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C·SPECC
Center for Security and Privacy Enhanced Cloud Computing

Access Control Evolution and Prospects

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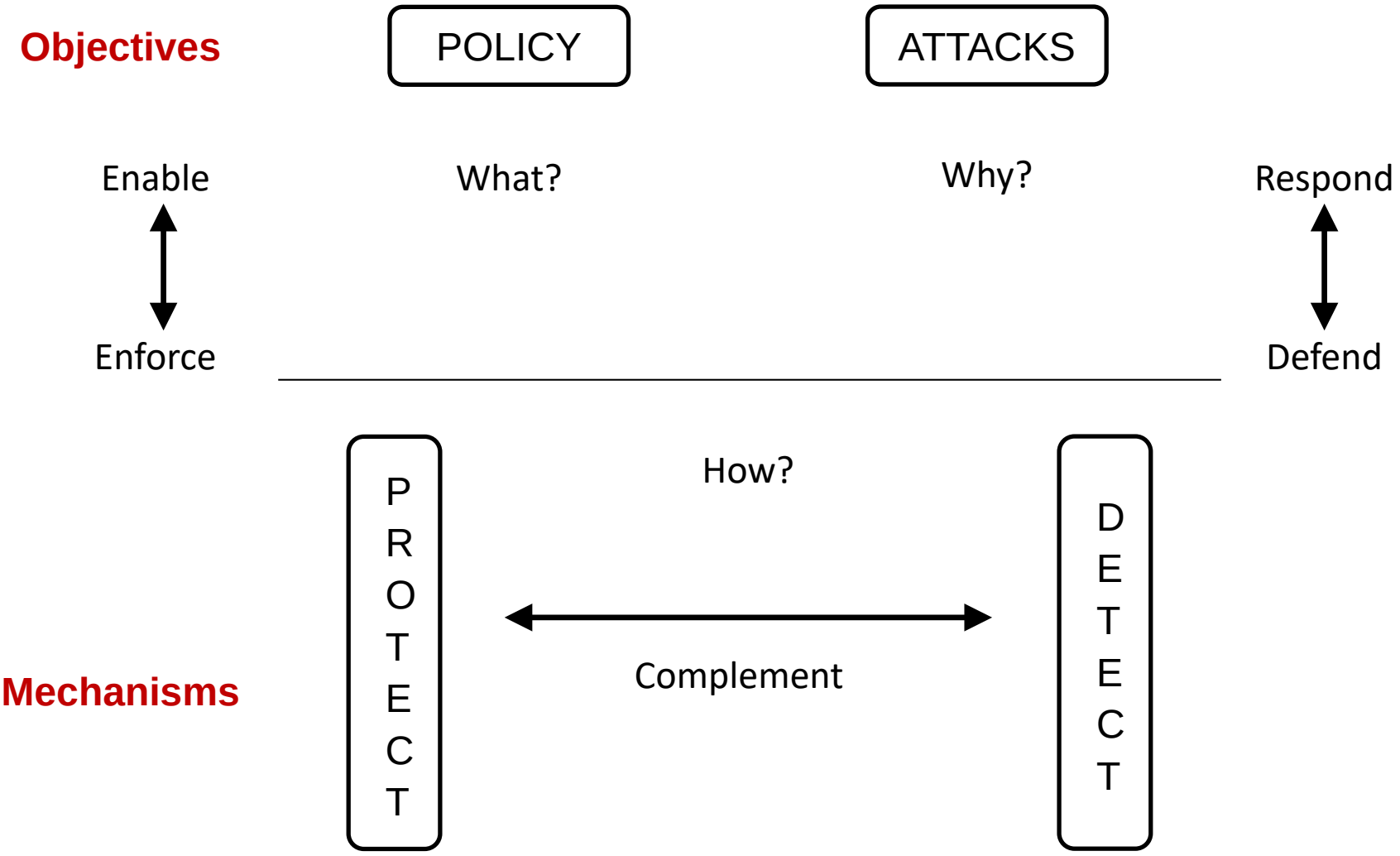
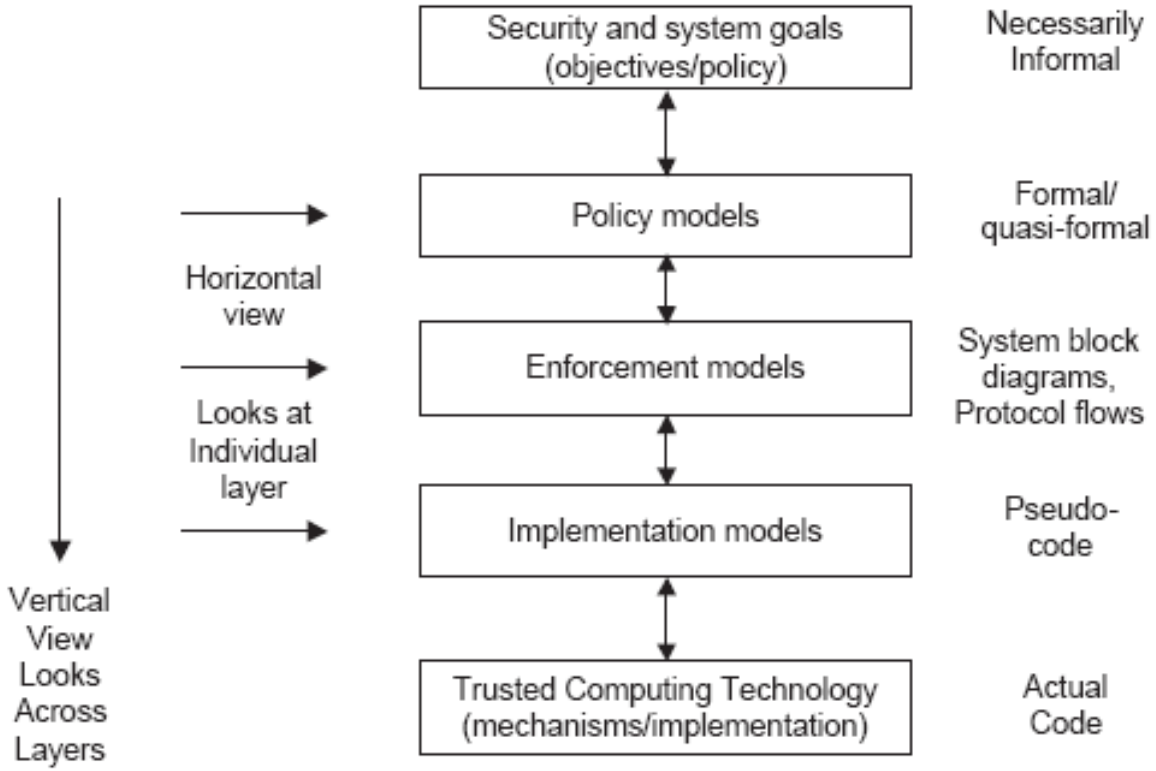
Holistic Cyber Security



Access Control PEI Layers



Idealized

Enforceable (Approximate)

Codeable

Access Control Fundamental Limits

- Copy control
- Inference
- Trusting humans vs trusting software
- Trusted computing base vulnerabilities
- Side channels and covert channels

