Closed Loop Requirement Based Testing

For Autonomous Driving

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ALL4TEC

MaTeLo

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MODEL BASED TESTING SOLUTIONS

All4Tec, a Model-Based Company

- Independent Company established in 1998

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Inspired from experiences in various Industrial and R&D projects

Autonomous Vehicle Safety

SVA

Autonomous Vehicle Combinatoric explosion

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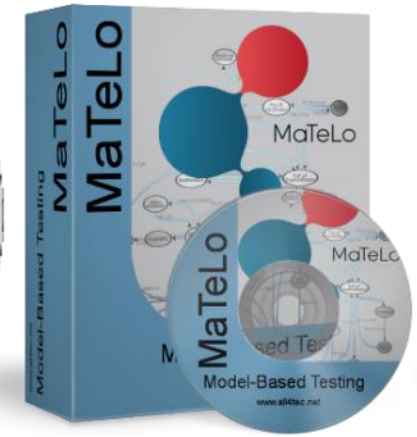
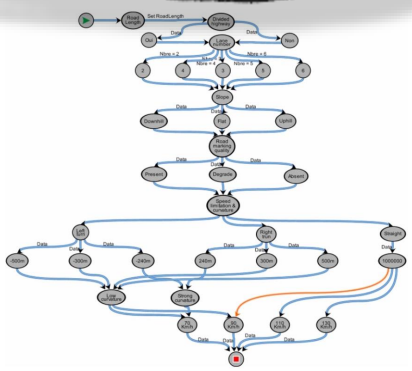
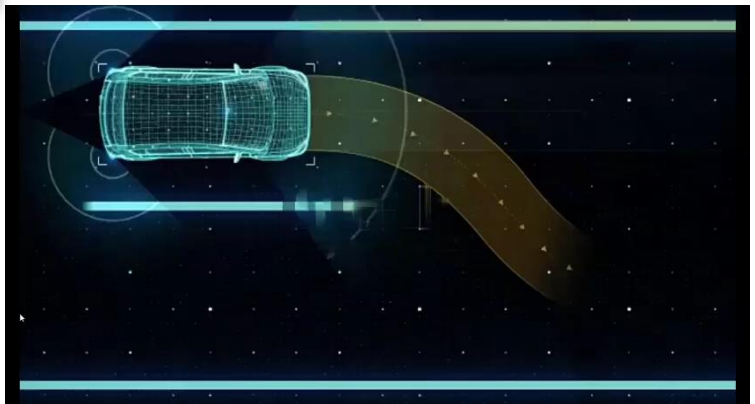
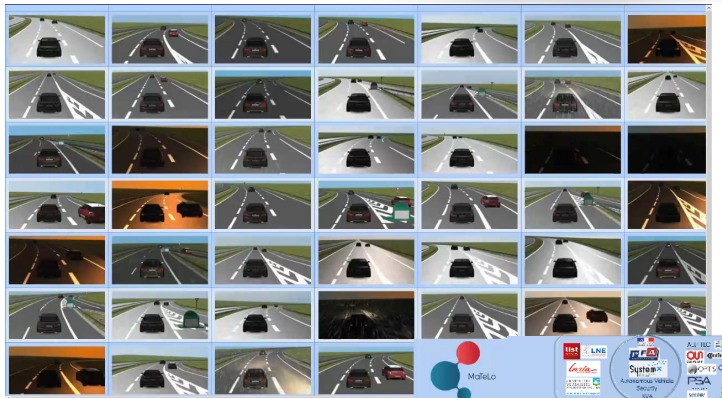
Traditional Testing

MaTeLo Model Based Testing & AV simulation engine









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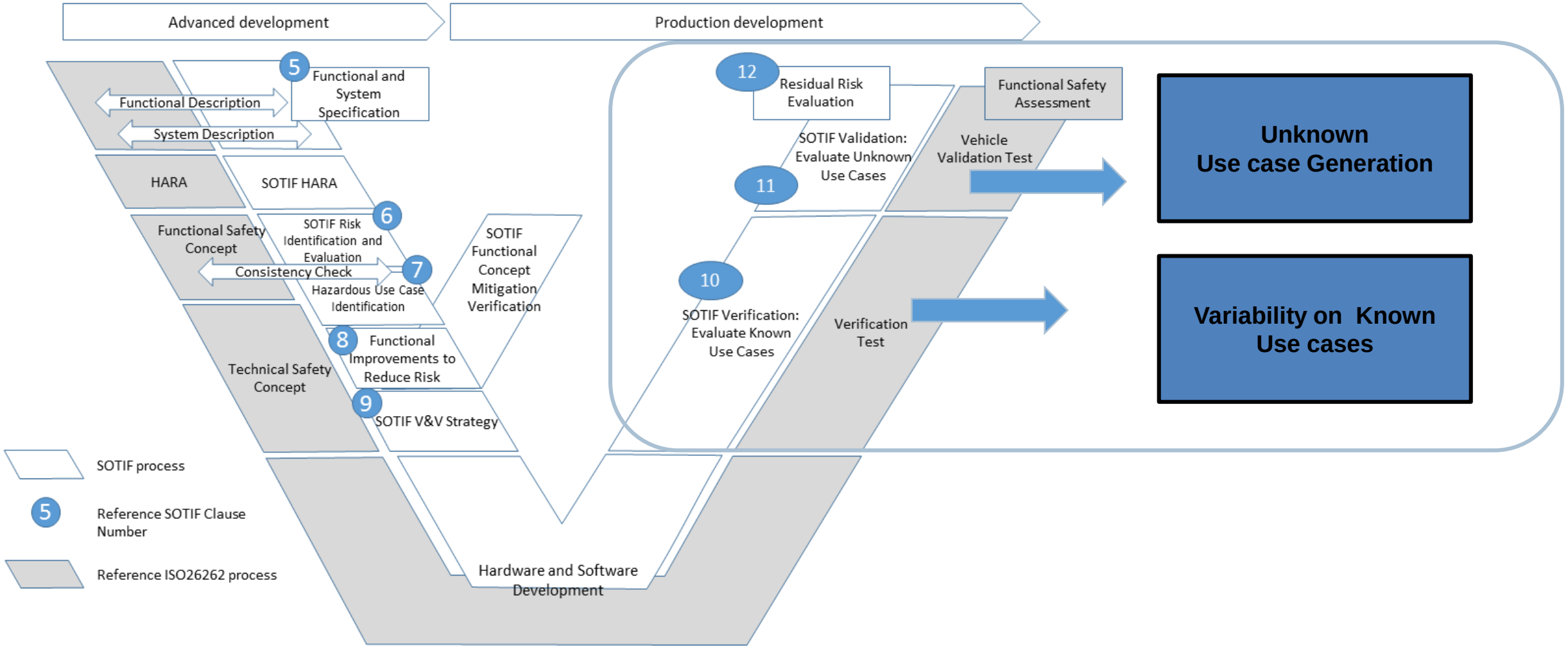
SOTIF requirements



