Chair of Communications Engineering
TUM Department of Electrical and Computer Engineering
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Master's Thesis

Proactive scheduling for automotive safety-related and infotainment services

Autonomous driving will rely on a multitude of connected applications with stringent quality of service (QoS) requirements in terms of low latency and high reliability. At the same time, passengers relieved of steering duty have the opportunity to enjoy infotainment services that are often associated with high data rates, e.g. video streaming (VS). The simultaneous usage of such safety-related (SR) and infotainment services leads to diverse QoS requirements that none of current wireless networks can meet. One of the promising solutions is a proactive resource allocation based on channel and network traffic prediction. In the era of self-driving cars, exact future position data is available due to pre-planned routes that allow for channel prediction. Further, data traffic can be highly predictable with periodically sent SR status updates. Such a proactive resource management enables to off-load the traffic by smartly adapting the transmission timing to the predicted network state (see e.g. [Hatem13]).

In this master thesis, we aim to study proactive scheduling in a multi-cell downlink network for automotive safety-related and infotainment services developped at BMW Group Research and Technology. The proactive scheduling should exploit transmitter cooperation to deal with the inter-cell interference [Gesbert10]. The possible research directions include:

- study of scheduling in a single-cell multi-antenna downlink [Kobayashi07].
- study of a multi-cell downlink with partial transmitter cooperation.
- modeling of temporally correlated network states and study of prediction methods.
- study of scheduling for a single-cell queued downlink with delay-constrained packets [Destounis18].

[Hatem13] A. Z. Hatem et al., ``Optimal predictive resource allocation: Exploiting mobility patterns and radio maps." IEEE Global Communications Conference (GLOBECOM), 2013.

[Gesbert10] D. Gesbert et al., ``Multi-cell MIMO cooperative networks: A new look at interference'', IEEE J. Sel. Areas Commun., vol. 28, no. 9, 2010.

[Destounis18] A. Destounis et al., ``Scheduling URLLC Users with reliable Latency Guarantees'', International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt), 2018

[Kobayashi07] M. Kobayashi and G. Caire, ``Joint Beamforming and Scheduling for a Multi-Antenna Downlink with Imperfect Transmitter Channel Knowledge'', IEEE J. Sel. Areas Commun., vol. 25, no. 7, 2007

Prerequisites

- Solid background in wireless communications, signal processing, and optimization.

- Matlab programming skills.

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Advisors

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