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FAST MESSAGE PROPAGATION OVER IOV SCENARIOS

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 1. 5 metriche no build + build + high build? Se ci stanno tutti e 3
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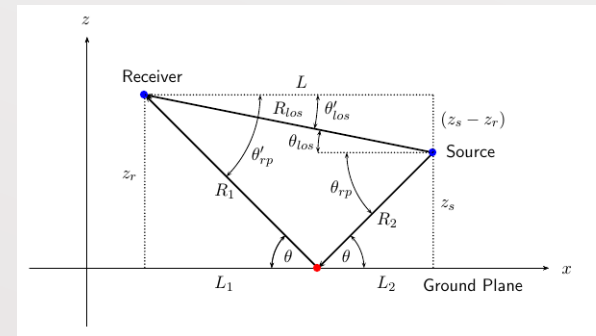
CONTEXT

- Vehicular and Drone Ad-Hoc Networks (VANETs and DANETs)
- Several applications
 - Smart city management
 - Video streaming
 - Traffic control
- Focus: Emergency Message Distribution (EMD)
 - Message delivery
 - Timeliness
 - Avoid medium saturation



CONTEXT 2

- Expensive large scale tests
 - Need to use simulators (ns-3)
- Additional tools and models
 - Real map data
 - Road junction modeling
- Signal propagation models
 - Two-Ray Ground
 - Obstacle shadowing (with 3D extension) [1] [2]



[1] C. Sommer, D. Eckhoff, R. German, and F. Dressler, "A computationally inexpensive empirical model of IEEE 802.11p radio shadowing in urban environments", 2011

[2] M. Romanelli, C. Palazzi, and A. Bujari, "Propagazione di messaggi tra veicoli con modello urbano realistico", Master's thesis, University of Padua, 2017.

FAST-BROADCAST

- Multi-hop delay-based broadcasting protocol
- Dynamic transmission range estimation
 - No need to know it *a priori*, as often assumed in other protocols
- Estimation Phase:
 - Vehicles exchange small Hello Messages (beacons) to estimate their transmission range
- Broadcast Phase:
 - A vehicle sends an Alert Message
 - The neighbors receive it and participate in contention to broadcast it
 - The vehicles farther from sender wait less time before broadcast



ROFF

- Multi-hop delay-based broadcasting protocol
- Deterministically determines the farthest forwarder
- Estimation Phase:
 - Vehicles exchange beacons to discover their entire neighborhood
 - Each vehicle builds a Neighbor Table (NBT) with one entry for each neighbor
- Broadcast Phase:
 - Vehicles differentiate their waiting times based on **unique forwarding priority**
 - Nodes farther from the previous sender have higher priority



MY CONTRIBUTIONS

- Improvements to Fast-Broadcast
- Implementation and extension to 2D and 3D scenarios of ROFF
- Evaluation and comparison of Fast-Broadcast and ROFF through simulations
 - Scenarios with and without buildings
- Proposal of extension to exploit road junctions to increase message delivery ratios
 - **SJ-Fast-Broadcast** and **SJ-ROFF** (SJ=Smart Junction)



SIMULATIONS – SCENARIOS AND METRICS

- Several scenarios of increasing complexity

| Scenario name | Type | Buildings | Drones |
|------------------------|------|-----------|--------|
| Platoon | 1D | ✗ | ✗ |
| Grid | 2D | ✓ | ✗ |
| Los Angeles | 2D | ✓ | ✗ |
| Padua | 2D | ✓ | ✗ |
| Los Angeles smart city | 3D | ✓ | ✓ |

- Metrics

- Total delivery ratio
- Total delivery ratio on circumference
- Number of hops
- Number of slots
- Forwarding node number

