ATD-2
Integrated Arrival/Departure/Surface

NASA

Modelling and Simulating Airport Surface Operations with Gate Conflicts

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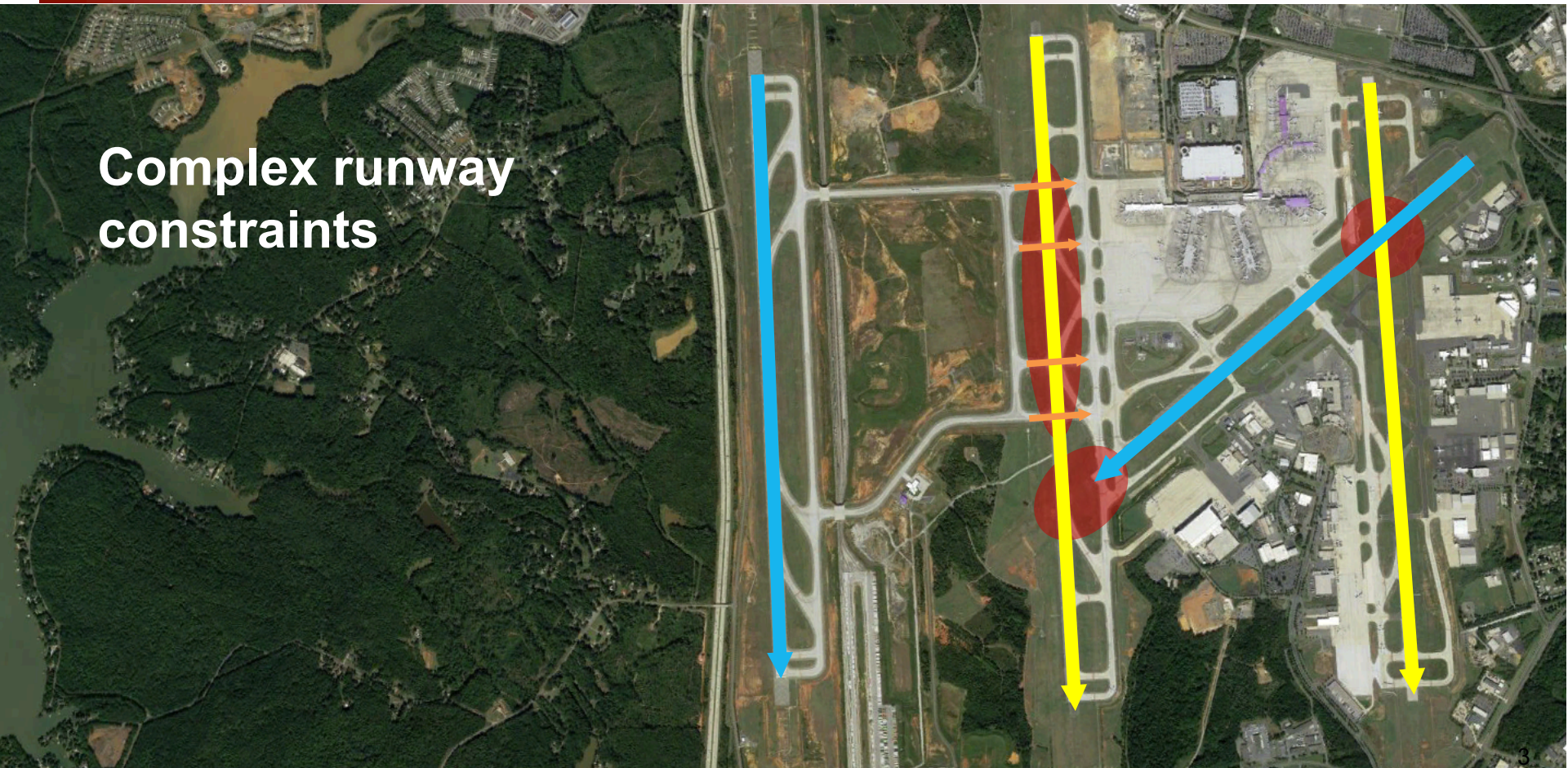
Surface Operations Scheduler & Simulator (SOSS)

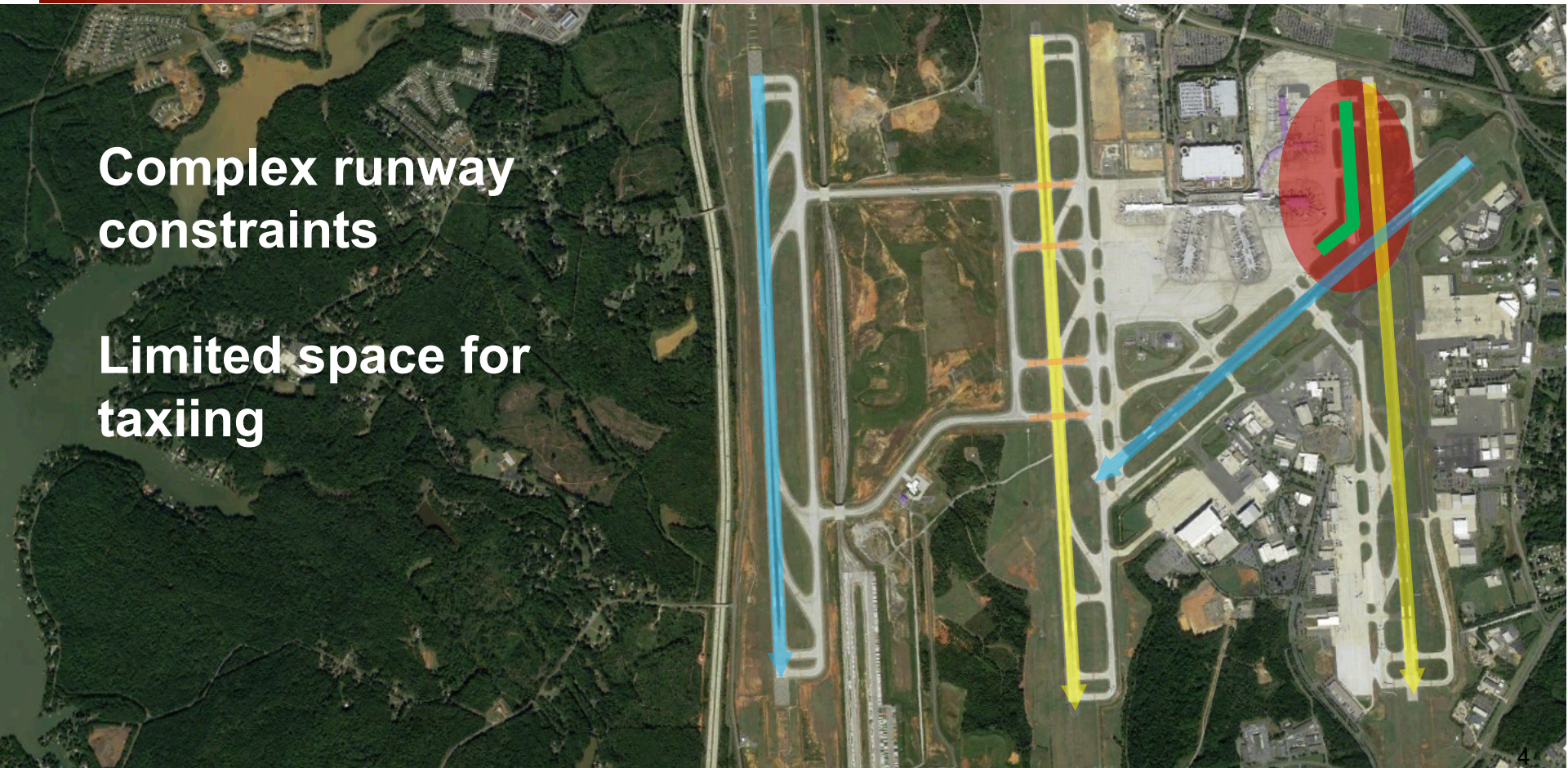
SOSS is:

- A fast-time simulation environment for surface operations
- Used to develop and test surface scheduling concepts
- Currently testing a surface scheduling concept for Charlotte Douglas International (CLT)

CLT Surface Operations Challenges



CLT Surface Operations Challenges



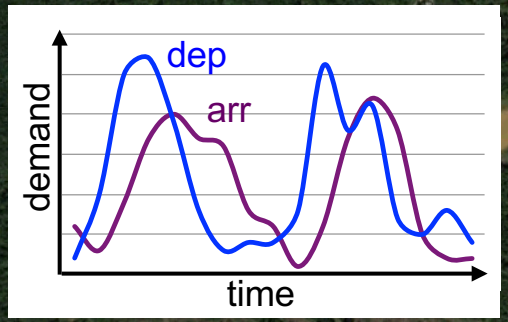
CLT Surface Operations Challenges

Gate Conflicts

Flights need the same gate at the same time:

