BLITZklang – tickless server – 19 June 2023 – third revision

Equipment required to duplicate the results
ASUS Crosshair VII HERO motherboard – mine does not have wifi attached.
AMD RYZEN 5700X
Corsair memory – 16 Gb total
SSD for the OS – I am using an old 35 Gb SSD that is more than sufficient. Blitz is using an unspecified SSD drive.
Use a good cooler – I am using a NOCTUA with a little fan that I run very slowly. I cannot hear it and DIETPI reports that the CPU is running very cool – even at this point before the magic is added.
I am using a WIFI to LAN adapter

Blitz is using a CORSAIR ATX supply while he works on his own linear supply. I am using an HDPLEX 400 watts linear supply which is no longer available. It is what I was using with WTF.

As Blitz stated before he found x86 to sound better. I assume the 8 cores available with this CPU is also a reason to use this.

This is a client-server setup so you need to use something to tell the computer what to do.

I am using the same computer that has REW and my DSP controller installed. This is plenty convenient for me. Blitz is using a Ipad and using SOUNDIROCK because he likes it. I figure most will have their own way of handling this.

If you use the ASUS Crosshair VII you will have to update the BIOS before it will boot. The board has a trick feature that allows you to update the BIOS before you install the CPU or anything else. You would be best looking at how to do this on the internet. Don't be dumb like me and have to find out even though I was told this had to be done.

The AMD CPU has no graphics stuff so you will have to use a video card initially. After we go to .ssh you can remove the card.

Now is a good time to go through the BIOS and turn everything off you think you can turn off. This is not settled as to what is best and where to stop.

The two most important things to change are in ADVANCED settings – make sure you choose ECO MODE to limit power to 45 watts and to disengage SMT which is what AMD calls Hyper-threading. If you do not turn this off you will see 16 cores instead of 8.

I disabled all of the USB ports other than the one I am using.

Download DIETPI for the platform you are going to use. Copy it to some kind of USB device.

Set your BIOS BOOT to use this USB device first.

Start your system and when the screen comes up ask for DIETPI to be installed.

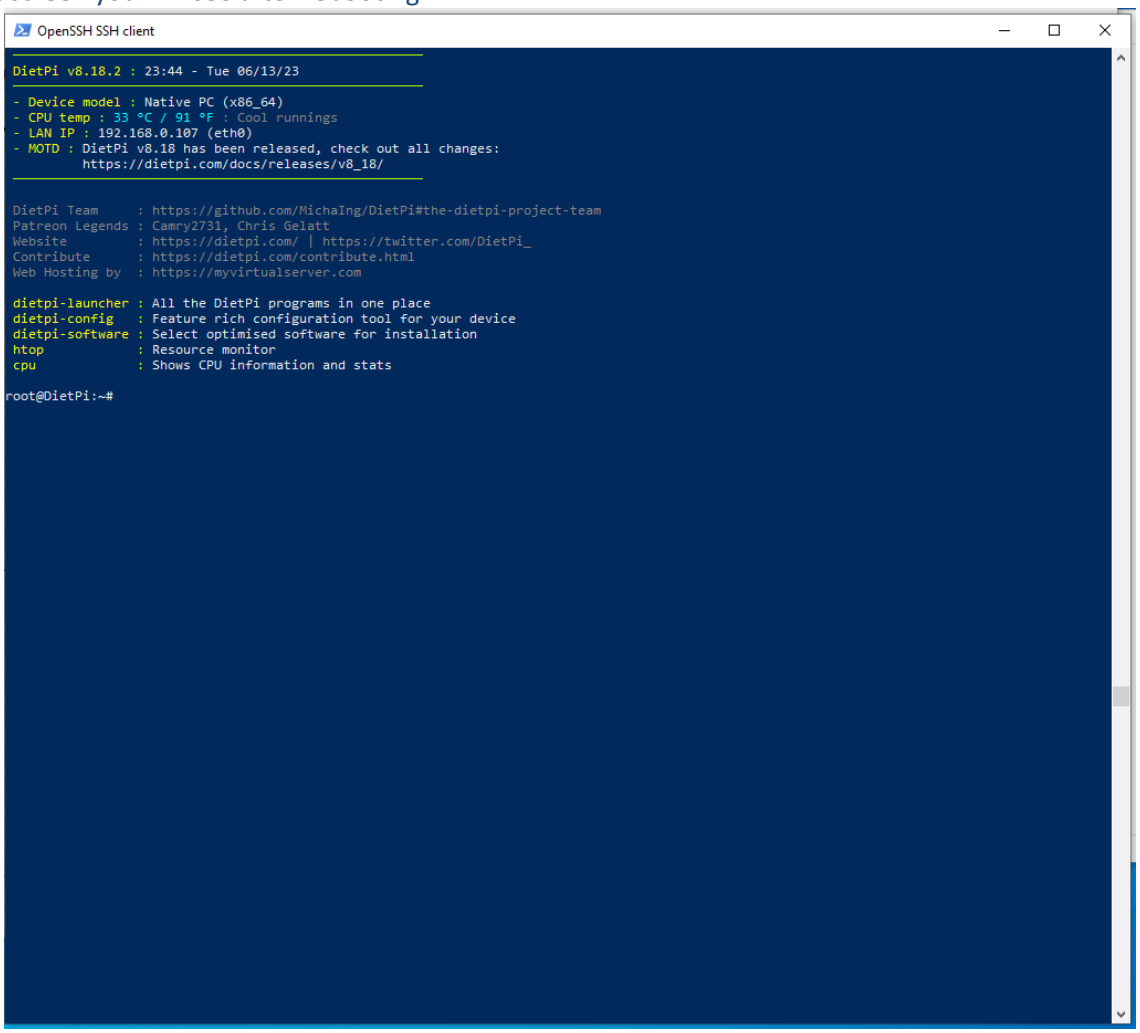
It will turn off after the initial installation step and you should remove the USB device and then turn the board back on.

RETURN key to logon
type ROOT and then it will ask for the password and this is DIETPI.

You will then go through the remainder of the setup process.

Do not agree to the feedback option – choose your language and keyboard. Do not install the series port stuff. You can change your password during this if you think you need to.

This the first screen you will see after rebooting:



Fill in the password and ENTER

Now you see the IP address of DIETPI – this is what you will use to make an .ssh connection to the client.

At this point you need to choose your client and that will depend on personal taste and what operating system is being used for the client. I chose MPDctrl – there are not too many for WINDOWS and this one does what I want.

Now is a good time to make sure it is working.

From this point on it is easier to work on DIETPI on another computer with .ssh.

In my case with WINDOWS 10 I type in WINDOWS PowerShell (admin) ssh root@dietpi

So give it a try.

(I only use WINDOWS since neither of the other programs I need did very well on a MAC mini.
REW on WINDOWS is a completely different thing, so much better ad it doesn't crash.)

I am using a WIFI to LAN adapter to access my network.

Initially it will want to fingerprint you – Just say yes and then you can enter the password.

If you make a change to DIETPI, like re-installing the OS, you will have to go through this again but in that case you will need to erase the saved key in the .ssh folder first. It won't let you connect until you do.

Once connected – unless you changed it during installation –
the default password is dietpi

Now we can begin making DIETPI work for us.

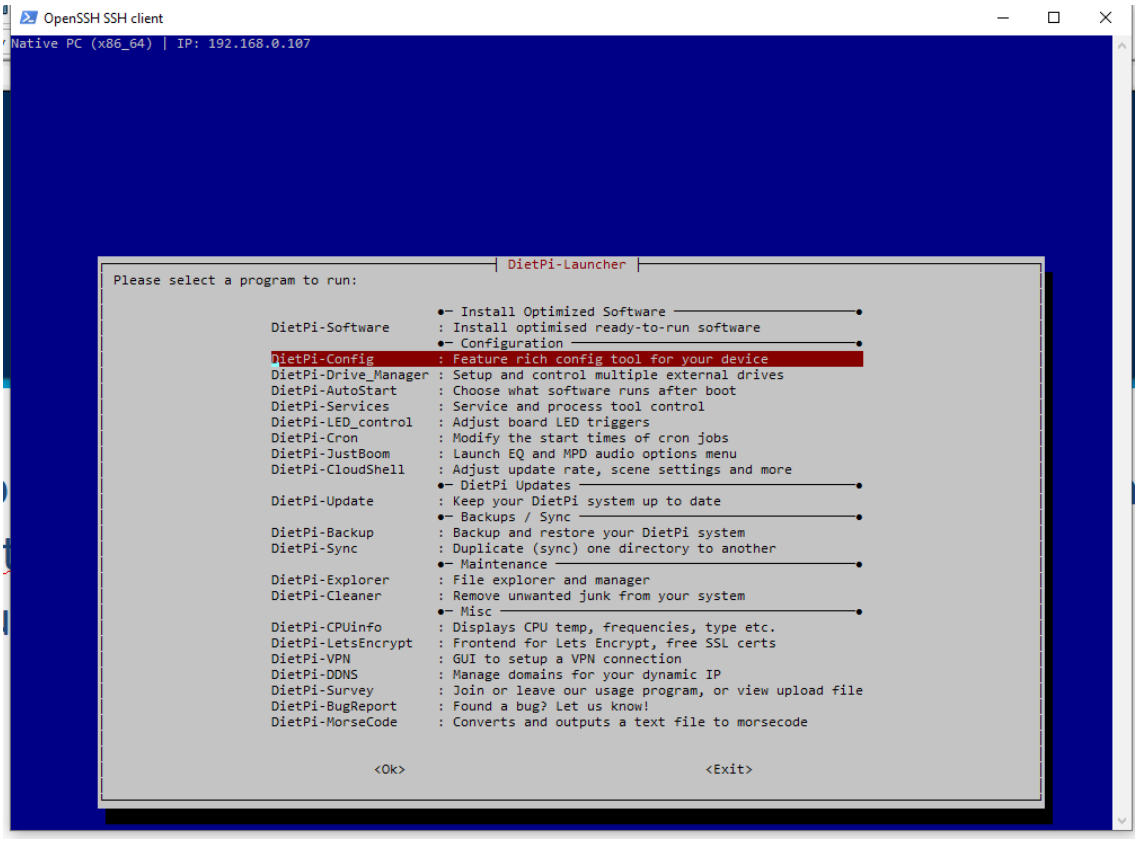
It is a good idea to familiarize yourself with what all of the modules do. Good way to get used to how you have to work with DIETPI – it took me a little while to get used to how you have to use the keyboard to do what you want – no mouse is used.

