Access Control and Privacy Policies (3)

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Slides:	KEATS (also home work is there) **(I have put a temporary link in there.)**

one general defence mechanism is
defence in depth

Defence in Depth

- overlapping systems designed to provide security even if one of them fails.

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otherwise your “added security” can become the point of failure

PALs

- Permissive Action Links prevent unauthorised use of nuclear weapons (so the theory)

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modern PALs also include a 2-person rule

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- the current Trident nuclear weapons can be launched from a submarine without any code being transmitted

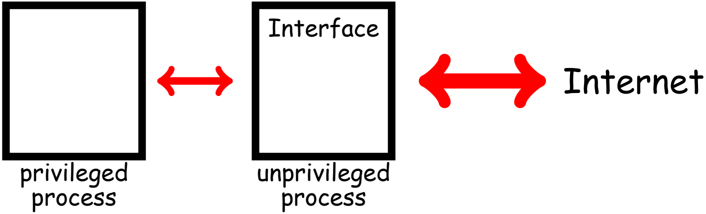
Access Control in Unix

- access control provided by the OS
- authenticate principals (login)
- mediate access to files, ports, processes according to roles (user ids)
- roles get attached with privileges

> principle of least privilege:
> programs should only have as much privilege as they need

Access Control in Unix (2)

- the idea is to restrict access to files and therefore lower the consequences of an attack



Process Ownership

- access control in Unix is very coarse

$$\frac{\text{root}}{\text{user}_1\ \text{user}_2 \ldots \text{www, mail, lp}}$$

root has UID $= 0$

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you also have groups that can share access to a file

but it is difficult to exclude access selectively

Access Control in Unix (2)

- privileges are specified by file access permissions ("everything is a file")
- there are 9 (plus 2) bits that specify the permissions of a file

```
$ ls - la
-rwxrw-r--   foo_file.txt
```

Login Process

- login processes run under UID $= 0$

```
ps -axl | grep login
```

- after login, shells run under UID $=$ user (e.g. 501)

```
id cu
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- non-root users are not allowed to change the UID — would break access control
- but needed for example for `passwd`

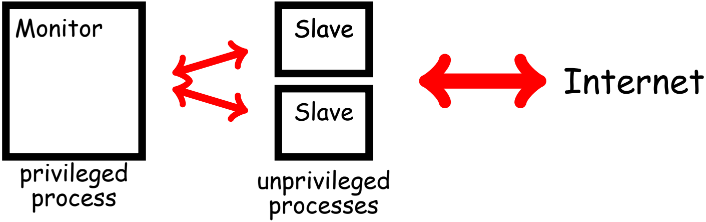
Setuid and Setgid

The solution is that unix file permissions are 9 + 2 Bits: Setuid and Setgid Bits

- When a file with setuid is executed, the resulting process will assume the UID given to the owner of the file.
- This enables users to create processes as root (or another user).
- Essential for changing passwords, for example.

```
chmod 4755 fobar_file
```

Privilege Separation in OpenSSH



- pre-authorisation slave
- post-authorisation

- 25% codebase is privileged, 75% is unprivileged

Network Applications

ideally network application in Unix should be designed as follows:

- need two distinct processes
  - one that listens to the network; has no privilege
  - one that is privileged and listens to the latter only (but does not trust it)
- to implement this you need a parent process, which forks a child process
- this child process drops privileges and listens to hostile data
- after authentication the parent forks again and the new child becomes the user

Famous Security Flaws in Unix

- `lpr` u you
  had th .

Only failure makes us experts. – Theo de Raadt (OpenBSD, OpenSSH)

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- `lpr` unfortunately runs with root privileges; you had the option to delete files after printing ...
- for debugging purposes (FreeBSD) Unix provides a "core dump", but allowed to follow links ...
- `mkdir foo` is owned by root

