Integrated Provenance Data for Access Control in Group-centric Collaboration

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August 09, 2012
International Conference on Information Reuse and Integration

PROVENANCE-AWARE SYSTEM

Provenance of a digital data object is defined as the documentation of its origin and all the processes that influence and lead to its current state.

In a provenance-aware system, related provenance information of system transactions/events are captured, stored, and maintained.

Provenance potentially provides many enhanced benefits: usage tracking, workflow control, versioning, trustworthiness, repeatabity, access control, etc.

Provenance information may be more sensitive than the underlying data.

SECURE DIGITAL PROVENANCE

Is necessary: Integrity, Confidentiality, Availability, Privacy

Our focus: Access Control.

Two aspects**: Provenance-based Access Control** and Provenance Access Control.

Provenance data naturally forms a Directed-Acyclic Graph (DAG), aligned with information flow and causality

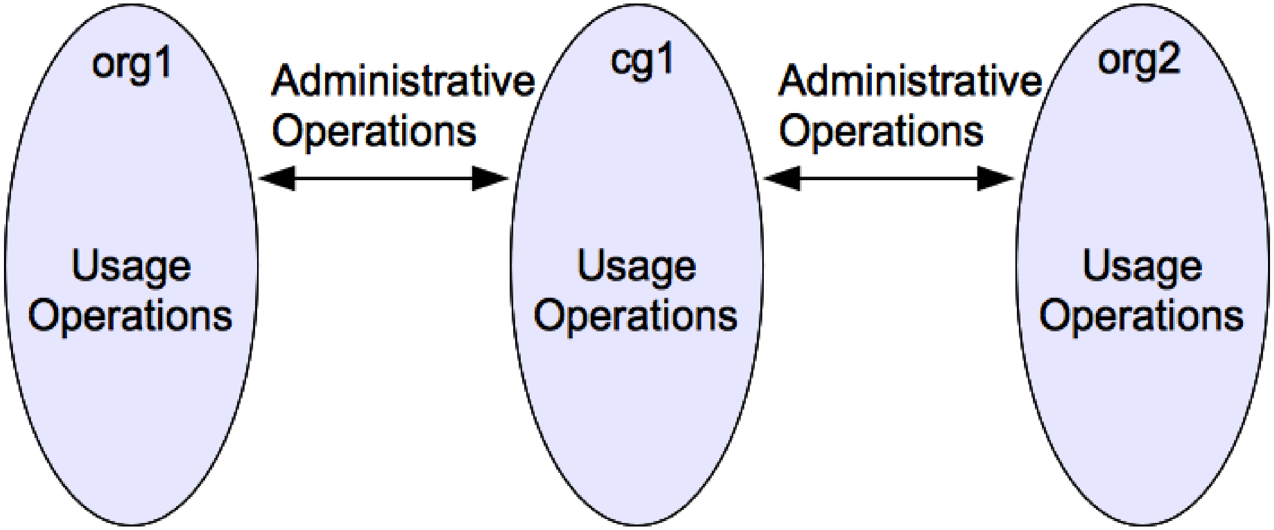
GROUP-CENTRIC COLLABORATION

Difference in the incorporation of base model for PBAC in uni vs. multi-provenance systems.