After you have your client working you can remove the video card. The only things connected to the motherboard will be the USB cable to your DAC, or if you use something like the MUTEC MC3+ USB which DIETPI will recognize as your "DAC". The sata cable for the music drive, in my case, and the LAN cable for NAS. Blitz uses NAS and I am not sure if that is integrated with his controller. I guess it has to be, again, I know nothing about NAS.

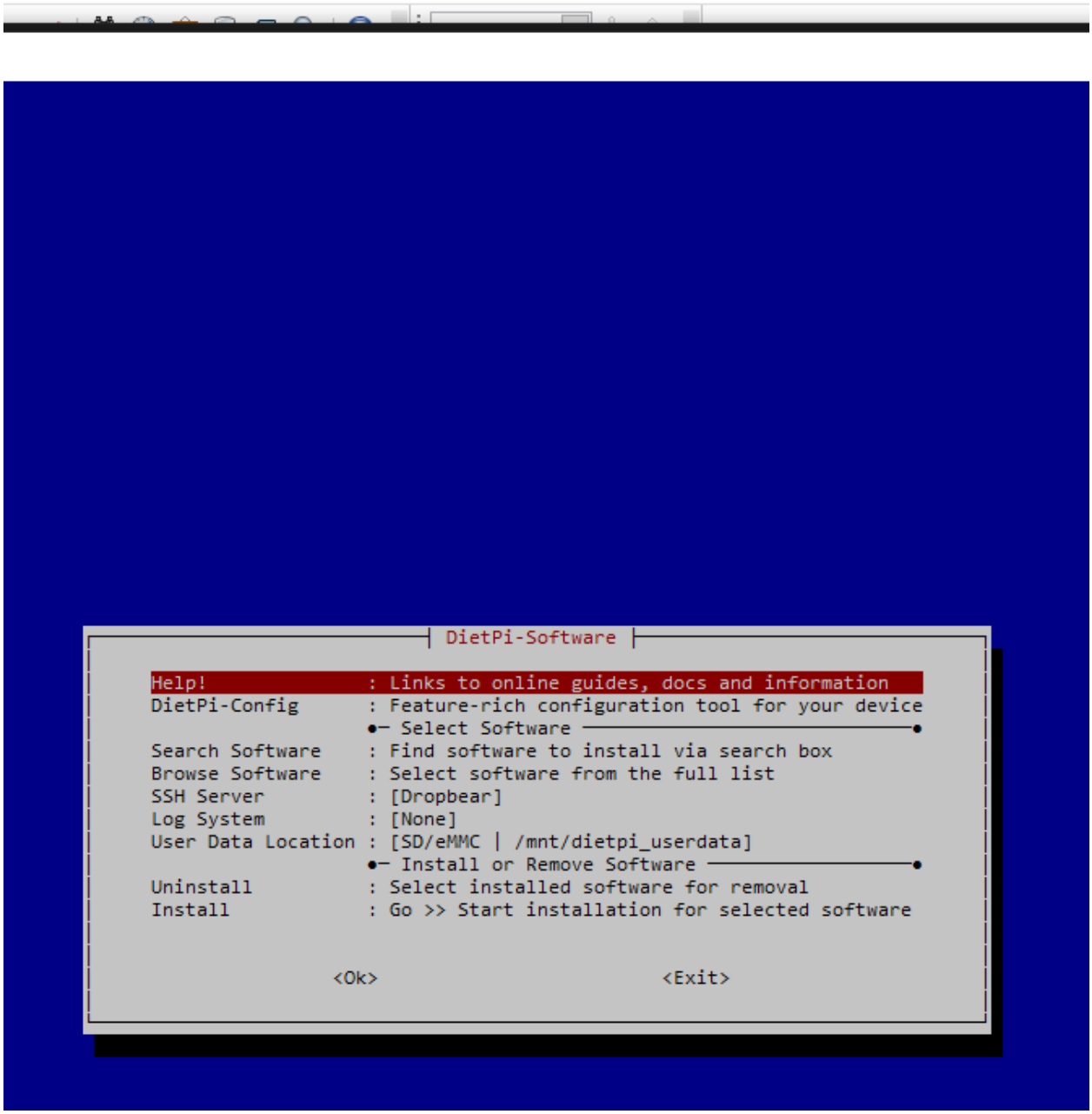
You will need to turn the computer off to remove the video card. To turn it off use the command POWEROFF – to reboot is REBOOT.

Now we turn it back on again and go through the login process.

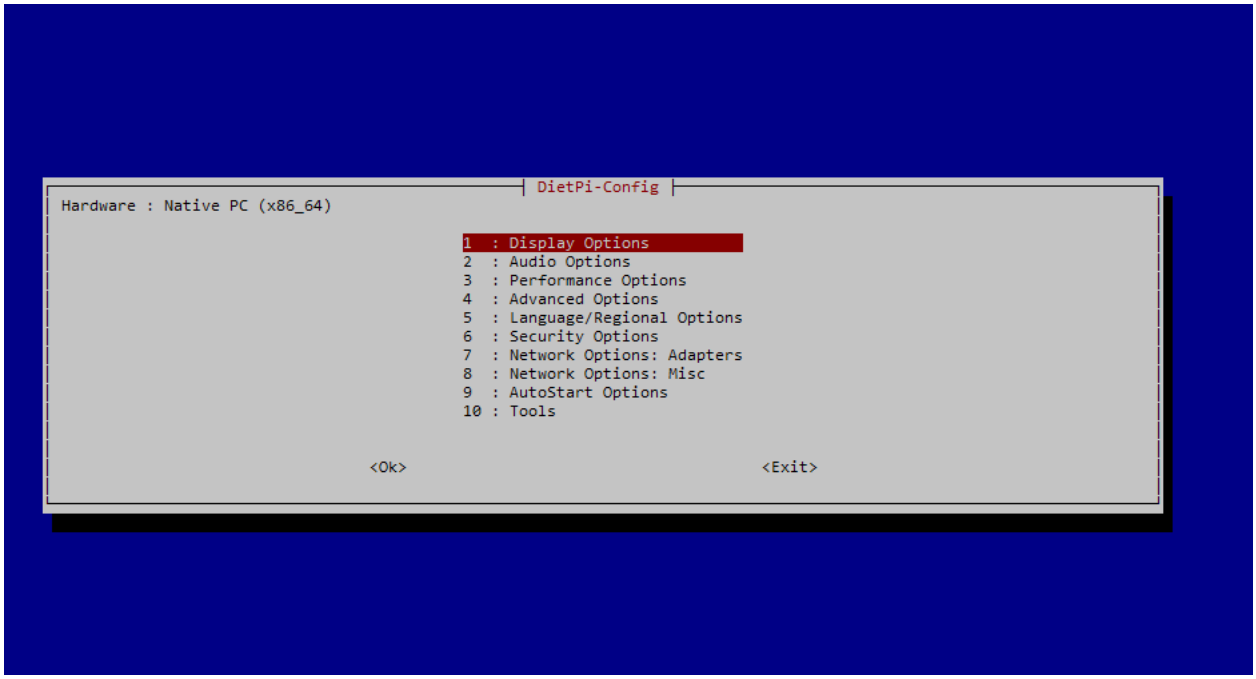
Type dietpi-launcher ENTER *(you can get to all of the modules with this – you could also type dietpi-<whatever module you want> and ENTER)*
You can get to everything with this one – it can take a little practice to get the hang of how you have to yes, no and esc to get around with the keyboard. It is not necessarily intuitive. You would have to be determined to screw things up so don't be afraid to see what happens. The best way to learn.



Start with software – scroll down to BROWSE SOFTWARE – ENTER
Scroll down to MPD – use the space bar to select – this all we will use
ESC out – SCROLL to INSTALL SOFTWARE – and follow the simple instructions
This will take awhile since it will also install ALSA

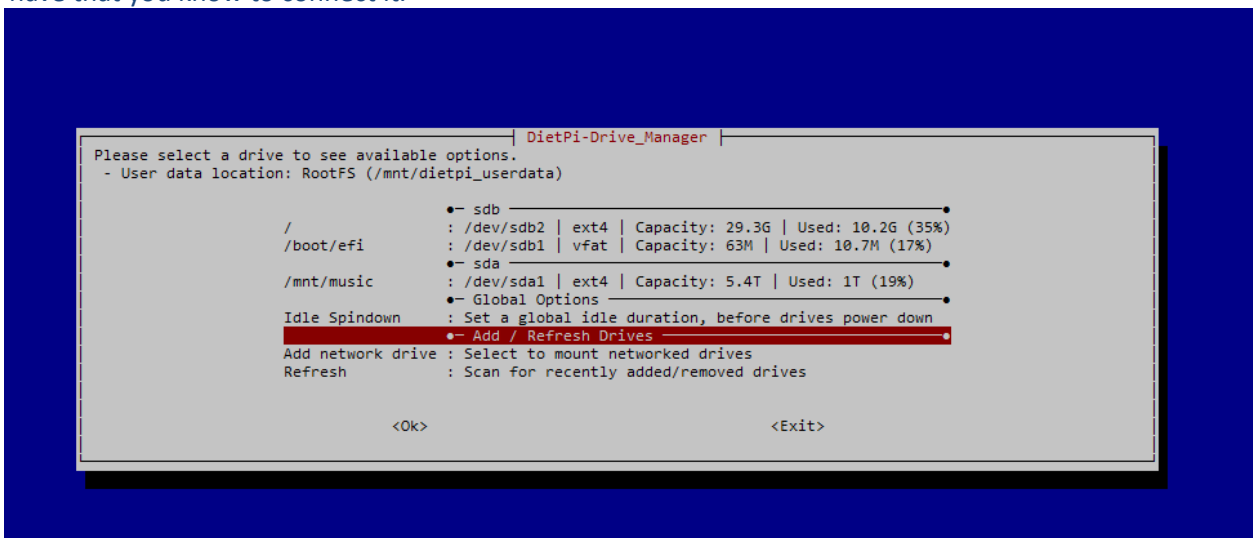


Now select DIETPI CONFIG



Select AUDIO OPTIONS
Select SOUND CARD - ENTER
Scroll to your sound card - ENTER
ESC to go back to AUDIO OPTIONS
ESC to return to LAUNCHER

Now return to DIETPI-LAUNCHER select DIETPI-DRIVE_MANAGER – ENTER
I am assuming you will use an attached drive -if it is NAS Blitz will need to add instructions though I am assuming if you already have that you know to connect it.



