Splitting GSM Schemas: A Framework for Outsourcing of Declarative Artifact Systems

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Where innovation starts

Context

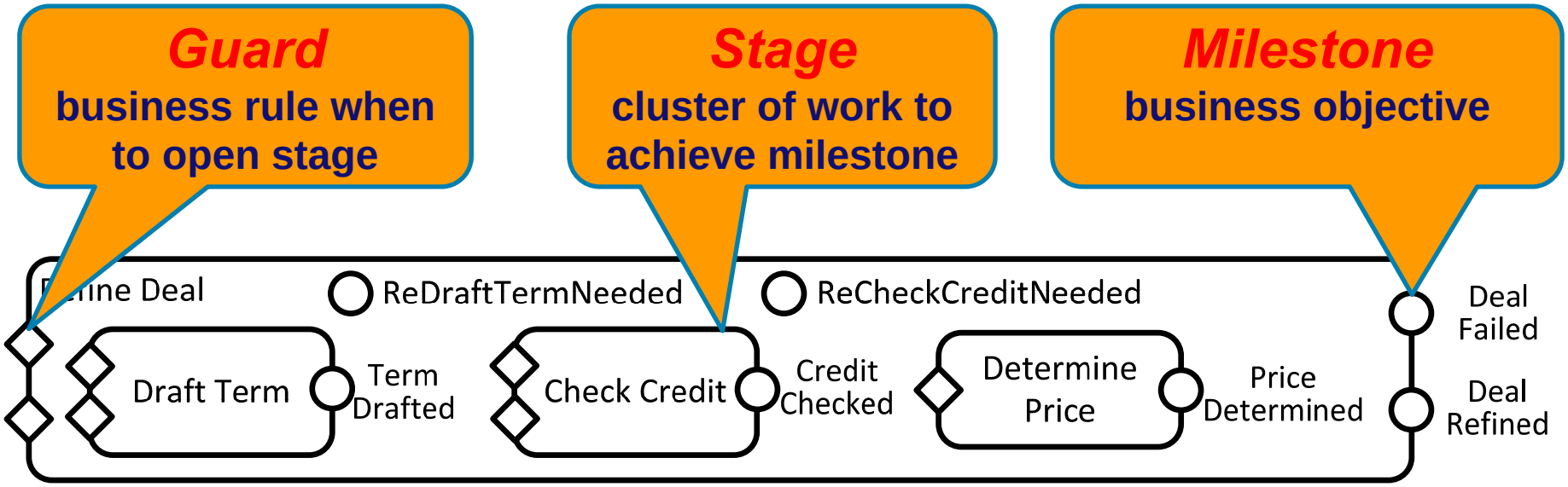
Motivation

- Business Process Outsourcing (BPO): part of a business process is performed by another organization
- Cloud-computing is key enabler of BPO

This study

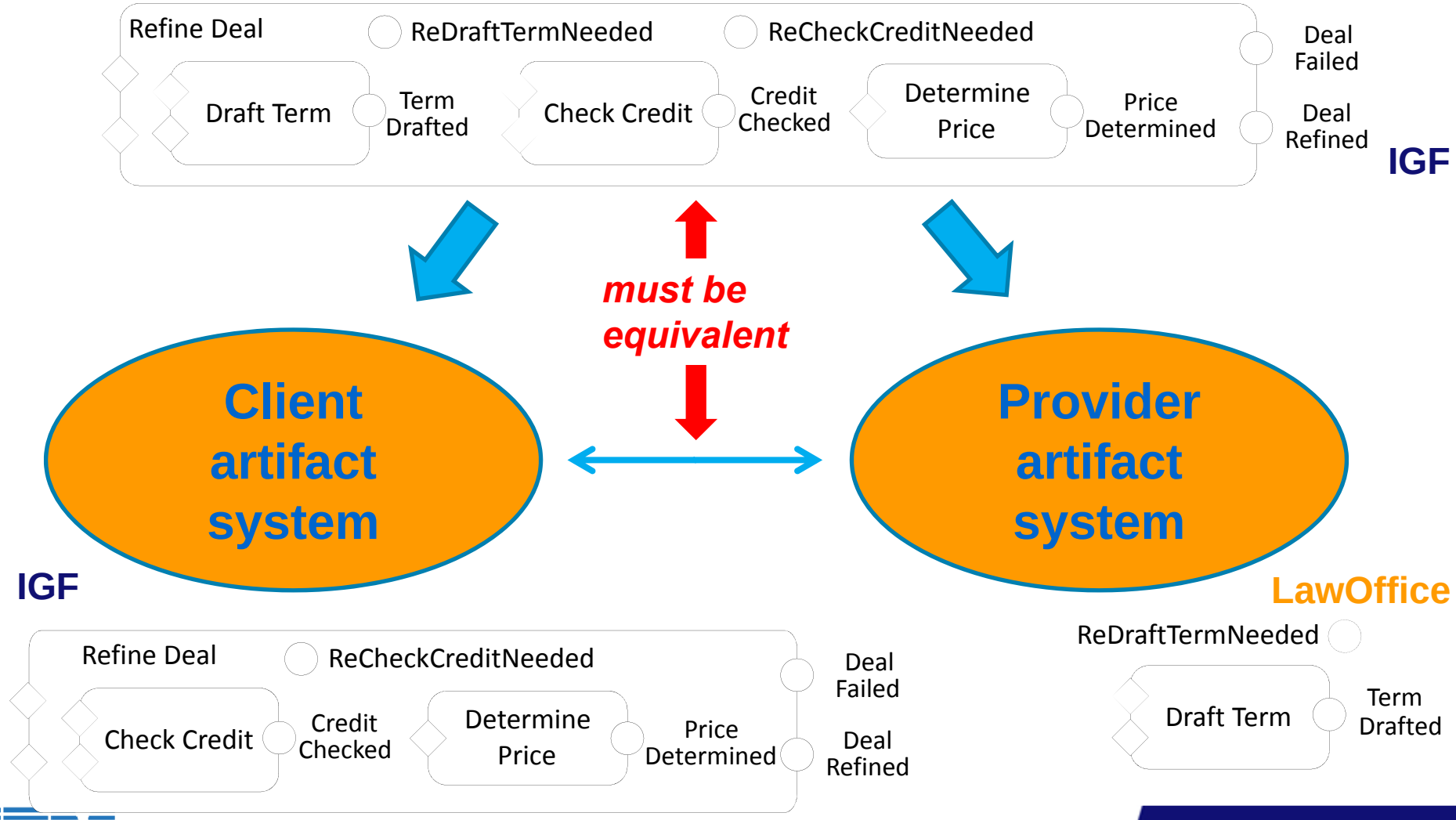
- BPO for declarative case management
  - Spez., Guard-Stage-Milestone business artifact model
  - GSM is basis for OMG's CMMN standard
- Main result: framework that
  - enables BPO at design-time and run-time
  - supports hiding business logic

Guard-Stage-Milestone (GSM) schemas



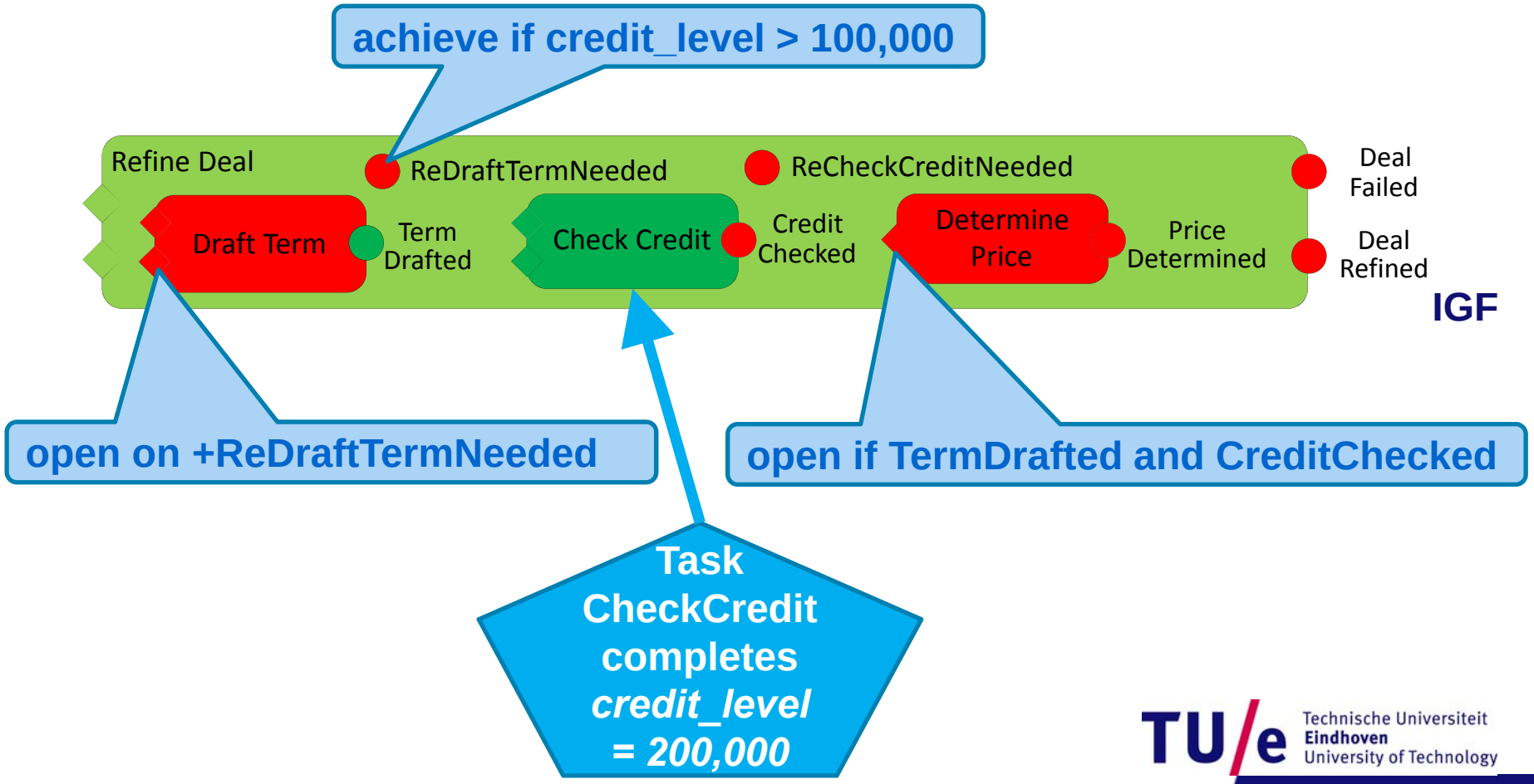
- Status of each stage,milestone ∈ { on, off}
- Business rules specify when stage/milestone changes state
  - Might refer to status of other stages/milestones
- Rules need to be evaluated in right order to ensure that all changes have maximal effect
- Unit of change triggered by external event is called a B-step