- Arrival is early
- Departure is late or held for metering

Common in hub operations arrival/departure banks



Resolution option: Temporary parking in hardstands

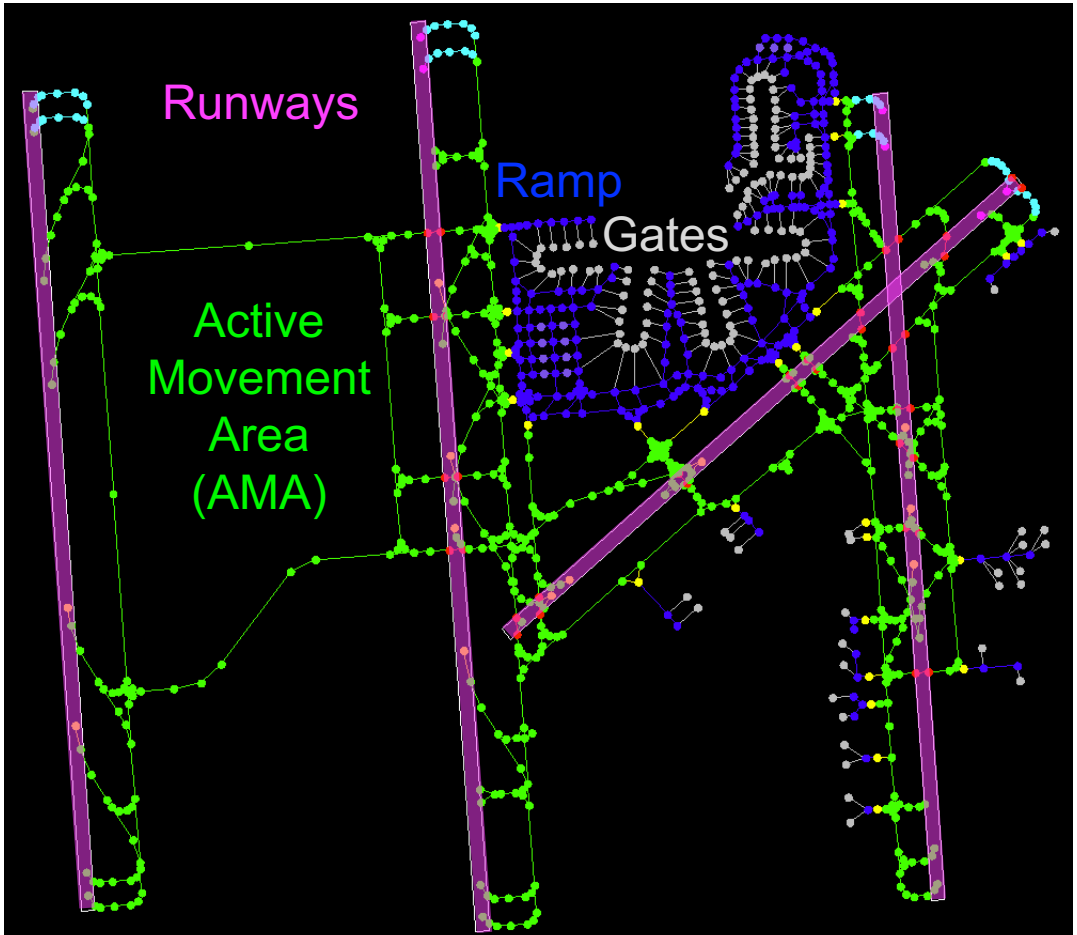
Objectives

- Describe SOSS and new functionality to model hardstand operations
- Compare gate conflict management approaches' impact on surface scheduling operations