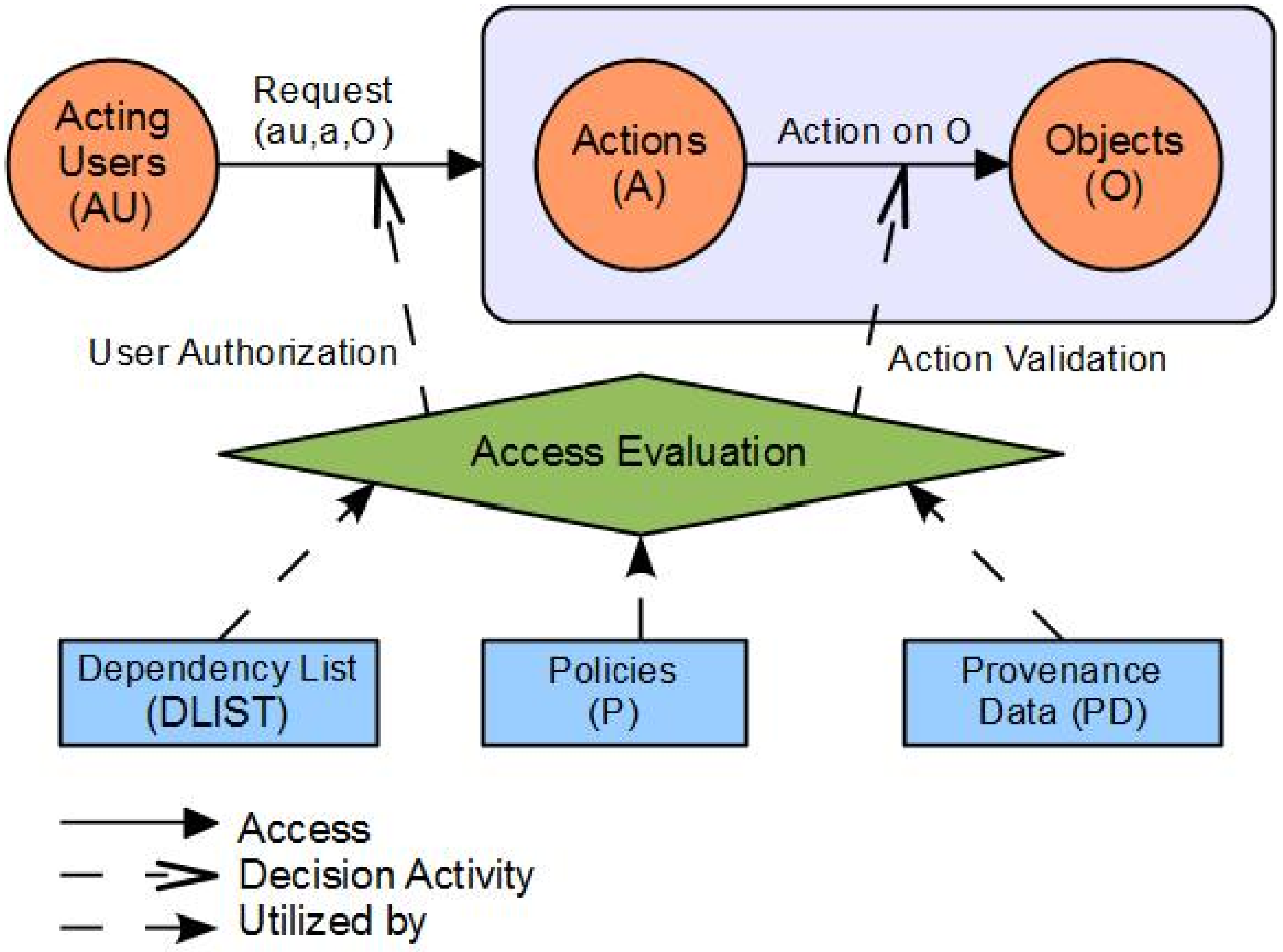
Group-centric collaboration provides secure information sharing.

Support **administrative** and **usage** operations.

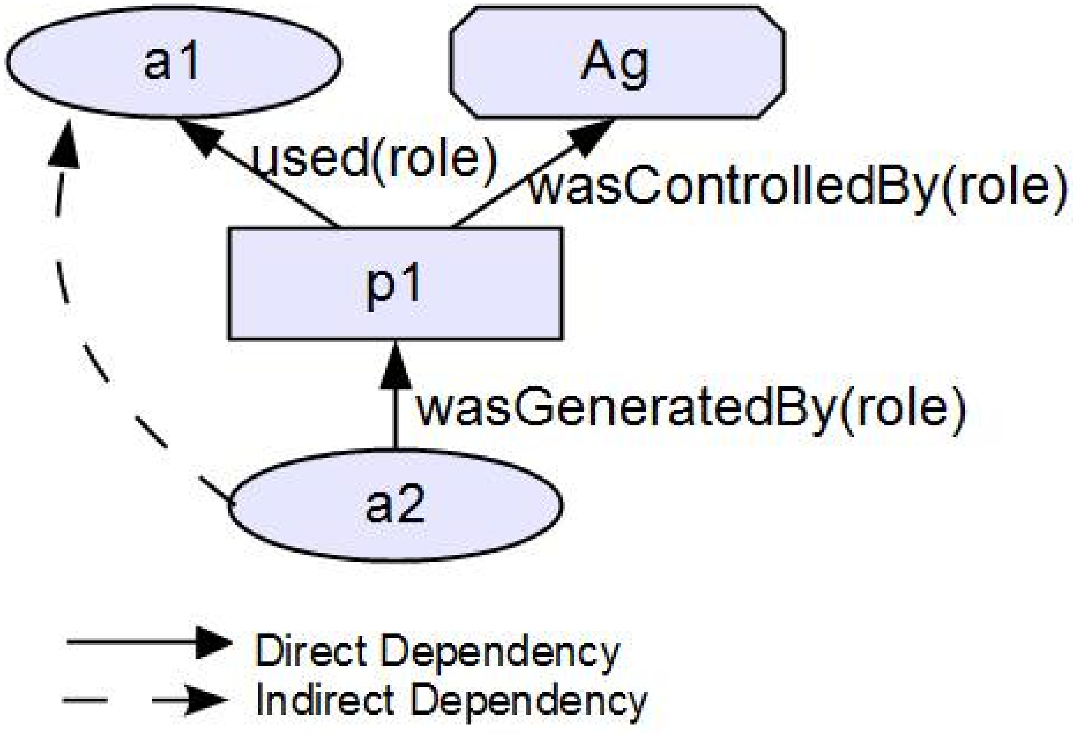
Focus on usage operations such as: Add, Merge, Update, Create.



