

Lost in the City? - A Scoping Review of 5G Enabled Location-Based Urban Scenarios

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Abstract

5G mobile network technologies and scenarios with the associated innovations receive growing interest among academics and practitioners. Current literature on 5G technologies discusses several scenarios and specific chances and challenges. However, 5G literature is fragmented and not systematically reviewed. We conducted a scoping review on 5G applications in urban scenarios. We reviewed 1,394 papers and identified 20 studies about urban logistics and emergency indoor localization. Our review accumulates current academic knowledge on these scenarios and identifies six further research directions in four research fields. It reveals several further research opportunities, e.g., regarding trust and privacy concerns. We review and discuss 5G literature for academics and practitioners, contribute towards more tailored 5G research and reflect on cost-efficient 5G applications in urban scenarios.

Keywords: 5G technologies, 5G applications, scoping review, urban scenarios, further research agenda

1. Introduction and research needs

The 5G cellular network standard is a topic of increasing interest. The rising number of research projects from policy-makers, i.e., the European Commission (2022) reveal ongoing research on diverse topics like standardization or hardware innovations in connection to 5G, which can fuel new knowledge about this field in the next years. Key innovations of 5G include a higher data transmission rate, lower latency, and bigger overall capacity (Shafi et al., 2017). Besides that, it is planned to make 5G a highly accurate and widely available localization system (Dwivedi et al., 2020). With the ongoing standardization efforts by the 3rd Generation Partnership Project (3GPP), 5G will

achieve increased localization accuracy with an error margin below one meter (Loidl, 2020). As elaborated by Tahat et al. (2016), 5G localization will see main application areas in scenarios where there is No Line of Sight (NLOS) to a sufficient number of satellites from Global Navigation Satellite Systems (GNSSs), causing imprecise position estimates. This condition is caused by obstacles being in the direct path between sender and receiver. Such conditions can be found indoors and in streets dominated by high-rise buildings ("urban canyons"). Here NLOS is the rule rather than the exception.

Determining users' precise geolocation can enable location-based services, i.e., Intelligent Transport Systems (ITS). Amongst others, French et al. (2021) list emergency services, autonomous driving, and geographic routing as areas that profit from accurate wireless localization. We therefore, derived Urban Logistics (UL) and Emergency Indoor Localization (EIL) as topics of scientific interest and subsumed them under the term "urban scenarios." Thus, we focus on two specific application areas. We select the urban environment since 5G roll-outs occur mainly in cities first (C. Sun & Ghose, 2021). Ongoing improvement in 5G localization carries a lot of potential in those urban scenarios and should attract scientific research. However, a systematic analysis of academic literature concerning these scenarios is missing. Our motivation is to analyze the utilization of ubiquitous device localization for innovations in public safety.

Emergency services can, directly and indirectly, benefit from mission-critical localization accuracy. Location intelligence can increase survival rates through fast and clear access paths for Emergency Medical Service (EMS) vehicles enabled by intelligent traffic management (Lee et al., 2014). On-site, Laoudias et al. (2018) envision indoor mapping and navigation but could not find any application studies. They underline the symbiosis of 5G based location for ITS and