Modelling on-board crowding

(Smart transfer nodes)

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Smart transfer nodes

- Many stations are operating over or near capacity and crowding at stations are connected to on-board crowding.
- Station performance is important for the efficiency and attractiveness of the public transport system.
- Develop methods to support station planning and operations with respect to
  - Passenger flows
  - Impact on crowding in vehicles
- The project supports the final stages of two PhD students.

Project members: Fredrik Johansson (Project leader, VTI), Erik Jenelius (KTH), Anders Peterson (LiU), Therese Lindberg (LiU/VTI), Oded Cats (KTH), Soumela (Melina) Peftitsi (KTH)

Crowding in Public Transport

- Overcrowding affects passengers' travel experience.
- Service supply is underutilized due to variations in crowding across services, trips and compartments of the same vehicle.

Real-time crowding information (RTCI) provision can potentially reduce

- Crowding unevenness
- Denied boardings

Research objective:

Extend existing PT simulation models to provide passengers with predictive crowding information concerning individual train cars and assess the impact of RTCI provision.

Modelling on-board crowding distribution

Earlier extension

BusMezzo - Dynamic Transit Operations and Assignment Model

- Individual transit vehicles, i.e. trains, movements.
- Individual passenger car boarding choices.
- Captures on-board crowding distribution and evaluates user cost in a more realistic way.

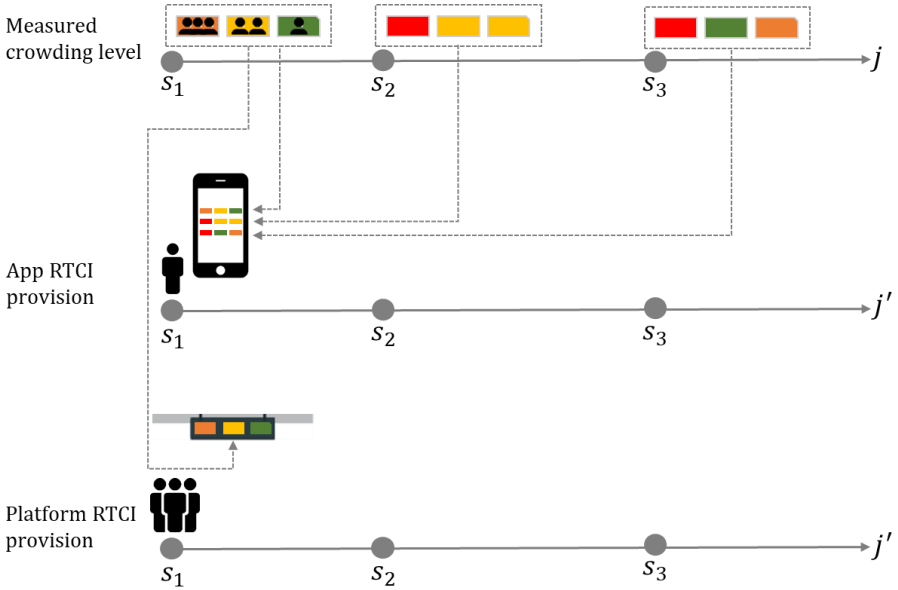
Modelling car-specific RTCI in BusMezzo

- Measure the crowding level in each train car when train departs from a stop.
  - Crowding factor is a function of the car occupancy level.

RTCI level	Car capacity utilization		Crowding factor
	<= 80% seated capacity		1.0
	>80% seated capacity	<= 100% seated capacity	1.3
	>100% seated capacity	<= 50% total capacity	1.5
	>50% total capacity		1.8

- Predict RTCI for each trip segment based on the measured car crowding level of the *most recent train run*.
- Each passenger utilizes the generated car-specific RTCI, as an *in-vehicle time multiplier* of a given trip segment, in the decision making process.

