Attribute Transformation for Attribute-Based Access Control

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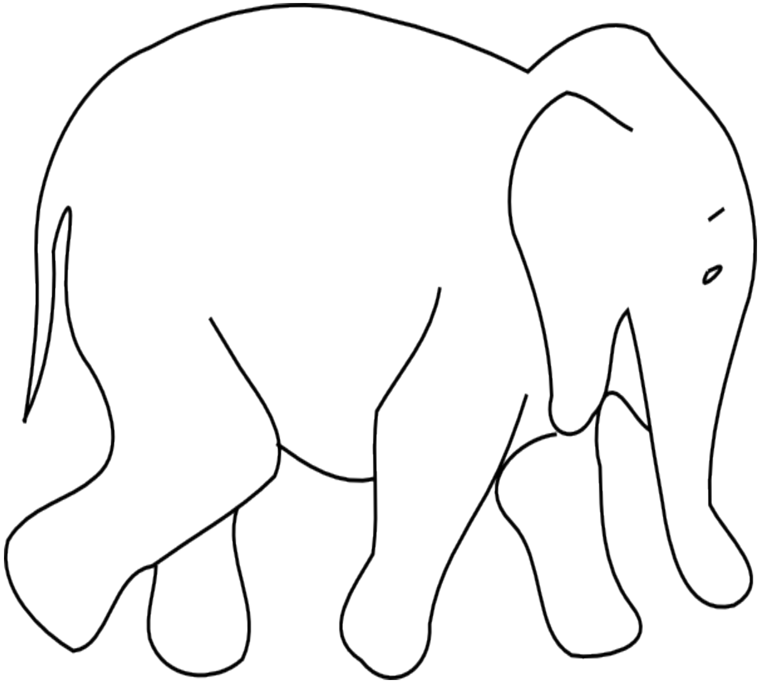
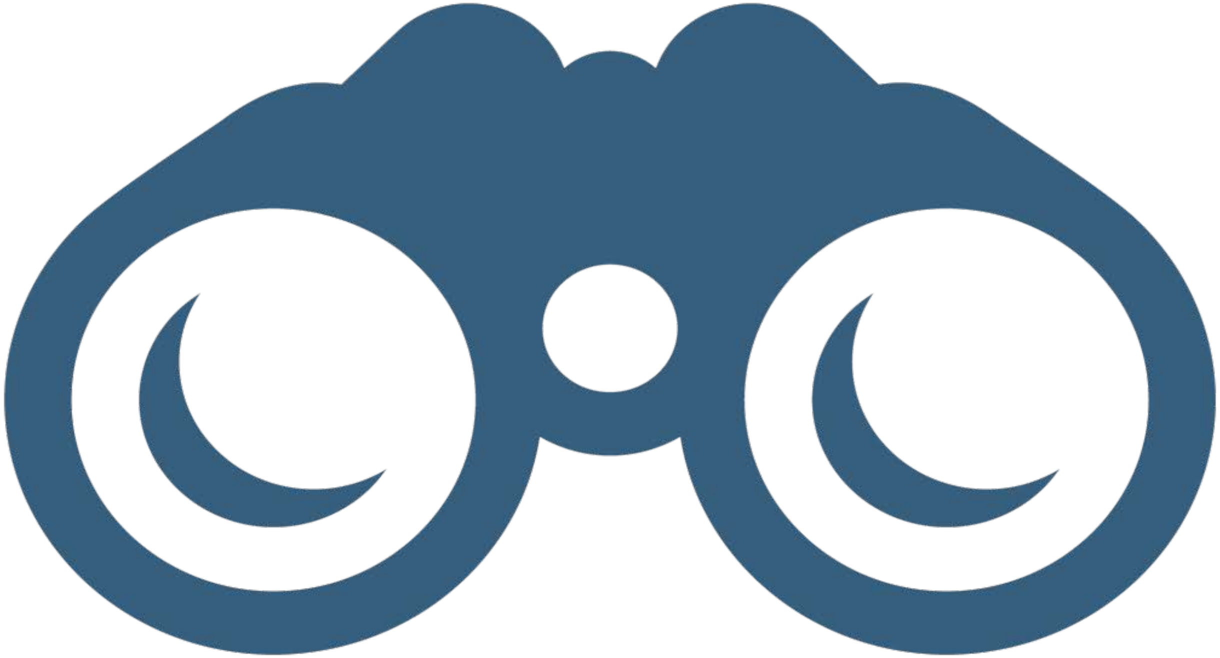
Outline

- Summary
- Motivation
- Attribute Transformation
- Attribute Reduction
- Attribute Expansion
- Conclusion
- Q/A



Summary

We have presented a concept of attribute transformation and specify two types of transformation---attribute reduction and attribute expansion.



Motivation

Attribute explosion!

