Nexus: Sample Use Cases

Workshop on Rail Analytics and Simulation Research
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Mobility Network

Nexus Use Cases

Capacity analysis and flow management		Other
Capacity analysis of the USRC	Hub and network flow management	Specialized route operations
Crowding relief benefits of the DRL	Rail disruption management	Transfer optimization
Crowding analysis of the B-Y Station		Integration with activity based demand model

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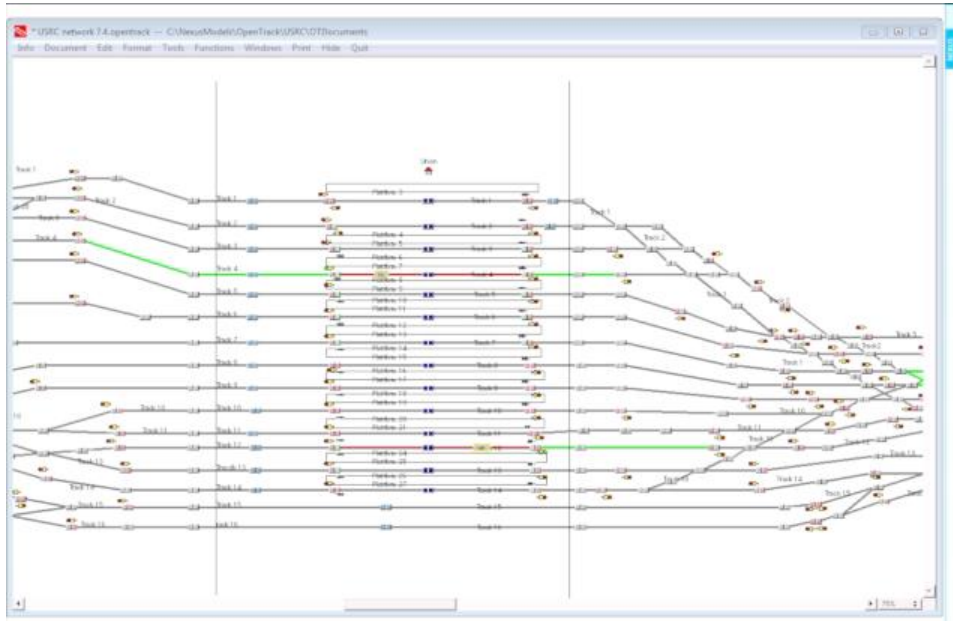
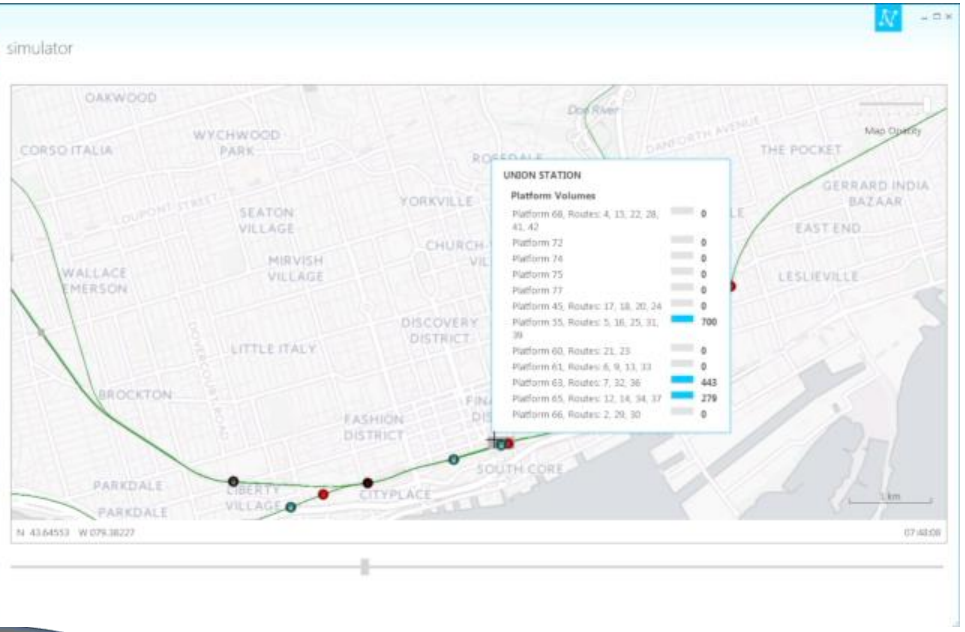
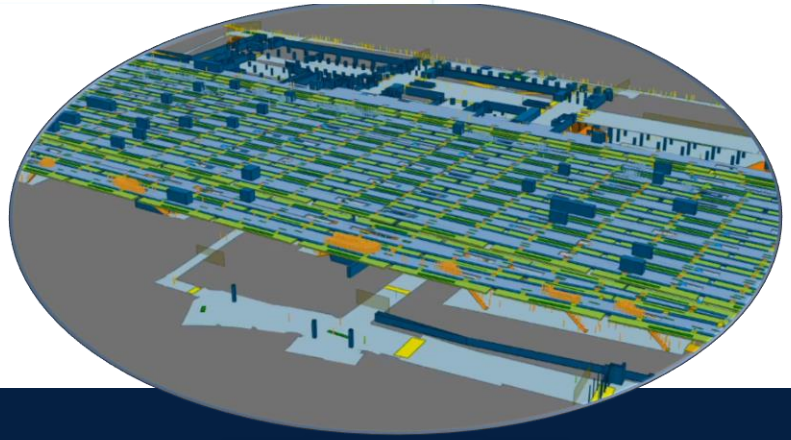
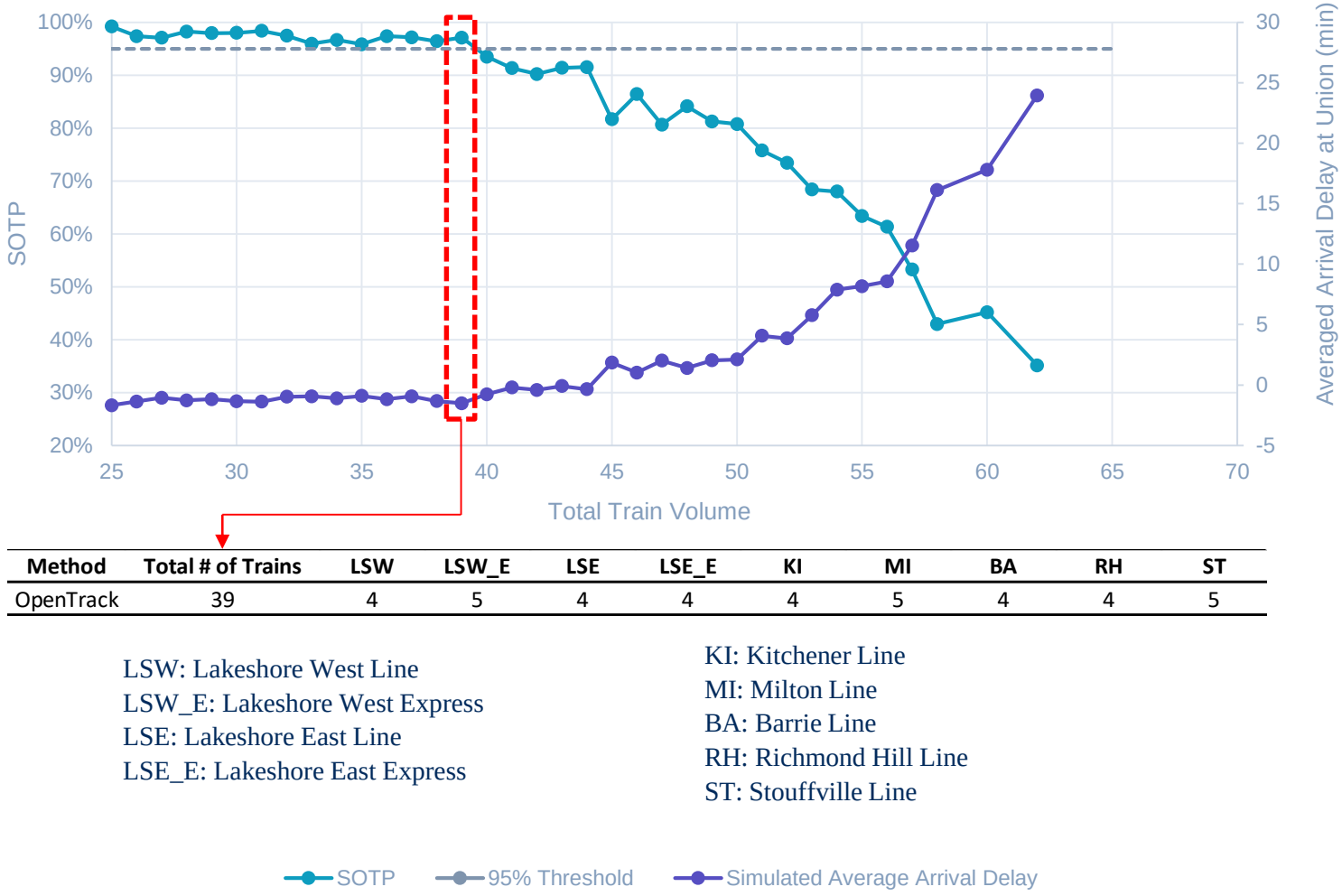
Capacity Analysis of the USRC







