Assessing disruption management strategies in rail-bound urban public transport systems from a passenger perspective

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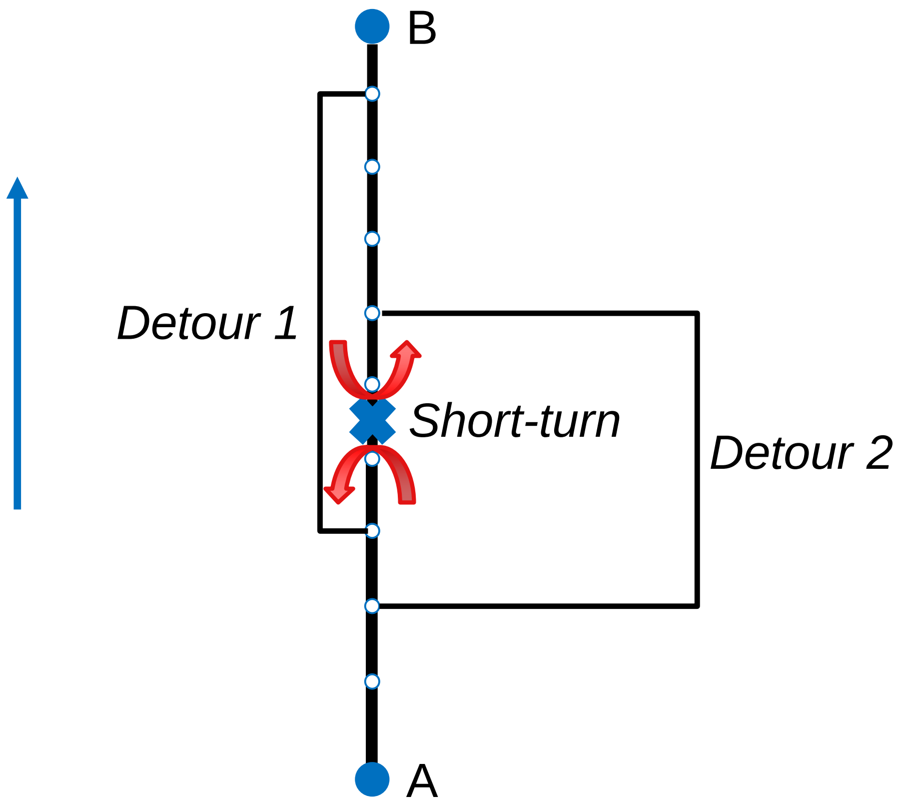
Introduction

- Much interest in minimizing impacts of disturbances
- Current protocols driven from resource perspective
- Seems to be a preference for detouring
- Passenger impact different alternatives unknown



Introduction

- **Research question**

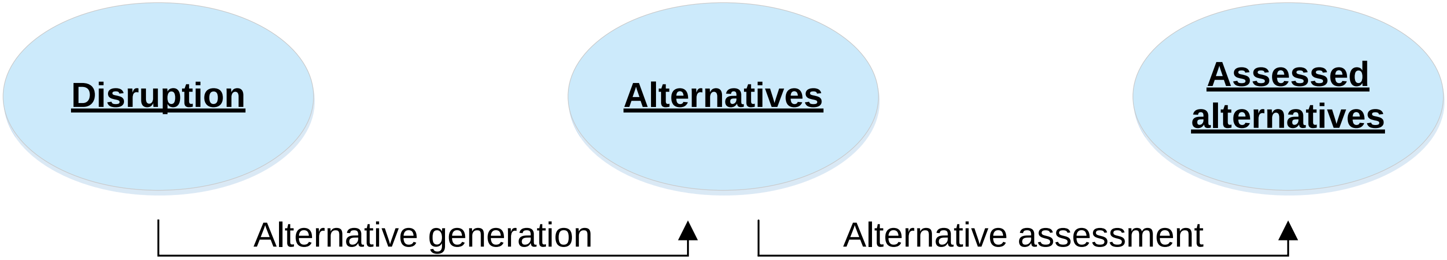
  How can disrupted operations in rail-bound urban public transport systems be managed, in order to minimize total generalized passenger travel time, taking into account operational consequences?