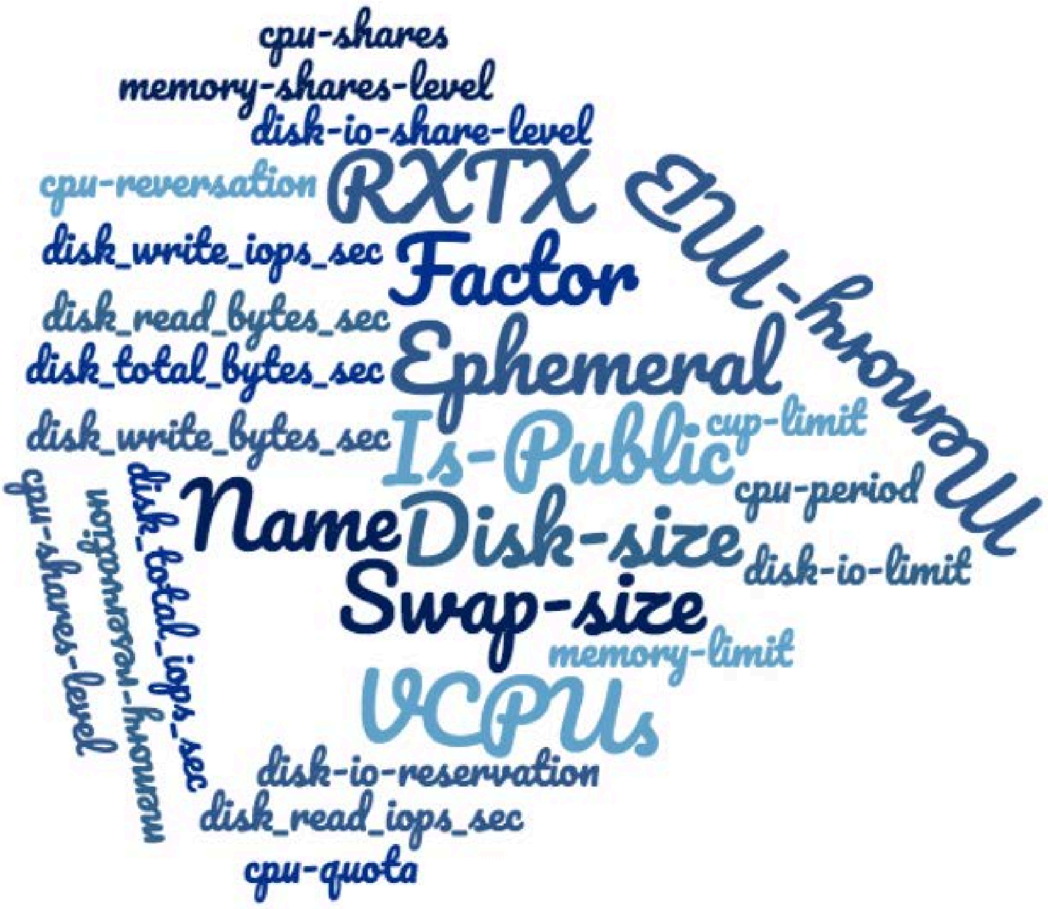
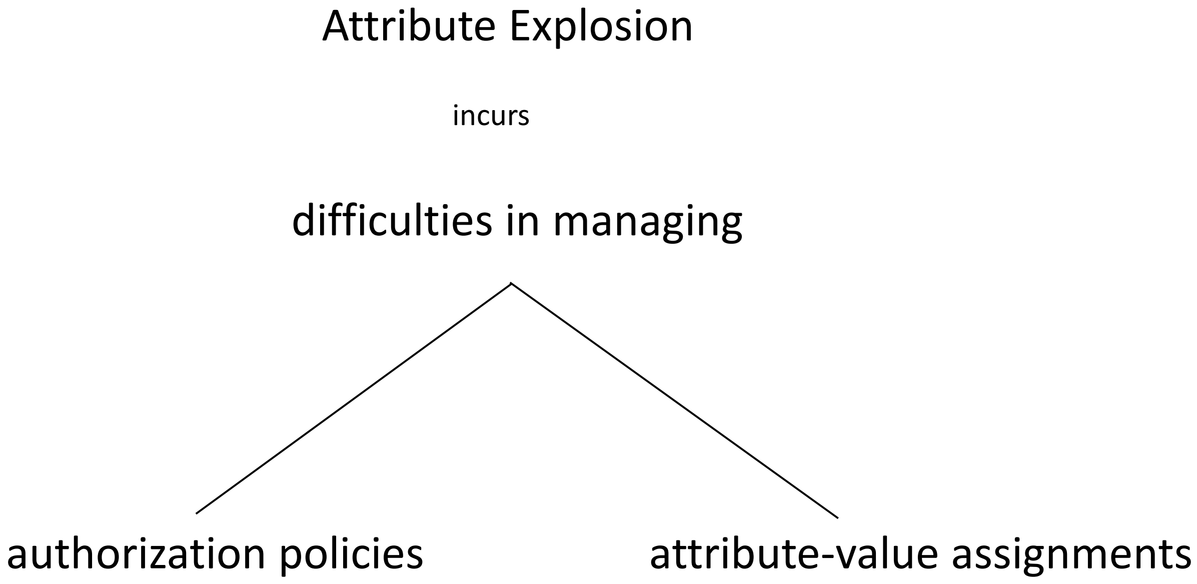


Figure 1: Attributes defined for OpenStack Virtual Machines

Motivation (continuing)



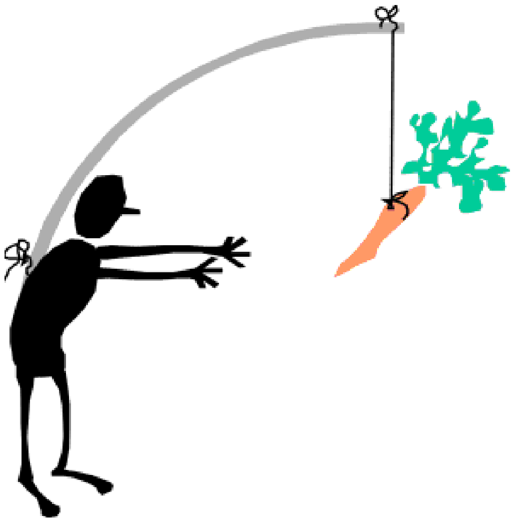
Attribute Explosion

incurs

difficulties in managing

authorization policies

attribute-value assignments



Motivation (continuing)

