Abstract of the Master Thesis

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Topic: **Effects of prioritization measures for public transport on total waiting times and emissions**

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The increasing number of motorized personal transportation (MIV) road users has lead to a situation where the road space has become overloaded. To counteract the resulting reduction of traffic quality, there has been an increasing attempt to increase the share of public transport and non-motorized transportation (NMIV such as cycling or walking). The focus of the considerations in this case is particularly the promotion of public transport, as it can carry a higher amount of passengers using fewer vehicles compared to MIV. This leads to a reduction of the number of vehicles on the road, providing more road space, as well as having a positive environmental impact.

Measures to increase the attractiveness of buses, trams and road trains are essential, including providing faster, safer and more economical journeys. Here, in particular measures to reduce the time spent at intersections with traffic signals have made significant acceleration effects. The preemption of public transport means the priority treatment of public vehicles to other road users of road space. This conventional approach often leads to trade-offs with the other users as well as the existing boundary conditions.

Thus public transport is subject to various influences, such as the situational traffic and irregularities in the run procedure. Through the use of traffic-dependent control the light signal program should be affected to the extent that public transportation vehicles have privileged over the other road users. The case-initiated interventions represent the approaching public transport vehicles ready for green period and thus allow a passing of the node with no or low signal-related delay times and holdings. Other road users, in particular cross-border flows, thereby experience a shortening of their available green period.

The prioritization of public transport to traffic signals can take different forms, with the absolute priority representing the strongest form. In this case, a clear ride for the public transport is guaranteed at all points of conflict. A weakened form of prioritization represents the conditional priority, which on certain conditions public transport allows depend a drive-through. For the choice of public transport preemption, the effects always depend on the strategy for traffic management, with factors such as the intersection design, traffic load, and the privileged mode of transport, to be taken into account.

The aim of this master thesis is to use a microscopic traffic simulation to study and evaluate the traffic flow and environmental effects of accelerating public transport at traffic lights.

In a first step the necessary basis for assessing the quality of an intersection with traffic light is explained, in particular the criteria of traffic flow and the environment (emissions). Related was based on a detailed literature review the description of the existing ways to speed up public transport by detailed consideration of measures to prioritization of public transport at traffic lights. In this regard, different prioritization types as well as the possibilities of the procedure are explained in the control program of the traffic light.

Thereafter, the impact of public transport priority adjustments to the flow of traffic, the road users and the environment are compiled according to international studies and research reports. Here, it is investigated to what extent interference with the signal control influences delay time at traffic lights. Where the data base permits the analysis is carried out for all road users, where the focus is on the NMIV and MIV.

In a further step, the observed effects of the public transport priority adjustments are checked using a simulation with the software VISSIM node. The basis of the urban intersection serves Bieberer Straße / Untere Grenzstraße / Rhönstraße in Offenbach am Main with light signal controlled traffic management. These different scenarios by interference with the signal light program as well as structural measures on the basis of the microscopic traffic flow simulation are simulated. In summary, the intervention of the simulated conditional priority include the extension of the required green period as well as the requirement of a phase exchange with simultaneous reduction of the remaining phases and constant cycle length. Moreover, the impact of structural measures at the example of a decorated bus lane is investigated.

To assess the effects of resulting travel times, waiting times and queue lengths for each road user group are first calculated separately for each lane. On the basis of the data obtained the personal total waiting times are then determined at the intersection and made a classification of the traffic quality. Furthermore, the results of the different scenarios are compared to the base case without public transport prioritization in order to draw conclusions regarding the effects of the individual measures. In addition, scenarios can be investigated with regard to their environmental effects on the basis of the amount of nitrogen oxide and carbon monoxide generated.

As part of the evaluation of positive developments with regard to traffic and environmental characteristics compared to the current traffic flow were observed for the scenario green period adjustment. However, already contributed occasional negative effects to a reduction in the quality level of the pedestrian. Due to the small number of this user group the existing overall quality could still be maintained. The interior of the bus lane at the same time extending the green period did not lead to an expected acceleration of public transport. Rather, a dramatic deterioration of the traffic flow of the east node access could be observed, consequently the total waiting time of all user groups, and consequently the overall quality is decreased. Furthermore, there was a phase skipping, whereby the total waiting times of public transport could be increased without penalizing the pedestrian traffic. Because of the sometimes considerable reduction of the release times of vehicle flows deterioration of road quality was for the MIV, however, determine what was reflected in a reduction in the overall quality. Specific effects of measures to encourage public transport prioritization on emissions could not be detected, however, a correlation between these and the stabilization of traffic flow could be determined.

From the study it can be concluded that when considered in isolation from public transport prioritization measures, these noticeable effects can be achieved. Including the rest of the road users, especially the MIV, contrary effects are observed for the considered case study in part. Accordingly, isolation from public transport prioritization no longer seems appropriate from an economic perspective. This assumption however, needs to be analyzed in further studies involving the occupation levels during peak hours. From this example approaches for the future adaptation of the criteria for impact evaluation could result.

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