

Arigatoni on Wheels / Kick-off Meeting

# Simulation of an urban bus network with Omnet++.

Roberto Cominetti <[rcominet@dim.uchile.cl](mailto:rcominet@dim.uchile.cl)>

Juan Carlos Maureira <[jcm@dim.uchile.cl](mailto:jcm@dim.uchile.cl)>

Centre for Mathematical Modelling (CMM)

(<http://www.cmm.uchile.cl>)

University of Chile



CENTRO DE  
MODELAMIENTO  
MATEMATICO

# Agenda

- The problem of a public transportation network
- Public transportation network equilibrium and passengers choices
- Modelling big networks (Stochastic and discrete)
- Omnet++ and transportation networks
- Our approach to face the public transportation network in Santiago de Chile

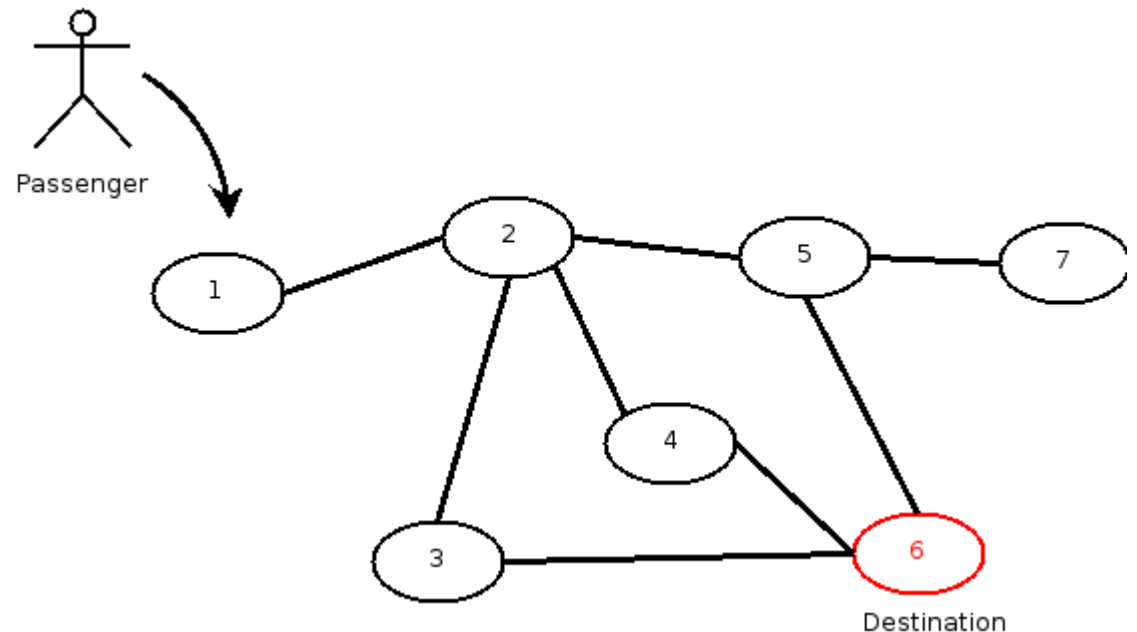
# The Problem of Public transportation Networks

- The Public Transportation offering (Bus, Tram)
  - Fixed model, Laboratory situation
  - Flexible model, a bit more complex
  - Self-organized model, Real Time application.
- The Passenger demand
  - Origin – Destination (OD) Matrix.
  - Modelling Passenger choices.
- Met a network equilibrium (offer v/s Demand)

# Passenger Choices (behaviour?)

- Each Passenger has an  $[2,n]$  matrix.
  - Represents their “expectations” once a node is reached
  - Decision based on previous experience.
  - Learning rule to compute the average TT Observed

