Universidad Nacional de Educación a Distancia

Escuela Técnica Superior de Ingeniería Informática

Proyecto de fin de Grado en Ingeniería Informática

Planificación eficiente de infraestructuras virtuales basadas en docker y kubernetes para el streaming de vídeo

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Curso 2022/2023, convocatoria junio

Planificación eficiente de infraestructuras virtuales basadas en docker y kubernetes para el streaming de vídeo

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de modalidad genérica

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Fecha de lectura y defensa: Fecha de lectura

Agradecimientos

Incluir todos los agradecimientos

Resumen

Se pretende realizar despliegue y evaluación de diversas tecnologías de servidores de streaming de video sobre contenedores ligeros. Para la consecución del objetivo principal, se deberán realizar los siguientes:

- Creación de las infraestructuras paralelas distribuidas.
- Recopilación de información sobre servidores de streaming de video.
- Puesta en marcha y evaluación de prestaciones de los servidores de vídeo seleccionados.
- Generación de documentación para el despliegue de los servidores utilizados tanto en local como en la nube.

Abstract

Resúmen del PFG en inglés.

Palabras clave

video, distribuido, Kubernetes

Keywords

video, distributed, Kubernetes

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Capítulo 1

Introducción

La utilización de "nuevas tecnologías"para la educación es uno de los temas centrales de las universidades y centros educativos en todo el mundo. Con la aparición de internet a finales de la década de los ToDo con la idea de compartir información de forma más rápida. La UNED ha conseguido acercar la experiencia de la formación presencial a la modalidad remota mediante la utilización de herramientas que se han ido modernizando con el paso del tiempo. Desde el uso de la radio y vídeos, pasando por televisión y más recientemente las clases online, la UNED siempre ha intentado poner a disposición de sus alumnos material audiovisual que ayudara al alumnado a la obtención de los conocimientos necesarios. Actualmente la utilización de diversas plataformas online ayudan a conseguir dicho objetivo. Una de las maneras en que se puede mejorar la calidad de la educación a distancia es mediante las clases online con streaming de vídeo. En este momento esta es una d elas herramientas utilizadas por nuestra universidad y por ello es interesante conocer herramientas que puedan ayudar ToDo

En este TFG he intentado revisar algunas tecnologías que ayuden a realizar el lema de nuestra UNED "Que la sabiduría se mueva más que las cosas que se mueven". Para ello he llevao a cabo pruebas de renidmiento sobre servidores de vídeo que puedan ayudar a realizar eficientemente streaming de vídeo y que esto se convierta en una herramienta más que ayude a la transferencia de información del profesorado al alumnado.

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Estado del arte

Capítulo 3

Propuesta

Contenido del capítulo...

Capítulo 4

Diseño

Contenido del capítulo...

Capítulo 5

Desarrollo del proyecto

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Capítulo 6

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Capítulo 7

Conclusiones

Contenido del capítulo...

Bibliografía

[1] G. Sayfan, *Compiladores: Principios, técnicas y herramientas.* Pearson Addison-Wesley, 2008.

[2] J. M. Díaz Martínez, *Fundamentos básicos de los sistemas operativos.* Sanz y Torres S.L., 2011.

[3] Giridharaprasad. (2020, January) Setup kubernetes cluster using kubeadm in vsphere virtual machines. [Online]. Available: https://gprasath.medium.com/setup-kubernetes-cluster-using-kubeadm-in-vsphere-virtual-machines-985372ee5b97

Apéndice A

Primer anexo

Contenido del anexo...