PBAC MODEL


Acting Users (AU)
Request (au,a,O)
Actions (A)
Action on O
Objects (O)
User Authorization
Action Validation
Access Evaluation
Dependency List (DLIST)
Policies (P)
Provenance Data (PD)
Access
Decision Activity
Utilized by

OPEN PROVENANCE MODEL (OPM)



A SIMPLIFIED SCENARIO

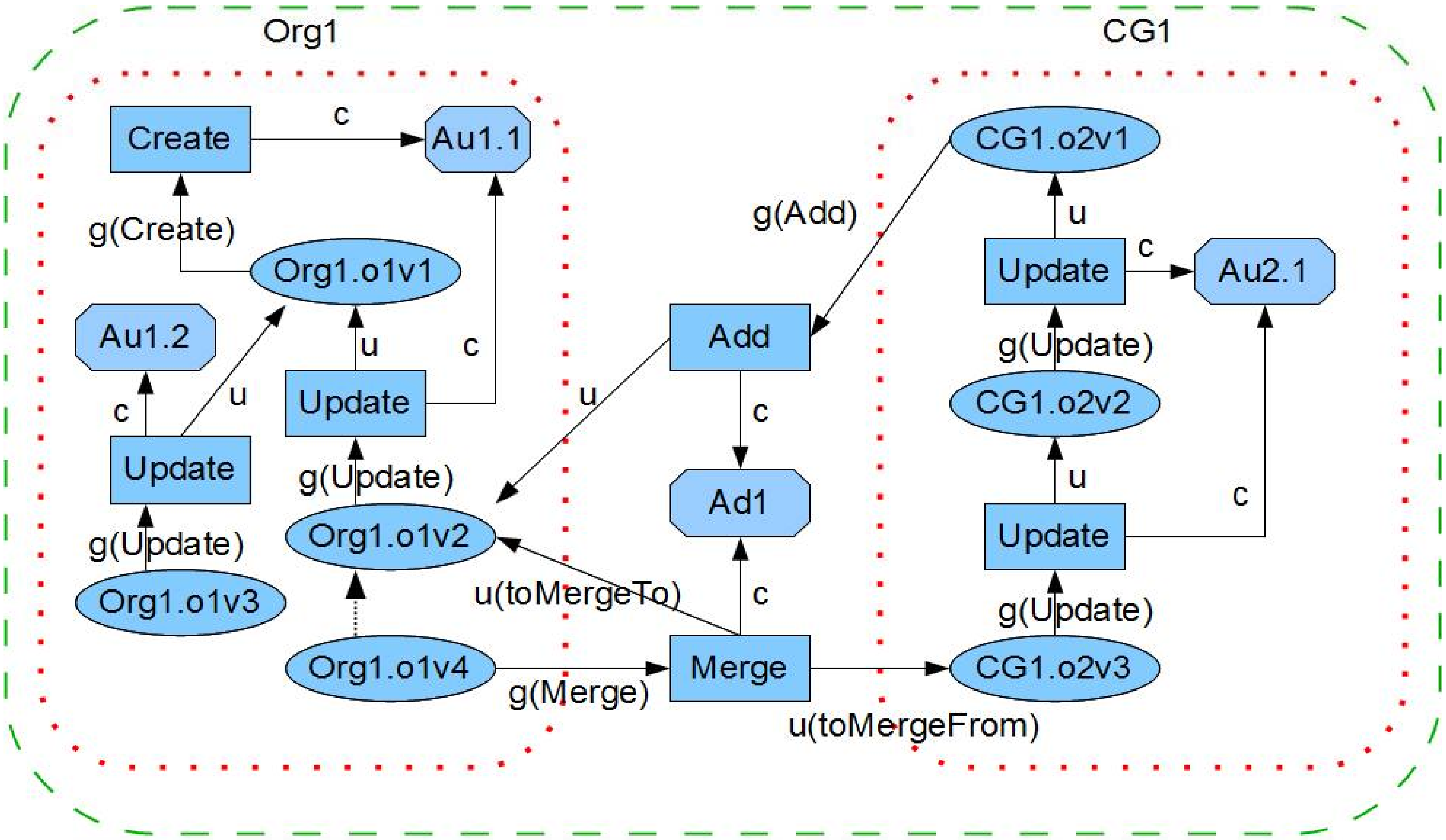
An object is created in org1 and modified locally into versions in accordance to the versioning system.

