Capacity Evaluation of ERTMS/ETCS Hybrid Train Detection using Simulation Methods

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CAPACITY EVALUATION

ERTMS

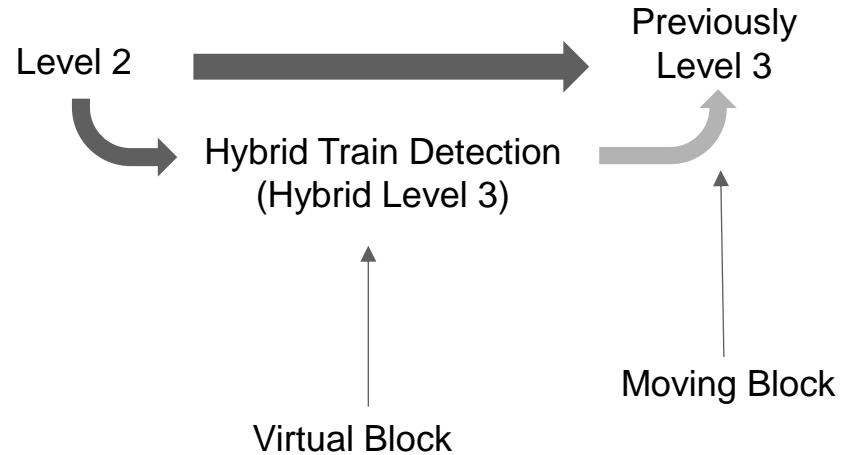Train Position ✔

Train Integrity ▬

Train Position ✔✔

Train Integrity ✔

Level 2 → Previously Level 3

Hybrid Train Detection (Hybrid Level 3)

Virtual Block

Moving Block

CAPACITY GAINS WITH HYBRID TRAIN DETECTION (HTD)?

- What effects do different virtual block lengths have on capacity?

- How does the share of trains with or without train integrity affect capacity?

- Differences in capacity between HTD and Moving Block?

Foto Satu AB/VTI

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CAPACITY STUDIES

Case	Number of Trains	Timetable	Infrastructure	Variables	Indicator
1	2	Conceptual	Conceptual	Length of Virtual Block	Headway
2	235	Timetable 2022	Norrköping–Mjölby	Share of L3 trains	Punctuality
3	235	Timetable 2022	Norrköping–Mjölby	Share of L3 trains	Capacity Utilization

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HEADWAY BETWEEN TWO TRAINS

- Virtual block lengths:
    - 500 m
    - 200 m

- Scenarios:
    - L3 followed by L3
    - L3 followed by L2
    - L2 followed by L3
    - L2 followed by L2
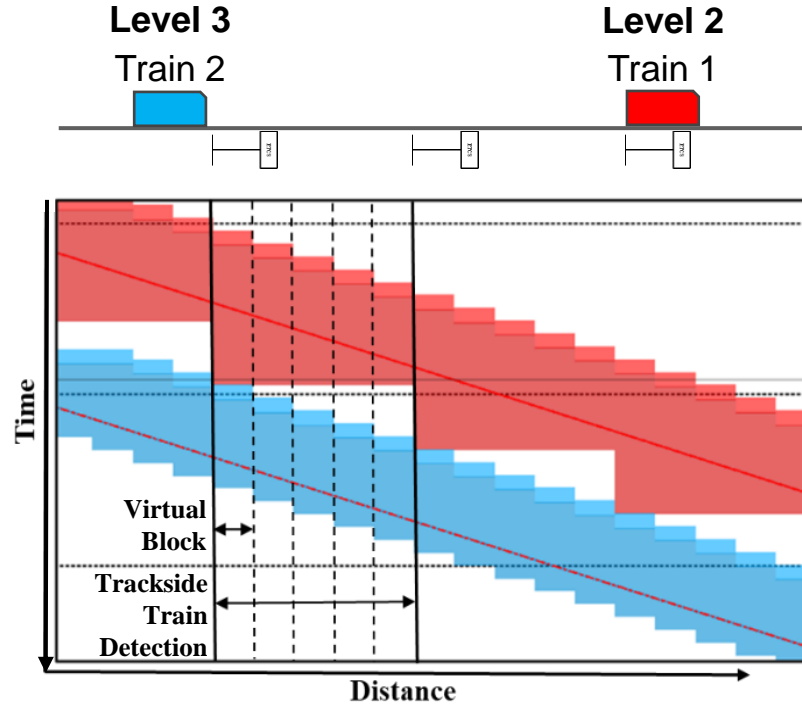
RESULTS
Headway between Two Highspeed Trains

