Pass
the SALT

No Root, No Problem
RootAsRole: Linux Privileges and Ansible

ESORICS 2025

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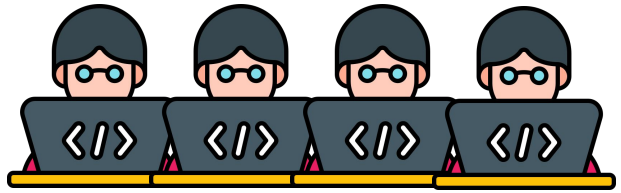
Why do we need Administrative Privileges on OS ?

1 admin

each server…

image: Flaticon.com

Why do we need Administrative Privileges on OS ?

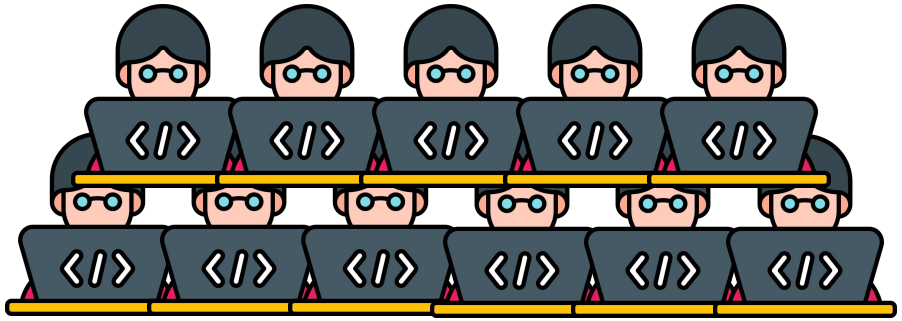


1 admin team

each server…

image: Flaticon.com

Why do we need Administrative Privileges on OS ?



1 admin team per department

each server…

> 120 admins just for basic system!

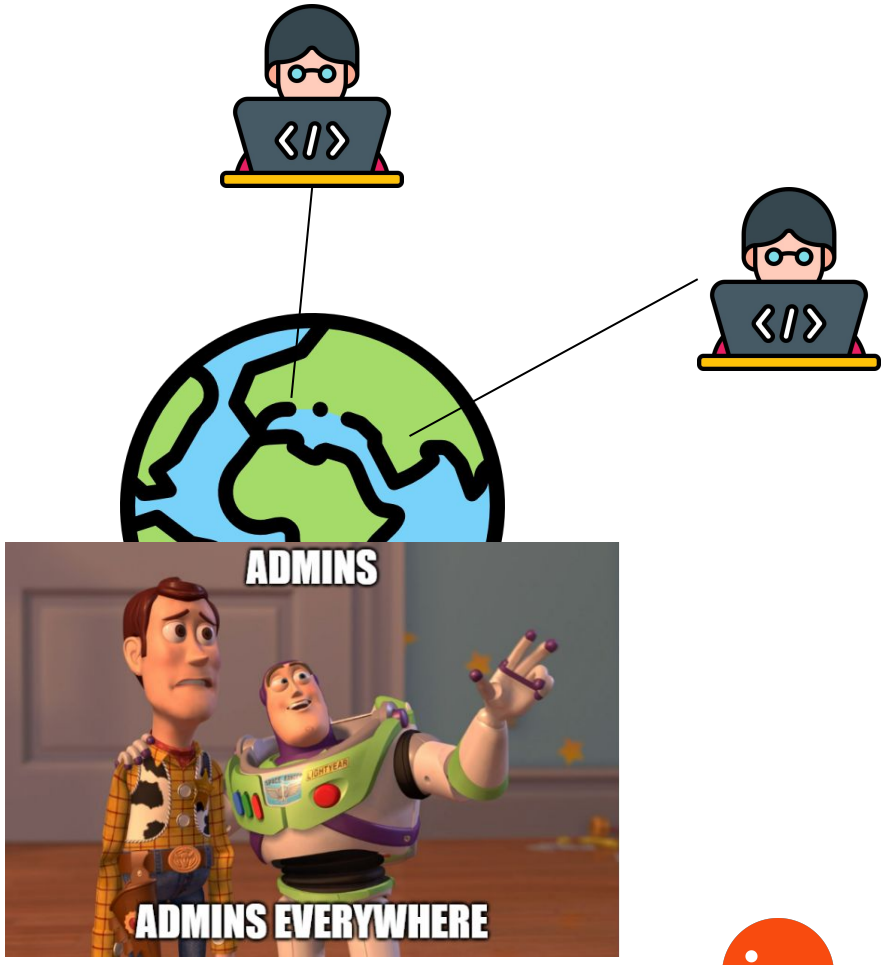


image: Flaticon.com

Why do we need Administrative Privileges on OS ?

