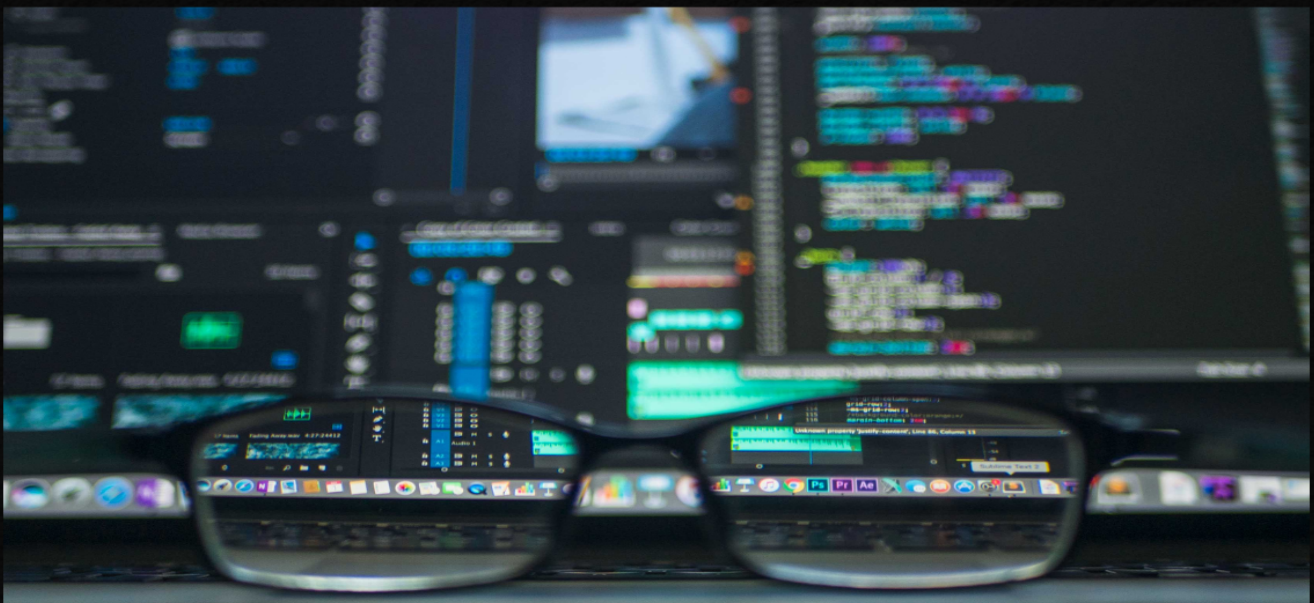# PRAGMATIC SELF-HOSTING

HOW TO GET STARTED WITH SELF-HOSTING FOR ABSOLUTE BEGINNERS

WRITTEN BY ANDREJ FRIESEN

Pragmatic Self-Hosting

How to get started with self-hosting for absolute beginners

Andrej Friesen

This book is for sale at http://leanpub.com/pragmatic-self-hosting

This version was published on 2024-07-14

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Preface

There are a ton of books out there about Linux and similar topics. Why another one? I think giving an overview and an objective can be beneficial for learning and that is something this book shall provide. When I started my journey into self-hosting I had no idea what I was doing. There was no single resource that gave me an overview of what is possible and how to get started. There where plenty of tutorials on how to setup a specific service for a specific use case. Most of them where outdated and did not work.

What will you get out of this book?

This book will give you a broad overview of the whole landscape of self-hosting. You will get an overview of operating systems, tools, applications on how to run your own self-hosted apps you desire. You will learn what self-hosted apps are out there. How to find answers to your problems along the journey. Everybody has different needs and requirements and therefore the self-hosting journey is a different path for everyone. There are many ways to achieve your goals and this book will give you an overview of the possibilities. After reading you should be able to find solutions for your own problems and get started with your own self-hosting journey.

What it won't cover

This is not a step by step kind of book. This is not a tutorial that you can follow blindly. This book is not part of the tutorial hell. You will have to do the hard part: feeling uncomfortable and try things and learn by yourself.

Who is this book for?

