



SAPIENZA
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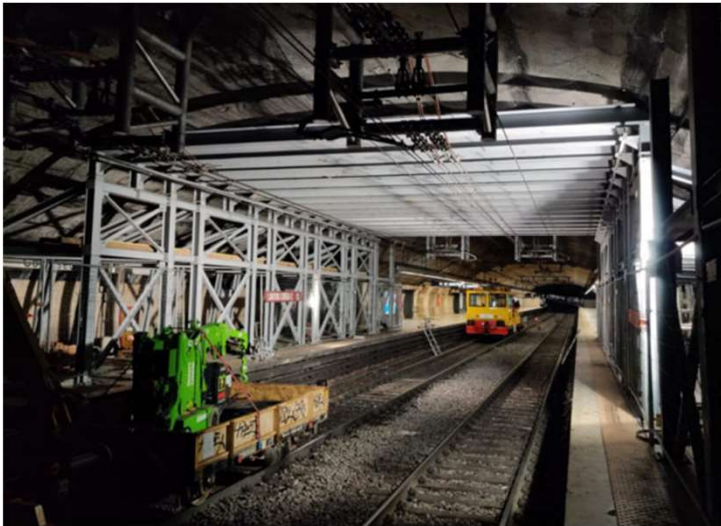


Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

A black and white photograph showing the interior of a crowded public transit vehicle, likely a bus or tram, with many passengers visible. The image is slightly blurred, emphasizing the density of the crowd.

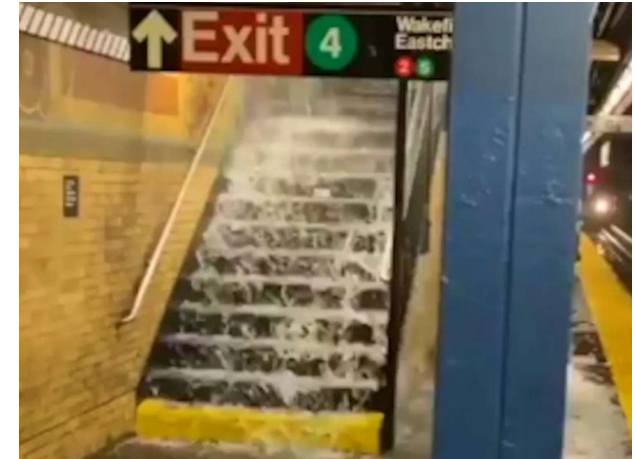
Extension of the Hyper Run Assignment Model to Real-Time passenger forecasting in congested transit networks considering dynamic service disruptions

Lory Michelle Bresciani Miristice, Guido Gentile, Francesco Corman
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Disruptions in Public Transport

Planned disruptions



Disruptions in Public Transport

Unplanned disruptions

How do PuT agencies react to unplanned service disruptions?



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- Inform users about the disruption



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- Select a recovery action from a set of predefined operation management strategies
- Inform users about the disruption and suggested alternatives

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Assess and apply recovery actions

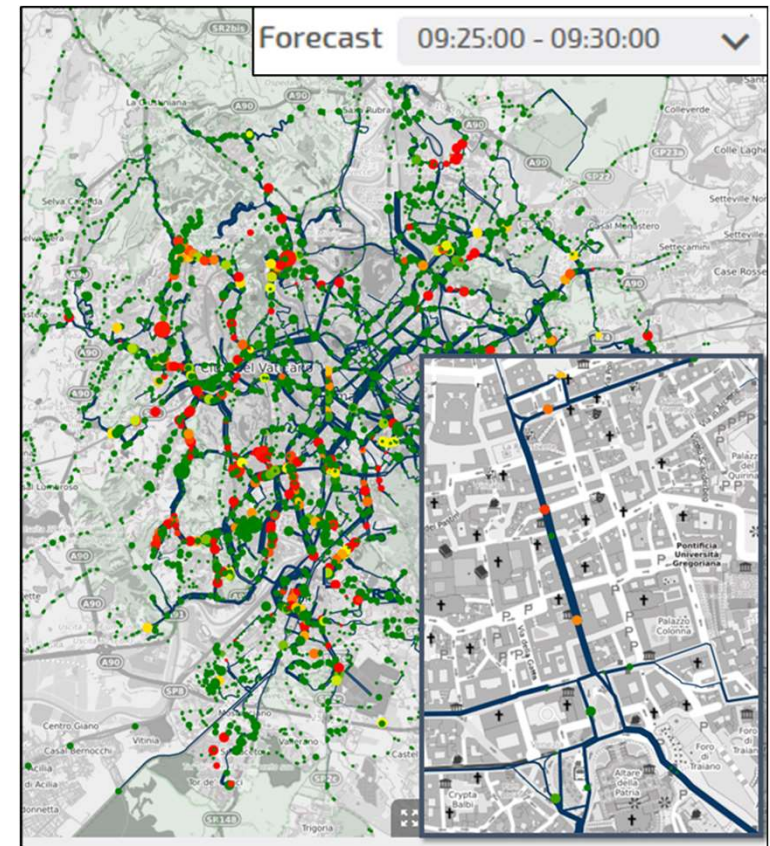
- Simulate recovery actions using forecasts and select the best ones to limit downside effects
- Inform the user about service evolution and suggested alternatives

Objective: Tool for Real-Time PuT Operation Management

Monitoring of current situation and forecasting the **short-term evolution** of congestion

