Abstract of the master-thesis

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Topic: **A Study on the Impact of Prioritizing Public Transport in Traffic Signals**

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The increasing number of Motorized Personal Transportation causes congestion in the street, which reduces the quality of traffic. To address such situation, there has been an increase in the public transportation and Non-motorized transportation, such as pedestrians and cyclists. The promotion of public transport plays a central role. Public transport carries more people as compared to private vehicles. It transports more people using fewer vehicles. This reduces the number of active users on the road and increases the capacity of road space.

With acceleration measures for buses, trams or light rail, it reduces travel time and makes the rides faster, more secure and economical. Measures to reduce the delay times at intersections with traffic lights have to be particularly effective in order to achieve significant acceleration effects. The prioritization of public transport stands for the prioritization of public transport over cars and pedestrians on the street. Public transport such as trams and buses are given priority and preferential treatment at traffic signals as compared to individual vehicles.

Due to various factors such as the current traffic situation or unpredictable passenger exchange, there are irregularities in the travel process of public transport. This is reflected in the variation of travel and travel times. An acceleration effect within a fixed timetable can be achieved by accessing control logic over the entire signal cycle of the traffic signal control and minimize the delay times at intersections for public transport. In the context of public transport, priority interventions initiated in the traffic signal program give clearance to approaching public transport vehicles and enable their transit. The clearance time for other road users, especially for the crossing Motorized Personal Transportation is shortened. The prioritization of public transport at intersections with signalized traffic control can take different forms. The strongest form is the full priority, which ensures the free passage of public transport to all points of conflict. The conditional prioritization represents an attenuated form of prioritization, which allows the passage of public transport only under certain conditions. The type, intensity and timing of the public transport priority basically depend on the strategy pursued by the traffic control, the intersection design, congestion and the preferential form of the transportation.

Given the increased traffic congestion at junctions with traffic signal control, public transport prioritization may adversely affect other road users. Motorized Personal Transportation may encounter crossing streams, long travel times and increasing congestion lengths, which in turn can entail increased exhaust emissions. For pedestrians, it can lead to unacceptably long waiting times. The thesis aims to investigate the effects of public transport prioritization and to identify possible negative effects on the affected road users. The instructions to minimize these effects should be derived from the identified

adverse effects. Accordingly, a concept for public transport prioritization will be developed wherein the interventions in the traffic are adjusted to the requirements of the involved road users. The focus is to increase road safety and improve the quality of traffic flow, with the intention of the economic efficiency and reduction of environmental impact.

As a pre-orientation, the first step shows a comprehensive basis for the planning of a public transport prioritization. Common rules and designated technical literature enable the development of public transport prioritization principles. All the conditions required for initiating a public transport prioritization processes are presented. Then, the operation of the signal system and applied acquisition systems are explained. The signal control methods are presented including their role in the traffic control and the initiation of the public transport prioritization processes. This is further elaborated on the system architecture managing public transport prioritization. The measures for the implementation of public transport priority are specified. In this regard, several Priority forms are collected and operating conditions are considered. Moreover, the possibilities of interventions in the traffic signal program are explained as well as the measures to control public transport prioritization on local intersections and street networks or sections.

In the second step, the study focuses on the effects of public transport prioritization. It is based on the literature search. It also includes International Studies and technical reports on the acceleration measures for public transport and analyses on the impact of public transport priority. It examines the extent of signal control method, acquisition systems and forms of prioritization or interference within traffic signal control. Conclusions as to the cause of the effects are considered. The investigation is carried out for all road users. A special emphasis is placed on the negative effects. Future proposals to minimize the negative effects considered positive aspects.

The third step verifies the observed effects at a fictitious intersection. For this purpose, a full node calculation with traffic signal control according to HBS 2001 is set up. To play a possible real picture of the environment in which the public transport prioritization takes place, an inner-city hub is simulated with traffic signal controlled traffic flow. A crossing with a separate public transport lane in the middle position is chosen as a hub. The intersection design is based on the most commonly public transport control in areas with high capacity utilization of Motorized Personal Transportation.

The investigation of the effects of the public transport priority has different priority species simulated by different interventions in the light signal plan. The principle of the interventions is carried out by extending the phase in which public transport is signalized, while shortening the other phases. The signal cycle period does not extend to preserve the coordinated traffic flow. The interventions include early green, green extension, simultaneous early green and green extension and insertion of a phase. The inserted phase is reserved only for public transport. By choosing one or many of these intervention-possibilities, different priority forms can be emulated. The full priority is achieved by choosing all interventions, which provide the release of public transport throughout the entire signal cycle period. The conditional priority is achieved by choosing only early green and green extension. Depending on the choice of both or a single intervention, the public transport is released only in a certain range of the signal cycle period.

To assess the resulting effects, the delay times are calculated separately for each lane before and after the procedure for every road user. The calculations are performed for three different degrees of traffic volumes of Motorized Personal Transportation in order to regard possible effects of a traffic increase or decrease. In using delay times, the assessment of the traffic quality is affected. The resulting delays are

compared with each other and give conclusions about the applied interventions and thus the trailing public transport priority species. The adjustment aims to make it visible through simple and reproducible calculations on possible causes and extent of effects. To estimate the economic benefits and the impact on the environment, the person delay times and the overall delay times are considered.

Chapter 6 summarizes the results of the literature and the fictitious intersection. In the first part, identified positive and negative effects are collected and analyzed. Among others, a considerable deterioration in the quality of the traffic quality was assessed in combination with green extension and phase-insertion. The increase of the traffic volume has exceeded the capacity of the fictitious intersection. For the pedestrians, the phase-insertion caused extensive security-deficits.

Based on the results of the literature review and the test run on the fictitious intersection, suggestions are developed in the second part of the sixth chapter to minimize negative effects of public transport prioritization. In this context, general measures for improving the effectiveness of public transport prioritization are presented. Moreover, possibilities of adapting public transport prioritization to existing traffic conditions are also discussed.

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