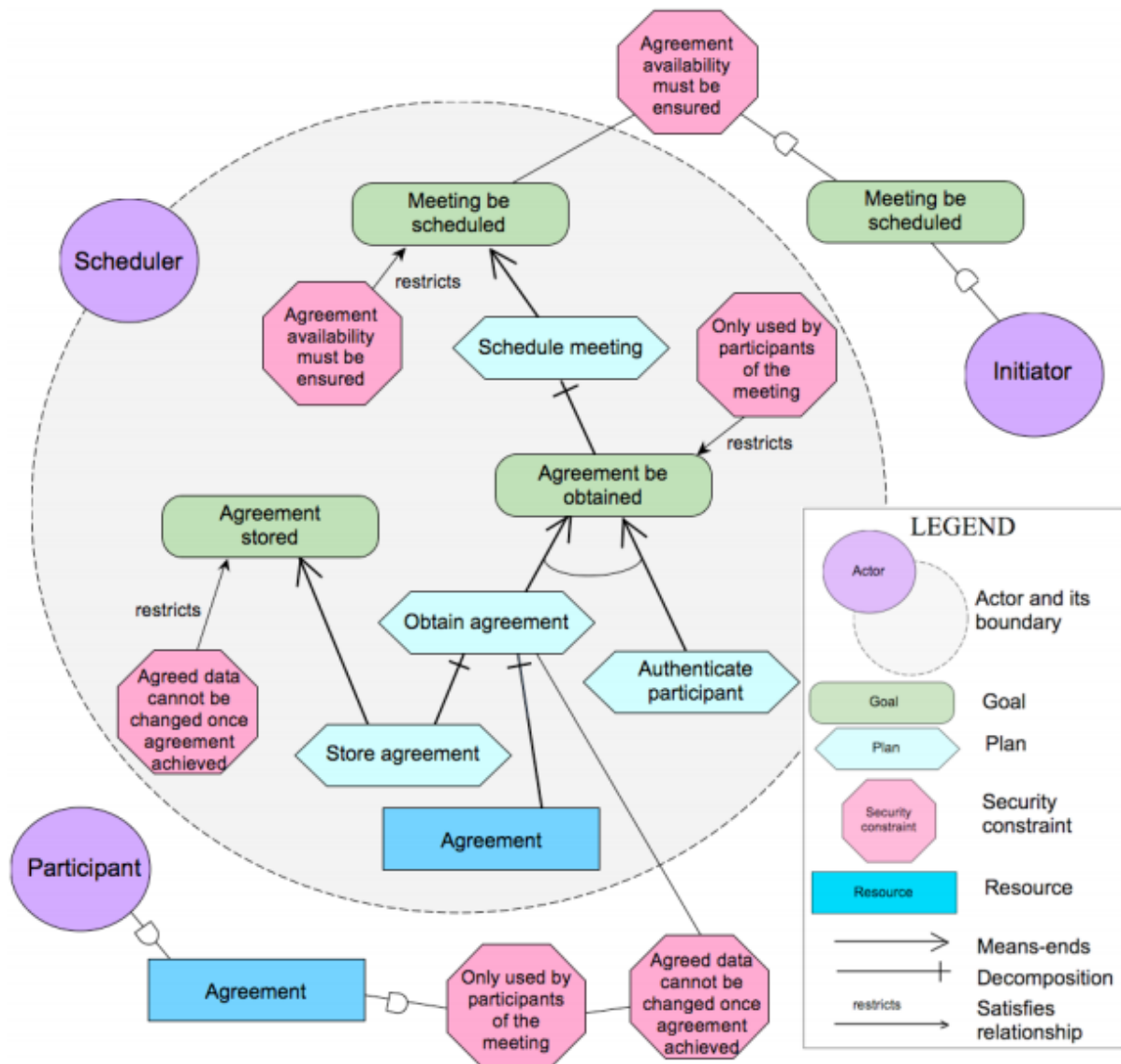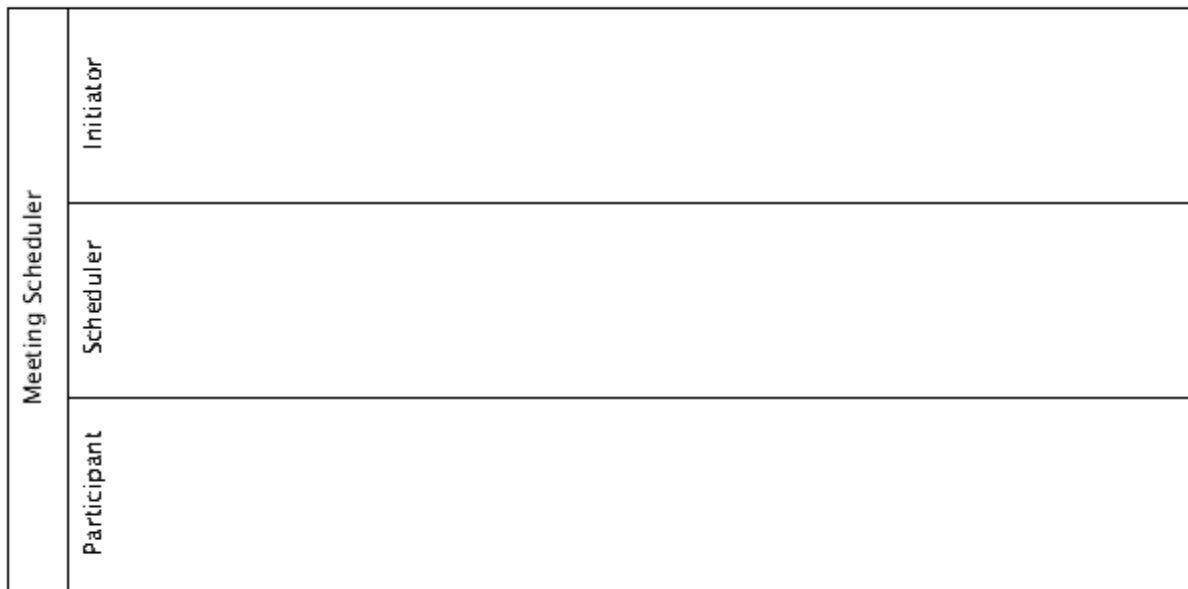# Example Transformation for Secure Tropos (ST) to Business Model and Notation 2.0 (BPMN 2.0)