Apéndice B

Segundo anexo

```
args@BobPc02:\$ docker pull somatorio/obs-studio
Using default tag: latest
latest: Pulling from somatorio/obs-studio
b3e1c725a85f: Pull complete
4daad8bdde31: Pull complete
63fe8c0068a8: Pull complete
4a70713c436f: Pull complete
bd842a2105a8: Pull complete
ad2d0b4ee955: Pull complete
Digest: sha256:583b32f6719ff422f70cc553d97968b34025f0bc3cc1e5495bcb46c7ea672fb3
Status: Downloaded newer image for somatorio/obs-studio:latest
docker.io/somatorio/obs-studio:latest
```

isntall obs studio

```
root@BobPc02:/home/args# sudo apt-get update && apt-get install -y obs-studio
    curl ffmpeg
```

Installing Ansible and sshpass. checking ansible version

```
tfg@mint01:~$ sudo apt update && sudo apt install software-properties-common &&
    sudo add-apt-repository --yes ppa:ansible/ansible && sudo apt install ansible
Hit:1 http://mirror.tedra.es/ubuntu jammy InRelease
Hit:2 http://mirror.tedra.es/ubuntu jammy-updates InRelease
Hit:3 http://mirror.tedra.es/ubuntu jammy-backports InRelease
Get:4 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Ign:5 https://mirrors.ptisp.pt/linuxmint vera InRelease
Hit:6 https://mirrors.ptisp.pt/linuxmint vera Release
Hit:8 https://download.sublimetext.com apt/stable/ InRelease
Get:9 http://security.ubuntu.com/ubuntu jammy-security/main amd64 DEP-11
    Metadata [41,4 kB]
Get:10 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 DEP-11
    Metadata [18,5 kB]
Fetched 170 kB in 1s (214 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
7 packages can be upgraded. Run 'apt list --upgradable' to see them.
W: https://download.sublimetext.com/apt/stable/InRelease: Key is stored in
    legacy trusted.gpg keyring (/etc/apt/trusted.gpg), see the DEPRECATION
    section in apt-key(8) for details.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
software-properties-common
```

```
0 upgraded, 1 newly installed, 0 to remove and 7 not upgraded.
Need to get 9.712 B of archives.
After this operation, 16,4 kB of additional disk space will be used.
Get:1 https://mirrors.ptisp.pt/linuxmint vera/upstream amd64 software-properties
    -common all 2.2.1 [9.712 B]
Fetched 9.712 B in 0s (26,5 kB/s)
Selecting previously unselected package software-properties-common.
(Reading database ... 610456 files and directories currently installed.)
Preparing to unpack .../software-properties-common_2.2.1_all.deb ...
Unpacking software-properties-common (2.2.1) ...
Setting up software-properties-common (2.2.1) ...
You are about to add the following PPA:
Ansible is a radically simple IT automation platform that makes your
    applications and systems easier to deploy. Avoid writing scripts or custom
    code to deploy and update your applications automate in a language that
    approaches plain English, using SSH, with no agents to install on remote
    systems.

http://ansible.com/

If you face any issues while installing Ansible PPA, file an issue here:
https://github.com/ansible-community/ppa/issues
More info: https://launchpad.net/~ansible/+archive/ubuntu/ansible
gpg: directory '/root/.gnupg' created
gpg: keybox '/root/.gnupg/pubring.kbx' created
gpg: /root/.gnupg/trustdb.gpg: trustdb created
gpg: keybox '/etc/apt/keyrings/6125E2A8C77F2818FB7BD15B93C4A3FD7BB9C367.keyring'
    created