Virtual Block Length	Trackside Train Detection Length	L3 followed by L3	L3 followed by L2	L2 followed by L3	L2 followed by L2
500 m	2500 m	01:12	01:12	01:48	01:48
				- 36s	
200 m	2500 m	01:07	01:07	01:48	01:48
				- 41s	

Headway: shortest time train 2 can depart after train 1

RESULTS
# Headway between Freight Followed by Highspeed

Virtual Block Length	Trackside Train Detection Length	Freight (L3) followed by Highspeed (L3)	Freight (L2) followed by Highspeed (L3)	Freight (L2) followed by Highspeed (L2)
500 m	2500 m	04:55 ← - 54s ← 05:49 ← - 1s ← 05:50		
200 m	2500 m	04:45 ← - 43s ← 05:28 ← - 22s ← 05:50		

Headway: shortest time train 2 can depart after train 1

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SIMULATION USING REAL TIMETABLE
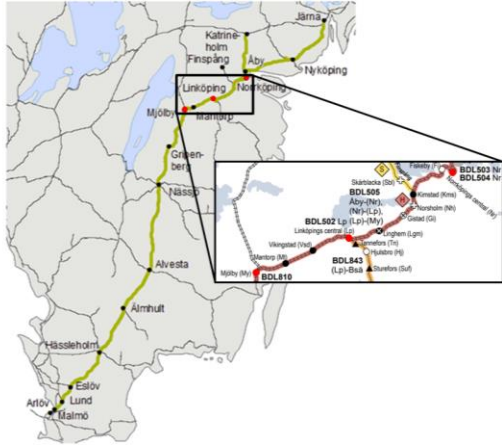
- Southern mainline

- Length: 79 km

- Traffic: 235 trains
  - 36 Highspeed
  - 78 inter-city
  - 99 Regional
  - 22 Freight
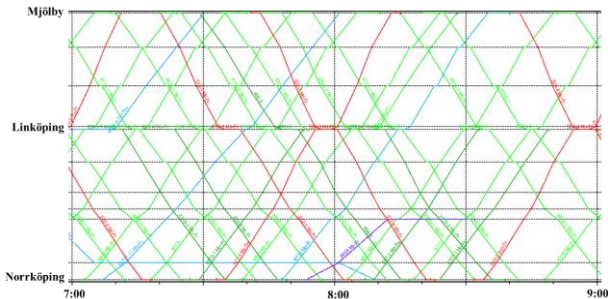
- Input:
  - Timetable 2022
  - Delay data 2019 (before covid-pandemic)

Scenario	Non integer train	Integer trains
Scenario A	Freight, Railcar, Locomotive-hauled passenger	-
Scenario B	Freight, Locomotive-hauled passenger	Railcar
Scenario C	Freight	Railcar, Locomotive-hauled passenger
Scenario D	Some freight (Loss of TIMS)	Railcar, Locomotive-hauled passenger, Freight
Scenario E	-	Railcar, Locomotive-hauled passenger, Freight

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RESULT – Effects on Punctuality