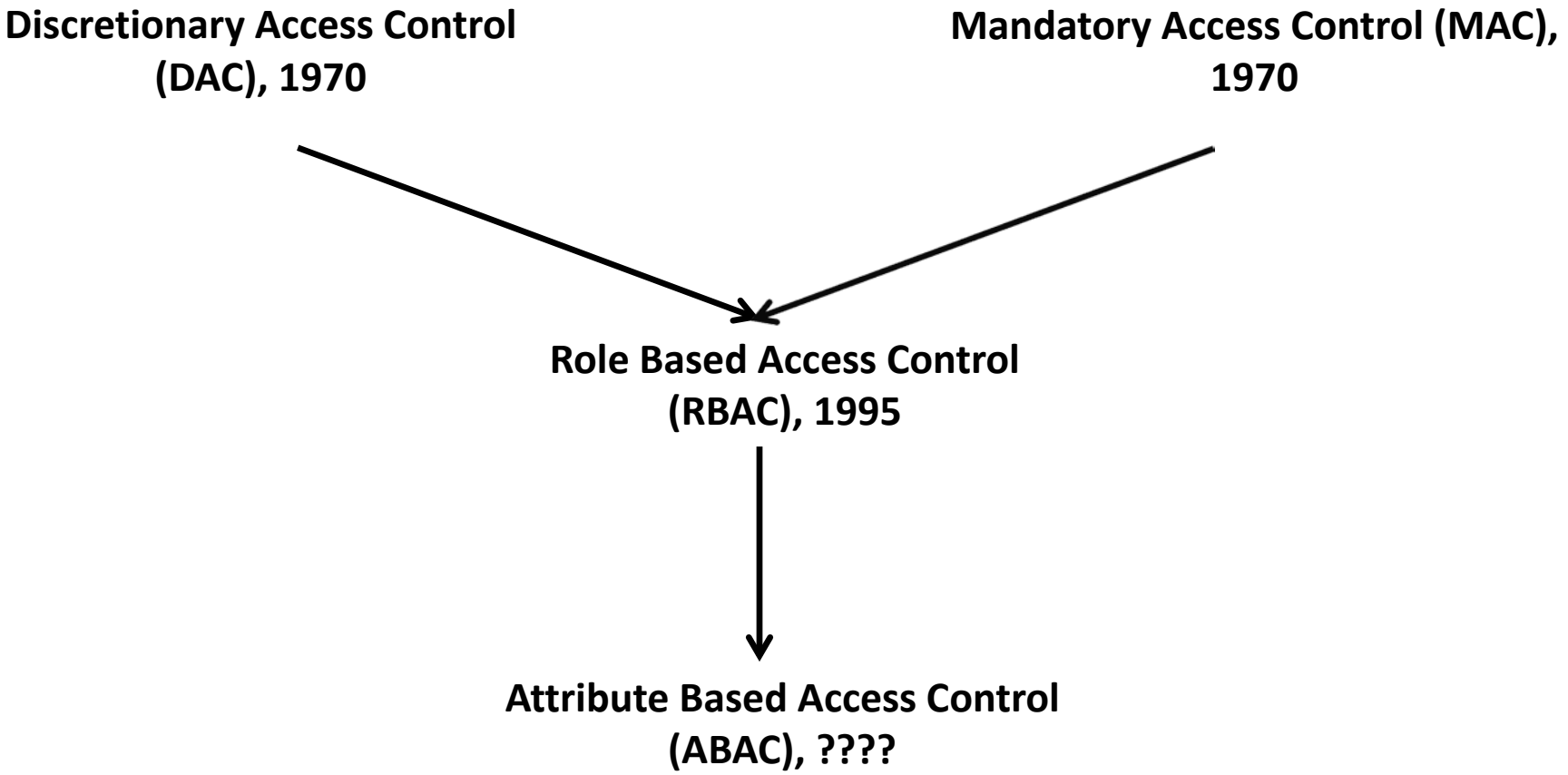
Cryptography

Symmetric Key Cryptography, 1977

Asymmetric Key Cryptography, 1996

BlockChain Applications, ????

Access Control



Discretionary Access Control (DAC)

- Core concept:

  Custodian of information determines access

- Core drawback:

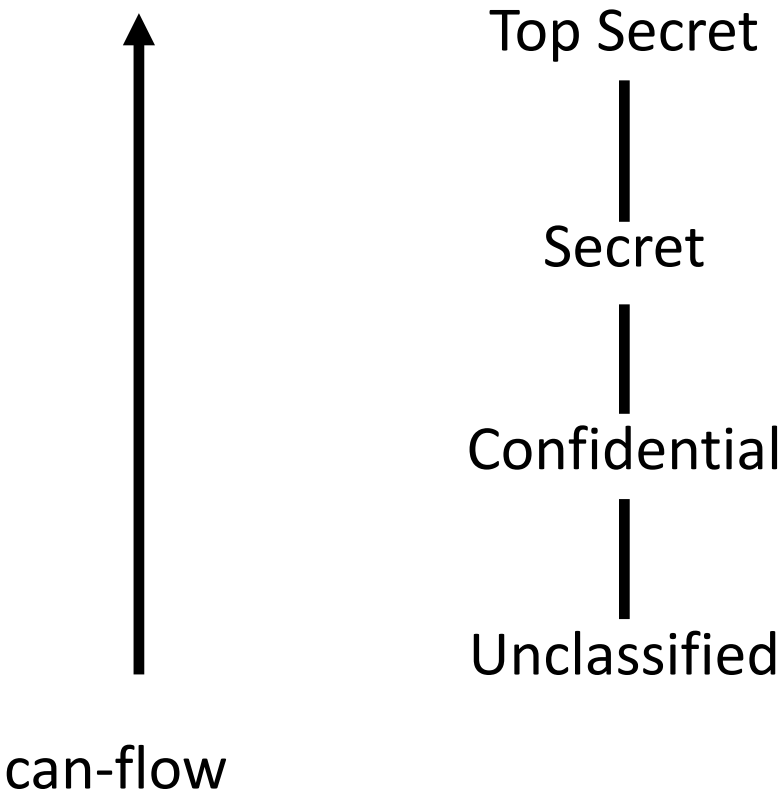
  Does not protect copies
  Therefore OK for integrity but not for confidentiality

- Sophistication:

  Delegation of custody

  Denials or negative rights

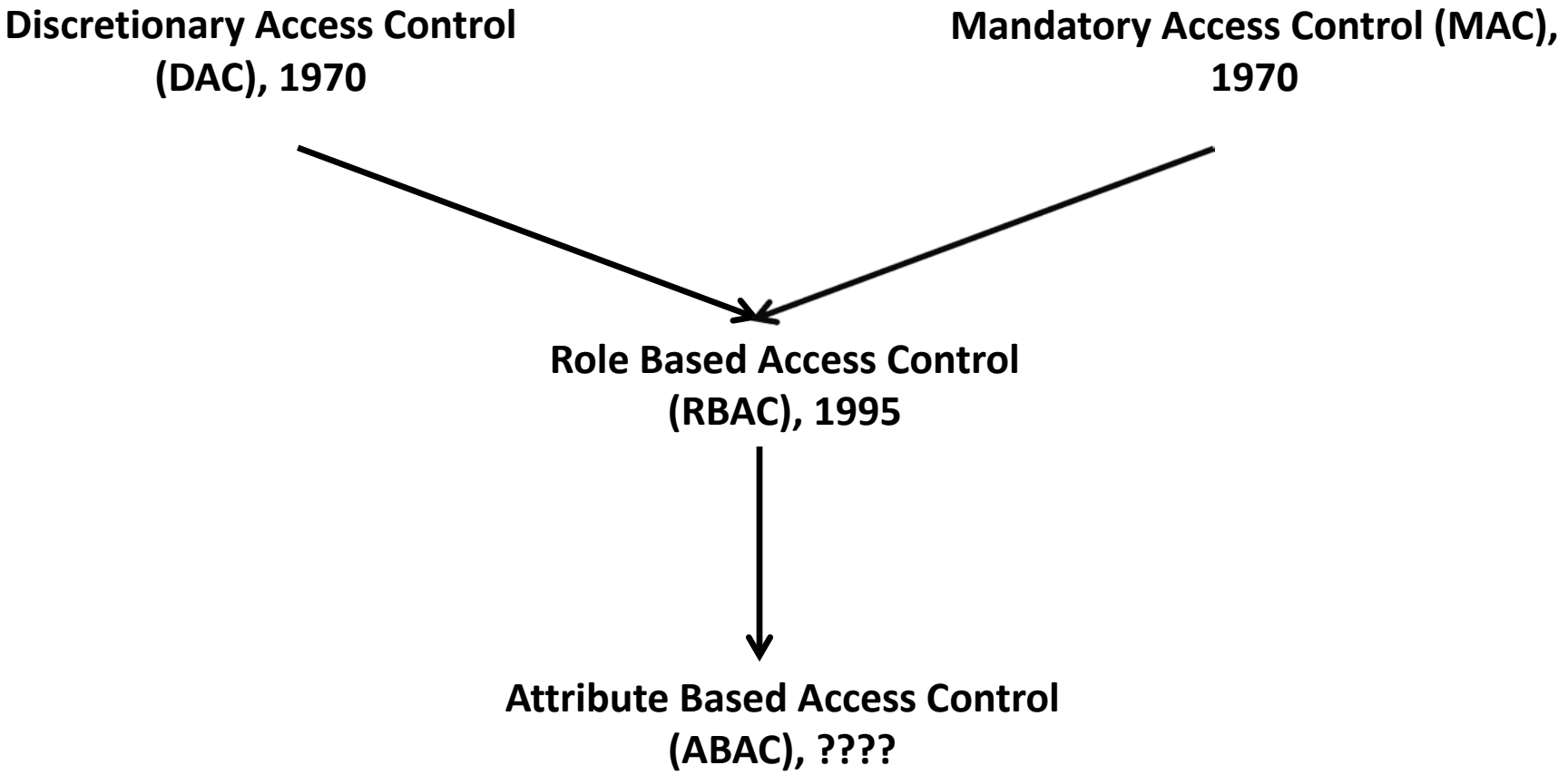
Mandatory Access Control (MAC)



