



Microsimulation

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Overview

What

Why

Who

Where

How

When

What?

Modeling the dynamic evolution and actions of discrete agents across time and space

- Observe emergent behavior

- Interaction

- Cooperation

- Coordination

*Between autonomous,
perceptive, and
deliberative agents*

- Understand the system

- Maybe forecast it

How it differs...

“Traditional” models

- Closed form equilibrium
- Well understood
- Typically deterministic
- Well-behaved behavior
- “Manageable” variation
- Computationally efficient

Microsimulation

- Disequilibrium
- Large systems NWU
- Stochastic
- Diverse behavior
- Handles wide variances
- Computationally heavy

Why?

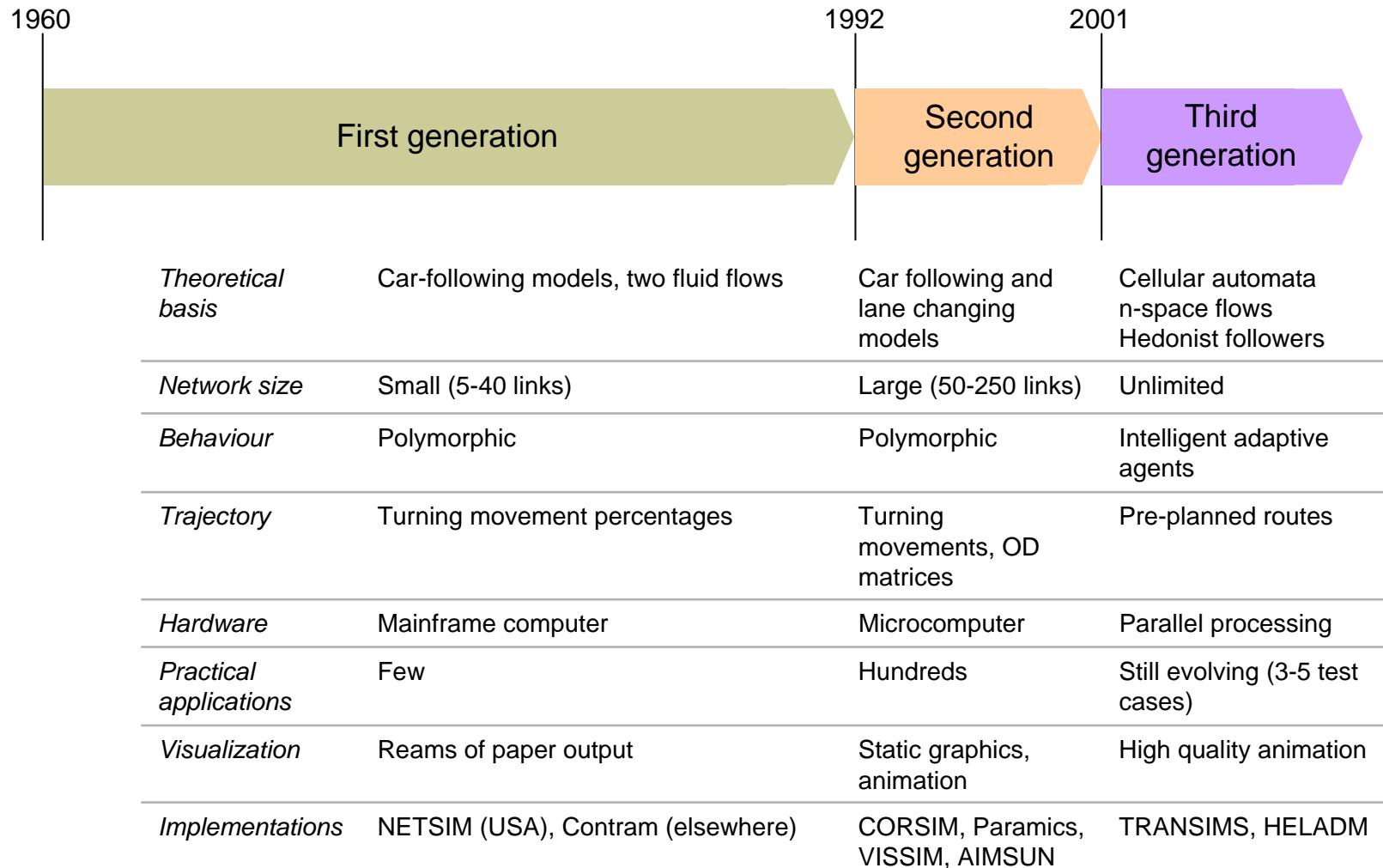
- Reduce aggregation bias
- Capture complexities hard to model otherwise
 - Time-dependent states
 - Non-linear regimes (congestion!)
 - Adaptive behavior
 - Highly variable behavior
- Fuses disparate data
- Shift burden from wetware to hardware
 - Increased computational burden
 - Reduced model complexity
- Flexible and complete accounting
- Variability → reliability and risk

Approaches to software

Approach	Characteristics	Examples
Procedural	Sequential design Batch-oriented Code emphasis Efficiency as primary goal	Fortran C
Object-oriented	Behavioral design Objects encapsulate data+behavior Encourages teamwork	C++ and C# Java
Agent-based	“Objects with an attitude” Distributed computing Dissociative systems	Active Objects Jack Swarm

Who & where?

