

Security Principles

CS 161: Computer Security

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<http://inst.eecs.berkeley.edu/~cs161/>

January 19, 2017



TL-15



TL-30



TRTL-30



TXTL-60

“Security is economics.”



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Save...

Disagree

Agree

uTorrent

2 items



uTorrent



Applications

LIGHT. LIMITLESS. ENGINEERED FOR
POWERFUL DOWNLOADING.

μTorrent

Add Add URL Add Feed Start Stop Remove Upgrade Now Search piracy

TORRENTS

- All
- Downloading
- Completed
- Active
- Inactive

LABELS

- No Label

FEEDS

- All Feeds

Advertisement

Name	#	Size	Done	Status	Seeds	Peers	↓ Speed	↑ Speed	ETA	Uploaded

General Trackers Files Peers Speed

Downloaded:
Availability:

TRANSFER

Time Elapsed:	Remaining:	Wasted:
Downloaded:	Uploaded:	Seeds:
Download Speed:	Upload Speed:	Peers:
Down Limit:	Up Limit:	Share Ratio:
Status:		

GENERAL

Save As:	Pieces:
Total Size:	
Created On:	
Hash:	
Comment:	

↓ 0.0 kB/s ↑ 0.0 kB/s 0.000



What is this program *able* to do?

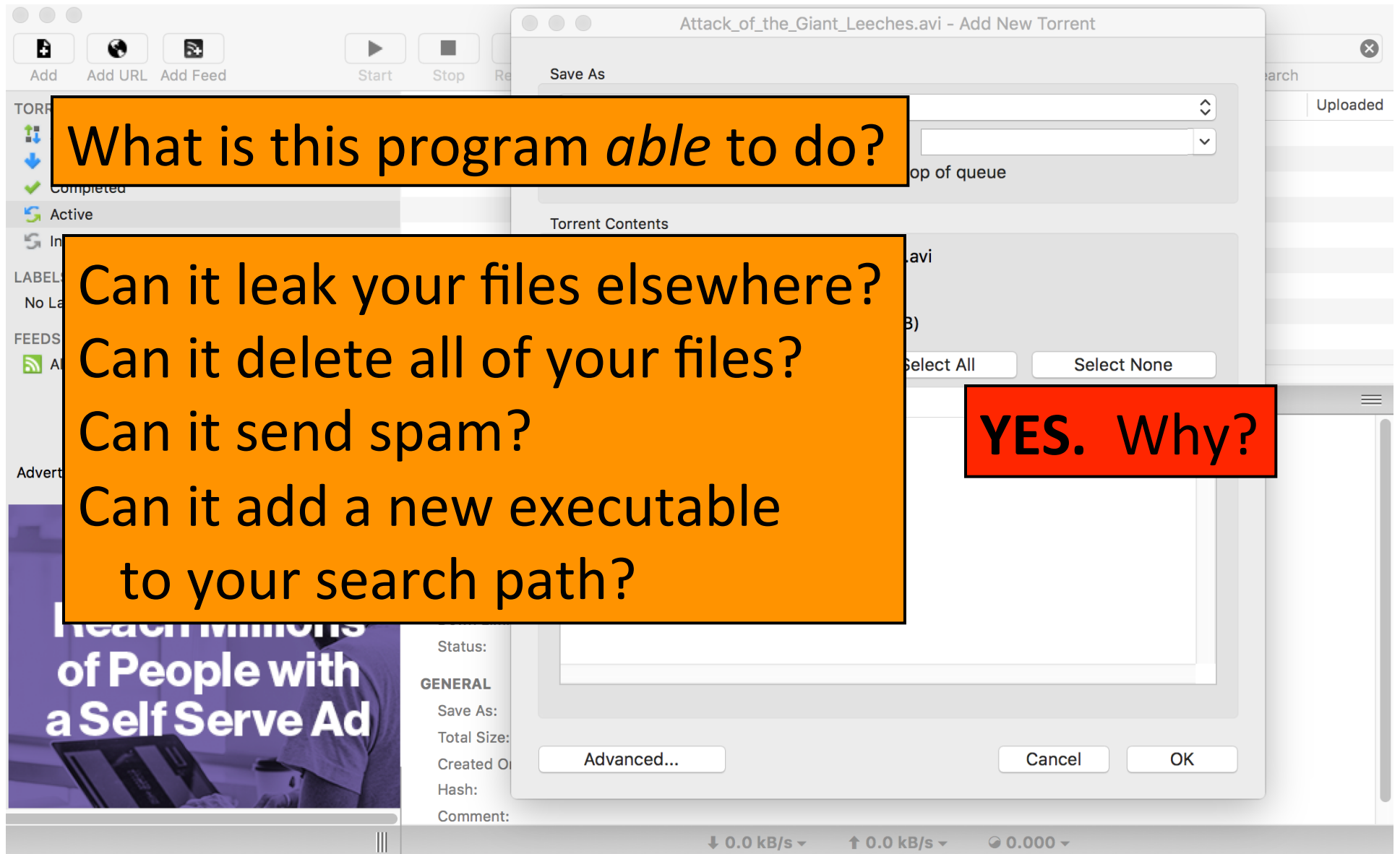
Can it leak your files elsewhere?

Can it delete all of your files?

Can it send spam?

Can it add a new executable
to your search path?

YES. Why?





What does this program *need* to be able to do?

Maybe:

- access screen

- manage a directory of downloaded files

- access config & documentation files

- open connections for a given set of protocols

- receive connections as a server

“Least privilege.”

Check for Understanding

- We've seen that laptop/desktop platforms grant applications a lot of privileges
- Quiz: Name a platform that does a better job of least privilege

**Allow “Adult Cat Finder” to
access your location while
you use the app?**

We use your location to find nearby
adorable cats.