- **Scope**
  - Infrastructure blockage
  - Detours and short-turning

    → Guidelines detour vs. short-turning

- **Case**
  - HTM The Hague, the Netherlands
  - Tram network
  - Introduction of bi-directional vehicles

Methodology



Alternative generation

- Graph representation network
- Generation of detours
  - *k*-shortest path algorithm (Yen, 1971)
  - Filtering process
- Generation of short-turn possibilities
  - Model input

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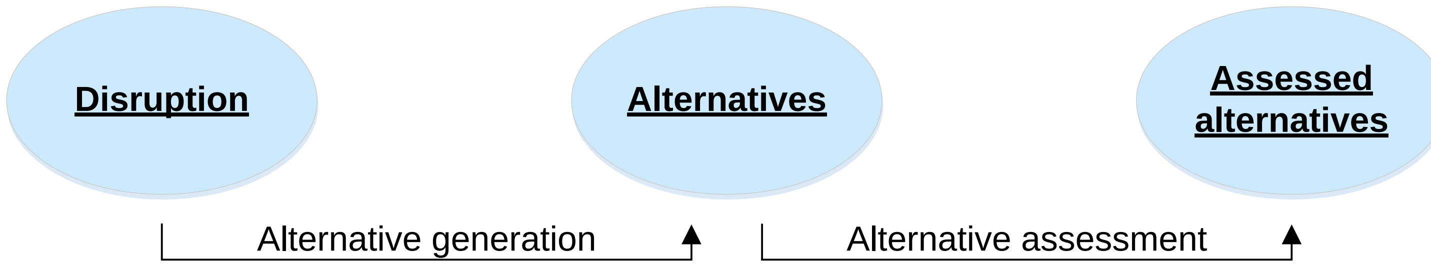
Assessment of alternatives

1. <u>Passenger perspective</u>
   – Total generalized passenger travel time (TGTT)
      • Historical smartcard data (OV-chipkaart)
      • Different trip elements
   – Assumption passenger behaviour:
      • Stop skipped → Walk or wait

2. <u>Resource perspective</u>
   – Delay destination terminal
   – Subsequent activity

Methodology



- Detour alternatives
- Short-turn alternatives

- Total generalized passenger travel time
- Delay destination terminal

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Case study The Hague

HTM

- Discrete event-based simulation (Simio)

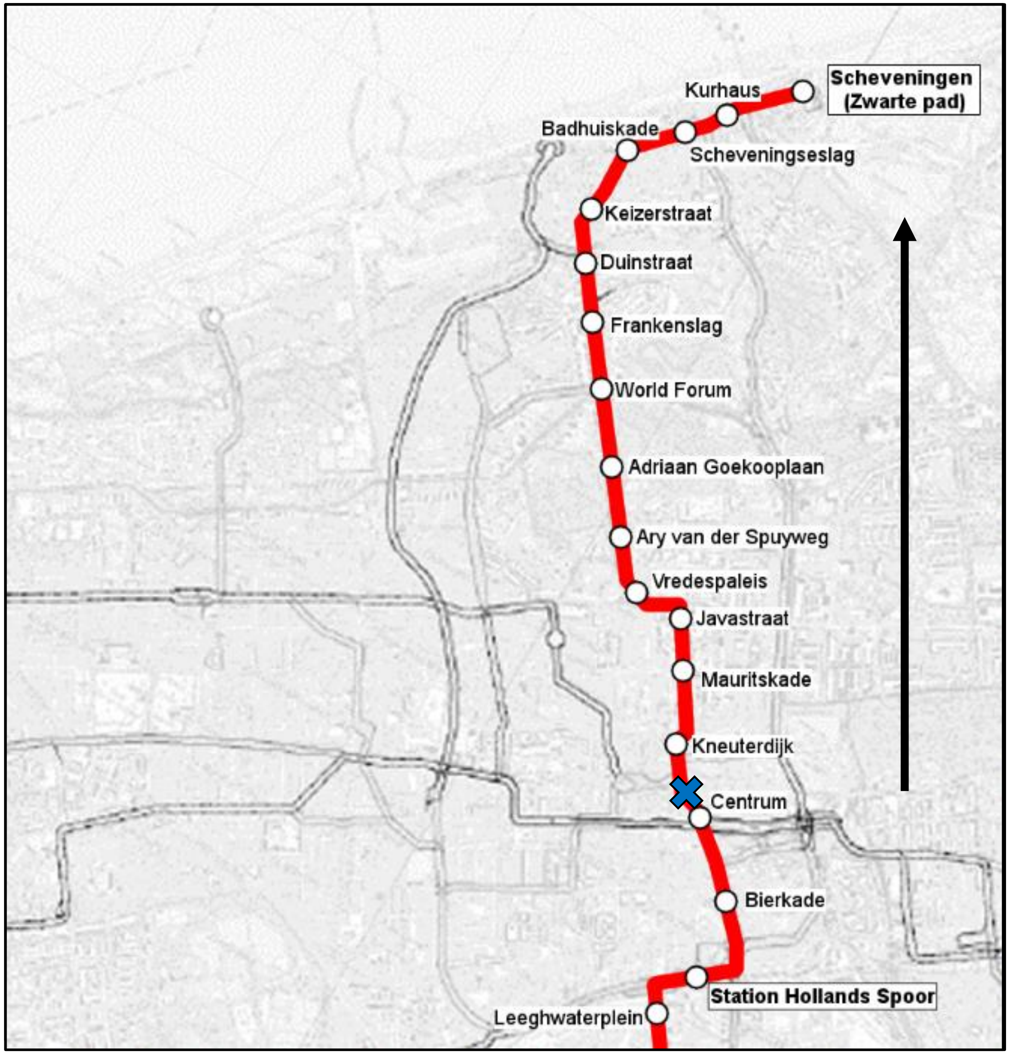
- Four hypothetical disruption locations (A-D)
  - Two passenger demand patterns

