Safety of $ABAC_\alpha$ is Decidable

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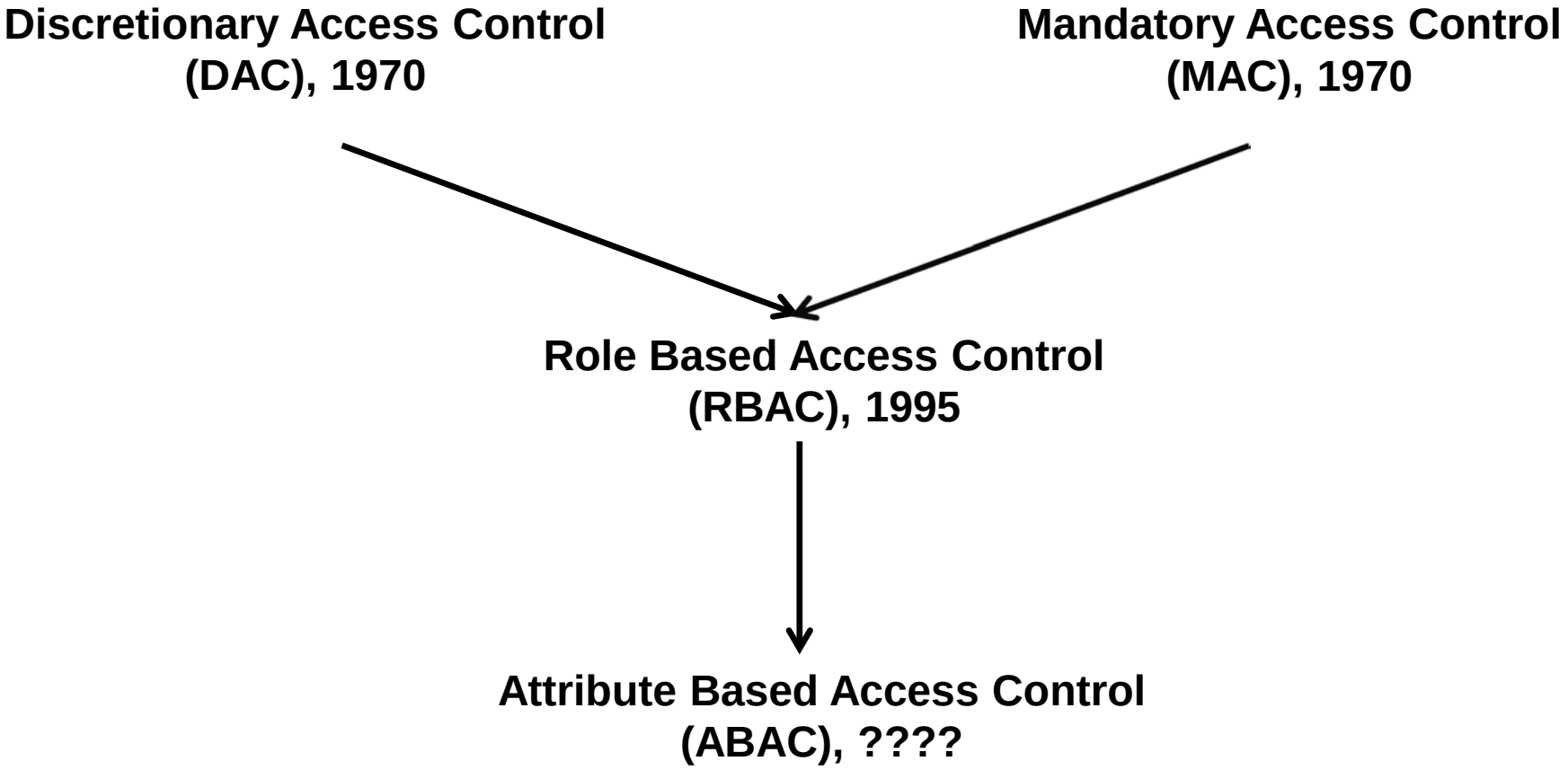
Safety Problem

