OSSP INDIVIDUAL ASSIGNMENT

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ARCHLINUX – PIPE()

SUBMITTED TO : MR. WENDIMU BAYE

Introduction

Background

ArchLinux is a lightweight, flexible Linux distro known for its simplicity, modernity, and user-centric design. Arch linux follows a rolling release model, meaning it receives continuous updates rather than discrete versions. This approach ensures users always have the latest software versions available.

Motivation

My motivation for exploring and getting deeper into this OS was that this specific distro is designed for users who want to understand how their system works from the ground up, making it an great learning platform for those interested in Linux system internals.

Objectives

- To successfully install ArchLinux in a virtual environment using VMware Workstation 17
- To explore and understand the unique features of ArchLinux, particularly its package management system
- To implement and understand the pipe() system call
- To examine the advantages and disadvantages of ArchLinux compared to other Linux distributions
- To gain insights into process communication using pipes
- To overcome the really challenging installation process and learn from it
- To configure a functioning desktop environment from scratch using manual methods

Requirements

Hardware Requirements

- Processor: 1 GHz processor or better
- RAM: > 512MB (2GB recommended for desktop environments)
- Storage: > 2GB of free disk space (10GB recommended) Graphics:
- Any GPU with basic graphics capabilities

Software Requirements

- Virtualization software: VMware Workstation 17 Pro
- ArchLinux ISO file
- Internet connection for downloading packages during installation
- Basic knowledge of Linux commands and terminal usage

Installation Process

Installing Arch Linux was nothing like installing other common OSs. The installation process was entirely CLI based, with zero graphical interfaces to help out.

I started by setting up a new virtual machine in VMware Workstation 17. I've used VirtualBox before, but VMware Workstation 17 offered better performance for my setup, so I used that. Creating the VM was the easy part - with a dynamic storage, UEFI boot enabled. Then I loaded up the distro's ISO file.

After booting from the ISO, I was greeted with a CLI. There was no installation wizard, no welcome screen - just a plain, simple terminal prompt.

After that these are the steps I took to install the OS:

1. Verify my boot mode (UEFI in my case)

```
ls /sys/firmware/efi/efivars
```

2. Check my internet connection

```
ping -c 3 archlinux.org
```

3. Update the system clock

```
timedatectl set-ntp true
```

4. Partition my disk manually using fdisk

```
fdisk /dev/sda
```

This was nerve wracking. One wrong command and I'd have to start over. I created:

- 512MB EFI partition

- 4GB swap partition

- The rest as my root partition

5. Format the partitions

```
mkfs.fat -F32 /dev/sda1
mkswap      /dev/sda2
swapon      /dev/sda2
mkfs.ext4 /dev/sda3
```

6. Mount the file systems

```
mount /dev/sda3 /mnt

mkdir /mnt/boot

mount /dev/sda1 /mnt/boot
```

7. Install the base packages

```
pacstrap /mnt base linux linux-firmware
```

8. Generate an fstab file

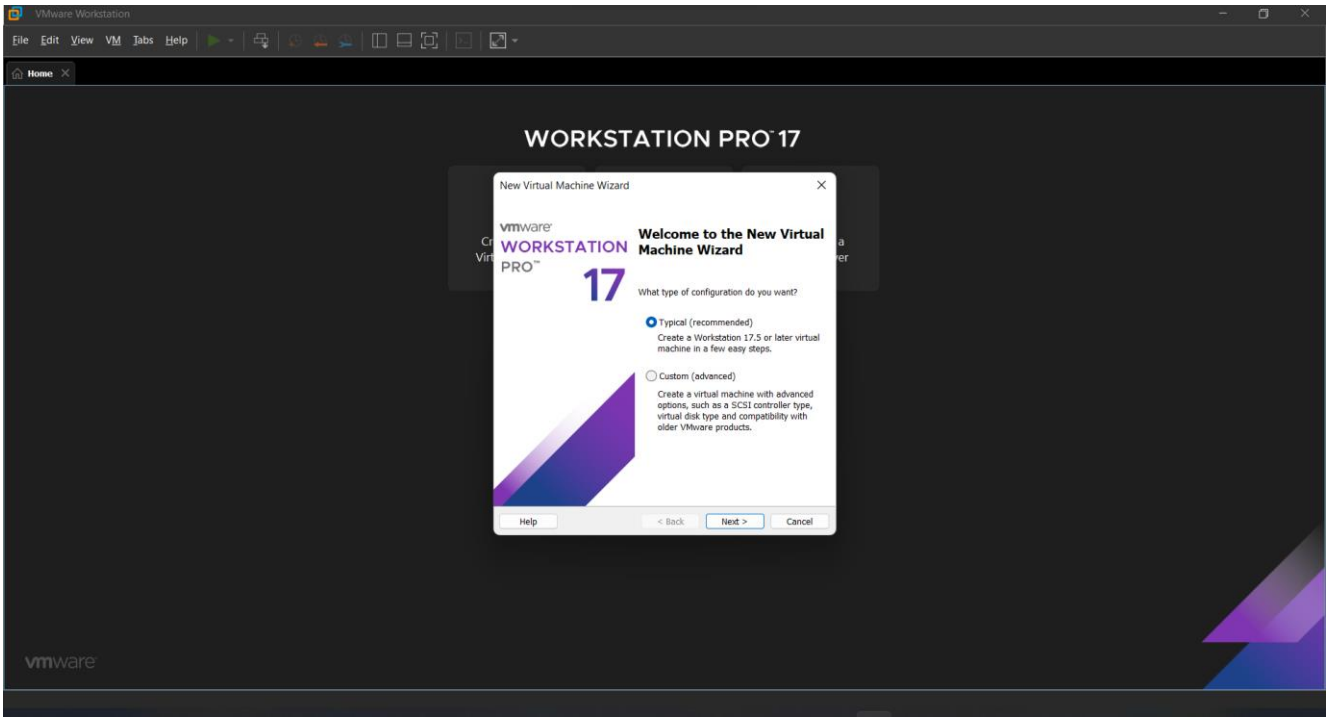
```
genfstab -U /mnt >> /mnt/etc/fstab
```

