# Local Data Gathering Using Opportunistic Networking in a Urban Scenario

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# Outline

- Goals, Model and Simulation
- Experiment Results
- Conclusion and next research

# Goals

We consider mobile (pedestrian and cars) and fixed terminals in a ***urban area*** that are interested in collecting the information originated from several sources.

In particular, each terminal may be interested in retrieving the data items in a limited ***region of interest*** centered around the node position.

The goal is to maximize the amount of information each node is able to gather exploiting ***opportunistic communications*** among neighboring nodes.

# UDel Model as a base

- It is based on essays and statistical studies of real motion and habits of people.
- It includes a realistic radio propagation model that study very deeply the wireless propagation.
- We base on this tool to establish the motion of objects.
- We base on this tools to establish if the channel loss among object enables or no the communication among them.

# The grid and nodes

- A bidimensional grid is associated with the scenario, typically a urban district.
- Each cell grid is associated with a random value , that can represent an environmental information or an RFID tag. The grid cell side size is $\delta$ .
- Object nodes can be fixed (F) or mobile (pedestrians (P), cars (V), Random Walk nodes (R)).

# Performance index(1)

- The performance (*Coverage*) measured is the percentage of one's own Region of Interest (*ROI*) known and it is calculated each second after cell grid data read and information propagation mechanism are triggered.
- The interest zone is a square of side $\Delta f$ for stationary (fixed) objects and $\Delta v$, $\Delta p$, $\Delta r$ for mobile objects (cars, pedestrians or random walk) centred on object position itself.
- We are interested in performance mean for object type during all the simulation period.

# Performance index(2)

Another index

of interest is :