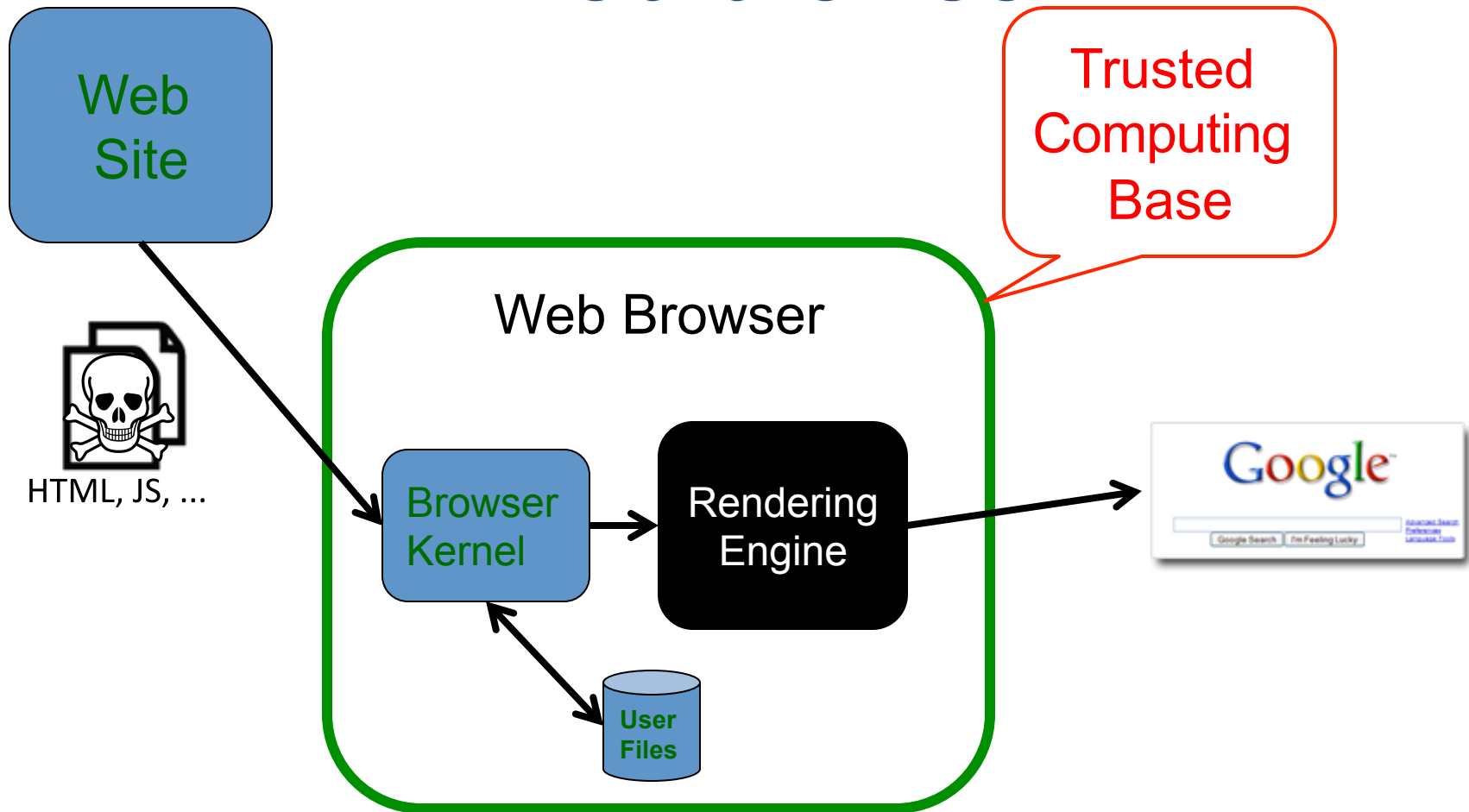
Don't Allow

Allow

Thinking About *Least Privilege*

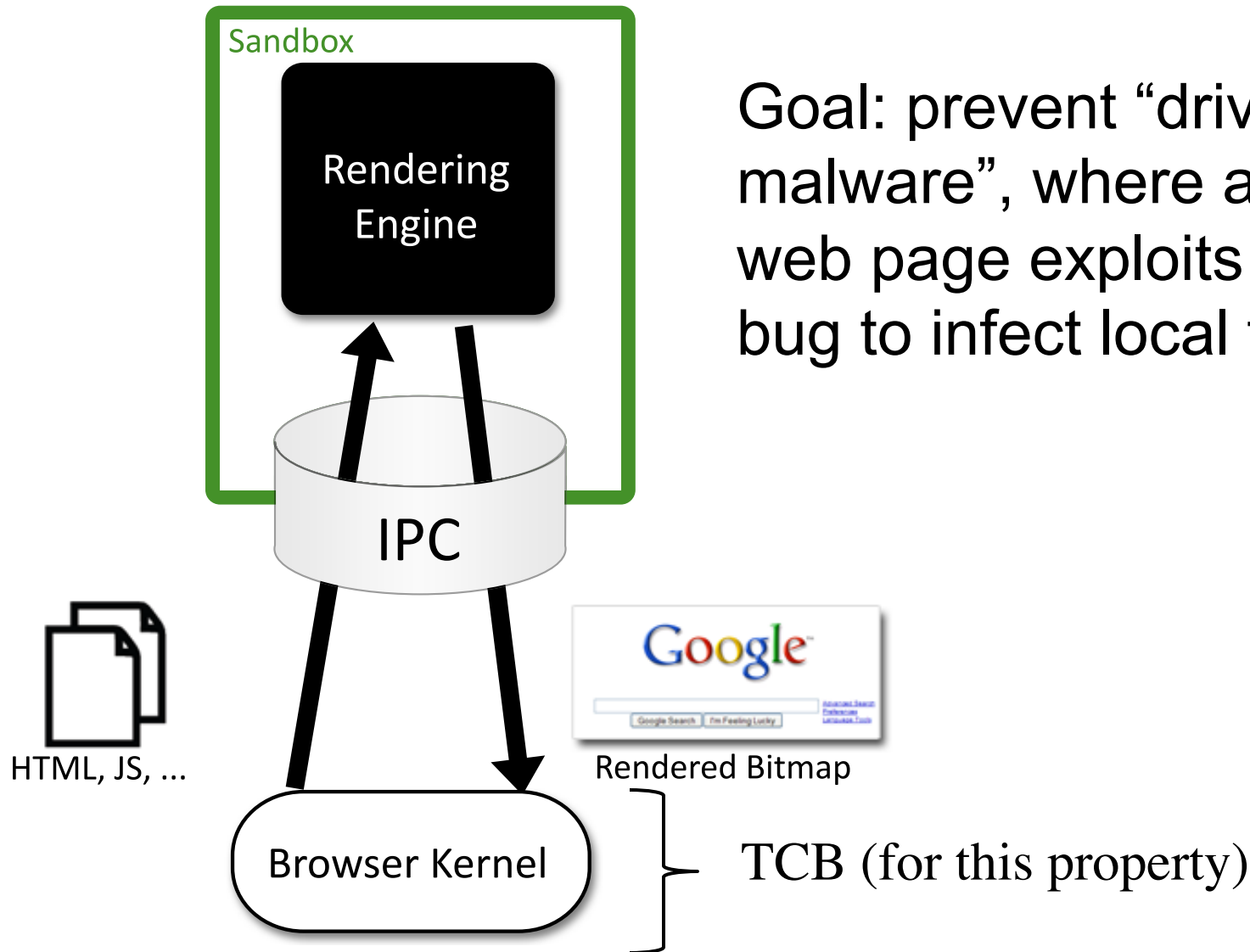
- When assessing the security of a system's design, identify the *Trusted Computing Base* (TCB).
 - What components does security **rely upon**?
- Security requires that the TCB:
 - Is **correct**
 - Is **complete** (can't be bypassed)
 - Is itself **secure** (can't be tampered with)