Problem: outsourcing GSM subschema



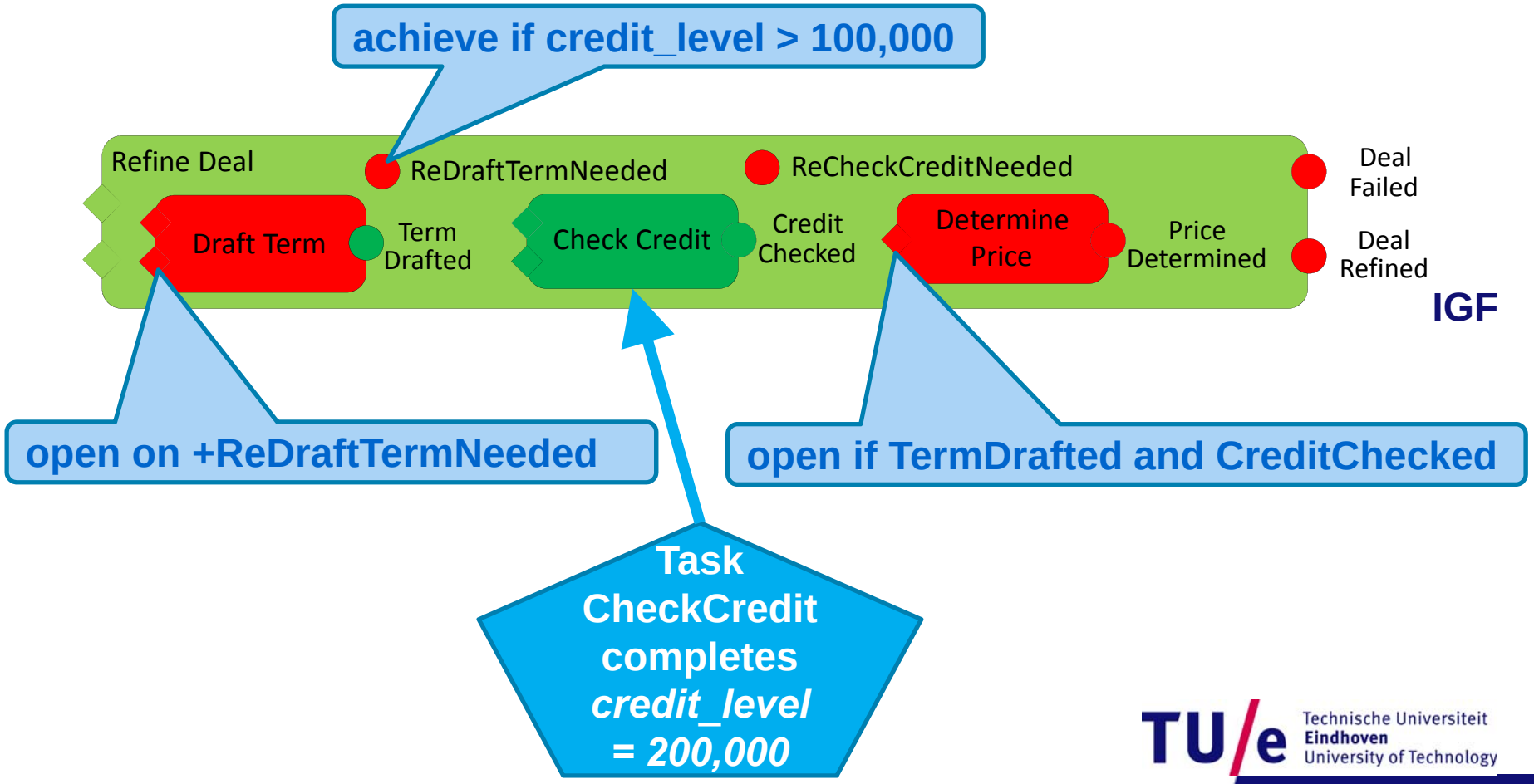
Example scenario in original GSM schema

- status is on
- status is off



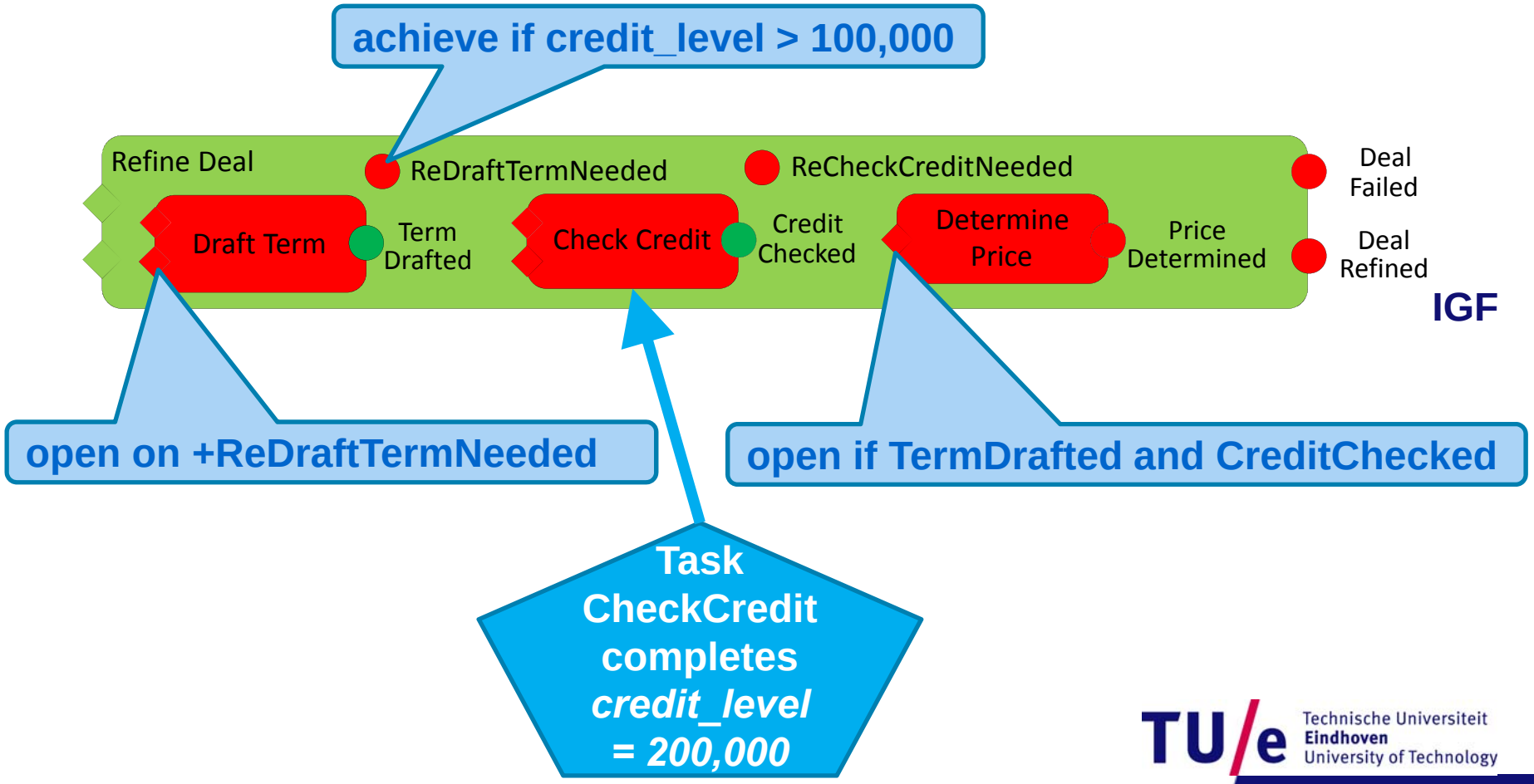
Starting B-step (1)

- status is on
- status is off



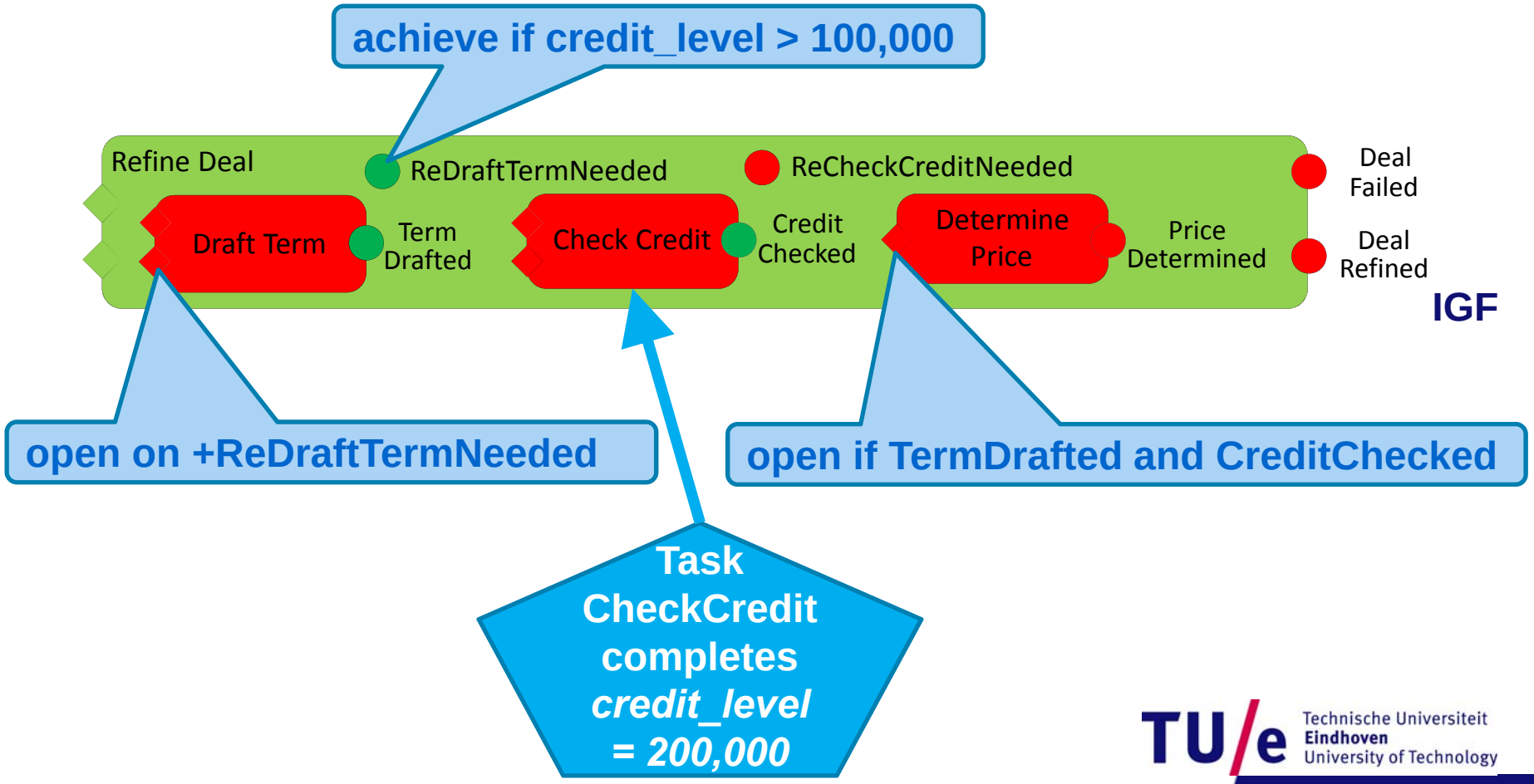
Continuing B-step (2)