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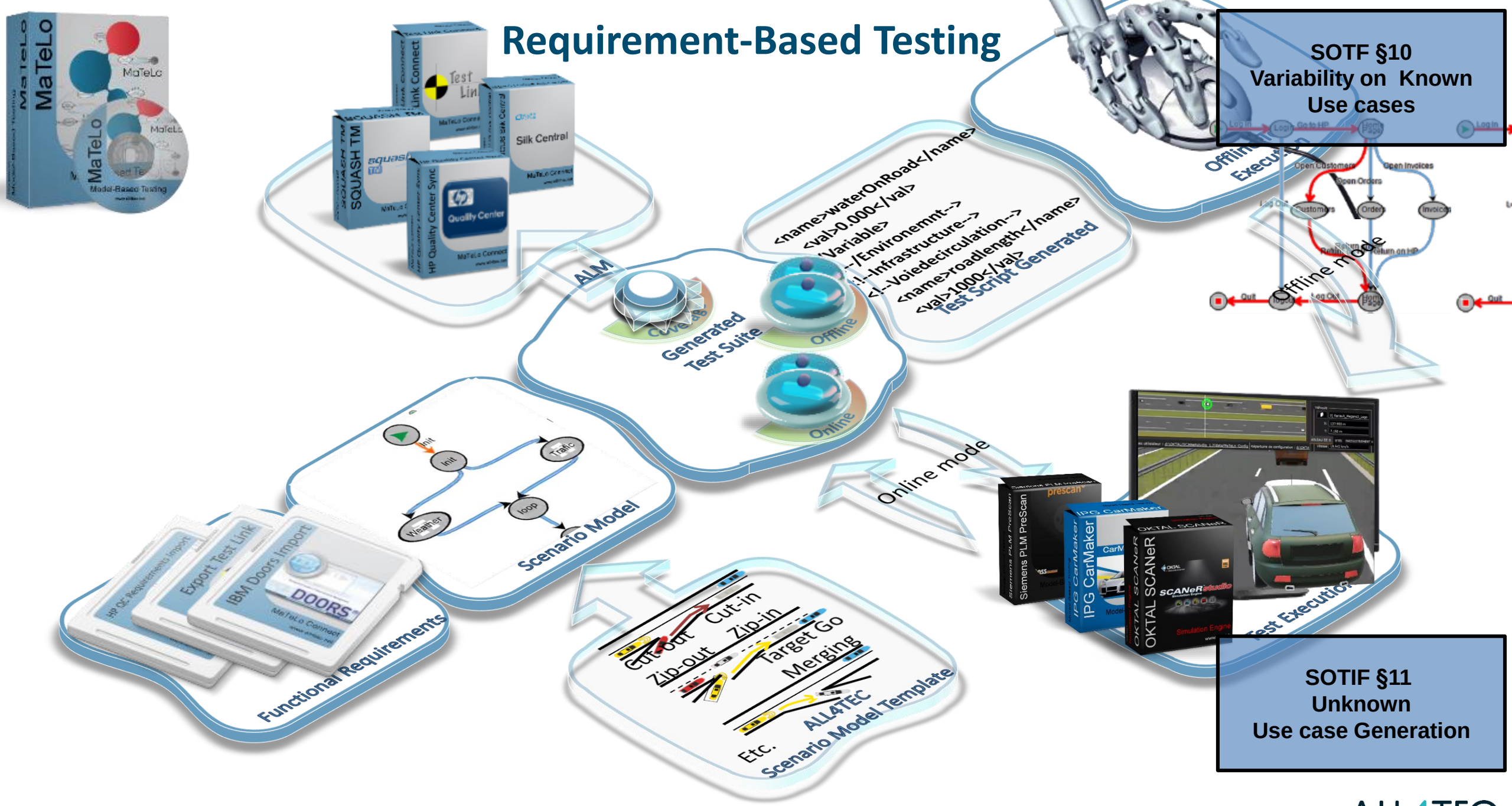
Requirement-Based Testing



SOTF §10
Variability on Known
Use cases

SOTIF §11
Unknown
Use case Generation

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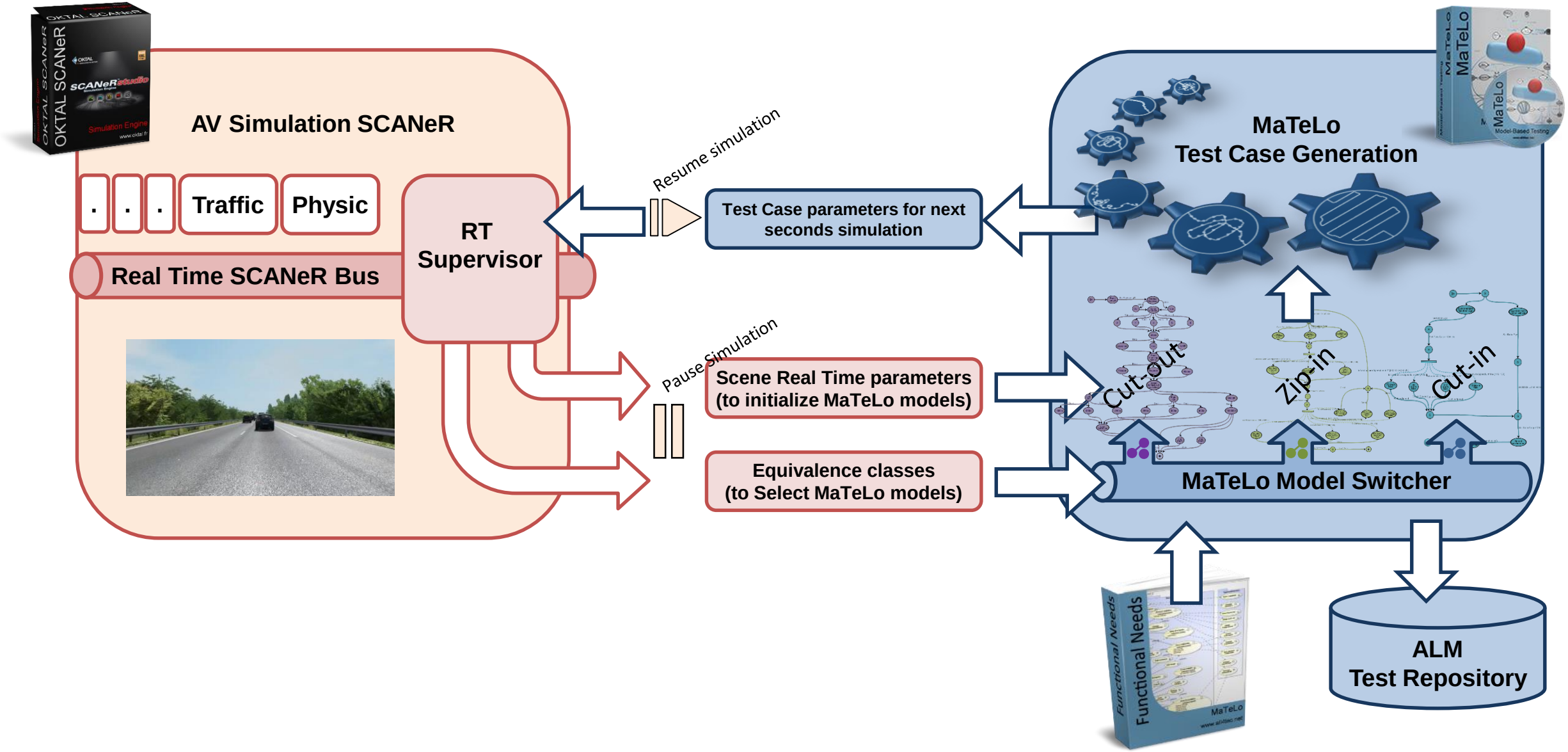
Requirement in the Loop



