

GSN (Goal Structuring Notation) is a graphical assurance case notation. The current version of GSN is defined by Goal Structuring Notation Community Standard Version 3 released in May 2021.

In this white paper we describe how GSN is implemented in NOR-STA version 7.6 released in November 2021.

NOR-STA is an assurance case management tool which internally uses TRUST-IT assurance case metamodel but also enables development of GSN arguments. All assurance case data is stored and managed in NOR-STA database. GSN diagrams are one of the available forms to represent arguments in NOR-STA.

1 Core GSN

All GSN elements are implemented in NOR-STA.

The naming convention in NOR-STA differs from GSN but this has no impact on the meaning of the argument.

The supported elements types are:

- Goal (Claim),
- Strategy,
- Justification (Rationale in NOR-STA),
- Assumption,
- Solution (Reference in NOR-STA),
- Context (Information in NOR-STA).

In this document we will use GSN names for simplicity.

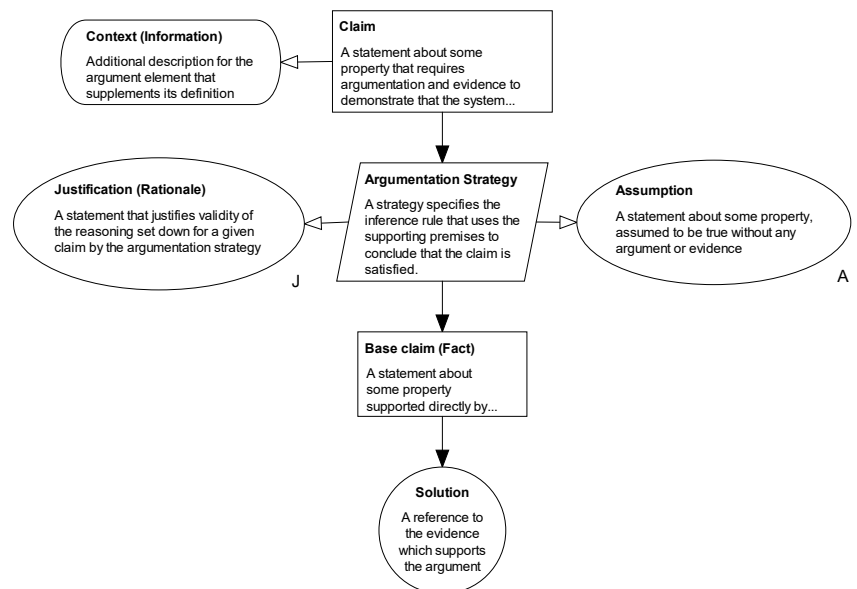


Figure 1. Sample GSN diagram produced in NOR-STA

NOR-STA implements a more rigorous approach to assurance case development and the following rules apply to the argument structure in NOR-STA:

1. A goal (claim) can be supported by a strategy or by a solution (evidence) but not both at the same time. To distinguish this the base claims (supported directly by evidence) are renamed to facts.
2. Reasoning steps are explicit in NOR-STA. A strategy is required for each reasoning step. You cannot specify a claim supported directly by another claim in NOR-STA. A justification is automatically created for each strategy and it is a recommended element in NOR-STA for each reasoning step however you may leave it unused.
3. NOR-STA argument structure is a tree with linked elements while GSN structure is an undirected graph. An element used more than once has a number of linked occurrences. They may be specified on different pages of the argument diagram.

1.1 Pages of assurance case diagrams

NOR-STA supports development of large assurance cases. As such assurance cases can be difficult to visualize as one monolithic GSN diagram, it is possible to divide the diagram into several pages. A user can decide if the argument is to be presented on one big page or on a number of pages. NOR-STA still maintains the consistency of an assurance case no matter how its GSN representation had been split into pages..

NOR-STA implements 'Off-Page' decorators. By clicking on a decorator you can navigate to the other page of the diagram.

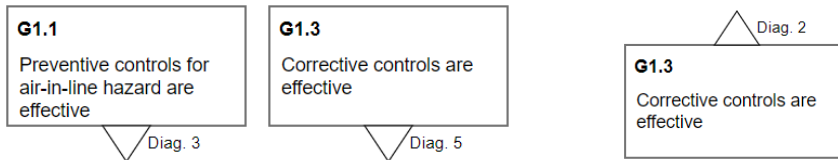


Figure 2. 'Off-Page' decorators for assurance case diagrams divided into pages

Elements on the boundaries of a diagram pages are claims. It is required that one reasoning step is presented on one page and cannot be divided between different pages. A single reasoning step is a claim, its context, supporting strategy and premises.

