INFS 767 Fall 2000

Lecture 3
Administrative RBAC
ARBAC97

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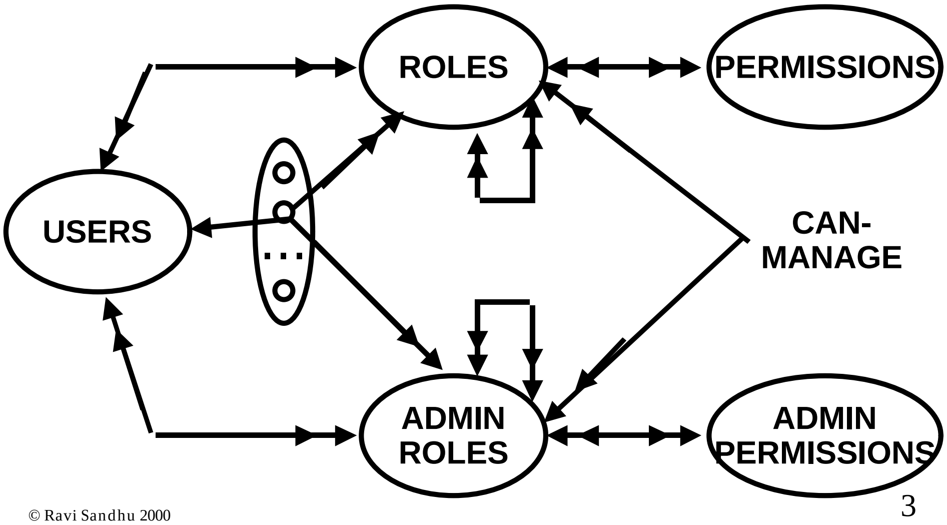
SCALE AND RATE OF CHANGE

- **roles: 100s or 1000s**
- **users: 1000s or 10,000s or more**
- **Frequent changes to**
  - **user-role assignment**
  - **permission-role assignment**
- **Less frequent changes for**
  - **role hierarchy**

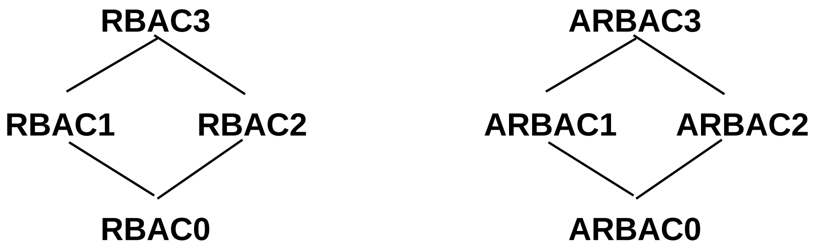
ADMINISTRATIVE RBAC



ARBAC97 DECENTRALIZES

- user-role assignment (URA97)
- permission-role assignment (PRA97)
- role-role hierarchy
  - groups or user-only roles (extend URA97)
  - abilities or permission-only roles (extend PRA97)
  - UP-roles or user-and-permission roles (RRA97)

ADMINISTRATIVE RBAC



RBAC3

RBAC1 RBAC2

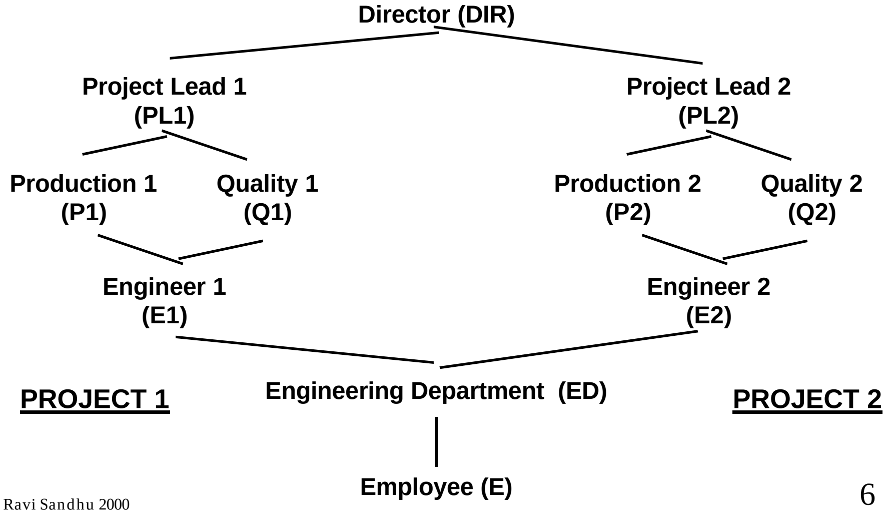
RBAC0

ARBAC3

ARBAC1 ARBAC2

ARBAC0

EXAMPLE ROLE HIERARCHY



Director (DIR)

