On-demand Pooling in Christchurch: Benefit or Bane?

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Research Problem

Transportation is a major source of emissions in NZ due to fossil fuel combustion, high congestion levels, and low private vehicle occupancy. Public transit is one solution. However, NZ cities are often low-density, and public transit may not be easily accessible in some areas.

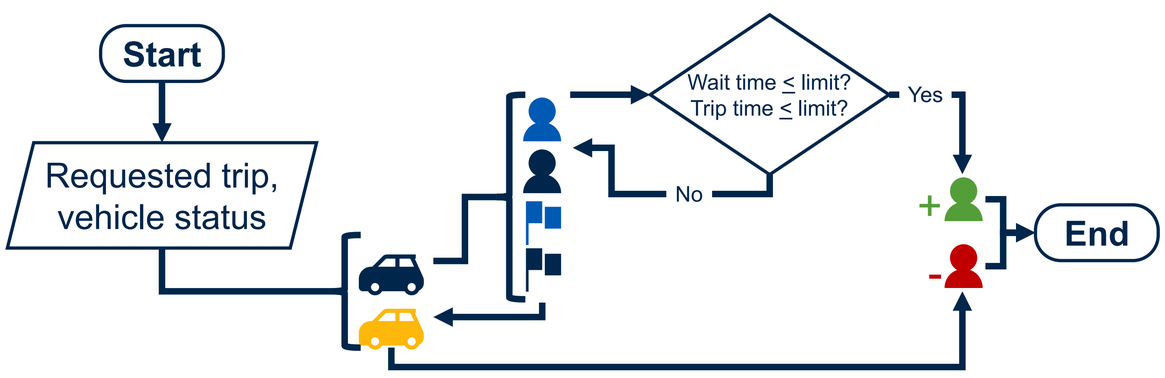
On-demand pooled services could:

- Act as an alternative mode or a feeder within public transit systems
- Increase convenience and accessibility of shared mobility

However, large service fleets may also create congestion.

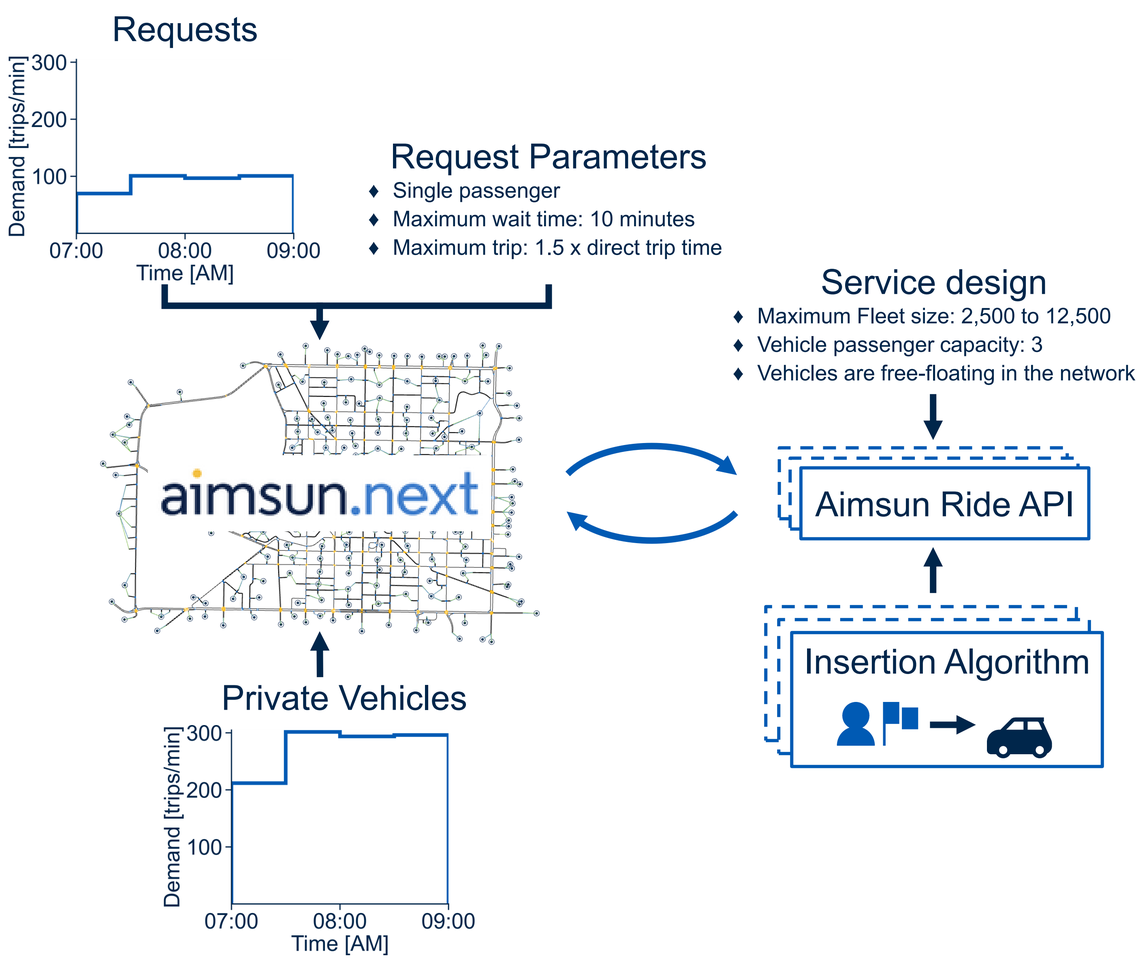
On-demand Service Model

The on-demand service offers pooled rides and prioritises user experience. The optimisation objective is to minimise user travel time, which is implemented through an insertion algorithm for fast request assignment.