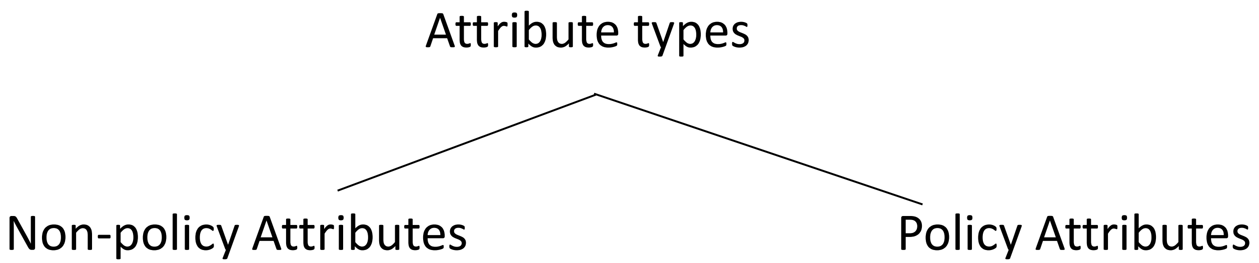
We cannot get rid of attributes we need.

But we can manage

with

Attribute Transformation

Attribute Transformation (assumptions)



Attribute types

Non-policy Attributes

Policy Attributes

Assumptions:

Non-policy Attributes ∩ Policy Attributes = ϕ
Non-policy Attributes >> Policy Attributes

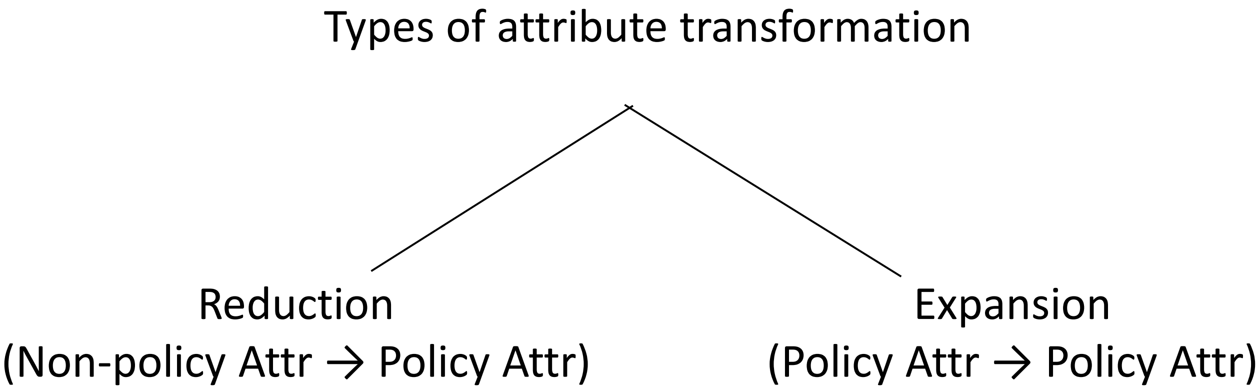
Examples:

Object attributes (Non-policy):
size, created_by, shared, location

Object attributes (Policy):
sensitivity, security-label

Attribute Transformation

Attribute Transformation is the process of transforming one set of attribute-value assignments into another set of assignments.



