

VisBOL Enhancements For SBOL 2.0

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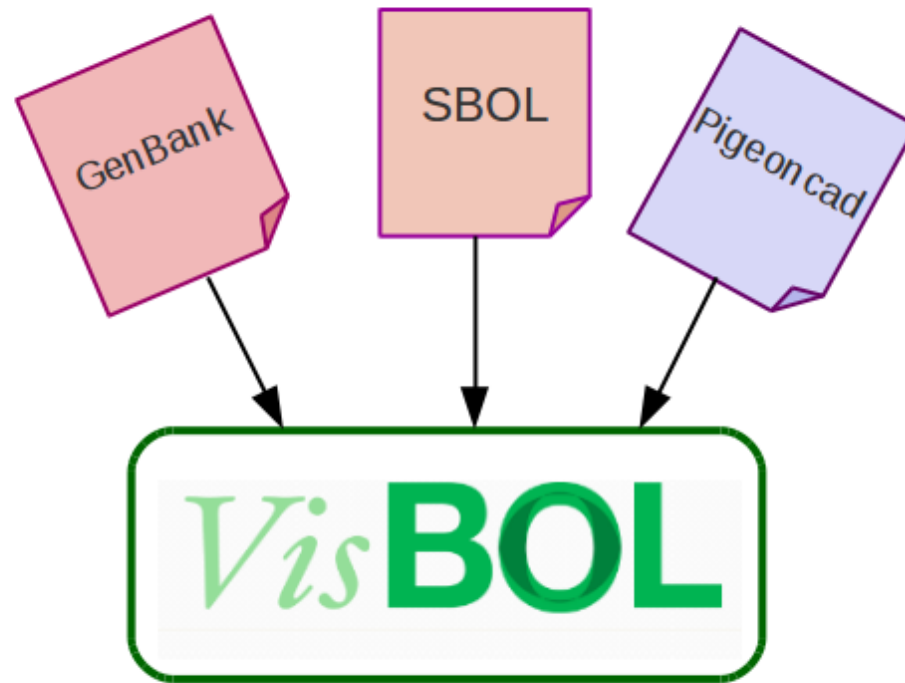
