

FAA/NASA/Industry
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Airport Planning
workshop



Exploring New Frontiers in the Use of VISSIM for Airport Simulation



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Background

- The landside
- Micro-simulation model (VISSIM)
- Landside Simulation Challenges
- Landside Integrated Simulation Model
- What's next?



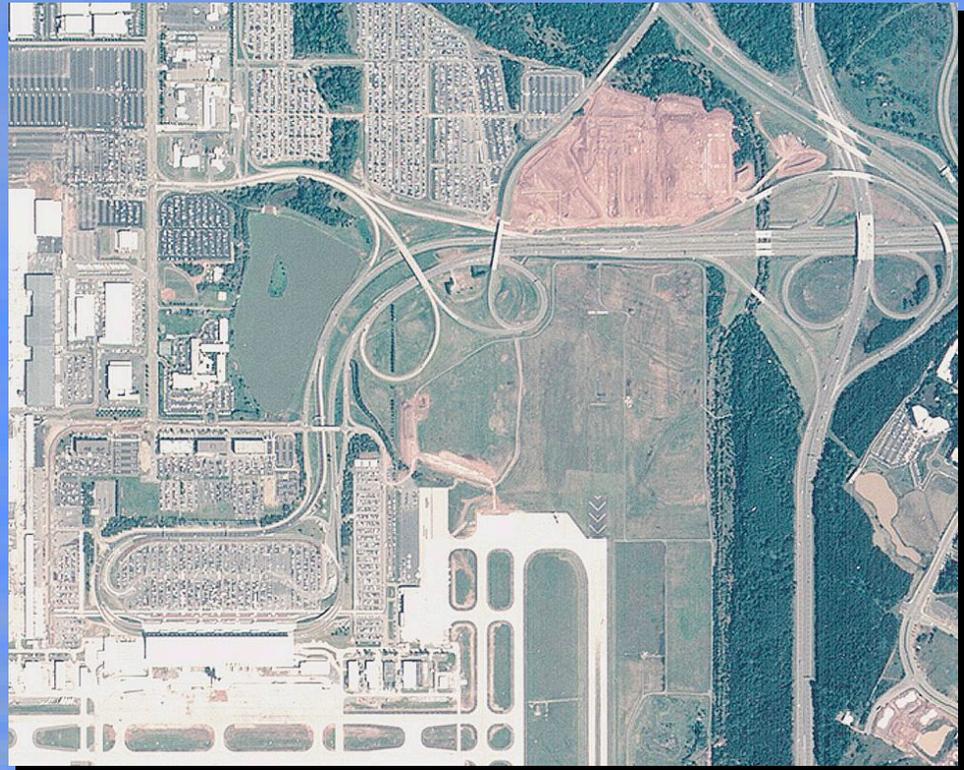
The Landside Components

- Traditionally:
 - Roadways, curbs
 - Parking facilities (garages, surface lots, plazas)
 - Rental car facilities
 - CV facilities (staging areas, queuing areas)
 - Ground transportation centers
 - Transit facilities (rail, bus)
- More recently:
 - Cell phone lots
 - Vehicle security screening areas
 - Passenger waiting areas



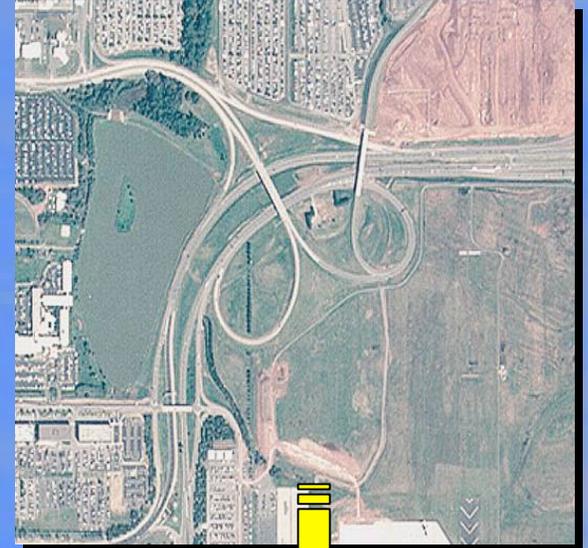
What do these components have in common?

- They are all connected by:
 - Roadway network
 - Tracks
 - Walkways
- They operate as a system



Why is Simulation Necessary?

- Because of the particularities of driver's behavior and airport landside operation
- Only simulation allows to reasonably model the complexity of vehicle/vehicle and vehicle/pedestrian interactions
- Allows integration of linked components
- The airport as a model of itself

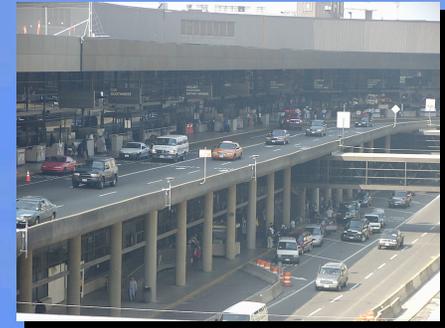


Is the airport landside really different from off-airport roadway systems?

- **Yes!**
 - Primarily infrequent users, often under stress
 - Multiple decisions in short period: information overload
 - Constrained decision distances
 - Greater amount of weaving and merging
 - Most Federal/State design standards are not applicable
 - Low speed/uninterrupted flow
 - Distinct modal behavior
 - Rapid change of regime from freeway to curb/parking

Where do we use Simulation?

- Inventory and observation
- Existing conditions analysis]
- Forecasts of landside activity
- Demand / capacity and LOS analysis]
- Facility requirements]
- Concept alternative development/evaluation]
- Detailed planning / design]
- Implementation: costing, phasing, MOT]

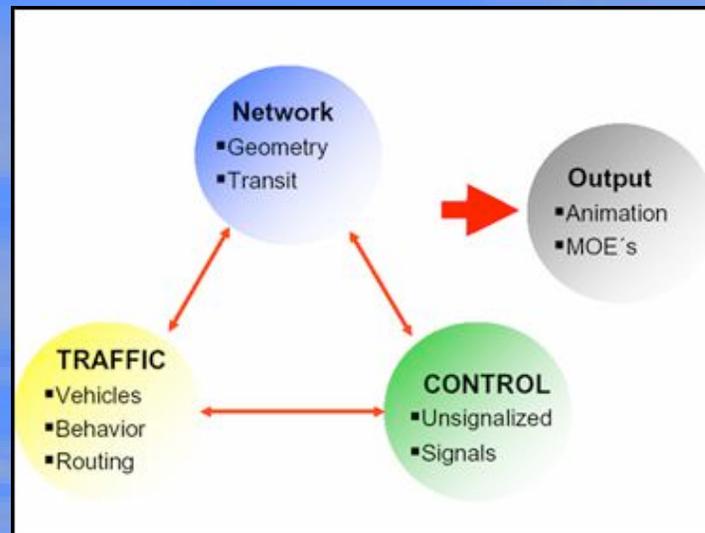


Simulation Models

- Models being used in airports can be classified according to how simulation time advances:
 - Time-driven discrete simulation: time is incremented by a constant time step
 - VISSIM, CORSIM, PARAMICS, AIMSUM
 - Event driven: time increment is triggered by the next earlier occurring event
 - ARENA

The VISSIM Model

- VISSIM is a microscopic, time-step and behavior-based simulation model developed to analyze a full range of traffic operations on virtually any kind of roadway.