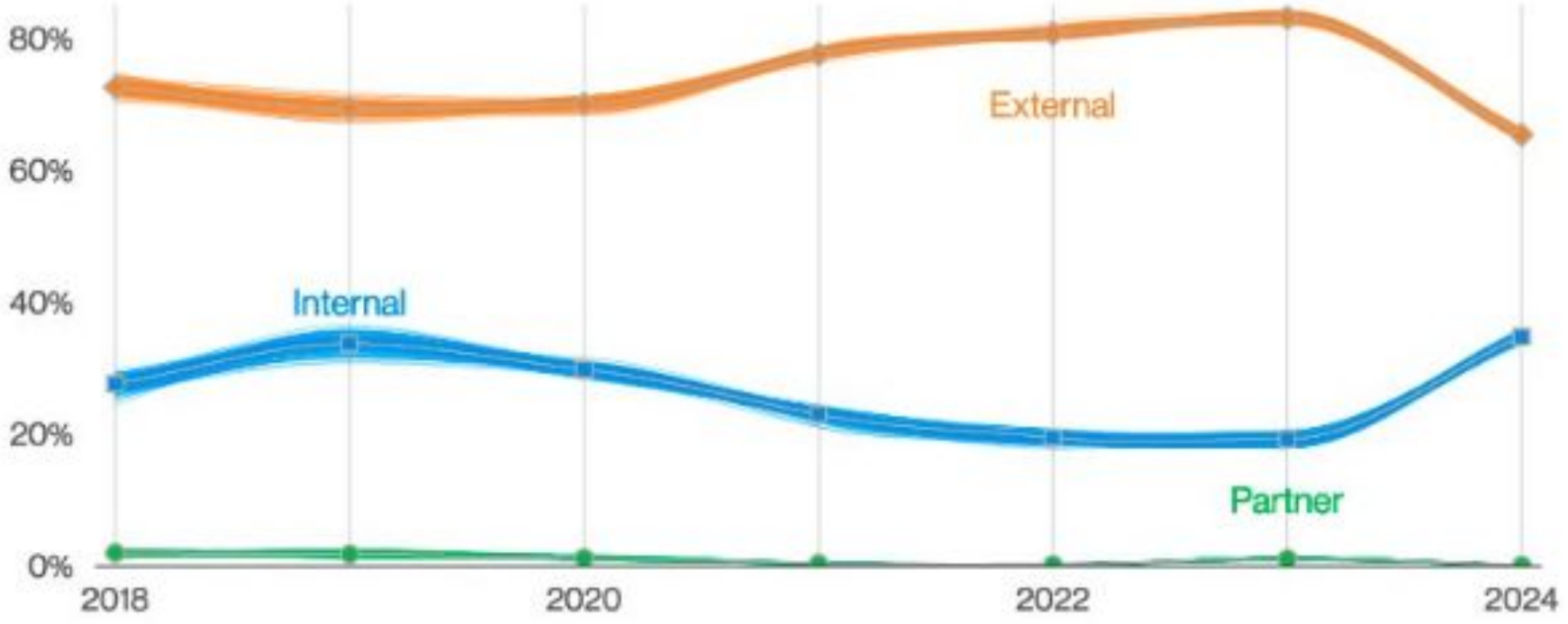
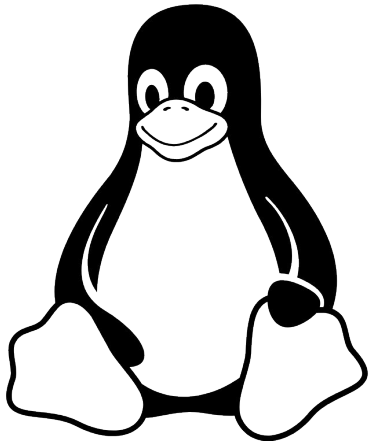


Figure 11. Threat actors in breaches over time

But concretely ?
What can-we do on our *(linux)* systems?

From the beginning, granting privileges on Linux



The great "Root", with all its privileges

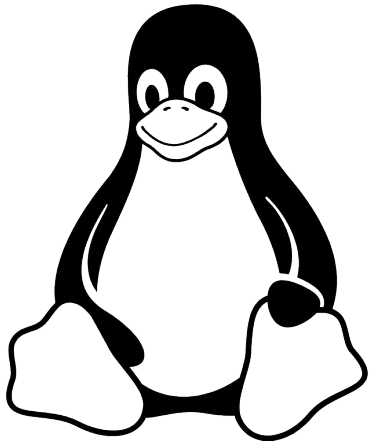
Louis XVI

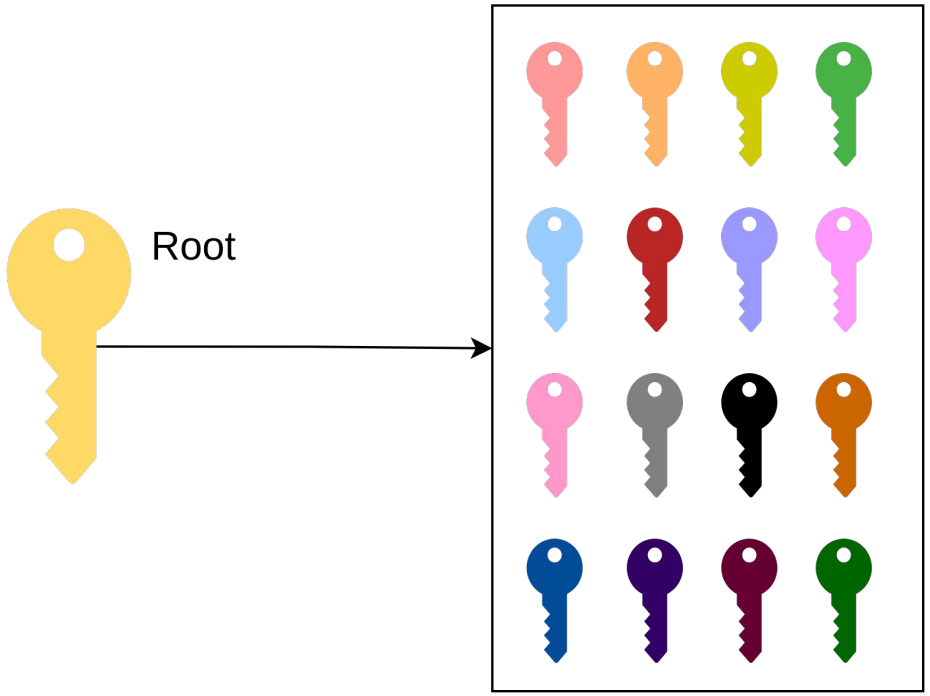
su,sudo

The users

Repas de paysans - *LENAIN. FECIT*

26 years ago, the destitution

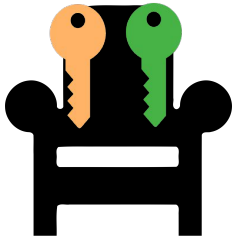




What can-we do with these privileges?

Distribute administrative roles!

