



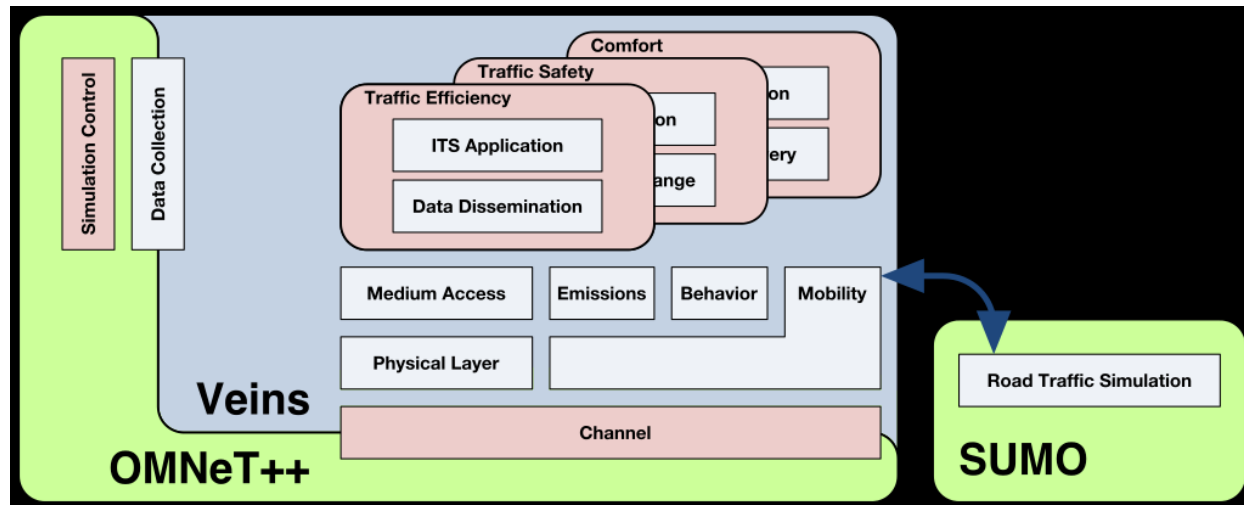
# Tutorial 1: Introduction to the Simulation Setup

## Introduction to the Simulation Setup

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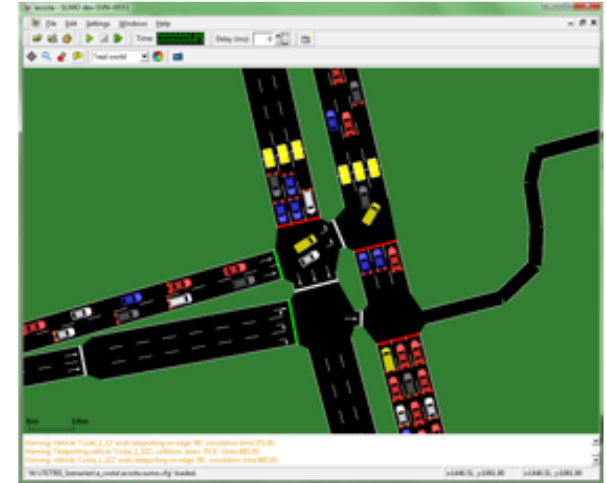
Module "Vehicle-2-X: Communication and Control"

- Veins simulator
  - Traffic simulator + network simulator
  - SUMO: Simulation of urban mobility
  - OMNet++
    - Discrete event simulator for networks
- What can we test?
  - To be elaborated at Tutorial parts



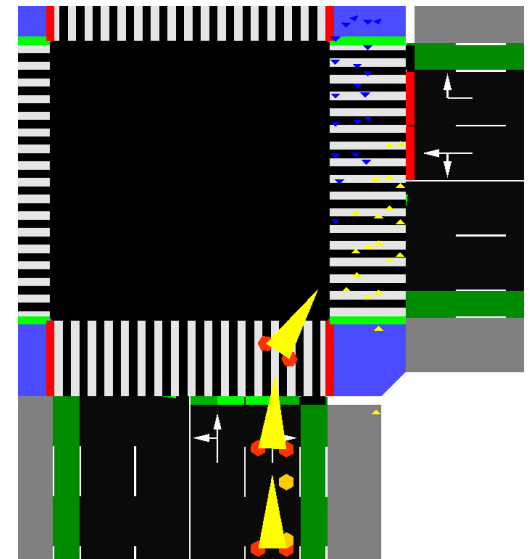
Source: Veins simulator website

- Microscopic transport simulation
- DLR's open source microscopic transport system simulation software
- Under development since 2001 with the explicit goal to simulate large cities in real-time
- TraCI (Traffic Control Interface) allows access to a running road traffic simulation
  - It allows to retrieve values of simulated objects and to manipulate their behavior „on-line“
  - In our case „Veins simulator“ connects to SUMO via TraCI!



