

Quality of Service and Bandwidth Management Issues in Wireless Networks with Mobile Hosts

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Parte 3

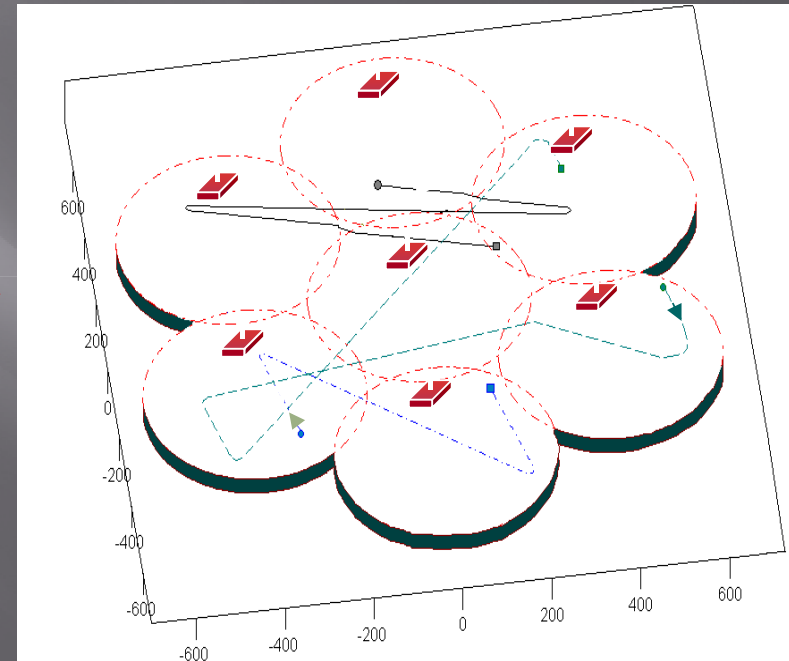
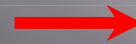
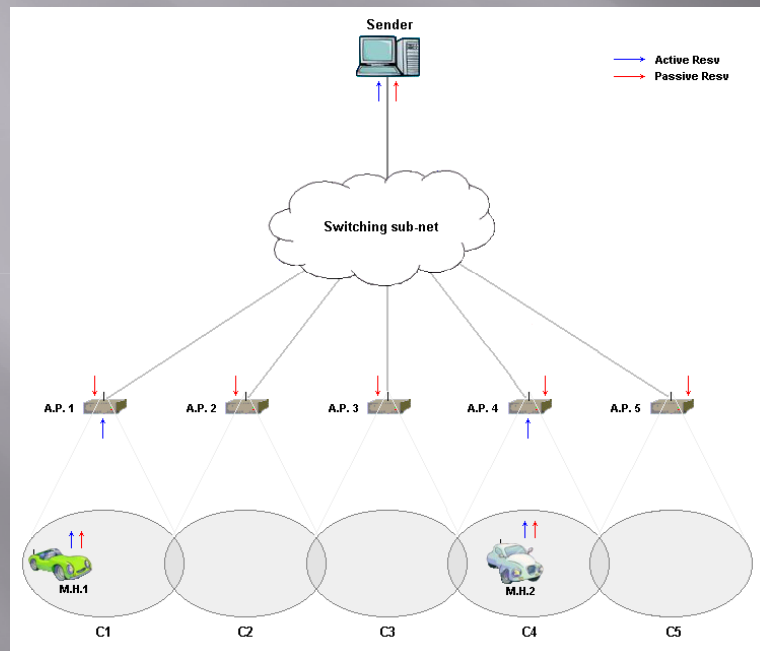
Executive Summary

- QoS in Telecommunication Systems
- Wireless Communications and Issues
- Wireless Channel Modeling
- Bandwidth Management
- Mobility Generation
- Mobility Analysis and Prediction
- Some Reachable Results and Conclusions
- Research Group Description

Mobility Analysis and Prediction

From 1D to 2D

Let us now consider real scenarios (2D):

