SysML
Requirement diagrams

Requirements

- A requirement is used to specify constraints (specific functions, performance levels…) that must be met by the system.
- A requirement can be seen as a “contract” between the customer and the development team of the system.
- SysML uses stereotyped (specialized) classes to represent requirements.

<<Requirement>> Name of the requirement
Id = “Number id” Text=“Text describing the requirement”

A requirement

<<Requirement>> Response time
Id = “001” Text=“The response time of the system must not exceed 1s”

An example

Requirements

- Other properties for requirement can be defined, such as:
  - Priority (high, intermediate, low)
  - Source (customer, legislation, technical…)
  - Risk (high intermediate, low)
  - Status (proposed, validated, implemented, tested…)
  - Verification method (analysis, test…)

<<Requirement>> Response time
Id = “001” Text=“The response time of the system must not exceed 1s”
Priority=high Source=customer Risk=high Status=proposed Verification method=test

Links between requirements

- Several types of links can be defined between requirements, or between requirements and other SyML model elements
  - Contains (very similar to composition for classes)
  - Refines (used to add precisions to a requirement but also for traceability, to link a requirement and a behavioural model element : use-case scenario, statechart…)
  - DeriveReq (used to allocate a requirement throughout the system's architecture)
  - Satisfy (used for traceability, to link a requirement and a block)
  - Verify (used for traceability to link a requirement and a test case)

Links between requirements : Contains

- The contains relationship is very similar to composition in class diagrams (the main difference is purely graphical : circle with a cross instead of a filled diamond…).
- The semantics is that a requirement is composed by more elementary component requirements (which therefore can be components of only one composed requirement).
- Requirement with “and” keyword are a good clue for a composed requirement.