Requirements

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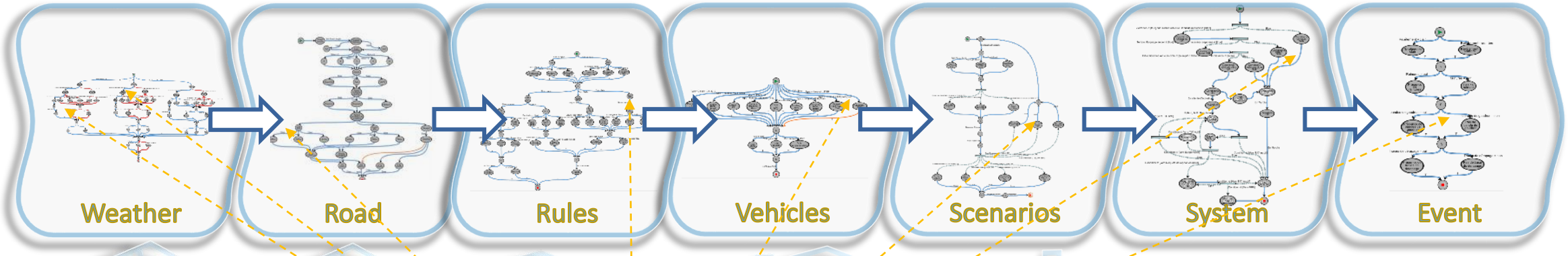
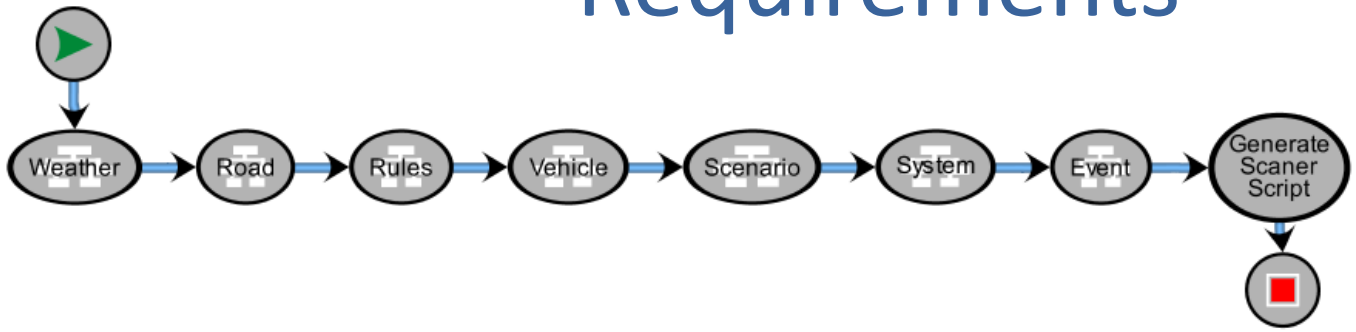
Model of equivalence class families

The model represents an abstraction of the states of the environment decomposed in main combinatoric families



Requirements



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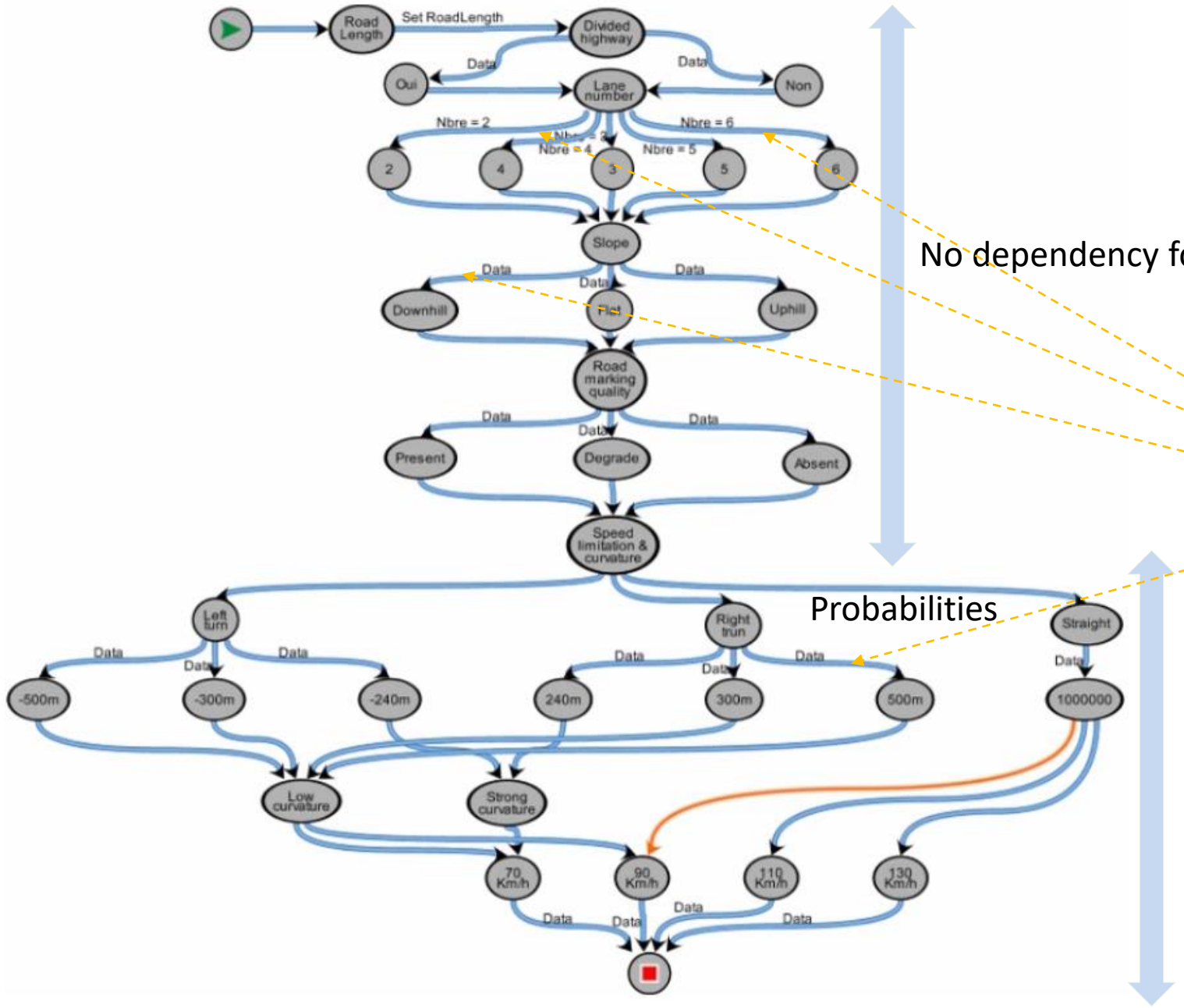
Equivalence class representation and dependencies



