



MICHAEL BAZZELL

DIGITAL EDITION

EXTREME PRIVACY:
LINUX DEVICES
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First Published: August 2023

Project Editors: Anonymous Editor #1, Anonymous Editor #2

Cover Concept: Anonymous Podcast Listener

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Due to the use of quotation marks to identify specific text to be used as search queries and data entry, the author has chosen to display the British rule of punctuation outside of quotes. This ensures that the quoted content is accurate for replication. To maintain consistency, this format is continued throughout the entire book.

The technology referenced in this book was edited and verified by a professional team for accuracy. Exact tutorials in reference to websites, software, and hardware configurations change rapidly. All tutorials in this book were confirmed accurate as of July 25, 2023. Readers may find slight discrepancies within the methods as technology changes.

Revision: 2023.09.18

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ABOUT THE AUTHOR: MICHAEL BAZZELL

Michael Bazzell investigated computer crimes on behalf of the government for over 20 years. During the majority of that time, he was assigned to the FBI's Cyber Crimes Task Force where he focused on various online investigations and Open Source Intelligence (OSINT) collection. As an investigator and sworn federal officer through the U.S. Marshals Service, he was involved in numerous major criminal investigations including online child solicitation, child abduction, kidnapping, cold-case homicide, terrorist threats, and advanced computer intrusions. He has trained thousands of individuals in the use of his investigative techniques and privacy control strategies.

After leaving government work, he served as the technical advisor for the first season of the television hacker drama *Mr. Robot*. His books *OSINT Techniques* and *Extreme Privacy* are used by several government and private organizations as training manuals for intelligence gathering and privacy hardening. He now hosts the *Privacy, Security, and OSINT Show*, and assists individual clients in achieving ultimate privacy, both proactively and as a response to an undesired situation. More details about his services can be found at [*IntelTechniques.com*](http://IntelTechniques.com).

LINUX DEVICES PREFACE

I wrote my first privacy-related book in 2012 titled *Hiding From The Internet*. This eventually evolved into the title of *Extreme Privacy*, which is now a large 517-page textbook in its fourth edition, released in early 2022. In early 2023, I began conversations with my staff about the potential for a future fifth edition. There was some resistance. We had just released the 550-page *OSINT Techniques* textbook and we were all exhausted from the process. The idea of attacking a new version of *Extreme Privacy* seemed overwhelming at the time. We threw around the idea of a smaller book.

Many readers of *Extreme Privacy* expressed frustration at the overall amount of information presented within one volume. At 320,000 words, it could be overwhelming to digest all at once. Other criticism was that readers did not necessarily need all of the information within the book. Some wanted to focus on trusts, LLCs, and nomad domicile, and did not need all of the technology-themed chapters. Others only wanted to learn about secure computers, mobile devices, and other technical topics, and did not care about my ideas on an anonymous home or car. This was helpful feedback, and impacted the decision to release this digital book. The most criticism from *Extreme Privacy* was about the format. My large OSINT and Privacy books are only available in print. This has upset many readers who want to avoid Amazon or prefer to read on a screen. With this release, and the previous *Mobile Devices* eBooks, we are only providing PDFs. There are no official print versions and we have eliminated Amazon from the entire publication process. This allows us to offer a lower price, and 90% of each purchase directly supports our free podcast. If you bought this, thank you for your support!

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With *Extreme Privacy: Linux Devices*, I continue this new approach to our tutorials. It is not a replacement for *Extreme Privacy* (the printed book). Please consider it a much more thorough supplement about Linux devices. My hope is that this will further continue this series of shorter volumes which each focus on one specific topic. This allows people to only purchase the content which they need at a more affordable price. It also allows us to publish content more rapidly, as we can focus our efforts on one area at a time as needs arise, instead of reserving content for a potential future release. Free updates are also a win for everyone. I now present our digital guide solely about building the optimal Linux device.

INTRODUCTION

I began using Linux as my full-time primary operating system a couple of years ago. I had dabbled with Linux for decades and relied heavily on it for virtual machines within my OSINT books, but I did not commit to it as my daily driver until I finally had enough of the privacy invasions forced onto me by Microsoft and Apple.

Windows and macOS operating systems constantly monitor your usage and collect sensitive data about your devices, locations, documents, and overall activities. They claim to store this data for your benefit in order to provide a tailored computing experience. This is probably true, but what happens when this data is leaked, breached, or court-ordered to be given away? What can we do to leave this ecosystem of privacy and security risks?

I believe the answer is Linux. If you are only familiar with macOS or Windows environments, I suspect you will be pleasantly surprised by the ease and simplicity of using Linux as your computer's operating system. There will be a learning curve, but I promise that anyone reading this guide can make the switch. I believe you will prefer Linux after a month of daily usage. You might even find macOS and Windows machines difficult to use after completely committing to Linux.

This book will help you create a machine which does not send any sensitive data to Apple, Microsoft, or other providers who abuse this information. We will stop them from archiving our activities within the hardware which we have purchased. No online accounts will be required in order to use our operating system or download applications. We will have full control of our devices and operating systems. A name, telephone number, or physical address will never be requested in order to use our systems. We will all take our privacy back, while possessing the perfect machine for our unique needs.

This entire book is designed for the reader interested in extreme privacy. I will not sugar coat my opinions or offer less-secure options for the sake of convenience. I will explain every step and will never make assumptions on the reader's level of technology awareness. This is our entire playbook for every new client's Linux device. It is comprised of our internal client tutorials and staff handbooks, with extended details provided by myself. It should allow you to create a perfect private and secure Linux device for your needs. I leave nothing out, and include many new strategies previously omitted from *Extreme Privacy, 4th Edition*.

I offer one last vital piece of information before we start. I encourage you to generate your own opinions as you read along. You may disagree with me at times, which is ideal. That means you are really thinking about how all of this applies to you. **If everyone unconditionally agrees with every word I say, then I am probably not saying anything interesting. If this book only presents content which no one could dispute, then there is no need for this text.** Please read with an open mind and willingness to try new things. Let's begin.

CHAPTER ONE: WHY LINUX?

I mentioned in the introduction that Windows and macOS machines collect and store data about your usage of their products. Let's dive deeper into that. In 2019, I requested all of the data stored about me from Apple. I was preparing to record a podcast about the data which Apple collects about all of us, and I wanted to see the damage first-hand. I possessed several Apple ID accounts in alias names, so I requested the data from each of them. Since I never gave Apple my true name, I assumed the exposure was no big deal. I was wrong. The data provided by Apple confirmed they knew the following about my "anonymous" Apple accounts.

- My full alias name and email address provided during account creation
- My alias physical address provided during account creation
- The serial numbers for all devices
- The dates I first used the email addresses with Apple
- Multiple IP addresses possessed during use of the devices
- The internal computer names assigned to all devices
- The dates/times of any reformatting of the systems
- The dates/times and IP address of last access to iTunes, FaceTime, and iCloud
- My time zones during usage of the devices
- The VoIP telephone number provided during Apple account logins
- An alternative email address I once entered into Apple Mail
- Songs I had listened to through the official Apple Music application
- The moments within the songs when I paused the playback
- My IP addresses during media streaming from Apple's servers
- My preferred musical artists identified during their onboarding process
- The serial number of an iPhone which I had accessed in 2017
- All podcasts subscribed to through iOS devices
- Titles of podcast episodes which had been completed or paused (hundreds)
- Dates of podcast subscriptions and listening times
- Podcasts which possessed reviews from me, including full review text
- All app purchases, including free apps, downloaded to the device
- All IP addresses assigned during downloads
- All books downloaded through Apple Books
- Hundreds of IP addresses used during my connections
- An export of all entries from Apple Calendar
- Documents and contacts remaining in iCloud
- Auto-stored contacts from Apple Mail
- Recipient email addresses accessed within Apple Mail
- Dates and times of outgoing email
- **My real name extracted from outgoing email headers**

I remind you that this data was all monitored, collected, and stored while I assumed I was being anonymous. There simply is no anonymity with Apple devices, as the digital trail will eventually identify any user. If you have followed my digital guide *Extreme Privacy: macOS Devices*, you know you can block almost all of this telemetry, but it can be a chore to maintain. I believe we should not need to take such extreme measures to prevent companies from this invasion.

Microsoft is no better. By default, Windows 10 and 11 require a Microsoft online account in order to install the operating system. Some versions allow you to bypass account creation altogether by being offline, but Microsoft is pushing to eliminate this option in Windows 11. An active Microsoft account is not required in order to receive important software updates, but Microsoft's Telemetry service continuously collects the following data, plus numerous additional details, sending it to their corporate servers in Seattle.

- Typing diagnostic data from your keyboard
- Microphone transmissions
- Index of all media files on your computer
- Webcam data
- Browsing history
- Search history
- Location activity
- Health activity collected by HealthVault, Microsoft Band, and other trackers
- Privacy settings across the Microsoft application ecosystem

This data would make it very easy to identify you, your location, and all online activity. Microsoft claims this collection of data is only to enhance your experience, but I find this activity to be invasive and unnecessary. This is where Linux comes in. Consider the following summary of the benefits of Linux over Windows and macOS systems.

- Linux operating systems do not require an account for installation or usage. You will not be asked for a name, email address, physical address, telephone number, username, or credit card just to use the system which you purchased.
- Most flavors of Linux possess either no telemetry or minimal data collection, which can be easily disabled. Unlike macOS, there are no account requirements in order to download official software. This alone is a huge privacy benefit.
- I believe the security of Linux systems is much better than Microsoft Windows. Most malicious software targets Windows systems due to the abundance of Windows users in both personal and professional spaces, but also because of the overall ability for programs to access system resources. There are viruses and other malicious programs which target Linux and macOS, but these are fairly rare. Any time you hear about a machine becoming infected with ransomware or other computer viruses, it is almost certain to have involved a Windows system. While I believe macOS systems are more secure than Linux or Windows, the privacy invasions negate many of the benefits.
- Linux is completely free and open source. This means that all Linux operating systems are transparent and can be audited by anyone. There are many active Linux communities which pour over all of the code to make sure nothing nefarious is going on behind the scenes. Microsoft and Apple hide their code from the public view and we never truly know just how bad things might be. Open-source code also allows people to create many different versions of Linux which can accommodate specific needs and niches. We will soon discuss the many flavors of Linux and which of them might be most appropriate for your needs.
- Almost every aspect of Linux can be modified and customized. If you are a macOS user, you know that you cannot uninstall stock Apple software such as Mail, Photos, Facetime, Music, and other undesired applications. You are stuck

with them. Most Linux systems begin with minimal programs and allow you to choose what should be added. You can remove anything desired and are never stuck with a default list of stock apps.

- Linux is a very lightweight operating system. It runs smoothly on modern and legacy hardware, which allows for easy testing without the purchase of new and expensive machines.
- Since Linux can be installed on practically any computer hardware, we can be very selective about each part. Most Linux machines allow you to modify all parts including batteries, RAM, drives, etc. If you purchase a MacBook Pro and later decide to upgrade any of these specifications, you are likely out of luck. You would have to buy a whole new machine.

I could provide many more additional reasons I prefer Linux over more traditional systems, but I believe the previous points suffice for most people. Instead of trying to convince you to give Linux a shot, I prefer to explain the ways in which I customize my own Linux usage, and the process for clients. I believe by the end of this guide you will be ready to build or purchase your own Linux device. Next, let's tackle hardware choices, which can be overwhelming.

CHAPTER TWO: HARDWARE CONFIGURATION

If you are a macOS user, you are limited to specific hardware approved and sold by Apple. If you want a laptop, you have a handful of options which can be minimally optimized. Linux is a different beast. Since it runs on practically any computer hardware, the options are endless. You likely possess an old computer which is capable of running Linux without much effort or commitment. If not, you probably have a macOS or Windows device which could host a Linux virtual machine. If you decide to purchase a new computer specifically designed for Linux, you have a new set of overwhelming choices. Let's make sense of all of these options.

Used Equipment: One of the best ways to test Linux is to install it onto a retired machine. If your computer is capable of running Windows, it will likely also handle Linux. If you possess an Apple computer, things are not as straight forward. Older Apple computers made before 2016 should handle just about any Linux variation. If you have a newer Intel-based laptop with a touch bar, you will need a special variant of Linux available from t2linux.org. If your device was made after 2020 and has the latest Apple processor, I do not recommend attempting a Linux installation. Everything else should be possible. I keep old laptops specifically for testing new Linux builds.

Virtual Machines: If you only have one computer, then a Linux virtual machine is ideal for experimentation. Chapter Eight goes into great detail about creating virtual machines within any Linux, macOS, or Windows platform. It also explains how to build Linux and Windows virtual machines within your Linux host. Once created, your virtual machine will behave just like a traditional installation on a host.

New Computers: This is always my preference. If you decide to commit to a Linux lifestyle, purchasing a dedicated Linux machine with your own specifications is ideal. It also opens the flood gates with multiple manufacturers, models, and customizations. However, I will walk you through my preferred options. A new machine with Linux pre-installed is not only the easiest way to get going, it should offer the best possible integration into your daily activities.

During the rest of this chapter, I will assume that you want to purchase a new computer specifically for your Linux experience. However, the next chapter explains how to install Linux within any capable device. For now, let's focus on hardware options.

There are thousands of new and used machines which could run Linux well. You might have a preference for Lenovo ThinkPad laptops, and you might want to stick with that which is familiar. Maybe you prefer Dell machines. Both Lenovo and Dell work great with Linux, but I believe we can do better. Let's start with the processor. The processor is the main chip which allows your computer to complete all of the functions and tasks which you tell it to do. It is the heart of a computer. It can also be the first vulnerability from an outside attack. Virtually every Intel processor made since 2008 possesses software known as the Intel Management Engine (Intel ME). It is a subsystem of proprietary firmware embedded directly onto the chip. It is a small operating system. Any traditional operating system installed to the computer, such as Linux, would have no control over Intel ME. The Intel ME software runs during boot, while the computer is running, and while it is asleep. As long as the chipset is supplied power, it even continues to run when the system is turned off.

The legitimate purpose of Intel ME, and AMD's option called AMD Secure Technology (AMD ST), is to allow your device to be managed within a low-powered state. Administrators of large computer networks can take advantage of this technology to remotely control many aspects of a computer within the network. The concerns arise due to the control in which Intel ME has to all aspects of the device, the overall secretiveness around the closed-source code behind these functions, and several known vulnerabilities which have been reported since 2017.

Let's have a reality check. Intel ME and AMD ST are not monitoring everything typed on a machine or allowing strangers to remotely access your screen. Substantial configuration on your device and the network to which it connects is required. You might never have a problem using an Intel ME enabled chip. My concern is any new undisclosed vulnerabilities which could be abused by criminals. This presents my first requirement for my Linux device. I want a machine which has Intel ME disabled. You will likely never find a computer with all traces of Intel ME completely removed from its processor. However, there is an active community of people and companies constantly working to minimize the Intel ME processes allowed to run within a system. The most active vendor of Linux-based machines with default disabled Intel ME is System76 (system76.com).

A company called Purism had previously offered laptops without Intel ME, but I strongly advise against any purchase from Purism. They are still trying to fulfill orders of their Linux-based phones several years after purchase. In some cases, people have been waiting five years for their device to ship, while being ignored by customer support. They refuse to issue refunds for non-shipped items. Please avoid them.

System76 sells only devices which are targeted toward Linux users and possess Linux when shipped. I have placed several orders for customized machines which ship the next day from Colorado. Most of their laptops have Intel ME disabled by default.

The second reason I prefer System76 over other vendors is their use of open-source firmware called Coreboot. This software replaces the proprietary code included with most motherboards. It is typically much faster and more secure. More importantly, it removes the hidden closed-source code which could be doing bad things on a hardware level.

Hopefully you have decided that you also want a machine which has Intel ME disabled and Coreboot instead of stock firmware. This means you will need an Intel-based machine from System76. Sounds easy, right? You still have many options. System76 currently offers nine different laptop models and four desktop variants. Let's begin with the laptop versus desktop discussion. I possess a System76 Thelio desktop computer for all of my data breach work. I prefer a desktop for this because I can easily expand my storage and allow the desktop to complete lengthy tasks while I am away. I also like the sense of walking away from the computer instead of always having a laptop within arm's reach. However, I don't typically recommend desktops to most people. Laptops are portable and include a screen, keyboard, and trackpad. They are also more common and appropriate for most of my clients. If you need a desktop, you know your reasons why and do not need my input.

If you are looking at nine System76 laptops and feel confused, you are not alone. I spent several hours digesting all of the options before I committed to my own machine. Since we can only have Coreboot and disabled Intel ME on Intel-based devices, this eliminates the Pangolin with AMD chip from the lineup. That leaves us with eight options.

The Gazelle, Adder, Oryx, Serval, and Bonobo laptops are extremely powerful machines targeted toward people who need 4K screens up to 17", dedicated graphics cards, and top-of-the-line processors. If you are processing HD video all day or need a high-end gaming machine, these are for you. However, they are not for me or my clients. That leaves us with three choices left.

The Galago Pro, Lemur Pro, and Dartar Pro would each work for our needs. The end user would need to look at them and decide which is the best fit. The Galago Pro has only five hours of battery and the Lemur Pro does not have an Ethernet port. This is why the Dartar Pro is my current laptop and the device often issued to my clients. It has the bigger 15" screen, both USB-A and USB-C ports, a microSD card slot, and a nine-hour battery. I also prefer the Dartar Pro keyboard which includes a number pad to the right, but some people may not like the standard keyboard which is slightly shifted to the left.

If you want a more portable (and much lighter) device with 14" screen, I prefer the Lemur Pro, but note that it does not have an ethernet port if that is important to you. Next are the specs. I chose the following options at the time of this writing.

Processor: I chose the default Intel i5 1340p processor, which I find more than sufficient for everyday tasks. The jump to an i7 is over \$200, and most users would never take advantage of the additional horsepower. If you know that you will be performing process-intensive tasks which will benefit from this upgrade, it may be worth it to you. If you spend most of your time in a browser, you would see no improvement. This contradicts my advice in the macOS guide where I encourage users to go with higher specifications. This is because macOS machines cannot be upgraded and we want to future-proof them the best we can.

Memory: The default 8 GB of RAM is less than I desire. Since I often have virtual machines open, I believe 16 GB of RAM is more appropriate.

OS Drive: The default 250 GB of disk space may work for most people, but I find it limiting. I also find the 3,300 MB/s read speed of the default drive less than optimal. I prefer to increase the size to 1 TB and the speed to 7,000 MB/s with the PCIe Gen4 drive. If you ever need to process large amounts of data, you will appreciate the upgrade. This increase of 4x the size and 2x the speed is only \$115 more.

My customization presented a total price of \$1,259.00. An equivalent Apple laptop would be twice that amount. I want to stress that my choice of laptop may not be the same as yours. There is no such thing as the perfect machine. Do your own research and find the appropriate model for you. Watch online review videos to see a realistic representation of any device. The Galago Pro, Lemur Pro, and Dartar Pro each include Coreboot and disabled Intel ME, and are very portable. All System76 computers have the option of shipping with either Ubuntu or Pop!_OS, as explained next.

I am sure some readers are questioning my enthusiasm for System76 products. In the name of full transparency, I received no compensation from System76 for the promotion of their products in this book. I purchased my own machine(s) and I am not a System76 affiliate. I receive no kickbacks from any past or future orders. In fact, I had a hard time getting their press team to respond to my multiple requests asking for permission to use their trademarked name within this guide.

CHAPTER THREE: OS CONFIGURATION

I will assume that you have now identified the way in which you will begin your Linux journey. Whether you have decided to test things with an old computer, play around within a virtual machine, or commit to the Linux world with a brand-new laptop, this entire chapter (and rest of the book) applies to you. Our next discussion is over the version of Linux best for your needs. This is where I always see great debate. Offering a Linux variant preference is similar to stating which religion is best. There are many die-hard Linux fanatics who will scold me regardless of the route I take. Let's rip this bandage off and get right to it. My preference for Linux installation is Pop!_OS. There, I said it. I know many of you are screaming at me right now. Before you sharpen your pitchforks, please allow me to explain some other popular options, and the reasons I choose Pop!_OS for my daily laptop.

Qubes OS: Any time I mention Linux on my show, numerous people write in to tell me I should be recommending Qubes OS. Qubes OS is a security-focused Linux operating system that aims to provide security through isolation via virtualization. It allows you to launch every application within its own isolated virtual machine. This is quite impressive and extremely secure. However, it can also be annoying. The learning curve from macOS or Windows to Qubes OS is steep and daily usage can be trying. I once attempted to use Qubes OS for 30 days, but failed after much frustration trying to perform daily tasks. If you use Qubes OS full-time, you have my respect. For most people, I believe it is overkill and more likely to make them return to easier traditional systems.

Kali: Many people advocate using a Linux build called Kali which is pre-loaded with numerous security-related tools. However, Kali is designed to be executed as a virtual machine and I believe it should never be executed for personal usage.

TAILS: The entire TAILS operating system relies on the Tor network for increased anonymity online. However, it is not meant to be a host. It is designed to be launched from an external drive in a way in which it leaves no trace on the computer after the session is closed. Much like Kali, it is not intended to be used as a daily driver host.

Debian: Debian is designed to be used as a host, and it provides a very minimal software experience. I believe Debian can be a great choice for those who have a lot of Linux experience. I used it for a while, but ran into driver issues and the occasional software conflict. Of the previous options, it is the closest we have to a full-functioning Linux host operating system.

Ubuntu: This is probably the most familiar choice as it is one of the most popular Linux distributions. It is a fantastic beginner's operating system because it typically just works upon launch. It has its own application store and many software developers offer online steps to make their applications work on Ubuntu. I recommend Ubuntu for use as an OSINT virtual machine, as explained in my OSINT Techniques book, and it has worked very well for me over the years. However, there are minor things which annoy me. First, Ubuntu pushes you to use their own Snap software installation and go out of their way to prohibit you from using more traditional installation processes. It is rumored that Ubuntu is ditching the Snap option altogether in mid 2024, but we are stuck with it for now. They also include some minor telemetry which needs disabled. I think Ubuntu, and a variant called Mint could both be used as daily Linux drivers by anyone, but I believe we have a better option.

Pop!_OS: Finally, we have my preferred operating system for myself and clients. Pop!_OS is based on Ubuntu, but redesigned for privacy and security. There are many differences from stock Ubuntu, including the following.

- The Pop!_OS installer applies full-disk encryption by default.
- All telemetry is disabled and third-party connections are opt-in.
- The application store can install and update Flatpak/Deb programs.
- Snap is not installed.
- Pop!_OS has better window tiling options.
- It includes a recovery partition to easily restore your system when needed.
- It feels less sluggish and more polished.

While almost all of the remainder of this guide can be used with Ubuntu, Mint, or any other Debian-based distribution, I will focus on Pop!_OS within my demonstrations. Please do not let that deter you from testing other options. I had to choose one operating system for my examples, and I chose Pop!_OS because that is what I use every day. It should be quite easy to replicate all techniques within Ubuntu with minimal, if any, alterations. If you use Arch, Fedora, Manjaro, or another flavor of Linux, you know your reasons why, and you should proceed with your own preference.

If you purchased a machine which included Pop!_OS, you can skip the next section. For those installing Pop!_OS (or any other version of Linux) themselves onto a dedicated host computer, you will need to create a bootable USB installation drive. I conducted the following to create my own drive.

- Navigate to <https://pop.system76.com/> and click "Download".
- Choose the "Download 22.04 LTS" option and allow the download.
- Install Balena Etcher from <https://etcher.balena.io/>.
- Launch Balena Etcher and click "Flash from file".
- Select the downloaded iso file.
- Click "Select target" and choose your USB drive.
- Click "Flash" and allow the process to complete.

Please note that this will completely erase any chosen USB drive, so be careful. At the end of the process, you should have a bootable USB drive ready for Linux installation. Insert this drive into your computer and turn it on. Immediately press the key which presents boot options. This is typically, ESC, F1, F7, F8, F10, or DEL. Once you have your boot options screen loaded, select the USB drive with your Linux installation. The exact process to install any Linux distribution, including Pop!_OS, will change over time. However, the following steps used during the writing of this guide should help get you through the process. My experience with Pop!_OS is outlined in the following.

- Click "Try or Install Pop!_OS".
- Choose your desired language, location, and keyboard.
- Choose clean install and select your internal drive.
- Click "Erase and Install".
- Provide your desired computer name and password.
- Select the default option to encrypt the drive.
- If desired, allow the same Linux password to be used for the drive encryption. This is more convenient but could pose a security risk. If you want an extra layer of protection, you could specify a unique password for each option of

drive encryption and Linux, but this may be overkill for most users. I use the same password for both options.

- Allow the process to complete and click "Restart Device".

When the computer reboots, you should be presented with a screen to unlock the encrypted disk with a password. This is the first layer of protection which comes default in Pop!_OS. This same protection can be configured during installation of Ubuntu or other systems. Unlocking the drive simply allows access to it. You should then be presented with the Pop!_OS user selection and password entry screen. This unlocks your version of Pop!_OS and boots the machine. Continue through the one-time setup with the following steps.

- Choose your layout options for the dock and click "Next".
- Choose your Top Bar options and click "Next".
- Click "Next" twice to continue through the menu.
- Choose your desired appearance and click "Next".
- Choose your Wi-Fi (if available), supply the password, and click "Next".
- Keep location services disabled and click "Next".
- Choose your desired time zone and click "Next".
- Click "Skip" to bypass any online accounts then click "Start Using Pop!_OS".