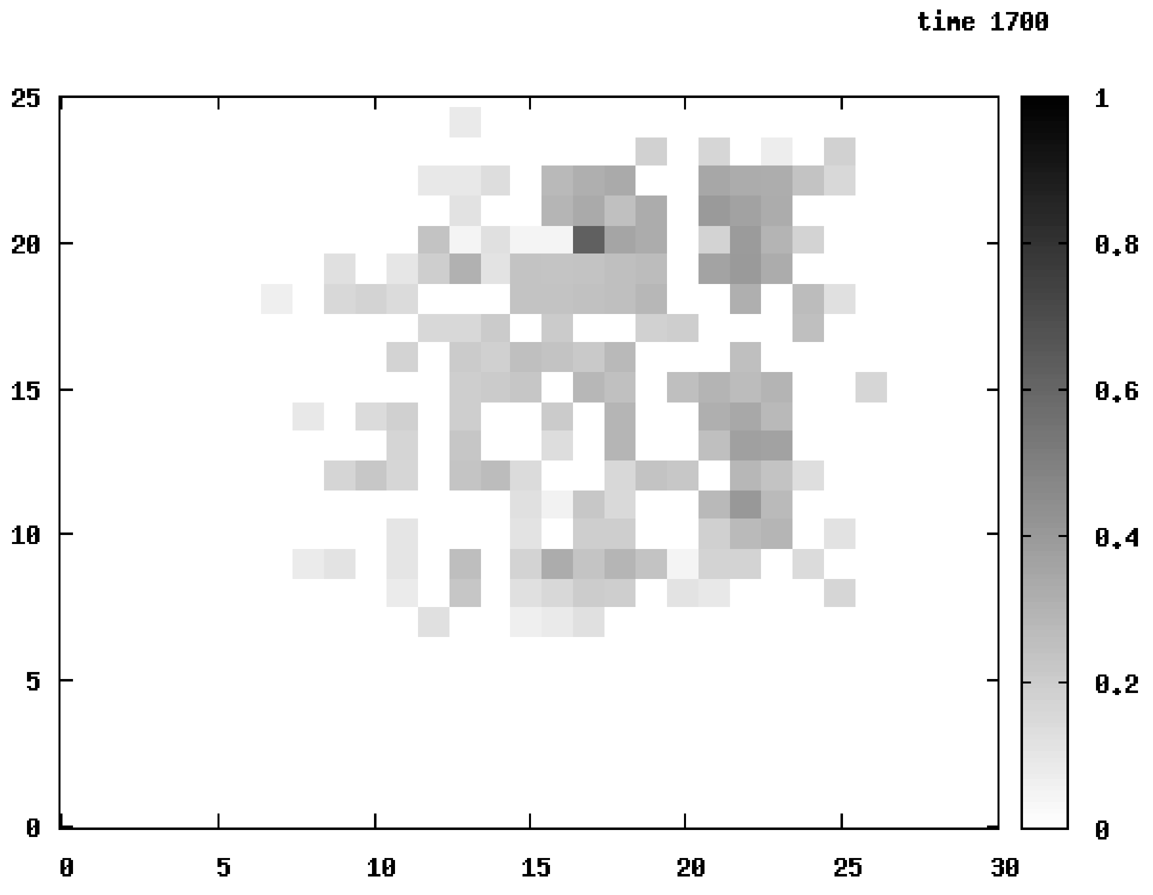
Mean of

performance index

for object class

and grid cell

at time t.



# Propagation model

- Two objects see each other if the channel loss between them is less than a prefixed *threshold.*
- Each object can read and store the information related to its position and can exchange some data with few neighbours in a random way at each second of time.
- In general nodes have a limited memory size buffer.

