Rows: | Export:

route_id	total_trips
4	28
5	4
2	14
3	4



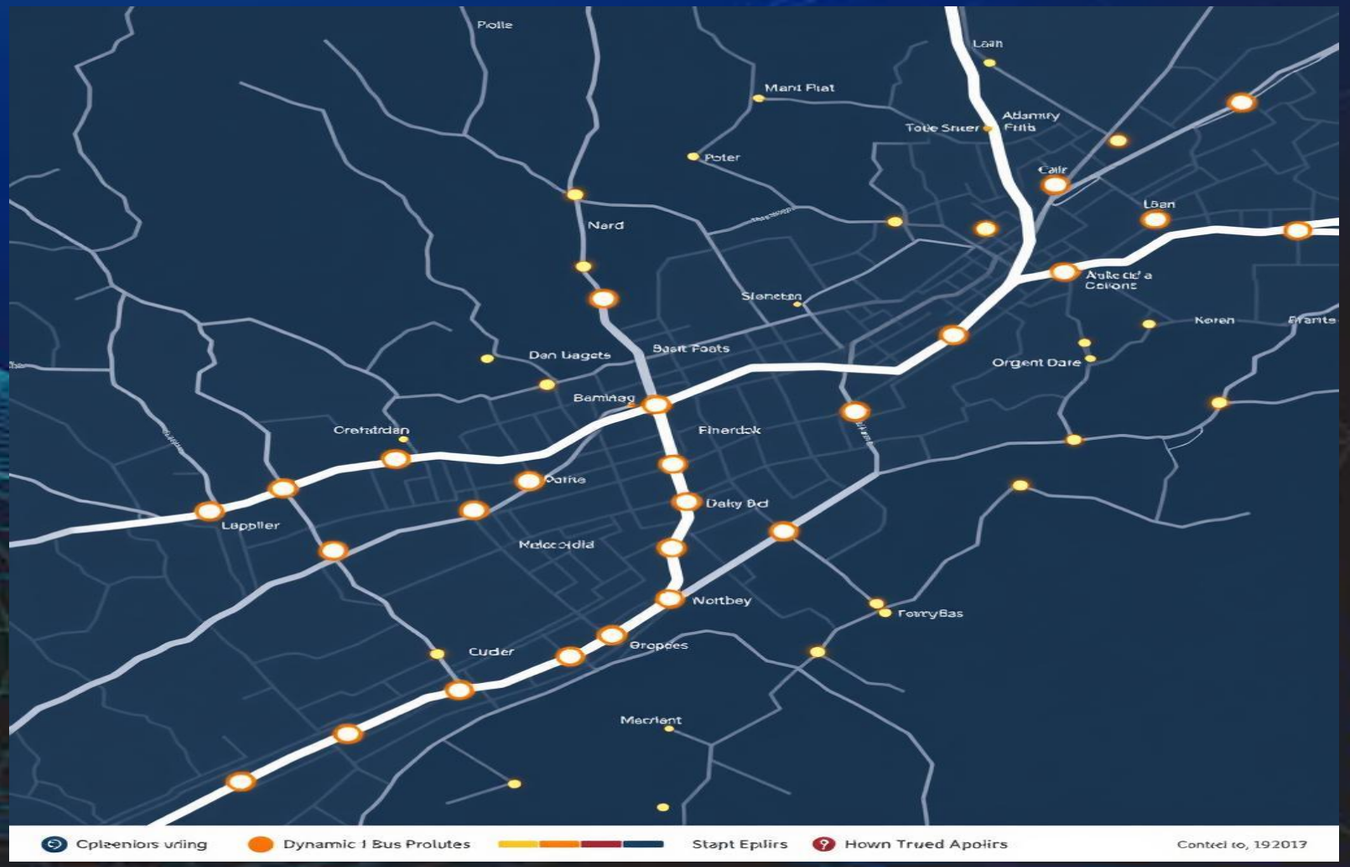
Average Delay per Route

```sql
-- 2. Average Delay per Bus

SELECT
    bus_id,
    AVG(delay_minutes) AS avg_delay
FROM
    trip_logs
GROUP BY
    bus_id;
```

Result Grid | Filter Rows: | Export:

bus_id	avg_delay
6	9.2500
9	8.3636
4	11.6667
8	6.7500
5	8.2500
3	3.2000
1	6.6667
10	4.0000
2	3.5000
7	1.0000

