# stiEF Presentation

Motivation, overview and publication

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# stiEF
## Goals and Key Features

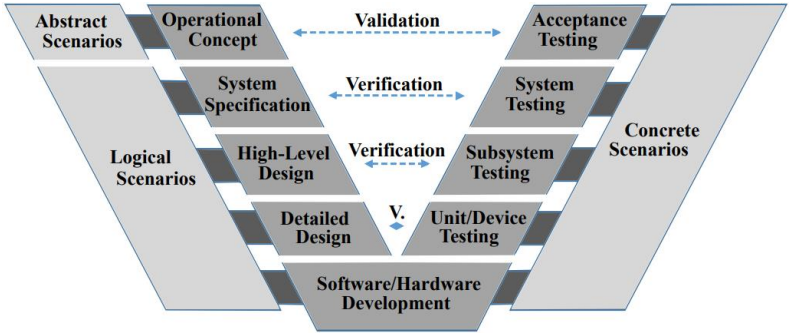
- **stiEF** („scenario-accompanied, textbased, iterative Evaluation of automated driving Functions“) is a textual domain-specific language for traffic scenario descriptions

- **stiEF** is based on
  - aldready existing manually created scenarios to provide a natural language style description format
  - the PEGASUS abstraction levels (functional, logical, concrete) and the content layers (1: road level, 2: traffic infrastructure, 3: temporary modifications, 4: objects & maneuvers, 5: environment conditions) to structure scenarios
  - the open-source framework JetBrains Meta Programming System (MPS)
  - Note: „Abstract scenario“ ⇔ „Functional scenario“

- stiEF is currently limited to freeway/highway descriptions
- stiEF provides the scenario descriptions in English and German
- stiEF provides generators/exporters for Word, Excel, JSON, PNG and animated GIF

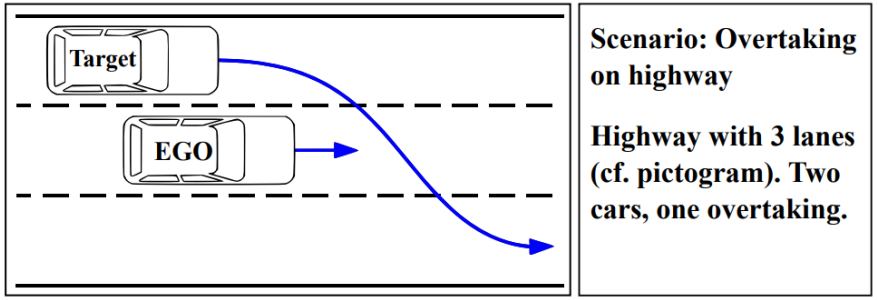
# stiEF
## Problem definition

- Scenarios are used throughout the development process




From: F.Bock, C.Sippl, A.Heinz, C.Lauer, R.German – "Advantageous Usage of Textual Domain-Specific Languages for Scenario-Driven Development of Automated Driving Functions", SysCon 2019, Orlando

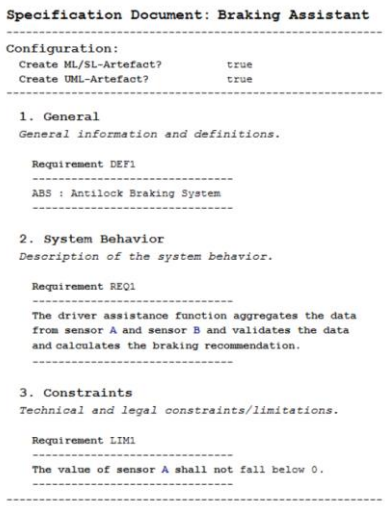
- Scenario creations is done mainly by hand
- Scenario descriptions are often inconsistent or incomplete (also visualization)
- Support for multiple languages by manual translations



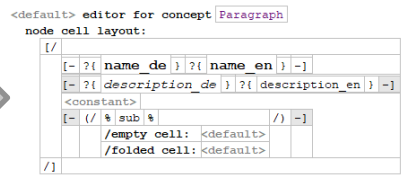
# stiEF
## DSLs in JetBrains MPS[1]

- A DSL in JetBrains MPS includes three different aspects:
  - Structure: The data model of the language with all entities and their attributes
  - Editor: The visualization of the data model for the user based on rules
  - Generator: Rules to generate target artifacts out of the data model