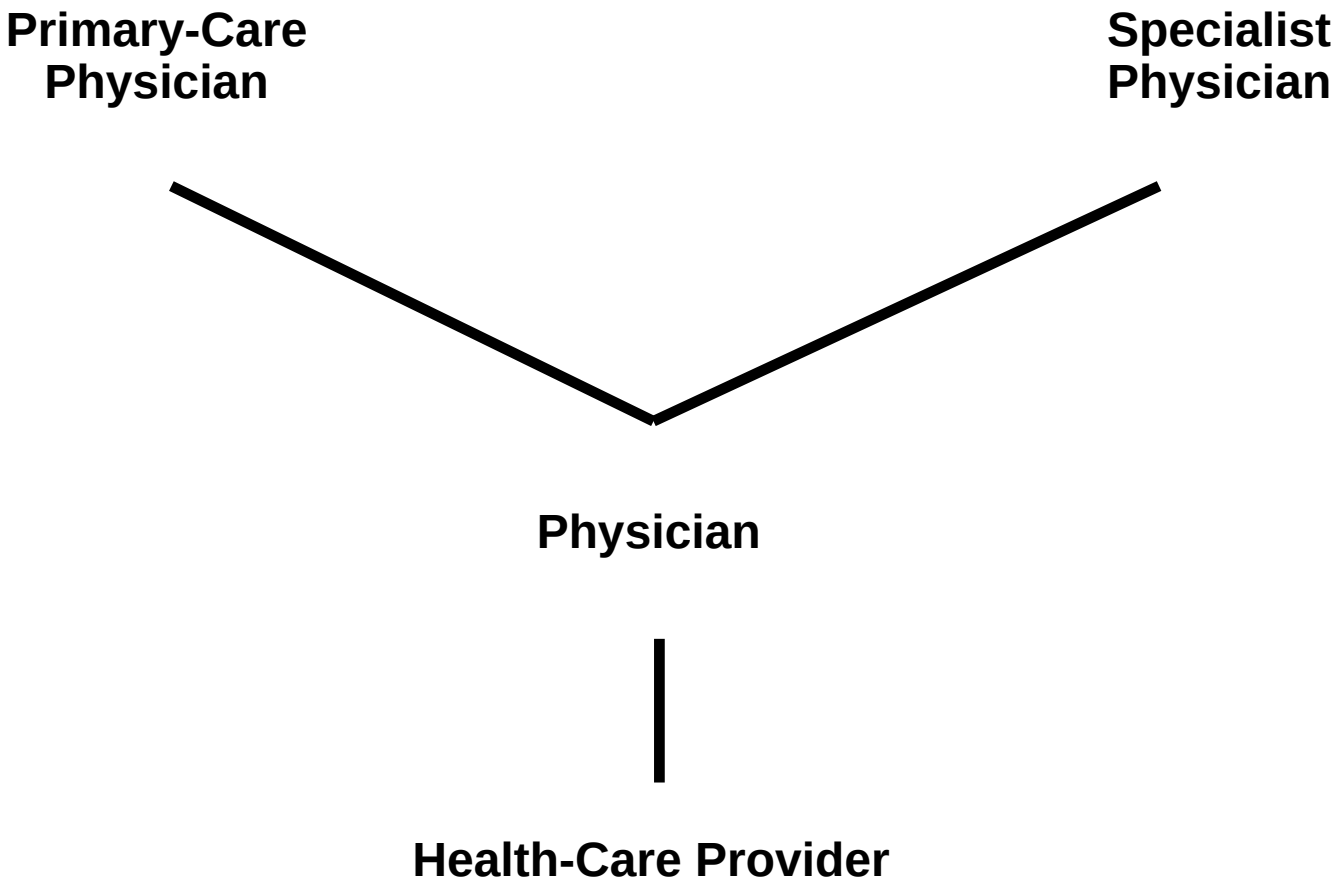
Mandatory Access Control (MAC)

- Core concept:
  - Extend control to copies by means of security labels
- Core drawback:
  - Covert/side channels enable copies that bypass this control
  - Inference not prevented
  - Too strict
- Sophistication:
  - Dynamic labels

Access Control



Role-Based Access Control (RBAC)



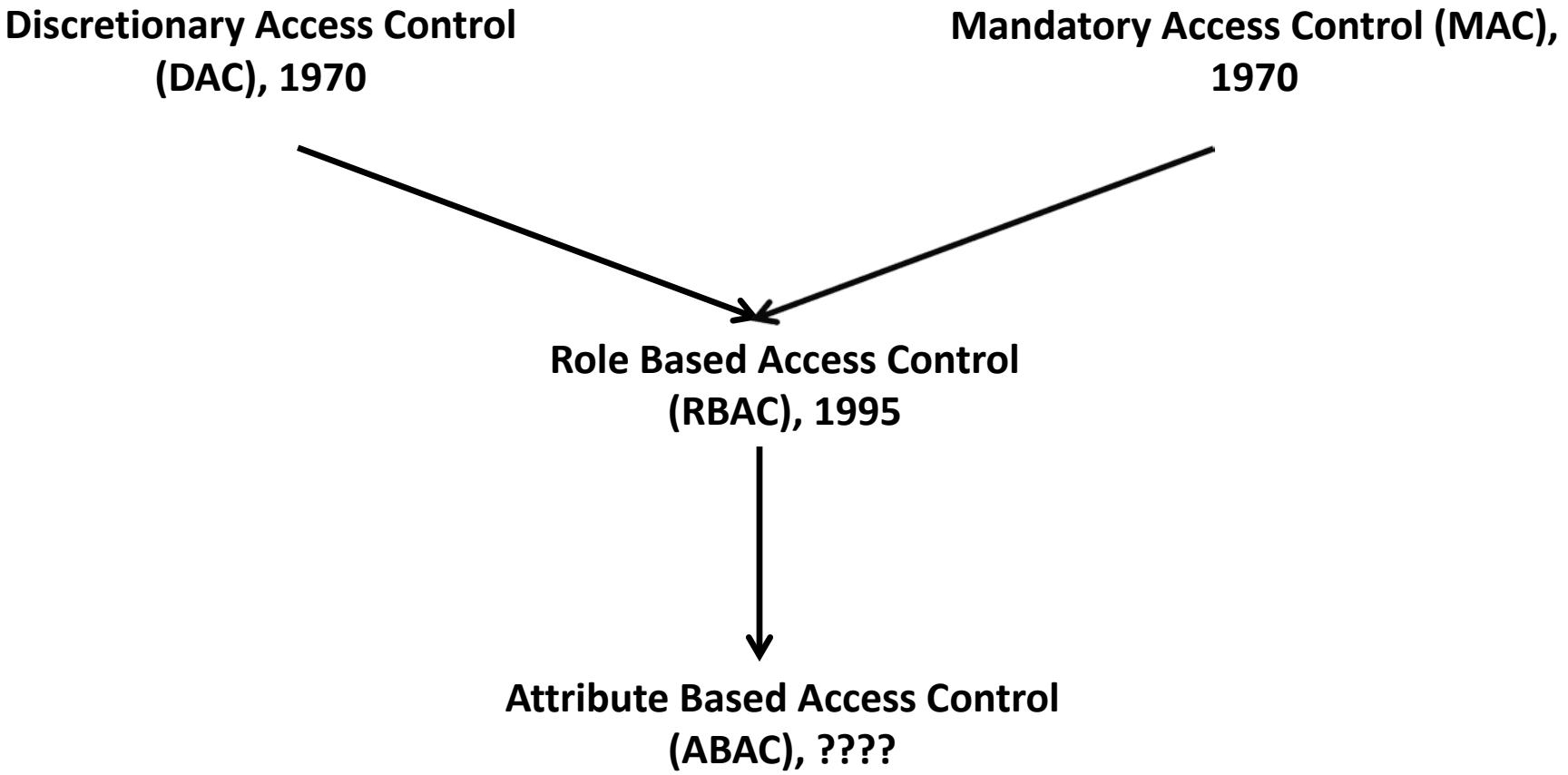
Role-Based Access Control (RBAC)