- status is on
- status is off



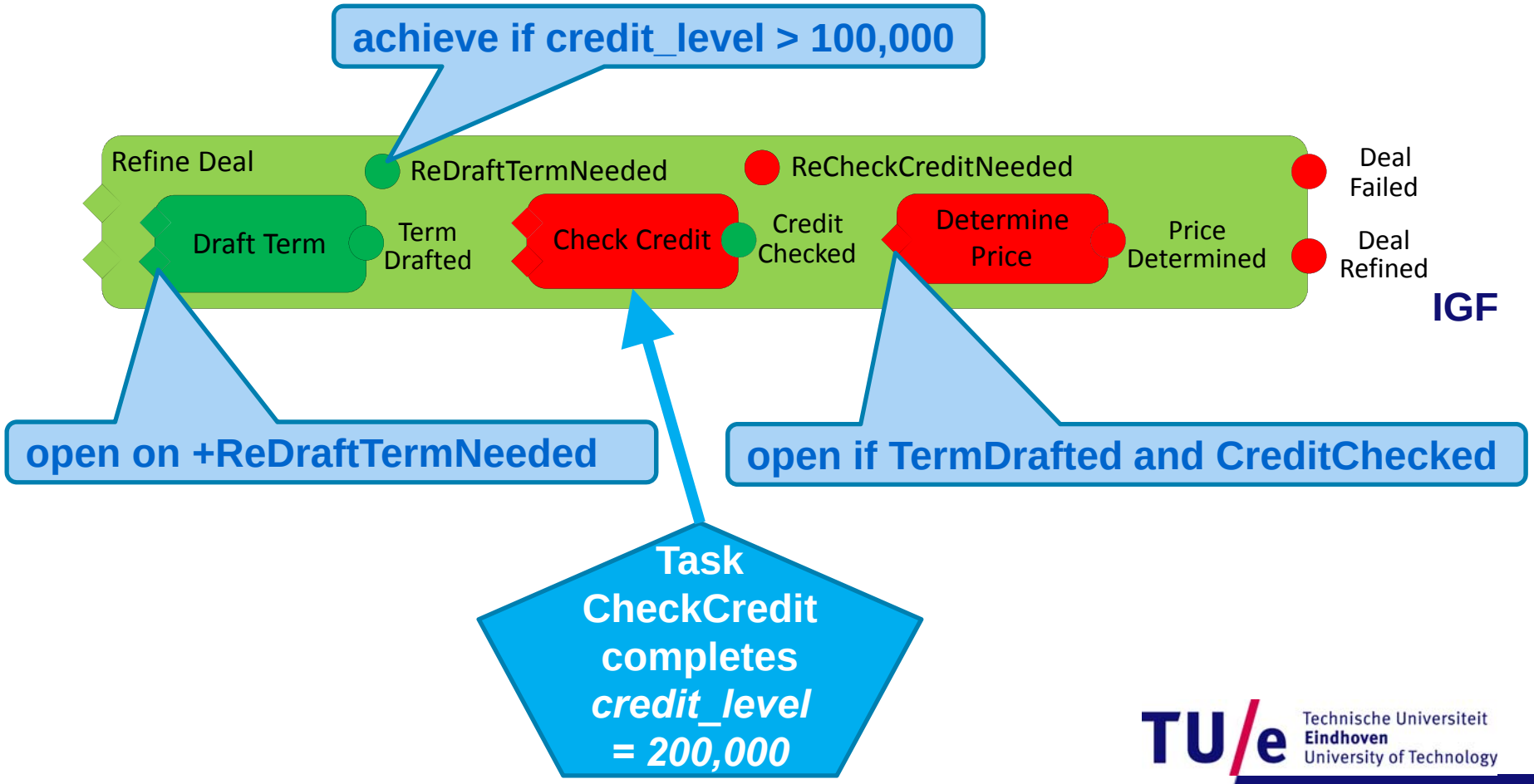
Continuing B-step (3)

- status is on
- status is off



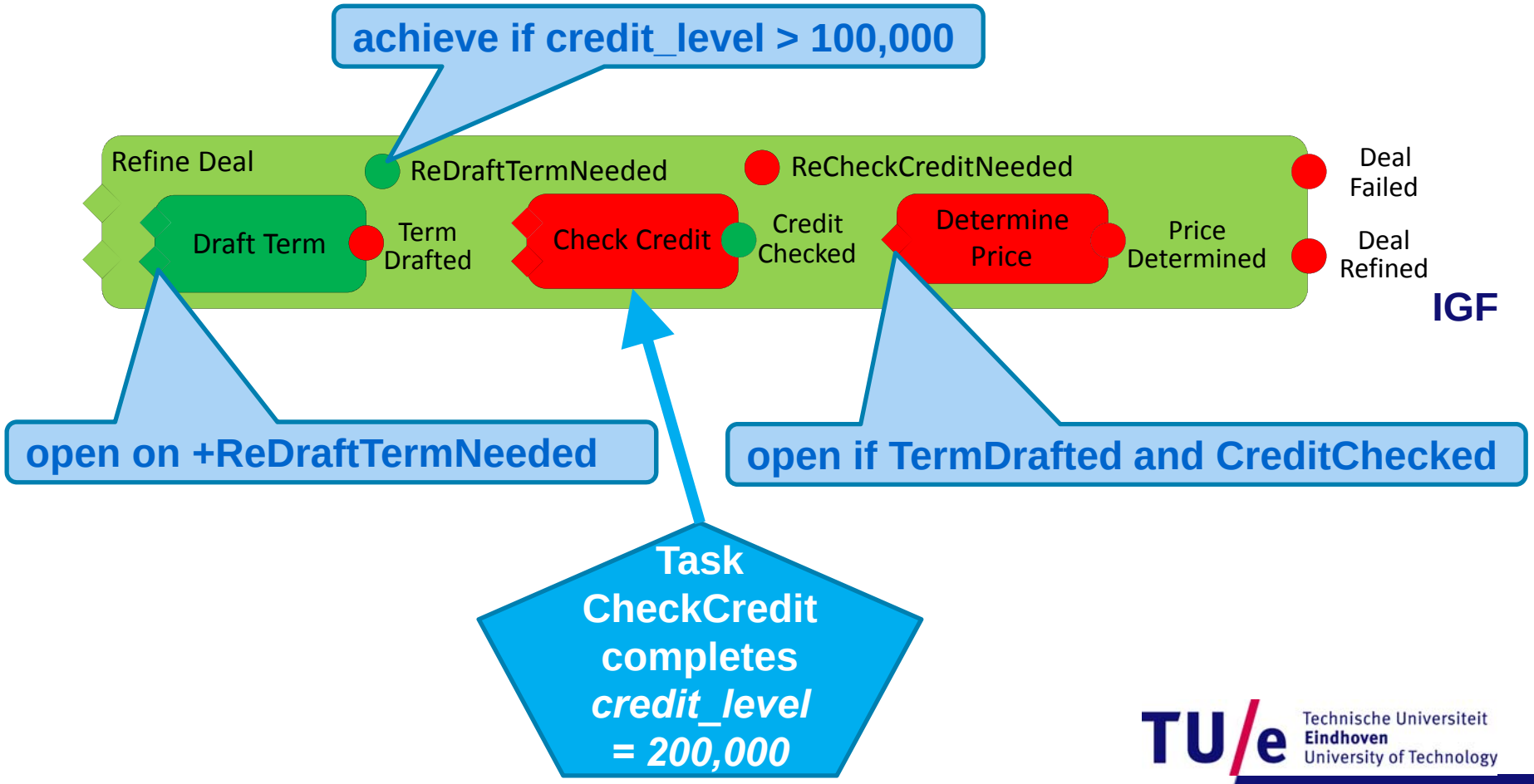
Continuing B-step (4)

- status is on
- status is off

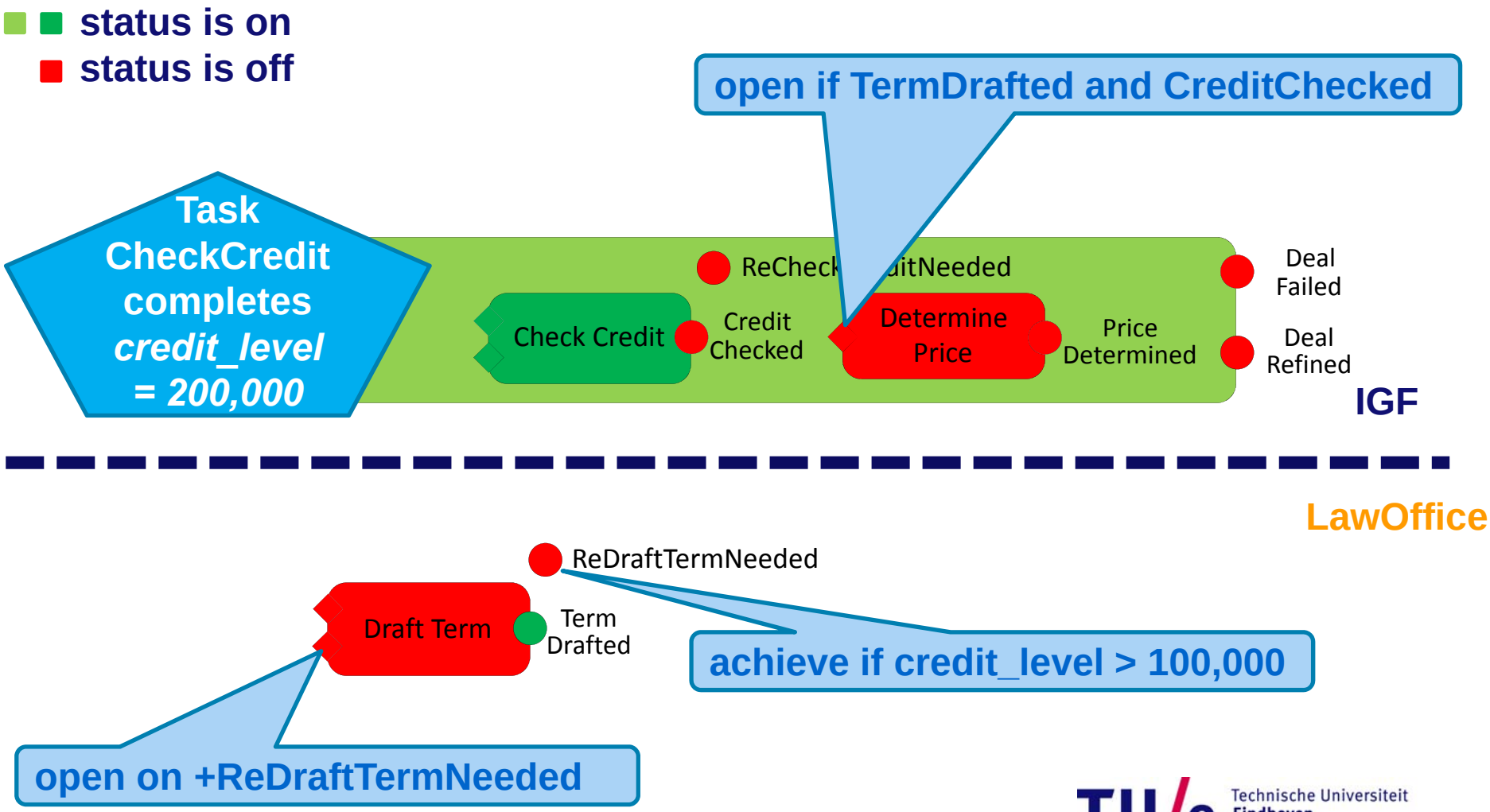


End of B-step (5)