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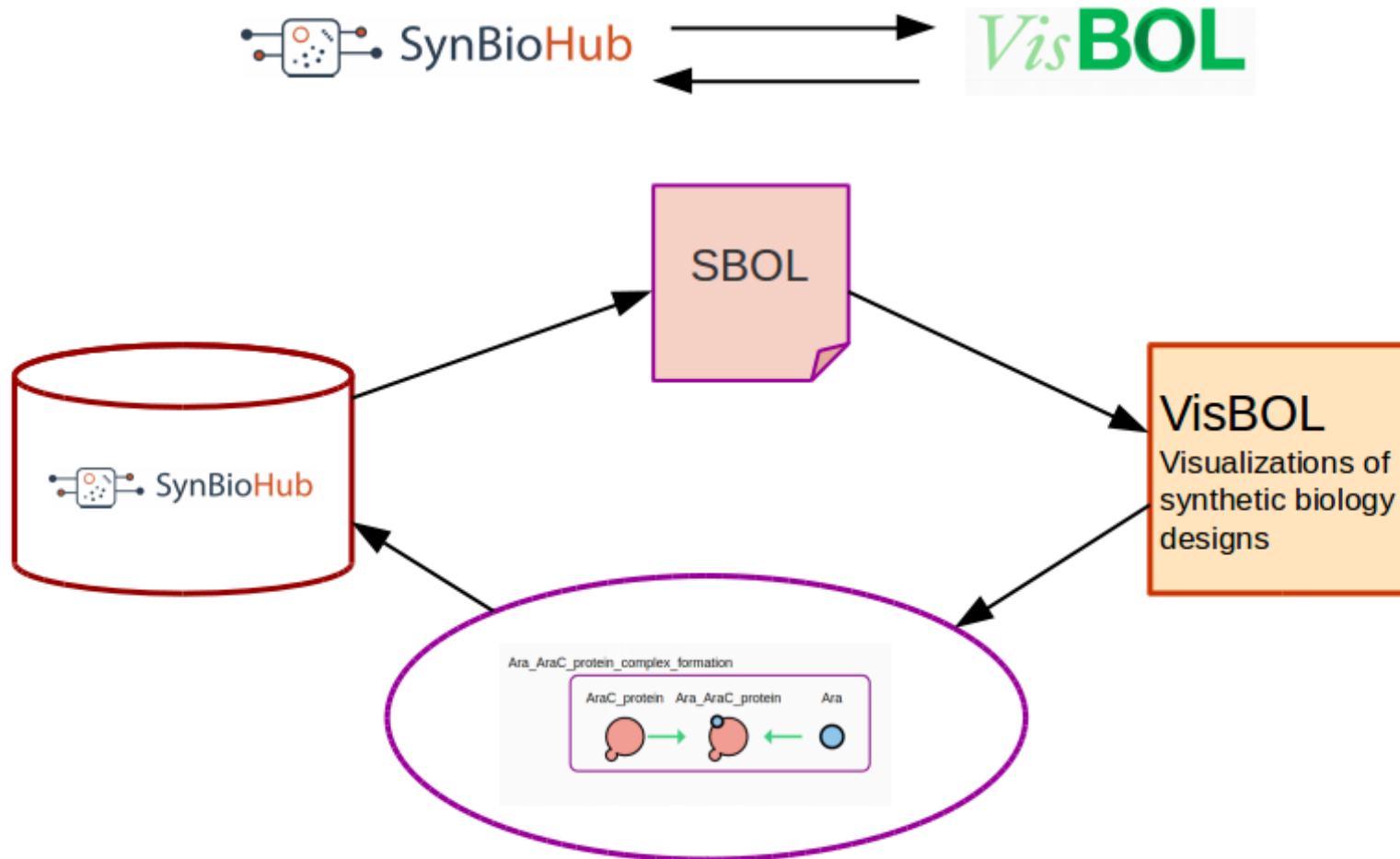
VisBOL Overview and Motivation