Some people are annoyed at the need to enter the same password twice upon each boot. I do not mind this, but I respect the question of redundancy. If you know the password to decrypt the drive, I do not see a huge security issue if you disable the secondary password to log into Pop!_OS. This can be done with the following steps, and reversed at any time, but please note my warning presented in a moment.

- Launch the Settings application in the lower-right of the dock.
- Choose "Users" in the left menu.
- Click "Unlock" and enter your password.
- Enable the "Automatic Login" toggle.
- Close Settings and reboot the computer by click the upper-right menu bar and selecting "Power Off / Log Out" > "Restart" > "Restart".

You should now only be prompted for the decryption password. Once past that screen, Pop!_OS should boot normally. **I want to stress that this is optional.** If you chose a unique password for each the decryption and login, you should not enable automatic login. This will also cause some programs to demand your password more often than if one was manually entered at login due to the way the Linux keyring is unlocked. Always identify the appropriate balance of convenience and security for your own needs. Enabling automatic login does not erase the password for the account, or decrease the security when a password is required otherwise, but it may add more inconvenience than if you just entered it at every boot, which is what I do. Pop!_OS is more private than Ubuntu by default, but I still like to make a few modifications. I conduct the following after a new installation.

- Launch the Settings application in the lower-right of the dock.
- Click "Bluetooth" in the left menu and disable the toggle.
- Click "Privacy" in the left menu and disable "Connectivity Checking".
- Click "File History & Trash" and disable everything.

While the following are not related to privacy or security, I find the modifications to enhance my own usage of Linux. Your preferences may not match.

- Click "Screen" and change "Blank Screen Delay" to a longer period.

- Go back to the main screen, click "Power" in the left menu and disable "Automatic Screen Brightness" and "Dim Screen".
- Click "Automatic Suspend" and disable all options.
- Enable "Show Battery Percentage".

Much like Ubuntu, Pop!_OS offers numerous images for use as our background wallpaper. Right-clicking on the desktop presents a menu with an option to "Change Background". However, I prefer a solid background without any image. Similar to Ubuntu, Pop!_OS does not offer a menu option to change the background to a solid color. Let's fix that. The following Terminal command removes the background image completely, leaving a solid blue background on the desktop. You can launch Terminal from the black icon in the lower Dock.

```
gsettings set org.gnome.desktop.background picture-uri ''
```

This is better, but I prefer a slightly muted version of blue, which I change with the following Terminal command. This command, and the others in this chapter, should be executed as a single command within one line. Your PDF viewer may split the lines and you will need to move everything within one command.

```
gsettings set org.gnome.desktop.background primary-color 'rgb(66, 81, 100)'
```

You can change the numbers as desired to create the perfect color for your desktop. The site at https://www.w3schools.com/colors/colors_rgb.asp should assist.

The next modification I like to execute is to move the Dock from the bottom to the left with the following Terminal command.

```
gsettings set org.gnome.shell.extensions.dash-to-dock dock-position LEFT
```

Next, I prefer to decrease the default size of the icons since I will be adding numerous programs soon. You can change the number to any size appropriate for your screen size with the following Terminal command.

```
gsettings set org.gnome.shell.extensions.dash-to-dock dash-max-icon-size 30
```

When you right-click a file or folder to delete it, you currently have the option to "Move to Trash". The following Terminal command adds a new option directly underneath the Trash entry titled "Delete Permanently". This allows me to bypass the Trash altogether and simply eliminate any desired content.

```
gsettings set org.gnome.nautilus.preferences show-delete-permanently true
```

By default, most Linux operating systems hide "hidden" files from view. These are typically system files but can also include cache and configuration files which we may need to access. Therefore, I execute the following two Terminal commands in order to make these valuable files visible at all times.

```
gsettings set org.gnome.nautilus.preferences show-hidden-files true
gsettings set org.gtk.Settings.FileChooser show-hidden true
```

You likely have pending operating system updates which should now be applied.

- Click the "Pop!_Shop" icon in the dock bar next to Settings.
- Click the "Installed" tab and then "Update All".

Once we begin installing applications, you will see additional update options within this menu. I typically launch Pop!_Shop at least once weekly to apply all updates.

While you may be tempted to begin installing all of your desired applications, please

wait. The next chapter discusses firewalls which help us block undesired outgoing traffic from our devices. This is a crucial step in protecting our privacy and security.

CHAPTER FOUR: DNS CONFIGURATION

The moment you enable an internet connection to any device, the system begins sending information to a variety of servers. This could include unarmful data such as a check for updates, time synchronization, or retrieval of any pending messages. While most Linux operating systems do not send invasive telemetry in the way that Microsoft and Apple do, third-party applications might. Many of the apps we trust are actually sending usage information about us behind our backs. My goal is to present options which reduce or eliminate the exposure. The way we can do this is with a third-party DNS service.

If you have read my macOS guide, you know that this chapter focused on the use of a software firewall instead of DNS. While a firewall application called Open Snitch exists for Linux, I currently do not recommend it. It has been quite buggy for some time, and currently does not work within Ubuntu or Pop!_OS without tweaking the execution any time you want to launch the application. While I insist on a software firewall for macOS devices, I do not believe it is necessary for Linux. My main usage of Little Snitch on macOS is to block connections to Apple. Linux does not present these concerns. However, I do believe we need some type of content filtering.

First, we should understand the nature of the Domain Name System (DNS). DNS can be a very overwhelming topic. In a very basic and simple explanation, DNS translates domain names, such as inteltechniques.com, into IP addresses in order to locate the appropriate content. In a typical setup, your home or mobile internet service provider (ISP) conducts your DNS queries quietly without your input. In other words, your ISP knows every website domain you visit, regardless of SSL encryption, and knows your billing details. If you did not purchase internet or cellular service anonymously, then they also know your identity. ISPs collect a lot of valuable information about you this way, and often sell these details to for marketing purposes. I want to stop that.

By default, your Linux device relies on the DNS service of the network to which you are connected. This could be your home Wi-Fi or cellular provider's service. You have the option to specify a different DNS server for all queries generated from your device. I implement NextDNS (nextdns.io) service for all of the desktop devices and phones of all clients.

NextDNS conducts the DNS queries required in order to navigate your internet traffic, but it also includes filtering options. I will explain with an actual configuration demonstration conducted from my test device in a moment. First, create a new free account at <https://my.nextdns.io/signup>. Any masked or private email service should be accepted and no payment source is required. I used an alias name. The free tier allows 300,000 monthly queries at no cost.

After registration, you should be taken to your NextDNS user portal which should display a "Linux" menu option under "Setup Guide". The first option should display the preferred "systemd" installation, but it will likely conflict with a VPN application. Instead, we will install NextDNS with the following Terminal command.

```
sh -c "$(curl -sL https://nextdns.io/install)"
```

Provide the following responses:

- Enter "i" to install, and provide your password when prompted.
- Enter your NextDNS profile ID, such as d4e2af.
- Enter "Y" to report device name and "n" to setup as router.

- Enter "y" to enable caching and "y" to enable instant refresh.
- Enter "Y" to setup local DNS hosts.

This will launch NextDNS as your system DNS provider after installation. You can use the following commands to start, restart, or stop the service at any time.

```
nextdns start
```

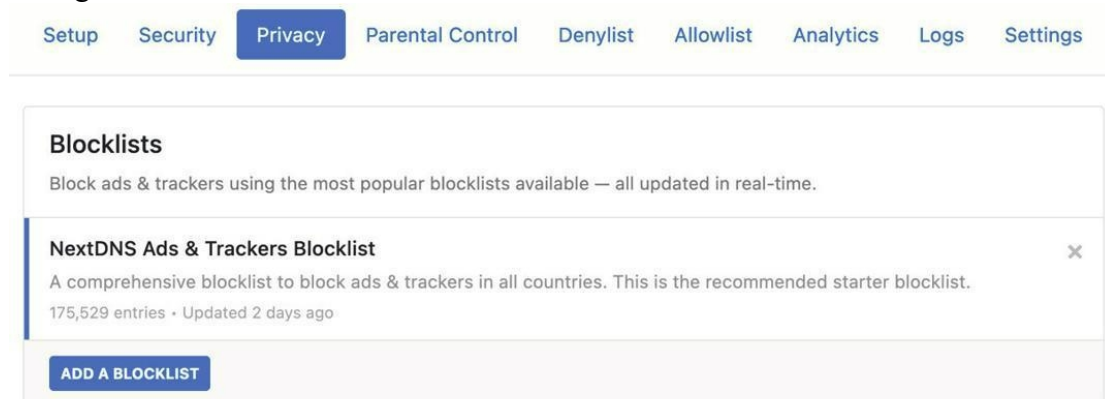
```
nextdns restart
```

```
nextdns stop
```































Every time you boot the computer, the DNS service should stay in the same state as the previous shutdown. If you shut down the machine while NextDNS was active, it should be active at the next boot. In Chapter Nine, we will create a script which allows easy enabling and disabling of NextDNS, which might be important when we discuss VPNs. **If your machine cannot connect to the internet, execute nextdns restart.** This will correct the situation most of the time.

As long as this connection is active, your Linux device is using NextDNS for all DNS queries, and you can see the logs of these requests in your NextDNS portal. This may be alarming to some readers. The "Logs" tab in your portal identifies every connection being made from your device. This can be a privacy concern, but it has many benefits. We can now apply filters which will block many undesired connections.

Click the "Privacy" tab and notice the automatically-applied blocklist. If this was not applied, add the "NextDNS Ads & Trackers Blocklist". This database blocks over 100,000 connections which are associated with ads, trackers, and malware. This will block a lot of unwanted connections such as pop-up ads, tracking code, telemetry, and user analytics. You now have greater protection. The following image displays my configuration and the menu.



Click on the "Logs" tab again and take a look at the traffic. You may need to refresh the page to see new results. Mine appeared as follows.

 virginia.time.system76.com	  a few seconds ago
 paris.time.system76.com	  a few seconds ago
 oregon.time.system76.com	  a few seconds ago
 ohio.time.system76.com	  a few seconds ago
 brazil.time.system76.com	  a few seconds ago
 2.ubuntu.pool.ntp.org	  a few seconds ago
 apt.pop-os.org	  a few seconds ago
 1.ubuntu.pool.ntp.org	  a few seconds ago
 0.ubuntu.pool.ntp.org	  a few seconds ago
 ntp.ubuntu.com	  a few seconds ago

This may seem alarming, as these multiple connections are transmitting data without us doing anything but rebooting the system. However, this is harmless. All of the connections except "apt.pop-os.org" are time servers attempting to make sure our clock is synchronized correctly. The "apt" connection is looking for any software updates which may need applied. These results prove that the filtering is working. NextDNS is conducting all of our DNS queries and filtering any content which it deems malicious or invasive.

These multiple queries to time servers may seem like overkill. The five System76 time servers are the default option and the "ntp" servers are a fallback. Since System76 uses the encrypted Network Time Security (NTS) protocol, I prefer to rely solely on them. If you want to remove any of the options, you can do so by modifying a couple of system files. However, we have a problem.

The files we need to modify are protected system files. If we navigate to them and open with a double-click, we will be in read-only mode without the ability to modify the contents. We can cheat with the following Terminal command, which opens the "Files" application (Nautilus) with administrative privileges. After execution, you will be prompted to enter your Linux password.

```
sudo nautilus
```

You should now be presented with a file explorer which possesses administrative rights. Consider the following.

- Navigate to "Computer" > "etc" > "chrony" > sources.d.
- Double-click the file titled "system76-nts.sources".
- Remove any undesired servers and click "Save".
- Close all open windows.

If you want to disable the non-encrypted Ubuntu fallback options, conduct the following.

- Execute `sudo nautilus` within Terminal.
- Navigate to "Computer" > "etc" > "chrony".
- Double-click the file titled "chrony.conf".
- Remove each line containing "ubuntu.pool.ntp.org".
- Change "pool ntp.ubuntu.com" to "pool pool.ntp.org" and click "Save".

- Close all open windows.

Let's reboot and take a new look at our NextDNS logs. I removed the international System76 servers and all Ubuntu options. I replaced the one fallback option to a standard public server instead of Ubuntu's option. My total connections now appear as visible in the following image.



 apt.pop-os.org	 a few seconds ago
 pool.ntp.org	 a few seconds ago
 virginia.time.system76.com	 a few seconds ago

These are all very minor modifications which would probably have little to no impact on our privacy or security. I feel better avoiding the Ubuntu options in favor of a more generic fallback server, and appreciate System76's implementation of the secure synchronization protocol. Let's move on to some real-world benefits.

Open the Firefox browser on your device and visit a few websites. Then, refresh the NextDNS Logs page and notice the difference. You will likely see several connections allowed and others being blocked. This is the filter lists in action. If you see a connection being allowed which you do not want to occur, you can copy that domain and add it to the "Denylist" tab. I did this for a domain which was being queried by an application in order to send "anonymous" analytics about my usage. I will provide more detailed examples in a moment.

If you plan to use NextDNS full-time on your device(s), I highly recommend that you modify the logging aspects. Click the "Settings" tab within your NextDNS portal and review the "Logs" section. You can disable logs completely or change the retention period. I choose the latter while I am testing my devices. I leave logs enabled; disable "Log Client IPs"; enable "Log Domains"; and set the retention to "1 Hour". This way, I can always connect to the portal to see what is being blocked and allowed, but the logs will be purged an hour after each activity. I can make modifications while I am configuring my mobile or desktop devices and see my results immediately.

Once I have all desired NextDNS configurations in place, I disable logging completely. This eliminates any history of my internet activity through NextDNS. We will rely on these logs in future chapters, so do not disable them completely just yet. Whenever desired, you can purge all logs with the "Clear logs" button.

Next, you should ensure that your connections are encrypted. Within Firefox, navigate to <https://test.nextdns.io> to conduct a test. You should see either "protocol:DOH" (DNS over HTTPS if using the browser setting explained later) or "protocol:DOT" (DNS over TLS using this OS DNS option). If you see either, you are hiding much of your internet traffic from your ISP and your VPN.

While you have the Firefox browser open, visit yahoo.com and allow the entire page to load. If you are familiar with that site, you may notice that the majority of the popup annoyances, embedded videos, and flashing ads are no longer present. This is because NextDNS blocked those connections before they ever reached your device. Next, return to your NextDNS portal and reload the Logs page. It may take a couple of minutes for the results to appear. You should see something similar to the following.

 jill.fc.yahoo.com	  3 minutes ago
 beap-bc.yahoo.com	  3 minutes ago
 idsync.rlcdn.com	  3 minutes ago

The red bar on the left confirms which incoming connections were blocked. We can see our blocklist in action. On yahoo.com, dozens of ads and trackers were blocked without any effort from us. We do not need any browser extensions or firewall applications. This is the true power of NextDNS. This blocking strategy is much cleaner with minimal resource usage. It also prevents conflicts with VPN applications. This is all a lot to digest. Let's summarize some of the key takeaways. By default, your internet service provider supplies DNS services, and often uses that data maliciously. When you configure NextDNS on your Linux device, you are using their lookup service instead. Furthermore, the blocklists can prevent applications from sending out telemetry and analytics about your usage. This will become much more apparent in the next chapter. Remember the limits of the free tier. Most people will not exceed 300,000 queries a month. If you have multiple devices, you can either create an account for each or pay a small fee for NextDNS's premium service. Some readers may be upset that I have chosen NextDNS over AdGuard as a filtering DNS provider. My reasons are the following.

- I have more trust in NextDNS. The founders are publicly visible and I know who runs the company. They are reputable people who have been heavily involved in this space and are transparent about their reasons for the service.
- A premium-tier business model explains the funding for resources.
- AdGuard is a Russian company which was moved to Cyprus, but their infrastructure remains in Russia. A Russian CEO has minimal presence on the internet, but there is no information about any other owners.
- The support from NextDNS has been superior. When I contacted both companies with questions about the product, only NextDNS responded. One of the owners provided full details.
- AdGuard recently announced a new program similar to NextDNS which will allow custom filtering. However, my emails requesting information were unanswered. The custom options from NextDNS have been thoroughly tested and vetted.

The final privacy consideration in regard to DNS is account-based versus publicly-available servers. While a custom NextDNS account can be wonderful for blocking (or allowing) connections, it does carry some risk. Since you have an account, all queries could be tracked back to a specific user. Disabling logs should prevent this, but a court order could override your configuration. Using an alias name should provide comfort. Public NextDNS servers do not require an account, but provide no custom filtering. If you want to filter ads without an account, I do believe AdGuard is currently your best option (dns.adguard.com). However, you cannot modify the protection. If they block a domain, there is no way to unblock it. Again, this is where custom filtering from NextDNS is superior.

Are you sick of DNS yet? There are many opinions of the proper way to use DNS services. None of them are perfect for everyone. I hope you take the information

presented here and use it as a starting point toward your own DNS and VPN strategy. Please consider the remaining chapters before you lock in your own plan. In Chapter Six, we will rely on NextDNS to further harden our device's privacy and security. Now that you have your operating system properly configured and DNS filtering in place to protect you from data intrusions, we can finally start installing the applications which we will use on our new machine.

CHAPTER FIVE: APPLICATIONS

Pop!_OS possesses its own application installation store called Pop!_Shop, much like Ubuntu has Snap Store. I typically prefer to install sensitive Linux applications directly from the software providers so that I know I am receiving official and updated content. However, I do use Pop!_Shop for installing and updating most general applications. Let's work through this with an example.

Password Managers

I only recommend open-source encrypted password managers which can easily export a backup for use on another machine. I believe every reader of this book should possess a password manager, and I recommend two options for two unique experiences. We will also install both.

Offline - KeePassXC (keepassxc.org): If you want extreme privacy and cannot tolerate the idea of storing your passwords in the cloud, regardless of the encryption and security, then an offline password manager is appropriate for you. I use KeePassXC and make sure I have a good backup.

Online - Bitwarden (bitwarden.com): If the idea of manually synchronizing your password database to any other device or backup drive makes you want to give up on the security benefits of a password manager, then Bitwarden is the best option. It is much easier than KeePassXC and keeps all of your passwords updated across devices, but it also technically stores an encrypted version of your passwords on the internet. This data is protected with strong encryption and not even Bitwarden employees can access your data, but you are presenting a slight risk. It can also handle all software token 2FA while itself being protected with a hardware YubiKey. Most of my clients choose Bitwarden while a few extremists go with KeePassXC.

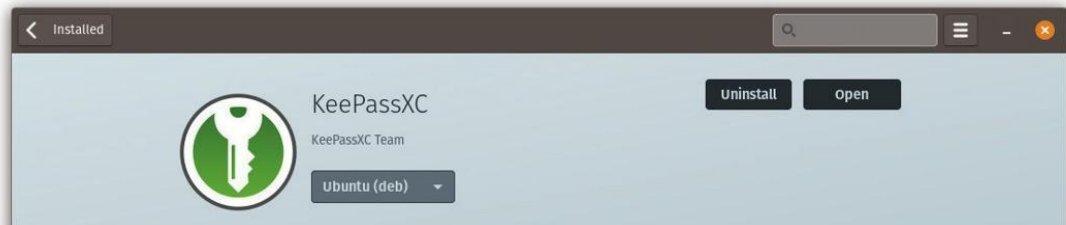
The official KeePassXC website provides ten different ways to install their application within various Linux environments. The first is an AppImage. You can simply download this file, right-click, select properties, check "Allow executing file as a program", then double-click it for installation. However, this is not my preferred method. I would need to manually check for updates often since this AppImage cannot auto-update itself (instead of allowing my system to apply updates).

The second option is to install via Flatpak. Flatpak is a utility for software deployment and package management for Linux. It offers a sandbox environment in which users can run application software in isolation from the rest of the system. That sounds like a great option for a password manager, but I foresee a problem. If I wanted to use the KeePassXC browser extension within Firefox, it will likely not be able to connect to the KeePassXC database due to this secure isolation. Let's keep going.

The third option is a Snap package, but I do not have Snap on this machine (nor do I want it). Finally, the fourth and fifth options offer solutions for Ubuntu and Debian. Since Pop!_OS is based on Ubuntu, and Ubuntu is based on Debian, these should work well for us. Before proceeding, let's take a look at the options within the official Pop!_Shop. If I search KeePassXC within Pop!_Shop, I receive one result for that software (not to be confused with KeePassX). Clicking the item displays a menu with installation options. I can choose the default Flatpak selection or change the dropdown to an Ubuntu (deb) option. The second option should be the same as installing via Terminal with the following command.

```
sudo apt install keepassxc -y
```

Let's test our theory and execute the previous command to install KeePassXC manually. After installation, re-open Pop!_Shop and click the "Installed" tab. If you scroll, you should find KeePassXC listed within the installed applications and services. Click the item and notice the screen change. The Ubuntu (deb) option now confirms it is installed and provides the option to uninstall via the click of a button. The following image displays my result.



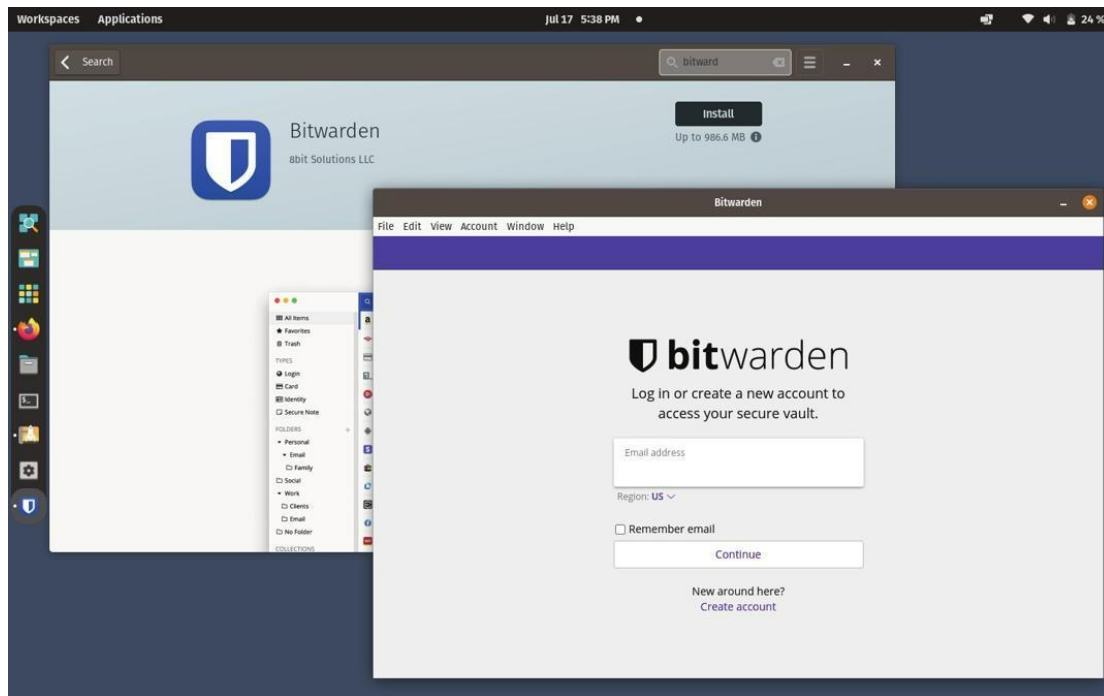
This does not mean that I always prefer Apt installation over Flatpak. In this scenario, it was the best choice because I needed another application (Firefox) to be able to connect to the program. Manually installing via Terminal removed any trust that the Pop!_Shop version could be tainted. Since this is a sensitive application, I want to scrutinize any installation and update options. This application will be updated when we execute our weekly commands presented at the end of this chapter.

Let's repeat with Bitwarden. Searching Bitwarden within Pop!_Shop presents only one installation option, but it does not tell me much about it. The Bitwarden website mentions nothing about Flatpak, and an online search tells me that the version of Bitwarden within Flatpak is not an official release. There are probably no malicious intentions with this offering, but I only want my password managers directly from an official source.

Contrary to KeePassXC, I prefer the AppImage installation for Bitwarden. This is because you can download the official application from their site and it will fetch its own updates without the need for any software repository. However, there is a new problem. The default way in which Pop!_OS handles AppImages causes many to fail to open. After downloading, modifying the permissions, and executing, there is a good chance nothing will happen. This is why I prefer a different AppImage manger called AppImageLauncher. I executed the following within Terminal.

```
sudo add-apt-repository ppa:appimagelauncher-team/stable -y
sudo apt update
sudo apt install appimagelauncher -y
```

Now that AppImageLauncher is installed, we can simply double-click any AppImage file, including the Bitwarden program downloaded directly from their site. You should see a new window when doing this, and the default options are acceptable. The first time you launch an AppImage from this new application, you should be prompted to integrate AppImageLauncher into your system. I chose "Integrate and run". You should now see any AppImage programs embedded into your Applications menu and you can right-click entries there to uninstall them or pin them to your Dock. We can now search Bitwarden within Pop!_Shop to check our work. The image below shows my result. Pop!_Shop only gives me the option to install Bitwarden, even though I have the program installed and running. This is how we know we did not install the Flatpak version.



Are you confused yet? I know this can seem overwhelming when first encountering Linux. My software installation policy is simple. I search any sensitive programs within a web browser, visit the official site for the application, and identify the official ways of installing the software per their recommendations. If a "deb" or "apt" solution is available, I will typically prefer that in order to incorporate the program into my system. If only a Flatpak option is available on the official site, and in Pop!_Shop, I will install that if I am sure the application will work in a completely isolated environment. If the only way to automatically update a program is to use an official AppImage file, I will replicate the tutorial we just completed. We will have much more practice throughout the rest of this guide.