- One actual disruption (July 15th, 2016)

Scenario matrix

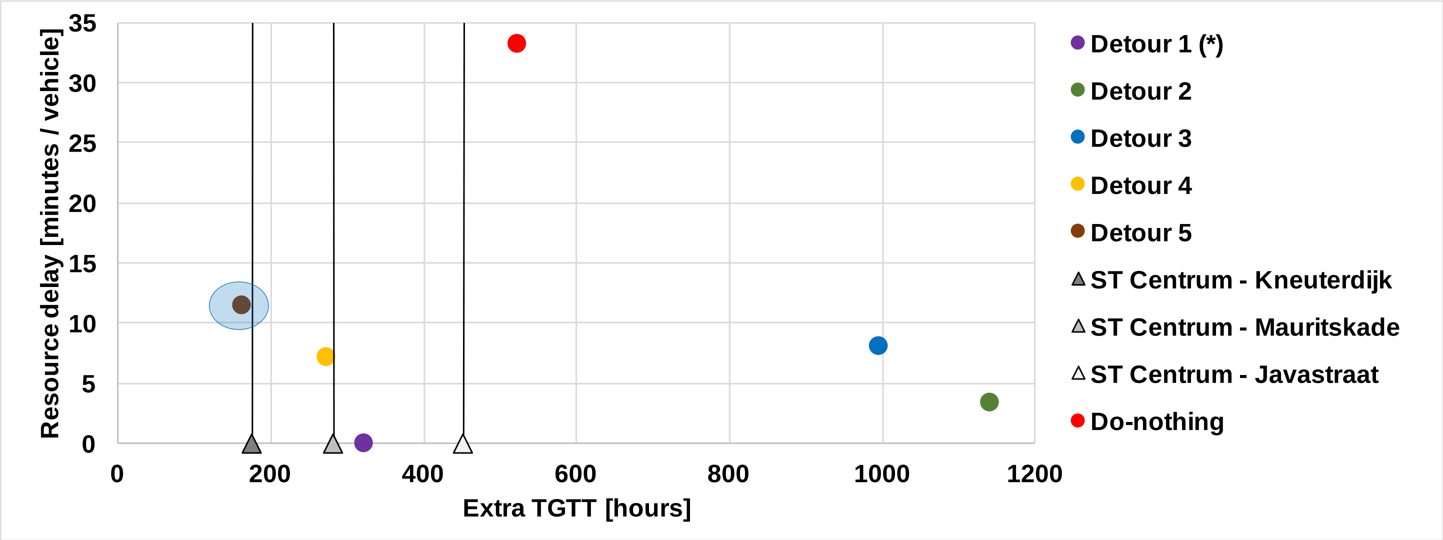
	Generated detouring alternatives	Generated short-turning alternatives	Disruption management protocol
Disruption location A - **Morning-peak** - **Rest-of-day**			
Disruption location B - **Morning-peak** - **Rest-of-day**			
Disruption location C - **Morning-peak** - **Rest-of-day**			
Disruption location D - **Morning-peak** - **Rest-of-day**			
Actual disruption July 15th, 2016			(+ actual implemented measure)