Project Lead 1 (PL1)

Project Lead 2 (PL2)

Production 1 (P1)

Quality 1 (Q1)

Production 2 (P2)

Quality 2 (Q2)

Engineer 1 (E1)

Engineer 2 (E2)

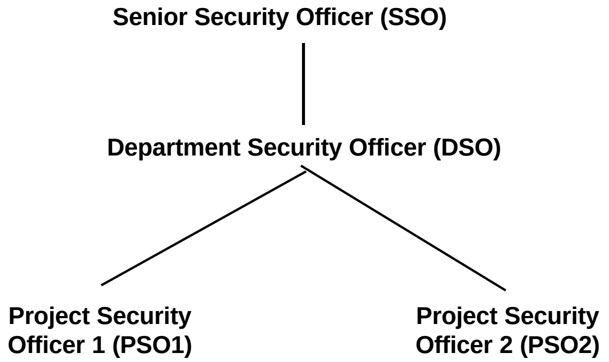
PROJECT 1

Engineering Department (ED)

PROJECT 2

Employee (E)

EXAMPLE ADMINISTRATIVE ROLE HIERARCHY


Senior Security Officer (SSO)
Department Security Officer (DSO)
Project Security Officer 1 (PSO1)
Project Security Officer 2 (PSO2)

URA97 GRANT MODEL: can-assign

ARole	Prereq Role	Role Range
PSO1	ED	[E1,PL1)
PSO2	ED	[E2,PL2)
DSO	ED	(ED,DIR)
SSO	E	[ED,ED]
SSO	ED	(ED,DIR]

URA97 GRANT MODEL : can-assign

ARole	Prereq Cond	Role Range
PSO1	ED	[E1,E1]
PSO1	ED & ¬ P1	[Q1,Q1]
PSO1	ED & ¬ Q1	[P1,P1]
PSO2	ED	[E2,E2]
PSO2	ED & ¬ P2	[Q2,Q2]
PSO2	ED & ¬ Q2	[P2,P2]

URA97 GRANT MODEL

- **“redundant” assignments to senior and junior roles**
  - **are allowed**
  - **are useful**

URA97 REVOKE MODEL

- ◆ **WEAK REVOCATION**
  - ● **revokes explicit membership in a role**
  - ● **independent of who did the assignment**

URA97 REVOKE MODEL

- ◆ **STRONG REVOCATION**
  - ● **revokes explicit membership in a role <u>and</u> its seniors**
  - ● **authorized only if corresponding weak revokes are authorized**
  - ● **alternatives**
    - ■ **all-or-nothing**
    - ■ **revoke within range**

URA97 REVOKE MODEL : can-revoke

ARole	Role Range
PSO1	[E1,PL1)
PSO2	[E2,PL2)
DSO	(ED,DIR)
SSO	[ED,DIR]

PERMISSION-ROLE ASSIGNMENT

- **dual of user-role assignment**
- **can-assign-permission**
  can-revoke-permission
- **weak revoke**
  strong revoke (propagates down)

PERMISSION-ROLE ASSIGNMENT CAN-ASSIGN-PERMISSION

ARole	Prereq Cond	Role Range
PSO1	PL1	[E1,PL1)
PSO2	PL2	[E2,PL2)
DSO	E1 $\vee$ E2	[ED,ED]
SSO	PL1 $\vee$ PL2	[ED,ED]
SSO	ED	[E,E]

PERMISSION-ROLE ASSIGNMENT CAN-REVOKE-PERMISSION

ARole	Role Range
PSO1	[E1,PL1]
PSO2	[E2,PL2]
DSO	(ED,DIR)
SSO	[ED,DIR]

ARBAC97 DECENTRALIZES

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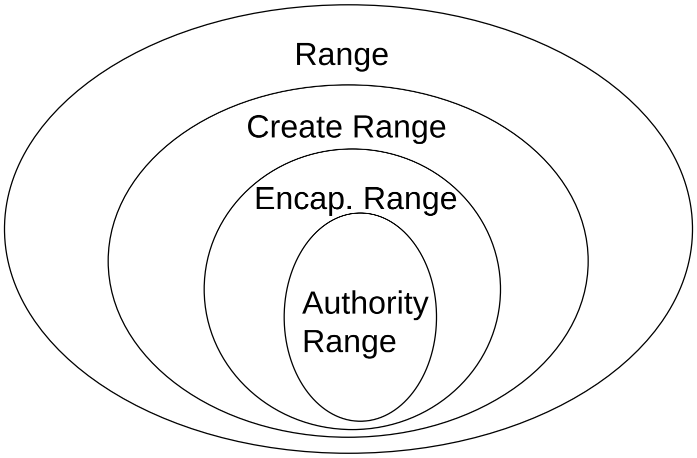
Range Definitions



