Development of a System Framework for Implementation of an Enhanced Role-Based Access Control Model to Support Collaborative Processes

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Outline

• Objectives
• Overview of the EnhancedRBAC model
• System framework for implementation
• Access policy encoding and interpretation
• New York State HIV Clinical Education Initiative (CEI)
• Evaluation
• Discussion
• Conclusion
Objectives

• History
  – Access Matrix (Lampson 1969)
  – Rule-Based Access Control (LaPadula 1973)
  – Discretionary Access Control (DAC) and Mandatory Access Control (MAC) (DoD, 1973)
  – Role-based Access Control (Sandhu 1996)
  – Attribute-based Access Control (Chen 2011)
  – Temporal Role-based Access Control model (Bertino 2001)
  – And many others (Motta 2003; Ni 2010; etc.)
Objectives (2)

• Limitations of existing work
  – Few of these works have addressed information access management in the context of team collaboration and workflow
  – Neither have they been applied for coordination of clinical education programs
Enhanced RBAC Model

- Universal constraints
- Permission
  - object, operation, workflow status
- Collaboration
  - Bridging entity
  - Contributing attributes
- Domain ontologies

Role-Based Access Control (RBAC) (Sandhu 1996)
Enhanced RBAC

- UNIVERSAL CONSTRAINTS
  - Separation of Duty
  - Access Delegation
  - Collaboration Constraint
  - Temporal Constraint
  - Organizational Constraint

- WORKFLOW STATUS

- OPERATIONS (ACTIONS)

- OBJECTS (ASSETS)

- PERMISSIONS

- Role Hierarchy

- SESSIONS

- USERS
  - URA

- ROLES
  - RPA

- WORKFLOW
  - request received
  - arrangement pending
  - training scheduled
  - training completed
  - reporting completed

- Operation
  - read
  - write

- Object
  - request

- Role
  - role

- User
  - center staff

- Contributing Attribute
  - course
  - format
  - location

- Organization
  - training center

- Constraint
  - invitation
  - revocation
  - geographical constraint
  - topic constraint
  - format constraint
  - temporal constraint
  - organizational constraint

EnhancedRBAC

instances or specializations in domains or applications
relations between components
constraints on components or relations
System Framework for Implementation

• Three-layer approach
  – Policy Encoding layer
  – Policy Interpretation layer
  – Application layer
A. Protégé Classes:
- p1: core RBAC
- p2: RBAC Extension

B. Protégé Instances:
- access policy instances

C. Protégé Property of Instances:
- values of specific variables for access policies
∀r ∈ ROLE, ∀req ∈ REQUEST, ∀w₁ ∈ WORKFLOWSTATUS₁, ∀op₁ ∈ OPERATION_WRITE, ∀course ∈ COURSE, ∀format ∈ FORMAT, ∀agency ∈ AGENCY, ∀loc ∈ LOCATION:

role-permission(r, req, w₁, op₁) ⇐

pl:rolePermission(?r, ?p) ⇐
workflow(?w) ∧
permissionRequest(?p, ?req) ∧
permissionOperation(?p, ?op) ∧
permissionStatus(?p, ?w) ∧
operationW(?op) ∧

status(req, w₁) ∧
request(req, course, format, agency) ∧
location(agency, loc) ∧
inChargeLocation(r, loc) ∧
inChargeCourse(r, course) ∧
inChargeFormat(r, format) ∧

(a) in first-order predicate logic

status(?req, ?w) ∧
requestCourse(?req, ?course)
 ∧ requestFormat(?req, ?format)
 ∧ requestAgency(?req, ?agency) ∧
agencyLocation(?agency, ?loc) ∧
inChargeLocation(?r, ?loc) ∧
inChargeCourse(?r, ?course) ∧
inChargeFormat(?r, ?format) ∧

(b) in SWRL
Demo Tool

A. All users, roles, objects, and workflow statuses
B. Selected users, roles, objects, and workflow statuses
C. The results after running the enhanced RBAC on the selected users, roles, objects, and workflow statuses
D. Execution traces and system logs.
# NYS HIV Clinical Education Initiative (CEI)

<table>
<thead>
<tr>
<th>Center</th>
<th>Role</th>
<th>Responsibility</th>
<th>Topic</th>
<th>Location</th>
<th>Format</th>
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<td>r_{cecup}</td>
<td>onsite training</td>
<td>all topics</td>
<td>upstate region</td>
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<td>evaluation</td>
<td>all topics</td>
<td>all areas</td>
<td>onsite/online</td>
</tr>
</tbody>
</table>

- **CECUP**: Clinical Education Center for Upstate Providers
- **TPDC**: Testing, Post-Exposure Prophylaxis, and Diagnosis Center
- **MHC**: Mental Health Center.
- **PSUC**: Prevention and Substance Use Center
- **TC**: Technology Center
CEI Training Centers

Enhanced RBAC System

Agencies (hospitals, clinics, community healthcare centers, etc.)