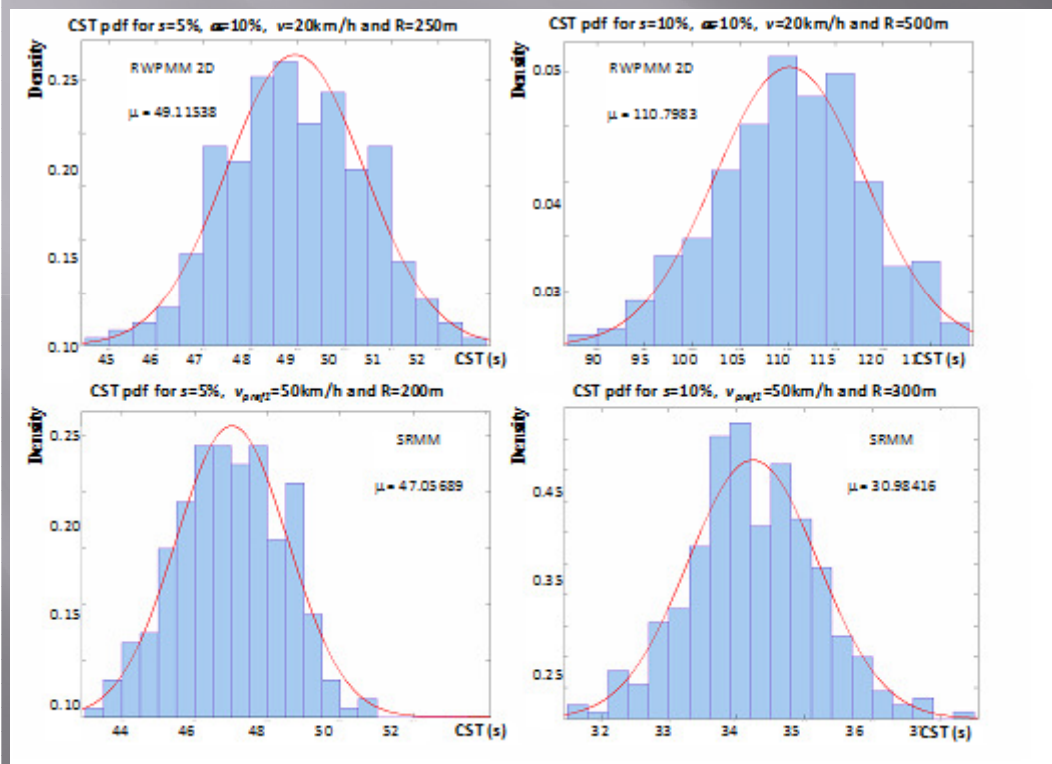


Are there new issues?

Mobility Analysis and Prediction

From 1D to 2D

Other simulation campaigns have been carried out in order to evaluate **CST** distribution.



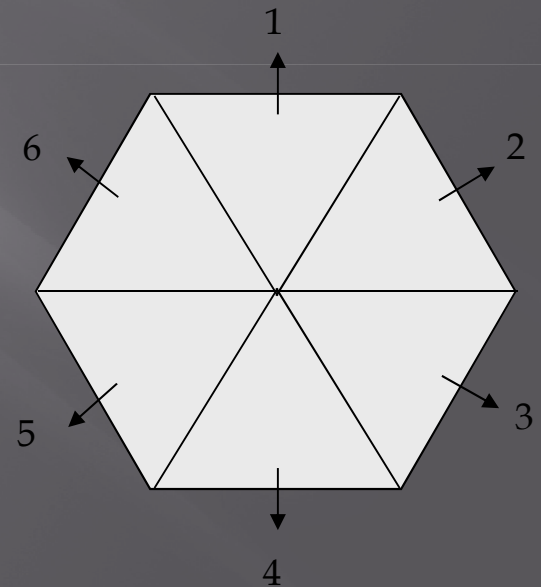
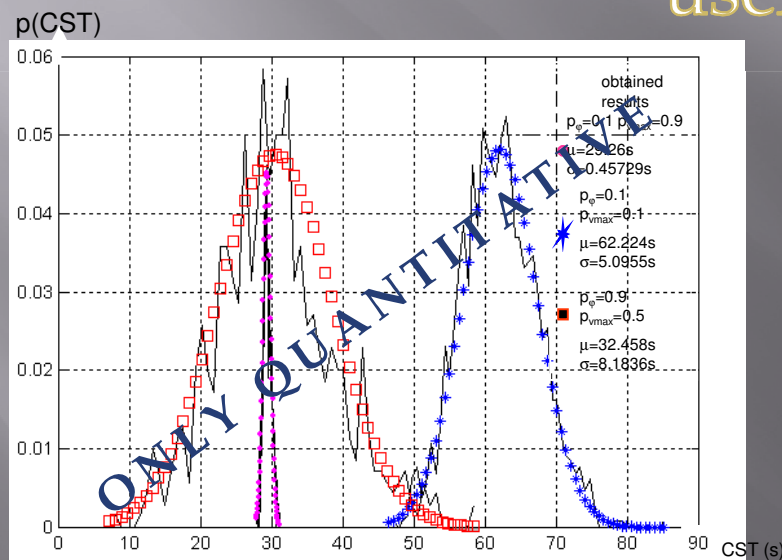
The same considerations of the previous case (1D) can be made for 2D models (like RWP and SR). The hypothesis of Gaussian distribution is still valid.