PRELIMINARY TESTS

Scenario configuration

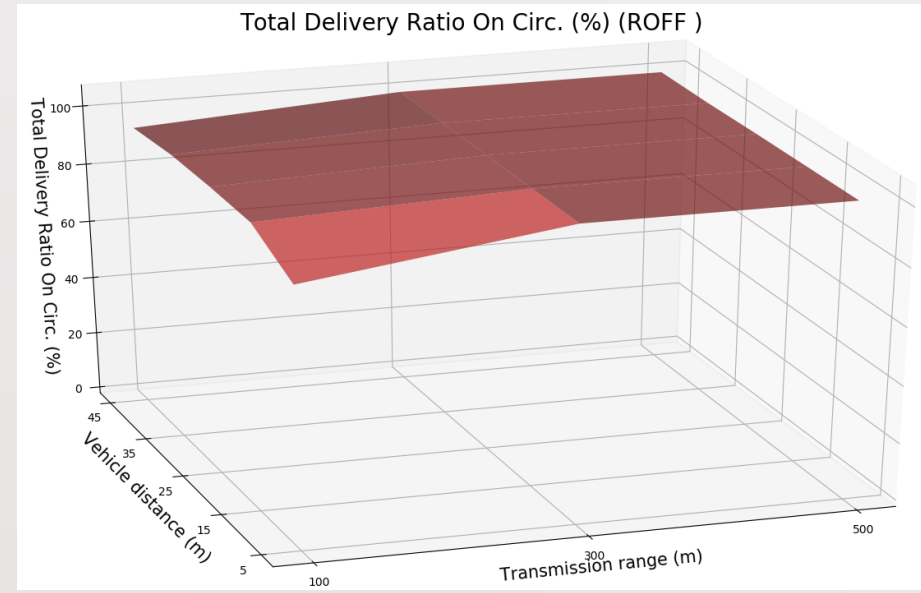
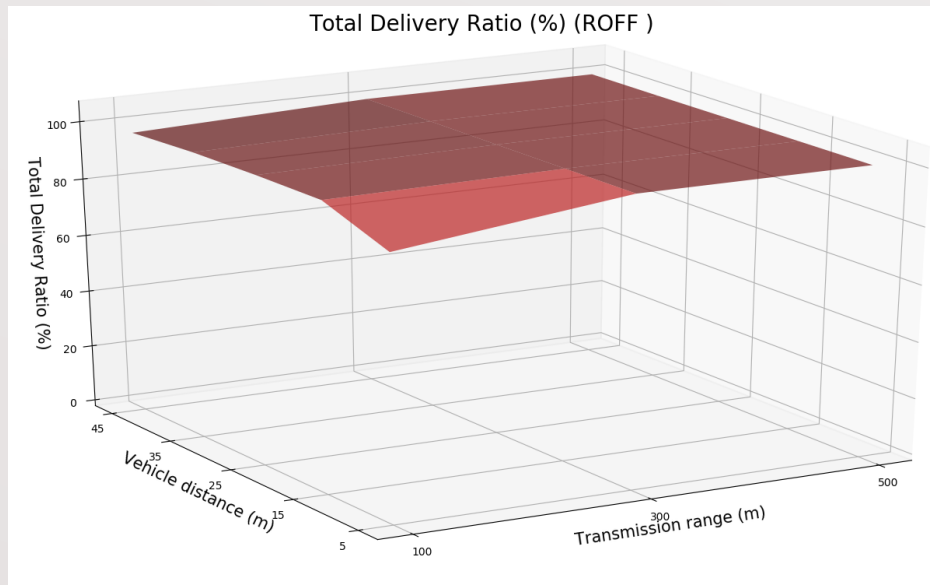
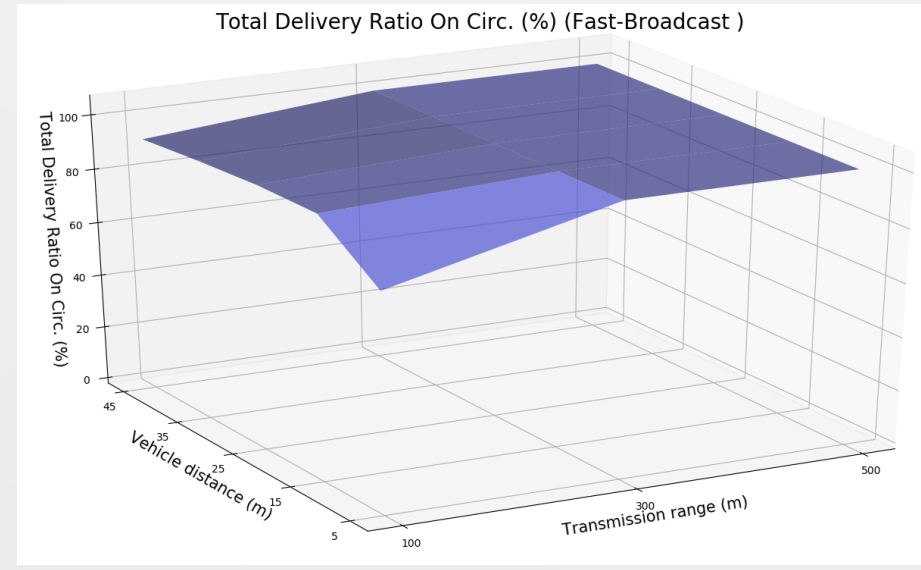
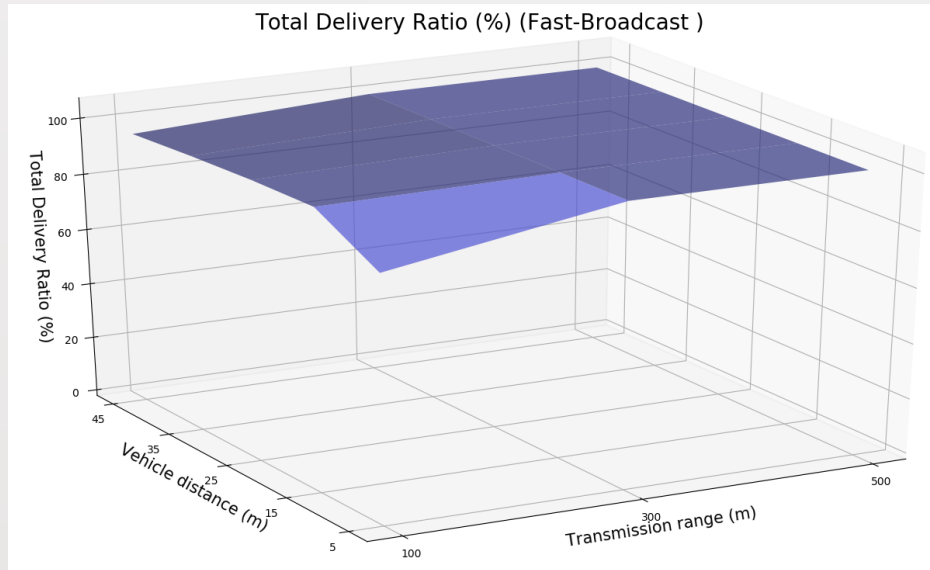
| | |
|---------------------------|------------------------------|
| Scenario name | Padua |
| Latitude N | 45.4171 |
| Latitude N | 45.3981 |
| Longitude W | 11.8654 |
| Longitude E | 11.8923 |
| Road length | 1200 |
| Distance between vehicles | 5, 15, 25, 35, 45 |
| Number of vehicles | 4975, 2856, 1776, 1318, 1072 |
| Number of simulations | 4500 |