At some point in time, a version of this object is added to a collaboration group cg1 so users from a different organization can participate in updating the object content (now represented as a different object with its own versions).

Meanwhile, users in the org1 also perform updates on local versions.

At some point, a version of the object from cg1 is merged back to the version tree of the original object in org1

A SIMPLIFIED OPM SCENARIO



u - used
g - wasGeneratedBy
c - wasControlledBy

— — Uni provenance system

· · · · · Multi provenance system

SAMPLE POLICIES/ DLIST

Req (ad1,merge,CG1.o2v3,Org1.o1v2) ?

$$\boxed{allow(au, merge, o_{from}, o_{to}) \Rightarrow o_{to} \in (o_{from}, wasDerivedversionOfCopyOf)}$$

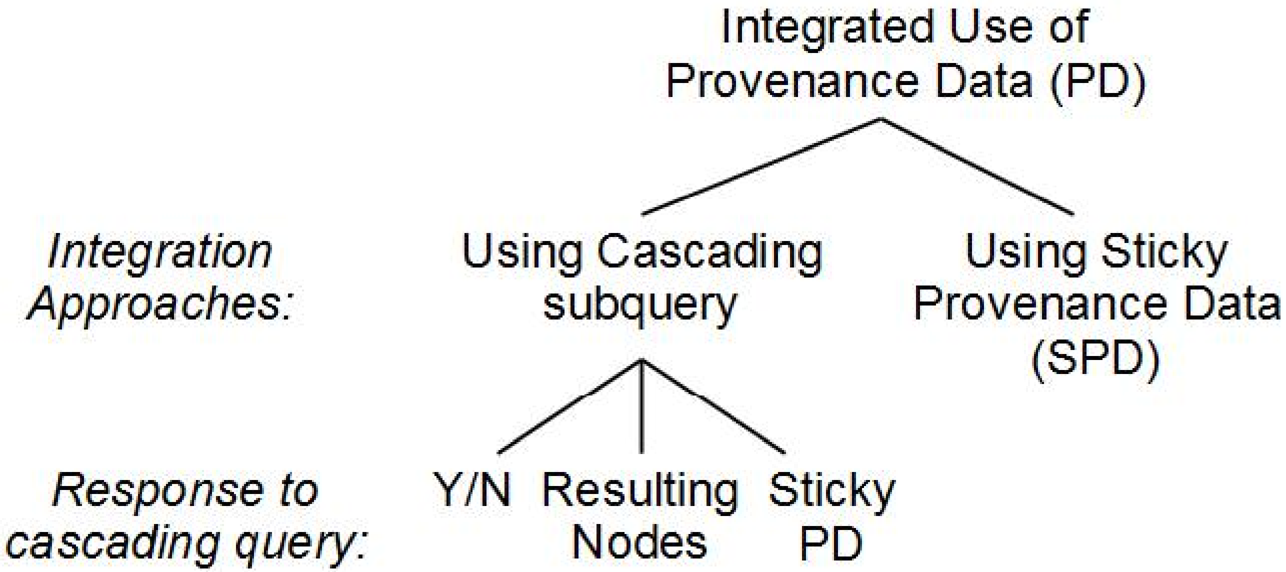
(**wasDerivedVersionOfCopyOf**:: [g(Update).u]*.g(Add).u)