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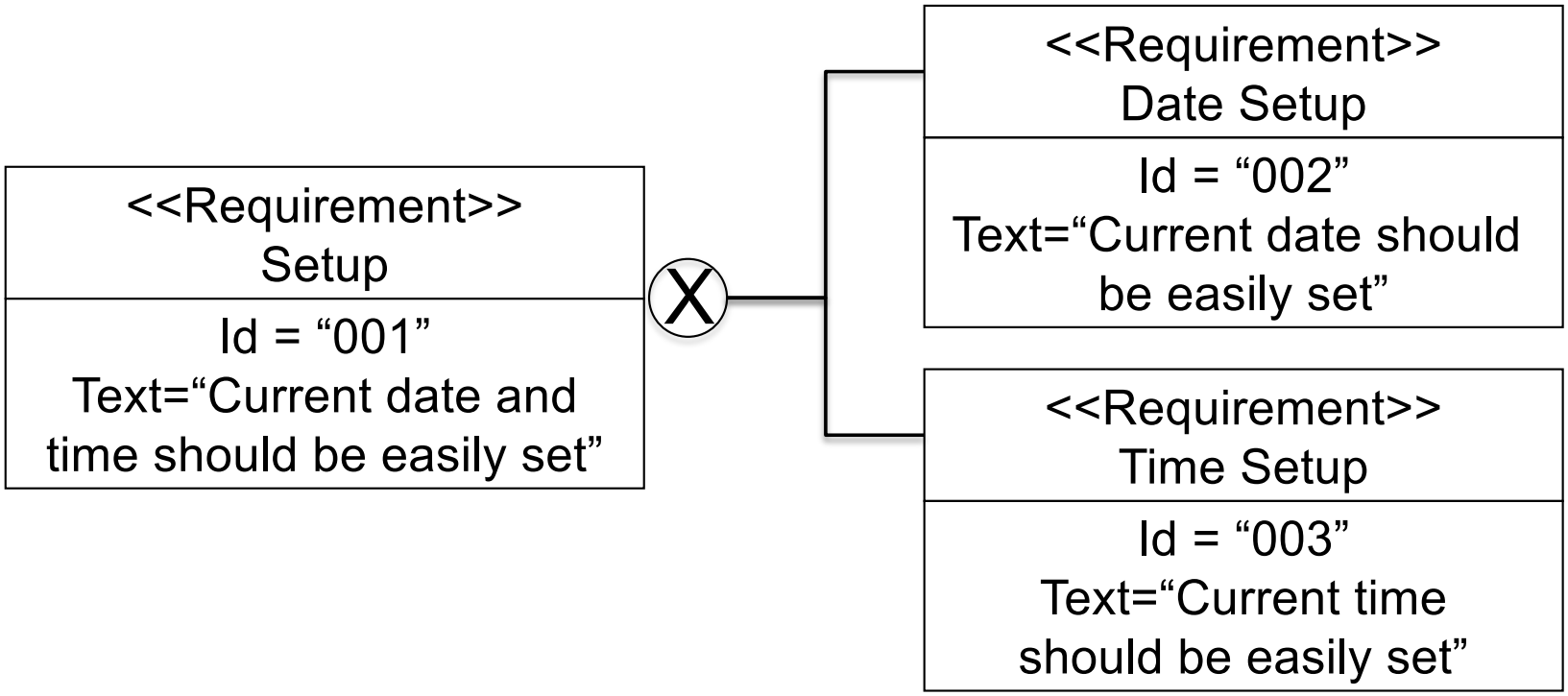
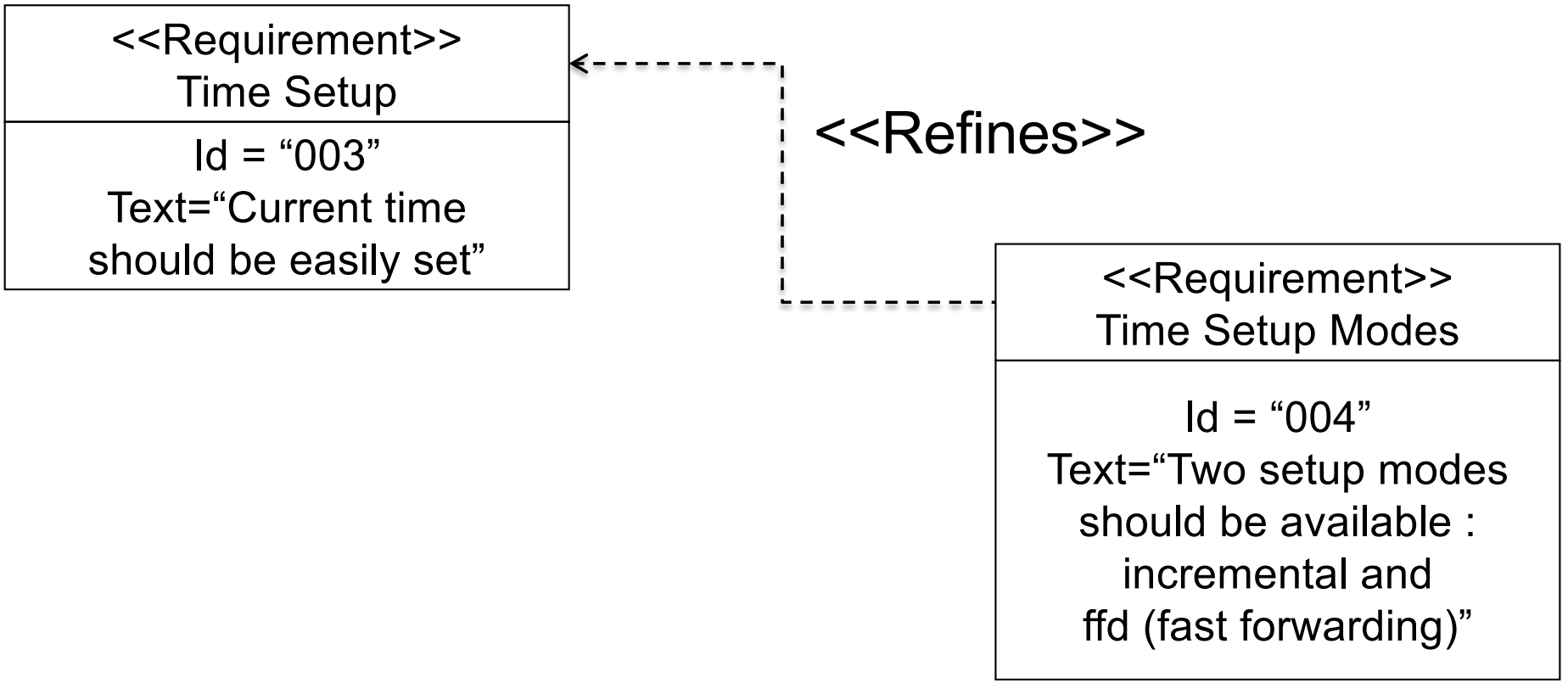
Links between requirements : Contains