- Best way to be assured of correctness and its security?
 - **KISS** = *Keep It Simple, Stupid!*
 - Generally, **Simple** = **Small**
- One powerful design approach: **privilege separation**
 - **Isolate** privileged operations to as small a component as possible

Web browser



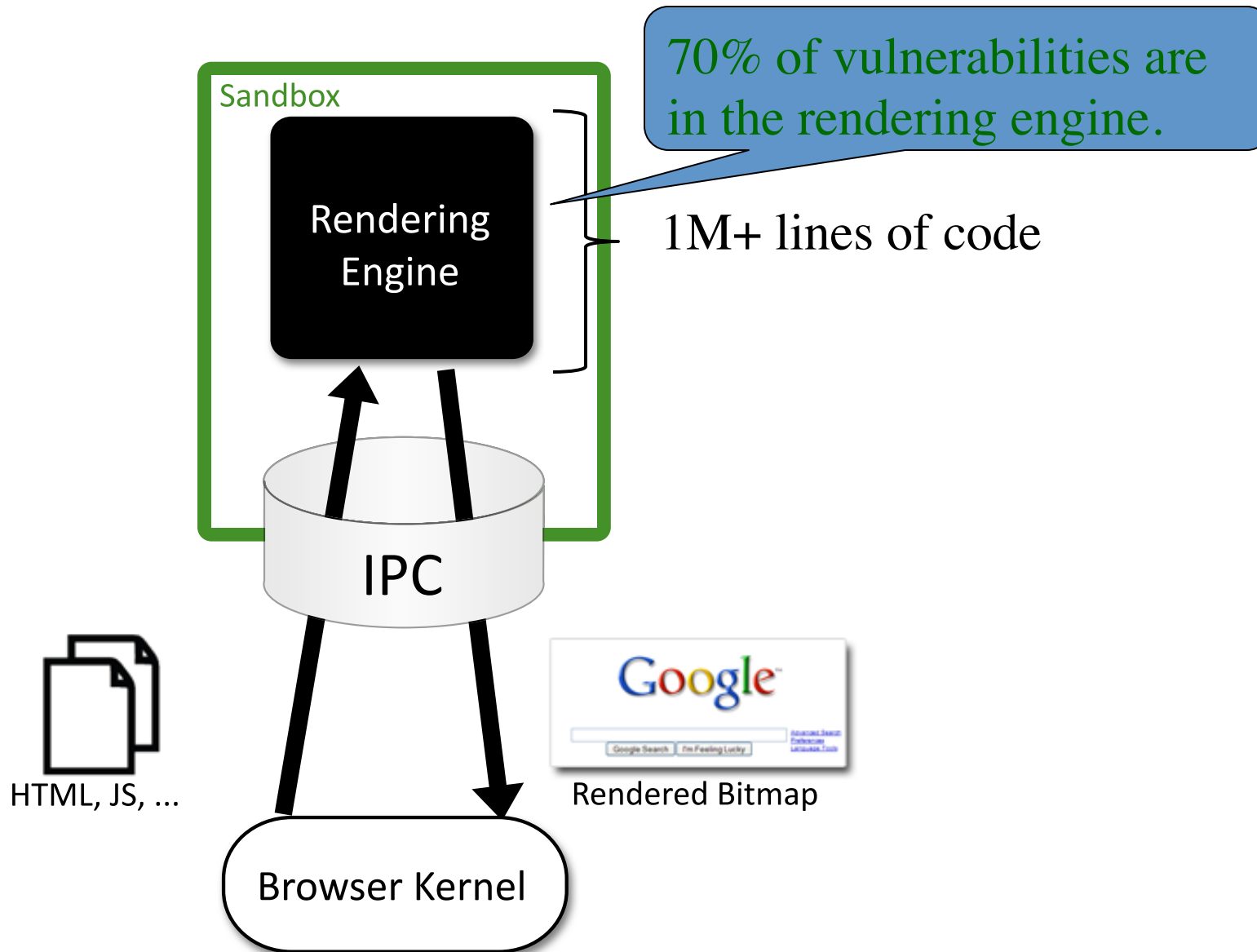
“Drive-by malware”: malicious web page exploits browser bug to infect local files