- VisBOL supports automated generation of visualizations from designs specified using the Synthetic Biology Open Language (SBOL) version 2.0, as well as formats including GenBank and Pigeoncad.
- VisBOL designs can be exported to formats including PNG and SVG images to be embedded in other documents.



VisBOL Application

- SynBioHub, a design repository for synthetic biology constructs is exclusively using VisBOL for visualization of designs.



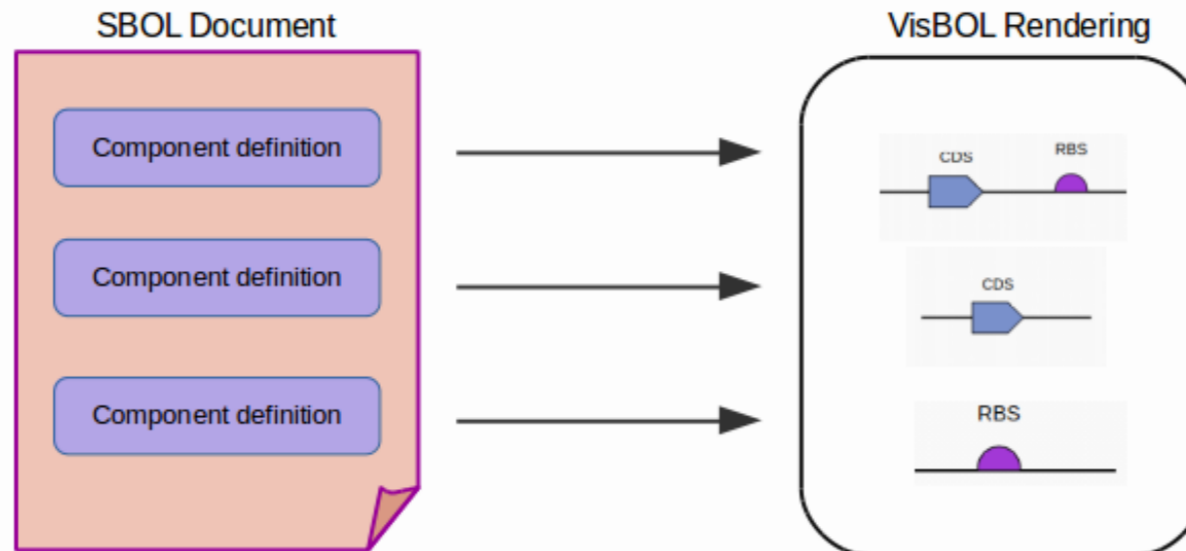
Previous State of VisBOL

Visualization Capabilities

- ✔ general support for visualization of the structure of DNA constructs
- ✔ visualization of each part separately using SBOL visual glyph set (sequence feature glyphs, interaction glyphs, molecular splices glyphs)

What was not supported by VisBOL

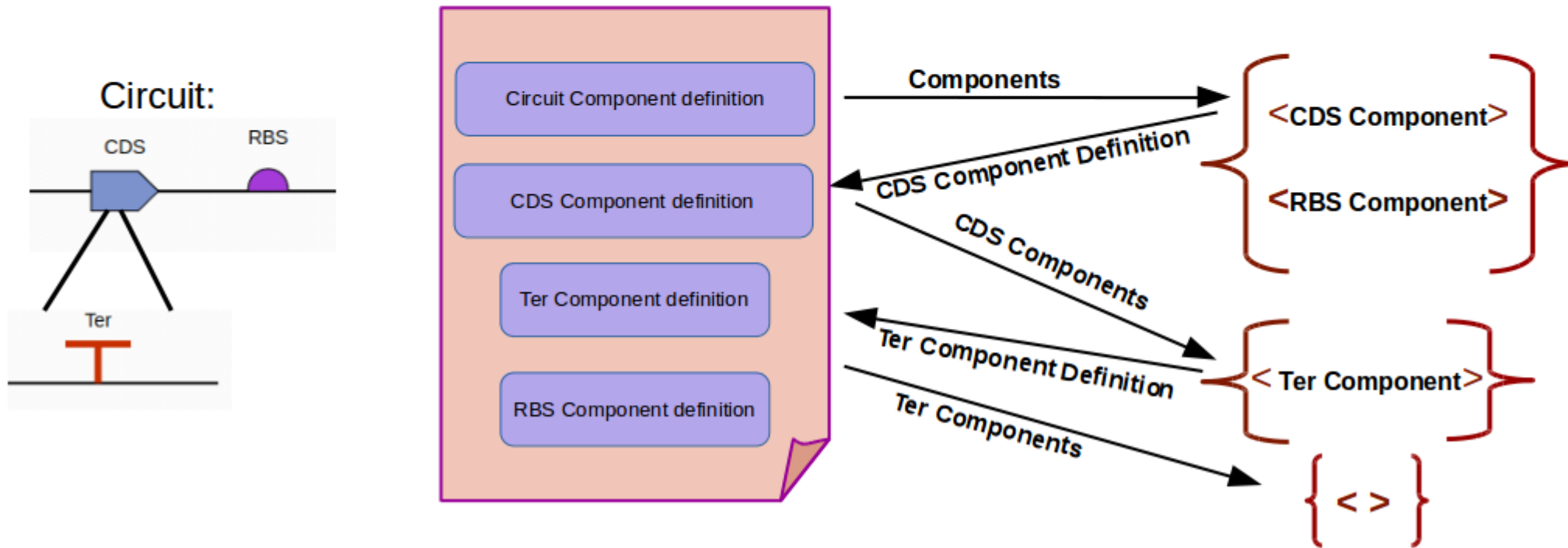
- ✘ Visualization of non-DNA entities
- ✘ Visualization of composite entities embedding sub-designs
- ✘ Visualization of functional relationships between DNA parts and proteins



VisBOL Enhancements: Visualization Of Composite Entities

Composite Parts Detection

- A composite part, is a part having another sub-design embedded in it.
- There is no associated SO term for composite parts which makes detection of composite parts more complicated than those having no sub-structure.