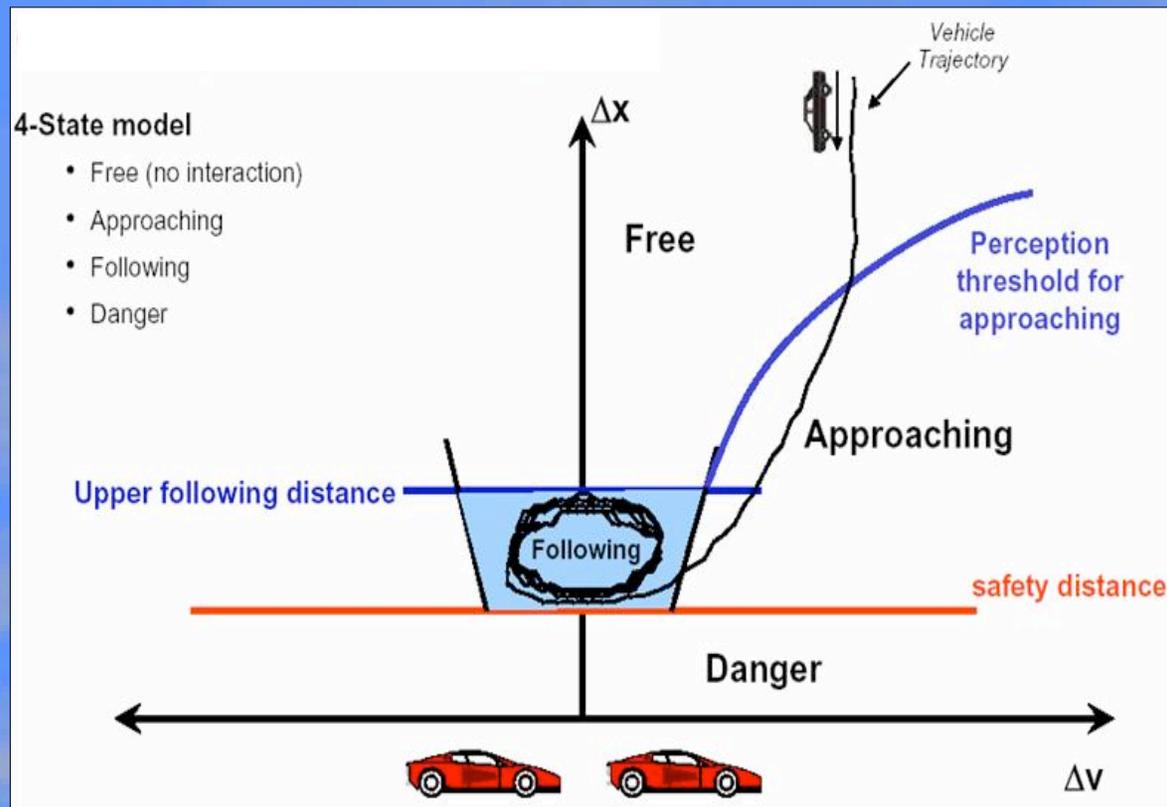


The VISSIM Model

- The traffic flow model is based on two behavioral models:
 - the car-following model, which regulates how vehicles behave longitudinally
 - the lane-change model, which uses a rule-based algorithm to govern lateral movements.

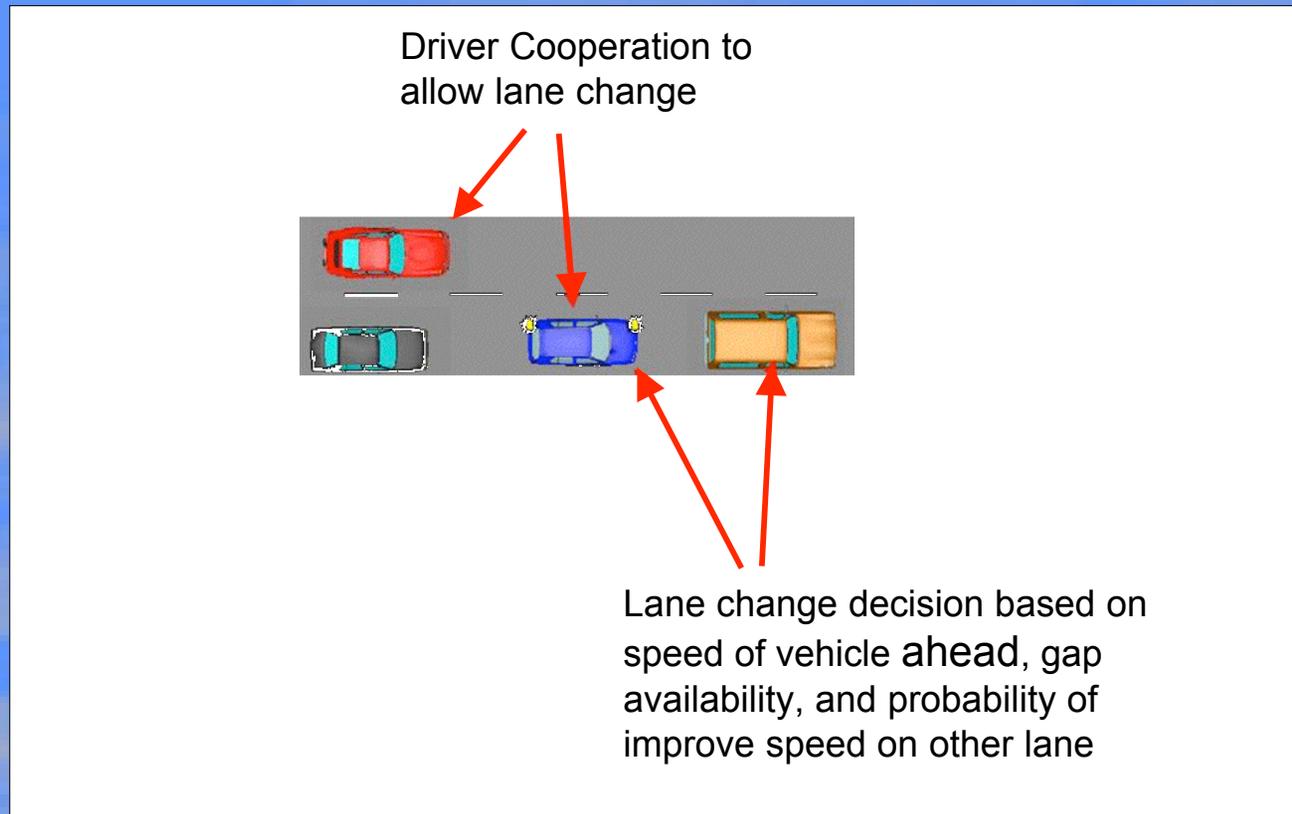
The VISSIM Model

- The car-following model



The VISSIM Model

- The lane-changing model



VISSIM in The Airport Simulation Toolbox

Airfield	Passenger Conveyance	Terminal	Curb	Parking/Roads
SIMMOD	Arena			
Total Airport Sim				VISSIM
	ALPS			
	Legends		ACTSIM	CORSIM
				SYNCHRO
			VISSIM	
				