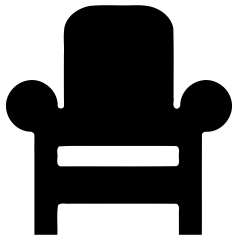
Admin Software



Admin Network

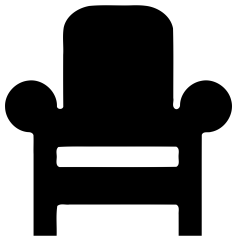
Admin IAM

What can-we do with these privileges?



Admin Software

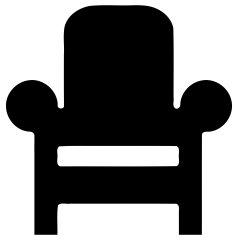
Update system



Admin Network

Update firewall

Create network



Admin IAM

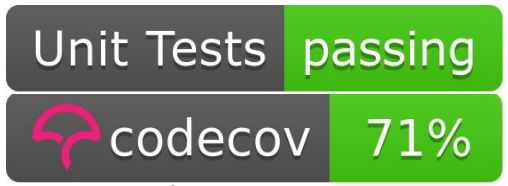
Add new user

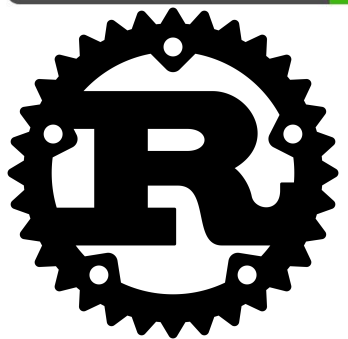
RootAsRole: A memory-safe and security-oriented alternative to sudo/su commands

- Role-based access control
- Role hierarchy & Separation of Duties
- More configuration features
- JSON & CBOR interchangeable policy format
- glob & PCRE2
- **Documented**
- **Heavily tested**
- **Written in Rust**

The main tool name is

sr





Demo time!

Did you know?

When you want :

1. find a file, you can *open a new terminal*?
2. backup your data, you can *open a new terminal*?
3. use a text editor, you can *open a new terminal*?
4. … and many more can be found on GTFOBINS website

Around 390 binaries can be exploited to perform a malicious attack… let's see how with this demo.
Of course you can find the equivalent list for Windows on LOLBAS website
Beware Microsoft users!! 👻

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let’s ~~find a file~~… with sudo

Install a malware in the kernel

```
ebilloir@lechatpdulabo:~$ sudo find . -exec /bin/bash \; -quit
Place your right index finger on the fingerprint reader
root@lechatpdulabo:/home/ebilloir# id
uid=0(root) gid=0(root) groups=0(root)
root@lechatpdulabo:/home/ebilloir# cat /proc/self/status | grep CapPrm
CapPrm: 000001fffffffffff
root@lechatpdulabo:/home/ebilloir# insmod attack.ko
root@lechatpdulabo:/home/ebilloir# lsmod | grep attack
attack                 12288  0
root@lechatpdulabo:/home/ebilloir#
```

And now, find a file with sr

```
ebilloir@lechatpdulabo:~$ sr find . -exec /bin/bash \; -quit
Place your right index finger on the fingerprint reader
bash: cannot set terminal process group (28492): Inappropriate ioctl for device
bash: no job control in this shell
ebilloir@lechatpdulabo:~$ id
uid=12299(ebilloir) gid=1350(gsiera) groups=1350(gsiera),27(sudo),44(video),136(libvirt)
ebilloir@lechatpdulabo:~$ cat /proc/self/status | grep CapPrm
CapPrm: 0000000000000004
ebilloir@lechatpdulabo:~$ insmod attack.ko
insmod: ERROR: could not insert module attack.ko: Operation not permitted
 1 ebilloir@lechatpdulabo:~$ sudo insmod attack.ko
sudo: The "no new privileges" flag is set, which prevents sudo from running as root.
sudo: If sudo is running in a container, you may need to adjust the container configuration
to disable the flag.
 1 ebilloir@lechatpdulabo:~$ lsmod | grep attack
 1 ebilloir@lechatpdulabo:~$ su
Password:
su: cannot set groups: Operation not permitted
 1 ebilloir@lechatpdulabo:~$
```


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	setcap??	*doas*	*sudo*	*sudo-rs*	*sr (for Switch Role)*
Change user/groups		mandatory	mandatory	mandatory	mandatory and optional
Centralized policy		no	LDAP-based	no	planned (RDBMS)
Authentication management		PAM	PAM, standalone, etc.	PAM	PAM
Logging features		syslog	syslog, logsrvd, etc.	syslog	syslog
Set capabilities	on files only	no	no	no	Ambient-based
Prevent direct privilege escalation		no	no	no	“Bounding set” based
Untrust authorized users		no	no	no	using Immutable file flag