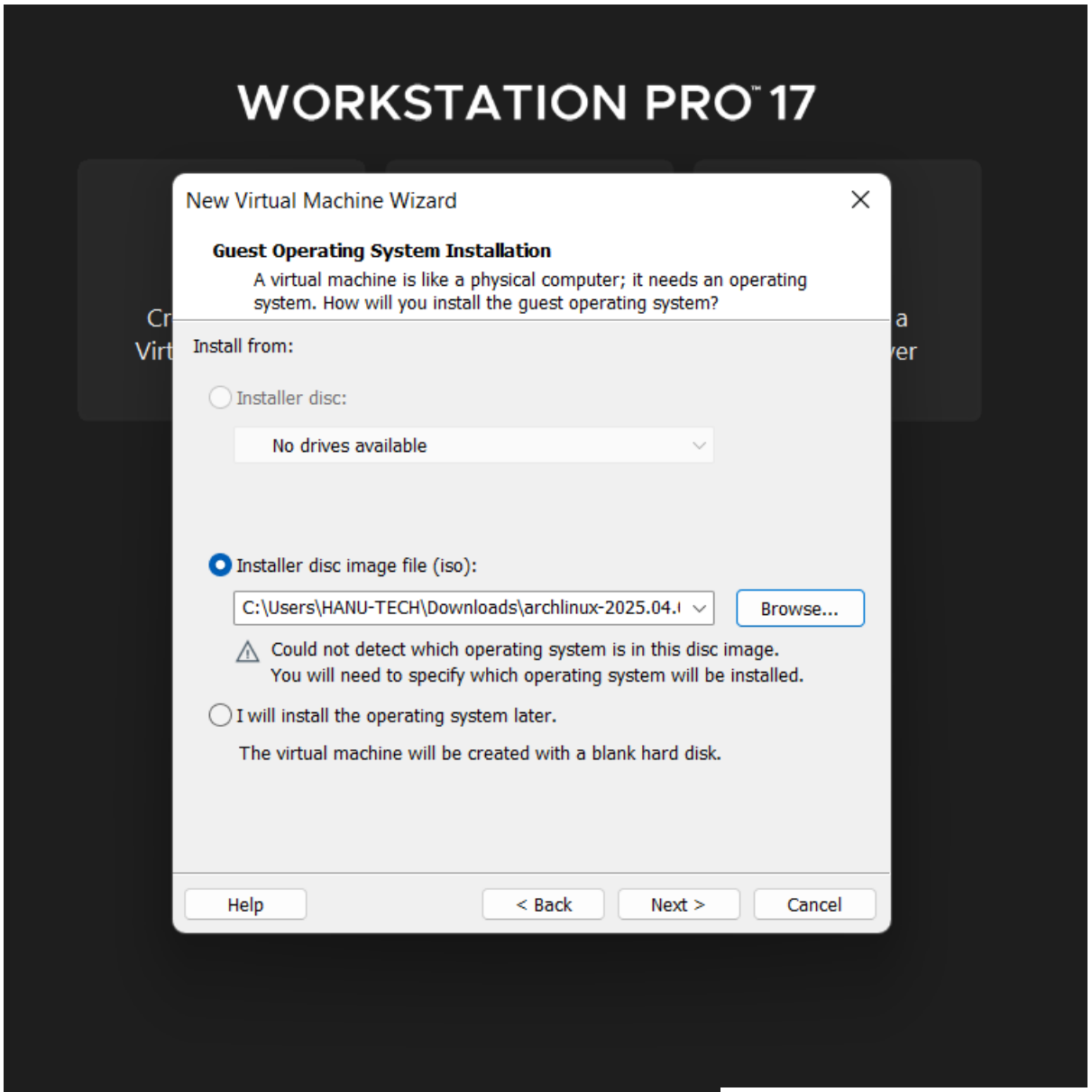
9. Chroot into the new system

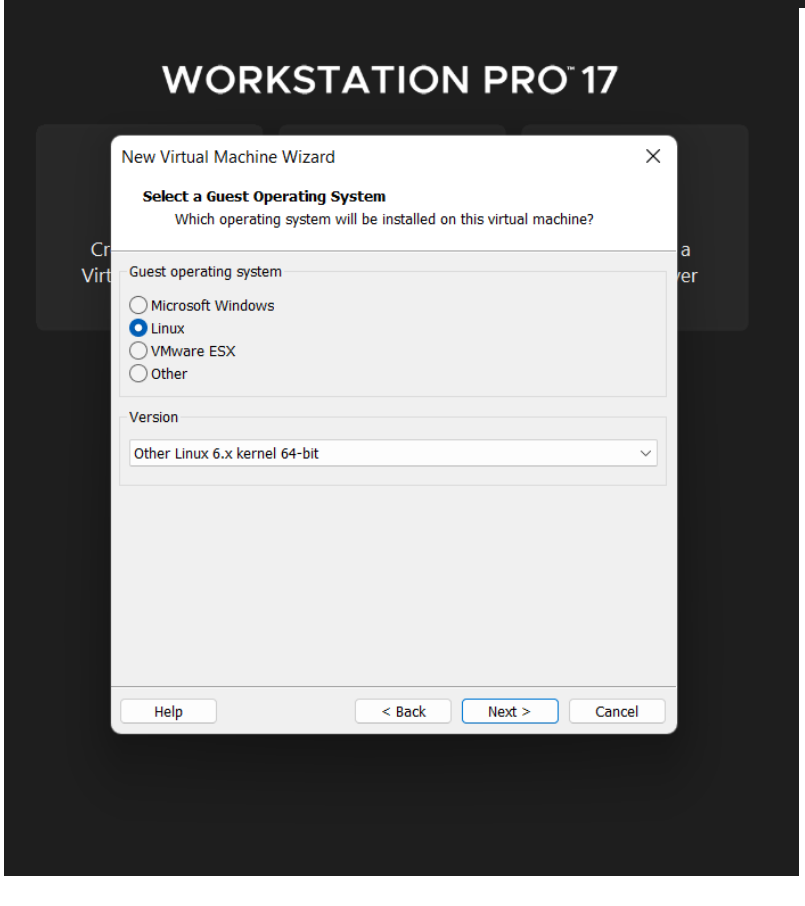
```
arch-chroot /mnt
```

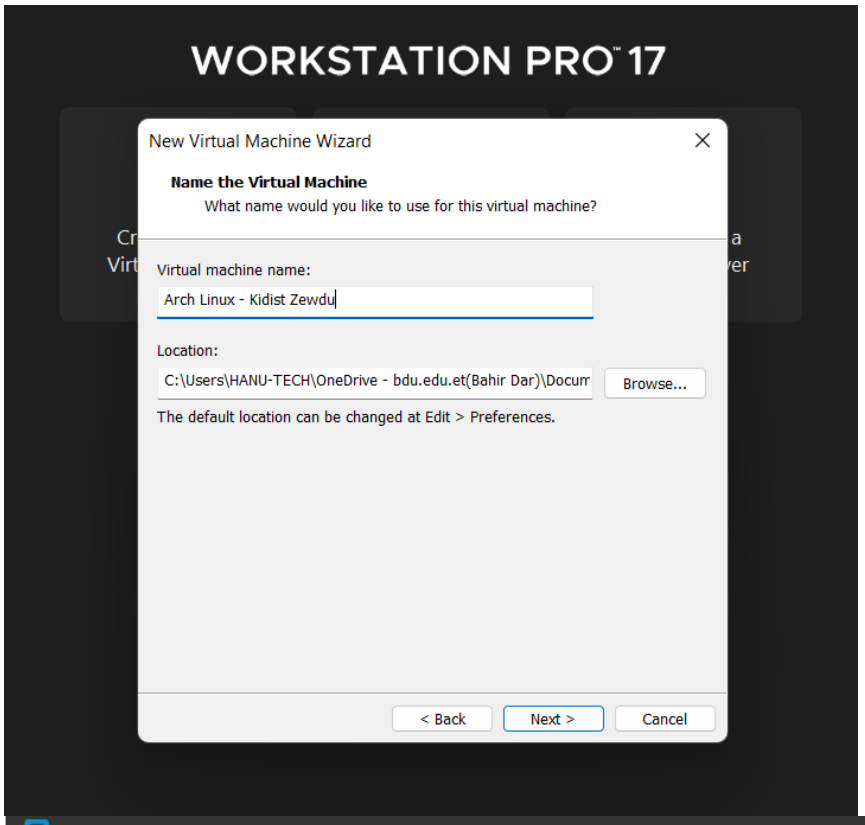
10. Set timezone, localization, hostname, root password, and a dozen other configuration steps - all through the terminal