- status is on
- status is off



Splitting example scenario results in race condition



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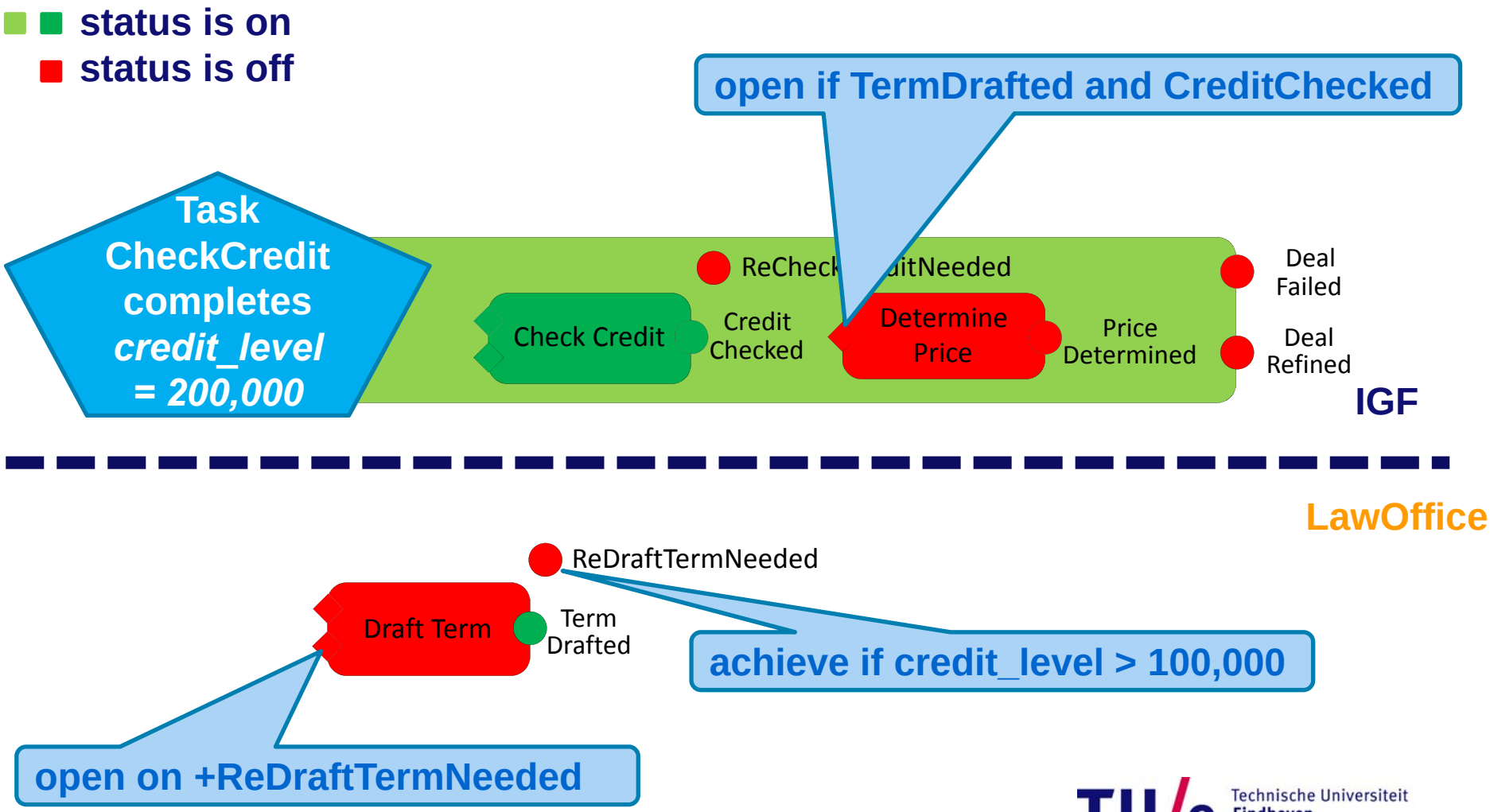

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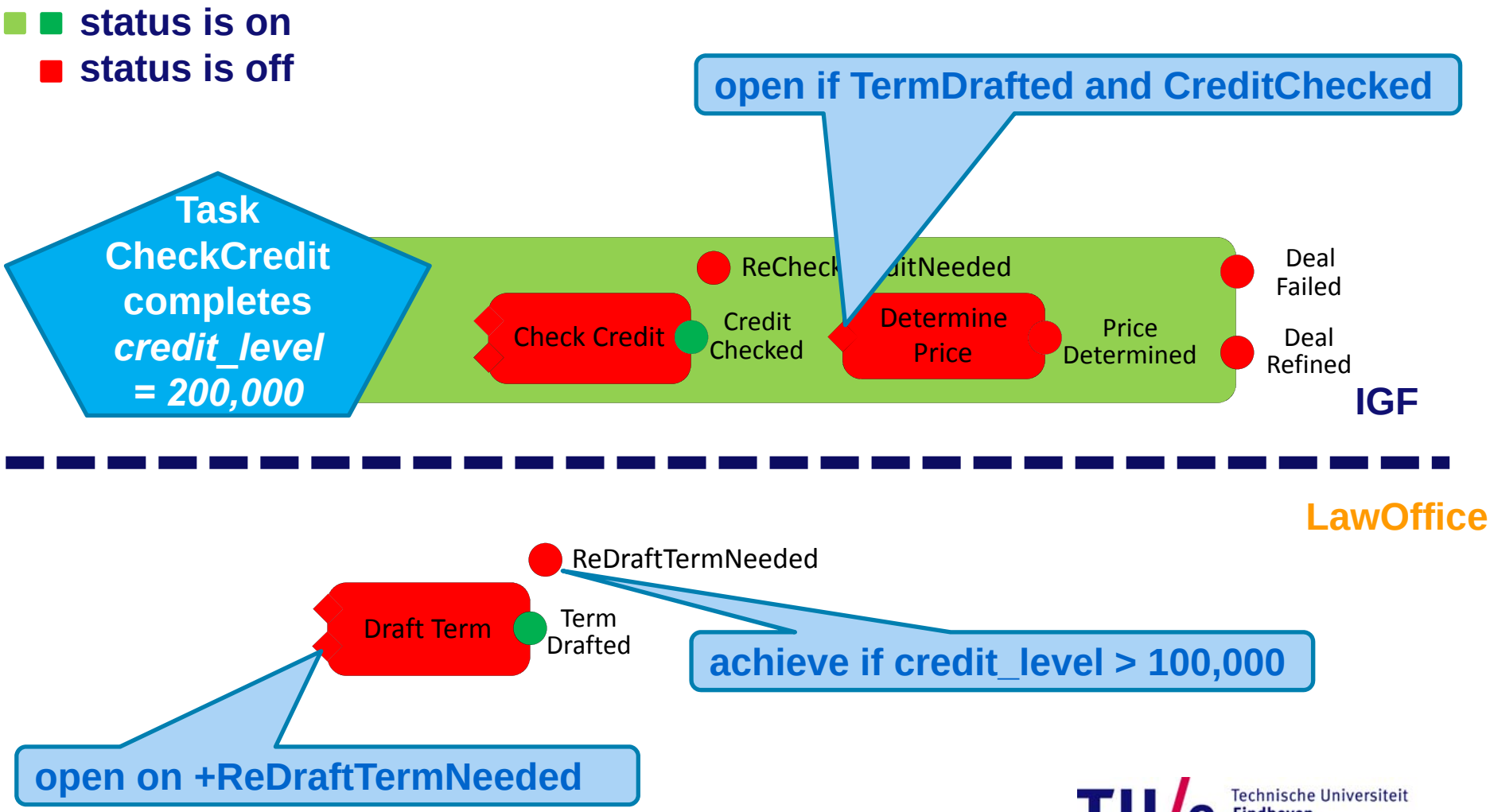

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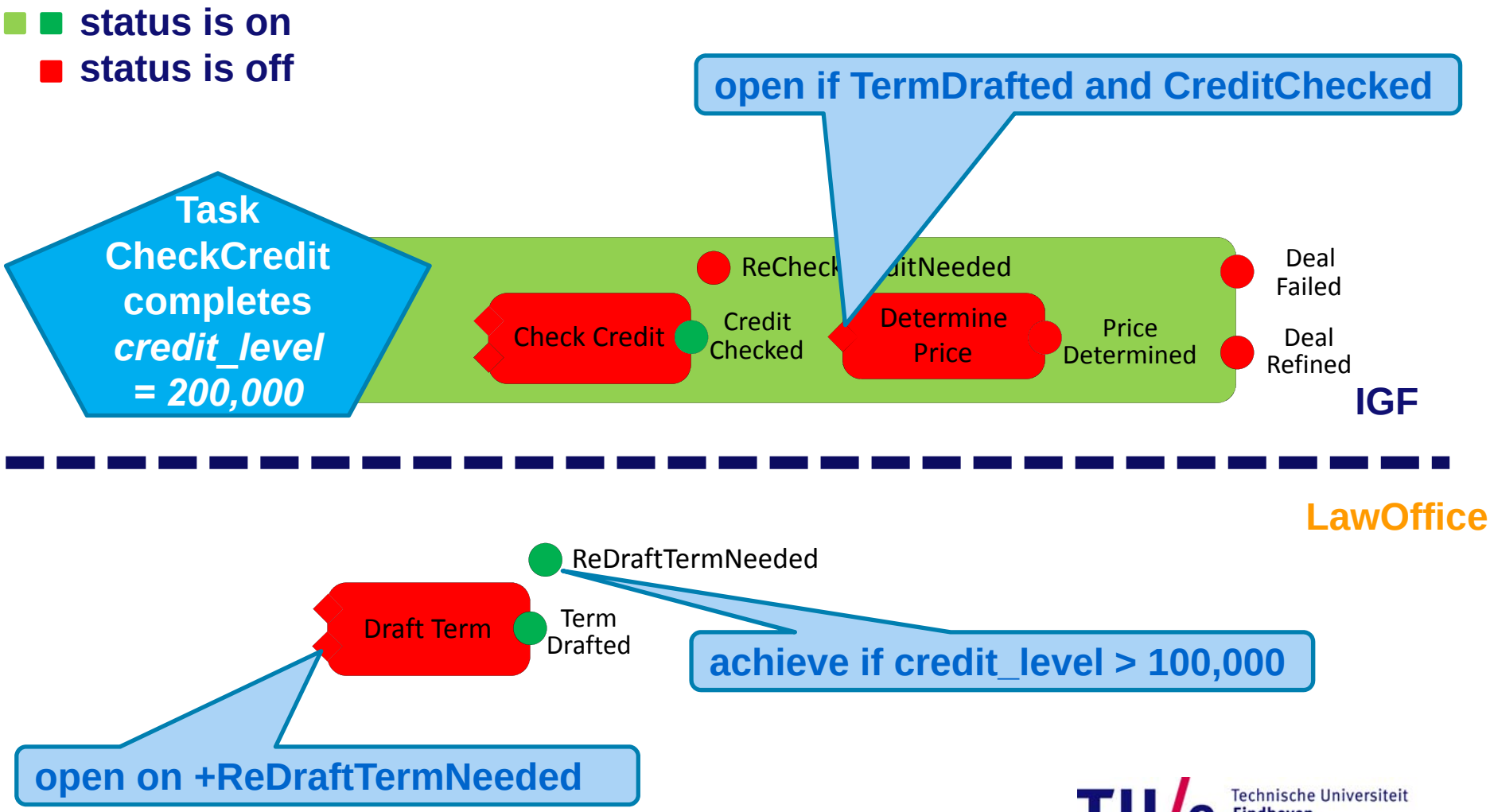