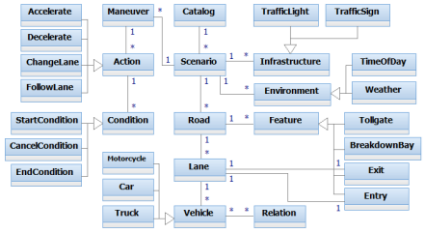




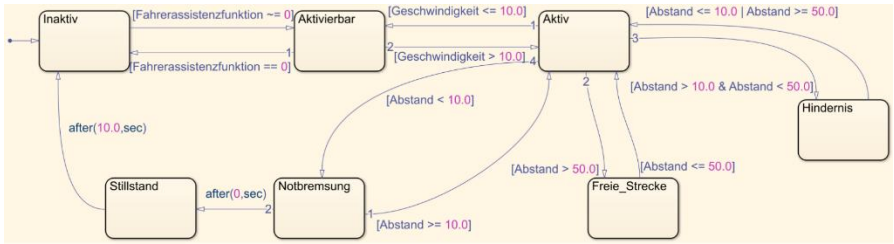

View




Data




Generation




1 Jetbrains „Meta Programming System“ (MPS)
https://www.jetbrains.com/de-de/mps/

# stiEF
## Initial prototype – English representation

Road level

Infrastructure

Temporal changes

Objects

Maneuvers

Environment

Ego maneuvers

```
Abstraction level: 01_abstract . Scenario workstep: 03_complete .
-------------------------------------------------------------------------------------------------------
(L1) Road level:
   A straight road ( ID: ROAD1 ) with a emergency lane . It has the following lanes :
     A normal lane ( ID: LANE0 ) , which has the following vehicles on it : None .
     A normal lane ( ID: LANE1 ) , which has the following vehicles on it : car 0,  car 1 .
     A normal lane ( ID: LANE2 ) , which has the following vehicles on it : truck 2,  truck 3 .

   Additional features:
     No features defined.


(L2) Traffic infrastructure:
   A traffic sign of type ' no overtaking ' .

(L3) Temporal infrastructure changes:
   Lane LANE0 is blocked by an accident .

(L4) Dynamic elements:
   Vehicles:
     A car (ID: 0 ) .
     A car (ID: 1 ) .
     A truck (ID: 2 ) .
     A truck (ID: 3 ) .
     A bicycle (ID: 4 ) .

   Relative vehicle positions:
     car 0 is in front of car 1 .
     truck 2 is in front of truck 3 .

   Maneuver seugence:
     Maneuver : car 1 accelerates [start] instantly until [end] the lane LANE1 is free .
     Maneuver : truck 2 follows the road [start] instantly .
     Maneuver : car 0 decelerates [start] after 5 s .

   Ego-Vehicle: car 1

(L5) Environment conditions:
   The current weather is: sunny . The scenario is set at day .

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  Eog behavior:
   Maneuver seugence:
     Maneuver : car 1 accelerates [start] instantly until [end] the lane LANE1 is free .
-------------------------------------------------------------------------------------------------------
```
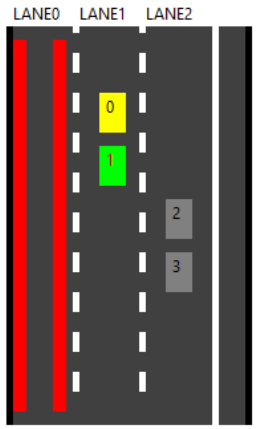

English

Preview:




Live visualization of the scenario

Goal: Review and discussion with the stakeholders

# stiEF
## Initial prototype – German representation

Road level

Infrastructure

Temporal changes

Objects

Maneuvers

Environment

Ego maneuvers

```
Abstraktionslevel: 01_abstrakt . Szenarienarbeitsschritt: 03_vollständig .
-----------------------------------------------------------------------------------------------------------
(L1) Straßenebene:
   Eine gerade Straße ( ID: ROAD1 ) mit einem Standstreifen . Sie hat folgende Fahrbahnen :
     Eine normale Fahrbahn ( ID: LANE0 ) , auf der sich folgende Fahrzeuge befinden : None .
     Eine normale Fahrbahn ( ID: LANE1 ) , auf der sich folgende Fahrzeuge befinden : PKW 0,  PKW 1 .
     Eine normale Fahrbahn ( ID: LANE2 ) , auf der sich folgende Fahrzeuge befinden : LKW 2,  LKW 3 .

   Zusätzliche Merkmale:
     No features defined.

(L2) Straßenausstattung:
   Ein Verkehrszeichen vom Typ ' Überholverbot ' .

(L3) Temporäre Infrastrukturänderungen:
   Fahrbahn LANE0 ist durch einen Unfall blockiert .

(L4) Dynamische Elemente:
   Fahrzeuge:
     Ein PKW (ID: 0 ) .
     Ein PKW (ID: 1 ) .
     Ein LKW (ID: 2 ) .
     Ein LKW (ID: 3 ) .
     Ein Fahrrad (ID: 4 ) .

   Relative Position der Fahrzeuge:
     PKW 0 ist vor PKW 1 .
     LKW 2 ist vor LKW 3 .