Req(au2.1,update,CG1.o2v3) ?

$$\boxed{allow(au, update, o) \Rightarrow au \notin (o, creatorOfOriginalVersionOf)}$$

(**creatorOfOriginalVersionOf** :: [g(Update).u]*.g(Add).u.[g(Update).u]*.g(Create).c)

TAXONOMY OF APPROACHES



Integrated Use of Provenance Data (PD)

Integration Approaches:

Using Cascading subquery

Using Sticky Provenance Data (SPD)

Response to cascading query:

Y/N

Resulting Nodes

Sticky PD

CASCADING QUERY

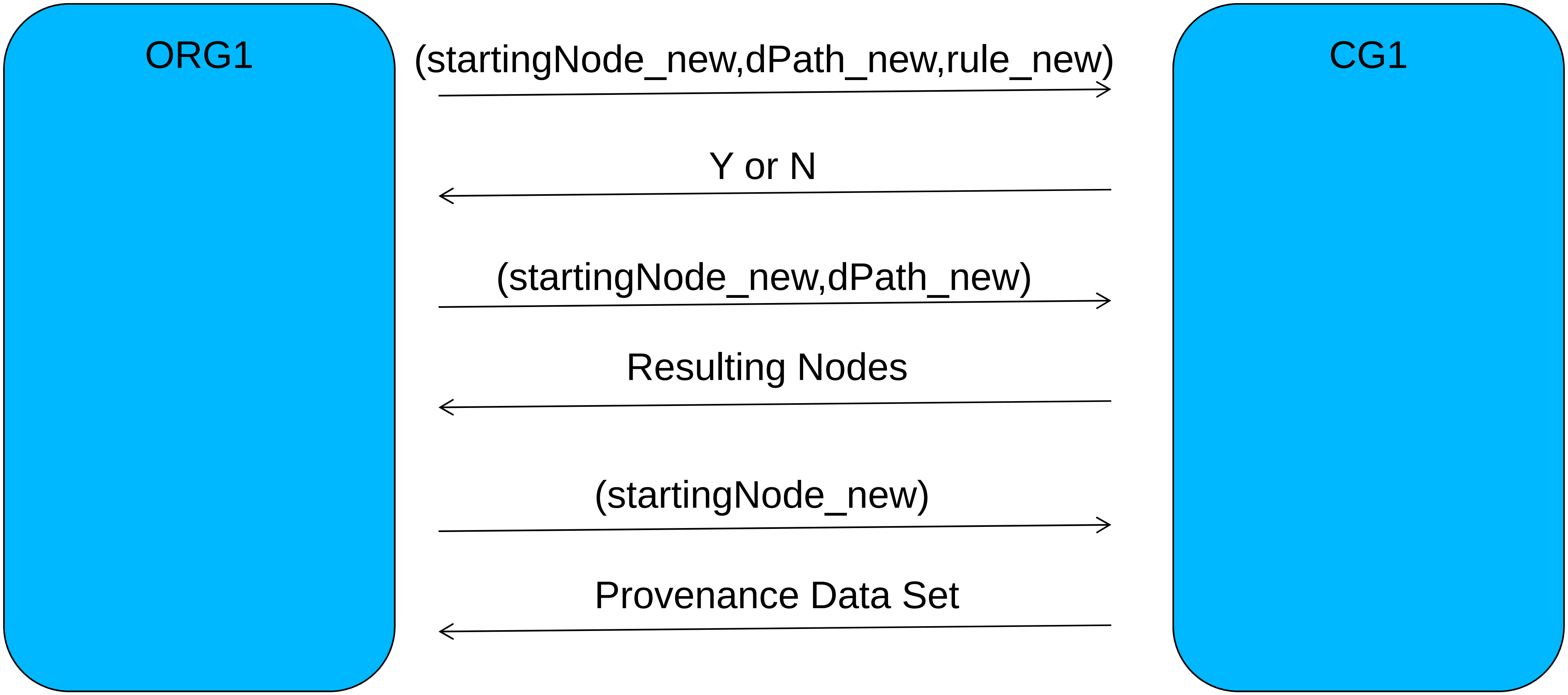
A reconstructed query from the local query.