Calendar & Contacts

Pop!_OS possesses default calendar and contacts applications, which can be accessed from the "Show Applications" icon within the Dock. By default, any data entered within these programs is stored locally within the encrypted drive. If you only need your calendar and contacts within your Linux device, these options should work well. However, locally-stored data is not likely sufficient for your needs. Most people want to synchronize their calendar events and contact data across multiple devices, especially to their mobile phones. You have two secure options for this.

If you use Proton Mail, Tutanota, or Skiff Mail for your email, all stored contacts and calendar entries are end-to-end encrypted for your protection (Proton Mail does not encrypt the name and email address in order for their system to function properly, but the telephone numbers and notes are protected). This would allow you to see your data within web browsers and mobile device email apps. However, none of these services can synchronize your data to the stock Linux calendar and contacts applications (or the mobile equivalents). On mobile devices, this means that telephone apps and event notifications cannot access this data. For full secure synchronization, we need EteSync.

EteSync (etesync.com) is a service which offers end-to-end encrypted calendar, contacts, and notes data. For \$2 monthly, they will store your data on their servers in a secure way in which they cannot access any of your data. You can then download the

EteSync Bridge software onto your Linux machine and mobile devices. This software connects your encrypted EteSync data to any calendar or contacts applications. Any changes made within these apps are immediately reflected within the EteSync data. You could then synchronize this data with any other device, such as a smart phone. The one-time setup can be a hassle, but should never need repeated. If you want to use traditional calendar and contacts applications within Linux which synchronize securely to another device, EteSync is your best option. Let's install it. First, create a free trial account at <https://pim.etesync.com/signup>. This allows one week of unrestricted access. After you have established credentials for the service, log into your account and create a new calendar and address book. Title these any way desired, then navigate to <https://github.com/etesync/etesync-dav/releases/latest> and download the file titled "linux-amd64-etesync-dav". After you have the file, execute the following within Terminal.

```
cd Downloads
chmod +x linux-amd64-etesync-dav
./linux-amd64-etesync-dav
```

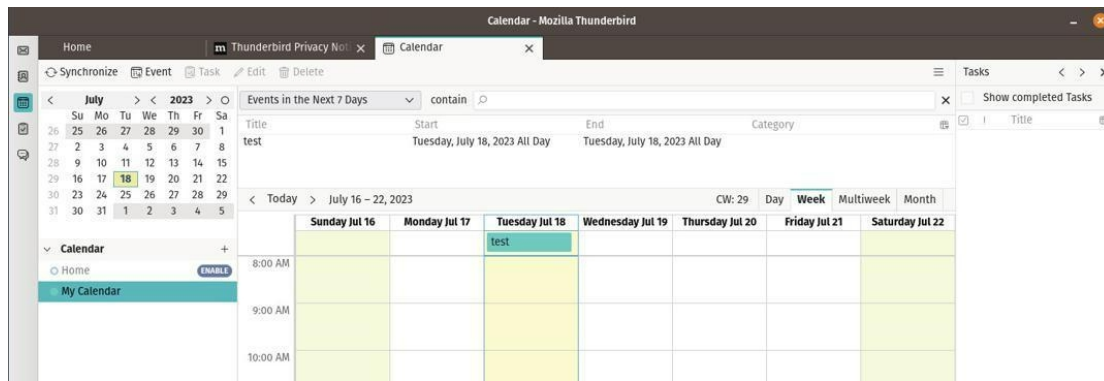
This should launch your browser to a page which will accept your EteSync credentials from your free trial. You will need to "Add" your account and then login with the same information. You are now synchronized to the EteSync server.

Next, you need an application which can connect to your new secure EteSync account and synchronize the data in a viewable form. For this, I prefer Thunderbird.

Thunderbird is an all-in-one email, calendar, and contacts solution which we will use for several tasks. Install and configure it with the following steps.

- Open the Pop!_Shop and search "Thunderbird".
- Click the entry to see the application details.
- Change the Flatpak installation option to "Pop!_OS (deb)".
- Click "Install".
- Launch Thunderbird and cancel any wizard or welcome windows.
- If prompted, choose the option to use thunderbird without email (for now).
- Click the Calendar icon in the left menu, then the "+" next to "Calendar".
- Select "On the Network" and click "Next".
- Enter your EteSync username.
- Return to your browser on the page at <http://localhost:37358/.web>.
- Click the "Collection Lists" link.
- Right-click on the link for your calendar and select "Copy link".
- Return to Thunderbird and paste this link into the location field.
- Click "Find Calendars" and provide your EteSync password when prompted.
- Click "OK" and allow the connection to complete.
- Click "Subscribe" once the calendar has been identified.

Let's test everything. Open your browser and navigate to <https://pim.etesync.com>. Log into your account and click the Calendar tab. Create a new entry labeled "Test" in today's date. Now open Thunderbird and make sure you are in the Calendar section. You should see your EteSync calendar along with the "Home" default calendar. The following image displays my own result. As you can see, my Thunderbird calendar shows this new entry. If yours does not, right-click your EteSync calendar and select "Synchronize Calendars".



If you open the stock Calendar application within Pop!_OS, you should also see any entries from your EteSync account. This is because EteSync is serving the data to Thunderbird, and Thunderbird is making that data available to any other traditional calendar application. If you like the stock option better than Thunderbird, you could use it. Personally, I use Thunderbird for all calendars, contacts, and email, which will be explained soon. First, is this all worth it?

This may seem like a lot of effort just to synchronize a calendar. You could just use a Google account to replicate all of this without the fuss. However, we care more about privacy than convenience. Let's digest what we have accomplished and how it may be more beneficial than the traditional way of accessing this data.

EteSync stores all of your calendar and contact information securely with end-to-end encryption. They cannot access any of your data, as it is encrypted with your credentials. No one but you can see this information. Your Linux machine is set to synchronize the data at EteSync to your Thunderbird software. Any changes you make in Thunderbird (or the stock Calendar application) synchronizes to your EteSync account. Any other device with EteSync can also synchronize this data. Whenever I make a change to my calendar in Thunderbird, that change is synchronized to my EteSync account, and then also synchronized to my mobile device and second laptop. This way, I have a completely encrypted calendar across all devices in my life. I can also share calendars with my staff for group usage.

The setup is a hassle, but worth it to me. However, we are not done. This is all working because the EteSync server is running in the background after we launched it during the previous instructions. We need this to always be running if we want constant synchronization capabilities. We can do this with the following steps.

- Launch "Show Applications" from the Dock and search "Startup".
- Launch the Startup Applications program.
- Click "Add" and label the name as "EteSync".
- Click "Browse" and select the "linux-amd64-etesync-dav" in Downloads.
- Click "Add" then "Close".

Your EteSync program should now launch when you boot the device. However, let's test it. Close all open applications and reboot the system. Launch Thunderbird and right-click one of your EteSync calendars, selecting "Synchronize Calendars". If you do not receive a connection error, you are all set. If you want to go further, you could log back into the web browser version, add a new event, refresh Thunderbird again, and make sure you see the change.

I do not want the local calendars visible at all. I right-clicked the "Home" calendar and selected "Delete Calendar". This prevents me from mistakenly modifying a non-synchronized calendar.

EteSync is the only service I have found which synchronizes this type of data in a secure way which can be accessed locally on the machine. It is worth the \$2 monthly fee to me. You should test the service with a trial before committing. If you only need to synchronize this data within a browser-based service without access within stock applications, then Proton Mail, Tutanota, or Skiff may be all you need without any fees at all. Know your options and evaluate your own needs. We can now replicate these steps to synchronize our contacts within EteSync to our Linux device.

- Re-launch Thunderbird and cancel any wizard or welcome windows.
- Click the Contacts icon in the left menu.
- Click the drop-down next to "New Address Book".
- Select "Add CardDAV Address Book".
- Enter your EteSync username.
- Return to your browser on the page at <http://localhost:37358/web>.
- Click the "Collection Lists" link.
- Right-click on the link for your address book and select "Copy link".
- Return to Thunderbird and paste this link into the location field.
- Click "Continue" and provide your EteSync password when prompted.
- Click "OK" and allow the connection to complete.
- Click "Continue" once the address book has been identified.

Your instance of Thunderbird should now be synchronizing all of your contacts and calendars to the EteSync server. If you do not have a calendar or address book in the collections list, you need to log back into EteSync and create them. While EteSync has an option for secure notes, I do not use it. I prefer Standard Notes, which will be explained later. You could now use my *Extreme Privacy: Mobile Devices* guide to synchronize your Android or iOS device to EteSync for a full contacts and calendars solution. My GrapheneOS device always has the latest changes.

Email

I always prefer to handle daily email tasks within the web browser while logged into my provider's site, but I also insist on a traditional email client within my Linux machine. I believe we should all have a full backup of our email messages, and we should never blindly rely on any email provider to be there when we need our content. What if they go out of business, suffer an online attack, or trigger our account as fraudulent? If we use our own domain for all email, we can forward it to a different provider. If we lose access to our email account, we have all of our messages saved locally.

Much like the previous tutorials for calendars and contacts, I prefer Thunderbird as my Linux email client. After launching Thunderbird, you can either use their onboarding welcome menus or manually configure your email account by clicking the "Email" option under "Choose What to Set Up". You would then enter your email credentials supplied by your provider. This should be fairly straight-forward for most traditional email services. Encrypted options have hurdles.

If you use Tutanota or Skiff as your encrypted email provider, you have no option to automatically synchronize your email messages to an email client. I rely on Proton Mail as my primary provider, and they supply a "Bridge" which makes the process fairly easy. The Pop!_Shop has the unofficial Flatpak version ready to go, but I have reservations trusting unknown online individuals with the installation of this program. Therefore, I download the "deb" file directly from <https://proton.me/mail/bridge>. This is an official build which will prompt within the application to install any official

updates. I can then right-click the downloaded file, choose "Open with Eddy", and click "Install". Once finished, I can launch the Proton Mail Bridge application and follow the prompts to configure the service.

Once Proton Mail Bridge is functioning, it will synchronize your account locally in an encrypted manner, but that will not give you access to your messages. For this, we must configure Thunderbird to keep our messages synchronized, indexed, and searchable offline. In the email account setup menu, provide your desired name and the credentials provided to you within the Proton Mail Bridge application. These will be different than the details provided to log into their website. The rest of the details should be automatically imported. If they are not, follow the detailed instructions at <https://proton.me/support/protonmail-bridge-clients-windows-thunderbird>.

I do not want to present Thunderbird as an Apple Mail or Outlook clone. It may appear outdated to you, but the function is all we care about. I never send emails from Thunderbird. I only use it as a way to retrieve and archive the data from my email provider(s). I rely on my web browser to connect directly to my provider for daily email usage. The content on my machine is only for offline use and archiving. I launch Thunderbird and Proton Mail Bridge at least once a week to synchronize all new data. The backup may never be needed at all, but I will be relieved if disaster happens.

Notes

I am a huge fan of **Standard Notes** (standardnotes.com). The free version provides fully end-to-end encrypted (E2EE) data. Only you can see your content, and you can synchronize all data to any other desktop or mobile device. I rely on my notes throughout every day. The paid version introduces more text formatting options and spreadsheet entries, but I prefer the plain-text feel of the free edition. However, the paid edition includes the ability to store two-factor authentication (2FA) codes, which is a huge benefit. This allows me to possess a truly cross-platform, open-source, encrypted application for my 2FA.

Standard Notes possess an entry in Pop!_Shop (Flatpak), but it is also a community-supplied repository. I prefer to download any sensitive applications directly from the provider, much like I did with Proton Mail Bridge. If this were a simple text editor, I would have no problem using Pop!_Shop. However, this is my encrypted notes program which is extremely sensitive to me. Therefore, I navigate to the official website at <https://standardnotes.com/download/linux> and download the AppImage file with the "Begin Download" link. I then right-click on the downloaded file and select "Open With AppImageLauncher". I always choose the "Integrate and Run" option and allow the process to complete. Standard Notes will prompt you within the application if there are any pending updates.

Books

I prefer Calibre (calibre-ebook.com) as my eBook library software. It allows me to collect the books I have purchased or downloaded and synchronize them to practically any eBook reader. It can safely be installed within the Pop!_Shop Application.

Messaging

I strongly encourage you and your contacts to adopt encrypted (E2EE) messaging for all communications. Signal (signal.org), Element (element.io), and Wire (wire.com) provide open-source E2EE platforms for voice, video, and text. There are many other great options, but these are the best for those who are new to the idea. Any or all of these can be installed by following the Linux installation steps on their websites.

VLC

Pop!_OS does not include any powerful media player. If you will ever encounter various audio and video files, I highly recommend installing VLC from Pop!_Shop.

Office

Pop!_OS includes the LibreOffice suite of applications for word processing, spreadsheets, and presentations. However, I prefer ONLYOFFICE for this purpose. It can safely be installed from Pop!_Shop.

BleachBit Cleaner

After some time, your Linux device will likely become saturated with old cache files, leftover data, and other unnecessary files. I recommend executing BleachBit once weekly to keep things under control. I prefer the BleachBit (as root) option within the Pop!_Shop (Flatpak). I accept the default configuration upon first launch. I then select every option except "Free Disk Space" and click "Clean". At this point in the book, while working from a new machine, I was able to free 1.02 GB of data.

Utilities

I prefer to add a few system utilities to any Linux distribution including GNOME Feeds for RSS, GNOME Podcasts for podcasts, and Metadata Cleaner to sanitize personal information from within files. All of these can be installed from within the Pop!_Shop with the default options. For Metadata Cleaner to function, you also need a utility called mat2, which can be installed via Terminal with the following.

```
sudo apt install mat2 -y
```

After a reboot, you can right-click on any image, video, or other file which may contain hidden metadata and clean the content. This will produce a second file next to the original with "clean" added to the file name.

Virtual Currencies

If you need virtual currency access, I always recommend an offline software-based wallet without the need for a third-party exchange. I rely on Electrum for Bitcoin and Monero GUI Wallet for Monero. While you may find these programs within Pop!_Shop or another software repository, I would only install them directly from their original source. I obtain the AppImage file from the official Electrum site located at <https://electrum.org/#download> and then right-click the file to install it with AppImageLauncher. I then download the compressed Linux 64-bit file from the official site at <https://web.getmonero.org/downloads>, decompress it, and then right-click the Monero AppImage file to finish the installation process.

Application Updates

You should keep your newly-installed software updated. The "Installed" tab within Pop!_Shop will allow you to patch your operating system and any Flatpak/Deb programs, but it does not update all individual applications. I keep the following commands digitally ready within my local notes application for easy copying and pasting, but a future chapter will present a custom script which will automatically execute all of these commands.























```
sudo apt update
sudo apt upgrade -y
sudo apt full-upgrade -y
pop-upgrade release upgrade
sudo apt autoremove -y
sudo apt autoclean -y
flatpak update -y
```


You should now possess a Linux computer which is stable, secure, private, updated, cleaned, and includes the basic applications for daily use. There is still much more to be done, but you have the staples completed. When we create our custom maintenance script later in the book, we will add even more commands to make sure we are keeping our system tidy.

While most people rely on the providers of these applications to store encrypted data, extreme privacy enthusiasts might consider self-hosting as an option. This topic exceeds the scope of this guide, but there is plentiful information available online which could assist in self-hosting Bitwarden, EteSync, Standard Notes, and others. Next, we must tackle the most important program on our system: the web browser.

DNS Entries

This would be a good time to revisit your NextDNS portal and check your logs. I like to launch every program once and then shut it down, then see what types of connections were made within NextDNS. The damage on my machine was fairly minimal, as seen in the following image (top). Thunderbird was the worst offender because it synchronizes with their own server. This is not malicious, but you could block these requests if desired. Standard Notes connects to its own server for data synchronization, so no harm there. If you were uncomfortable with ONLYOFFICE sending any data back to its servers, you could block the entire domain within NextDNS. That would allow complete offline usage of the program. I made this change (second image) and the connection was blocked on the next launch (third image).

 autoconfig.thunderbird.net	 5 minutes ago
 www.mozilla.org	 5 minutes ago
 thunderbird-settings.thunderbird.net	 5 minutes ago
 give.thunderbird.net	 5 minutes ago
 www.thunderbird.net	 5 minutes ago
 support.mozilla.org	 5 minutes ago
 developer.thunderbird.net	 5 minutes ago
 api.standardnotes.com	 5 minutes ago
 objects.githubusercontent.com	 5 minutes ago
 static-oforms.onlyoffice.com	 6 minutes ago
 oforms.onlyoffice.com	 6 minutes ago



Next, we must consider proper web browser configuration and usage.

CHAPTER SIX: WEB BROWSERS

Before we consider connecting to various websites in order to take full advantage of our new Linux build, we should properly configure our web browsers. I recommend the Firefox web browser for most daily browsing, with limited use of other browsers for specific tasks. Firefox is already included with most Linux distributions, and the default Pop!_OS installation of Firefox is preferred for our needs. Launch Firefox and consider the following modifications.

- Click on the Firefox menu in the upper right and select "Settings".
- In the "General" options, uncheck "Recommend extensions as you browse" and "Recommend features as you browse". This prevents some internet usage information from being sent to Firefox.
- In the "Home" options, change "Homepage and new windows" and "New tabs" to "Blank page". This prevents Firefox from loading their default page.
- Disable all "Firefox Home Content" options.
- In the Search options, change the default search engine to DuckDuckGo and uncheck all options under "Provide search suggestions". This prevents queries from going directly to Google, and blocks the Google API from offering search suggestions.
- Click the "Privacy & Security" menu option and select "Strict" protection.
- Check the box titled "Delete cookies and site data when Firefox is closed".
- Uncheck the box titled "Show alerts about passwords for breached websites".
- Uncheck the box titled "Suggest and generate strong passwords".
- Uncheck the box titled "Autofill logins and passwords".
- Uncheck the box titled "Ask to save logins and passwords for websites".
- Uncheck the box titled "Autofill addresses".
- Uncheck the box titled "Autofill credit cards".
- Change the History setting to "Firefox will use custom settings for history".
- Uncheck "Remember browsing and download history" and "Remember search and form history".
- Check the box titled "Clear history when Firefox closes". Do not check the box titled "Always use private browsing mode", as this will break Firefox Containers.
- Uncheck "Browsing history" from the "Address Bar" menu.
- In the Permissions menu, click "Settings" next to Location, Camera, Notifications, and Virtual Reality. Check the box titled "Block new requests..." on each of these options. If you will never need audio communications within this browser, you could do the same for Microphone.
- Uncheck all options under "Firefox Data Collection and Use".
- Uncheck all options under "Deceptive Content and Dangerous Software Protection". This will prevent Firefox from sharing potential malicious site visits with third-party services.
- Select "Enable HTTPS-Only Mode in all windows".

These settings are what I refer to as the basics, and may be enough for most readers. This is where I want to deviate from previous writings. Prior to this publication, I always presented several settings which could be modified within the Firefox

"about:config" menu. I no longer recommend this, which may upset some privacy fanatics. Please consider my reasons before abandoning this chapter.

The purpose of my previous recommendations was mostly to prevent browser fingerprinting or canvassing. This activity is often abused by online sites which try to track you as you navigate the internet. If I own a clothing website and I can collect numerous identifiers from your browser, you are unique from everyone else who has ever visited my site. When you come back a week later, I know you are the same user, and I can continue to track your activity within my site.

Previously, I had recommended readers change various settings, such as the ability for a website to know your current battery level, in order to make you appear less unique to the malicious systems snooping on your connection. Today, thanks to advancements in fingerprinting technology, I believe those settings could do more harm than good. If you are the only visitor on that site which disabled this setting, you now appear even more unique than if you had done nothing.

At the risk of offending some readers, I firmly believe the following statement. **We can no longer defeat modern browser fingerprinting by making modifications to our browsers.** Anything we change, or any extension we add, almost always makes us a unique visitor in the eyes of sophisticated fingerprinting systems. The more actions you take to blend into the crowd likely makes you stick out more. There are exceptions to this, but for general usage, sites will continue to track us. They will also collect our IP addresses, installed fonts, video characteristics, location metrics, and browser specifications at all times. That will never change.

Furthermore, many of the current recommended about:config Firefox privacy tweaks break other desired functions. If you try to block all possible IP address leakage via WebRTC, you will likely also break the ability to use voice and video conferencing within your browser. There must be a balance of protections versus functionality.

Using a VPN, as explained later, and the previous Firefox settings stop most invasions. Since Firefox does not share cookies from one domain with another, we have strong privacy by default. If you want pure anonymity, stay off the internet. If you need the most protection possible, consider the Tor Browser, as explained later. Next, I will discuss the abundance of helpful browser extensions called add-ons.

The first vital add-on I install on every computer is **uBlock Origin**. It blocks many ads and tracking scripts by default, but it also can block any other type of script that is attempting to run on a page. This helps prevent tracking, malicious code execution, location sharing, and a number of other processes that could undermine your privacy and security.

This add-on is completely free and open source. It is highly customizable, while remaining relatively easy to work with. uBlock Origin works from blacklists which block trackers specified in the list(s). The add-on comes with several lists enabled, but there are several more that can be added through simple checkboxes in the preferences. Keep in mind that the more blacklists you enable, it may be more difficult to work within the browser. This section may seem a bit overwhelming at first, but experimenting with the advanced settings should help you understand the functionality.

I have previously recommended NoScript, Adblock Plus, Privacy Badger, and Disconnect as privacy add-ons that would help stop unwanted ads, tracking, and analytics. These are no longer present on any of my systems. I now only use uBlock Origin, as it replaces all of these options. Let's start with the basics.

Install uBlock Origin from the Firefox Add-ons page or directly by navigating to the application's website at <https://addons.mozilla.org/en-US/firefox/addon/ublock-origin/>. You are now protected on a basic level. By default, most known invasive advertisements, tracking code, and malicious content is blocked. This step alone would provide much needed protection from the internet. However, we can take it a step further.

Click on the uBlock Origin icon in the menu and select the "Dashboard" icon to the right, which appears as a settings option. This will open a new tab with the program's configuration page. On the "Settings" tab, click the option of "I am an advanced user". This will present an expanded menu from the uBlock Origin icon from now forward. Click on the "Filters" tab and consider enabling additional data sets that may protect your computer. I find the default lists sufficient, however I enable "Block access to LAN" under "Privacy". You now have extended protection that will be applied to all visited websites without any interaction from you. When you encounter a web page with a lot of advertisements, such as a news media website, it should load much faster. It will block many of the pop-ups and auto-play media that can be quite annoying when conducting research.

After you have enabled the Advanced settings as explained above, clicking on the uBlock Origin icon should now present an expanded menu which will change as you visit different sites. In order to explain the function of this menu, I will conduct a demonstration using the website cnn.com. Figure 6.01 displays the default view of uBlock Origin with the site loaded. Scrolling down this list of scripts that have either been loaded or blocked, you can see several questionable scripts such as Twitter, Amazon, and Turner. These scripts allow tracking across multiple websites and are the technology responsible for monitoring your interests, web history, and shopping habits.

This menu is split into three columns. The first simply identifies the type of code or domain name of the script. The second column is global settings. Anything changed here will apply to all website visits. The third column contains settings for the current website. A single plus sign (+) indicates that less than ten scripts were allowed from that specific option. Two plus signs indicate that between ten and one hundred scripts were allowed. The single minus sign (-) indicates that between one and nine scripts were blocked from that domain, while the dual minus signs tell us that ten to one hundred scripts were blocked.

In Figure 6.01, we know that over ten scripts were allowed to run from cnn.com, and at least one script was blocked from sending data to Twitter. This is all default behavior and provides a balance of functionality and security. uBlock Origin decides which content should be allowed and which should be blocked.

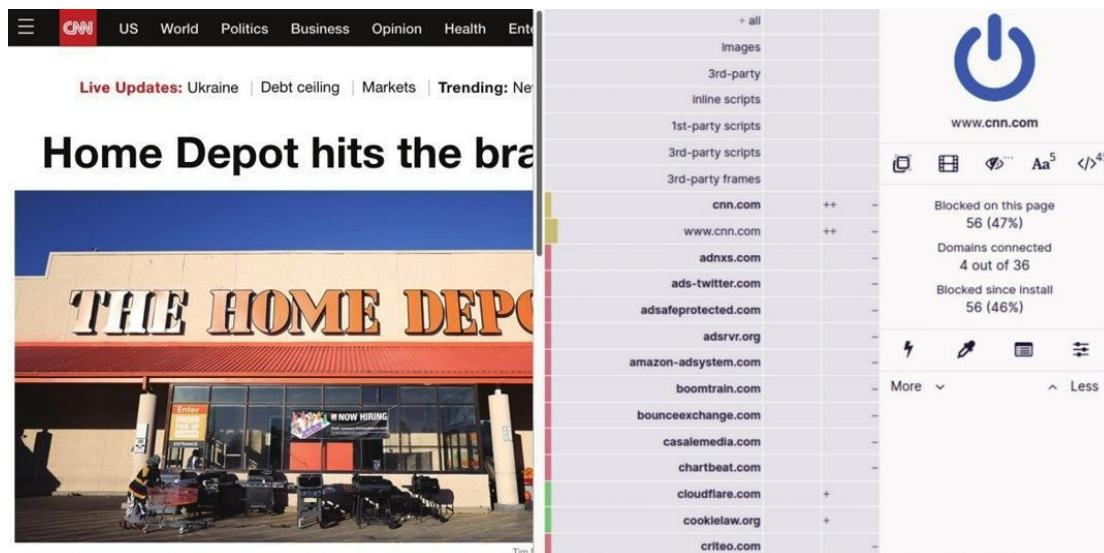


Figure 6.01: An advanced view of uBlock Origin.