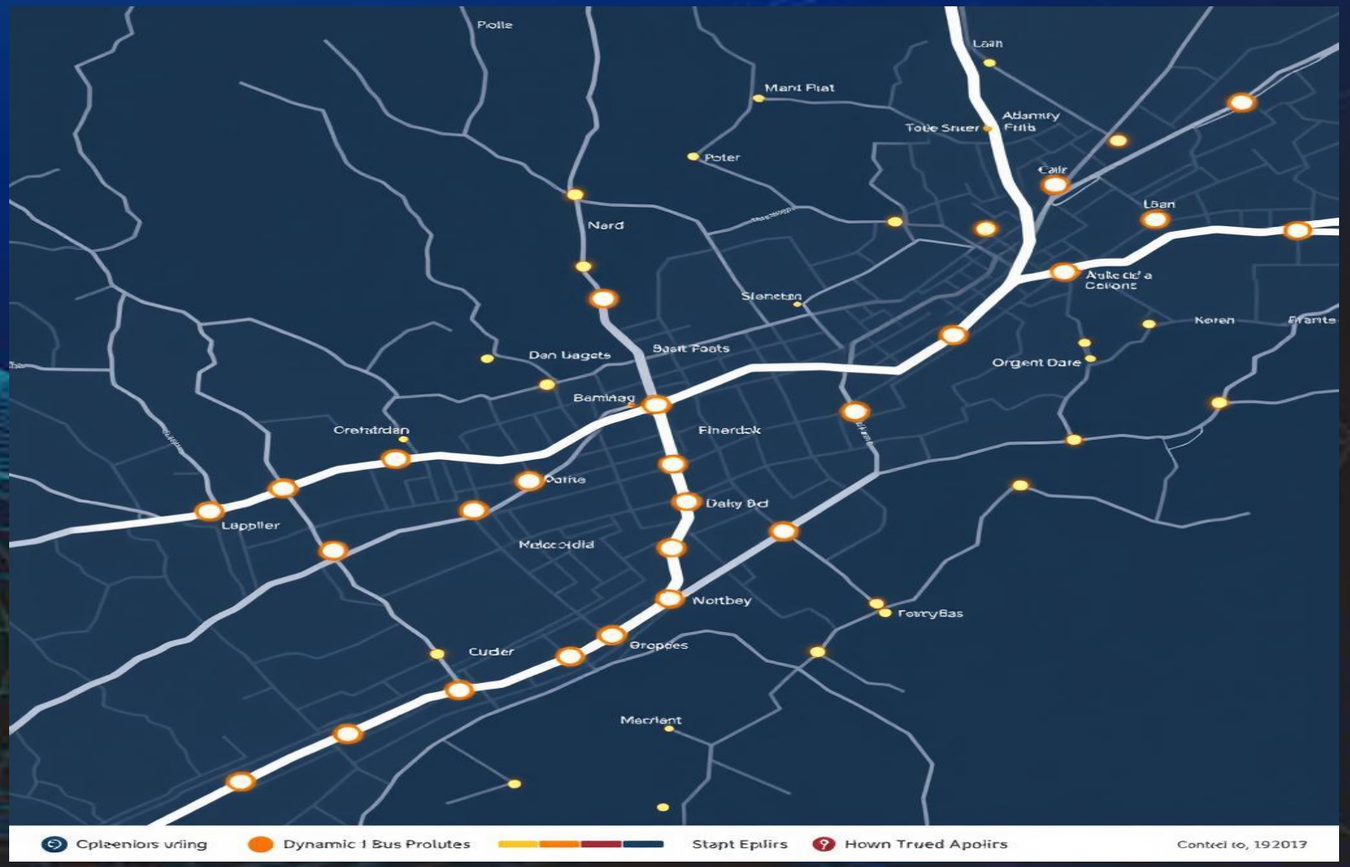


Number of Delayed Trips (Delay > 5 mins

```
25      -- 3. Number of Delayed Trips (delay > 5 mins)
26
27      SELECT
28          COUNT(*) AS delayed_trips
29      FROM
30          trip_logs
31      WHERE
32          delay_minutes > 5;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Conten

delayed_trips
20

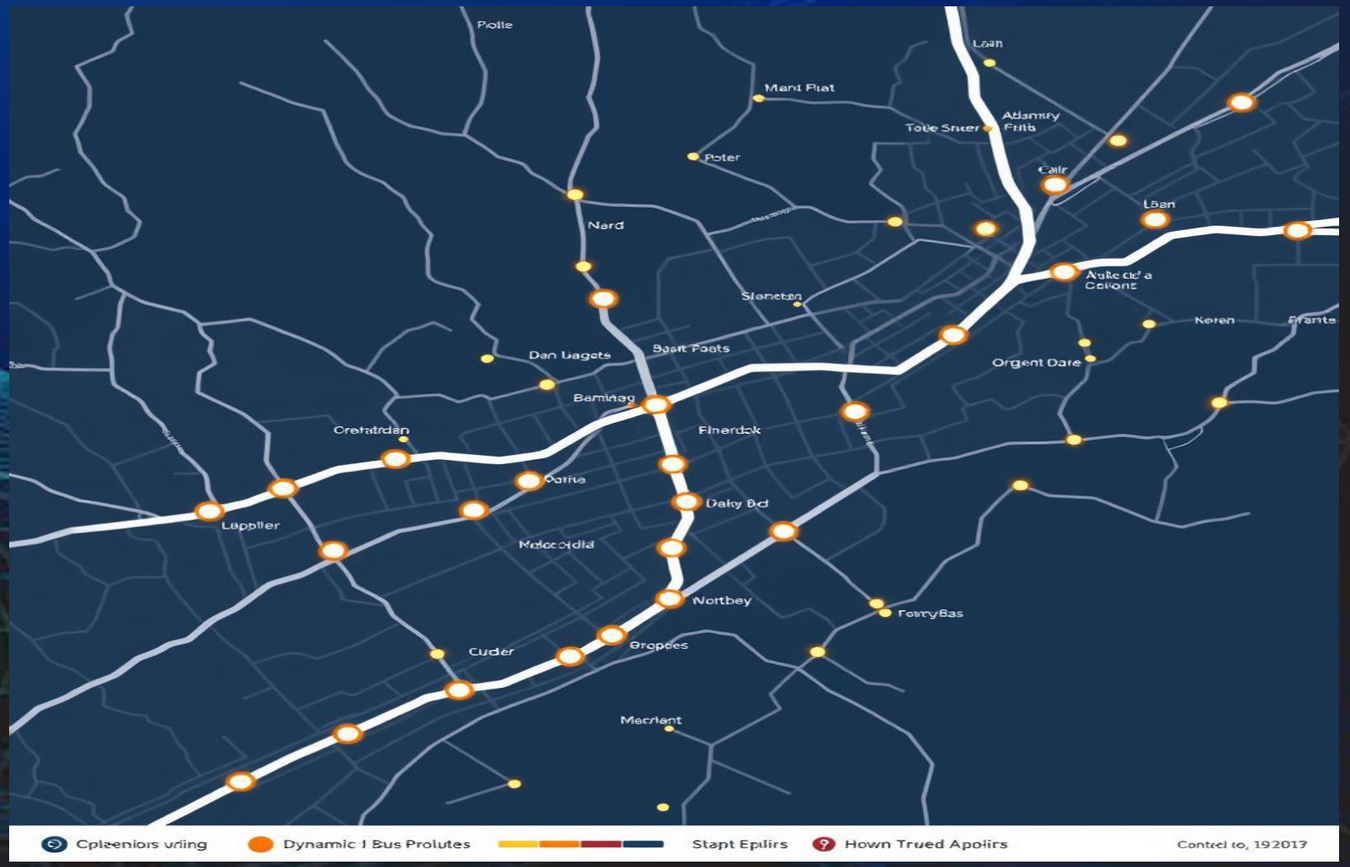


Delay Trend by Date (Daily Total Delay