gpg: key 93C4A3FD7BB9C367: public key "Launchpad PPA for Ansible, Inc." imported
gpg: Total number processed: 1
gpg:               imported: 1
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
python-babel-localedata python3-argcomplete python3-babel python3-distutils
python3-dnspython python3-jinja2 python3-jmespath python3-kerberos
python3-lib2to3 python3-libcloud python3-lockfile python3-ntlm-auth
python3-pycryptodome python3-requests-kerberos python3-requests-ntlm
python3-requests-toolbelt python3-selinux python3-simplejson python3-tz
python3-winrm python3-xmltodict
Suggested packages:
cowsay sshpass python3-sniffio python3-trio python-jinja2-doc
python-lockfile-doc
The following NEW packages will be installed:
ansible python-babel-localedata python3-argcomplete python3-babel
python3-distutils python3-dnspython python3-jinja2 python3-jmespath
python3-kerberos python3-lib2to3 python3-libcloud python3-lockfile
python3-ntlm-auth python3-pycryptodome python3-requests-kerberos
python3-requests-ntlm python3-requests-toolbelt python3-selinux
python3-simplejson python3-tz python3-winrm python3-xmltodict
0 upgraded, 22 newly installed, 0 to remove and 7 not upgraded.
Need to get 26,1 MB of archives.
After this operation, 259 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://mirror.tedra.es/ubuntu jammy/main amd64 python-babel-localedata all
    2.8.0+dfsg.1-7 [4.982 kB]
Get:2 http://mirror.tedra.es/ubuntu jammy-updates/main amd64 python3-tz all
```

```
    2022.1-1ubuntu0.22.04.0 [33,4 kB]
Get:3 http://mirror.tedra.es/ubuntu jammy/main amd64 python3-babel all 2.8.0+
    dfsg.1-7 [85,1 kB]
Get:4 http://mirror.tedra.es/ubuntu jammy/main amd64 python3-jinja2 all 3.0.3-1
    [108 kB]
Get:5 http://mirror.tedra.es/ubuntu jammy/main amd64 python3-pycryptodome amd64
    3.11.0+dfsg1-3build1 [1.027 kB]
Get:6 http://mirror.tedra.es/ubuntu jammy-updates/main amd64 python3-lib2to3 all
     3.10.6-1~22.04 [77,6 kB]
Get:7 http://mirror.tedra.es/ubuntu jammy-updates/main amd64 python3-distutils
    all 3.10.6-1~22.04 [139 kB]
Get:8 http://mirror.tedra.es/ubuntu jammy/main amd64 python3-dnspython all
    2.1.0-1ubuntu1 [123 kB]
Get:9 http://mirror.tedra.es/ubuntu jammy/universe amd64 ansible all 2.10.7+
    merged+base+2.10.8+dfsg-1 [17,5 MB]
Get:10 http://mirror.tedra.es/ubuntu jammy/universe amd64 python3-argcomplete
    all 1.8.1-1.5 [27,2 kB]
Get:11 http://mirror.tedra.es/ubuntu jammy/main amd64 python3-jmespath all
    0.10.0-1 [21,7 kB]
Get:12 http://mirror.tedra.es/ubuntu jammy/universe amd64 python3-kerberos amd64
     1.1.14-3.1build5 [23,0 kB]
Get:13 http://mirror.tedra.es/ubuntu jammy/main amd64 python3-lockfile all
    1:0.12.2-2.2 [14,6 kB]
Get:14 http://mirror.tedra.es/ubuntu jammy/main amd64 python3-simplejson amd64
    3.17.6-1build1 [54,7 kB]
Get:15 http://mirror.tedra.es/ubuntu jammy/universe amd64 python3-libcloud all
    3.2.0-2 [1.554 kB]
Get:16 http://mirror.tedra.es/ubuntu jammy/universe amd64 python3-ntlm-auth all
    1.4.0-1 [20,4 kB]
Get:17 http://mirror.tedra.es/ubuntu jammy/universe amd64 python3-requests-
    kerberos all 0.12.0-2 [11,9 kB]
Get:18 http://mirror.tedra.es/ubuntu jammy/universe amd64 python3-requests-ntlm
    all 1.1.0-1.1 [6.160 B]
Get:19 http://mirror.tedra.es/ubuntu jammy/main amd64 python3-requests-toolbelt
    all 0.9.1-1 [38,0 kB]
