Privileged programs (Set-UID programs)

TCS 591 : Unit 2

What is Set-UID

- **Setuid**, which stands for **set user ID on execution**, is a special type of file permission in Unix and Unix-like operating systems such as Linux . It is a security tool that permits users to run certain programs with escalated privileges.

Need for Privileged Programs

- When an executable file's setuid permission is set, users may execute that program with a level of access that matches the user who owns the file.
- For instance, when a user wants to change their password, they run the passwd command. The passwd program is owned by the root account and marked as setuid, so the user is temporarily granted root access for that limited purpose.

Viewing the setuid permission of a file

- When viewing a file's permissions with the **ls -l** command, the setuid permission is displayed as an "**s**" in the "user execute" bit position. For example:

  ls -l /usr/bin/passwd

-rwsr-xr-x 1 root 54192 Nov 20 17:03 /usr/bin/passwd

Setting the setuid permission of a file

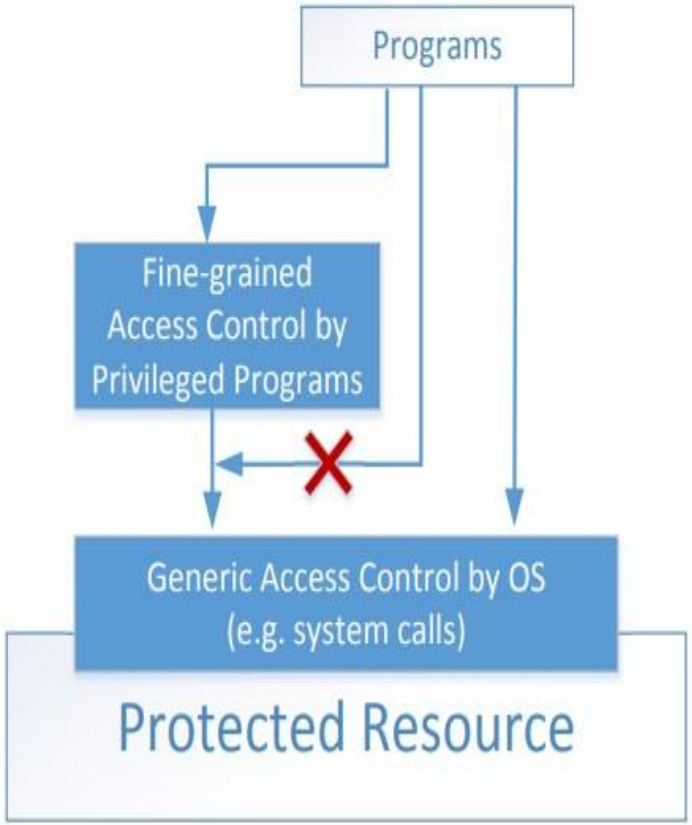
- To set the setuid permission for an executable file, use the permission identifier **u+s** with the **chmod** command:

  chmod u+s myfile

-rwSr--r-- 1 user 0 Mar 6 10:45 myfile

Two-Tier Approach

- Implementing fine-grained access control in operating systems make OS over complicated.
- OS relies on extension to enforce fine- grained access control
- Privileged programs are



Types of Privileged Programs

- Daemons
  - Computer program that runs in the background
  - Needs to run as root or other privileged users
- Set-UID Programs
  - Widely used in UNIX systems
  - Program marked with a special bit

Set-UID Concept

- **Allow user to run a program with the program owner's privilege.**
- Allow users to run programs with temporary elevated privileges
- Example: the passwd program

```
$ ls -l /usr/bin/passwd
-rwsr-xr-x 1 root root 41284 Sep 12  2012
                    /usr/bin/passwd
```

Set-UID Concept

- Every process has two User IDs.
- **Real UID (RUID)**: Identifies real owner of process
- **Effective UID (EUID)**: Identifies privilege of a process
  - Access control is based on EUID
- When a normal program is executed, RUID = EUID, they both equal to the ID of the user who runs the program
- When a Set-UID is executed, RUID ≠ EUID. RUID still equal to the user's ID, but EUID equals to the program **owner**'s ID.
  - If the program is owned by root, the program runs with the root privilege.

Turn a Program into Set-UID

- Change the owner of a file to root :

```
seed@VM:~$ cp /bin/cat ./mycat
seed@VM:~$ sudo chown root mycat
seed@VM:~$ ls -l mycat
-rwxr-xr-x 1 root seed 46764 Nov  1 13:09 mycat
seed@VM:~$
```

- Before Enabling Set-UID bit:

```
seed@VM:~$ mycat /etc/shadow
mycat: /etc/shadow: Permission denied
seed@VM:~$
```

- After Enabling the Set-

```
seed@VM:~$ sudo chmod 4755 mycat
seed@VM:~$ mycat /etc/shadow
root:$6$012BPz.K$fbPkT6H6Db4/B8cLWbQI1cFjn
h/pDyc5U1BWOzkWh7T9ZGu.:15933:0:99999:7:::
daemon:*:15749:0:99999:7:::
bin:*:15749:0:99999:7:::
sys:*:15749:0:99999:7:::
```

How it Works

A Set-UID program is just like any other program, except that it has a special marking, which a single bit called Set-UID bit

```
$ cp /bin/id ./myid
$ sudo chown root myid
$ ./myid
uid=1000(seed) gid=1000(seed) groups=1000(seed), ...
```

```
$ sudo chmod 4755 myid
$ ./myid
uid=1000(seed) gid=1000(seed) euid=0(root) ...
```

Example of Set UID

```
$ cp /bin/cat ./mycat
$ sudo chown root mycat
$ ls -l mycat
-rwxr-xr-x 1 root seed 46764 Feb 22 10:04 mycat
$ ./mycat /etc/shadow
./mycat: /etc/shadow: Permission denied
```

- Not a privileged program

```
$ sudo chmod 4755 mycat
$ ./mycat /etc/shadow
root:$6$012BPz.K$fbPkT6H6Db4/B8c...
daemon:*:15749:0:99999:7:::
...
```

- Become a privileged program

```
$ sudo chown seed mycat
$ chmod 4755 mycat
$ ./mycat /etc/shadow
./mycat: /etc/shadow: Permission denied
```

- It is still a privileged program, but not the root privilege

How is Set-UID Secure?

- Allows normal users to escalate privileges
  - This is different from directly giving the privilege (sudo command)
  - Restricted behavior – similar to superman designed computer chips

- Unsafe to turn all programs into Set-UID
  - Example: /bin/sh
  - Example: vi