```sql
35    -- 4.  Delay Trend by Date (Daily Total Delay)
36    SELECT
37        trip_date,
38        SUM(delay_minutes) AS total_daily_delay
39    FROM
40        trip_logs
41    GROUP BY
42        trip_date
43    ORDER BY
44        trip_date;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Cont

trip_date	total_daily_delay
2024-06-01	45
2024-06-02	39
2024-06-03	19
2024-06-04	5
2024-06-05	15
2024-06-06	22
2024-06-07	29
2024-06-08	20
2024-06-09	37
2024-06-10	45
2024-06-11	55
2024-06-12	17
2024-06-13	9
2024-06-14	-1

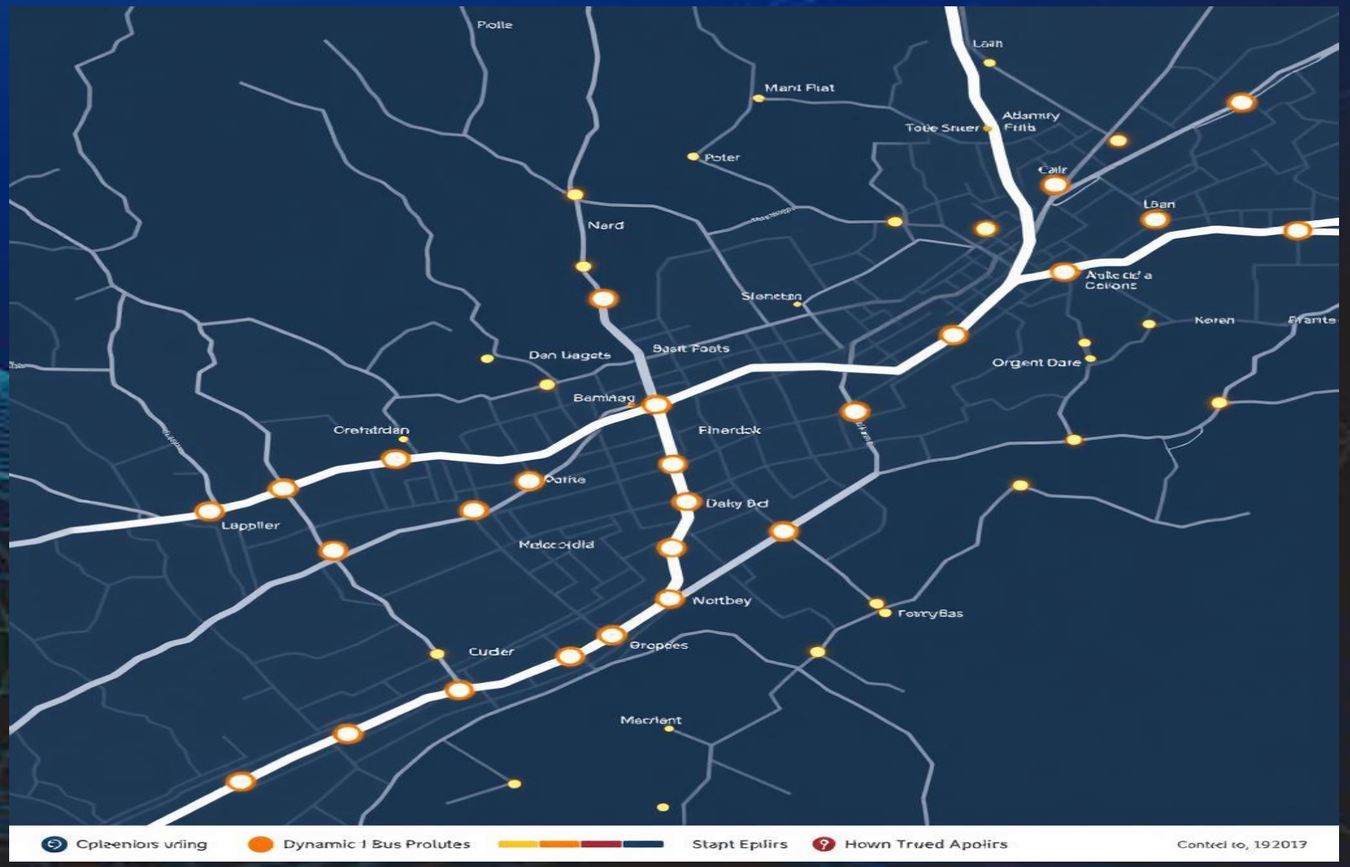


Route-wise Average Delay with Route Names

```sql
48      -- 5. Route-wise Average Delay with Route Names
49  •    SELECT
50         r.route_name,