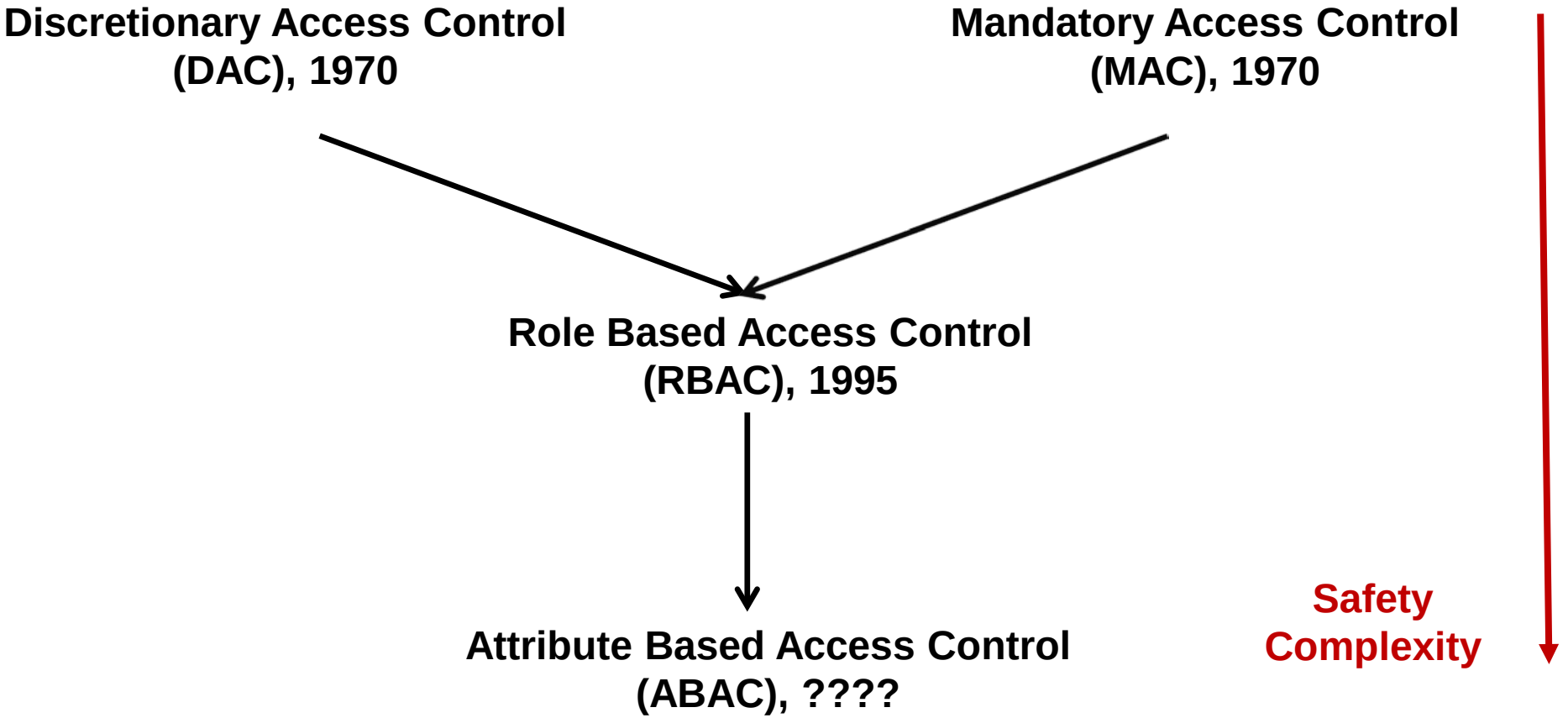
Can subject s obtain a right r on an object o?