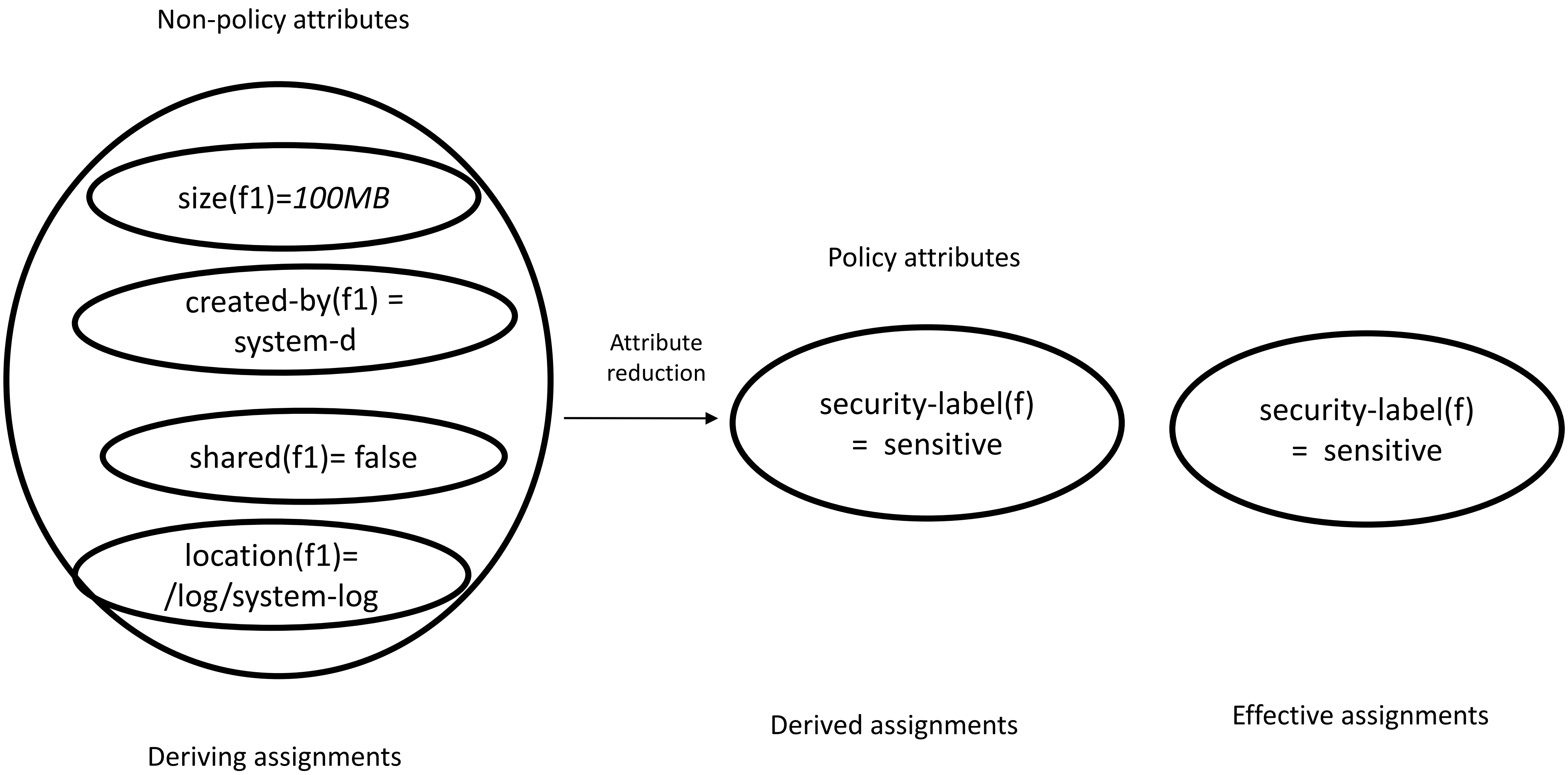
Types of attribute transformation

Reduction
(Non-policy Attr → Policy Attr)

Expansion
(Policy Attr → Policy Attr)

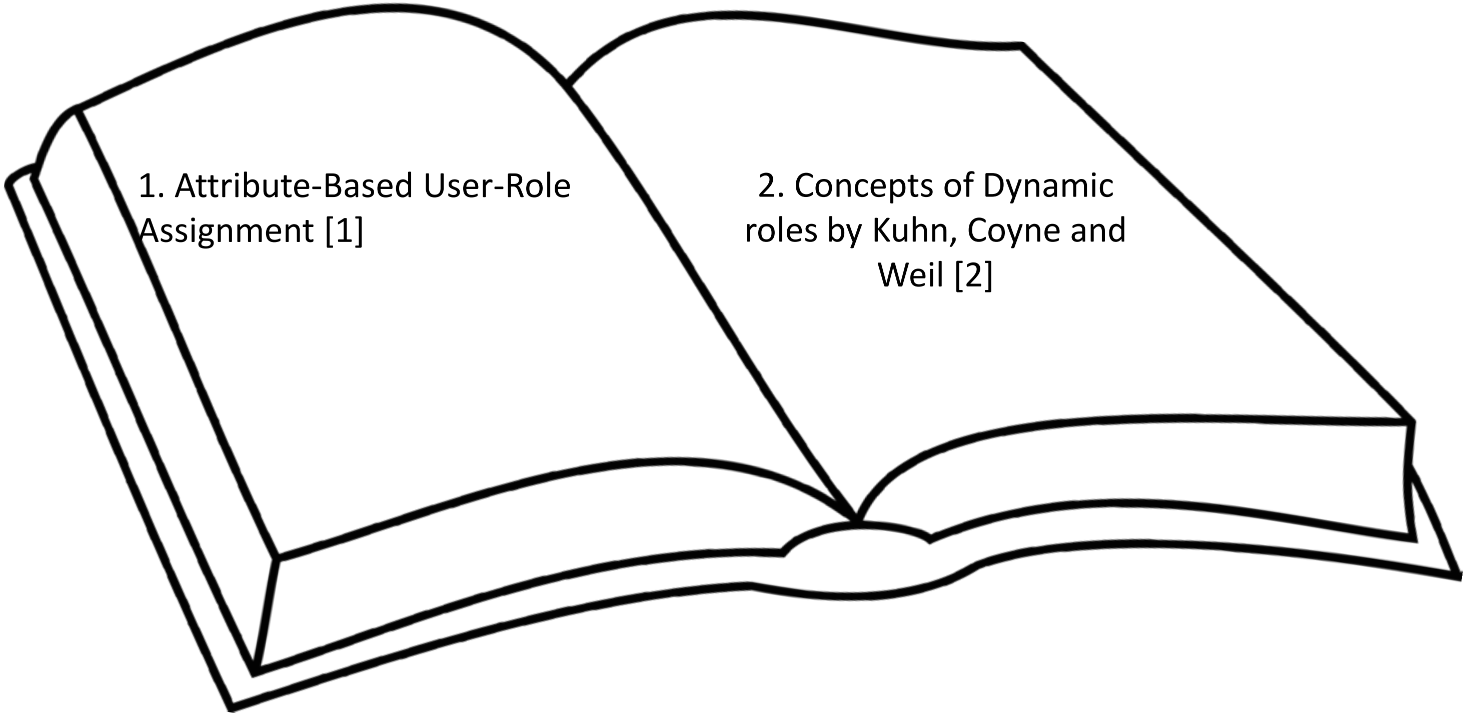
Attribute Reduction

The process of transforming non-policy attribute-value assignments into policy attributes-value assignments.



