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SMART – Future Urban Mobility

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SMART – Future Urban Mobility

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Overview

1. Overview
2. Networked Computing and Control
3. Future Scenarios
4. Conclusion



Acronyms

- SMART: Singapore – MIT Alliance for Research and Technology
- FM-IRG: Future Urban Mobility Interdisciplinary Research Group



FM-IRG: Overall Goal

- Develop *in and beyond Singapore* new paradigms for the **planning, design, and operation** of future urban transportation systems
 - Sustainability and societal well-being in a high-density, livable urban environment
 - Improve system performance through innovations in infrastructure, technology, operations, and policy

FM-IRG: Overall Goal (cont.)

- Multi-disciplinary elements:
 - Sensing, communications, computing
 - Advanced models, optimization and simulation
 - Human behavior
 - Land use, mobility, energy and resource use
 - From real-time management to long-term planning
 - Physical and simulation experiments
- INTEGRATION is at the core of our approach

FM-IRG Scope

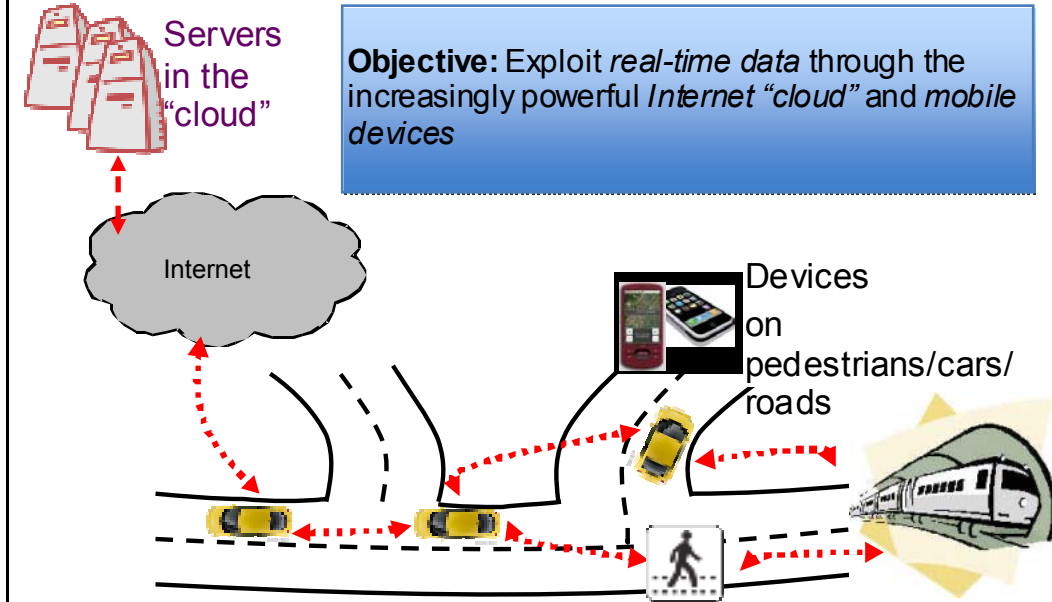
- Large research team led by 10 MIT Principal Investigators working on 18 projects
- Aspects covered in this presentation:
 - Networked Computing and Control (NCC) technologies and (real-time) system management
 - Future scenarios and comprehensive simulation (for planning applications)



Networked Computing and Control (NCC)

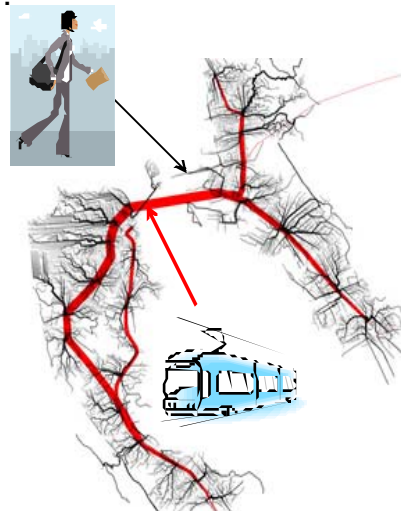


Networked Computing and Control (NCC)