- 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

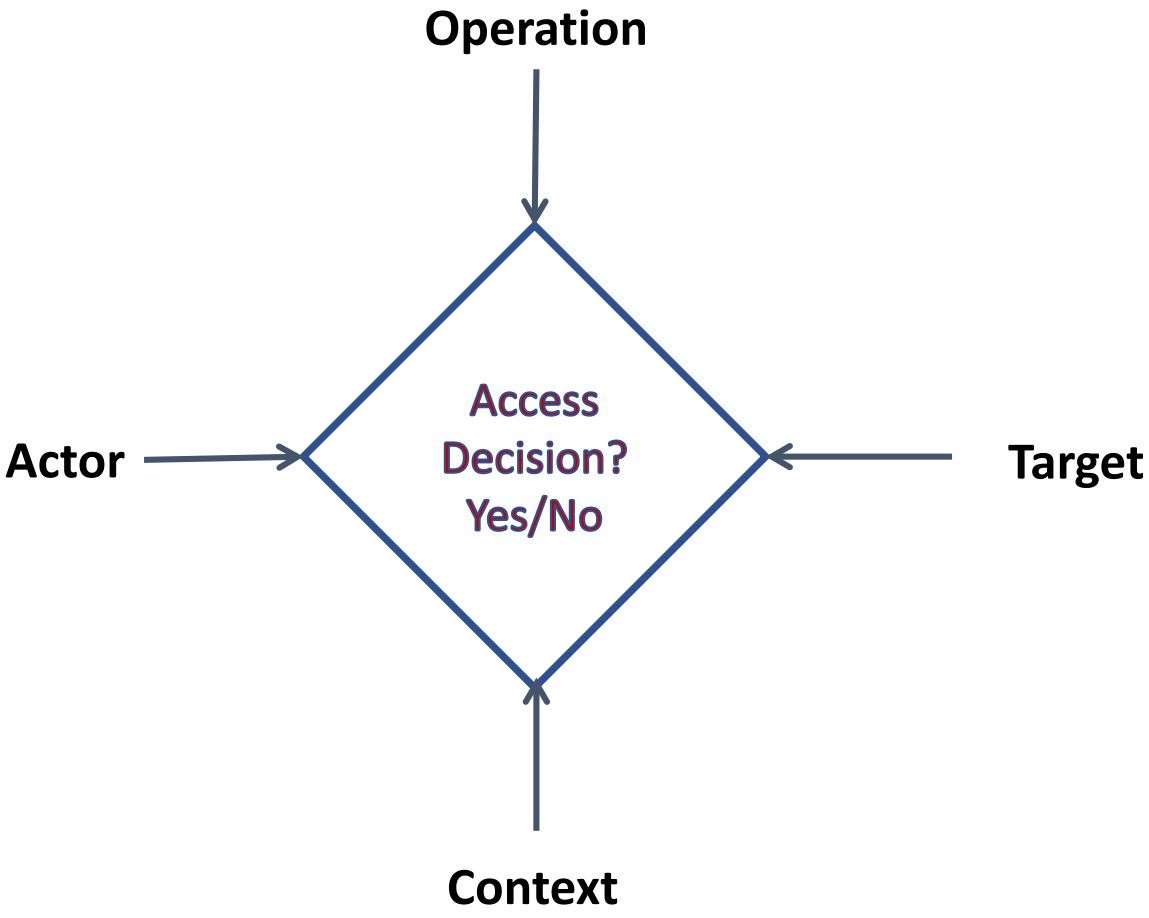
Role-Based Access Control (RBAC)

- Fundamental theorem of RBAC:
  - RBAC can be configured to do DAC
  - RBAC can be configured to do MAC

Access Control



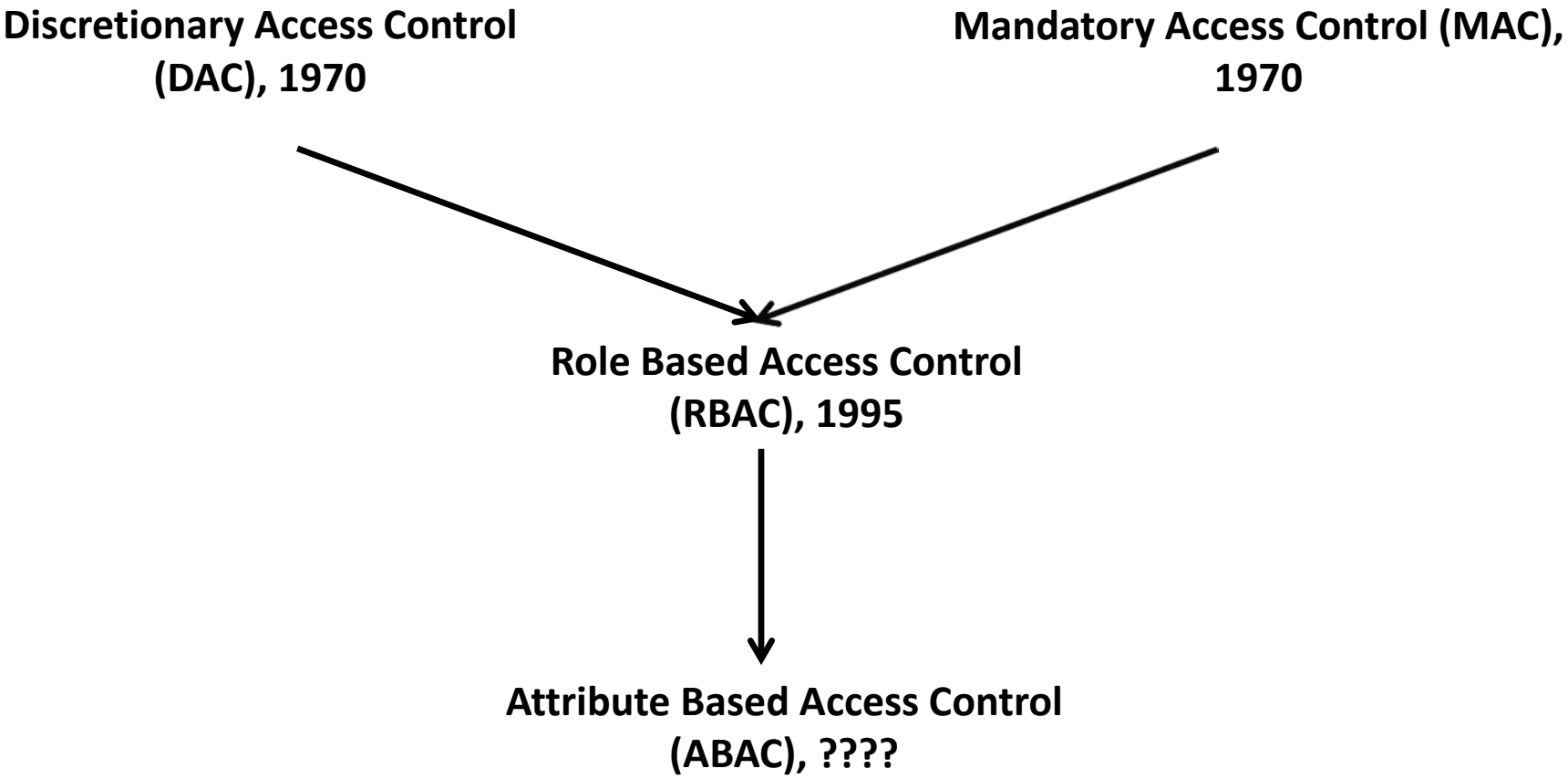
Attribute-Based Access Control (ABAC)