Jan Rehwaldt, University of Tartu

1. Asset Model Transformation

TR1. Secure Tropos' *Actors* are transformed into BPMN's *Lanes* defining all participants of the visualized system.
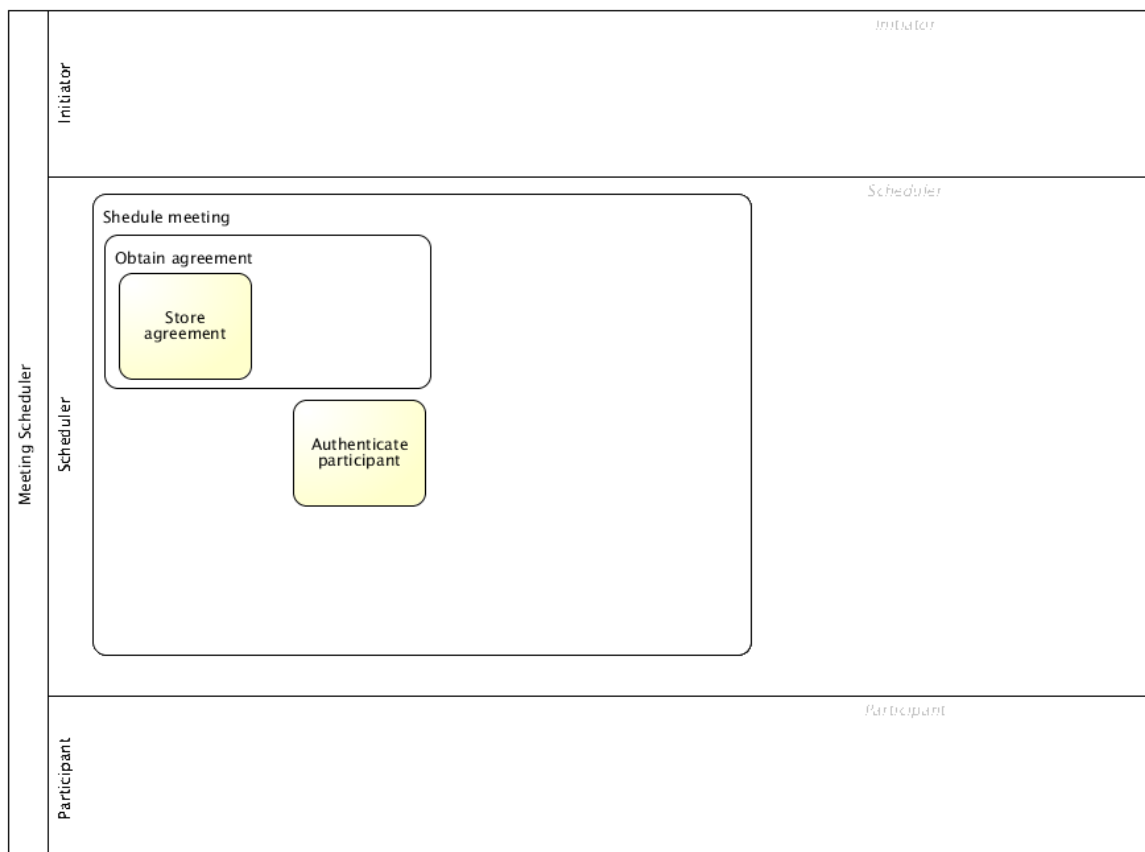

