

Universidad Nacional Autónoma de México

Facultad de Ingeniería

Fundamentos de Sistemas Embebidos

Reporte de Práctica 1: Instalación de Raspbian en la Raspberry Pi

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1. Introducción

Se instaló y configuró Raspberry Pi OS en una Raspberry Pi 4 Model B, incluyendo su red alámbrica, actualización, y configuración desacoplada con acceso remoto vía SSH desde un sistema anfitrión con Ubuntu.

2. Desarrollo

Se identificó la microSD con lsblk y se grabó la imagen oficial de Raspberry Pi OS Lite (64 bits) directamente sobre el dispositivo con `sudo dd of=/dev/mmcblk0 bs=4M status=progress conv=fsync`. En la partición de arranque se depositaron los archivos `ssh` y `userconf.txt` para habilitar el acceso remoto sin periféricos, y en la partición raíz (ext4, montada solo desde el sistema anfitrión) se configuró `eth0.nmconnection` con `method=auto` para DHCP. Tras el primer arranque se confirmó la IP asignada y se estableció la conexión SSH.

Al actualizar el sistema con `sudo apt update && apt upgrade -y` se obtuvo el error "Unable to acquire the dpkg frontend lock", ya que `&&` solo antepone `sudo` al primer comando de la cadena. Se corrigió ejecutando `sudo apt upgrade -y` de forma explícita, tras lo cual se instalaron 98 paquetes y 8 nuevos sin incidentes, reiniciando el equipo para aplicar el nuevo kernel.

3. Resultados experimentales

A continuación se presenta la evidencia correspondiente a los tres ejercicios de la práctica: instalación y arranque del sistema, actualización, y configuración desacoplada con acceso remoto vía SSH.

```
Debian GNU/Linux 13 raspberrypi tty1
#0 IP address is 192.168.0.200 ::ffff:127.0.1.1
raspberrypi login: pi
Passwd:
Linux raspberrypi 6.18.34-rpt-rpi-v0 #1 SMP PREEMPT Debian 1:6.18.34-1+rpt1 (2026-06-09) aarch64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.

Wi-Fi is currently blocked by rfkill.
Use raspi-config to set the country before use.

pi@raspberrypi:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default qlen 1000
    link/ether 88:a2:9e:63:22:20 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.200/24 brd 192.168.0.255 scope global dynamic noprefixroute eth0
        valid_lft 3300sec preferred_lft 3300sec
    inet6 fe80::a2:9e:63:22:20/64 scope link
    link/ether 88:a2:9e:63:22:21 brd ff:ff:ff:ff:ff:ff
pi@raspberrypi:~$ hostname -I
192.168.0.200
pi@raspberrypi:~$
```

Figura 1. Inicio de sesión local exitoso en la Raspberry Pi tras el primer arranque; se muestran además las salidas de `ip a` y `hostname -I`, confirmando la dirección IP asignada por DHCP a la interfaz `eth0` (ejercicio 1).

```
pi@raspberrypi: ~ -- ssh pi@192.168.0.200
~/Downloads

The authenticity of host '192.168.0.200 (192.168.0.200)' can't be established.
ED25519 key fingerprint is: SHA256:CdgA9E60iHA6JJ+Y57aHwTDxJLJY+WiM4NscIQpGNos
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '192.168.0.200' (ED25519) to the list of known hosts
pi@192.168.0.200's password:
Linux raspberrypi 6.18.34-rpt-rpi-v0 #1 SMP PREEMPT Debian 1:6.18.34-1+rpt1 (2026-06-09) aarch64

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This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.

Wi-Fi is currently blocked by rfkill.
Use raspi-config to set the country before use.

pi@raspberrypi:~$ ip addr show eth0
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default qlen 1000
    link/ether 88:a2:9e:63:22:20 brd ff:ff:ff:ff:ff:ff
    inet 192.168.0.200/24 brd 192.168.0.255 scope global dynamic noprefixroute eth0
        valid_lft 3100sec preferred_lft 3100sec
pi@raspberrypi:~$ nncli connection show eth0 | grep -i method
ipv4.method: auto
ipv6.method: disabled
proxy.method: none
pi@raspberrypi:~$
```

Figura 2. Conexión SSH establecida desde el equipo anfitrión, con aceptación de la huella digital ED25519 y confirmación de la dirección IP asignada por DHCP a `eth0` (ejercicios 1 y 3).