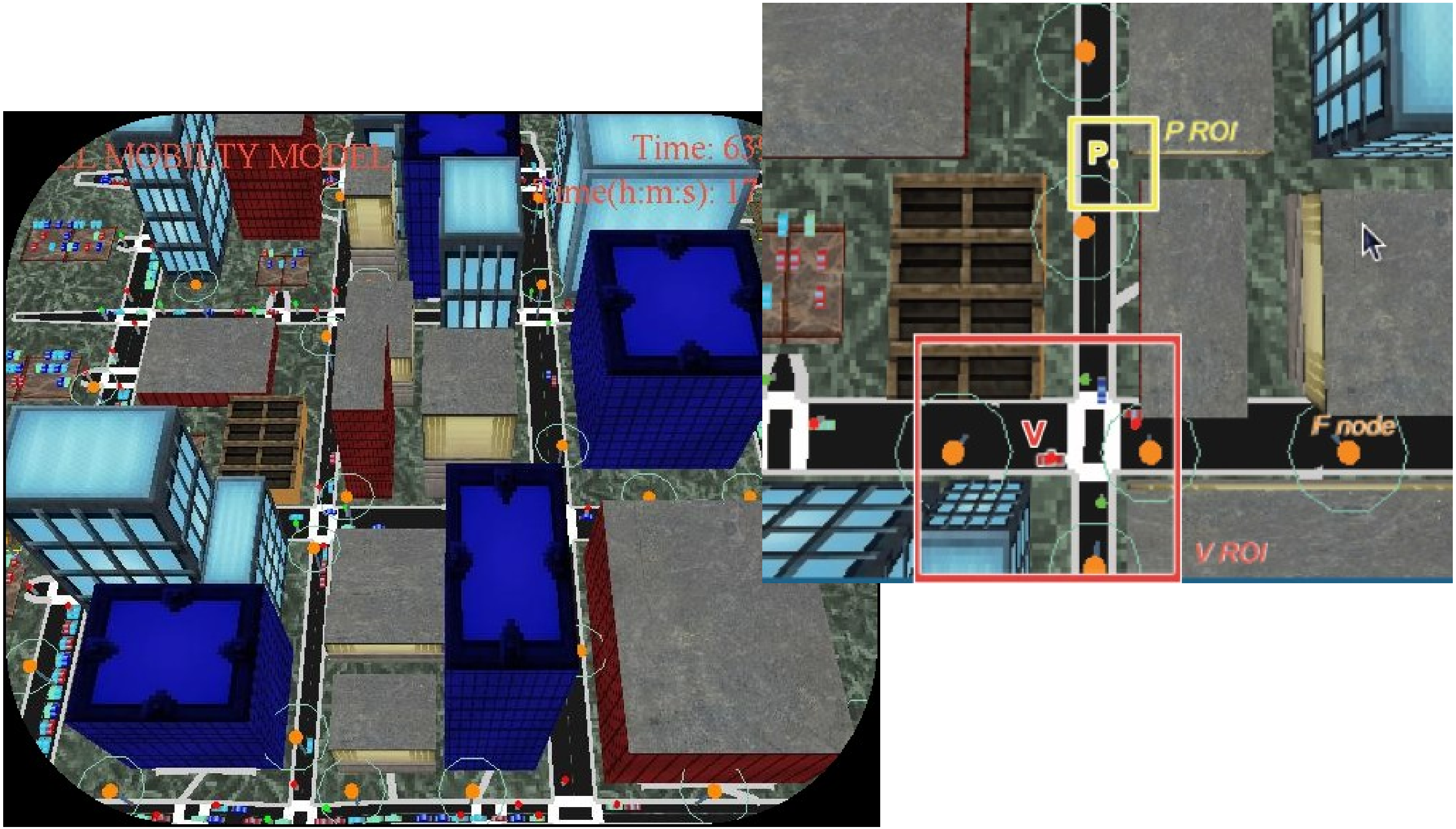
# Memory size

- Objects memory can be minimal equipped respect of size of interest zone information : $(\Delta / \delta)^2$.

Note that Δ is greater for fixed and cars than for pedestrians and so is also the relative *Region Of Interest(ROI)* and relative minimal memory device

- Memory sizes multiples of minimal ones are examined : $b\ ((\Delta / \delta)^2)$
- Unlimited memory sizes are examined

# P, V nodes and their ROI



# Memory policy

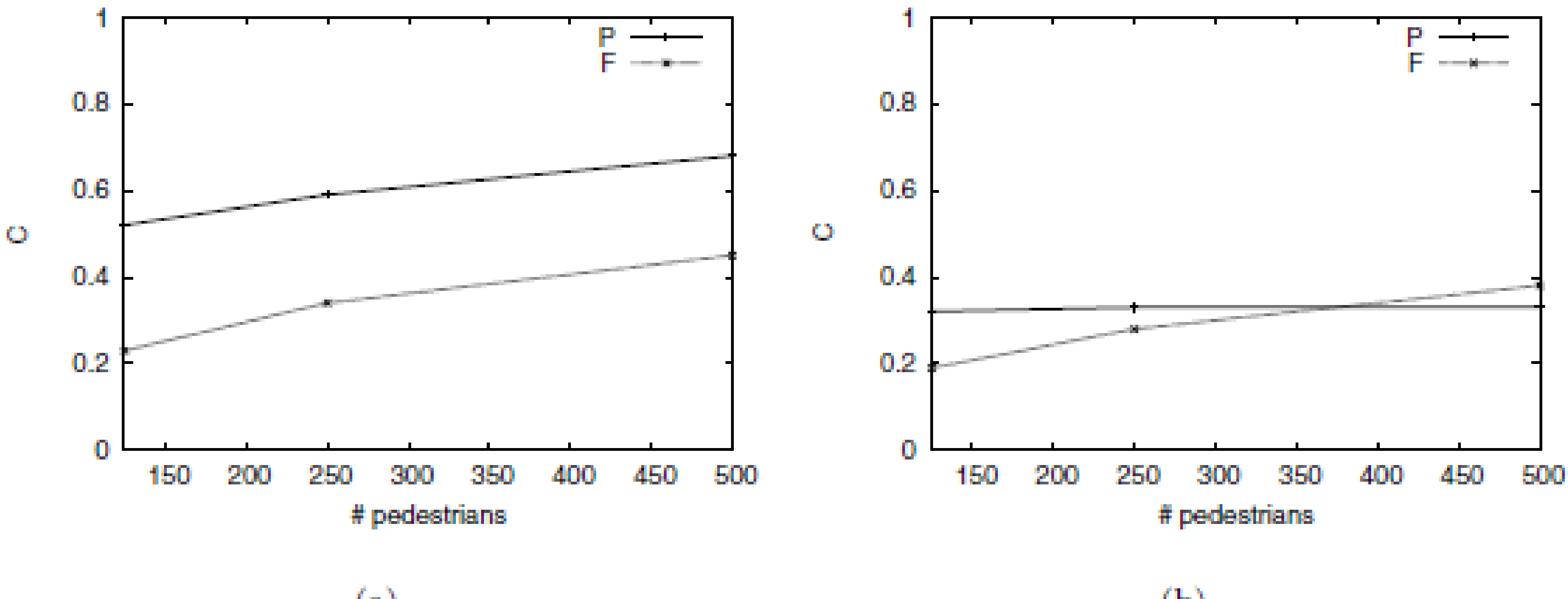
- basic (FIFO): when memory is full over its maxsize it is dropped in oldest order
- Selective drop : the elements are deleted only if possible if they are not in the interest zone of the object itself
- Selective insert : new elements are inserted in memory only if they are inside the interest zone
- Selective insert and drop : both the previous are applied