TR2. Secure Tropos' *Plans* are transformed into BPMN's *Tasks*.
  Note: The resulting Event should be located in the Lane of the Actor
  a) in which boundaries the Goal is, or,
  b) which is the closest to the Goal.
  Note: Secure Tropos' *Decomposition*-Relations are transformed into BPMN's *Sub-Tasks* with all following *Means-End*-related *Plans* and *Goals* included within this *Sub-Task*.
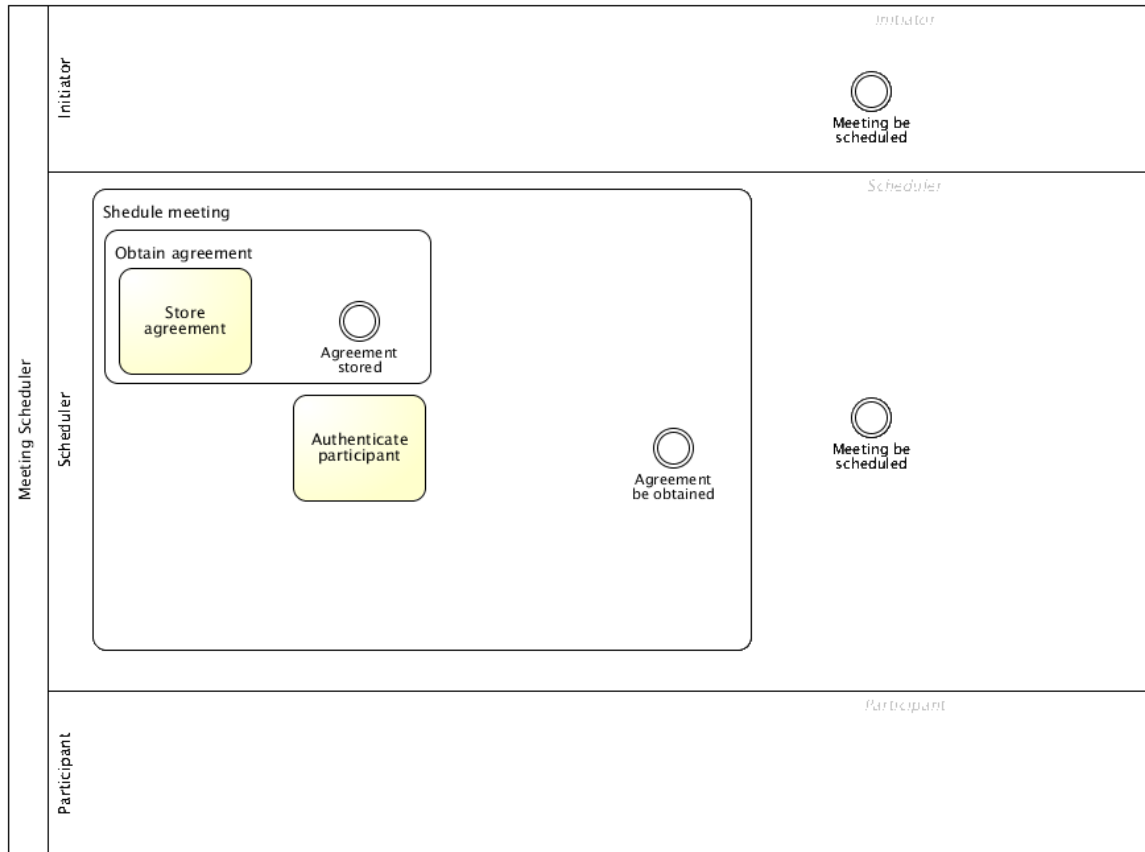
**TR3.** Secure Tropos' *Goals* are transformed into BPMN's *(Throwing) Intermediate Events*.
Note: The resulting Event should be located in the Lane of the Actor
   a) in which boundaries the Goal is, or,
   b) which is the closest to the Goal.