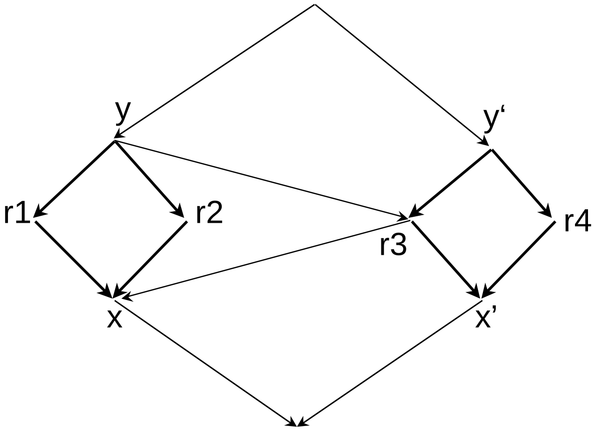
Authority Range

- **Range:**
  - **$(x, y) = \{r : Roles \mid x < r < y\}$**
- **Authority Range:**
  - **A range referenced in *can-modify* relation**
- **Partial Overlap of Ranges:**
  - **The ranges Y and Y' partially overlap if**
    - **$Y \cap Y' \neq \phi$ and**
    - **$Y \not\subset Y' \wedge Y' \not\subset Y$**
- **Partial Overlap of Authority Ranges is forbidden**

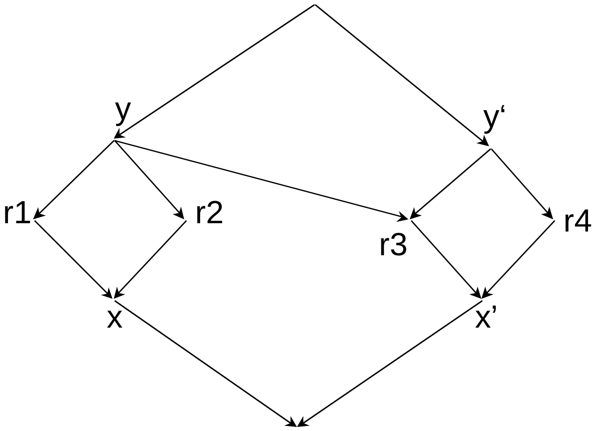
Authority Range

- **Encapsulated Authority Range:**
  - **The authority range (x, y) is said to be encapsulated if**
    - **$\forall r1 \in (x, y)$ and $\forall r2 \notin (x, y)$**
      - $r2 > r1 \Leftrightarrow r2 > y \wedge$
      - $r2 < r1 \Leftrightarrow r2 < x$

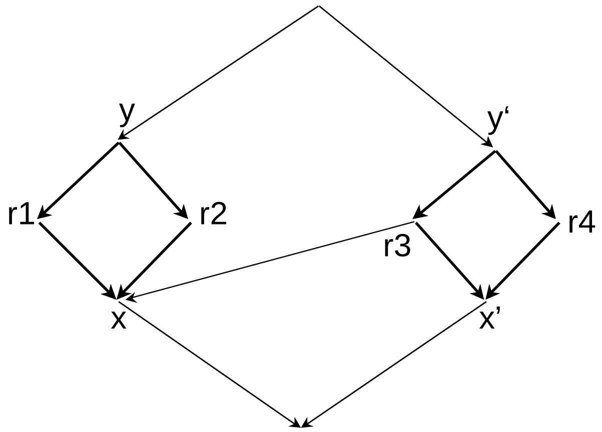
Non-encapsulated Range (x, y)



Encapsulated Range (x, y)



Encapsulated Range (x, y)



ROLE CREATION

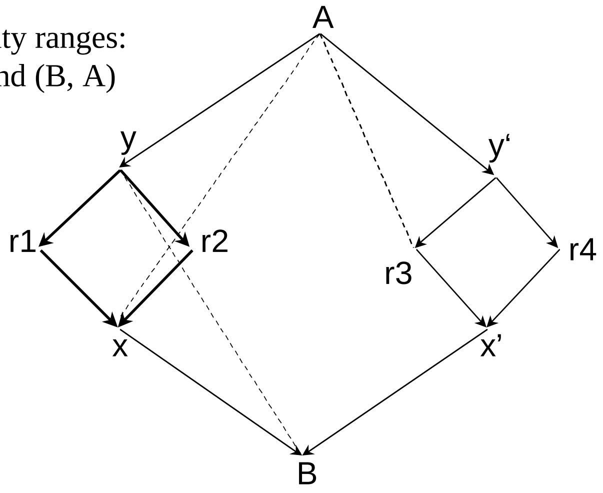
- **New roles are created one at a time**
- **Creation of a role requires specification of immediate parent and child**
  - **immediate parent and child must be a create range**