← 2003

← 2006

- Roadways, curbs
- Parking facilities
- Rental car facilities
- CV facilities
- GTC
- Transit facilities
- Cell phone lots
- Security Areas



State-of-the-Art in Landside Simulation

♣ Before

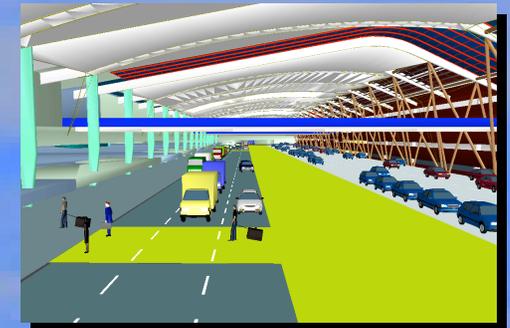
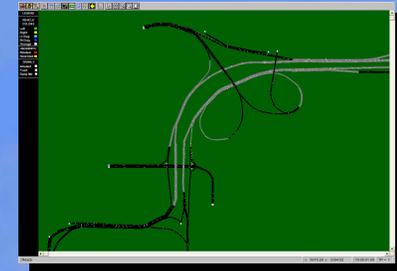
- ♣ Only Roadway Analysis

♣ Now

- ♣ Roadways, Curbs, GTC, CV Hold, Entry and Exit Plazas, Security Screening Areas, Cell lots, Parking

♣ Future

- ♣ Full integration with terminal and airside



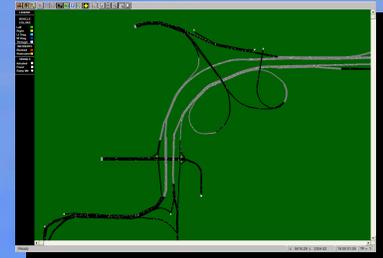
State-of-the-Art in Landside Simulation

♣ Before

- ♣ Only vehicle interaction
- ♣ Few vehicle modes
- ♣ Limited functionality

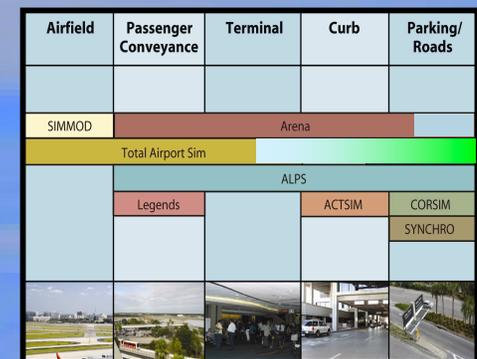
♣ Now

- ♣ Vehicle and Pedestrian Interaction
- ♣ Full range of vehicle types and modal behaviors
- ♣ Flexible, expandable



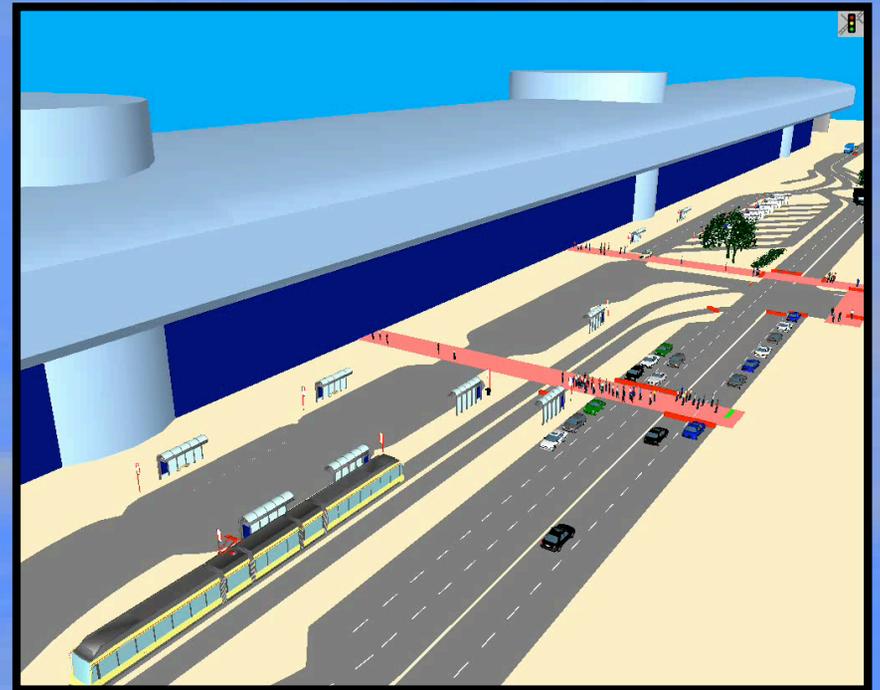
VISSIM in The Airport Simulation Toolbox

- VISSIM is continuously growing in capabilities and features, increasing the range of application
- Consultants are developing add-on tools and techniques that further expand the use of the model
- Faster computers have reduced the processing (running) time



Application of VISSIM beyond roadways

- VISSIM has not been conceived with airport landside in mind, but....
- It's the best off-the-shelf available tool that allows for full integration of the landside
 - Improved network paradigm
 - More flexibility
 - On-the-fly Interaction
 - Programming capabilities



Landside Simulation Challenges

- Multiple types of operation influenced by:
 - Free flow, low speed areas
 - Signalized or unsignalized intersections
 - Controlled access
 - Speed zones and speed reduction areas (e.g. curb access)
 - Pedestrian crossings
 - Curb Activity
 - Roadway geometry
 - Type of vehicular mode (commercial vehicle vs. private vehicle)
 - Service time and queuing



Landside Simulation Challenges

- Multiple types of behaviors in response to:
 - Wayfinding/signing
 - Priority treatment for specific transportation modes
 - Mixed flow of unfamiliar drivers (private vehicles) and professional drivers (commercial vehicles)
 - Security inspections
 - Restricted access areas
 - Time critical operation (for originating passengers)
 - Congested conditions



Simulation of Access and Circulation Roadways

North Area Roads Dulles Airport (IAD)

Simulation Challenges:

- Low speed, uninterrupted flow
- Traffic signals, stop-controlled intersections
- Pedestrian crossings
- Multiple modes
- Influence of signing
- Driver behavior
- Controlled access



