Access Control Policy Tool (ACPT), an assurance tool that combines symbolic model checking with combinatorial coverage

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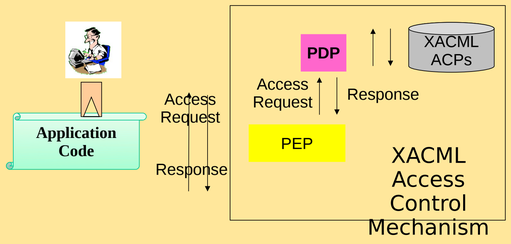
Access Control

- ✓Access control is one of the most widely used privacy and security mechanisms
  - ✓protect critical IT infrastructures such as healthcare, military, intelligence systems
  - ✓prevent security vulnerabilities by controlling access to resources
- ✓Access control is often governed by security policies called Access Control Policies (ACPs)
  - ✓include rules that specify which principals such as users or processes have access to which resources

Motivation

- ✓Improper access control is a critical problem
  - ✓ranked the 5th among the most dangerous errors
  - ✓cause critical consequences (e.g., privacy issues)
- ✓Ensure correctness of ACPs
  - ✓ACP specification may not encapsulate security requirements
    - ✓manual verification of ACPs is tedious and error-prone
  - ✓ACPs are becoming more complex
    - ✓manual verification of request/response is time-consuming



Policy Generation

✓XACML is OASIS standard XML-based language to specify ACPs

```
<Rule Effect="permit"
RuleId="rule-1">
  <Target>
    <Subjects>
      <Subject>federal
employee</Subject>
    </Subjects>
    <Resources>
      <Resource>access
</Resource>
    </Resources>
    <Actions>
      <Action>confidential
document </Action>
    </Actions>
  </Target>
 </Rule>
<Rule Effect="deny"
RuleId="rule-2">
  <Target>
    <Subjects>
      <Subject>state
employee</Subject>
    </Subjects>
    <Resources>
      <Resource>access
</Resource>
    </Resources>
    <Actions>
      <Action>confidential
document </Action>
    </Actions>
  </Target>
 </Rule>
```

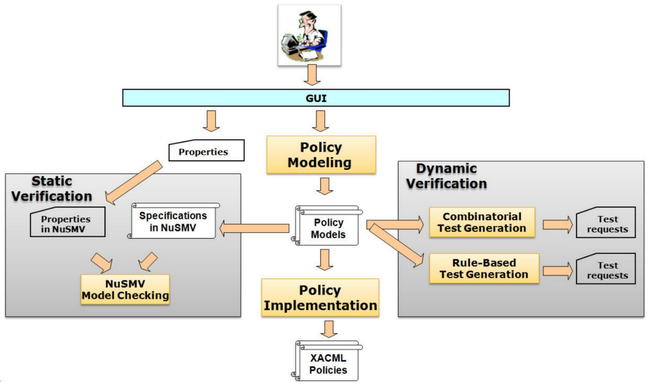
Evaluation

- ✓Coverage achieved by generated test requests
  - ✓Subject: 10 collected ACPs
    - ✓from 4 sources
  - ✓ Evaluation result:
    - ✓achieve 100% rule coverage
    - ✓achieve 100% combinatorial coverage

We demonstrated that our static verification models and verifies various policy models (e.g., RBAC, workflow, …)[4,7]

Detailed evaluation results http://research.csc.ncsu.edu/ase/projects/policy/

Our Approach



Policy Model

Support for various policy models (e.g., RBAC, workflow, …)[4,7]

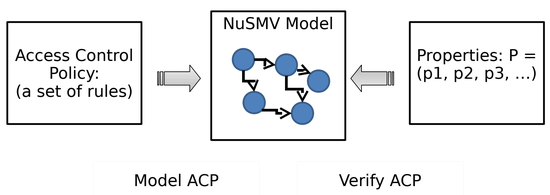
1. The federal employee is permitted to access the confidential document
2. The state employee is denied to access the confidential document

Role-based access control model

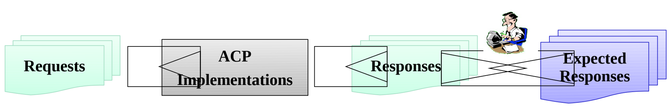
1. The federal employee ϵ Role ∧ access ϵ Action ∧ confidential document ϵ Resource → Permit
2. The state employee ϵ Role ∧ access ϵ Action ∧ confidential document ϵ Resource → Deny

Static and Dynamic Verification

- ✓Static verification verifies a formal ACP against user-specified properties
  - ✓ACPT converts a policy p in the NuSMV format (the format accepted by the NuSMV symbolic model checker)
    - ✓e.g., checking of privacy and regulation violations



- ✓Dynamic verification (i.e., test-input generation) generates and executes test requests
  - ✓based on policy structural coverage
  - ✓based on combinatorial coverage



lease and Related Work

✓ O… Policy Tool (ACPT) …nd companies …ications (e.g., [4, 5, 6, 7])

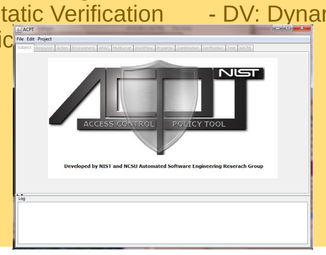
Product	GUI	SV	DV
Our approach			
Existing approaches [1,2,3]		Partial	
IBM Security Policy Manager		Partial	
Cisco Policy Manager			

inventure ENTERPRISES
SAIC
Fermilab

Comparison of ACP management tools

- ✓O… current system prototype (NIST/NCSU ACPT)
  - ✓Support for policy modeling, static and dynamic verification, and policy generation
  - ✓Beta-version on the NIST website [8]
- ✓Our future plan
  - ✓Improve our verification techniques
    - ✓Condition, e.g., time and location constraints
    - ✓Context-aware, e.g., state transition
  - ✓Extend our approach to different application domains
    - ✓Healthcare, law statutes, military, …

- GUI: Modeling via GUI
- SV: Static Verification
- DV: Dynamic Verific…



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