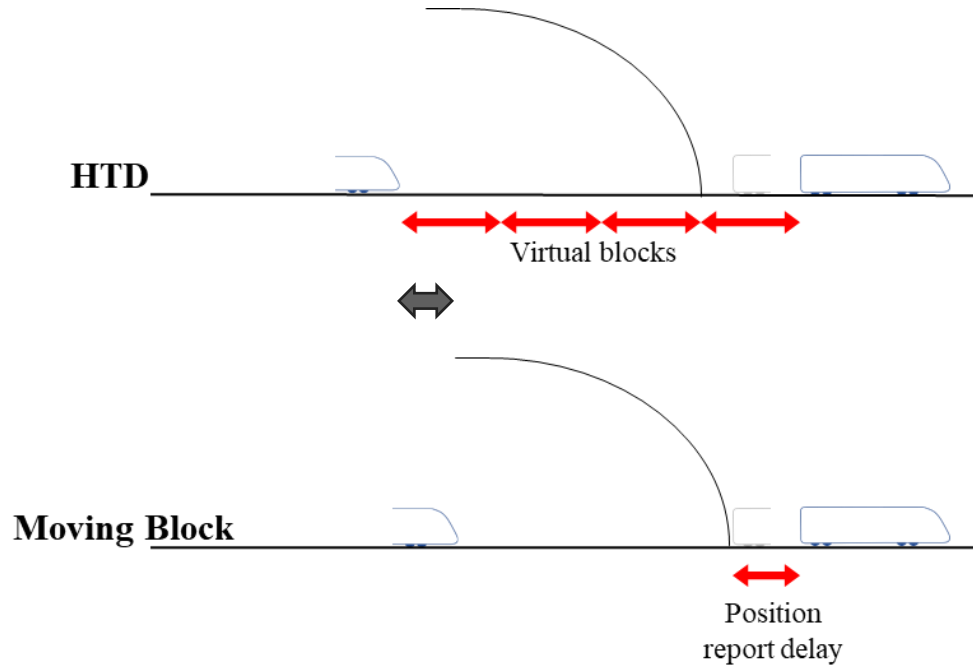| Scenario	Punctuality (%)	Average delay (mm:ss)
Scenario A	88.7 %	02:18
Scenario B	88.6 %	02:22
Scenario C	88.6 %	02:22
Scenario D	88.6 %	02:22
Scenario E	88.6 %	02:22

FACTORS INFLUENCING HTD CAPACITY EVALUATION

- Station capacity and switches on the line

- Timetable not designed for HTD

- Timetable margins

Foto Satu AB

DIFFERENCES IN CAPACITY BETWEEN HTD AND MOVING BLOCK?