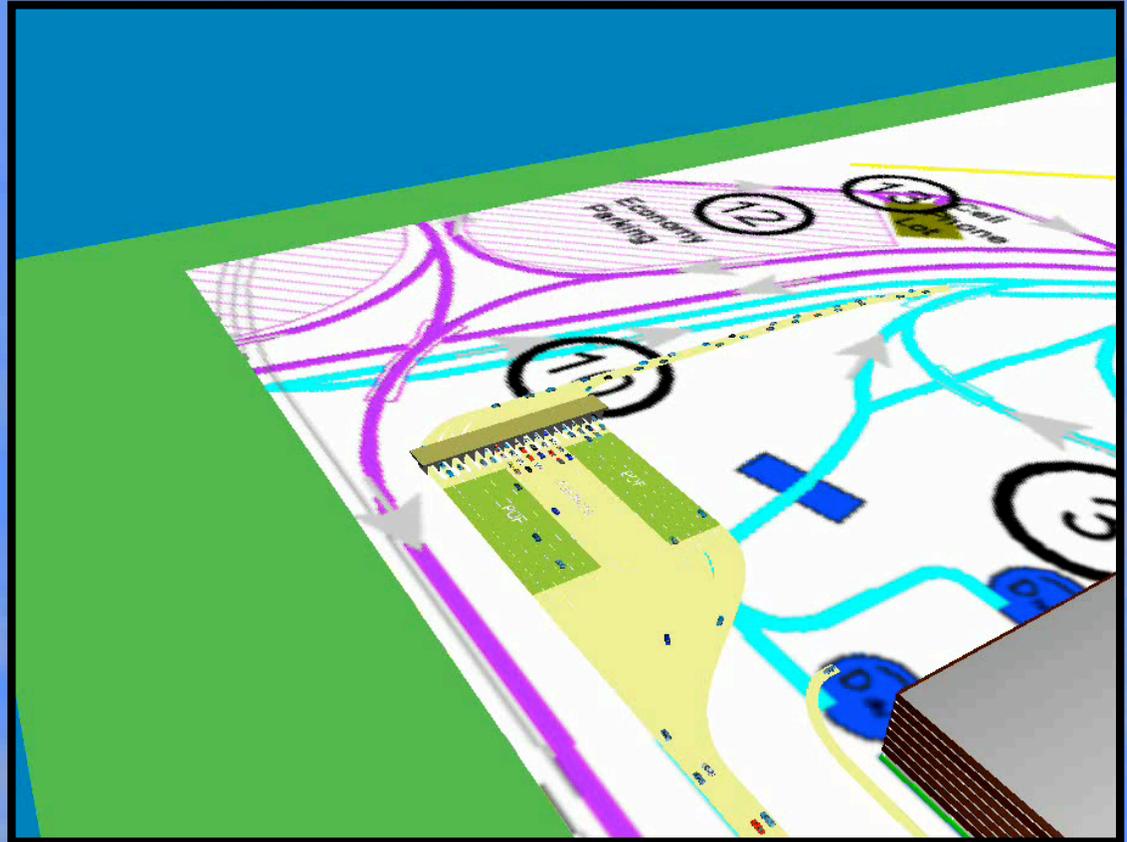
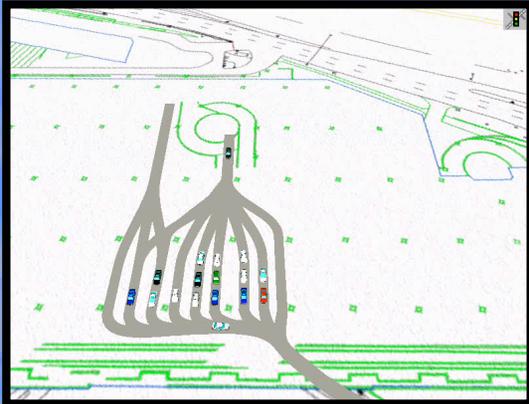
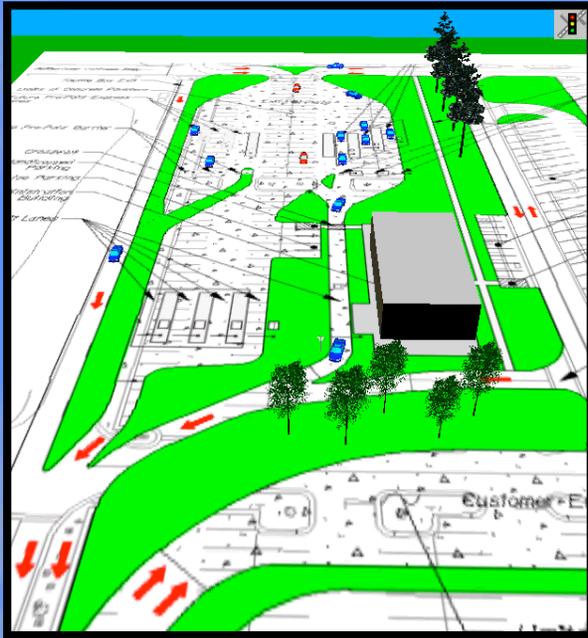
Parking Entry and Exit Plazas

- Issues:
 - Processing time distribution
 - (e.g., cashiers vs. Pay-on-Foot)
 - Lane selection
 - Complex geometry
 - Severe weaving
 - Approach roadways
 - Exit roadways



Parking Entry and Exit Plazas

Dulles – Future Remote Parking Exit Plaza



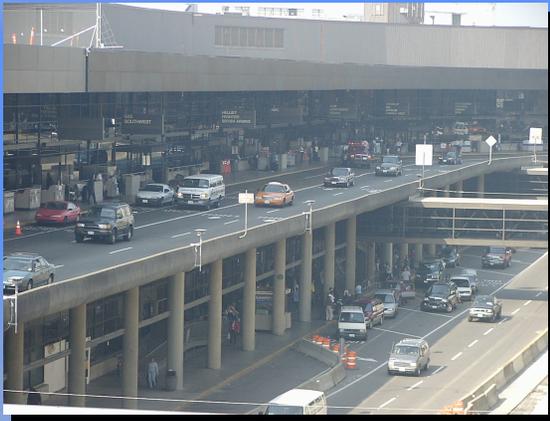
ATL – Proposed South Exit Plaza
(Conceptual)