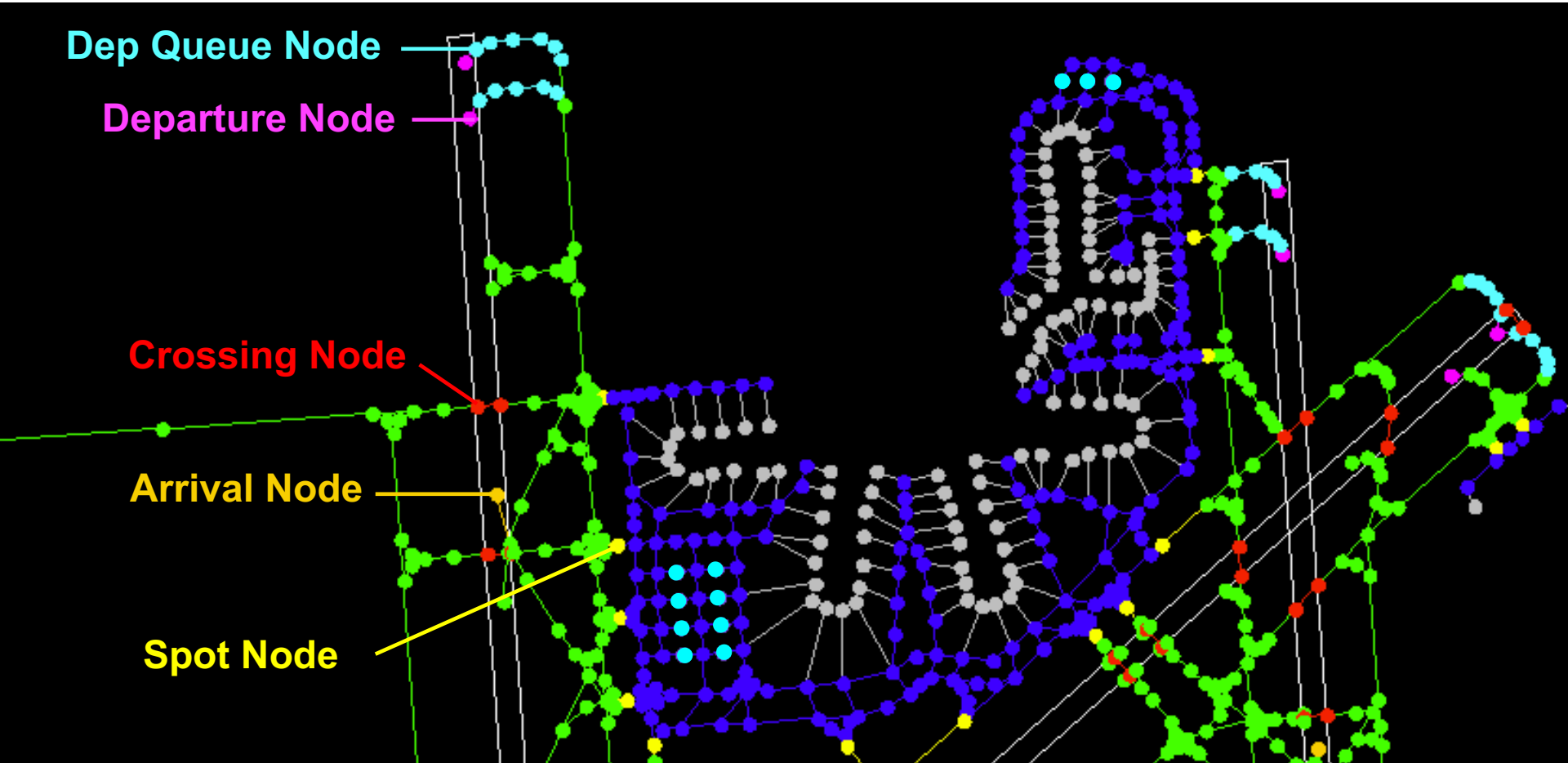
Outline

- SOSS
- Gate Conflict Management
- Experiment Setup
- Results

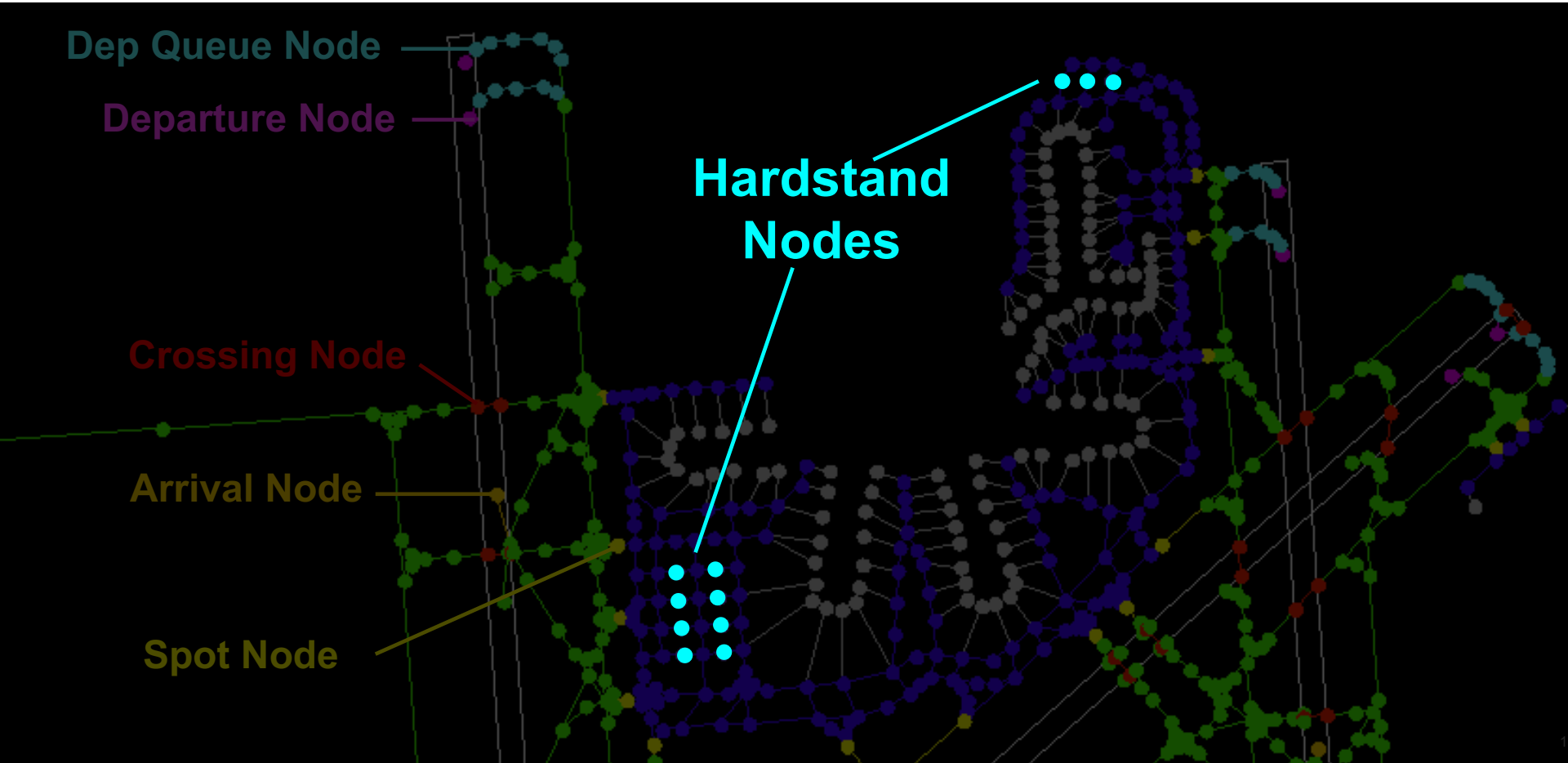
SOSS Airport Model



SOSS Airport Model



SOSS Airport Model



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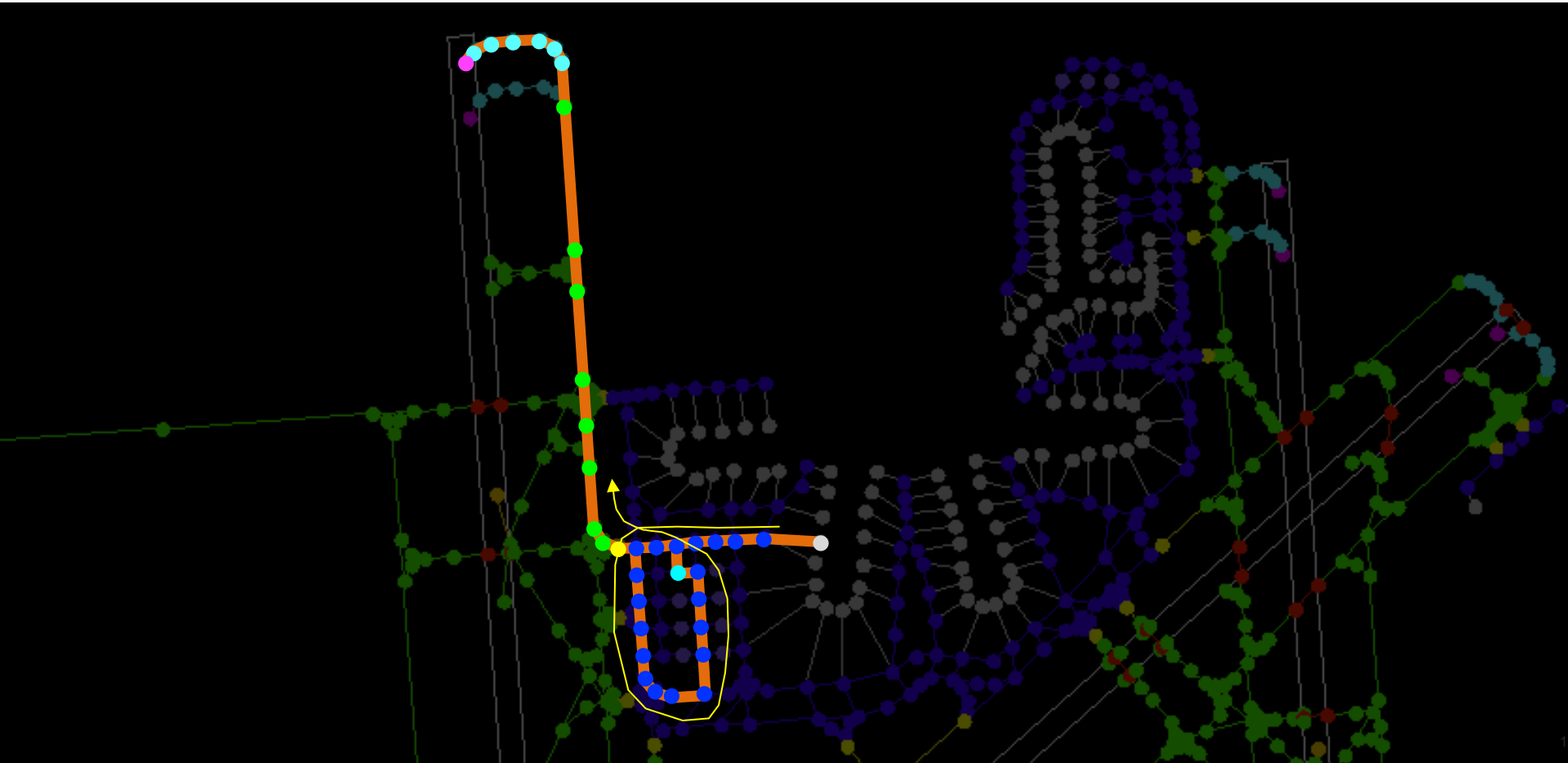
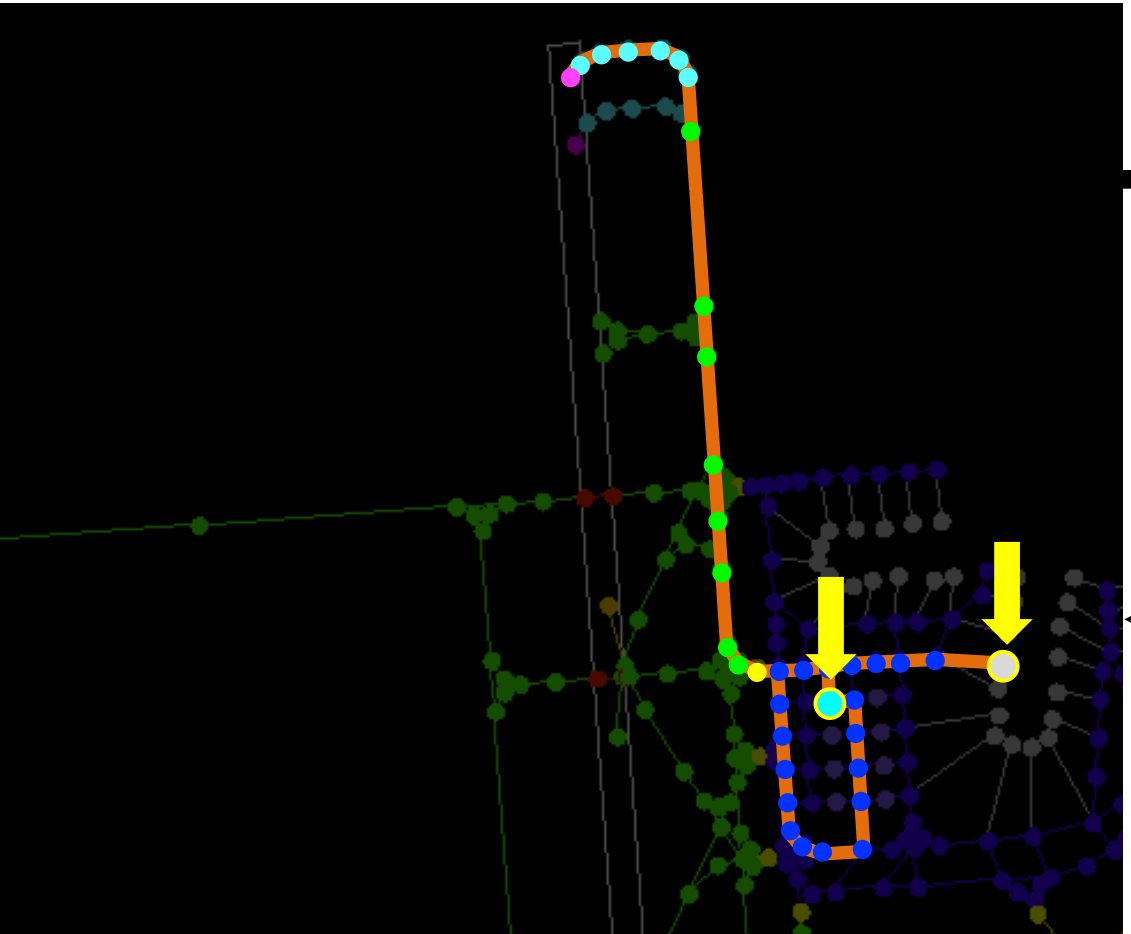
Flight Taxi Movement and Routing

