Chapter 7: Hybrid Policies

- Overview
- Chinese Wall Model
- ORCON (ORiginator CONtrolled Access Control)
- RBAC (Role Based Access Control)

Overview

- Chinese Wall Model
  - Focuses on conflict of interest
- ORCON (ORiginator CONtrolled Access Control)
  - Combines mandatory, discretionary access controls
- RBAC (Role Based Access Control)
  - Base controls on job function

Chinese Wall Model

Problem:

- Tony advises American Bank about investments
- He is asked to advise Toyland Bank about investments

- *Conflict of interest* (COI) to accept, because his advice for either bank would affect his advice to the other bank

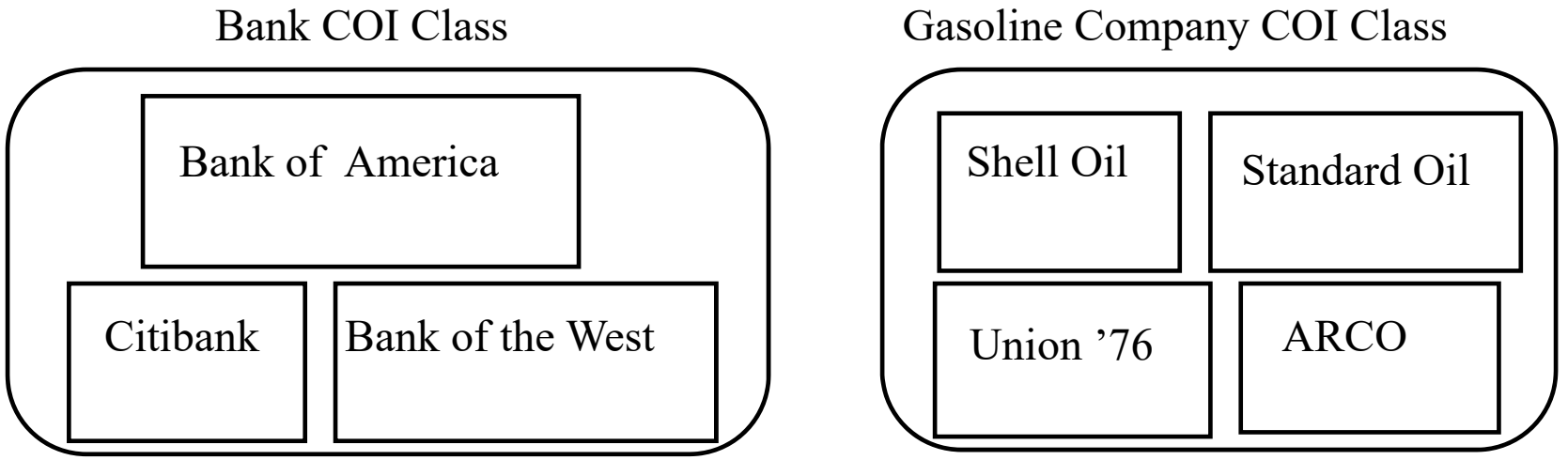
Organization

- Organize entities into “conflict of interest” classes
- Control subject accesses to each class
- Control writing to all classes to ensure information is not passed along in violation of rules
- Allow sanitized data to be viewed by everyone

Definitions

- *Objects*: items of information related to a company
- *Company dataset* (CD): contains objects related to a single company
  - Written *CD*(*O*)
- *Conflict of interest class* (COI): contains datasets of companies in competition
  - Written *COI*(*O*)
  - Assume: each object belongs to exactly one *COI* class

Example


Bank COI Class
Bank of America
Citibank
Bank of the West
Gasoline Company COI Class
Shell Oil
Standard Oil
Union ’76
ARCO

Temporal Element

- If Anthony reads any CD in a COI, he can *never* read another CD in that COI
  - Possible that information learned earlier may allow him to make decisions later
  - Let $PR(S)$ be set of objects that S has already read