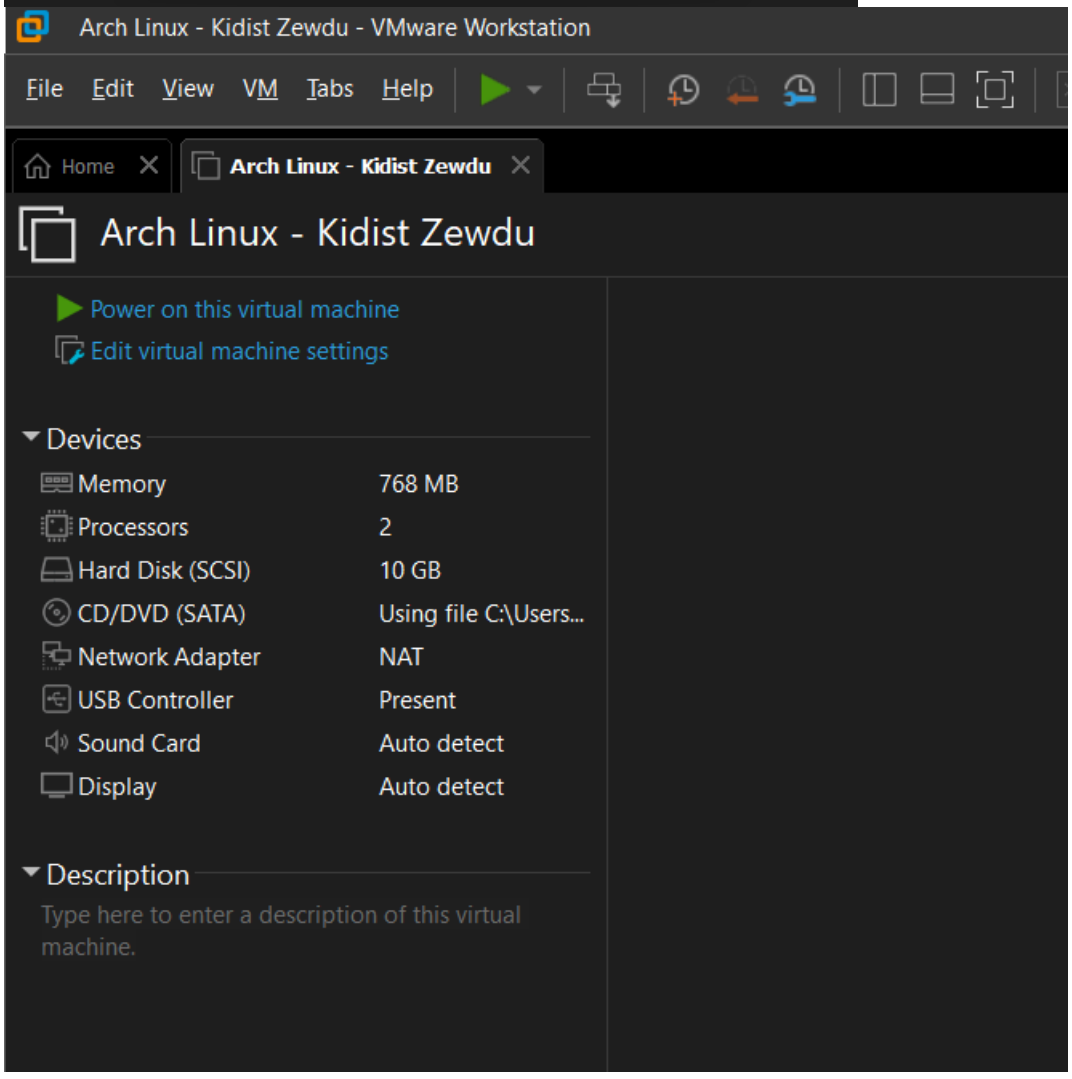
I messed up a couple of times during this process, specially when I got to the chroot part. Another time I didn't install the network manager and ended up with a system that had no internet connection after reboot.




WORKSTATION PRO™ 17
New Virtual Machine Wizard
Guest Operating System Installation
A virtual machine is like a physical computer; it needs an operating system. How will you install the guest operating system?
Install from:
Installer disc:
No drives available
Installer disc image file (iso):
C:\Users\HANU-TECH\Downloads\archlinux-2025.04.
Browse...
Could not detect which operating system is in this disc image.
You will need to specify which operating system will be installed.
I will install the operating system later.
The virtual machine will be created with a blank hard disk.
Help
< Back
Next >
Cancel


WORKSTATION PRO™ 17
New Virtual Machine Wizard
Select a Guest Operating System
Which operating system will be installed on this virtual machine?
Guest operating system
Microsoft Windows
Linux
VMware ESX
Other
Version
Other Linux 6.x kernel 64-bit
Help
< Back
Next >
Cancel


WORKSTATION PRO 17
New Virtual Machine Wizard
Name the Virtual Machine
What name would you like to use for this virtual machine?
Virtual machine name:
Arch Linux - Kidist Zewdu
Location:
C:\Users\HANU-TECH\OneDrive - bdu.edu.et(Bahir Dar)\Docum
Browse...
The default location can be changed at Edit > Preferences.
< Back
Next >
Cancel


Arch Linux - Kidist Zewdu - VMware Workstation
File Edit View VM Tabs Help
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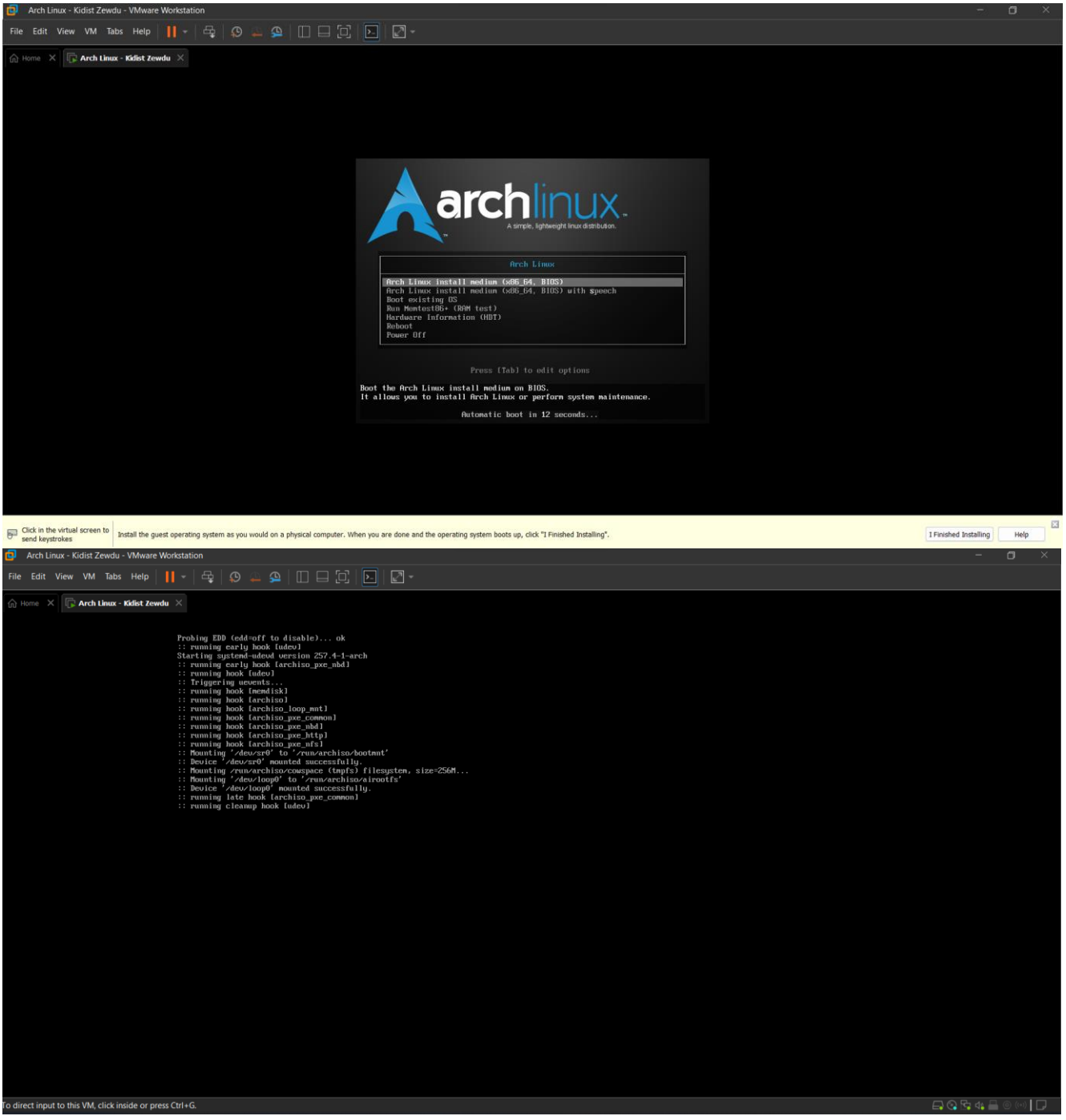
Arch Linux - Kidist Zewdu
Power on this virtual machine
Edit virtual machine settings
Devices
Memory 768 MB
Processors 2
Hard Disk (SCSI) 10 GB
CD/DVD (SATA) Using file C:\Users...
Network Adapter NAT
USB Controller Present
Sound Card Auto detect
Display Auto detect
Description
Type here to enter a description of this virtual machine.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archlinux
A simple, lightweight linux distribution.
Arch Linux
Arch Linux install medium (x86_64, BIOS)
Arch Linux install medium (x86_64, BIOS) with speech
Boot existing OS
Run Memtest86+ (RAM test)
Hardware Information (HBT)
Reboot
Power Off
Press [Tab] to edit options
Boot the Arch Linux install medium on BIOS.
It allows you to install Arch Linux or perform system maintenance.
Automatic boot in 12 seconds...