What is the new issue?

Mobility Analysis and Prediction

From 1D to 2D

The CST knowledge is not enough for users description in a 2D environment, because it gives **only a quantitative** knowledge of the number of cells that a user will visit.

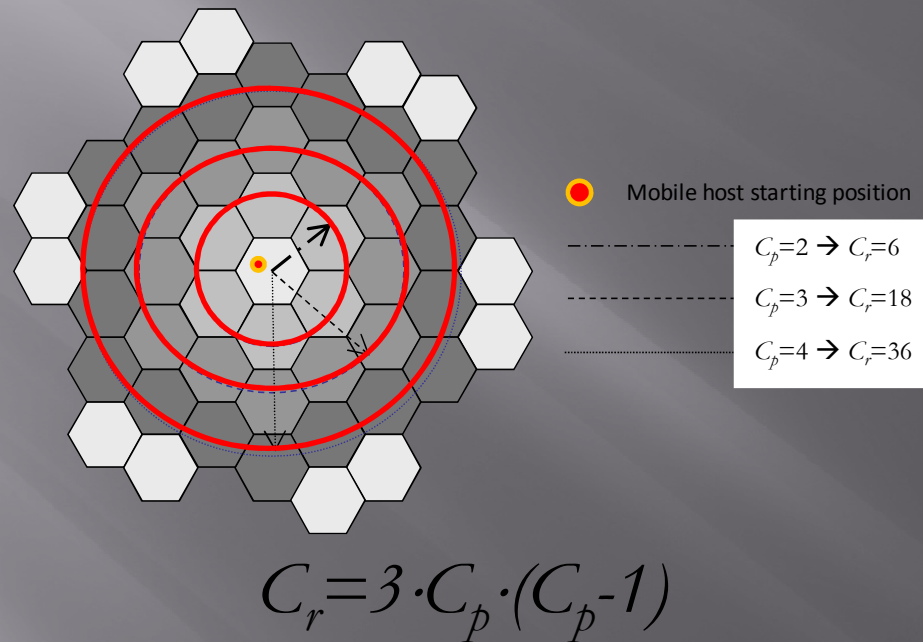


The possibly preferred movement directions of users must be taken into account, so a **qualitative** analysis becomes feasible.

Mobility Analysis and Prediction

From 1D to 2D

WHY QUALITATIVE ANALYSIS IS NEEDED IN 2D?