Note: If the *Goal* is connected by a *Decomposition*-Relation with a *Plan* then the resulting *Event* is included in the *Sub-Task* as transformed in TR2.
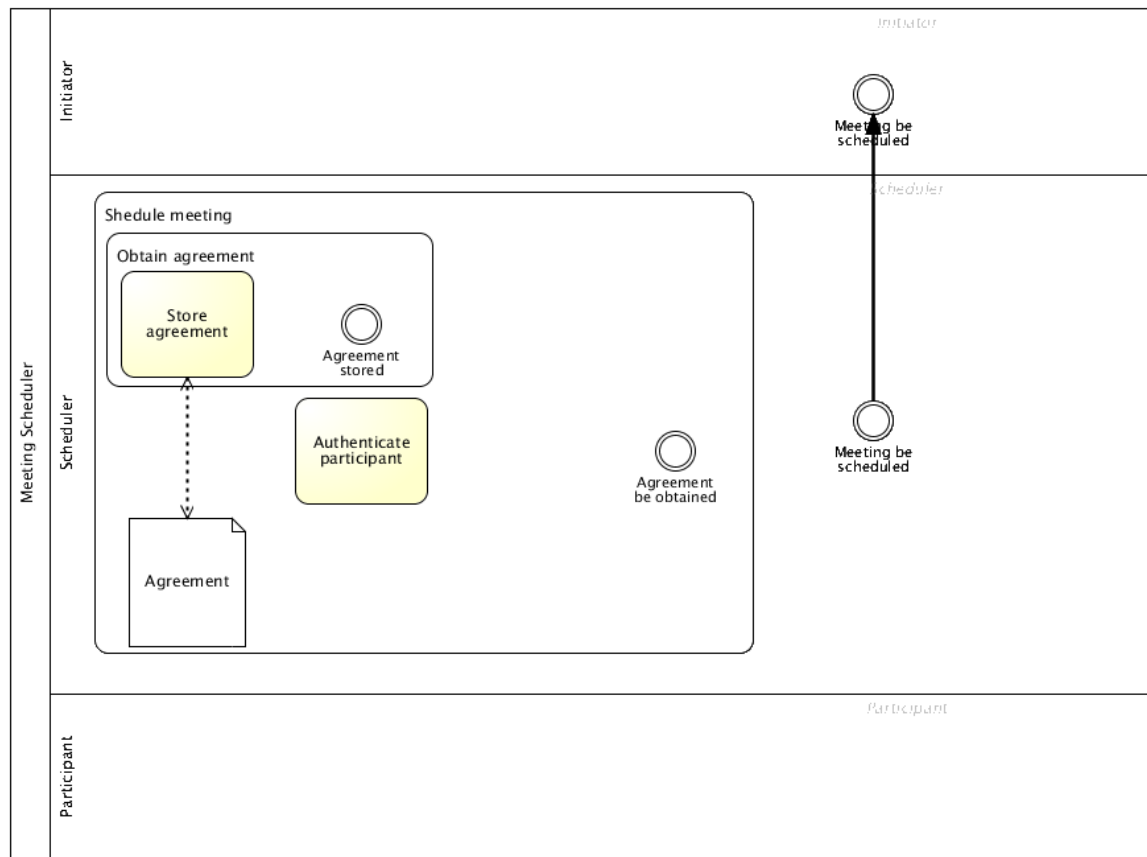
TR4. Secure Tropos' *Resources* are transformed into BPMN's *Data Objects*.
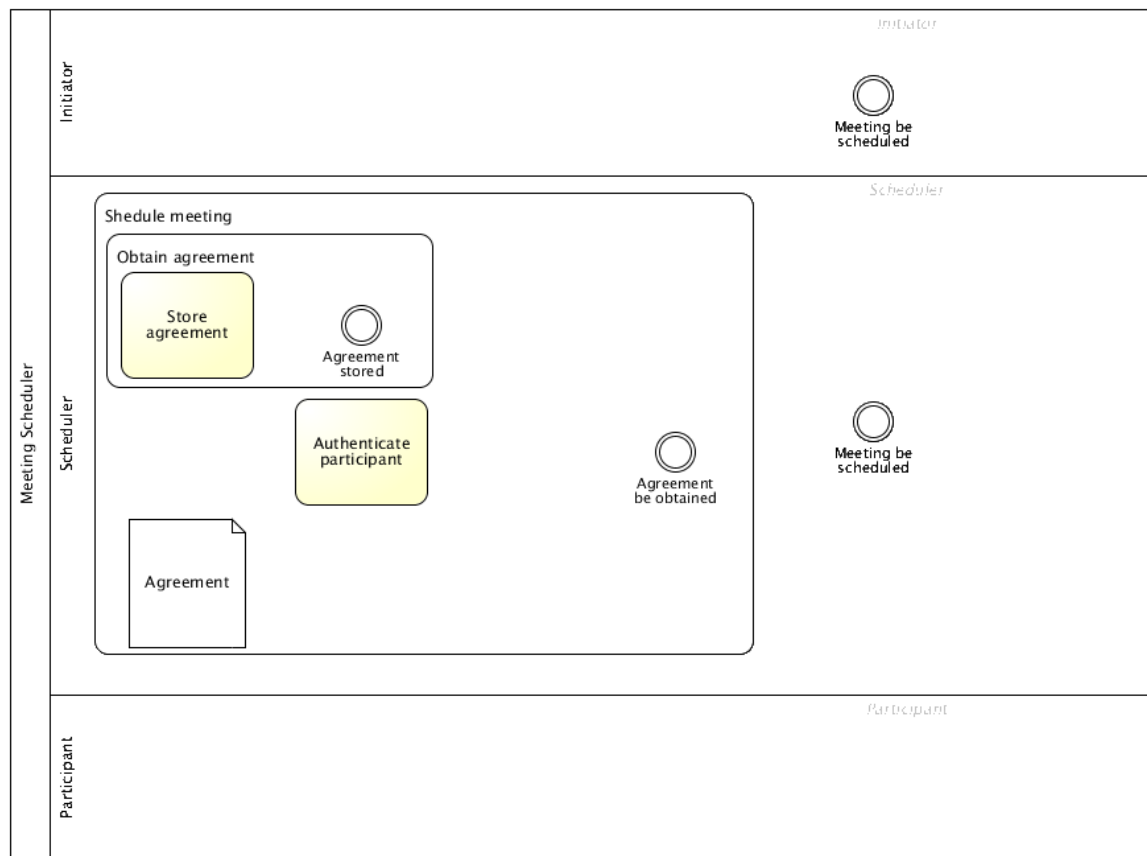
TR5. Add a *unidirectional Association*-Relation between Tasks and Data Objects for each *Means-End*-Relation between Plan and Resource.
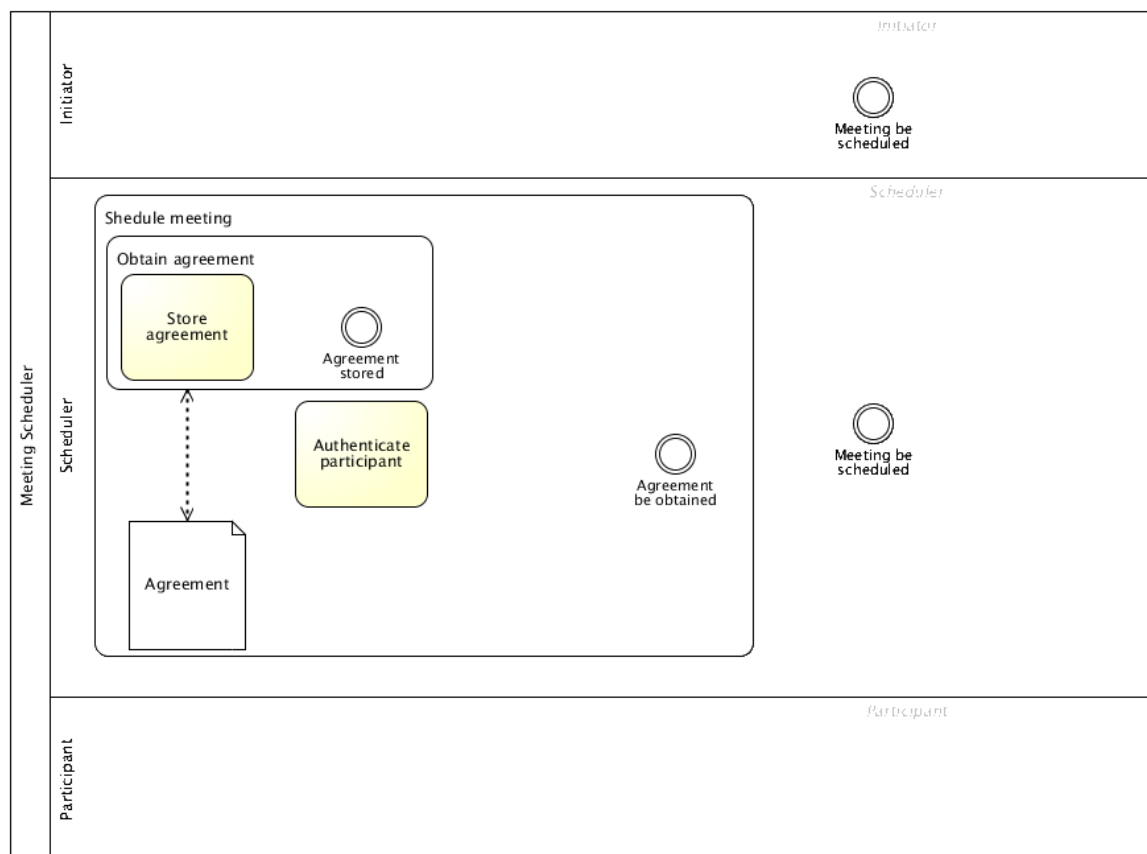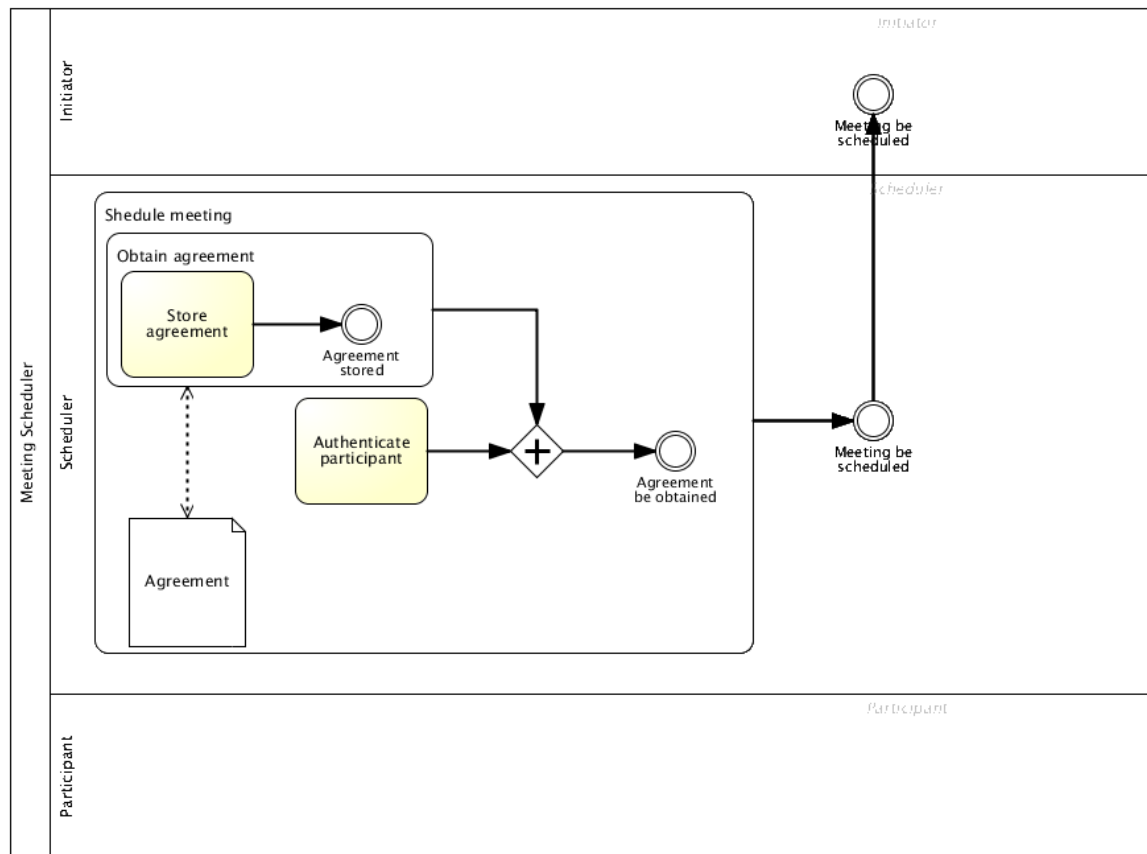
TR6. Add a *Sequence Flow* <u>in inverse order</u> between Tasks and Events for Direct *Dependency-* Relations between Plans and Goals and vise versa.
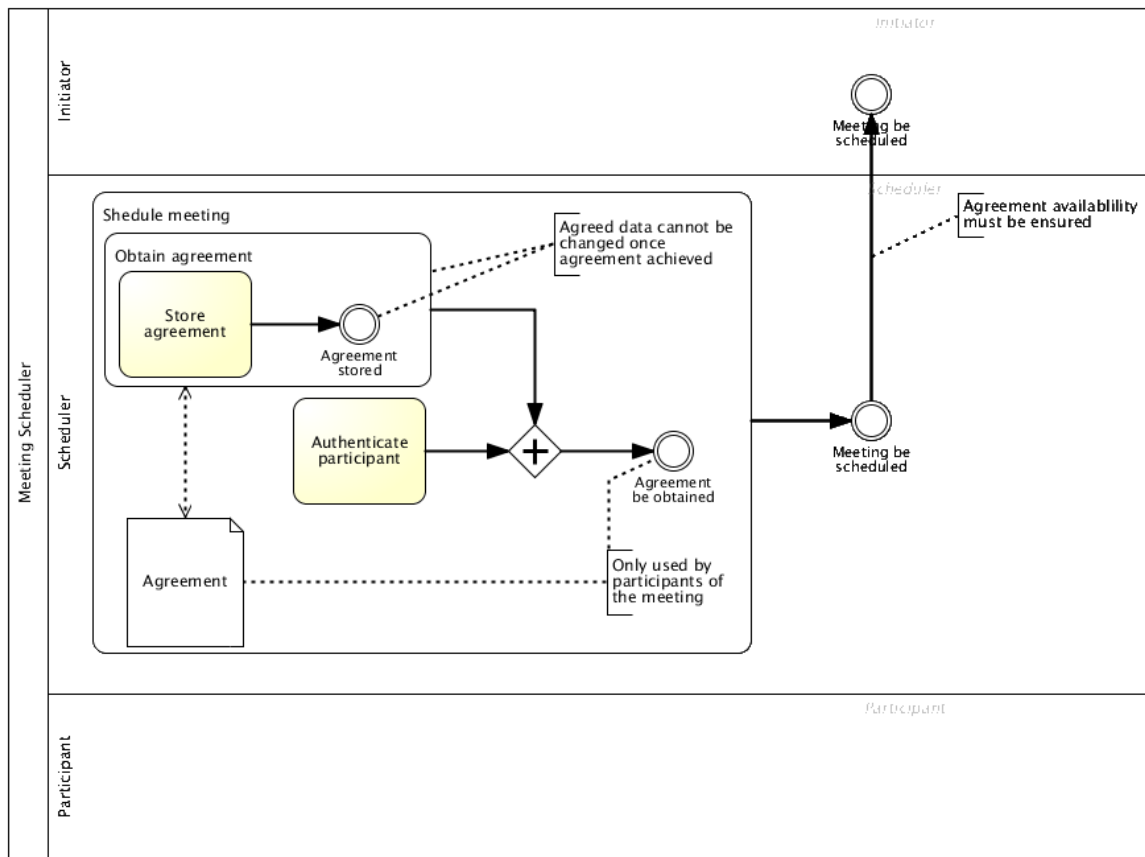
TR7. Add a *Sequence Flow* between Tasks and Events for each *Means-End*-Relation between Goals and Plans.

