



# Performance Evaluation of Train Moving-Block Control

Giovanni Neglia, Sara Alouf, Abdulhalim Dandoush, Sebastien Simoens,  
Pierre Dersin, Alina Tuholukova, Jérôme Billion, Pascal Derouet

► **To cite this version:**

Giovanni Neglia, Sara Alouf, Abdulhalim Dandoush, Sebastien Simoens, Pierre Dersin, et al.. Performance Evaluation of Train Moving-Block Control. Reliability, Safety and Security of Railway Systems, Jun 2016, Paris, France. 2016. hal-01404854

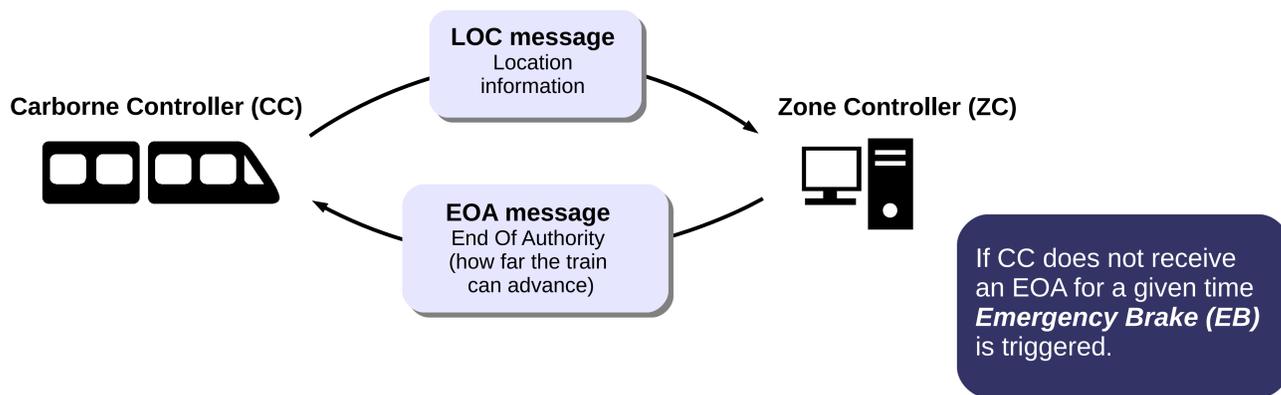
**HAL Id: hal-01404854**

**<https://hal.inria.fr/hal-01404854>**

Submitted on 29 Nov 2016

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



**In this work we study  
Emergency Brake rate**

## Approach and General Formula

We derived general formula for the EB rate that requires to provide the loss and delay model

$$\text{EB rate} = f \left( \text{Loss Model}, \text{Delay Model} \right)$$

Probability that the  $k$ -th LOC-EOA exchange is lost.

Probability that the  $k$ -th EOA arrives too late to deactivate the timer of LOC<sub>1</sub>

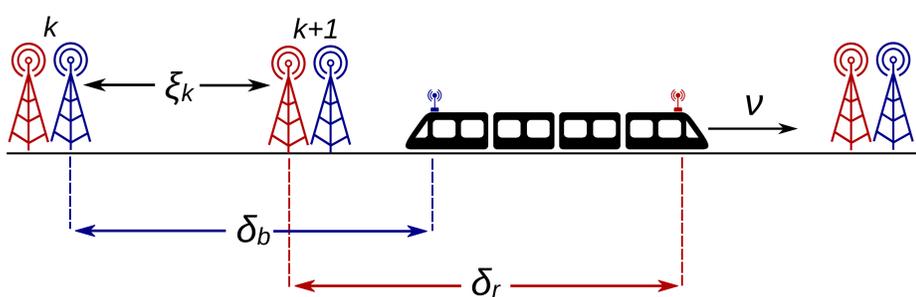
### Two cases for loss model

#### Case 1: Independent and Homogeneous losses

- ✓ Exact expression for EB rate
- ✓ Understanding of the role of different system parameters

#### Case 2: Losses due to handover (HO)

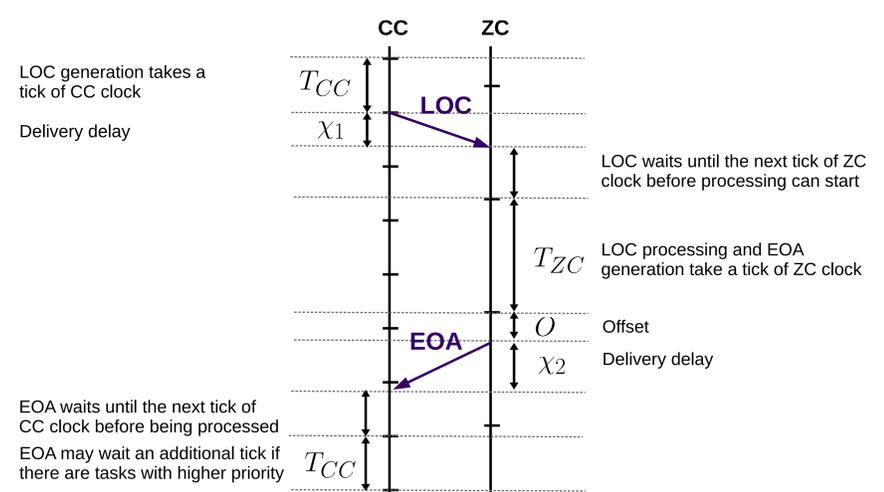
As the train moves, it regularly loses communication due to handover phases. These handover phases depend on train's mobility.



### Delay model is based on real implementation for metro by ALSTOM Transport

CC and ZC servers work on the basis of ticks. CC generates LOC every third tick of its clocks.

The figure explains the procedure of one LOC-EOA exchange.

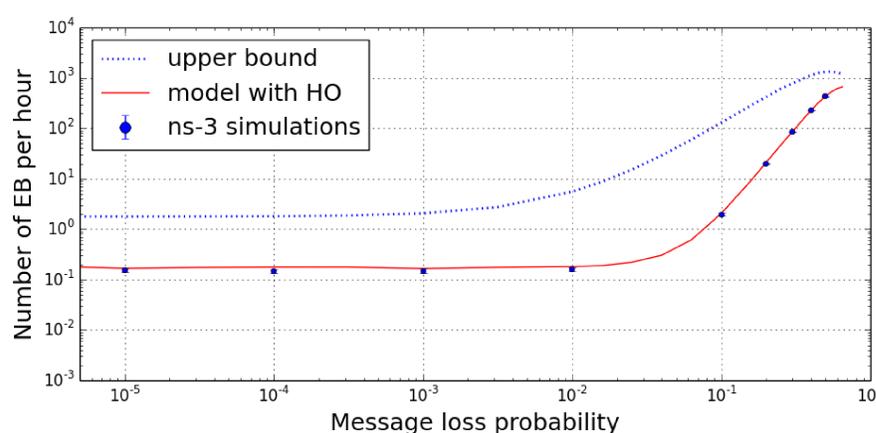


## Simulation results

It is hard to derive a closed-form expression for EB rate in presence of handovers (case 2).

We evaluate the EB rate with Monte-Carlo simulations.

Computational costs do not depend on the loss probability value. Thus it is efficient even when emergency brakes are rare (as they should be).



✓ Theoretical results are validated with ns-3 simulations.

✓ Too loose bounds justify our analysis.