NASA



Scheduler Interface



Flight states and intent

Scheduler

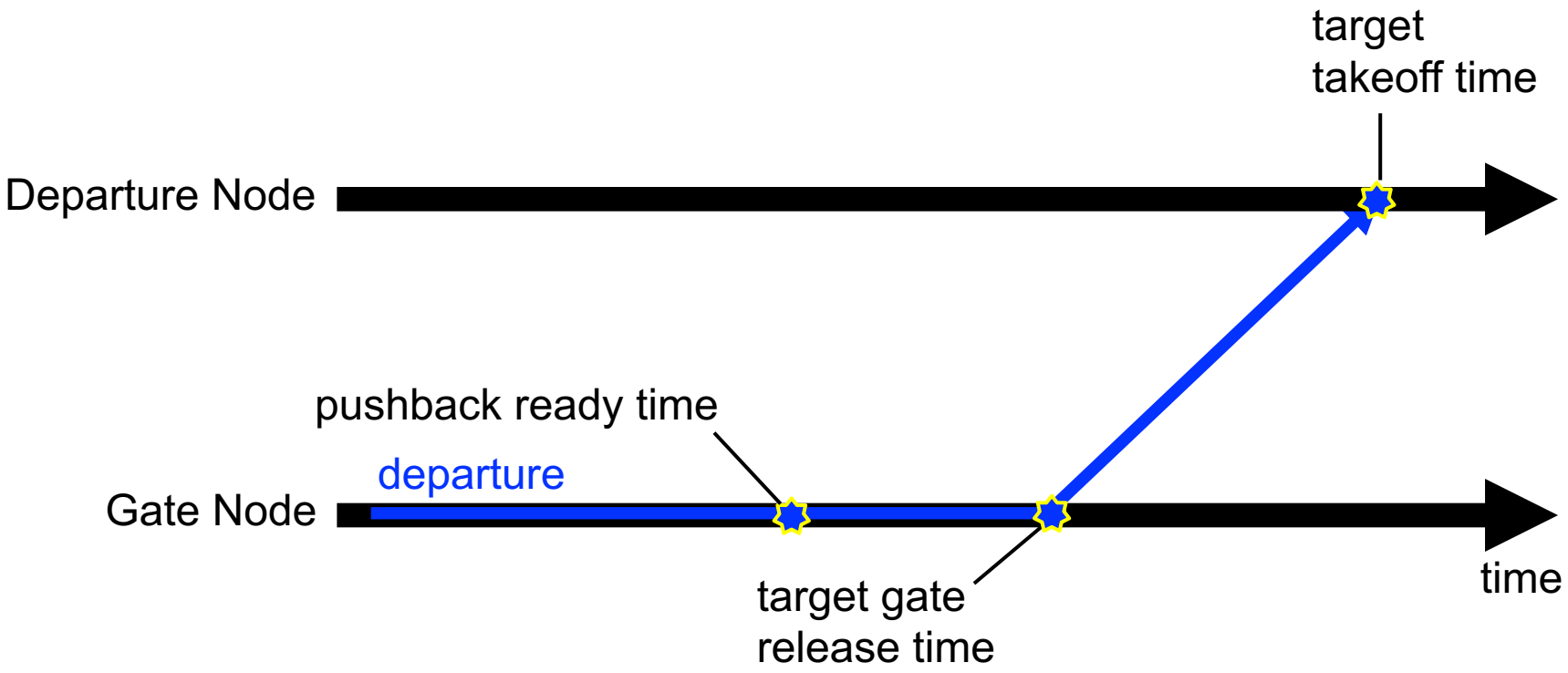
Reroutes

Release times
- Gate nodes
- Hardstand nodes

Outline

- SOSS
- **Gate Conflict Management**
  - **Prediction**
  - **Resolution options**
  - **Management approaches**
- Experiment Setup
- Results

Gate Conflict Prediction



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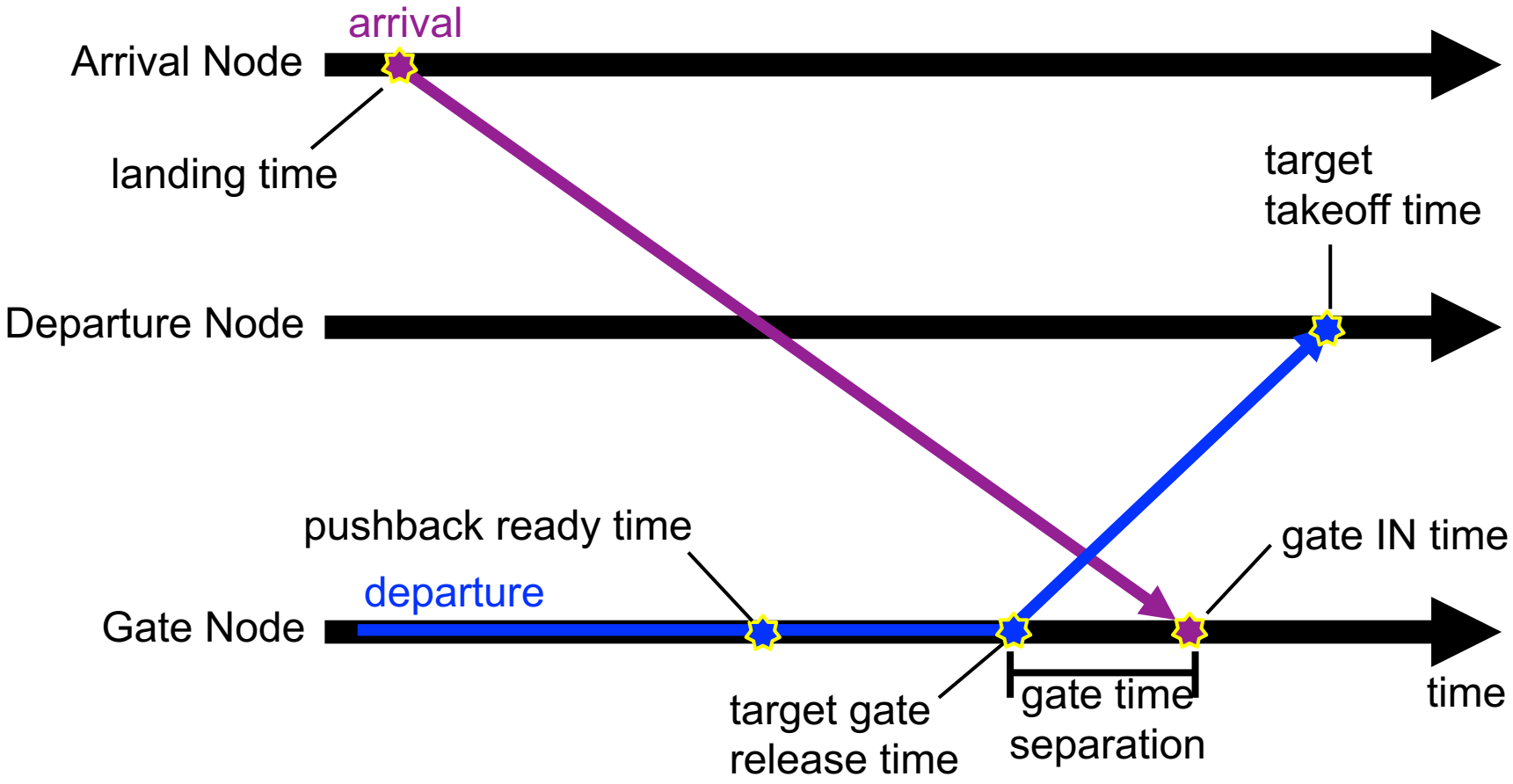

