

## Simulation for the Safety of the Autonomous Driving

### Industrial partners:

GRUPE RENAULT

PSA  
GROUPE

Continental

Valeo

ANSYS

AVSIMULATION

ALL4TEC  
MODEL BASED TESTING SOLUTIONS

( expleo )

apsys  
SIMULATING COMPLEXITY

sector  
group

### Academic partners :

DE LA RECHERCHE À L'INDUSTRIE  
cea

UNIVERSITÉ DE  
VERSAILLES  
ST-QUENTIN-EN-YVELINES  
université PARIS-SACLAY

LNE  
Le progrès, une passion à partager

lsu

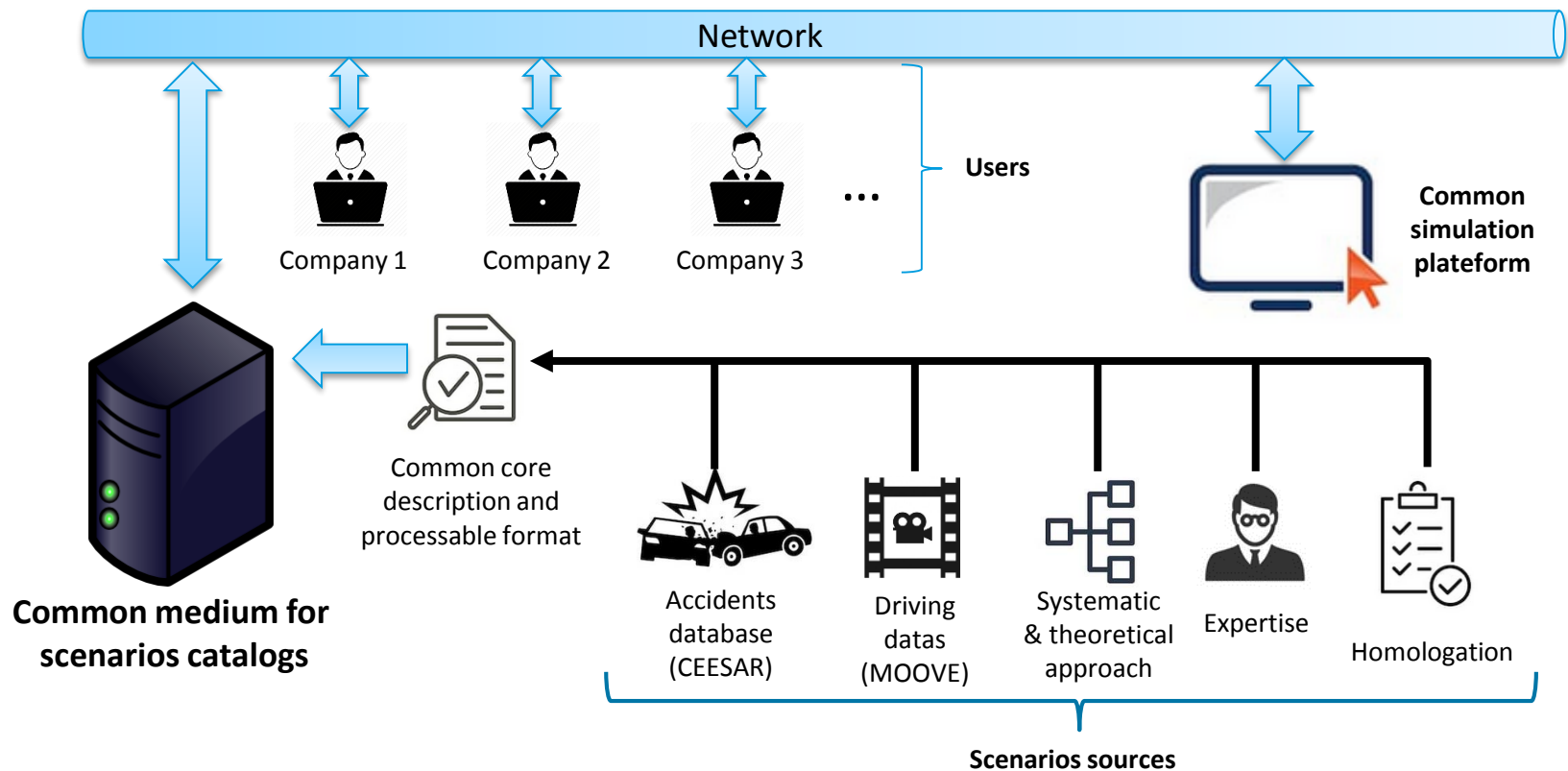
## Safety of Autonomous Driving

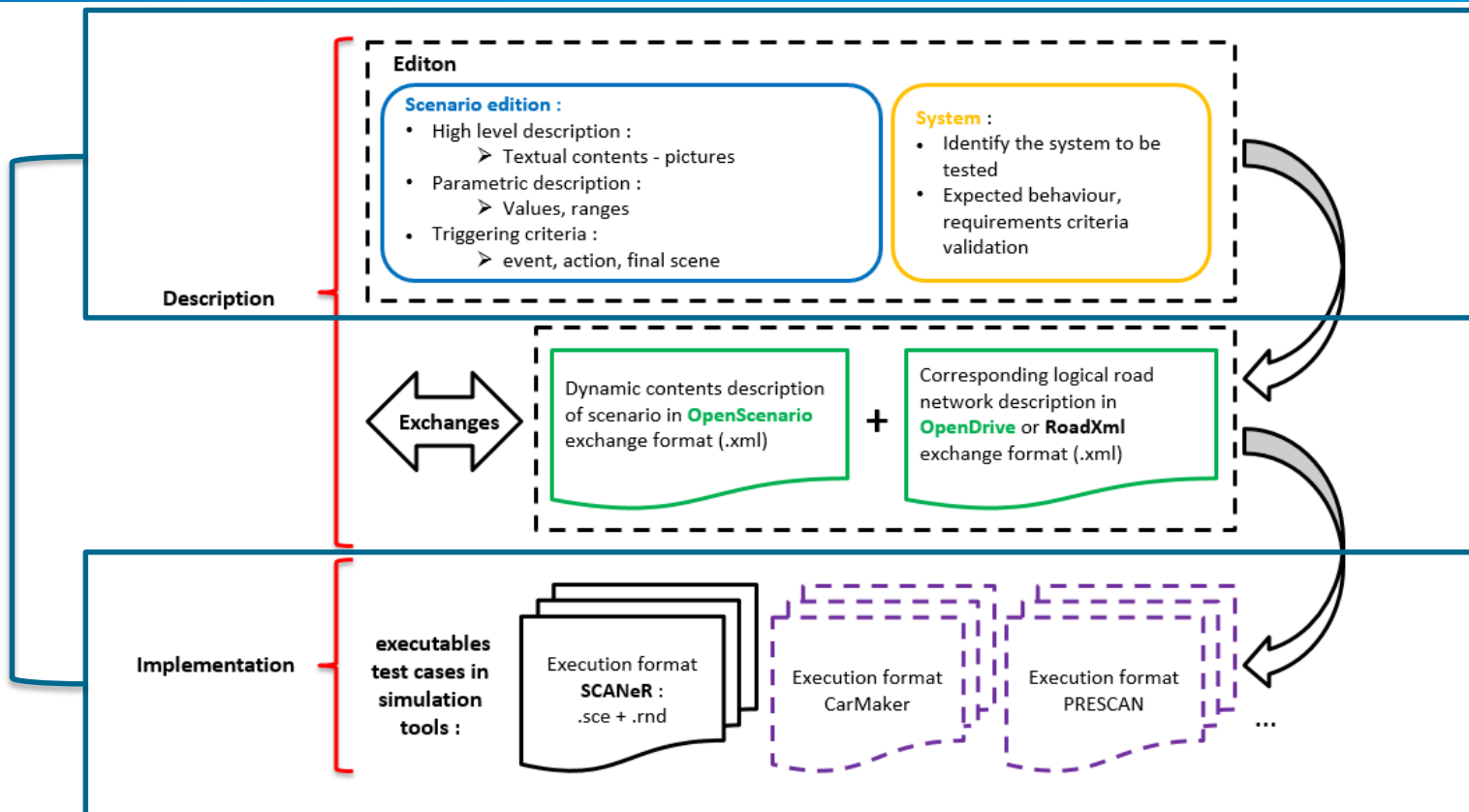
- Since 2015

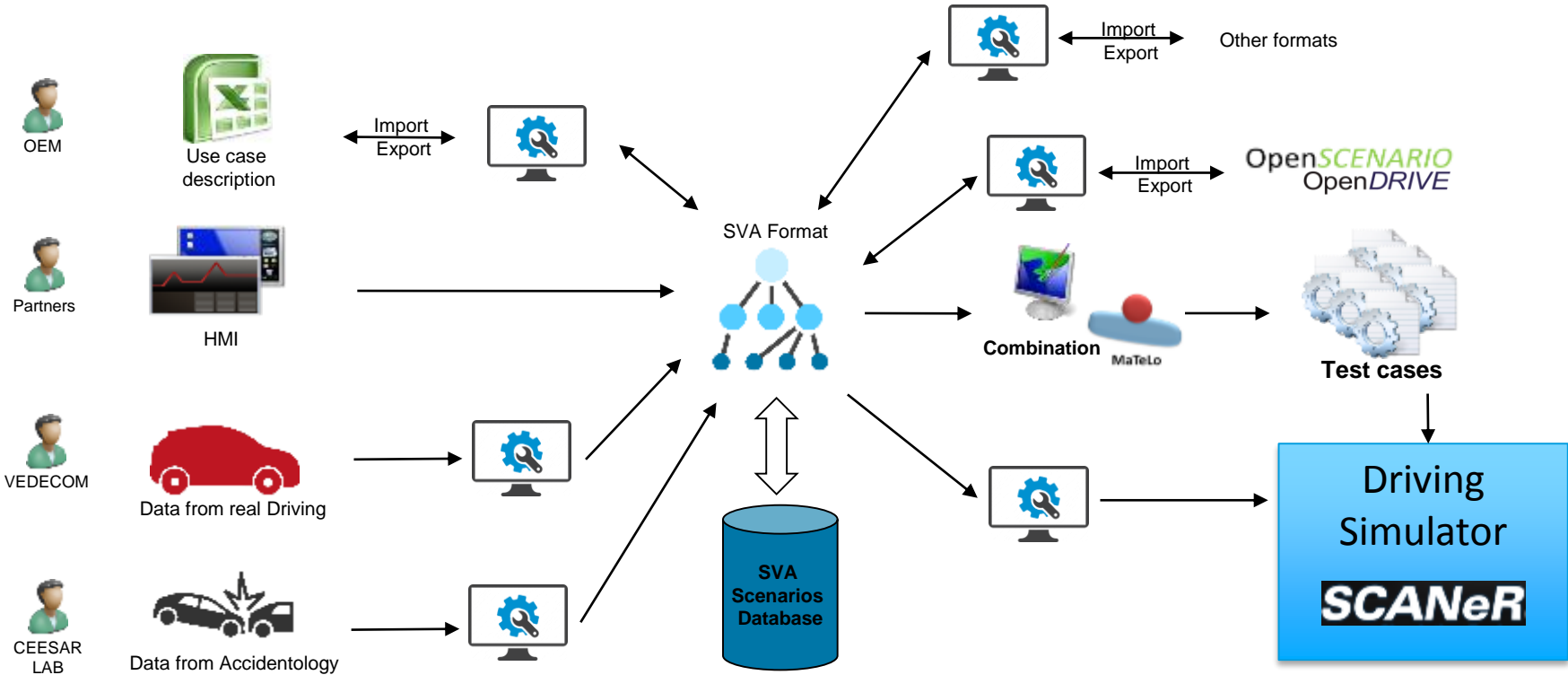
PFA | FILIÈRE  
AUTOMOBILE  
& MOBILITÉS