The Chrome browser



Goal: prevent “drive-by malware”, where a malicious web page exploits a browser bug to infect local files

The Chrome browser





“Ensure complete mediation.”

For every requested action,
check *authenticity, integrity,*
authorization


Ensuring Complete Mediation

- To secure access to some capability/resource, construct a *reference monitor*
- Single point through which all access must occur
 - E.g.: a network firewall
- Desired properties:
 - **Un-bypassable** (“complete mediation”)
 - **Tamper-proof** (is itself secure)
 - **Verifiable** (correct)
 - (Note, just restatements of what we want for TCBs)
- One subtle form of reference monitor flaw concerns *race conditions* ...

TOCTTOU Vulnerability

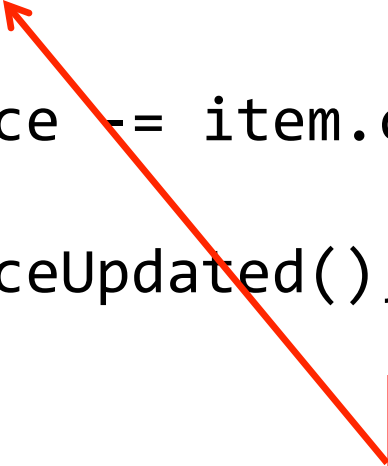
```
procedure withdrawal(w)
  // contact central server to get balance
  1. let b := balance
  2. if b < w, abort
  // contact server to set balance
  3. set balance := b - w
  4. dispense $w to user
```

Suppose that *here* an attacker arranges to suspend first call, and calls `withdrawal` again **concurrently**