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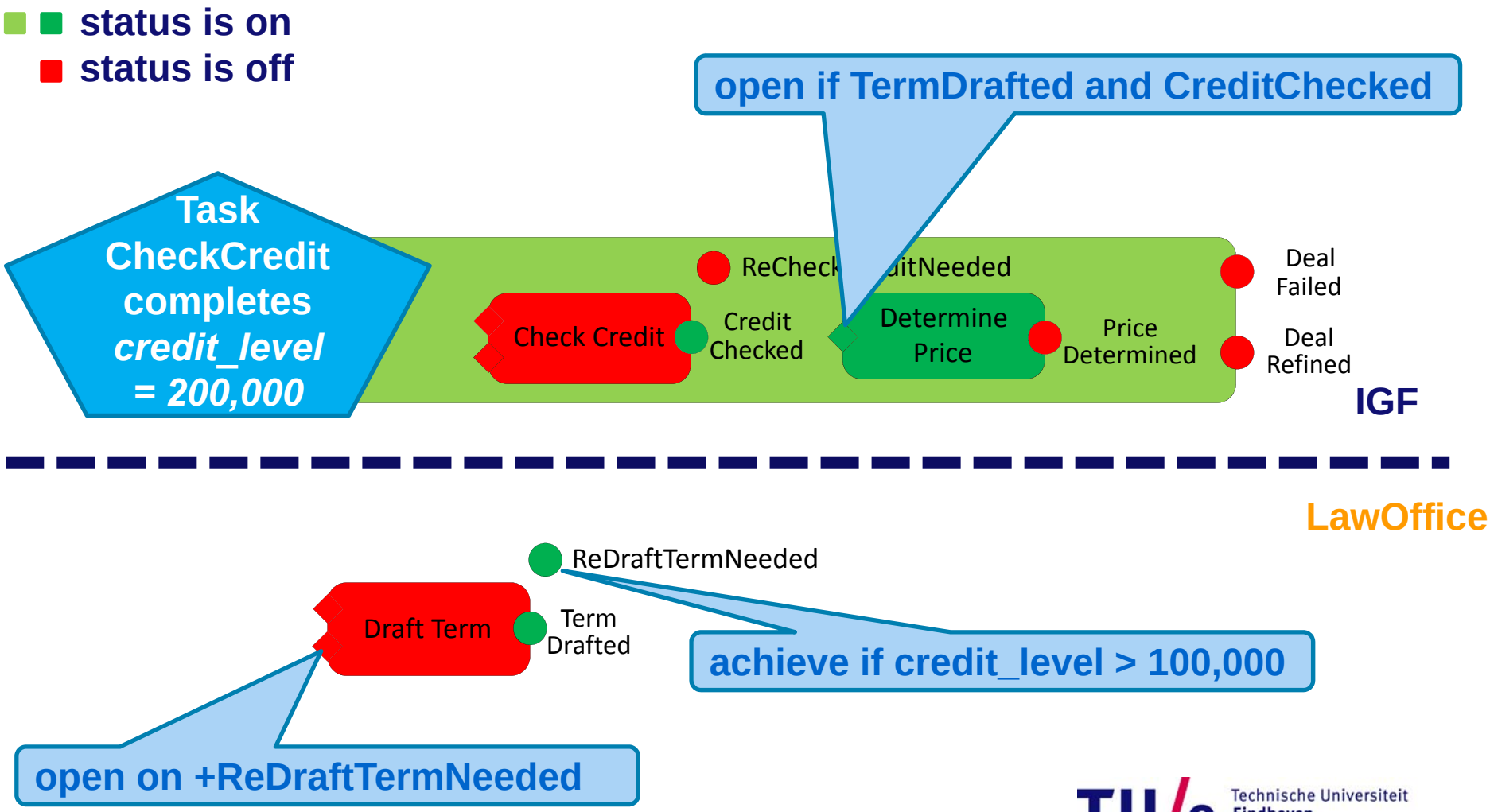

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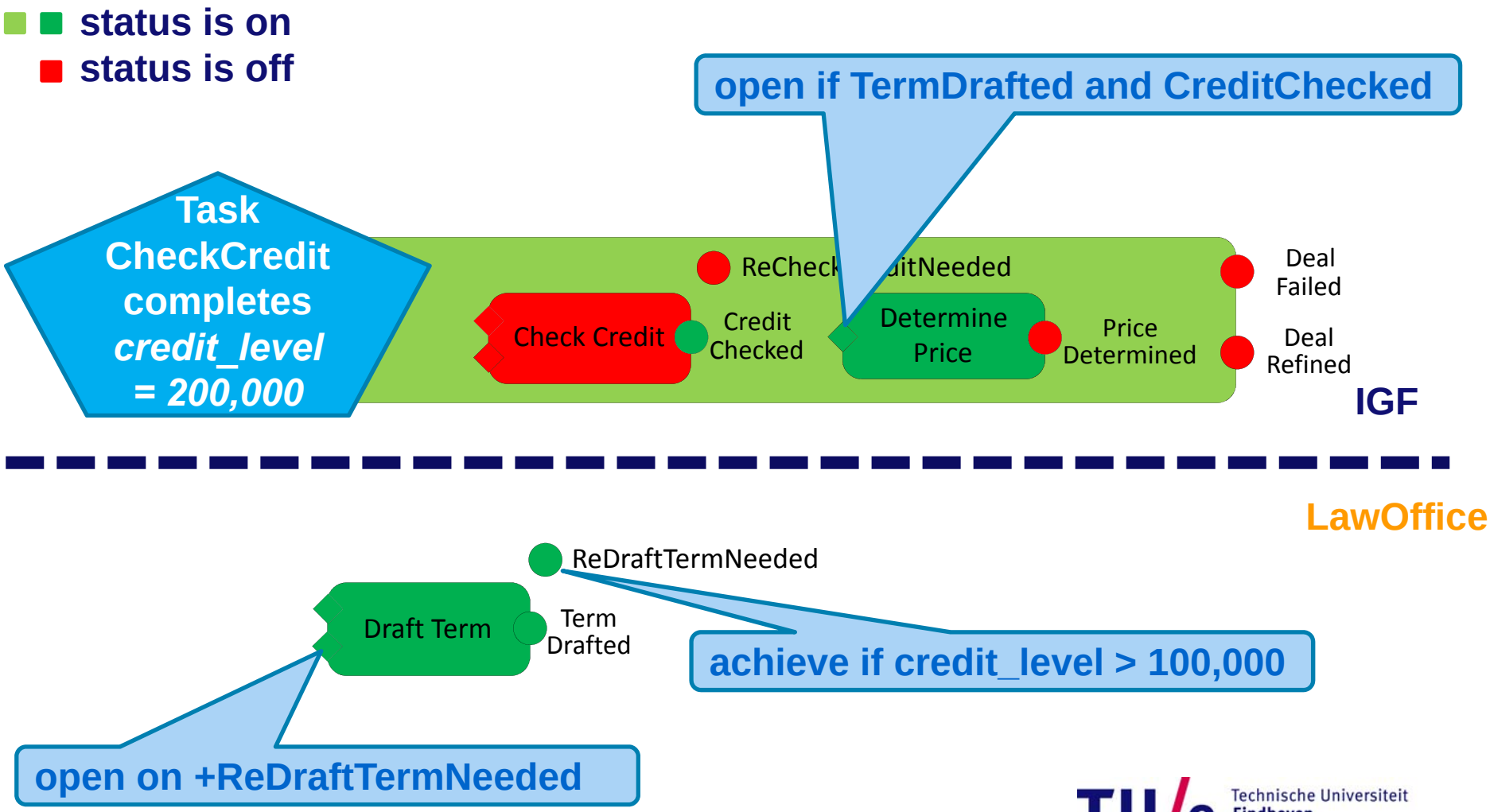

