Executive Summary

Infrastructure Australia, in its 2019 report, paints a dire picture of the level of road congestion in Adelaide and its continued worsening in the coming years in line with both an increasing population and an increasing reliance on public transport in comparison to cars. The report estimated the annualised cost of road congestion for Greater Adelaide to be approximately **$1.4 billion** in **2016** and is projected to rise to **$2.6 billion** in **2031** (source).

With this backdrop in mind, the South Australia Department for Infrastructure and Transport (DIT) has in its possession a wealth of data relating to traffic information collected by way of Bluetooth probes, which take count of motor vehicle numbers in a particular area and time, therefore producing a metric for congestion. This data can be analysed in conjunction with historical real time bus trip updates collected by GTFS-R which provide the actual arrival times for each stop on a bus's trip.

The aim of the proposed analysis is to identify road segments where bus travel times are highly correlated with road congestion and are therefore less robust to increasing levels of demand, thereby providing a pre-emptive opportunity to mitigate increasingly lengthier, more crowded, and costlier bus travel times.

Objective

We aim to find the extent of the relationship between road congestion and bus travel times for segments of interest.

Deliverables

- Detailed travel time or congestion analysis comparing public transport response to road traffic factors on selected sections of road – South Road
- Repeatable methodology to analyse public transport response to road traffic factors.
- Reusable code, functions and visuals producing detailed analysis on sections, segments, or intersections.
- Indication of what predictive modelling would be possible and with what features.

Metrics to be Analysed

- Road congestion – measurement options are:
    1. Primary – using links data, the congestion provided for a direction of traffic measured according to Bluetooth equipped vehicles
    2. Secondary – using sites data, the number of unique vehicles identified over a given period per Bluetooth probe site, and the average duration spent by a vehicle in that site during that period
- Bus travel time – the time taken between the first and last stops across the segment. This removes the possibility that we are measuring how accurately the schedule predicts and/or buffers for congestion

Scope

The proposed analysis can be performed through several possible time and location dimensions:

- Time Dimensions
    - Per the morning peak (6am to 10am) and evening peak (3pm to 7pm)
    - Aggregation level(s). For example, 15-minute aggregates, hourly aggregates, …
    - By day of the week
- Location Dimensions
    - Segment of a road
    - A link
    - Bus stop or pair of stops

- Intersection
- Towards or away from the city, or both
- With or without bus lanes
- North-South/East-West

The time and location dimensions lists are not exhaustive, and we are happy to examine any other perspectives of interest you may identify.

Road Segment Candidates

The selection criteria we identified for potential road segments to be analysed consist of primarily spatial overlap of bus time updates and traffic congestion information, as well as segments with historically high levels of congestions. Possible candidates are:

- South Road
- North Road
- Wakefield Road
- Glen Osmond Road
- North East Road

We are happy to re-prioritise or expand the list of examined sections to include other areas of interest.

Data Sources

DIT AWS data lake

Proposed Methodology

- Limit analysis to a period of interest. For example, March 2022, or quarter ending June 2022
  - Disregard weekends and public holidays within that period
- Analysis to be conducted on time-aggregated statistics applied equally to both road congestion and bus travel time. For example, 15-minute aggregation resulting in 7am to 7:15am as one aggregate slice, followed by 7:15 to 7:30, 7:30 to 7:45, …
- Limit analysis to segment(s) identified

Calculating Bus Travel Time

1. Identify start and end bus stops on the segment to measure travel time on
2. Calculate the average travel time between the identified bus stops on the segment per time aggregate across the entire period. For example, between 7am and 7:15am across March 2022
3. Calculate average travel time between pairs of stops on the segment to identify bottlenecks

It is important to note that our proposed method of calculating travel time does not consider possible factors such as boarding/alighting time at stops, bus dwell time, traffic lights, and incidents.

Calculating Road Congestion Using Links

1. Identify sequence of non-overlapping links that compose the segment
2. Calculate the average congestion per link per aggregated time across the entire period to identify traffic bottlenecks within a segment
3. Calculate the average congestion of all the links within a segment per aggregated time across the entire period, to produce the average congestion across the entire segment

Calculating Road Congestion Using Sites

Same calculation steps as when using links, however the resulting congestion is measured as the number of vehicles and average time spent by a vehicle in the sites contained within a segment and time aggregate across the period under analysis.

Comparison Between Bus Travel Time and Congestion

The relationship between road congestion and bus travel times will be determined by analysing the variation in bus travel times compared with the variation in congestion levels. Visualisation will be used to examine the relationship per time aggregate. Specific aspects may be highlighted according to the dimensions desired, for example separate visualisations can be constructed according to the direction towards or away from the city, as well the relationship during morning and evening peak hours.

If a relationship is established for a segment, further analysis could be initiated such as:

- Narrowing the time or area scopes to produce outcomes of higher granularity. This can establish a prioritization of where resources should be allocated
- Performing the analysis on the same period from previous years to highlight possible trends. This can identify areas where the congestion effect on bus travel times is accelerating at a higher pace
- Examining specific portions of road or bus stops with consistently occurring bottlenecks. This allows for early proactive action on pinch points that can save future resources when the bottlenecks get exacerbated through time
- Examining days that exhibit bigger than usual congestions and bus travel times, and the possible causes (such as a sporting event). Can the travel times be reduced by taking specific actions such as the use of an express bus service to and from events? Simulations can be performed to determine the effects of such measures