Assessment of recovery strategies in case of exceptional conditions

Inform users on updated and forecasted service conditions

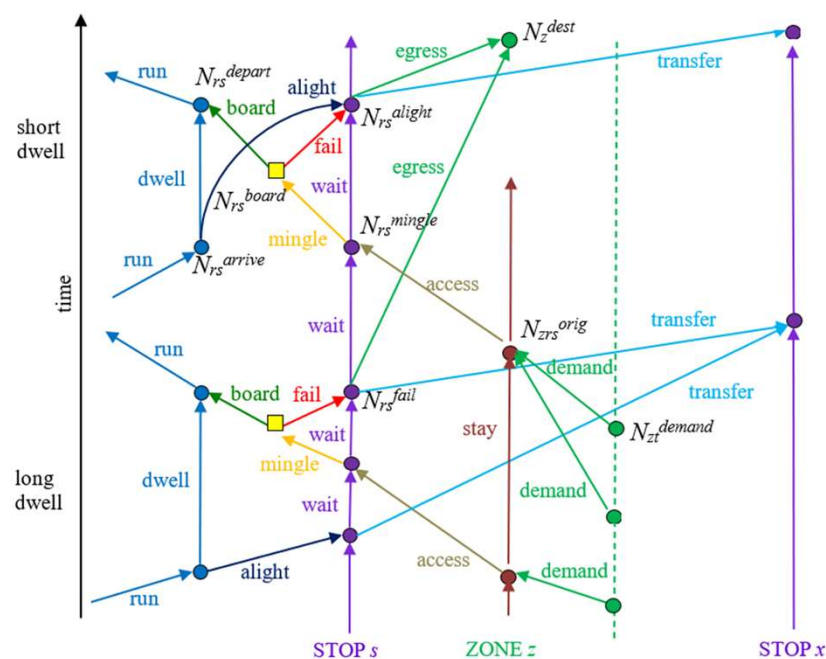


Methodology

- DUE

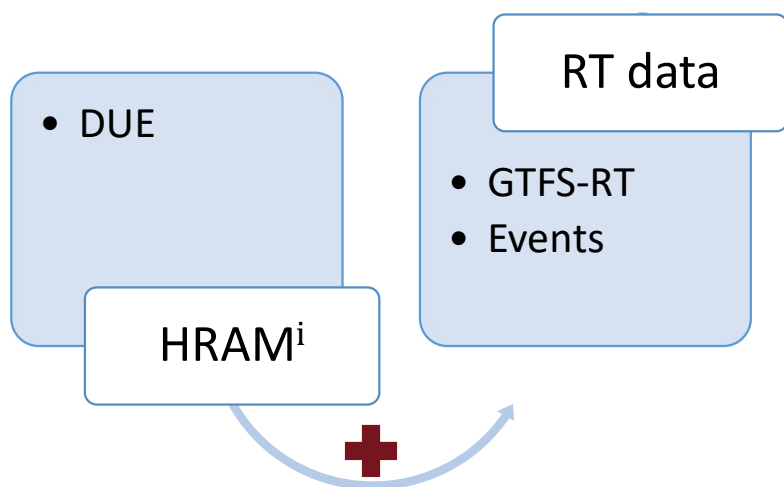
HRAMⁱ

- Dynamic User Equilibrium
 - Diachronic optimized **hypergraph**
 - Congestion on board and at platforms → **BPR functions**
 - Strict capacity constraints → **fail-to-board hyperarcs**

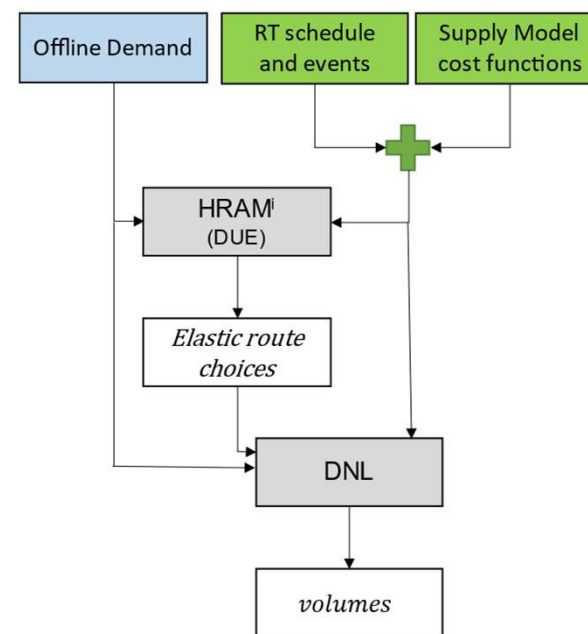


ⁱ Gentile, G., Mirastice, L.M., Tiddi, D., & Meschini, L. (2021). *The Hyper Run Assignment Model: simulation on a diachronic graph of congested transit networks with fail-to-board probabilities at stops.*