Virtual Blocks: 500 m
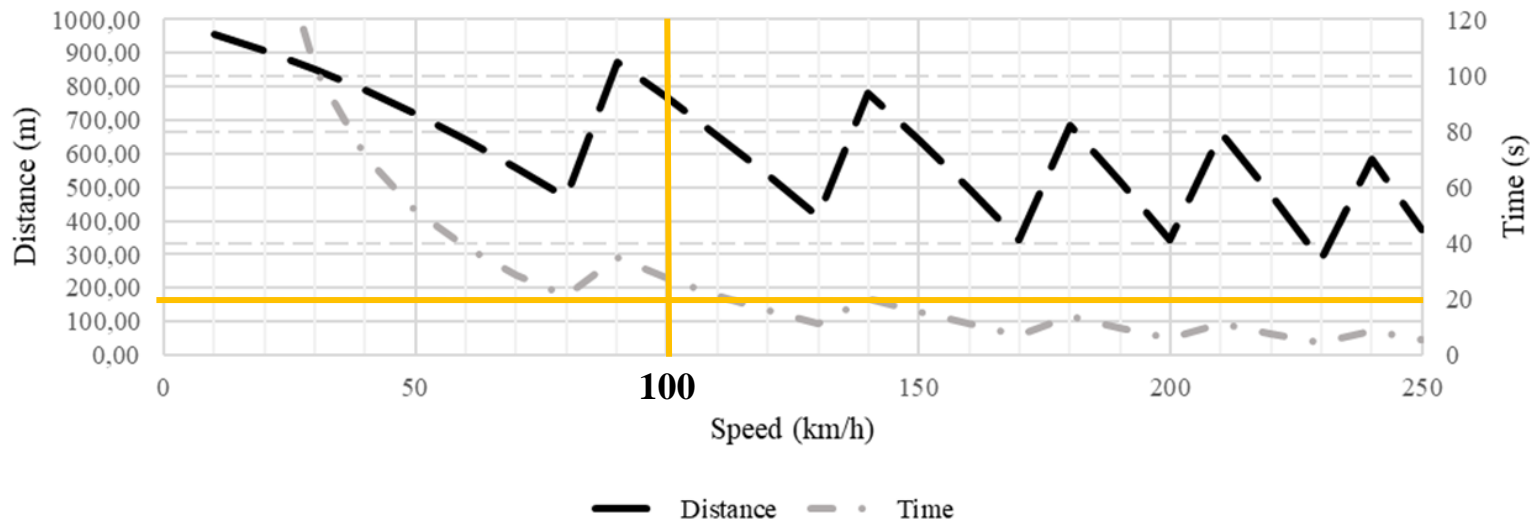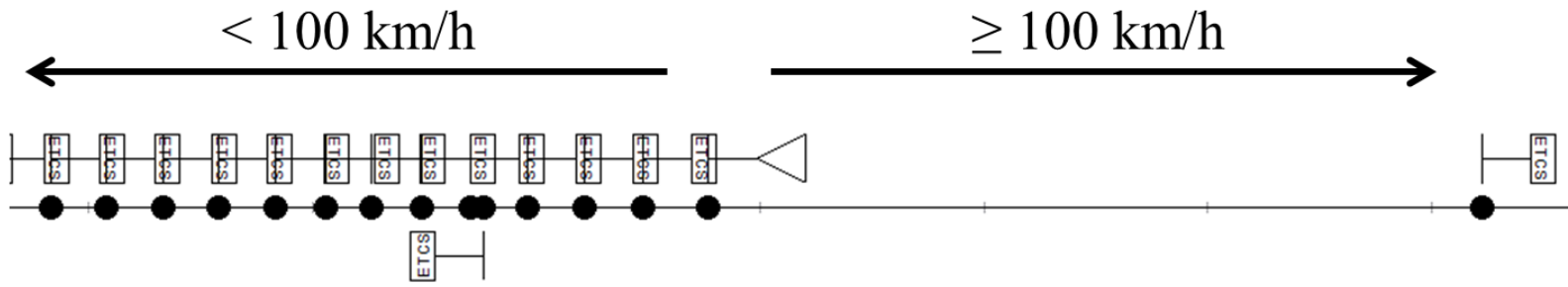
RESULTS – Effects on Capacity Utilization

	VSS length	Share of trains with train integrity
Scenario A	(only TTDs)	0 %
Scenario B	500 m	80 %
Scenario C	500 m	91 %
Scenario D	500 m	97 %
Scenario E	500 m	100 %
Scenario F	Moving Block	100 %
Scenario G	500 m (on the line), 25 m (under 100 km/h)	100%

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RESULTS – Effects on Capacity Utilization

	VSS length	Share of trains with train integrity	Capacity utilization [%]
Scenario A	(only TTDs)	0 %	54.7
Scenario B	500 m	80 %	54.2
Scenario C	500 m	91 %	54.1
Scenario D	500 m	97 %	54.1
Scenario E	500 m	100 %	53.9
Scenario F	Moving Block	100 %	48.1
Scenario G	500 m (on the line), 25 m (under 100 km/h)	100%	49.9

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SUMMARY

- Performance (HTD implementations)

	Share of Integer trains	Virtual block lengths
Headway	↘	→
Capacity Utilization	→	↘
Punctuality	→	→

- Limiting factors

  - Stations and switches on the line

  - Timetable not designed for HTD & margins

- Moving Block

Foto Mats Egeberg

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Thank you for your attention

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