Can be transmitted and evaluated in remote system.

Three types of response, each require different additional information:

1. Y or N: (startingNode_new,dPath_new,rule_new) must be transmitted.
2. Resulting Nodes: (startingNode_new,dPath_new) must be transmitted.
3. Provenance Data Set: (startingNode_new) must be transmitted.

CASCADING QUERY RESPONSE


ORG1
(startingNode_new,dPath_new,rule_new)
Y or N
(startingNode_new,dPath_new)
Resulting Nodes
(startingNode_new)
Provenance Data Set
CG1

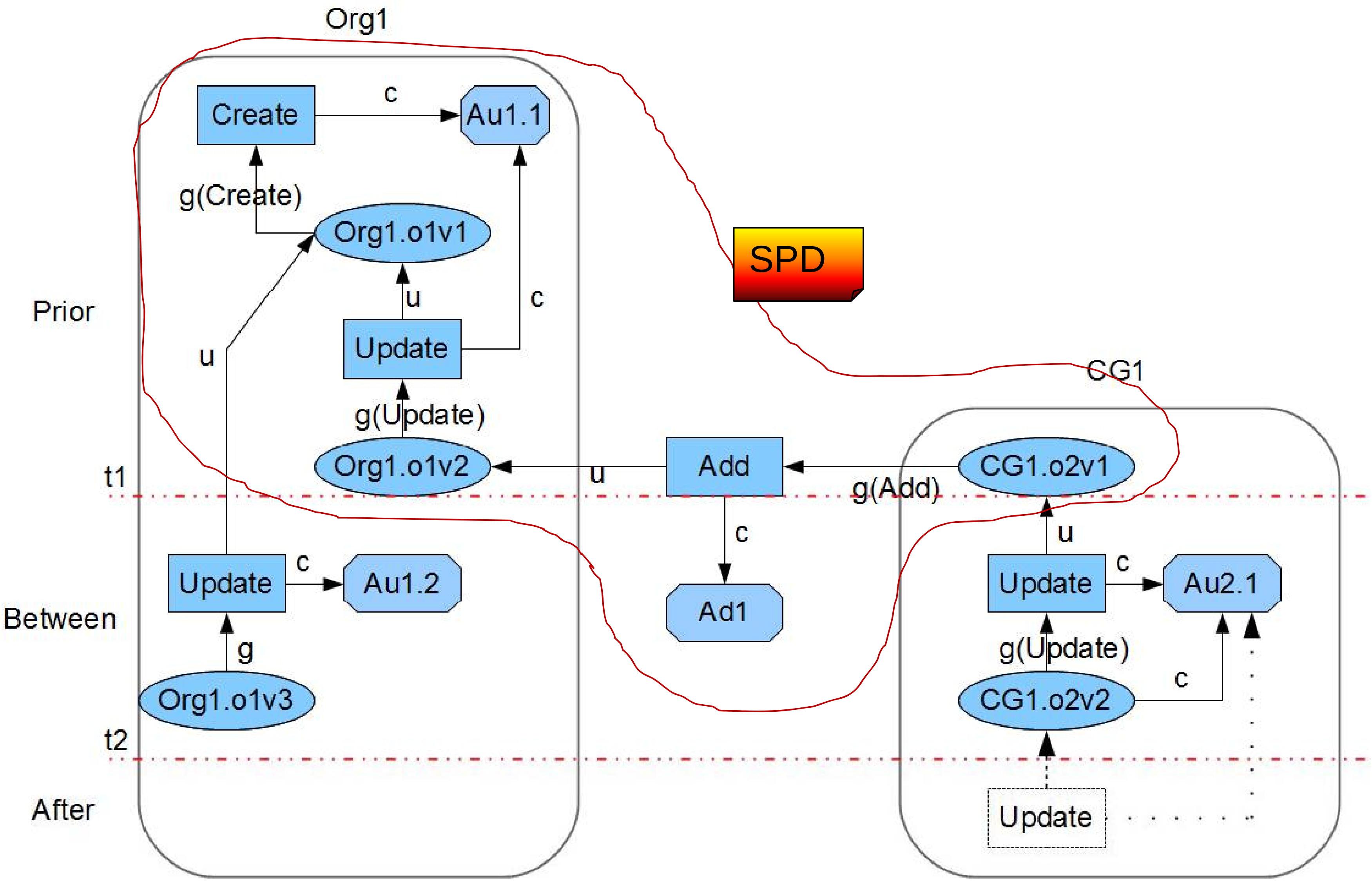
STICKY PROVENANCE DATA

The sticky provenance data of an object/version contains all the provenance information of that object/version up to the point in time when the information flow takes place.