This book is for my younger self. I wish I had a guide on what is possible and how to get started with servers. I just did not know what I can do with a computer other than play games. I did not know anybody in that field. The internet was still young and I did not know where to start. Later I somehow found WordpRess. I did like the idea of having my own blog and I think I have set it up 50 times with the LAMP stack back in then. I never blogged on that WordPress instance because it was just on my laptop. But man, weirdly I liked setting it up.

I want this to be a high map to guide you through your own self-hosting journey.

You do not have to have any technical expertise to follow this book. Technical expertise will help you but you can pick up things along the way. That is the whole deal. Learn one thing at a time and solve your current problem.

You will need to research your own solutions to your problems. But you do not know what you do not know. This book shall just push you in the right direction.

I want you to have a smooth head start so that you know what you need to research.

Be it running your own media server, sharing photos with your family, hosting your own blog, getting up a gamer server for you friends and/or kids, there are endless possibilities. Everybody wants do to something different. If you are interested on how to get into this hobby, you are at the right place.

Hey and maybe you make a career out of it like I did?

Who it's not for

You already work as a admin, system engineer, devops, site reliability engineer (SRE), platform engineer or what ever the next name for such roles will be. If you already are technical enough to figure things out yourself feel free to buy this and support me but you will not get much value out of this book.

People who expect a step by step guide. This is not it. This will not tell you exactly the commands you need in order to setup your NextCloud or file server. This would be to specific and out of date in no time. And nothing is more frustrating than an outdated tutorial.

Do I need to know the terminal or Linux?

In general no. You can start your self-hosting journey without the command line. This might limit what you can achieve but you can get started.

However, you will greatly benefit from the command line which you can pick up on the go. It might be daunting at first. But if you keep it simple and only solve problems which you are facing right now you will get there. Also, you have a good friend: The Internet!

Seriously, a huge amount of professional IT people job is to find information. They do not know everything from their head. You remember by constantly doing something over and over again. Our good old friend repetition.

I myself have written a blog article about `netstat` about IPv4 and IPv6 output. Guess what, years later I have asked myself the same question again just to find the answer on my own blog. You will forget things which you do not use often and that is okay. And you will remember commands and things which you use often automatically.

Same things applies to Linux. Learn as you go what you need. It will compound over time and you will feel more and more comfortable. Do not try to memorize commands like vocabulary. Like with never used vocabulary you will not remember them in time. Only real world experience will.