Role Creation

- **Create Range:**
  - **The range (x, y) is a create range if**
    - **(a) $AR_{immediate}(x) = AR_{immediate}(y)$** $\vee$
    - **(b) x = End point of $AR_{immediate}(y)$** $\vee$
    - **(c) y = End point of $AR_{immediate}(x)$**
  - **Note: only comparable roles constitute a create range.**

Create Range

Authority ranges:
(x, y) and (B, A)



Role Deletion

- Roles in the authority range can be deleted by administrator of that range.
- End points of authority ranges cannot be deleted.

Inactive Roles

- End points of authority ranges can be made inactive.
- Inactive Roles:
  - A user associated to it cannot use it.
  - Inheritance of permissions is not affected.
  - Permissions and users can be revoked.

Other Restrictions on deletion of roles

- Roles can be deleted only when they are empty.
- Delete the role and at the same time:
  - assign permissions to immediate senior roles.
  - Assign the users to immediate junior roles.

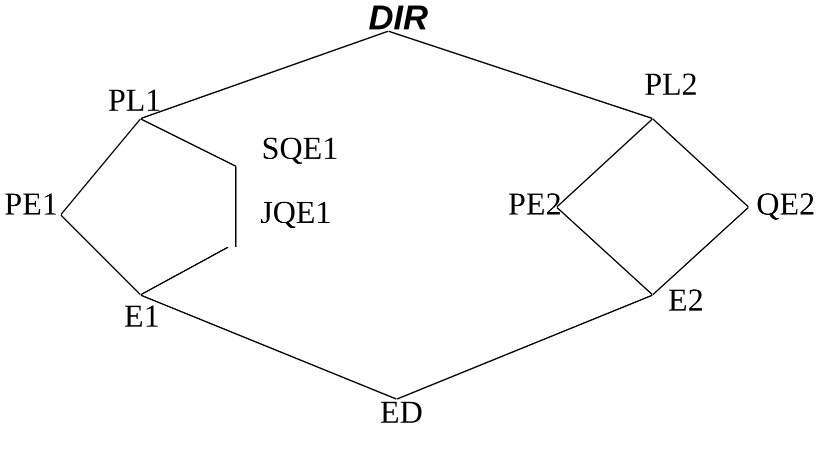
INSERTION OF AN EDGE

- Inserted only between incomparable roles (No Cycles)
- Inserted one at a time.
- The edge AB is inserted if
  - (a) $AR_{immediate}(A) = AR_{immediate}(B)$ and
  - (b) For a junior authority range (x, y):
    - $(A = y \wedge B > x)$ or $(B = x \wedge A < y)$ must ensure encapsulation of (x, y).

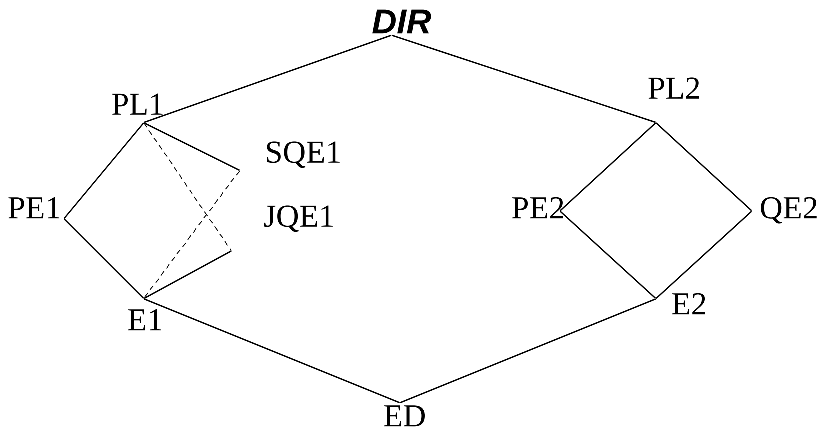
DELETION OF AN EDGE

- Deleted one at a time.
- The edges in transitive reduction are candidates for deletion.
- Edges connecting the end points of an authority range cannot be deleted.
- Implied edges are not deleted

Example : Before deletion (SQE1, JQE1)



Example : After deletion (SQE1, JQE1)



Conclusion

- RRA97 completes ARBAC97
- RRA97 provides decentralized administration of role hierarchies.
- Gives administrative role autonomy within a range but only so far as the side effects of the resulting actions are acceptable.