51         AVG(t.delay_minutes) AS avg_delay
52     FROM trip_logs t
53     JOIN routes r
54     ON t.route_id = r.route_id
55     GROUP BY
56         r.route_name
57     ORDER BY
58         avg_delay DESC;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Con

route_name	avg_delay
Route D	7.7500
Route B	7.0000
Route E	6.7500
Route C	3.5000

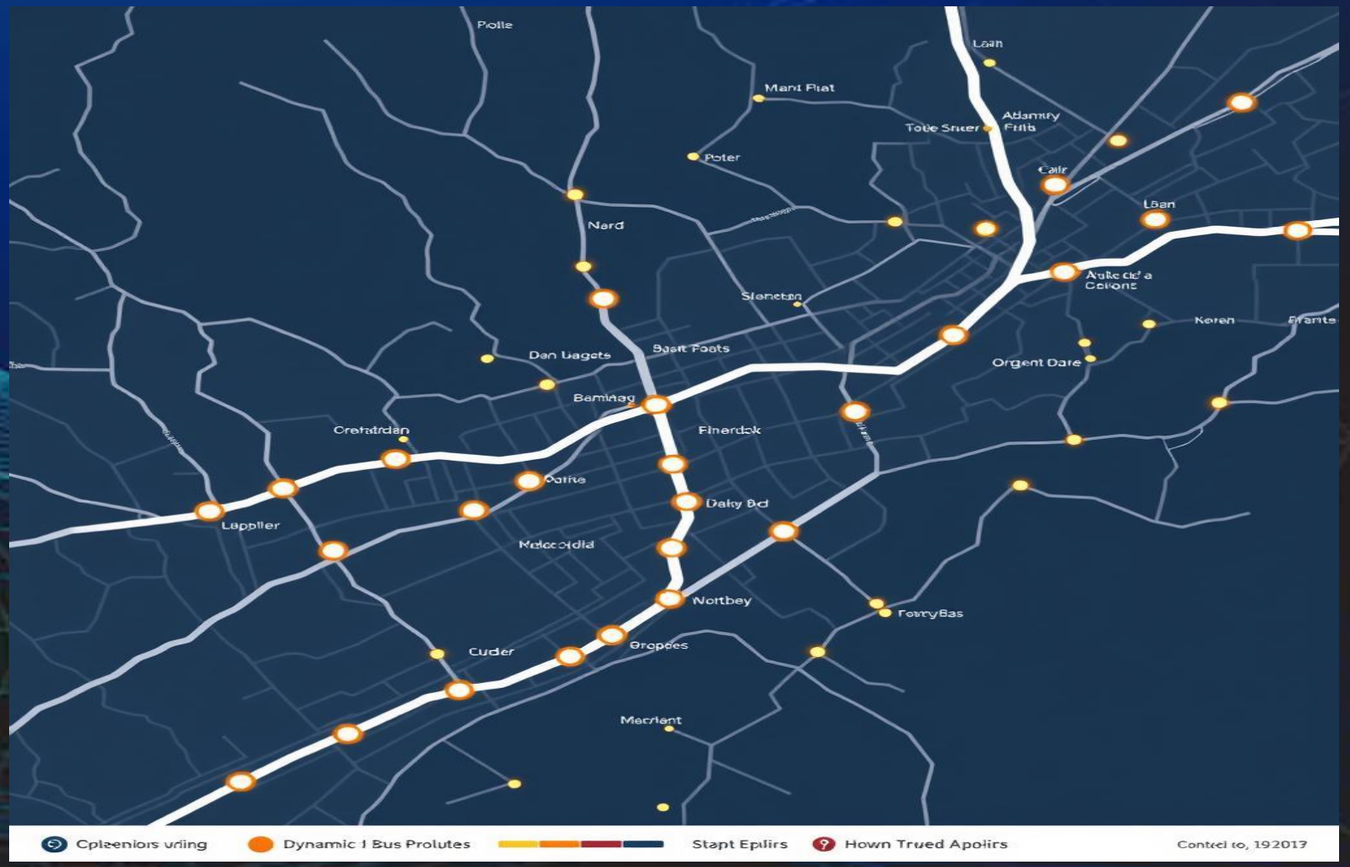


Number of Trips Delayed > 10 min for each Bus

```sql
-- 6. Number of Trips Delayed >10 Min for Each Bus
SELECT
    bus_id,
    COUNT(*) AS severely_delayed_trips
FROM trip_logs
WHERE delay_minutes > 10
GROUP BY
    bus_id
ORDER BY
    severely_delayed_trips DESC;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Cont