DCA – Existing Exit Plaza from
Parking Garage B/C

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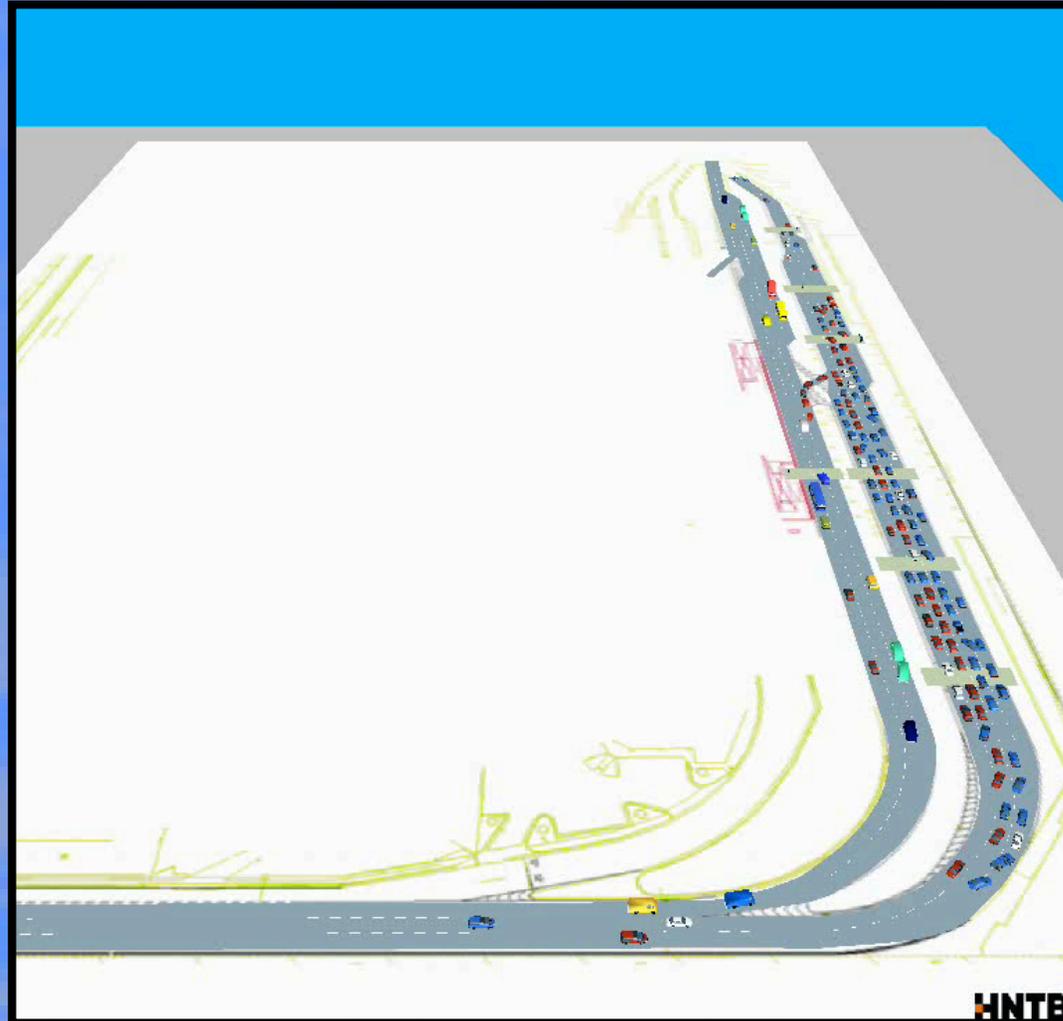
Curb Simulation Challenges



- Close-space decisions
- Severe weaving
- High concentration of activity not equally distributed along the curb
- Multiple-lane parking/blockage
- Different vehicle modes with different driver behavior (e.g., private vehicles vs. commercial vehicles)
- Pedestrian interaction
- Influence of dwell time distribution
- Driver cooperation vs. aggressiveness

Curb Simulation

*Hartsfield-Jackson Atlanta
International Airport – Existing
South Upper Curbs – Testing
of RAC operation on the outer
curb*



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Ground Transportation Center

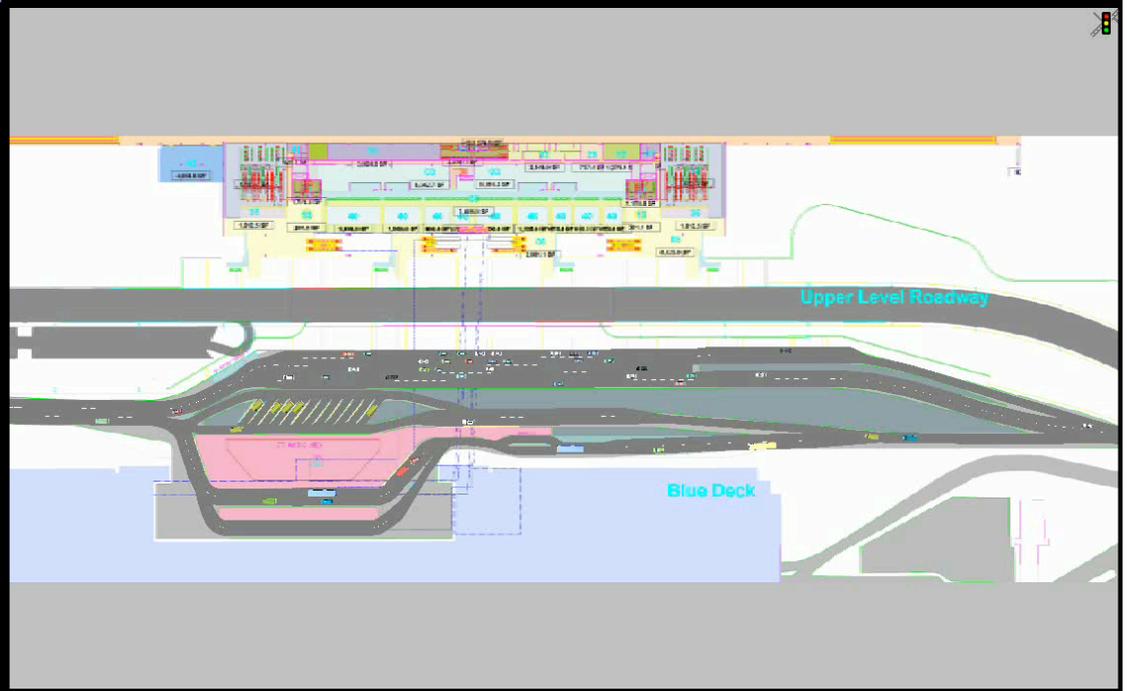
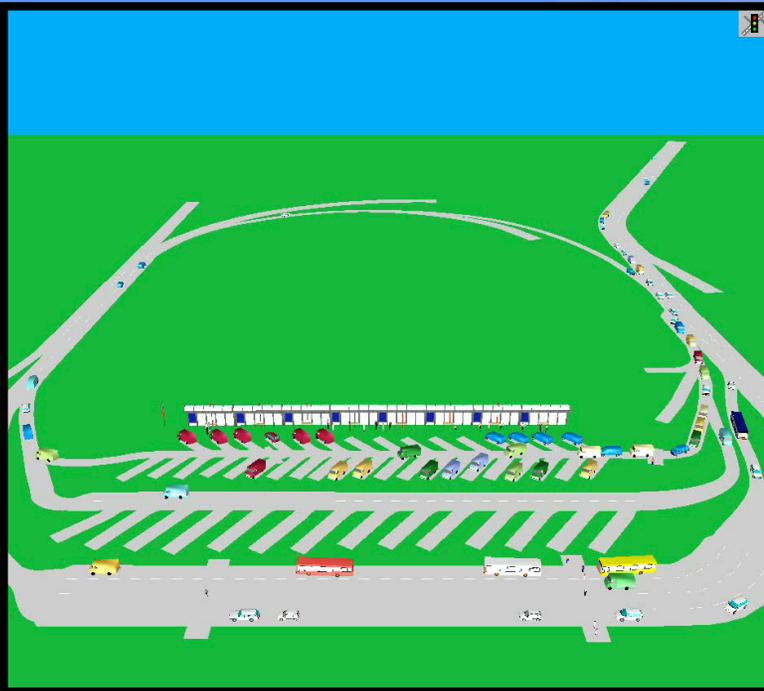
- Simulation Challenges:
 - Multiple interactions and conflicting movements
 - Angle and parallel parking
 - Multiple type of operations
 - Dwell time
 - Headways
 - Multiple types of vehicles
 - Pedestrian interaction