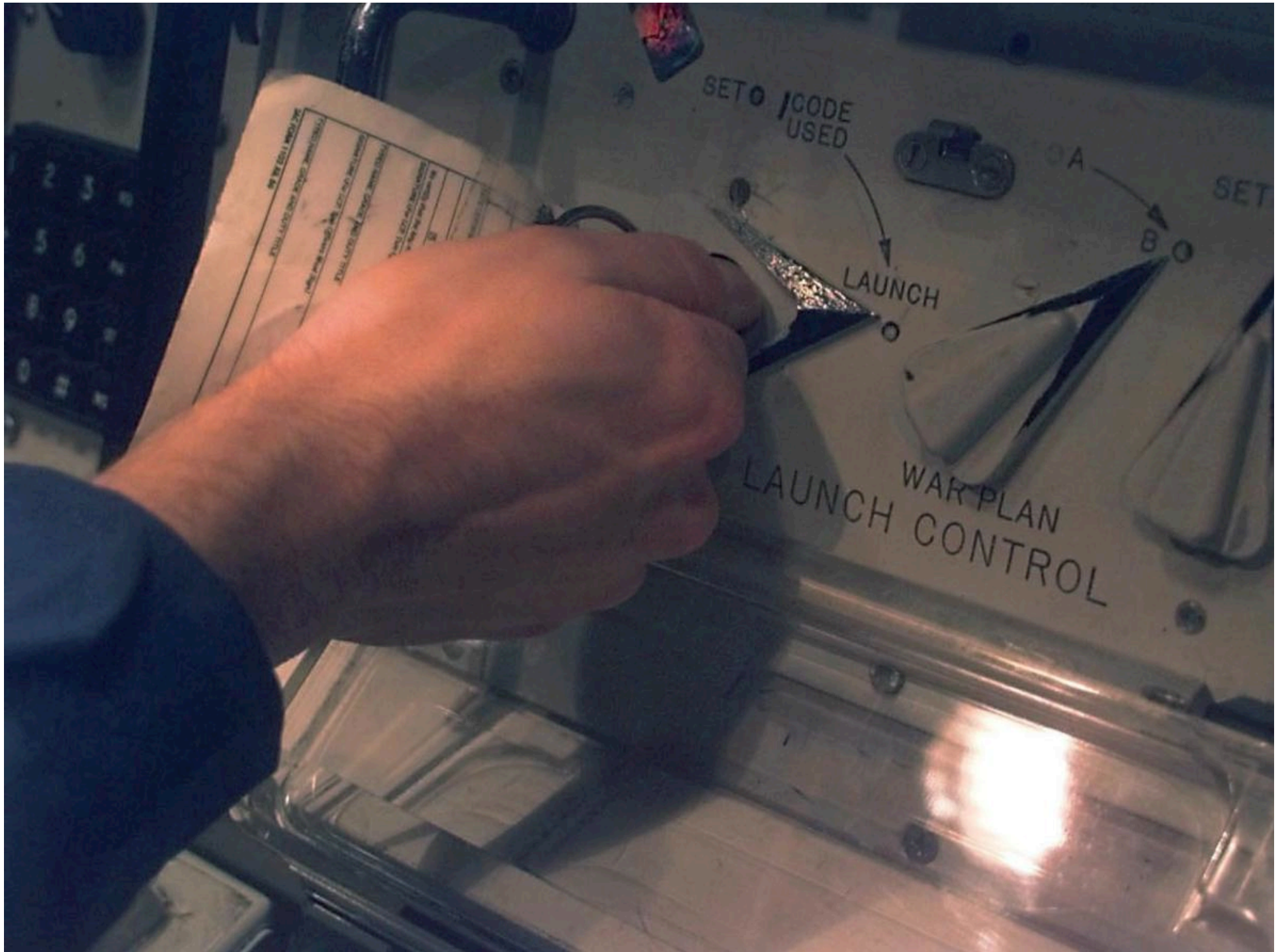
TOCTTOU = Time of Check To Time of Use

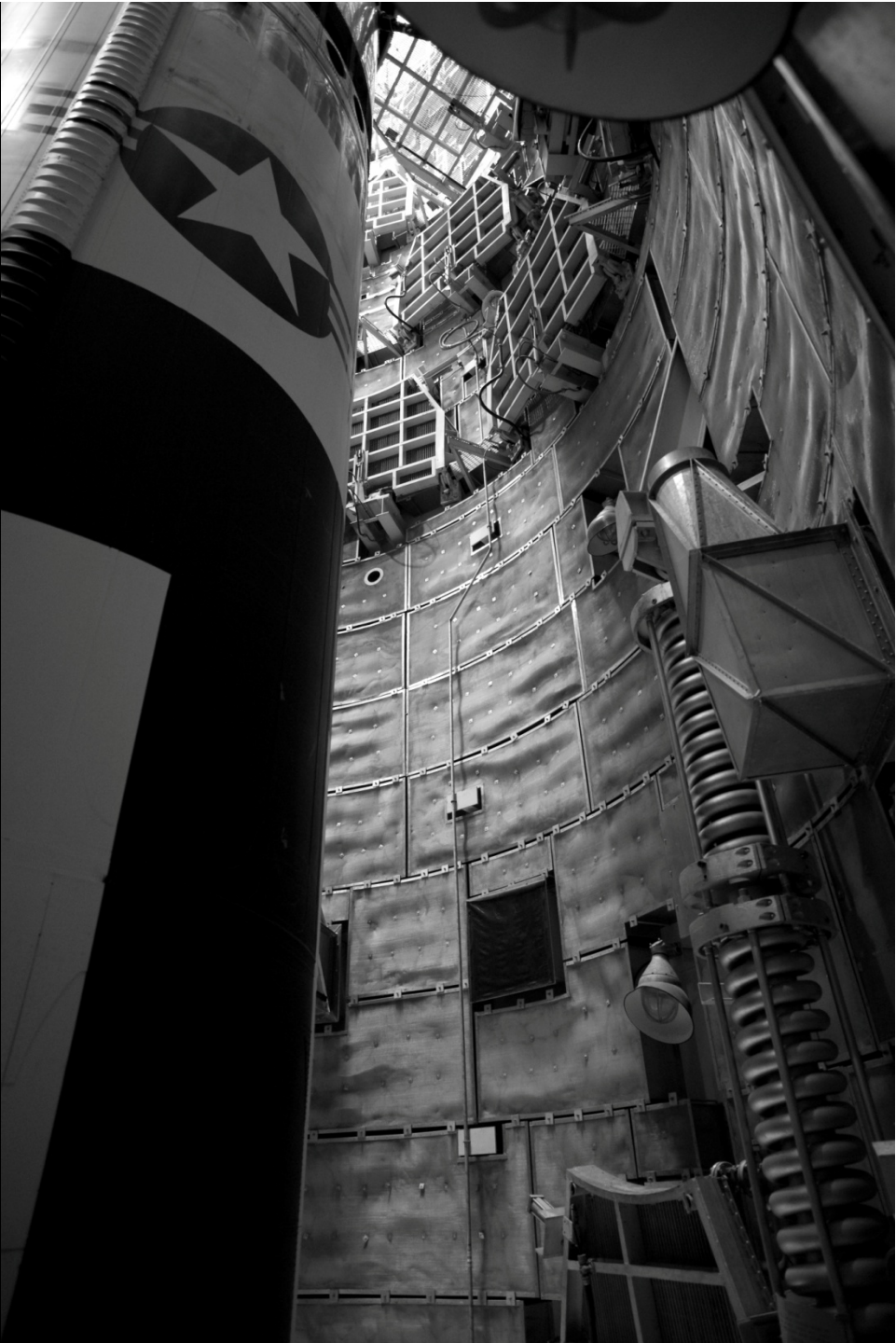
```
public void buyItem(Account buyer, Item item) {  
  
    if (item.cost > buyer.balance)  
        return; /* they can't afford it */  
  
    buyer.possessions.put(item); /* provide item */  
  
    buyer.possessionsUpdated(); /* freshen screen */  
  
    buyer.balance -= item.cost; /* deduct cost */  
  
    buyer.balanceUpdated(); /* freshen screen */  
  
}
```



What if an **uncaught exception** happens *here*?







“Separation of responsibility.”