Location Alternatives

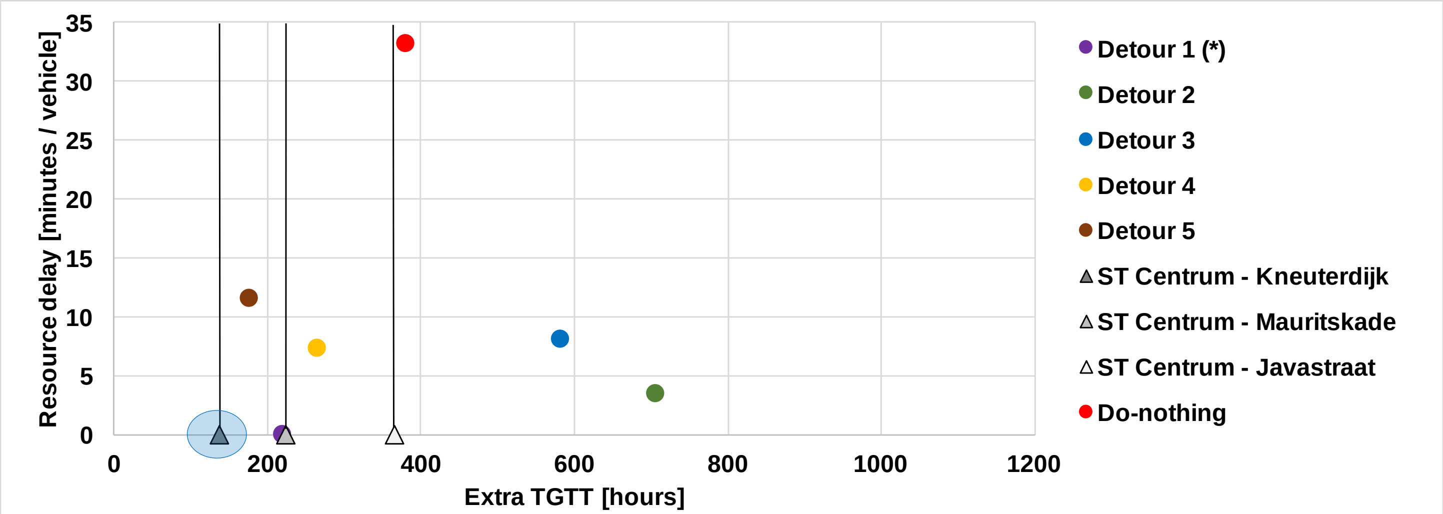


Location A – TGTT vs. delay

Morning-peak



Rest-of-day



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Case studies – results passenger perspective

- Detouring versus short-turning
  - ‘Best’ detour alternative vs. ‘best’ short-turn alternative

	Difference detouring vs. short-turning [extra TGTT]	
	Morning-peak	Rest-of-day
Location A	- 6%	+ 28%
Location B	+ 15%	- 2%
Location C	- 29%	- 40%
Location D	- 80%	- 64%

Detouring yields 6% less TGTT for location A (peak), as compared to short-turning

Detouring yields 28% more TGTT for location A (rest-of-day), as compared to short-turning