Note: If multiple *Means-End*-Relations go to the same Goal or Plan combine those with an *AND-Gateway*.
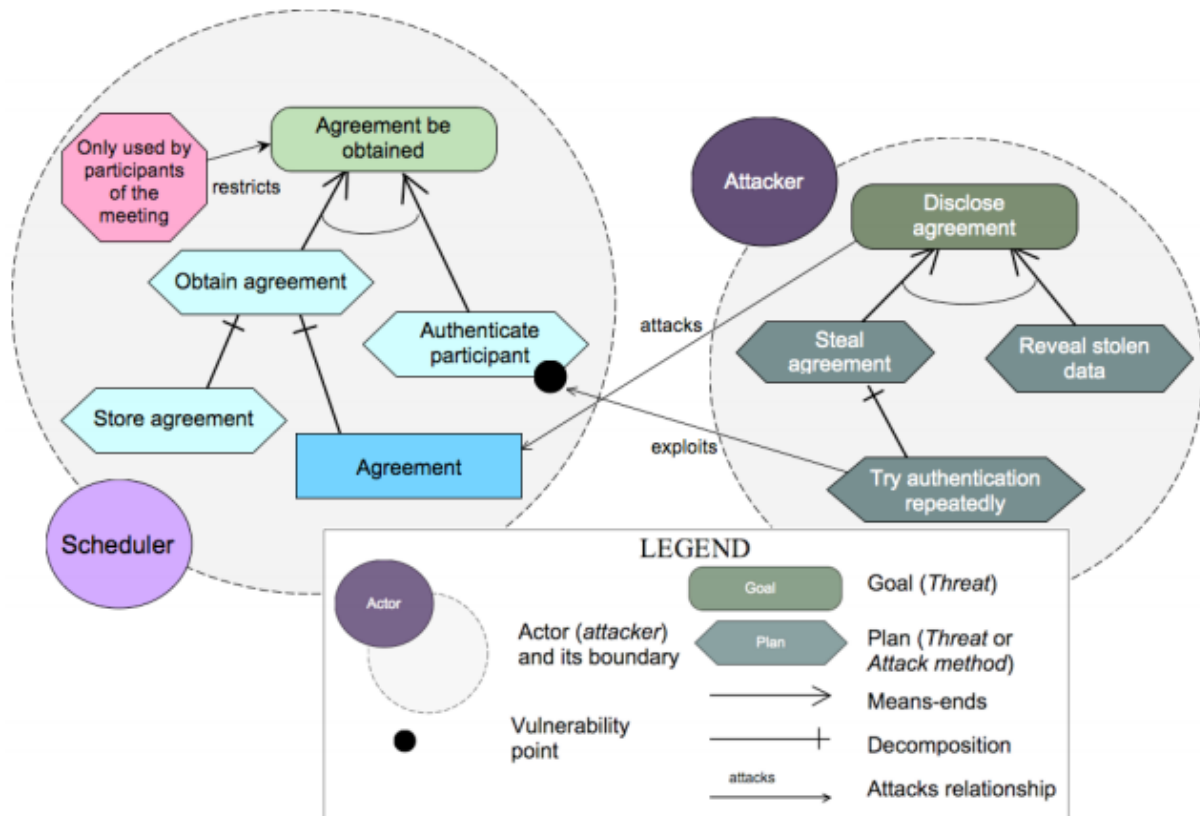
TR8. For each Secure Tropos' Security Constraint add a BPMN's Annotation to the model associated with the target object as transformed in previous steps.
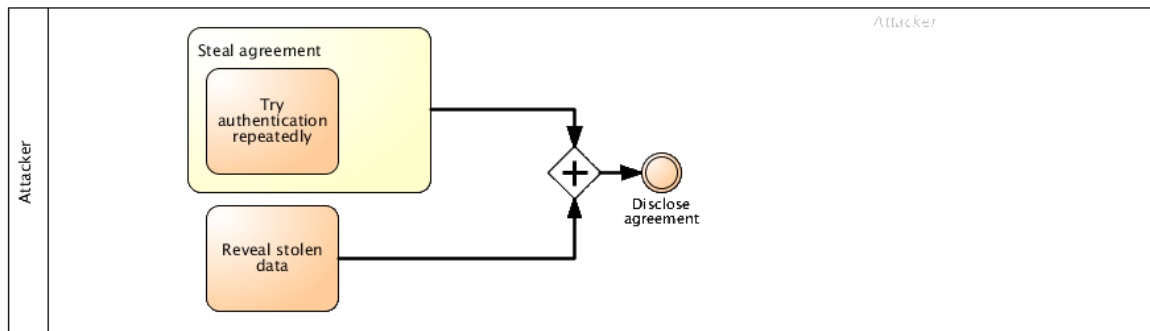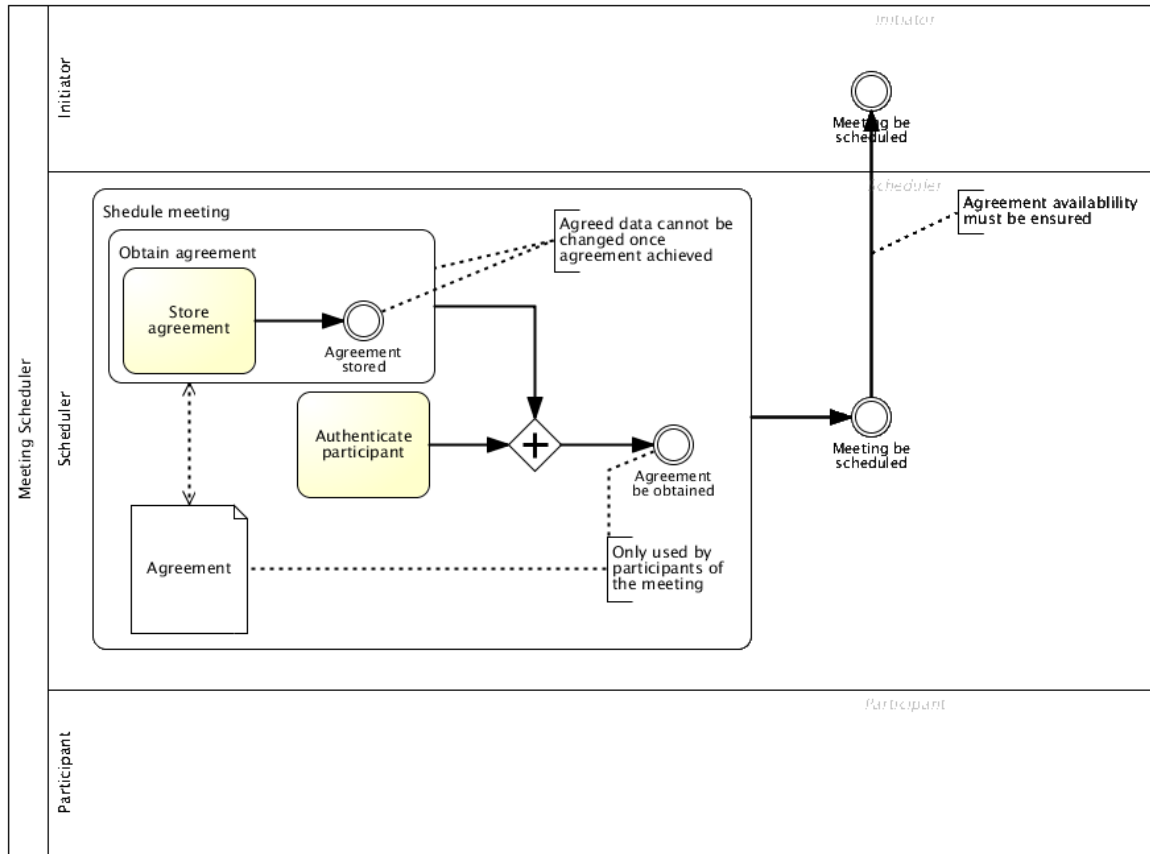