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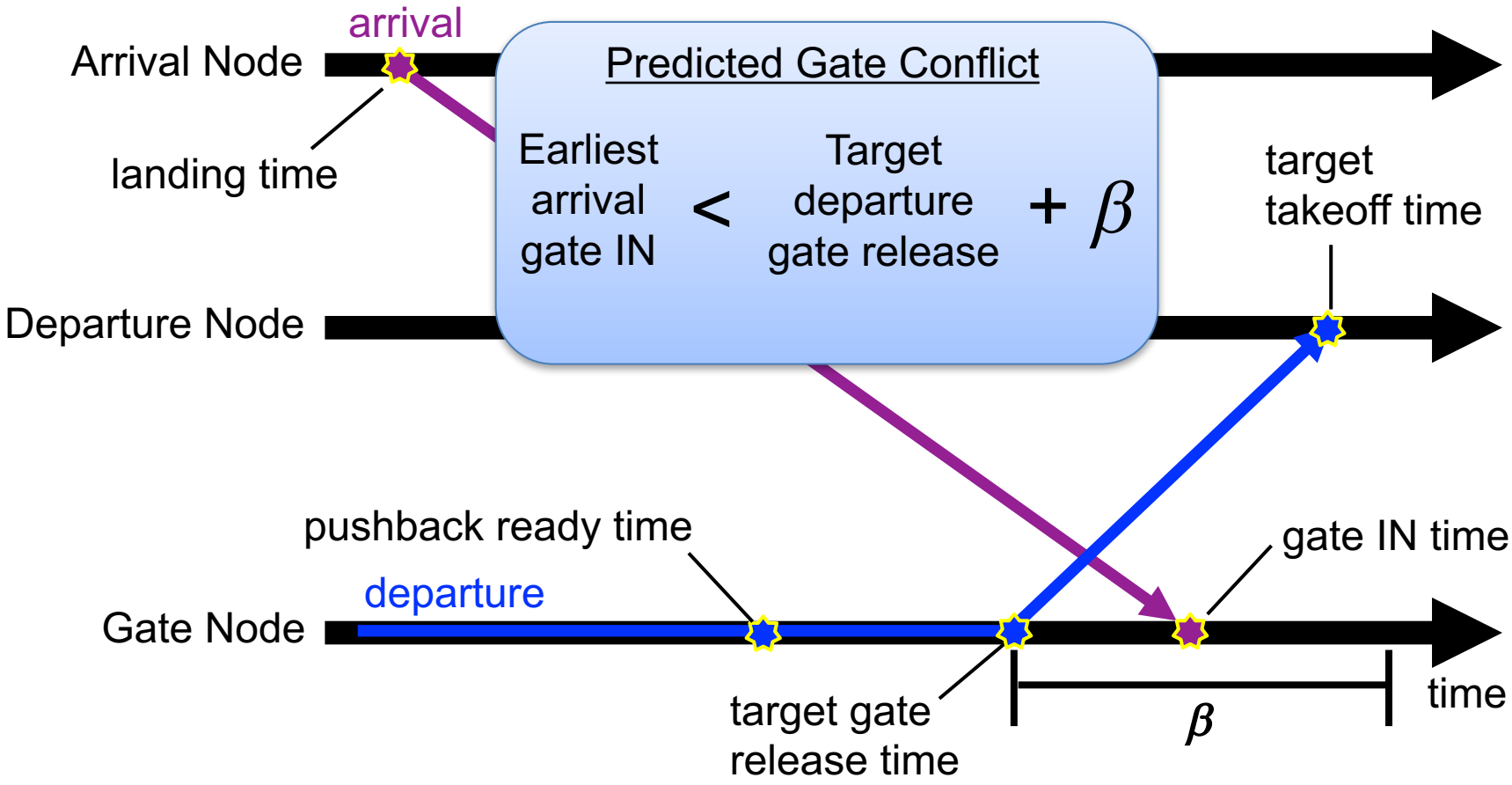
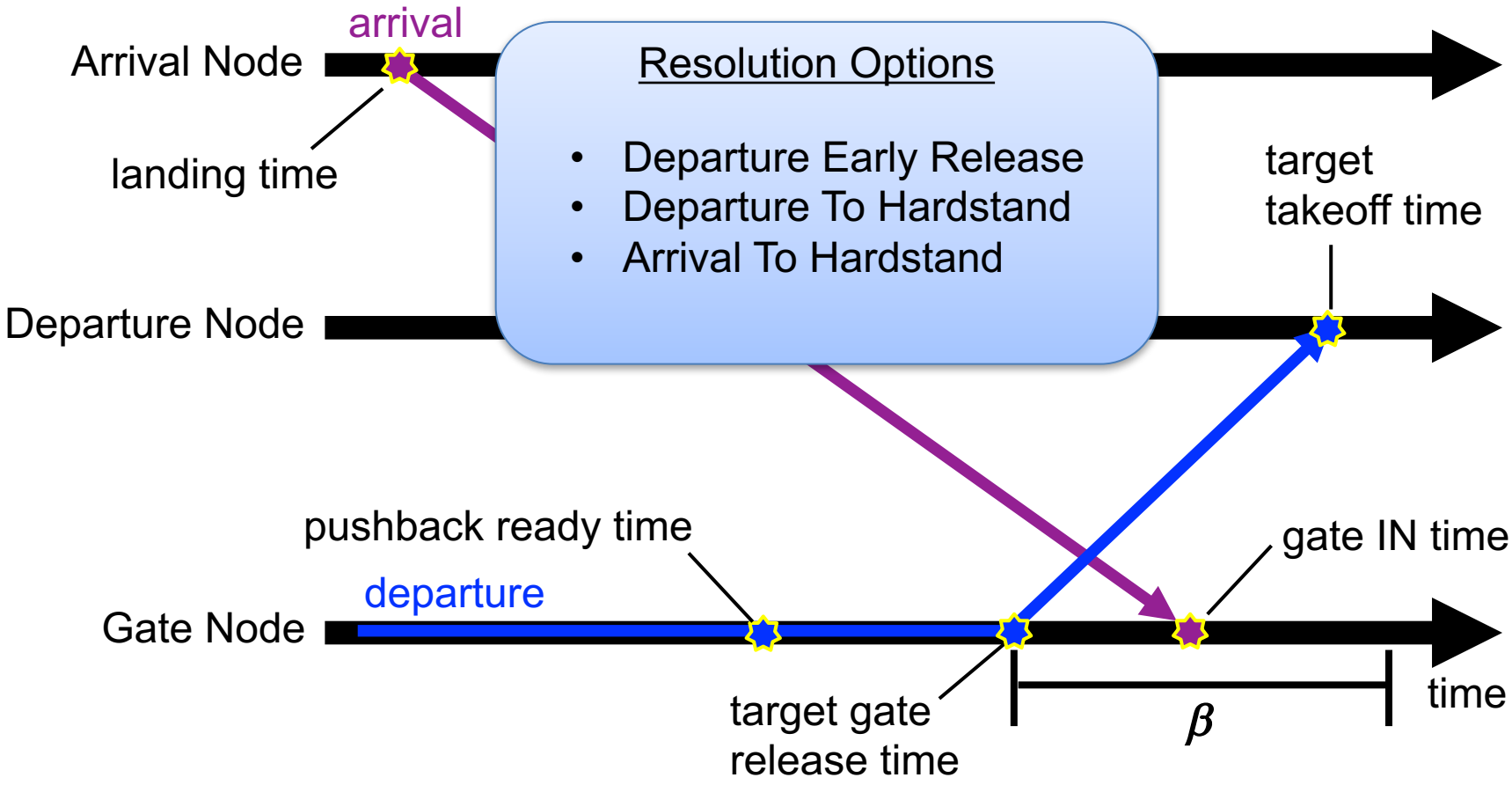
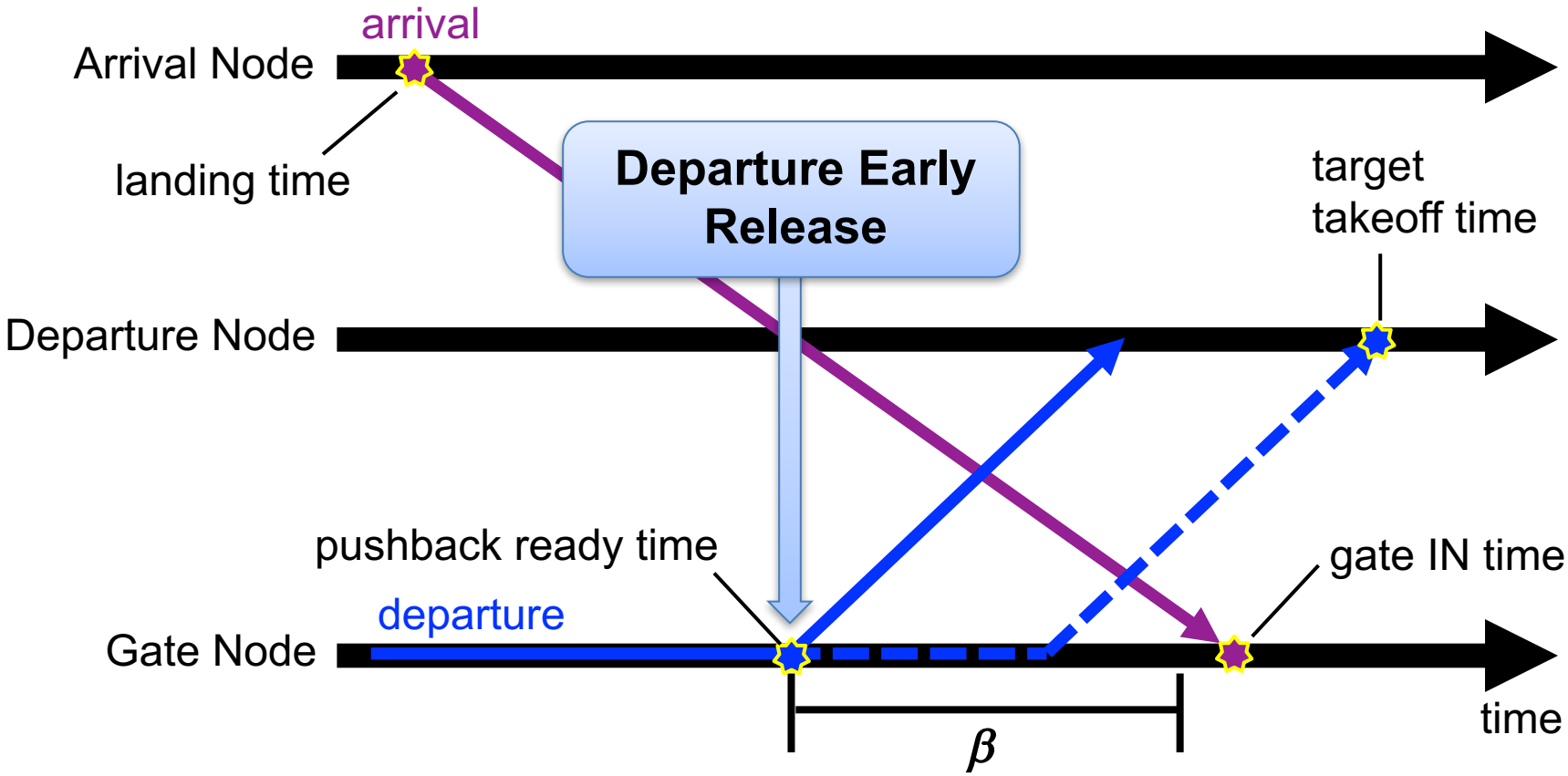