???	not planned	planned	good	better

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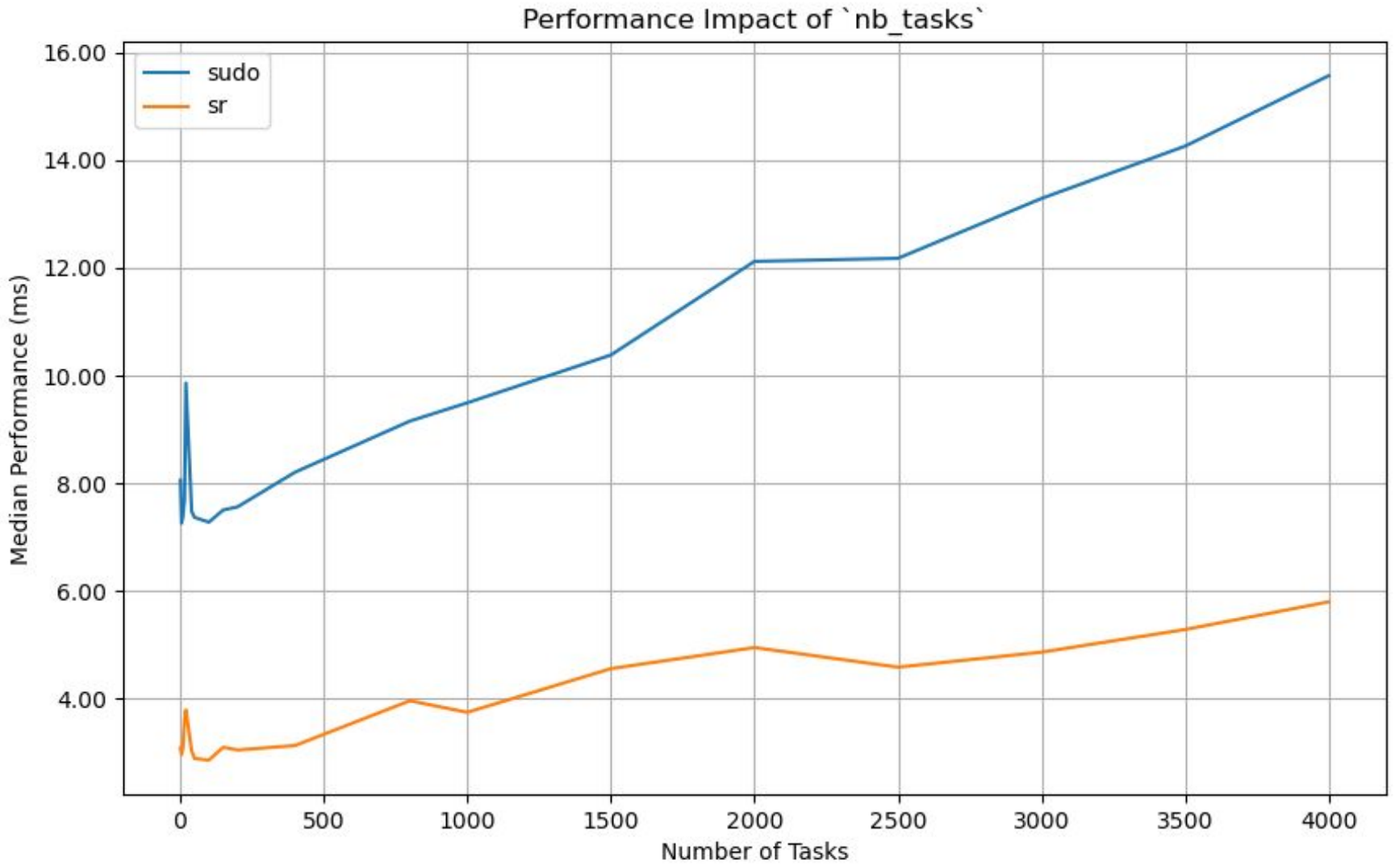
Using CBOR format (Work in Progress)



Let’s install apache2 with RootAsRole

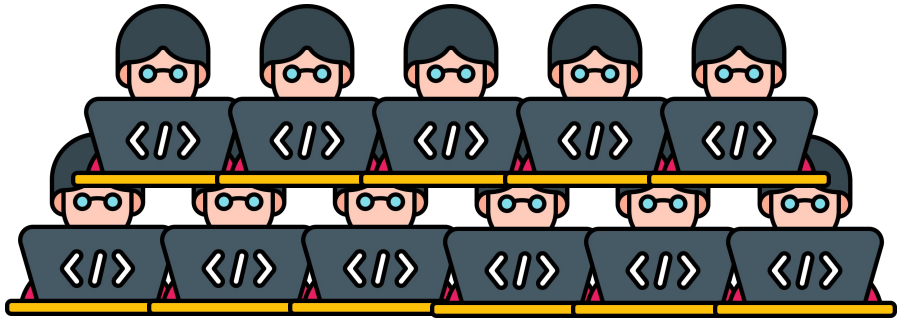
1. Create a role, i.e. “deploy_apache”
2. Assign the group to this role : “ansible”
3. Create the task : “install_apache2”
4. Add the command “apt install apache2” in the task
5. Grant capabilities on the “install Apache2” task
   a. Run “sr capable -j apt install apache2”

```
ebilloir@lechatpdulabo:~$ sr capable -j apt install apache2
["CAP_DAC_OVERRIDE"]
```

7. Ansible group can now execute “**sr apt install apache2**”
   a. Authenticating, and it works

Complicated, Right?

