ECS 235B Module 34
Policy Composition

Composition of Policies

- Two organizations have two security policies
- They merge
  - How do they combine security policies to create one security policy?
  - Can they create a coherent, consistent security policy?

The Problem

- Single system with 2 users
  - Each has own virtual machine
  - Holly at system high, Lara at system low so they cannot communicate directly
- CPU shared between VMs based on load
  - Forms a *covert channel* through which Holly, Lara can communicate

Example Protocol

- Holly, Lara agree:
  - Begin at noon
  - Lara will sample CPU utilization every minute
  - To send 1 bit, Holly runs program
    - Raises CPU utilization to over 60%
  - To send 0 bit, Holly does not run program
    - CPU utilization will be under 40%
- Not “writing” in traditional sense
  - But information flows from Holly to Lara

Policy vs. Mechanism

- Can be hard to separate these
- In the abstract: CPU forms channel along which information can be transmitted
  - Violates *-property
  - Not “writing” in traditional sense
- Conclusion:
  - Bell-LaPadula model does not give sufficient conditions to prevent communication, *or*
  - System is improperly abstracted; need a better definition of “writing”

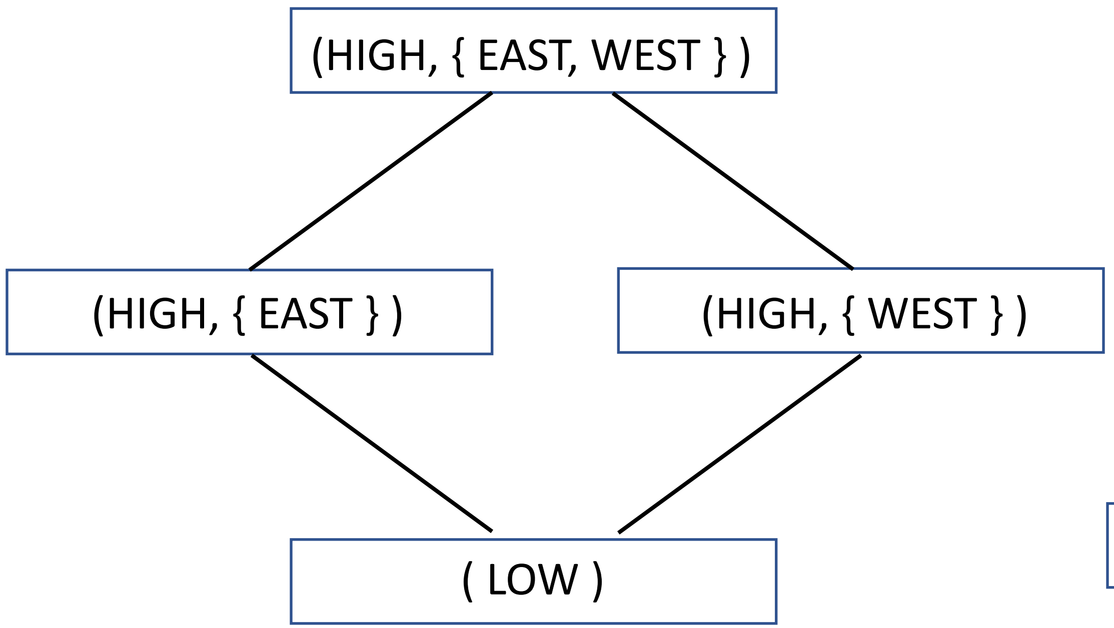
Composition of Bell-LaPadula

- Why?
  - Some standards require secure components to be connected to form secure (distributed, networked) system
- Question
  - Under what conditions is this secure?
- Assumptions
  - Implementation of systems precise with respect to each system's security policy