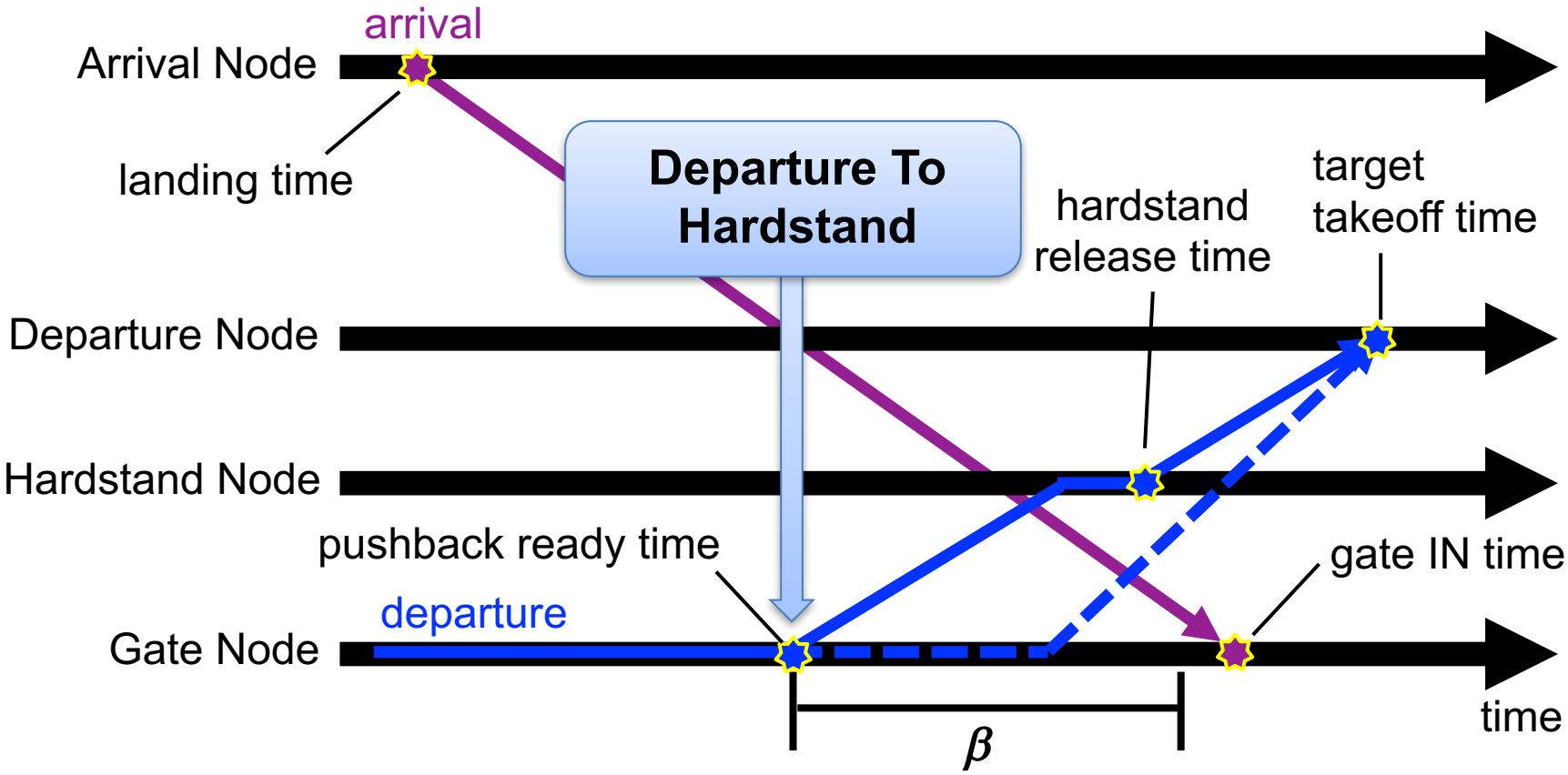
Gate Conflict Resolution



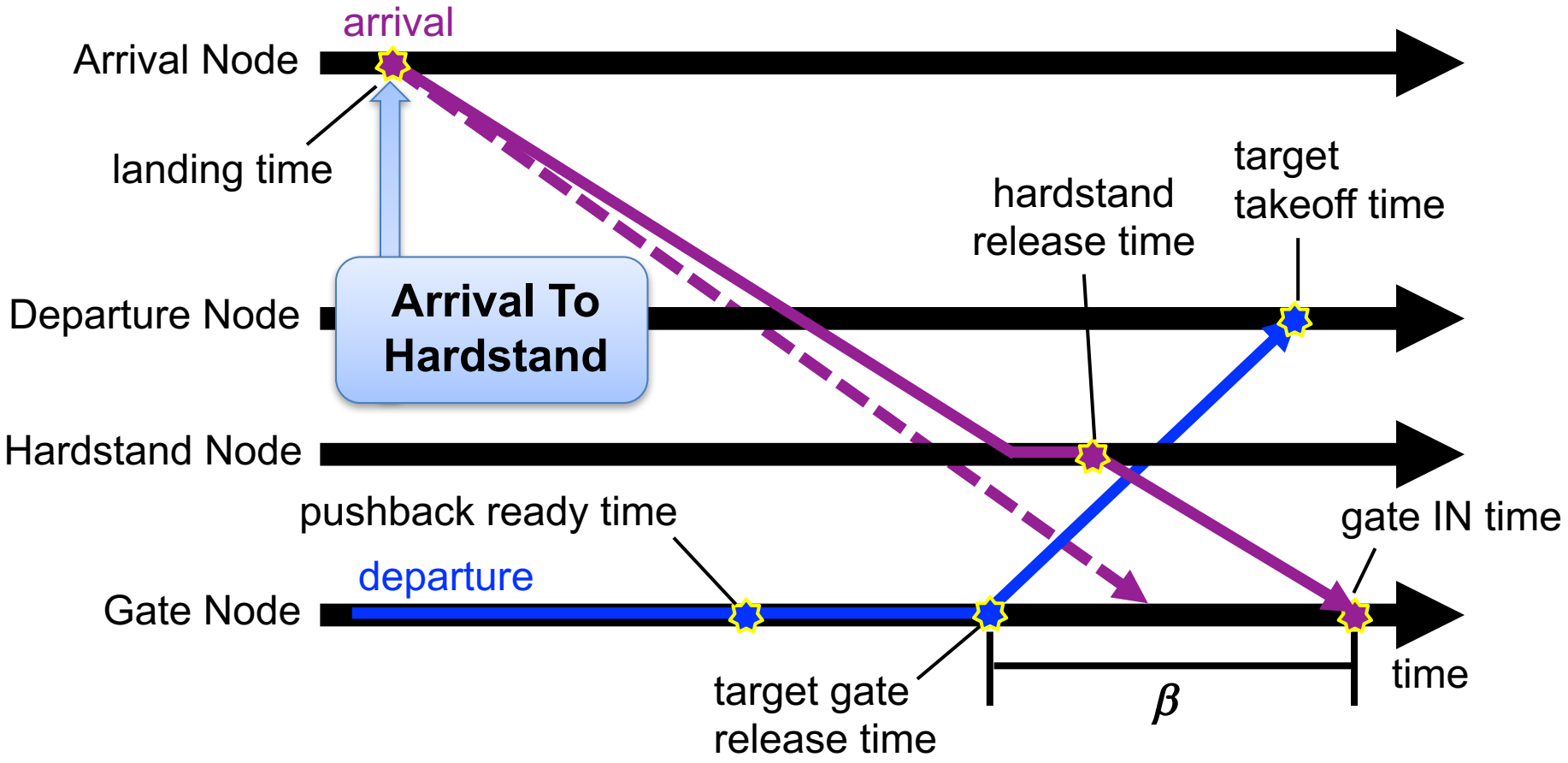
Gate Conflict Resolution



Gate Conflict Resolution



Gate Conflict Prediction



Gate Conflict Management Approaches

Management Approach	Resolutions Allowed: Departure Early Release	Resolutions Allowed: Departure To Hardstand	Resolutions Allowed: Arrival To Hardstand
No Hardstand	✓		
Departure Hardstand	✓	✓	
Arrival Hardstand			✓
Dual Hardstand	✓	✓	✓

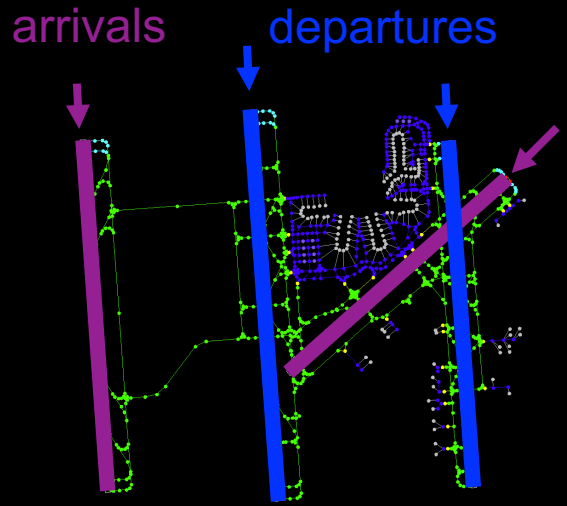
Outline

- SOSS
- Gate Conflict Management
- **Experiment Setup**
- Results

Experiment Setup

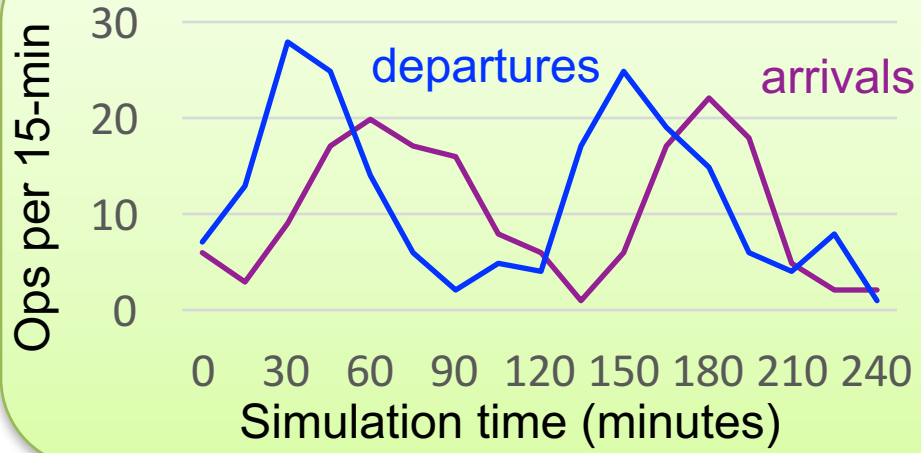
SOSS

0.5 sec time step



Surface congestion uncertainty modelled

Demand Scenario



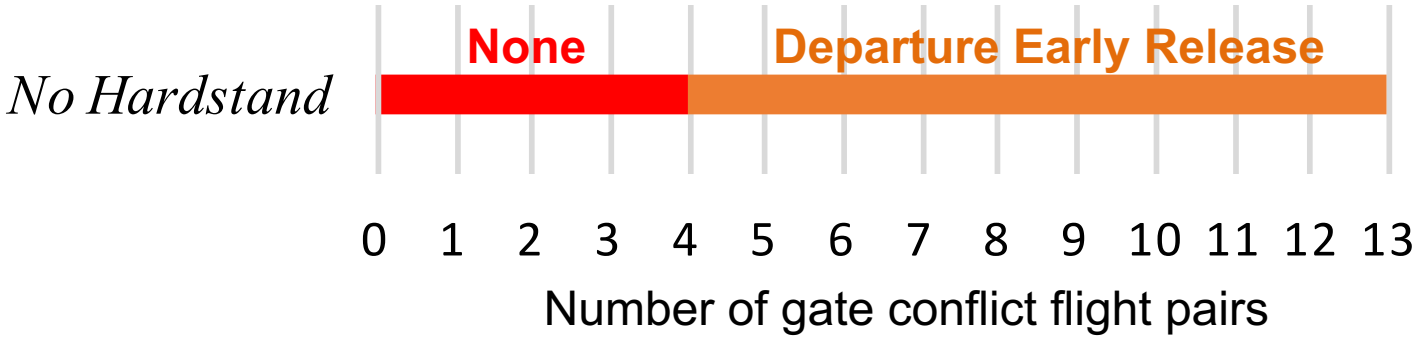
Scheduler

- Called every 10 seconds
- Surface metering ON
- Gate conflict management (4)