Simulator configuration

| | |
|---------------------------|--------------------|
| Packet payload size | 100 byte |
| Frequency [GHz] | 2.4 |
| Channel bandwidth [MHz] | 22 |
| Transmission speed [Mbps] | 11 |
| Transmission powers [dBm] | -7.0, 4.6, 13.4 |
| Transmission ranges [m] | 100, 300, 500 |
| Modulation | DSSS |
| Propagation loss model | ns3::TwoRayGround |
| Propagation delay model | ns3::ConstantSpeed |

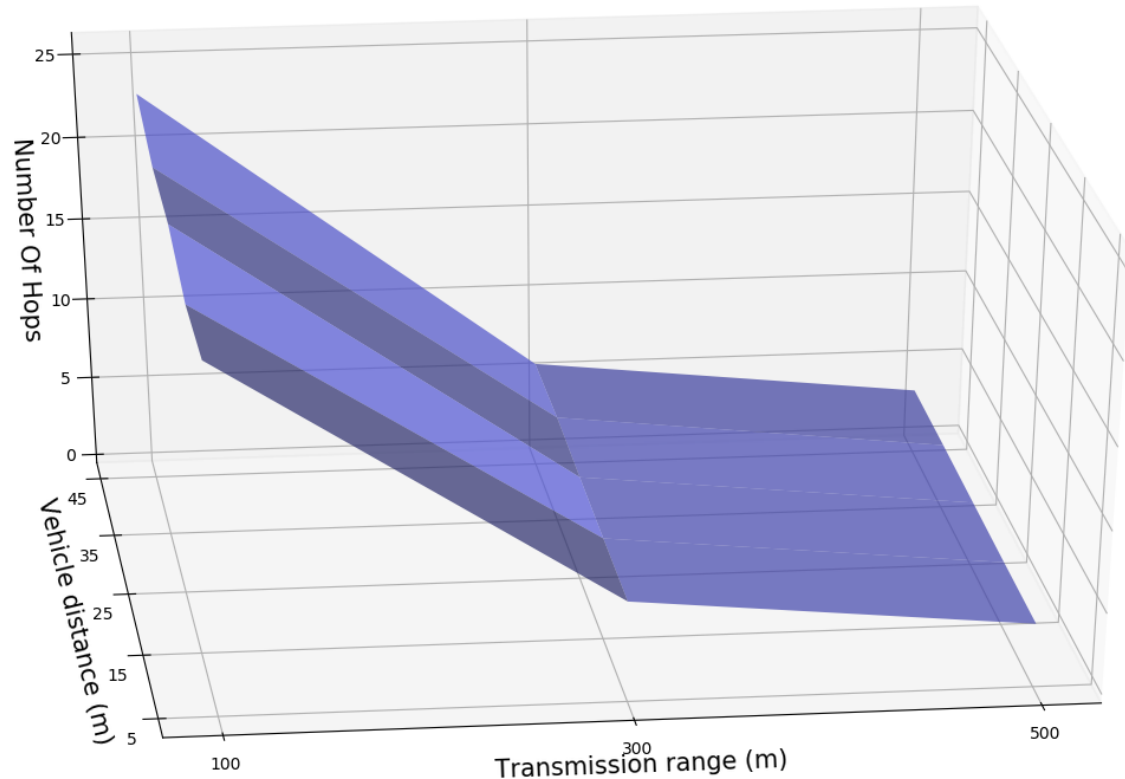


PRELIMINARY TESTS - DELIVERY RATIOS

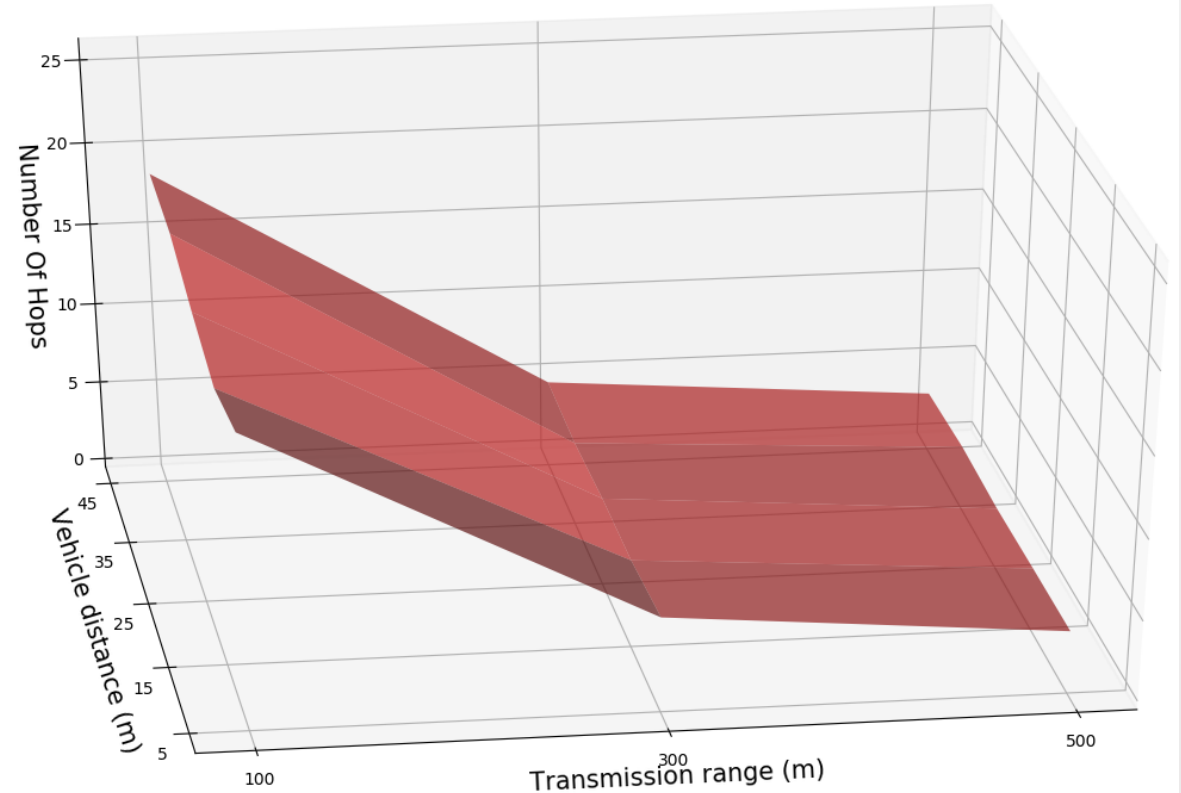


PRELIMINARY TESTS – NUMBER OF HOPS

Number Of Hops (Fast-Broadcast)

