CS615 - Aspects of System Administration

Multiuser Fundamentals

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Multiuser

UNIX was designed from the beginning (1970s) as a portable, multi-tasking, 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.
Granting Privileges requires Trust

We are considering *computer-human systems*.

For humans, trust, but (be able to) verify.

For computers, apply the *Least Privilege* principle.
Implications of a Multi-User System

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- users may want to share files
- 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

alice
bob
claire
dennis
edsger
root
nobody

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
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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: jschaum
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+VJSnGoVyh92J8XKBuK4aL7MGQn8ML0Y (RSA)
2048 SHA256:TzwuHGc5BKBe+VJSnGoVyh92J8XKBuK4aL7MGQn8ML0Y (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
- ...

Multiuser Fundamentals
April 6, 2018
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
UNIX Fundamentals: User Accounts and File Permissions

Every account

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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

```
-rw-r--r-- 1 root wheel 1396 Aug 17 08:59 /etc/passwd
```

- file name
- last modified date
- size in bytes
- group
- owner
- number of hard links
- execute permissions for 'other'
- write permissions for 'other'
- read permissions for 'other'
- execute permissions for 'group'
- write permissions for 'group'
- read permissions for 'group'
- execute permissions for 'owner'
- write permissions for 'owner'
- read permissions for 'owner'
- file type
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:

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

account enabled

sudo(8) enabled

dev group permissions
Multiuser Truths

- All users are equal.
- Some users are more equal than others.
- The principle of least privilege applies to all.
- Humans require trust.
- Trust does not scale.
- You will always face trade-offs.
Adding and Removing Accounts

In-class exercise:
Reading

User Management:

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

- https://is.gd/wg50sE