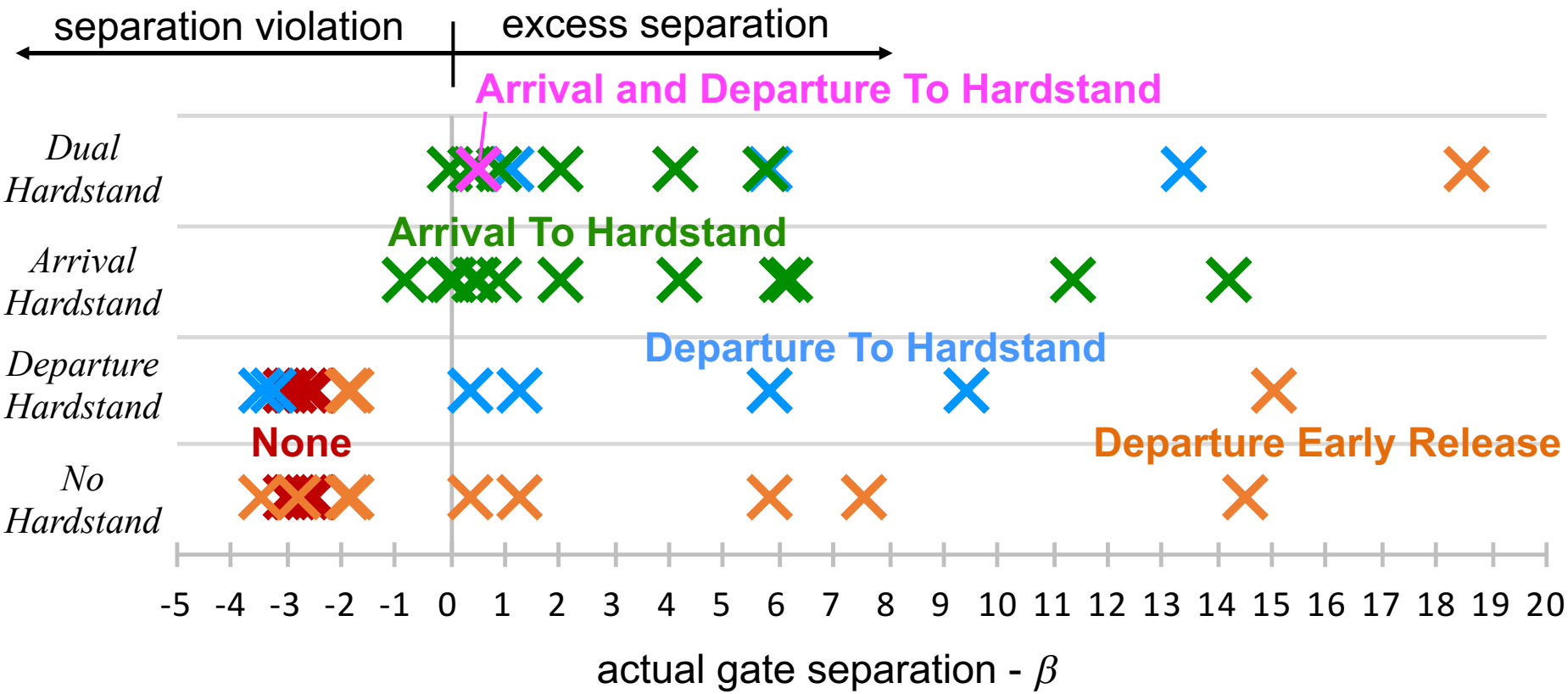
Outline

- SOSS
- Gate Conflict Management
- Experiment Setup
- **Results**
  - **Resolution types**
  - **Gate time separation**
  - **Runway time predictability**
  - **Surface transit time**