No dependency for theses equivalence classes

Requirements

Probabilities

Dependencies for theses equivalence classes

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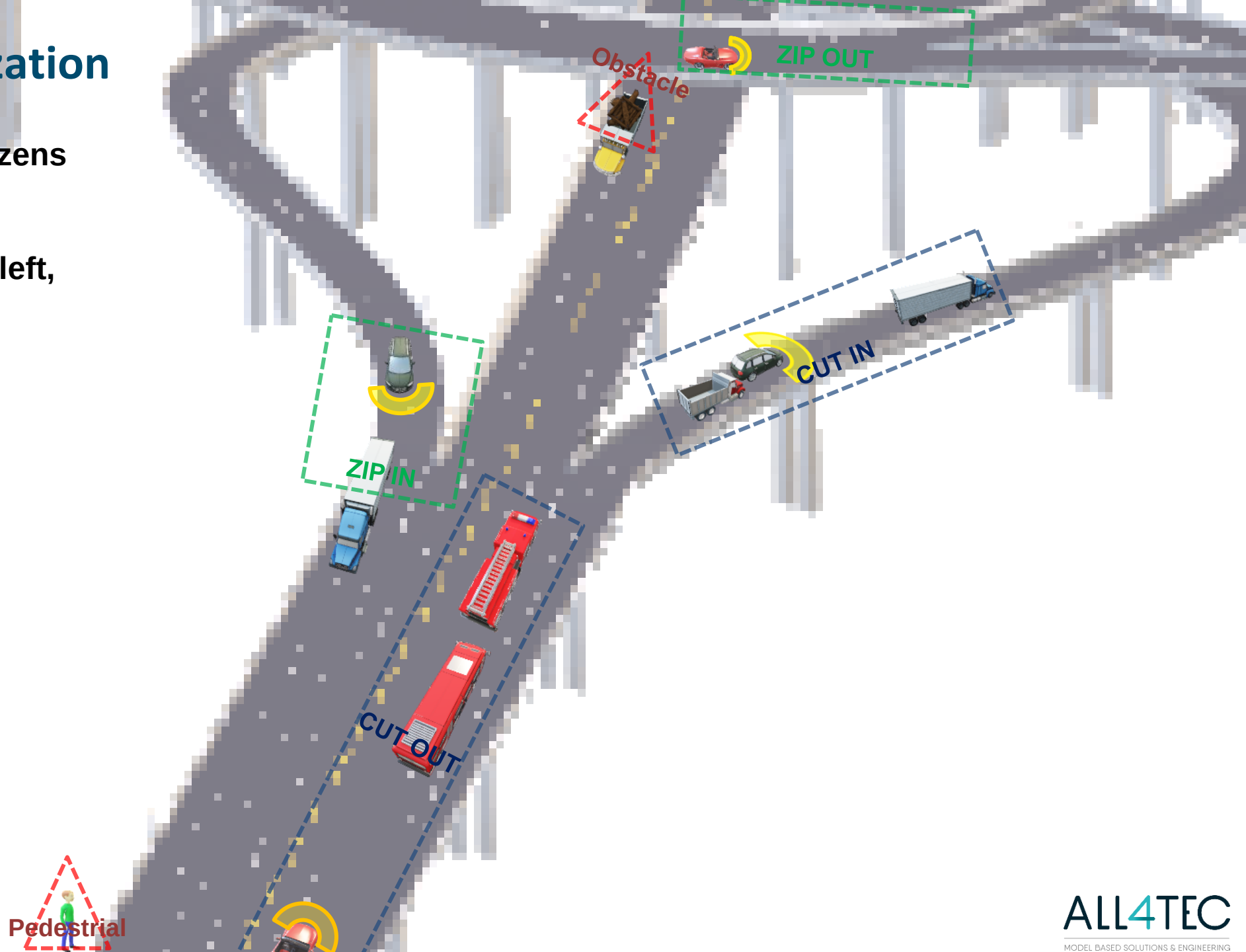
Scenarios Categorization

Expert categorization of dozens risked template scenarios :

- **Cut-in from behind from left,**
- **Cut-out**
- **Insertion**
- **Target Following**
- **Target Go**
- **Target Stop**
- **Cut-out Cut-in**
- **…**



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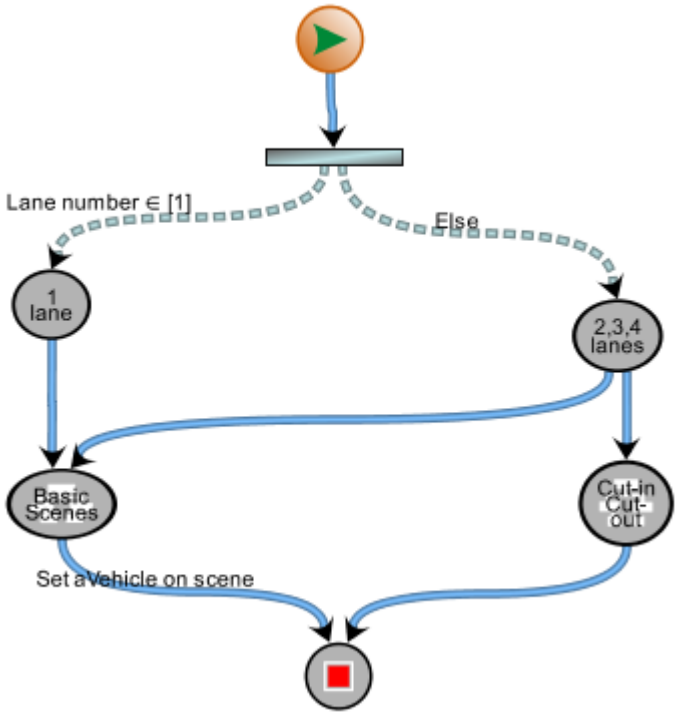
Scenarios Categorization

Each scenario is a sub model
A scenario can only occurs when depending previous classes are compliant



All scenarios are built in order to achieve the objective with the maximum determinist