You will see your drives – scroll down to your drive with your music files – ENTER You can here I have named by drive music

Yours will be the one that is unmounted. And most likely quite large in comparison to your OS drive.

You will then choose MOUNT – ENTER – and to make things easy remove all of the gibberish and name it something like music – ENTER – ESC to DIETPI-LAUNCHER

We need to tell MPD where your music is and which DAC to use. This is done in the MPD Config-File which we edit with the command: nano /etc/mpd.conf
Please study this file carefully and make the following changes (the # is important !):

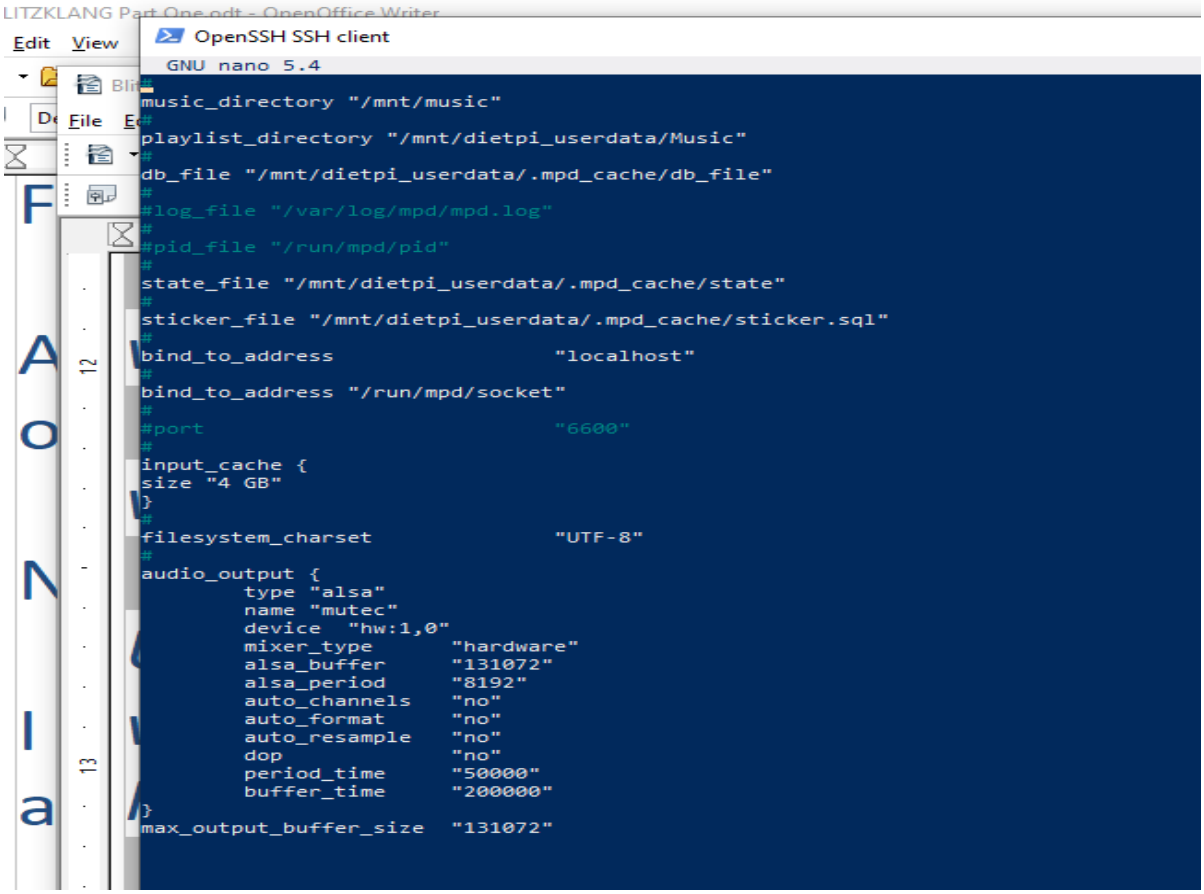
Blitz's /etc/mpd.conf file looks like this (adjust to to your dac and music directory):

```
music_directory        "/mnt/Musik"
```
use the name of you NAS or, it like me and unlike Blitz, the name you have given your attached music drive. I name mine music *– this drive is mounted and named in dietpi-drive_manager*
```
playlist_directory          "/var/lib/mpd/playlists"
db_file             "/var/lib/mpd/tag_cache"
log_file             "/var/log/mpd/mpd.log"
pid_file            "/run/mpd/pid"
```
I left the four above as default in my setup – when I would use these settings I could no longer reach MPD – I figure this is because of Blitz's attached drive
```
state_file          "/var/lib/mpd/state"
sticker_file        "/var/lib/mpd/sticker.sql"
input_cache {
size "4 GB"
}
filesystem_charset         "UTF-8"
audio_buffer_size "8192"
buffer_before_play "100%"

audio_output {
        type "alsa"
        name "Andrea”
```
whatever name you choose
```
        device "hw:1,0"
```
what you chose in dietpi-config/Audio Options/DAC

mixer_type "hardware" *Use this setting for fixed volume/no control – use “software” if you want the system to be able to adjust volume. Hardware is better.*

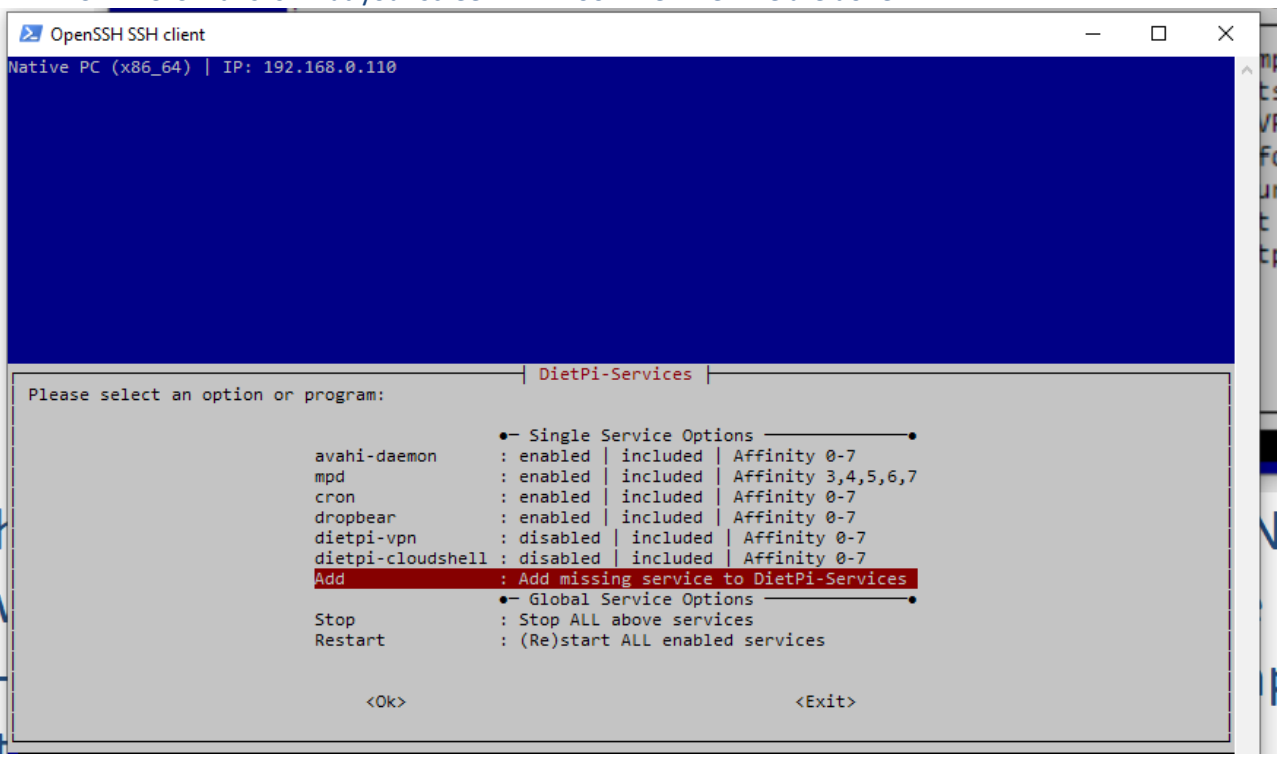
```
        alsa_buffer "131072"
        alsa_period "8192"
        auto_channels "no"
        auto_format    "no"
        auto_resample  "no"
        dop "no"
        period_time "50000"
        buffer_time "200000"
}

max_output_buffer_size "131072"
```

You can minimize the size of this folder along with making it easier to deal with by removing all of the text. Not that it makes a difference for sound quality. Mine is slightly larger than Blitz's – kept those areas he is using which I figure are for NAS in case I made change in the future- the only parts that are active are in white type.