Result.

- Most constructs may be successfully transformed
- Security constraints are only preserved as comments
- Some Tasks may be unordered
- Only AND-Gateways and plain Sequence Flow may be generated
- Means-End from Goal / Plan to Goal / Plan may not be successfully transformed as it is unclear whether it should be a Sub-Task or rather an AND-Gateway

2. Risk Model Transformation

LEGEND

| Symbol	Meaning
Actor	Actor (*attacker*) and its boundary
●	Vulnerability point
Goal	Goal (*Threat*)
Plan	Plan (*Threat* or *Attack method*)
→	Means-ends
—+—	Decomposition
attacks →	Attacks relationship

TR9. Perform Transformation steps T1-8 for all additional artifacts.

TR11. Transform *Attack*-Relation from Goal or Plan to Resource as *unidirectional Association*-Relation.
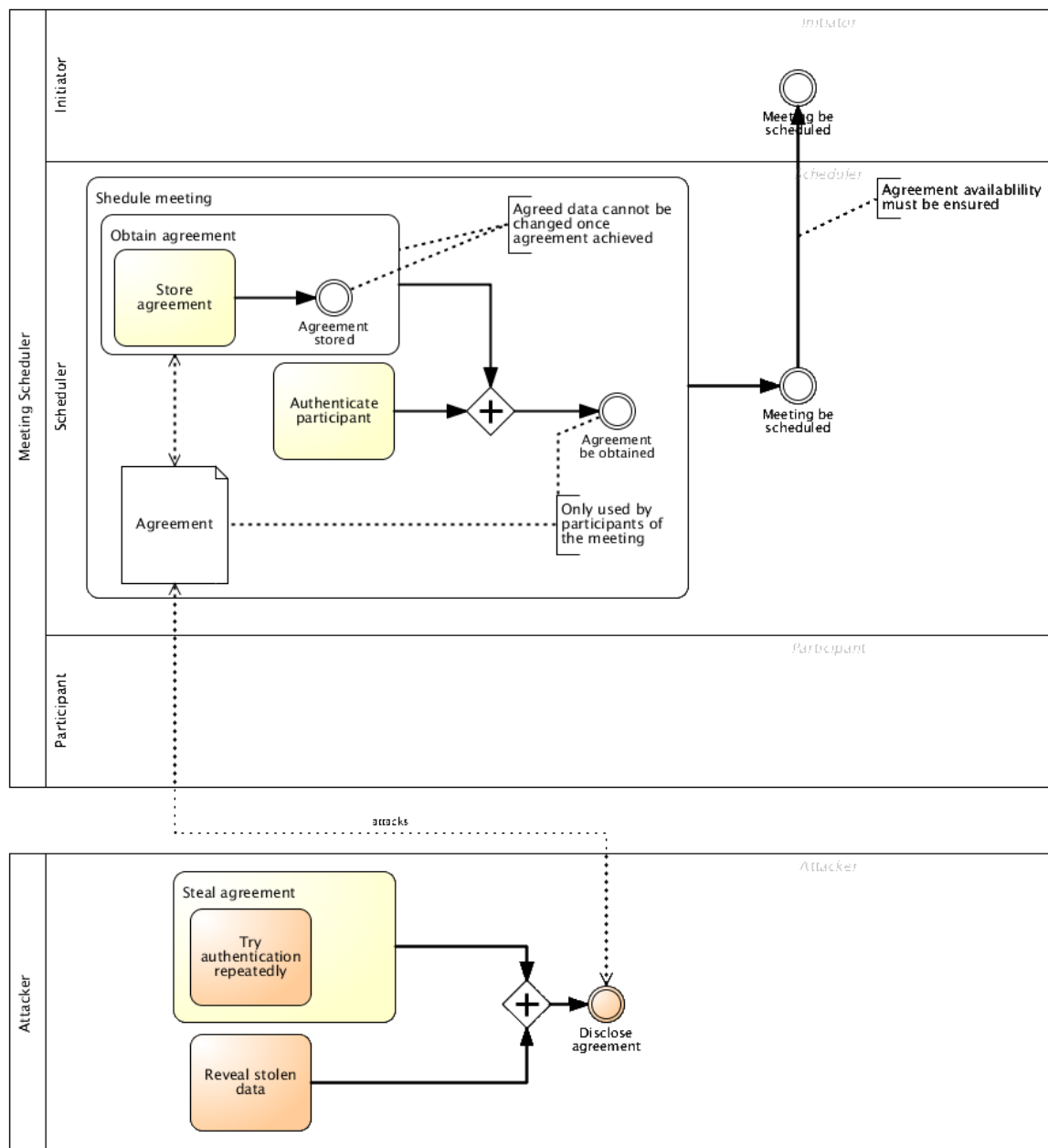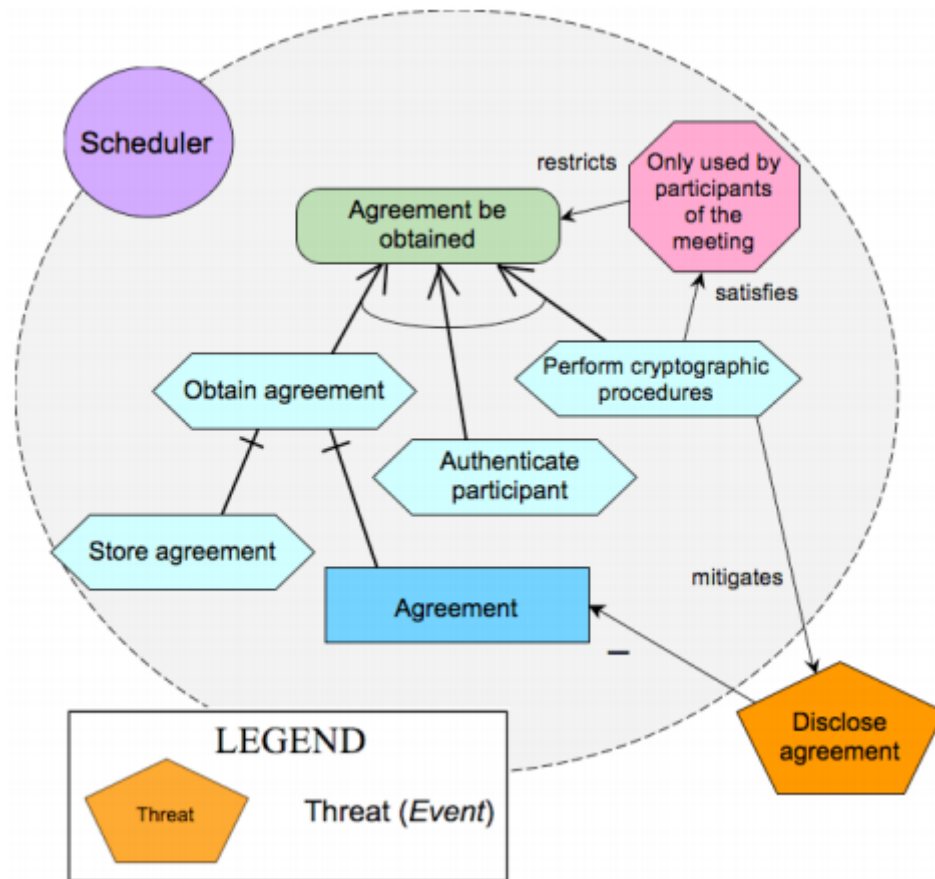
TR12. Secure Tropos' *Exploits*-Relations are transformed into BPMN's *Message Flow*-Relations.
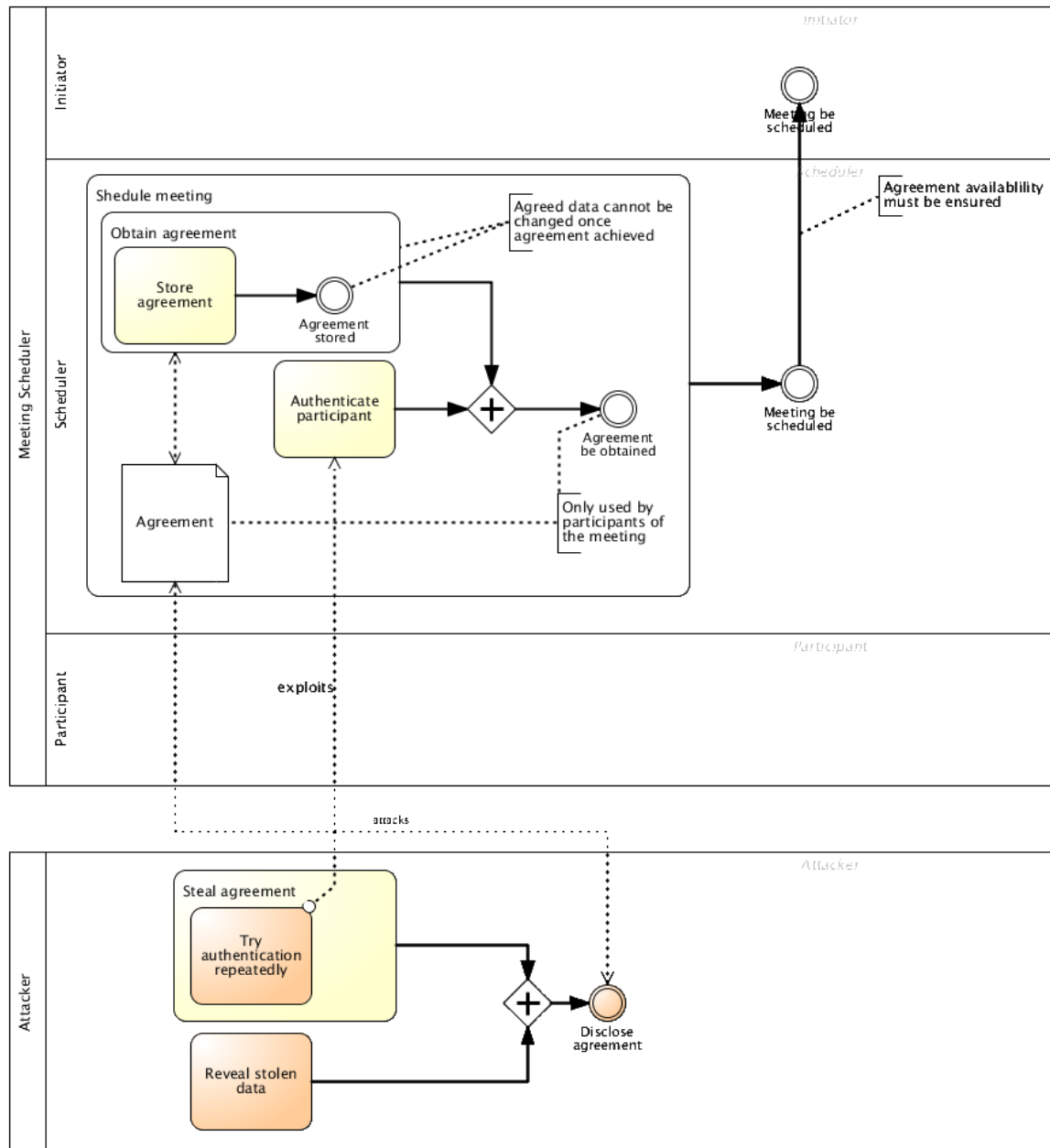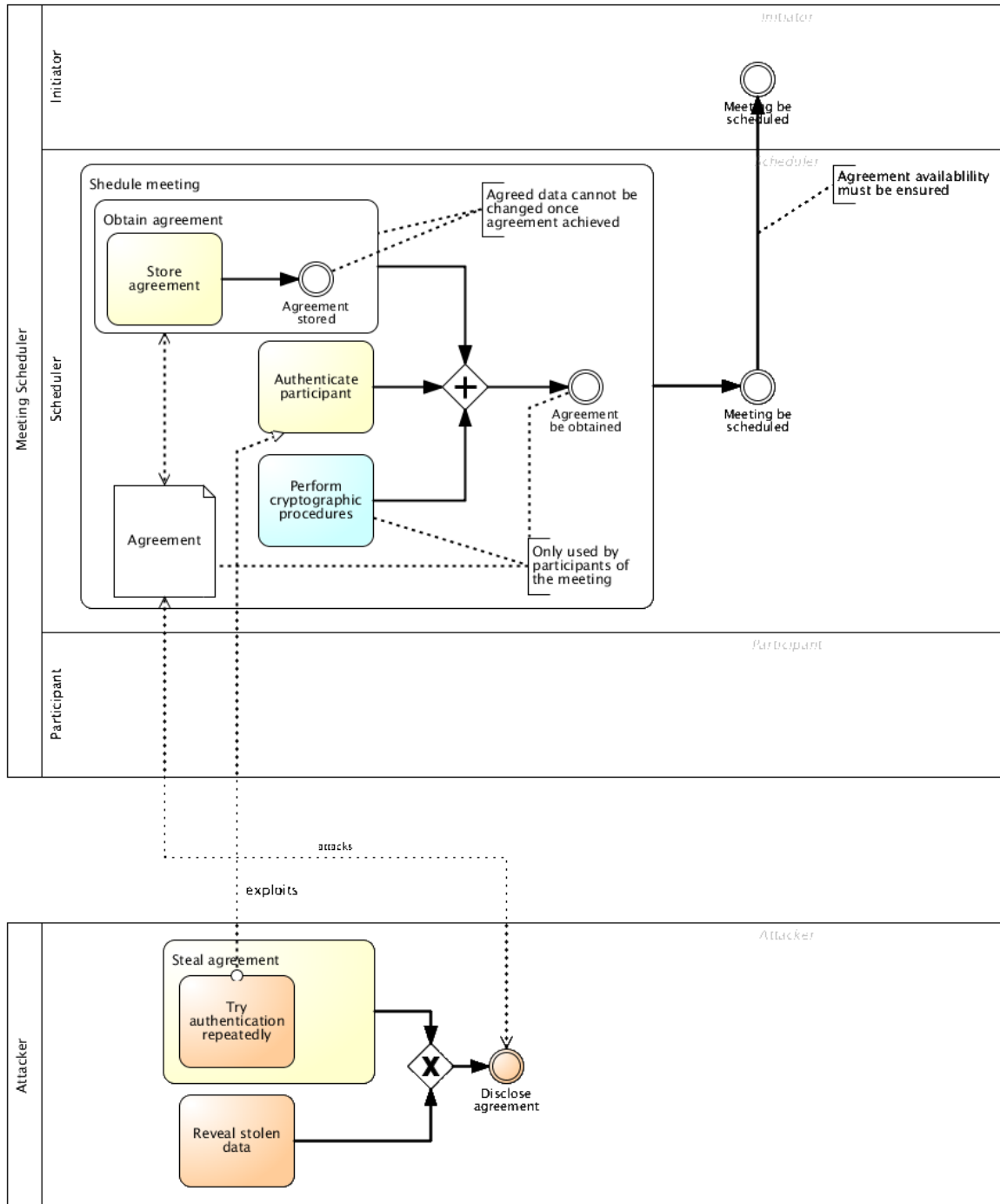

