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RobustRails

Can LTE become an alternative to GSM-R?

Overview of the project: "Communication Technologies Support to Railway Infrastructure & Operations"

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I. INTRODUCTION AND MOTIVATION

GSM-R is the first widely adopted international mobile communication network for railways. It is a part of the European Rail Traffic Management System (ERTMS), which substitutes legacy national railway signaling technologies. GSM-R is designed to provide two fundamental services: transmission of the European Train Control System (ETCS) messages and voice communication for railways. ETCS system offers safe and reliable in-cab signaling and train supervision, which reduces the risk of train driver error and increases the track occupancy. Thus, GSM-R, as a basis for ETCS, contributes to the safety and the performance of railways [1].

Despite its benefits, mainly in terms of interoperability, GSM-R shows fundamental shortcomings [2]. The first one is the insufficient capacity, which does not satisfy railway needs. There is a shortage of user communication channels, what becomes an issue at major train stations and other areas with high train concentration [3]. Another shortcoming of GSM-R is the low network resource utilization. One of the main applications of GSM-R is delivery of bursty, low-rate ETCS data messages. Since GSM-R is based on circuit-switched transmission, ETCS connections need to continuously occupy network resources even when these are not utilized [1]. Finally, GSM-R offers very limited support for data services. For instance, bitrate of a single connection cannot exceed 9.6 Kbit/s [1] and packet delay is approximately 400 ms [1]. These parameters can meet requirements only of applications with very low demands. Thus, GSM-R cannot support modern data services demanded by railways such as [2]: video surveillance, Internet access, etc. The shortcomings of GSM-R are the driving force for further research on alternative railway communication technologies. The technology that should be considered as the most likely alternative to GSM-R is LTE. This is because it brings a number of benefits over previous mobile communication technologies – both GSM and the later UMTS. These benefits include improvements such as a more efficient packet-switched core network, reduced packet delay and a high throughput radio access [4]. LTE improvements address the previously listed shortcomings of GSM-R.

II. RESEARCH QUESTIONS

Despite LTE having major advantages over GSM-R [4], it is still an open question whether LTE can become a railway communication technology. There are three general questions which need to be answered to confirm that LTE is a viable alternative to GSM-R.

Question 1: Can LTE support ETCS signaling?

ETCS is a crucial railway application and one of the main reasons for introducing GSM-R in railways. Thus, LTE needs to fulfill all the ETCS requirements such as [3]: received signal power, data transfer delays, data integrity.

Question 2: Can LTE offer all the advanced railway voice communication functionality offered by GSM-R?

Despite the growing importance of data communication, voice communication is still an essential service for railways. Railway telephony needs to provide specific features such as: group calls, call prioritization, location and function dependent addressing [1].

Question 3: Can LTE ensure sufficient transmission quality of safety-critical applications while offering additional non-safety applications at the same time?

The last question concerns Quality-of-Service (QoS) mechanisms in LTE, which need to allow resource sharing between safety and non-safety applications. Efficiency of these mechanisms needs to be verified.

The project motivation and the research questions are summarized in an online presentation available at the following address: <http://prezi.com/kvcjxxwrqvaj/lte-as-an-alternative-to-gsm-r/>

III. ACKNOWLEDGMENTS

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<http://www.dtu.dk/subsites/robustrails/English.aspx>

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