   Manöversequenz:
     Manöver : PKW 1 beschleunigt [Start] sofort bis [Ende] die Fahrbahn LANE1 frei ist .
     Manöver : LKW 2 folgt der Straße [Start] sofort .
     Manöver : PKW 0 bremst [Start] nach 5 s .

   Ego-Fahrzeug: PKW 1

(L5) Umgebungsbedingungen:
   Das aktuelle Wetter ist: sonnig . Das Szenario findet tagsüber statt .

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  Egoverhalten:
   Manöversequenz:
     Manöver : PKW 1 beschleunigt [Start] sofort bis [Ende] die Fahrbahn LANE1 frei ist .
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```
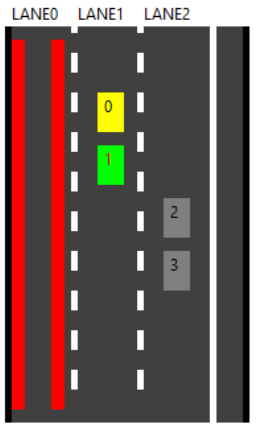

German

Vorschau:

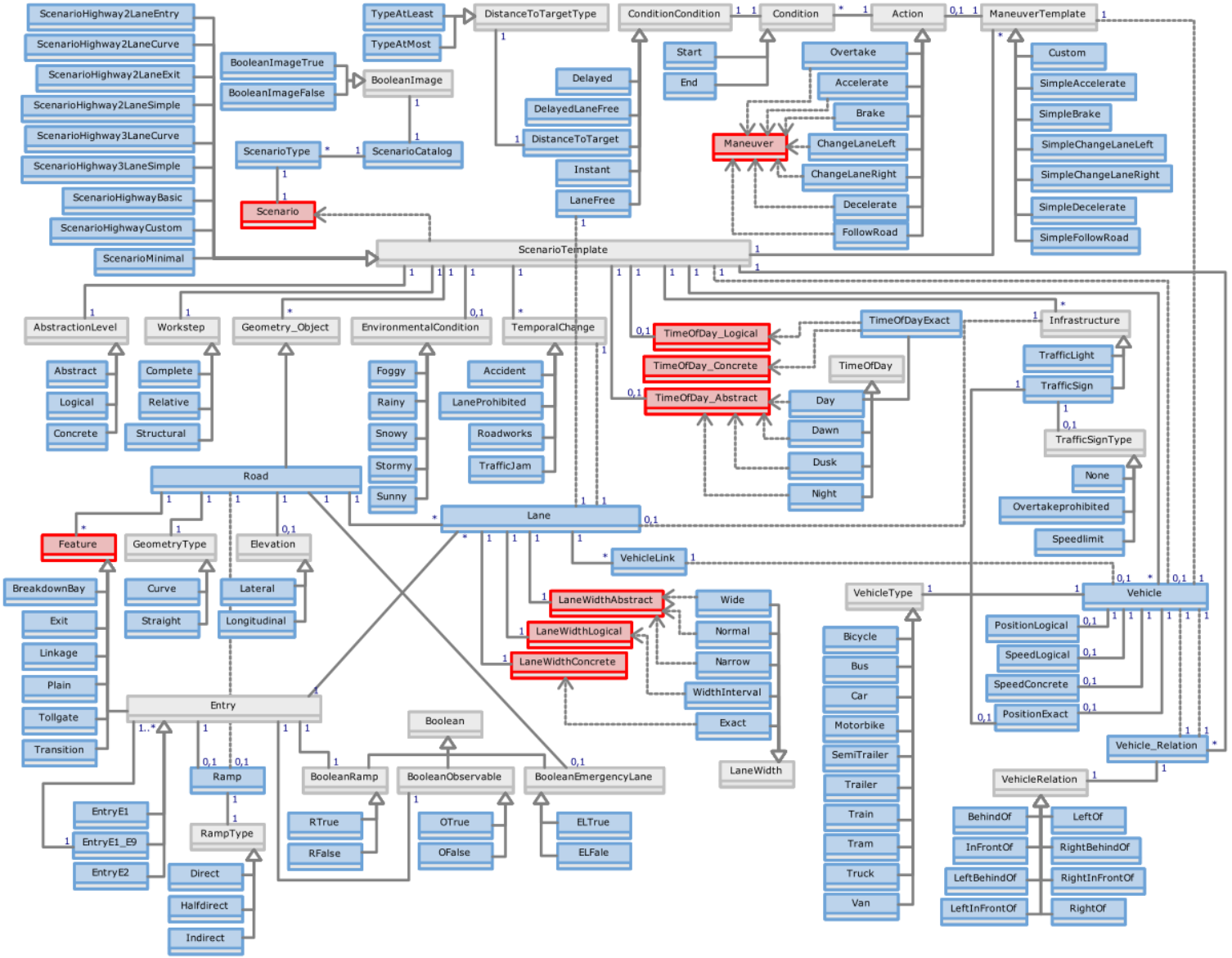