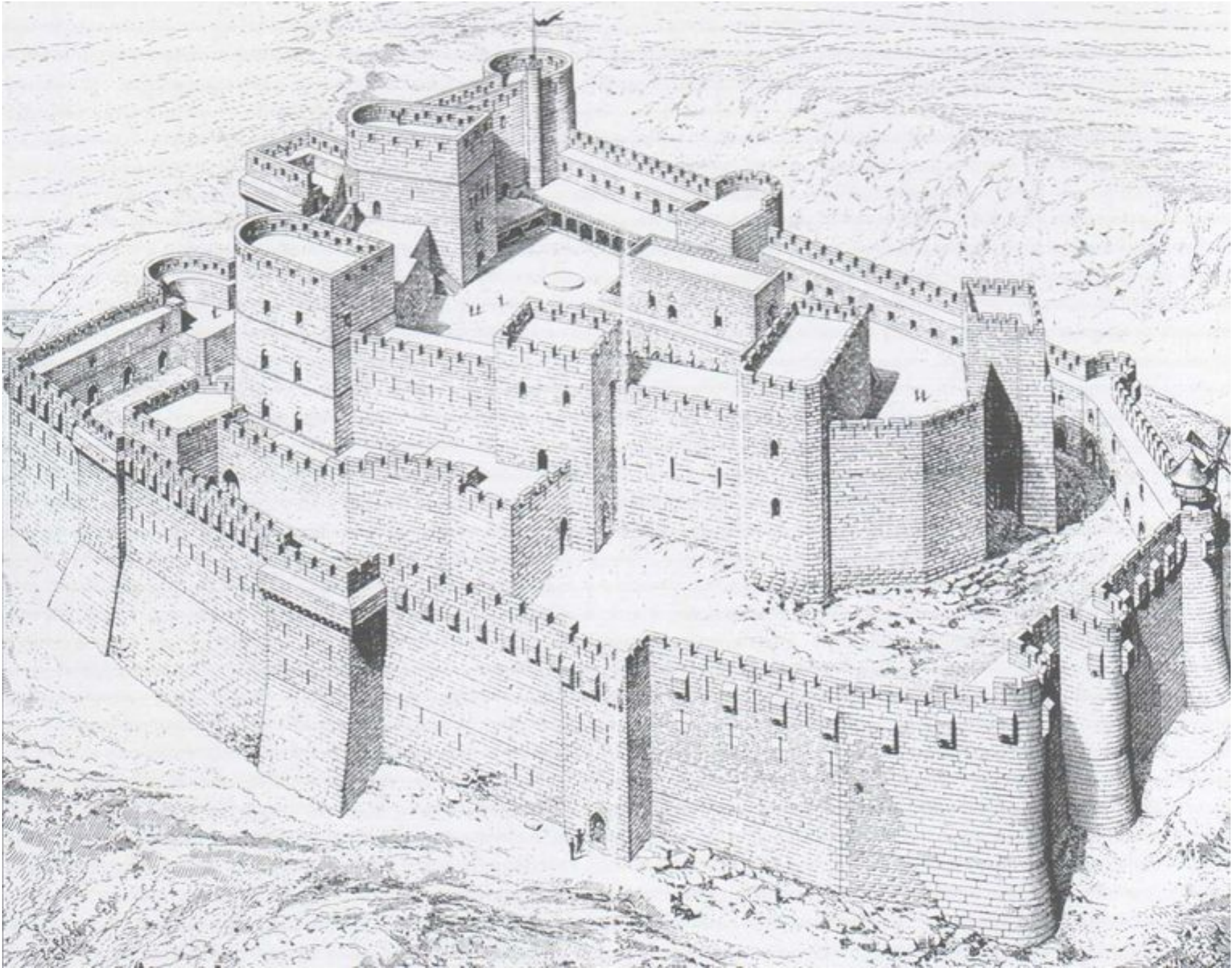
Independent
audit



Summary:

Notions Regarding Managing Privilege

- **Least privilege**
 - The notion of avoiding having unnecessary privileges
- **Privilege separation**
 - A way to achieve least privilege by isolating access to privileges to a small Trusted Computing Base (TCB)
- **Separation of responsibility**
 - If you need to have a privilege, consider requiring multiple parties to work together (collude) to exercise it



“Defense in depth.”

GSA Container Classes Defined:

GSA: General Services Administration (US Government)

GSA Class 1:

a GSA approved container meeting Federal Specification AA-F-357 (canceled) with entry protection consisting of 30 Man-Minutes forced entry, 30 Man-Minutes surreptitious entry

GSA Class 2:

a GSA approved container meeting Federal Specification AA-F-357 (canceled) with entry protection consisting of 20 Man-Minutes forced entry, 20 Man-Minutes surreptitious entry

GSA Class 3:

a GSA approved container meeting Federal Specification AA-F-358 with entry protection consisting of 20 Man-Minutes forced entry, 20 Man-Minutes surreptitious entry

GSA Class 4:

a GSA approved container meeting Federal Specification AA-F-358 with entry protection consisting of 20 Man-Minutes forced entry, 20 Man-Minutes surreptitious entry and 30 Man-Minutes covert entry



AA-F-357 (canceled) with entry protection consisting of 10 Man-Minutes forced entry, 20 Man-Minutes surreptitious entry

AA-F-357 (canceled) with entry protection consisting of 10 Man-Minutes forced entry, 20 Man-Minutes surreptitious entry

Specification AA-F-358 with entry protection consisting of 10 Man-Minutes forced entry, 20 Man-Minutes surreptitious entry

Specification AA-F-358 with entry protection consisting of 10 Man-Minutes forced entry, 20 Man-Minutes surreptitious entry



Class 5 Four Drawer

GSA Class 5:

a GSA approved uninsulated container meeting Federal Specification AA-F-358 with entry protection consisting of 10 Man-Minutes forced entry, 20 Man-Minutes surreptitious entry and 30 Man-Minutes Covert entry

358 with entry protection consisting of 20 Man-Minutes surreptitious entry and 30 Man-Minutes covert entry



“Company policy: passwords must be at least 10 characters long, contain at least 2 digits, 1 uppercase character, 1 lowercase character, and 1 special character.”

company Portal
password: 1secret

Bank
password:
goMets12

e-mail:
letmein

credit card:
bowser8

brokerage:
initial23

Log in

https://login.postini.c

Google

Log in to your message center.