bus_id	severely_delayed_trips
9	4
5	3
4	2
6	1
8	1
10	1
3	1

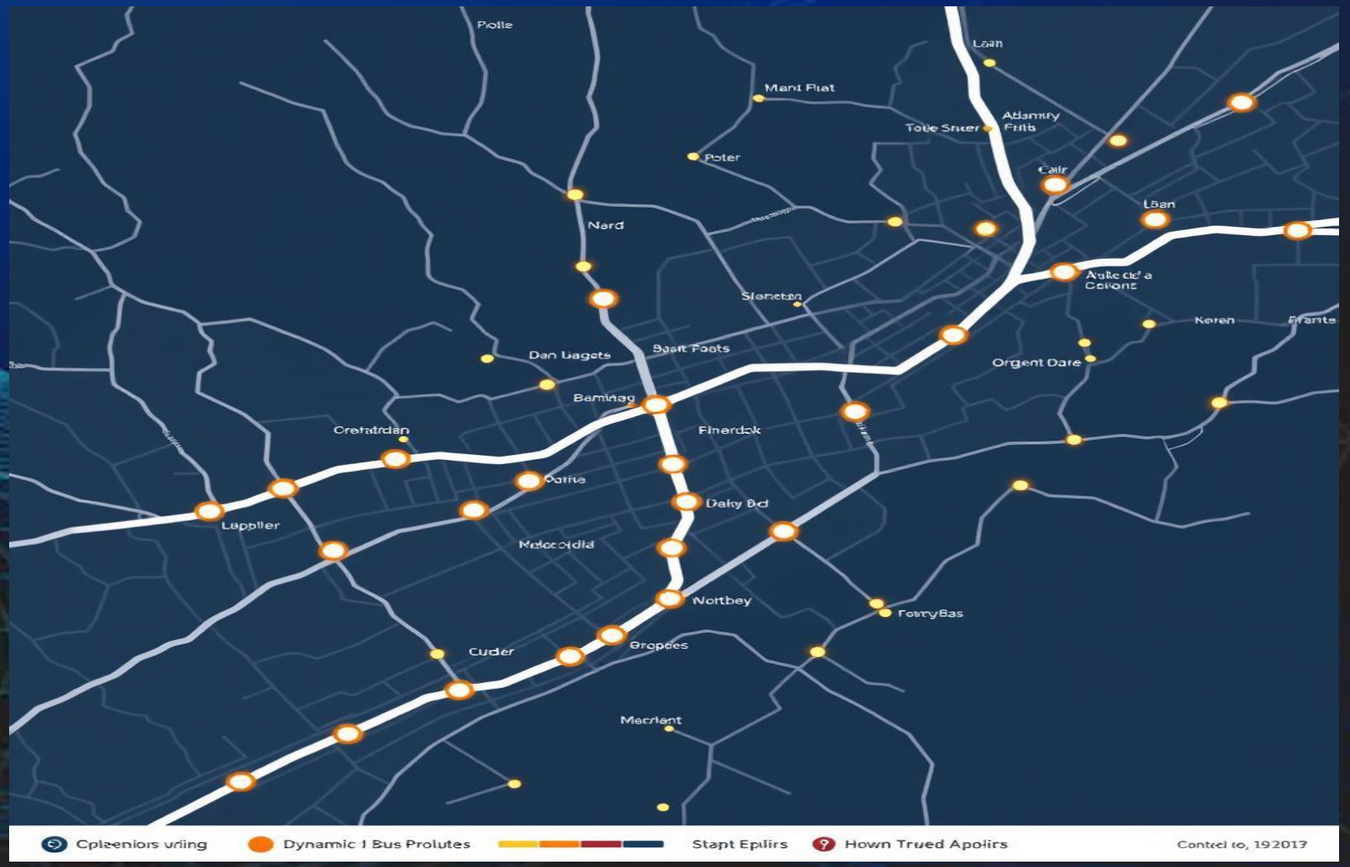


Average Delay by Day of the week

```sql
-- 7.  Average Delay by Day of the Week
 SELECT
    DAYNAME(trip_date) AS weekday,
    ROUND(AVG(delay_minutes), 2) AS avg_delay
FROM
    trip_logs
GROUP BY
    weekday
ORDER BY
    field( weekday,'Monday','Tuesday','Wednesday','Thursday','Friday','Saturday','Sunday');
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

weekday	avg_delay
Monday	9.14
Tuesday	12.00
Wednesday	6.40
Thursday	3.88
Friday	3.50
Saturday	10.83
Sunday	6.91

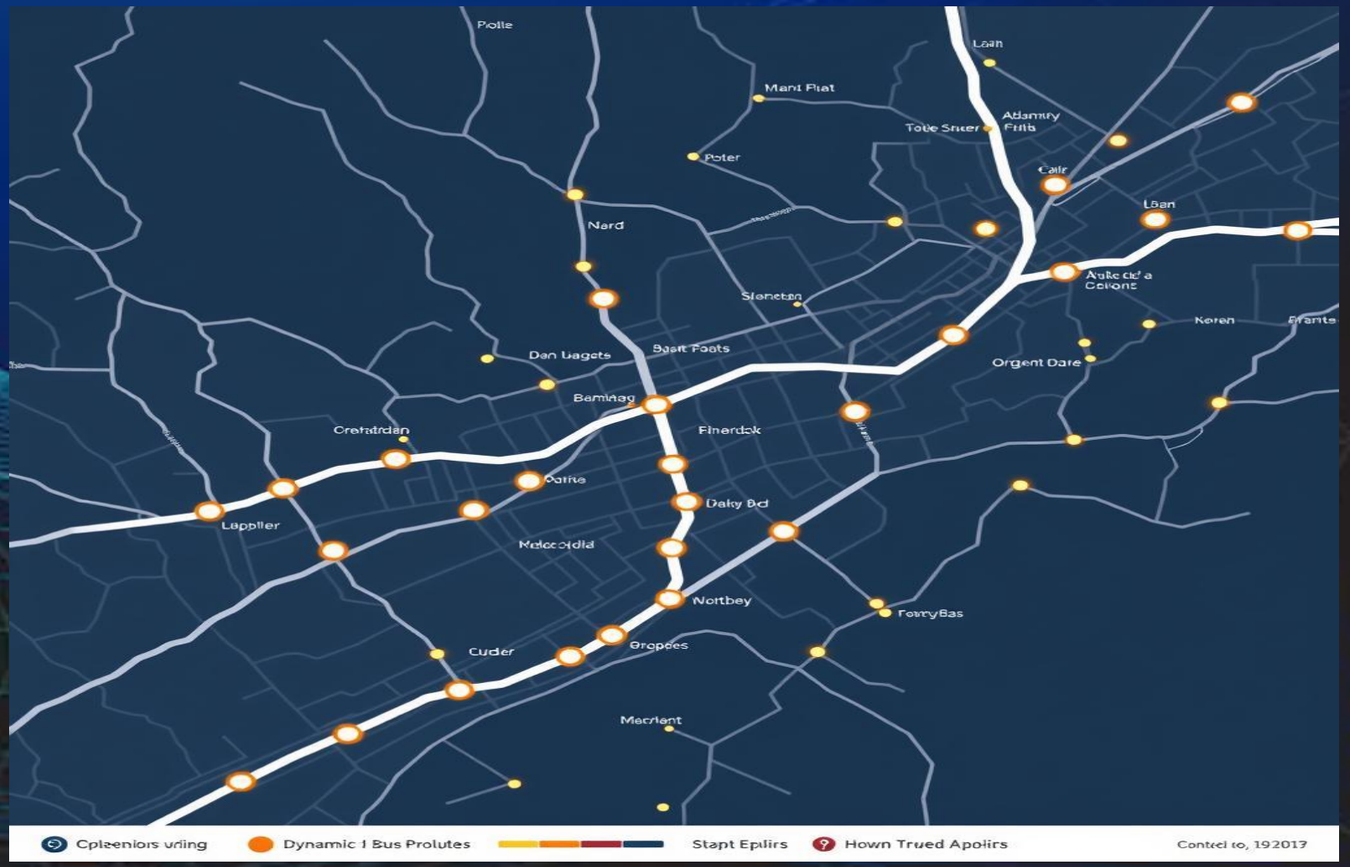


Peak Delay Hour (Hour of Scheduled time with Highest Avg Delay