Click in the virtual screen to send keystrokes
Install the guest operating system as you would on a physical computer. When you are done and the operating system boots up, click "I Finished Installing".
I Finished Installing
Help
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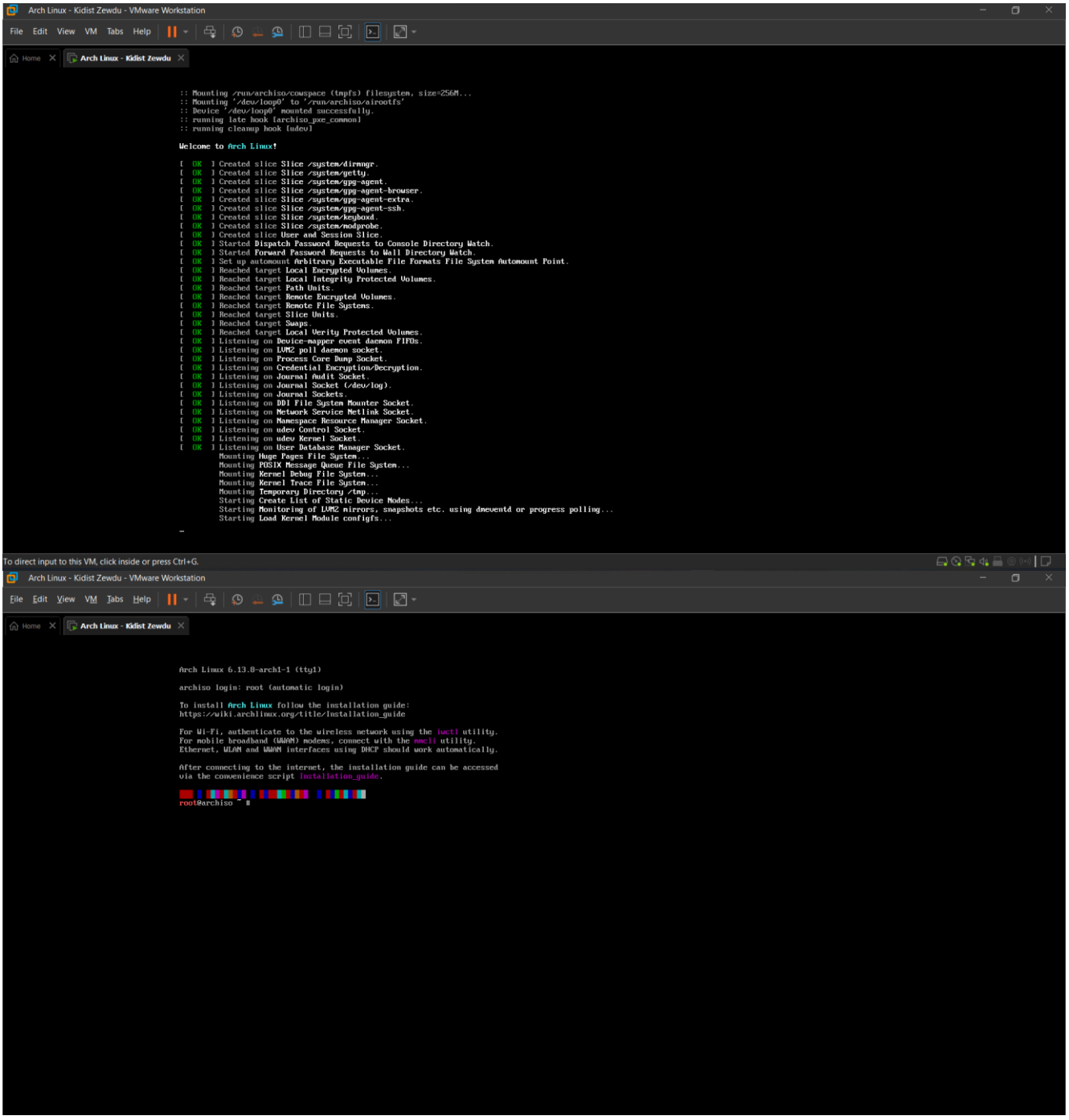
Probing EDD (edd=off to disable)... ok
:: running early hook [udev]
Starting systemd-udevd version 257.4-1-arch
:: running early hook [archiso_pxe_nbd]
:: running hook [udev]
:: Triggering uevents...
:: running hook [memdisk]
:: running hook [archiso]
:: running hook [archiso_loop_mnt]
:: running hook [archiso_pxe_common]
:: running hook [archiso_pxe_nbd]
:: running hook [archiso_pxe_http]
:: running hook [archiso_pxe_nfs]
:: Mounting '/dev/sr0' to '/run/archiso/bootmnt'
:: Device '/dev/sr0' mounted successfully.
:: Mounting /run/archiso/cowspace (tmpfs) filesystem, size=256M...
:: Mounting '/dev/loop0' to '/run/archiso/airootfs'
:: Device '/dev/loop0' mounted successfully.
:: running late hook [archiso_pxe_common]
:: running cleanup hook [udev]
To direct input to this VM, click inside or press Ctrl+G.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:: Mounting /run/archiso/cowspace (tmpfs) filesystem, size=256M...
:: Mounting '/dev/loop0' to '/run/archiso/airootfs'
:: Device '/dev/loop0' mounted successfully.
:: running late hook [archiso_pxe_common]
:: running cleanup hook [udev]
Welcome to Arch Linux!
[OK] Created slice Slice /system/dirmngr.
[OK] Created slice Slice /system/getty.
[OK] Created slice Slice /system/gpg-agent.
[OK] Created slice Slice /system/gpg-agent-browser.
[OK] Created slice Slice /system/gpg-agent-extra.
[OK] Created slice Slice /system/gpg-agent-ssh.
[OK] Created slice Slice /system/keyboxd.
[OK] Created slice Slice /system/modprobe.
[OK] Created slice User and Session Slice.
[OK] Started Dispatch Password Requests to Console Directory Watch.
[OK] Started Forward Password Requests to Wall Directory Watch.
[OK] Set up automount Arbitrary Executable File Formats File System Automount Point.
[OK] Reached target Local Encrypted Volumes.
[OK] Reached target Local Integrity Protected Volumes.
[OK] Reached target Path Units.
[OK] Reached target Remote Encrypted Volumes.
[OK] Reached target Remote File Systems.
[OK] Reached target Slice Units.
[OK] Reached target Swaps.
[OK] Reached target Local Verity Protected Volumes.
[OK] Listening on Device-mapper event daemon FIFOs.
[OK] Listening on LVM2 poll daemon socket.
[OK] Listening on Process Core Dump Socket.
[OK] Listening on Credential Encryption/Decryption.
[OK] Listening on Journal Audit Socket.
[OK] Listening on Journal Socket (/dev/log).
[OK] Listening on Journal Sockets.
[OK] Listening on DDI File System Mounter Socket.
[OK] Listening on Network Service Netlink Socket.
[OK] Listening on Namespace Resource Manager Socket.
[OK] Listening on udev Control Socket.
[OK] Listening on udev Kernel Socket.
[OK] Listening on User Database Manager Socket.
Mounting Huge Pages File System...
Mounting POSIX Message Queue File System...
Mounting Kernel Debug File System...
Mounting Kernel Trace File System...
Mounting Temporary Directory /tmp...
Starting Create List of Static Device Nodes...
