Foundations of Computer Security

Lecture 13: Covert Channels I

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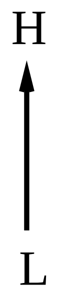
Is BLP Secure?



Consider the simple lattice of labels in the diagram, where $H > L$. There are no need-to-know categories in this system.

If this represents a BLP lattice, then information flow is permitted from L to H, but not vice versa. This captures the metapolicy of this simple system.

If we can instantiate this system such that BLP is satisfied, but information flows in violation of the metapolicy, something is clearly wrong.

A Simple BLP System

Consider a simple system that has READ and WRITE operations with the following semantics:

READ (S, O): if object O exists and $L_S \geq L_O$, then return its current value; otherwise, return a zero.

WRITE (S, O, V): if object exists O and $L_S \leq L_O$, change its value to V; otherwise, do nothing.

These operations pretty clearly are acceptable instances of READ and WRITE for a BLP system.

A BLP System (Cont.)

Suppose we want to add two new operations, CREATE and DESTROY to the system, with the following semantics:

CREATE (S, O): if no object with name O exists anywhere on the system, create a new object O at level L_S; otherwise, do nothing.

DESTROY (S, O): if an object with name O exists and the $L_S \leq L_O$, destroy it; otherwise, do nothing.

These operations seem to satisfy the BLP rules, but are they "secure" from the standard of the metapolicy? Why or why not?

Covert Channel Example

In this system, a high level subject S_H can signal one bit of information to a low level subject S_L as follows:

S_H **Transmits 0**	S_H **Transmits 1**
Create (S_H, F0)	*do nothing*
Create (S_L, F0)	Create (S_L, F0)
Write (S_L, F0, 1)	Write (S_L, F0, 1)
Read (S_L, F0)	Read (S_L, F0)
Destroy (S_L, F0)	Destroy (S_L, F0)

In the first case, S_L sees a value of 0; in the second case, S_L sees a value of 1. Thus, S_H can signal one bit of information to S_L by varying its behavior.

So What?

Who cares if one bit flows from high to low?

- It's enough to show that BLP cannot *guarantee* that the metapolicy is satisfied.
- If S_L and S_H can coordinate their activities, S_H can transfer arbitrary amounts of information to S_L, given enough time.

In an access control policy like BLP, objects are the *only* entities recognized to carry information.

For the channel above, the "information" is not in the contents of any object. It's in the answer to the question: *can* S_L *read an object named O?*

Covert Channels

If S_L *ever* sees varying results depending on varying actions by S_H, that could be used to send a bit of information from S_H to S_L, in violation of the metapolicy.

Such a mechanism is called a *covert channel*.

Lessons

- An access control policy constrains information flowing by subjects reading or writing objects.
- There may be other system features that could be manipulated to convey information.
- Such channels are called "covert channels."

Next lecture: Covert Channels II