# Optimized handover detection for IEEE 802.11a deployment in tunnels for metro applications

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***Abstract*— The deployment of wireless technologies for public transport may imply several constraints due to specific environment, such as tunnels. In this work, we evaluate the performance of IEEE 802.11a deployed in tunnels for metro. The signal attenuation specific to the tunnel propagation is taken into account. We propose an optimization of the handover detection mechanism to minimize the connectivity loss when the train moves between Access Points. We propose a performance evaluation based on OPNET simulator.**

## I. WORK CONTEXT

IEEE 802.11 technology is used in the metro context for control-command applications. The deployment of this technology in tunnels has to take into account several constraints related to these specific environments. Particularly, the propagation of IEEE 802.11 waves does not follow the same rules in tunnels as in open areas. In [1], authors have been able to obtain path-loss models for a signal in the 5 GHz band using a 3D-ray tracing simulator. We integrated this path-loss model into the OPNET (Optimized Network Engineering Tool) simulator [2] to compute the signal attenuation at receiver level each time a packet is transmitted over this frequency band.

In this work, considering a realistic model of the propagation in tunnel, we propose an evaluation of the IEEE 802.11 handover (HO) detection in simulation We consider two handover detection mechanisms: a basic mechanism based on the Radio Signal Strength Indicator (RSSI) variable and a second mechanism adapted to the fast fading encountered in tunnels.

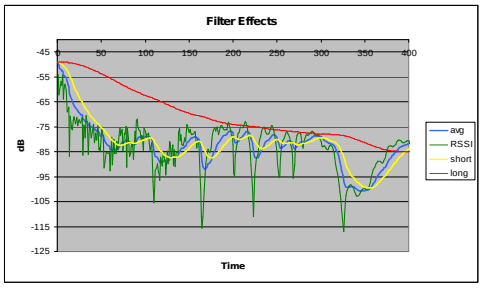


Figure 1. RSSI filters.

The HO detection based on the RSSI is admitted to offer good performances, in regular deployment, as it may detect the need to perform the HO before the loss of the connection [3]. However, the trigger of the HO detection may be affected by the particular signal behavior in tunnels.

An adaptation of the HO detection mechanism based on the remove of signal fluctuations in tunnels due to multipaths is proposed. The new HO detection mechanism consists in averaging out the RSSI values measured over the time. Two filters are used to follow the average behavior of the original signal while filtering out the rapid variations. The first filter results in a signal (RSSIavg) that follows the average behavior of the original signal, while filtering out rapid variations (fast fading). The second filter results in a signal ($RSSI_{long)}$ that follows the overall behavior of the RSSI very slowly. Fig. 1 depicts the effect of these filters over a signal representing the electric field amplitude versus the distance into a square section tunnel.

## II. SIMULATION AND RESULTS

We consider a simulation scenario that involves wireless train-to-wayside communications for metro applications in tunnels: Communication Based Train Control (CBTC) and Closed-Circuit Television (CCTV). The first one is a safety application and the second one is a surveillance application.

We evaluate the performance of the two HO detection mechanisms both in open area and in tunnel. For this purpose, we analyze the connectivity offered to the train and the effects of handovers on the exchanged data. In addition, we observe the particular behaviors of each application deployed over the system: CCTV and CBTC.

Results have shown that the HO detection mechanism, adapted to tunnels, ensures a stable connectivity in tunnel and reduces delay for transmitted data. However, this mechanism damages the robustness of the network as we show an increase in data loss compared with the classic HO detection mechanism, which affects the performances of applications.

## REFERENCES

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