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Under the SAFE4RAIL project, we are developing a simulation platform based on a discrete-events network simulator. This platform models the Train-to-Ground (T2G) link in the framework of a system-level simulation of Train Control Management System (TCMS). The modelled T2G link is based on existing wireless technologies, e.g. Wi-Fi and LTE. Different T2G scenarios are defined in order to evaluate the performances of the Mobile Communication Gateway (managing train communications) and Quality of Services (QoS) offered to TCMS applications in the context of various environments (regular train lines, train stations, shunting zones, etc.) while varying the number of communicating trains, train’s speed, radio channel characteristics (delay spread, channel attenuation, etc.). This paper focuses on the design and validation of the TCMS transmission over Wi-Fi/LTE via an approach based on simulation. This simulation platform aims to be also used to test actual TCMS equipment’s, i.e. Mobile Communication Gateway and Ground Communication Gateway, connected to it through Hardware-In-the-Loop facilities of the chosen discrete-events network simulator.