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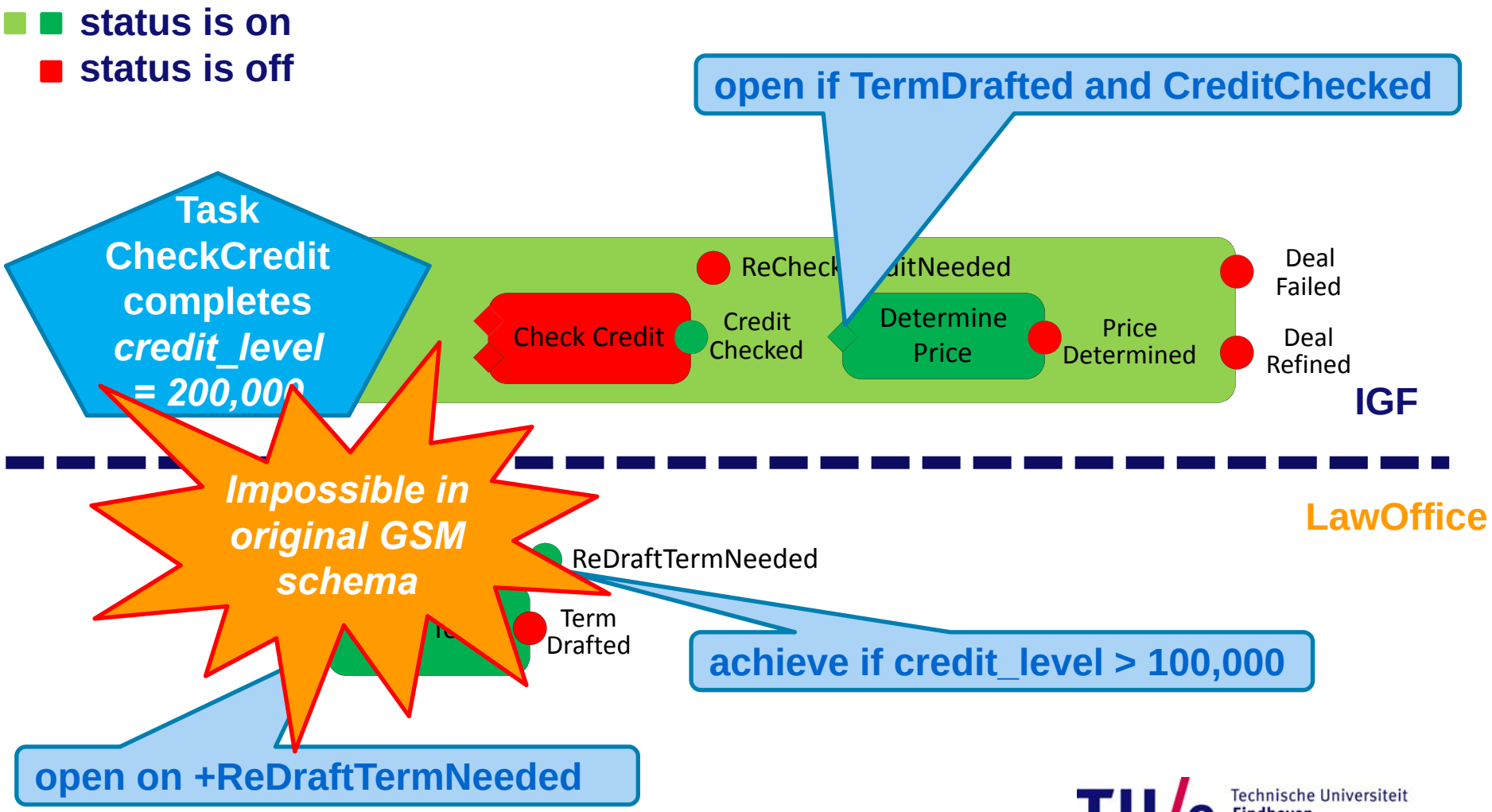
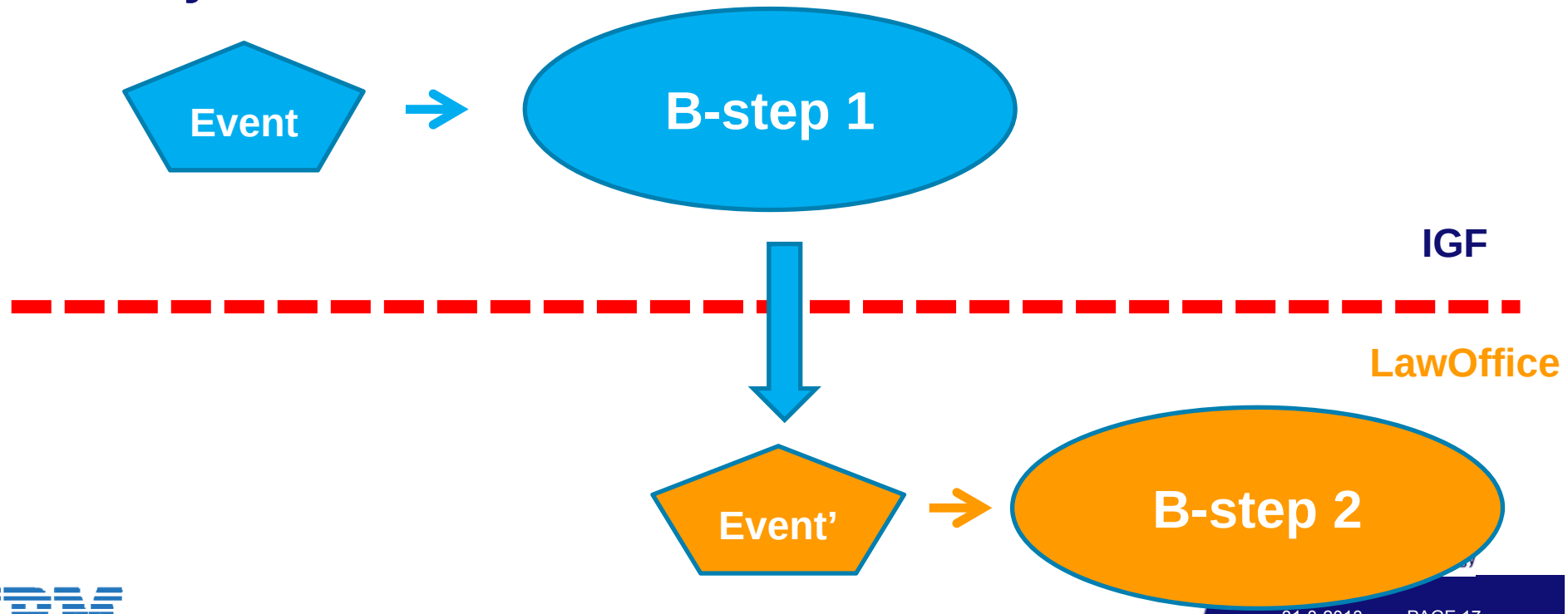
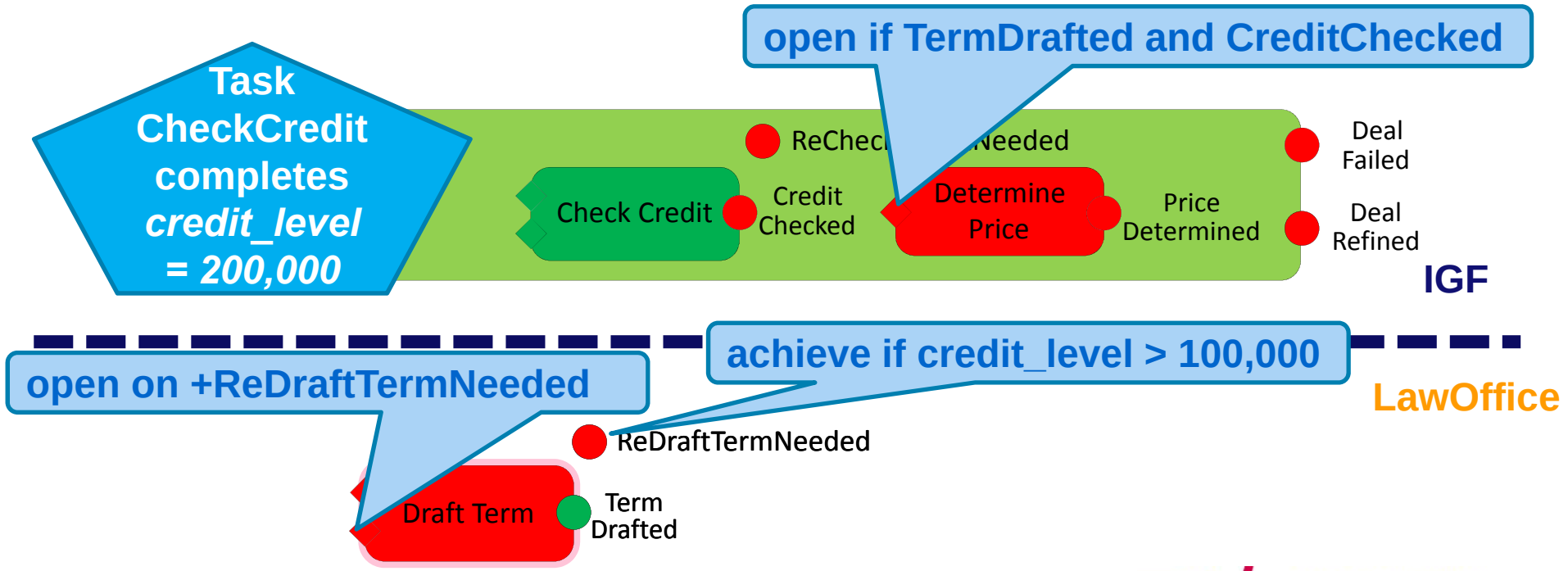


Possible solutions

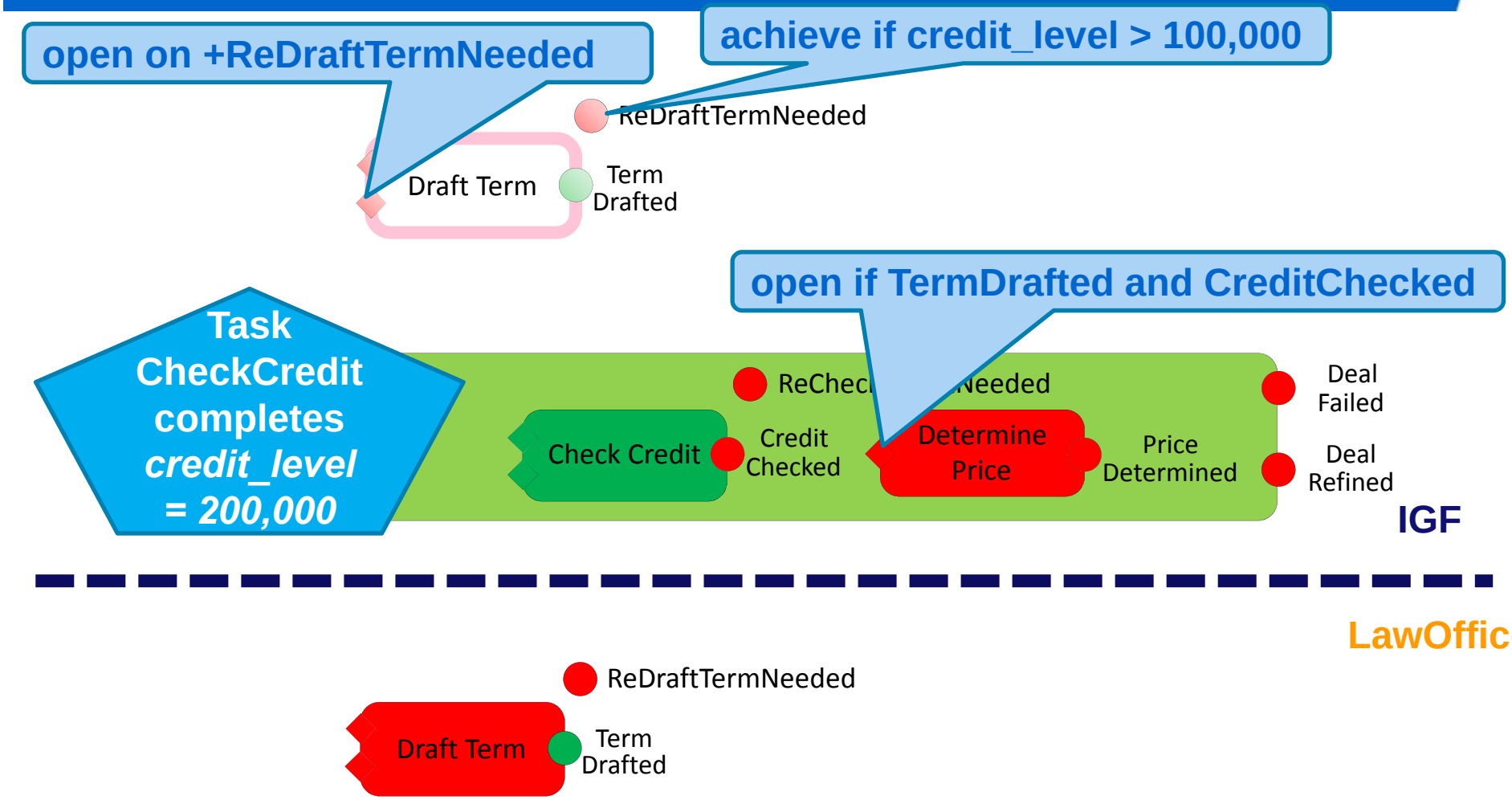
1. Extend local GSM engines with complex synchronization logic
2. Better: restructure GSM schema to avoid complex synchronization