Attribute Reduction (motivation)

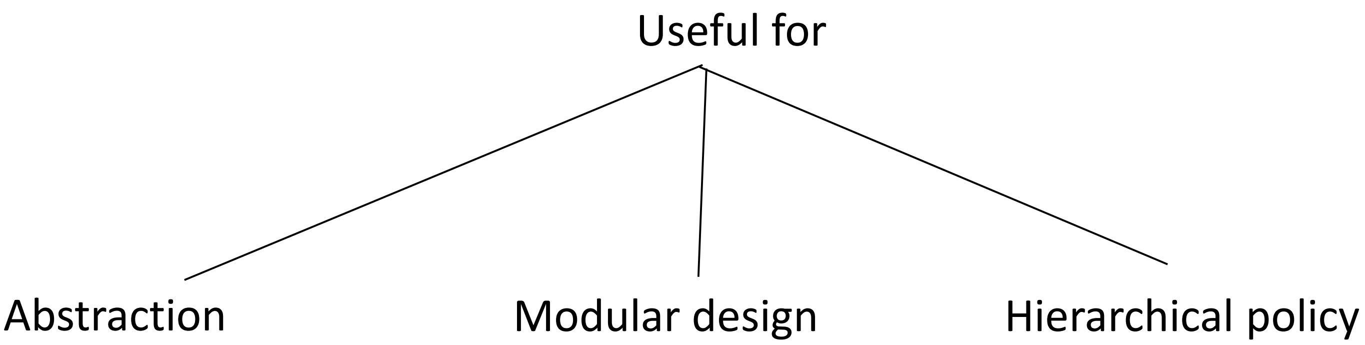
Motivation from literature:

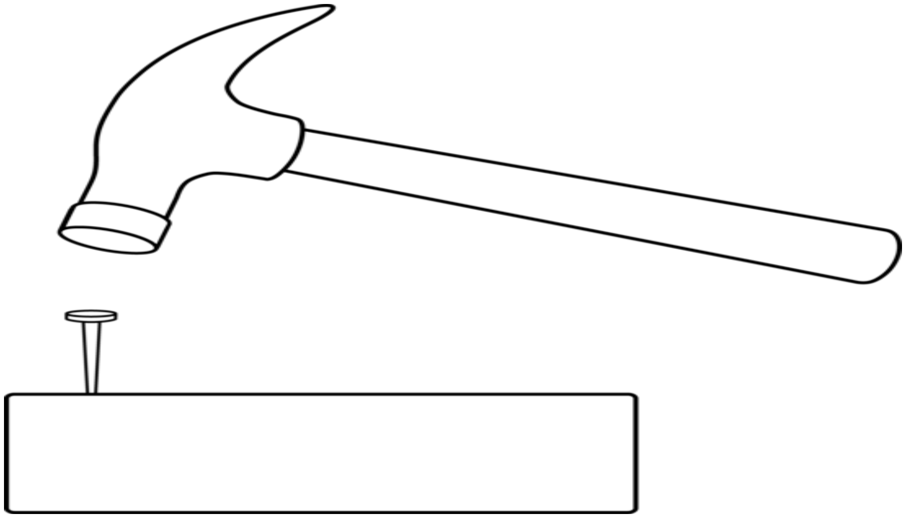


1. Attribute-Based User-Role Assignment [1]

2. Concepts of Dynamic roles by Kuhn, Coyne and Weil [2]

Attribute Reduction (usefulness)





Attribute Reduction (usefulness)

Authorization policy with Policy attributes:

Can-read ≡ security-label(o) = sensitive ∧ role(u)=manager

Mapping rules with Non-policy Attributes:

VM-mapping ≡ resource-type(o) = VM ∧ image-type(o) = corporate → security-label(o) = sensitive

Firewall-mapping ≡ resource-type(o) = firewall ∧ protocol(o) = UDP ∧ network(o) = internal → security-label(o) = sensitive

Attribute Reduction (mapping rules)

Example of mapping rule:

file-length(f) = 100 MB ∧ created-by(f) = system-d ∧ is-shared(f) = false → security-label(f) = sensitive