Ground Transportation Centers

Hartsfield-Jackson Atlanta International Airport – Existing
Ground Transportation Center

Detroit Metro – North Terminal Planning – Proposed GTC



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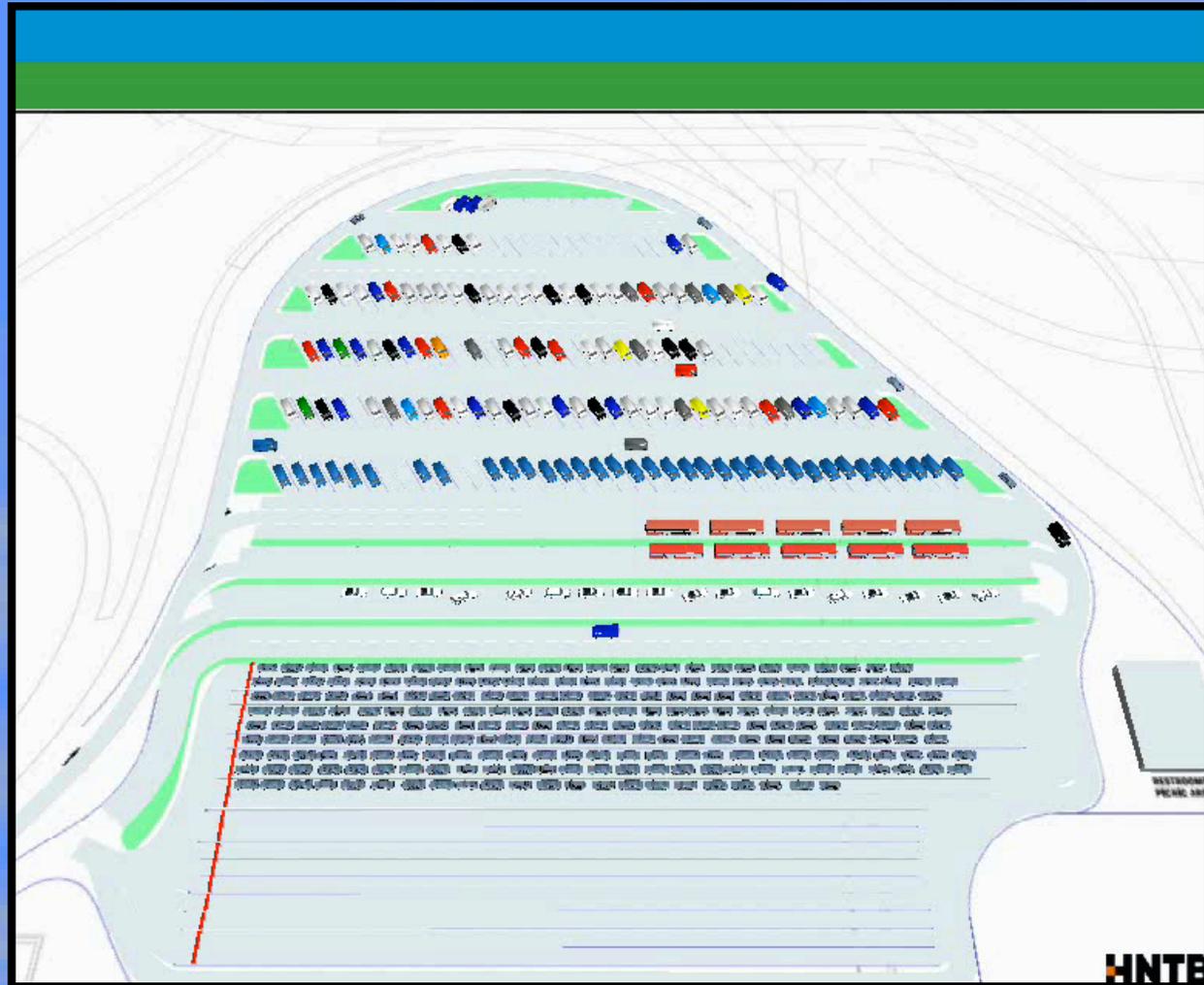
Commercial Vehicle Hold Areas

- Simulation Challenges
 - Dispatching mechanisms
 - Complex internal circulation
 - Integration with GTC