The Kaizen principle applies here: Small steps over time will lead to big results.
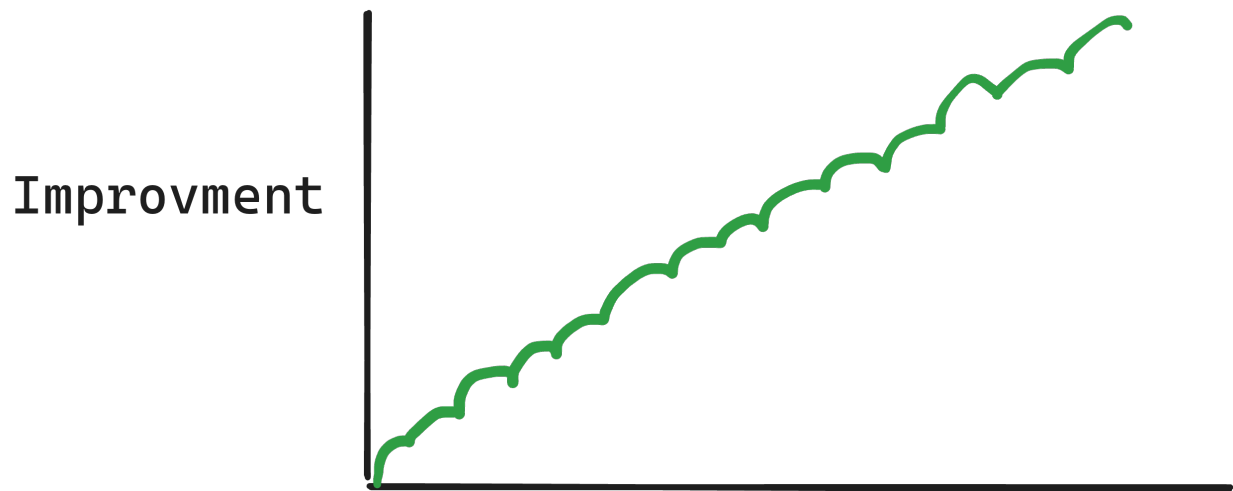
Figure 1. Kaizen improvement
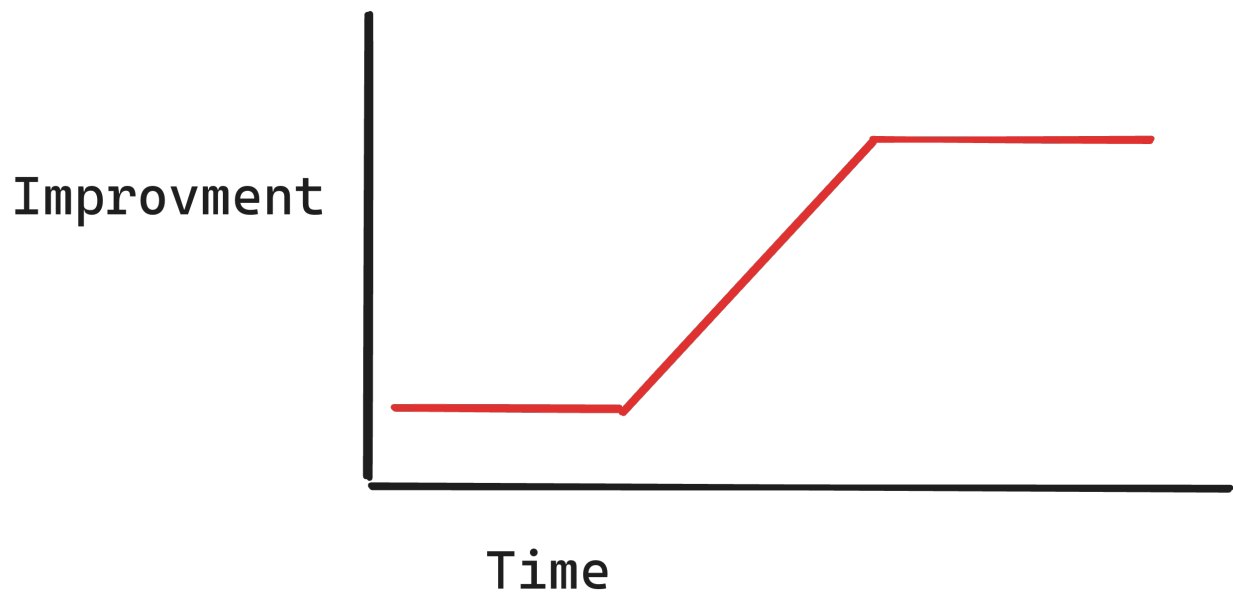
Figure 2. Just big improvement

About the author

I am Andrej Friesen. I am a software and system engineer from Germany working for a Cloud Provider/Hyper Scaler.

I have been working in the IT industry since 2016.

However, my journey was not a straight line. I started with studies in rescue engineering and later switched to quality engineering. There was not a single It related topic in my studies. However, I was always interested in computers and the internet. I knew I wanted to work in the IT industry but I thought I was not smart enough to do so.

Every day during my studies I was thinking about how to get into the IT industry. The opportunity came when I was in a lecture about quality engineering. The lecturer was talking about a software tool which was used to create knowledge bases in companies. Just a Wiki for an enterprise to gather and share knowledge. I immediately raised my hand and asked for a job. A few weeks later I was working as a student worker at a startup helping everywhere I possibly could. It started with automating Windows laptop deployment and later a but of Ansible and maintaining Linux servers.

I switched to an admin role working with AWS and Kubernetes. Building a data center on AWS and moving the company application from VMs to containers and AWS with Kubernetes (before managed Kubernetes was a thing). Afterward, I moved down the stack and build PaaS (Platform as a Service) like Kubernetes, Databases, Filesystems as a service.