Capacity Analysis of the USRC



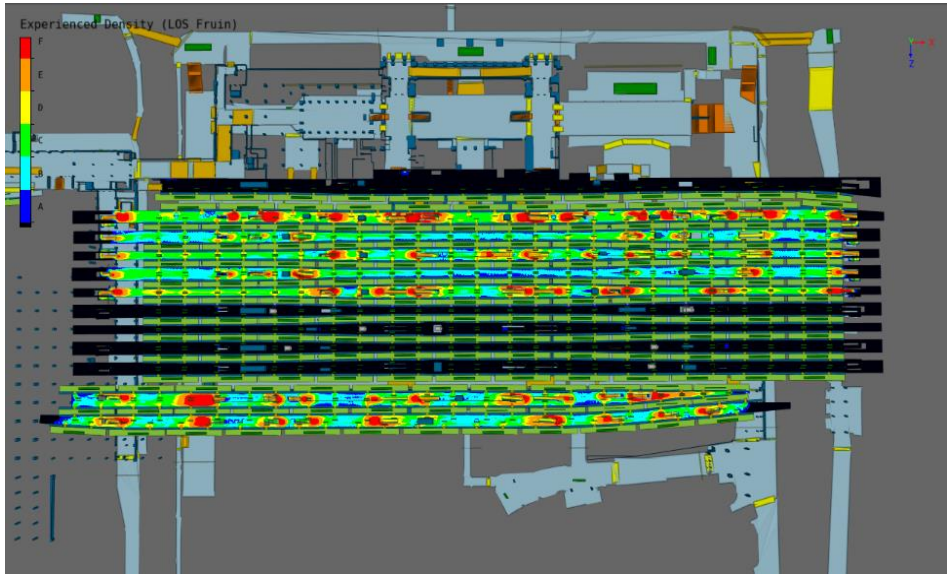
Method	Total # of Trains	LSW	LSW_E	LSE	LSE_E	KI	MI	BA	RH	ST
OpenTrack	39	4	5	4	4	4	5	4	4	5

LSW: Lakeshore West Line
LSW_E: Lakeshore West Express
LSE: Lakeshore East Line
LSE_E: Lakeshore East Express

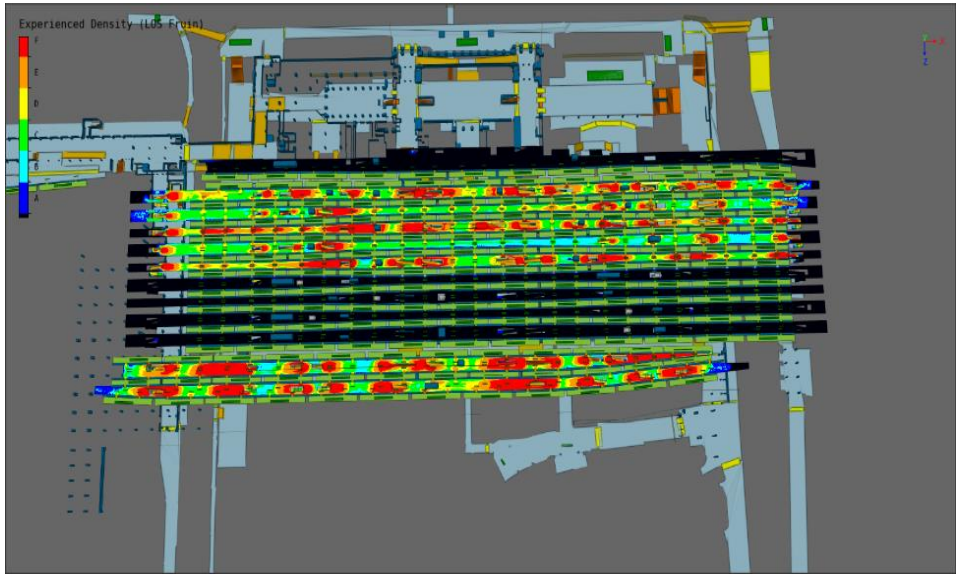
KI: Kitchener Line
MI: Milton Line
BA: Barrie Line
RH: Richmond Hill Line
ST: Stouffville Line