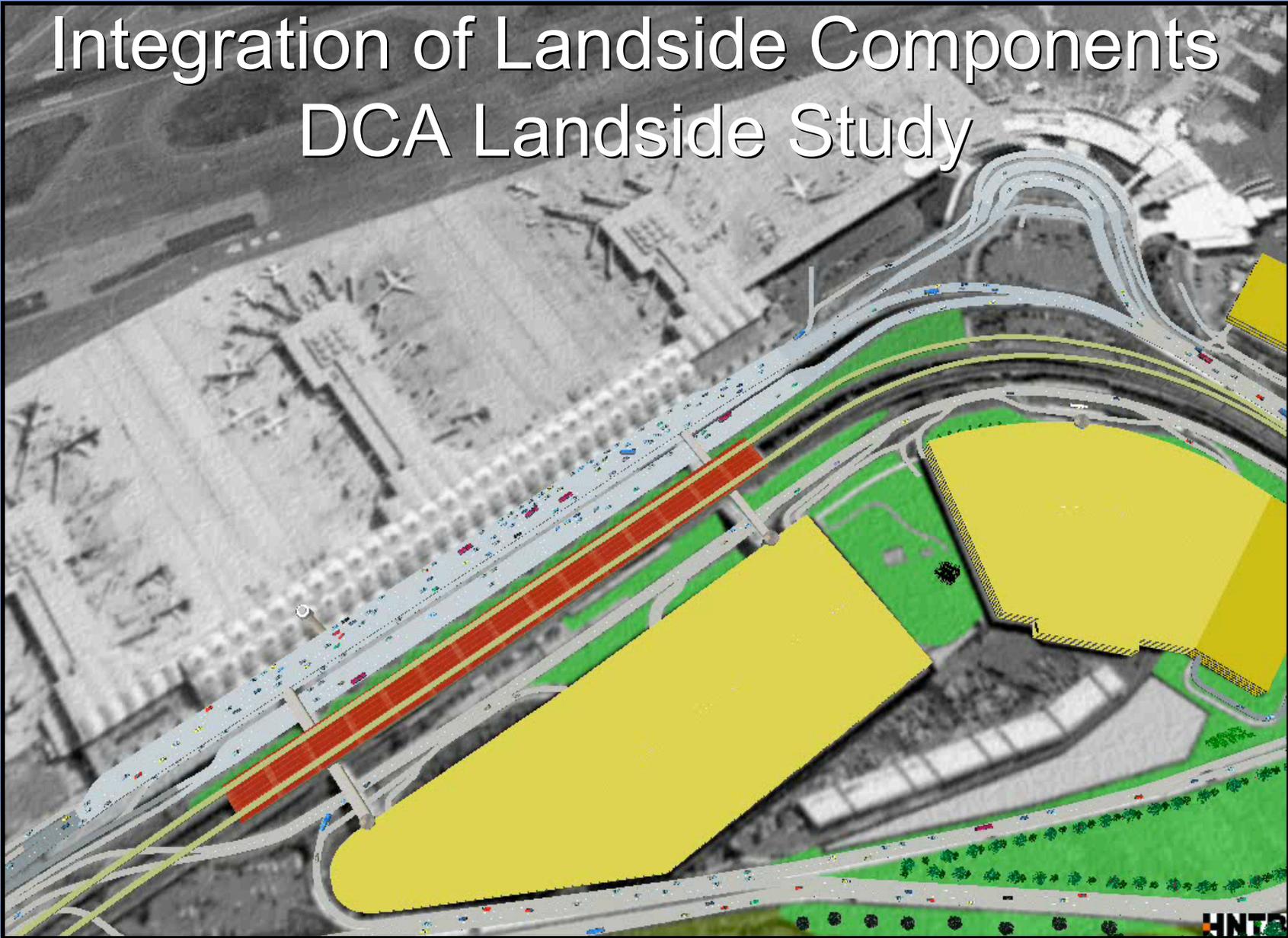
CV Hold Simulation

Atlanta Hartsfield – CV Hold
under planning



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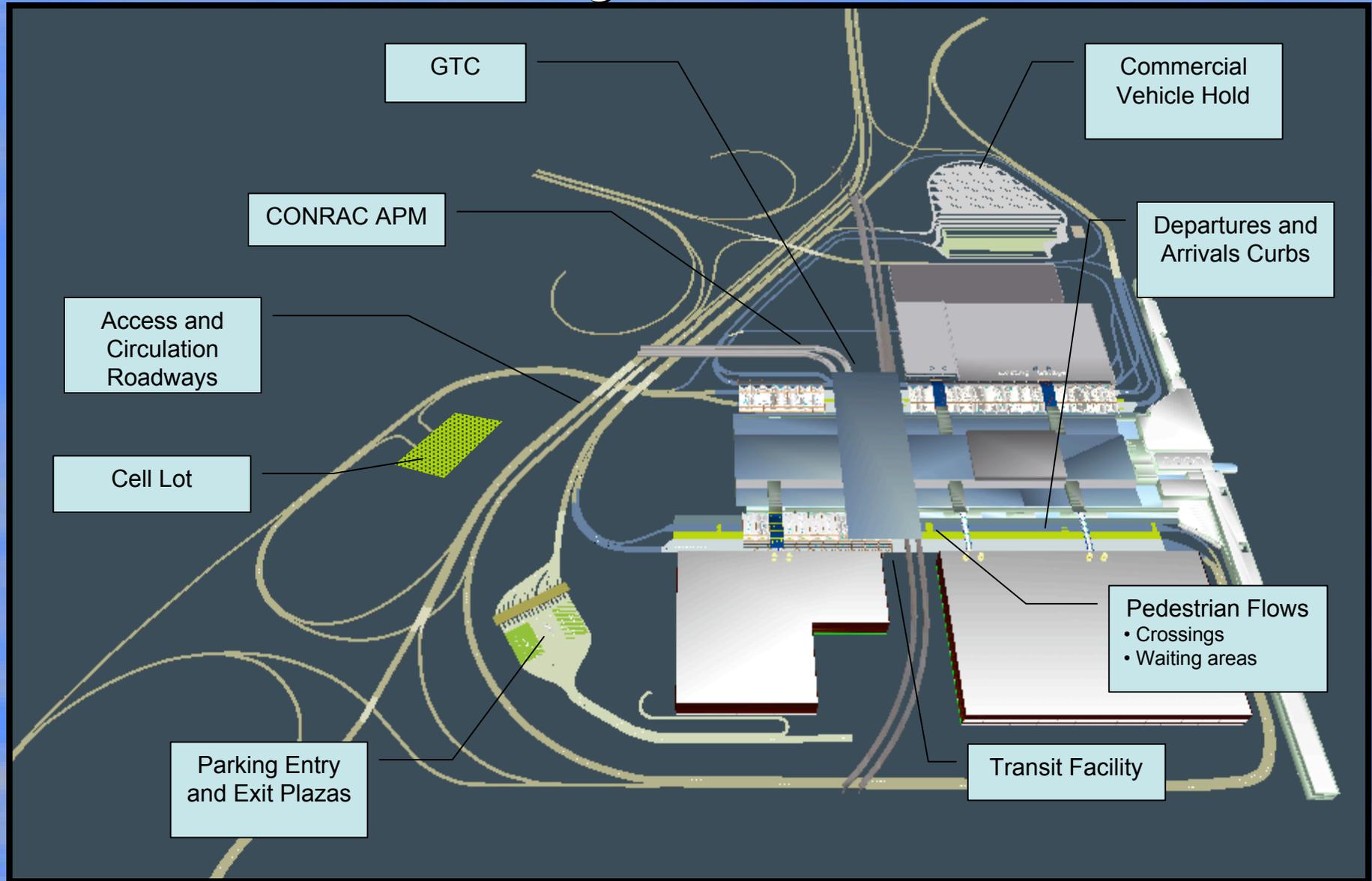
Integration of Landside Components DCA Landside Study



