Operating System fundamentals

Configure and secure SSH

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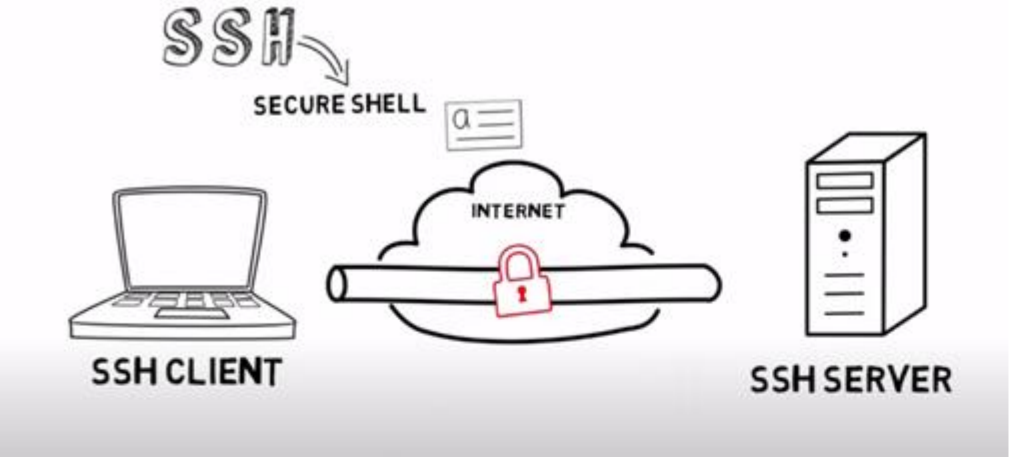
Course text

- Chapter 15. Configure and Secure SSH
  - (RedHat chapter 10 + extra material)
  - Access the Remote Command Line with SSH
  - Configure SSH Key-based Authentication
  - Customize OpenSSH Service Configuration

How does SSH work?

How does SSH work?

- server has a “fingerprint”
- ssh checks if the fingerprint corresponds to known fingerprints
- if ok: creates an encrypted connection with the server



Checking the fingerprint

```
The authenticity of host '192.168.56.110 (192.168.56.110)' can't be
established.

ED25519 key fingerprint is
SHA256:egKYWuLRs+un6P62++dUHet8I7ifbsl7PnxagouFxzE.

This key is not known by any other names

Are you sure you want to continue connecting (yes/no/[fingerprint])?
```

Examples

```
[student@workstation ~]$ ssh hosta
student@hosta password: student
...output omitted...
[student@hosta ~]$
```

user account not specified, current user

```
[student@host ~]$ ssh developer@hosta
developer@hosta's password: shadowman
...output omitted...
[developer@hosta ~]$
```

different user account specified

```
[student@host ~]$ ssh developer@hosta hostname
developer@hosta's password: shadowman
hosta.lab.example.com
[developer@hosta ~]$
```

do not login, simply run a command

Examples

```
[student@host ~]$ ssh developer@10.20.30.5
developer@10.20.30.5 password: shadowman
...output omitted...
[developer@hosta ~]$
```

Sometimes ip addresses are used when the hostname cannot be resolved using dns

```
[student@host ~]$ ssh developer@myserver.kdg.be
developer@myserver.kdg.be password: shadowman
...output omitted...
[developer@myserver ~]$
```

or a full domain name can be used

Identifying remote users

```
[developer@host ~]$ ssh developer@hosta
developer@hosta's password: redhat
[developer@hosta ~]$ w -f
 16:13:38 up 36 min,  1 user,  load average: 0.00, 0.00, 0.00
USER             TTY      FROM             LOGIN@   IDLE   JCPU   PCPU
WHAT
developer2   pts/0    172.25.250.10    16:13    7:30   0.01s  0.01s -bash
developer1   pts/1    172.25.250.10    16:24    3.00s  0.01s  0.00s w
[developer@hosta ~]$
```

Exercise

- Create an SSH connection from your graphical VM to the headless VM and look at the output of the “w” command

Encryption

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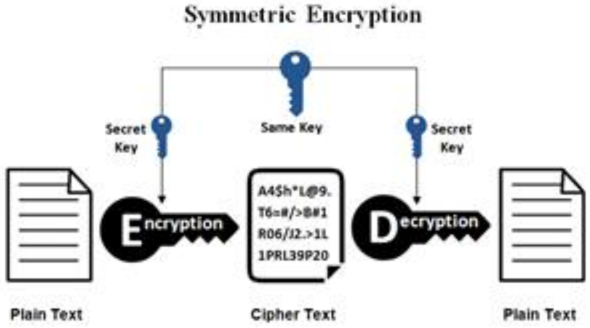
Symmetric and asymmetric encryption