- *In current state?*
- *In some future state?*

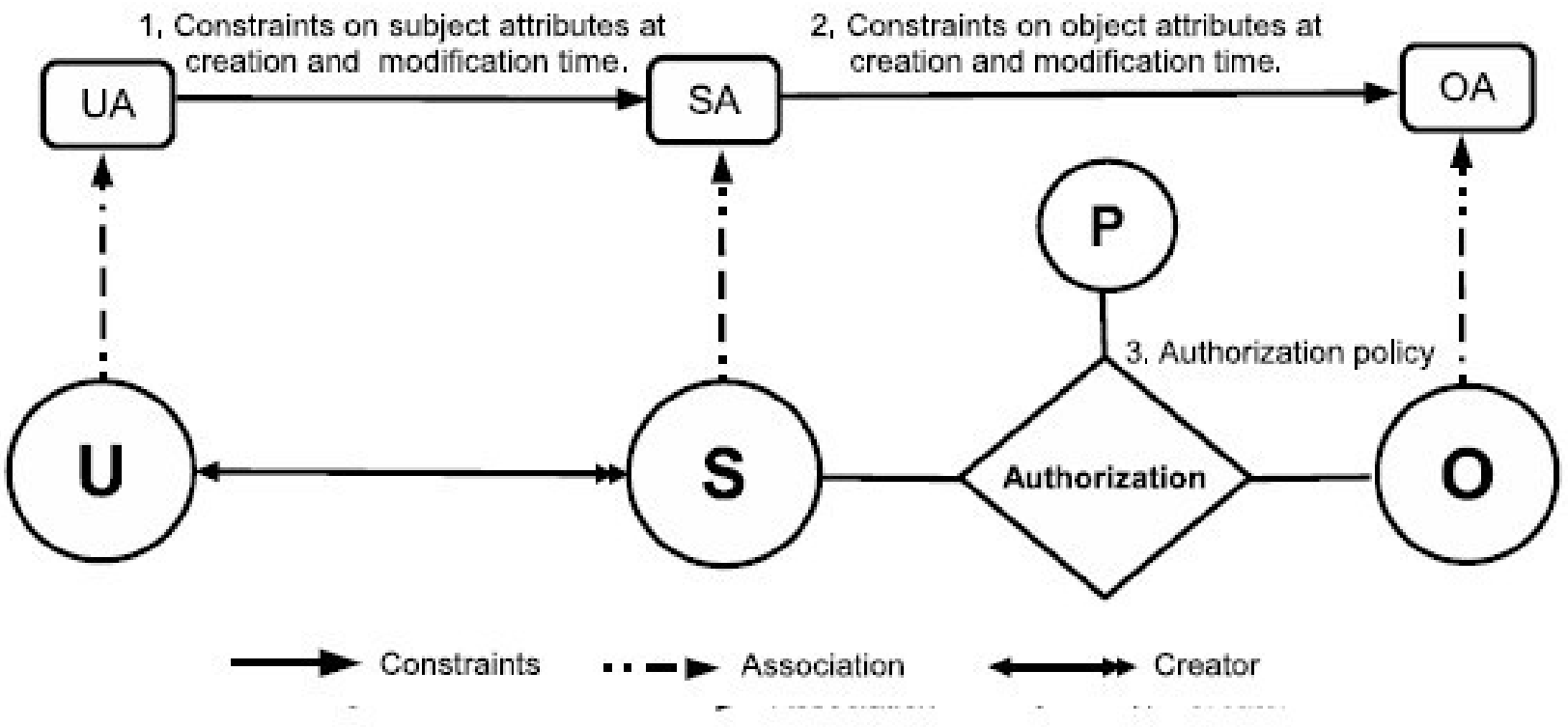
Access Control Evolution



Access Control Evolution



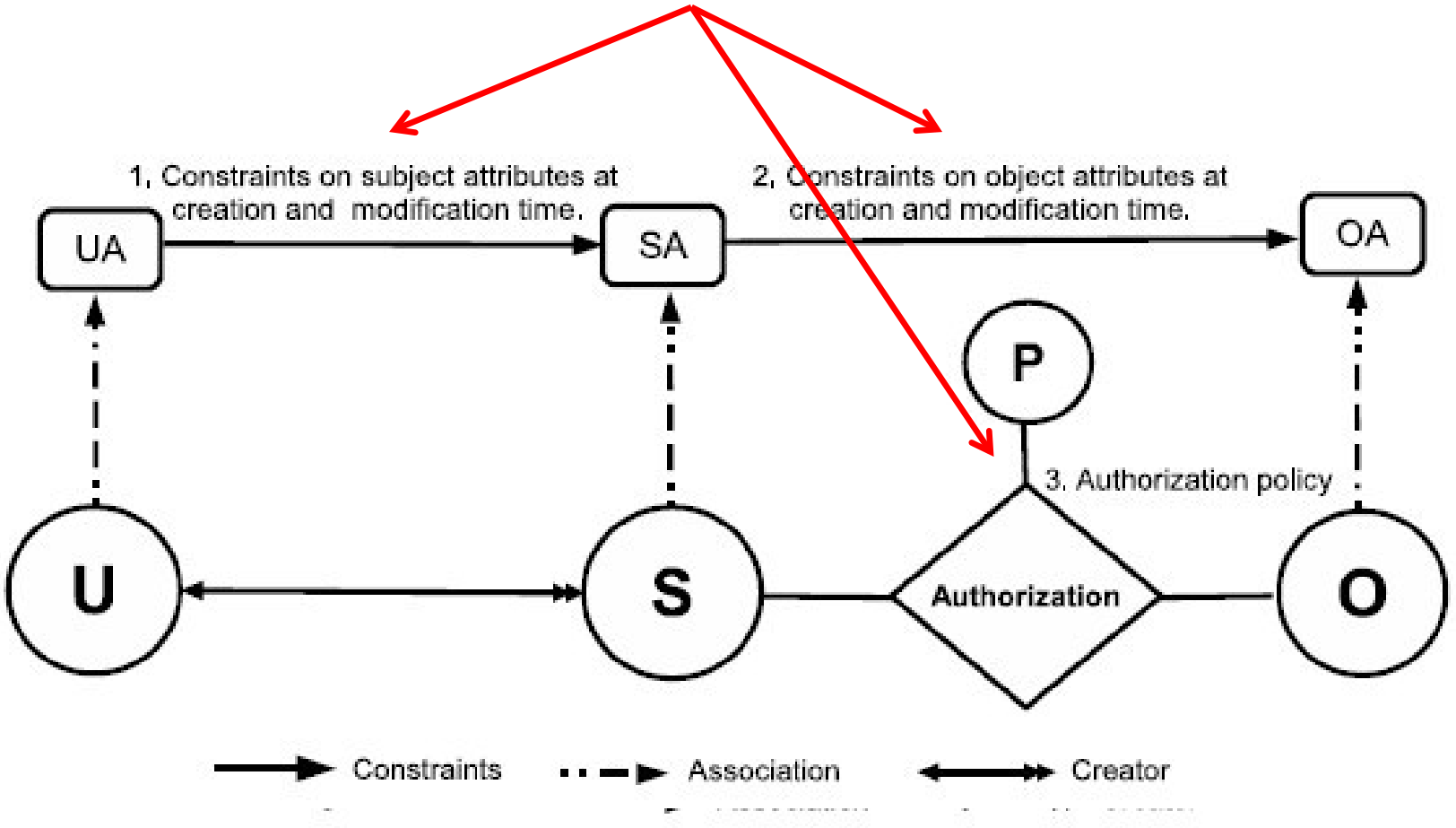
$ABAC_\alpha$ Model



Can be configured to do simple forms of DAC, MAC, RBAC
Jin, Krishnan, Sandhu 2012

ABAC$_\alpha$ Model

Policy Configuration Points



Can be configured to do simple forms of DAC, MAC, RBAC
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$ABAC_\alpha$ Model Components

- Set of **Users** (**U**) , **Subjects** (**S**) and **Objects**(**O**)
- Set of **User Attributes** (**UA**), **Subject Attributes** (**SA**) and **Object Attributes** (**OA**)
- **Authorization Policy:**
  - Set of Permissions P
  - Authorization Policy $Authorization_p(s, o)$
- **Creation and Modification Policy:**
  - Subject Creation and Modification Constraint
  - Object Creation and Modification constraint

- **Functional Specification**
  - $Access_p(s, o)$
  - $CreateSubject(u, s, savt)$
  - $ModifySubjectAtt(u, s, savt)$
  - $DeleteSubject(u, s)$
  - $CreateObject(s, o, oavt)$
  - $ModifyObjectAtt(s, o, oavt)$

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Safety Decision Strategy

Can subject s obtain a right r on an object o?