Using this same page, let's modify the options. In Figure 6.02 (left), I have clicked on the far-right portion of the first cell in the third column. This turned the entire third column red in color. This action activated an option to refresh the page (arrows) and an option to save the change (padlock). Clicking the padlock and then refreshing the page presented me with the example in Figure 6.02 (right). Since I blocked every script, the page would not fully execute. It could not load images, design scripts, or any JavaScript. This is not useful at all, so I disabled my actions by clicking on the left (grey) section of the top cell in the third column, which turned the entire column back to grey in color. Saving these changes and refreshing the page brought me back to the example in Figure 6.01.

We can also take this to the opposite extreme. In Figure 6.03 (left), I clicked on the "power button" in the upper-right. This turned the entire left edge green in color, and allowed all scripts to load on cnn.com. This includes the dozens of intrusive scripts that could load advertisements on the page. You can also see that small plus signs confirm that scripts were allowed to run while the minus signs in Figure 6.03 (right) state the opposite. For most users, this allowance would seem irresponsible.

Next, we will modify the second (middle) column, which will apply settings globally. By default, all options are grey in color, which is desired by most users. This indicates that the default block list is applicable, and only invasive scripts will be blocked everywhere. For demonstration, I clicked on the right (red) portion of the top cell in the second column. This turned the entire column red, and indicates that all scripts across all websites will be blocked. After I saved my changes, every website will only load the most basic text content. This will prohibit much of our usage.

Loading a page such as a Twitter profile resulted in no usable content. By clicking on the uBlock Origin icon and clicking the left (grey) sections of specific cells within the third column, I enabled those scripts without allowing everything on the page. In Figure 6.03 (right), you can see the difference in colors. In this example, the entire second column is red. This indicates that all scripts are blocked globally. The third column is mostly red, but the options for twitter.com and twimg.com are grey. Those scripts will be allowed, if approved by uBlock Origin's rules, only for that domain. If I load a blog that has scripts from Twitter, they would still be ignored.



Figure 6.02: Disabled scripts within uBlock Origin.



Figure 6.03: Fully and partially enabled scripts within uBlock Origin.

These are extreme examples. Let's bring this back to some sanity. The following is how I recommend using uBlock Origin. Install, enable advanced options, and proceed with your work. When you arrive at a website that is blocking something you want to see, open the menu and click on the left (grey) section of the top cell in the third column. That will allow everything to load on that page, and that page only. When you are about to navigate to a questionable site that may try to install malicious code on your machine, click on the right (red) section of the top cell in the second column. That will block all scripts on all pages. Conduct your usage and reverse the change when you are finished. Remember to click the save button (padlock) after each change and refresh the page.

Hopefully, you are practicing these settings and learning how this program functions. It is an amazing option that has protected me many times. If you are doing things right, you have likely completely messed-up your settings and are now blocking things you want while allowing things you do not. Don't worry, we can reverse all of our mistakes by first changing the global (second column) settings back to grey (left section of top cell). Next, return to the dashboard settings of the add-on, and click on the "My Rules" tab. In the second column (Temporary Rules), select all of the text and press the delete key on your keyboard. Click the "Save" button in this same column and then the "Commit" button to apply these settings everywhere. This resets our extension and brings us back to default usage regardless of your modifications. This is important in the event you go too far with settings in the future. Removing and reinstalling the extension does not always wipe this data out of your system. The primary benefit of uBlock Origin over other options is the simple ability to block malicious scripts without customization, while having an option to allow or block any or all scripts at our disposal. This is a rarity in these types of add-ons. Another benefit is the ability to bypass website restrictions, such as a news site blocking articles

unless the visitor has a subscription service. Consider the following example with the Los Angeles Times. Visiting the page allows you to view three articles for free, but you must have a paid subscription in order to continue using the site. If I click on the uBlock Origin menu while on this page, select the right (red) option on the right (third) column under the setting for "3rd party scripts", then the padlock icon, and reload the page, I see a different result. I am now allowed to see the article. This is because this website relies on a third-party script to identify whether a visitor is logged in to the service. This modification presents unlimited views of articles without registration on this and thousands of other websites.

The next Firefox add-on which I use daily is the **Multi-Account Containers** option from Mozilla. It can be found at addons.mozilla.org/firefox/addon/multi-account-containers. Prior to 2021, I used this service to create individual containers which isolated website cookies from each site. However, Firefox introduced "Total Cookie Protection" within version 86 released in February of 2021. Because of this, temporary internet files from each domain are confined to the websites where they originated (when "Strict" is selected under "Enhanced Tracking Protection"). Firefox creates a virtual container for each site loaded. Facebook cannot see the cookies downloaded from Amazon and vice-versa. Many believe this eliminates the need for Multi-Account Containers, but I disagree.

Multi-Account Containers allows you to separate your various types of browsing without needing to clear your history, log in and out, or use multiple browsers. These container tabs are like normal tabs except that the sites you visit will have access to a separate slice of the browser's storage. This means your site preferences, logged-in sessions, and advertising tracking data will not carry over to the new container. Likewise, any browsing you do within the new container will not affect your logged in sessions, or tracking data of your other containers.

Consider an example. I have a container tab open which I use to log in to a Twitter account. I want to log in to another Twitter account within the same browser. If I open a new tab and go to twitter.com, I am automatically logged in to the same account as the previous tab. However, if I open a new container tab, I am presented the option to log in to a new Twitter account. I simply open a unique container tab for each of these events. Each sees the session as unique, and no data is shared from one service to another. Once installed, you will see a new icon in the upper right which appears as three squares. Click on it and select the container you want to open. Default options include choices such as Personal and Shopping, but you can modify these any way you desire. I have ten containers titled Private01 through Private10. You can create, delete, and edit containers from the Containers menu. When you click the Edit Containers or the + buttons, you can change the color or icon associated with a container or change the container name.

I also use this extension in order to have quick access to all of my Google Voice numbers. I created a new container for each Google Voice number I own. I then logged in to the appropriate account for each container and disabled the option to clear my cookies upon exit. Today, I can launch Firefox, select the container titled with the number I want to use, and immediately place or accept a call via my desktop. I can close the browser completely when I am done. I also changed the icon and name to reflect this purpose. This has been most beneficial when I have been on a call with a financial institution and they want to call me back at a specific number which they have on file. Opening the browser and being immediately ready is better than

connecting to Google Voice; opening my password manager; inserting my credentials; providing 2FA; accessing the account; allowing my microphone; and accepting the call. My device is encrypted and protected with a strong password in the event it is stolen.

Some readers may be frustrated with my setup for Firefox and may insist on using a Chromium-based browser. I completely respect this, and offer the option of Brave Browser. Brave is based on Chromium, which is the bones of the Google Chrome browser. Brave insists they have removed all calls to Google which Chromium makes by default, implementing the use of Quad9 as the DNS provider (instead of Google). However, Brave has faced strong criticism for injecting code to hijack affiliate web links and their overall push to use their embedded rewards program. If you NEED a Chrome-like browser, I recommend Brave over Chrome. If you can use Firefox, I find it to be much more privacy-focused. Personally, I would never use any Chromium-based desktop browser, including Brave.

KeePassXC-Browser

If you installed the KeePassXC password manager and want to access auto-fill functionality within Firefox, install the official extension from the Firefox repository on their site at <https://addons.mozilla.org/en-US/firefox/addon/keepassxc-browser>.

After installation, conduct the following.

- Open your KeePassXC database and click the settings icon.
- Choose the "Browser Integration" menu option.
- Select "Enable browser integration" and enable "Firefox".
- Click "OK" and return to Firefox.
- Click the KeePassXC icon and then click "Connect".
- Provide a unique name, such as "Firefox", and click "Save and allow access".

Your Firefox browser can now access passwords stored within the KeePassXC database without any data being sent over your internet connection.

Missing Icons

Firefox made a change recently which hides all extensions within the "Extensions" icon in the toolbar. I don't like this and prefer immediate access to my extensions. The following two images display the default configuration (top) and the appearance after modification (bottom). I conduct the following within Firefox.

- Click the puzzle piece in the upper-right.
- Right-click each entry and select "Pin to Toolbar".
- Right-click the toolbar and select "Customize Toolbar".
- Drag away any unwanted options and reorganize as desired.
- Click "Done" in the lower-right.



Browser DNS Configuration

If you configured NextDNS as your DNS query and filtering provider, you do not need to modify the DNS settings within Firefox. By default, Firefox will use the system DNS which we previously configured with NextDNS. Any changes you make to the Firefox DNS settings will override your system DNS when querying websites through Firefox. This removes your filtering options. However, you may have a need to switch Firefox queries to another provider. If you are exceeding the 300,000 monthly lookups because of heavy browser usage or want an unfiltered browser while maintaining protection to the rest of your Linux device, you might want to make a change. Overall, the order of DNS usage is as follows.

- If your web browser has a custom DNS assigned, then all queries from within that browser will use the specified DNS, regardless of any other settings within Linux.
- If you have no DNS assigned within the browser, then your DNS queries will be conducted based on the provider which is assigned within Linux.
- If you did not assign any DNS provider within the browser or Linux, then your DNS will rely on your network (likely the ISP).

I really like NextDNS as the DNS service for my entire Linux system, as it filters unwanted connections from some installed applications, such as the ONLYOFFICE example from the previous chapter. However, I really do not need that level of filtering within Firefox since uBlock origin does the same thing with immediate access within the browser extension. I conduct the following within Firefox.

- Navigate back to the "Settings" menu and select "Privacy & Security".
- Scroll down to the "DNS over HTTPS" section.
- Click the "Max Protection" option and select "NextDNS".

Your browser will now conduct all DNS queries within an encrypted connection to NextDNS, regardless of any other settings within Linux. This is a public instance of NextDNS, and is not associated with your account. Note that this only applies to websites visited from within this installation of Firefox, and not to any other applications.

From now on, all domain name queries from my operating system or other applications will be conducted by NextDNS and associated with my account. Filtering is active. All DNS queries within Firefox will be conducted through a public NextDNS server and will not be associated with my account. There will be no filtering and the uBlock Origin extension will be the sole content filtering provider. The Firefox queries will not count against my monthly free allotment from NextDNS.

VPN Configuration

Virtual Private Networks (VPNs) provide a good mix of both security and privacy by routing your internet traffic through a secure tunnel. The tunnel goes to the VPN's server and encrypts all the data between your device and that server. This ensures that anyone monitoring your traffic before it reaches the distant server will not find usable, unencrypted data. Privacy is also afforded through the use of a distant server. Because your traffic appears to be originating from the VPN's server, websites will have a more difficult time tracking you, aggregating data on you, and pinpointing your location.

Virtual Private Networks are not a perfect anonymity solution. It is important to note that VPNs offer you privacy, not anonymity. The best VPNs for privacy purposes are paid subscriptions with reputable providers. There are several excellent paid VPN providers out there and I strongly recommend them over free providers. Free

providers often monetize through very questionable means, such as data aggregation. Paid VPN providers monetize directly by selling you a service, and reputable providers do not collect or monetize your data. Paid providers also offer a number of options which will increase your overall privacy and security.

I currently use and recommend Proton VPN as my primary VPN and Private Internet Access (PIA) as a limited secondary dedicated IP option when VPNs are actively being blocked. Navigate to inteltechniques.com/vpn.html for further information and the best affiliate purchase links. Purchases include unlimited use, connection to multiple devices simultaneously, and fast speeds. I pay for my VPN with Bitcoin in an alias name, but that may be overkill for many readers.

For most readers, and almost every client I have consulted, I recommend sticking with the standard Linux application provided by the VPN company. These branded apps should suffice for most needs. Proton VPN can be downloaded within Pop!_Shop, which is an official version provided by Proton. Once installed, simply provide your account credentials and launch your VPN connection. Fortunately, Proton VPN has made their applications completely open-source. This makes it much more difficult to hide malicious programming within them.

My VPN policy is quite simple, but my opinions about VPN companies can be complex. Any time that I am connected to the internet from my Linux device, I am connected through my VPN. I rely on Proton VPN through their app on my Linux device **only while I am traveling**. Home devices are protected through a firewall with Proton VPN, as explained in *Extreme Privacy, 4th Edition*. At home, I never need to launch a VPN within my computer itself due to the VPN firewall. I encounter constant issues with any Linux VPN application, so I prefer to rely on my home network firewall whenever I can, while leaving any Linux VPN apps disabled.

I trust Proton VPN more than most commercial options and I believe their business model is the most transparent. Being hosted in Switzerland provides some aspect of privacy from vague government intrusion, but international servers could always be compromised. Any updates in regard to my VPN recommendations and configurations will be posted on my website at inteltechniques.com/vpn.html.

Relying on a VPN company is difficult. We place a lot of trust into the provider(s) we choose, without knowing much about the umbrella companies. One could argue that the huge parent companies might have ill intentions for the data collected from millions of VPN users. One could also argue that being a small needle within their huge haystack might possess its own benefits. I believe all VPNs are flawed, but still a requirement for us. Almost every VPN provider relies on rented servers across the globe which are out of their control. Some providers unknowingly use the same servers as their competition.

When using a VPN, you are simply placing your internet history into someone else's hands. This sounds bad on the surface, but it is better than doing nothing at all.

Without a VPN, we know our ISPs are monitoring, collecting, and sharing our internet activity. With a VPN, we are told that this information is not logged or shared. Are we bullet-proof? No. However, I would rather make the attempt to hide my traffic than do nothing at all. **My main purpose for a VPN is to prevent services such as my email provider from knowing my true home IP address.** Your needs may differ.

Some may question the amount of data shared about your online history when you send all of your traffic through a VPN versus your ISP. There are always

vulnerabilities which could expose more data than intended, but we can discuss a few misconceptions about your internet traffic. First, we should tackle SSL/TLS. SSL (Secure Sockets Layer) and its successor, TLS (Transport Layer Security), are protocols for establishing authenticated and encrypted links between networked computers. This is related to the lock icon you see in your browser address bar when on any website which begins with "https". This indicates a secure connection, but what does that really mean? I will simplify this technology with a couple of examples. Assume you are on your home computer connected directly to your internet service provider (ISP). You are not using a VPN. You connect to Google and conduct a search for "inteltechniques". The response URL presented to you, including the search results from the query, is <https://www.google.com/search?q=inteltechniques>. Does your Internet Service Provider (ISP) know you conducted a search on Google? Yes. Do they know you searched for "inteltechniques"? No. This is because Google encrypts the actual search URL. The provider of your internet connectivity can only see the domain name being accessed. It cannot see any details about specific pages or any credentials entered.

This is why https versions of websites are so important. Your browser can see this entire URL, but it does not directly share any details with your provider. Now, let's introduce a VPN. After connecting to your VPN, such as Proton VPN, you conduct the same search. Does your ISP know you conducted a search on Google? No. Does your VPN provider know you conducted a search on Google? Yes. Does your VPN provider know you searched for "inteltechniques"? No. Why does this matter? Everyone has a unique threat model, but I will present a few scenarios where you may be concerned. First, consider that I am suing you through civil court, and I have convinced a judge to grant me a court order to collect your internet activity. Since I know where you live, I can assume the provider of your internet service. A court order is issued to your ISP for your internet activity. If your ISP logs your traffic, which most do, the response would tell me every domain which you visited and the dates and times of occurrence. I could use this to prove you were visiting specific websites or transmitting large amounts of data to designated services. If you had a VPN enabled, I could only prove your device(s) were connected through a VPN. I would not know any domains from your activity. A second court order to the VPN provider would not reveal this data. Reputable VPNs do not log this traffic, and IP addresses are shared between thousands of users.

Next, assume I want to know where you live. I know your email provider is Gmail, and a subpoena to them would reveal your IP address at a specific date and time. If this IP address belongs to your internet service provider, a second subpoena will disclose the address of service (your home). If the IP address belongs to your VPN provider, it will not disclose any details about you or the VPN account. A subpoena to the VPN provider for information about the IP address will reveal no logs and an education about IP address sharing between thousands of strangers.

Now, let's combine the strategies mentioned previously to thwart this behavior. Since you are always connected to a VPN, your ISP knows nothing about your internet traffic. A subpoena to them would not reveal the sites you visit. Since Proton Mail does not log your IP addresses in clear text, they cannot determine your true IP address. Since Proton VPN and Proton Mail are Swiss-based companies, they would not respond to a subpoena from the United States. If you purchased a VPN service without providing your true name, there is nothing to glean from the VPN provider

about your account (such as a personal credit card number or home address). I hope you now see that all of these strategies strengthen each other.

No VPN company is perfect and all expose a potential digital trail. I choose the option which is most likely to protect me because it has the most to lose. If Proton VPN were caught storing or selling user data, their entire company would lose all credibility and many customers. If a company which owns several VPN brands gets caught doing this, they can simply shut one down and spin up a new marketing campaign for another. I believe Proton VPN has more motive to protect their product and reputation than the larger VPN companies.

Important Note: During substantial testing of Proton VPN within various Linux environments, I encountered situations where my internet connectivity stopped after enabling or disabling the VPN. This was due to a conflict between NextDNS and Proton DNS. If this happens to you, the following command within Terminal restarts the NextDNS service and should fix the issue. I discuss much more about this on the next page.

```
nextdns restart
```

VPN DNS

It is important to note that if you are using a VPN application on your computer, it will likely ignore any DNS modifications made on your device and use its own server. This is acceptable for many situations, but not ideal for everyone. By allowing your VPN to secure all traffic and provide all DNS queries, you are placing all of your eggs within one basket and no longer benefiting from NextDNS's filtering. You are trusting your VPN provider with the ability to log all of your internet history and traffic. This is probably not a huge threat if you are using a trustworthy VPN, but we can do better. I will assume you have configured NextDNS as previously explained, and modified your browser to use a public NextDNS server. If you take no action within the DNS settings of your VPN application, then the following applies:

- When your Linux VPN application is disabled, your entire Linux system is using your NextDNS account for all DNS queries with filtering, and Firefox is using a public NextDNS server for queries without filtering.
- When your Linux VPN application is enabled, it is using its own DNS and you have no filtering from NextDNS within your operating system, but Firefox is still using its own public NextDNS server for queries without filtering.

If you want to change this you would simply need to restart the NextDNS service after connecting to the VPN. The following is my strategy when I need to launch and later terminate the Proton VPN application on my Linux device.

- Launch the VPN.
- Restart the NextDNS service and conduct my online activity.
- Terminate the VPN when finished.
- Restart the NextDNS service.

If I have my NextDNS service running and I launch my VPN, the VPN starts using its own DNS server. In some cases, your entire internet connection might be disabled as the two services fight it out. When I restart NextDNS, it overrides the VPN DNS server. When I terminate the VPN, it may also terminate any conflicting DNS, which is why I restart NextDNS as soon as I close my VPN. In Chapter Nine we will create a simple script for this. Let's recap.

- I have my NextDNS account configured within my Pop!_OS installation as previously explained in Chapter Four. It is the catch-all DNS for all of my apps and the system itself. I have filtering enabled.
- In my Firefox browser, I have the secure DNS option set to "Max" with NextDNS as the option. All DNS queries within Firefox will be done through a public server without filtering. My uBlock Origin extension will handle the filtering of all undesired traffic.
- I have Proton VPN installed, but I rarely open it. I use a network-wide home firewall as explained in *Extreme Privacy 4th Edition*. This provides me VPN protection on my machine without a Linux VPN application, and the ability to assign any DNS server within my Linux software.
- When I am not at home, I launch the Proton VPN application and then restart my NextDNS service. My Linux system and all non-Firefox apps will then use this DNS and benefit from the filtering service. I also restart the NextDNS service after closing the VPN.

For most, the overall goal is to prevent your ISP from snooping on your traffic. All of these situations prevent that, even if you do not change your VPN DNS. It is up to you how far to take it.

Tor Browser

If you follow various privacy-related communities, you will hear many people promote the Tor Browser. This Firefox-based browser only connects to the internet via the Tor network, which hides your true IP address without a VPN. Since every Tor Browser user has the exact same browser configuration, we may not appear as a unique user when a website tries to fingerprint us. However, this is not perfect. If you are the only Tor Browser visitor to my fictitious clothing website, you stick out. Furthermore, many websites block connections from the Tor network altogether. If you try to log in to your bank from within Tor, expect to get blocked. Even worse, your account may be suspended.

I only use the Tor Browser for investigations which rely on it in order to access a specific website within the Tor network (which usually ends in ".onion"). For everything else, I rely on my hardened Firefox, as previously explained. Installing Tor Browser within Linux is never straight-forward. Searching Tor within Pop!_Shop presents multiple options. At the time of this writing, I found the following to work best for Pop!_OS.

- Open Pop!_Shop and search for "Tor".
- Select the option titled "Tor Browser Launcher" and install the default option.
- Launch "Tor Browser" from the "Show Applications" menu.
- Allow the installation to complete and launch the browser.
- Enable the "Always connect automatically" option and click "Connect".

You should now be able to launch Tor Browser any time and begin using the program right away. Your web browser is your window to the internet. Please make sure you have hardened it to a level appropriate for your needs, but not to the point which you have restricted your necessary online activity. Having a hardened version of Firefox will provide great privacy from daily invasions into your online behavior while Tor Browser will be there for more sensitive tasks.

CHAPTER SEVEN: VoIP SERVICE

Now that you have your computer configured as privately and securely as possible, you may want to use it for traditional telephone calls over your internet connection. As explained in my previous digital guide about mobile devices, I never want to rely on the number associated with my mobile device for my daily communications. Therefore, we will need a way to make and receive standard telephone calls and text messages without using our cellular plans. Within GrapheneOS (mobile), I relied on an application called Sipnetic and various Voice over Internet Protocol (VoIP) providers for all telephone calls. Desktop Linux systems will rely on an application called Linphone for use with these same providers. Before we configure our devices, let's understand the reasons we should be careful about true cellular number usage.

- When you make calls and send text messages through your standard cellular number, there is a permanent log of this activity stored by the provider of your service. This log identifies all of your communications and can be accessed by employees, governments, and criminals. I have witnessed call and text logs be used as the primary evidence within both criminal and civil trials.
- Your cellular telephone number is often used as a primary identifier for your account. If I know your number, I can use this detail to obtain further information such as location history of the mobile device. Your cellular provider stores your location at all times based on the cell towers to which you connect. I can abuse court orders to obtain these details or hire a criminal to breach your account. In past years, we have learned about the ability of bounty hunters to locate mobile devices in real time by simply knowing the cellular number. No court order was required. Journalists have been able to track people's movements for years.
- Cellular telephone numbers are prone to SIM-swapping attacks. If I know your primary number, I can take over your account through various tactics and become the new owner of the number. I can portray you and receive communications meant for you. If you used that number for two-factor authentication, I now have the second factor.
- When you give your telephone number to your friends and family, they will likely store it in their contacts and associate your name with the entry. Someone will then download a nefarious app which requests access to the contact list, sending the contacts to online databases which can be queried. We have seen this with several apps in the past, including caller ID services such as TrueCaller and Mr. Number, which shared private contact details with the world. Have you ever received an email from LinkedIn asking you to connect with someone you knew? This happens when that person agrees to share their contacts, including email addresses and telephone numbers, with the service. Twitter also wants to obtain these details from any members willing to share them. It only takes one instance to make your cell number publicly attached to your true name.

Using VoIP numbers eliminates much of these concerns. Consider the following.

- VoIP calls and messages are also logged within the VoIP provider's portal. However, we have more control of this information, and possess options to permanently purge content whenever desired.

- VoIP communications do not possess the same location details as cellular connections. While the VoIP provider might possess an IP address for the connection, there are no cellular towers which provide exact GPS coordinates. If you break into my VoIP account, you will never learn my true location.
- Illegally overtaking a cellular account is trivial today. It can be done within an hour. Porting a VoIP number into another provider can take over a week, and notification of this action will allow you to stop it. Whenever I am forced to use a telephone number for two-factor authentication, I always prefer a VoIP number over a cellular account.
- You cannot stop your friends and family from sharing your telephone number with abusive applications and services. If they only know your VoIP number, there is less risk. Once a VoIP number is publicly leaked with association to your real name, you can easily change it if desired. If you have multiple VoIP numbers, you can isolate them for various uses. When the world knows a VoIP number belongs to you, it cannot be abused in the same way cellular numbers can. Again, VoIP numbers cannot share your location.

The solution to all of this is to never use a true cellular number. Instead, we will only use VoIP numbers for all calls and standard text messages. In the following pages, I explain how to configure various VoIP services for telephone calls and SMS text messages. My goal is for you to create your own VoIP product which allows you to make and receive telephone calls on your new secure Linux device at minimal cost. Furthermore, the numbers will be in your control. You will not need to maintain access to a Google Voice account in order to enjoy the benefits of VoIP calls.

This section is technical, but anyone can replicate the steps. As with all online services, any of these steps can change without notice. It is probable that you will encounter slight variations compared to my tutorial during configuration. Focus on the overall methods instead of exact steps. The following explains every step I took in order to create my own VoIP solution with Twilio. Afterward, I present other options which may be more appropriate for some readers. Please read the entire chapter before making any decisions. **Most of this chapter is identical to the VoIP content within the mobile and macOS guides previously released.**

Before we dive into various options, we must take a quick detour and discuss domain registration. I encourage you to digest this next portion before moving on. The steps you take now might make everything much easier later.