2 Modular Extension

NOR-STA implements modular arguments and binding of different argument modules through their interfaces. How NOR-STA implements elements of GSN Modular Extension is described below:

Modular Extension in **argument view**:

- **Away goal reference** for claims supported by claims in other argument modules. The symbol of the supporting module is presented at the bottom part of the rectangle, next to the shaded module symbol (Fig. 3, left).
- **Public decorator** – a small module icon in the right top edge of the rectangle for claims published on a module interface. This indicates that the element is publicly visible in one or more interfaces of the module and can be referenced as an away element (Fig. 3, right).

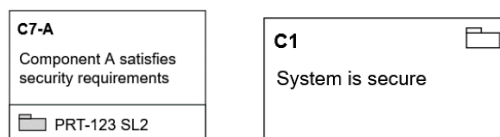


Figure 3. Away claim and public claim elements used in NOR-STA

Modular extension in **architecture view**:

- **Argument modules** are represented as rectangles,
- **ModuleSupportedBy** relationship is represented as a line with a solid arrowhead.

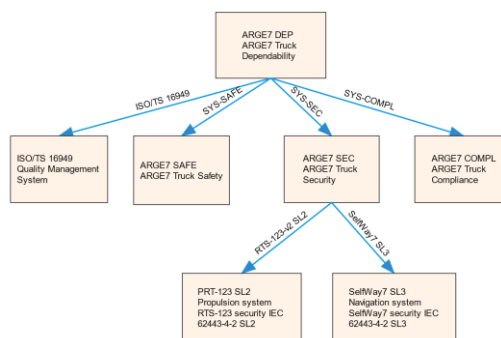
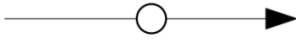



Figure 4. Architecture view in NOR-STA


The scope of argument binding in NOR-STA is limited to claims. No other types of away elements are implemented in the current version of NOR-STA.

3 Argument Pattern Extension

NOR-STA features include argument templates and a synchronization mechanism which implement some elements of GSN Argument Pattern Extension:

- Optional instantiation** 

NOR-STA implements optional instantiation with the use of tags. Users may use tags to denote branches of the argument in the template and then for each implementation argument they can specify branches to be applicable for a given instantiation. The same parameters can be used to control a number of optional branches of the template.
- Choice instantiation** 

NOR-STA implements optional instantiation with the use of tags. Users may use tags to denote sets of branches of the argument in the template. For each implementation argument the user may specify parameters to control sets of applicable branches.
- Multiple instantiations** 

Multiple instantiations are managed manually at the instantiation time. By default NOR-STA creates one instantiation and the user can perform multiplication with copy/paste operation.

NOR-STA implements the pattern mechanisms described above however the graphical symbols used in GSN are not implemented in the current version of NOR-STA.

4 NOR-STA Extensions – Argument assessment

NOR-STA implements argument assessment and enables presenting GSN diagrams colored depending on the assessment results. A sample diagram is presented in Fig. 5.

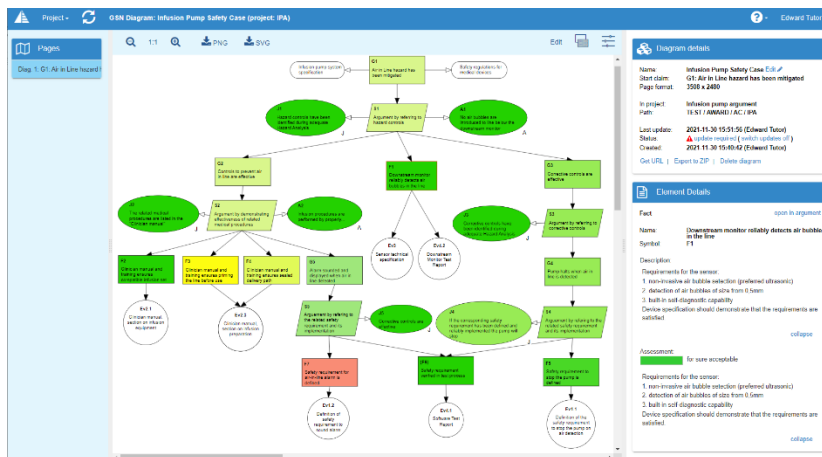


Figure 5. NOR-STA extension: presenting assurance case assessment

When you need more information about NOR-STA please visit our website www.argevide.com or contact us at office@argevide.com