Capacity Analysis of the USRC

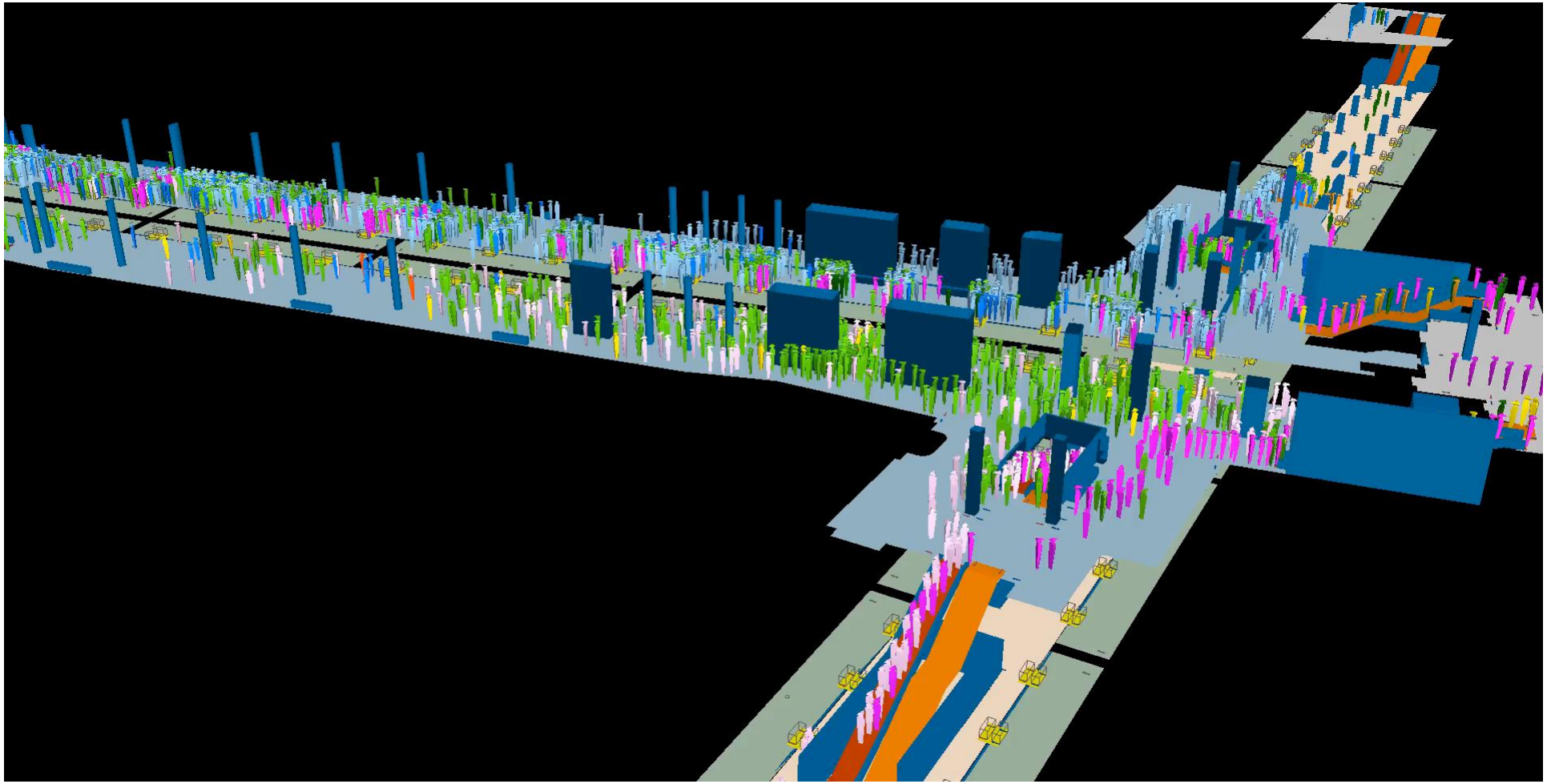
Base Model



High Volume Scenario



Crowding Analysis of the Bloor-Yonge Station



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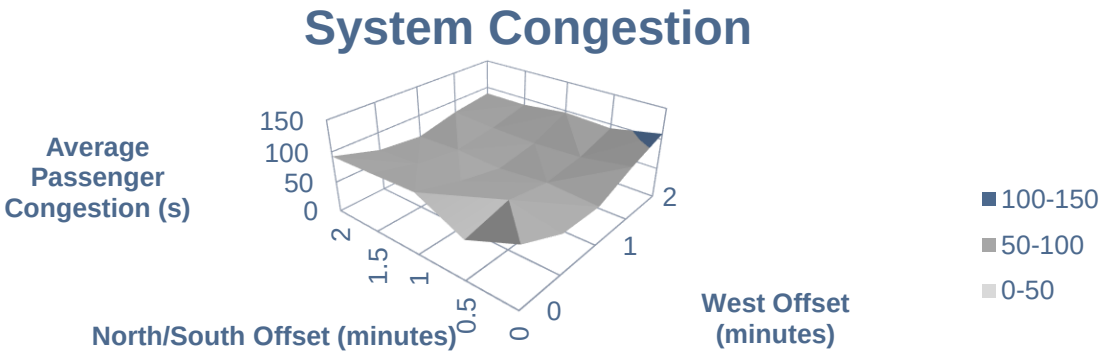
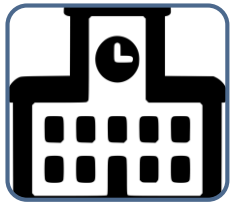


Volume Level	Best Arrival Pattern (Direction: Offset) Worst Arrival Pattern (Direction: Offset)	System Congestion Per Passenger(s)/Std Dev (s)	Relative Standard Deviation (%)	Range (min/max)	ATC Scenario-System Congestion Per Passenger(s)/Std Dev (s)	Uniform Southbound Boarding Distribution-System Congestion Per Passenger(s)/Std Dev (s)
100% Capacity	W: 1 min N/S: 1 min	61.9/7.7	17.1	47.2 (61.8/109.1)	28.3/10.0	50.8/7.7
	W: 2 min N/S: 0 min	109.1/7.8			30.9/5.1	96.1/8.2

Hub and Network Flow Management

Nexus

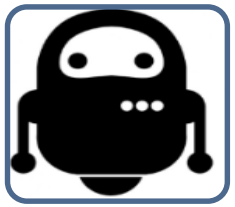


Station Macroscopic Model (e.g. CTM-based)

- Adaptive based on real-time data
- Facility-level passenger flows and densities

Railway Mesoscopic Model (e.g. SPUR)

- Adaptive based on real-time data
- Delay at the segment level (or block-level)



Model-based RL-based Control

- Inflow control to maintain the capacity
- Train management (e.g., real-time rescheduling)

Input

- Passenger OD
- Station layout (TTC)

Railway Station Model

Cell Transmission Model (CTM) based model of passengers

Output

- Passenger flow and density through facilities (stairs, platform, etc.)
- Boarding and Alighting passengers
- Dwell time