- *Develop a safety algorithm specifically for $ABAC_\alpha$*
- *Reduce the safety problem for $ABAC_\alpha$ to the safety problem for some other ABAC model with known decidable safety*

Safety Decision Strategy

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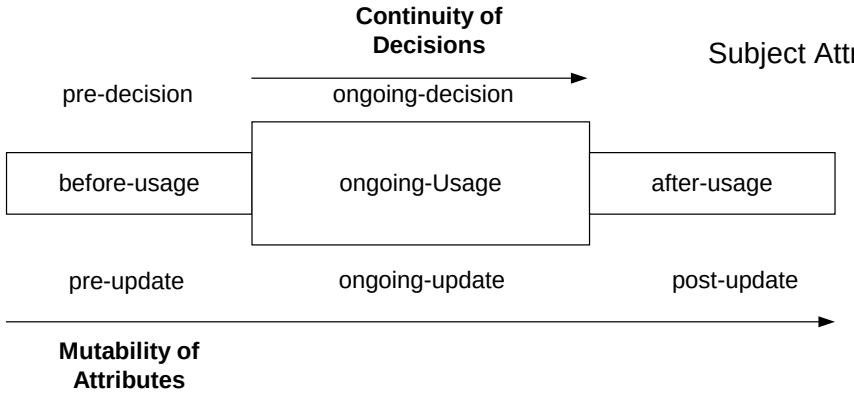
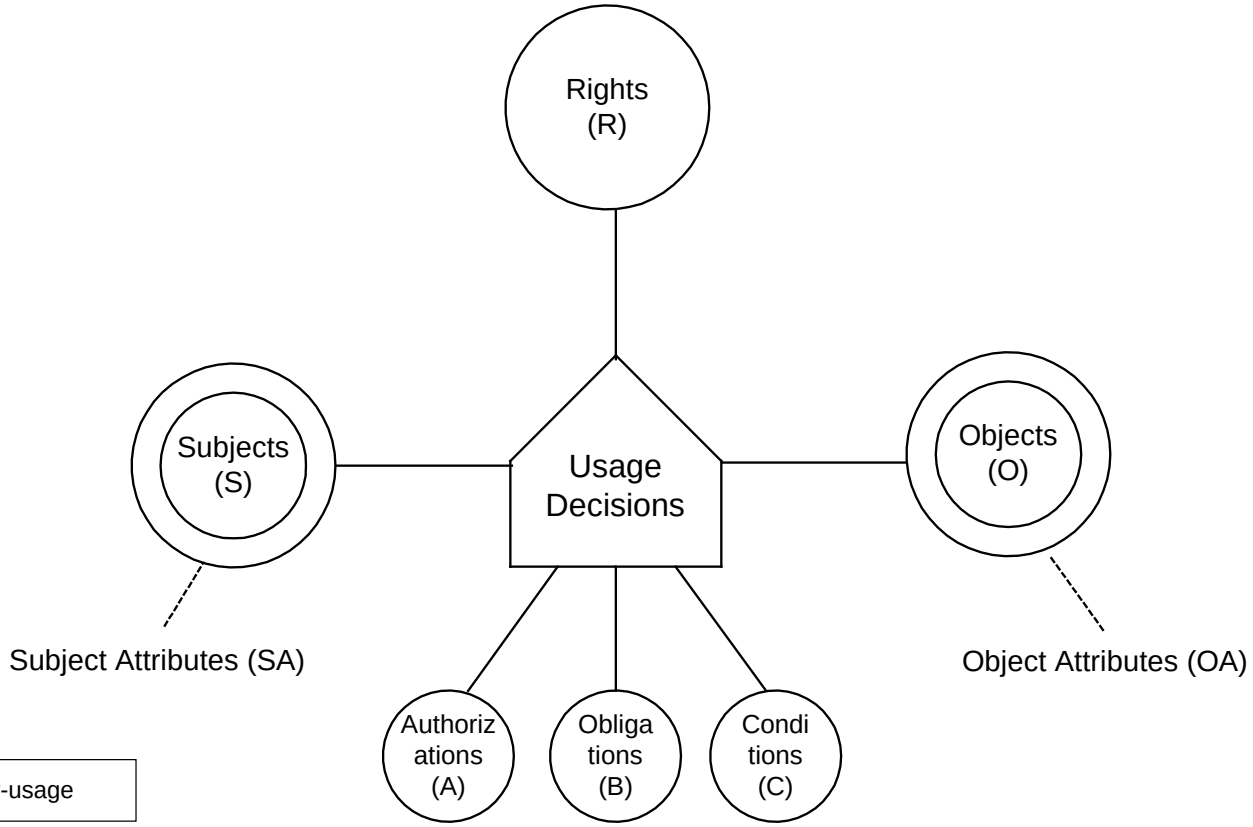
$UCON_{ABC}$ Model