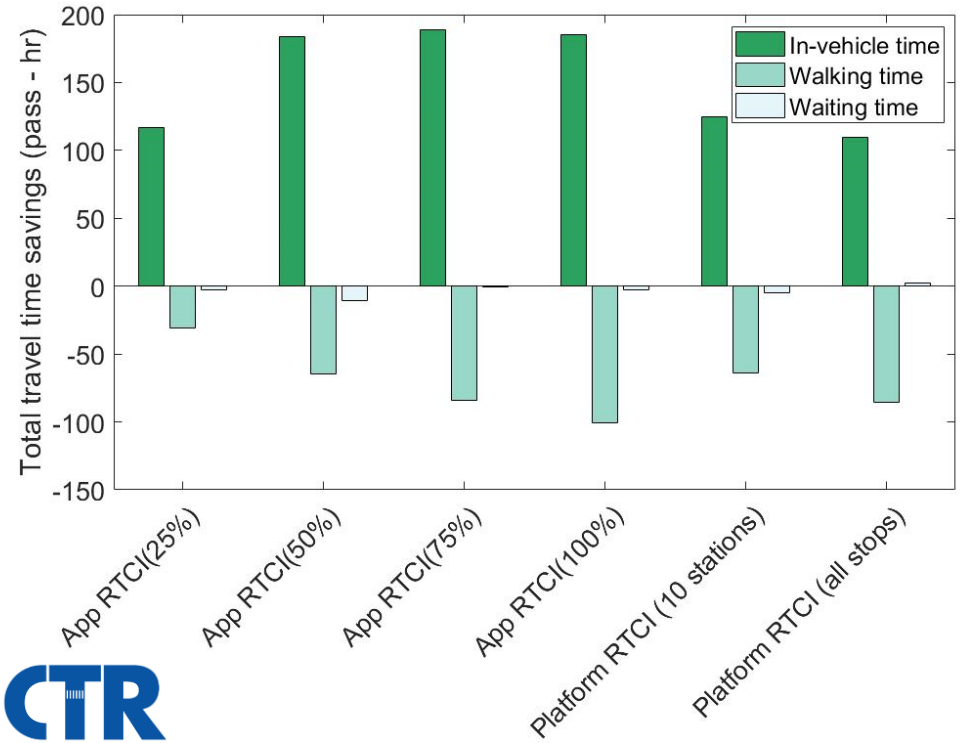
RTCI provision schemes



- The app-based scheme provides the RTCI for each stop along the passenger's path alternative.
- The platform-based scheme provides the RTCI on-board train trip at the passenger's boarding stop.

Stockholm metro network application

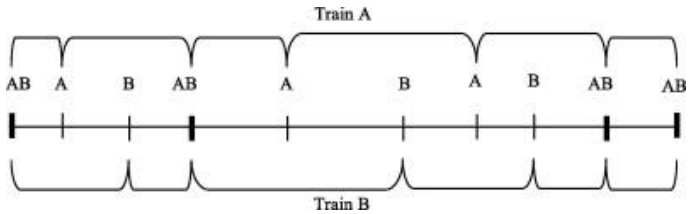
Effect of RTCI on passengers' generalized travel cost



- Passengers' adjusted car boarding choices translate into improved on-board experience at the cost of increased walking times.
- Providing platform RTCI system only at busy stops results in time savings that are on-par with those attained when equipping all stops with information displays due to passengers larger motivation for adapting their choices at crowded stations.

On-going work

- Use simulation as a tool to investigate the effect of other control measures (e.g. *fixed skip-stop operation*) for reducing crowding and improving passengers' travel experience, concerning station layout and passenger flow distribution.
- Potential effects on passengers:
  - Decreased in-vehicle time.
  - Increased travelling comfort.
  - Increased waiting time.



List of research articles

- Peftitsi, S., Jenelius, E. & Cats, O. (2021) Modelling the effect of real-time crowding information (RTCI) on passenger distribution in trains. Under review in Transportation Research Part A.
- Peftitsi, S., Jenelius, E. & Cats, O. (2021) Evaluating crowding in individual train cars using a dynamic transit assignment model. Transportmetrica B: Transport Dynamics 9(1), 693-711.
- Peftitsi, S., Jenelius, E. & Cats, O. (2020). Determinants of passengers' metro car choice revealed through automated data sources : a Stockholm case study. Transportmetrica A: Transport Science, 16(3), 529-549.

Thank you

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