Methodology

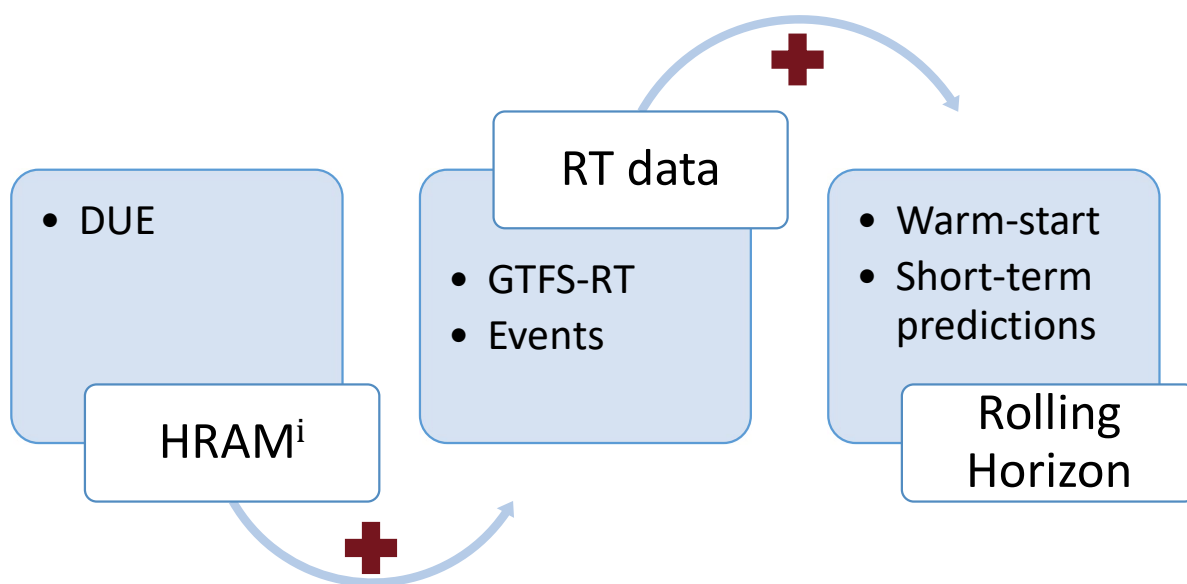


- Real-time data
 - Schedule changes → **real-time diachronic hypergraph**
 - HRAM for elastic route choices assuming **fully informed passengers**
 - Capacity constraints → **dynamic network loading with strict capacity**

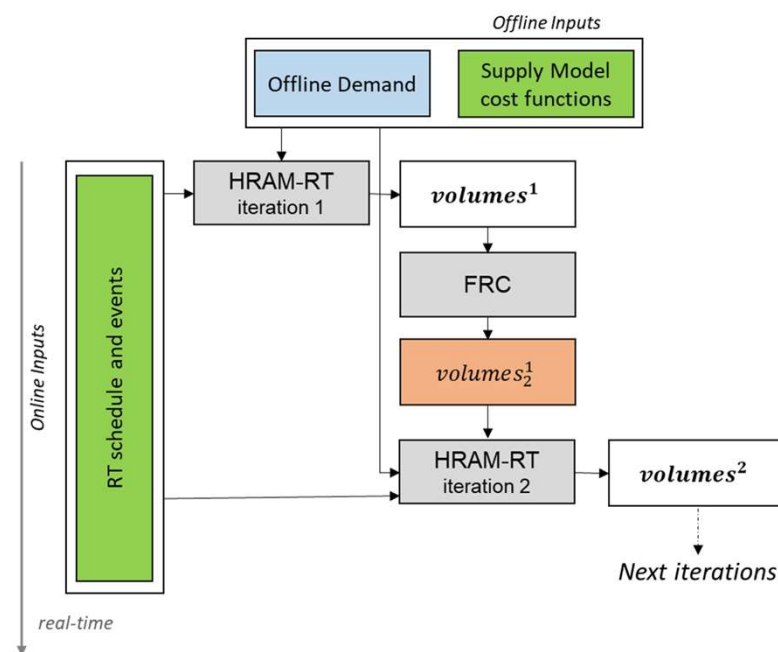


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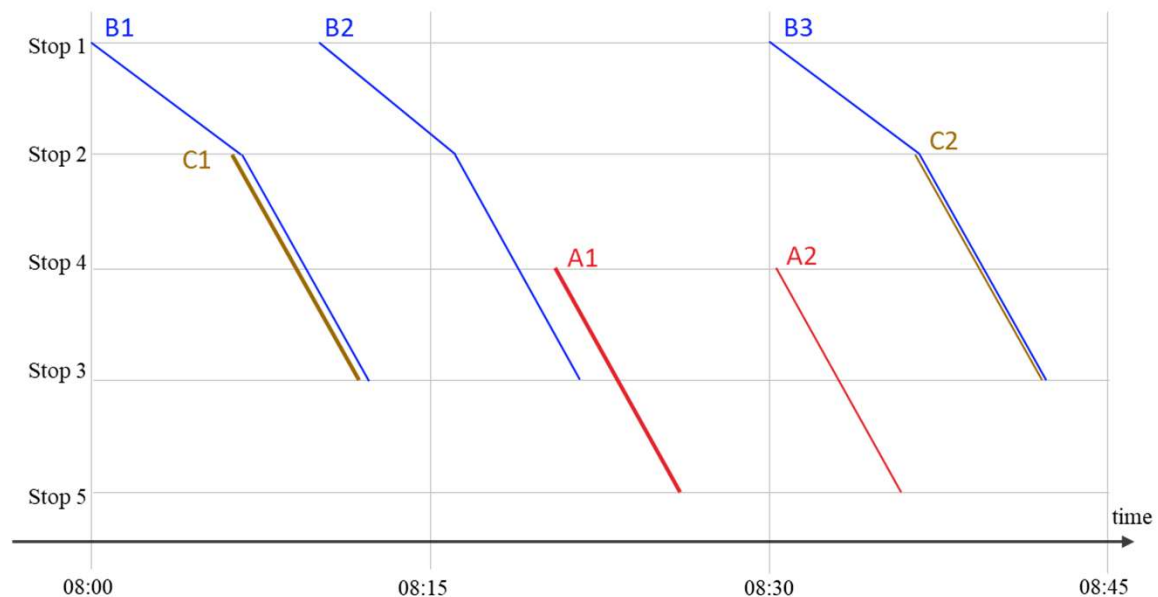
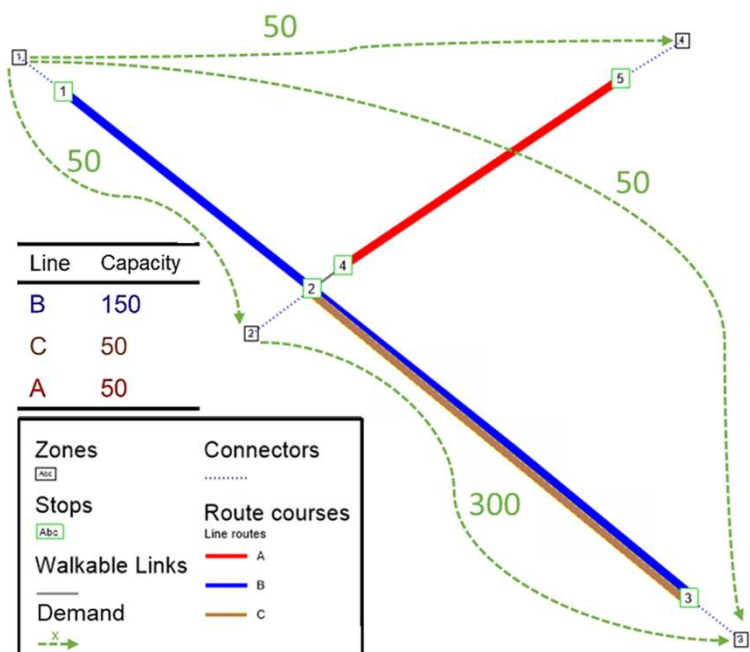