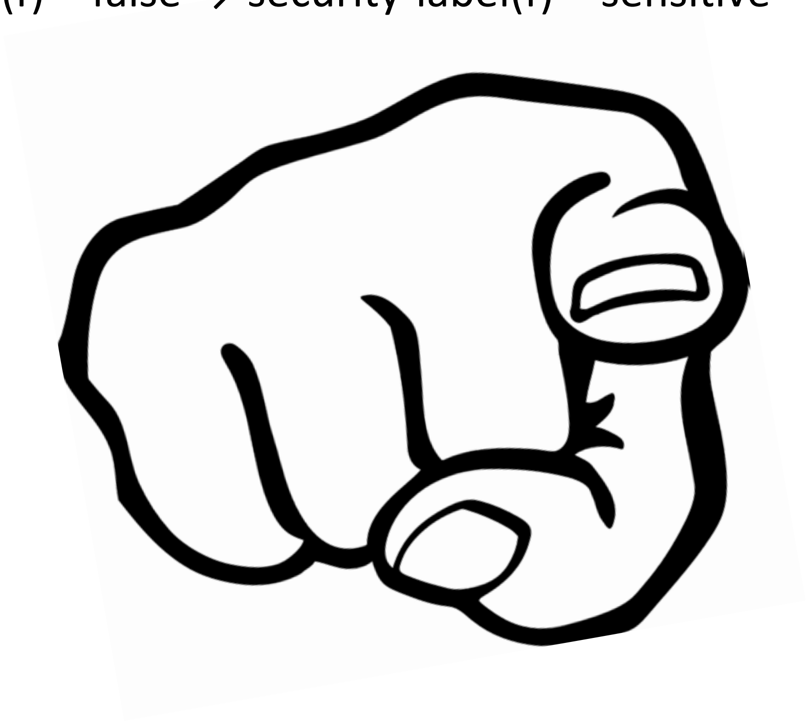
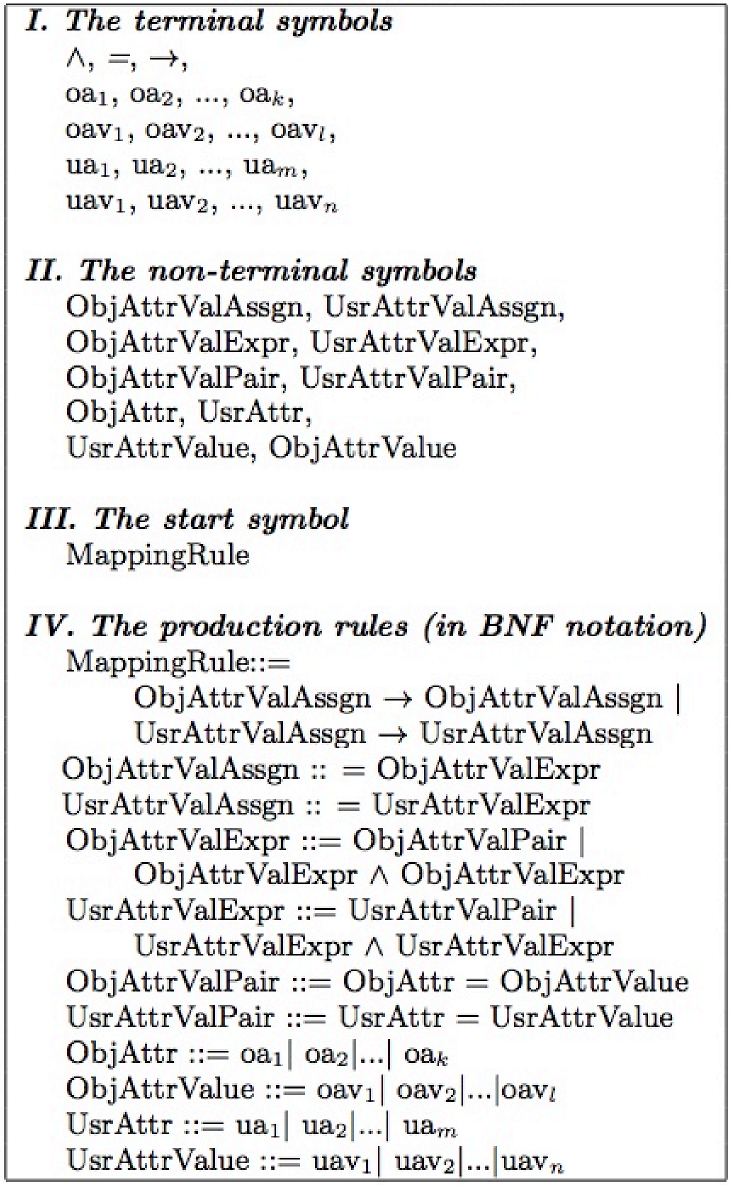


Table 1: Mapping rules



I. The terminal symbols

$\wedge$, $=$, $\rightarrow$,

oa_1, oa_2, ..., oa_k,

oav_1, oav_2, ..., oav_l,

ua_1, ua_2, ..., ua_m,

uav_1, uav_2, ..., uav_n

II. The non-terminal symbols

ObjAttrValAssgn, UsrAttrValAssgn,
ObjAttrValExpr, UsrAttrValExpr,
ObjAttrValPair, UsrAttrValPair,
ObjAttr, UsrAttr,
UsrAttrValue, ObjAttrValue