Domain Registration

In past writings, I explained ways to use anonymous email forwarding services and temporary access providers when registering for online services. I supplied tutorials for providing these masked and disposable addresses to various services to protect our privacy. Today, I believe you should establish a new domain for use with your new private and secure Linux device. Many privacy-focused email services are actively blocked by online providers. If you try to use a SimpleLogin masked email address to open a new line of cellular service, it will probably be blocked. If you try to fool a VoIP provider into accepting a Mailinator or 10MinuteMail address for a new account, expect an immediate suspension. Because of this, I want to have unlimited acceptable email addresses associated with a recognizable domain as I continue to configure my Linux device.

You could simply buy a new domain such as vandalay-industries.net and configure it for email access, but that may not be the best idea. Many VoIP service companies are

now scrutinizing new accounts. If you register with a brand-new domain, they can see that. Many fraud prevention systems block any registrations from domains which were created in the past 30 to 60 days. Therefore, I prefer existing domains which have recently expired and been dropped from their registrar.

First, I navigate to expireddomains.net and then click the "Deleted Domains" tab. I then sort by the following categories until I see desired domain structures.

BL: Number of known backlinks

ABY: The first year the domain was seen at Archive.org

ACR: Number of Archive.org crawl results

Reg: Number of Top Level Domains (TLDs) which match the domain

Below is an example of a few random results. While two of these have some internet history, none of them look like a traditional business domain which would pass human scrutiny. I only acquire ".com" addresses for this purpose, as some providers block newer TLDs such as ".work".

Domain	BL	DP	ABY	ACR	Dmoz	C	N	O	D	Reg	RDY
esolo.top	0	0	2021	1	-	●	●	●	●	12	1.0 K
bhc331.top	0	0	-	0	-	●	●	●	●	0	0
bananad.top	2	0	-	0	-	●	●	●	●	4	226

Next, compare those results to the following, which I found by sorting by each category. Personally, I like "Rental-Bus.com" and "PrairieBoard.com". Either should pass as a legitimate company name. "PrairieBoard.com" could be presented as a board of directors' entity acting on behalf of practically any business. This may seem overkill for a computer, but I believe it is justified. After purchase, I reserve email addresses associated with this domain solely for use with my new Linux device.

When we get into VoIP providers, you will be glad you were proactive with this.

PrairieBoard.com	0	0	-	0	●	●	●	0	1	2 days	available
neamemories.com	0	0	-	0	●	●	●	0	0	Yesterday 19:44	available
FishyChat.com	0	0	-	0	●	●	●	0	0	Yesterday 19:45	available
BankerSkit.com	0	0	-	0	●	●	●	0	0	Today 19:04	available
Rental-Bus.com	0	0	-	0	●	●	●	2	2	3 days	available
biaidi.com	0	0	-	0	●	●	●	0	2	7 days	available
polisick.com	163	2	-	0	●	●	●	0	0	Yesterday 19:43	available
GoodStuffForGoodPeople.com	0	0	-	0	●	●	●	0	0	Yesterday 19:42	available

Next, I like to verify domain registration history through online services such as Whoisology.com. Many online services, especially VoIP providers, will replicate this type of search, so I want to know what they will see if their systems scrutinize a domain associated with a new account. Below is the entry for rental-bus.com. You can see that domain registration has been captured since April of 2013. If I were to purchase this dropped domain and use it with the email account I provide during purchase, I may appear much more legitimate than using a new domain which has never appeared online before.

Register Today

Whoisology is a searchable reverse whois / domain name ownership database with billions of records and tens of billions of data points.

Historic Whois Lookups

September 2022*	June 2022
March 2022	December 2021
September 2021	June 2021
March 2021	December 2020
September 2020	June 2020
March 2020	December 2019
September 2019	June 2019
March 2019	December 2018
September 2018	June 2018
March 2018	December 2017
September 2017	June 2017
March 2017	December 2016
September 2016	June 2016
April 2016	December 2015
August 2015	June 2015
December 2014	April 2015
April 2014	August 2014
August 2013	December 2013
December 2012	April 2013

* Indicates the archive you are currently viewing

Disabled archives

do not contain WHOIS data for this domain

rental-bus.com

This is Whoisology's most current historical whois lookup for the domain name rental-bus.com. Click any of the records below (address, phone, email, etc) to perform a reverse lookup.

Admin Contact

The Admin Contact is the person or organization who controls the domain.

Name	Masone, Michael (31)
Org.	Global Charter Services (31)
Email	itdept@busbank.com (26)
Street	141 W JACKSON BLVD STE 300A STE 300A (26)
Street 2	-
City	CHICAGO (782,250)
Region	IL (279,576)
Zip / Post	60604-2992 (37)
Country	UNITED STATES (92,024,163)
Phone	17035362106 (76)

Other Details

These are technical details & related, connected to the domain.

Registrar Name	Network Solutions, LLC(5,500,237)
Created Date	2004-11-08(7,415)
Whois Servers	whois.networksolutions.com(5,593,499)
Updated Date	2020-12-14(45,196)
Expires Date	2022-11-08(503,691)
Name Servers	NS29.1AND1.COM(5,453)
Archive Date	2022-07-29

Finally, I want to buy a domain and generate email forwarding service from it. There are numerous domain registrars and web hosts which will suffice, but I prefer Cloudflare. For \$9 annually, I can own this domain and forward unlimited incoming email catch-all addresses to any external encrypted email provider, such as Proton Mail. I do not need to purchase a hosting plan from a third-party provider. For this example, I created a free Cloudflare account, which I associated with a new Proton Mail email address.

Once I was signed in to Cloudflare and presented with my account portal, I navigated to "Domain Registration" > "Register Domains". I then searched rental-bus.com and received the following result.

Find a domain

Domain fees will be changing soon. [Click here](#) for more info.

Enter a domain name

Domain	Price
rental-bus.com	\$9.15

Purchase

I purchased a domain for \$9.15 and used a masked Privacy.com card for the transaction, but a traditional credit card could also be used. During the process, I was asked for my name, physical address, email address, and telephone number. These are

all ICANN requirements, the entity which controls domain name registration. One could lie here, but I do not recommend it for two reasons.

- Providing false information could result in losing the domain. I have only seen this happen when domains were abused to send spam, but it could happen to us. We should obey the rules.
- Providing an alias name and non-existing email address is a sure-fire way to lose control of the domain. If you are ever required to verify ownership of the domain via email or ID, you will not be able to confirm yourself.

Therefore, let's be honest...kind of. Any time I register a domain, I provide a shortened version of my true first and middle names as my full name. If my full name was "Michael John Bazzell", I might provide "Mich John" as my name. I have friends who call me Mike, but I have never seen them spell it. Therefore, maybe it is "Mich" in their heads. If my middle name is John and my grandmother called me Michael John often, that is my real name.

Next, they demand a physical address. I always purchase new domains while I am staying at hotels during travel. Technically, it is my home for the night. I always include the room number during my registration. I typically provide the hotel phone number as well, since domain registration is always verified over email. I provide the same Proton Mail email address which I supplied to Cloudflare as the domain registration contact. I maintain a digital copy of my hotel receipt, including my first and middle name, along with the dates of my stay and room number, in case I am ever asked to provide proof of the provided residence (I have never been asked).

Is this overkill? Maybe. Cloudflare does not publicly share any of your registration details, and requires a court order to release that information. However, a breach or bad employee could easily eliminate all of my hard work to be as anonymous as possible. Therefore, I mask the information to a level which I feel comfortable presenting as my own.

Once I own the domain, I navigate to "Websites" and select my new domain. I then click the "Email" tab and complete the "Email Routing" requirements. At the time of this writing, the following applied. Please note that the exact wording changes rapidly at Cloudflare, so you may see some minor differences.

- Click the "Get started" button.
- Create a custom email address, such as "comms@rental-bus.com".
- Provide a destination address where your incoming email should be forwarded.
- Click "Create and continue".
- Confirm the request within your receiving email account.
- Click "Add records and enable" to apply the appropriate DNS settings.

In this scenario, any email sent to "comms@rental-bus.com" would be forwarded to the Proton Mail email address which I previously supplied. You should now click "Email" > "Email Routing" within the Cloudflare portal. Then, click the "Routes" tab and enable "Catch-all addresses". This allows any email to your new domain to be forwarded to your receiving address. If you sign up for a service using email addresses of "VoIPcall@rental-bus.com", "sales@rental-bus.com", "manager@rental-bus.com", they will all automatically forward to your reception address. This allows you to create new addresses on the fly without any email configuration. Note that these will only receive messages, you cannot send from them.

Obviously, you do not have to use Cloudflare for this. You could register a domain at any web host and pay them for email services. I prefer this route due to cost, as I own

many domains which I use for specific purposes. For comparison, a domain and email hosting through Namecheap would start at \$30 annually. **You do not need a custom domain at all in order to follow the rest of this book.** If you have no plans for obtaining VoIP service, you could probably skip this step entirely. I find it beneficial to bypass the fraud filters at most of the telephony providers, so I want everything configured before I need it. Let's proceed.

Twilio VoIP Service

When an app or service advertises "Burner Phone", "Second Phone", "Second Line", or other enticing verbiage, they do not actually provide a telephone number or telephony services. Almost all of them rely on a VoIP service called Twilio. Even MySudo provides access through Twilio. These companies purchase numbers and service through Twilio and upsell the service to you. What if we eliminated the middle man? You could create your own Twilio account, purchase a number, and possess service without any third-party involvement. This Do-It-Yourself option is easier said than done, but a very attainable task.

The first step is to create a new account at Twilio (twilio.com) from a desktop computer. This will be the most difficult part of this entire process. You must provide a name, email address, and phone number to Twilio as part of your registration. Twilio possesses strong fraud mechanisms in order to suspend accounts which seem suspicious. During the first tests of this strategy, my accounts were immediately suspended. I had provided a vague name, burner email address, and Google Voice number while connected to a VPN. This triggered the account suspension and I was asked to respond to a support email explaining how I would be using Twilio. This began communication with two Twilio support personnel. While talking with customer service, I was advised that the VPN IP address was most likely the reason for the suspension. After providing a business name, "better" email address, and explanation that I would be using the product for business VoIP solutions, my account was reinstated. **If you get caught within this dragnet, I discourage you to let them know you are following the protocol in this book to establish VoIP services.** Twilio does not like me or my general audience. We are small individual customers compared to big businesses.

After you create your free account, it will be severely restricted. Individual Twilio employees will analyze your registration details and decide if you can be "upgraded" into a fully-functioning account. I think you will find your account restrictions lifted within an hour if you apply the following guidelines.

- Provide your true first and middle name, especially if they are generic. In my experience, a true last name is not needed.
- If you created a custom domain, as explained in the previous chapter, provide an email address associated with this domain. Privacy-themed addresses from Proton Mail, Tutanota, or masked providers will be flagged and the account will be suspended. Gmail and other free addresses will be heavily scrutinized (or blocked entirely).
- If possible, register without protection from a VPN. I will explain VPN usage later, but this can be a trigger for all new accounts. Public Wi-Fi, such as a local library, usually works well.
- The telephone number provided could be an existing VoIP number or any landline number to which you have access. If you have an old Google Voice number, this should work well.

- A Twilio employee will likely email you and ask how you plan to use their services. Do not ignore this. You must convince them that you are worthy of paying for their product. I typically provide something similar to the following.
 "I am a software developer and my boss asked me to look at the Twilio API with hopes of replacing our landlines with VoIP services. I plan to purchase a few SIP numbers and assign them to employees."
 "I provide I.T. services to several companies and they are asking about VoIP services. I would like to test the Twilio API to see how that could fit into their existing systems."
 "One of my customers currently uses Telnix for VoIP services, but is unhappy with their product. They have asked me to look into the Twilio API for potential migration into your environment."

Never use any of these paragraphs verbatim! If we all send the same email, we will all get suspended. Take these general ideas and formulate your own reason for usage. While we are being misleading, maybe even dishonest, there is no fraud here. We will pay for the services we need. I have witnessed numerous readers' accounts become suspended when they advise that they only need a couple of numbers for personal use. If you are required to respond to a Twilio email, and you used a custom domain with Cloudflare hosting, you have a new problem. You cannot send emails from the address you provided during registration. However, that is not required. Within your Twilio portal, navigate to "Docs and Support" > "Support Center" in the left menu and select "Ticket History". You should see a copy of any messages sent by Twilio staff. You can select the message of concern and respond directly within the portal. This will then be sent to Twilio staff from your registered email address.

Once your account is approved and you pay for the service, you will disappear into the background and you will probably never be contacted again by a Twilio employee. As long as you do not create a situation where you appear suspicious, or violate their terms of service, they should leave you alone. If Twilio demands a copy of government ID, push back. I was able to activate two accounts without ID after initial suspension. Overall, they just want paid users who do not abuse their networks. I will now assume that you have a Twilio account created with a strong password, and that it has been upgraded by Twilio staff. The free credits in your account allows you to test many features of the service, but a \$20 deposit will be required before our account is fully usable for outside communications. I paid for mine with a masked debit card. However, I don't see a huge problem with using a real credit card. Many people will think that is reckless, and it would leave a digital trail to your true identity. This is true, but consider the following.

If you will be using VoIP numbers associated with your true identity, there will be a trail anyway. If I give a new VoIP number to my friends, family, and co-workers, it will be connected to me through usage, logs, and contact sharing. The whole point of VoIP is to have a less-invasive way to make and receive calls under your true identity. The pattern of behavior would identify you as the account holder, and that is OK. I do not believe we need to remain completely anonymous with our VoIP provider. However, I do believe we should be anonymous with our cellular provider. If anyone investigated the VoIP account, they could probably make the association anyway based on the numbers called. Therefore, I do not see an issue with using a true credit card to pay for these services. I also don't see a problem using your true name if

required. If you followed my advice in *Extreme Privacy 4th Edition* and obtained a secondary credit card in your first and middle name, even better.

Let's get back to the Twilio account. Clicking on the upper left "down arrow" should allow you to create a new account, which was once called a "project". If this option is missing, go to <https://www.twilio.com/console/projects/summary> and choose "Create new account". Provide a generic account name. I called mine "VoIP". This might require you to confirm a telephone number to "prove you are human". Fortunately, they accept VoIP numbers here, and I provided a Google Voice number. After confirming the number, answer the questions presented about your desired usage. The answers here have no impact on your account.

Once you have your new project created, you should see a test balance of at least \$10. It is now time to configure our VoIP telephone number. First, determine the locality of the Twilio server closest to you, based on the following configurations. I will be using the "East Coast" U.S. option, so my example server will be [phone number].sip.us1.twilio.com. The most stable option in the U.S. is "us1".

- North America Virginia: [phone number].sip.us1.twilio.com
- North America Oregon: [phone number].sip.us2.twilio.com
- Europe Dublin: [phone number].sip.ie1.twilio.com
- Europe Frankfurt: [phone number].sip.de1.twilio.com
- South America Sao Paulo: [phone number].sip.br-1.twilio.com
- Asia Pacific Singapore: [phone number].sip.sg1.twilio.com
- Asia Pacific Tokyo: [phone number].sip.jp1.twilio.com
- Asia Pacific Sydney: [phone number].sip.au1.twilio.com

If the following menu items have changed, search through their online Twilio documentation for the updates. Twilio changes their menu options often without warning or documentation. If I see drastic changes, I will update this PDF and you will be notified to download a free updated document. Let's begin.

Within the Twilio Dashboard, click "Get a Trial Number". Use the search feature to find a number within your desired area code. This will deduct \$1 from your balance. If this option is not present, click the "Develop" link in the upper left menu, then "Phone Numbers", then "Manage", then "Active Numbers", then "Buy a Number". Click "Buy" next to the desired number. My demo number is "2025551212". Proceed with the following.

- Click the "Voice" link in the left menu.
- Choose the "Manage" menu option.
- Click the "SIP Domains" option and click the "+" to create a new domain.
- Enter the assigned telephone number as the "Friendly Name", such as "2025551212". Enter the assigned telephone number as the "SIP URI", such as "2025551212".
- Under "Voice Authentication", click the "+" next to "Credential List".
- Enter a "Friendly" name of your number, such as "2025551212".
- Enter a "Username" of your number, such as "2025551212".
- Enter a secure password and click "Create".
- Under "SIP Registration", click the "Disabled" button to enable it.
- In the "Credentials List" drop-down, choose your telephone number.
- Click "Save".
- Navigate to <https://www.twilio.com/console/runtime/twiml-bins>.
- In the left menu click the three dots next to "Twiml Bins".

- Click "Pin to Sidebar".
- Click the "+" to create a new TwiML Bin.
- Provide a "Friendly" name of "incomingvoice".
- Place the following text in the TwiML box. Replace "2025551212" with your number.

```
<?xml version="1.0" encoding="UTF-8"?>
<Response>
<Dial answerOnBridge="true">
<Sip>2025551212@2025551212.sip.us1.twilio.com</Sip></Dial>
</Response>
```
- Click "Create" and "Save".
- Click "Phone Numbers" > "Manage" > "Active Numbers" in the left menu.
- Click your telephone number.
- Under "Voice & Fax", then "A Call Comes In", choose "TwiML Bin".
- Select "incomingvoice" in the drop-down menu and click "Save".
- Click "TwiML Bins" > "My TwiML Bins" in the left menu.
- Click the plus sign to create a new bin.
- Provide a "Friendly" name of "outgoingvoice".
- Place the following text in the TwiML box.

```
<?xml version="1.0" encoding="UTF-8"?>
<Response>
<Dial answerOnBridge="true" callerId= "{{#e164}}{{From}}
{{/e164}}">{{#e164}}{{To}}{{/e164}}</Dial>
</Response>
```
- Click "Create" and "Save".
- Click "Voice" > "Manage" > "SIP Domains" in the menu.
- Select your domain.
- Under "Call Control Configuration" > "A Call Comes In", change "Webhook" to "TwiML Bin" and select "outgoingvoice" in the drop-down menu.
- Click "Save".

You may have noticed a warning about an emergency call fee of \$75. This is to entice you to associate your physical home address with your account, and pay a monthly fee for the privilege. This is not required. However, any calls to 911 from this VoIP number may generate a \$75 fee from Twilio for some reason. I would never call 911 from these numbers. If there is a true emergency, I would just use the cellular connection through the dialer app on my device. This will disclose my true cellular number to the operator, but privacy should never be a priority during an emergency. You are now ready to receive and generate calls with your new number. You cannot do this through Twilio's website, as you will need software designed for this purpose, as explained next.

Twilio Linphone Configuration

You now have a SIP domain and credentials created which allow you to associate your Twilio account with VoIP software called **Linphone** (linphone.org), which can be installed from within Pop!_Shop. The following configuration steps should apply to all Linphone applications, but you may see minor variations across platforms. You will need to repeat each step on every Linux device which you want to use for VoIP calling. Launch Linphone and conduct the following.

- If prompted, choose "Use a SIP Account". If this is not present, click the "Home" button and choose "Account Assistant".
- If prompted, click "I understand" about any restrictions.
- Enter a "Username" of your number, such as "2025551212".
- Enter a "Display Name" of your telephone number, such as "2025551212".
- Enter the appropriate "SIP Domain", such as 2025551212.sip.us1.twilio.com.
- Enter the "Password" you previously created for the credential account.
- Change the "Transport" to "TLS". If this ever fails, try "UDP" or "TCP".

Click the confirmations until you return to the main application. You can now click the number selection area in the upper left corner in order to select your new account, or choose between multiple accounts if you add more. You should see a green or grey light next to the account if the connection from Linphone to Twilio is successful. We can now make our first call.

- Confirm that your Twilio account is selected within the Linphone application.
- In the search field at the top, input any known telephone number.
- Click the "phone" button to initiate a call.

You should receive an automated message thanking you for using your demo account. I had to click the three dots, then the "Multimedia parameters" in order to select the appropriate incoming and outgoing sound properties. This confirms that we can place calls to Twilio's servers, but we are far from unlimited usage to real numbers. As long as you receive a confirmed test call message from Twilio, your configuration is complete. If you would like to remove all restrictions to make and receive calls to and from any number, you must "Upgrade" the account. The following should be conducted within the Twilio portal.

- Return to the Dashboard in the upper left menu.
- Click the "upgrade" link and provide all requested billing details.
- Provide any credit, debit, or registered prepaid card.
- Apply \$20 to the account.

You should now have an unrestricted Twilio account which should be fully functional for voice calls. Please do not upgrade the account until you know your test calls are going through. You should also have a fully functional VoIP application which can facilitate calls. Linphone can be used to place a call at any time from your Linux device. You can also add as many numbers as you wish by repeating this process. Incoming calls will "ring" your Linux device as long as the Linphone application is open and your status is "green". Before you create dozens of new numbers, let's discuss the costs. Each Twilio number withdraws \$1.15 every month from your balance. If you followed these steps, you are funded for almost three years of usage of the initial phone number. Incoming and outgoing calls cost \$0.004 per minute. During all of my testing for this tutorial so far, I spent \$1.21. There are several huge benefits with this strategy, as outlined below.

- You can now make and receive telephone calls through your Linux device. Windows, Linux, Android, and iOS are also supported through Linphone.
- You have more control over your number(s). You are not at the mercy of Google, and their data collection, in order to process calls.
- You can add as many numbers as desired as long as you have the funds to support them. I have five numbers through Twilio and I can access all of them through every device I own. My annual cost for this, including my usage, is

about \$70. Twilio does not know my real name and only possesses a custom domain email address and Google Voice number in association to my account.

- You can port a number into Twilio. If you plan to cancel a cell phone or VoIP number, you can port it into Twilio and still have access through Linphone.
- This process works well with custom Android operating systems, such as GrapheneOS, as explained in the ***Extreme Privacy: Mobile Devices*** guide.
- You can call international numbers (at increased costs). Most VoIP providers such as Google, Twilio, and others restrict calling to nearby countries. You can enable any country in Twilio by navigating to Programmable Voice > Calls > Geo Permissions.

Please think of this VoIP strategy as being similar to landline service. While configuring Twilio within the Linphone application during testing of this strategy, I encountered several devices which presented authentication errors during usage. These usually claim that the Twilio credentials supplied to Linphone have failed and the user is prompted to enter the correct password. Supplying the appropriate password fails. This appears to be an issue with Twilio temporarily blocking access due to too many invalid attempts, incorrect protocol settings, or launching and closing of Linphone from mobile devices too many times within a sixty-minute threshold. Any account restrictions should reset after twenty minutes of inactivity, but the following settings within Linphone should mitigate these issues. Navigate to Preferences > Settings > SIP Accounts > Proxy Accounts and click the pencil icon (Edit) and confirm the following.

- Transport: TLS
- Register: Enabled
- Publish presence information: Enabled
- ICE/AVPF/STUN/TURN: Disabled
- Outbound Proxy: Disabled

Linphone software accepts multiple numbers for incoming and outgoing calls. However, their menu only allows you to place outgoing calls from the most recently added (default) number. You can select the default number for outgoing calls within the upper left number selection menu.

It is important to note that VoIP telephone calls and messages are not encrypted and we should expect no privacy. However, I have some isolation from my true identity. I use these numbers mostly for outgoing calls, such as calls to businesses. This strategy is an affordable option which allows telephone calls without relying on your cellular carrier-provided number. It can also be used to isolate outgoing "junk" calls which are likely to abuse your number. Twilio has the ability to see our logs, but so would any cellular carrier if we had made the calls via our official number. In a moment we will purge those logs as often as desired.

The biggest feature of this process is the ability to possess affordable VoIP numbers without a third-party service. Any time you allow a third-party service to facilitate your calls, you are also allowing them to intercept and see your data. All of these services rely on a VoIP provider such as Twilio, so I believe we should consider creating our own solutions and eliminate any additional companies which are unnecessary.

VoIP solutions often have limitations over traditional cellular communications. Twilio, and any services which rely on Twilio, do not always support "short codes". These are abbreviated phone numbers that are usually 5 or 6 digits in length. They are

commonly used to send SMS and MMS messages with verification codes for account access. I think of these numbers as landline replacements which allow me to send and receive voice calls and personal texts. I maintain a single Google Voice account which can receive short codes. I explain more about this later.

By default, there is no name associated with the caller ID when you place a call from your Twilio number(s). This may be desired by some, but could be a disinformation campaign for others. On one of my Twilio numbers which I use for personal calls in my true identity, I attached my name to the caller ID. This way, my name appears as the caller on the screen of my bank or credit card company when I call from a Twilio number. It adds an extra layer of assurance. On another number, which I use with my alias name, I prefer that name to display as the caller. This also adds credibility to my call as an alias. Twilio requires you to contact their support in order to request these modifications.

Overall, I view this method as a simple and affordable phone line which provides unlimited numbers at my disposal. I can place calls from my laptop or mobile devices when needed without exposing my true cellular number. I can accept incoming calls on my laptop as if it was a traditional landline telephone. The person on the other end does not know I am using VoIP instead of a standard phone line. In my experience, VoIP calls while possessing a stable internet connection can be much more reliable than cellular calls with a weak signal.