Get:20 http://mirror.tedra.es/ubuntu jammy/universe amd64 python3-selinux amd64
    3.3-1build2 [159 kB]
Get:21 http://mirror.tedra.es/ubuntu jammy/universe amd64 python3-xmltodict all
    0.12.0-2 [12,6 kB]
Get:22 http://mirror.tedra.es/ubuntu jammy/universe amd64 python3-winrm all
    0.3.0-2 [21,7 kB]
Fetched 26,1 MB in 3s (8.628 kB/s)
Selecting previously unselected package python-babel-localedata.
(Reading database ... 610459 files and directories currently installed.)
Preparing to unpack .../00-python-babel-localedata_2.8.0+dfsg.1-7_all.deb ...
Unpacking python-babel-localedata (2.8.0+dfsg.1-7) ...
Selecting previously unselected package python3-tz.
Preparing to unpack .../01-python3-tz_2022.1-1ubuntu0.22.04.0_all.deb ...
Unpacking python3-tz (2022.1-1ubuntu0.22.04.0) ...
Selecting previously unselected package python3-babel.
Preparing to unpack .../02-python3-babel_2.8.0+dfsg.1-7_all.deb ...
Unpacking python3-babel (2.8.0+dfsg.1-7) ...
Selecting previously unselected package python3-jinja2.
Preparing to unpack .../03-python3-jinja2_3.0.3-1_all.deb ...
Unpacking python3-jinja2 (3.0.3-1) ...
Selecting previously unselected package python3-pycryptodome.
Preparing to unpack .../04-python3-pycryptodome_3.11.0+dfsg1-3build1_amd64.deb .
..
```

```
Unpacking python3-pycryptodome (3.11.0+dfsg1-3build1) ...
Selecting previously unselected package python3-lib2to3.
Preparing to unpack .../05-python3-lib2to3_3.10.6-1~22.04_all.deb ...
Unpacking python3-lib2to3 (3.10.6-1~22.04) ...
Selecting previously unselected package python3-distutils.
Preparing to unpack .../06-python3-distutils_3.10.6-1~22.04_all.deb ...
Unpacking python3-distutils (3.10.6-1~22.04) ...
Selecting previously unselected package python3-dnspython.
Preparing to unpack .../07-python3-dnspython_2.1.0-1ubuntu1_all.deb ...
Unpacking python3-dnspython (2.1.0-1ubuntu1) ...
Selecting previously unselected package ansible.
Preparing to unpack .../08-ansible_2.10.7+merged+base+2.10.8+dfsg-1_all.deb ...
Unpacking ansible (2.10.7+merged+base+2.10.8+dfsg-1) ...
Selecting previously unselected package python3-argcomplete.
Preparing to unpack .../09-python3-argcomplete_1.8.1-1.5_all.deb ...
Unpacking python3-argcomplete (1.8.1-1.5) ...
Selecting previously unselected package python3-jmespath.
Preparing to unpack .../10-python3-jmespath_0.10.0-1_all.deb ...
Unpacking python3-jmespath (0.10.0-1) ...
Selecting previously unselected package python3-kerberos.
Preparing to unpack .../11-python3-kerberos_1.1.14-3.1build5_amd64.deb ...
Unpacking python3-kerberos (1.1.14-3.1build5) ...
Selecting previously unselected package python3-lockfile.
Preparing to unpack .../12-python3-lockfile_1%3a0.12.2-2.2_all.deb ...
Unpacking python3-lockfile (1:0.12.2-2.2) ...
Selecting previously unselected package python3-simplejson.
Preparing to unpack .../13-python3-simplejson_3.17.6-1build1_amd64.deb ...
Unpacking python3-simplejson (3.17.6-1build1) ...
Selecting previously unselected package python3-libcloud.
Preparing to unpack .../14-python3-libcloud_3.2.0-2_all.deb ...
Unpacking python3-libcloud (3.2.0-2) ...
Selecting previously unselected package python3-ntlm-auth.
Preparing to unpack .../15-python3-ntlm-auth_1.4.0-1_all.deb ...
Unpacking python3-ntlm-auth (1.4.0-1) ...
Selecting previously unselected package python3-requests-kerberos.