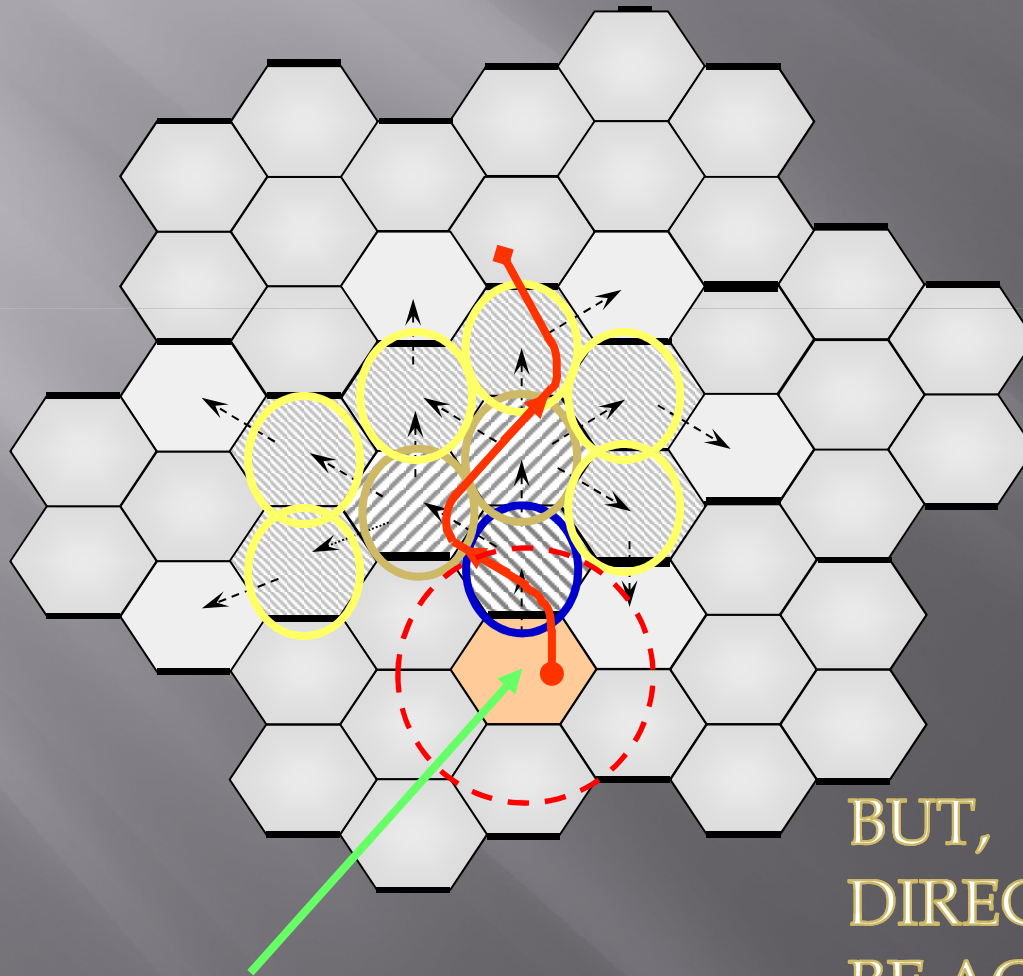


The number of cells on which the reservations must be made increases in polynomial way, following the illustrated rule: the bandwidth wastage is not negligible (for $C_p=5$ we have $C_r=60!!!$).

Mobility Analysis and Prediction

From 1D to 2D

WHY QUALITATIVE ANALYSIS IS NEEDED IN 2D?



The number of passive reservations is drastically reduced because the circular reservation is not needed now, since directional information is available.

BUT, HOW CAN DIRECTIONAL BEHAVIOR BE ACCOUNTED FOR?

