

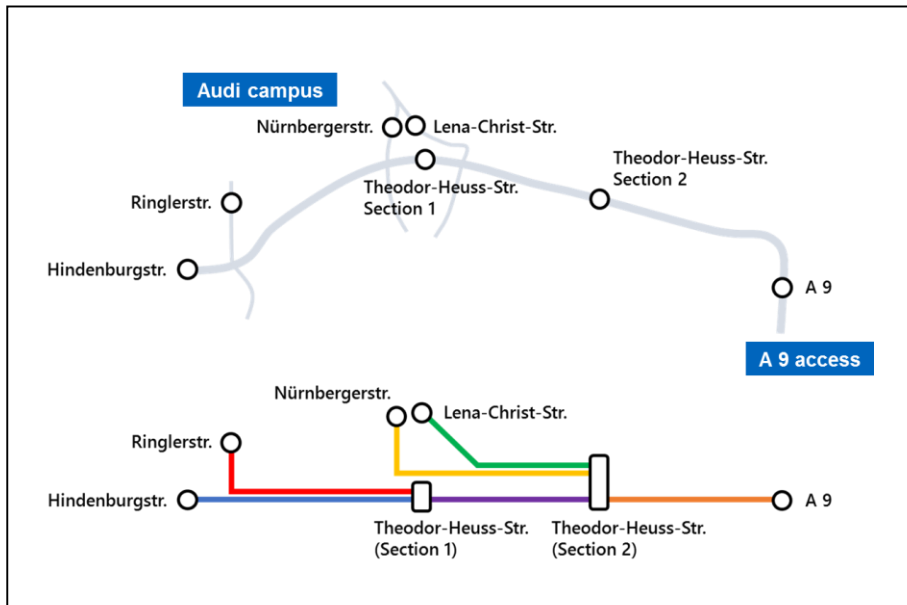
# Simulative analysis of various traffic management strategies for the traffic generated at the end of shifts at Audi in Ingolstadt

## Master's Thesis of Jason Lu

### Supervision:

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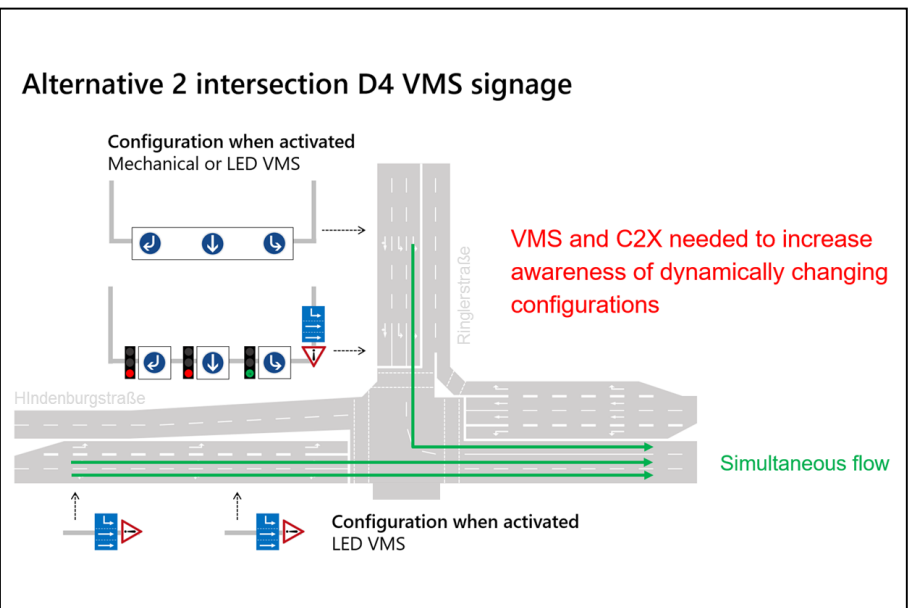
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Audi AG covers an area of 2.7 million square kilometers in Ingolstadt and employs 40,000 workers, more than 80% of whom commute by driving alone. To accommodate employees and their vehicles, the campus currently has 19,200 parking spaces. Predictably, this leads to significant service quality reductions on the roadway network during peak periods. To address current and future traffic challenges, Audi has developed a “Transport Development Plan” (Verkehrsentwicklungsplan) in order to study the network and plan for possible improvements, which include infrastructure expansion as well as strategies to alter modal shares. This master's thesis seeks to complement the Transport Development Plan by studying the network in more detail. The study area consists of corridors and intersections that connect the campus with the A 9 Autobahn. Primary key performance indicators used in the study include travel time, travel time reliability and network travel times. Solutions were developed to address deficiencies in the network and modelled using VISSIM.

After the network analysis, several intersections and corridors were identified for potential improvements. Measures ranged from infrastructure modifications to ITS strategies, while some consideration was given to potential Car2X communication use cases.

One of the solutions identified included dynamic lane allocation, where the intersection layout was dynamically adapted to traffic patterns. This was applied to the intersection of Hindenburgstraße and Ringlerstraße. At this intersection, the afternoon peak period sees significant southbound left-turn traffic as well as eastbound through-traffic. While these two movements are usually not compatible, dynamic lane allocation was used to reconfigure the intersection and close the middle lane on the southbound approach to left-turn traffic, so that the streams were separated. Combined with signal modifications, vehicles in these two streams would theoretically be able to travel at the same time.



Travel time measurement route	No-build	Alt 4	% change
Hindenburgstr. To Theodor-Heuss Str. Section 1	153	155	2%
Ringlerstr. To Theodor-Heuss Str. Section 1	362	239	-34%
Nürnberggerstr. To Theodor-Heuss-Str. Section 2	307	337	10%
Lena-Christ-Str. To Theodor-Heuss-Str. Section 2	219	133	-39%
Theodor-Heuss-Str. Section 1 to Section 2	115	123	7%
Theodor-Heuss-Str. Section 2 to A 9	70	68	-3%

However, allowing these streams to travel simultaneously still holds a safety risk. Maintaining safety during dynamic lane allocation operations would require some infrastructure measures, such as dynamic barriers, and additional driver warnings. As a result, this is a potential usage case for Car2X communications. While VMS infrastructure would communicate warnings to drivers via roadside signage, Car2X would allow this information to be shown directly to the driver, allowing for uninterrupted information flow and greater driver awareness of the situation.

If further safety measures for dynamic lane allocation strategies are developed and verified to be effective, it could have significant benefits for intersection traffic. Analysis done in this study confirms that dynamic lane allocation during periods of high demand is capable of reducing delays up to 39%. Implementing this strategy in Ingolstadt would provide significant localized traffic improvements.