Preparing to unpack .../16-python3-requests-kerberos_0.12.0-2_all.deb ...
Unpacking python3-requests-kerberos (0.12.0-2) ...
Selecting previously unselected package python3-requests-ntlm.
Preparing to unpack .../17-python3-requests-ntlm_1.1.0-1.1_all.deb ...
Unpacking python3-requests-ntlm (1.1.0-1.1) ...
Selecting previously unselected package python3-requests-toolbelt.
Preparing to unpack .../18-python3-requests-toolbelt_0.9.1-1_all.deb ...
Unpacking python3-requests-toolbelt (0.9.1-1) ...
Selecting previously unselected package python3-selinux.
Preparing to unpack .../19-python3-selinux_3.3-1build2_amd64.deb ...
Unpacking python3-selinux (3.3-1build2) ...
Selecting previously unselected package python3-xmltodict.
Preparing to unpack .../20-python3-xmltodict_0.12.0-2_all.deb ...
Unpacking python3-xmltodict (0.12.0-2) ...
Selecting previously unselected package python3-winrm.
Preparing to unpack .../21-python3-winrm_0.3.0-2_all.deb ...
Unpacking python3-winrm (0.3.0-2) ...
Setting up python3-lockfile (1:0.12.2-2.2) ...
Setting up python3-requests-toolbelt (0.9.1-1) ...
Setting up python3-ntlm-auth (1.4.0-1) ...
Setting up python3-pycryptodome (3.11.0+dfsg1-3build1) ...
Setting up python3-kerberos (1.1.14-3.1build5) ...
Setting up python3-tz (2022.1-1ubuntu0.22.04.0) ...
```

```
Setting up python-babel-localedata (2.8.0+dfsg.1-7) ...
Setting up python3-simplejson (3.17.6-1build1) ...
Setting up python3-xmltodict (0.12.0-2) ...
Setting up python3-jmespath (0.10.0-1) ...
Setting up python3-requests-kerberos (0.12.0-2) ...
Setting up python3-dnspython (2.1.0-1ubuntu1) ...
Setting up python3-selinux (3.3-1build2) ...
Setting up python3-argcomplete (1.8.1-1.5) ...
Setting up python3-lib2to3 (3.10.6-1~22.04) ...
Setting up python3-distutils (3.10.6-1~22.04) ...
Setting up python3-requests-ntlm (1.1.0-1.1) ...
Setting up python3-babel (2.8.0+dfsg.1-7) ...
update-alternatives: using /usr/bin/pybabel-python3 to provide /usr/bin/pybabel
(pybabel) in auto mode
Setting up python3-libcloud (3.2.0-2) ...
Setting up python3-jinja2 (3.0.3-1) ...
Setting up python3-winrm (0.3.0-2) ...
Setting up ansible (2.10.7+merged+base+2.10.8+dfsg-1) ...
Processing triggers for man-db (2.10.2-1) ...
tfg@mint00:~$ ansible --version
ansible 2.10.8
config file = None
configured module search path = ['/home/tfg/.ansible/plugins/modules', '/usr/
    share/ansible/plugins/modules']
ansible python module location = /usr/lib/python3/dist-packages/ansible
executable location = /usr/bin/ansible
python version = 3.10.6 (main, Mar 10 2023, 10:55:28) [GCC 11.3.0]

tfg@Mint03:~$ sudo apt-get install sshpass
[sudo] password for tfg:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
sshpass
0 upgraded, 1 newly installed, 0 to remove and 8 not upgraded.
Need to get 11,7 kB of archives.
After this operation, 35,8 kB of additional disk space will be used.
Get:1 http://mirror.tedra.es/ubuntu jammy/universe amd64 sshpass amd64 1.09-1
    [11,7 kB]
Fetched 11,7 kB in 0s (214 kB/s)
Selecting previously unselected package sshpass.
(Reading database ... 649950 files and directories currently installed.)
Preparing to unpack .../sshpass_1.09-1_amd64.deb ...
Unpacking sshpass (1.09-1) ...
Setting up sshpass (1.09-1) ...
Processing triggers for man-db (2.10.2-1) ...
```