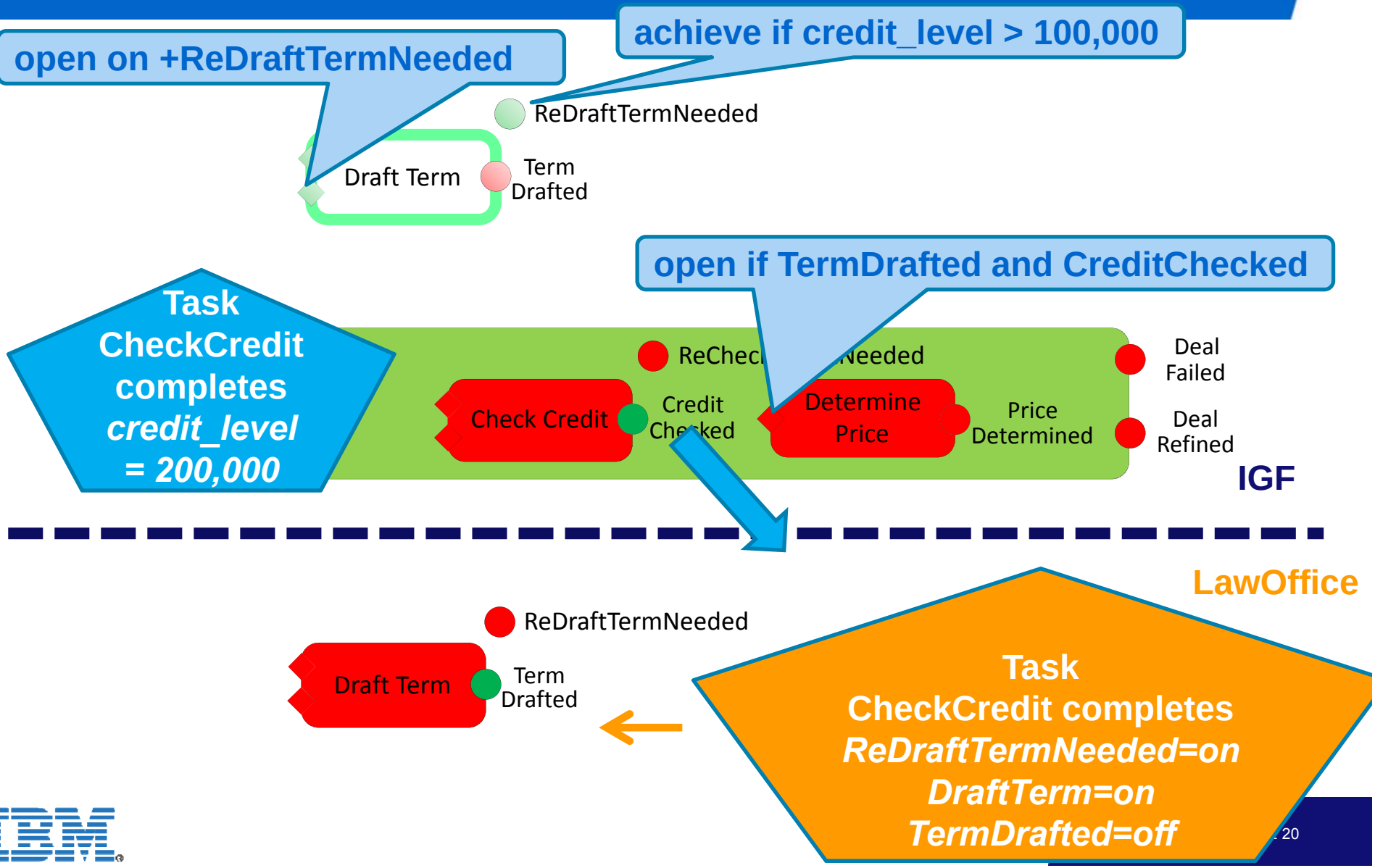
Resolved race condition



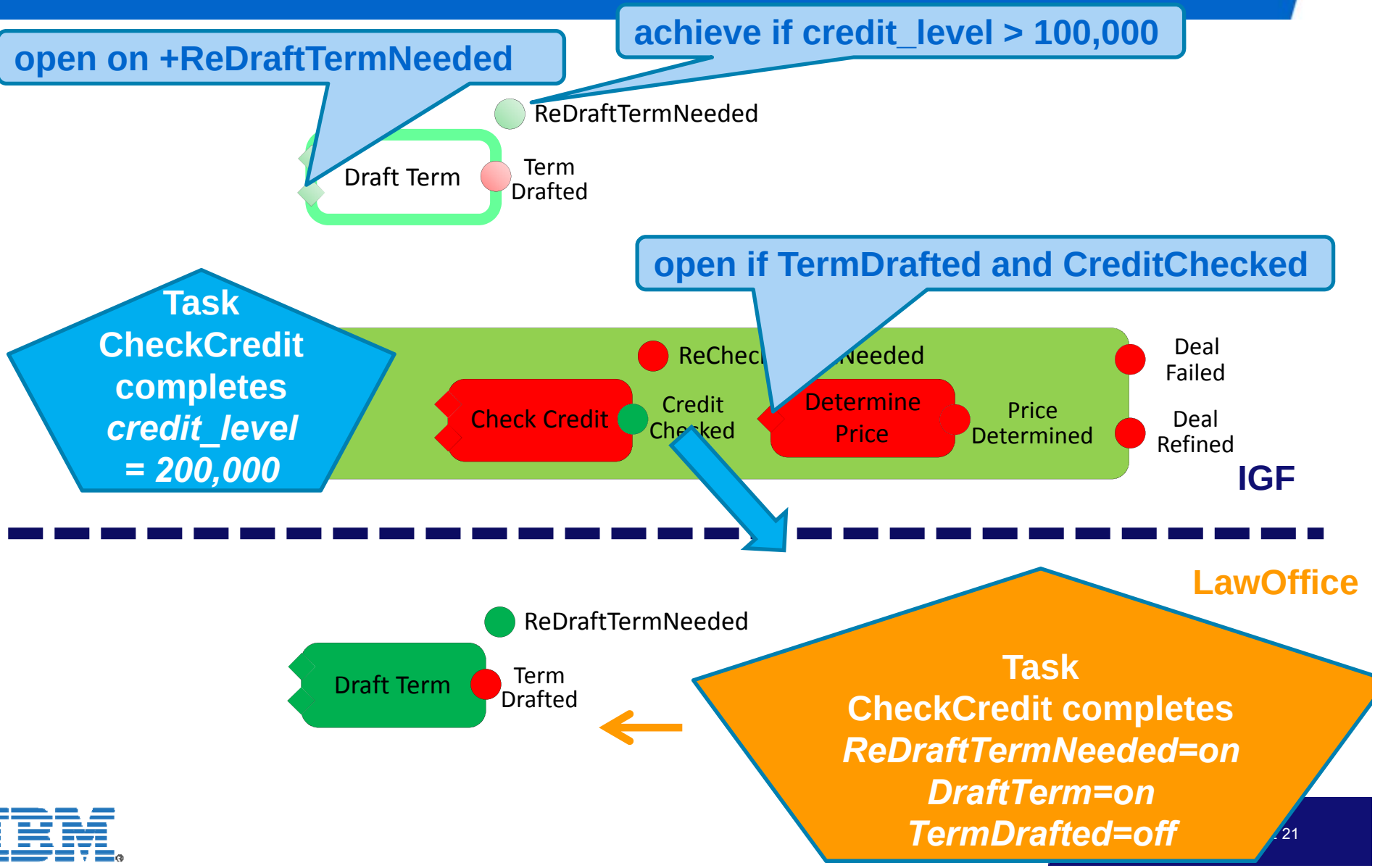
Resolved race condition



Resolved race condition: after B-step 1



Resolved race condition: after B-step 2



Solution approach

- Keep local cache of status of needed remote stages/milestone
  - determined per external event type
- Reallocate business rules to avoid complex synchronization
  - Sometimes: rule executes at different location than the corresponding stage/milestone
- Runtime simulation protocol based on distributed 2-phase commit
- Result (see paper): split GSM schema faithfully simulates original GSM schema

Formal results

Theorem 1

- Let Σ be a snaphot of GSM schema Γ ;
- Let schemas Γ_1 and Γ_2 be a “split” of schema Γ ;
- Let snapshots Σ_1 and Σ_2 be the split of Σ;
- Let e be an external event of type E;
- Then: the application of e on (Σ_1,Σ_2) faithfully simulates the application of e on Σ

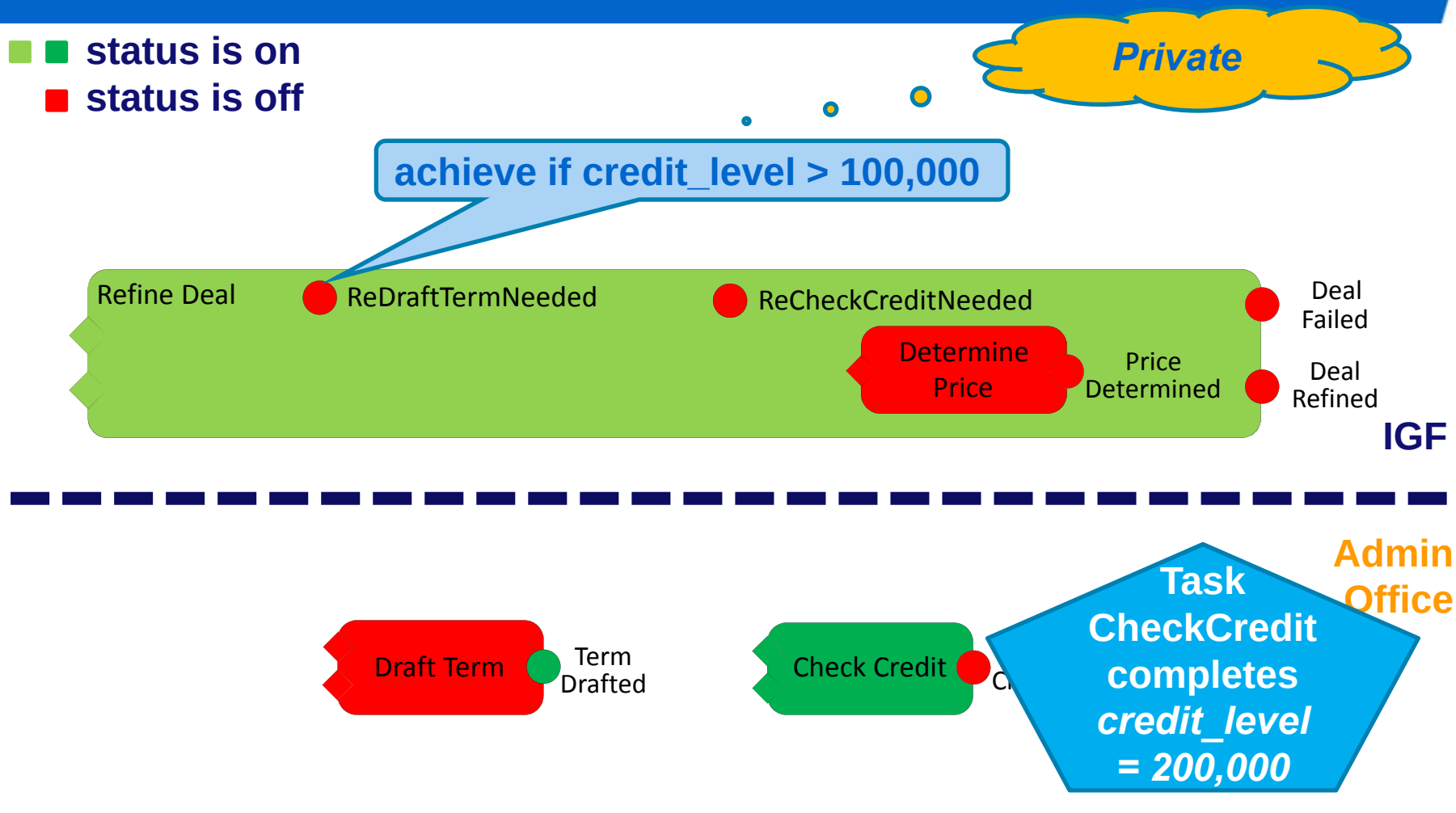
Theorem 2

- Using the “runtime simulation protocol” (see paper) the above result generalizes to streams of external events.