CW-Simple Security Condition

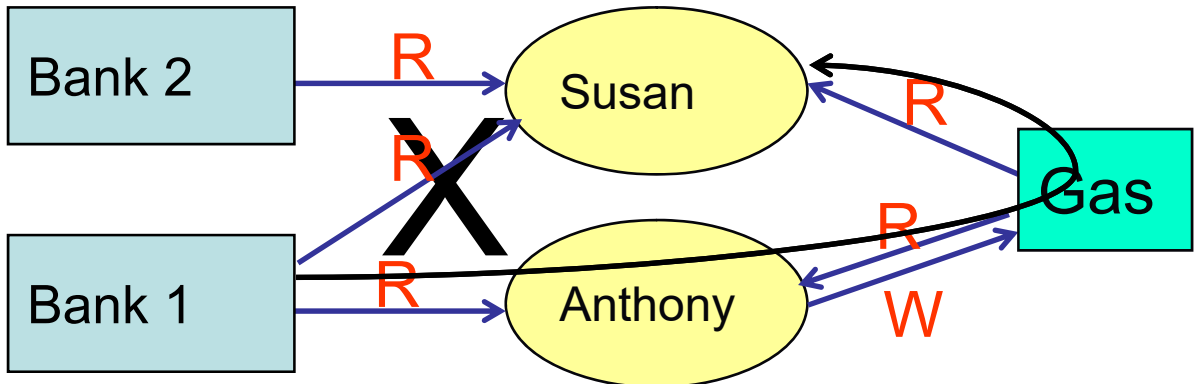
- *s* can read *o* iff either condition holds:
  1. There is an o' such that *s* has accessed o' and $CD(o') = CD(o)$
     - Meaning *s* has read something in *o*'s company dataset
  2. For all $o' \in O$, $o' \in PR(s) \Rightarrow COI(o') \neq COI(o)$
     - Meaning *s* has not read any objects in *o*'s conflict of interest class
- Ignores sanitized data (see below)
- Initially, $PR(s) = \varnothing$, so initial read request granted

Sanitization

- Public information may belong to a CD
  - As is publicly available, no conflicts of interest arise
  - So, should not affect ability of analysts to read
  - Typically, all sensitive data removed from such information before it is released publicly (called *sanitization*)
- Add third condition to CW-Simple Security Condition:
  3. *o* is a sanitized object

Writing

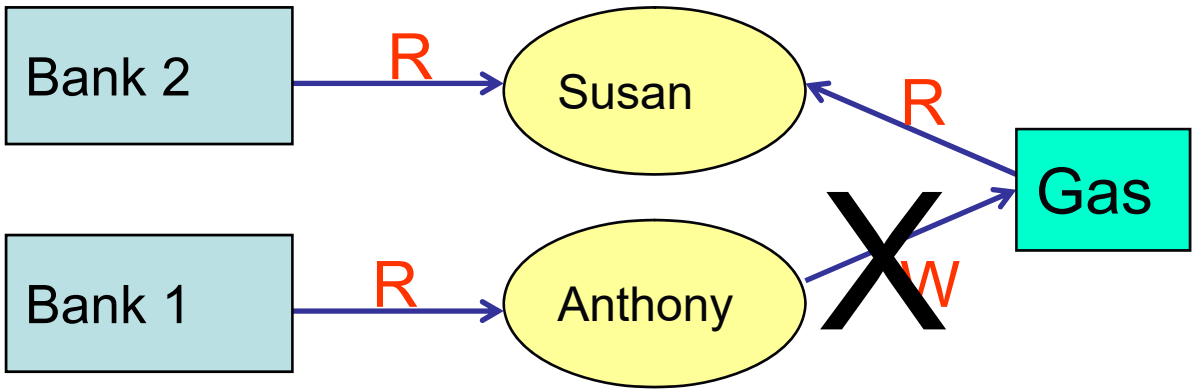
- Anthony, Susan work in same trading house
- Anthony can read Bank 1's CD, Gas' CD
- Susan can read Bank 2's CD, Gas' CD
- If Anthony could write to Gas' CD, Susan can read it
  - Hence, indirectly, she can read information from Bank 1's CD, a clear conflict of interest



CW-*-Property

- *s* can write to *o* iff both of the following hold:
  1. The CW-simple security condition permits *s* to read *o*; and
  2. For all *unsanitized* objects *o′*, if *s* can read *o′*, then *CD*(*o′*) = *CD*(*o*)

- Says that s can write to an object if all the (unsanitized) objects it can read are in the same dataset



Compare to Bell-LaPadula

- Fundamentally different
  - CW has no security labels, B-LP does
  - CW has notion of past accesses, B-LP does not
- Bell-LaPadula cannot track changes over time
  - Susan becomes ill, Anna needs to take over
    - C-W history lets Anna know if she can
    - No way for Bell-LaPadula to capture this
- Access constraints change over time
  - Initially, subjects in C-W can read any object
  - Bell-LaPadula constrains set of objects that a subject can access

ORCON

- Problem: organization creating document wants to control its dissemination
  - Example: Secretary of Agriculture writes a memo for distribution to her immediate subordinates, and she must give permission for it to be disseminated further.
  - This is "originator controlled" (here, the "originator" is a person).

