

Use of Backend Data in the Connected Vehicle in BMW Customer-Oriented Testing

Master's Thesis of Fabian Fehn

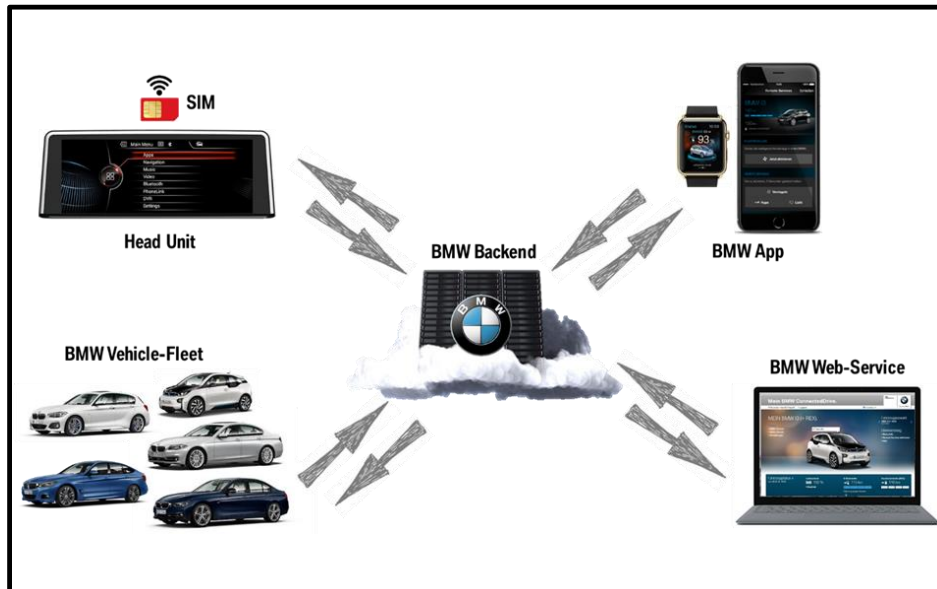
Mentoring:

Dr.-Ing. Matthias Spangler

External Mentoring:

Dipl.-Ing. Norman Müller (BMW Group)

Dipl.-Ing. Dominik Steiner (BMW Group)



The use of data in the connected vehicle in general and the collection of testing related data in particular, have extremely increased in the last few years in automotive industry. BMW, as one of the biggest car producers worldwide, tries to establish backend data in all sections of the value chain. The department for customer-oriented testing focuses on the customer's benefit concerning the vehicles. To cope with the ever-increasing number of digital services, the department looks for possibilities to use backend data instead of in-situ testing, to get new insights and replace analog testing procedures by digital ones.

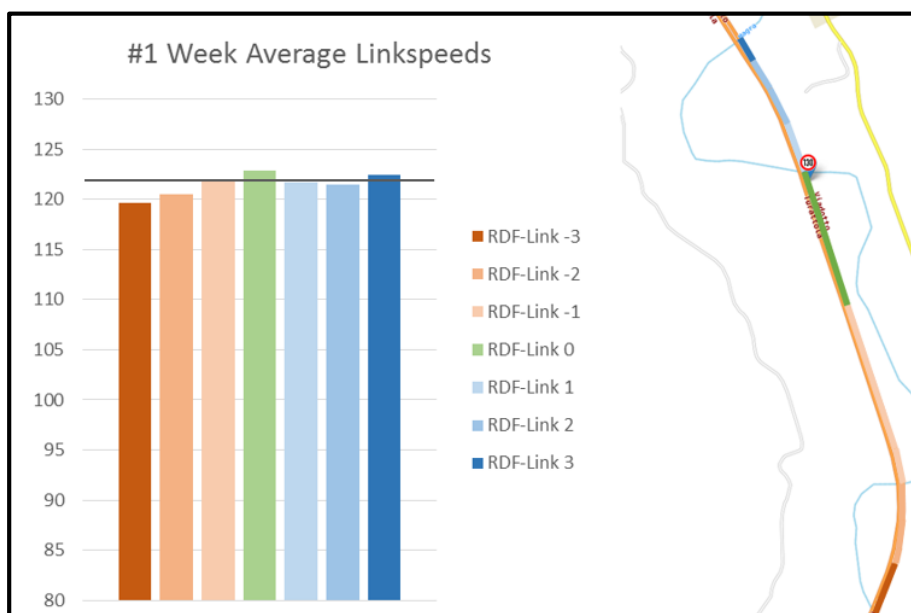
There are two types of backend data at BMW: general fleet data, like positioning and velocity; and specific data, i.e. hazards on the route of a specific vehicle. Every service which should be evaluated, needs specific ground truth data, to verify its predictions. This ground truth data can either be delivered by a data provider or collected by the vehicle fleet.

This thesis investigated three BMW services in different stages of development, namely "hazard preview", "speed limit information" and "on-street parking information". The objective is to optimize testing, and development, with the help of backend data. To evaluate the three services, different approaches were developed. They all have in common, that ground truth data is compared to the predictions of the service. However, they rely on different proceedings.

In the case of hazard preview, data of meteorological services were compared to the predictions of BMW. The result was that the service could be improved by adapting the rule set for hazard event creation and taking other data sources, like meteorological services, into account.

Regarding the speed limit information feature, ground truth data are collected by the BMW vehicle fleet. The average speed of the vehicle fleet was used to monitor the correctness of speed limits accumulated in the BMW map.

	detected (positive-negative)		
actual (true-false)			
		TRUE-POSITIVE 	TRUE-NEGATIVE
		FALSE-POSITIVE 	FALSE-NEGATIVE



The detection rate of incorrect speed limits in the system could be increased from zero up to around 90%, depending on the location of the speed limit sign.

The BMW on-street parking feature is in an early stage development. This thesis investigated, how good the tested ultrasonic parking spot detection system works and how the whole system could be improved. One possibility could be to add a camera-based parking spot detection system to verify the ultrasonic system.

In general, it was found that the evaluation of different types of services with backend data is an adequate method to improve the quality of services and to find optimization potential. Backend data opens new possibilities in service improvement and development and is going to be an inherent part of future BMW "connected services".