Creación del cluster instalamos el master en mint00

configuración de la red de los equipos: se crea una conexión de tipo *bridge* y se le da una IP fija a cada equipo, de esta manera las VM tienen conexión a Internet y una red dedicada.

- mint00 192.168.1.100
- mint01 192.168.1.101

- mint02 192.168.1.102
- mint03 192.168.1.103

instalación kubectl: se descarga la última release:

```
curl -LO https://storage.googleapis.com/kubernetes-release/release/$(curl -s
  https://storage.googleapis.com/kubernetes-release/release/stable.txt)/bin/
  linux/amd64/kubectl
```

hacemos que el archivo sea ejecutable

```
chmod +x kubectl
```

movemos el binario al path del usuario para ejecutarlo directamente desde la consola.

```
sudo mv kubectl /usr/local/bin/kubectl
```

probamos que se ha instalado ejecutando el comando, comprobando que muestra su ayuda

```
tfg@mint01:~$ kubectl
kubectl controls the Kubernetes cluster manager.

Find more information at: https://kubernetes.io/docs/reference/kubectl/

Basic Commands (Beginner):
create          Create a resource from a file or from stdin
expose          Take a replication controller, service, deployment or pod and
expose it as a new Kubernetes service
run             Run a particular image on the cluster
set             Set specific features on objects

Basic Commands (Intermediate):
explain         Get documentation for a resource
get             Display one or many resources
edit            Edit a resource on the server
delete          Delete resources by file names, stdin, resources and names, or
by resources and label selector

Deploy Commands:
rollout         Manage the rollout of a resource
scale           Set a new size for a deployment, replica set, or replication
controller
autoscale       Auto-scale a deployment, replica set, stateful set, or
replication controller

Cluster Management Commands:
certificate     Modify certificate resources.
cluster-info    Display cluster information
top             Display resource (CPU/memory) usage
cordon          Mark node as unschedulable
uncordon        Mark node as schedulable
drain           Drain node in preparation for maintenance
taint           Update the taints on one or more nodes

Troubleshooting and Debugging Commands:
```

```
describe        Show details of a specific resource or group of resources
logs            Print the logs for a container in a pod
attach          Attach to a running container
exec            Execute a command in a container
port-forward    Forward one or more local ports to a pod
proxy           Run a proxy to the Kubernetes API server
cp              Copy files and directories to and from containers
auth            Inspect authorization
debug           Create debugging sessions for troubleshooting workloads and
nodes
events          List events

Advanced Commands:
diff            Diff the live version against a would-be applied version
apply           Apply a configuration to a resource by file name or stdin
patch           Update fields of a resource
replace         Replace a resource by file name or stdin
wait            Experimental: Wait for a specific condition on one or many
resources
kustomize       Build a kustomization target from a directory or URL

Settings Commands:
label           Update the labels on a resource
annotate        Update the annotations on a resource
completion      Output shell completion code for the specified shell (bash,
zsh, fish, or powershell)

Other Commands:
api-resources   Print the supported API resources on the server
api-versions    Print the supported API versions on the server, in the form of
"group/version"
config          Modify kubeconfig files
plugin          Provides utilities for interacting with plugins
version         Print the client and server version information

Usage:
kubectl [flags] [options]

Use "kubectl <command> --help" for more information about a given command.
Use "kubectl options" for a list of global command-line options (applies to all
commands).
```

podemos ejecutar los 4 comandos a la vez:

```
curl -LO https://storage.googleapis.com/kubernetes-release/release/$(curl -s
  https://storage.googleapis.com/kubernetes-release/release/stable.txt)/bin/
  linux/amd64/kubectl &&  chmod +x ./kubectl && sudo mv ./kubectl /usr/local/
  bin/kubectl && kubectl
```

Instalamos docker Engine

```

```