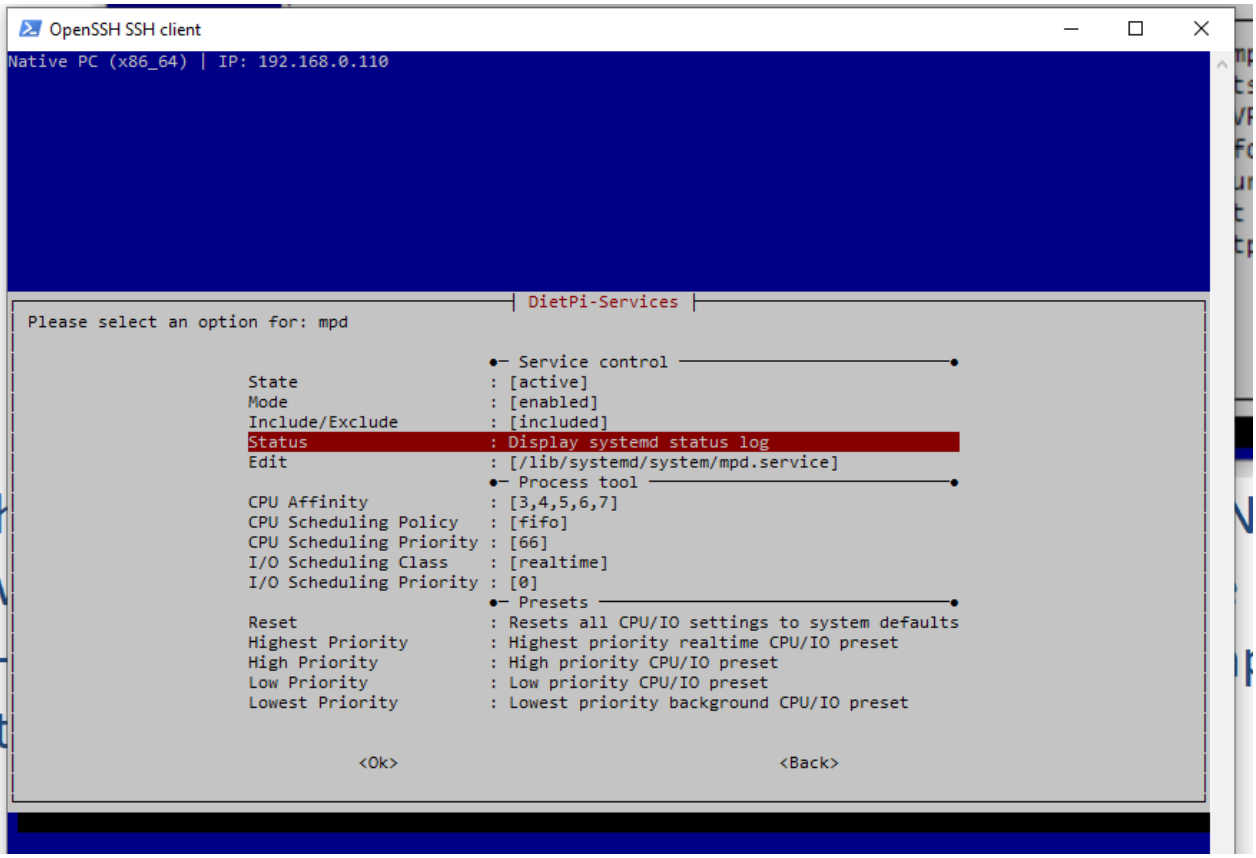


Return to DIETPI-LAUNCHER

Select DIETPI-SERVICES – this is what your screen WILL look like when we are done



Select MPD and you will see something like this – this is the result of what we will do



Select CPU affinity and select cores 3,4,5,6,7 – you do this by using the space bar to unselect cores 0 and 1

Select CPU SCHEDULING POLICY and select fifo

Select CPU SCHEDULING PRIORITY and select 66

Select I/O SCHEDULING POLICY and select realtime

From memory I/O SCHEDULING PRIORITY should already say 0 - just be sure it does

ESC from MPD – we will make no changes to the remaining services.

ESC from DIETPI-SERVICES

reboot from the command line

You always need to reboot after making changes, any changes, to conf files or to stop and restart a service.

Now you should be able to hear the thing play music.

I had no idea that MPD sounded like this – I have to say I think Blitz's choice of motherboard and CPU has much to do with what you will first hear.

After getting a handle on this sound we move on to the next step.

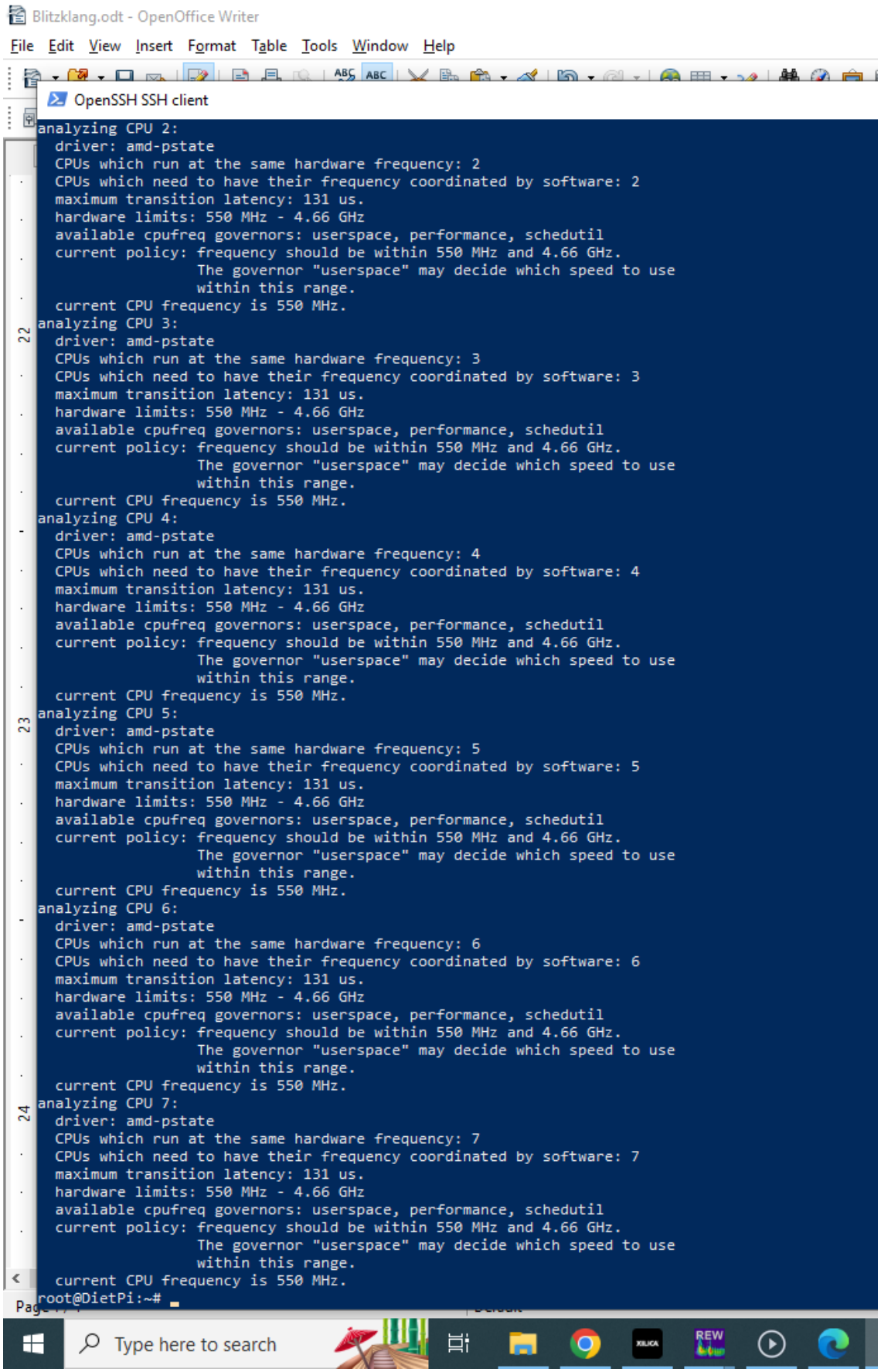
Please install a tool to understand precisely what is going on with your cpu frequency and your governor and cpu driver:

apt-get install -y cpufrequtils

After install please type

cpufreq-info

You will see a similar picture like this, but with different content. Please make a screenshot and post it to the thread. This is a screen from the finished version. Yours will report much higher speeds.



Missing CPU0 & 1 – they say the same things

Before we start to make the tickless kernel let's check our current version

At this point Blitz assumes we are getting the idea of how to use LINUX

uname –r
I found I had to do uname first and then ask for uname -r

This will show you your current Kernel version and you should see something like 5.10
That is what both Blitz and I saw

We will be downloading the kernel from kernel.org (and yes, we want exactly this version of the kernel)

wget https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.19.17.tar.gz

wget https://cdn.kernel.org/pub/linux/kernel/v5.x/linux-5.19.17.tar.sign

tar xvzf linux-5.19.17.tar.gz
This extracts the files we just downloaded

cd linux-5.19.17
We work on the kernel in this directory so the original kernel is not affected. If you mess up you will still have music if you are using it already and you should since it already sounds good

So, you downloaded, unpacked and placed this kernel into its own folder.