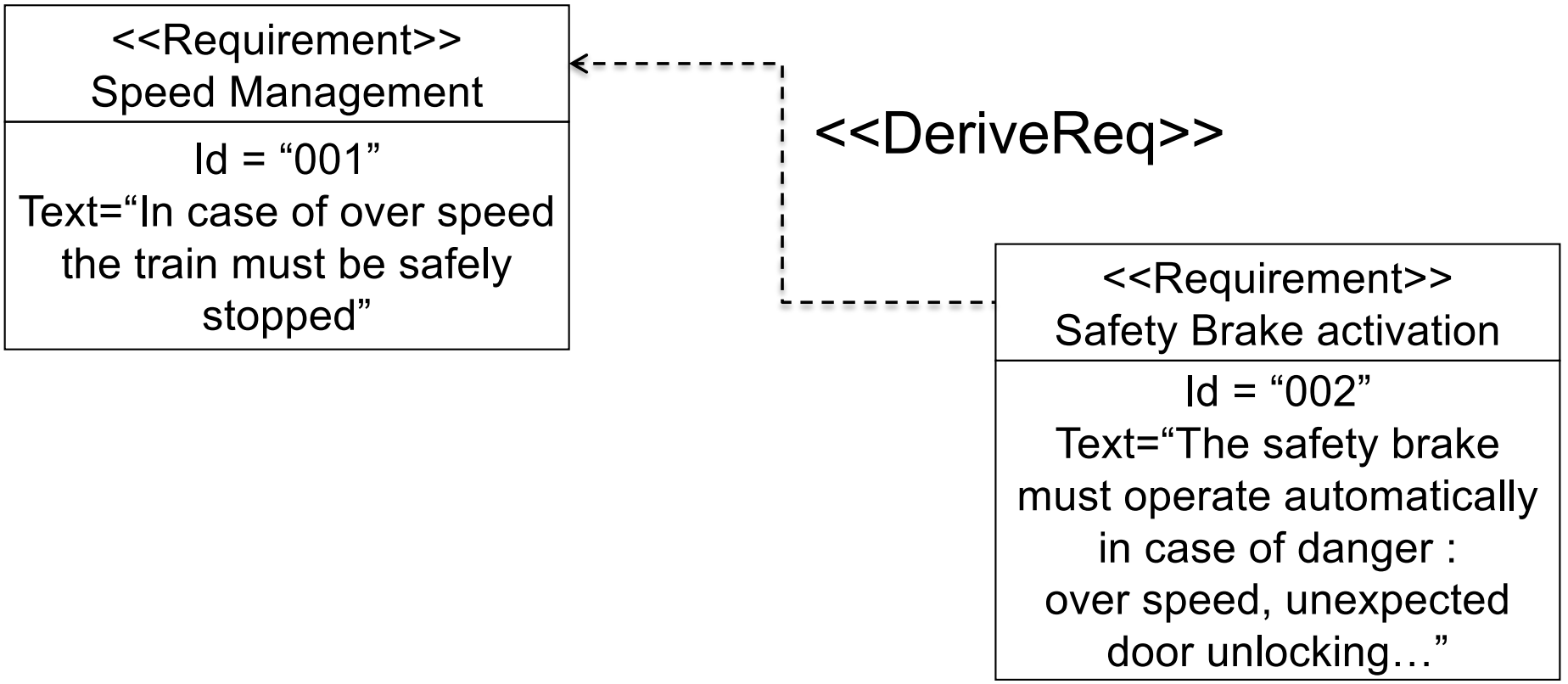
Links between requirements : refines

The refines relationship consists in addition of precisions (e.g. numerical values) to a given relationship.