Requirements of ORCON

- Subject $s \in S$ marks object $o \in O$ as ORCON on behalf of organization X. X allows o to be disclosed to subjects acting on behalf of organization Y with the following restrictions:
  1. o cannot be released to subjects acting on behalf of other organizations without X's permission; and
  2. Any copies of o must have the same restrictions placed on it.

Combining DAC and MAC to Meet the Above Requirements

- The owner of an object cannot change the access controls of the object.
- When an object is copied, the access control restrictions of that source are copied and bound to the target of the copy.
  - These are MAC (owner can't control them)
- The creator (originator) can alter the access control restrictions on a per-subject and per-object basis.
  - This is DAC (owner can control it)

RBAC (Role-Based Access Control)

- Access depends on function, not identity
  - Example:
    - Allison, bookkeeper for Math Dept, has access to financial records.
    - She leaves.
    - Betty hired as the new bookkeeper, so she now has access to those records
  - The role of "bookkeeper" dictates access, not the identity of the individual.

Definitions

- Role *r*: collection of job functions
  - *trans*(*r*): set of authorized transactions for *r*
- Active role of subject *s*: role *s* is currently in
  - *actr*(*s*)
- Authorized roles of a subject *s*: set of roles *s* is authorized to assume
  - *authr*(*s*)
- *canexec*(*s*, *t*) iff subject *s* can execute transaction *t* at current time

Axioms

- Let S be the set of subjects and T the set of transactions.
- *Rule of role assignment*:
  $$(\forall s \in S)(\forall t \in T)\ [canexec(s, t) \rightarrow actr(s) \neq \varnothing].$$
  - If s can execute a transaction, it has a role
  - This ties transactions to roles
- *Rule of role authorization*:
  $$(\forall s \in S)\ [actr(s) \subseteq authr(s)].$$
  - Subject must be authorized to assume an active role (otherwise, any subject could assume any role)

Axiom

- *Rule of transaction authorization*:

$$(\forall s \in S)(\forall t \in T)$$

$$[canexec(s, t) \rightarrow t \in trans(actr(s))].$$

  – If a subject *s* can execute a transaction, then the transaction is an authorized one for the role *s* has assumed

Containment of Roles

- Trainer can do all transactions that trainee can do (and then some). This means role r contains role r' ($r > r'$). So:

  $$(\forall s \in S)[\ r \in \mathit{authr}(s) \wedge r > r' \rightarrow r' \in \mathit{authr}(s)\ ]$$

- r: trainer
- r' : trainee

Separation of Duty

- Let r be a role, and let s be a subject such that $r \in auth(s)$. Then the predicate $meauth(r)$ (for mutually exclusive authorizations) is the set of roles that s cannot assume because of the separation of duty requirement.
- Separation of duty:

$$(\forall r_1, r_2 \in R)\ [\ r_2 \in meauth(r_1) \rightarrow$$
$$[\ (\forall s \in S)\ [\ r_1 \in authr(s) \rightarrow r_2 \notin authr(s)\ ]\ ]\ ]$$

Role-Based Access Control

- An RBAC system is defined with respect to an organization, such as company, a set of resources, such as documents, print services, and network services, and a set of users, such as employees, suppliers, and customers.

