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Norfolk Southern

November 7-13, 2020

FREIGHT RAILROAD TERMINAL CLOCK OPTIMIZER

2020 INFORMS Annual Meeting



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01

BACKGROUND

PRECISION SCHEDULED RAILROADING AT NORFOLK SOUTHERN

- Shift from implementation to “continuous improvement” phase
- Development of a tool for continuous improvement of:
 - Reduce dwell time
 - Increase car velocity
- Business requirements:
 - Ability to improve an existing plan or a plan that is under development
 - Tight integration with existing planning tools such as Operating Plan Developer (OPD)
 - Automated data transfer for loading and promoting
 - Norfolk Southern’s Network Planning & Optimization (NPO) department can run multiple iterations per day if needed

02

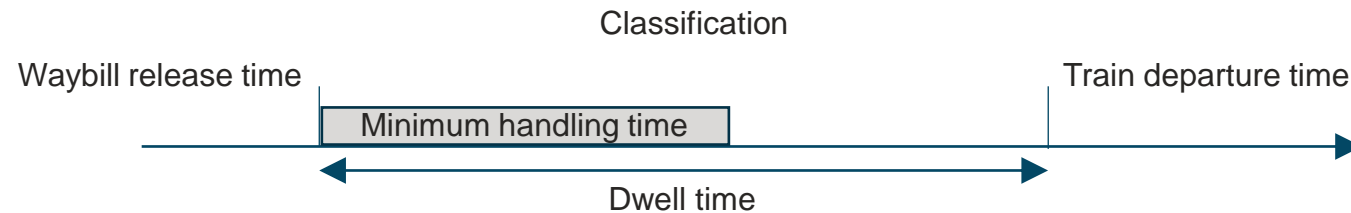
TERMINAL CLOCK OPTIMIZER

TERMINAL CLOCK OPTIMIZER (TCO)

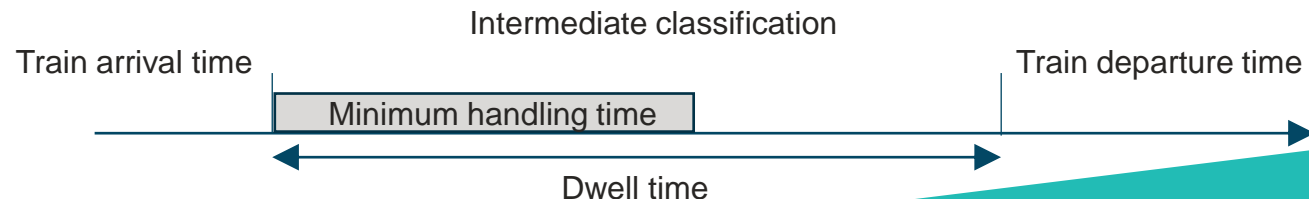
- **Objective:** Reduce car dwell time and optimize terminal clock imbalance

- Car dwell times considered:

- At origin

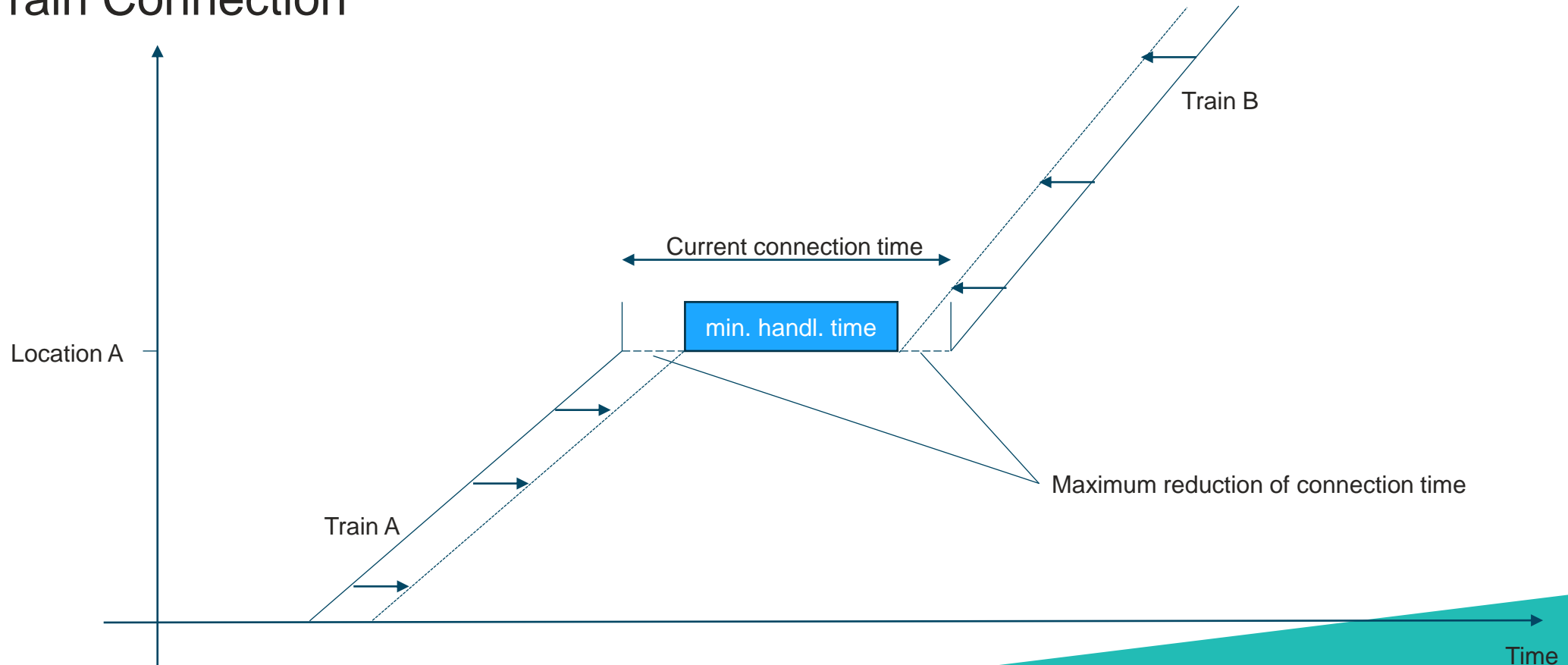


- Intermediate classification



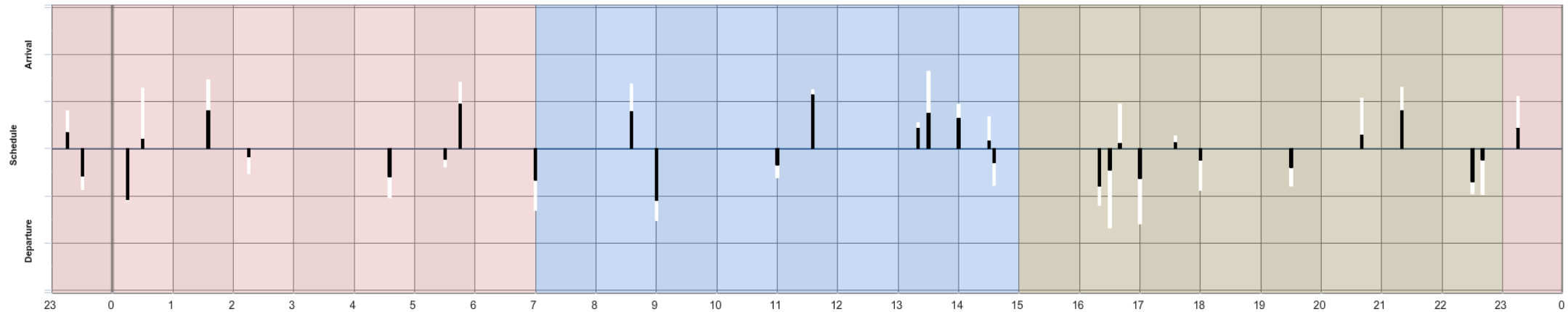
YARD CLOCK SCHEDULE OPTIMIZATION