III. The start symbol

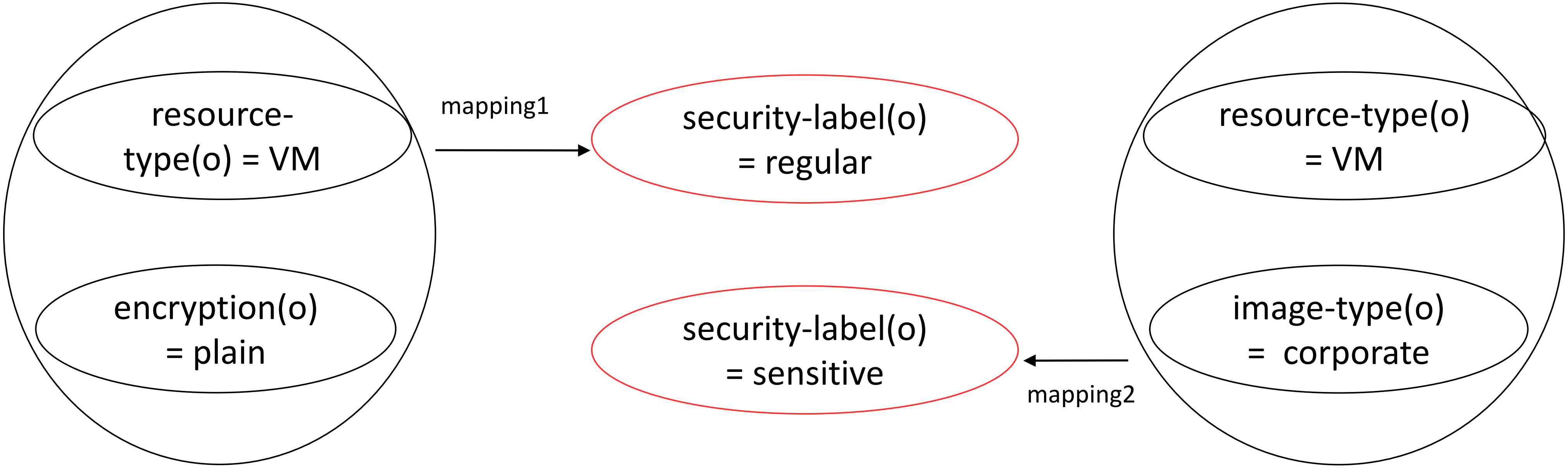
MappingRule

IV. The production rules (in BNF notation)

```
MappingRule::=
        ObjAttrValAssgn → ObjAttrValAssgn |
        UsrAttrValAssgn → UsrAttrValAssgn
ObjAttrValAssgn :: = ObjAttrValExpr
UsrAttrValAssgn :: = UsrAttrValExpr
ObjAttrValExpr ::= ObjAttrValPair |
        ObjAttrValExpr ∧ ObjAttrValExpr
UsrAttrValExpr ::= UsrAttrValPair |
        UsrAttrValExpr ∧ UsrAttrValExpr
ObjAttrValPair ::= ObjAttr = ObjAttrValue
UsrAttrValPair ::= UsrAttr = UsrAttrValue
ObjAttr ::= oa1| oa2|...| oak
ObjAttrValue ::= oav1| oav2|...|oavl
UsrAttr ::= ua1| ua2|...| uam
UsrAttrValue ::= uav1| uav2|...|uavn
```

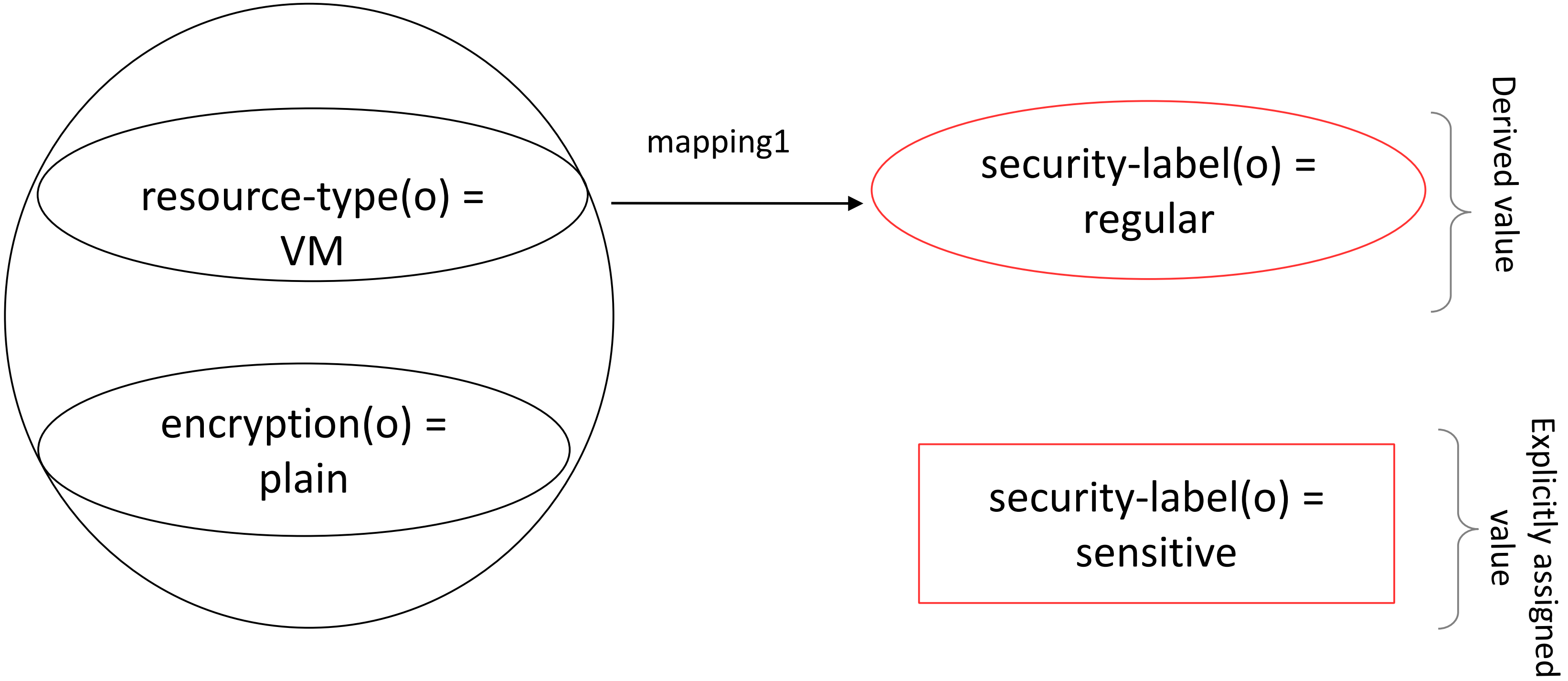
Attribute Reduction (issues)