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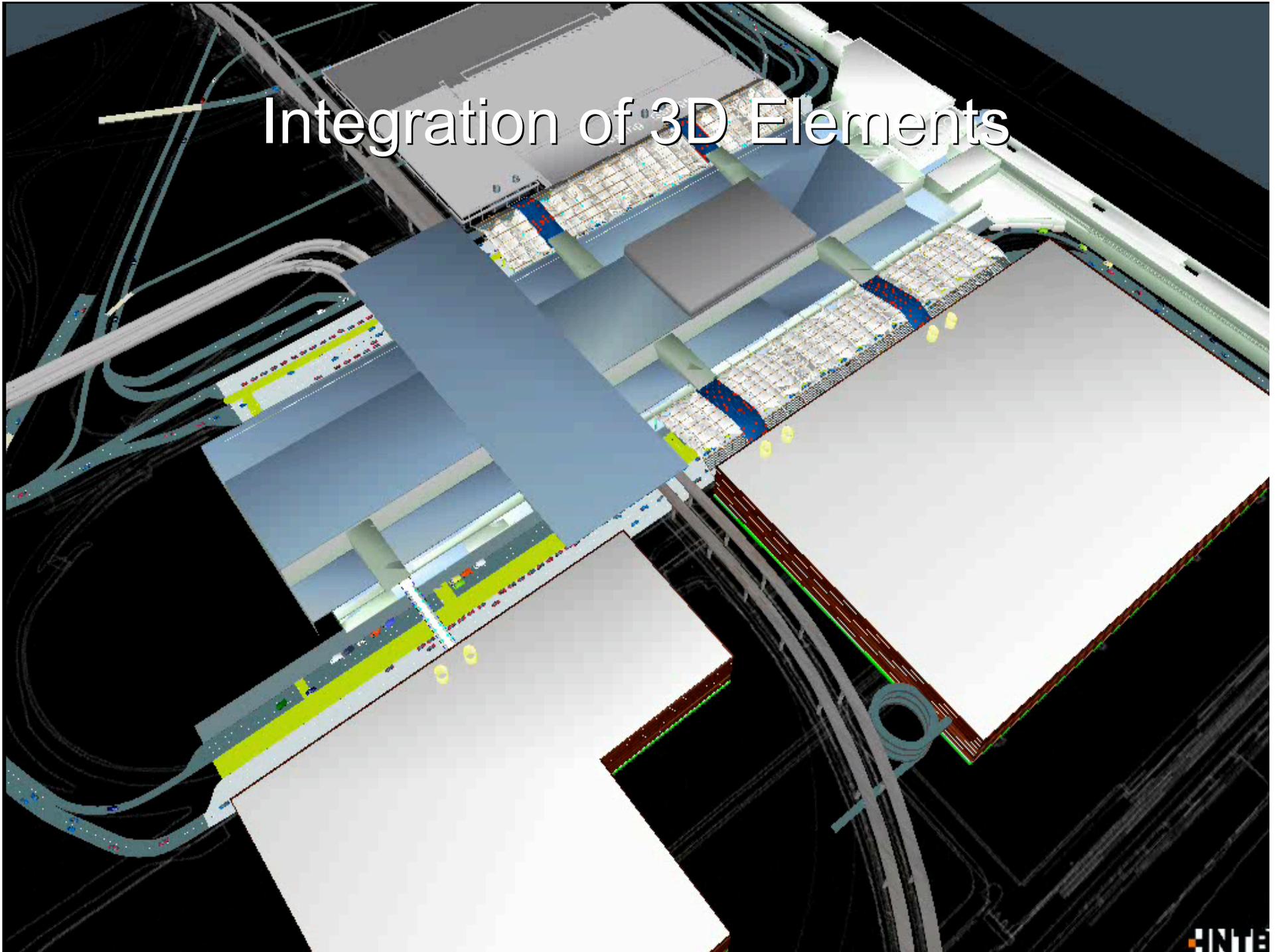
The ATL Model – In Progress ...



Lessons we are learning

- Plan ahead
 - Coding conventions
 - Definition of component specific needs
- Better to start with a complete network than later integrate each component separately

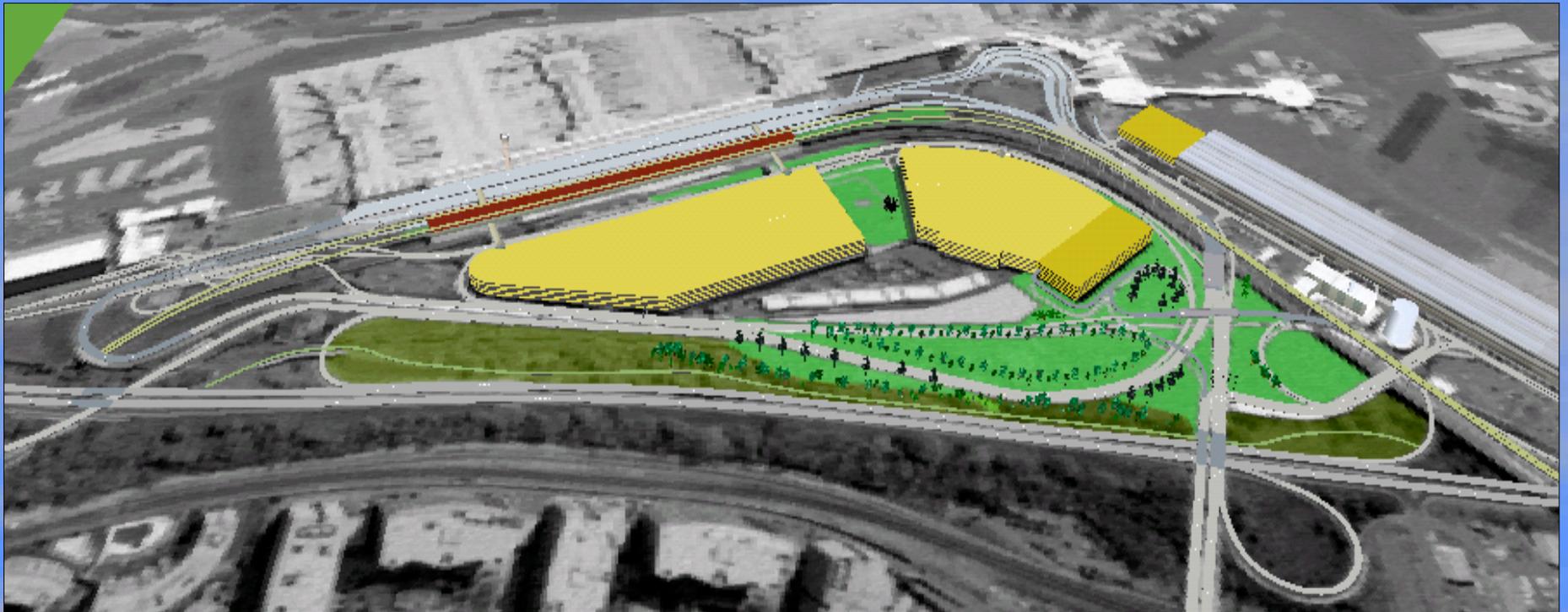
Integration of 3D Elements



What's Next?

- We believe full integration of landside, terminal, and airside could be achieved in the future, but it may take some time...
- Developers are prototyping an airside model (AIRSIM) which will be fully integrated with VISSIM
- A more robust pedestrian flow model is upcoming. This will allow for complete terminal simulation and integration with landside

Questions?



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