- unified model integrating
  - authorization
  - obligation
  - conditions
- and incorporating
  - continuity of decisions
  - mutability of attributes

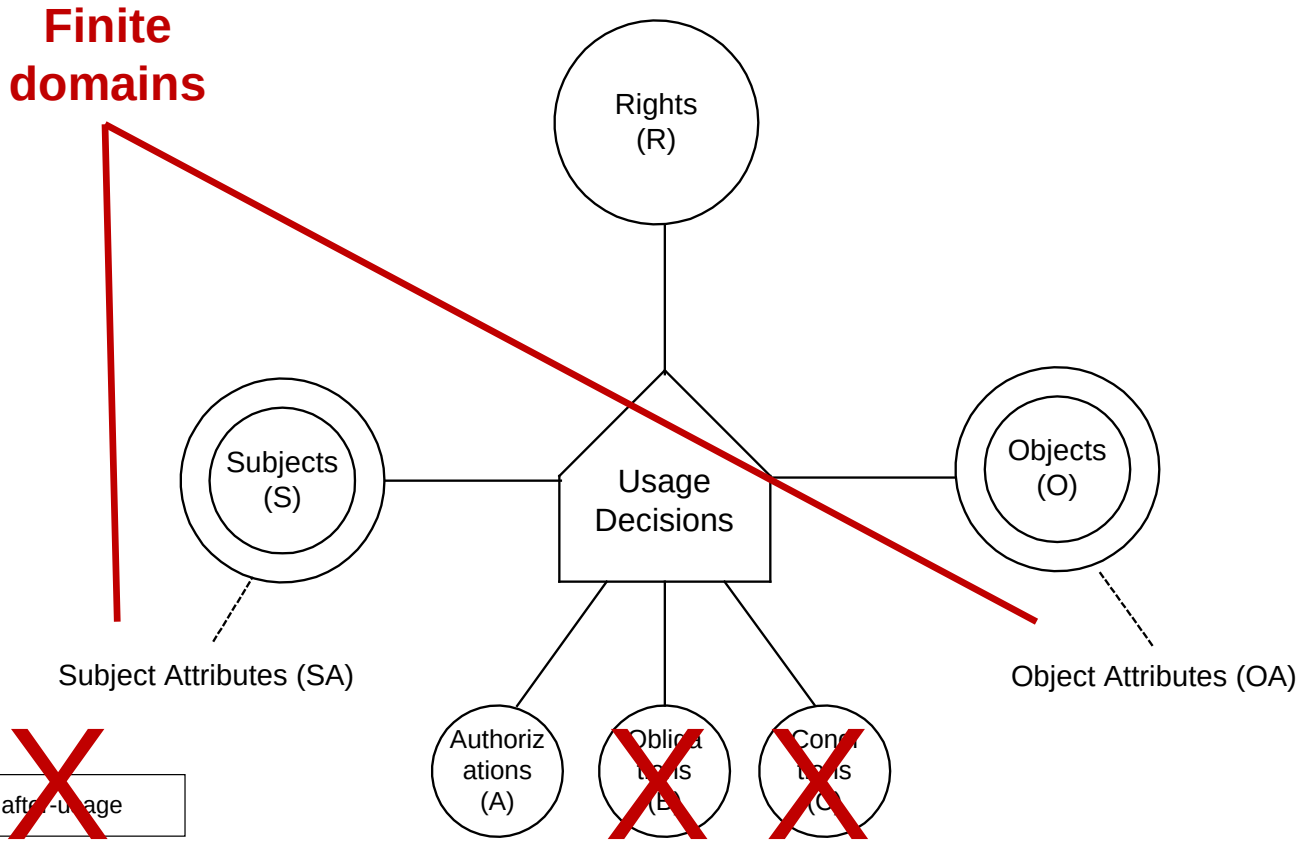


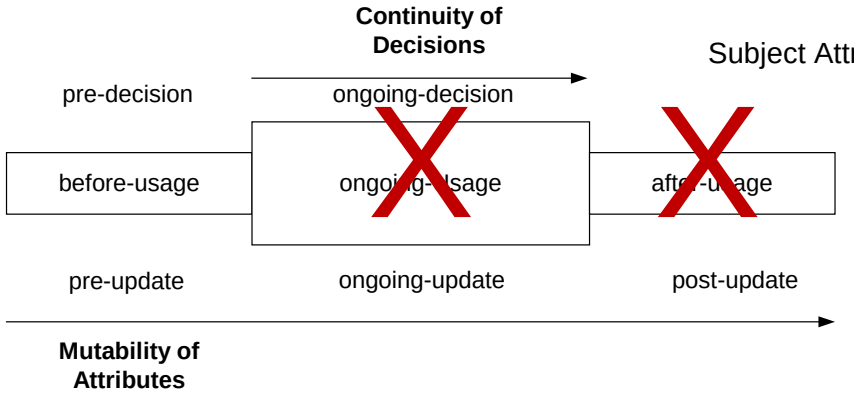


Usage Control Models, early 2000s
Park, Sandhu, Pretschner