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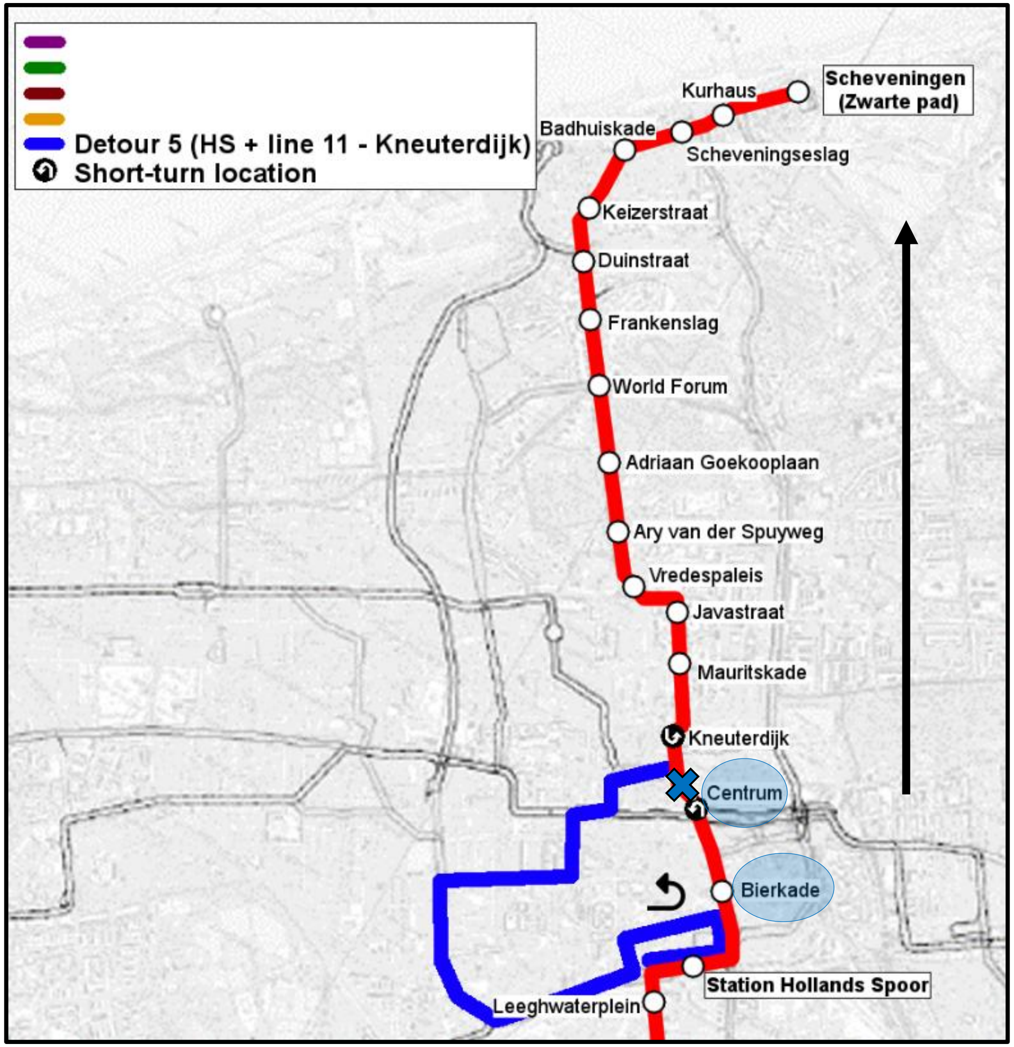
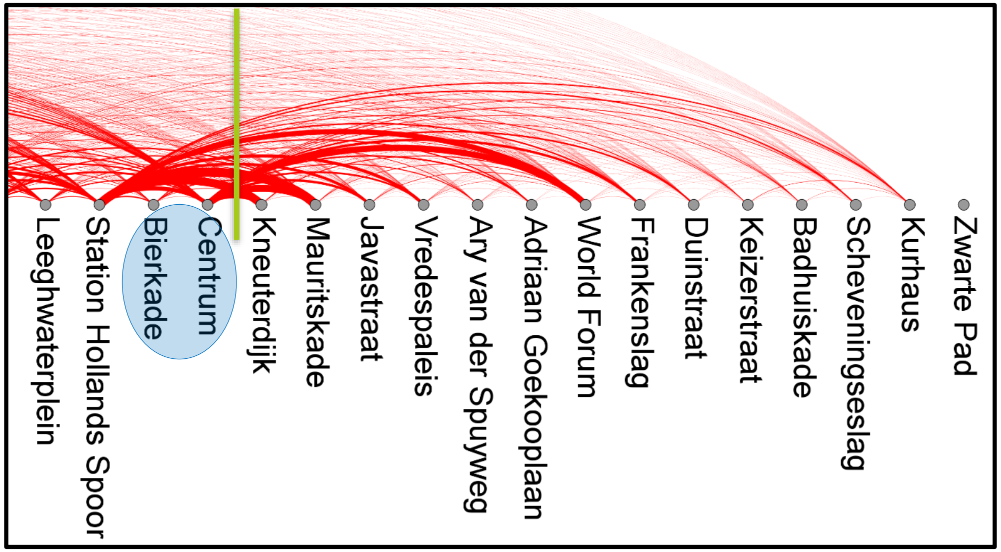
Difference detour 5 & ST