Results: Resolution Types



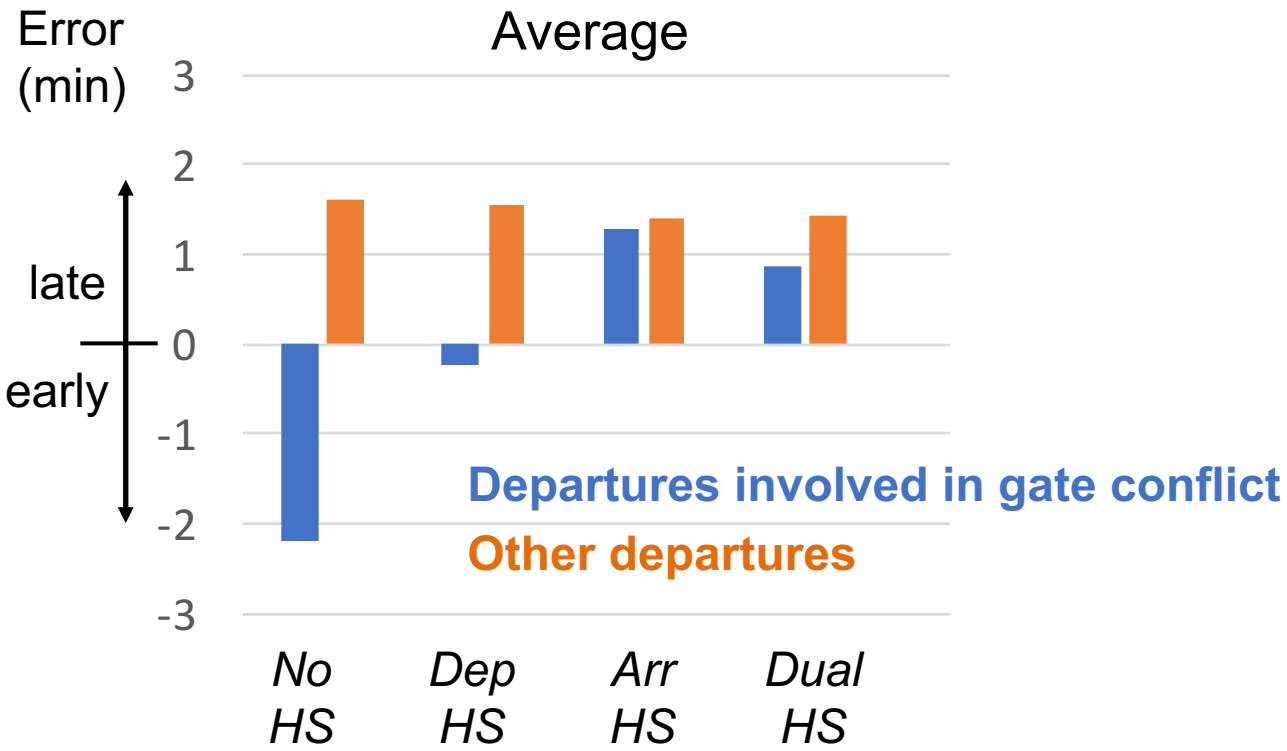
Results: Gate Time Separation



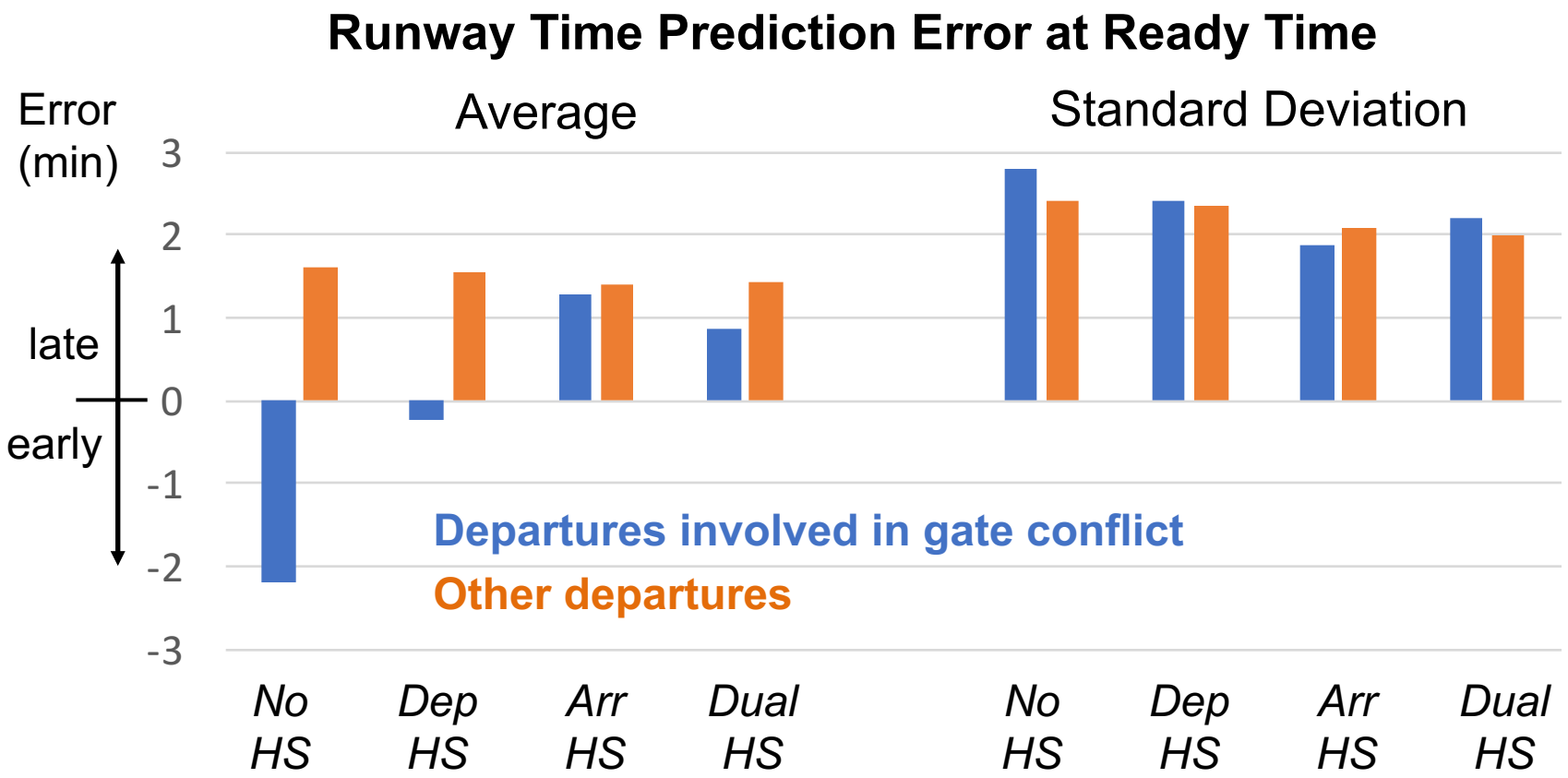
Results: Gate Time Separation

Results: Runway Time Predictability

Runway Time Prediction Error at Ready Time



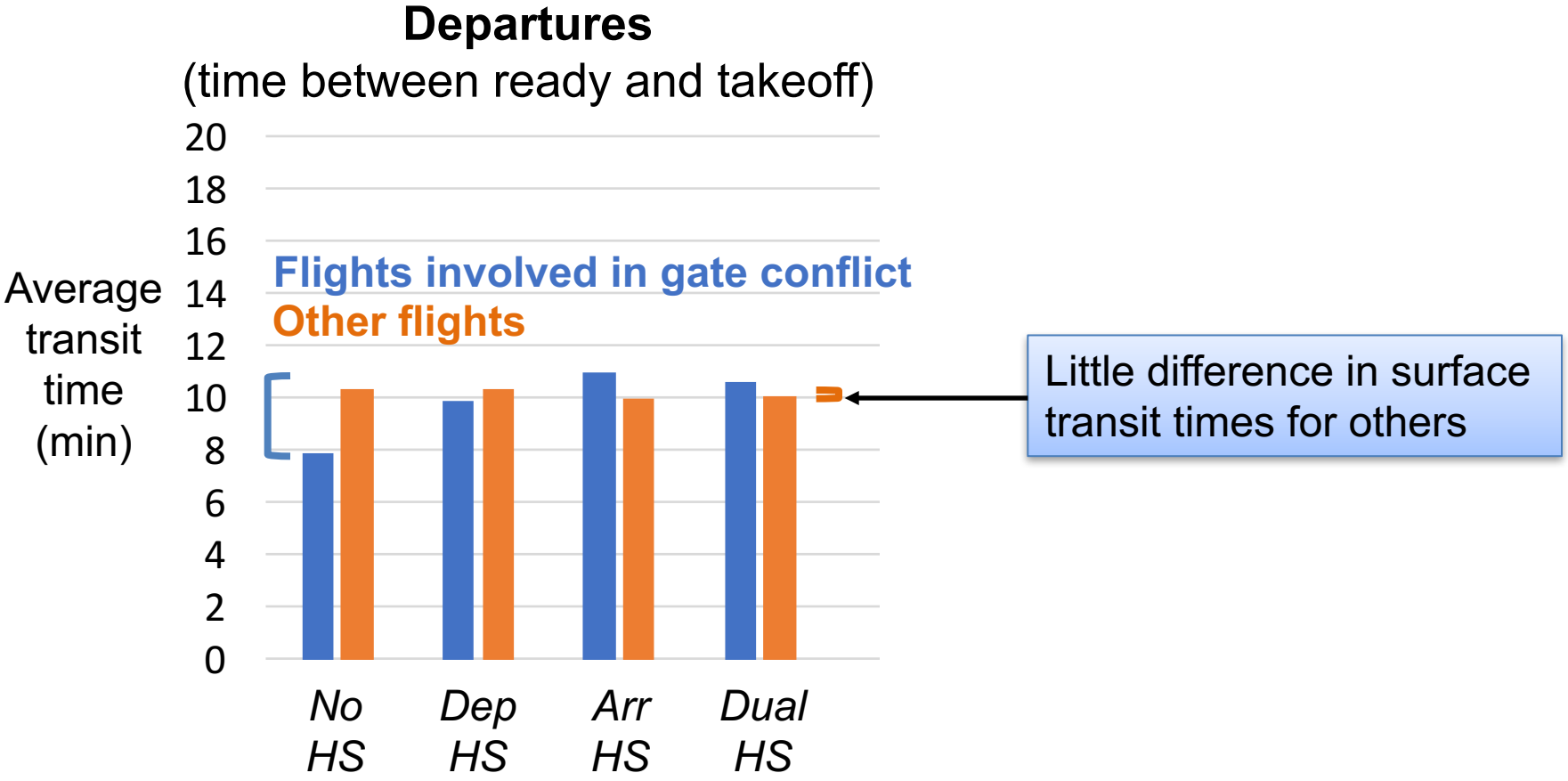
Results: Runway Time Predictability



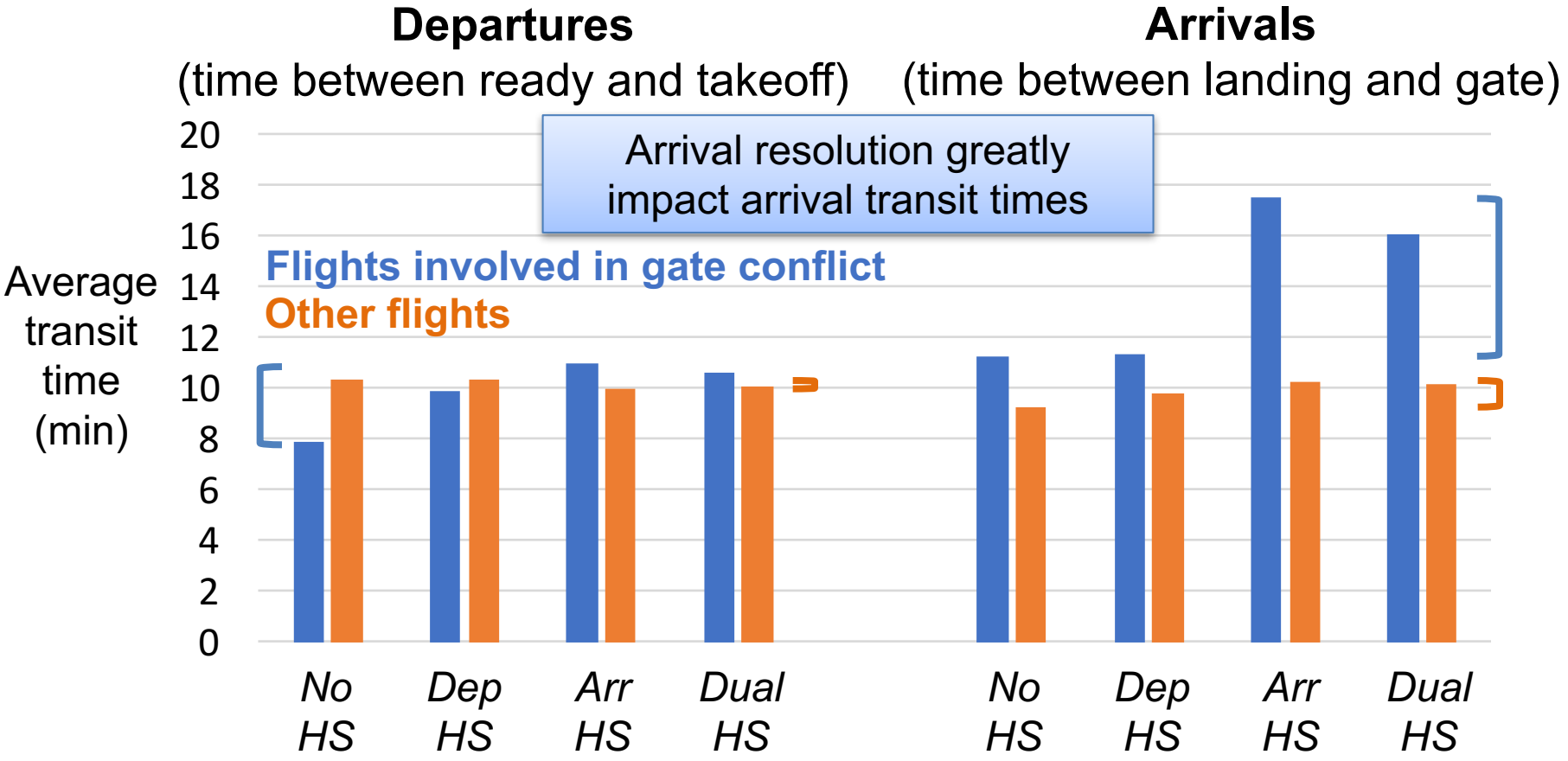
Results: Runway Time Predictability

Runway Time Prediction Error at Ready Time

Results: Surface Transit Time



Results: Surface Transit Time



Summary and Conclusions

Gate Time Separation	Arrival resolutions are best at achieving desired gate time separation
Runway Time Predictability	Arrival resolutions have least impact on runway time predictability
Surface Transit Time	Arrival resolutions greatly impact arrival surface transit times

- *Arrival Hardstand* approach is sufficient for simulations of tactical surface metering
- *Dual Hardstand* approach may be needed for simulations with large departure delays due to Traffic Management Initiatives

Future Work

- Explore use of *Dual Hardstand* approach in simulations with Traffic Management Initiatives
- Enhance SOSS to allow flights to be rerouted at any time

Questions

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