Starting Monitoring of LVM2 mirrors, snapshots etc. using dmeventd or progress polling...
Starting Load Kernel Module configfs...
To direct input to this VM, click inside or press Ctrl+G.
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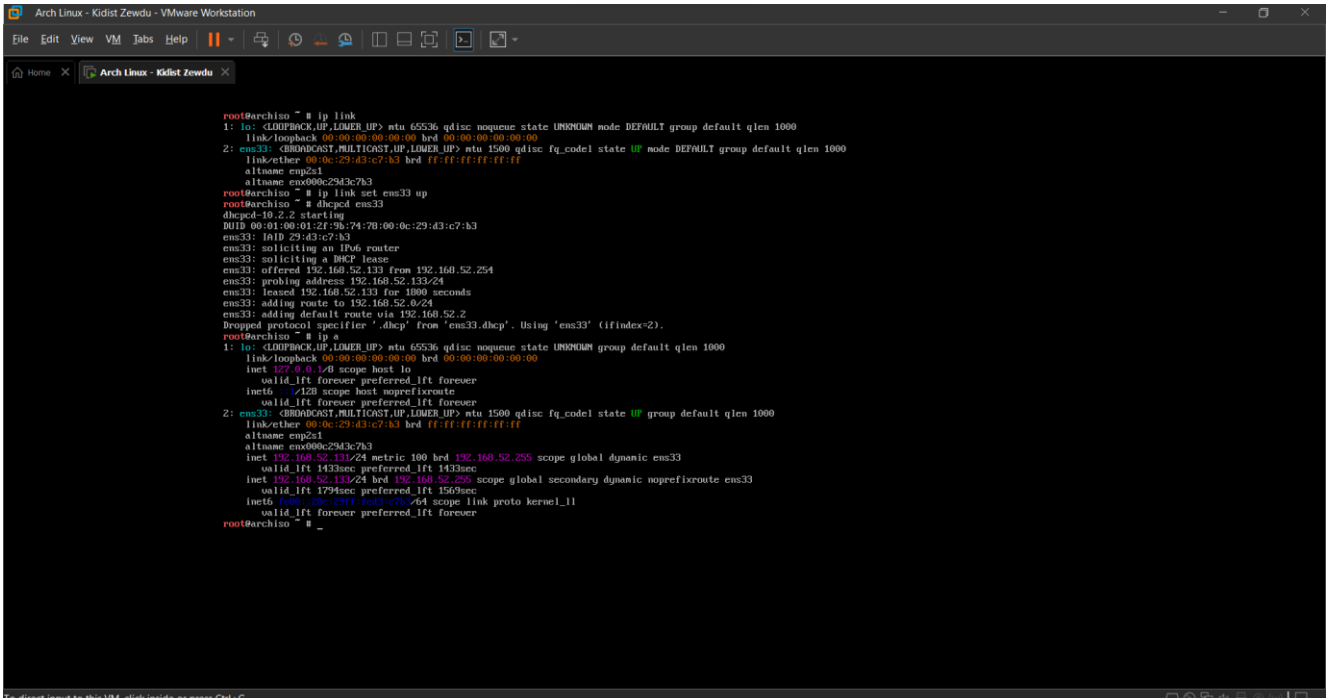
Arch Linux 6.13.8-arch1-1 (tty1)
archiso login: root (automatic login)
To install Arch Linux follow the installation guide:
https://wiki.archlinux.org/title/Installation_guide
For Wi-Fi, authenticate to the wireless network using the iwctl utility.
For mobile broadband (WWAN) modems, connect with the mmcli utility.
Ethernet, WLAN and WWAN interfaces using DHCP should work automatically.
After connecting to the internet, the installation guide can be accessed
via the convenience script Installation_guide.
root@archiso ~ #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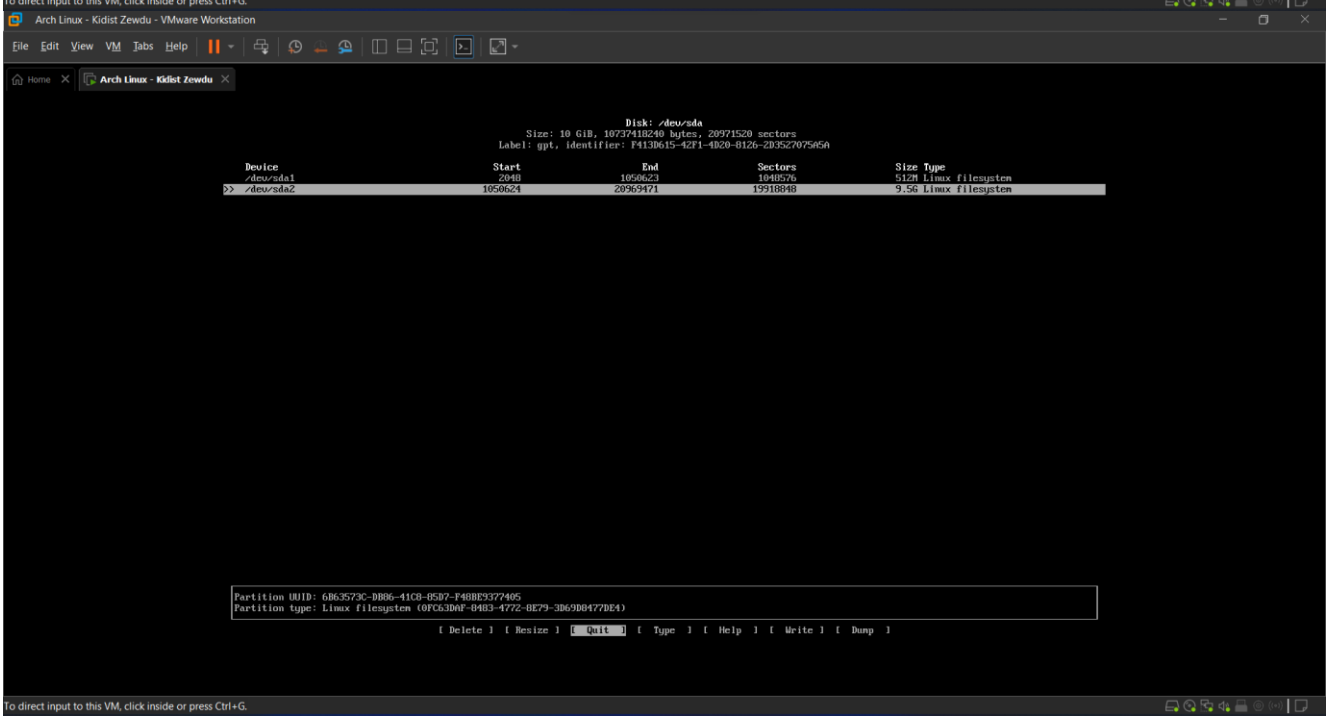
root@archiso ~ # ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT group default qlen 1000
link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mode DEFAULT group default qlen 1000
link/ether 00:0c:29:d3:c7:b3 brd ff:ff:ff:ff:ff:ff
altname enp2s1
altname enx000c2943c7b3
root@archiso ~ # ip link set ens33 up
root@archiso ~ # dhcpcd ens33
dhcpcd-10.2.2 starting
DUID 00:01:00:01:2f:9b:74:78:00:0c:29:d3:c7:b3
ens33: IAID 29:d3:c7:b3
ens33: soliciting an IPv6 router
ens33: soliciting a DHCP lease
ens33: offered 192.168.52.133 from 192.168.52.254
ens33: probing address 192.168.52.133/24
ens33: leased 192.168.52.133 for 1800 seconds
ens33: adding route to 192.168.52.0/24
ens33: adding default route via 192.168.52.2
Dropped protocol specifier '.dhcp' from 'ens33.dhcp'. Using 'ens33' (ifindex=2).
root@archiso ~ # 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: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
link/ether 00:0c:29:d3:c7:b3 brd ff:ff:ff:ff:ff:ff
altname enp2s1
altname enx000c2943c7b3
inet 192.168.52.131/24 metric 100 brd 192.168.52.255 scope global dynamic ens33
valid_lft 1433sec preferred_lft 1433sec
inet 192.168.52.133/24 brd 192.168.52.255 scope global secondary dynamic noprefixroute ens33
valid_lft 1794sec preferred_lft 1569sec
inet6 fe80::20c:29ff:fed3:c7b3/64 scope link proto kernel_ll
valid_lft forever preferred_lft forever
root@archiso ~ # _
To direct input to this VM, click inside or press Ctrl+G.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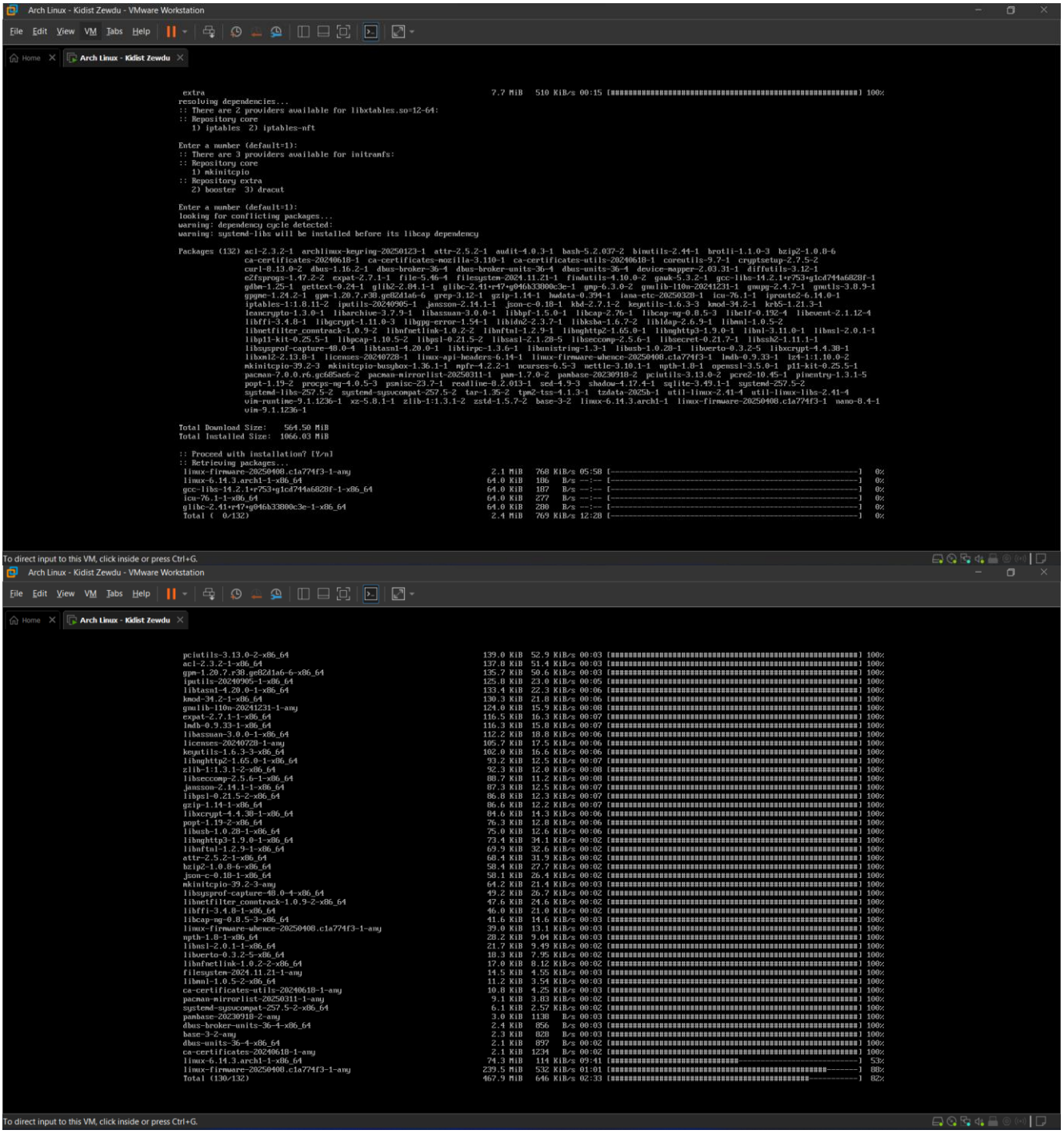
Disk: /dev/sda
Size: 10 GiB, 10737418240 bytes, 20971520 sectors
Label: gpt, identifier: F413D615-42F1-4D20-8126-2D3527075A5A
Device Start End Sectors Size Type
/dev/sda1 2048 1050623 1048576 512M Linux filesystem
>> /dev/sda2 1050624 20969471 19918848 9.5G Linux filesystem
Partition UUID: 6B63573C-DB86-41CB-85D7-F48BE9377405
Partition type: Linux filesystem (0FC63DAF-8483-4772-8E79-3D69D8477DE4)
[Delete] [Resize] [Quit] [Type] [Help] [Write] [Dump]
To direct input to this VM, click inside or press Ctrl+G.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extra 7.7 MiB 510 KiB/s 00:15 [##########] 100%
resolving dependencies...
:: There are 2 providers available for libxtables.so=12-64:
:: Repository core
1) iptables 2) iptables-nft
Enter a number (default=1):
:: There are 3 providers available for initramfs:
:: Repository core
1) mkinitcpio
:: Repository extra
2) booster 3) dracut
Enter a number (default=1):
looking for conflicting packages...
warning: dependency cycle detected:
warning: systemd-libs will be installed before its libcap dependency
Packages (132) acl-2.3.2-1 archlinux-keyring-20250123-1 attr-2.5.2-1 audit-4.0.3-1 bash-5.2.037-2 binutils-2.44-1 brotli-1.1.0-3 bzip2-1.0.8-6
ca-certificates-20240618-1 ca-certificates-mozilla-3.110-1 ca-certificates-utils-20240618-1 coreutils-9.7-1 cryptsetup-2.7.5-2
curl-8.13.0-2 dbus-1.16.2-1 dbus-broker-36-4 dbus-broker-units-36-4 dbus-units-36-4 device-mapper-2.03.31-1 diffutils-3.12-1
e2fsprogs-1.47.2-2 expat-2.7.1-1 file-5.46-4 filesystem-2024.11.21-1 findutils-4.10.0-2 gawk-5.3.2-1 gcc-libs-14.2.1+r753+g1c4744a6828f-1
gdbm-1.25-1 gettext-0.24-1 glib2-2.84.1-1 glibc-2.41+r47+g046b33800c3e-1 gmp-6.3.0-2 gnulib-l10n-20241231-1 gnupg-2.4.7-1 gnutls-3.8.9-1
gpgme-1.24.2-1 gpm-1.20.7.r38.ge82d1a6-6 grep-3.12-1 gzip-1.14-1 hwdata-0.394-1 iana-etc-20250328-1 icu-76.1-1 iproute2-6.14.0-1
iptables-1:1.8.11-2 iputils-20240905-1 jansson-2.14.1-1 json-c-0.18-1 kbd-2.7.1-2 keyutils-1.6.3-3 kmod-34.2-1 krb5-1.21.3-1
leancrypto-1.3.0-1 libarchive-3.7.9-1 libassuan-3.0.0-1 libbpf-1.5.0-1 libcap-2.76-1 libcap-ng-0.8.5-3 libe1f-0.192-4 libevent-2.1.12-4
libffi-3.4.8-1 libgcrypt-1.11.0-3 libgpg-error-1.54-1 libidn2-2.3.7-1 libksba-1.6.7-2 libldap-2.6.9-1 libmnl-1.0.5-2
libnetfilter_conntrack-1.0.9-2 libnfnetlink-1.0.2-2 libnftnl-1.2.9-1 libnghttp2-1.65.0-1 libnghttp3-1.9.0-1 libnl-3.11.0-1 libnsl-2.0.1-1
libp11-kit-0.25.5-1 libpcap-1.10.5-2 libpsl-0.21.5-2 libsasl-2.1.28-5 libseccomp-2.5.6-1 libsecret-0.21.7-1 libssh2-1.11.1-1
libsysprof-capture-48.0-4 libtasn1-4.20.0-1 libtirpc-1.3.6-1 libunistring-1.3-1 libusb-1.0.28-1 libverto-0.3.2-5 libxcrypt-4.4.38-1
libxml2-2.13.8-1 licenses-20240728-1 linux-api-headers-6.14-1 linux-firmware-whence-20250408.c1a774f3-1 lmdb-0.9.33-1 lz4-1:1.10.0-2
mkinitcpio-39.2-3 mkinitcpio-busybox-1.36.1-1 mpfr-4.2.2-1 ncurses-6.5-3 nettle-3.10.1-1 npth-1.8-1 openssl-3.5.0-1 p11-kit-0.25.5-1
pacman-7.0.0.r6.gc685ae6-2 pacman-mirrorlist-20250311-1 pam-1.7.0-2 pambase-20230918-2 pciutils-3.13.0-2 pcre2-10.45-1 pinentry-1.3.1-5
popt-1.19-2 procps-ng-4.0.5-3 psmisc-23.7-1 readline-8.2.013-1 sed-4.9-3 shadow-4.17.4-1 sqlite-3.49.1-1 systemd-257.5-2
systemd-libs-257.5-2 systemd-sysvcompat-257.5-2 tar-1.35-2 tpm2-tss-4.1.3-1 tzdata-2025b-1 util-linux-2.41-4 util-linux-libs-2.41-4
vim-runtime-9.1.1236-1 xz-5.8.1-1 zlib-1:1.3.1-2 zstd-1.5.7-2 base-3-2 linux-6.14.3.arch1-1 linux-firmware-20250408.c1a774f3-1 nano-8.4-1
vim-9.1.1236-1
Total Download Size: 564.50 MiB
Total Installed Size: 1066.03 MiB
:: Proceed with installation? [Y/n]
:: Retrieving packages...
linux-firmware-20250408.c1a774f3-1-any 2.1 MiB 768 KiB/s 05:58 [----------] 0%
linux-6.14.3.arch1-1-x86_64 64.0 KiB 106 B/s --:-- [----------] 0%
gcc-libs-14.2.1+r753+g1c4744a6828f-1-x86_64 64.0 KiB 107 B/s --:-- [----------] 0%
icu-76.1-1-x86_64 64.0 KiB 277 B/s --:-- [----------] 0%
glibc-2.41+r47+g046b33800c3e-1-x86_64 64.0 KiB 280 B/s --:-- [----------] 0%
Total (0/132) 2.4 MiB 769 KiB/s 12:28 [----------] 0%
To direct input to this VM, click inside or press Ctrl+G.