Twilio SMS Messaging

Linphone has no embedded voicemail or SMS/MMS text message capabilities and is only for voice calls. If you desire the ability to send SMS/MMS text messages associated with this new Twilio number, you must create an environment which can facilitate this communication. You have a few options for this, but I will present my recommended approach. The following allows you to forward any incoming SMS text messages to another telephone number, such as Google Voice or any other number.

This is the simplest option for text message forwarding.

- Click the "Twiml Bins" option in the left menu then "My Twiml Bins".
- Click the plus to add a new bin and provide a name of "incomingsms".
- Insert the following within the Twiml field, replacing "12125551212" with your own receiving number, and click "Save".

```
<Response><Message to='+12125551212'>{{From}}:
  {{Body}}</Message></Response>
```
- Click "Phone Numbers", "Manage", "Active Numbers", then select number.
- Under "Messaging", and "A Message Comes In", choose "Twiml Bin".
- Choose "incomingsms" in the field to the right and click "Save".

All incoming text messages should now forward to your other number. Note that you pay a small fee for both the incoming and the forwarding text from your Twilio balance. Advanced users may want to instantly forward any incoming SMS text messages to an email address. **This requires an online web server and the knowledge of uploading files to it.** A shared host and any custom domain will suffice. Create a text file called twilio.php with the following content. Change "your@email.com" to the address where you want to receive notifications. Change "@yourdomain.com" to your actual domain name. Upload this file to your web host.

```
<?php
```

```
$to = " your@email.com ";
```

```
$subject = "Text Message from {$_REQUEST['From']} to  
{$_REQUEST['To']}";  
$message = "{$_REQUEST['Body']}";  
$headers = "From: twilio@yourdomain.com";  
mail($to, $subject, $message, $headers);
```

Navigate to your Twilio dashboard and conduct the following.

- Click "Phone Numbers", "Manage", "Active Numbers", and select number.
- Under "Messaging" and "A Message Comes In", change each to "Webhook".
- Provide the full address of the PHP file you previously created within both fields. This may be similar to <https://yourdomain.com/twilio.php>.

Test your new SMS option from another number. Any incoming SMS messages to your Twilio number should now be forwarded to your email. The subject will appear as "Text Message from 2125551212 to 6185551212" and the body will contain the message sent. I prefer this option because it does not require another telephone number, such as Google Voice, in order to receive messages. When I give my car dealer this Twilio number during a maintenance visit, I receive an email when they send a text notifying me my vehicle is ready.

If you want to send SMS text messages from your Twilio number, there is a "Try it out" feature within your Twilio dashboard, but I find this process cumbersome and it relies on you to be constantly logged in to Twilio. Instead, consider a Twilio "Quick Deploy" option.

First, navigate to <https://www.twilio.com/code-exchange/browser-based-sms-notifications>. Next, confirm that the "Account name" is the VoIP project which you created for this process. If you have more than one number, select the appropriate option. Finally, create a passcode which prevents random people from finding your project and sending messages. This should be a fairly secure passcode, but should also be rememberable. Click "Deploy my application" and you will be presented a URL similar to <https://sms-notifications-6431-bf4jg3.twil.io/index.html>.

Visiting this page presents a form which allows unlimited outgoing SMS text messages from your new Twilio number. Enter one or more target numbers; apply your application passcode; and write your message. Be sure to bookmark this page within your browsers in order to access it easily. If you want to send a response to a received message, you can open your new Twilio page and send it from there.

To be transparent, I do not do this. It is simply too much effort. Also, Twilio has an unknown threshold regarding outgoing text messages. If you surpass it, they will demand either a SSN or EIN issued by the IRS in order to continue service. This is to combat SMS spam. I want no part of that. **I only view these VoIP numbers as a way to make and receive telephone calls, and receive text messages.** If you are looking for a way to send unlimited messages to others, consider the secure encrypted options previously mentioned in this book.

Twilio Voicemail Configuration

Next, consider voicemail. Some may prefer to have no option to leave a voice message. The instructions up to this point will either ring your Sipnetic application for 30 seconds and then hang up, or simply terminate the call right away if Linphone is not open and connected. I prefer this for some numbers, as I do not want the caller to be able to record a message. However, we can enable voicemail, tell Twilio to record the message, save it to their servers, and email us a link of the recording. Conduct the following within the Twilio Dashboard.

- Navigate to <https://www.twilio.com/labs/twimlets/my/> to access Twimlets.
- Choose "Voicemail" then "Create New Twimlet".
- Provide your desired email address to receive voicemail notification.
- Provide your desired outgoing greeting.
- Choose "True" to have the messages transcribed to text or "False" to avoid transcription. Note that transcriptions add an extra cost and do not impact the ability to hear the voice messages. I do not transcribe them for privacy reasons.
- Click "Save URL" then provide a nickname of "voicemail".
- Copy the URL, similar to "<http://twimlets.com/AC5b84e8/voicemail>".
- Click "Twiml Bins" in the left menu and select "incomingvoice".
- Replace the current text with the following.


```
<?xml version="1.0" encoding="UTF-8"?>
<Response>
<Dial answerOnBridge="true" timeout="30"
action="http://twimlets.com/AC5b84e8/voicemail">
<Sip>2125551212@2125551212.sip.us1.twilio.com</Sip>
</Dial>
</Response>
```
- Replace "<http://twimlets.com/AC5b84e8/voicemail>" with your URL.
- Replace "2125551212" with your own number.
- Replace "us1" with your own server location if necessary.
- Click "Save" and test the service.

If your Linphone application is open and connected, an incoming call should ring for 30 seconds. If you do not pick up the call in that time, the voicemail system presents a generic greeting and allows the caller to record a message. If Linphone is closed or not connected to Twilio, the greeting is presented right away. If a caller leaves a voicemail, you will receive an email at the address provided which includes a link to hear the recorded MP3 file. This recording can also be accessed by navigating to "Voice" > "Overview" in your Twilio Dashboard.

Similar to Google Voice, you can delete the recorded file from this menu. This file is not secure or private. It is very similar to the way a traditional cellular provider or Google Voice would store voicemails available to your device. If you have no devices connected to your Twilio account which are ready to receive a call when a call comes in, expect to see error messages within the Twilio "Monitor" menu. These are to notify you that your phone system could not receive the call and can be ignored. Before you commit to voicemail transcription, consider my thoughts on Twilio account sanitization, which are presented in the next section. If desired, disable the "Daily Calls Log Archives" logging feature within Twilio at "Voice" > "Settings" > "Log Archives". This does not stop Twilio from storing VoIP call metadata, but it does eliminate a small layer of internal logging.

Keep in mind that additional numbers will extract funds faster. I only recommend additional numbers if you understand the reasons which you need them. Repeat the previous steps for each number needed. While writing this update, I configured a toll-free number. The monthly fee for this number is \$2.00 (twice the price of a standard number), but it presents a more professional appearance. I have also witnessed toll-free numbers behave differently when used as number verification. One of my banks absolutely refused any VoIP number as my required 2FA authorization number. However, providing a VoIP toll-free number passed the scrutiny. When I attempted

this on PayPal, a toll-free number was absolutely refused. There seems to be no standards with this. Testing different options might lead you to your own best option. You can now choose between multiple different numbers within your Linphone application. Whichever is chosen as default allows outgoing calls to be completed from that number. Incoming calls to any numbers will ring the app and allow connection regardless of the default account. Incoming text messages will be stored at the Twilio Dashboard and voicemail will be transcribed and sent to your email address. You can replicate this for unlimited numbers, as long as you have funding to support them.

Twilio Account Sanitization

If you use any manual SMS/MMS messaging option, message metadata and content remain on Twilio's servers, and could be accessed by employees. Every voicemail you receive also stays present on their servers as an MP3 file, which can be accessed via direct URL without any credentials. Let's identify manual ways to remove this data, beginning with stored text messages. An automated option is presented soon.

- Navigate to <https://console.twilio.com>.
- Make note of the "Account SID" and "Account Token".
- Click on "Messaging" then "Overview" in the left menu.
- Open any "Recent Message" by clicking the date and note the "Message SID".

You can now open Terminal and issue a command to delete each message. If your "Account SID" was 11, "Account Token" was 22, and "Message SID" was 33, the command would be as follows.

```
curl -X DELETE https://api.twilio.com/2010-04-01/Accounts/11/Messages/33.json \
-d "Body=" \
-u 11:22
```

This can be quite annoying if you need to purge hundreds of messages. Voicemail and call log deletion is more straightforward within the website. The following steps allow you to remove this data from your console.

- Navigate to <https://www.twilio.com/console/voice/dashboard>.
- Open any log entry which has an arrow icon under "Recording".
- Click "Delete this call log" and confirm.
- If desired, delete individual call logs from this location.

Twilio stores 13 months of call log history by default. If you possess numerous recordings which need removed, you can use the bulk deletion tool with the following directions.

- Go to <https://www.twilio.com/console/voice/recordings/recording-logs>.
- Click "Select", "Select All", "Actions", "Delete Recordings", then confirm.

If you have enabled the call transcription service, you may wish to remove all voicemail text transcriptions stored within your account.

- Click "Monitor", "Logs", then "Call Transcriptions" in the left menu.
- Open each transcription and click "Delete this transcription".

While writing this section, I realized that my data had not been sanitized for a long time. My Twilio dashboard possessed voicemails and text transcriptions about my health, family, friends, and work. I spent an hour cleaning all of it, then disabled transcriptions using the previous tutorials. It saves me \$0.05 per call and eliminates one more place where sensitive information could be stored. We can also disable some logging by Twilio with the following modification.

- Click "Voice", "Settings", and "General" in the left menu.
- Disable "Request Inspector" and click "Save".

All of this logging may seem invasive. It is, but it is not unique to Twilio. Twilio is doing nothing more than every other telephony provider including cellular and landline telephone companies. We have some control of how the data is stored, but I do not want to present false expectations here. While Twilio may appear to have deleted your call logs, voicemails, messages, and transcriptions, they are all likely still stored somewhere within their system. Our only goal is to remove the data from within our dashboard. Never expect any level of privacy when it comes to traditional phone calls and messages. VoIP services should never be used for sensitive communication. Assume there is a log of everything which will be stored forever.

Telnyx VoIP Service

In past writings, I highly recommended a Twilio alternative called Telnyx. At the time, they were less scrutinous of new accounts and encouraged people to try their services. Today, I urge caution before proceeding. This is due to several issues.

- Telnyx only provides accounts to confirmed businesses. However, your new custom domain email address may suffice.
- Telnyx no longer provides actual customer support. Support tickets only receive canned responses, and the request is eventually closed without a solution. Calls to their support line inform you to send an email, which is never answered. You will need to do your own troubleshooting if required.
- Telnyx does not provide voicemail services.
- Telnyx does not allow you to delete your user logs or text messages from their system in the way Twilio does.
- Telnyx suspends paid accounts if their automated fraud system detects unusual activity. I have experienced this myself when an unused account appeared suspicious to them. When I questioned about this practice, I was ignored.

However, I know of some people who prefer Telnyx over Twilio. Their monthly number fee is slightly less and redundancy is always a good thing. If the Twilio tutorial did not generate the usage you desire, possibly due to a suspended account, you might consider Telnyx (<https://refer.telnyx.com/refer/zrfmo>). This VoIP provider replicates the service provided by Twilio, but their setup process is easier. Now that you have an understanding of Twilio, I will abbreviate the steps here for Telnyx.

- Create a free account at <https://refer.telnyx.com/refer/zrfmo>. This specific URL provides \$20 in free credits which can be used right away.
- Provide a custom domain email address, which was previously explained.
- If prompted for purpose, choose "SIP Trunking".

You should now be logged in to the Telnyx portal. You can now create your first connection and purchase a telephone number.

- Click "Voice" then "SIP Trunking" from the side menu.
- Click the "+ Add SIP Connection" button.
- Enter the name you wish to have for your connection (I chose "VoIP").
- Click "Create Sip Connection".
- Enable "Credentials" as the "Connection Type".
- Copy the username and password automatically generated.
- Click "Save and finish editing".
- Click "Numbers", "My Numbers", and "Search & Buy Numbers".

- Enter a location and click "Search Numbers".
- Choose a number and click "Add to Cart".
- Click the "Cart" in the upper right.
- Under "Connection or Application", select your connection (mine was previously created as "VoIP").
- Purchase the number using your free credits by clicking "Place Order".
- Click "Voice", "Outbound Voice Profiles" then "Add new profile".
- Provide the name of "outgoingvoice" and click "Create".
- Click "Outbound Voice Profiles" then the "Edit" icon next to "outgoingvoice".
- Select your connection (VoIP) and click "Add Connection/Apps to Profile".
- Click "Voice", "Sip Trunking", "SIP Connections" then "Outbound Options" to the right of the connection.
- Enter your new phone number in "Caller ID Override", then click "Save".

Telnyx Linphone Configuration

- Launch Linphone and click the "Home" button.
- Choose the Account Assistant.
- Choose "Use A SIP Account".
- Enter a "Username" of your login name provided by Telnyx.
- Enter a "Display Name" of your telephone number, such as "2025551212".
- Enter the "SIP Domain" as "sip.telnyx.com".
- Enter the "Password" of your login credential provided by Telnyx.
- Change the "Transport" to "TLS". If this ever fails, try "UDP" or "TCP".

Your Linphone application can now make and receive calls without adding any funds. This is unique to Telnyx. If you want to commit to Telnyx as your VoIP provider, be sure to add \$20 in new funds to your account in order to prevent termination of the trial. This provides enough credits (\$40) to provide VoIP service for over three years, including a single number and usage.

Telnyx does not offer native SMS forwarding to their web portal or another number. The only option is self-hosting a forwarder to an email address as we did with Twilio. If you have your own domain and a shared web host, create a text file titled telnyx.php with the following content. Change "your@email.com" to the address where you want to receive notifications. Change "@yourdomain.com" to your actual domain name.

```
<?php
$to = "your@email.com ";
$subject = "Text Message from {$_REQUEST['From']} to
{$_REQUEST['To']}";
$message = "{$_REQUEST['Body']}";
$headers = "From: telnyx@yourdomain.com ";
mail($to, $subject, $message, $headers);
```

Upload the file to your web host. Afterward, your specific URL may be similar to <https://yourdomain.com/telnyx.php>. Within Telnyx, conduct the following.

- Click "Messaging", "Programmable Messaging", then "Add New Profile".
- Provide a name of "sms" and select "Twexit API".
- In both "webhook" fields, enter the URL of the PHP file previously created.
- Click "Save".
- Click "Numbers" then "My Numbers" within the left menu.
- Within your number entry, select "sms" in the "Messaging profile" field.

- Confirm the rate notice if prompted.

Incoming text messages should now be forwarded to your email address. The subject will identify the sender and recipient while the message body will display the text message. This method prevents Telnyx from storing all of your incoming messages (content) on their own server in the way that Twilio does, but they still maintain a permanent log. They would still have the ability to intercept and see the contents, but that is unlikely. Once the message is routed to your email, you should be the only host of the content (but not the log).

If you want to send a text from your new Telnyx number, click "Messaging" > "Programmable Messaging" > "Learn & Build" > "Send & Receive a Message". You can use the online form to send a SMS text message to any number. You can also use the commands provided on that page to send messages from within Terminal. Similar to Twilio, I do not use this feature. I never use a VoIP number for back-and-forth conversations. I only need to receive the occasional confirmation text message, which forwards to my email from both providers.

You can customize the caller ID name displayed during your outgoing calls within the Telnyx portal. Click "Numbers" > "My Numbers" from the menu and then "Caller ID/CNAM Listing" under the services area of your chosen number. Enable the "CNAM Listing" and "Caller ID Name" options, then enter any name desired. It may take a week to take effect. Be sure to enable two-factor authentication (2FA) through "My Account" in the "Security" section.

While this configuration is simpler than Twilio, it has less features. However, there are also benefits which are not available with Twilio. Consider the following.

- With Twilio, unanswered calls went directly to voicemail, and messages were transcribed and emailed to me. With Telnyx, unanswered calls disconnect after about 30 seconds. There is a voicemail option, but it requires a paid third-party service. If you want voicemail and transcription, Twilio is best.
- Twilio allows incoming text messages to be natively delivered directly to your dashboard or forwarded to any other number. Telnyx requires you to host your own message forwarding server for this to work. If you need the number to support incoming SMS text without third-party services, then Twilio is the appropriate option. If you have your own website, replicating this is fairly easy.
- Twilio possesses numerous fraud triggers which can impact our usage. Many readers report difficulties simply creating an account and being allowed access. Telnyx provides immediate access upon registration of a "business" email address. However, I have witnessed Telnyx suspend accounts created using free email domains behind a VPN. Always provide an email address associated with a custom domain while connected to public Wi-Fi in order to present the highest chance of obtaining a new account. Since you will be using this service to make and receive telephone calls associated with your real name, I see very little reason to attempt registration with an alias.
- The pricing and overall call quality for Telnyx and Twilio is almost identical.

I currently maintain numbers through both services and configure each into Linphone. If I were forced to rely on only one service, it would be Twilio due to the voicemail recording, sanitization options, and overall stability. If you have a Telnyx account and it works for you, great. However, I encourage others to focus their efforts on Twilio. I currently maintain several numbers through Twilio and configure each into Linphone. Incoming SMS text messages are forwarded to my email account via my website. The

service is not perfect. Twilio often changes their settings without notice and support is not always responsive.

VoIP.ms Service

I first attempted to obtain VoIP service from VoIP.ms several years ago. Every time I opened an account it was immediately suspended and support staff demanded I send an unredacted photo ID to them. I always refused. This was disappointing because VoIP.ms offers a unique way to obtain two-way SMS messaging along with voice services. In July of 2023, I reached out to the CEO and asked about the issue. He stated that they are currently attempting to modify their fraud controls with hopes of minimizing the need for an ID due to Know Your Customer (KYC) regulatory requirements. Today, I possess a working VoIP.ms account, and I encourage you to test their service. If you are able to secure a functioning account, I think you will find it much easier than the previous two providers. First, you need an account by registering at **<https://voip.ms/en/invite/Mzc2NjM3>**.

Using this link at signup should provide you \$10 in free credits after you add \$15 to your balance, and a bit less scrutiny on your new account. However, please note all of my comments at the beginning of this chapter. If you supply "John Doe" with a burner email and CMRA address, expect to get suspended. Since we will be using these VoIP numbers with people in our circles as an alternative to our cellular number, I see no reason to use an alias name for this service. In late July, this affiliate link's stats showed that 35% of the people who used the link were able to open an account while 65% were denied pending identity verification (we do not see any names or other account details). I have no solutions to this. If you are able to obtain service, consider adding a number and connecting it to Linphone with the following steps.

- Log in to your VoIP.ms portal within a web browser.
- Navigate to "DID Numbers" > "Order DID(s)".
- Select your desired country, state, and location, then view numbers.
- Select your desired number and plan (I prefer "Per Minute").
- Choose a server close to you, click "Order DID", and confirm order.
- Click "Sub Accounts" > "Create Sub Account".
- Amend the username with your 10-digit number (12345_2025551212).
- Enter a strong password.
- Select your DID number as the caller ID and click "Create Account".
- Navigate to "DID Numbers" > "Manage DID(s)".
- Select your number and click "Edit Selection-All Settings at Once".
- Change "SIP/IAX" to the new Sub Account.
- Open the Linphone app.
- If prompted, choose "Use a SIP Account". If this is not present, click the "Home" button and choose "Account Assistant".
- If prompted, click "I understand" about any restrictions.
- Enter a "Username" of your Sub Account username previously created.
- Enter a "Display Name" of your telephone number, such as "2025551212".
- Enter the "SIP Domain" previously selected, such as "atlanta.voip.ms".
- Enter the "Password" you previously created for the credential account.
- Change the "Transport" to "UDP". If this ever fails, try "TCP".
- Click "Use".

You should now be able to place a test call from this account through Linphone in the same way as the previous tutorials, and your voice calling account should function the

same as Twilio and Telnyx. If you plan to only use the voice features of VoIP.ms, you are all set. However, text messaging is different than the other providers. VoIP.ms is unique in that they offer true two-way SMS text communication via their own free open-source mobile application.

If you are using VoIP.ms for voice calls, and you are an Android user, I recommend the official VoIP.ms SMS application available within F-Droid. Apple iOS users should consider Groundwire. I provide full tutorials for each of these options within the ***Extreme Privacy: Mobile Devices*** digital guide.

If you prefer to forward all incoming SMS text messages to an email address, conduct the following within the VoIP.ms portal.

- Navigate to "DID Numbers" > "Manage DIDs".
- Click the "Edit DID" icon next to your desired number.
- In the "Message Service" section, select the email forwarding option.
- Enter your desired email address and apply changes.

Since I use the mobile application for sending and receiving SMS messages through VoIP.ms, I do NOT perform these tasks. You must select only one option. If you prefer mobile access to SMS texting, VoIP.ms with their mobile app is the best option, as explained in ***Extreme Privacy: Mobile Devices***.

I currently maintain numbers through all three services and configure each into Linphone. If I were forced to rely on only one service, it would be Twilio due to the voicemail options, overall stability, and ability to easily sanitize my account. If you need easy two-way mobile SMS messaging, Voip.ms is the clear winner. If you have a Telnyx account and it works for you, great. There is no perfect option for everyone. While Twilio had their own roadblocks during account creation, they were the first VoIP company which actually provided me service. Anticipate fraud-related hurdles from all three providers, but know that you can usually break through the temporary annoyances. Many people ask about services such as JMP.chat. JMP also uses Twilio numbers, but charges \$3 monthly (three times the cost). I see no reason to pay that to a middle man when you could buy your own numbers for less.

VoIP Number Decisions

My accounts from Twilio, Telnyx, and VoIP.ms present over a dozen phone numbers at my disposal. I have never found myself without a working way to make and receive calls and texts. I remind you again that redundancy is key to this lifestyle. However, how many numbers do you really need? This will vary for every reader. Most of my clients only need two VoIP numbers, as explained below.

Personal Number: This is the number you would give to people who know your true name in place of providing your real cellular number. This could include friends and family members who refuse to move over to secure communications. It could be a ported number from your previous cellular account or a brand-new number with a fresh start. I have a VoIP number which is the default communications for people from my past who will never embrace Signal or another secure method of communication. If I search that number within caller ID services, it displays my full name. It has served its purpose well and kept my true cellular number private.

Alias Number: This is the number you would use in any situation which you do not want associated with your true name. This could be a number to provide to a restaurant while waiting for a table or the mechanic who is working on "John Smith's" vehicle. It is a junk number available to you when you do not want the company

seeing your name as the owner when they use caller ID lookup services within their systems.

I believe two numbers aside from your true cellular number are the minimum requirement for our VoIP needs. However, you can take it further if desired. Many of my clients isolate a VoIP number specifically for use with their employer. This prevents co-workers from knowing your personal numbers and allows you to "turn off" when needed without pausing all communications from friends and family. Some clients get addicted and possess over twenty numbers for various purposes.

I always recommend starting small and working your way up. While I enjoy having many numbers at my disposal, I also pay a premium for that luxury. Many of my numbers are never used throughout the month, but I still pay a monthly fee for access. Only add new numbers when you are aware of the specific need for them.

VoIP Acceptance Issues

VoIP numbers work great for incoming and outgoing calls. They can work well forwarding incoming text messages if you are willing to configure the options. Outgoing text messages can be a pain. The real problems occur when an organization refuses to allow you to provide a VoIP number for services. Many banks require a true cellular telephone number in order to use their online banking. When you provide a VoIP number, you are likely denied the connection. If you try to provide a VoIP number during account creation with many social networks, you are declined an account. This is a constant battle.

If you have an interest in porting your true cellular number into a VoIP account, or forwarding VoIP calls to other numbers, please download my guide ***Extreme Privacy: Mobile Devices***.

There is a lot to digest here. Take your time and determine the best path for your daily communications strategy.

CHAPTER EIGHT: VIRTUAL MACHINES

Virtual machines (VMs) virtualize or emulate a particular computer system. They are computer operating systems on top of computer operating systems. Most commonly, a software program is executed within an operating system, and individual operating systems can launch within that program. Each virtual machine is independent from the other and the host operating system. The environment of one virtual machine has no impact on any others.

Quite simply, it is a way to have numerous computers within your single computer. VMs offer a "clean" environment with no contamination from other internet usage. You will be able to clone an original VM in minutes and trash them immediately. We will use virtual machines in order to isolate specific computer usage from the daily driver which gets bombarded with online tracking.

When I have discussed Windows and macOS systems in other guides, I have encouraged readers to consider a Linux VM for sensitive tasks such as banking. If you are now using a Linux host, I believe secondary Linux VMs are overkill for many readers. You already possess great privacy and security within your host. Therefore, my guidance within this guide will focus on the following areas.

- Create Linux VMs on Windows hosts in order to experiment with Linux or possess a secure Linux environment for specific tasks.
- Create Linux VMs on macOS hosts in order to experiment with Linux or possess a secure Linux environment for specific tasks.
- Create Linux VMs on Linux hosts in order to experiment with other Linux builds or possess a secondary Linux environment for specific tasks.
- Create Windows VMs on Linux hosts in order to have traditional Windows operating system options within Linux.
- Create Android VMs on Linux hosts in order to have traditional Android operating system options to launch mobile apps within Linux.

Before creating a virtual machine, you must possess virtual machine software. There are several free and paid programs which allow you to create and execute virtual machines. Premium options such as VMWare offer a free version, but it is extremely limited in function. Parallels works great on macOS, but is expensive. VirtualBox has always been the free gold standard for virtual machine creation, but it does not play well with newer macOS machines. UTM works well on M series Apple processors, but not any other systems. The list goes on. Therefore, I will break out each option in the following pages.