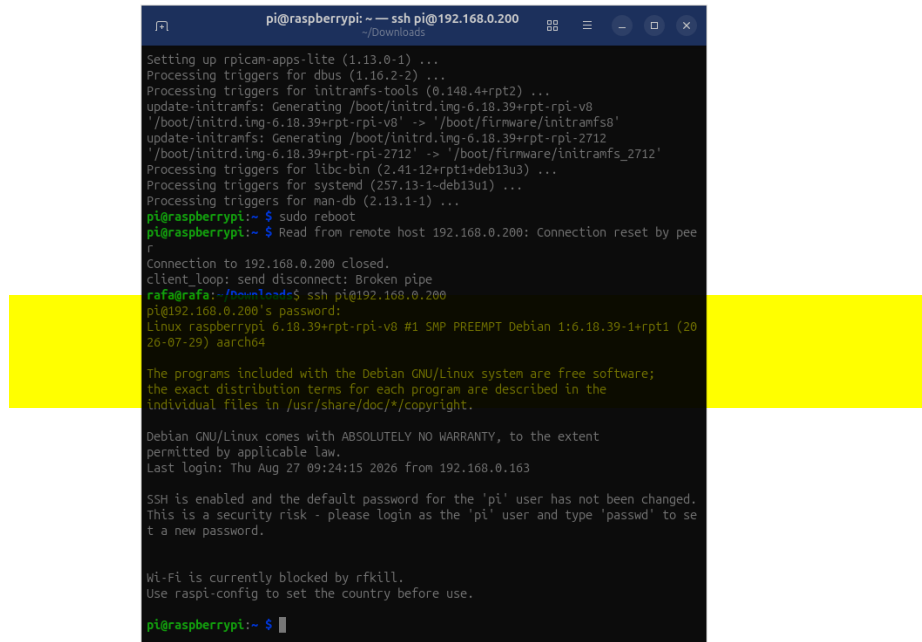
```
pi@raspberrypi: ~ -- ssh pi@192.168.0.200
~/Downloads
ages [3,144 B]
Get:18 http://deb.debian.org/debian-security trixie-security/contrib armhf Pack
ages [3,144 B]
Get:19 http://deb.debian.org/debian-security trixie-security/contrib Translatio
n-en [2,564 B]
Get:20 http://deb.debian.org/debian trixie-updates/main arm64 Packages [4,424 B
]
Get:21 http://deb.debian.org/debian trixie-updates/main armhf Packages [4,408 B
]
Fetched 27.2 MB in 6s (4,655 kB/s)
98 packages can be upgraded. Run 'apt list --upgradable' to see them.
Notice: Repository 'http://deb.debian.org/debian trixie InRelease' changed its
'Version' value from '13.5' to '13.6'
Error: Could not open lock file /var/lib/dpkg/lock-frontent - open (13: Permiss
ion denied)
Error: Unable to acquire the dpkg frontend lock (/var/lib/dpkg/lock-frontent),
are you root?
pi@raspberrypi:~$ sudo apt upgrade -y
The following package was automatically installed and is no longer required:
  libyuv0
Use 'sudo apt autoremove' to remove it.

Upgrading:
base-files          libblastlog2-2      openssl
bluez              liblzma5             openssl-provider-legacy
bsdextrautils      libmount1           python3-idna
bsdutils           libnss3             python3-urllib3
curl               libntfs-3g09t64     python3.13
dhcpcd-base        libnisp-common       python3.13-minimal
dirmngr            libnisp1            python3.13-venv
eject              libpython3.13       raspi-config
fdisk              libpython3.13-minimal raspi-config-core
firmware-atheros   libpython3.13-stdlib raspi-utils
firmware-brcm80211 librpican-app1      raspi-utils-core
firmware-libertas librpieepromab0     raspi-utils-dt
firmware-mediatek librpifwcrypto0     raspi-utils-eeeprom
firmware-realtek  libsmartcols1       raspi-utils-otp
gnupg-utils       libssh2-t64         raspinfo
```