Now we need to install some tools to build it:

apt-get install build-essential linux-source bc kmod cpio flex libncurses5-dev libelf-dev libssl-dev dwarves bison

You will be asked to say yes to proceed with the install

Now we copy your old configuration from dietpi into the new kernel version:

make olddefconfig

Now we begin the fun part, so you can select what you want to do to creat the dietpi tickless kernel:

Now for the configuration.

BY the way…please look over each setting carefully, not just those I explicitly named. Yours should look like mine (Blitz's).

DO NOT CHANGE ANY OTHER stuff !!! Or your Linux Kernel might be smoked. I smoked a dozen of kernels.
I was on my way to having that many

You find in the left upper corner the path of the menu where you do the settings, if you cant find stuff.
You will have to enlarge the screen and move over to the left side to see this – then you will have to move back to where the work is done.

It is a good idea to be sure you are in the folder where our newly downloaded kernel is, which we have done previously by

cd linux-5.19.17

Just as a check to be sure we will be working on the new kernel

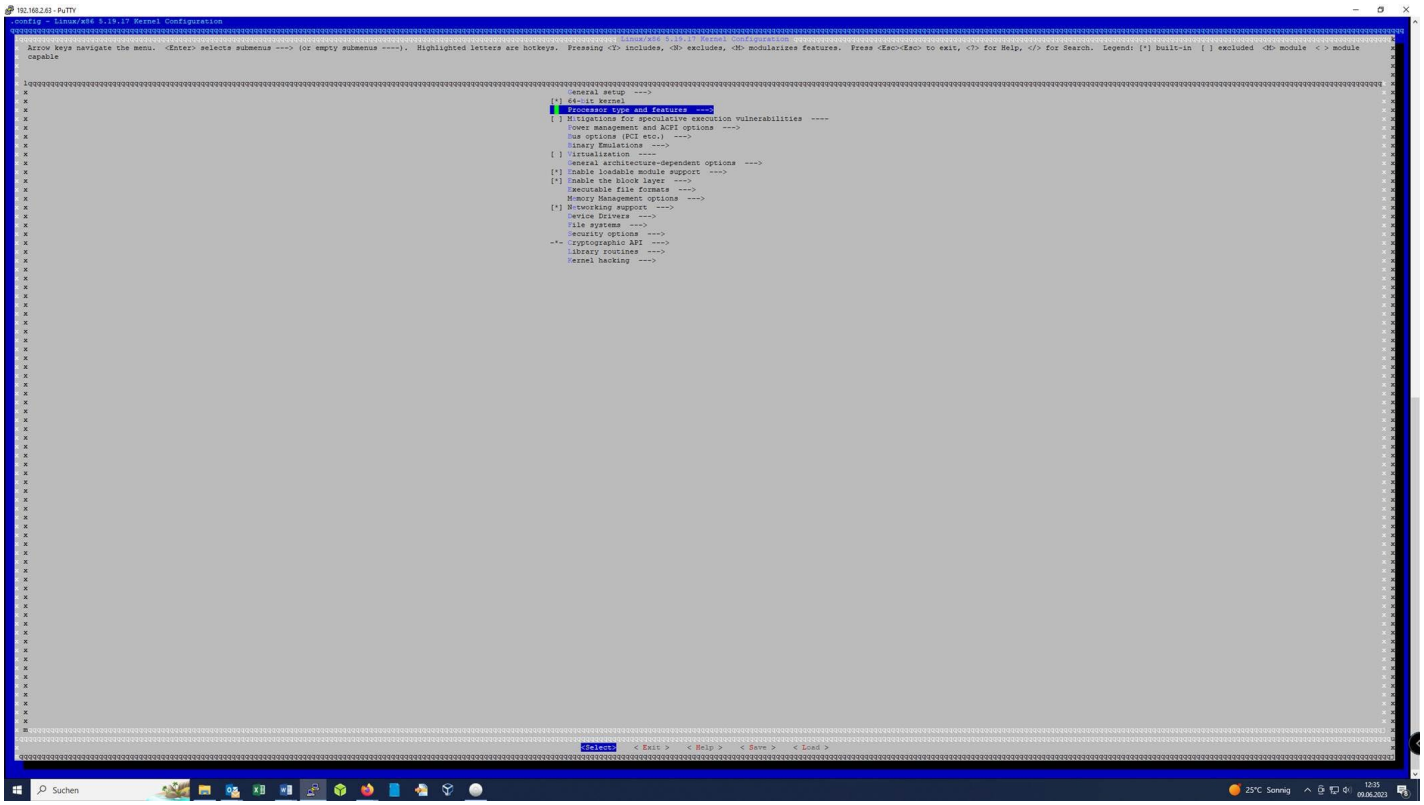
make menuconfig

(please ensure that the terminal windows is large enough so the whole menu can be displayed)

Make sure your screen looks like the screenshots, sometimes you will need to go into the menus. There will be a screenshot to show you when this happens.

Press Y to get the X in the box – Press N to delete it – Press M to specify MODULE

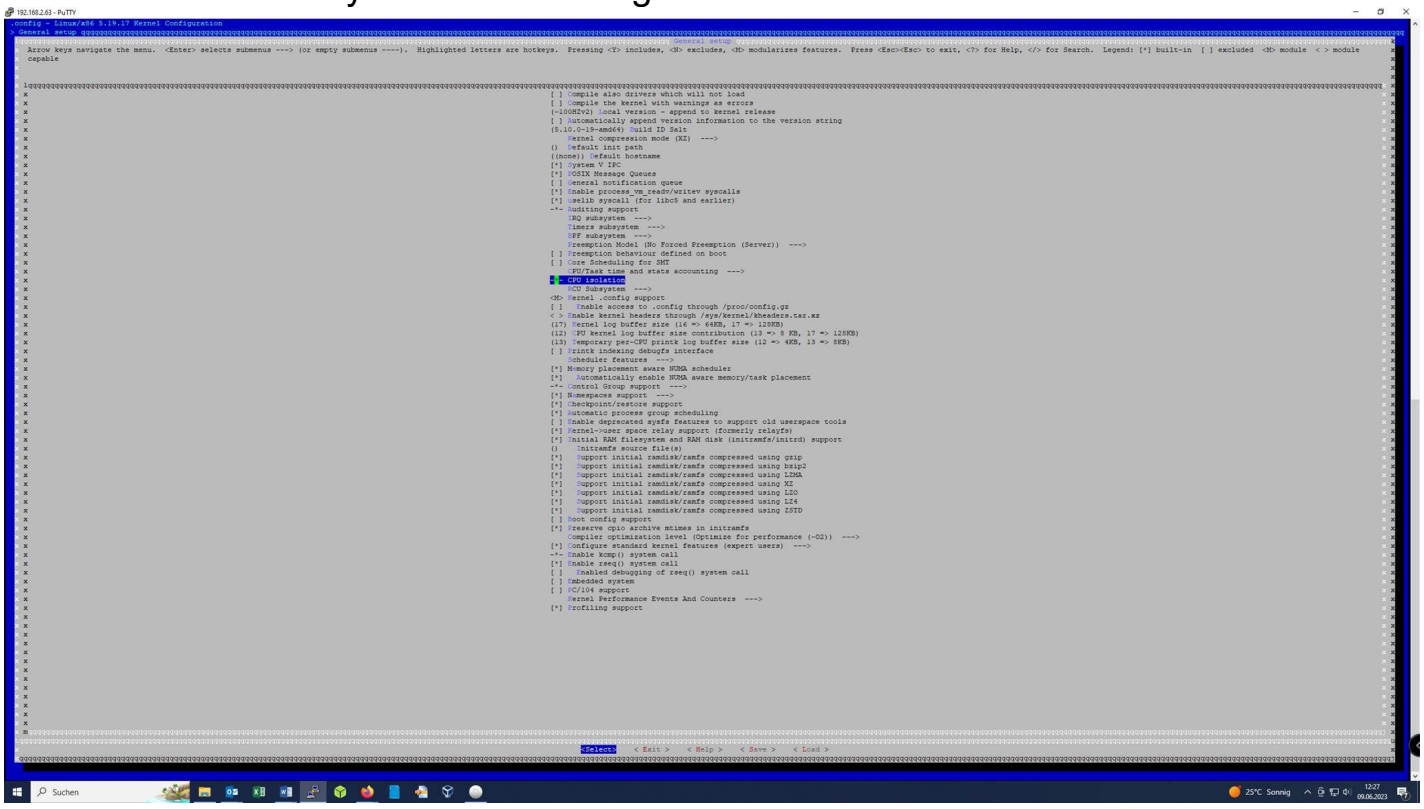
We disable anything for Speculative Execution Vulnerabilities and Virtualization:
Third & fourth lines