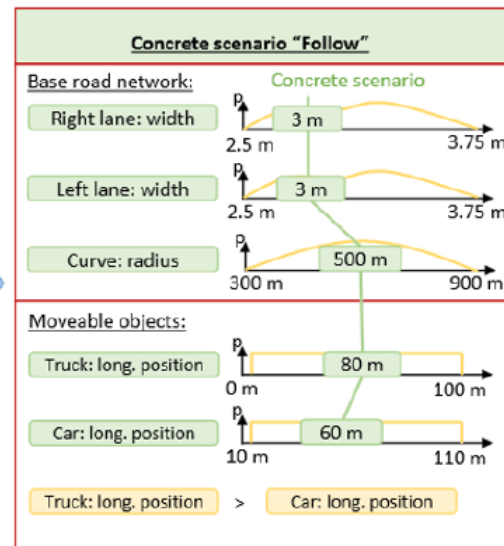
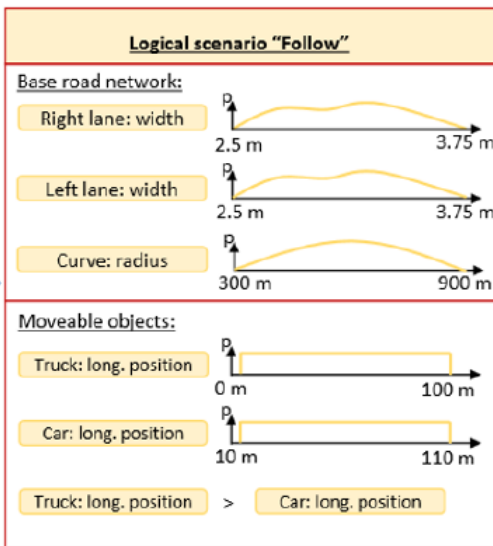
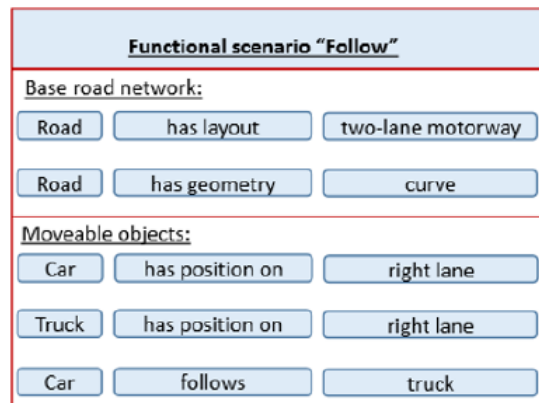
### Goals :

- To provide methodologies and tools that are able to assist design and validation of the AD systems.
- To specify, adapt or develop models (vehicle components, environment) in order to simulate the behavior of the vehicle in case of critical situations or failures.









T. Menzel, G. Bagschik, and M. Maurer. Scenarios for development, test and validation of automated vehicles. *CoRR*, abs/1801.08598, 2018. URL <http://arxiv.org/abs/1801.08598>.

## Scenario Manager

[home](#) / [scenarios](#) / [accidentology](#)

### Scenarios

Accidentology

Driving

Functional

Dysfunctional

### Collections

Infrastructures

Actors







## ACCIDENTOLOGY scenarios

Scenario type:

Show all

Filter by scenario type

Add scenario

Scenario	Status	Tools
<p><a href="#">Cut-In</a></p> <p>Vehicle 1 is on the middle lane. Vehicle 2 follows vehicle 3 on the right lane. Vehicle 1 began a cut-in between vehicles 2 &amp; 3 and by fear of crashing into the vehicle 3, vehicle 1 braked and made a left steering action. Vehicle 1 crashed into the security barrier on the left, bounced and made a second crash with the wall (left side).</p>	NEW	
<p><a href="#">Cut-Out</a></p> <p>Vehicle 1 weaved through the traffic. Vehicle 2 is on the right lane. Vehicle 1 wanted to take the exit way so it made a steering action and crashed with vehicle 2. Rear-frontal crash (rear for the vehicle 1 and frontal for the vehicle 2).</p>	NEW	
<p><a href="#">Cut-Out</a></p> <p>Vehicle 1 made a lane change behind vehicle 2 and crashed into it on its left rear side. Vehicle 2 crashed first into concrete median trip and then into security barrier.</p>	NEW	
<p><a href="#">Insertion</a></p> <p>Vehicle 1 started from emergency lane and inserted into the right lane whereas vehicle 2 arrived into this same lane. Side-frontal crash &amp; Vh1 takes fire</p>	NEW	
<p><a href="#">Jam</a></p> <p>Vehicle 2 is in tail of traffic jam (low speed) and a vehicle 1 crashed into it. Source scenario: no traffic jam in-front of vh2.</p>	NEW	
<p><a href="#">Misuse</a></p> <p>Vehicle circulated on the right lane and the driver falling asleep. The vehicle crashed into the metal security barrier.</p>	NEW	



### 110\_001

Status: DRAFT

Origin: ACCIDENTOLOGY

Parent: Picto 110

Groups	Creation	Last update	Submission:
ACCIDENTOLOGY	Unknown	2019-03-22 14:33:01	<p>&gt; Request validation</p> <p>🔄</p>

## Scenario

### Overview



### Description

B runs on lane n°2, A runs in wrong way on lane n°2.  
A and B carry on without steering or braking.  
Following impact, B is turned upside down and A points in the right way of traffic.