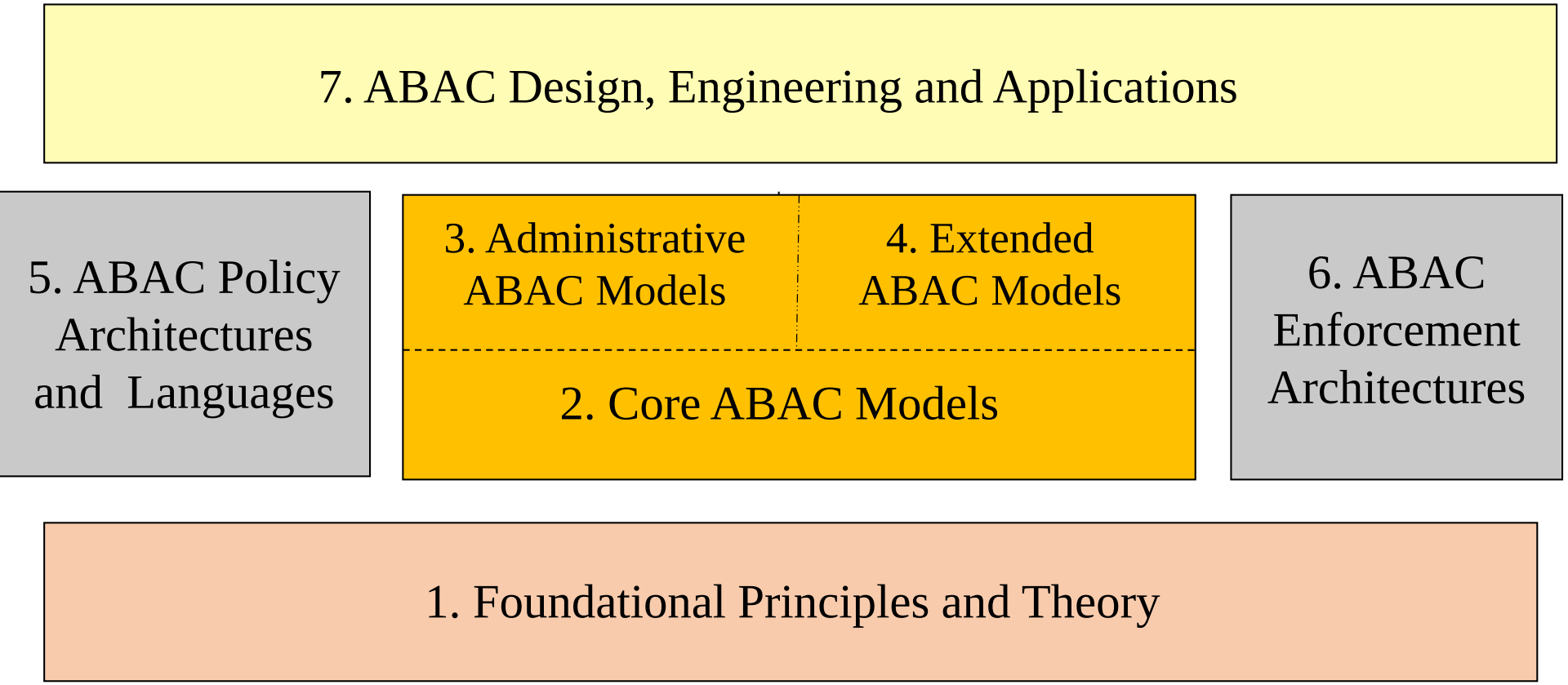
Attribute-Based Access Control (ABAC)