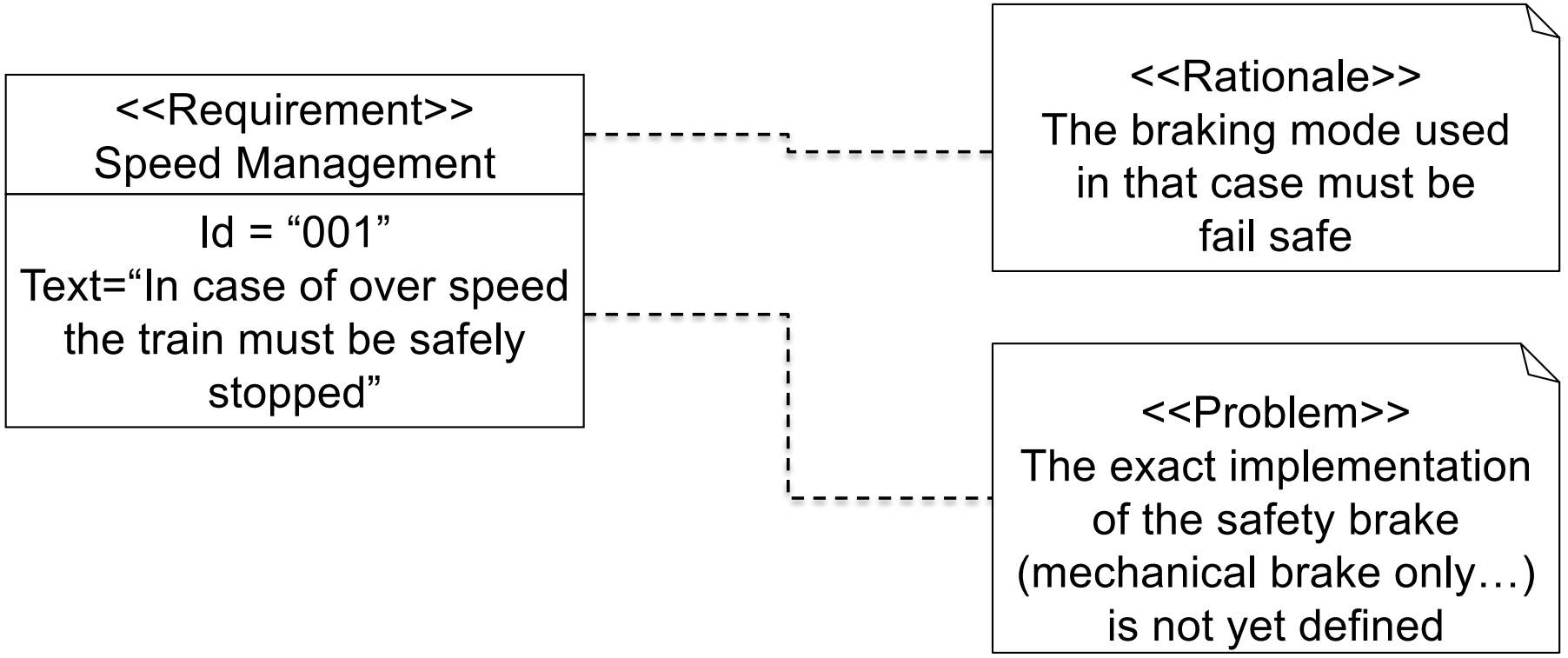
Links between requirements : DeriveReq

The DeriveReq is the relationship between requirements in the system architecture (system/subsystem) ;



Documentation of requirements : notes

SysML defines two stereotypes for UML element “note” to document requirement diagrams : <<Problem>> (for exposing a problem to be solved) an <<Rationale>> (for exposing the “while” of a particular choice)