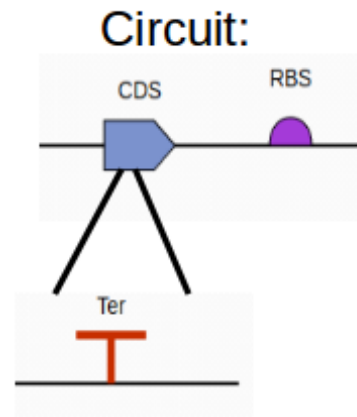
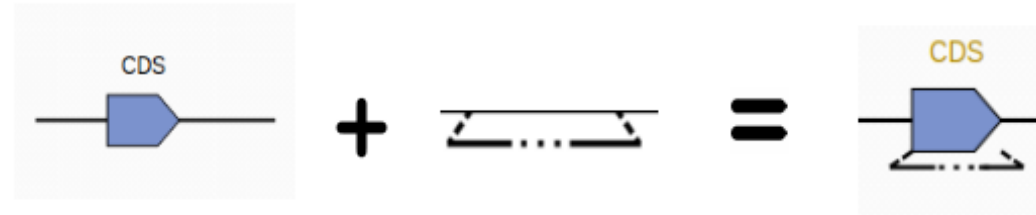


VisBOL Enhancements: Visualization Of Composite Entities

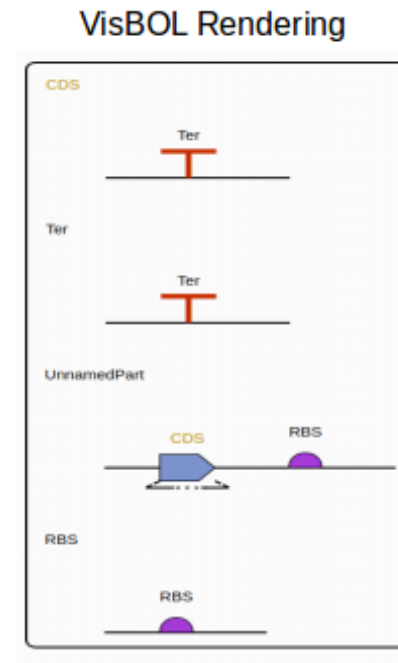
Composite Parts Detection:

- Component list of composite parts have a length of at least one which makes them distinguishable from those with no sub-design.

Composite parts visualization:



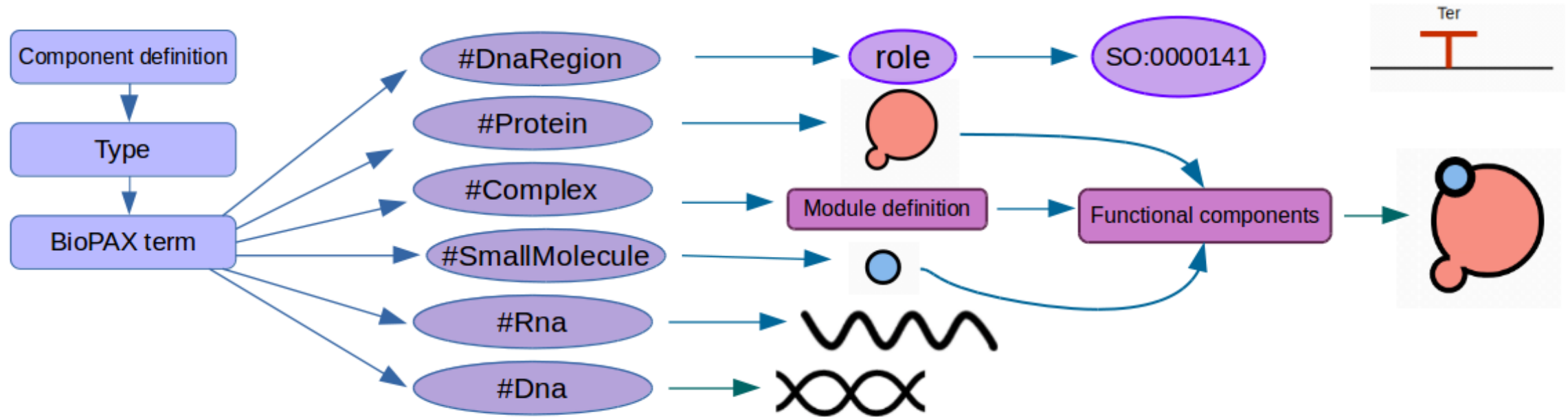
Label color of composite parts matches label color of their corresponding segments in VisBOL rendering