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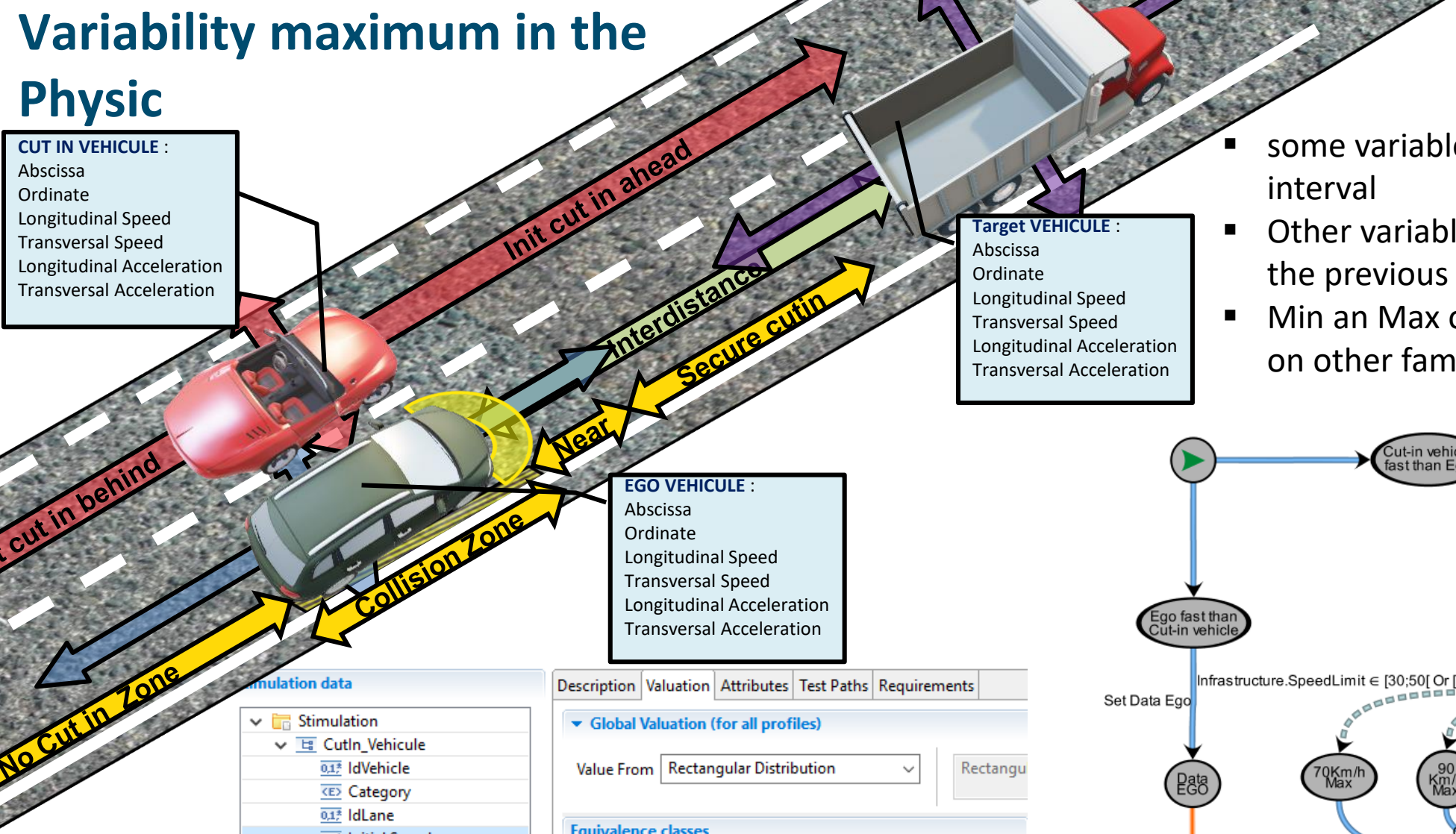
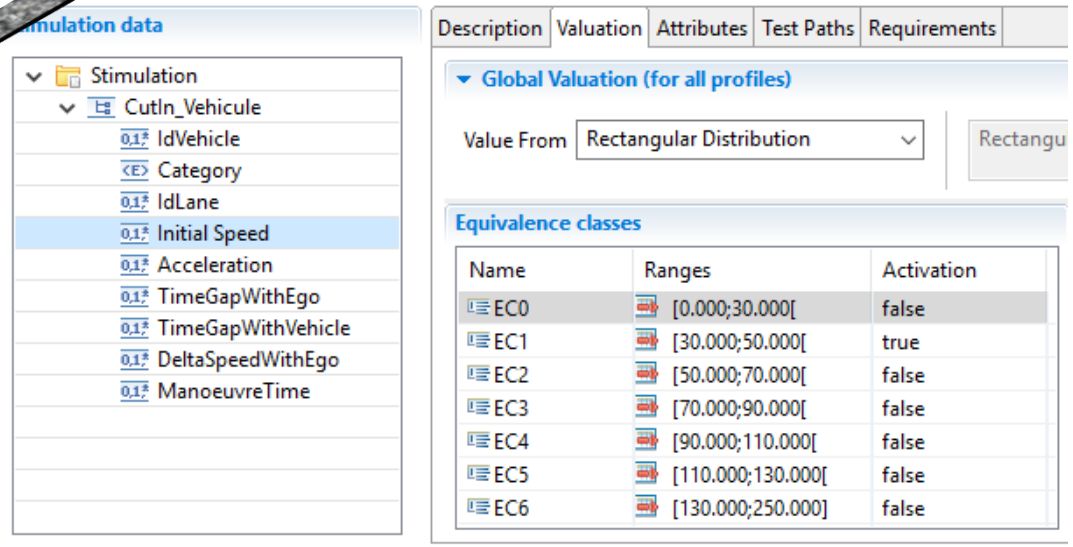
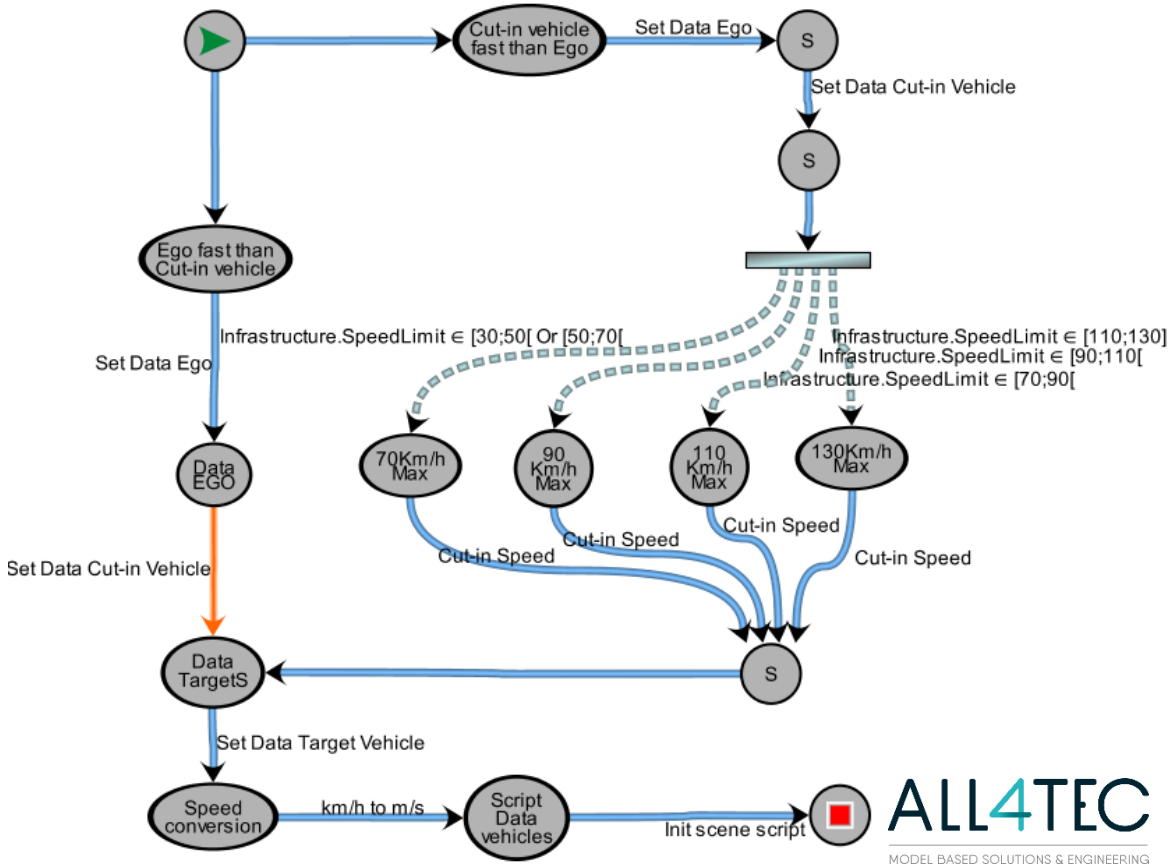
Variability maximum in the Physic