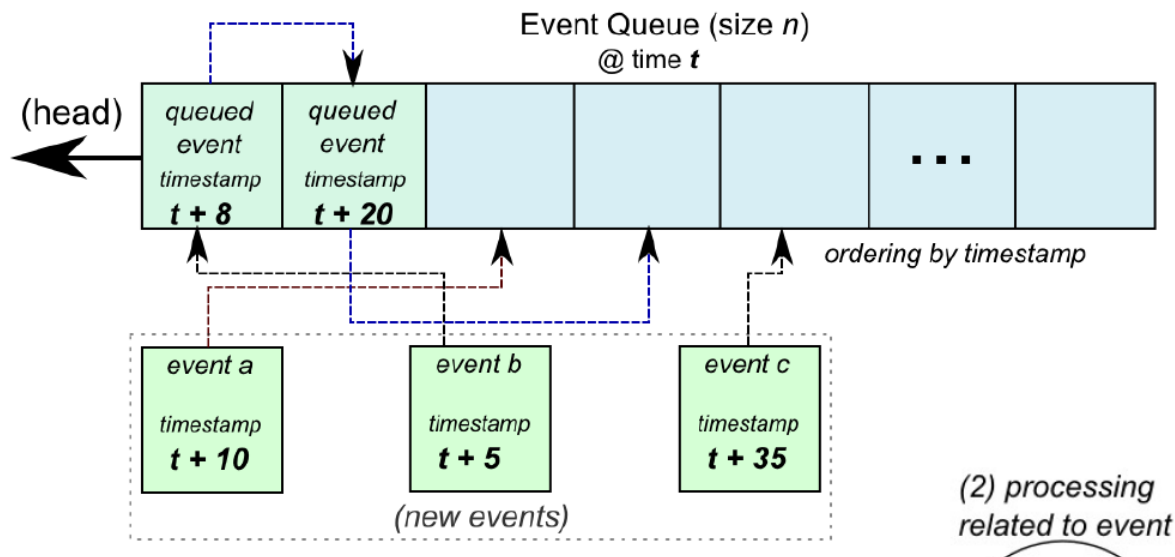
# SUMO – What can be Run?

- Cars
- Busses
- Passengers
- Bicycles
- Pedestrians
- Ships
- Goods traffic

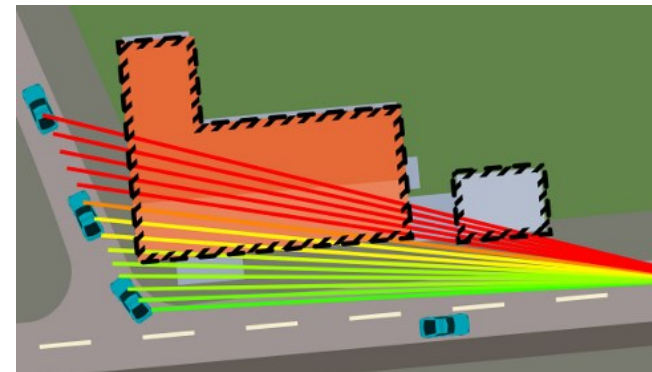


- Planning and evaluation/assessment
  - Traffic management
  - Infrastructure changes (traffic lights?)
  - Public transport
  - New technologies
    - Vehicular communication
    - Automated transport systems
  - Optimization
    - Traffic lights
    - Routing
  - Data fusion for traffic surveillance

- **Objective Modular Network Testbed in C++**
- Discrete event simulator
- Provides generalized framework for network simulation
- Written in C++
  - Source code publicly available
- Simulation model for Internet, IPv6, Mobility, etc.



- Open source framework for running vehicular network simulations
- Based on two well-established simulators
  - OMNeT++: network simulator
  - SUMO: traffic simulator
- Allows online re-configuration and re-routing of vehicles in reaction to network packets
- Relies on IEEE 802.11p and IEEE 16094 DSRC/WAVE network layers
- Cellular networking: LTE
- Can perform city-block level simulations in real-time
- Suits our purpose! – I'm sold, let's use this



# But You Need Some Skills

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- Some software skills required
- Open source programs are usually developed on Linux/Unix platforms
- We have Windows machines
- **MinGW** is a free and open source software development environment to create MS Windows applications
  - Includes a port of the GCC (compiler), GNU Binutils, Window specific header files and import libraries



- MinGW commands
  - ls: display files and folders
  - cd: change directory (e.g., cd .. Changes directory up!)
  - *./file\_name*: Execute an executable
  - echo \$PATH: displays environment variable PATH
  - export PATH=PATH:/User/user/src/
    - Adds a path to the PATH variable so that the system could find the location of the libraries and binaries
  
- Now I want you to start with Veins Tutorial
  - <https://veins.car2x.org/tutorial/>

- Do not install the newest version of the softwares
- If you scroll down on the SUMO release page, you will find „older releases“ please install the version indicated in the Veins tutorial (0.32.0)
- You will find that the simulation is really slow
- This is due to the animation effects of the packets
- If you run at fast or express speed you will see that simulation is orders of magnitude faster
  - There are buttons on the top of the OMNet++ GUI when you launch the simulation