CS615 - Aspects of System Administration

Multiuser Fundamentals

Department of Computer Science
Stevens Institute of Technology
Jan Schaumann
jschauma@stevens.edu
https://stevens.netmeister.org/615/
Multiuser

UNIX was designed from the beginning (1970s) as a portable, multi-tasking, \textit{multi-user} system.

Windows gained this functionality with WindowsNT in 1993.

Mac OS followed in 2001 with OS X.
Implications of a Multi-User System
Implications of a Multi-User System
Consider Scalability

Things to consider:
Granting Privileges requires Trust

- different environments have different trust models
- human interactions in small groups strengthen trust
- larger groups are divided into smaller, close-nit groups
- the more groups you have, the weaker their trust bonds are
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Trust does not scale.
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Implement *Zero Trust* principles.
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For humans, apply *Least Privilege*, time-based access expiration, and automated renewal with strong audit capabilities.
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For computers, apply *Least Privilege*, time-based access expiration, and automated renewal with strong audit capabilities.

For humans, apply *Least Privilege*, time-based access expiration, and automated renewal with strong audit capabilities.

But beware getting in people’s ways - they *will* find ways to circumvent your controls!
Implications of a Multi-User System

- users may want to keep files private
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- users may (try to gain) access to files they shouldn’t have access to
- users may (want to) do things that affect other users
- different users may require different privileges
Users and User-IDs

<table>
<thead>
<tr>
<th>alice</th>
<th>bob</th>
</tr>
</thead>
<tbody>
<tr>
<td>claire</td>
<td>dennis</td>
</tr>
<tr>
<td>edsger</td>
<td>root</td>
</tr>
<tr>
<td>nobody</td>
<td></td>
</tr>
</tbody>
</table>

Bijective?
Users and User-IDs

Not surjective!
Users and User-IDs

Not injective, either!
Users and User-IDs

nobody
Authentication

- proof of identity, not proof of *authorization*
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- something you know, something you have, something you are
- multi-factor authentication combines these to help protect against different threats
- mutual authentication may be a requirement
Authentication

Common examples:

NetBSD/amd64 (SERVER) (console)

login: jschauma
password: *********************
NetBSD 7.0.2 (SERVER) #2: Tue Jan 24 02:33:13 EST 2017

Welcome to NetBSD!
hostname$
**Authentication**

Common examples:

```
$ ssh-keygen -l -f /dev/stdin <<<$(aws ec2 get-console-output \
i-0990f1eb069c853c4 | grep ^ecdsa)
$ ssh -i ~/.ssh/myawskey ec2-54-227-16-184.compute-1.amazonaws.com
The authenticity of host 'ec2-54-227-16-184.compute-1.amazonaws.com (54.227.16.184)' can't be established.
Are you sure you want to continue connecting (yes/no)? yes
NetBSD 7.0.2 (SERVER) #2: Tue Jan 24 02:33:13 EST 2017

Welcome to NetBSD!
hostname$
```
Authentication

Common examples:

$ kinit
Password for jschauma@DOMAIN: *****************************

$ klist
Ticket cache: /tmp/krb5cc_ttypa
    Default principal: jschauma@DOMAIN

    Valid starting       Expires       Service principal
    02/13/17 13:50:21    02/13/17 21:50:20   krbtgt/KDC@DOMAIN

$ ssh somehost
somehost$
Authentication

Common examples:

localhost$ ssh sshca
YubiKey for ‘jschauma’: ******************************
Password: ******************************
localhost$ ssh-add -l
2048 SHA256:TzwuHGc5BKBe+VJSnGoVyh92J8XKBuLaL7MGQn8ML0Y (RSA)
2048 SHA256:TzwuHGc5BKBe+VJSnGoVyh92J8XKBuLaL7MGQn8ML0Y (RSA-CERT)
localhost$ ssh somehost
Duo two-factor login for jschauma

Enter a passcode or select one of the following options:

1. Duo Push to XXX-XXX-0712
2. Phone call to XXX-XXX-0712
3. SMS passcodes to XXX-XXX-0712

Passcode or option (1-3): 1
Success. Logging you in...
Last login: Thu Jan 26 17:39:30 2017 from 10.1.2.3

somehost$
Authentication

Common examples:
Authentication

Common examples:

- passwords, PINs
- ssh keys, PGP keys, X.509 certificates
- security tokens: OTPs in hardware or software, RFIDs
- physical biometrics: fingerprint, retina scan, facial recognition
- behavioral biometrics: speech pattern, gait, keystroke dynamics...

Mix and match the above to yield multi-factor authentication:

- password + PIN via e.g. SMS
- ssh key + TOTP from e.g. mobile device
- fingerprint + security token
- ...
UNIX Fundamentals: User Accounts and File Permissions

Every account
- has a *unique* ID
- belongs to at least one group
- may or may not be password protected
- may or may not have a valid login program
- may or may not be allowed to escalate privileges
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Every file
- is associated with a uid and a gid
- has a number of protection bits
UNIX Fundamentals: User Accounts and File Permissions
Raising privileges

Some tasks require special privileges:

- binding a port $< 1024$ (e.g. 22, 25, 80, 443)
- operating on raw sockets (e.g. `ping(1)`, `traceroute(8)`)
- changing local passwords
- accessing files/directories without explicit permissions
- just about anything involving file systems
- ...

...
Raising privileges

Options:

$ ls -l command
-rwsr-xr-x 1 daemon wheel 12556 Feb 17 21:45 command
$ man setuid
Raising privileges

Options:

```
somehost$ exit
$ ssh root@somehost
#
```
Raising privileges

Options:

$ su user2 -c 'some command'
Password:
$ su - root
Password:
#
Raising privileges

Options:

somehost$ sudo bash

jschauma is not allowed to run sudo on somehost. This incident will be reported.
Raising privileges

Options:

jschauma@somehost$ ls dir
ls: cannot open directory dir: Permission denied
jschauma@somehost$ sudo bash
Sorry, user jschauma is not allowed to execute `/bin/bash’ as root on somehost.
jschauma@somehost$ sudo ls dir
Sorry, user jschauma is not allowed to execute `/bin/ls’ as root on somehost.
jschauma@somehost$ sudo -u otheruser ls dir
Password: **************************
file1  file2
jschauma@somehost$
Unix Groups

- enables *arbitrary* collections of users to share resources
- information stored in `/etc/group`, format is:
  
  name::GID:user1,user2,...

- most Unix systems impose a limit of 16 or 32 group memberships per user
- most Unix systems have a common default group for new users (some Linux versions deviate)
- some Unix systems have/had group shadow files
Group Access

At any but the smallest environments, we find:

- a central user database
- users divided into different access groups
- access to systems is granted primarily by such group membership
- privileges on a system are also granted by such group membership

The privileges granted in this manner are commonly broken down and controlled via *role-based access control* (RBAC).
Group Access

- Users
- Wheel
- Dev

Account enabled
Sudo(8) enabled
Dev group permissions
Multiuser Truths

- *All users are equal.*
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- All users are equal.
- Some users are more equal than others.
- The principle of least privilege applies to all.
- Trust does not scale. (Think “Zero Trust”)
- You will always face trade-offs.
Adding and Removing Accounts

Recommended exercise:
https://stevens.netmeister.org/615/useradd-exercise.html
Reading

User Management:

- *Frisch*: Ch 6; *Burgess*: Ch 5;

- https://is.gd/wg50sE