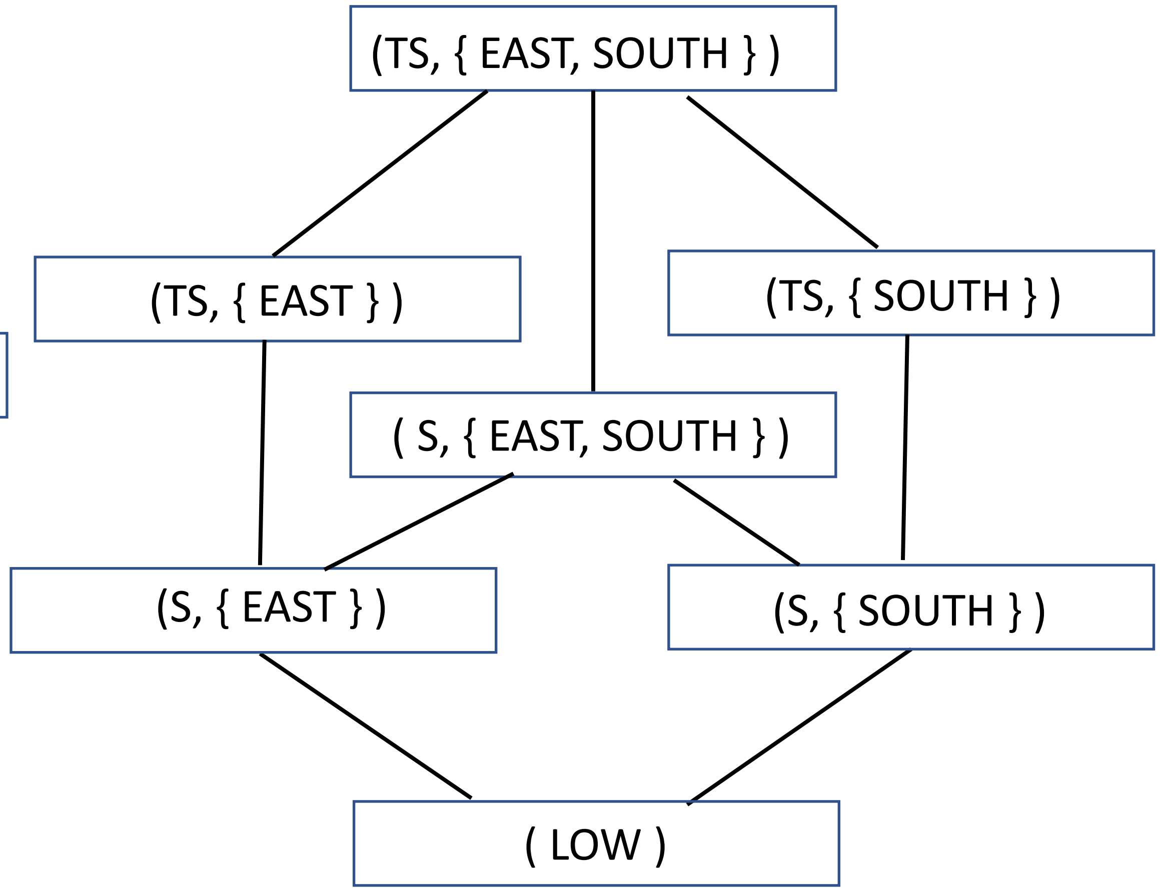
Issues

- Compose the lattices
- What is relationship among labels?
  - If the same, trivial
  - If different, new lattice must reflect the relationships among the levels

Example



(HIGH, { EAST, WEST })
(HIGH, { EAST })
(HIGH, { WEST })
(LOW)



(TS, { EAST, SOUTH })
(TS, { EAST })
(TS, { SOUTH })
(S, { EAST, SOUTH })
(S, { EAST })
(S, { SOUTH })
(LOW)

Analysis

- Assume S < HIGH < TS
- Assume SOUTH, EAST, WEST different
- Resulting lattice has:
  - 4 clearances (LOW < S < HIGH < TS)
  - 3 categories (SOUTH, EAST, WEST)

Same Policies

- If we can change policies that components must meet, composition is trivial (as above)
- If we *cannot*, we must show composition meets the same policy as that of components; this can be very hard

Different Policies

- What does “secure” now mean?
- Which policy (components) dominates?
- Possible principles:
    - Any access allowed by policy of a component must be allowed by composition of components (*autonomy*)
    - Any access forbidden by policy of a component must be forbidden by composition of components (*security*)

Implications

- Composite system satisfies security policy of components as components' policies take precedence
- If something neither allowed nor forbidden by principles, then:
  - Allow it (Gong & Qian)
  - Disallow it (Fail-Safe Defaults)

Example

- System X: Bob can’t access Alice’s files
- System Y: Eve, Lilith can access each other’s files
- Composition policy:
  - Bob can access Eve’s files
  - Lilith can access Alice’s files
- Question: can Bob access Lilith’s files?

Solution (Gong & Qian)

- Notation:
  - (*a*, *b*): *a* can read *b*'s files
  - AS(*x*): access set of system *x*
- Set-up:
  - AS(X) = ∅
  - AS(Y) = { (Eve, Lilith), (Lilith, Eve) }
  - AS(X∪Y) = { (Bob, Eve), (Lilith, Alice), (Eve, Lilith), (Lilith, Eve) }

Solution (Gong & Qian)

- Compute transitive closure of AS($X \cup Y$):
  - AS$(X \cup Y)^+$ = { (Bob, Eve), (Bob, Lilith), (Bob, Alice), (Eve, Lilith), (Eve, Alice), (Lilith, Eve), (Lilith, Alice) }
- Delete accesses conflicting with policies of components:
  - Delete (Bob, Alice)
- (Bob, Lilith) in set, so Bob can access Lilith's files

Idea

- Composition of policies allows accesses not mentioned by original policies
- Generate all possible allowed accesses
  - Computation of transitive closure
- Eliminate forbidden accesses
  - Removal of accesses disallowed by individual access policies
- Everything else is allowed
- Note: determining if access allowed is of polynomial complexity