- some variables are randomly drawn in an interval
- Other variables are calculated based on the previous random variables
- Min an Max of each variable can be linked on other family variables



Name	Ranges	Activation
EC0	[0.000;30.000[	false
EC1	[30.000;50.000[	true
EC2	[50.000;70.000[	false
EC3	[70.000;90.000[	false
EC4	[90.000;110.000[	false
EC5	[110.000;130.000[	false
EC6	[130.000;250.000]	false



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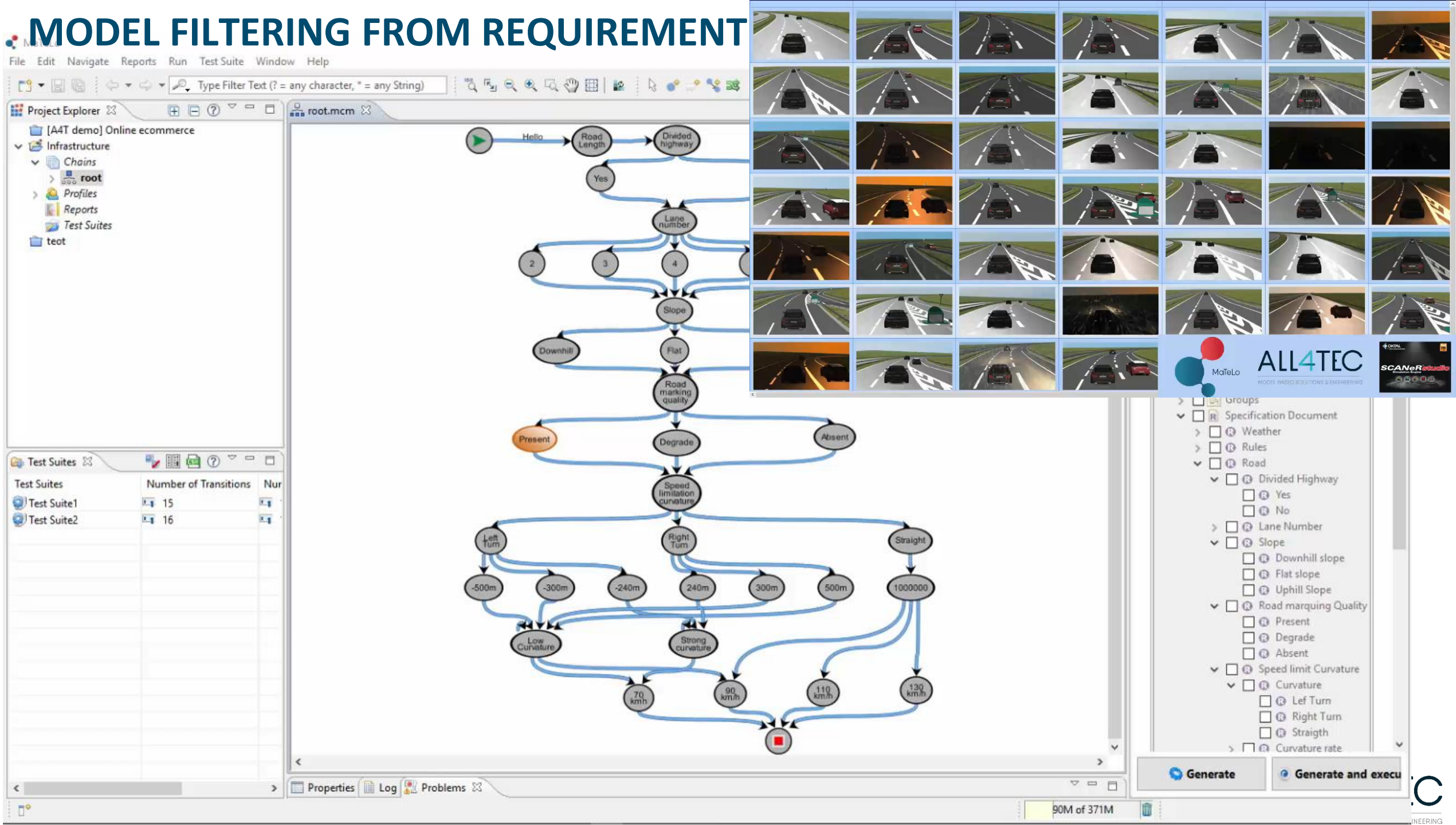