Creating a Linux VM on a Windows Host

For Linux VMs on a Windows host, I recommend **VirtualBox** ([virtualbox.org](https://www.virtualbox.org)). Full installation steps can be found at [virtualbox.org](https://www.virtualbox.org) but are not usually straightforward.

At the time of this writing, the following steps installed VirtualBox within Windows.

- Navigate to [virtualbox.org/wiki/Downloads](https://www.virtualbox.org/wiki/Downloads).
- Click the first appropriate link for your OS, such as "Windows Hosts".
- Select the highest version NOT including "Beta", such as "7.0.0".
- Download the appropriate "exe" file for Windows.
- Download the Extension Pack for your version, such as "7.0.0.vbox-extpack".
- Install the exe file with all default settings.
- Double-click the Extension Pack and install it to VirtualBox.

While VirtualBox is free for personal use, make sure you or your organization meets the requirements for usage of the software, especially the free Extension Pack license. The only requirement for VirtualBox to function is a computer that supports virtualization. Any modern Windows host should work without any modification. Most mid-range and high-end computers made within the past five years should have no problem, but may require you to enable virtualization support in the BIOS (Basic Input / Output System) during startup. Netbooks, older machines, and cheap low-end computers will likely give you problems. If you are in doubt about meeting this requirement, search for your model of computer followed by "virtualization" and you should find the answers. The rest of this section will assume that your Windows host computer meets this requirement and now possesses VirtualBox.

First, we need to download the Pop!_OS ISO file as previously explained. This file behaves similarly to a physical CD which would install Windows or any other operating system. Save the file to your Desktop or anywhere else to which you have easy access. Expect an approximate file size of 3 GB. Next, open VirtualBox and click on the button labeled "New". The following creates a VM appropriate for our needs. These exact steps change often, but this should provide the general settings required.

- Provide a name of "Pop!_OS" and choose your location to save the machine.
- Select "Linux" as type, "Ubuntu 22.04 (64-bit)" as version, and click "Next".
- Under Base Memory, move the slider to select 50% of your system memory.
- Under Processors, move the slider to select 50% of your resources.
- Click "Next" and then "Create".
- Leave the hard disk file type as "VDI" and click "Next".
- Select the default option of "Dynamically allocated" and click "Next".
- Choose the desired size of your virtual hard drive. If you have a large internal drive, 50 GB should be sufficient. If you are limited, you may need to decrease that number.
- Click "Create".

Your VM has been created, but it will do nothing upon launch. We need to tell it to boot from the ISO file which we previously downloaded. Select your new machine in the menu to the left and complete the following.

- Click the Settings icon then the Storage icon.
- Click the CD icon which displays "Empty" in the left menu.
- Click the small blue circle to the far right in the "Optical Drive" option.
- Select "Choose a disk file".
- Select the Pop!_OS ISO previously downloaded then click "Open".
- Click "OK" and then "Start" in the main menu.
- If prompted, confirm your choice by clicking "Start".

Your Pop!_OS installation process should now start within a new window. You should be booting to the ISO file previously downloaded, which is behaving as if you had placed a Pop!_OS install CD into the virtual computer. This is your first virtual machine running on top of your host operating system. If the window is too small, click "View", "Virtual Screen", then "Scale to 200%" within the VirtualBox menu. Avoid this, if possible, as it may cause viewing issues later. Consider reversing this setting once you are finished if things appear large. We can now finish the installation of Pop!_OS with the previous tutorials.

You should now have a functioning virtual machine which contains the basic programs we need to use the internet. By default, it is using your host computer's internet connection, and taking advantage of your host's VPN if you have it connected. Technically, we could start using this machine right away, but the experience would get frustrating. We need to take some additional steps to configure the device for optimum usage. The first step should be to install VirtualBox's Guest Additions software. This will allow us to take advantage of better screen resolution and other conveniences. Conduct the following steps.

- In the VirtualBox Menu, select "Devices" > "Insert Guest Additions...".
- Click "Run" when the dialogue box pops up.
- If no dialogue is present, right-click "autorun.sh" in the CD in the dock.
- Choose "Run as Program" and provide your password when prompted.
- Allow the process to complete, press Return, and restart the VM.

You should now have VirtualBox Guest Additions installed. You can test this by resizing the screen. If you make the Pop!_OS VM full screen, you should see the overall screen resolution change with it. If you previously changed the scaling of the window in VirtualBox, change it back to 100%. If the screen is still too small, right-click the Pop!_OS desktop and choose "Display Settings". If the option is present, choose a "scale" of 200% and see if that works better for you. Overall, I would rather modify the resolution within the Pop!_OS VM and not within the VirtualBox settings. I like the Pop!_OS VM to possess maximum resolution possible, in full screen mode, with a choice of the higher scale if required.

If all appears to be functioning, you can right-click the CD icon in the left Dock and choose "Eject". If not, double-click the CD icon and choose "Run Software" in the upper right corner to repeat the process. Next, we should make some modifications within the VirtualBox program in order to experience better functionality. Shut down the VM by clicking on the upper right menu. In VirtualBox, select your VM and click the "Settings" icon. Next, conduct the following.

- In the "General" icon, click on the "Advanced" tab.
- Change "Shared clipboard" and "Drag n' Drop" to "Bidirectional".
- In the "Display" icon, change the "Video Memory" to the maximum.
- In the "Shared Folders" icon, click the green "+".
- Click the drop-down menu under "Folder Path" and select "Other".
- Choose a desired folder on your host to share data back and forth.
- Select the "Auto-mount" option and then "OK".
- Click "OK" to close the settings window.
- Restart your VM.

You should now have a more robust display, copy and paste capabilities, and a new shared folder connecting your VM to your host on the Desktop. You can copy files from your VM directly to your host and vice versa.

Snapshots

A great feature of virtual machines is the use of Snapshots. These "frozen" moments in time allow you to revert to an original configuration or preserve an optimal setup. Most users install the virtual machine as previously detailed, and then immediately create a snapshot of the unused environment. When you accidentally remove or break a feature, you can revert to the previously created snapshot and eliminate the need to ever reinstall. Completely shut down the Virtual Machine and conduct the following.

- In the VirtualBox Menu, click on the "Snapshots" button in the upper right.

- Click on the blue camera icon to "take a snapshot".
- Create a name and click "OK".

You can now use your virtual machine as normal. If you ever want to revert to the state of the machine that existed at the time of the snapshot, follow these instructions:

- Completely shut down the Virtual Machine.
- In the VirtualBox Menu, click on "Snapshots" and select the snapshot to apply.
- Click on the blue camera icon with arrow to "restore snapshot".
- Deny the option to save the current data, and click "Restore".

Optionally, if you ever want to remove a snapshot, simply click the icon with a red "X". This will remove data files to eliminate wasted space, but you cannot restore to that image once removed. It will not impact the current machine state. Many users remove old, redundant snapshots after creating newer clean machines.

I wish I could say that every reader will be able to easily build virtual machines on any computer. This is simply not the case. While most computers are capable of virtual machine usage, many will demand slight modifications in order to allow virtualization. Let's take a look at the most common errors presented by VirtualBox.

VT-x is disabled: Any version of this error is the most common reason your VMs will not start. This indicates that the processor of your computer either does not support virtualization or the feature is not enabled. The fix for this varies by brand of machine and processor. Immediately after the computer is turned on, before the operating system starts, enter the BIOS of the machine. This is usually accomplished by pressing delete, F2, F10, or another designated key right away until a BIOS menu appears. Once in the BIOS, you can navigate through the menu via keyboard. With many Intel processors, you can open the "Advanced" tab and set the "Virtualization (VT-x)" to "Enable". For AMD processors, open the "M.I.T." tab, "Advanced Frequency" Settings, "Advanced Core" settings, and then set the "SVM Mode" to "Enable". If none of these options appear, conduct an online search of the model of your computer followed by "virtualization" for instructions.

VT-x is not available: This is usually isolated to Windows 10 and 11 machines. Navigate to the Windows Control Panel and open "Programs and Features". Click "Turn Windows features on or off" and uncheck all "Hyper-V" features. Click "OK" and reboot. If the Hyper-V option is not enabled, enable Hyper-V, restart the computer, disable Hyper-V, and reboot again. Attempt to start your VM with these new settings. This may seem backwards, but it makes sense. Previous versions of VirtualBox cannot run if you are using "Hyper-V" in Windows. Basically, both systems try to get exclusive access to the virtualization capabilities of the processor. Hyper-V within Windows receives the access first and impedes VirtualBox from the capabilities. The latest version of VirtualBox attempts to correct this. If the previous setting did not help, try to re-enable all of the Hyper-V options within Windows, reboot, and try to boot your VM again. If you are still experiencing problems, read the troubleshooting chapter of the VirtualBox manual at [virtualbox.org/manual/ch12.html](https://www.virtualbox.org/manual/ch12.html). Expand any errors received and search the provided error codes to identify further solutions.

VirtualBox Displays: Some readers of previous editions have reported the inability to resize VM windows within VirtualBox and the "Auto-resize Guest Display" menu option greyed out. The following commands within Terminal of the Linux VM should repair this issue. There is no harm running these if you are unsure.

```
sudo apt update
```

```
sudo apt install -y build-essential dkms gcc make perl
sudo rcvboxadd setup
reboot
```

Creating a Linux VM on a macOS Host

I believe UTM (mac.getutm.app) is the best virtualization software for Apple computers. This phenomenal free and open-source software works better with macOS than any other free or paid product. Install it from Terminal with the following command (assuming you have Homebrew (brew.sh) installed).

```
brew install --cask utm
```

UTM allows macOS users to launch practically any virtual system within host machines which have either Intel or ARM (Apple) processors. This means it will work with any Apple computer, regardless of the hardware. UTM employs Apple's Hypervisor virtualization framework to run ARM operating systems on Apple Silicon at near native speeds. On Intel-based machines, traditional x86/x64 operating systems can be virtualized. In addition, lower performance emulation is available to run x86/x64 on Apple Silicon as well as ARM64 on Intel. This allows us practically any option desired, and is unique to this program. Even the paid alternatives do not offer all of these features. The software relies on QEMU, which has always been otherwise difficult to configure. I now rely solely on UTM for all VMs on my macOS machine, and I find it to be superior to a Windows or Linux host.

Upon opening UTM, you have the option to "Create a New Virtual Machine". If this is ever not visible, you can replicate the action by clicking "File" > "New" within the program's menu. Choosing this selection presents options which may be new to readers. You can select to either "Virtualize" or "Emulate" your new VM. We should understand the difference.

Virtualize: This process is accomplished with the help of hardware, typically the hypervisor. It virtually shares the hardware resources of a single physical computer into multiple virtual devices by allocating dedicated resources from the host system to the newly created virtual system. This is typically much faster than emulation and the option we will choose for our new VM. If you have an M1, M2, or newer Apple processor, you cannot virtualize x86/x64 operating systems, you can only virtualize ARM-based systems. Similarly, you cannot virtualize ARM-based systems from a x86/x64 machine. When using virtualization, the operating system must be created for the processor present within the device.

Emulate: This process is much more forgiving, but can be slow. It uses software to emulate specific hardware. This means that the VM needs a software interpreter translating its code into the host system's language. This eats up a lot of resources and can make things drag. Since the VM does not run on the host's physical hardware, emulation is slower when compared to virtualization. By contrast, in virtualization, the guest system gets direct access to the host's allocated resources, resulting in better speed. It is great to have this option, but we will not use it within this chapter.

Let's build our first Linux VM within UTM together. Choose the "Virtualize" option and then select "Linux". This brings us to our need to choose the proper path based on our hardware. You must choose the appropriate version of Linux for your processor. If you have an Intel device, you can use the standard Pop!_OS ISO file which was previously used to install it to a host. You could also use the Ubuntu ISO available on their website. If you have an M1, M2, or later processor, you need the ARM version

of Ubuntu, as Pop!_OS will not work with your machine. Below are the current download links for each.

Pop!_OS for Intel Devices: <https://pop.system76.com>

Ubuntu for Intel Devices: <https://ubuntu.com/download>

Ubuntu for ARM Devices: <https://cdimage.ubuntu.com/jammy/daily-live/current/>

If choosing the ARM version, make sure you do not accidentally select the AMD version. Let's talk about these versions a bit more before we proceed. The Pop!_OS and Ubuntu 22.04 Desktop LTS are the versions appropriate for all Windows and Linux hosts, and older macOS machines. They are the long-term versions with support until 2027. They are the easy choice for Intel-based machines. Apple M1, M2, and newer machines are tricky. They require an ARM version of Ubuntu, but Ubuntu does not currently offer an official ARM LTS release. However, they do support a daily ARM build which began with the official 22.04 LTS release. We could download the LTS Server edition and modify it for our needs, but I find that unnecessary. The ARM Desktop daily build, based on the current LTS version works well for me. However, I would never use the daily versions of releases such as 22.10, 23.04, 23.10, etc. Those tend to have more bugs and issues. If you are reading this before April of 2024, you should download the daily ARM build of 22.04. In 2024, hopefully we will have an official LTS ARM version. If not, use the ARM Daily version of 24.04.

Once you have downloaded the appropriate version of Linux for your system, click the "Browse" button within UTM and select the downloaded ISO file. Leaving the "Use Apple Virtualization" option unchecked is the safe and stable way to go. However, M1, M2, or newer devices may function better in the future with this option selected. Leave it unchecked for now, as you can always build another machine with this option later to compare the performance. It was not functioning with Linux during this writing. Click "Continue".

Choose half of your system's memory and CPU cores. If you had 16 GB of RAM and an eight-core processor, you would change the RAM to "8192" and the CPU Cores to "4". Never leave the cores as "Default", as it can confuse the operating system. Click "Continue" when complete. The size of the drive should be set to the maximum you will ever need. This is not the size of the VM as it grows, it is only the max. I set mine to "100" GB.

I prefer to enable file sharing, as it makes it easier to extract evidence from your investigation onto your host. Browse to your desired shared folder (I chose Downloads) and click "Continue". Finish through the process and click the arrow icon to start your new Linux VM. You are now ready to install Linux. If installing Pop!_OS, follow the previous guides for configuration. If installing Ubuntu, consider the following after initial boot of your new VM within UTM.

Ubuntu 22.04 LTS Desktop Only:

- Select "Try or Install Ubuntu".
- Select "Install Ubuntu".
- Select your desired language and location, then click "Continue".

Ubuntu 22.04 ARM Daily Desktop Only:

- Select "Try or Install Ubuntu".
- Enter the username of "ubuntu" and password of "password" if prompted.
- Double-click "Install Ubuntu 22.04.1 LTS" on the Desktop.
- Choose your language and keyboard layout and click "Continue".

All Ubuntu Installations:

- Select "Normal Installation", "Download Updates", and "Install third ...".
- Click "Continue".
- Select "Erase disk and install Ubuntu", then "Install Now".
- Confirm with "Continue".
- Choose your desired time zone and click "Continue".
- Enter a desired name, username, computer name, and password for each field.
- Choose "Log in automatically" and click "Continue".
- Allow Ubuntu to complete the installation and choose "Restart Now".
- Click the "CD" icon in the upper-right of the UTM VM window; highlight the CD/DVD option, and click "Eject". THEN press "Enter" to restart the VM or the "left triangle" within UTM.
- If necessary, choose the "power" or "restart" icons in the UTM window.

Your device should now boot to the login screen. If it boots into the installation ISO again, shut the machine down. In the main UTM window, select your new machine and click the settings icon in the upper-right. Under "Drives", identify the CD/DVD drive and change "Image Type" to "None". Reboot the VM and boot into the Ubuntu Desktop. The following will finish the default configuration.

- Click "Skip" then "Next".
- Select "No" and then "Next" when asked to help improve Ubuntu.
- Click "Next" then "Done" to remove the welcome screen.
- If prompted to install updates, click "Remind me later".
- Continue to the section titled "Ubuntu Customization".

Ubuntu Customization

You should now have an Ubuntu virtual machine executed within your Intel or ARM macOS device. Unlike the steps with VirtualBox, UTM does not require any special extension packs or software to be installed within the VM for the display to resize. You should be able to adjust your screen as desired, or make it full screen for best view. However, do not enter full-screen mode just yet. We still have some work to do and I want you to have easy access to the menu bar. Remember to always use the highest resolution available within Ubuntu and then choose the 100%, 200%, or additional options present within the Ubuntu display preferences. You can right-click the Ubuntu desktop and choose "Display Settings" to see this menu. Also, there are no concerning license restrictions. This is a much better scenario for all of us.

Some desired capabilities, such as clipboard and file sharing, require the installation of UTM's Spice daemon. Launch Terminal from the Applications menu within Ubuntu, and execute the following, which will also modify our background to match the previous tutorial. You may already have the required software, but let's make sure.

```
sudo apt install spice-vdagent spice-webdavd
gsettings set org.gnome.desktop.background picture-uri ''
gsettings set org.gnome.desktop.background primary-color 'rgb(66, 81, 100)'
```

Copy and paste capabilities should now be working, but you may not see your shared folder within Files on Ubuntu. The following should fix this.

- Shut down the VM and close the window.
- Within the main UTM window, click the "Settings" icon in the upper-right.
- Select "Sharing" on the left.
- Change "Directory Share Mode" to "Spice WebDAV" and click "Save".

- Reboot the VM.
- Click the "Shared folder" icon in the upper right of the UTM Ubuntu VM.
- Confirm your desired shared folder location.
- Open the Files application within Ubuntu.
- Click the "Other Locations" option in the left menu.
- Click the folder titled "Spice client" and wait for your VM to recognize it.
- Confirm you can access the shared folder within the left menu of Files.

It can take several minutes for the share to become available to Ubuntu. Once it does, it should appear until the VM reboots. Whenever you need to access the shared folder, simply click the Spice folder under "Other Locations" for that session. You can now copy files from your VM directly to your host and vice versa. I typically only do this after the VM has been booted for a while and I need the shared folder. Next, we should consider privacy and security settings within Ubuntu. The first two Terminal commands disable Ubuntu's crash reporting and usage statistics while the remaining steps within Ubuntu's operating system harden our overall privacy and security.

```
sudo apt purge -y apport apport-symptoms ubuntu-report
sudo apt autoremove -y
```

- Launch "Settings" from the Applications Menu.
- Click "Notifications" and disable both options.
- Click the "Privacy" option, then click "Screen" and disable all options.
- Click "File History & Trash", then disable any options.
- Click "Diagnostics", then change to "Never".
- Click the back arrow and click "Power", changing "Blank Screen" to "Never".
- Click "Automatic Suspend" and disable the feature.
- Close all Settings windows.

It is important to keep the software on this VM updated. There are different ways to do this, but I will focus on the easiest way within the operating system applications. While we do this, it may be a good time to add some commonly used applications to our Dock. Conduct the following steps.

- Launch the Applications menu (nine dots in lower-left).
- Type Terminal into the search field.
- Right-click on the application and select "Add to Favorites".
- Type Software into the search field and right-click on "Software Updater".
- Select "Add to Favorites".
- Press escape until all windows are gone.
- Launch the Software Updater icon from the Dock; click "Install Now"; and update all options.

UTM offers simple USB device access. While any USB drive is attached to the host computer, select the "USB Devices" icon in the upper-right of the UTM VM window. This presents that drive within the dock of Ubuntu for file transfer. If you plug in a USB device while the VM is running, it should prompt you to choose it.

While a VM is shut down and the VM window is closed, you will see options within the main UTM application for the selected VM in the upper-right. We will focus on the "Clone selected VM" and "Share" menu options. Clicking the clone option simply presents an option to make a full clone. This allows us to preserve our original VM and make copies whenever we want. The share option allows us to export an entire VM within a ".utm" file for easy archiving or sharing. The dialogue will prompt you

to choose the export location. If you ever want to see the location of all VMs within UTM, navigate to the following directory within the macOS host.

/Users/[your macOS username]/Library/Containers/UTM/Data/Documents/

If this location is not convenient, and I believe it is not, you can move your VM to any folder desired with the "Move selected VM" option within the main windows. I keep all of mine within a dedicated folder on my macOS host. Note that you can only move them once using the button option.

Creating a Linux VM on a Linux Host

In the first section of this chapter, I explained the usage of VirtualBox to create a Linux virtual machine within a Windows system. Those instructions could also apply to using VirtualBox to create a Linux VM on a Linux host. However, I believe there is something better. QuickEMU (<https://github.com/quickemu-project/quickemu>) offers pre-built VMs which require little effort. Install the software and interface with the following commands.

```
sudo apt-add-repository ppa:flexiondotorg/quickemu -y
sudo add-apt-repository ppa:yannick-mauray/quickgui -y
sudo apt update
sudo apt install quickemu -y
sudo apt install quickgui
```

After installation, open the QuickGUI application and conduct the following.

- Click "Create new machines" and click the "Select" button.
- Search "pop" and select "Pop!_OS".
- Click "Version" and select the latest option, such as "22.04".
- Select the "Intel" option and click the "Download" button.
- Allow the download to complete and click the "Dismiss" button.
- Close the "Downloader" menu with the "X" in the upper-left.

You can now click the "Manage existing machines" button to access your VM(s) at any time. Click the play button (right arrow) next to any machine to launch it. Use the full-screen button to maximize your VM. Repeat the previous tutorials in order to replicate the Pop!_OS machine throughout this book. You can also easily experiment with over 300 different Linux builds within this software.

QuickEMU offers a macOS installation option, but I have found it unreliable. The Android option works, but the version is 9.0 and quite outdated. We will use something better soon.

Creating a Windows VM on a Linux Host

For Linux hosts which need to possess Microsoft Windows, I recommend **VirtualBox** ([virtualbox.org](https://www.virtualbox.org)). This allows you to launch Windows applications whenever needed. VirtualBox installation instructions for Linux is as follows within Terminal.

```
sudo apt update
sudo apt install virtualbox virtualbox-ext-pack -y
```

Next, you need a copy of the Windows 11 installation media. I prefer the "Windows 11 (multi-edition ISO for x64 devices)" under the "Disk Image" section at <https://www.microsoft.com/software-download/windows11>. After download, launch VirtualBox and conduct the following.

- Click the "New" button.
- Provide a name of "Windows 11" and confirm your desired location.
- Select the downloaded ISO file and choose your desired edition.
- Confirm "Microsoft Windows" as type and "Windows 11 (64-bit)" as version.

- Enable "Skip unattended installation" and click "Next".
- Under Base Memory, move the slider to select 50% of your system memory.
- Under Processors, move the slider to select 50% of your resources.
- Click "Next" and leave the hard disk file type as-is.
- Click "Next" and "Finish".
- Disable internet connectivity to the computer.

We do not want internet access enabled, because Microsoft will require you to create an online account if it can connect to their servers. Click start to launch your new machine. When the option to boot from disk is displayed, press the space bar. I prefer to maximize the window by double-clicking the top menu bar. Proceed through the steps to install Windows 11 into your virtual machine. Choose "I don't have a product key" when prompted for a license and allow the installation process to complete. It may take some time. Pay attention to each option, and choose the best privacy and security options. These options change so often that I will not try to identify each of them here. Once finished, shut down Windows 11 and close VirtualBox.

You should now have a functioning Windows 11 virtual machine. You can use this in "trial" mode for thirty days, at which time you would need to build a new machine if you want to continue using Windows. You could also apply a valid license if available.

Re-enable internet access to the computer and restart the VM. By default, your VM is using your host computer's internet connection, and taking advantage of your host's VPN if you have it connected. We could start using this machine right away, but the experience would get frustrating. We need to take some additional steps to configure the device for optimum usage. The first step should be to install VirtualBox's Guest Additions software. This will allow us to take advantage of better screen resolution and other conveniences. Conduct the following steps within the Windows 11 VM.

- In the VirtualBox menu, select "Devices" > "Optical Drives" > "Remove disk from virtual drive", then select "Devices" > "Insert Guest Additions CD Image" and "Download" if prompted.
- Click "Run" when the dialogue box pops up.
- Allow the process to complete, press Return, and restart the VM.

You should now have VirtualBox Guest Additions installed. You can test this by resizing the screen. If you make the VM full screen, you should see the overall screen resolution change with it. Next, we should make some modifications within the VirtualBox program in order to experience better functionality. Shut down the VM. In VirtualBox, select your VM and click the "Settings" icon. Next, conduct the following.

- In the "General" icon, click on the "Advanced" tab.
- Change "Shared clipboard" and "Drag n' Drop" to "Bidirectional".
- In the "Display" icon, change the "Video Memory" to the maximum.
- In the "Shared Folders" icon, click the green "+".
- Click the drop-down menu under "Folder Path" and select "Other".
- Choose a desired folder on your host to share data back and forth.
- Select the "Auto-mount" option and then "OK".
- Click "OK" to close the settings window.
- Restart your VM.

You should now have a more robust display, copy and paste capabilities, and a new shared folder connecting your VM to your host on the Desktop. You can copy files

from your VM directly to your host and vice versa. VirtualBox has a lot of bugs and you may have a slightly different experience than mine. Search any errors or issues and I am confident you will find an online stranger who has fixed the same issue. You can apply Snapshots in the same way as in the previous VirtualBox Linux section.

