Scenarios do not necessarily mean scenarios

What is the content of a scenario and how is it described? How can scenarios be utilized in a development process?

Scenarios are a key element of the PEGASUS test concept.

The term Scenario has different contents and representations in a development process.

The concept phase describes scenarios with natural language on a high level of abstraction.

Technical development and test case generation have demand for a representation with parameter spaces in the physical state space.

The test case execution and assessment needs distinctively defined scenarios in common data formats.

Breakdown in three abstraction levels:
- Functional
- Logical
- Concrete

Structure of contents based on a 5 layer model.

5 layer model for description of scenarios

| Level 1: | Description of street layout and condition of the surface. |
| Level 2: | Traffic guidance infrastructure like signs, barriers, and markings. |
| Level 3: | Temporary overlay of topology and geometry for temporal construction sites. |
| Level 4: | Description of traffic participants and objects including interactions based on maneuvers. |
| Level 5: | Modeling of environment conditions like weather and daytime including influence on level 1 to 4. |

Abstraction levels of scenarios:
Functional scenarios contain natural language.
Logical scenarios describe parameter spaces in the state space.
Concrete scenarios depict a concrete representative of a logical scenario.

Functional scenarios
- Street level (L1)
  - Geometry and topology
  - Condition, boundaries
- Traffic infrastructure (L2)
  - Construction barriers
  - Signs, traffic guidance
- Temporal modifications L1 und L2 (L3)
  - Geometry and topology overlay
  - Time dependent > 1 day
- Movable objects (L4)
  - Dynamic, movable
  - Interactions, maneuvers
- Environment conditions (L5)
  - Influence on properties of other levels

Logical scenarios
- Base road network:
  - Lane width [2.3-3.5] m
  - Curve radius [0.6-0.9] km
  - Position traffic sign [0-200] m
- Stationary objects:
  - Environmental conditions
  - Temperature [20-40] °C
  - Droplet size [20-100] μm
- Movable objects:
  - End of traffic jam
  - Traffic jam speed
  - Ego distance [20-300] m
  - Ego speed [80-130] km/h

Concrete scenarios
- Base road network:
  - Lane width [3-2] m
  - Curve radius [0.7] km
  - Position traffic sign [100] m
- Stationary objects:
  - Environment
  - Temperature 20 °C
  - Droplet size 30 μm
- Movable objects:
  - End of traffic jam
  - Traffic jam speed 30 km/h
  - Ego distance 200 m
  - Ego speed 100 km/h

The concept phase describes scenarios with natural language on a high level of abstraction.
Usage of scenarios in the development process

Which process phases can use scenarios?
Which requirements are demanded by process phases?

V-model based development processes (e.g. ISO 26262) define the state of the art for development of automated driving functions.

Scenarios can be used in multiple process phases. The usage in different phases demands inconsistent requirements on the manner of representation of scenarios.

Concept phase
- Scenarios must be expressed in natural language
- Scenarios must be readable and understandable for human experts
- The vocabulary must be defined consistent and in atomic terms

System development
- Scenarios must describe parameter ranges for system states
- Scenarios must be organized in a formal representation for parameter ranges (data formats)

Test and validation
- Scenarios must be described as detailed as necessary to be conducted in testing methods and tools
- Scenarios must be described distinct and must not leave possibilities for interpretation (reproducibility)
- Scenarios must be efficiently readable for computer applications

V-model based development process based on ISO 26262:
Red frames highlight a possible usage of scenarios for system specification, realization or testing.