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pciutils-3.13.0-2-x86_64 139.0 KiB 52.9 KiB/s 00:03 [##########] 100%
acl-2.3.2-1-x86_64 137.8 KiB 51.4 KiB/s 00:03 [##########] 100%
gpm-1.20.7.r38.ge82d1a6-6-x86_64 135.7 KiB 50.6 KiB/s 00:03 [##########] 100%
iputils-20240905-1-x86_64 125.8 KiB 23.0 KiB/s 00:05 [##########] 100%
libtasn1-4.20.0-1-x86_64 133.4 KiB 22.3 KiB/s 00:06 [##########] 100%
kmod-34.2-1-x86_64 130.3 KiB 21.8 KiB/s 00:06 [##########] 100%
gmulib-l10n-20241231-1-any 124.0 KiB 15.9 KiB/s 00:08 [##########] 100%
expat-2.7.1-1-x86_64 116.5 KiB 16.3 KiB/s 00:07 [##########] 100%
lmdb-0.9.33-1-x86_64 116.3 KiB 15.8 KiB/s 00:07 [##########] 100%
libassuan-3.0.0-1-x86_64 112.2 KiB 18.8 KiB/s 00:06 [##########] 100%
licenses-20240728-1-any 105.7 KiB 17.5 KiB/s 00:06 [##########] 100%
keyutils-1.6.3-3-x86_64 102.0 KiB 16.6 KiB/s 00:06 [##########] 100%
libnghttp2-1.65.0-1-x86_64 93.2 KiB 12.5 KiB/s 00:07 [##########] 100%
zlib-1:1.3.1-2-x86_64 92.3 KiB 12.0 KiB/s 00:08 [##########] 100%
libseccomp-2.5.6-1-x86_64 88.7 KiB 11.2 KiB/s 00:08 [##########] 100%
jansson-2.14.1-1-x86_64 87.3 KiB 12.5 KiB/s 00:07 [##########] 100%
libpsl-0.21.5-2-x86_64 86.8 KiB 12.3 KiB/s 00:07 [##########] 100%
gzip-1.14-1-x86_64 86.6 KiB 12.2 KiB/s 00:07 [##########] 100%
libxcrypt-4.4.38-1-x86_64 84.6 KiB 14.3 KiB/s 00:06 [##########] 100%
popt-1.19-2-x86_64 76.3 KiB 12.8 KiB/s 00:06 [##########] 100%
libusb-1.0.28-1-x86_64 75.0 KiB 12.6 KiB/s 00:06 [##########] 100%
libnghttp3-1.9.0-1-x86_64 73.4 KiB 34.1 KiB/s 00:02 [##########] 100%
libnftnl-1.2.9-1-x86_64 69.9 KiB 32.6 KiB/s 00:02 [##########] 100%
attr-2.5.2-1-x86_64 68.4 KiB 31.9 KiB/s 00:02 [##########] 100%
bzip2-1.0.8-6-x86_64 58.4 KiB 27.7 KiB/s 00:02 [##########] 100%
json-c-0.18-1-x86_64 58.1 KiB 26.4 KiB/s 00:02 [##########] 100%
mkinitcpio-39.2-3-any 64.2 KiB 21.4 KiB/s 00:03 [##########] 100%
libsysprof-capture-48.0-4-x86_64 49.2 KiB 26.7 KiB/s 00:02 [##########] 100%
libnetfilter_conntrack-1.0.9-2-x86_64 47.6 KiB 24.6 KiB/s 00:02 [##########] 100%
libffi-3.4.8-1-x86_64 46.0 KiB 21.0 KiB/s 00:02 [##########] 100%
libcap-ng-0.8.5-3-x86_64 41.6 KiB 14.6 KiB/s 00:03 [##########] 100%
linux-firmware-whence-20250408.c1a774f3-1-any 39.0 KiB 13.1 KiB/s 00:03 [##########] 100%
npth-1.8-1-x86_64 28.2 KiB 9.04 KiB/s 00:03 [##########] 100%
libnsl-2.0.1-1-x86_64 21.7 KiB 9.49 KiB/s 00:02 [##########] 100%
libverto-0.3.2-5-x86_64 18.3 KiB 7.95 KiB/s 00:02 [##########] 100%
libnfnetlink-1.0.2-2-x86_64 17.0 KiB 8.12 KiB/s 00:02 [##########] 100%
filesystem-2024.11.21-1-any 14.5 KiB 4.55 KiB/s 00:03 [##########] 100%
libmnl-1.0.5-2-x86_64 11.2 KiB 3.54 KiB/s 00:03 [##########] 100%
ca-certificates-utils-20240618-1-any 10.8 KiB 4.25 KiB/s 00:03 [##########] 100%
pacman-mirrorlist-20250311-1-any 9.1 KiB 3.83 KiB/s 00:02 [##########] 100%
systemd-sysvcompat-257.5-2-x86_64 6.1 KiB 2.57 KiB/s 00:02 [##########] 100%
pambase-20230918-2-any 3.0 KiB 1138 B/s 00:03 [##########] 100%
dbus-broker-units-36-4-x86_64 2.4 KiB 856 B/s 00:03 [##########] 100%
base-3-2-any 2.3 KiB 828 B/s 00:03 [##########] 100%
dbus-units-36-4-x86_64 2.1 KiB 897 B/s 00:02 [##########] 100%
ca-certificates-20240618-1-any 2.1 KiB 1234 B/s 00:02 [##########] 100%
linux-6.14.3.arch1-1-x86_64 74.3 MiB 114 KiB/s 09:41 [#####-----] 53%
linux-firmware-20250408.c1a774f3-1-any 239.5 MiB 532 KiB/s 01:01 [#########-------] 88%
Total (130/132) 467.9 MiB 646 KiB/s 02:33 [#########----------] 82%
To direct input to this VM, click inside or press Ctrl+G.

