Access Control Convergence: Challenges and Opportunities

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Convergent Research

Disciplinary

Multi-Disciplinary

Inter-Disciplinary

Convergent

INCREASED
Collaboration
Interaction
New paradigms
New concepts
New language
New disciplines
Convergent Research

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NAP Report 2005

INCREASED

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NAP Report 2014

NAP = National Academies Press

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Convergent Research

**Disciplinary**

**Multi-Disciplinary**

**Inter-Disciplinary**

**Cross-Disciplinary**

**Trans-Disciplinary**

**INCREASED**

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Convergent Research

Disciplinary

Multi-Disciplinary

Inter-Disciplinary

Convergent

DRIVERS
-- Deep scientific questions
-- Pressing societal needs

INCREASED
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Cyber Security Research Convergence

Objectives

Enable
Enforce

POLICY
What?

ATTACKS
Why?

Respond
Defend

Mechanisms

PROTECT
How?

APPLICATION
Complement
Context

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Objectives

Policy

Attacks

Deep scientific questions:
-- We have no clue how to do this

Pressing societal need:
-- Cyber security is hugely important and broken
-- Cyber security researchers lack incentive to converge
Access Control Research Convergence

Convergent Access Control (CAC)

Access Control Policy Models

Access Control Enforcement Models

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Center for Security and Privacy
Enhanced Cloud Computing
Deep scientific questions:
-- We have no clue how to do this
-- Will revisit at end of talk

Pressing societal need:
-- Cyber security is hugely important and broken
-- Access control is an essential piece to secure modern cyber applications: IoT, CPS, smart communities, ...
-- Cyber security researchers have no incentive to converge
-- Convergence may be easier in Access Control vs all of cyber security
Access Control

Discretionary Access Control (DAC) 1970

Mandatory Access Control (MAC) 1970

Role Based Access Control (RBAC) 1995

Attribute Based Access Control (ABAC)
Relationship-Based Access Control (ReBAC)
Usage Control (UCON)
2020s (Hopefully)
Discretionary Access Control (DAC)

- Core concept:
  Custodian of information determines access

- Core drawback:
  Does not protect copies
  Therefore OK for integrity but not for confidentiality

- Sophistication:
  Delegation of custody
  Denials or negative rights
Mandatory Access Control (MAC)

- Core concept:
  - One-way information flow via security labels
  - Controls on originals and copies

- Core drawback:
  - Covert/side channels bypass MAC
  - Inference not prevented
  - Too strict
  - Too reductionist

- Sophistication:
  - Dynamic labels
Access Control

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Usage Control (UCON)
2020s (Hopefully)
Core concept:
Roles determine everything

Core drawback:
Roles are a natural concept for human users
But not so natural for:
Information objects
IoT things
Contextual attributes

Sophistication:
Role hierarchies
Role constraints
Access Control

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Usage Control (UCON)
2020s (Hopefully)
Attribute-Based Access Control (ABAC)

- Actor
- Target
- Access Decision? Yes/No
- Context
- Operation
Attribute-Based Access Control (ABAC)

- Core concept: Attributes determine everything. No fixed access decision rule.
- Core drawback: Flexibility at the cost of complexity.
- Sophistication: Chained attributes, Group attributes, Distributed decision rules, Automation, Adaptation.
Access Control

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Attribute Based Access Control (ABAC)
Relationship-Based Access Control (ReBAC)
Usage Control (UCON)
2020s (Hopefully)
Access Control: Where Are We?

- Rich set of building blocks: DAC, MAC, RBAC, ABAC, ReBAC, UCON
- We have some understanding of the relationships amongst these
Access Control: What Next?

- Rich set of building blocks:
  - DAC, MAC, RBAC, ABAC, ReBAC, UCON
- We have some understanding of the relationships amongst these

- Do we need more building blocks?
- We have very little understanding of synergy amongst these
Rich set of building blocks:
DAC, MAC, RBAC, ABAC, ReBAC, UCON

We have some understanding of the relationships amongst these

Do we need more building blocks?
We have very little understanding of synergy amongst these

Deep scientific question for convergent research
Access Control: What Next?

- Rich set of building blocks: DAC, MAC, RBAC, ABAC, ReBAC, UCON
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Pressing societal need? Deep scientific question for convergent research
Smart Communities

Integrated Community Cloud

Cloud-to-Cloud Data Transfer

IoT Devices Data Collections and Transmission

Relationships between Entities

Entities (e.g., Users and Devices) have attributes along with other environmental attributes and may have associated roles and capabilities in Smart Communities.

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