Training Request 1

Training Request 2

Training Request 3

Collaboration among CEI Centers

CECUP Center

TPDC Center

MHC Center

PSUC Center

TC Center
Request CEI Training Services

Please call the toll-free number and leave a detailed message or fill in the online request form. We will return your request as soon as possible.

Toll Free Telephone Number
1-800-435-5075

Training Request Form

Agency You Represent

Please start by typing your agency name and choose from the list.

Agency: 
Address: 
Address 2: 
City: 
County: Select 
State: Select 
Zip: 
Type of Agency: Select

Your Contact Information

Please enter your contact information.

First Name: 
Middle Name: 
Last Name: 
Title: 
Email: 
Phone:

Existing Courses

We have training courses that have been already developed. If any of these existing courses can serve your needs, please check them.

General Topics
- [ ] 803: Antiretroviral Therapy (1 hour)
- [ ] 804: Antiretroviral Therapy (3 hour)
- [ ] 802: Hepatitis C & HIV Co-infection
- [ ] 241: HIV & Opioid Health Care
- [ ] 207: HIV & Women’s Health
- [ ] 815: HIV and Sexually Transmitted Infections
- [ ] 259: HIV/STD Infection
- [ ] 020: Identifying Adherence Barriers: Management of Antiretroviral Side Effects and Drug-Drug Interaction Update
- [ ] 019: ARV Guidelines: A Case Presentation
- [ ] 018: Update on Tuberculosis

Online Training Request Form at www.CEItraining.org
### Training Sessions

**ID** | **Agency** | **Center** | **Training Topic/Course** | **Request** | **Call Back** | **Scheduling** | **TEF** | **PFF**
--- | --- | --- | --- | --- | --- | --- | --- | ---
1518-1 | University of Rochester Medical Center/Strong Memorial Hospital | PSUC | Course (916): Screening & Assessment for Substance Using HIV Infected Patients | 07/19/2012 | 07/19/2012 | 10/22/2012 | Add | View
1518-2 | University of Rochester Medical Center/Strong Memorial Hospital | CECUP URMC | Course (916): Screening & Assessment for Substance Using HIV Infected Patients | 07/19/2012 | View | View
1517-1 | Addiction Research Treatment Corp | PSUC | Topic 1: Prevention | 07/18/2012 | 07/18/2012 | 07/19/2012 | Add | View
1513-1 | Brooklyn Hospital The PATH Center | CECUP AMC | Course (902): Hepatitis C & HIV Coinfection | 07/11/2012 | View | View
1513-2 | Brooklyn Hospital The PATH Center | PSUC | Course (902): Hepatitis C & HIV Coinfection | 07/11/2012 | 07/11/2012 | 05/22/2012 | 05/22/2012 | Completed | View | View

### Collaboration Form

**Participant**

**Number of Participants (Trainer Head Count)**: 18

<table>
<thead>
<tr>
<th>Center</th>
<th>Invite</th>
<th>Faculty</th>
<th>Curriculum</th>
<th>Audience</th>
<th>Location</th>
<th>Other</th>
<th>Documentation</th>
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</tr>
</tbody>
</table>

- ☐ Invite Tech Center to Collaborate

- ☑ Invited

- ☐ Not Invited

- ☐ Location

- ☑ Other

- ☐ Documentation

[Image of the Collaboration Form with options for center selection and collaboration details]
Evaluation

Enhanced RBAC Model

- Encoding of Access Policy
- Computing Permissions

Selection of 9152 Study Cases

CEI Admin System

- Query Permissions

Selection of 512 Sample Cases

Reference Standard

Comparison (1)

Evaluation Method

Comparison (2)
Evaluation (2)

• Highlights of results
  – EnhancedRBAC vs. CEI Admin System
    • Kappa = 0.8-0.89
  – EnhanceRBAC vs. Reference Standard
    • Sensitivity 97-100%
    • Specificity: 100%
Discussion

• First application of access control model for clinical education programs

• Access control is not just restriction of access permissions

• Limitation

• Error analysis
  – Mistakes in preparing invitation data for the study cases to feed EnhancedRBAC
  – Situation to add/delete data directly to/from the CEI Admin database
  – Fault in querying workflow status of the study cases from CEI Admin System
Conclusion

• Successfully developed a system framework to implement the EnhancedRBAC model

• Initial evaluation has shown that this system framework can be effectively used for clinical education

• Future work
  – Extension of this system framework to support the continues development of EnhancedRBAC
  – Deployment of the framework to other domain applications for clinical education, biomedical research, and patient care
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  – Thomas Della Porta

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