- Rolling Horizon
 - Partially overlapping simulations
 - Warm-start → **Flow Recovery Model (FRC)**
 - RT data included if they are known before the simulation start



ⁱ Gentile, G., Miristice, L.M., Tiddi, D., & Meschini, L. (2021). *The Hyper Run Assignment Model: simulation on a diachronic graph of congested transit networks with fail-to-board probabilities at stops.*

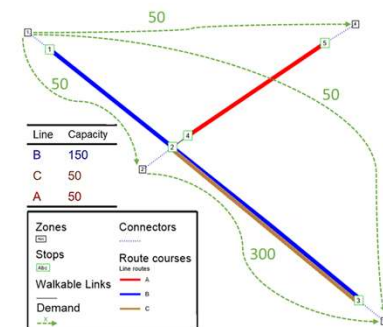
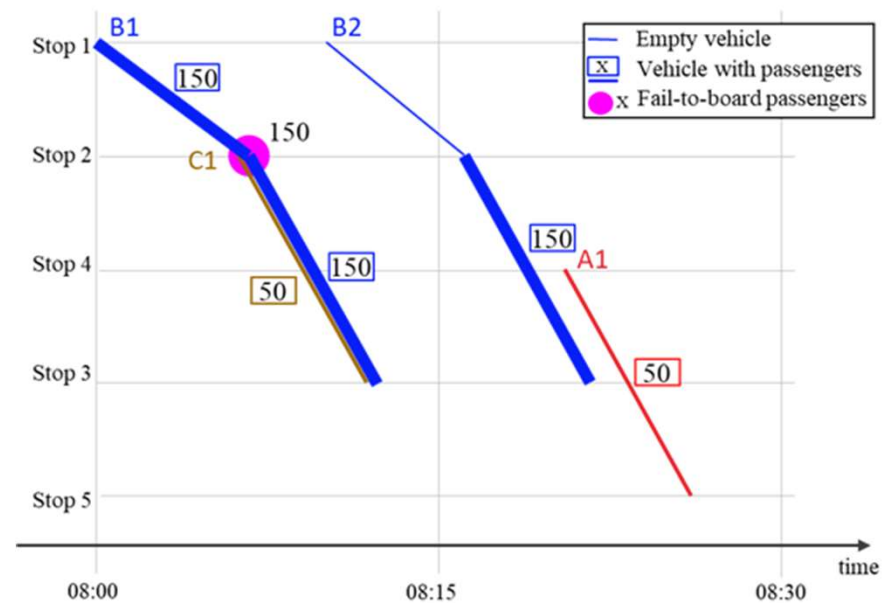
Simple network for tests





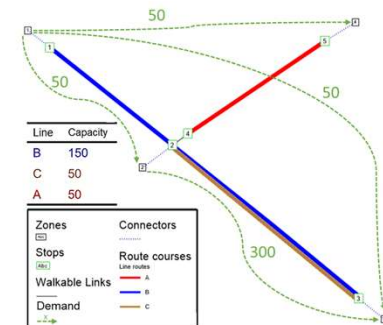
Simulation 07:30-08:30 and 08:00-09:00 (no disruptions)