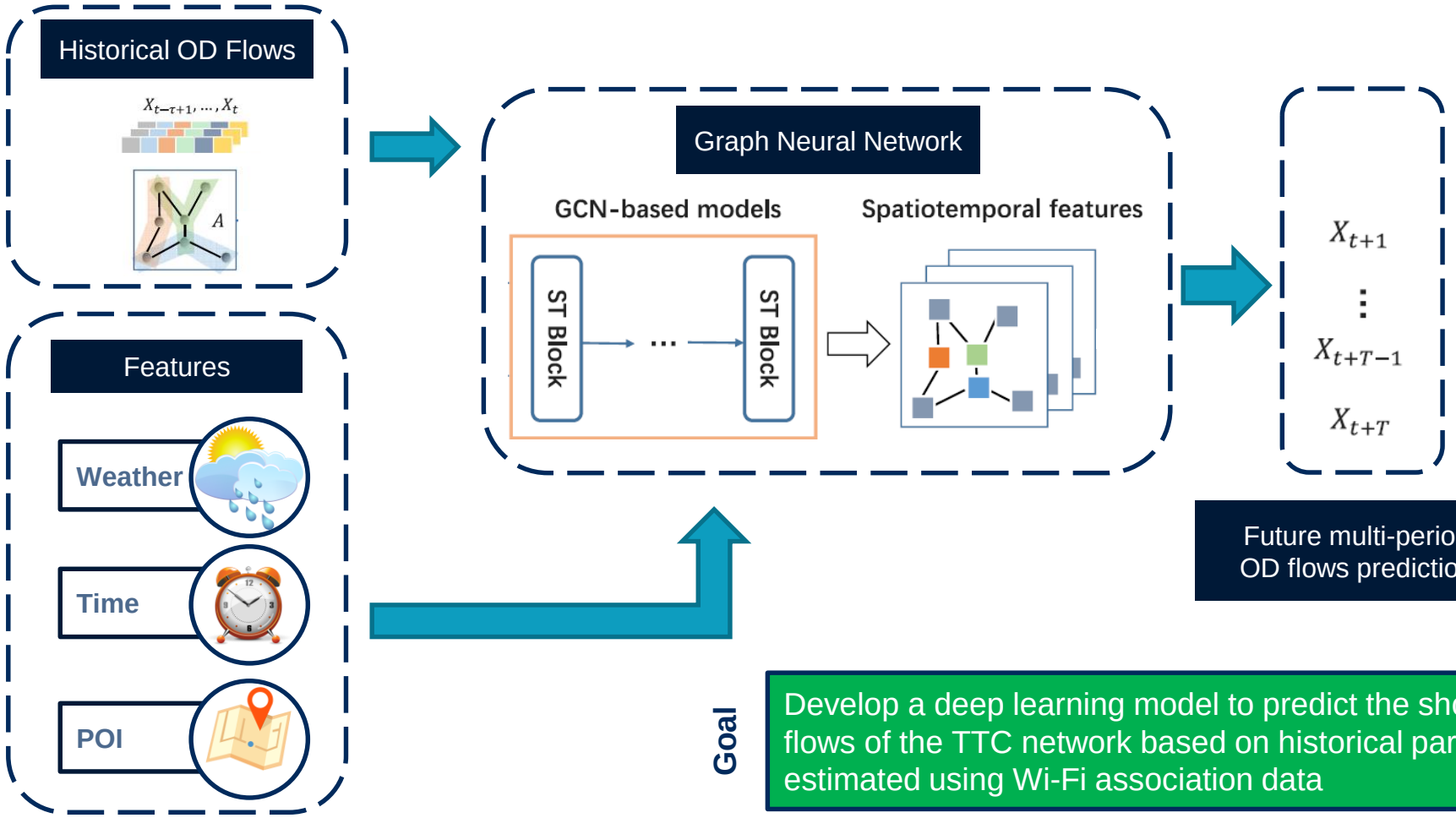
Railway Mesoscopic Model

Model-based RL-based station control

Applications

- Passenger inflow control at access points
- Hub passenger flow control
- Real-time rescheduling
- Etc.