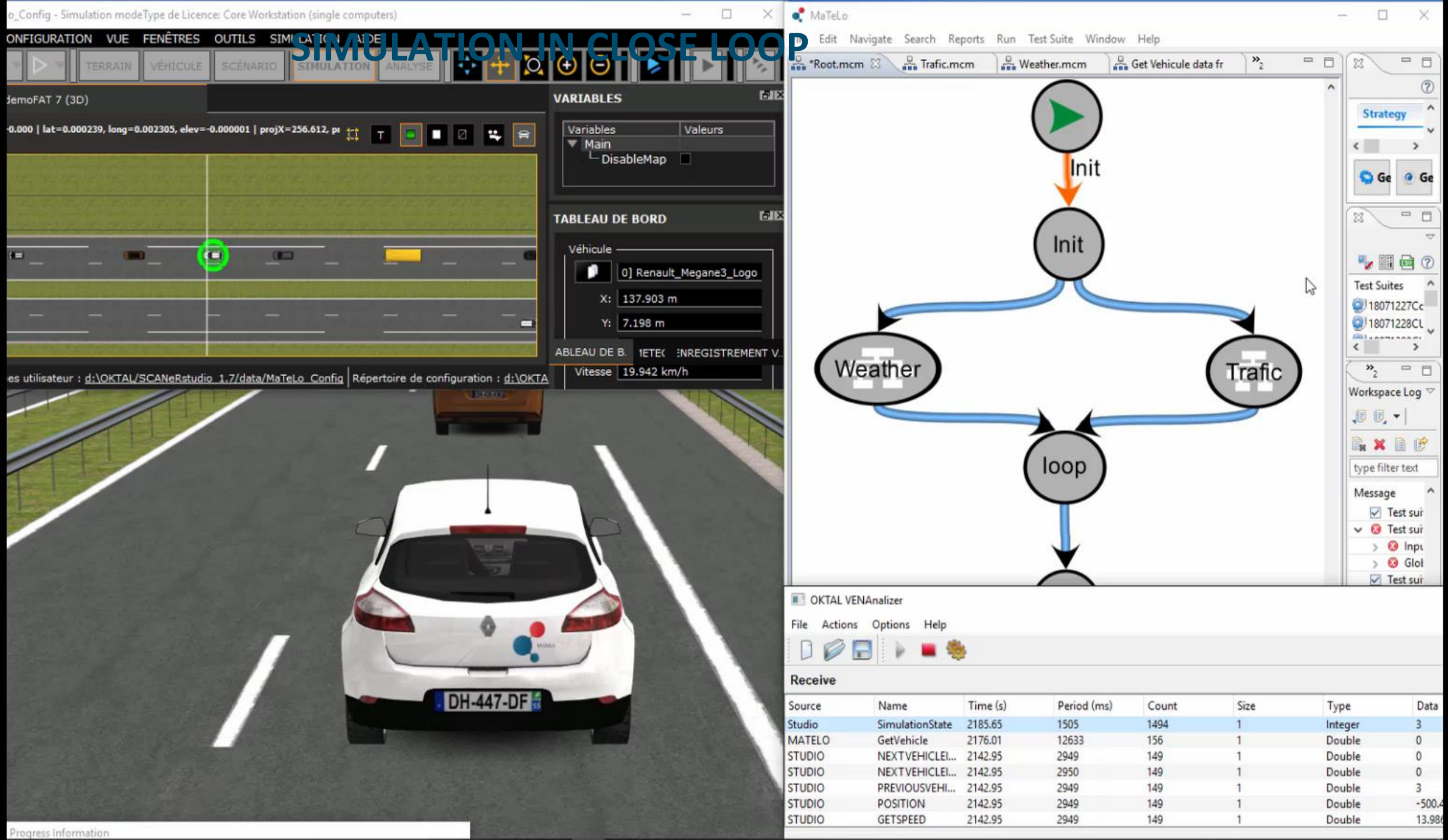
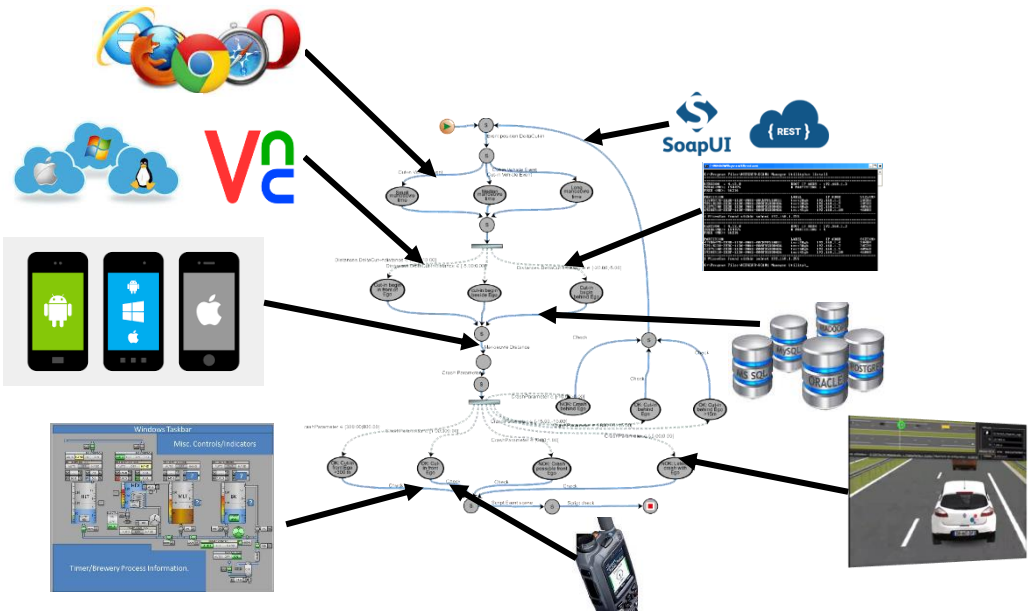
MODEL FILTERING FROM REQUIREMENT



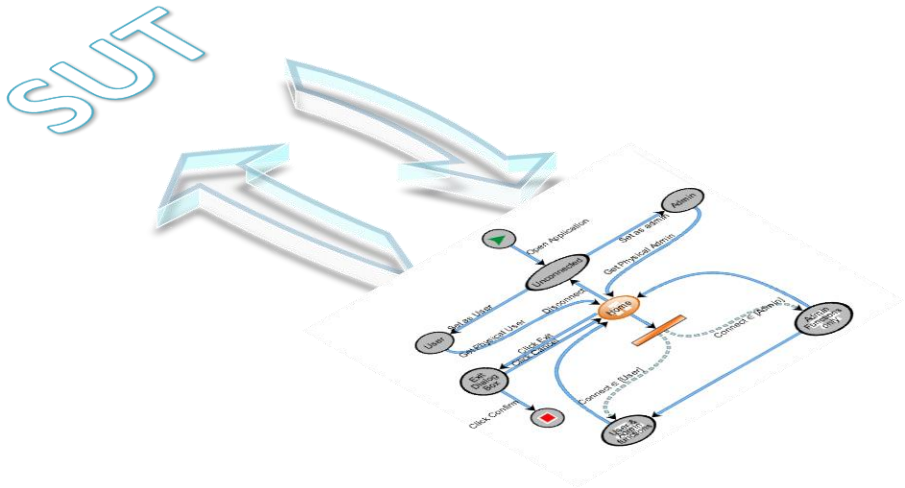
SIMULATION IN CLOSE LOOP



Benefits with Online Close Loop Requirement based testing



End 2 End Test Requirement with multiple Technologies



Adapt requirement testing durging the test execution

Execute as long as you want with always different test cases

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Thank you for your attention