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

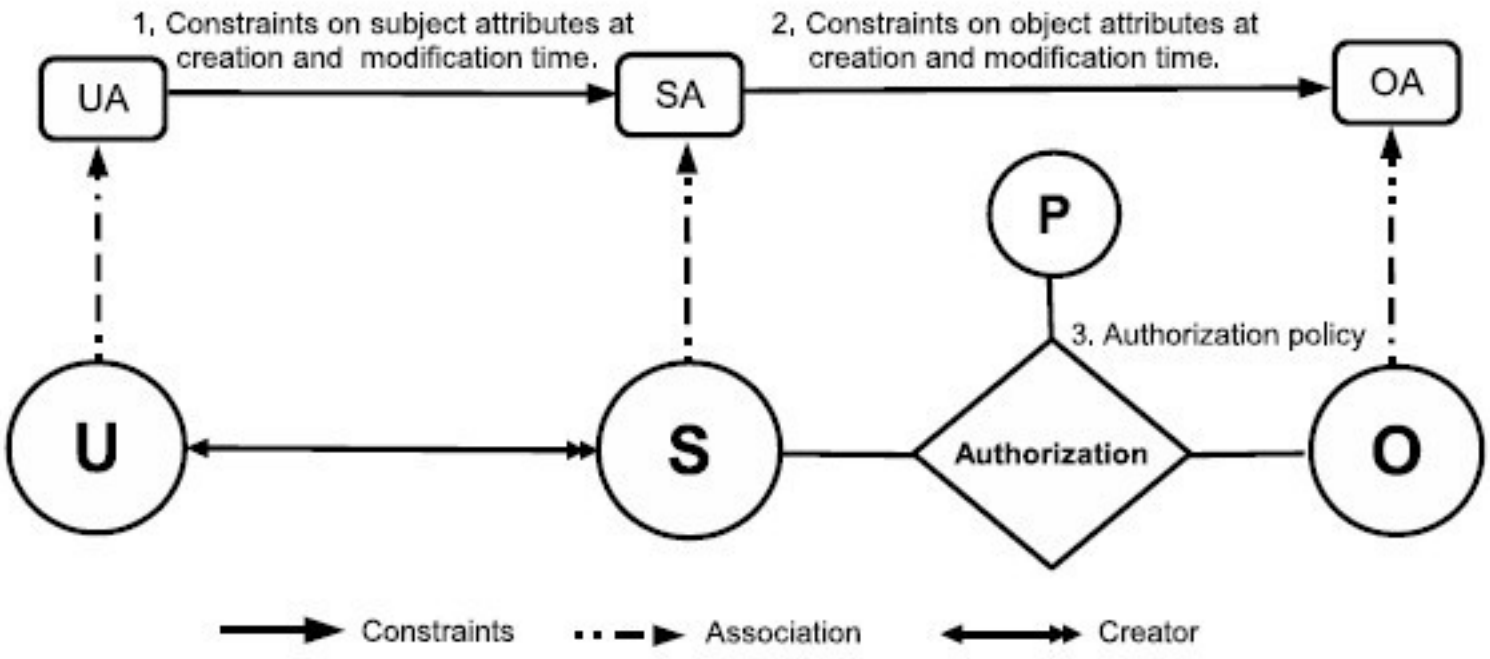
Access Control



ABAC Research Space



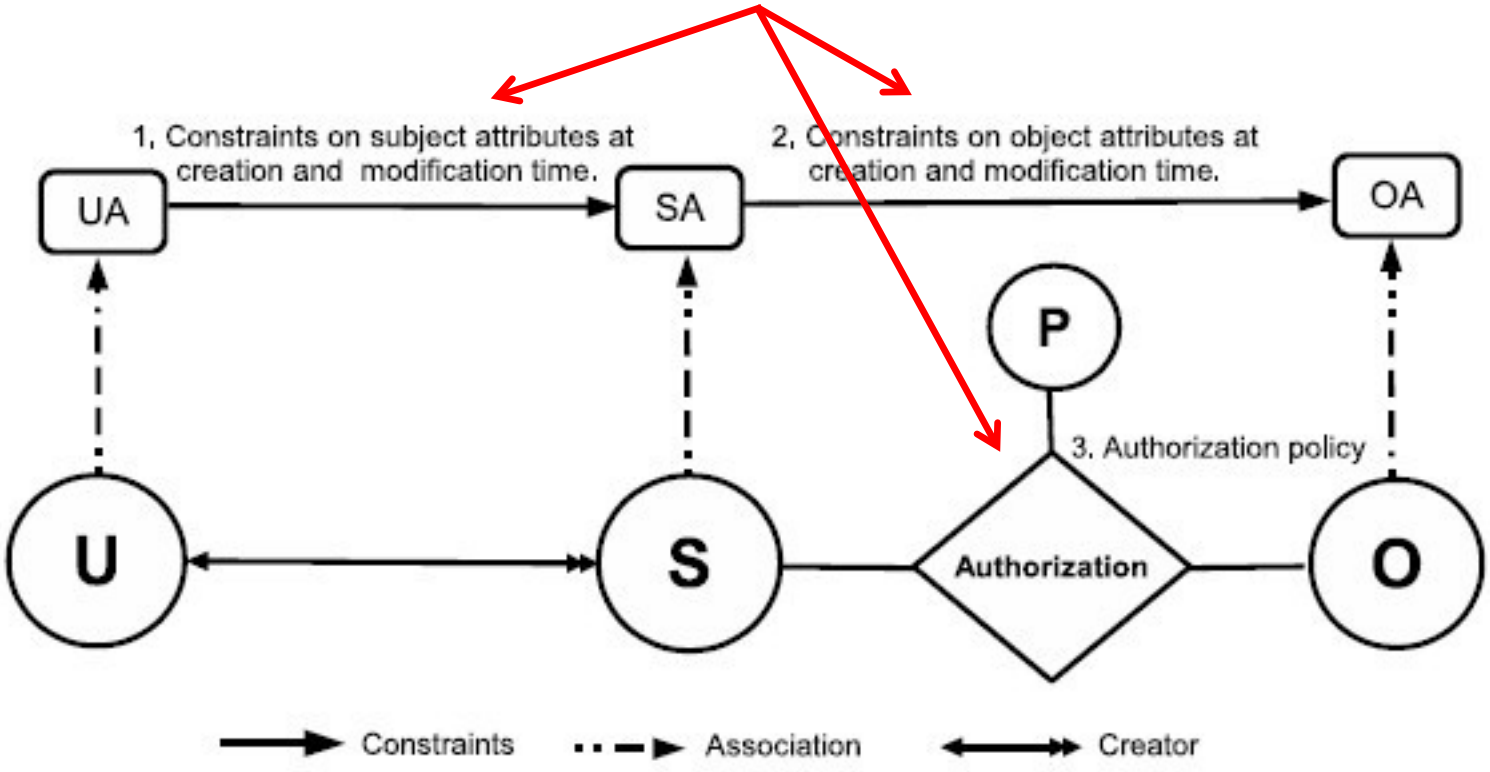
Core ABAC Models: $ABAC_{\alpha}$



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

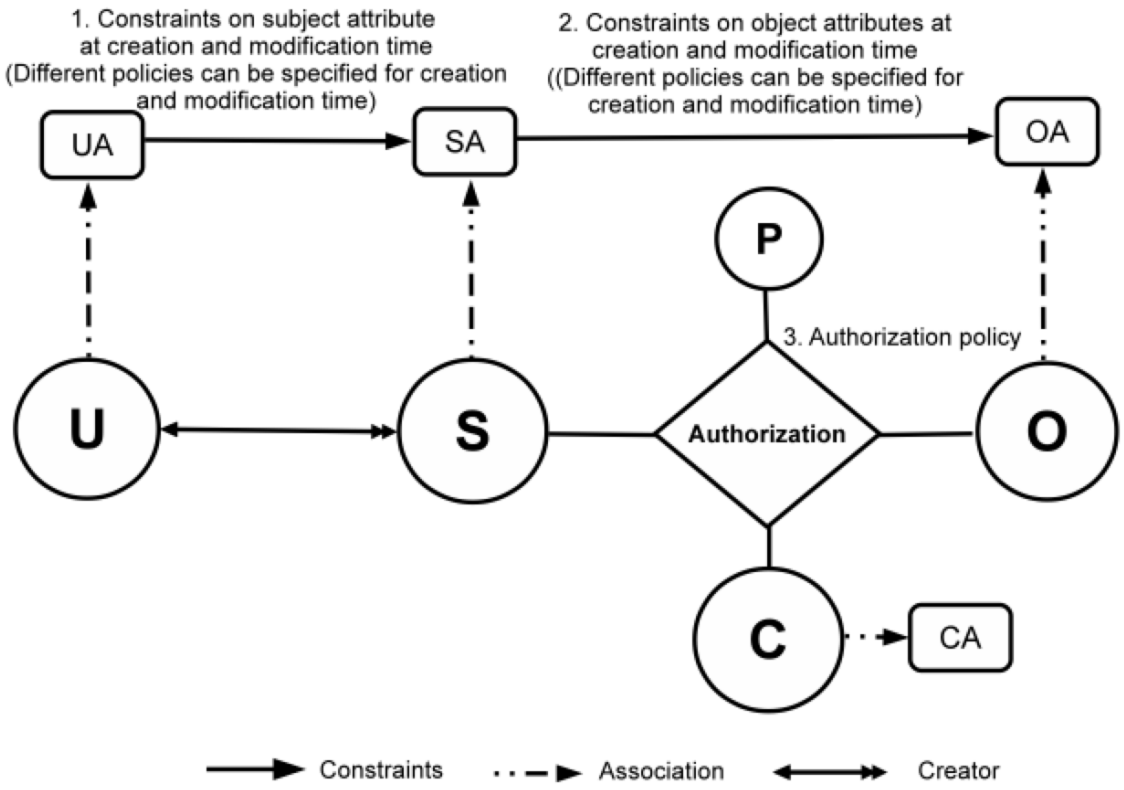
Core ABAC Models: $ABAC_{\alpha}$

Policy Configuration Points



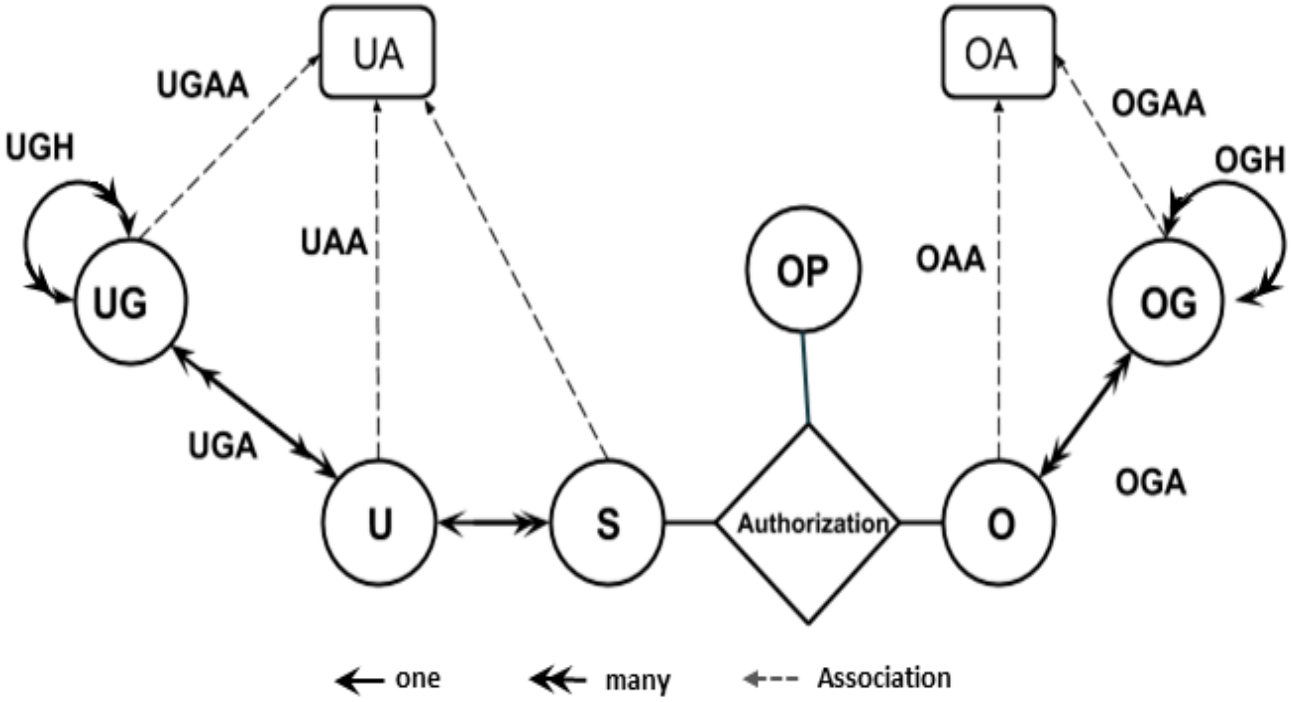
Can be configured to do simple forms of DAC, MAC, RBAC (Jin, Krishnan, Sandhu 2012)

Core ABAC Models: $ABAC_\beta$



Can further be configured to do many RBAC extensions (Jin, Krishnan, Sandhu 2014)