- Train Connection

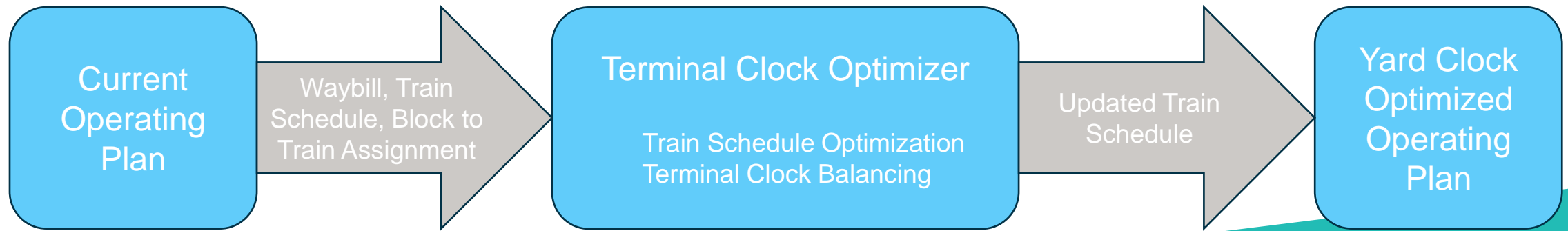


TERMINAL CLOCK OPTIMIZER (TCO)

- Terminal Clock

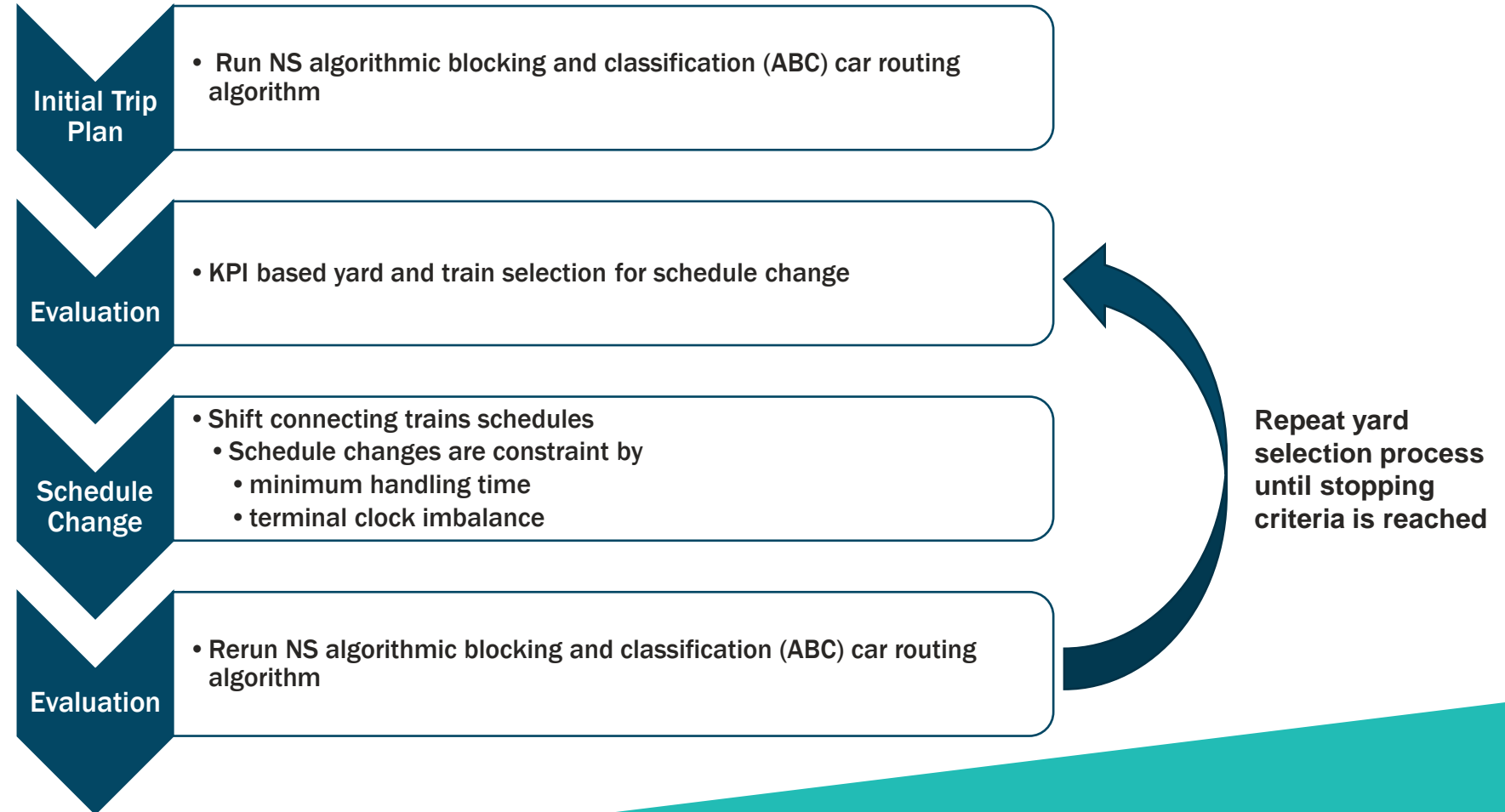


- Data Flow:



TERMINAL CLOCK SCHEDULE OPTIMIZATION

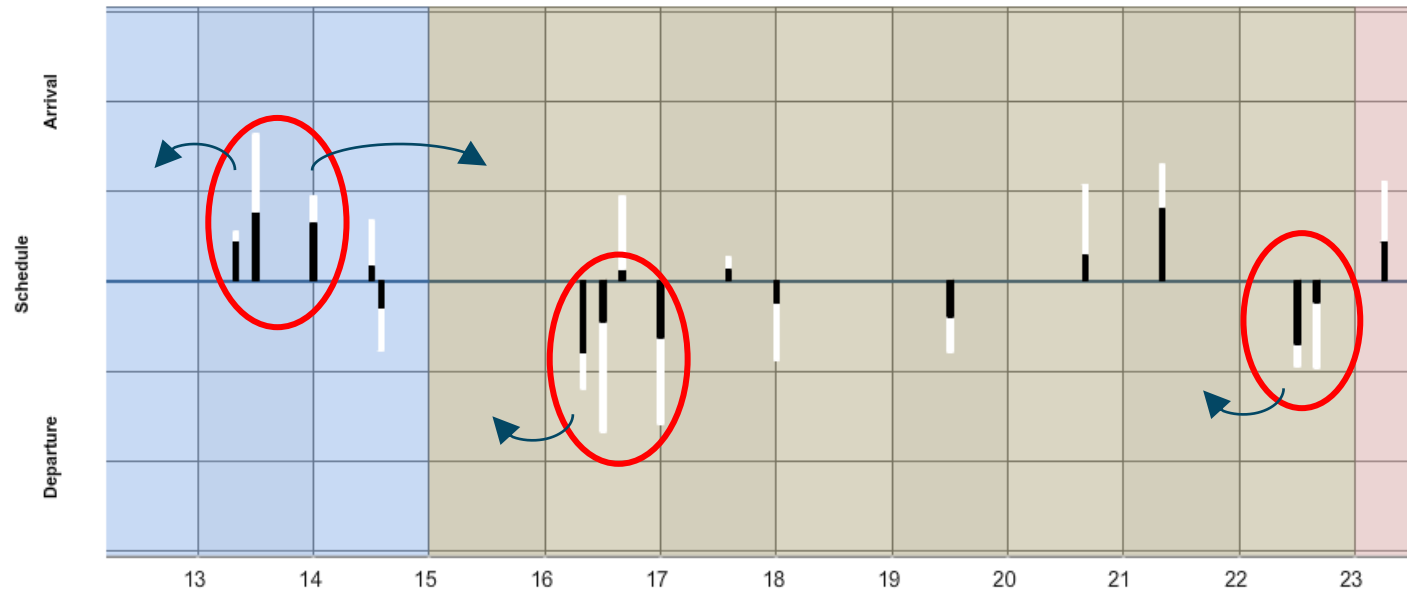
Algorithm flow



TERMINAL CLOCK BALANCING

Trains are shifted if the number of events exceed a set capacity in a terminal clock bucket

- Event-based capacity constraints
- Bucket size derived from current operating plan or provided by user
- Bi-directional shift



03

SUMMARY AND FUTURE PLAN

SUMMARY AND FUTURE PLAN

- Showcased how the Terminal Clock Optimizer is used for network studies at Norfolk Southern
- Continue enhancement of model by incorporating
 - minimum time gap constraint between same train event types
 - train frequency optimization

ACKNOWLEDGEMENTS

TCO Team:

- Peiheng Li
- Behzad Zahiri
- Maulik Dave

Development Supporting Team:

- Clark Cheng
- Edward Lin
- Co-ops

A wide-angle photograph of a large freight train yard. Numerous tracks run parallel, filled with various types of railcars, including boxcars and tank cars. The scene is set against a backdrop of a city skyline with several tall buildings visible in the distance. The sky is filled with large, dark clouds, suggesting an overcast day. The overall color palette is muted, with a dark blue overlay across the entire image.

THANK YOU