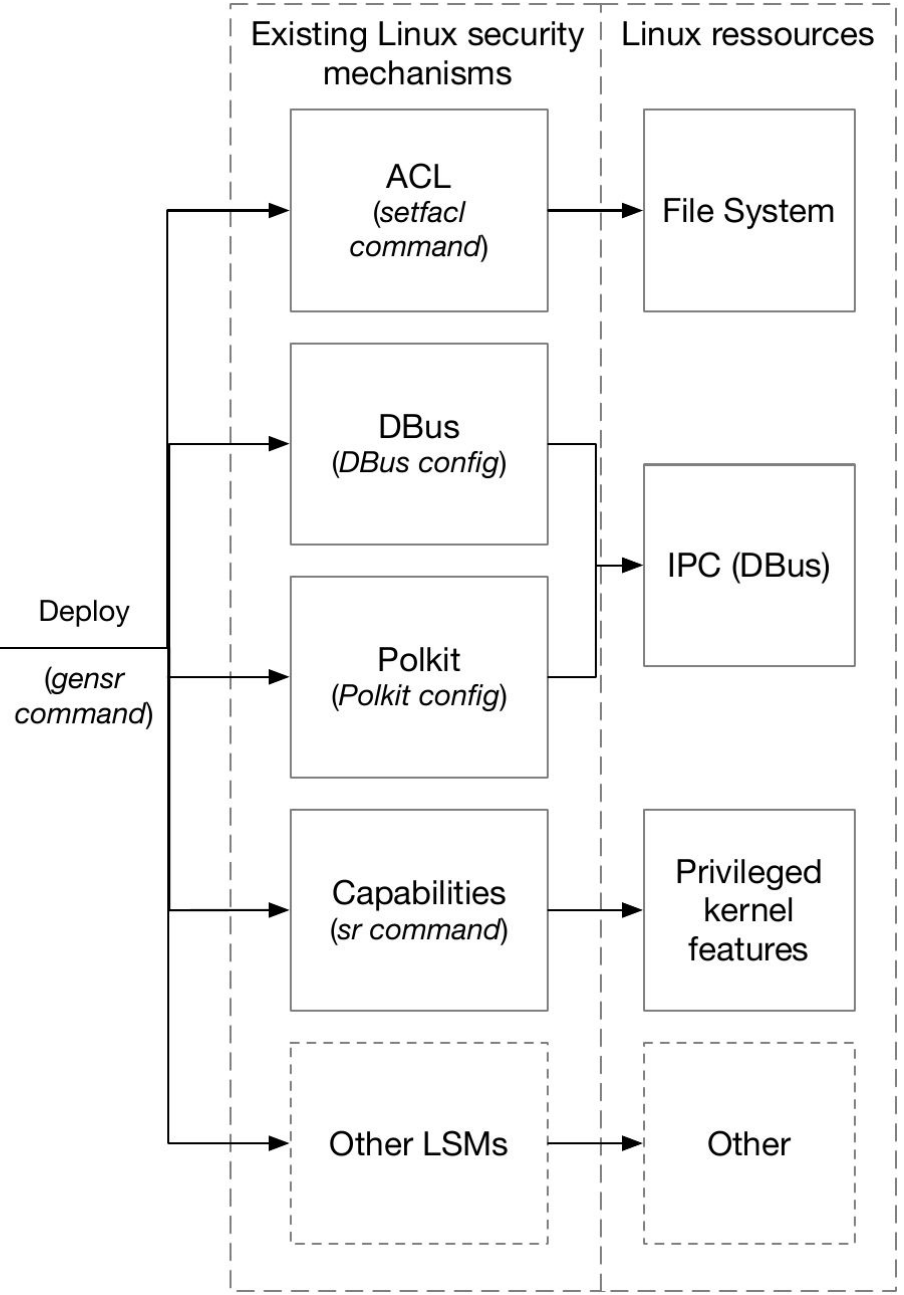
```
{
  // TRUNCATED
  "roles": [
    {
      "name": "deploy_apache",
      "actors": [
        {
          "type": "group",
          "groups": [
            "ansible"
          ]
        }
      ],
      "tasks": [
        {
          "name": "install_apache2",
          "purpose": "Install latest version of Apache",
          "cred": {
            "capabilities": {
              "default": "none",
              "add": [
                "CAP_DAC_OVERRIDE",
                "CAP_NET_BIND_SERVICE"
              ]
            }
          },
          "commands": {
            "default": "none",
            "add": [
              "apt install apache2"
            ]
          }
        }
      ]
    }
  ]
  // TRUNCATED
}
```



But Linux capabilities are only for specific administrative tasks.
Let’s do more!

RootAsRole Policy

```
{  "version": "3.0.0",
   "storage": {
      // Storage settings, such as location of Roles
      }
   },
   "options": {
      // Configuration of the environment such:
      // - environment variable (e.g. PATH)
      // - default policy for root and bounding
   },
   "roles": [ // Definition of roles
      {
         "name": "r_test",    // Role name
         "actors": [
           // List of Linux users assigned to this role
         ],
         "tasks": [
          // List of allowed tasks for this role
            {
               "name": "t_user",
               "purpose": "Purpose of this task",
               "cred": {
                  // Change User/Group before
                 // executing the command
                  "setuid": "root",
                  "setgid": "root",
                  "capabilities": {
                     // List of allowed capabilities
                     ]
                  },
                  "dbus": [
                     // List of allowed DBus services
                  ],
                  "file": {
                     // List of authorized file accesses
                  }},
               "commands": {
                  // List of allowed commands
                  ]}}]}]}
```



Monitoring & Analyzis of required privileges

(*gensr command*)

Generate

(*gensr command*)

RootAsRole Policy

```
{  "version": "3.0.0",
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   },
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                  ]}}]}]}
```

Deploy

(*gensr command*)

Existing Linux security mechanisms

Linux ressources

ACL (*setfacl command*)

File System

DBus (*DBus config*)

IPC (DBus)

Polkit (*Polkit config*)

Capabilities (*sr command*)

Privileged kernel features

Other LSMs

Other

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Now let’s simplify the process with Infrastructure as Code

ANSIBLE

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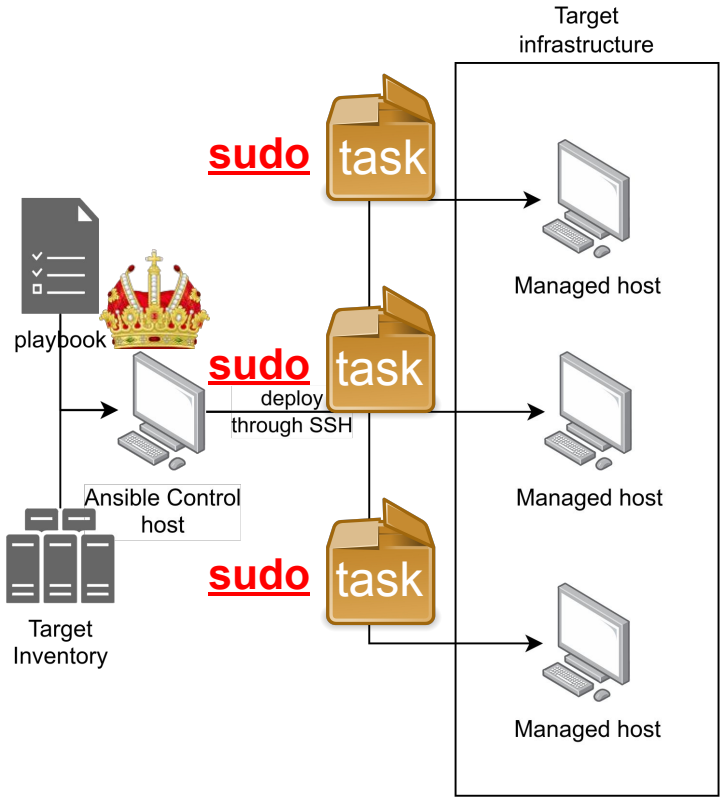
The Ansible example



