

IMPROVING DOOR-TO-DOOR JOURNEY TIMES: A NEW METHOD TO OVERCOME THE LIMITATIONS OF SKIP-STOP OPERATION FOR URBAN PUBLIC TRANSPORT

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Summary: Decreasing door-to-door journey time is vital to increase the attractiveness of public transport systems for urban travellers, compared with private alternatives such as the car. Skip-stop operations and other accelerated transit operations with fixed stopping patterns aim to reduce this metric. This paper demonstrates there is, however, a fundamental limitation of skip-stop operations and other related concepts, and gives a method for how to overcome it in future systems.

There are a set of operational concepts for accelerated transit operations with fixed stopping patterns, one of which is skip-stop operations. The concept for skip-stop operations is that stations are designated as A, B, or AB and vehicles as A or B with vehicles stopping at the stations that contain their assigned letter (A vehicles stop at A and AB, B vehicles stop at B and AB). Research has shown that this operation has benefits in lowering average travel times while maintaining area coverage, but it still carries important drawbacks. Some journeys are disproportionately worsened, headways between similar services are increased, and the improvements in average travel times are only fractional rather than revolutionary. This means that skip-stop operation, at best, offers minor improvements at a transport system level.

As has been shown through decades of research, structural aspects prevent public transport systems from offering competitive door-to-door journey times, in comparison to private individual modes. This is due to the coverage paradox, a result of the trade-offs between the time for passengers to access stations and the average speed of vehicles travelling on the line. The coverage paradox is the fundamental limitation restricting door-to-door journey times in all current operational concepts from being competitive.

This paper will show, through graph theory methods, that radical improvements can be made by taking a systems approach to identifying the underlying limitations of skip-stop operations. It shows that to overcome these limitations a concept shift needs to be made, from stopping patterns designated around stations, to being designated around vehicles. The results from an initial evaluation suggests that this approach could drastically reduce the number of intermediate stops during a passenger journey. This results in an increased average speed of the vehicle component of the journey, without affecting the network coverage, contributing to a reduction in generalised journey time.

We pose that the operational concept presented in this paper stands as a foundational platform for new research focused on the optimisation of door-to-door journey times.