Node	Average TT Observed
1	50 min
2	45 min
3	2 min
4	8 min
5	30 min
6	0 min



# Passenger Choices

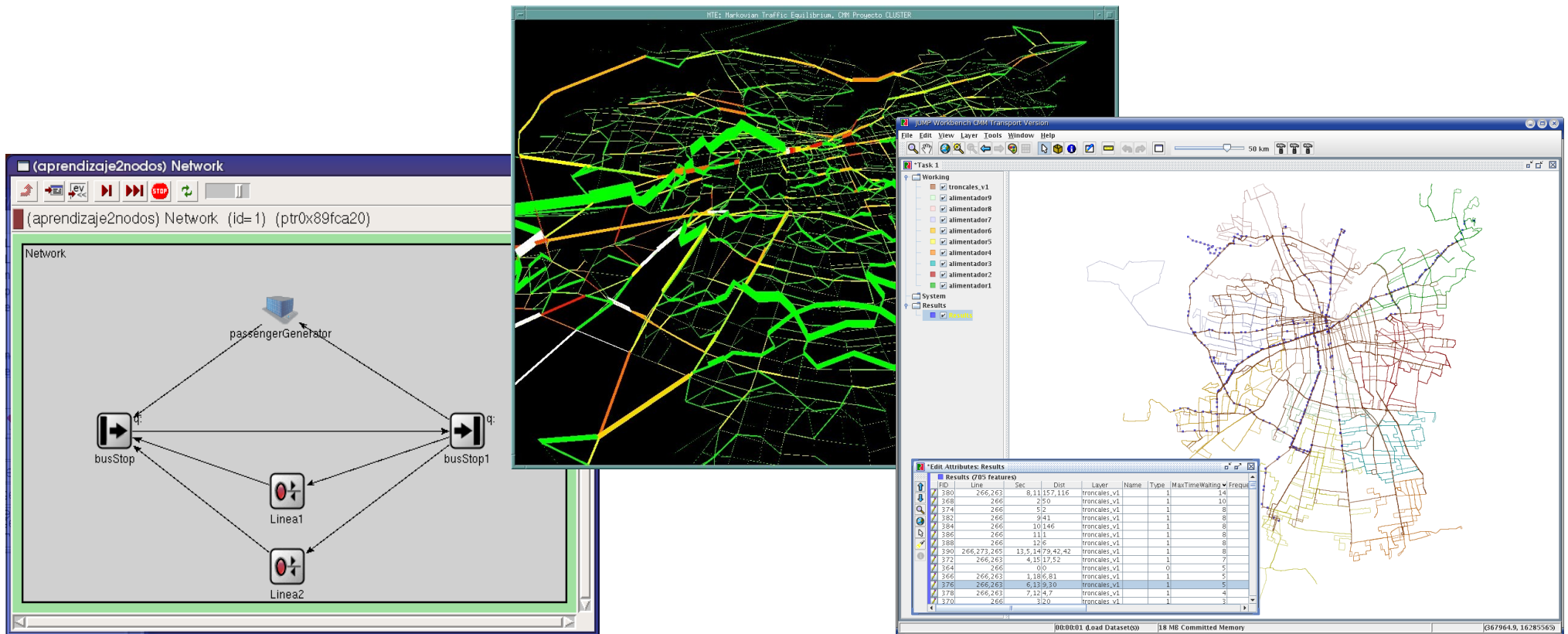
- OD fixed.
- Bus Offering fixed.
- Demand randomly spread on the network, identified by areas.
- Matrix represents the average time on the shortest route.
- Updated at the end of each trip.

# Big Networks Modelling

- First Model: Continuous simulation, Stochastic, 2 nodes, 2 buses lines (fast and slow), 50 passengers (Matlab)
- Second Model: Continuous simulation, Stochastic, Chicago Network (546 destinations, 2176 streets) (pure C)
- Third Model: Discrete event simulation, semi stochastic, 3 nodes, 2 buses lines (fast and slow), 70 passengers (Omnet++)

# Modelling Big Buses Networks

- Final Model: Santiago, ~5000 destinations, ~11k streets, 5000 buses in several lines, 4 millions passengers