# Simulation results

- Generally density and degree of mobility are advantageous for performance but not for nodes with very limited memory sizes
- The influence of some simply memory management is positive also for very limited memory size and so the performance is near to that of scenario with unlimited memory size objects
- Further if we add some random walk node we have another increase in performance that become also more than unlimited mem size scenario and make the correlation between performance and density or degree of mobility ever positive

# Coverage versus popolation density and memory size

Coverage for P and F nodes versus population density without memory limit (a) and with minimal memory (b), both with basic policy



# Coverage versus memory policy and randomicity

**Table 2: $C$ for different buffer management policies in the scenario with 200 P and 50 V nodes.**

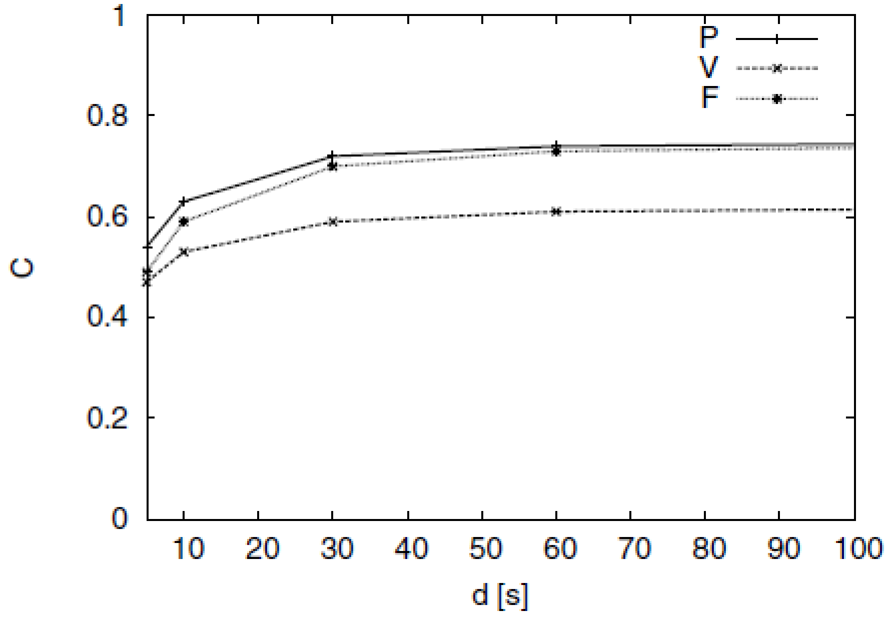
| Class | Policy | | | | |
|---|---|---|---|---|---|
| | FIFO $b = 1$ | SD $b = 1$ | SI $b = 1$ | SD/SI $b = 1$ | FIFO $b = \infty$ |
| P | 0.30 | 0.55 | 0.57 | 0.58 | 0.68 |
| V | 0.15 | 0.45 | 0.49 | 0.49 | 0.48 |
| F | 0.53 | 0.56 | 0.57 | 0.57 | 0.56 |

**Table 3: $C$ with the presence of 0,1 and 5 R nodes in the scenario with 200 P and 50 V nodes.**

| Class | Settings | | |
|---|---|---|---|
| | FIFO, $b = \infty$ no R nodes | SD, $b = 1$ 1 R node | SD, $b = 1$ 5 R nodes |
| P | 0.68 | 0.71 | 0.77 |
| V | 0.48 | 0.57 | 0.64 |
| F | 0.56 | 0.68 | 0.77 |

# Simulation results in variable environment scenario

Coverage for different class nodes versus the update interval d in secs, scenario with minimal memory, selective drop ,5R, 200P and 50V



# Conclusions(1)

- We use as performance index the mean knowledge of objects in a square interest zone centred on itself
- We underline the counter-productive function of density and mobility together with little memory size also using a detailed simulation model

# Conclusions(2)

- We use memory policy management and adding random walk nodes to improve system performance and to make ever positive the correlation between performance and density or degree of mobility
- In the next research we will focus on study alternative model of propagation, and also on increasing performance under also quick signal variability with attention to energy consumption and in future also using network coding
- Some questions ??