07:30-08:30



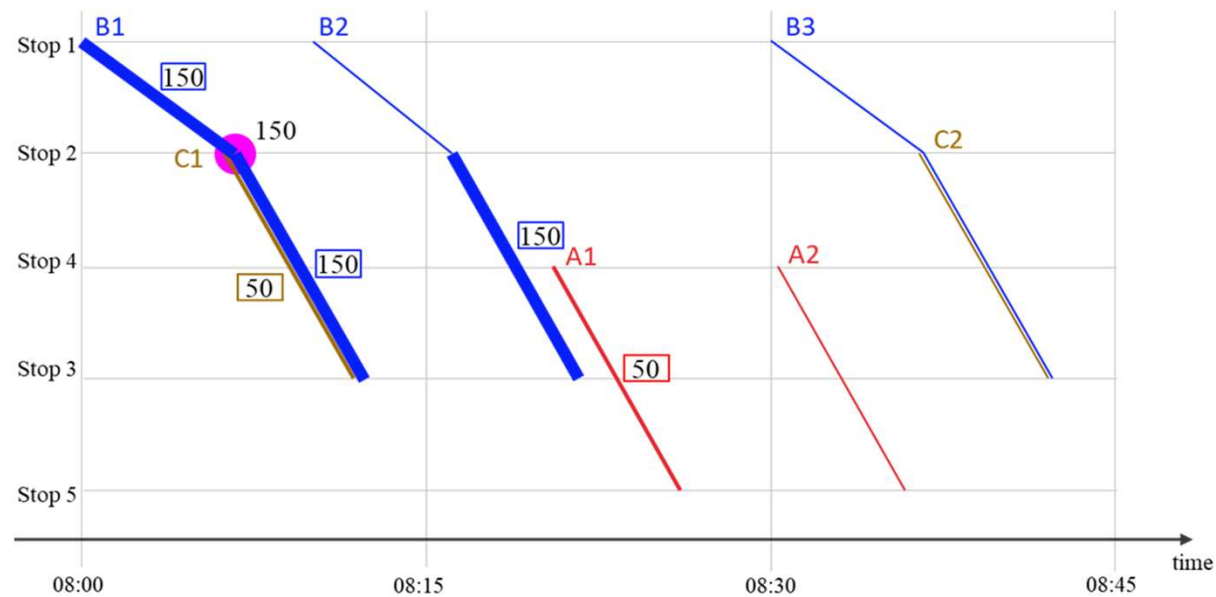
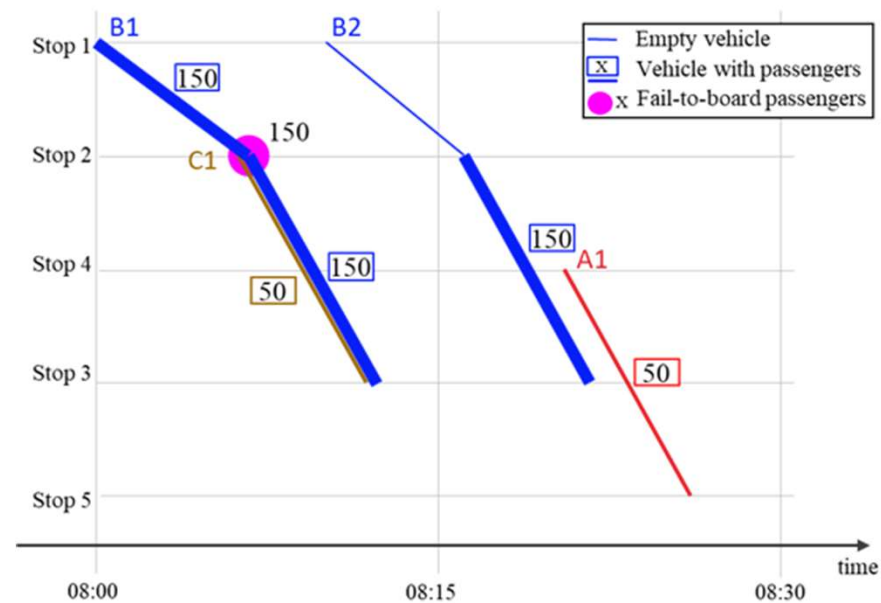


Simulation 07:30-08:30 and 08:00-09:00 (no disruptions)

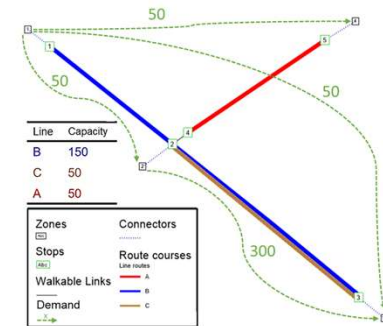


07:30-08:30

08:00-09:00

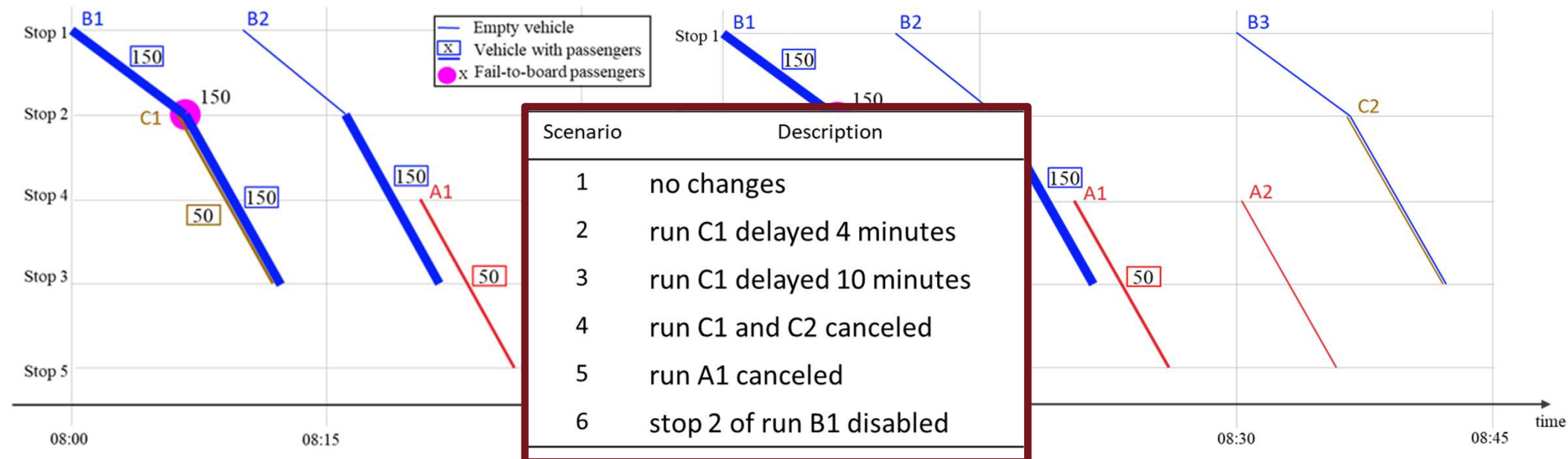


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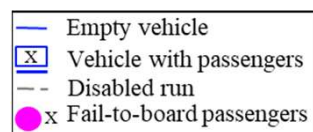
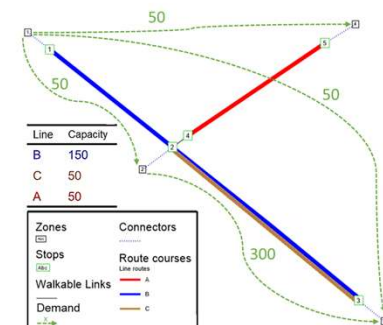