```
85    -- 8. Peak Delay Hour (Hour of Scheduled Time with Highest Avg Delay)
86    SELECT
87        HOUR(scheduled_time) AS hour_of_day,
88        ROUND(AVG(delay_minutes), 2) AS avg_delay
89    FROM trip_logs
90    GROUP BY
91        hour_of_day
92    ORDER BY
93        avg_delay DESC
94    LIMIT 3;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content: | Fetch rows:

hour_of_day	avg_delay
16	15.00
12	15.00
13	15.00

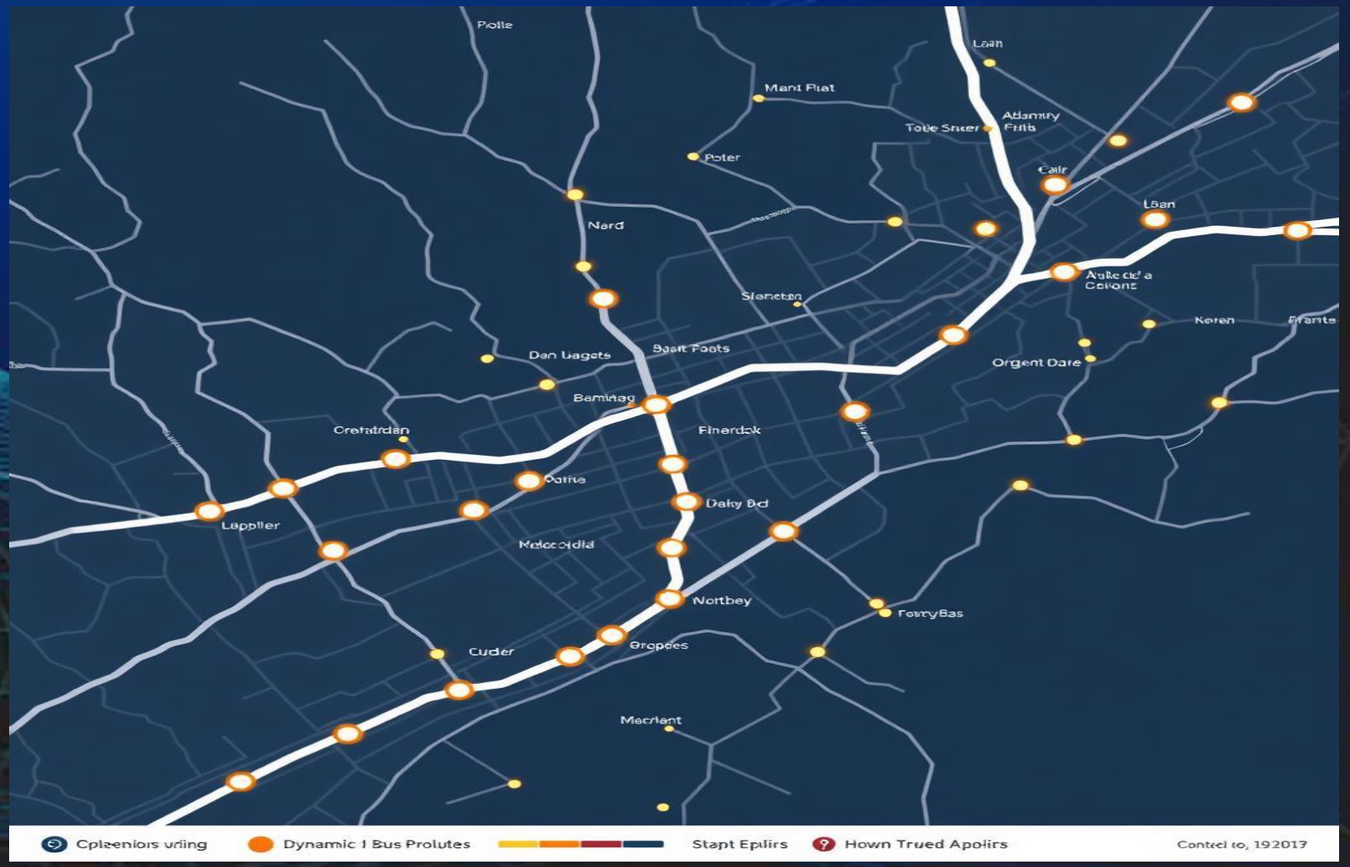


Bus Capacity vs Average Delay (Multi-table Join)

```sql
-- 9. Bus Capacity vs Average Delay (Multi-table JOIN)
SELECT
  b.bus_number,b.capacity,ROUND(AVG(t.delay_minutes), 2) AS avg_delay
FROM trip_logs t
JOIN buses b
ON t.bus_id = b.bus_id
GROUP BY
    b.bus_number, b.capacity
ORDER BY
    avg_delay DESC;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

bus_number	capacity	avg_delay
MP09-BUS-104	50	11.67
MP09-BUS-106	40	9.25
MP09-BUS-109	50	8.36
MP09-BUS-105	40	8.25
MP09-BUS-108	40	6.75
MP09-BUS-101	40	6.67