- SSH uses 2 types of encryption
  - symmetric encryption: 1 key is used for encryption and decryption
  - asymmetric encryption: 2 keys are used (1 for encryption and the other for decryption)

Symmetric encryption

- One key is negotiated with which messages are encrypted
- The same key is used to decrypt the message

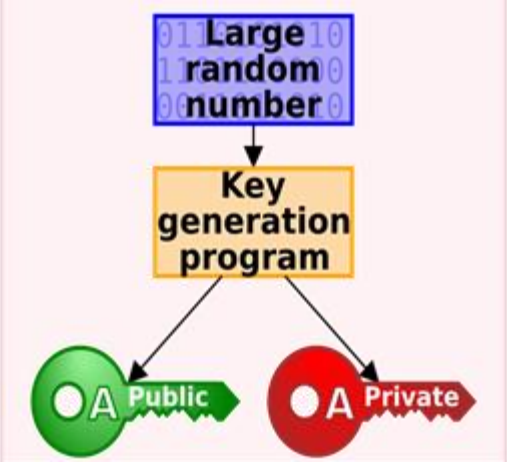
- advantage
  - encryption and decryption is fast
- disadvantage
  - you have to communicate the key with the other party -> possible security problem is somebody can intercept this



Asymmetric encryption

Two key are generated

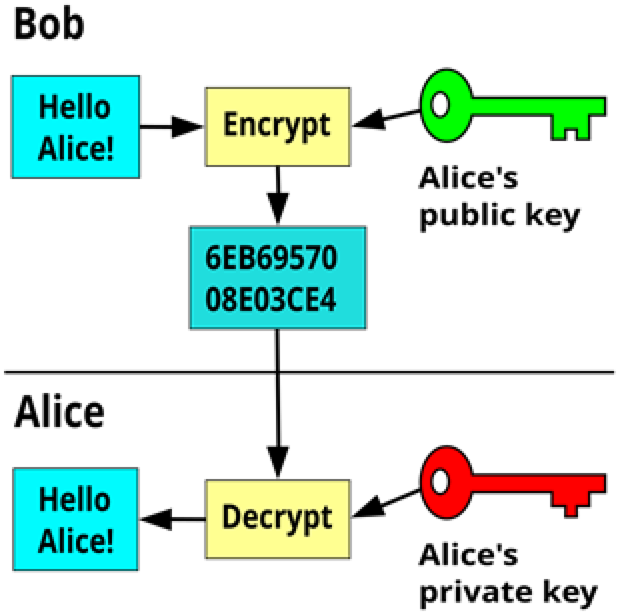
- the public key is visible for everybody
- the private key is not communicated with anybody



source: wikipedia

Asymmetric encryption

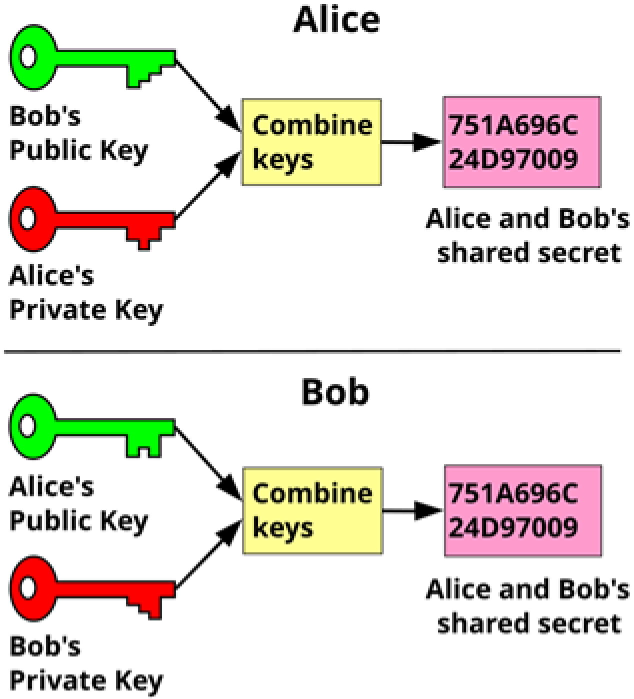
You can use one key to encrypt and the other to decrypt



source: wikipedia

Asymmetric encryption

Keys of both parties can be used in coniunction



source: wikipedia

SSH and encryption

- In order to create a connection with a remote server asymmetric encryption is used
- The fingerprint is the public key of the remote machine
- After this a new (symmetric) key is negotiated
- The new key is then used to encrypt all network traffic