Allows a locally generated query to be fully evaluated for decision making.

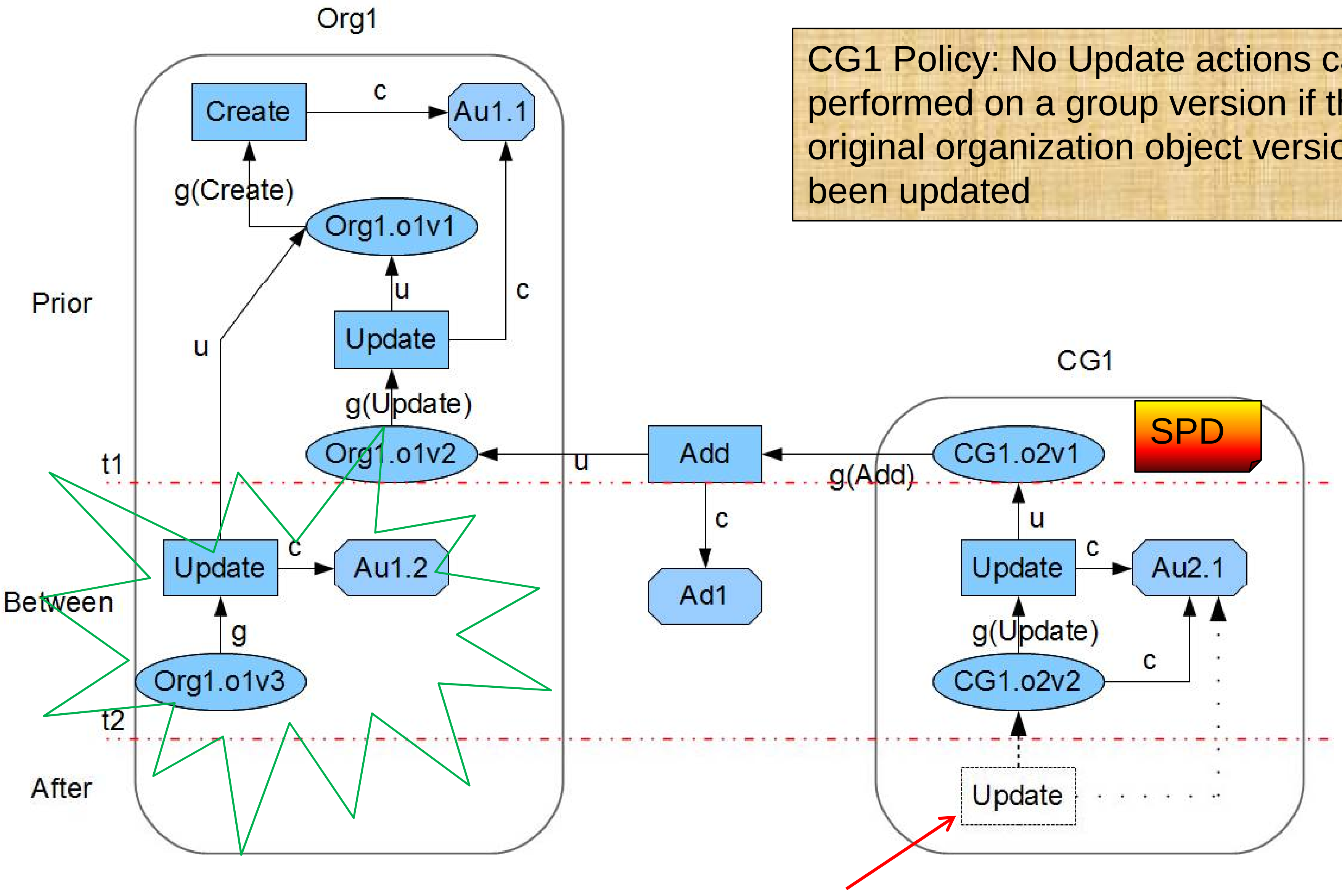
Demonstrate with a modified scenario next.