Issues/ Challenges

Using VMware Workstation 17 presented its own challenges. For solution I had to install the `open-vm-tools` package to get proper integration:

```
pacman -S open-vm-tools

systemctl enable vmtoolsd.service
```

Getting the display resolution to adjust correctly in VMware was another challenge.

Solution: I manually edited X11 configuration files to get it working properly.

Desktop Environment Setup

After getting the base system installed , I manually installed a desktop environment. I chose XFCE for its lightweight nature:

```
pacman  -S  xorg  xfce4  xfce4-goodies

pacman -S lightdm lightdm-gtk-greeter

systemctl enable lightdm
```

Each package installation required specific decisions about which providers to use for certain dependencies.

Daily Usage Experience

After the installation, I spent 2 days using Arch Linux as my daily driver in VMware Workstation 17. Some

observations:

1. **Package Management**: The pacman package manager is really fast compared to apt or dnf. Running `sudo pacman -Syu` to update the entire system typically took a couple of seconds, not minutes.
2. **VMware Integration**: After installing the proper tools, the integration with VMware Workstation 17 was smooth. Copying and pasting between host and guest worked, and the display scaled correctly with the window.
3. **System Performance**: Even in a VM with modest resources, Arch felt fast and responsive. The minimal nature of the system means there's very little things running in the background.
4. **Software Installation**: Everything is manual, which is both good and bad. I had to install basic utilities like a PDF reader, image viewer, and web browser explicitly because nothing comes pre-installed.
5. **Learning Curve**: I found myself constantly referring to the distro's Wiki page, which is possibly the best Linux documentation in existence. Every problem I encountered had a solution documented somewhere.
6. **Configuration**: Everything is configured through text files. Want to change how your network interfaces work? Edit a config file. Need to set up automatic mounting? Edit a config file. Coming from GUI-based systems, this was a really big adjustment.

Filesystem Support

ArchLinux Filesystem Options

Arch Linux offers robust support for a wide range of filesystems, providing users with flexibility to choose the most appropriate option for their specific needs. The main filesystems available in Arch Linux include:

Primary Filesystems

- **ext4**: It is the default and most widely used filesystem in Arch Linux. It offers a really good balance of performance, reliability, and features. Notable features include:
    - Journaling capabilities to prevent data corruption when power fails
    - Delayed allocation for a better performance and less fragmentation
    - Metadata checksumming for better data integrity
- **Btrfs**: It is a modern filesystem with advanced features like:
    - Built in RAID functionality
    - Transparent compression
    - Online filesystem defragmentation
- **XFS**: It is a high-performance journaling filesystem which was originally developed by Silicon Graphics:
    - Great for systems with large files
    - Online resizing (can only grow, not shrink)
    - Specifically well-suited for media storage

Other Supported Filesystems

- **F2FS**: It is designed specifically for flash based storage devices liks SSDs and SD cards
- **JFS**: IBM's Journaled File System which is known for very low CPU usage
- **ReiserFS**: Good for directories with many small files
- **ZFS**: Advanced filesystem with built-in volume management that is available through AUR
- **NILFS2**: which is a log structured file system designed for SSDs with excellent crash recovery

Advantages and Disadvantages

Advantages of ArchLinux

- **Rolling Release Model**: Always updated with the latest software versions without needing reinstallation.
- **Simplicity**: Follows the KISS principle (Keep It Simple, Stupid) with a minimal base installation.
- **Customizability**: Provides a blank canvas for users to build exactly the system they want. I only installed what I needed, resulting in a lean system tailored to my requirements.
- **Pacman Package Manager**: Fast, efficient package management with simple syntax. I came to love commands like `pacman -Ss` to search for packages and `pacman -Rns` to remove packages completely.
    - **Great Documentation**: The Arch Wiki is one of the most comprehensive Linux resources available. It saved me countless times during this project.

Disadvantages of ArchLinux

- **Steep Learning Curve**: Not suitable for Linux beginners due to the manual installation process.
- **Manual Configuration**: Requires significant time and effort to set up initially.
- **Frequent Updates**: Constant updates can be time consuming to manage.
- **Limited Official Support**: Relies more on community support than official channels.
- **Time-Consuming**: Setting up basic functionality that comes pre configured in other distributions takes time and effort.

Future Outlook

Arch Linux in the Evolving Linux Landscape

As Linux continues to evolve, Arch Linux is well positioned to maintain its unique place in the ecosystem. Many factors will likely influence its future:

Rolling Release Advantage

The rolling release model positions Arch to adapt rapidly to new technologies without the constraints of fixed release cycles. As hardware innovations modernize, this flexibility will become more valuable which allows users to adopt new technologies immediately rather than waiting for the next distro version.

Growing Accessibility

While Arch has been considered hard for beginners, several developments are greatly lowering the barrier to entry:

- Projects like Arch Installation Framework and improved documentation
- Community-maintained installation scripts that automate common setups
- GUI installers that still preserve the Arch philosophy of user choice and control

Virtualization

Virtualization in modern operating systems is a technology that creates abstracted versions of computing resources, which enables multiple operating systems and applications to run on a single physical machine.

Virtualization is used to maximize hardware utilization, reduce costs, increase flexibility, and improve disaster recovery capabilities.

Rather than dedicating separate physical servers to each workload, virtualization allows efficient resource sharing.

Common types include full virtualization (complete hardware simulation), paravirtualization (modified guest OS with specialized drivers), and container virtualization (lightweight OS- level virtualization sharing the host kernel).

UNIX Standardization

Arch Linux and UNIX Standards

Arch Linux is not officially certified as UNIX but it follows many of the fundamental Unix principles and standards that have shaped operating system design.

POSIX Compliance

Arch Linux maintains a high degree of POSIX (Portable Operating System Interface) compliance, which ensures compatibility with standardized Unix-like operating systems:

- The core utilities in Arch follow POSIX specifications for command syntax and behavior
- System calls and library functions follow POSIX standards
- Shell scripting in Bash which is the default shell supports POSIX compliant syntax
- File system hierarchy follows the Filesystem Hierarchy Standard (FHS)

This compliance make sure that software written for Unix-like systems generally works on Arch Linux with little modification.

The Single Unix Specification

Even if this distro is not officially certified against Single UNIX Specification (SUS), Arch Linux implements many of its requirements:

- Standard C library functions
- Standard command line utilities
- Standardized system interfaces

This unofficial compliance makes Arch Linux familiar to users of other certified Unix systems.

Conclusion

Through this project, I've gained many insights into ArchLinux and its approach to Linux distribution design. ArchLinux successfully achieves its primary goals of providing a flexible, powerful computing environment with a focus on simplicity and user control.

The installation process, while challenging and many times frustrating, it taught me more about Linux system internals than any book could have. VMware Workstation 17 proved to be a reliable platform for this exploration, allowing me to experiment freely without risking my main system.

The implementation of system calls, particularly pipe(), demonstrated the powerful Unix underpinnings of ArchLinux, allowing for sophisticated interprocess communication. The pipe system call provides a fundamental building block for more complex communication patterns between processes, enabling everything from simple data transfer to complex client-server architectures.

The powerful package management system, combined with the extensive Arch User Repository, provides access to virtually any software a user might need, while the excellent documentation in the Arch Wiki makes it possible for users to solve most problems on their own.