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Incentive Systems for New Mobility Services to Reduce Congestion

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Research Question

With rapid population growth and urban development, traffic congestion has become an inescapable issue. Governments have explored a variety of transportation demand management programs to reduce traffic, including congestion pricing to discourage drivers from using heavily traveled areas. An alternative travel demand management approach is the use of incentive programs to reward desirable behavior rather than fees to punish undesirable behavior. In these mechanisms, incentives are offered directly to individual drivers to influence their decisions on departure time, routing, and other factors that can reduce congestion (Figure 1a).

Future mobility services may offer a new and potentially more effective opportunity to incentivize congestion-reducing behavior. Ridesourcing (e.g., Uber and Lyft), food delivery (e.g., DoorDash), and package delivery (e.g., Amazon) companies make decisions that directly or indirectly affect routing for an increasing number of drivers. These organizations have more flexibility and more power to affect traffic, and targeting them with incentives may be more efficient than incentivizing individual

drivers. Furthermore, the large pool of drivers employed by these organizations provides more options for balancing route selection to spread traffic more evenly across the network.

Motivated by this idea, researchers at the University of Southern California developed a distributed algorithm for offering incentives to organizations to make socially optimal routing decisions (Figure 1b). The algorithm is designed to lower the traffic flow of congested roads without creating new congestion in other parts of the road network. The researchers also developed a simulation model to evaluate the performance of the proposed method using data from five Southern California counties stored in the University of Southern California's Archived Data Management System.

Key Research Findings

Incentivizing organizations is more cost effective than incentivizing individual drivers. Simulations showed that when 20% of drivers in the road network are working for organizations, incentivizing organizations can reduce congestion with 8 times more cost efficiency than incentivizing individual drivers.

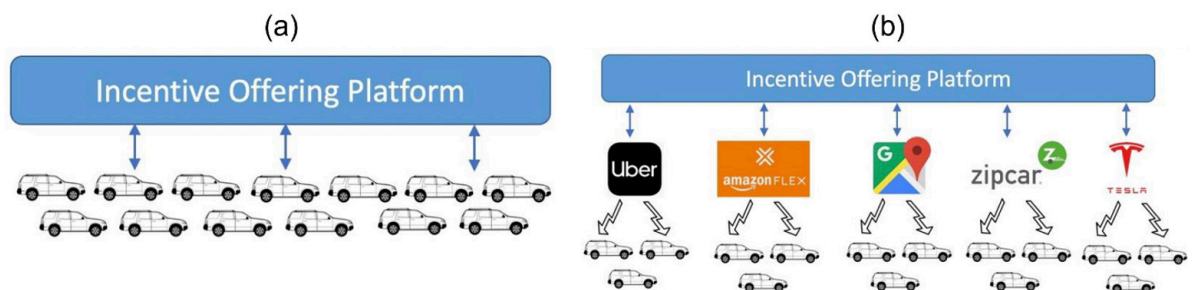


Figure 1. The image (a) at left depicts a traditional platform for offering incentives to individual drivers, while (b) at right depicts a platform for offering incentives through organizations.

Even a small incentive can reduce travel time in the road network when organizations can influence some drivers' decisions. The simulations for morning rush hour times showed that when 10% of drivers on the road are part of organizations, offering an incentive of around \$5 to each of those drivers to alter their route can reduce overall travel time by 4%. This is partly because organizations generally gain when drivers make socially optimal decisions.

Travel times and the cost of incentives decrease as an increasing percentage of drivers' routing decisions are influenced by their organizations. The simulations for the morning rush hour showed that increasing the percentage of drivers whose decisions are influenced by their organizations from 10% to 20% can cut overall travel time in half while also reducing the cost of incentives by 10%.

The researchers' proposed method can use distributed computing to calculate the optimal incentives. The optimization problem to calculate the appropriate incentive is large and complex. Using distributed implementation can reduce the computational burden.

Research Implications

This work shows that offering incentives to organizations to influence the routing decision of drivers working for them holds promise for reducing traffic congestion. The experiments demonstrate that this scheme is more cost effective than incentivizing individual drivers. However, the current model only offers incentives to alter drivers' routing decisions. Future work should also consider the effects of offering incentives to organizations to change their travel time or mode. These options will bring additional flexibility to the model, which in turn will result in further congestion reduction.

More Information

This research brief is drawn from "Incentive Systems for New Mobility Services," a report from the National Center for Sustainable Transportation, authored by Ali Ghafelebashi, Meisam Razaviyayn, and Maged Dessouky of the University of Southern California. The full report can be found on the NCST website at <https://ncst.ucdavis.edu/project/incentive-systems-new-mobility-services>.

For more information about the findings presented in this brief, contact Meisam Razaviyayn at razaviya@usc.edu or Ali Ghafelebashi at ghafeleb@usc.edu.

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