Creating an Android VM on a Linux Host

I like to have the ability to launch mobile applications within my Linux host. This requires an Android virtual machine, and I believe our best option for this is **Android Studio** (developer.android.com/studio). It can be installed within Pop!_Shop. This software is maintained by Google, the maker of Android. It is designed for Android developers who need to create and test mobile applications within a desktop environment before applying them to actual mobile devices. Android Studio is also available on Windows and macOS, but I will only discuss the Linux variant here.

Once you have it installed, conduct the following.

- Launch Android Studio.
- Do not import any settings but allow any default downloads.
- Choose "Don't Send" for analytics, then click "Next" in the Welcome Wizard.
- Choose the "Standard" option and click "Next".
- Select your desired appearance and click "Next" twice.
- Click both agreements and accept, then click "Next".
- Click "Finish" and allow the download.

Android Studio will download numerous items, which may take some time. If you receive any download errors, choose the "Retry" option. Once everything has been successfully downloaded, click "Finish" and it should launch the new application window, and the following should be performed.

- Click "New Project", then "Next" to confirm "Empty Activity".
- Provide a name for your application and click "Finish".
- Allow all additional default downloads and click "Finish".

The application will navigate to the main developer panel, and you should see several downloads continue in the lower right. Allow everything to complete before proceeding. You should then see a vertical bar on the right titled "Device Manager". Clicking this should present a virtual device, which may be titled similar to "Pixel_3a". This will likely contain the latest version of Android, but we should also explore other options. Click the "Create device" button, as seen in Figure 8.01. This allows you to select from many virtual Android options. I chose to add a Pixel 6 Pro to my available devices, and selected the most recent API level, which can also be seen in Figure 8.01.

Before we launch our first device, we should consider an important adjustment. Since Android Studio is targeted toward developers, virtual Android devices launch within the developer portal. I prefer my devices to launch within their own window, so I make the following configuration change in the "File" > "Settings" menu within Android Studio.

- Click on "Tools" then "Emulator".
- Disable "Launch in a tool window" and click "OK".

Now choose your desired device and click the arrow button to launch. You should see a device similar to that in Figure 8.02. You are now running a virtual version of Android within your desktop environment. If desired, you could follow my ***Extreme Privacy: Mobile Devices*** guide or ***OSINT Techniques*** book to configure a complete Android device.

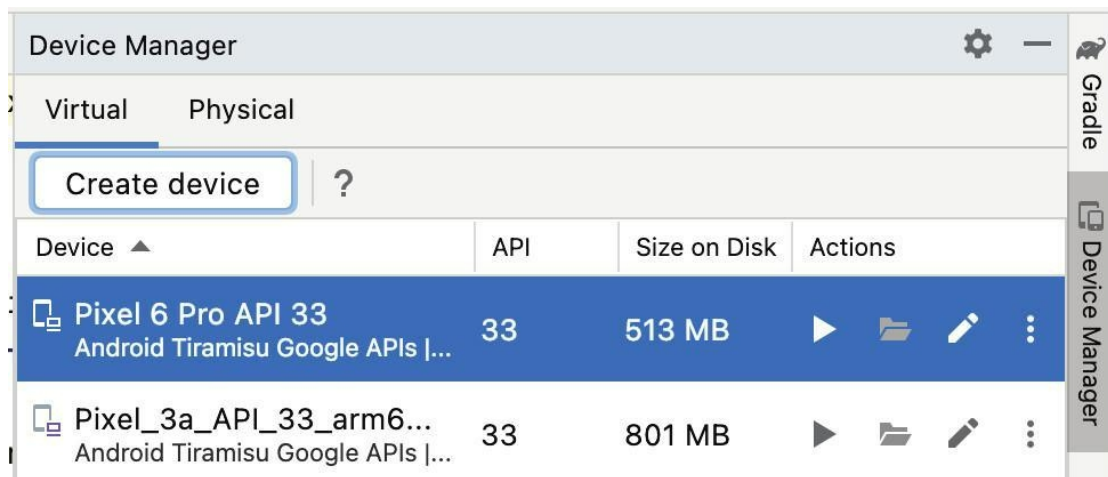


Figure 8.01: The Android Studio Device Manager.

Android Emulator - Pixel_6_Pro_API_33:5554

11:16

Sun, Nov 6



x -



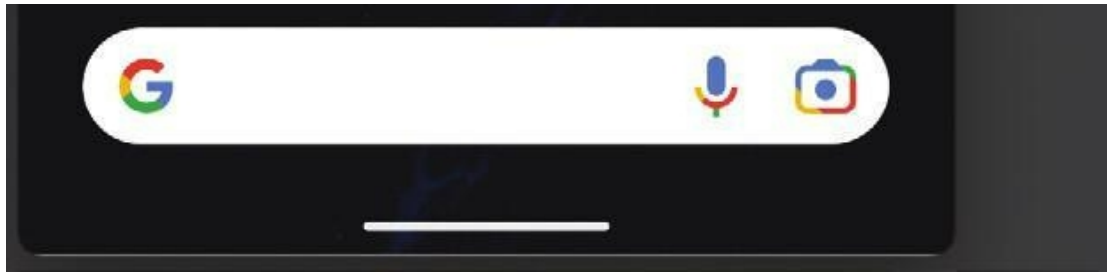


Figure 8.02: A virtual device screen within Android Studio.

Navigating these screens is identical to a physical device. However, controlling them from a mouse and keyboard may take some practice. You can click the circle on the floating bar to return to your home screen at any time. The square button allows you to browse through open apps and swipe them up to close them. The left arrow takes you back one step within an app. Always click and hold an app before moving it, and dragging the screen right or left navigates between home spaces.

Since we are working with a virtual device on a computer screen, there are a few nuances which should be discussed. By default, internet access is gained through your host computer. If you ever find that applications seem to stop communicating, check and be sure that "Wi-Fi" is enabled. I have experienced unexplained internet outages which were corrected by re-enabling Wi-Fi under "Settings". The easiest way to turn the device off is to click the power button on the top of the floating bar. Go ahead and turn the device off so we can explore cloning options. Once the screen is black, click the "X" in the floating bar and return to the Android Studio application.

Once you have your Android device configured exactly as desired, you can make a clone via the Android Studio application. While powered down, select your device from the Device Manager; click the three dots to expand the menu; and choose "Duplicate". You can also delete any unneeded devices on this screen.

Virtual machines are a luxury we now take for granted and I rely on mine every day. With a few simple steps, we can possess unlimited computers within a single piece of hardware.

CHAPTER NINE: CUSTOM SCRIPTS

I have explained a lot of ways in which you can harden and sanitize your new Linux machine. Everything up to this chapter relies on manual configuration. Next, let's automate a lot of the daily or weekly tasks by creating our own Linux maintenance script. I respect that some readers may just want to download a pre-configured script and use it right away. The following commands within Terminal will download the script, make it executable within your Linux machine, download the shortcut file, and move both to create a "Maintenance" shortcut in your "Applications" menu. The rest of the chapter explains how to create your own.

```
wget https://inteltechniques.com/data/maintenance.sh
```

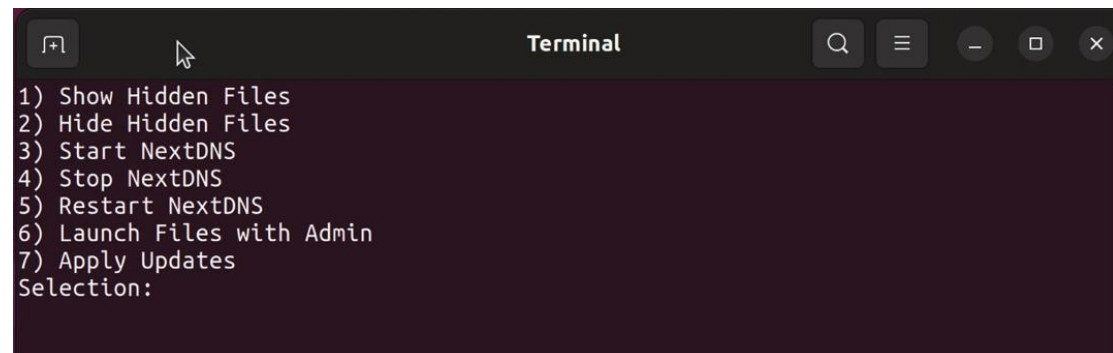
```
chmod +x maintenance.sh
```

```
wget https://inteltechniques.com/data/maintenance.desktop
```

```
sudo mv maintenance* /usr/share/applications/
```

The text on the following page displays the entire script. It identifies the file as a bash script; clears the screen; and presents a menu with seven selectable menu options. The image below displays the script once it is finished and executed. You would enter the number associated with the feature you want to execute and strike the Enter key.

Striking the Enter key at any prompt without a number presents the original menu again. Each option correlates to the commands previously presented throughout this guide. If you wanted to modify this script, you would choose option "6" to launch a file viewer with admin rights and navigate to /usr/share/applications and edit the maintenance.sh file.



```
1) Show Hidden Files
2) Hide Hidden Files
3) Start NextDNS
4) Stop NextDNS
5) Restart NextDNS
6) Launch Files with Admin
7) Apply Updates
Selection:
```

Now, let's understand how we could have built this manually. Copy the entire code presented within the next page in Courier New 11-point font and paste the text into a new file saved as maintenance.sh within your Documents folder using the Text Editor application on your own Linux machine.

```
#!/bin/bash
```

```
clear
```

```
COLUMNS=12
```

```
PS3='Selection: '
```

```
options=(
```

```
"Show Hidden Files"
```

```
"Hide Hidden Files"
```

```
"Start NextDNS"
```

```
"Stop NextDNS"
```

```
"Restart NextDNS"
```

```
"Launch Files with Admin"
```

```

"Apply Updates"
)
select opt in "${options[@]}"
do
case $opt in
"Show Hidden Files")
gsettings set org.gnome.nautilus.preferences show-hidden-files true
gsettings set org.gtk.Settings.FileChooser show-hidden true
;;
"Hide Hidden Files")
gsettings set org.gnome.nautilus.preferences show-hidden-files false
gsettings set org.gtk.Settings.FileChooser show-hidden false
;;
"Start NextDNS" )
nextdns start
;;
"Stop NextDNS" )
nextdns stop
;;
"Restart NextDNS" )
nextdns restart
;;
"Launch Files with Admin" )
sudo nautilus
;;
"Apply Updates")
sudo apt update
sudo apt upgrade -y
sudo apt full-upgrade -y
pop-upgrade release upgrade
sudo apt autoremove -y
sudo apt autoclean -y
flatpak update -y
;;
esac
done

```

This is a fairly basic Bash script, but let's walk through each piece to understand the functionality for future replication.

#!/bin/bash: This first line is known as a 'she-bang'. It identifies the text file as a script of commands to be executed.

clear: This command simply clears the screen in order to present a clean menu.

While not necessary in this script, I prefer to clear the screen before presenting any content. This eliminates any other text which may be confusing to the viewer.

COLUMNS=12: This command displays the contents within a column. It prevents the menu choices from being displayed as a single horizontal line. You can modify this number if your menu items do not fit as desired.

PS3='Selection: ': PS is short for Prompt Statement. PS3 presents a menu of choices in which you can select a corresponding number to execute the option. This basically creates an option for selection of future items in the script.

options=("Restart NextDNS"): This is where we place the options for the menu. These should be worded exactly as we want them to appear within Terminal. There is no limit and each should be in their own quotation marks.

select opt in "\${options[@]}": This continues the menu functionality.

do: This begins the process of executing our menu.

case \$opt in: This is used as an alternative to if/then style statements. It is an easier way to present choices for multiple executions within one script which can loop indefinitely.

"Restart NextDNS"): This identifies the menu option for which we will specify a command or series of commands. It should match the option as listed in the previous section verbatim.

nextdns restart: This is the Terminal command which we want executed when the menu item is selected.

;;: This identifies the end of the command(s) within the chosen menu item.

esac: This command (case backwards) ends our case statement.

done: This is the end of our script.

Next, you would create a "maintenance.desktop" file in your Documents folder which tells the operating system to launch the script from your Applications menu. Below is the code I used.

```
[Desktop Entry]
```

```
Type=Application
```

```
Name=Maintenance
```

```
Categories=Application;Maintenance
```

```
Exec=/usr/share/applications/maintenance.sh
```

```
Terminal=true
```

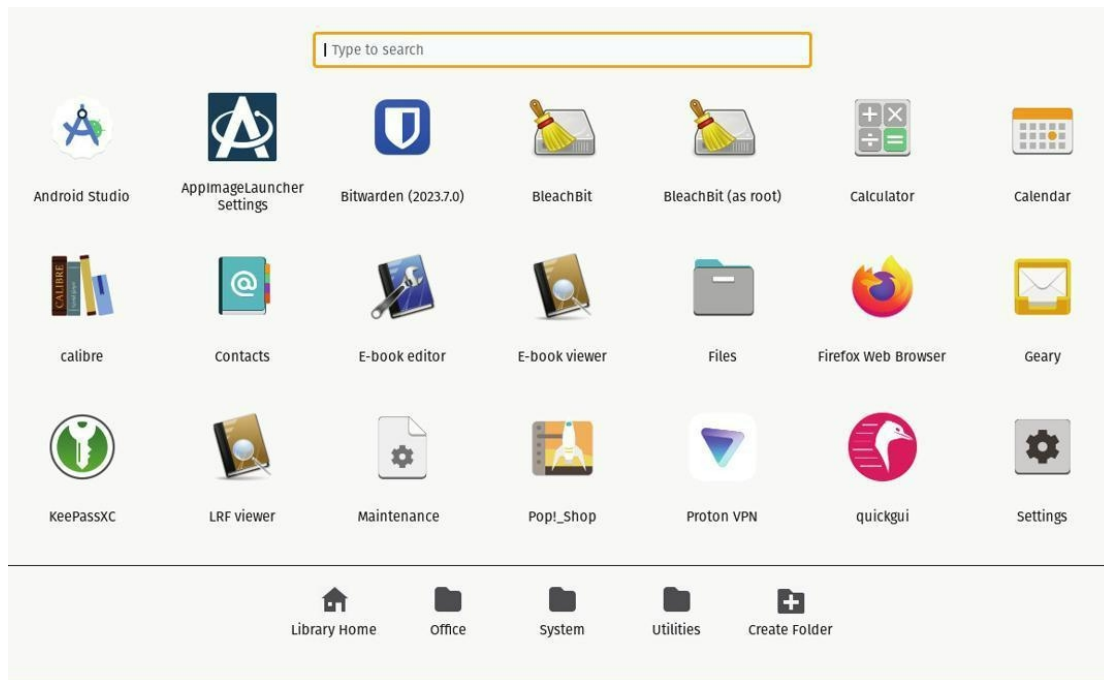
Now, you want to make the script executable and move both of these files to a location which is out of the way and can be seen by the operating system. I used the following commands.

```
cd Documents
```

```
chmod +x maintenance.sh
```

```
sudo mv maintenance* /usr/share/applications/
```

You should now see a new shortcut option within your Applications menu titled "Maintenance". The image below displays mine. Clicking this launches the script. I launch this script weekly to apply all updates, as discussed in the next chapter.



Twilio Sanitization Script

I previously explained the reasons Twilio is my preferred VoIP provider. If you use your Twilio numbers often, manually sanitizing the data stored on Twilio's servers is quite time consuming. I possess an automated script which conducts all actions on my behalf, and presents information about my account when needed, all without logging into my Twilio account. Let's start by installing Twilio's CLI tool with the following steps. This should only be applied if you have a Twilio account.

- Navigate to <https://github.com/twilio/twilio-cli/releases>.
- Expand the latest "Assets" area until you find one with an "amd64.deb" file.
- Download the file, similar to "twilio-5.10.0-amd64.deb".
- Right-click the downloaded file, select "Open with Eddy", and click "Install".

Once installed, execute the following within Terminal.

```
twilio login
```

This will ask for your Twilio SID and Token, which can be found in your portal.

When prompted, provide a name of "CLI". Next, execute the following.

```
twilio profiles:use CLI
```

This generates the appropriate configuration file which tells your computer to use this profile with the provided credentials for all future commands. You can now manually interact with the Twilio CLI using the following Terminal commands.

```
twilio phone-numbers:list
```

displays your current numbers in your account.

```
twilio api:core:calls:list
```

displays all voice call records in your log files.

```
twilio api:core:messages:list --properties="sid,from,body"
```

displays all SMS text messages stored within your account.

```
twilio api:core:recordings:list
```

displays all voicemail recordings.

```
twilio api:core:transcriptions:list
```

displays all voicemail transcriptions.

We can now automate the sanitation steps within a script which can be downloaded and installed with the following Terminal commands.

```
cd ~/Documents
```

```
wget https://inteltechniques.com/data/twilio.sh
```

```
chmod +x twilio.sh
```

```
wget https://inteltechniques.com/data/twilio.desktop
sudo mv twilio* /usr/share/applications/
The script content is displayed within the following page.
#!/bin/bash
COLUMNS=12
PS3='Selection: '
options=("Fetch Numbers" "Fetch Calls" "Fetch Messages" "Fetch
Recordings" "Fetch Transcriptions" "Delete All")
select opt in "${options[@]}"
do
case $opt in
"Fetch Numbers")
twilio phone-numbers:list
;;
"Fetch Calls")
twilio api:core:calls:list
;;
"Fetch Messages")
twilio api:core:messages:list --properties="sid,from,body"
;;
"Fetch Recordings")
twilio api:core:recordings:list
;;
"Fetch Transcriptions")
twilio api:core:transcriptions:list
;;
"Delete All")
twilio api:core:calls:list > ~/Desktop/calls.txt
cd ~/Desktop/ && sed -i '/^SID/d' calls.txt
sed -i 's/ .*//' calls.txt
sed 's/^/twilio api\:core\:calls\:remove \- \-sid /' calls.txt >
calls.sh
chmod +x calls.sh && ./calls.sh
rm calls.txt && rm calls.sh
twilio api:core:messages:list > ~/Desktop/messages.txt
cd ~/Desktop/ &&
sed -i '/^SID/d' messages.txt
sed -i 's/ .*//' messages.txt
sed 's/^/twilio api\:core\:messages\:remove \- \-sid /' messages.txt >
messages.sh
chmod +x messages.sh && ./messages.sh
rm messages.txt && rm messages.sh
twilio api:core:recordings:list > ~/Desktop/recordings.txt
cd ~/Desktop/ && sed -i '/^SID/d' recordings.txt
sed -i 's/ .*//' recordings.txt
sed 's/^/twilio api\:core\:recordings\:remove \- \-sid /'
recordings.txt > recordings.sh
chmod +x recordings.sh && ./recordings.sh
```

```
rm recordings.txt && rm recordings.sh
twilio api:core:transcriptions:list > ~/Desktop/transcriptions.txt
cd ~/Desktop/ && sed -i '/^SID/d' transcriptions.txt
sed -i 's/ .*//' transcriptions.txt
sed 's/^/twilio api\:core\:recordings\:remove \- \-sid /'
transcriptions.txt > transcriptions.sh
chmod +x transcriptions.sh && ./transcriptions.sh
rm transcriptions.txt && rm transcriptions.sh
;;
esac
done
```

You should now see a new shortcut option within your Applications menu titled "Twilio". Clicking it launches the script, which should appear as follows. The first five options allow you to easily monitor account details. Option "6" deletes all of your stored calls, messages, recordings, and transcriptions within Twilio's logs.

- 1) Fetch Numbers
- 2) Fetch Calls
- 3) Fetch Messages
- 4) Fetch Recordings
- 5) Fetch Transcriptions
- 6) Delete All

Selection:

Use the content here as a template whenever you want to create your own scripts and shortcuts. Practically any activity you conduct within Terminal can be automated with a Bash script. Modifying the names of the functions within quotes in the Maintenance script and the Terminal commands which follow each should give you a great start.

CHAPTER TEN: UPDATES & MAINTENANCE

I hope you now have your ideal Linux device configured specifically for your needs. Next, you need to make sure you keep it that way. I encourage you to adopt a Linux maintenance schedule which makes most sense for you. My routine is to conduct all computer maintenance on Friday afternoons when my digital workweek is over. It just so happens that I am writing this chapter on Friday, July 21, 2023. This makes it easy to document my entire process. I try to take the following actions once weekly when I am able to shut my computer down without interrupting any pending work.

First, I open the Maintenance script and quickly launch option 7. This applies all Apt, Pop!_OS, and Flatpak updates, and also removes unnecessary items from these updates. I then launch Pop!_Shop just to make sure there are no pending updates which my script may have missed. Next, I check for any additional updates from "Settings" > "OS Upgrade & Recovery". I run BleachBit as root and clean everything except "Free Disk Space". Finally, I reboot the machine.

Once my computer is completely updated, cleaned, and rebooted, I like to make a full backup. A paid program is not needed. Instead, I rely on a free and open-source program called FreeFileSync, available within Pop!_Shop. This program can be used to synchronize any two folders, but we will only focus on our Home directory.

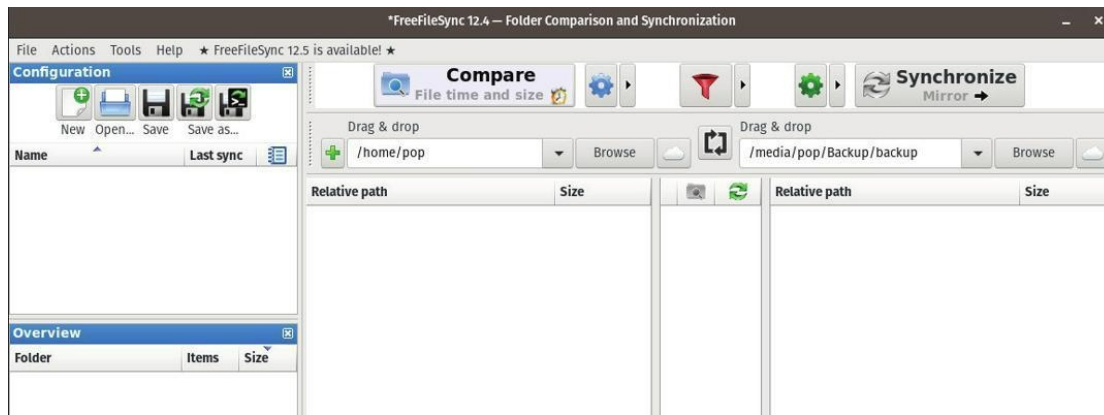
First, we need to format our external drive. I highly recommend an external USB SSD, such as the SanDisk Extreme line of drives. If you have a 1 TB or smaller internal drive, the \$82 SanDisk 1 TB Extreme Portable SSD (<https://amzn.to/42S7x7M>) would work well. Larger internal drives will require larger external devices. The more expensive "Pro" versions of these drives will not provide much benefit for our purpose. I format my external SSD specifically for backups with the following steps.

- In Pop!_OS, launch "Files" and right-click your external drive.
- Select "Format" and provide a name, such as "Backup".
- If you will only be using this with Linux, choose "Internal disk for use with Linux systems only (Ext4)".
- If you want the drive encrypted, select the "Password protect volume" option.
- Click "Next" and supply a secure password if prompted.
- Click "next" until you reach the "Format" option and click it.

If you encrypted the drive, which I recommend, the process will take some time to complete. You will need to unlock it with the password every time it is inserted into your machine. Now, let's conduct our first backup within FreeFileSync.

- Close any pop-up windows and click "Browse" in the left "Drag & drop" area.
- Click your home folder in the left menu, likely identified with the house icon.
- Click the "Open" button and click "Browse" in the right "Drag & drop" area.
- Select your external hard drive and click "Create Folder".
- Create a folder called "backup" on your USB disk, tap enter, and click "Open".
- Click the right arrow icon next to the green cog wheel near "Synchronize".
- Change the option to "Mirror".

The mirror option makes sure that the data on the external drive is always an exact replica of the content on your computer. If your system name was "pop" and external drive was labeled "backup", yours might look similar to mine below. You could save this configuration with the "Save as" icon, naming it "Home Backup".



Next, click "Compare" and allow the analysis. You may receive warnings that FreeFileSync is trying to access your Desktop, Download, and other folders, but this is acceptable for this purpose. You may also receive a warning about an area which is inaccessible to the program. I click "Ignore All" when this happens. Once complete, you should see a summary of all files which will be synchronized. Clicking the "Synchronize" button begins the backup process, which can take some time on the first run.

The next time you need to back up your data, you would connect your drive; unlock the encryption by entering the password; open FreeFileSync; and select the "Compare" button again. This time, you should only be presented the files which have been modified since the last backup. Then, the synchronization process should be much faster.

After I have conducted a backup, I open my email client and fetch all email from my provider onto my machine. I specifically do not do this before the backup. In the event that I deleted an important email from within my provider's server, which would then also delete the offline copy from my machine, I know that my previous backup has all emails which existed the previous week. This is minor, but something which has saved me in the past.

If I am able, I now shut down the machine and see how long I can go through the weekend without booting it back up. Some weekends are better than others. On Monday morning, I know I have a tidy, clean, and updated Linux machine ready for the week.

CONCLUSION

I hope you now possess a private and secure Linux device which does not share all of your activity with Microsoft, Apple, or Google. I believe you will find the minimalism and simplicity of your new device to be a superior experience. I practice what I preach, and configured my own Pop!_OS device from this guide. I no longer worry about unnecessary data collection or eavesdropping on my daily usage. My laptop no longer feels "dirty" a few weeks after using it. There is a great sense of freedom when you leave that world of data collection behind.

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Thank you for the continued interest in Privacy, Security, & OSINT.

~MB

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