MP09-BUS-110	40	4.00
MP09-BUS-102	40	3.50
MP09-BUS-103	50	3.20
MP09-BUS-107	50	1.00

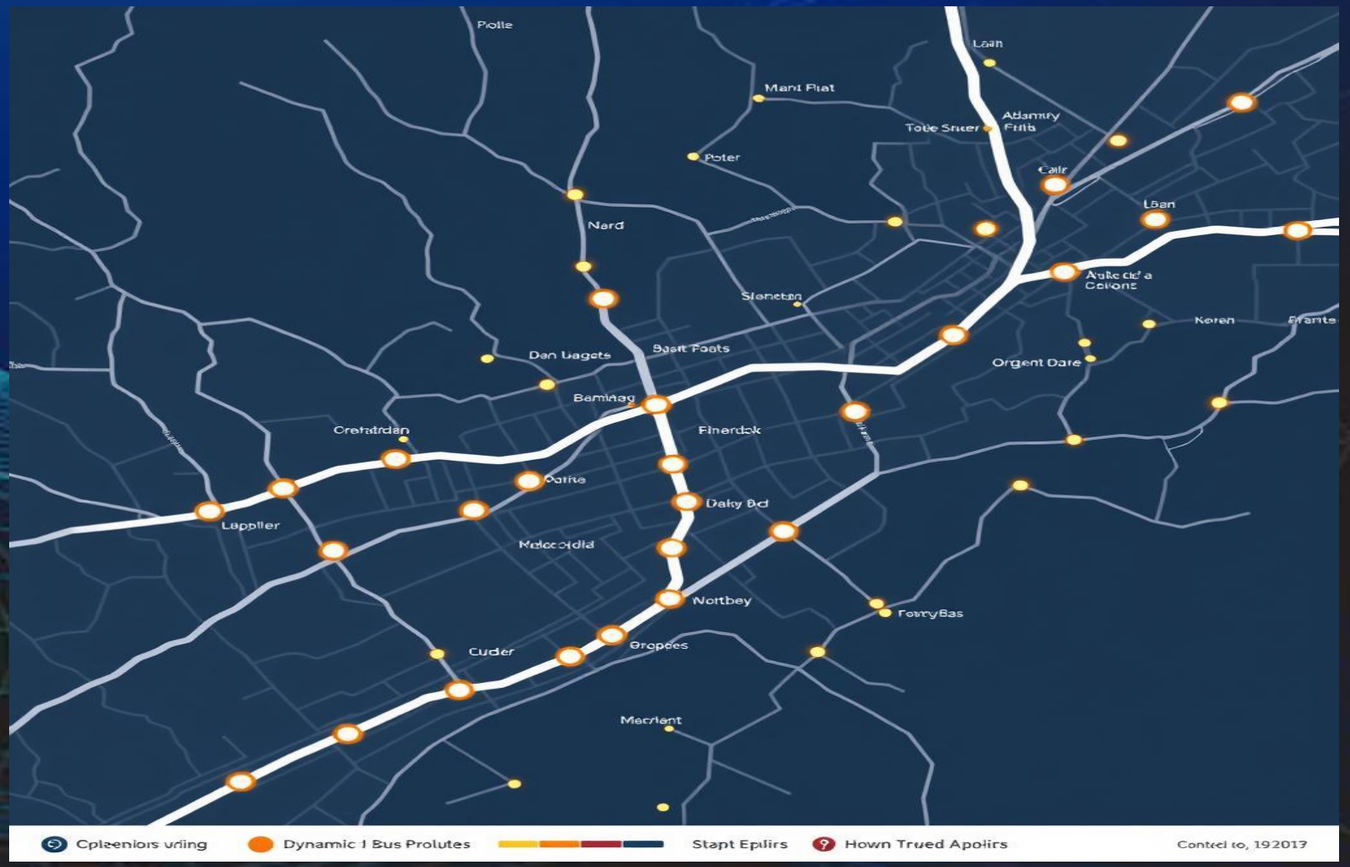


Day-Wise Average Delay Comparison

```sql
-- 10.  Day-wise Average Delay Comparison
SELECT
  DAYNAME(trip_date) AS day_of_week,
  ROUND(AVG(delay_minutes), 2) AS avg_delay_minutes
FROM
  trip_logs
GROUP BY
  DAYNAME(trip_date)
ORDER BY
  avg_delay_minutes DESC;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Cor

day_of_week	avg_delay_minutes
Tuesday	12.00
Saturday	10.83
Monday	9.14
Sunday	6.91
Wednesday	6.40
Thursday	3.88
Friday	3.50



Public Bus Route & Delay Analysis Dashboard

50
Total Trips

5
Delayed Trips

7.12
Average Delay (min)

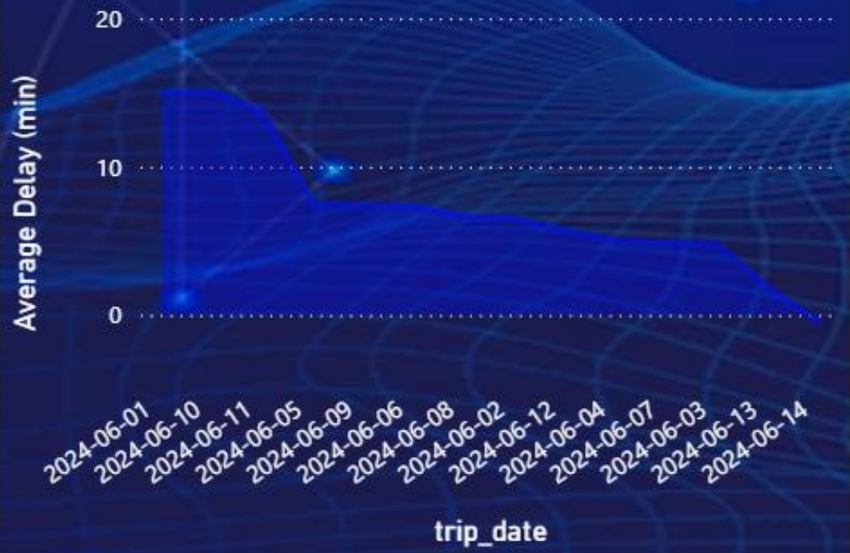
bus_number	Average Delay (min)	Total Trips
MP09-BUS-101	6.67	3
MP09-BUS-102	3.50	4
MP09-BUS-103	3.20	5
MP09-BUS-104	11.67	6
MP09-BUS-105	8.25	8
MP09-BUS-106	9.25	4
MP09-BUS-107	1.00	2
MP09-BUS-108	6.75	4
MP09-BUS-109	8.36	11
MP09-BUS-110	4.00	3
Total	7.12	50

