



UM-CRT model optimisation

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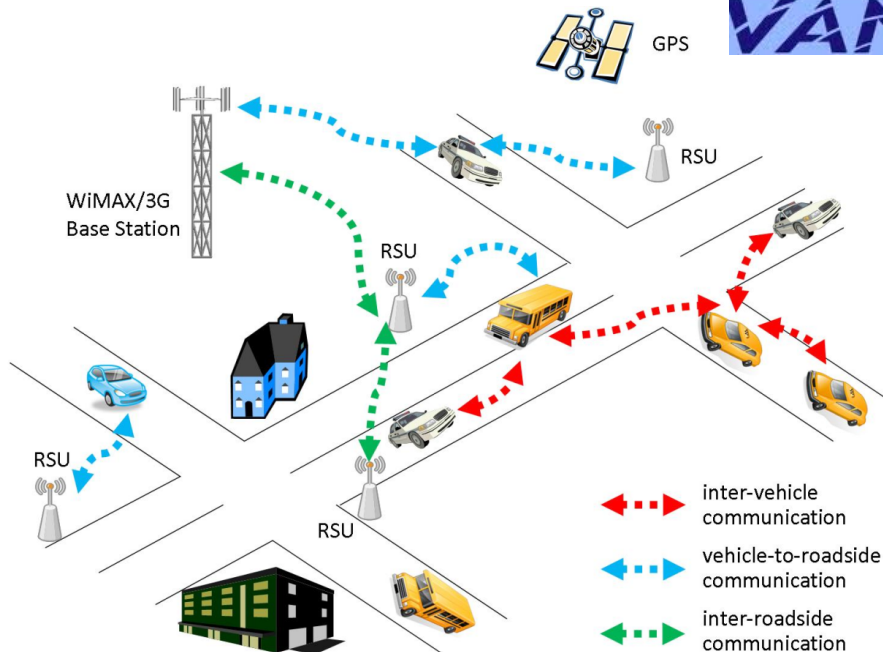
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Outline

- Introduction
- UM-CRT model
- Model optimisation & New criteria
- Results
- Conclusion

Introduction

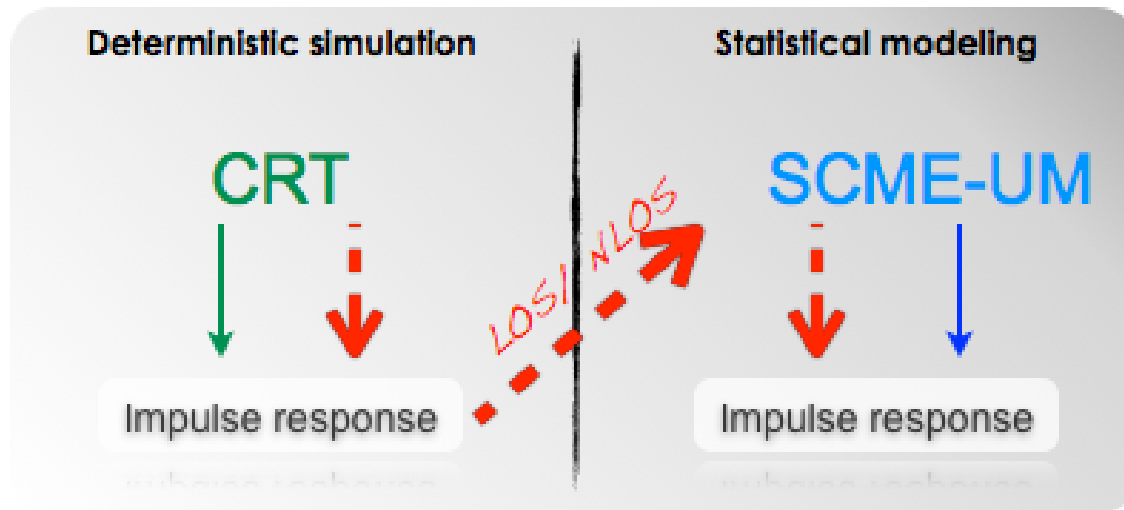
Context : **V**ehicular **A**d-hoc **NET**work



- Wireless communications at 5,9Ghz using the 802.11p physical layer.
- Most VANET simulator use simplistic channel model → real need for accurate channel models.

UM-CRT model

UM-CRT model is a compromise between a deterministic simulator (high computational time) and a stochastic channel model (fast simulation). It is a semi-deterministic channel model for the ns-2 simulator which associates realism and low computation time.