> I have a a weird confession: I like settings things up but never using them. I build a retro gaming station with all required software and hardware. When I was done I did not play even once.
>
> I have setup WordPress countless times. Unfortunately, I did not stick with blogging from back then. Would have loved to read my old thoughts again.
>
> I have setup countless todo and project management apps but never used them long enough.
>
> I like to setup more complex things. I learned a lot and was fun. For me.

Introduction

Since there are about a million ways to self-host, keep in mind: this is a opinionated way of selfhosting. In my opinion this is a good thing for a beginner. The sheer amount of possibilities will let you in analysis paralysis. Follow the recommendations, get some expierience and then you can start to customize your setup.

We are going to give you an overview about what is possible but later on will focus on Ubuntu and Docker because that is what I think makes most sense. (My opinion)

What is self-hosting?

Lets start formal and first define self-hosting.

Self-hosting
> You are hosting and managing applications on your own infrastructure.

What do I mean by application? It could be a simple website, a complex content management system (CMS), hosting your own cloud storage with Nextcloud instead of using Dropbox, Google Drive and alike. Almost anything.

What do I mean with "own infrastructure"? I mean everything. It could be your own pc/server, a single board computer (SBC) like the popular Raspberry Pi, a off the shelf NAS solution like Synology, something in the cloud / datacenter or even your laptop! Anything.

Some people might argue about this definition and have a strong opinion about cloud servers: "If you use cloud it is not self-hosting." I strongly disagree on this. As long as you are in control of the server, the operating system I still would call it self-hosting.

Dont let yourself judge you from others. Just do your thing. It is your journey and you are solving your own problems.

When to not listen to others

The good thing about communities are the people.

The bad thing about communities are the people.

Be aware of toxic people and people with really hard line opinions. An opinion on its own is nothing bad. This whole book is build on my own opinion. But you should always listen to the arguments and make up your own mind. There are ALWAYS pros and cons for almost EVERYTHING.

Be aware of people who judge you for your choices. Especially when they do not have the whole context you have. Always remember. You are solving your own problems and there is no need to justify your choices to others. Explaining your choices from a technical, financial or other point of view is a good thing. But you do not have to justify your choices to others.

Personal mistakes I have made

To save you some time I will list a few things which I had a hard opinion about which made my life harder. I later realized that having a hard opinion regarding tech is not okay.

> Everything should be plain text and databases are bad.

I do not know why but somewhere on the internet I have read a few opinions about that databases are bad. They lock you in. Every software which uses databases should be avoided.

This of course is just wrong and not smart. In general such broad statements are always wrong because they miss context.

There are pretty good reasons to use a database but there are also pretty good reasons you should not use a database and you should rely on plain text. This is the nature of technology. There is no silver bullet. You will always have something with pros and cons. Pick your poison.

> I will not run `$SOFTWARE`, it uses `$PROGRAMMING_LANGUAGE` which is `$REASON`.

Another one of these things I picked up on reddit, forums or where ever. Some person decided the some programming language is bad for what ever reason. And also decides not to use any software which is written in that language. I have seen this with Java, PHP and other languages.

Again: programming languages do have their pros and cons as well. But if you want to self host something you should solve a problem with that software. You might consider the language because of the memory consumption as a factor when choosing between different solutions which try to solve the same thing. But do not rule it out just because you got the idea that `$PROGRAMMING_LANGUAGE` is bad.

> You should not use `$PROGRAMMING_LANGUAGE` because it is stupid.

Same thing as above but focusing in the language or scripting language. If you need to write something yourself you should pick the language which you are most comfortable with and which fits your needs.

> You should not use $SOFTWARE because it is not free/open source.

Not everything in the world is open source. That is a bummer but you can not do much about it. If the software is actually solving your problem and you can not find a open source alternative you should consider using it.

What can I self host?

This is highly up to your own needs. But how shall you know what to self-host when you are new to this topic? How do you know what is out there?

There are great resources like the Awesome Self-Hosted list[1] on GitHub. This is a huge list of self-hosted software which is kept up to date by the community. It is a great start.