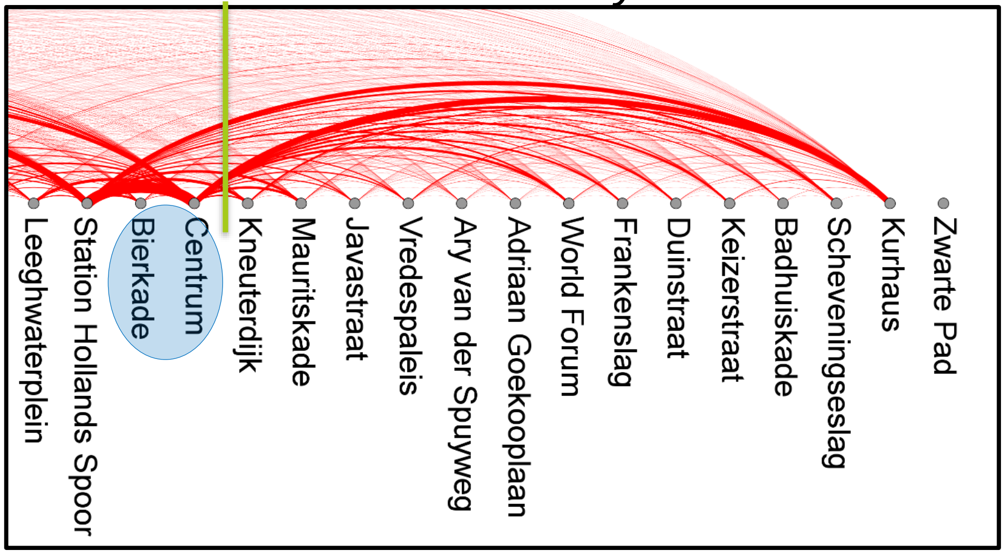
Passenger demand

Morning-peak



Detouring

Rest-of-day



Short turning

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Case studies – results passenger perspective