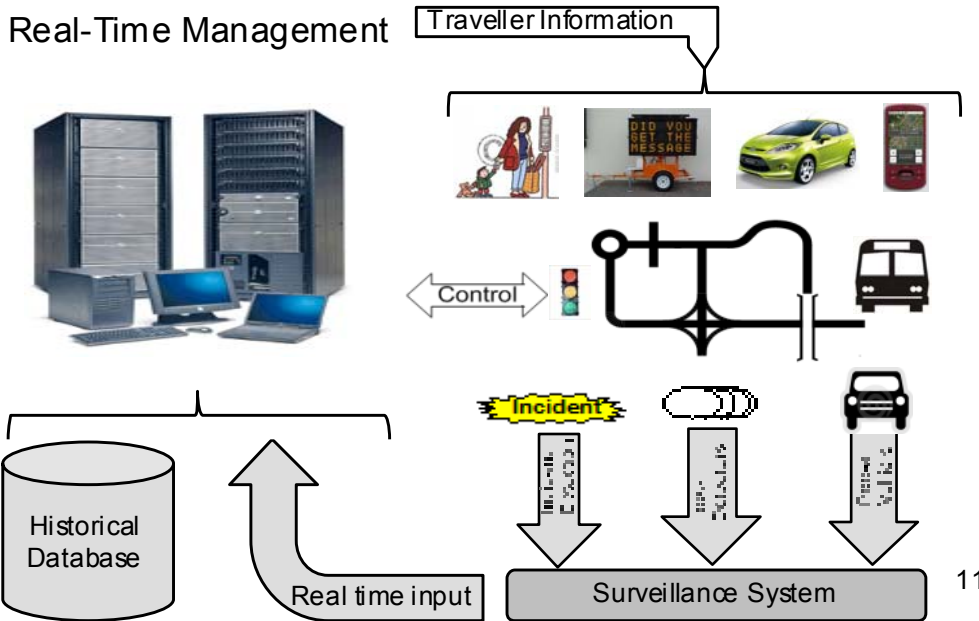


NCC Data Exploitation

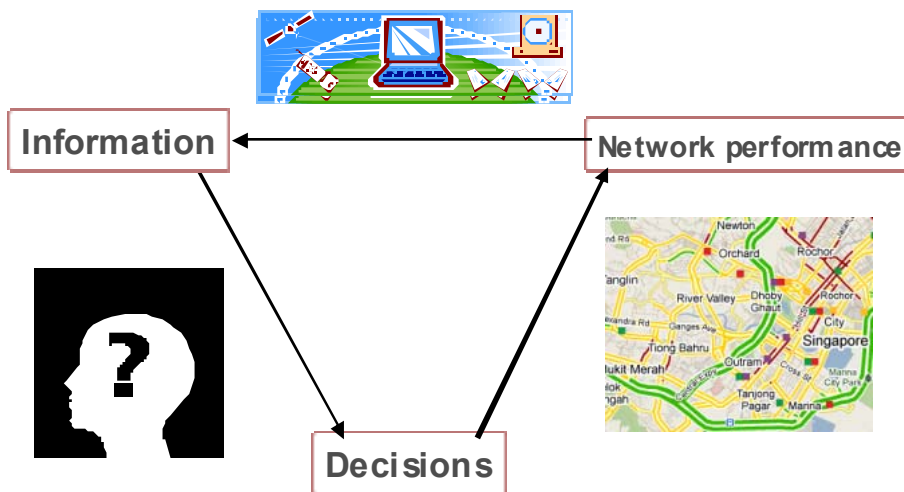
- The NCC data can be leveraged for:
 - Traffic and transit management
 - Transportation planning
 - Emergency management
- Challenge:
 - Massive, heterogeneous data fusion



Traffic and Transit Management System

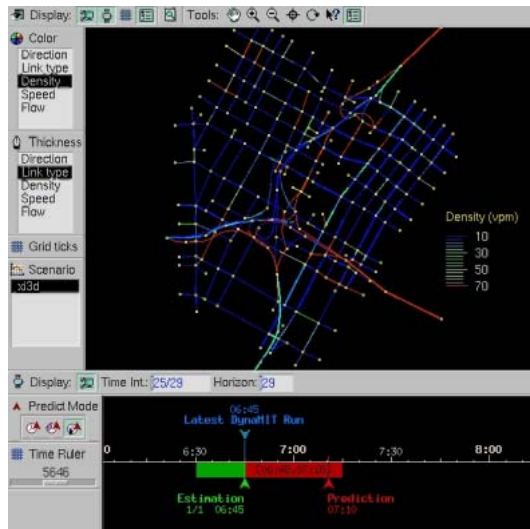


Consistent Anticipatory Information



Real-Time System: DynaMIT

- DYNamic Network Assignment for the Management of Information to Travelers



Future Scenarios

Research Challenges

- New evaluation framework for sustainable mobility (e.g., subjective well-being)
- Scenario planning techniques to account for future uncertainties
- Exporting / adapting beyond Singapore
- Portfolios of future mobility options enabled by NCCs



Development and Evaluation of Mobility Portfolios

Infrastructure Investments

- New highways
- New fixed guideway transit
- New land development schemes (logistics, transit oriented development (TOD))
- Etc.

+
?

Technological Innovations

- Automated Vehicles
- Mobility-on-Demand
- Virtual travel
- Mobility brokers
- Etc.

+
?

Policy/Management Innovations

- Carbon trading
- Recycling/waste management services
- “Last mile” delivery
- Dynamic externality pricing
- Etc.

What bundle of tactical and strategic options best performs under an inherently *uncertain* future?



Integrated Simulation Platform – SimMobility

- SimMobility is the simulation laboratory for Future Mobility
- Integrate and link various mobility-sensitive simulation models to evaluate future urban transportation scenarios



SimMobility

- Comprehensive
 - Include land use, travel, energy, multi-modal network, driving behavior, information, etc.
- Modular
 - Simulator is segmented by time-frame, coverage, and level-of-detail
- Open-source software
- Agent-based
 - Microsimulation of behavior of a population of agents and their interactions



Agent behavior

- Behavior models predict human decision making in response to:
 - New infrastructure
 - New technology
 - Policy changes
 - Pricing, regulation etc.