We enter GENERAL SETUP

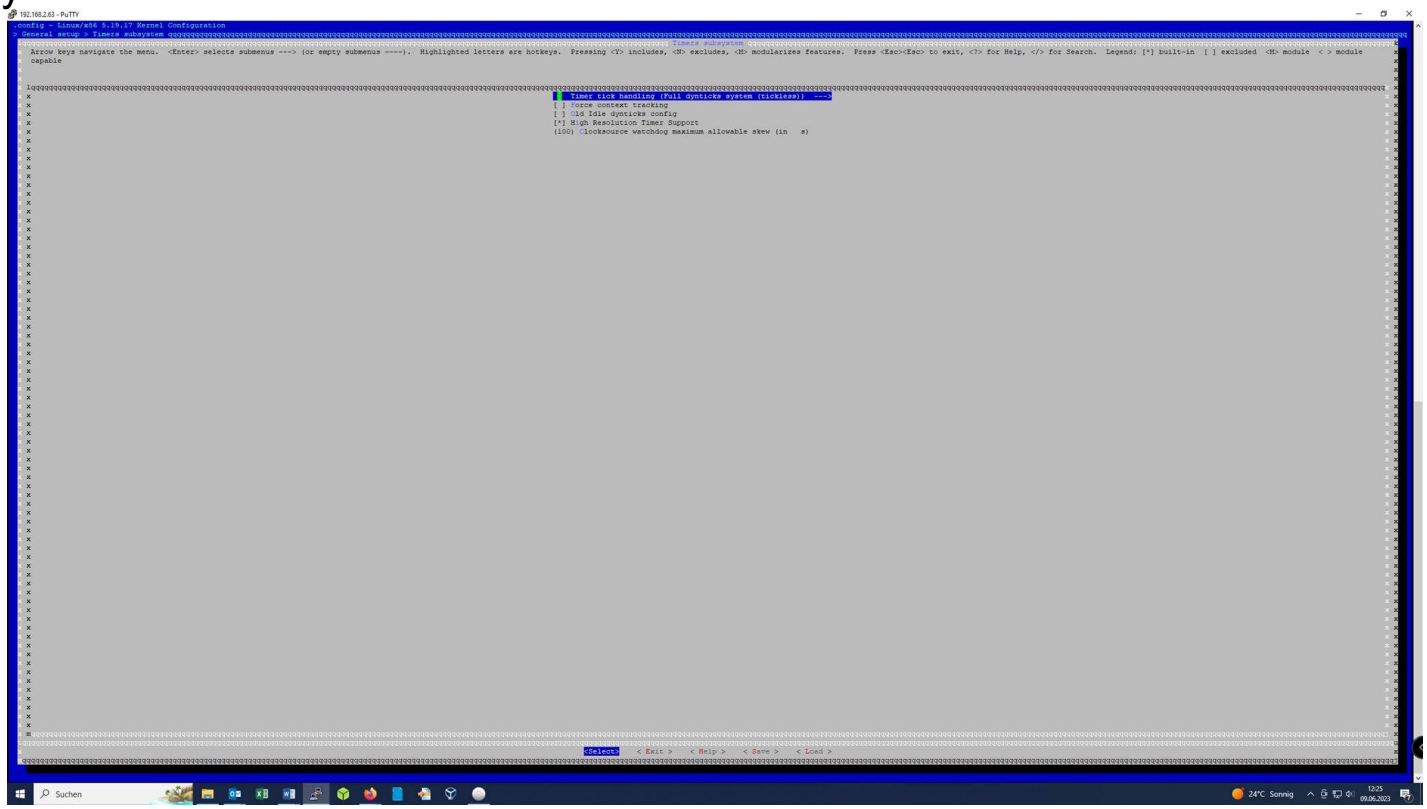
Notice the third line – you need to change that so it looks like below

Notice the fifth line – you need to change that so it looks like the below.

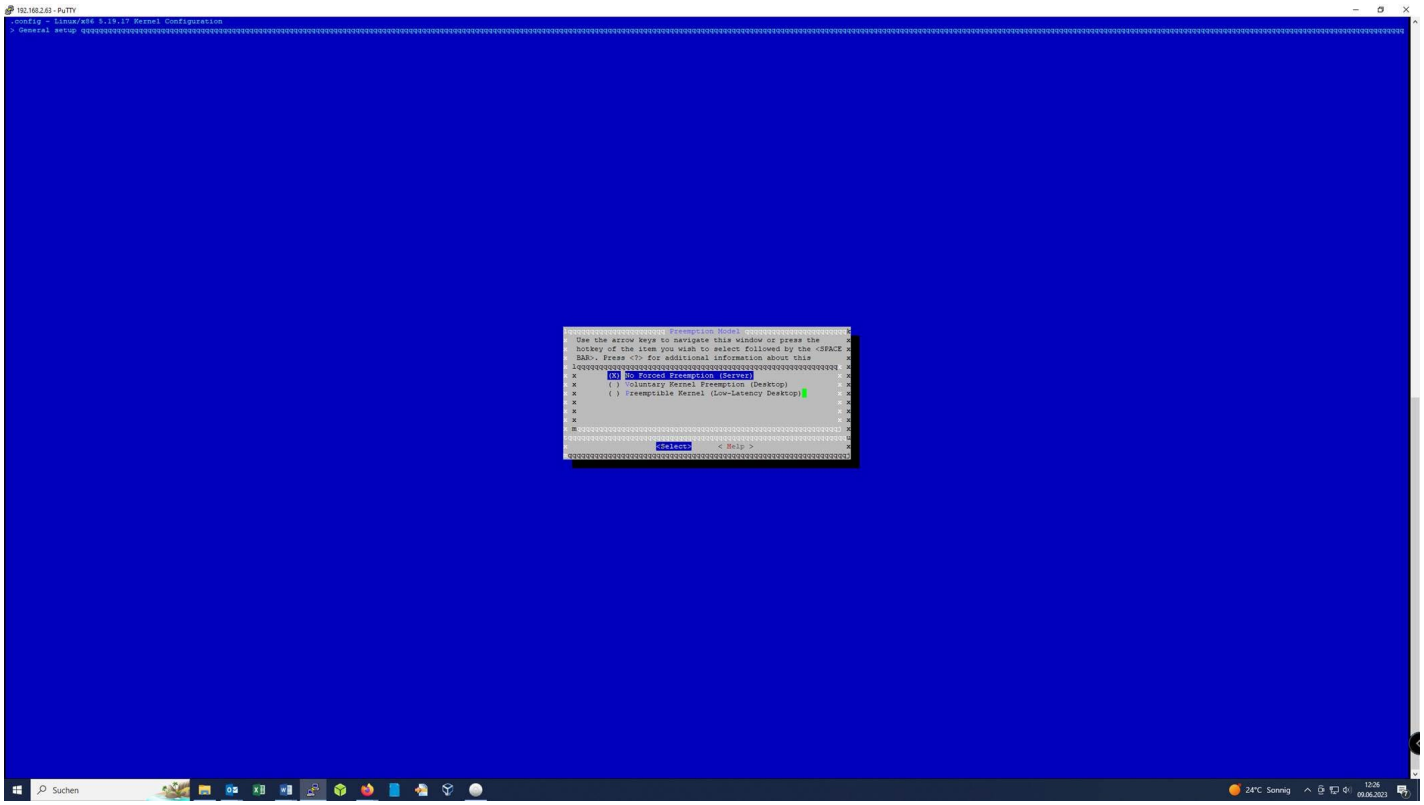


Still in GENERAL SETUP

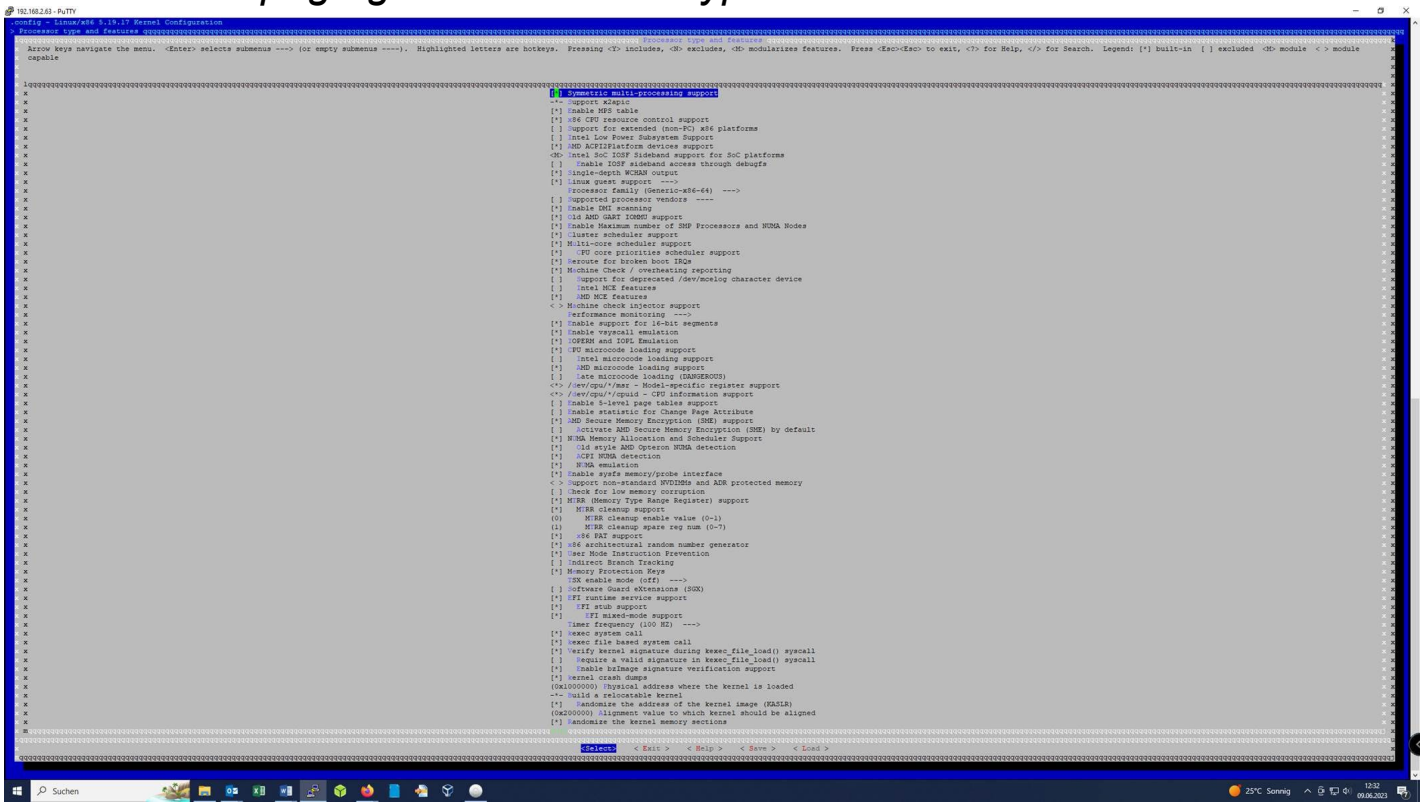
We want to setup tickless here and high resolution timer:
Where you see the green dot TIMER TICK HANDLING – ENTER – and choose FULL DYNTICKS SYSTEM (tickless) – ENTER – when you return your screen will look like this