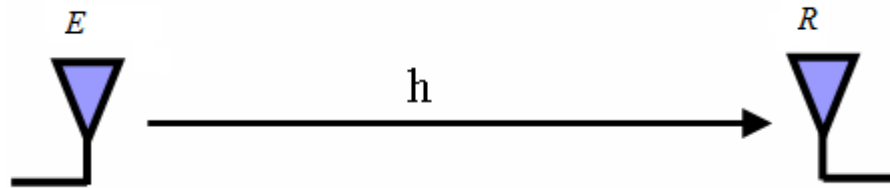


Principle of the UM-CRT model

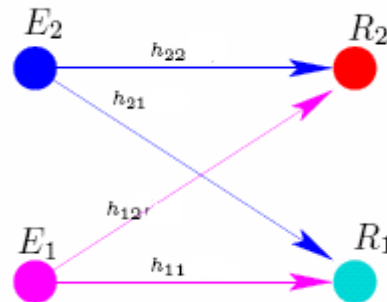
Ref : J. Ledy, H. Boeglen, A-M. Poussard, B. Hilt, R. Vauzelle, "A Semi-Deterministic Channel Model for VANETs Simulations", International Journal of Vehicular Technology, Volume 2012

UM-CRT model

- **SISO System (*Single Input Single Output*)**



- **MIMO System (*Multiple Input Multiple Output*)**



h_{ij} : Impulse Response (IR)

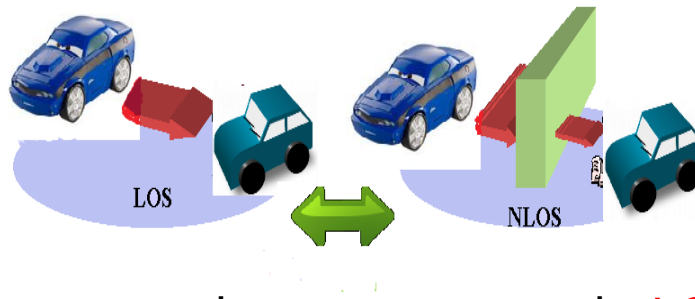
UM-CRT model

- Realistic + Low computation Time
- Adapted for VANETs simulations
- SISO / MIMO
- Integrated into NS2

Model optimisation & New criteria

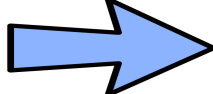
LOS/NLOS selection optimisation main objective :

To simplify the selection process and reduce computation time.



RayTracer simulator used to compute only **LOS** situation.

No reflexion or diffraction used into the simulation.

For delay = 0  **NLOS** else **LOS**

Model optimisation & New criteria

New Criteria

❖ **Capacity**

It is the amount of information that can be reliably transmitted over a communication channel.

- Computed with :
- Channel Matrix
 - Signal to Noise Ratio
 - Number of emitter/receiver

❖ **Outage Probability**

It is the probability that an outage will occur within a specified time period.

- Computed with :
- Signal to Noise Ratio for each modulation
 - Signal to Noise Ratio of the signal

Results

Models Evaluation

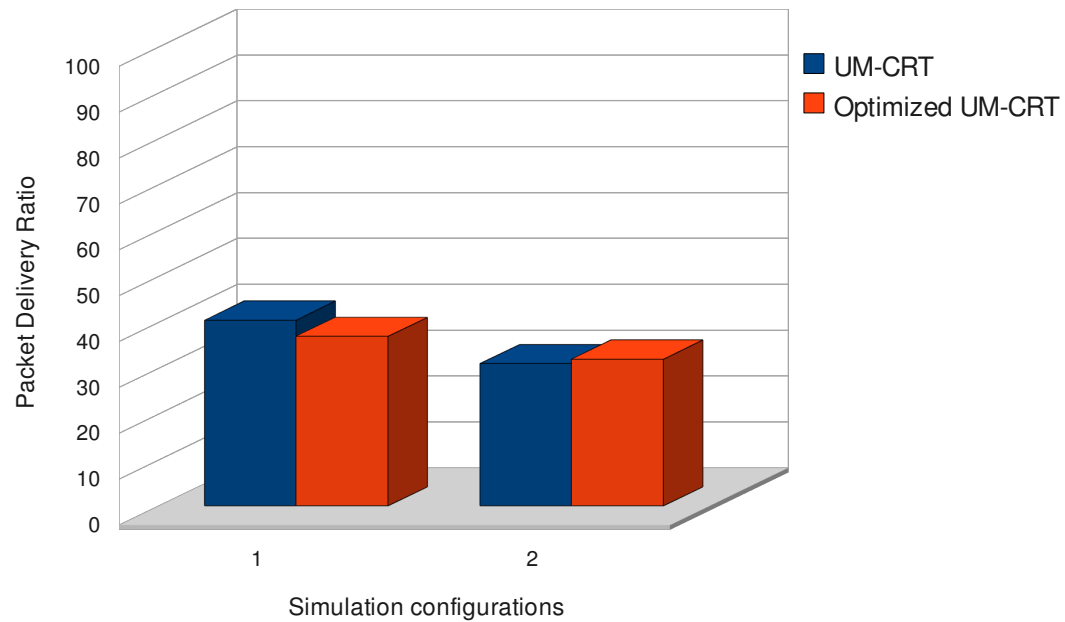
- 2 VANETs Scenarii

Scénario	NB Vehicles	Speed (m/s)	NB communications
1	40	8	3
2	40	15	3

- 2 Channel model :
 - CRT
 - SD
- 2 Transmission strategy :
 - SISO
 - MIMO
- Evaluation criteria :
 - Packet Delivery Ratio
- Environment :
 - Munich city center

Results

Optimisation Evaluation



Packet delivery comparison between : - UM-CRT model.
- Optimised UM-CRT model.