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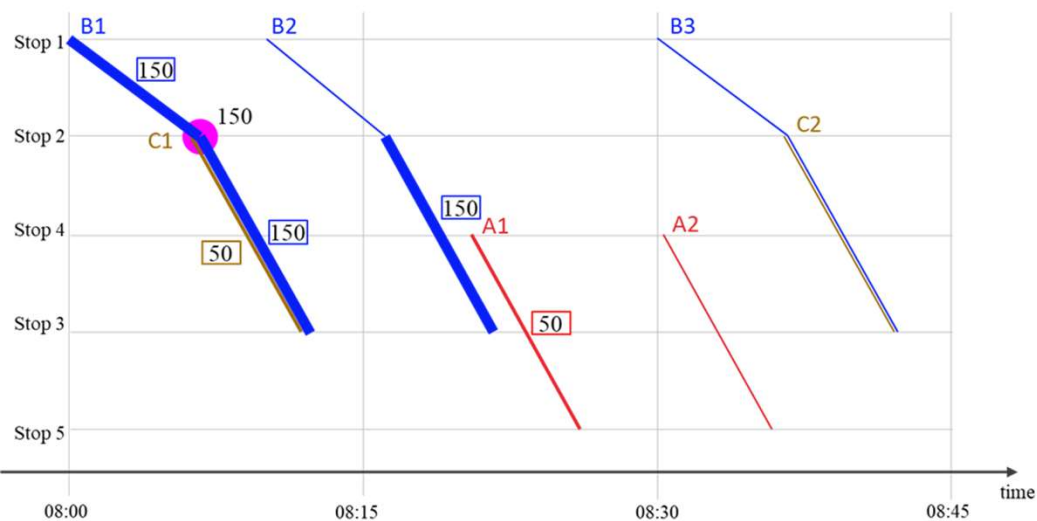
08:00-09:00



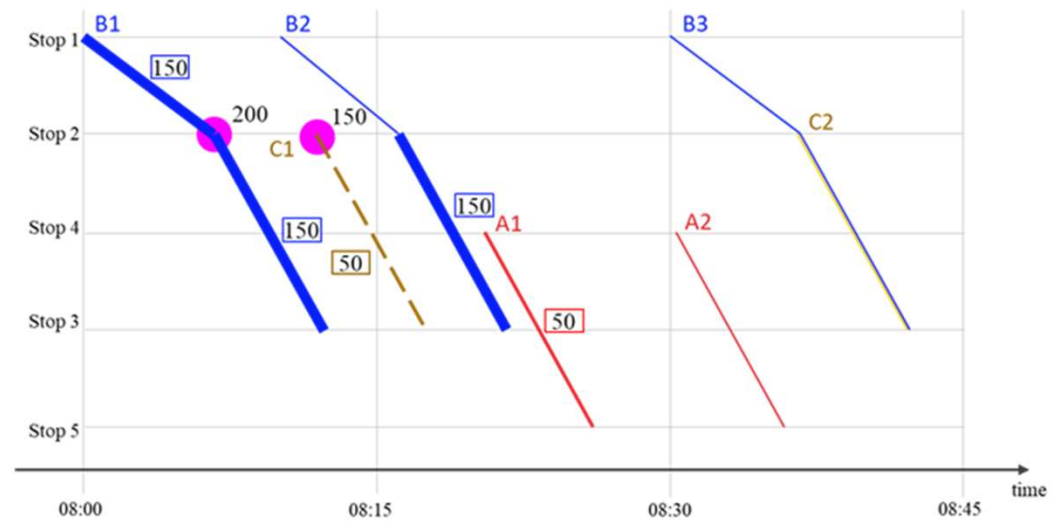
Simulation 08:00 – 09:00: C1 delayed 4 minutes



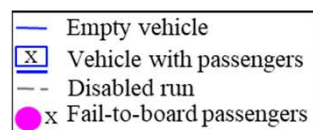
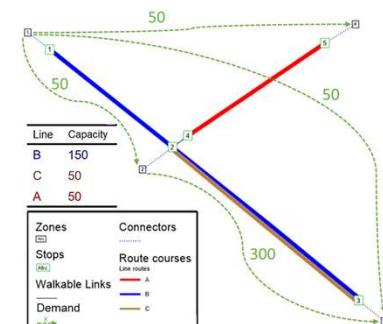
No disruptions