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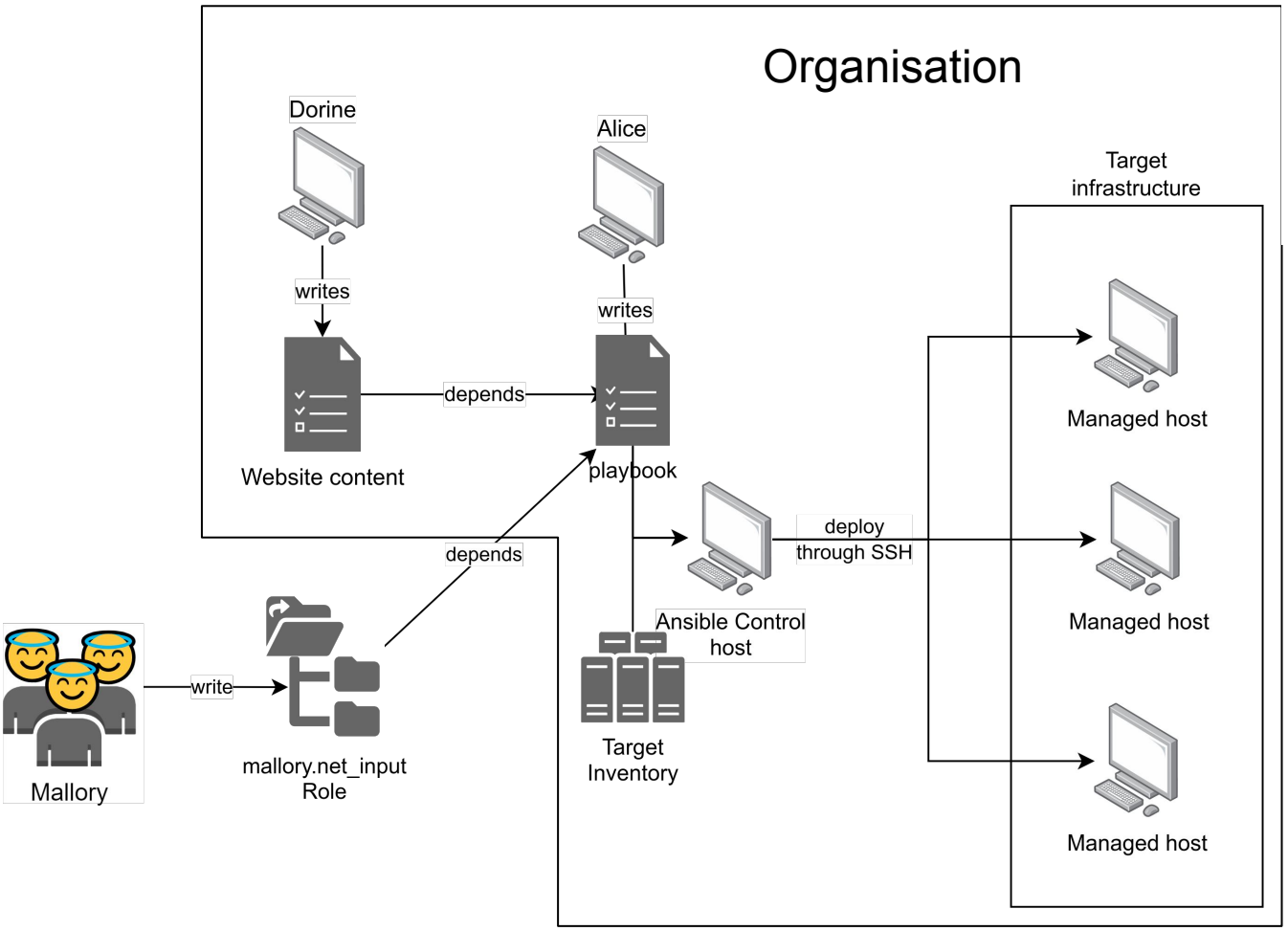
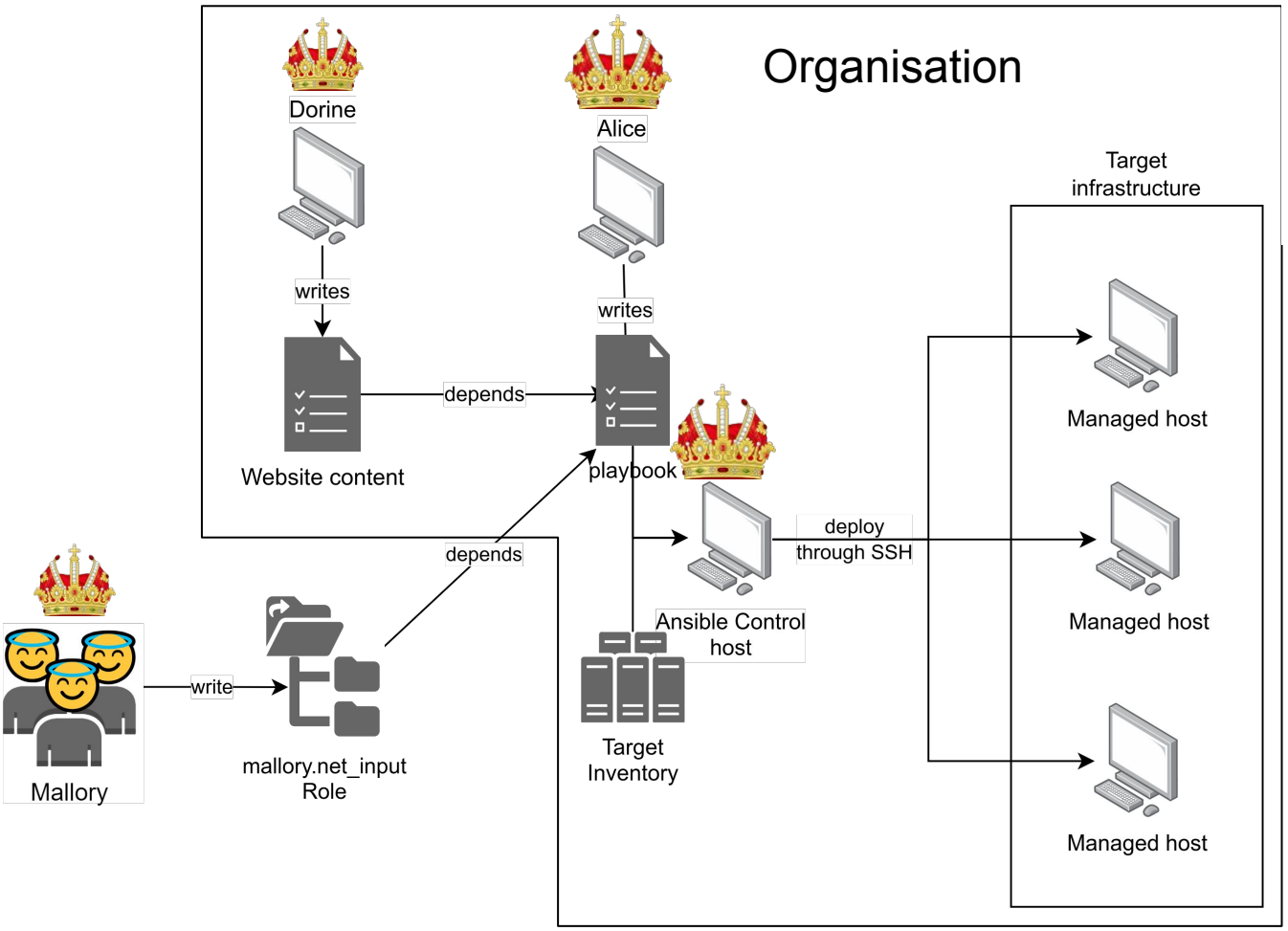



```yaml
---
- name: Ansible Playbook to Install and Setup Apache
  hosts: webserver
  become: true
  gather_facts: false
  tasks:
    - name: Install latest version of Apache
      apt:
        name: apache2
        update_cache: true
        state: latest
```