Figura 3. Error "Unable to acquire the dpkg frontend lock" al ejecutar sudo apt update && apt upgrade -y, seguido de la ejecución correcta de sudo apt upgrade -y (ejercicio 2).

```
pi@raspberrypi: ~ -- ssh pi@192.168.0.200
~/Downloads
'/boot/vmlinuz-6.18.39+rpt-rpi-2712' -> '/boot/firmware/kernel_2712.img'
Setting up gpgsm (2.4.7-21+deb13u1+b4) ...
Setting up rpiefwcrypto (20260626-1) ...
Setting up libcurl3t64-gnutls:arm64 (8.14.1-2+deb13u4) ...
Setting up rpiefwcrypto (20260626-1) ...
Setting up python3.13-venv (3.13.5-2+deb13u4) ...
Setting up raspi-utils (20260626-1) ...
Setting up fdisk (2.41.5-0+deb13u1) ...
Setting up linux-image-rpi-2712 (1:6.18.39-1+rpt1) ...
Setting up rpi-swap (1.2.3) ...
Setting up dirmngr (2.4.7-21+deb13u1+b4) ...
Setting up linux-headers-rpi-2712 (1:6.18.39-1+rpt1) ...
Setting up linux-image-rpi-v8 (1:6.18.39-1+rpt1) ...
Setting up libdrm2:arm64 (2.4.134-3-bpo13+1+rpt1) ...
Setting up rpi-eeeprom (28.30-1) ...
Setting up curl (8.14.1-2+deb13u4) ...
Setting up raspi-config (20260730) ...
Setting up linux-headers-rpi-v8 (1:6.18.39-1+rpt1) ...
Setting up gpg-wks-client (2.4.7-21+deb13u1+b4) ...
Setting up userconf-pi (0.19) ...
Setting up libcamera-ipa:arm64 (0.7.2+rpt20260817-1) ...
Setting up libcamera0.7:arm64 (0.7.2+rpt20260817-1) ...
Setting up librpican-app1:arm64 (1.13.0-1) ...
Setting up rpican-apps-core (1.13.0-1) ...
Setting up rpican-apps-lite (1.13.0-1) ...
Processing triggers for dbus (1.16.2-2) ...
Processing triggers for initramfs-tools (0.148.4+rpt2) ...
update-initramfs: Generating /boot/initrd.img-6.18.39+rpt-rpi-v8
'/boot/initrd.img-6.18.39+rpt-rpi-v8' -> '/boot/firmware/initramfs8'
update-initramfs: Generating /boot/initrd.img-6.18.39+rpt-rpi-2712
'/boot/initrd.img-6.18.39+rpt-rpi-2712' -> '/boot/firmware/initramfs_2712'
Processing triggers for libc-bin (2.41-12+rpt1+deb13u3) ...
Processing triggers for systemd (257.13-1-deb13u1) ...
Processing triggers for man-db (2.13.1-1) ...
pi@raspberrypi:~$
```

Figura 4. Conclusión exitosa de sudo apt upgrade -y, con la instalación de los 98 paquetes actualizados y 8 paquetes nuevos (ejercicio 2).



```
pi@raspberrypi: ~ -- ssh pi@192.168.0.200
~/Downloads
Setting up rpican-apps-lite (1.13.0-1) ...
Processing triggers for dbus (1.10.2-2) ...
Processing triggers for initramfs-tools (0.148.4+rpt2) ...
update-initramfs: Generating /boot/initrd.img-6.18.39-rpt-rpi-v8
'/boot/initrd.img-6.18.39-rpt-rpi-v8' -> '/boot/firmware/initramfs8'
update-initramfs: Generating /boot/initrd.img-6.18.39-rpt-rpi-2712
'/boot/initrd.img-6.18.39-rpt-rpi-2712' -> '/boot/firmware/initramfs_2712'
Processing triggers for libc-bin (2.41-12+rpt1+deb13u3) ...
Processing triggers for systemd (257.13-1+deb13u1) ...
Processing triggers for man-db (2.13.1-1) ...
pi@raspberrypi:~$ sudo reboot
pi@raspberrypi:~$ Read from remote host 192.168.0.200: Connection reset by peer
Connection to 192.168.0.200 closed.
client loop: send disconnect: Broken pipe
rafagrafa:~/Downloads$ ssh pi@192.168.0.200
pi@192.168.0.200's password:
Linux raspberrypi 6.18.39-rpt-rpi-v8 #1 SMP PREEMPT Debian 1:6.18.39-1+rpt1 (20
26-07-29) aarch64

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Last login: Thu Aug 27 09:24:15 2026 from 192.168.0.163

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to se
t a new password.

Wi-Fi is currently blocked by rfkill.
Use raspi-config to set the country before use.

pi@raspberrypi:~$
```

Figura 5. Reinicio del sistema (sudo reboot) y reconexión exitosa vía SSH tras la actualización del kernel, confirmando la persistencia de la configuración desacoplada (ejercicio 3).

4. Conclusiones

La práctica evidenció la importancia de comprender el alcance de los privilegios de superusuario al encadenar comandos con &&, así como la necesidad de verificar la naturaleza exacta de un medio de almacenamiento antes de manipularlo, dado que la microSD utilizada contenía inicialmente una instalación distinta a la esperada. Asimismo, se comprobó que la configuración desacoplada de un sistema embebido —modificando directamente los archivos de arranque y red de una microSD desde un sistema anfitrión— constituye una alternativa viable y eficiente frente a la configuración interactiva mediante monitor y teclado, particularmente cuando no se dispone de periféricos o se busca automatizar el aprovisionamiento de varios equipos.

Bibliografía

Free Software Foundation. (2026). GNU Coreutils manual: dd invocation. https://www.gnu.org/software/coreutils/manual/html_node/dd-invocation.html

NetworkManager Project. (s.f.). nm-settings-keyfile: NetworkManager reference manual. Recuperado el 27 de agosto de 2026, de <https://networkmanager.dev/docs/api/latest/nm-settings-keyfile.html>