# Omnet++ and Transportation Networks

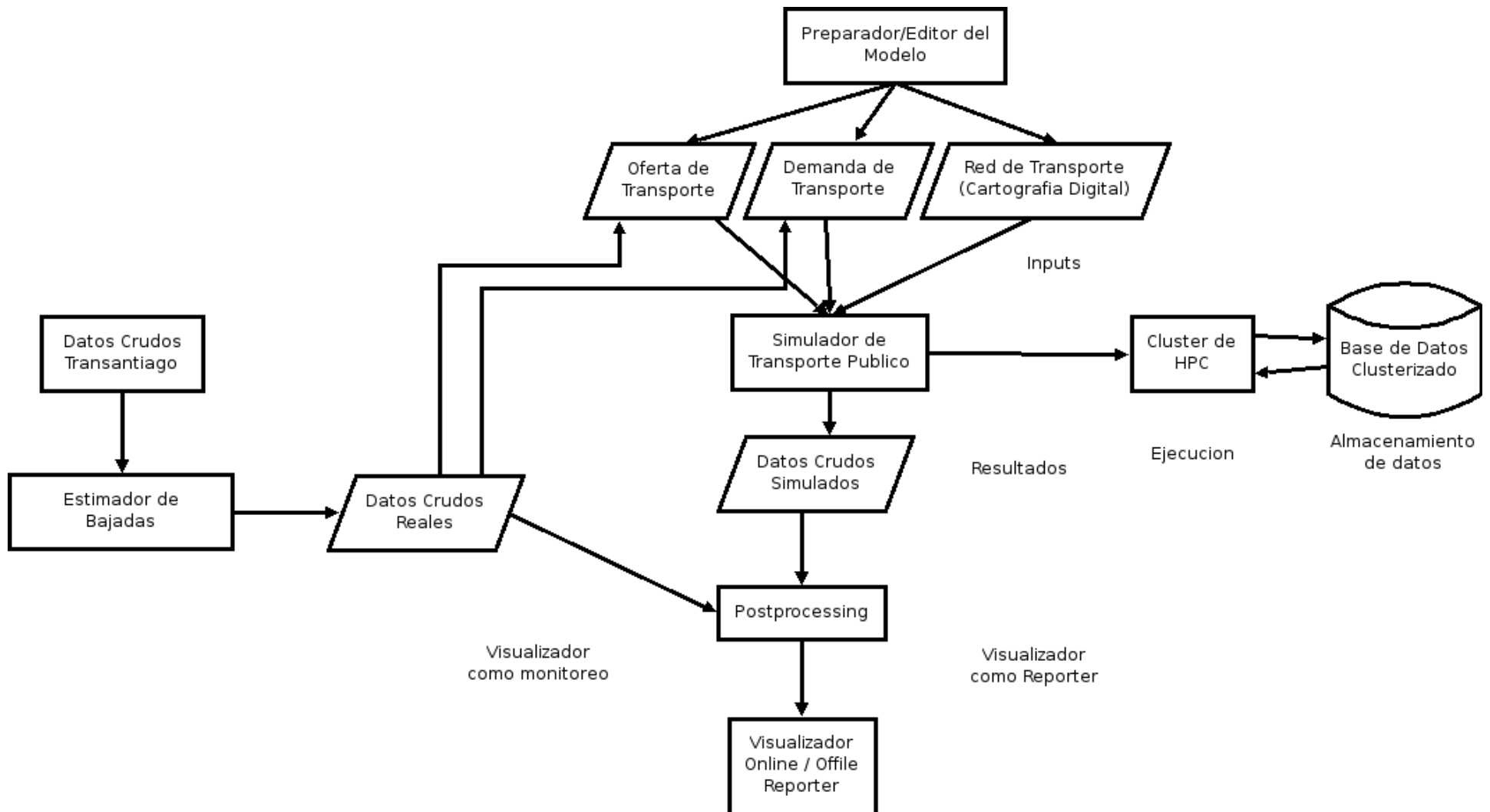
- Omnet++ allows :
  - to model “packets” -> Buses and Passengers
  - to model “links” -> Streets (continuous sim)
  - to model node behaviours -> bus stops, terminals, corners, etc.
  - transparent MPI implementation. Serializable objects.
  - Full C++ implementation, NED Language to describe networks.



# Omnet++ and transportation Networks

- Omnet++ as simulation Core
- JUMP project (Open Source GIS) to build the network and interact with the data.
- GML -> XML -> NED -> C++ -> MPI Model
- Distributed Database to handle the passenger matrix.

# Our Approach



# Future Perspectives

- Implement more functionalities to the core simulator and helper applications.
- Future PhD in Mascotte next year.
- Willing to go further on transportation M&S
- Interesting perspectives for Arigatoni on Wheels (buses are usually equipped with communication devices)

# Omnet++ and Public Transportation Networks

Thanks!

*Juan Carlos Maureira*  
<[jcm@dim.uchile.cl](mailto:jcm@dim.uchile.cl)>