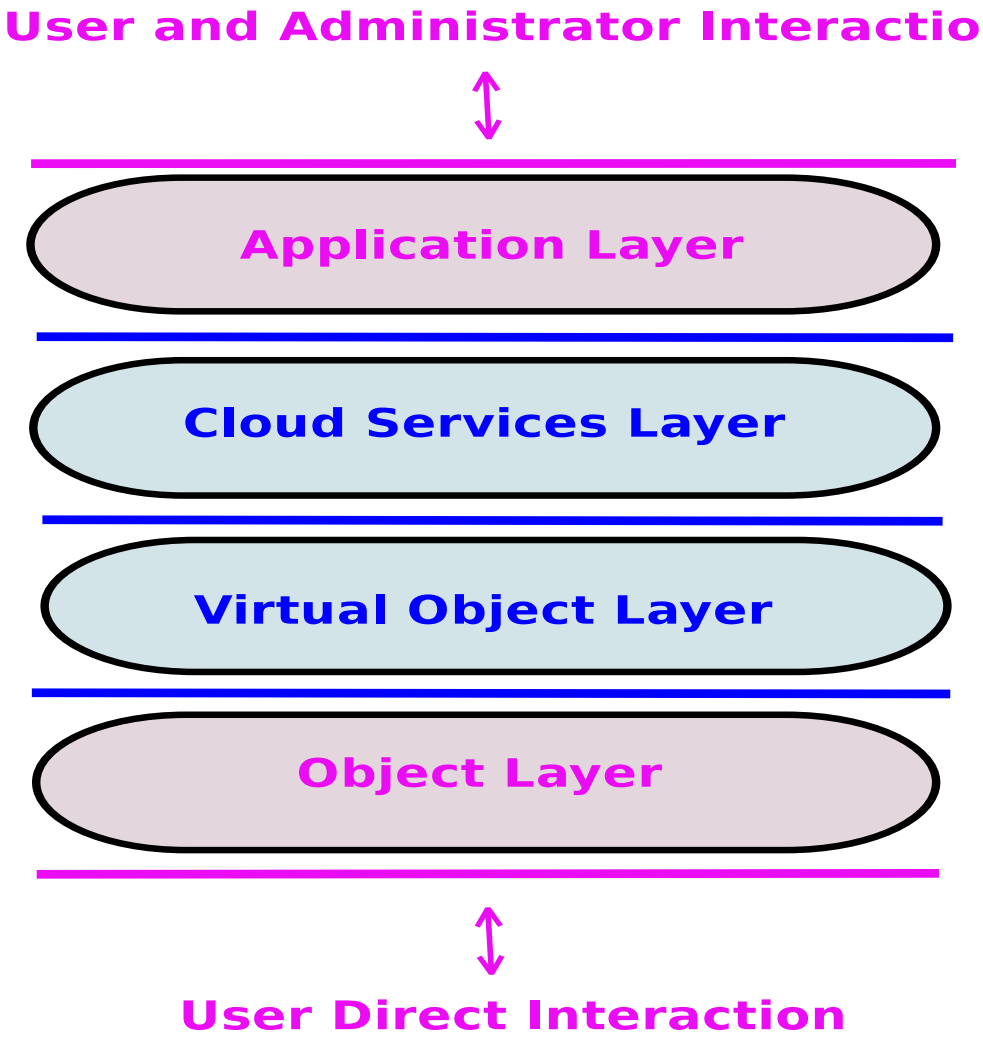
Administrative ABAC Models: HGABAC



- Hierarchical Group and Attribute Based Access Control (HGABAC)
  - Introduces User and Object Groups
  - Simplifies administration of attributes