Live visualization of the scenario

Goal: Review and discussion with the stakeholders

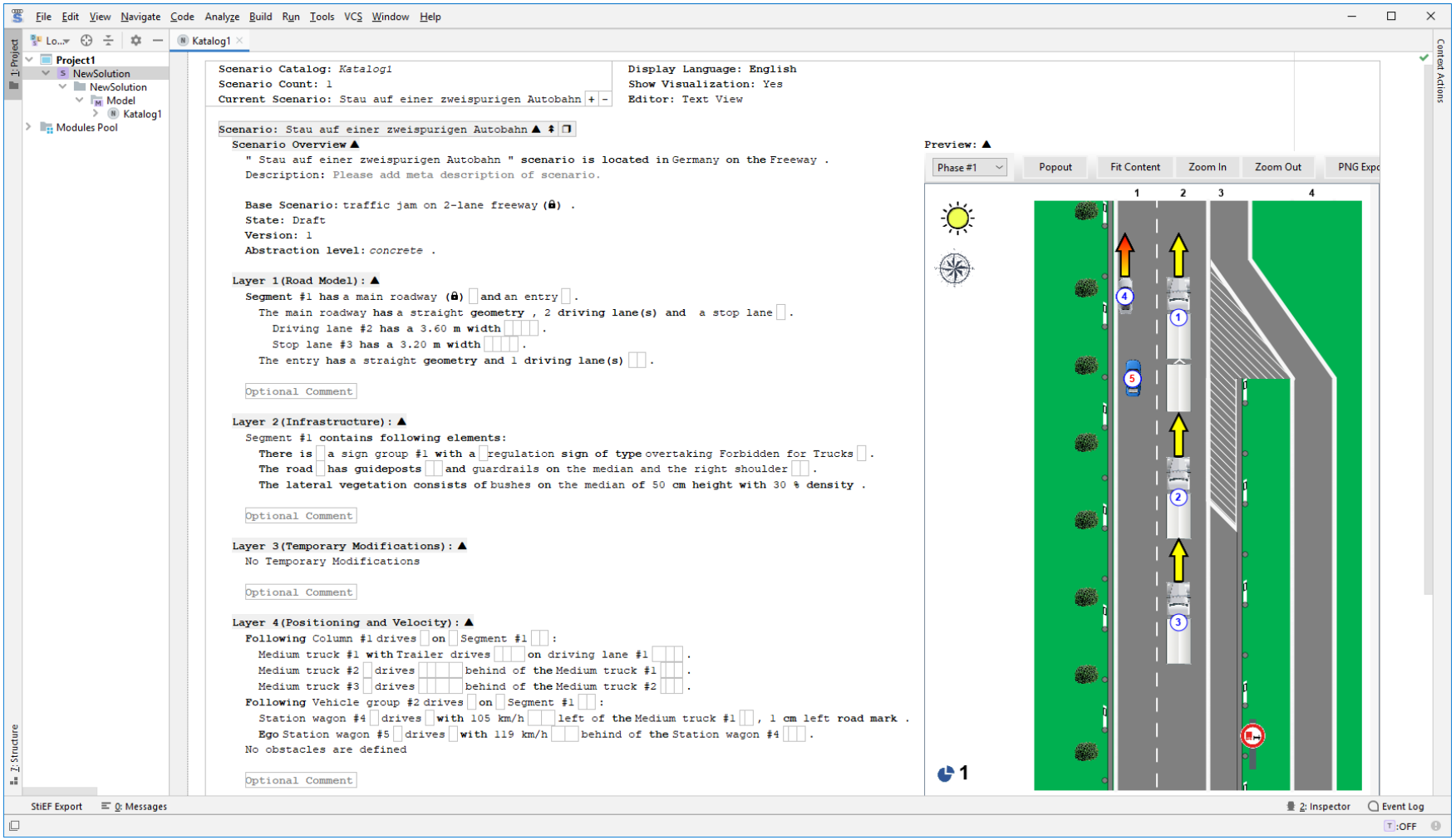
# stiEF

## Initial prototype – data model



# stiEF
## Final implementation – English representation

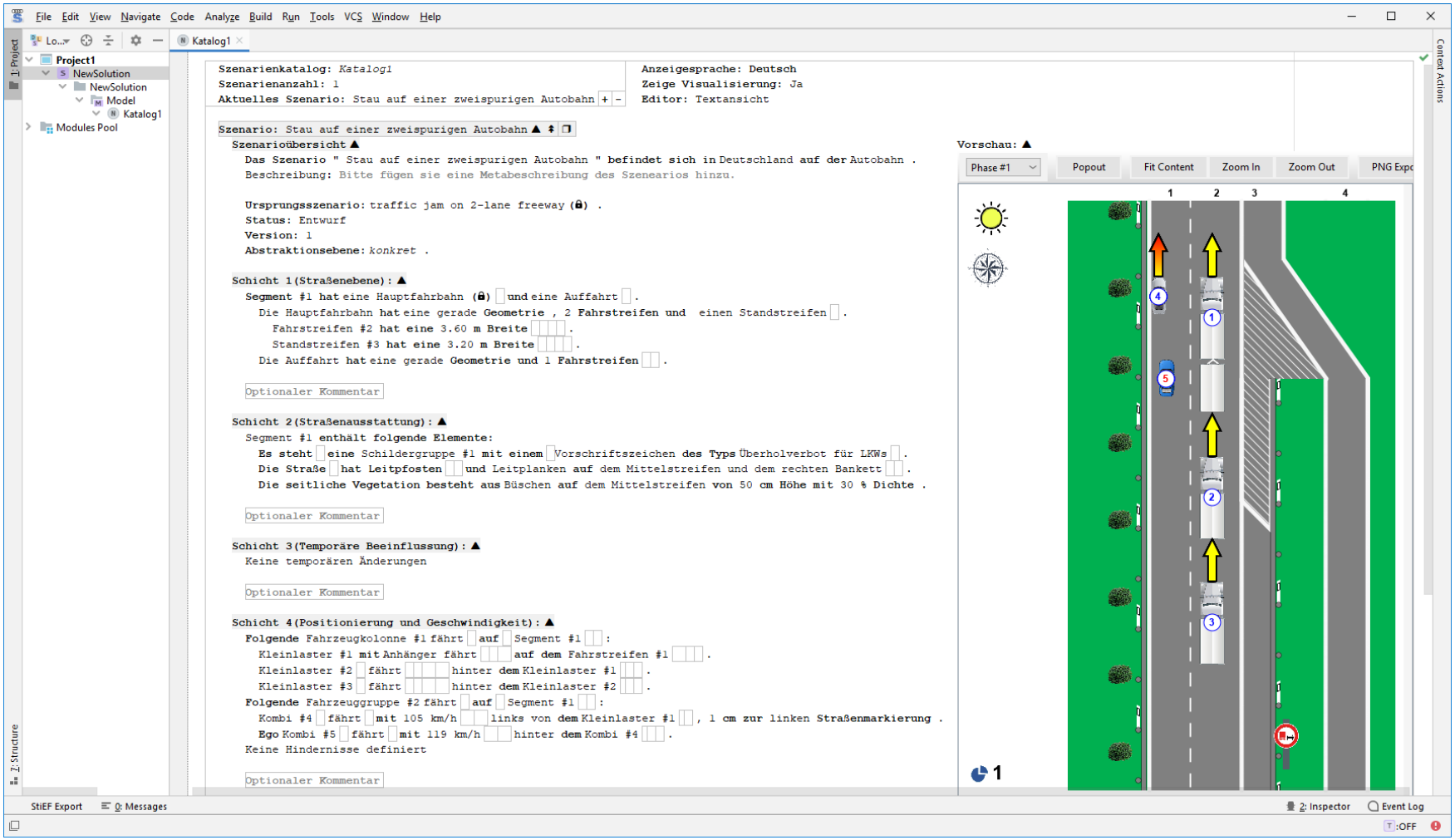
› Scenario description in English with the corresponding generated visualization:



# stiEF

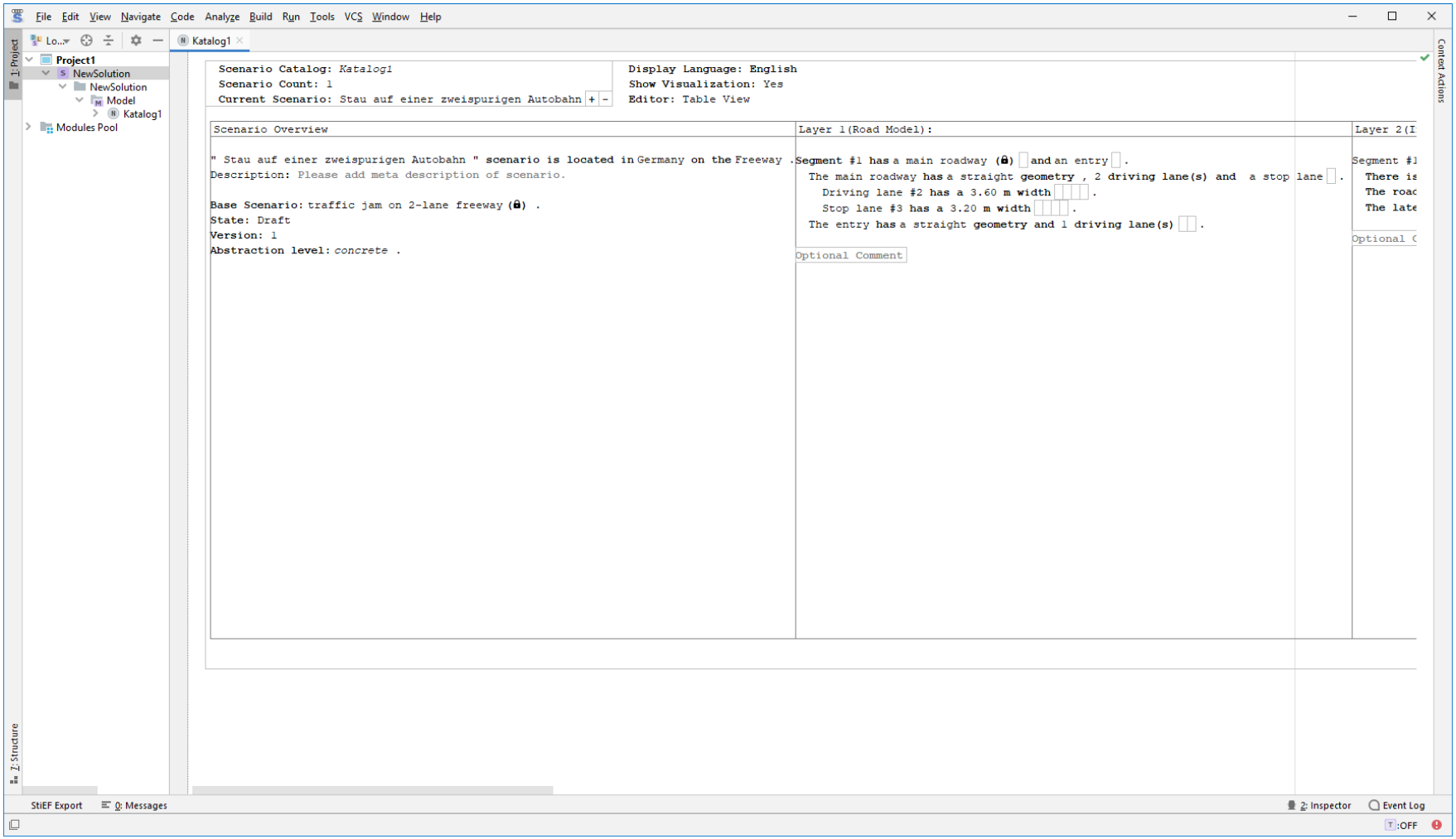
## Final implementation – German representation

› Scenario description in German with the corresponding generated visualization:



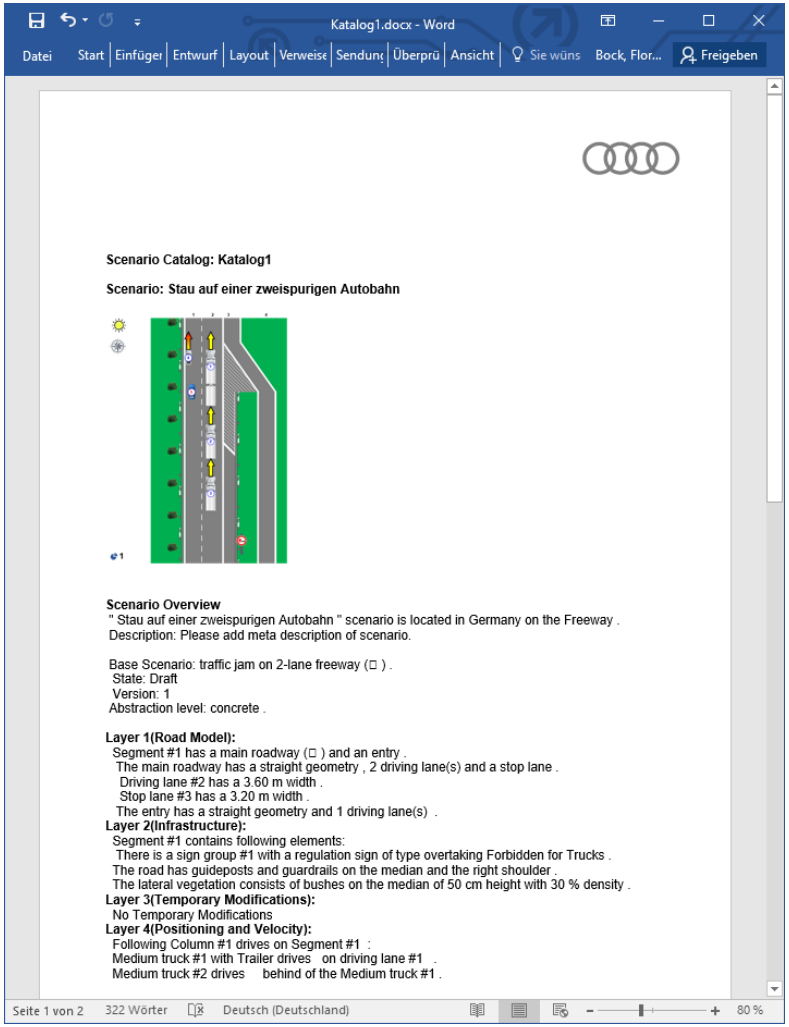
# stiEF
## Final implementation – Table view

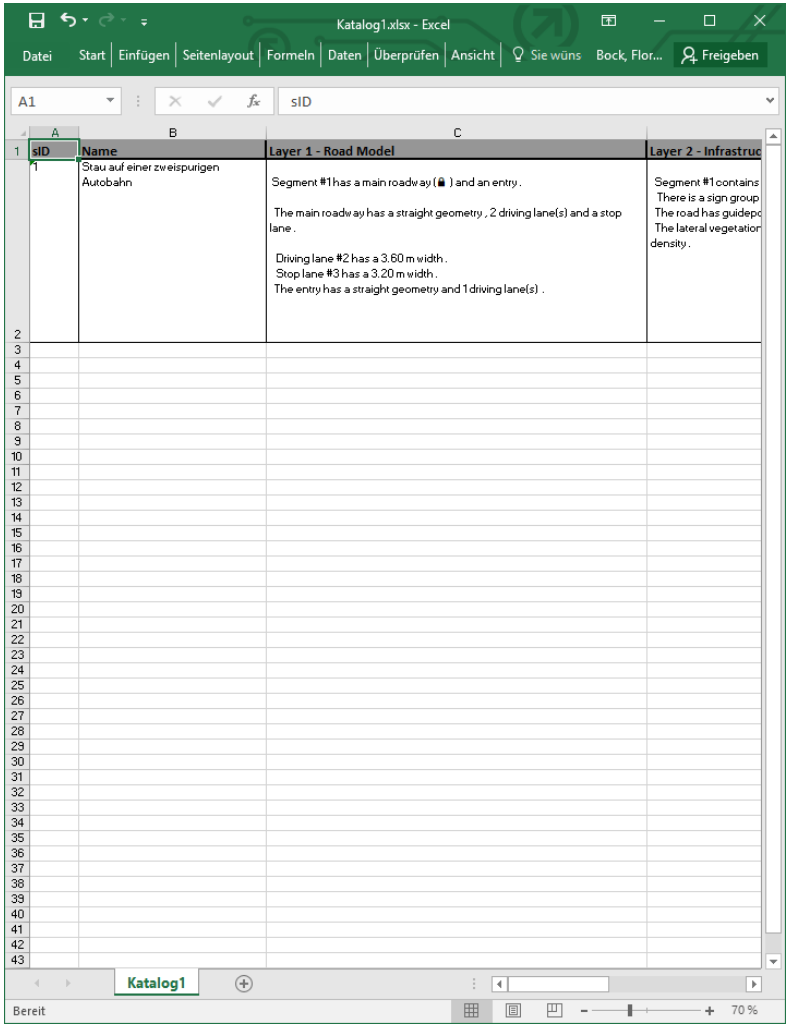