  ```
  -rwxr-xr-x 1 root wheel /bin/mkdir
  ```

  it first creates an i-node as root and then changes to ownership to the user's id

  (automated with a shell script)

Other Problems

There are thing's you just cannot solve on the programming side:

- for system maintenance you often have `cron`-jobs cleaning `/tmp`
  - attacker:
    ```
    mkdir /tmp/a; cat > /tmp/a/passwd
    ```
  - root:
    ```
    rm /tmp/*/*:
    ```
  - attacker:
    ```
    rm /tmp/a/passwd; rmdir /tmp/a;
    ln -s /etc /tmp/a
    ```

Security Levels

Unix essentially can only distinguish between two security levels (root and non-root).

- In military applications you often have many security levels (top-secret, secret, confidential, unclassified)

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- Information flow: Bell — La Padula model
  - read: your own level and below
  - write: your own level and above

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Access Control in 2000

According to Ross Anderson (1st edition of his book), some senior Microsoft people held the following view:

> Access control does not matter. Computers are becoming single-purpose or single-user devices. Single-purpose devices, such as Web servers that deliver a single service, don't need much in the way of access control as there's nothing for operating system access controls to do; the job of separating users from each other is best left to application code. As for the PC on your desk, if all the software on it comes from a single source, then again there's no need for the operating system to provide separation. (in 2000)

Research Problems

- with access control we are back to 1970s

> Going all the way back to early time-sharing systems we systems people regarded the users, and any code they wrote, as the mortal enemies of us and each other. We were like the police force in a violent slum.
>
> — Roger Needham

Research Problems

- with access control we are back to 1970s
- the largest research area in access control in 2000-07 has been “Trusted Computing”, but thankfully it is dead now
- a useful research area is to not just have robust access control, but also usable access control — by programmers and users
  (one possible answer is operating system virtualisation, e.g. Xen, VMWare)

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(one possible answer is operating system virtualisation, e.g. Xen, VMWare)
- electronic voting

Mobile OS

- iOS and Android solve the defence-in-depth problem by sandboxing applications

- you as developer have to specify the resources an application needs
- the OS provides a sandbox where access is restricted to only these resources

Security Theatre

Security theatre is the practice of investing in countermeasures intended to provide the feeling of improved security while doing little or nothing to actually achieve it. Bruce Schneier

Security Theatre

- for example, usual locks and strap seals are security theatre

From: Ross Anderson <Ross.Anderson@cl.cam.ac.uk>
To: cl-security-research@lists.cam.ac.uk
Subject: Tip off
Date: Tue, 02 Oct 2012 13:12:50 +0100

I received the following tip off, and have removed the sender's coordinates. I suspect it is one of many security vendors who don't even get the basics right; if you ever go to the RSA conference, there are a thousand such firms in the hall, each with several eager but ignorant salesmen. A trying experience.

Ross

I’d like to anonymously tip you off about this product:

http://www.strongauth.com/products/key-appliance.html

It sounds really clever, doesn’t it?

...

Anyway, it occurred to me that you and your colleagues might have a field day discovering weaknesses in the appliance and their implementation of security. However, whilst I’d be willing to help and/or comment privately, it’d have to be off the record ;-)

Schneier: Step 1

What assets are you trying to protect?

This question might seem basic, but a surprising number of people never ask it. The question involves understanding the scope of the problem. For example, securing an airplane, an airport, commercial aviation, the transportation system, and a nation against terrorism are all different security problems, and require different solutions.

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You like to prevent: "It would be terrible if this sort of attack ever happens; we need to do everything in our power to prevent it."

Schneier: Step 2

What are the risks to these assets?

Here we consider the need for security. Answering it involves understanding what is being defended, what the consequences are if it is successfully attacked, who wants to attack it, how they might attack it, and why.

Schneier: Step 3

How well does the security solution mitigate those risks?

Another seemingly obvious question, but one that is frequently ignored. If the security solution doesnÕt solve the problem, it's no good. This is not as simple as looking at the security solution and seeing how well it works. It involves looking at how the security solution interacts with everything around it, evaluating both its operation and its failures.

Schneier: Step 4

What other risks does the security solution cause?

This question addresses what might be called the problem of unintended consequences. Security solutions have ripple effects, and most cause new security problems. The trick is to understand the new problems and make sure they are smaller than the old ones.

Schneier: Step 5

What costs and trade-offs does the security solution impose?

Every security system has costs and requires trade-offs. Most security costs money, sometimes substantial amounts; but other trade-offs may be more important, ranging from matters of convenience and comfort to issues involving basic freedoms like privacy. Understanding these trade-offs is essential.