VisBOL Enhancements: Visualization of non-DNA Entities

What makes visualization of non-DNA entities different

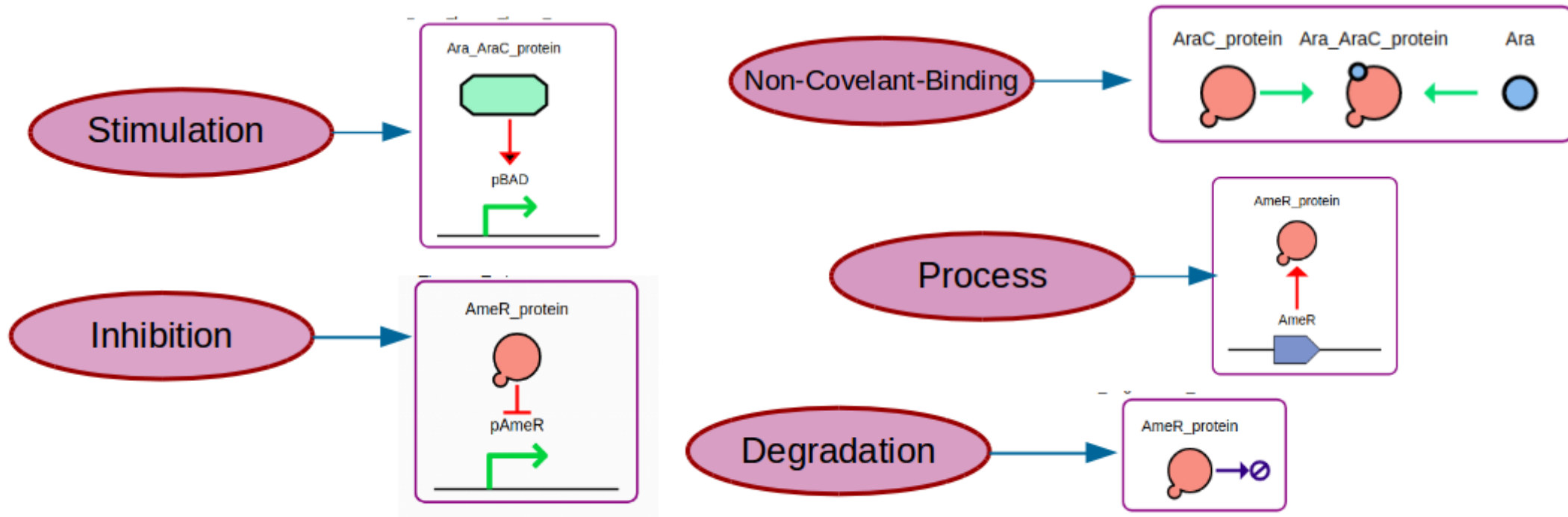
- These entities are not part of DNA strand and they represent molecular species.
- Non DNA parts don't have a role associated with them in their component definition.
- They participate in functional relationships with different parts on of DNA structure.
- Each non DNA part has a BioPAX term associated with them.