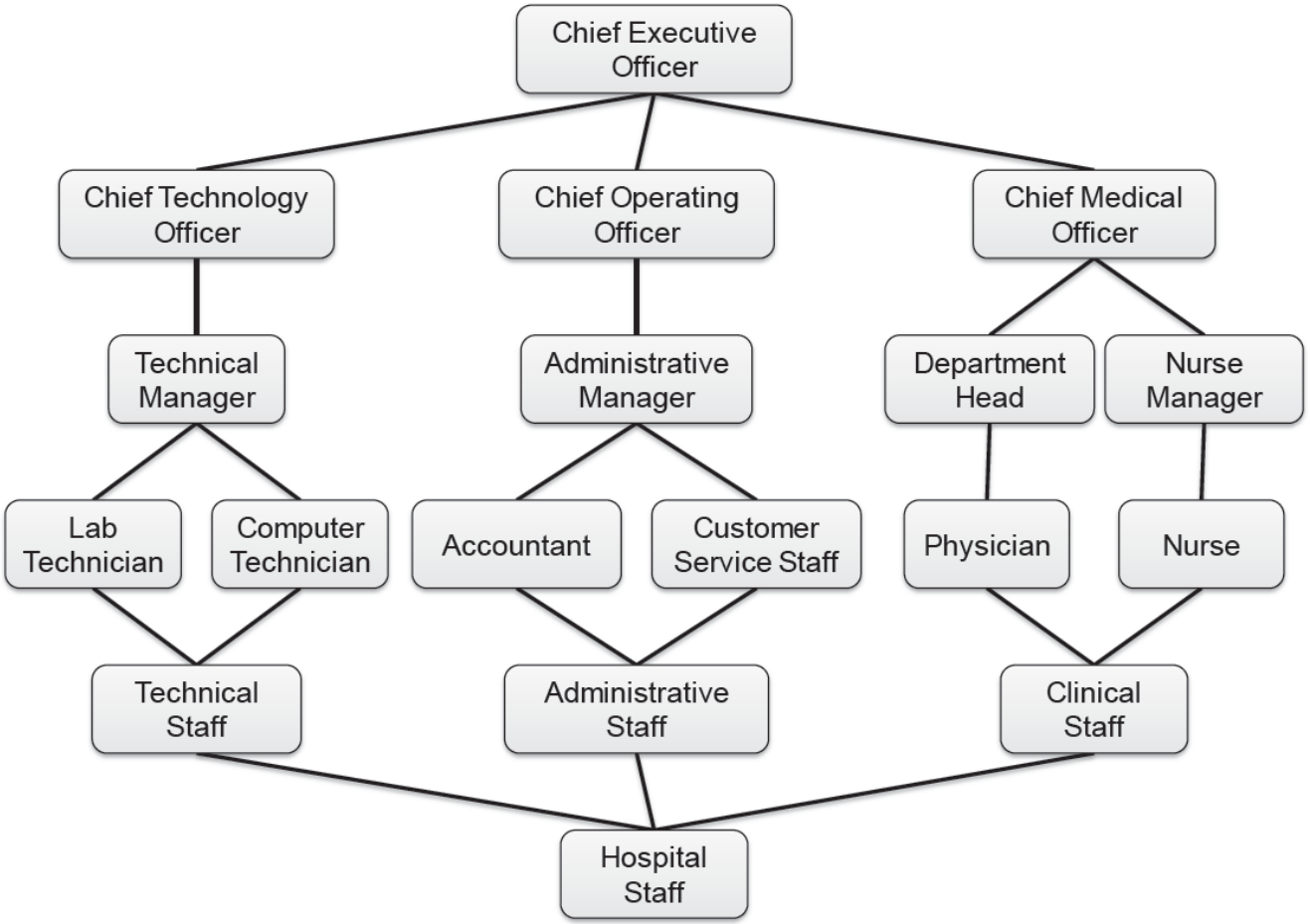
Hierarchical RBAC

- In the role-based access control model, roles can be structured in a hierarchy similar to an organization chart.
- More formally, we define a partial order among roles by saying that a role R1 **inherits role R2,** which is denoted

  $$R1 \geq R2,$$

  if R1 includes all permissions of R2 and R2 includes all users of R1.
- When $R1 \geq R2$, we also say that role R1 is **senior** to role R2 and that role R2 is **junior** to role R1.
  - For example, in a company, the role "manager" inherits the role "employee" and the role "vice president" inherits the role "manager."
  - Also, in a university, the roles "undergraduate student" and "graduate student" inherit the role "student."

Visualizing Role Hierarchy



Key Points

- Hybrid policies deal with both confidentiality and integrity
  - Different combinations of these
- ORCON model neither MAC nor DAC
  - Actually, a combination
- RBAC model controls access based on functionality