### Tags:

- TFE-06-10
- TFE-02-01
- Frontal collision
- Type of functional failures : Overall
- View obstruction due to road alignment (curve)



## Infrastructure

### Overview



### Name

Highway 4 lanes

### Description

Divided highway - 3 lanes - Lanes separated by low wall

Steel guardrail (right)

Right curve

Merging lane

Emergency lane

Regulatory speed : 130 km/h





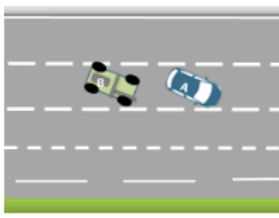





> Infrastructure details

## Actors


	Actor	Description	
	VLA		> Details
	VLB		> Details





## Steps

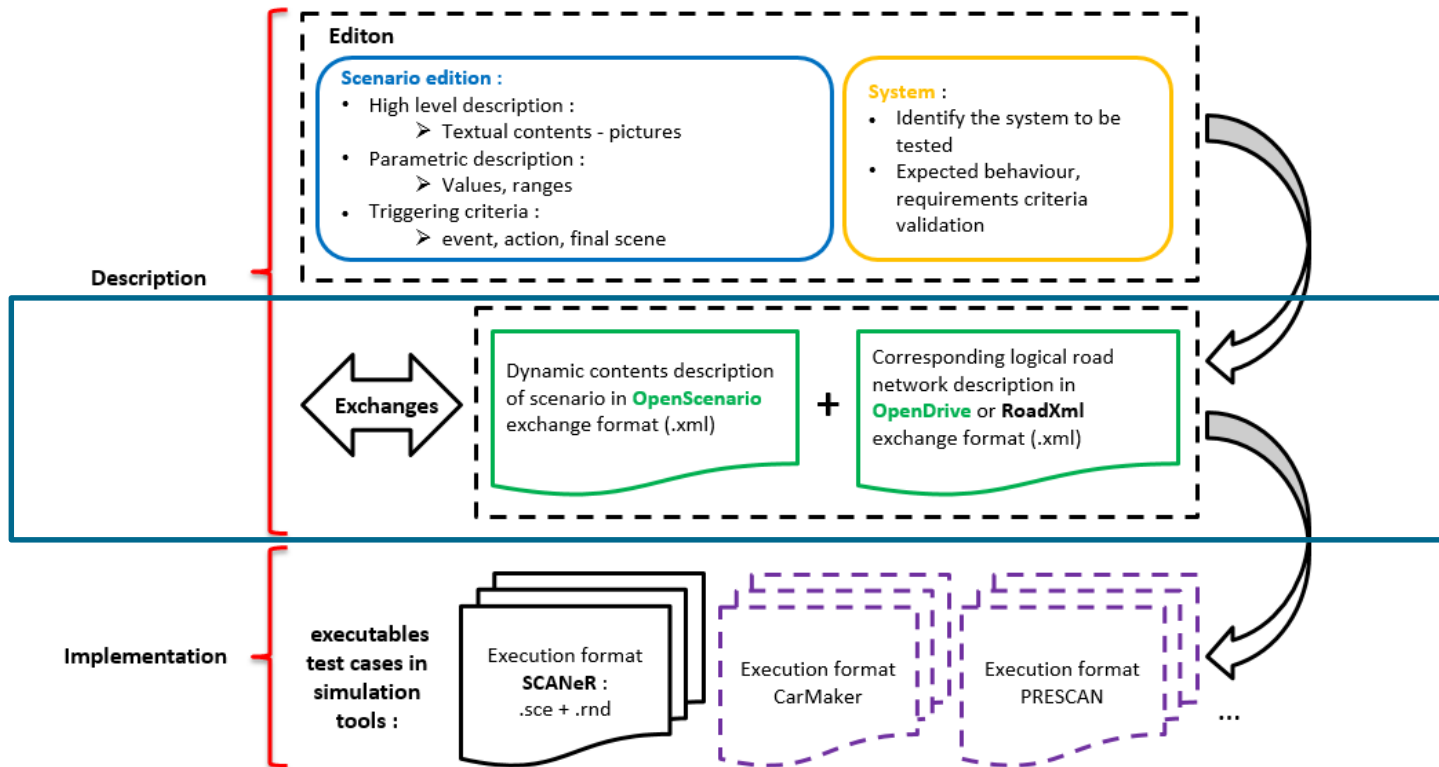
📷	Initial_Scene	Collision_Scene	Final_Scene
	 <p>B runs on lane n°2, A runs in wrong way on lane n°2 Vehicle A : 150 km/h &gt;&gt; Vehicle B : 130 km/h</p>	 <p>A and B carry on without steering or braking</p>	 <p>Following impact, B is turned upside down and A points in the right way of traffic</p>
▼	Actors		
>	 VLA		
>	 VLB		
▼	Environment		
>	 Weather		
>	 Road state		
>	 Traffic		

S. Ulbrich, T. Menzel, A. Reschka, F. Schuldt, and M. Maurer. Defining and substantiating the terms scene, situation, and scenario for automated driving. In *2015 IEEE 18th International Conference on Intelligent Transportation Systems*, pages 982–988, Sept 2015. doi : 10.1109/ITSC.2015.164.