website-content tasks
(by Dorine)

network-related content
(by Mallory)

The Ansible example

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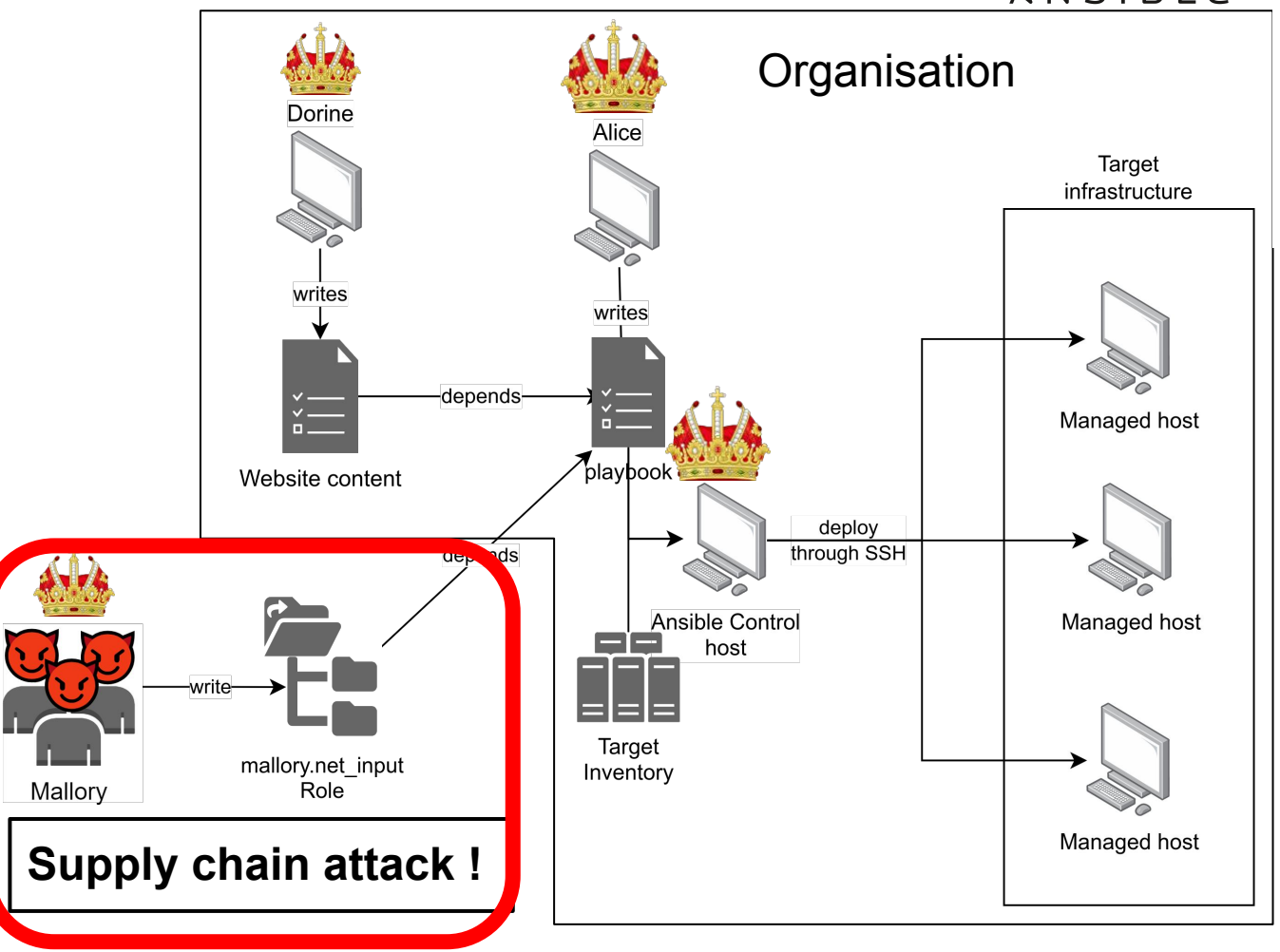