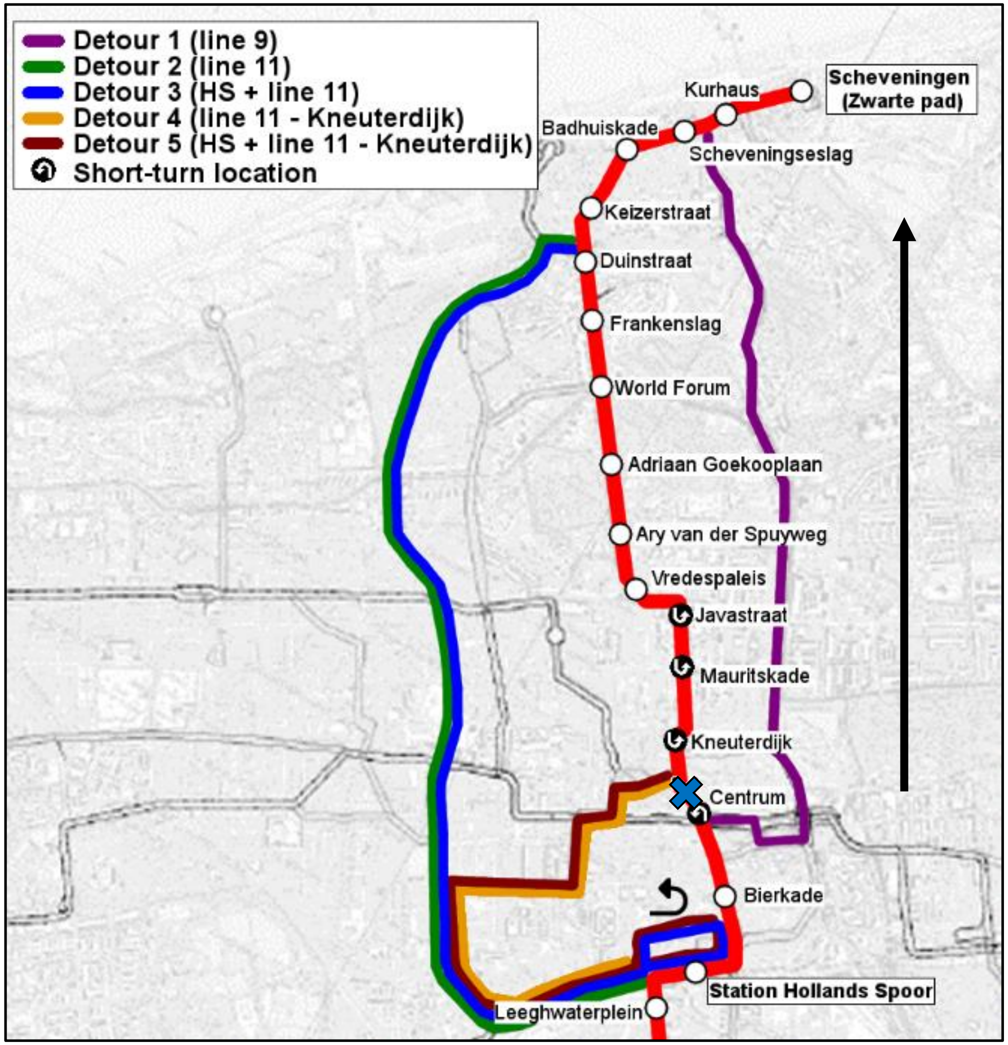
- Potential savings extra TGTT
  - 'Best' alternative vs. current disruption management protocol

	Potential savings protocol vs. 'best' alternative [extra TGTT]	
	Morning-peak	Rest-of-day
Location A	49%	39%
Location B	13%	0%
Location C	41%	41%
Location D	85%	73%

49% and 39% of the extra TGTT incurred by the protocol can be saved for location A (peak/rest-of-day), by implementing the alternative yielding the lowest TGTT

Case studies
[8/8]

Protocol



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Findings and conclusions

- Current protocols mainly driven from resource perspective

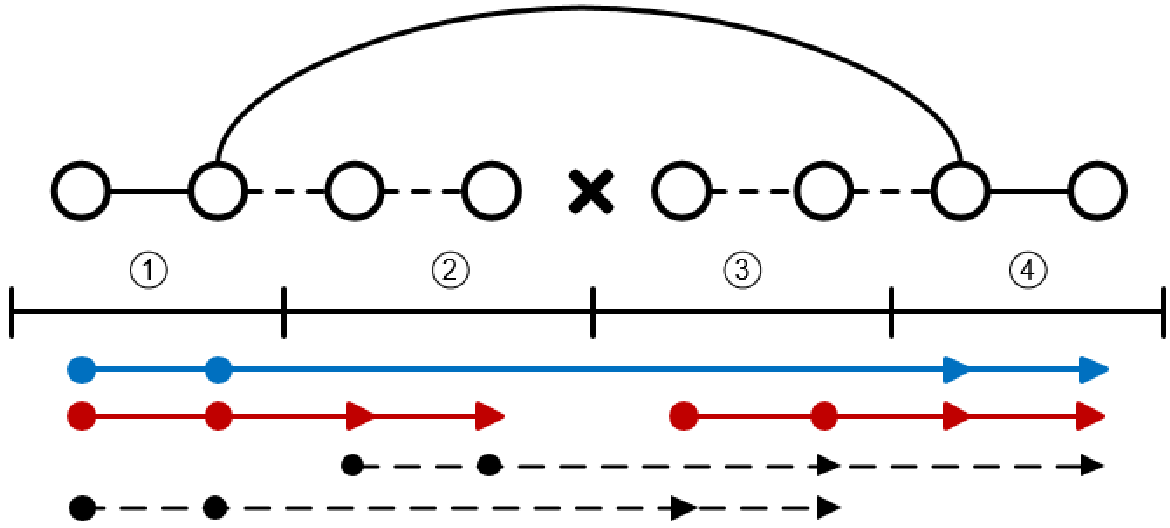
→ Importance passenger perspective

- Our approach provides insights into passenger impact of measures
- Passenger demand pattern affects impacts detouring and short turning on TGTT

- Detouring vs. short-turning?