Simulation Framework

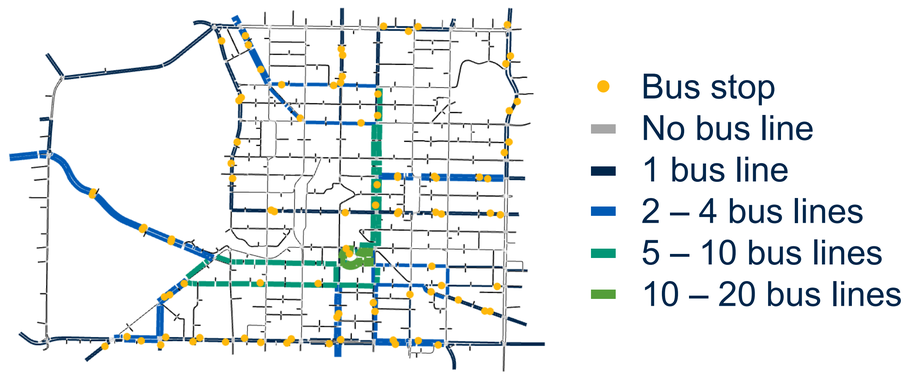
The network was simulated mesoscopically using Aimsun Next. On-demand service operations were implemented using the Aimsun Ride API.



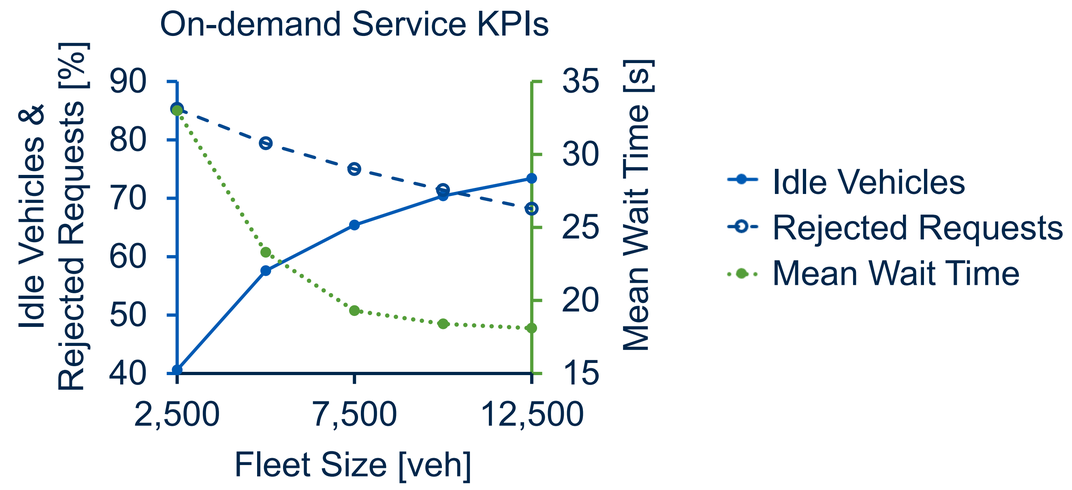
Case Study – Christchurch

The Christchurch CBD was modelled with the following features:

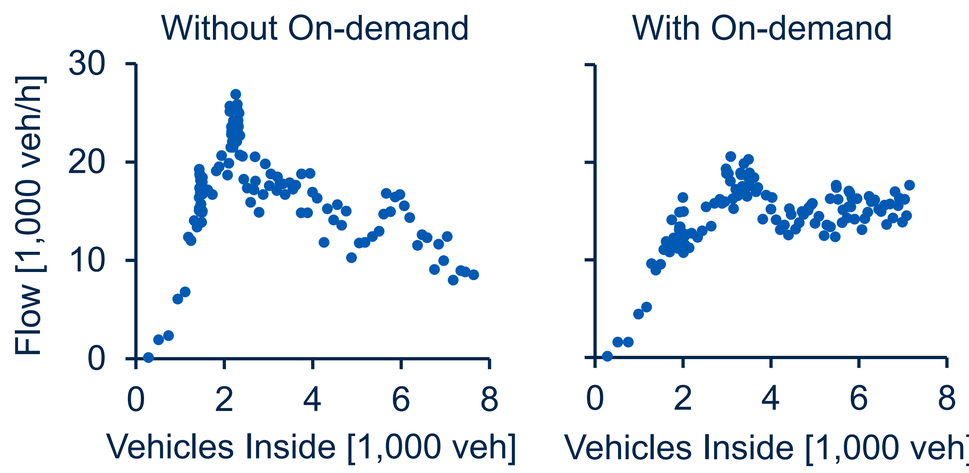
- Car trip demand matrix of 199 x 203 origin-destination pairs from the CAST v18a model for the morning peak period
- 25% of total car trip demand was assumed to be on-demand requests; the other 75% remained private car trips
- Cars (private and on-demand) used a C-logit model for stochastic route choice, with the shortest paths recalculated every 5 minutes



Service Results



Network Benefits



- Without the on-demand service, the network becomes congested
- Maximum flow is lower with the on-demand service, but the network remains at capacity through higher levels of vehicle accumulation

Conclusions – where to next?

On-demand operations were simulated in the Christchurch CBD:

- Prioritisation of ride quality in the insertion algorithm resulted in low request wait times but a high rate of rejection
- Increasing fleet size beyond 7,500 veh provided diminishing returns
- Presence of the on-demand service delayed congestion formation

Future directions include:

- Considering alternative priorities for the insertion algorithm
- Investigating the underlying reasons for network capacity increase