There are also countless threads on the r/homelab[2] subreddit about what people run at home where you can get some inspiration. The r/selfhosted[3] subreddit is also a good resource.

I will give you a few examples to let you get an idea about what is possible. This of course can not be a complete list of what you can do, that would not be possible. However this will give you a pretty good idea what is possible and where to get find more useful tools to self host.

File servers

We need to start with the good old classic file servers. Often known as the network share or a network drive.

You can put all your data onto the network share and mount that on multiple devices. You can also create and share multiple network shares with family members. Put all your photos in one place and access them with multiple devices at the same time.

SMB (SAMBA) and NFS are the most popular protocols for this.

Your own Streaming services

You have a bunch of movies, tv shows, music and audiobooks? You can host your own streaming services for all of that.

There are a couple of solutions for video streaming like Jellyfin, Plex and Emby.

For music you can use Navidrome, Airsonic, Funkwhale or others.

Audio books can be hosted with Audiobookshelf.

Have a look yourself in the community maintained lists and subreddits. My personal feeling is there is a lot of development going on in the audio and audio book space.

Cloud storage

You think Dropbox, Google Drive, OneDrive and others are to expensive or you do not trust them? There are several solutions for that. Nextcloud is a popular solution. Nextcloud is a fork of Owncloud

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[1]https://github.com/awesome-selfhosted/awesome-selfhosted
[2]https://www.reddit.com/r/homelab/
[3]https://www.reddit.com/r/selfhosted/

which was the first popular open source cloud storage solution. Both projects are still active. This comes with a lot of features like an online office suite, calendar, contacts, notes, tasks and more.

Need something more lightweight? Therre is Seafile or Syncthing for sharing files between devices.

Office suites

Did you ever use Google Docs or Office 365? You can host your own office suite with OnlyOffice or Collabora. You can basically the same features as with Google Docs or Office 365. Live editing with multiple people, comments, version history and more.

Weird Stuff

Want to track you babies feedings and diaper changes?

Babbybuddy.
A 👶 buddy to help caregivers track sleep, feedings, diaper changes, and tummy time to learn about and predict baby's needs without (as much) guess work.

Documentation and writing

News

Are you sick of aggregated feeds from social media which put you into a filter bubble? Feed readers are still a thing.

You can grab your RSS feeds from all your desired sources and put them into a feed reader.

Home Automation

Home Assistant anyone?

Password Managers

Bitwarden

Money management

firefly

Time Tracking

I do not know.

Business Applications

open project invoice ninja kanboard chat like rocket chat

What self-hosting can do for you

A lot of things

Why self-host

There are many reason do self-host as there are many reason not to. Lets get into reasons you might want to self host something yourself.

These are just possible reasons. Your personal reason might be different and that is totally okay.

Privacy

People dont trust third party sevices. The third party could sell your data or lose control of you data. Website analytics is a good example here.

Having your photos in the cloud is another example. It happend mulitple times now that a third party service accedentalially allowed others to see your private photos.

Owning data

The cloud provider you use can decide what to do with your data. If you only have that data in your one cloud storage and dont even have a local copy you can loose your data.

Services might scan your data in an automated way. If they find something like illegal movies the account can be locked. This also might be a false positive. Meaning you are perfectly obliging the law and do not violate their Terms of Services (TOS) but you still get blocked.

There is also another risk. The provider could just lose your data.

- OVH datacenter burn down and customer lost data

Being independent

Lets say the software which you need for you personal or business needs does not exist anymore for your new operating system. Since you need to update your system every now there might be a breaking change in the near future.

With self hosting you can create virtual machine (VM) or container and use it non the less without the risk of exposing yourself to the internet with an outdated operating system.

This is especially handy when the company you are getting the software or hardware from does not offer updates or is even out of busines. I

Is selfhosting cheaper than a subscribption

Oh boy. This is a tricky question. A lot of people will immediately tell you that self hosting is cheaper, what a dumb question. Because most people see that a service might cost you 10 $ per month. With 50 users that is 500 $ per month which is 6000 $ per year. A small server or NAS running this on a VM or as a container will do right?

Maybe.