› Scenario description viewed as table:



# stiEF
## Final implementation – Generated artifacts

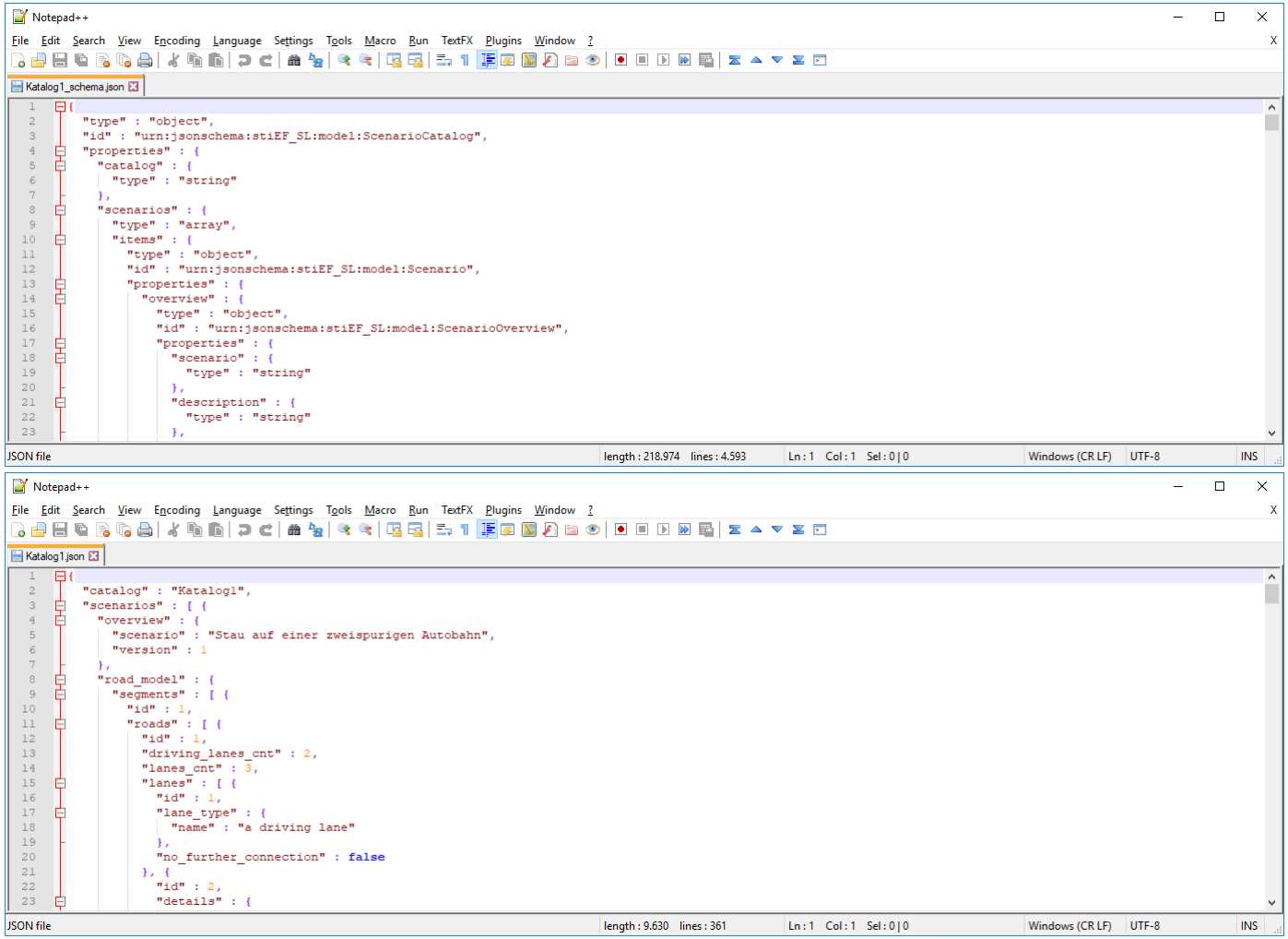
- Generated Work and Excel exports:



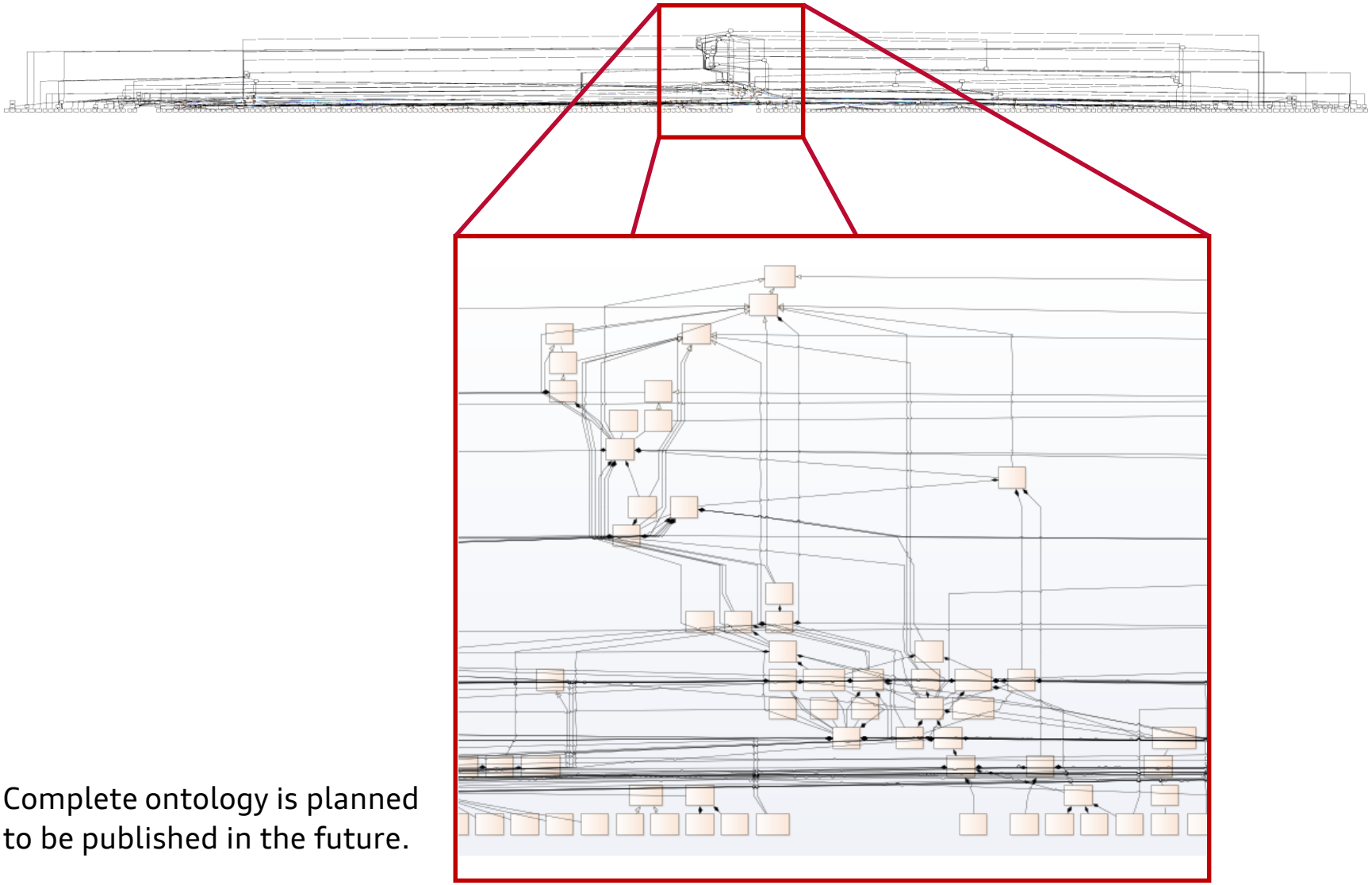
# stiEF
## Final implementation – Generated artifacts

› Generated JSON schema and JSON export for the scenario:



# stiEF

## Final implementation – data model



Complete ontology is planned to be published in the future.

# stiEF
## File location, documentation and installation steps

- Tool „stiEF“:
  - Currently AUDI IP, so only available internally at VW
  - Publication is currently discussed – no decision yet

- Language „stiEF“:
  - Publication of the language as a document is approved
  - Publication is currently prepared and will be available soon™

- Publications:
  - 2019 – “Advantageous Usage of Textual Domain-Specific Languages for Scenario-Driven Development of Automated Driving Functions”, SysCon 2019, Orlando
  - 2019 – “Scenario-Based Systems Engineering: An Approach Towards Automated Driving Function Development”, SysCon 2019, Orlando
  - 2020 – “Efficient usage of abstract scenarios for the development of highly-automated driving functions”, FKFS Symposium 2020, Stuttgart

# Thank you!

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