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Impact of ETCS Level 3 Hybrid on Railway Operations

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1 Introduction

Many of the existing railway lines in urban areas are already heavily used. At the same time, however, an increase in traffic volume is expected in these regions. In order to deal with the higher traffic volume, an increase in capacity on existing lines is unavoidable.[1] Therefore, a dissertation was written to examine how capacity in train stations can be increased by using train- and traffic control.[2] This poster is based on the doctoral thesis. It presents one Use case where European Train Control System (ETCS) Level 3 Hybrid is used.

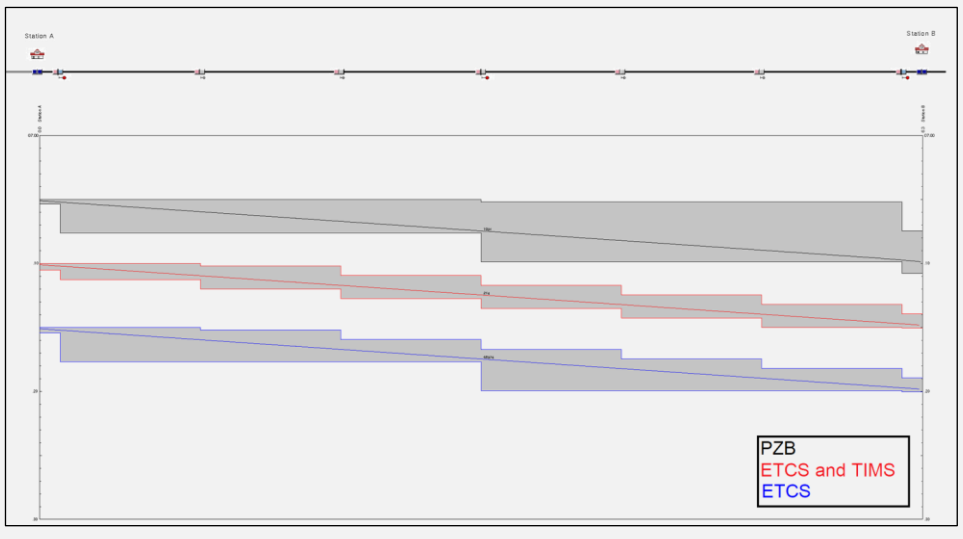
2 Methods

- The study is carried out at a microscopic level. The synchronous simulation is done with the software OpenTrack.
- Different train protection systems such as inductive train protection (PZB) or ETCS are used.
- Rolling stock: Electrical Multiple Units (EMU) operated in Austrian suburban traffic
- Parameters for ETCS based on Austrian values

3 Simulations

For the simulation, an infrastructure is created which consists a line with two stations. Beside the exit and the home signal there is a block signal on the open line between the two stations. At each of this signals an axle counter is located. The physical blocks are diverted in three Virtual Sub Sections (VSS).

Three different train categories are created. The first category with Class B train protection system (In this model PZB). A second category with ETCS and Train Integrity Monitoring System (TIMS), which enables the possibility to reserve and release the VSS. The third train category is equipped with ETCS but without TIMS.



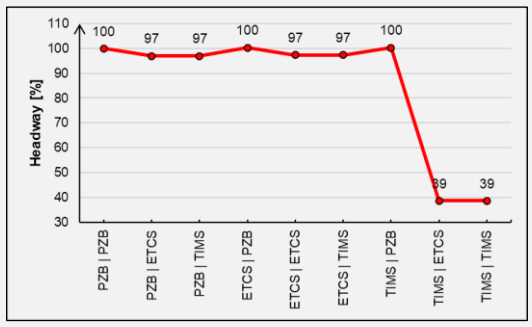
Time-distance diagram with three train types. Black train with Class B train protection system. Red train with ETCS and TIMS. Blue train with ETCS but without TIMS.

The train in black is equipped with PZB and can use only the line-side signals, which are equipped with Trackside Train Detection (TTD). As mentioned before axle counters are used. Therefore, the physical blocks can be reserved from a following train when the whole TTD section is released from the PZB train. The train in red is using ETCS and TIMS. This enables, that the train can reserve the virtual blocks in front and releases them separately. The train in blue is only equipped with ETCS without TIMS. So, this train can use the VSS in front, but it releases only the whole physical TTD section. Typically, this train could be a freight train. As it can be seen in the time-distance diagram the three train types will have different headway times.

4 Results and discussion

Considering the various train headway times, it can be seen that the maximum headway of 300s appears between two PZB trains. The shortest headway time of 116s can be calculated between two trains with ETCS and TIMS. This therefore represents a reduction of 61%. The results can be seen in the following table and diagram.

	First train	Second train	Headway [s]
1	PZB	PZB	300
2	PZB	ETCS	291
3	PZB	ETCS & TIMS	291
4	ETCS	PZB	301
5	ETCS	ETCS	292
6	ETCS	ETCS & TIMS	292
7	ETCS & TIMS	PZB	301
8	ETCS & TIMS	ETCS	116
9	ETCS & TIMS	ETCS & TIMS	116
		Δ Headway	**184**



The left part shows a table with the three train types. Each train type is tested in combination with the others and the headway is measured. The right part shows percentual comparison of headways.

5 Conclusion and expected impact

- A significant headway reduction is possible by using ETCS Level 3 Hybrid if trains are equipped with ETCS & TIMS.
- If a train with ETCS and TIMS is followed by a train with ETCS without TIMS, the headway can be significantly reduced.
- No reduction in the headway time when a PZB or ETCS train without TIMS is running ahead.
- Biggest impact on suburban railway lines with single-type trains

References

1. ÖBB Holding AG. (2021). ÖBB will Leistung im Güterverkehr bis 2040 verdoppeln (In German: ÖBB wants to have doubled freight transport volume by 2040). https://presse.oebb.at/dam/jcr:260a23ff-8068-4021-a194-11b7eb606099/20210520_PI_OeBB--Terminal-Wien-Sued.pdf.
2. Wagner, A. (2024). Influence of train and traffic control on railway station capacity (Doctoral dissertation, Technische Universität Wien).

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