Traffic simulation models



Who & where?

Activity & tour-based travel

- TRANSIMS
- Albatross
- New York City (NYMTC)
- San Francisco
- Columbus (MORPC)
- Oregon (TLUMIP)

Urban systems models

- ILUTE
- Propolis
- Delta
- UrbanSim
- TLUMIP
- Mussa

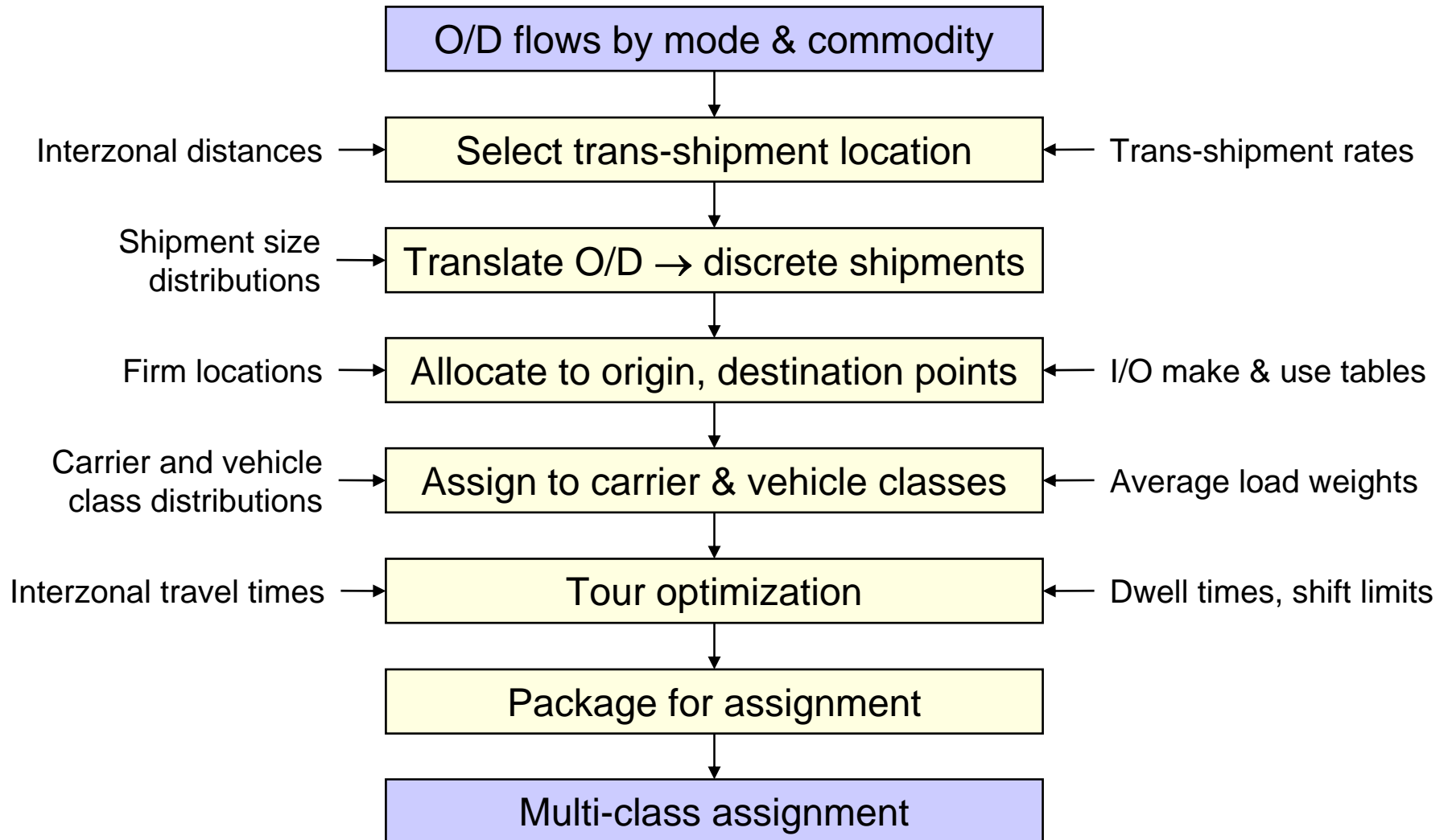
Freight

- Calgary
- Oregon (TLUMIP)
- NTNAC

TLUMIP commercial travel model

- Use intersectoral flows (annual \$) to depict origins and destinations by commodity
- Use a microsimulation process to generate discrete shipments of tours
- Capture important dynamics:
 - Trans-shipment
 - Trip chaining
- Package those tours for network assignment
- Resemble reality

Commercial model structure and flow



What (have we learned)?