Mobility Analysis and Prediction

DIRECTIONAL ANALYSIS IN 2D SCENARIOS

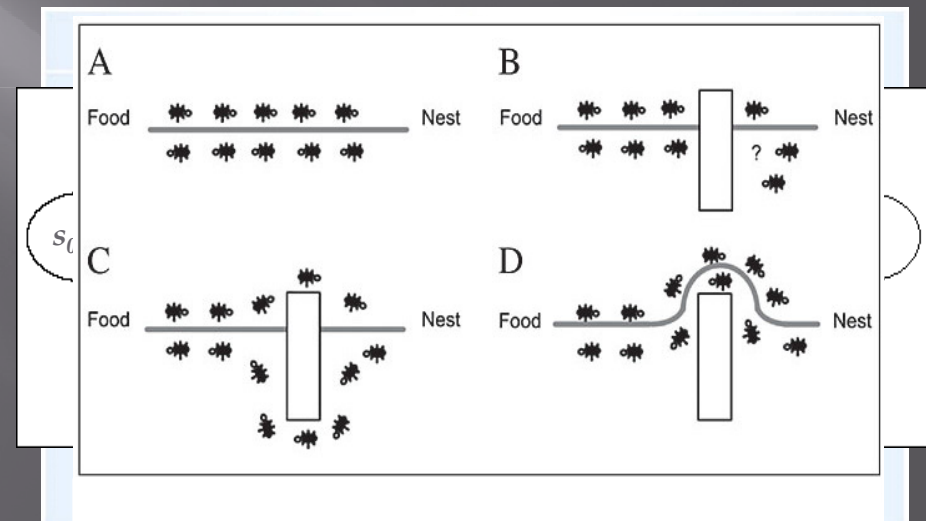
There are many works in literature which use many “tools” to account for directional behaviors:

NEURAL NETWORKS

MARKOV CHAINS

SWARM

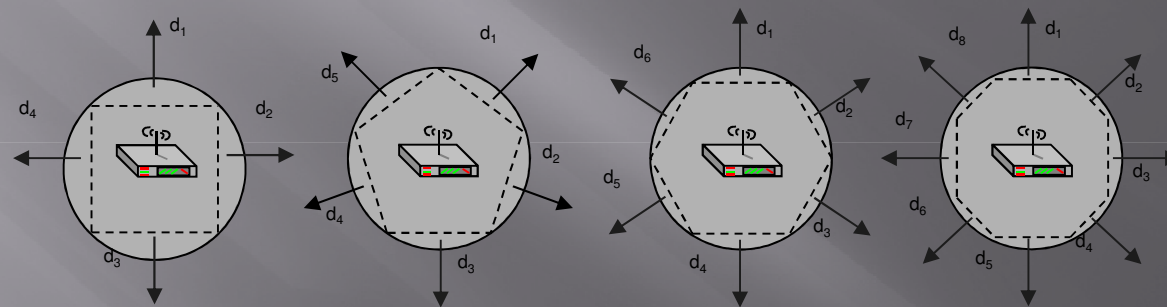
INTELLIGENCE



Mobility Analysis and Prediction

A PRACTICAL EXAMPLE

Coverage areas can be approximated through n-side regular polygons and n directions can be considered:



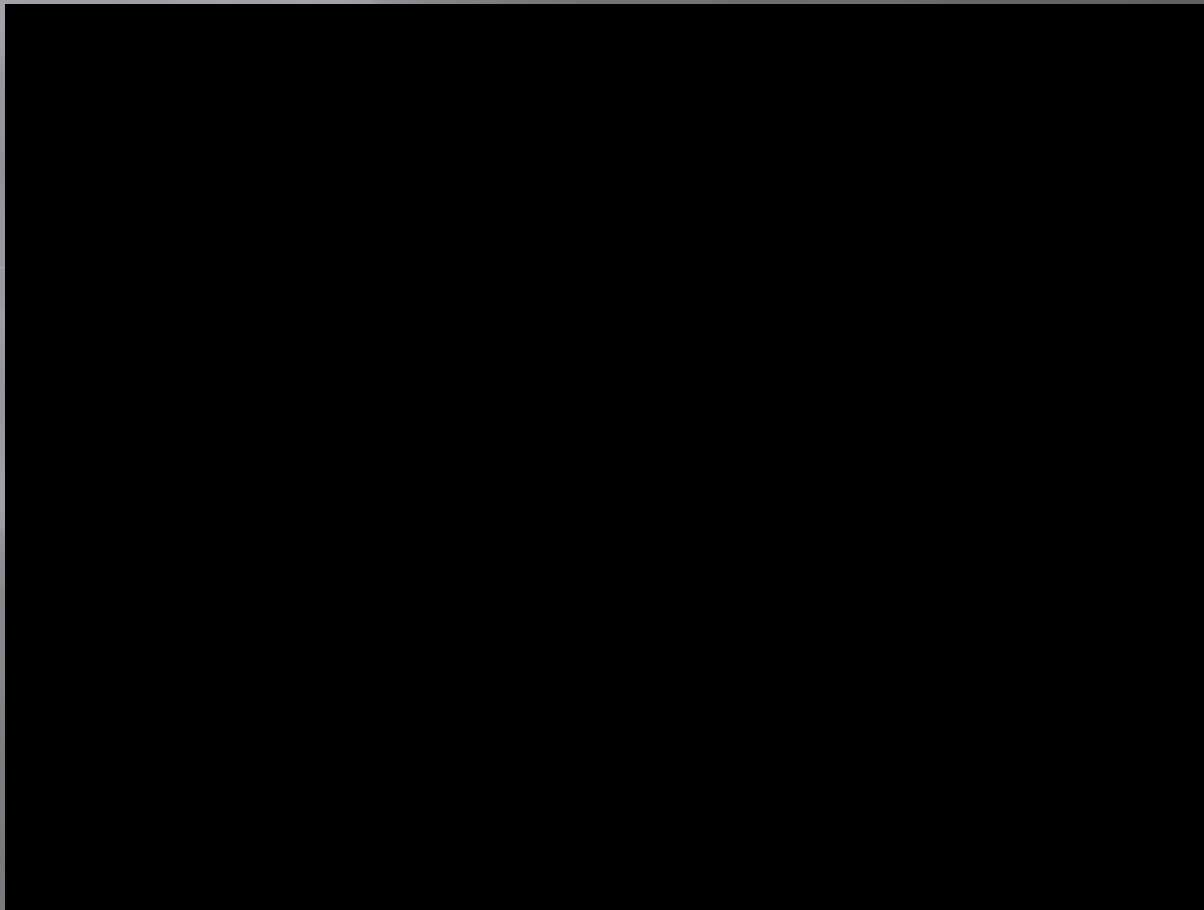
Then a $n \times n$ matrix can be considered, where the rows indicate the hand-in directions and the columns the hand-out directions; the elements are defined as:

$$M(x,y) = p_{x,y} = p_{cMIP}(x,y) = p(out\ to\ y \in S_{bo}\ t=t_0 + CST / in\ from\ x \in S_{bo}\ t=t_0)$$

Mobility Analysis and Prediction

A PRACTICAL EXAMPLE (n=6)

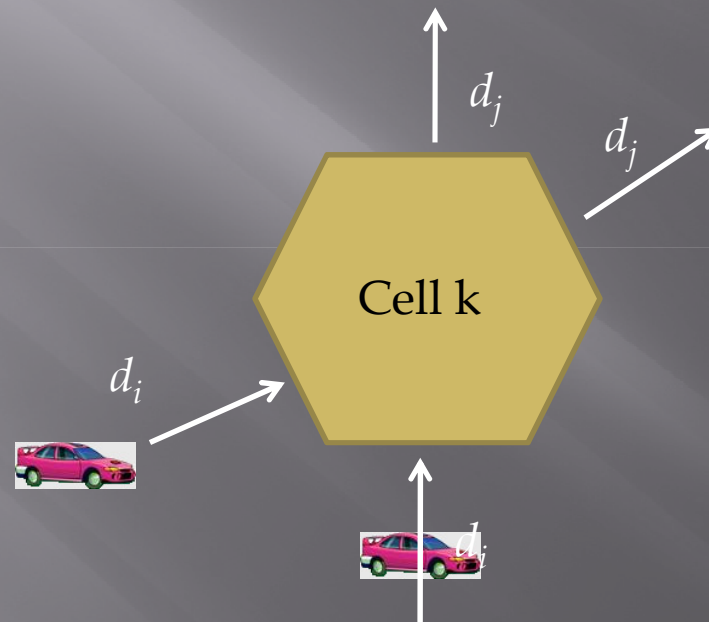
How the elements of the matrix M can be obtained?



Mobility Analysis and Prediction

A PRACTICAL EXAMPLE (n=6)

How the elements of the matrix M can be obtained?

