

“Reasonably foreseeable” and “preventable” concepts combined with scenario definition: some issues

This document aims at highlighting possible discrepancies in the definition of three linked important notions for automated systems’ safety demonstration: **“reasonably foreseeable”**, **“preventable”** conditions and **“traffic scenarios”**. These discrepancies, resulting from definitions set at the European level (EU 2022/1426), might deserve to be addressed cautiously in the forthcoming guidance (under JRC supervision at the EU level) and incorporating this in the UNECE documents (the recent “ODD Framework document” proposed by the DDT Workstream in FRAV).

1) Identified definition issues

The “reasonably foreseeable” conditions is a global notion aiming at guiding fully automated road system’s safety demonstration. This notion enlarges the scope of scenario methodology and principles. The FRAV requirements (and the EU Regulation 2022/1426) uses this concept without providing its definition.

Considering the notion of scenarios¹, it is useful to consider different types of scenarios, depending on their characteristics. The EU definition has distinguished nominal, critical and failure scenarios. Nominal scenarios are defined as follows in the Regulation: *‘nominal traffic scenarios’ means reasonably foreseeable situations encountered by the ADS when operating within its ODD. These scenarios represent the non-critical interactions of the ADS with other traffic participants and generate normal operation of the ADS.*

However, several occurrences of the terms “reasonably foreseeable” occur both in nominal scenarios and critical scenarios² in the text and in its annexes, including misuse by road users/passengers and collision avoidance. Moreover, this reference is used to describe parameter coverage of scenarios. This discrepancy suggests that the “reasonably foreseeable” conditions are not only linked to nominal traffic scenarios.

Furthermore, by mentioning “unexpected conditions” in the definition of critical scenarios, one may understand that critical scenarios do not fall under the “reasonably foreseeable”. This possible misinterpretation is highlighted by the following terms in the definition: “with an exceptionally low probability of occurrence” (which is somehow different from the “unexpected” concept).

Concerning the notion of “preventable” situation or scenario, the lack of common definition could lead to make an undue direct link between the ODD and the system response. The preventable notion should refer to two different notions:

- the identification and characterization, in the system’s conception and the safety demonstration process, of hazardous situations potentially generating collisions
- the characterization of the system response (linked with system performances), and its ability to prevent collisions derived from hazardous situations that have been identified and characterized (because foreseeable) in the ODD, within the conception / validation process.

It may be useful to distinguish more clearly these two notions.

2) Proposal for clarification

The “reasonably foreseeable” conditions are a strong guiding principle in scenario generation, feeding and enrichment. This global concept should not be linked with any kind of specific scenario type, as long as it reflects the entire approach.

¹ ‘scenario’ means a sequence or combination of situations used to assess the safety requirements for an automated driving system

² In particular the following terms: “all reasonably foreseeable critical traffic situations”.

Moreover, “reasonably foreseeable” applied to scenario generation should not be limited to evidence-based scenarios (e.g. data collected through incident or accident records), but include all scenarios that are “reasonably conceivable” for the system in its ODD.

Another important notion when working on scenario generation within system safety demonstration is not to link ODD definition and characterization with system response. The “reasonably foreseeable” principle should take into account any situation that might be encountered within the entire ODD. As long as a scenario has been considered within the “reasonably foreseeable” principle, it is assumed that the “preventable” concept comes into consideration.

By using “preventable”, it might lead to assume system capabilities (for example to avoid a collision or not) and finally characterizing the response (R) to the foreseeable object or hazard that has been detected (OED). The result of the “preventable” analysis should lead to characterize the potential collision (avoidance, mitigation or neither of them).

The strength of the concept of “reasonably foreseeable” deserves not to be weakened by possible discrepancies in definitions. It is hence worth addressing the identified discrepancies on “reasonably foreseeable” and “scenario” definitions, and avoiding these discrepancies to be duplicated in UNECE framework. A first step to avoid ambiguity, would be to remove the “reasonably foreseeable” notion from “nominal scenario” and to remove “unexpected conditions” from the “critical scenario” definition. Then to make a distinct difference between ODD and response, a solution would be not to use “preventable” without defining it clearly.

Finally, the use of “reasonably foreseeable” and “preventable” should be understood as two complementary concepts, aiming at demonstrating the exhaustive coverage of traffic scenarios. Scenario generation principles should guarantee the good coverage of driving situations in the ODD of the system.

3) Wording proposition

Defining nominal and critical situations without referring to “reasonably foreseeable situations” needs to refer to potential consequences caused by the situation either nominal or critical. The real difference between each situation is the risk consideration for the system. The following definitions propose to use this concept:

“nominal driving situation” means a driving situation in which the operating conditions of the given ODD and behavior of other road users are free from an immediate safety risk for the system (e.g. no immediate risk of collision), and no failure occur that are relevant to the ADS’s performance of the DDT.

“critical driving situation” means a driving situation in which a sudden change of the operating conditions of the given ODD or the behavior of one or more road users may result in an immediate risk of collision or any risk that could have an impact on system safety (e.g. ORU violating traffic rules, sudden storm or damage to road infrastructure).

As the “reasonably foreseeable” is a global concept the guides the safety demonstration through generating scenarios, French experts also propose to define the notion as a global principle:

“reasonably foreseeable” refers to a global safety demonstration principle related to scenario generation, regardless of the type of scenario, to provide an exhaustive coverage of traffic situations that might occur and that are conceivable for the specific system in its ODD.

“reasonably foreseeable conditions” means all the situations that fall under the reasonably foreseeable principle when considering a specific system in its ODD.

“preventable” characterizes system’s ability to avoid an accident when encountering a reasonably foreseeable situation within its ODD.

By amending these definitions, the French proposal aims at contributing to clarify terms and definitions used both at EU level and UNECE level for safety demonstration principles, in particular around scenarios.