Hub and Network Flow Management – OD Flow Prediction



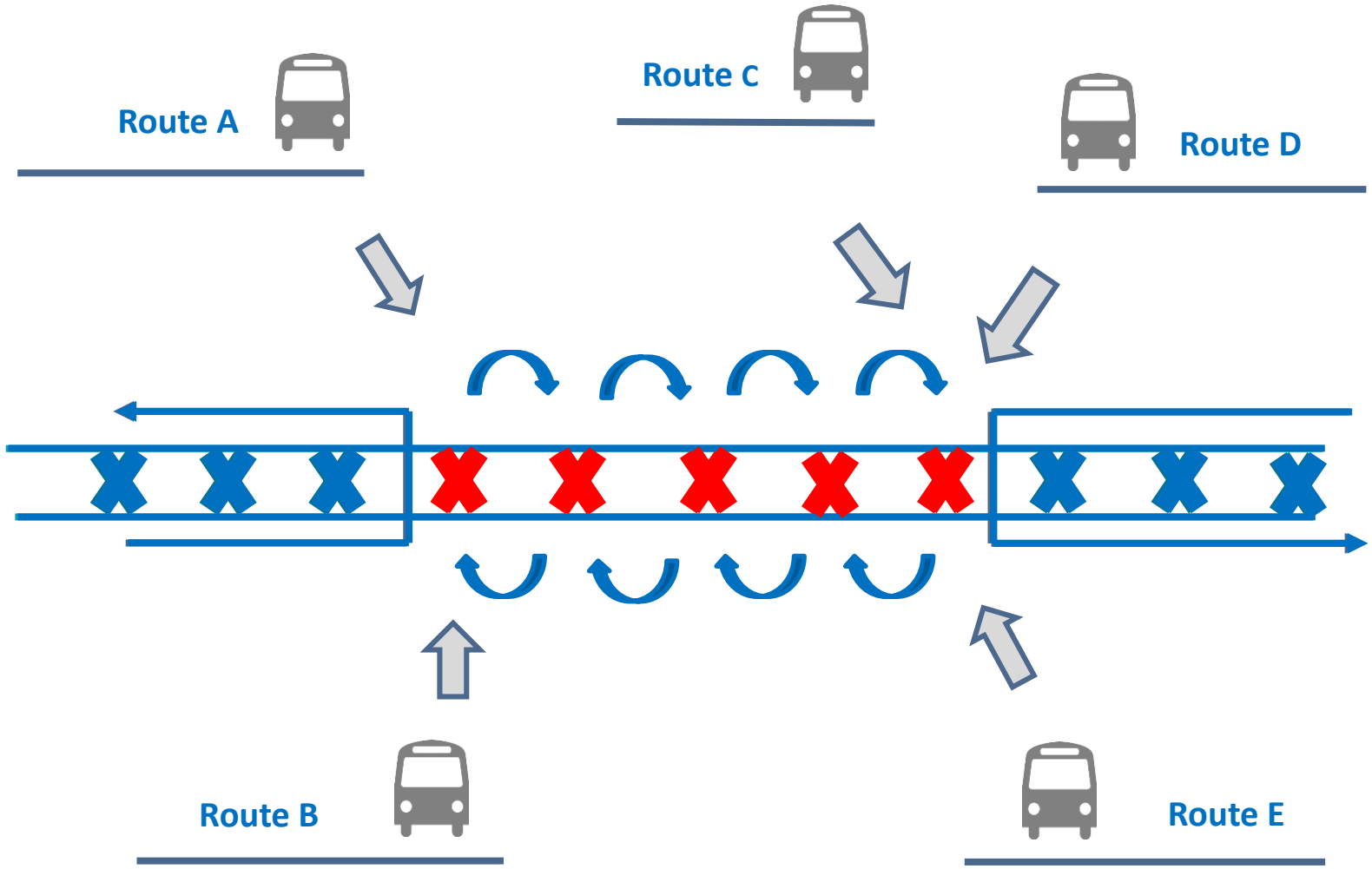
Goal

Develop a deep learning model to predict the short-term OD flows of the TTC network based on historical partial OD flows estimated using Wi-Fi association data

Challenges

- Sparsity due to partial observation
- Time lag in Wi-Fi data storage
- Incomplete trips due to connectivity issues

Rail Disruption Management via Bus Bridging



Rail Disruption Management via Bus Bridging

User Specified Input

- Incident location and time
- Expected duration of incident
- Dispatch time and Demand reduction
- Number & assignment of shuttle buses

Data Inputs

- Transit network characteristics
- Train and bus ridership
- Train and bus travel time

DASh-Bus Planner

- Subway Passengers' Delay
- Bus Riders' Delay
- Detailed measures at disrupted stations
- Longest queue at disrupted stations
- Detailed impact on each bus route
- Shuttle buses performance measures
- Degree of utilization of shuttle buses
- Deadhead time of shuttle buses