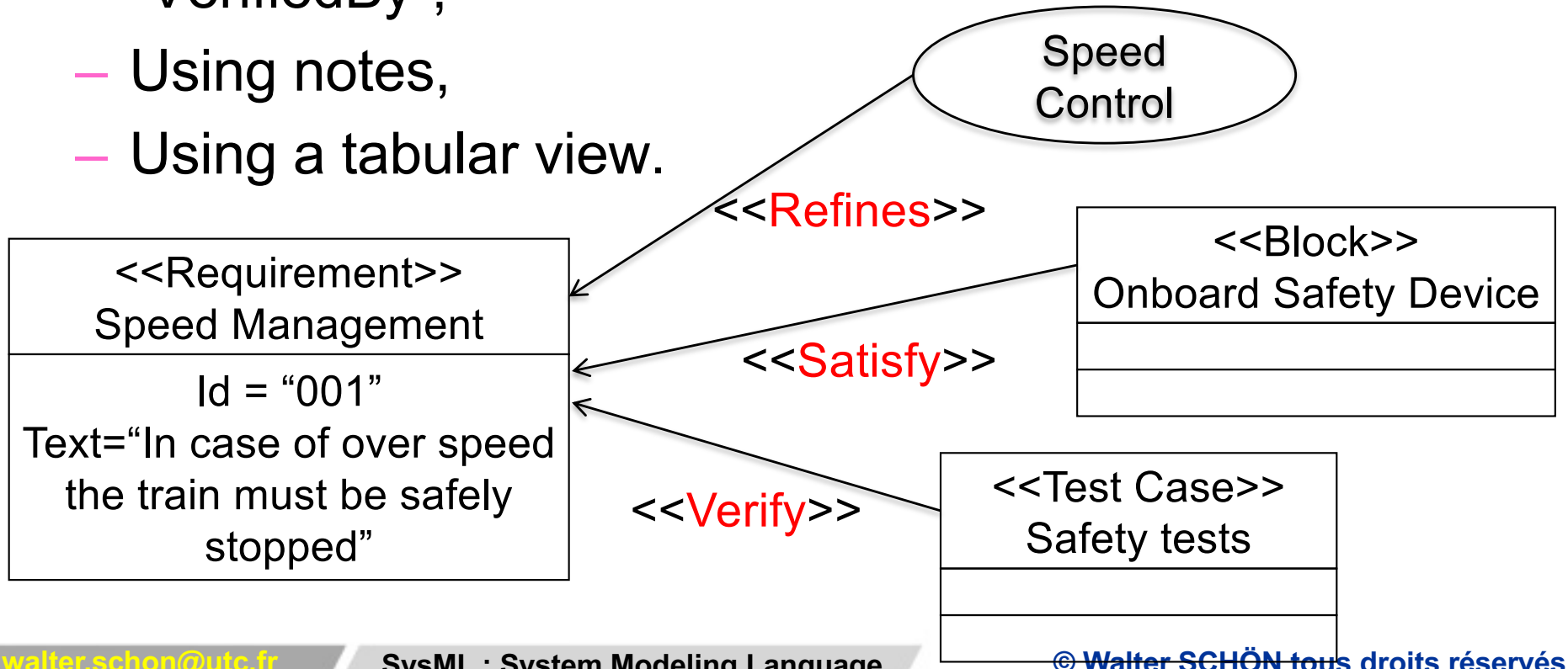
Requirements traceability

- One of the major concern of system engineering is requirements traceability (from initial expression to final fulfilment).
- SysML defines 3 stereotyped relations between requirements and other SysML model elements :
  - Refines : requirement-use case (or statechart) which must take the requirement into account.
  - Satisfy : requirement-block which must implement the functions needed to meet the requirement.
  - Verify : requirement-test case which allows to verify the fulfilment of the requirement (a test case is another type of stereotyped class describing verification and validation scenarios and expected results)

Requirements traceability

These stereotyped relations can be represented :

- As usual for UML relations by dashed arrows and the keyword of the corresponding stereotype,
- As “attributes” of the stereotyped block “requirement” with the keywords “RefinedBy”, “SatisfiedBy” and “VerifiedBy”,
- Using notes,
- Using a tabular view.



Requirements traceability

These stereotyped relations can be represented :

- As “attributes” of the stereotyped block “requirement” with the keywords “RefinedBy”, “SatisfiedBy” and “VerifiedBy”,

<<Requirement>> Speed Management
Id = “001” RefinedBy = Speed Control SatisfiedBy = Onboard Safety Device Text=“In case of over speed the train must be safely stopped” VerifiedBy = Safety Tests

Requirements traceability

These stereotyped relations can be represented :

- Using notes