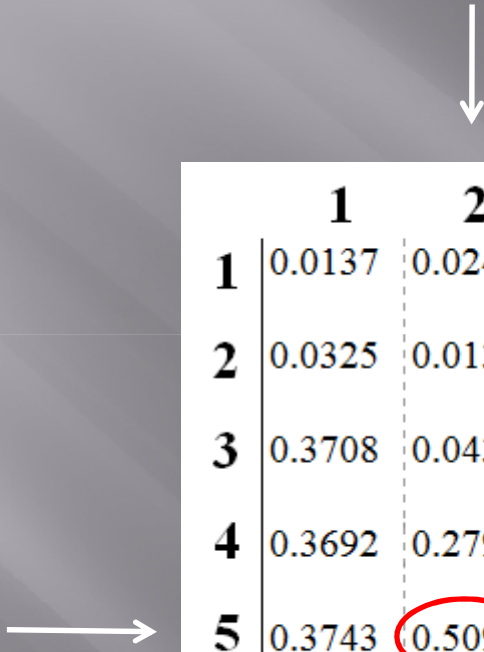


$$M_k(i, j) = \frac{\text{Number_of_handins_from_}d_i_\text{and_handout_to_}d_j}{\text{Number_of_total_handins_from_}d_i}$$

All the elements are averaged on the number of mobile host

Mobility Analysis and Prediction

A PRACTICAL EXAMPLE (n=6)



| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|--------|--------|--------|--------|--------|--------|
| 1 | 0.0137 | 0.0244 | 0.2779 | 0.3663 | 0.3034 | 0.0256 |
| 2 | 0.0325 | 0.0132 | 0.0399 | 0.3700 | 0.5056 | 0.0549 |
| 3 | 0.3708 | 0.0430 | 0.0125 | 0.0316 | 0.0521 | 0.5054 |
| 4 | 0.3692 | 0.2798 | 0.0249 | 0.0129 | 0.0248 | 0.2994 |
| 5 | 0.3743 | 0.5094 | 0.0440 | 0.0328 | 0.0127 | 0.0437 |
| 6 | 0.0318 | 0.0426 | 0.5094 | 0.3769 | 0.0427 | 0.0145 |

$$M(5,2)=0.5094$$

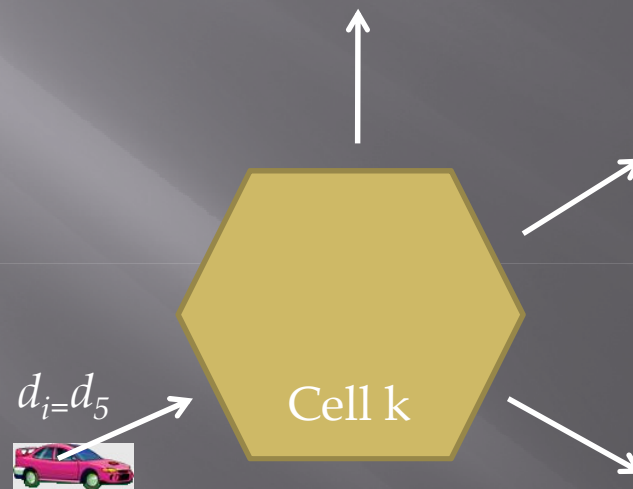
All the elements are averaged on the number of mobile host

Mobility Analysis and Prediction

A PRACTICAL EXAMPLE (n=6)

HOW TO USE THE MATRIX

| | 1 | 2 | 3 | 4 | 5 | 6 |
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| 1 | 0.0137 | 0.0244 | 0.2779 | 0.3663 | 0.3034 | 0.0256 |
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HOW MANY NEIGHBORS DO WE WANT TO CONSIDER?