The problem is you have to consider the Total Cost of Ownership (TCO). Here are a few examples and I bet I am missing a few:

Power cost

This highly depents on your area.

Just a few examples in US $ per kilowatt-hour as of writing this (2023-01-03):

Country	Price/Watt-hour	60 Watt Server/Year	100 Watt Server/Year
Germany	$0.48	$246,067	$410,112
United Kingdom (UK)	$0.33	$169,171	$281,952
United States (US)	$0.16	$82,022	$136,704
France	$0.19	$97,402	$162,336
Japan	$0.23	$117,907	$196,512
South Africa	$0.15	$76,896	$128,160
Australia	$0.21	$107,654	$179,424
Brazil	$0.19	$97,402	$162,336

Environment cost (Air conditioning, Noise)

If you are putting your mini server into you small office you have to account for air conditioning. But you might not need to use air conditioning but still have a drawback. The room might get significatnly warmer than you want it to be.

Also noise could potentially also be a problem.

Initial configuration

Time for regular updates

Hardware failure

Hardware fails. That is a fact.

Be it you CPU, mainboard, power supply, HDDs and SSDs, you name it.

You need to be prepaired for that. You need to think about your failure scenario. This could be something which is High Available with automatic fail over. Complex and expensive.

Or a manual process where you quickly boot up everything from a backup. This

Both are valid scenairios. You need to decide for yourself how

(HA systems are complex and expensive)

Backups

backups

Cost of having the service down

(Can everybody work? Especially important when a lot of people rely on that service. Mail, phone systems, ticket systems, etc.)

Cost of opportunity

You need someone who is managing all the updates for the software, operating system, backups and all that. This is time. It might be not much time but it is still time. This time can be used to do something more important.

Where to get help?

The most important part in this journey is: You are not struggeling alone! There are hundreds of people out there trying what you want to da as well. The chance someone has had the same problem and there is a solution out there is high! And there are hundreds of people try to help people to solve their problems.

A good place is Reddit. Here are a few subreddits which are helpfull for general guidance:

- https://www.reddit.com/r/selfhosted/
- https://www.reddit.com/r/HomeDataCenter/
- https://www.reddit.com/r/homelab/
- https://www.reddit.com/r/HomeServer/

The arch wiki

YouTube Channels:

- https://level1techs.com/

Communites, youtube, forums, etc.

Pragmatic Self-Hosting Manifesto

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Keep it simple

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Design your system for time off and leisure time

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Do not use too many machines

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You do not need clusters

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You do not need Kubernetes at home

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Have dedicated hardware for certain tasks

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Automate, but do not automate everything

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Do not judge tools based on their programming language

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Databases are not bad

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Backups

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Basic security

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Update your systems/software

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High uptime is a bad metric

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Downscaling is okay

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Do not judge others for their setup

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Do not listen to these rules when the goal is learning

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Choosing Hardware and Operating System

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ARM vs x86

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x86

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ARM

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Used Hardware - PCs, Thin Clients, Laptops

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Laptop

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Old PC

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Thin Client - Tiny/Mini/Micro PC

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DIY NAS - Build your own NAS/PC

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Cases

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Buy and build the main components - CPU, Motherboard, CPU, RAM, Power supply

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Power consumption

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RAM

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Power supply

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HBAs and RAID controllers

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Hard Drives

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How and what HDDs should you buy?

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Burn in hard drives

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Check your firmware version

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Fast and "easy" route - Of the shelf NAS with vendor OS

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A word about enterprise hardware

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Remote management with KVMs

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Alternatives to integrated remote management

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19 inch rack equipment

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Using a server in the Cloud

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ARM based systems like the Raspberry Pi

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The Raspberry Pi

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Choosing NAS OS or Linux Distribution

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Why Ubuntu?

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Can I use the Ubuntu Desktop image?

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Other Distributions

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Operating Systems tailored to self-hosting

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TrueNAS Scale

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OpenMediaVault

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Rockstor

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Proxmox

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Other noteworthy things

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Conclusion and Action Plan

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Install the operating system

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Download Ubuntu Server Image

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Create a bootable USB stick

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UEFI or Legacy BIOS

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