Simulating Cellular Communications in Vehicular Networks:

making SimuLTE interoperable with Veins

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Outline

• Why cellular communications and vehicular networks
• SimuLTE background
• Modularity and Interoperability
• Proposed solution
Context

Cellular communications (4G/5G)
- Ubiquitous coverage
- Support to high speed mobility
- Direct communication (D2D)

Vehicular networks
- Vehicle to everything (V2X)
  - V2V
  - V2I
  - V2P
Interactions

Enables fast and reliable communications
Provide multiple communication paradigms (D2D vs D2I)

Cellular communications

Vehicular networks

Mobility paradigm of users
New challenges:
- Bulk handovers
- “Load” mobility
- Stringent delay constraints
SimuLTE Basics

• OMNeT-based system-level simulator of LTE networks

• Focused on testing algorithms for resource scheduling at large scale

• INET based

• Built as an additional NIC interface

• Follow the evolution of cellular communications
LTE Basics (1)

Binder

Standard Hosts

Antonio Virdis - SimuLTE 2017
Requirements from Veins

- **TraCIMobility**
  - Module responsible for mobility

- **Dynamic creation/destruction**
  - Module management
  - Addressing

- **Handover**
Related Work: VeinsLTE

• First attempt to integrate SimuLTE and Veins
• Modifications to both Veins and SimuLTE
• Veins need to interact directly with SimuLTE

• Introduces a third framework
Proposed solution

Modularity and Interoperability

OMNeT++

SIMULte

INET Framework

veins
Mobility modules

- Two mobility modules
- Only one active at a time
- Use the Feature mechanism
- Interested modules will register to the active mobility module
Dynamic creation/destruction: Modules

- Initialize and finish functions will interact with the Binder, which keeps track of active UEs
Dynamic creation/destruction: Addressing

- Designed to minimize modification to applications.
- Node creation: IP autoconfiguration
- Traffic start: check existence
- Node destruction: drop packets
Handover support

• Allows UEs to **change serving cell** -> cell selection
• Implemented using a **best-SINR policy**
• **Initial association** can be either static or handover-like
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Evolved Packet Core (EPC)
Exemplary Scenario

*manager.moduleType="lte.corenetwork.nodes.cars.Car"
*manager.moduleName="car"
*car[0].vehicularMobility.accidentCount = 1
*car[0].vehicularMobility.accidentStart = 20s
*car[0].vehicularMobility.accidentDuration = 30s
**dynamicCellAssociation = true
*car[*].masterId = 1
*car[*].macCellId = 1
Further Developments and Case Studies

• Moving towards 5G
  • CRAN deployments
  • Mobile Edge Computing (MEC) applications
  • Include novel protocol aspects
• Implement V2V applications (e.g. platooning)
• Persevere with interoperability (e.g. other mobility models)

Somewhat similar to the concept of Fog computing
Conclusions

• Cellular technologies and vehicular networks

• Requirements coming from Veins

• How to support interoperability between Veins and SimuLTE
  • Mobility modules
  • Dynamic creation/destruction
  • Handover support

• Case studies
Thanks for your attention

simulte.com
or
github -> inet -> simulte