$UCON_{preA}^{finite}$ Model

- unified model integrating
  - authorization
  - obligation
  - conditions
- and incorporating
  - continuity of decisions
  - mutability of attributes





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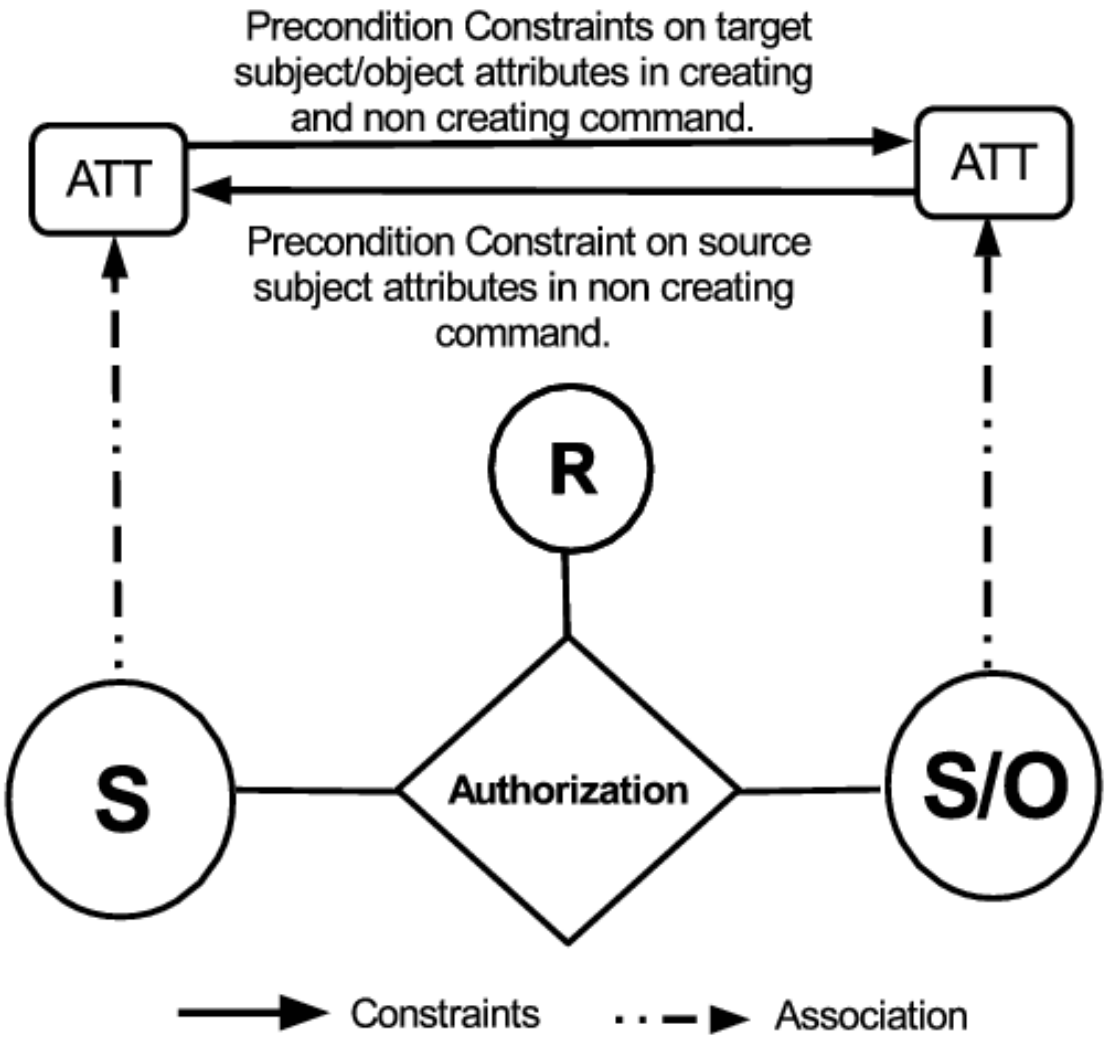