We use the server mode here to minimize the thread overhead handling.
We want no overhead and max throughput instead of low latency.
Path General/Preemption Model – ENTER and choose NO FORCED PREEMPTION – ENTER and you will see your choices

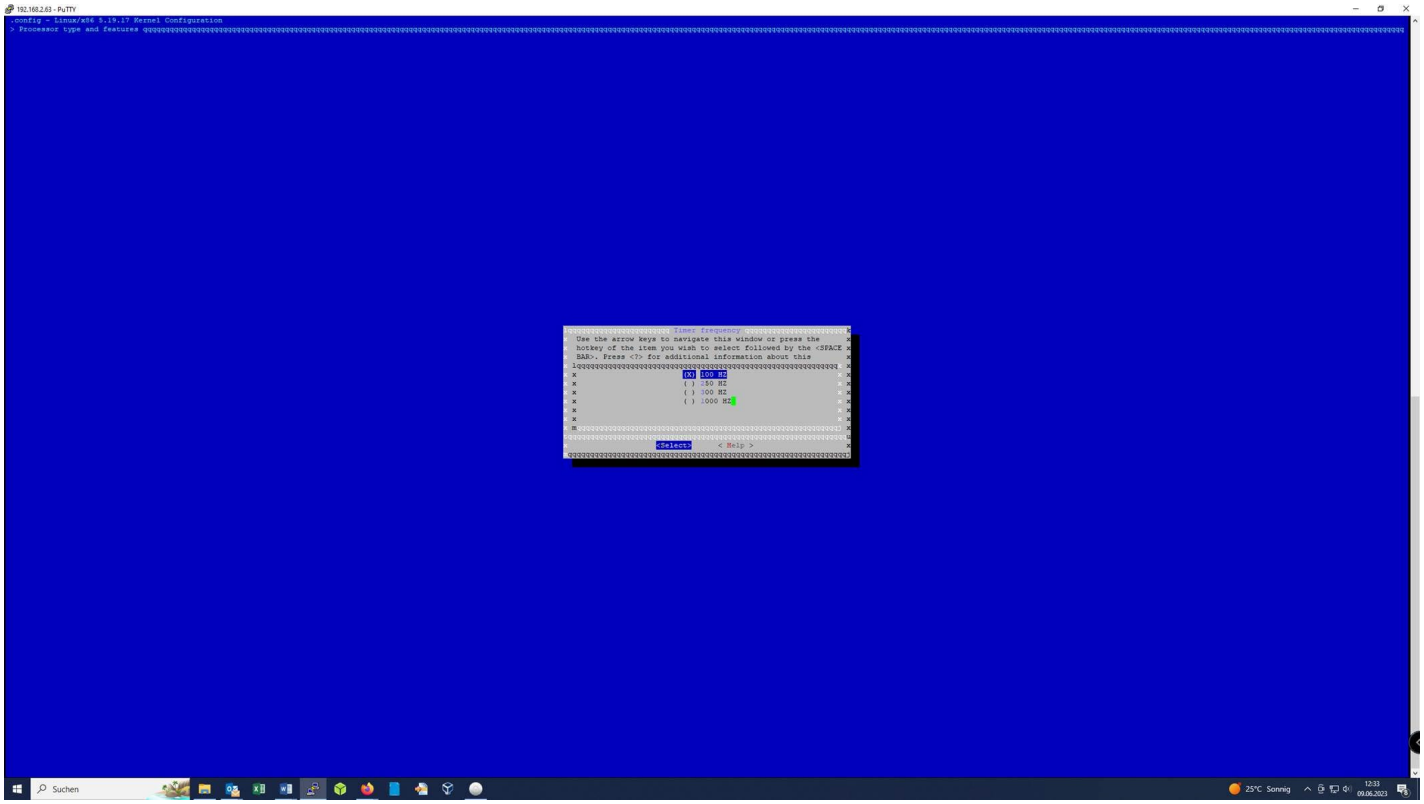


We get rid of the intel stuff and enable all the AMD stuff per below
From the first page go to Processor Type and Features



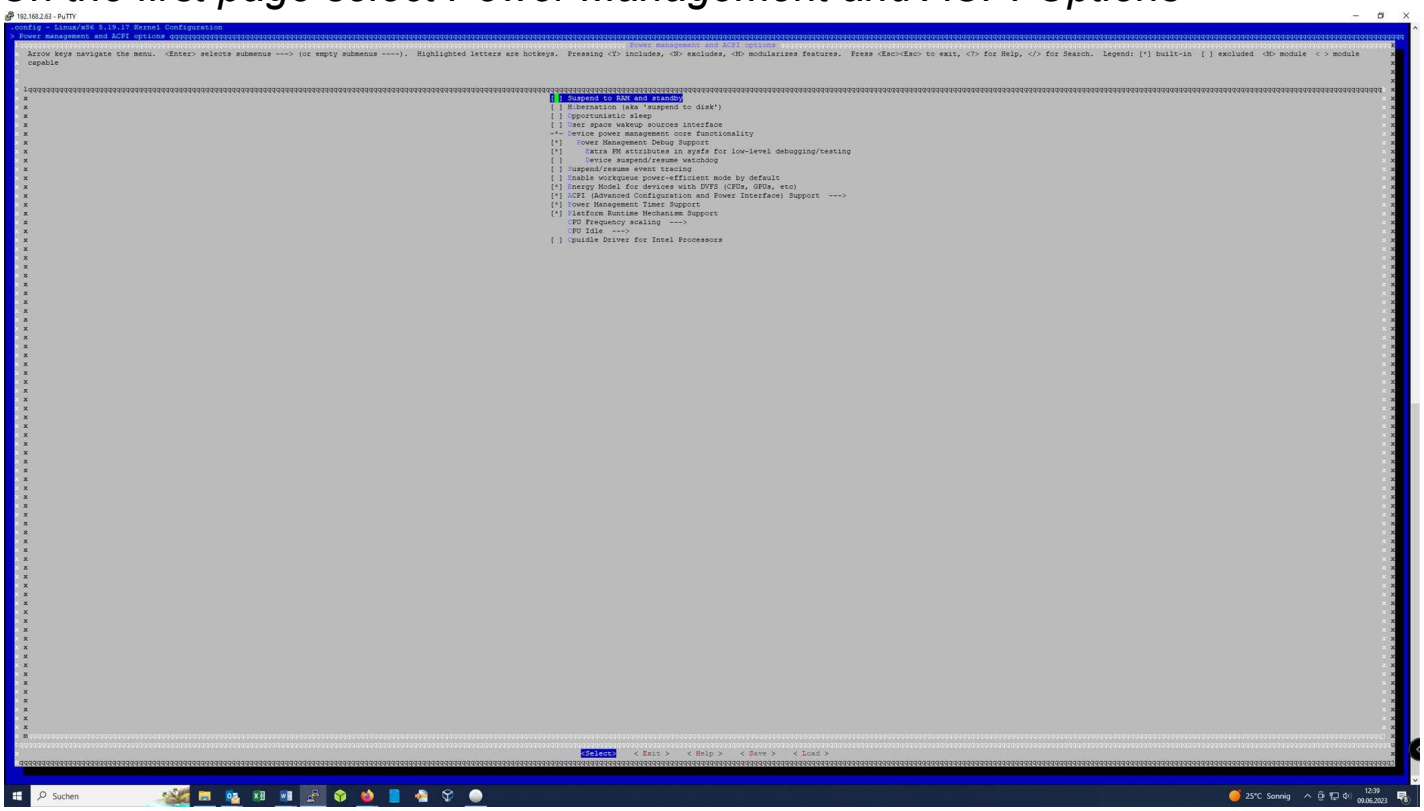
We set the timer frequency for highest throughput to 100HZ, less interrupts, less noise.

This is on the Processor Type and Features page -TIMER FREQUENCY ENTER and then select 100 Hz - ENTER