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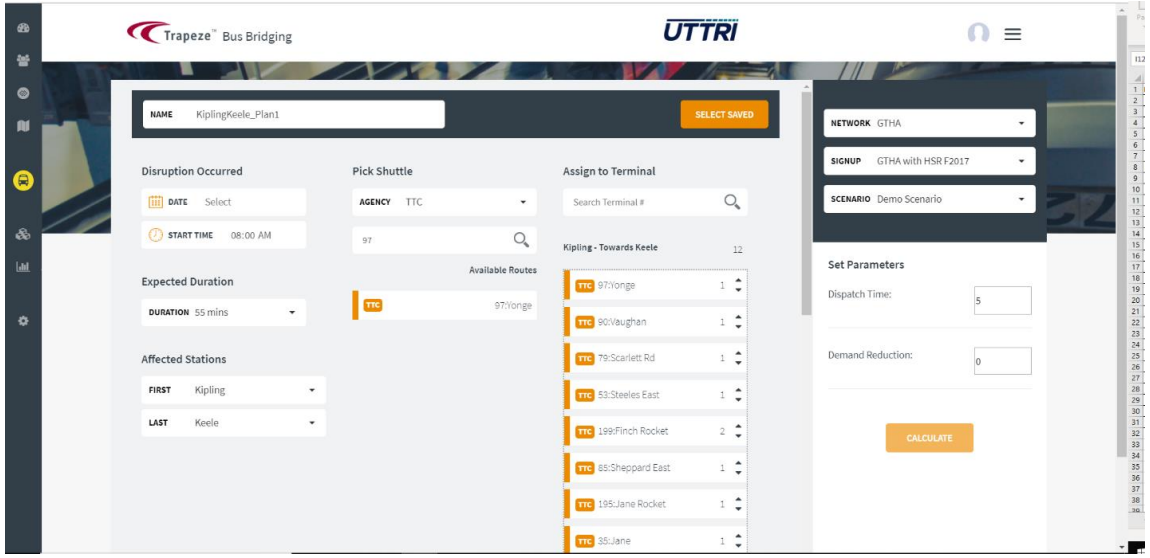
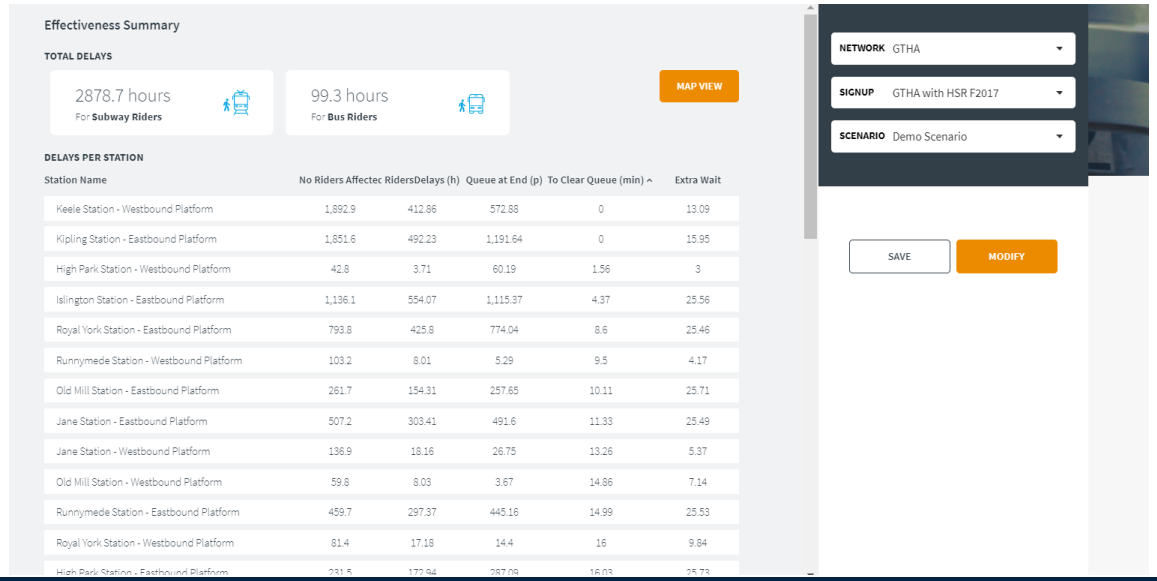
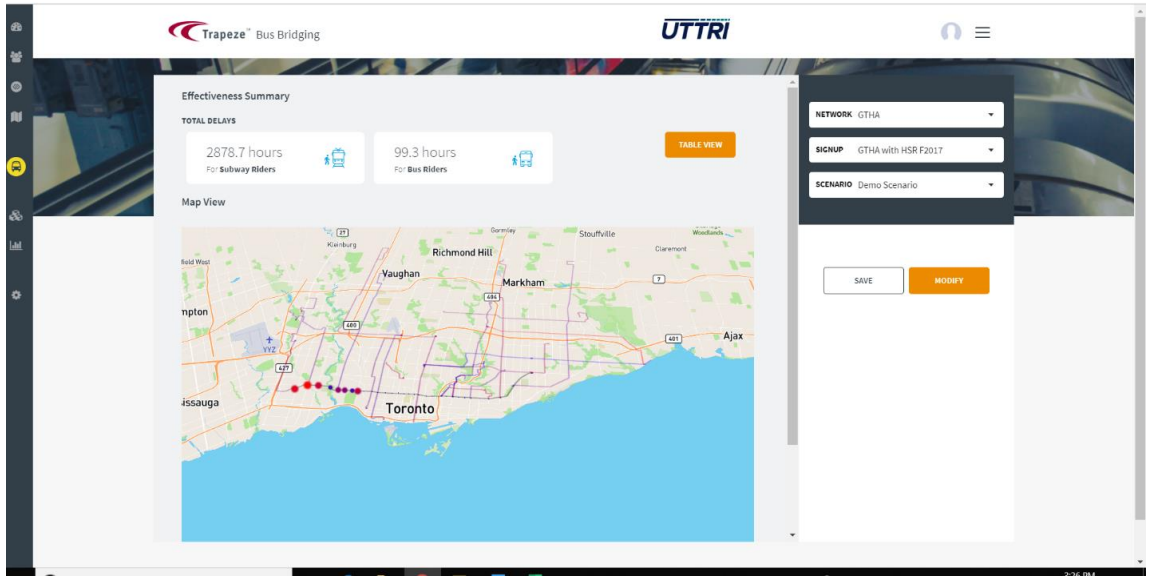
DASh-Bus Optimizer

- Number of shuttle buses
- Optimal Bus routes
- Number of buses from each route
- Initial end station for each bus

DASh-Bus Visualization Dashboard







Questions?