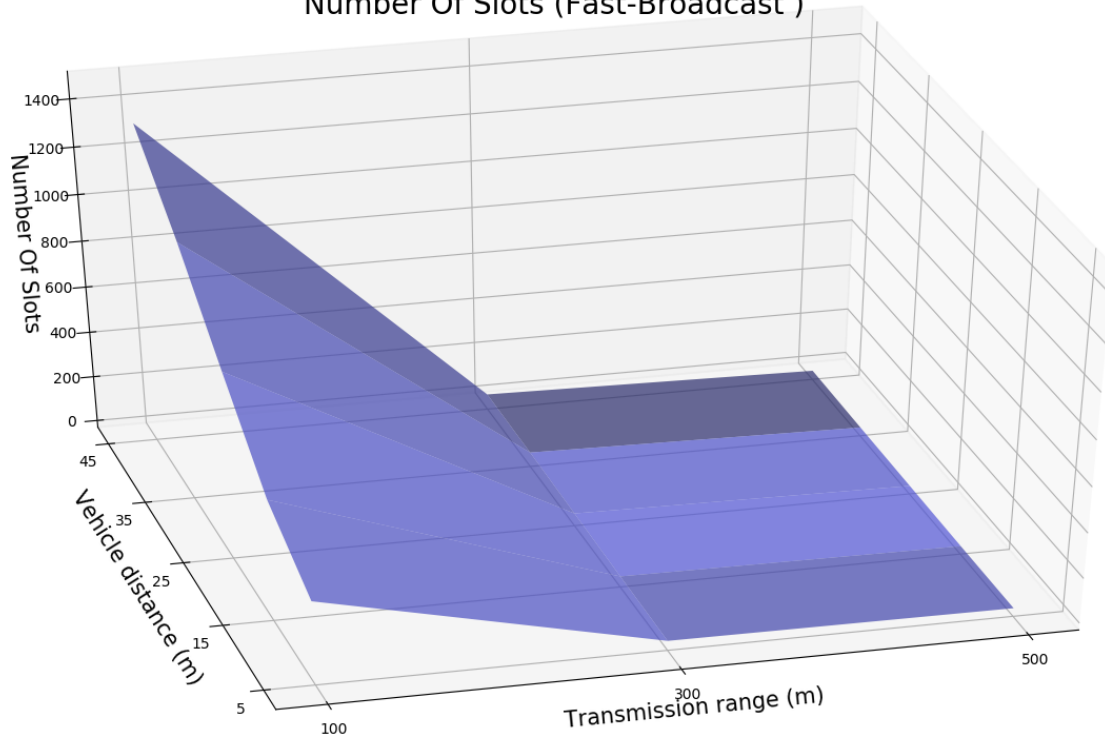


Number Of Hops (ROFF)