Conflicts resulting from multiple mappings


resource-type(o) = VM
encryption(o) = plain
mapping1
security-label(o) = regular
security-label(o) = sensitive
mapping2
resource-type(o) = VM
image-type(o) = corporate

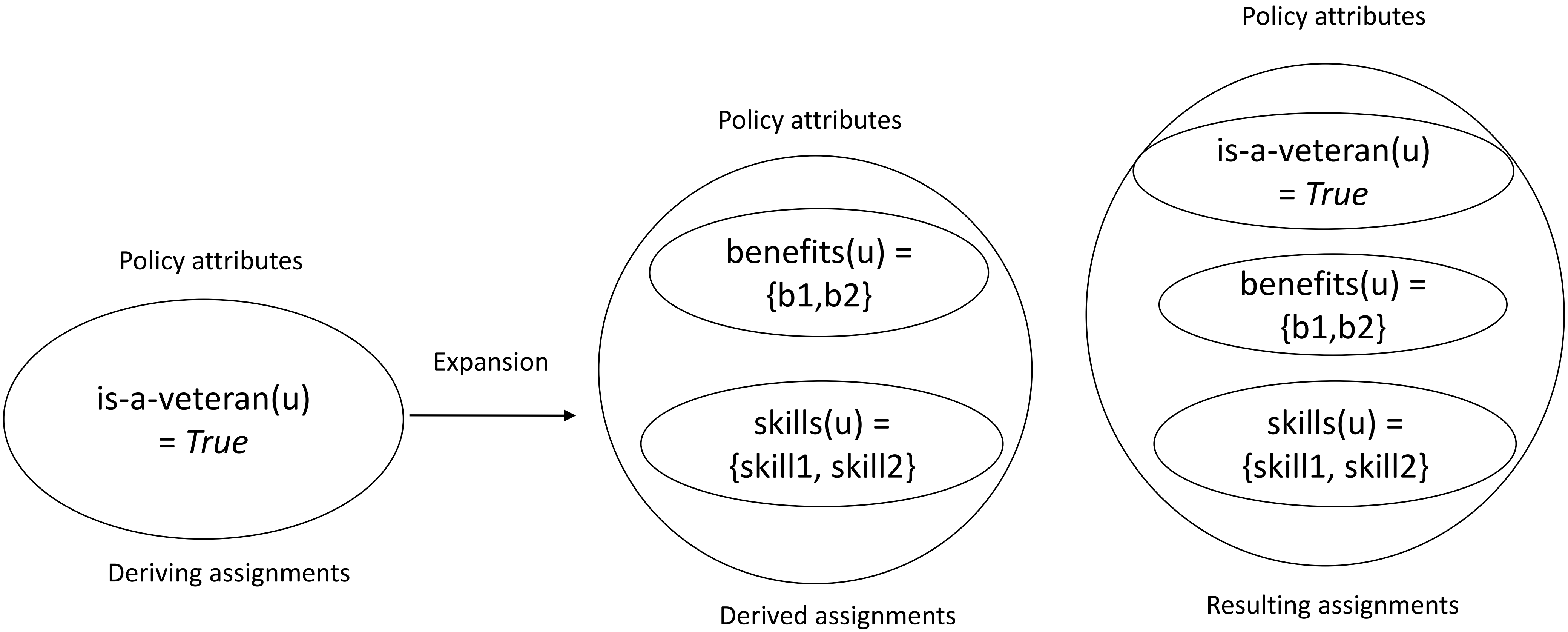
Attribute Reduction (issues)

Conflicts resulting from assigned and derived values


resource-type(o) = VM
encryption(o) = plain
mapping1
security-label(o) = regular
Derived value
security-label(o) = sensitive
Explicitly assigned value

Attribute Expansion

The process of transforming policy-attribute-value assignments into a different set of policy-attributes-value assignments.



Attribute Expansion (motivation)

Motivation from literature:

1. Hierarchical Group and Attribute-Based Access Control (HGABAC) [3]

Conclusion

What next?

- Other forms of Attribute Transformation
- Chain of Attribute Transformation
- Fitting Attribute Transformation in ABAC models

References

1. Servos, Daniel, and Sylvia L. Osborn. "HGABAC: Towards a formal model of hierarchical attribute-based access control." International Symposium on Foundations and Practice of Security. Springer International Publishing, 2014.

2. Kuhn, D. Richard, Edward J. Coyne, and Timothy R. Weil. "Adding attributes to role-based access control." Computer 43.6 (2010): 79-81.

3. Servos, Daniel, and Sylvia L. Osborn. "HGABAC: Towards a formal model of hierarchical attribute-based access control." International Symposium on Foundations and Practice of Security. Springer International Publishing, 2014.