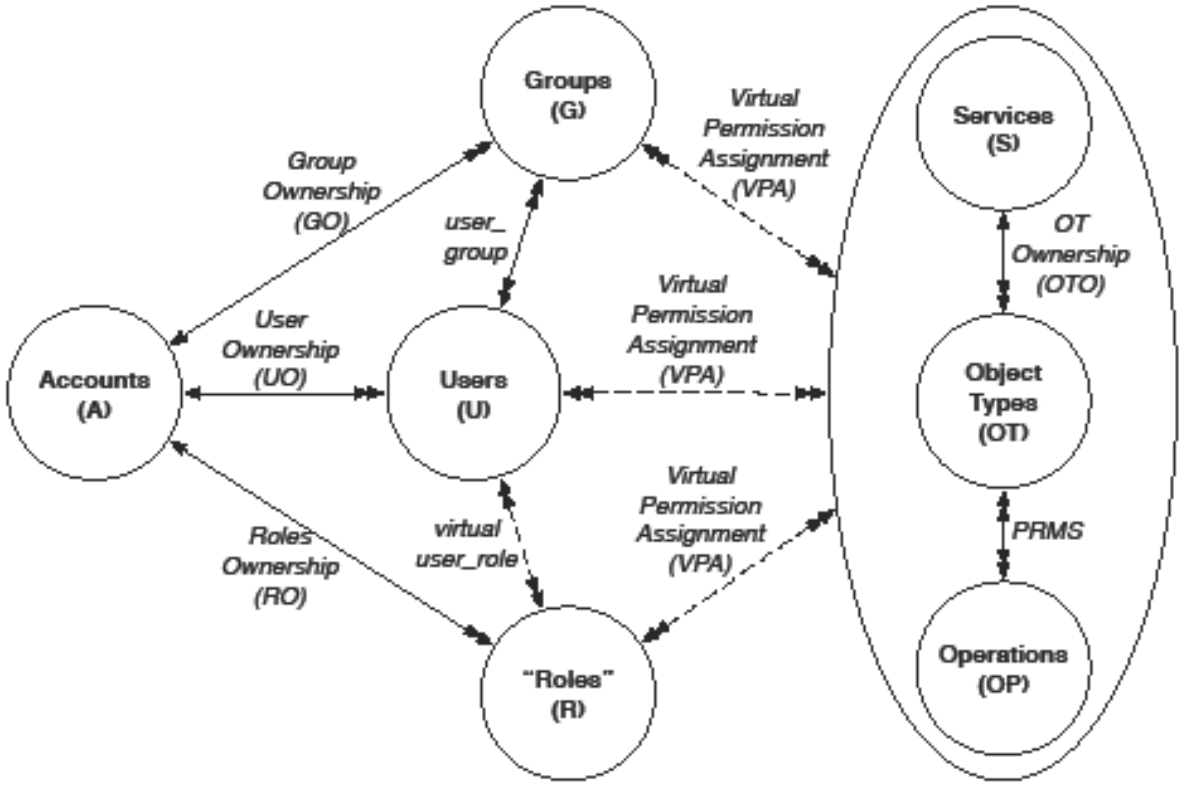
Servos and Osborn, 2015

ABAC Applications: Cloud Enabled IoT



Alsheri, Bhatt, Patwa, Benson, Sandhu 2016 onwards

Policy Architecture: Amazon AWS style



ABAC Research Space

* 7. ABAC Design, Engineering and Applications

* 5. ABAC Policy Architectures and Languages

3. Administrative * ABAC Models

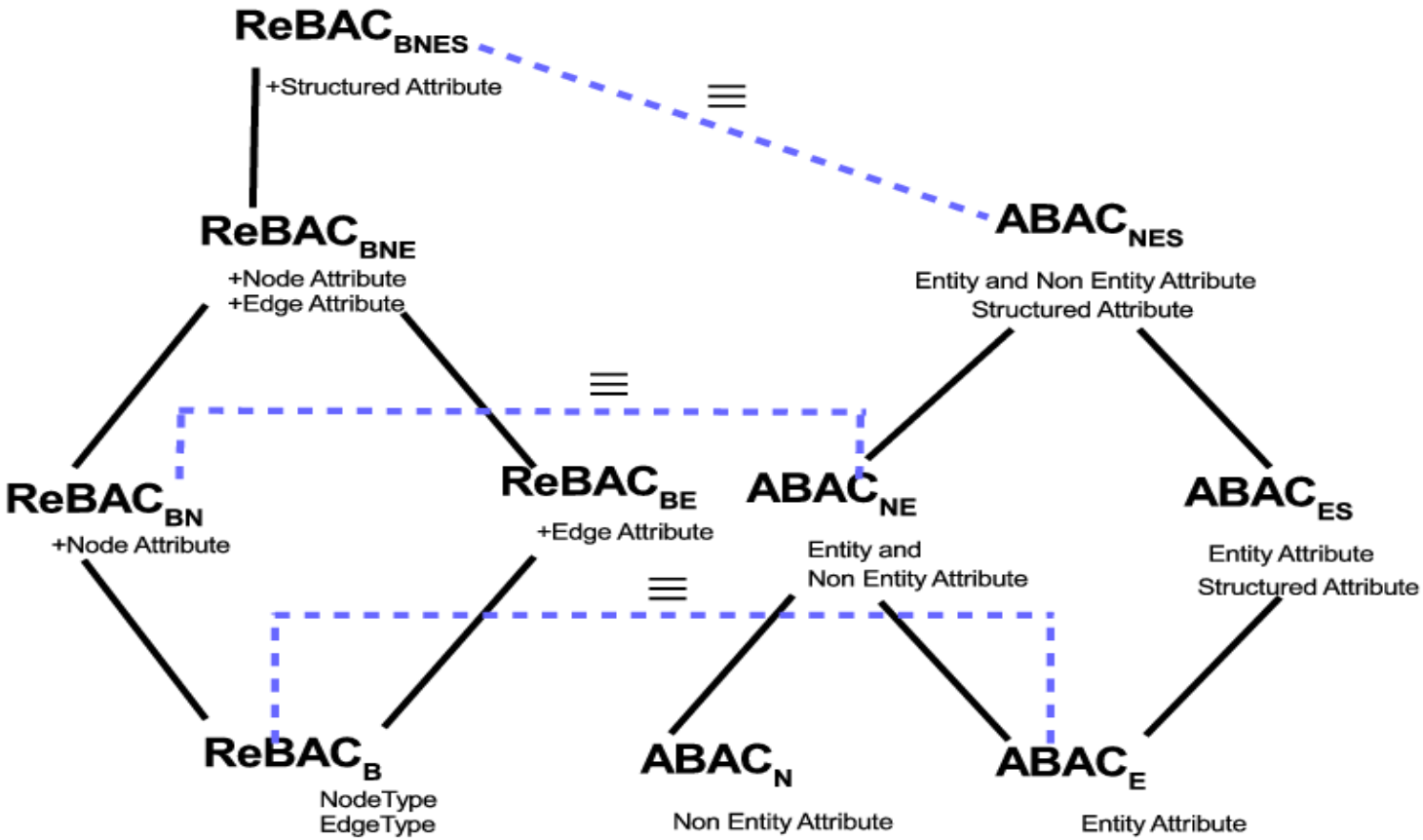
4. Extended ABAC Models

* 2. Core ABAC Models

6. ABAC Enforcement Architectures

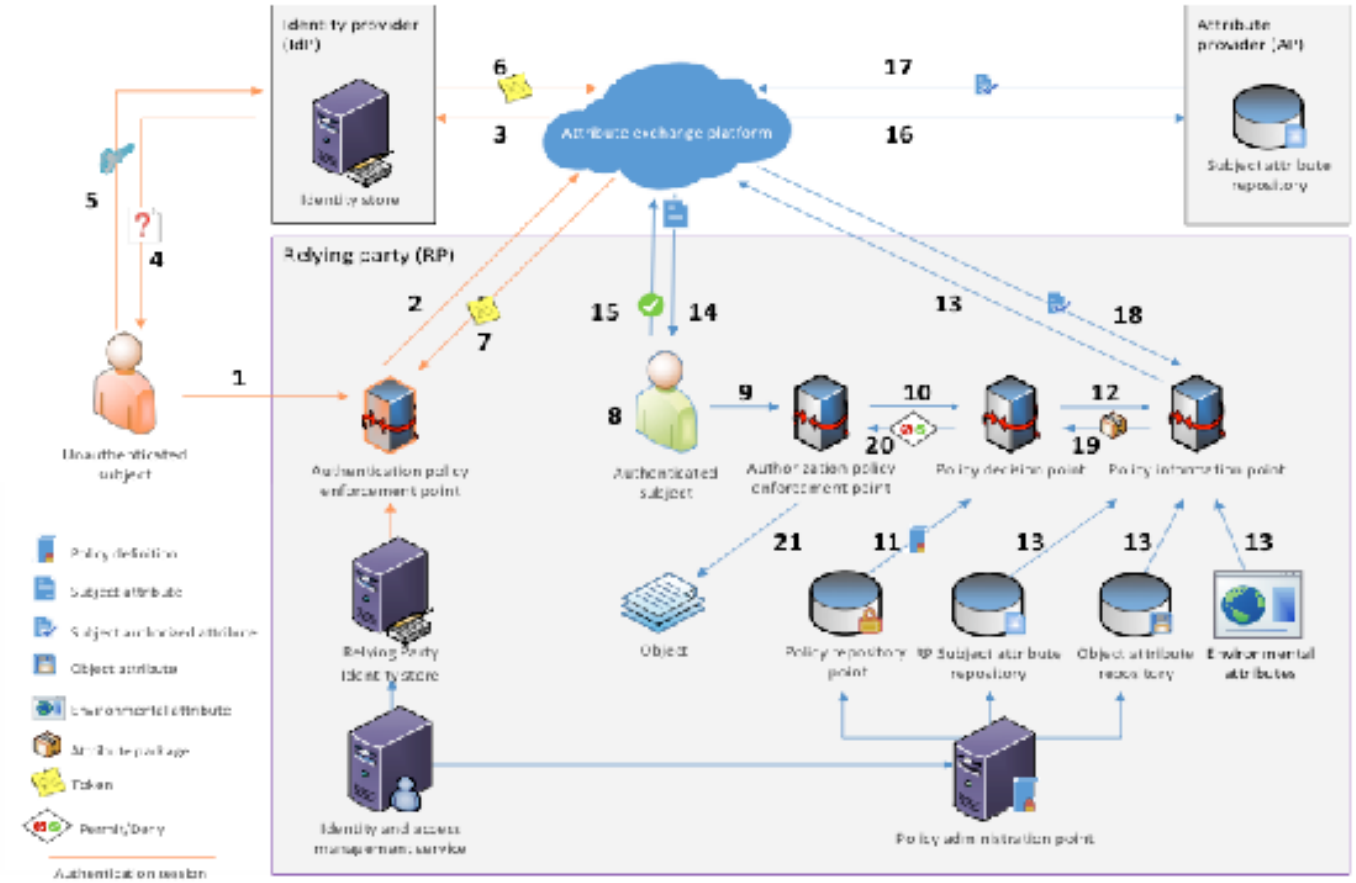
1. Foundational Principles and Theory

Extended ABAC Models: ReBAC versus ABAC



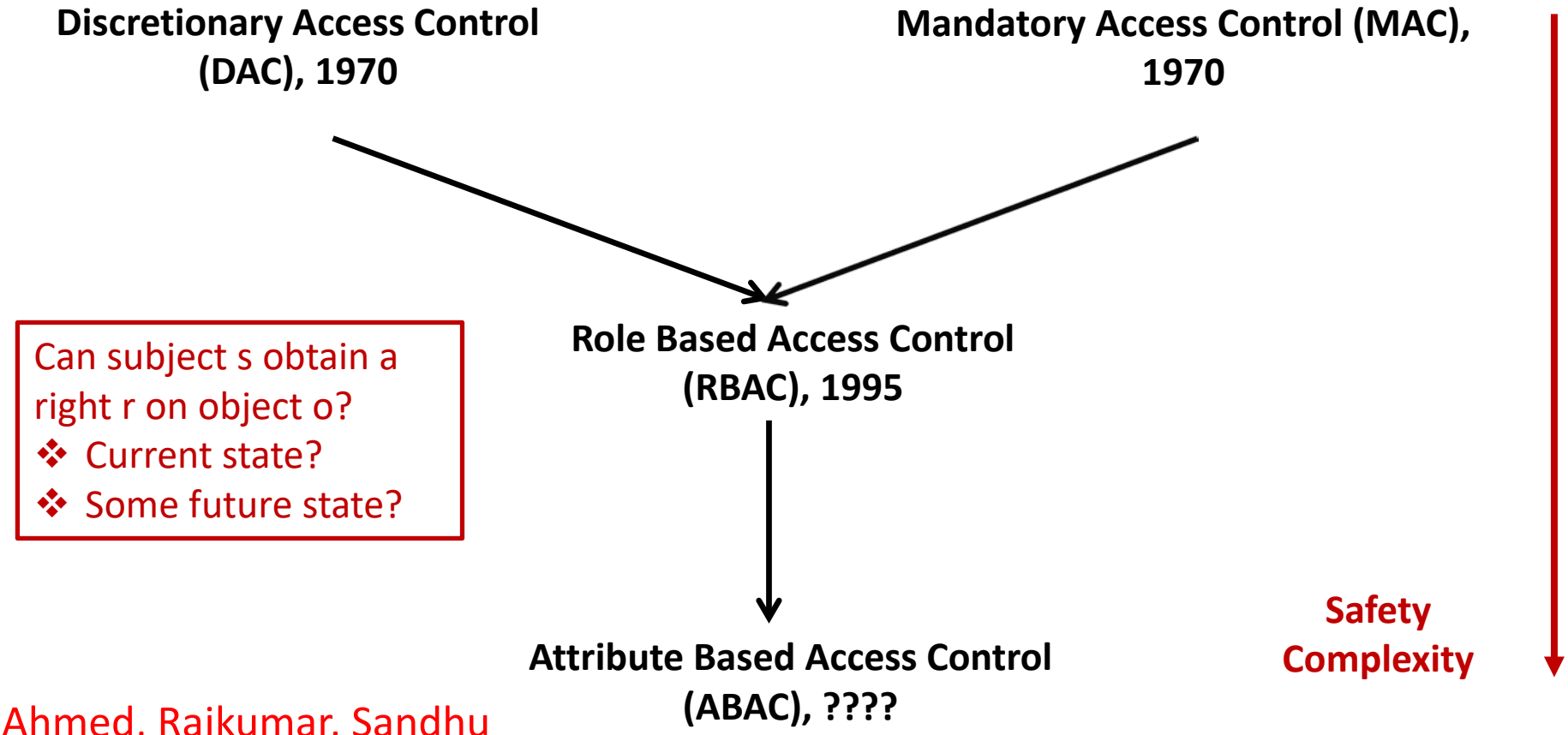
ReBAC and ABAC are not that different (Tahmina, Sandhu 2017)

ABAC Enforcement Architecture: Federated ABAC



Fisher 2015
NCCOE, NIST, Building Block

Foundations: Safety Analysis



Can subject s obtain a right r on object o?

- Current state?
- Some future state?

Ahmed, Rajkumar, Sandhu 2016 onwards