Figure 4: $UCON_{preA}^{finite}$ Model

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$UCON_{preA}^{finite}$ Model Components

- $Object\ schema\ OS_{\Delta}: \{a_1{:}\sigma_1, \ldots, a_n{:}\sigma_n\}$
- $Usage\ Rights\ UR{:}\{r_1, r_2, \ldots, r_k\}$:
- $Usage\ Control\ Commands\ UC{:}\{uc_1, uc_2, \ldots uc_l\}$
- $Set\ of\ Attributes\ ATT = \{a_1, a_2, \ldots a_n\}$
- $Set\ of\ Attribute\ Value\ tuples\ AVT = \sigma_1 \times \sigma_2 \times \cdots \times \sigma_n$

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$UCON^{finite}_{preA}$ Command Structure

Non-Creating Command	Creating Command

Command_Name$_r$(s,o)
PreCondition: f_b(s,o)→ {true,false};
PreUpdate: s.a_{i_1} := $f_{1,a_{i_1}}$(s,o);
⋮
s.a_{i_p} := $f_{1,a_{i_p}}$(s,o);
o.a_{j_1} := $f_{2,a_{j_1}}$(s,o);
⋮
o.a_{j_q} := $f_{2,a_{j_q}}$(s,o);
	Command_Name$_r$(s,o)
	PreCondition: f_b(s)→ {true,false};
	PreUpdate: create o;
	s.a_{i_1} := $f_{1,a_{i_1}}$(s);
	⋮
	s.a_{i_p} := $f_{1,a_{i_p}}$(s);
	o.a_{j_1} := $f_{2,a_{j_1}}$(s);
	⋮
	o.a_{j_q} := $f_{2,a_{j_q}}$(s);

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$ABAC_{\alpha}$ Vs. $UCON_{preA}^{finite}$

- ***Entities:*** $ABAC_{\alpha}$ has users, subjects, objects as entities while $UCON_{preA}^{finite}$ has only subjects and objects as entities.

- ***Attribute Mutability :*** Attributes of $ABAC_{\alpha}$ are Immutable while Attributes of $UCON_{preA}^{finite}$ is Mutable.

- ***Operations:*** $ABAC_{\alpha}$ functions has configurable condition part and mandatory update part while $\mathbf{UCON_{preA}^{finite}}$ has tightly coupled PreCondition part with optional Update part.

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$ABAC_\alpha$ Vs. $UCON^{finite}_{preA}$

- Shown in this paper:
  - $\boldsymbol{ABAC_\alpha}$ can be reduced to $\boldsymbol{UCON^{finite}_{preA}}$
  - Therefore $\boldsymbol{ABAC_\alpha}$ has decidable safety
- Open question:
  - Can $\boldsymbol{UCON^{finite}_{preA}}$ be reduced to $\boldsymbol{ABAC_\alpha}$

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