- Successful trials
 - Builds on successes in other disciplines
 - Varying scales and choice complexities
 - Several domains (travel, urban systems, freight)
- Performance issues
 - OO or AB architecture
 - Distributed computing approach
 - Will limit uptake?
- Need a compelling case
 - Surpass conventional models
 - Provide insights not possible with current models
 - Limited in forecasting, cannot approach optimization
 - Maintenance issues

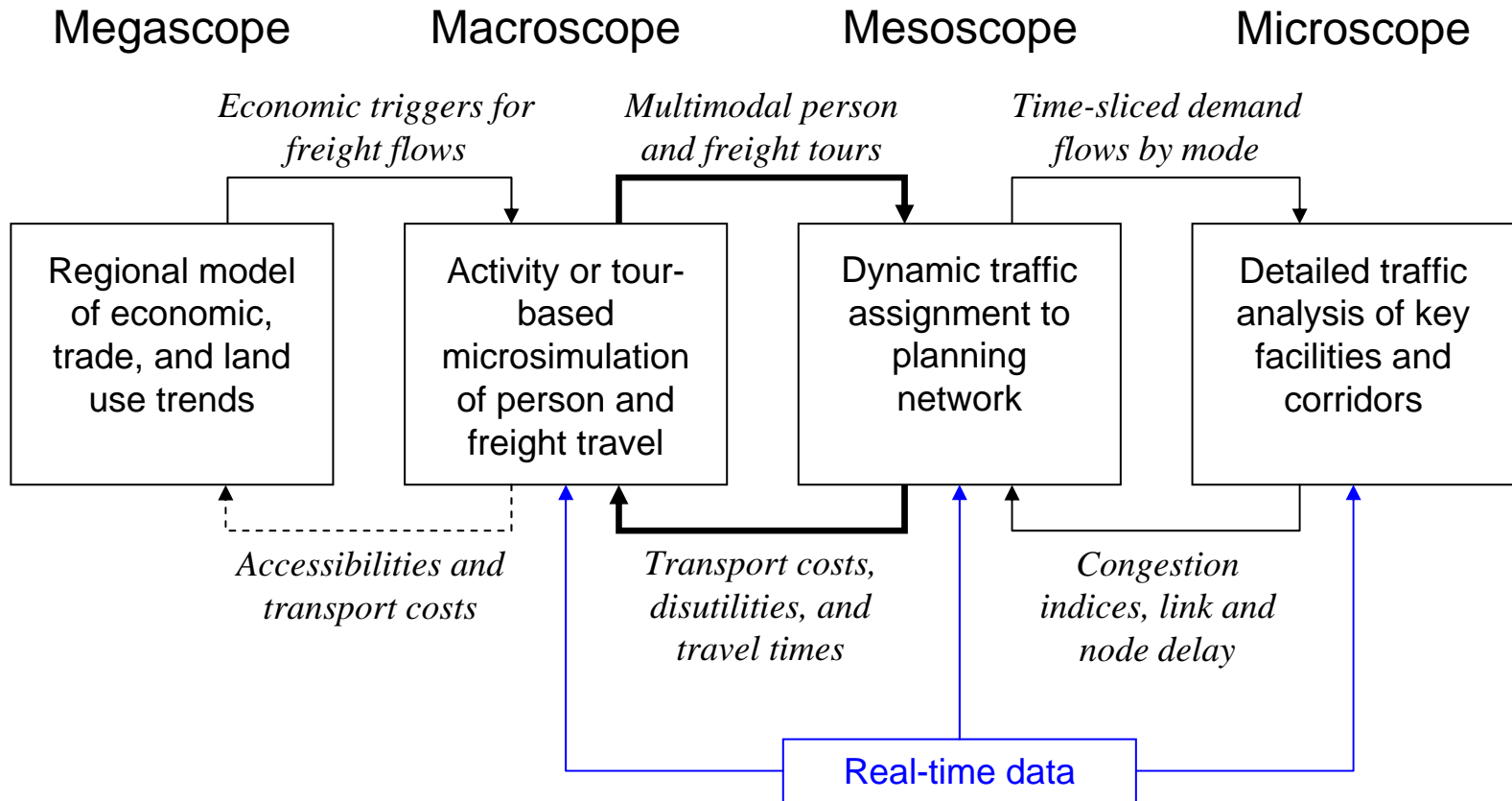
Where (are we going)?

- Rethink modeling requirements
 - Wider range of issues
 - Shift towards operations and technology
 - Diverse clientele
 - Larger realm (travel → development → economy)
- Experience with large scale models
 - Data reduction and fusion
 - Efficient and robust representation
 - Calibration
 - Validation

Where (are we going)?

- Important research needs
 - Joint decision-making
 - Balance resolution and fidelity (supply ↔ demand)
 - Calibration strategies
- Institutional obstacles
 - Different skill set (OOP, agents, control system)
 - Teamwork: programmers+GIS+modelers...
 - Hardware and OS acquisition and support

Where (are we going)?



Questions for Joan?