Foundations of Computer Security
Lecture 17: Non-Interference

Dr. Bill Young
Department of Computer Sciences
University of Texas at Austin
Recall that earlier we said:

*If $S_L$ ever sees varying results depending on varying actions by $S_H$, that can be used to send a bit of information from $S_H$ to $S_L$.*

That applies whether the action by $S_H$ is to write into a file or to modulate some system attribute.

If security demands that $S_H$ must never communicate with $S_L$, there shouldn’t be *anything* that $S_H$ can do that has effects visible to $S_L$.

This observation is the basis of a very general security policy called *Non-Interference*. 
Non-Interference is the best known instance of a class of policies called *information flow* policies.

Rather than constraining subject actions, we specify which subjects are allowed to “interfere with” which other subjects.

You can think of “interfere with” as meaning “do something that has an effect visible to.”
The system *policy* is a reflexive binary relation \((a \mapsto b)\) over the subjects of the system that says which subjects are permitted to "interfere with" which other subjects. For example, given subjects \(S_1\), \(S_2\) and \(S_3\), a potential non-interference policy is:

\[
S_1 \mapsto S_2, S_2 \mapsto S_3,
\]

graphed to the right. Since \(\mapsto\) is reflexive, we don’t bother to specify the additional clauses: \(S_1 \mapsto S_1\), \(S_2 \mapsto S_2\), and \(S_3 \mapsto S_3\).
It is possible to take any MLS policy and turn it into a Non-Interference policy.

A BLP system with subjects:
- A at (Secret: \{Crypto, Nuclear\}),
- B at (Secret: \{Crypto\}), and
- C at (Unclassified: \{\}).

yields the NI policy on the right.

In general, \( S_i \rightarrow S_j \) if the level of \( S_j \) dominates the level of \( S_i \). Think about why that’s so.
It is *not* true that any Non-interference policy can be reformulated into an MLS policy.

For example, the NI policy on the right is not transitive, since there is no arrow from $S_1$ to $S_3$. All MLS policies are transitive by definition.

*Would anyone ever want a non-transitive policy?*
Non-Transitive Policies

Consider, a firewall system that mediates all traffic from the Internet into your LAN.

The appropriate policy is:

\[
\text{INTERNET} \rightarrow \text{Firewall} \\
\text{Firewall} \rightarrow \text{LAN}
\]

We explicitly don’t want a channel from the Internet directly into the LAN. But there’s no way in MLS to specify this policy.
Non-interference is an *information flow* policy, meaning that it specifies the security of the system by stating which flows are allowed.

The policy is specified by a reflexive relation over the subjects of the system stating which can “interfere” with which others.

NI is very general. Any MLS policy can be rewritten as an NI policy, but not vice versa.

**Next lecture:** Non-Interference II