VisBOL Enhancements: Visualization of Interactions

- VisBOL uses interaction glyphs which are different forms of arrows for visualizing different types of interactions between sequence features and/or molecular 2 species.
- For interactions happening between a part of DNA structure and a non-DNA entity, non-DNA parts are always rendered on top of their corresponding participant in the interaction and the appropriate interactions glyph connects the two participants together.

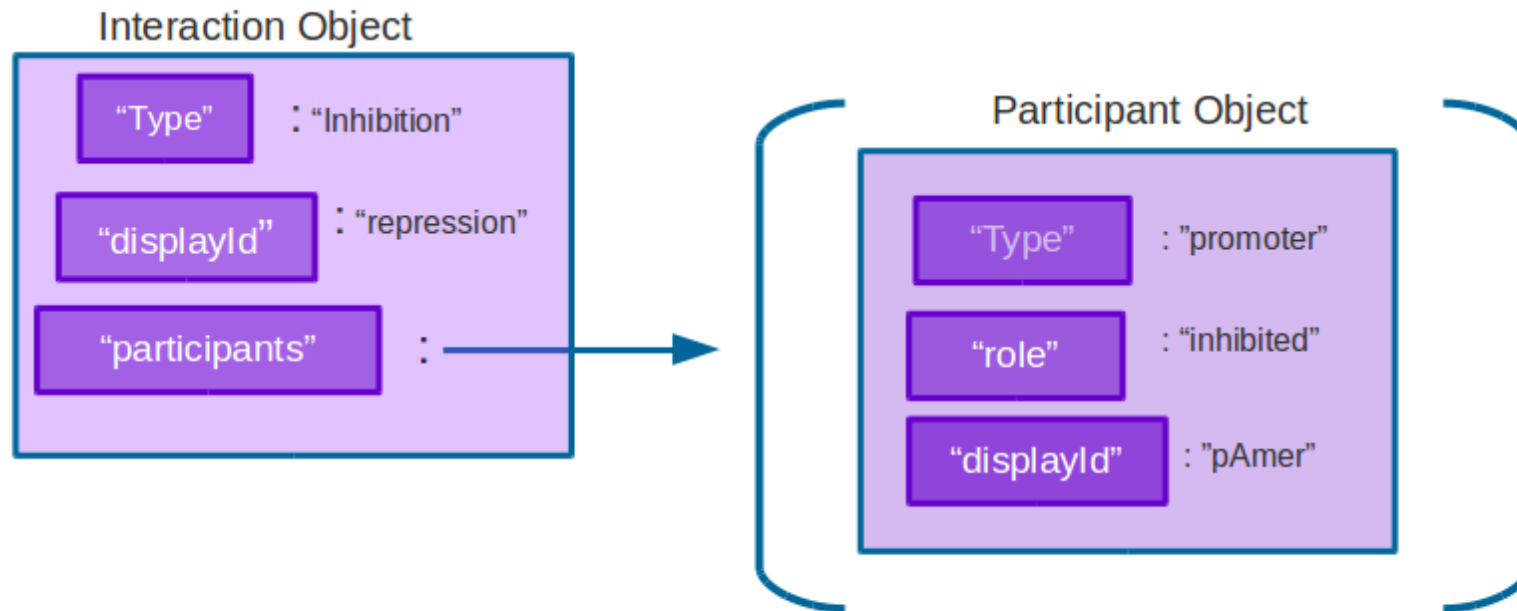
Different types of interactions supported by VisBOL:



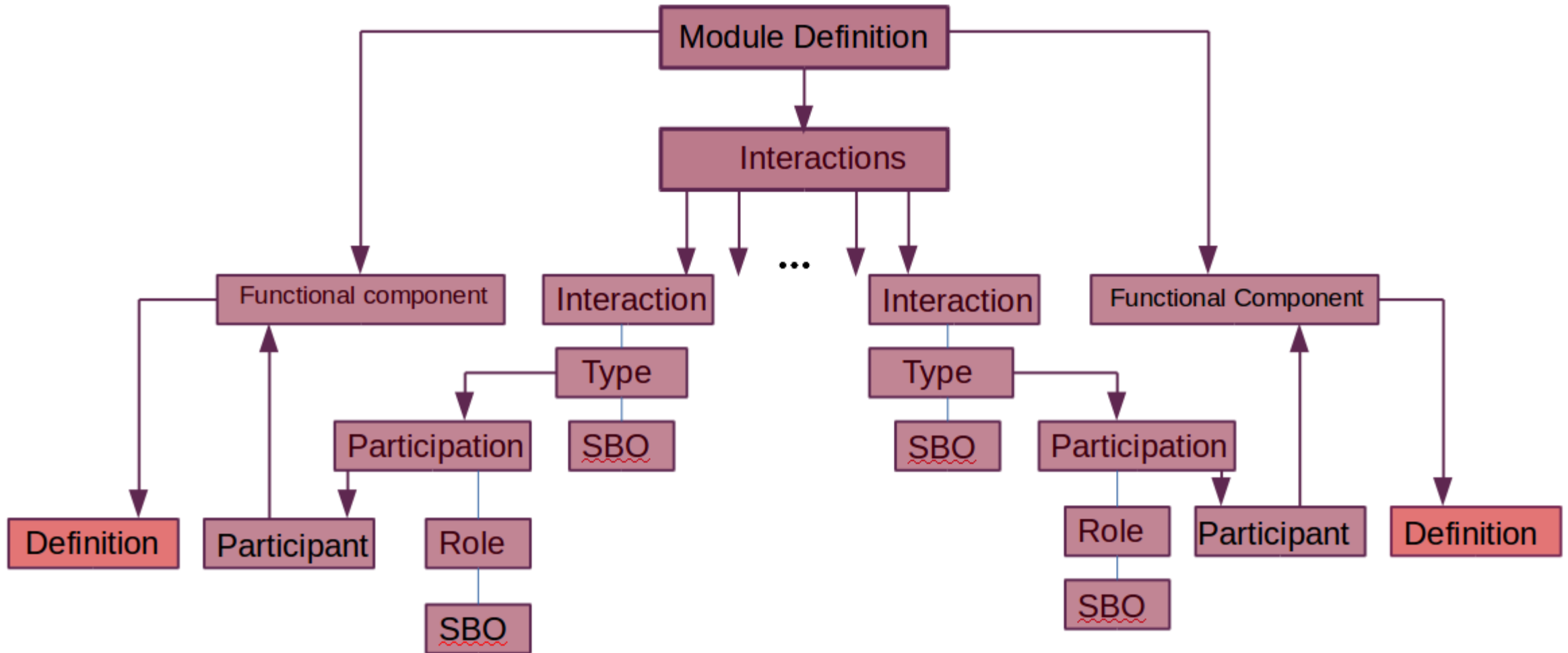
VisBOL Enhancements: Visualization of Interactions

Interaction Objects

- To be able to render interactions, module definitions need to be parsed and interaction objects are created using the information extracted from module definition.
- These interaction objects have all the necessary information required for visualizing interactions happening on top of DNA strand.



VisBOL Enhancements: Visualization of Interactions



Current Issues And Future Work

Issue: Redundancy in visualization

- Currently for each interaction happening on top of DNA strand, there is a separate visualization which leads to redundancy in visualization.
- ✓ This issue is going to be addressed in the next version with some restrictions being applied to the layout and interactions happening between molecular species.

Issue: Mapping SOs to participants

- Currently finding the participant in the sequence feature is being done based on some assumptions, Due to SBOL structure.
- ✓ This issue is going to be addressed in next version of SBOL.

VisBOL rendering for a module definition having 4 interactions

