



# Influence of dynamic traffic control systems and autonomous driving on motorway traffic flow

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## Abstract

As in many other countries, traffic demand on German motorways is continuously rising, especially during peak hours. Enhancing the road infrastructure by building additional lanes or new motorways is cost-intensive and - due to the complex planning process in Germany – extremely tedious. Thus, the government tries to maximise the performance of the existing infrastructure using dynamic control systems. The development and deployment of autonomous driven vehicles can have positive effects on the capacity of road elements. In this study the effect of dynamic control systems on the traffic flow on motorways is analysed in case studies using microscopic traffic simulation. Furthermore it is outlined that autonomous driving in an environment where access to the motorway is limited to autonomous vehicles only can have a positive effect in terms of higher capacities and more harmonized traffic resulting in fewer traffic breakdowns.

*Keywords: telematic system, dynamic traffic control system, dynamic speed sign, traffic flow, motorway, microscopic simulation, autonomous vehicles*

## 1 Introduction

Dynamic traffic control systems have become an effective measure to control traffic on German motorways over the last decades. To estimate the economic feasibility prior to their implementation, cost-benefit analyses are applied, which concentrate on the traffic safety and performance of traffic flow. The traditional deterministic methods of analysis as they are offered in the German guidelines HBS (and also the Highway Capacity Manual (HCM)) do not cover the evaluation of dynamic control systems. Moreover, they cannot regard distinctive local behavioural patterns that may have a significant influence on motorway capacity. However, it is required to predict the effects of a system quite precisely before deciding on implementing a dynamic traffic control system.

In this paper the results of surveys on two motorways sections are presented. In these surveys the effects of dynamic traffic control systems on traffic flow were analysed using microscopic simulation. Additionally the traffic flow on these motorway sections was analysed under the assumption that only autonomous vehicles are using the respective facilities.

## 2 Telematic Systems on German motorways

Financial resources for the road infrastructure in Germany are limited. On the other hand traffic demand is increasing year by year. The costs to enhance road capacity by building additional lanes are very high and -due to the complex planning process- extremely tedious. Thus, the government tries to maximise the performance of the existing infrastructure. This is aspired by the use of dynamic traffic control systems. In Germany primarily four types of telematic systems are used on motorways:

- Dynamic Traffic Control Systems
- Temporary hard shoulder running
- Ramp metering
- Dynamic Guidance Systems

In this paper the first two of these telematics systems are discussed and therefore described briefly in the following.

### Dynamic Traffic Control Systems

Dynamic Traffic Control Systems are used to harmonise traffic flow. These variable signs are able to indicate dynamic speed limits, no passing for heavy vehicles and warning of congestion, work zones or weather conditions. The main functionality, the dynamic speed limit, is varied according to traffic flow, mean speed, or traffic density on the motorway. This harmonizes the traffic flow at high traffic volumes (Pischner, Hangleiter, Lambacher, Trupat, Kühne, & Schick, 2003) and reduces the probability of traffic flow breakdowns (Geistefeldt, 2009)



Figure 1: Dynamic Traffic Control System

### Temporary hard shoulder running

Using temporary hard shoulder running (THSR) it is possible to increase the capacity of the road segment in peak hours by up to 25 % (Geistefeldt & Glatz, 2010). This tool is adapted to the demand, because the hard shoulder is opened for traffic to increase capacity during peak hours, but the hard shoulder is still available for emergencies in the off peak hours.

THSR can be implemented with limited planning and financial efforts compared to the addition of a permanent lane.

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