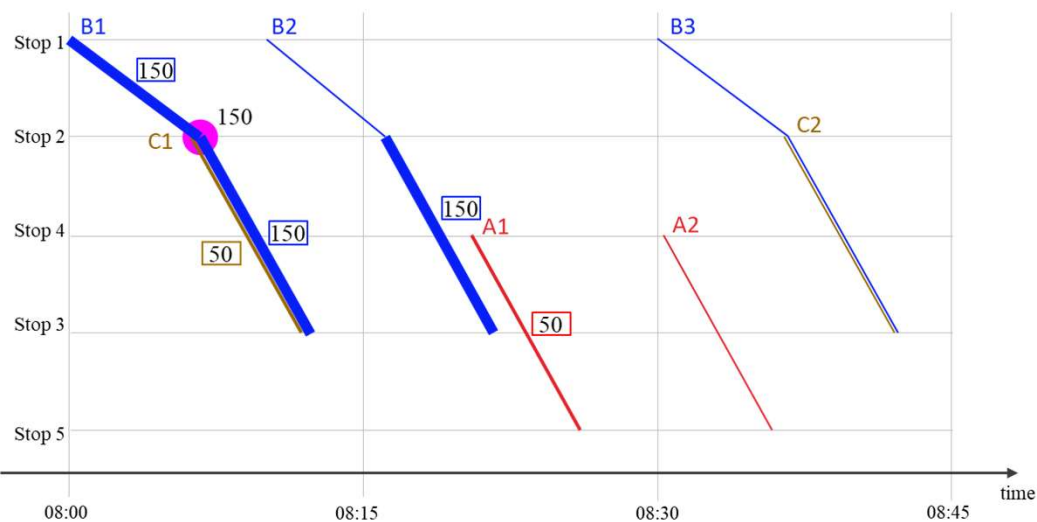
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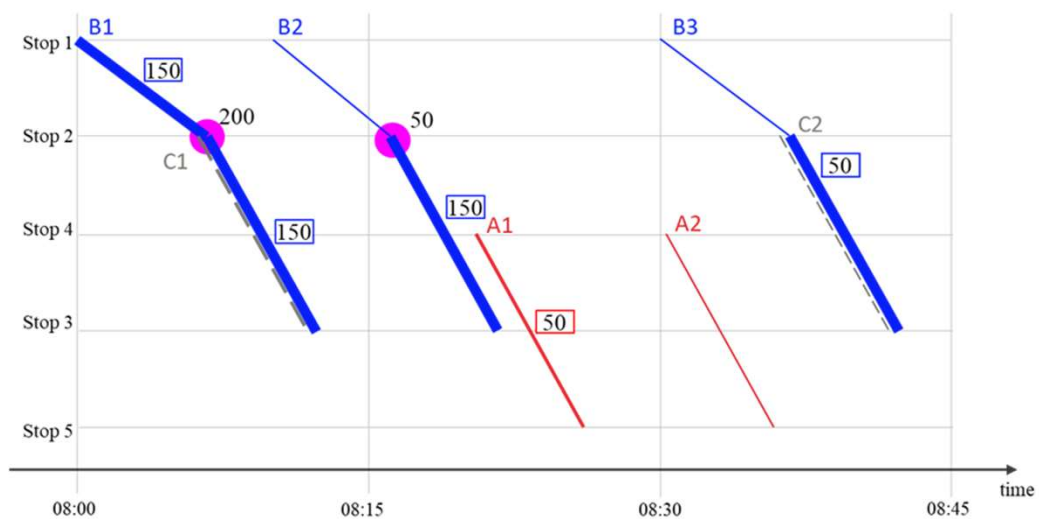
Simulation 08:00 – 09:00: C1 and C2 cancelled