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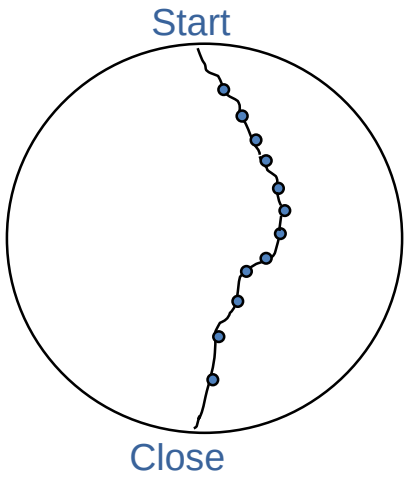
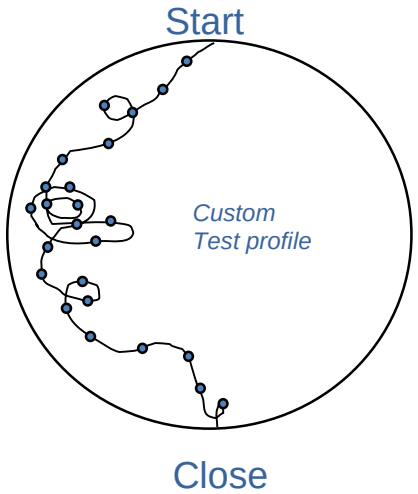
Test Application Life cycle strategy

Most probable approach



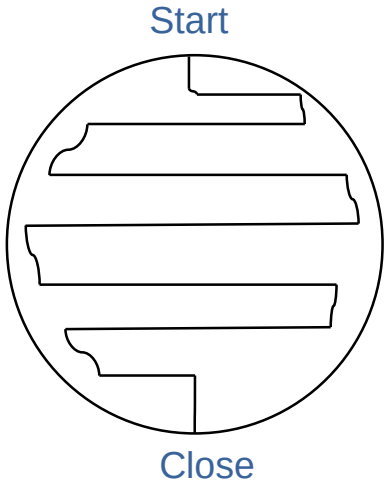
FREQUENCY FOCUS

Usage & Risk based Approach



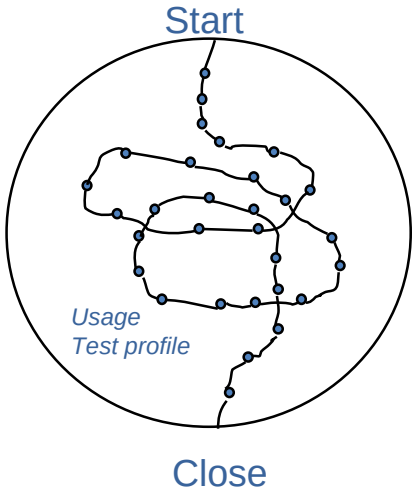
CRITICALITY, COMPLEXITY UPDATE FOCUS

Arc Coverage approach



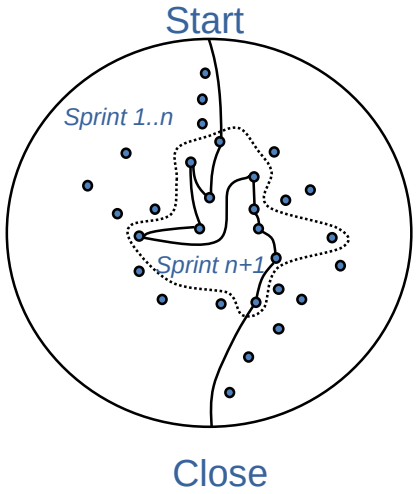
REQUIREMENTS COVERAGE

Random approach



OPERATIONAL COVERAGE

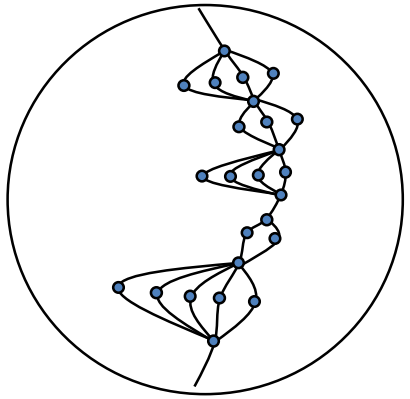
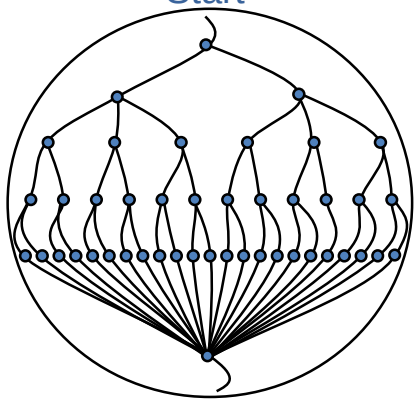
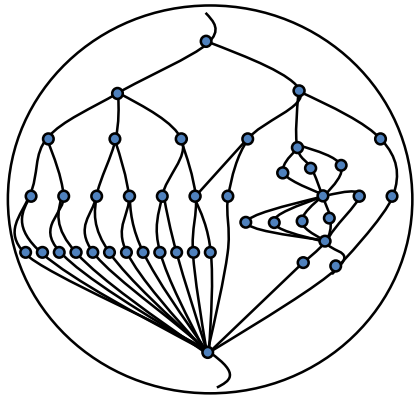
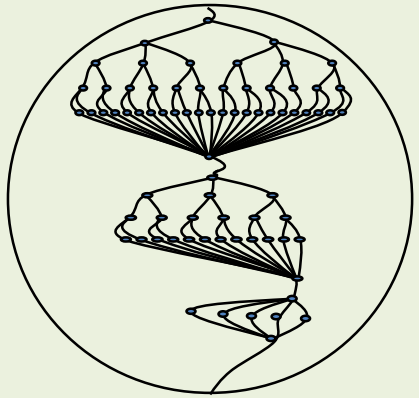
Δ Sprint approach



SPRINT N+1 - SPRINT N COVERAGE

SMOKE TESTING	RISK BASED TESTING	REGRESSION TESTING	COMBINATORY USAGE TESTING	EVOLUTION TESTING Without Regression

Combinatorics coverage

Minimum Data Coverage	Full Data Coverage	Custom Data Coverage	**Gibbs Sampling**
Start	Start	Start	Start
			
Close	Close	Close	Close
Minimum number of test	Large number of test Dependence of classes	Specific coverage	Fast sampling
Equivalence classes covered one time	**Equivalence Classes combinatorics**	**Custom equivalence class coverage**	**Converge toward stationary distribution**