Result.

- Vulnerability Points are implicitly identified by target of exploits Message Flow
- Attacker activities and Actors are successfully contributed to the first step's BPMN model
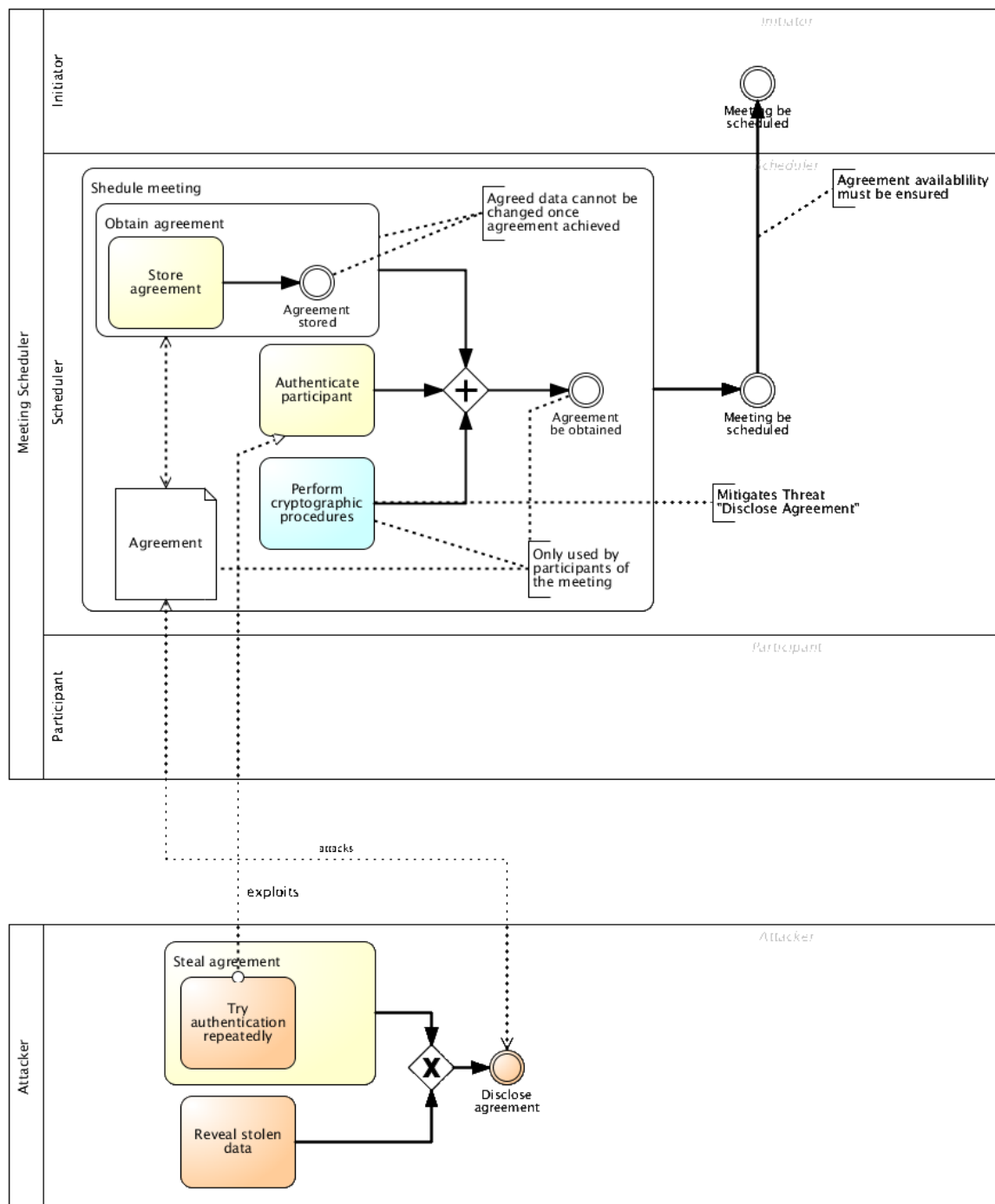
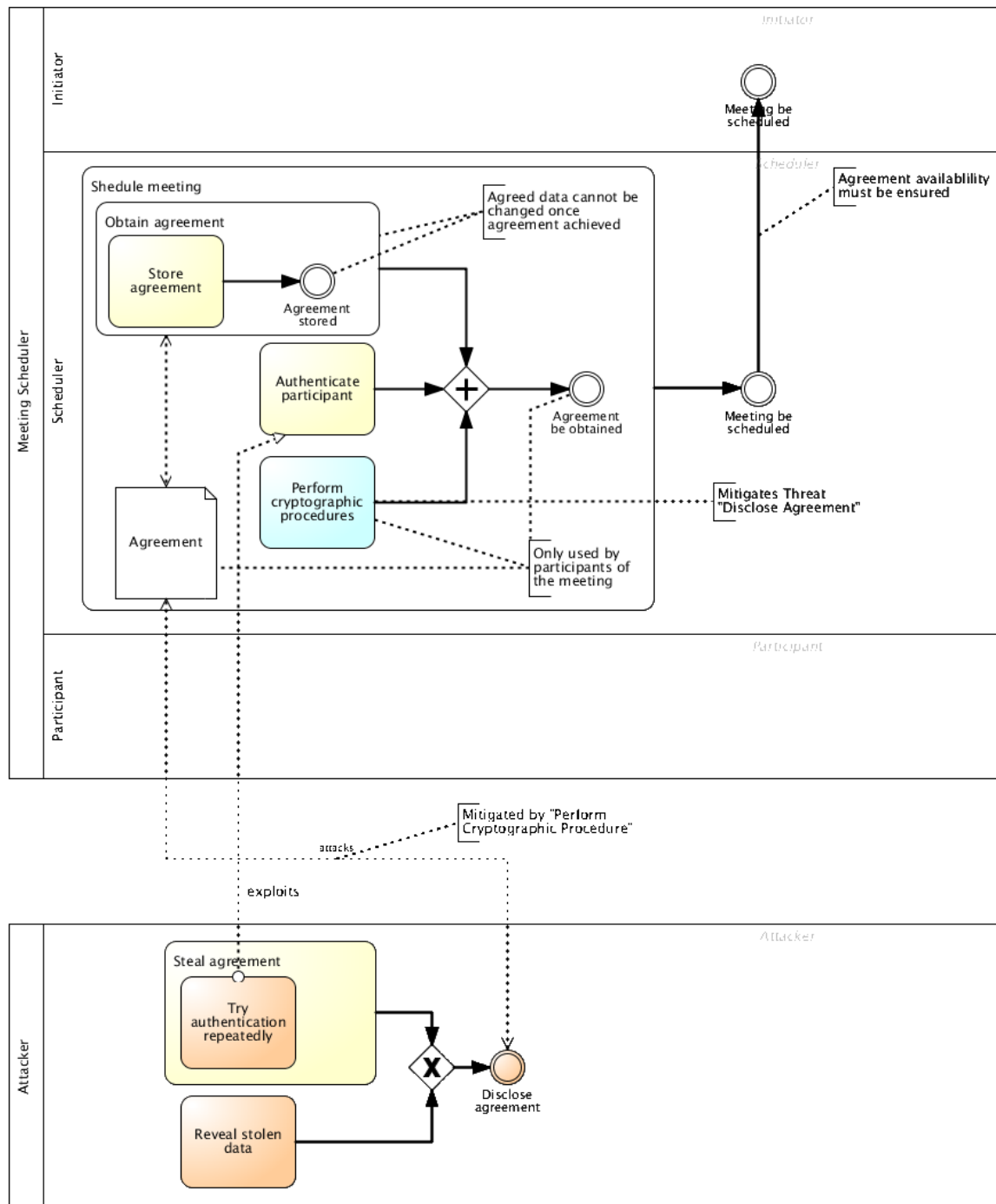## 3. Risk-Treatment Model Transformation

TR13. Perform Transformation steps T1-12 for all additional artifacts.

TR14. Secure Tropos' *Mitigates*-Relations from Goal or Plan to Threat are transformed into BPMN's *Annotations* associated with the source Task or Event.

TR15. Secure Tropos' *Impact*-Relations (- / +) from Threat to Resource are transformed into BPMN's *Annotation* and associated with the Threat's Attack-Relation (from step TR11) or discarded, if such a relation does not exist.

Result.

- Security-related constructs mainly transformed as Annotations
- Impact link may become visible when splitting BPMN diagram into pre- and post-Risk Treatment versions

Finalize & Handwork

TR16. Link unlinked Tasks with each other.

TR17. Define starting and end points, possibly additional events.

TR18. Revise Tasks and Events for specialized types (e.g. Message Event instead of Plain Intermediate Event).

TR19. Combine or split Tasks.