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  hosts: webserver
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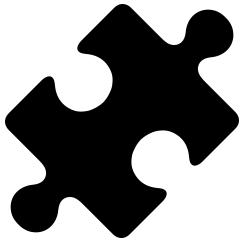
      apt:
        name: apache2
        update_cache: true
        state: latest
```

website-content tasks
(by Dorine)

network-related content
(by Mallory)

Link a RootAsRole policy to Ansible deployments



sr
become
plugin

```
{
  // TRUNCATED
  "roles": [
    {
      "name": "deploy_apache",
      "actors": [
        {
          "type": "group",
          "groups": [
            "ansible"
          ]
        }
      ],
      "tasks": [
        {
          "name": "install_apache2",
          "purpose": "Install latest version of Apache",
          "cred": {
            "capabilities": {
              "default": "none",
              "add": [
                "CAP_DAC_OVERRIDE",
                "CAP_NET_BIND_SERVICE"
              ]
            }
          },
```

```
---
- name: Ansible Playbook to Install and Setup Apache on Ubuntu
  hosts: webserver
  become: true
  become_method: sr
  gather_facts: false
  tasks:
    - name: Install latest version of Apache
      become_flags: "-r deploy_apache -t install apache2"
      apt:
        name: apache2
        update_cache: true
        state: latest
```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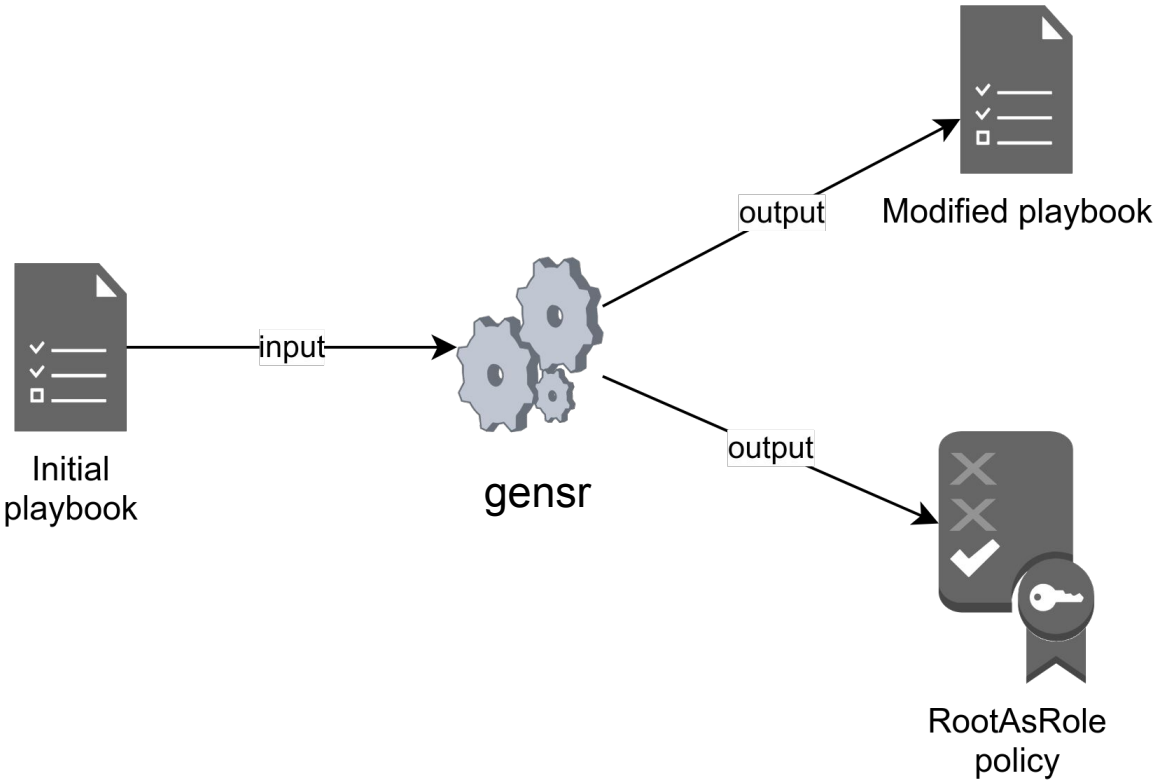
As we don’t want to do it by our hands



(PoC)

Conclusion

- **We propose “sr”, which is better solution than sudo**
- **We provide automation tools to help lazy people**
- **We integrate the solution to Ansible IaC solution**

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A PhD open to Opportunities in Cybersecurity

Seeking Roles in:

- **Secure System Design & Architecture**
- **Cybersecurity Expert or R&D**
- **Or propose a better one 😁**

What I Bring:

- Expertise in Linux security (SELinux, eBPF, nftables, etc.)
- Foundations in secure coding and access control models
- Proven successes in R&D and vulnerability analysis

Contact Me:

📧 eddie.billoir@gmail.com

Let's talk !

Root As Role

Give us a star

ESORICS 2025

Rank A accepted paper

Questions ?

Eddie Billoir,
Romain Laborde,
Ahmad Samer Wazan,
Yves Rütschlé,
Abdelmalek Benzekri

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