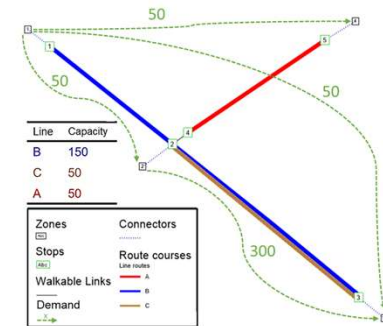
No disruptions



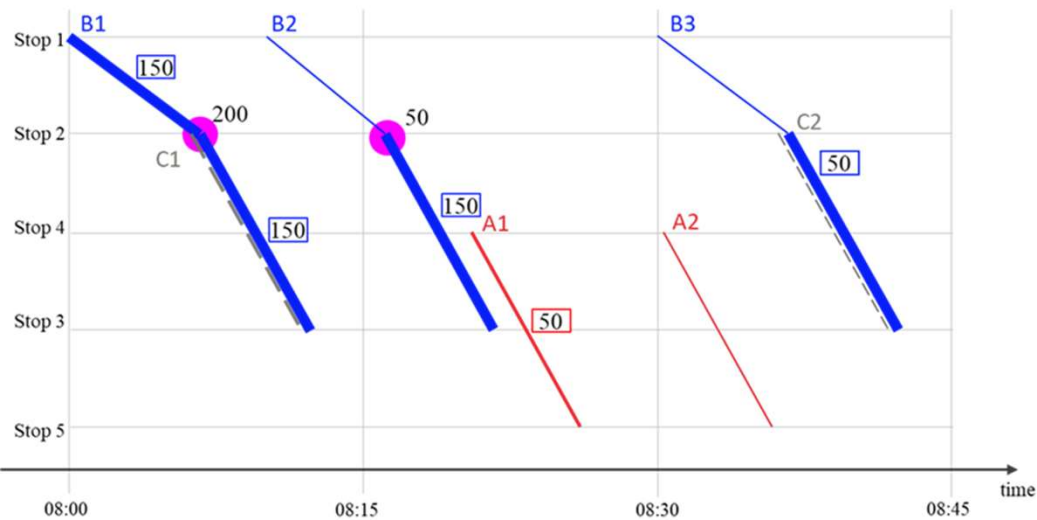
C1 and C2 cancelled



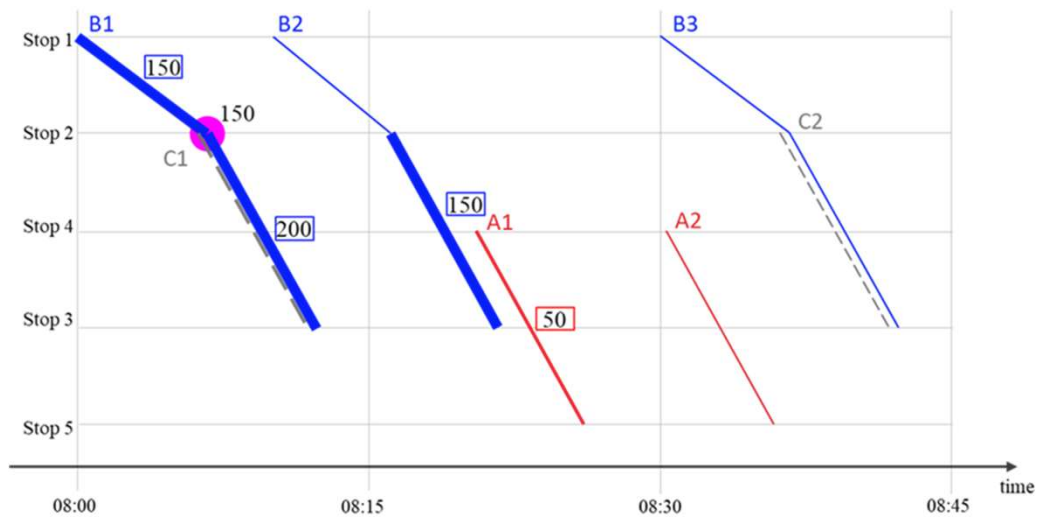
Simulation 08:00 – 09:00: C1 and C2 cancelled and recovery action

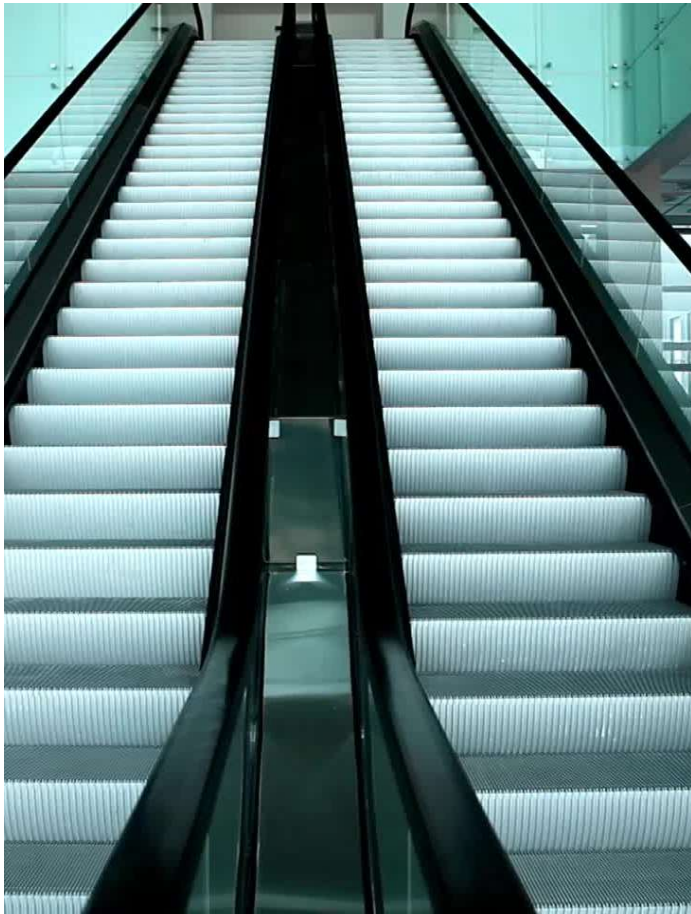


C1 and C2 cancelled



Increase capacity of line B from 150 to 200 passengers



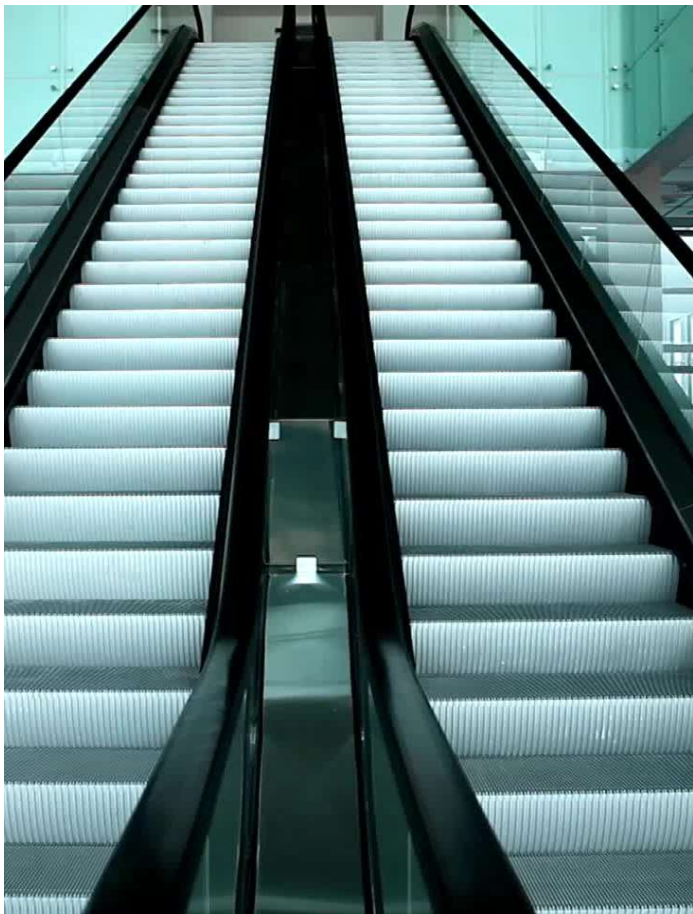


Conclusions and further research

- **HRAM-RT** considers scenarios and recovery actions on a simple network.
- Validation on a real network wrt. historical counts must still be done.
- The model will be applied to **long-distance Swiss railways** (disruption scenarios)

Further research:

- Elastic route choice computation:
 - Relax the assumption of fully informed passengers (different levels of information)
 - Include strategic behavior of passengers
- Include passengers counts to correct the volumes resulting from DNL



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