A “STICKY” SCENARIO



A “STICKY” SCENARIO

CG1 Policy: No Update actions can be performed on a group version if the original organization object version had been updated



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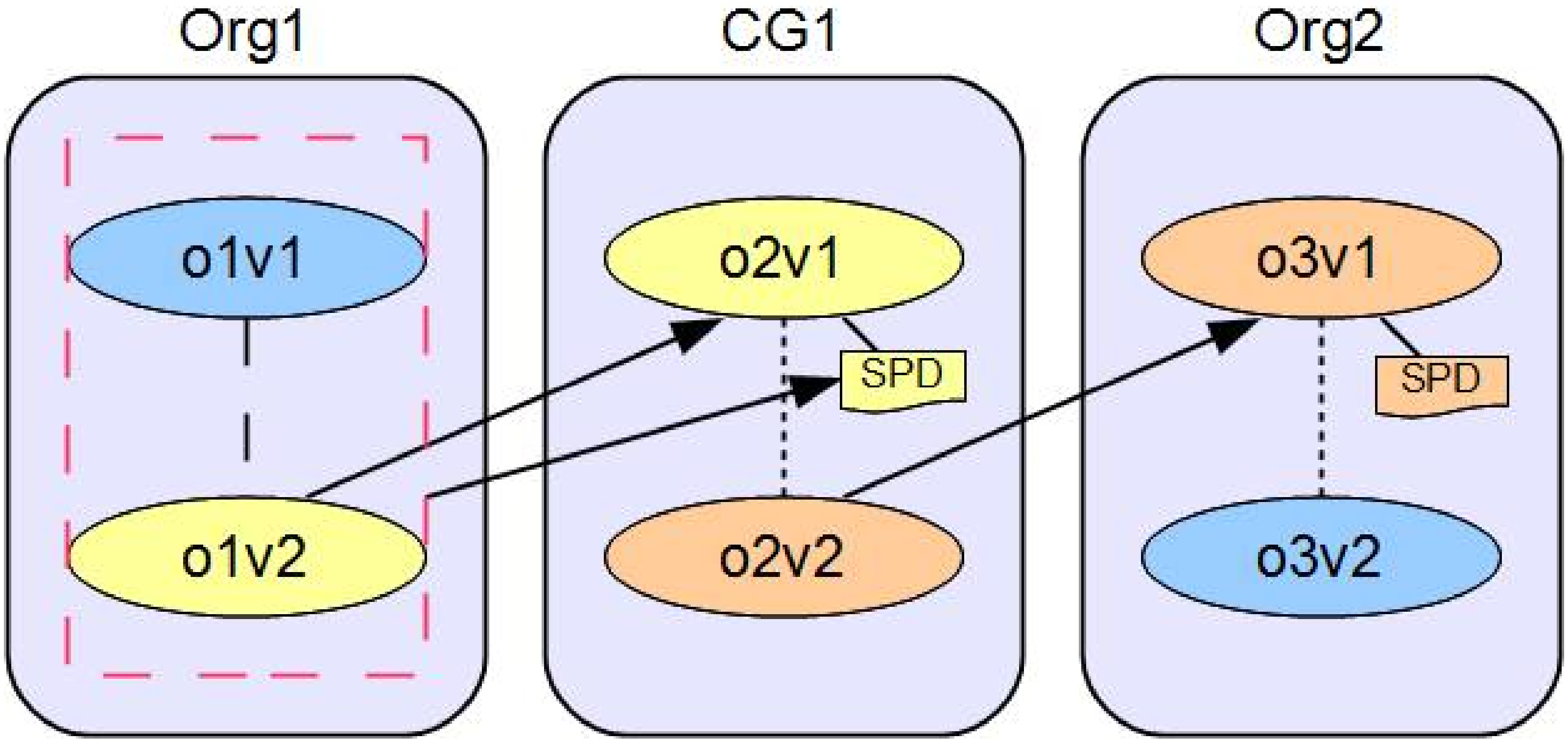
A "STICKIER" SCENARIO



Should SPD(o3v1) contain:
SPD(o2v1,o2v2) ?
SPD(o2v1,o2v2) + SPD(o2v1) ?

CONCLUSION

Demonstrated the incorporation of PBAC in a Group-centric collaboration environment.

Identified the issue in a multi-provenance systems setting.

Proposed two approaches to address such issue.