▼	 VLA
...	<div>Kinematic</div> <div> <b>Lateral position</b>  Road segment  Segment 1  Strip  Traffic lane 2  Shift  CENTERED  <b>Longitudinal position</b>  Reference  <i>Not defined</i>  Position  <i>Not defined</i>  <b>Speed</b>  130 km/h  <b>Angle</b>  STRAIGHT </div>

	Trafic ^
	<b>Density</b> FLOWING

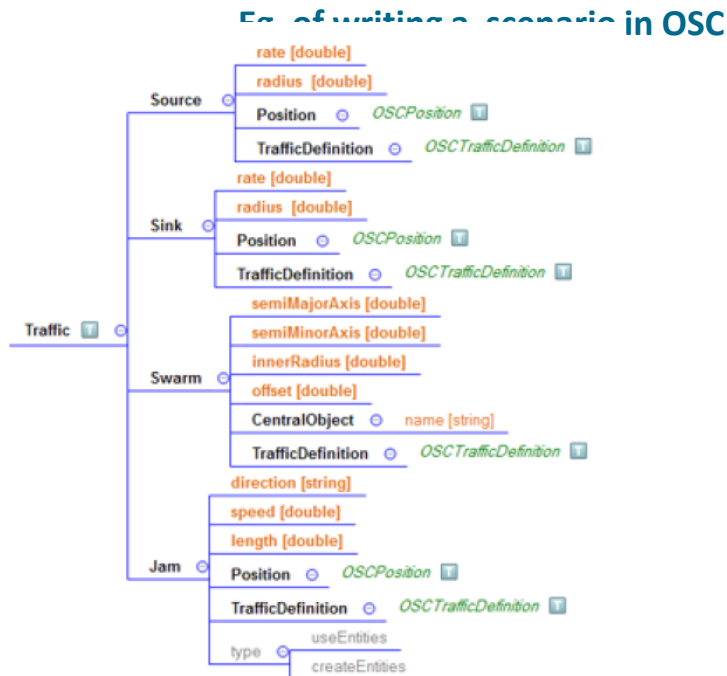
	Environment ^
	<b>Road</b> DRY <b>Luminosity</b> DAYLIGHT <b>Temperature</b> 0 ° - 0 ° <b>Wind</b> 0 km/h - 0 km/h <b>Rain</b> 0 mm - 0 mm



- **Elements/Parameters mapping between :**
  - Those available in OpenScenario
  - Those we are using to describes our scenarios
- **Studying the format and exploration of the sources throught:**
  - The examples given from the website
  - The redmine's project (Subscriber)
  - Symposium participation (2017)
- **Attempt to include OpenScenario in our works :**
  - A few of scenario's from our catalog were translated in OSC



MindMap



OSC

## Eg. of check a scenario in OSC

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- <OpenSCENARIO>
  <FileHeader author="Florian FAUCHER" date="2018-02-28T10:00:00" description="Scenario - Merging on highway" rev\
+ <ParameterDeclaration></ParameterDeclaration>
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+ <RoadNetwork></RoadNetwork>
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        - <Condition delay="0" edge="rising" name="MergeOnHighwayStartCondition">
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    </StartConditions>
  </Act>
</Story>
</Storyboard>
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```

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TemplateOSCMergeScenario.xml:3: parser error : StartTag: invalid element name
</OpenSCENARIO>
^
TemplateOSCMergeScenario.xml:3: parser error : Extra content at the end of the
document
</OpenSCENARIO>
^
ffaucher@ffaucher-Latitude-3340 ~/OpenScenarioProject/OpenSCENARIO v0.9.1
vim TemplateOSCMergeScenario.xml
ffaucher@ffaucher-Latitude-3340 ~/OpenScenarioProject/OpenSCENARIO v0.9.1
xmlint --schema OpenSCENARIO v0.9.1.xsd TemplateOSCMergeScenario.xml --noout
TemplateOSCMergeScenario.xml validates
```