end_stop and start_stop

start_stop ● Stop 1 ● Stop 11 ● Stop 21 ● Stop 31 ● Stop 41

bus_number
- MP09-BUS-101
- MP09-BUS-102
- MP09-BUS-103
- MP09-BUS-104
- MP09-BUS-105
- MP09-BUS-106
- MP09-BUS-107
- MP09-BUS-108
- MP09-BUS-109
- MP09-BUS-110

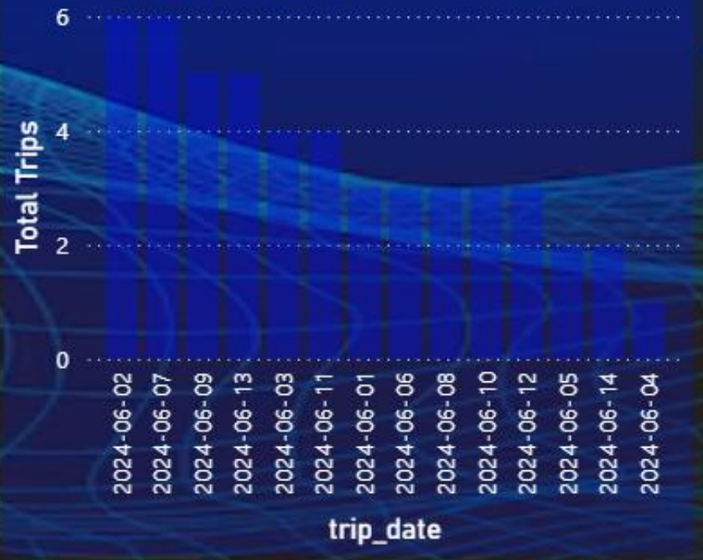
Average Delay (min) by trip_date



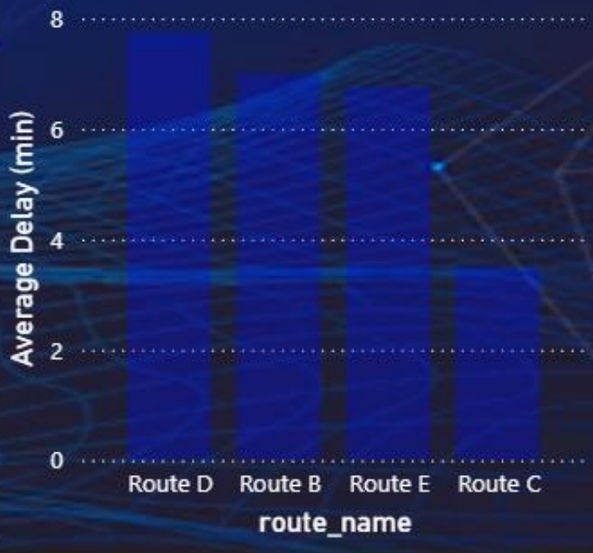
Filter by route

- Route A
- Route B
- Route C
- Route D
- Route E

Total Trips by trip_date



Average Delay (min) by route_name



Key Insights from Analysis

1

Route-Based Delay Patterns

Route D shows the highest current average delay (~7.8 min), followed by Route B (~7 min) and Route E (~6.8 min). Delays are moderate and fairly similar across routes.
These routes might be affected by traffic congestion, longer stop times, or poor scheduling.

2

Buses with Frequent Delays

- **Bus MP09-BUS-104 shows the highest fleet average delay (~11.7 min) compared to overall fleet avg (~7.1 min). Needs further check for scheduling or maintenance.**.
- Suggests the need for bus inspection, driver performance evaluation, or reassignment.

3

Time-Based Delay Peaks

Most delays occur during **9–11 AM** and **5–7 PM**, aligning with office rush hours.
Indicates potential for schedule adjustments or deploying more buses during peak times.

4

Day of Week Trends

Fridays and Sundays had significantly higher average delays compared to mid-week days.
Useful for weekly planning and allocating better resources for high-delay days.

5

Delay Severity

Around **10% of all trips** were delayed by more than **15 minutes** — a significant KPI for public satisfaction and system efficiency.

Recommendations

Optimize High-Delay Routes

•Focus on Route D, which currently shows the highest average delay (~7.8 min).

•Review timetable spacing, analyze local traffic patterns, or slightly shorten low-priority stops to reduce lateness.

Investigate Underperforming Buses

•**Bus MP09-BUS-104** has the fleet-highest delay (~11.7 min vs fleet avg 7.1 min).

•Schedule preventive maintenance, review driver shift & behavior logs, and consider reassigning it to less time-critical runs.

Adjust Scheduling (Future Analysis)

•Conduct hour-of-day and weekday analysis to confirm real peak windows before shifting timetables.

•Once peak windows are verified, add extra buses or reschedule departures to cut waiting time.

Set Delay Threshold Alerts

Trigger **Power BI alerts / emails** when:

Fleet average delay exceeds **10 min**

Any route or bus crosses **20 % delayed trips**

THANK YOU

Thank you for viewing my project!
I welcome any feedback or questions."

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