Invalid log in or server error. Please try again.

[Forgot your password?](#)

Log in Address
example: joe234@jumbowidgetsco.com

Password
note: password is case-sensitive

Remember my Address and Password ([what is this?](#))

Done login.postini.com

“Psychological acceptability.”

Internet Explorer



When you send information to the Internet, it might be possible for others to see that information. Do you want to continue?

In the future, do not show this message.

Yes

No

Internet Explorer



When you see a dialog box like this, click 'Yes' to make it go away. If available, click the checkbox first to avoid being bothered by it again.

In the future, do not show this message.

Yes

No

Website Certified by an Unknown Authority



Unable to verify the identity of svn.xiph.org as a trusted site.

Possible reasons for this error:

- Your browser does not recognise the Certificate Authority that issued the site's certificate.
- The site's certificate is incomplete due to a server misconfiguration.
- You are connected to a site pretending to be svn.xiph.org, possibly to obtain your confidential information.

Please notify the site's webmaster about this problem.

Before accepting this certificate, you should examine this site's certificate carefully. Are you willing to accept this certificate for the purpose of identifying the Web site svn.xiph.org?

Examine Certificate...

- Accept this certificate permanently
- Accept this certificate temporarily for this session
- Do not accept this certificate and do not connect to this Web site

OK

Cancel

Website Certified by an Unknown Authority



Unable to verify the identity of `svn.xiph.org` as a trusted site.
Blah blah geekspeak geekspeak geekspeak.

Before accepting this certificate, your browser can display a second dialog full of incomprehensible information. Do you want to view this dialog?

[View Incomprehensible Information](#)

- Make this message go away permanently
- Make this message go away temporarily for this session
- Stop doing what you were trying to do

OK

Cancel

What a piece of work is a man! how Noble in Reason! how infinite in faculty! in form and moving how express and admirable! in Action, how like an Angel! in apprehension, how like a God!

-- Hamlet Act II, Scene II

“Humans are incapable of securely storing high-quality cryptographic keys, and they have unacceptable speed and accuracy when performing cryptographic operations. (They are also large, expensive to maintain, difficult to manage, and they pollute the environment. It is astonishing that these devices continue to be manufactured and deployed. But they are sufficiently pervasive that we must design our protocols around their limitations.)”

-- Network Security: Private Communication in a Public World, Charlie Kaufman, Radia Perlman, & Mike Speciner, 1995

“Consider human factors.”

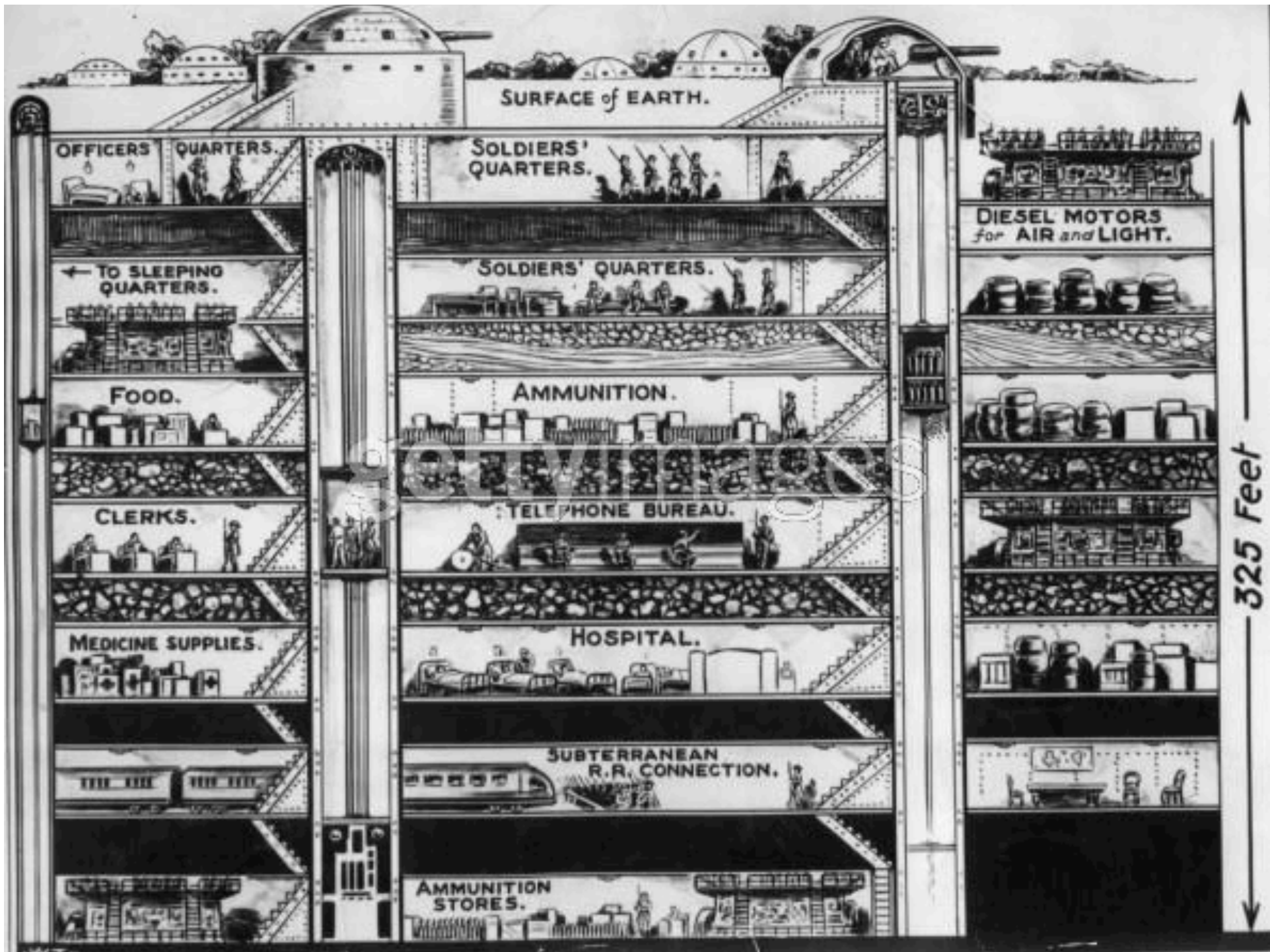


Summary:

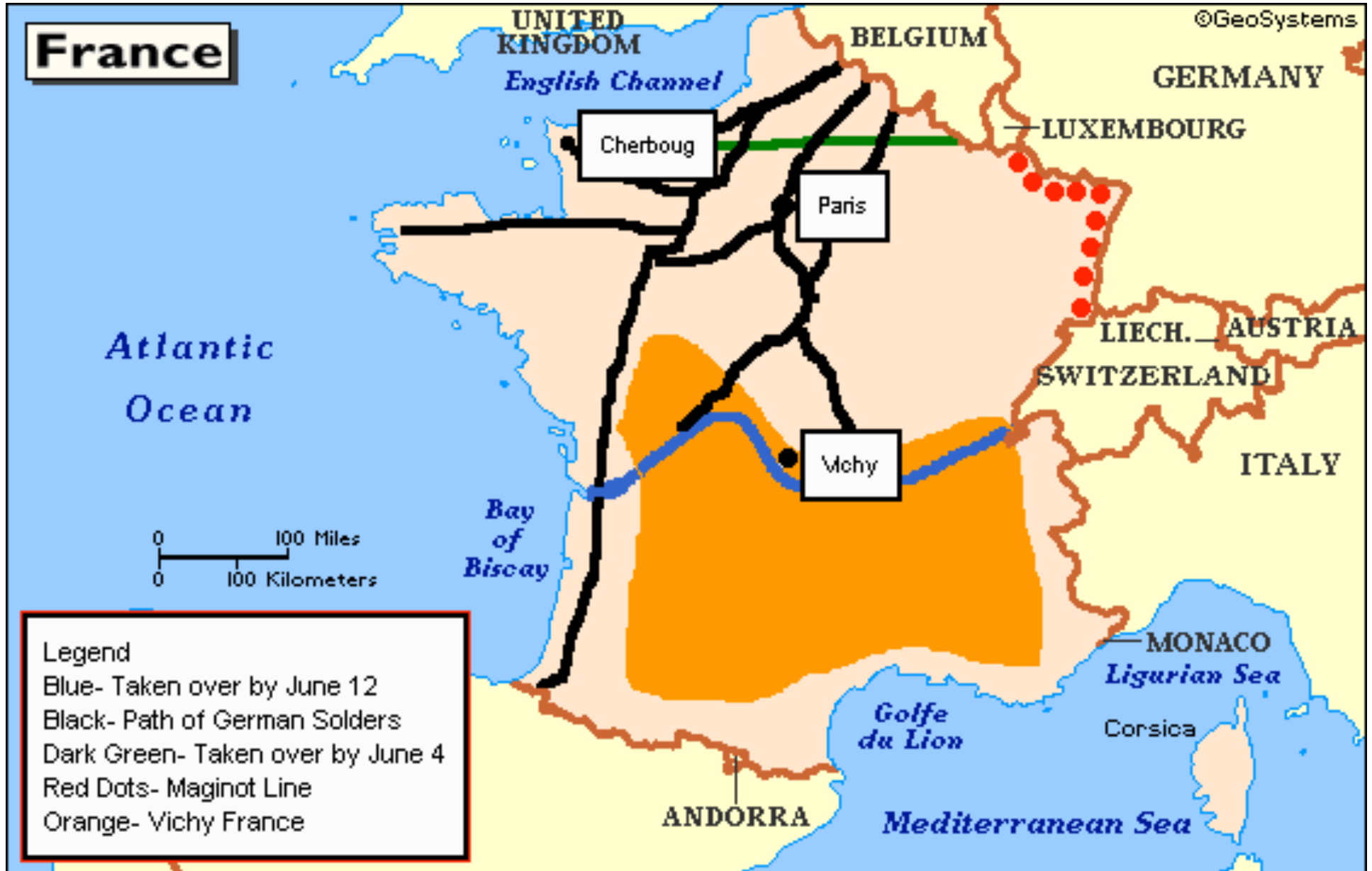
Dealing with Users

- Psychological acceptability
 - Will users abide a security mechanism, or *decide* to subvert it?
- Consider human factors
 - Does a security mechanism assume something about human behavior when interacting with the system that might not hold, even *in the absence* of conscious decisions by the users to subvert









“Only as secure as the weakest link.”







RAPTORS
AHEAD
CAUTION

WINDY
OUTLOOK

MARSH

10000
10000
10000



TRAPPED
IN SIGN
FACTORY



SEND
HELP!




“Don’t **rely on security through
obscurity.”**





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Handwritten graffiti in white and blue ink on the top panel of the ATM machine. The text is partially obscured by the shelf and other components.

Handwritten graffiti in white ink on the right side of the ATM machine, partially obscured by the shelf.

Handwritten graffiti in blue ink on the top panel of the ATM machine, above the screen.

Lutujeme, ale bankomat je

Bankomat
Karta
Karta
Karta



“Trusted path.”

User needs to know they're talking w/ legit system.
System needs to know it's talking w/ legit user.
These channels should be unspoofable & private.