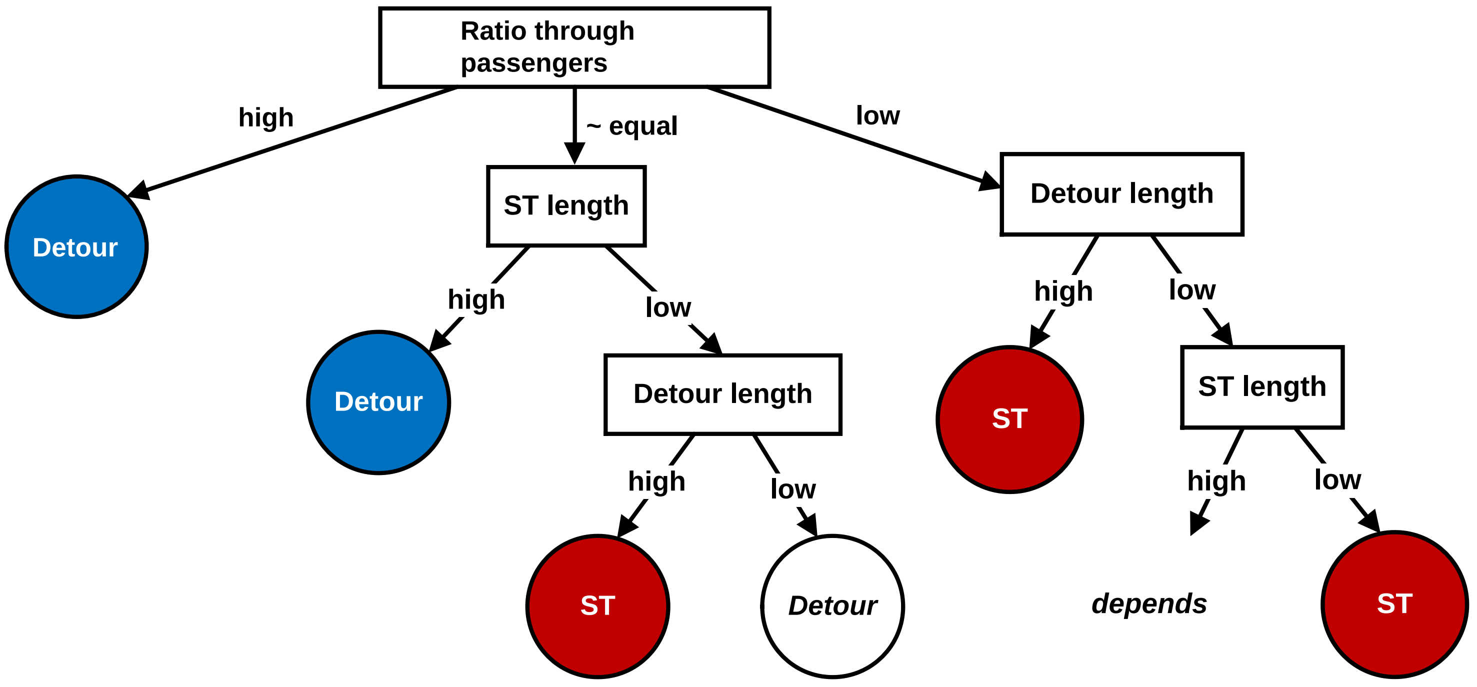
Detouring vs. short-turning

- Three variables of main importance:
  - Passengers favoured by detouring vs. passengers favoured by short-turning
  - Detour length
  - Distance short-turning stops



Findings and conclusions [3/3]

Detouring vs. short-turning



Recommendations

1. Applicability framework at HTM
   - Management of operations process
     - Tactical: Disruption management protocols
     - Real-time: Decision support system
   - Planning process
     - Strategic: Planning additional infrastructure
     - Tactical: Planning of buffer-time in schedules
2. Extending methodology
   - Incorporate passenger route choice model: network impacts

Questions / contact

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