Decisions

- Household
 - Residential locations
 - Job locations
 - Social network
 - Day-to-day activities
 - Travel etc.
- Firm
 - Locations
 - Equipment
 - Operations schedule
 - Supply-chain
 - Production activities etc.

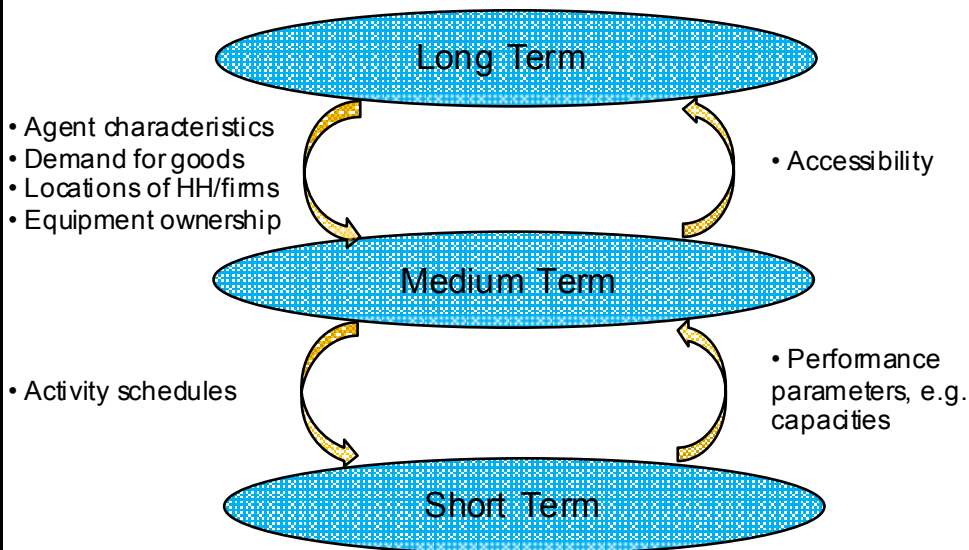


Activity-based approach for travel demand modeling

- Travel demands are derived from demand for activities
 - Work, eat, shopping, leisure etc.
- The chain of activities and travel constitute an activity schedule

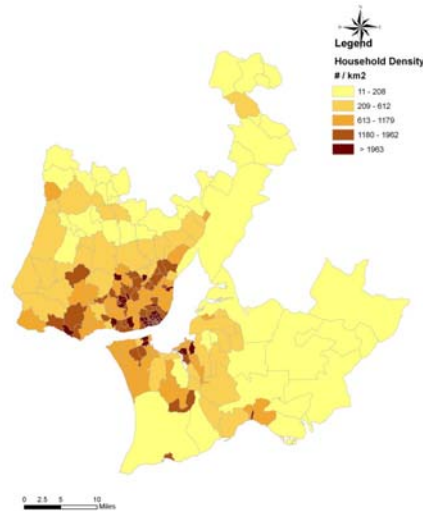


SimMobility Framework



Long Term Model Example

- UrbanSim: Lisbon, Portugal
 - Land use micro-simulator of residential and job location and real estate development
- Input
 - Zoning
 - Transportation system performance
 - Economic and population change
- Supply: buildings
- Demand: housing / employment location
- Interaction: real estate price
- Output: land use



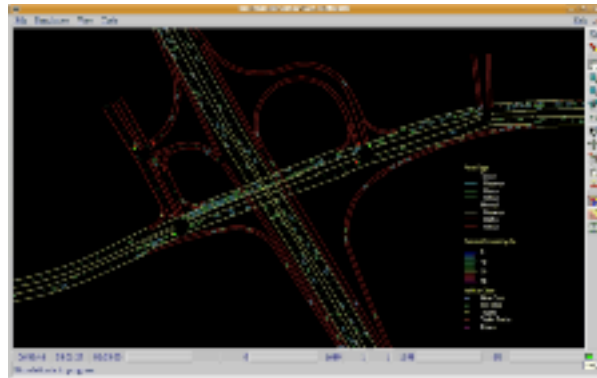
Medium Term Model Example

- DynaMIT-P: Beijing, China
 - Mesoscopic traffic model to study impacts of congestion mitigation
- Input
 - Demand and supply parameters
- Output
 - Evaluation of mitigation strategies
 - Expected network performance



Short Term Model Example

- MITSIMLab: London, UK
 - Microscopic traffic simulator to assess the impacts of intervention on the network capacity
- Input
 - Road network and signal timings
 - Sensor data/OD matrix
 - Bus service data
- Output:
 - Network capacity, travel times, queues



Conclusion

- Summary
 - Real-Time: NCC Technologies & DynaMIT
 - Planning: Innovation Scenarios & SimMobility
- Next Steps
 - Collaborating partners (Universities & Authorities)
 - Smart phone data collection, experiments, and case study development
 - Real-time system and simulation platforms