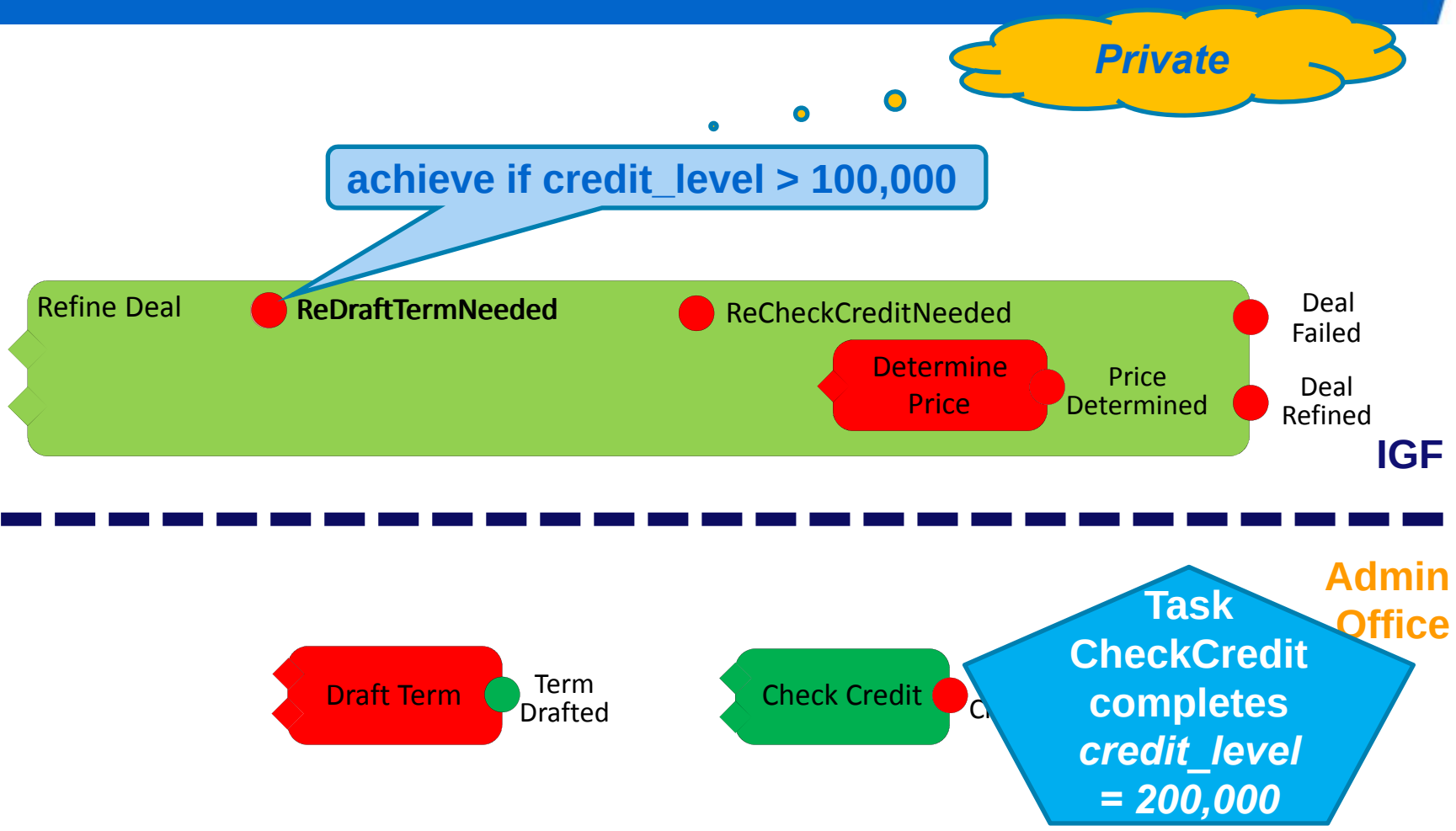
Yet another problem…

... revealing of secrets

Alternative outsourcing scenario



Restructured GSM schema



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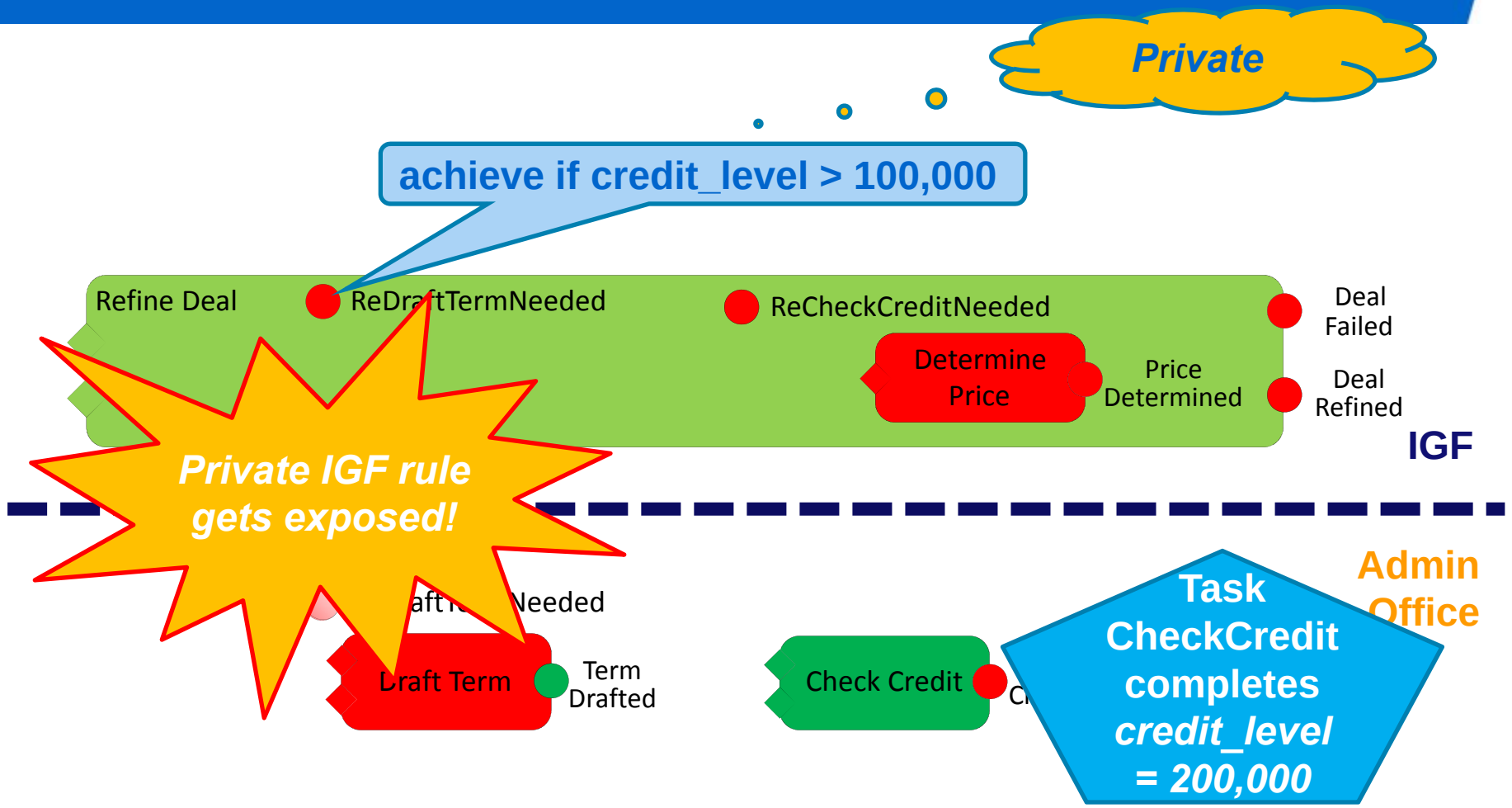
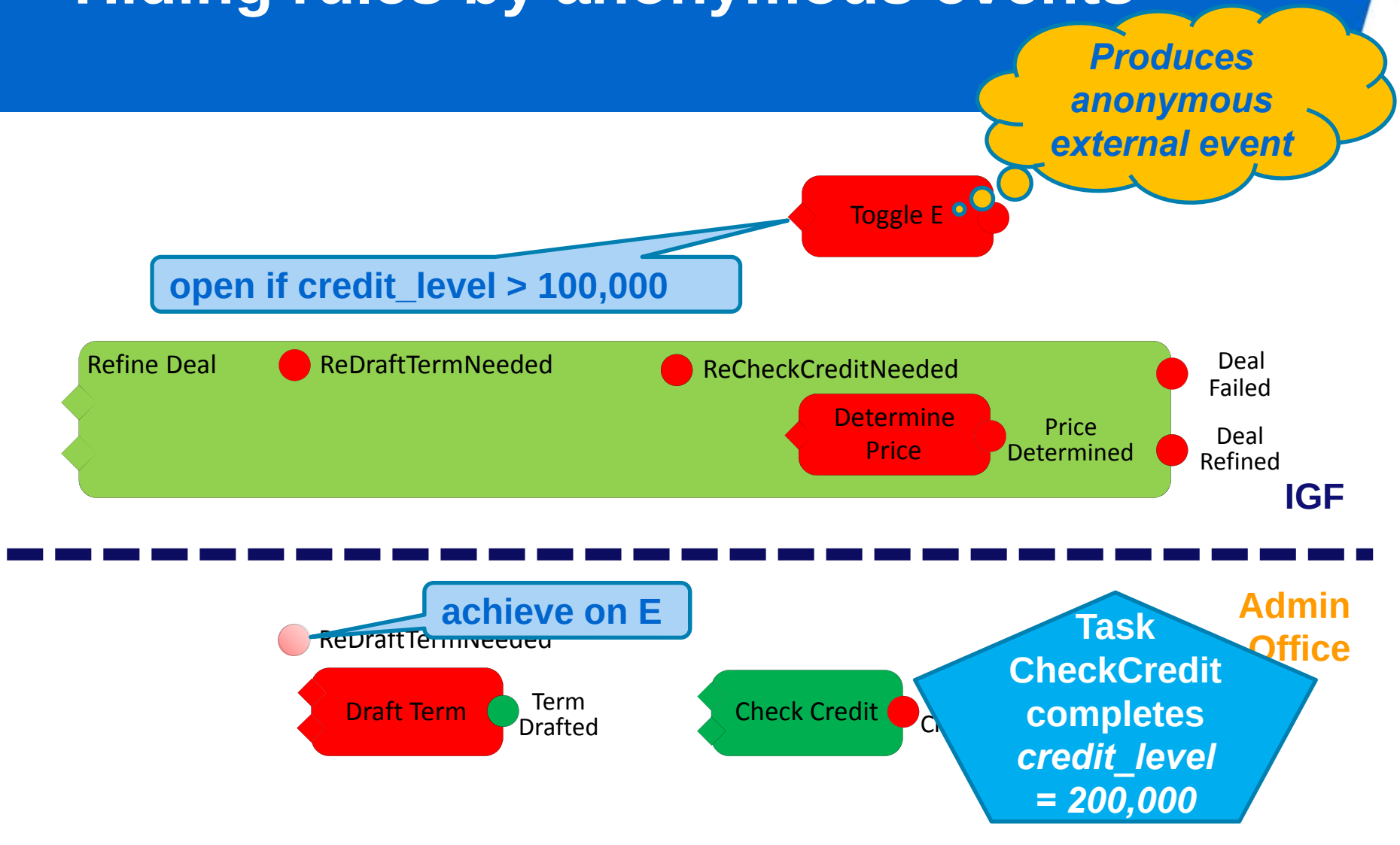


Hiding rules by anonymous events



Result on privacy

- Let *Γ* be GSM schema and let *H* be a set of attributes whose rules should be hidden.
- Construct *Γ' = hide(Γ,H)* as follows
  - For hiding the rules of *n* status attributes, in centralized GSM model
    - For each hidden status attribute *a*, create an anonymous event E_a
    - Each rule that triggers *a* is transformed into a rule that triggers a stage that generates E_a
- Lemma: each B-step of *Γ* is faithfully simulated by a cluster of *n* + 1 B-steps of *Γ'.*
- To perform splitting with hidden status attributes, create *Γ' = hide(Γ,H)* and split *Γ'*.

Complete algorithm

- **Input:**
  - **GSM schema Γ**
  - **desired split of stages/milestones**
  - **status attributes H whose rules are to be hidden**
- **Step 1: introduce anonymous events in $\Gamma \rightarrow \Gamma'$**
- **Step 2: perform splitting on $\Gamma' \rightarrow (\Gamma_1 , \Gamma_2)$**

- **Main result (see paper):**
  - **(Γ_1 , Γ_2) faithfully simulates Γ**
  - **(Γ_1 , Γ_2) does hide rules for status attributes in H**

Conclusion

- Comprehensive framework for supporting outsourcing of GSM schemas
- Covers both design-time and run-time
- Future work:
  - multi-party outsourcing
  - interacting artifact types
  - extend results to OMG's Case Management Modeling Notation

Thank you!