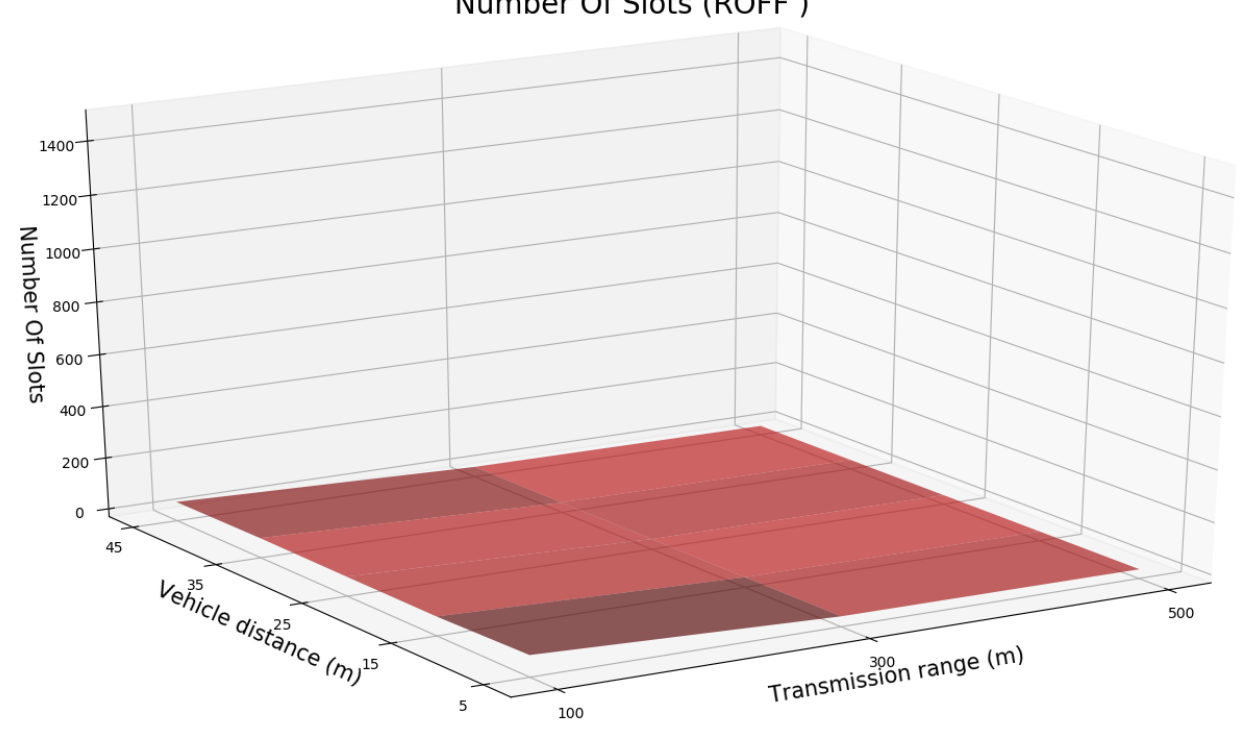


PRELIMINARY TESTS – NUMBER OF SLOTS

Number Of Slots (Fast-Broadcast)

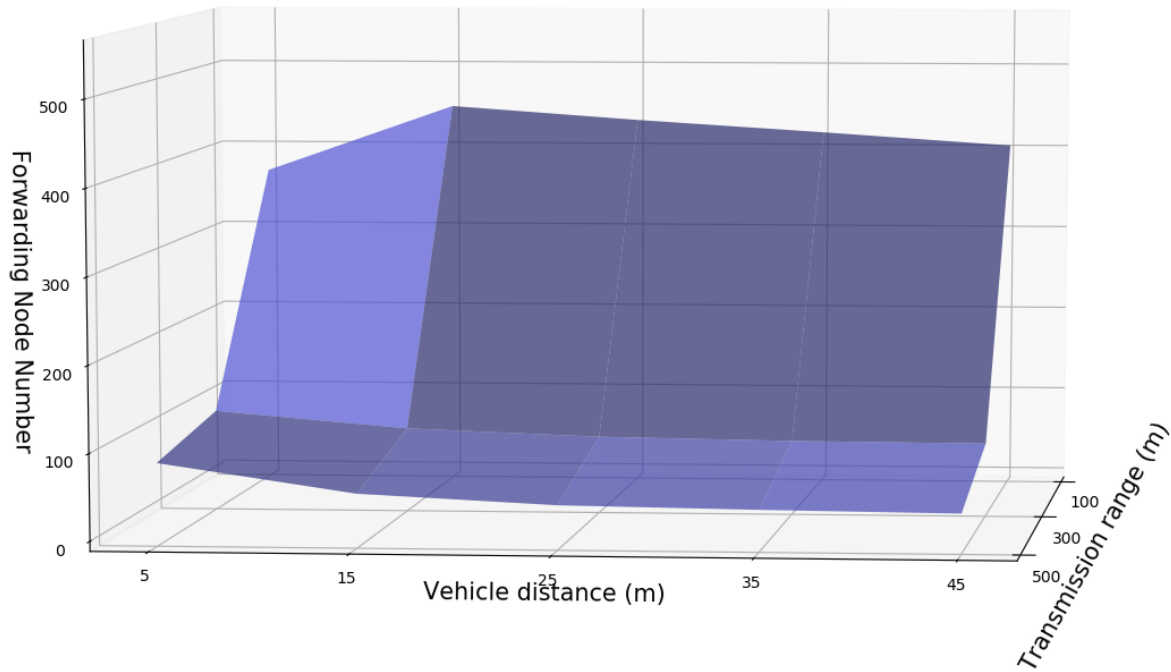


Number Of Slots (ROFF)



FORWARDING NODE NUMBER

Forwarding Node Number (Fast-Broadcast)



Forwarding Node Number (ROFF)