Results

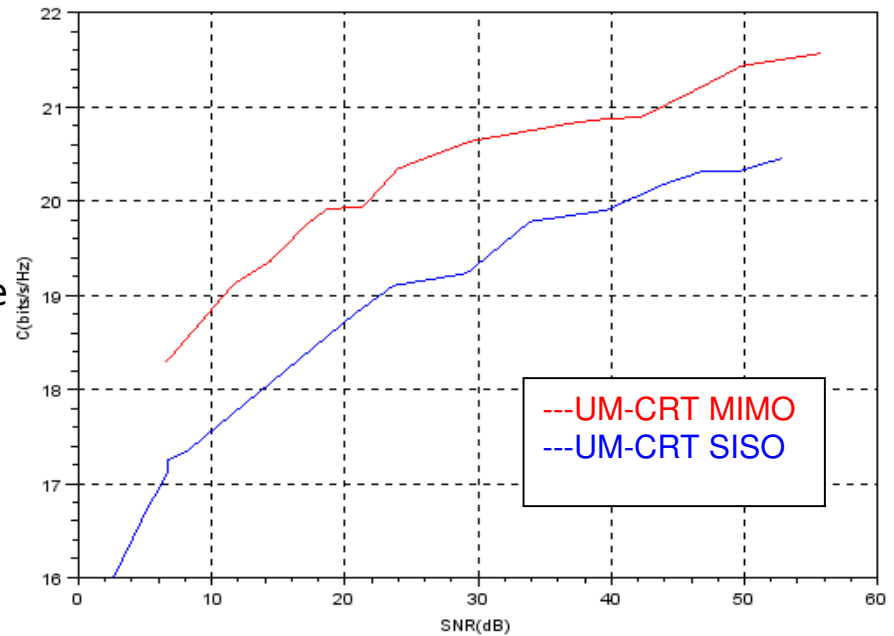
New criteria Evaluation :

Capacity

MIMO channel performs better than **SISO** one

⇒ Better link quality

⇒ Better information flow



Capacity versus Signal to Noise Ratio for both SISO and MIMO strategy

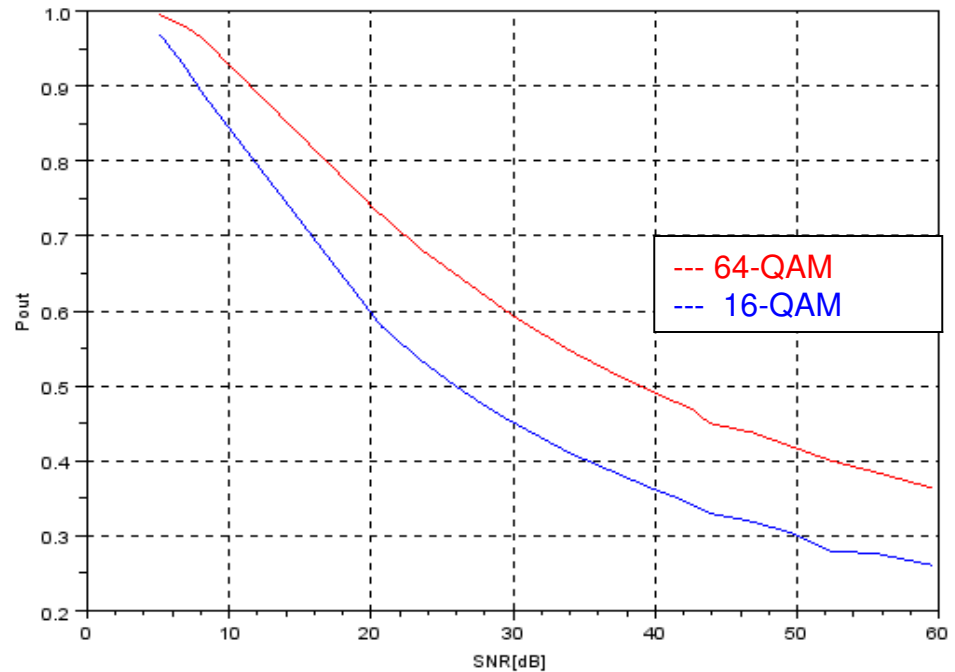
Results

New criteria Evaluation :

Outage probability

As the modulation size increase,
the Outage probability increase.

As the SNR increase,
the Outage probability decrease.



Probabilité de coupure en fonction du
SNR pour deux types de modulations

Conclusion

- UM-CRT model computation time is optimised
- The optimised model is still realist
- Capacity is implemented for both SISO and MIMO
- Outage probability is implemented for 2 modulation

Futurs works

- Usage of the new criteria in higher layers
- Improve QoS in VANETs
- Cross layering



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