- 1 \rightarrow Reserve on next cell on direction d_2
- 2 \rightarrow Reserve on next cells on directions d_2 and d_1
- 3 \rightarrow Reserve on next cells on directions d_2, d_1 and d_3

Summary

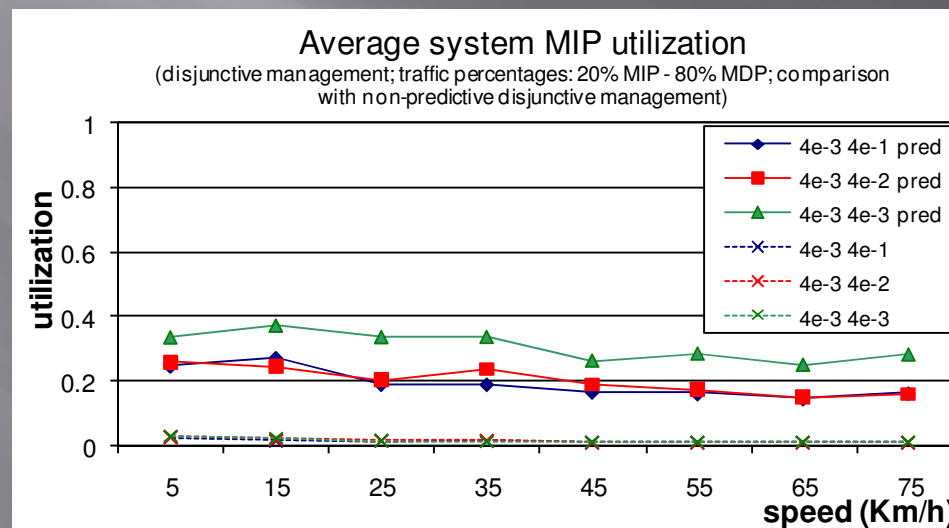
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Some Reachable Results

The introduction of quantitative and qualitative analysis gives the opportunity to enhance system utilization

MIP = QoS
service class

MDP = No QoS
service class



20% MIP
80% MDP

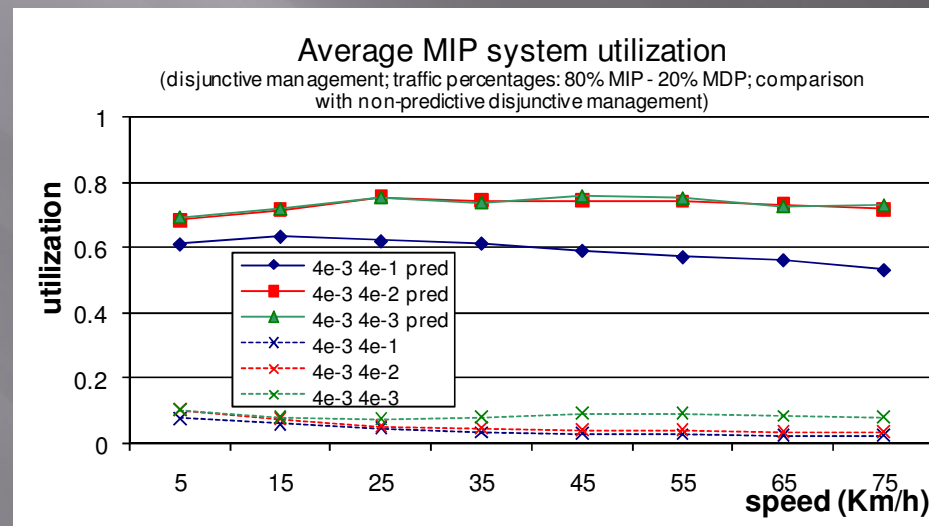
Passive bandwidth is not allocated on all the cells of the system, so a better resources management has been introduced (from about 5% to about 35%).

Some Reachable Results

The introduction of quantitative and qualitative analysis gives the opportunity to enhance system utilization

MIP = QoS
service class

MDP = No QoS
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80% MIP
20% MDP

System utilization increases until the 53%-75% depending on some simulation parameters.

Conclusions

- Needing of QoS guarantees in wireless networks;
- Influence of wireless link and how to model it;
- Importance of passive reservations;
- Impact of mobility and hand-over management;
- How to analyze and use mobility history;
- Importance of prediction in wireless networks.

Research Group Description

RESEARCH TOPICS

- Vehicular Ad-hoc NETworks (routing);
- Mobility models and analysis (prediction);
- Wireless Channel Modeling (stochastic proc.);
- Satellite communications (DVB-RCST);
- Wireless Sensor Networks (energy manag.);
- Delay Tolerant Networks (energy manag.);
- Underwater and Interplanetary Communications (modeling);