Configuration and fingerprints

Take a look at these files on your virtual machine

- The configuration of SSH can be found in:
  - /etc/ssh/ssh_config (system wide)
  - ~/.ssh/config (per user)
- SSH saves fingerprints (public keys) of known servers in:
  - /etc/ssh/ssh_known_hosts (system wide)
  - ~/.ssh/known_hosts (per user)
- if the fingerprint does not correspond to the known one an error is displayed and access is denied
  - can be because of a man-in-the-middle attack
  - can also be a reset of the server

Key based authentication

SSH authentication

- You can login using SSH in two ways
  - with password
  - using an (asymmetrical) key
- Using a key:
  - generate a pair of keys using “**ssh-keygen**”
  - copy the public key to the server using“**ssh-copy-id**”
  - connect now using ssh

SSH key generation

```
[user@host ~]$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/user/.ssh/id_rsa): Enter
Created directory '/home/user/.ssh'.
Enter passphrase (empty for no passphrase): Enter
Enter same passphrase again: Enter
Your identification has been saved in /home/user/.ssh/id_rsa.
Your public key has been saved in /home/user/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:vxutUNPio3QDCyvkYm1 user@host.lab.example.com
The key's randomart image is:
+---[RSA 2048]----+
|                 |
|   .     .       |
|  o o     o      |
| . = o   o .     |
|  o + = S E .    |
| ..O o + * +     |
|.+% O . + B .    |
|=*oO . . + *     |
|++.      . +.    |
+----[SHA256]-----+
```

SSH key generation

- Remarks
  - you can protect the private key with a password
    - the password will be asked for, every time you use the private key
    - advantage: the password is not sent over the network. It stays on your local machine
  - using the -f option another name for the key pair can be specified (default is “id_rsa”)
  - if the name of an existing key pair is given, the keys are <u>overwritten</u>!
    - backup regularly!

Copy the public key to the server

```
[user@host ~]$ ssh-copy-id -i .ssh/id_rsa.pub user@remotehost
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed:
"/home/user/.ssh/id_rsa.pub"
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new
key(s), to filter out any that are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if
you are prompted now it is to install the new keys
user@remotehost's password: redhat
Number of key(s) added: 1

Now try logging into the machine, with:   "ssh 'user@remotehost'"
and check to make sure that only the key(s) you wanted were added.
```

Exercise

- remove the ~/.ssh directory in your graphical VM and also in the headless server
- Create a key pair on your graphical VM (use a password to protect it)
- Can you find the location of the generated keys?
- Transfer the public key to the headless server
- Look what happens in the .ssh directory
- Look what happens to the .ssh directory on the headless server (authorized_keys)
- Create an SSH connection from the graphical VM towards the headless server. What happens when you have to provide the password for the private key?
- Log out and log back in with SSH. Do you need to provide the password again?

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Key managers

What is a key manager?

- When you create a private key with a password, it needs to be provided every time you use it
- A key manager stores passwords locally so you don’t need to type them in every time

Manual key manager

- In the graphical version the key manager is automatically activated
- In the headless version you can enable the key manager using this command:
  eval $(ssh-agent)
- now you have to manually add the password to the key manager using **ssh-add**

Exercise

- Create a key pair on the headless server (using a password)
- Put the public key on the graphical VM
- Create twice an ssh connection to the graphical VM
  - do you need to enter the password every time?
- Start the key manager
- Add the password to the key manager
- Create an ssh connection with the graphical VM
  - normally you should not have to enter a password now

SSH configuration

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SSH configuration

- You can improve the security of SSH
  - make sure that root cannot use SSH to login
  - disable the possibility to login using a password (enforce the key pair method)

Disabling root access

- Open the file **/etc/ssh/sshd_config**
- Search for “PermitRootLogin”
- Set it to “no”
- Restart the SSH service with **systemctl reload sshd**

Disable password acces with SSH

- Open the file **/etc/ssh/sshd_config**
- Search for “PasswordAuthentication”
- Set this to “no”
- Restart the SSH service with **systemctl reload sshd**

Exercises

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Exercises

- KdG
  - …
- RedHat
  - ch10s02
  - ch10s04
  - ch10s06
  - ch10s07

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