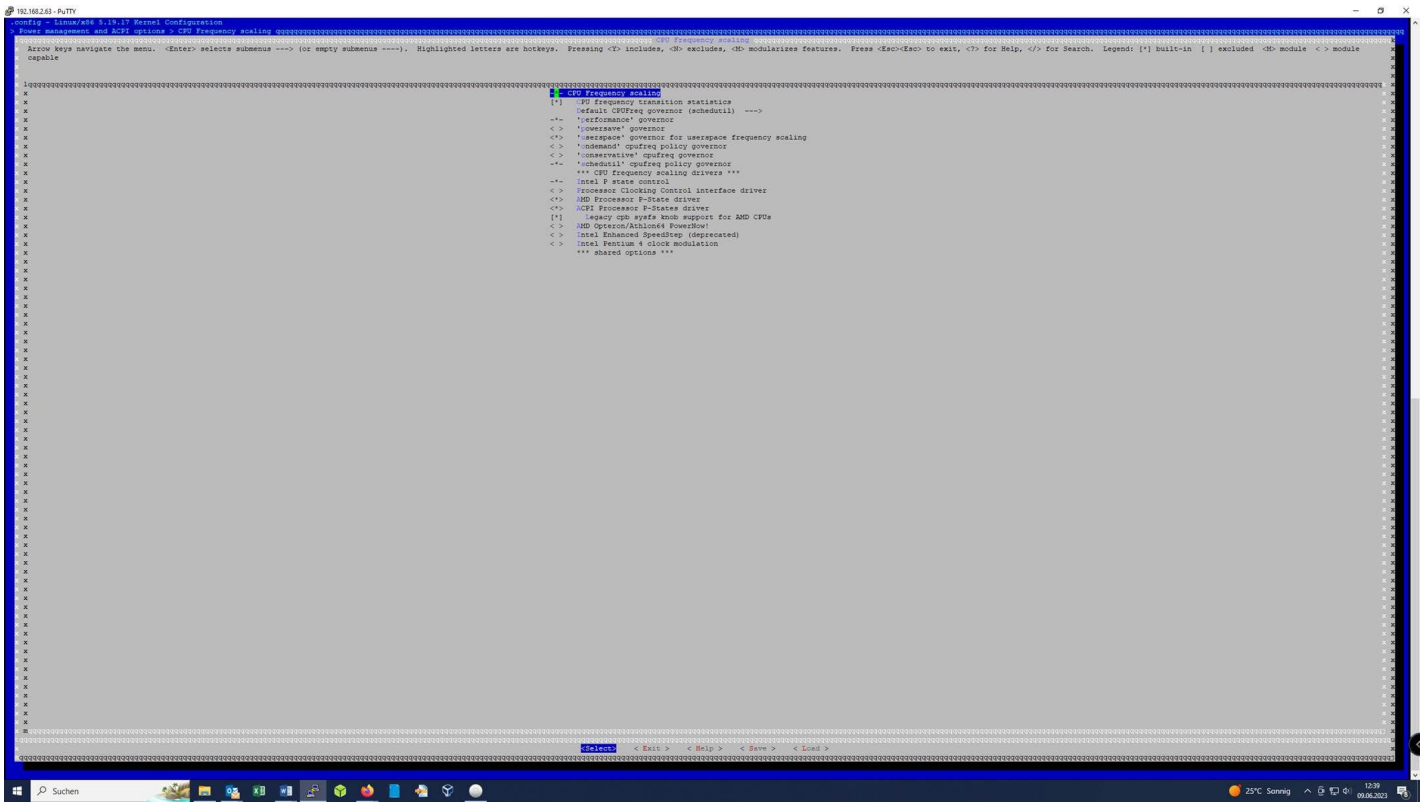


No Hibernation and stuff:

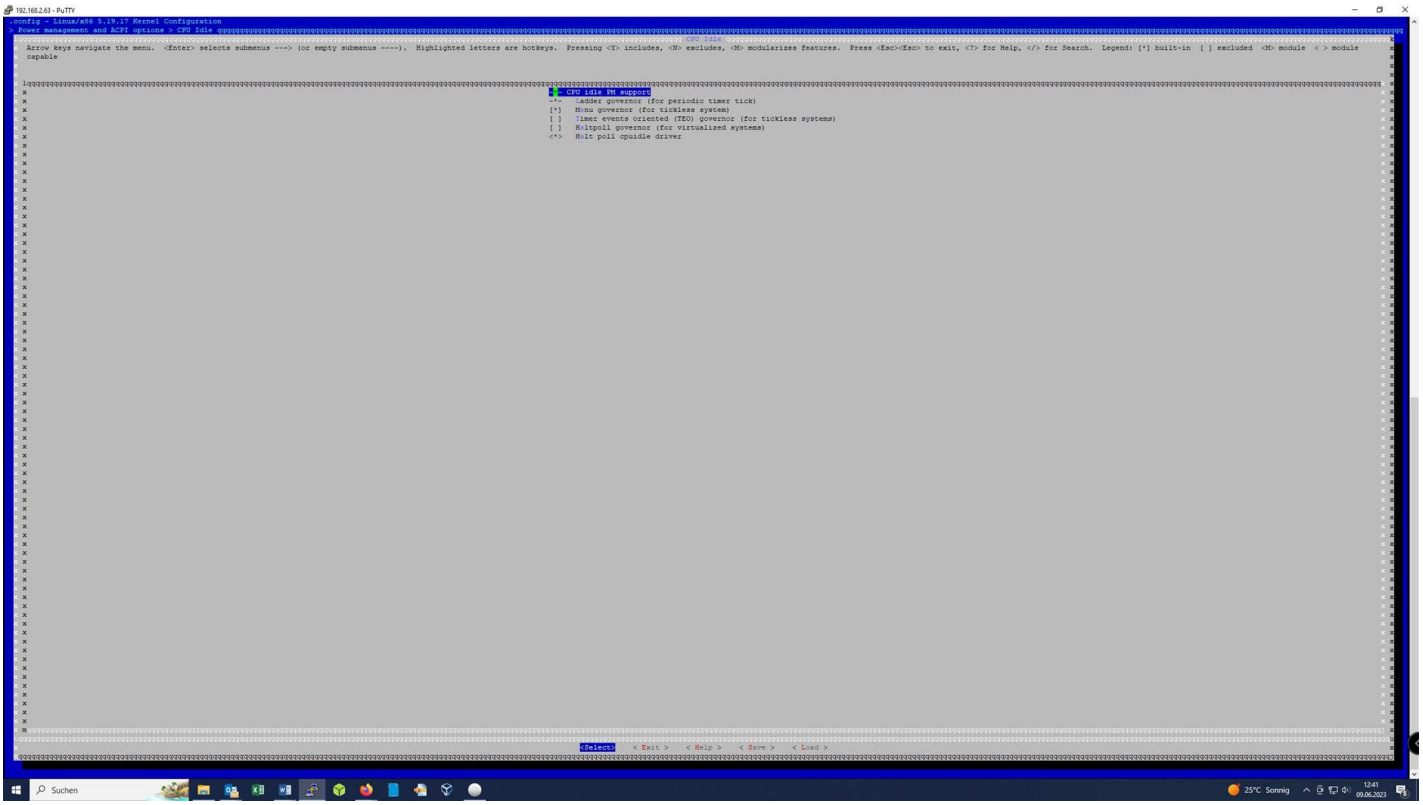
On the first page select Power Management and ACPI Options



Governor Userspace enabled. AMD P-state & Driver enabled:
Within Power Management and ACPI Options is the CPU Frequency Scaling option - ENTER

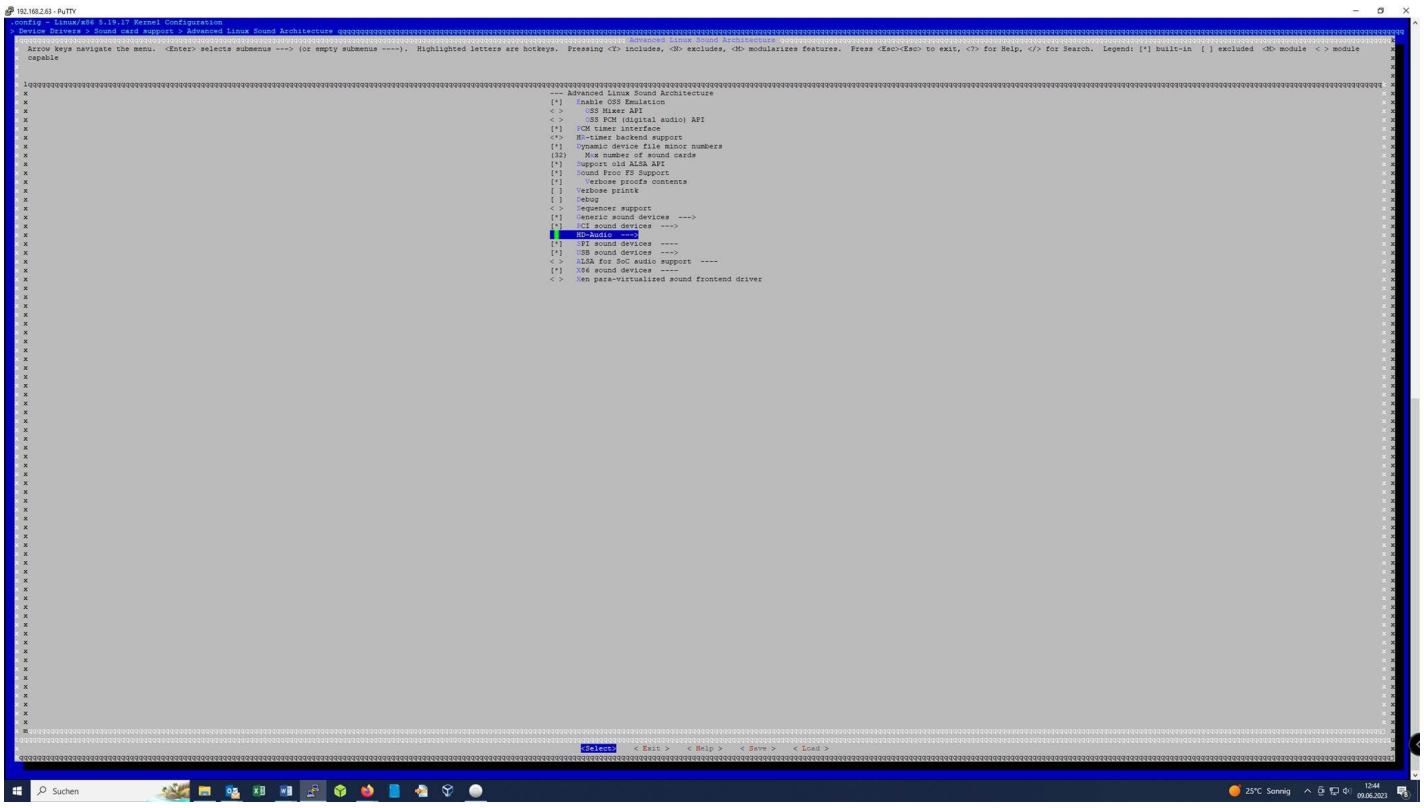


Within Power Management and ACPI Options is the CPU Idle option - ENTER



HR-Timer enabled:

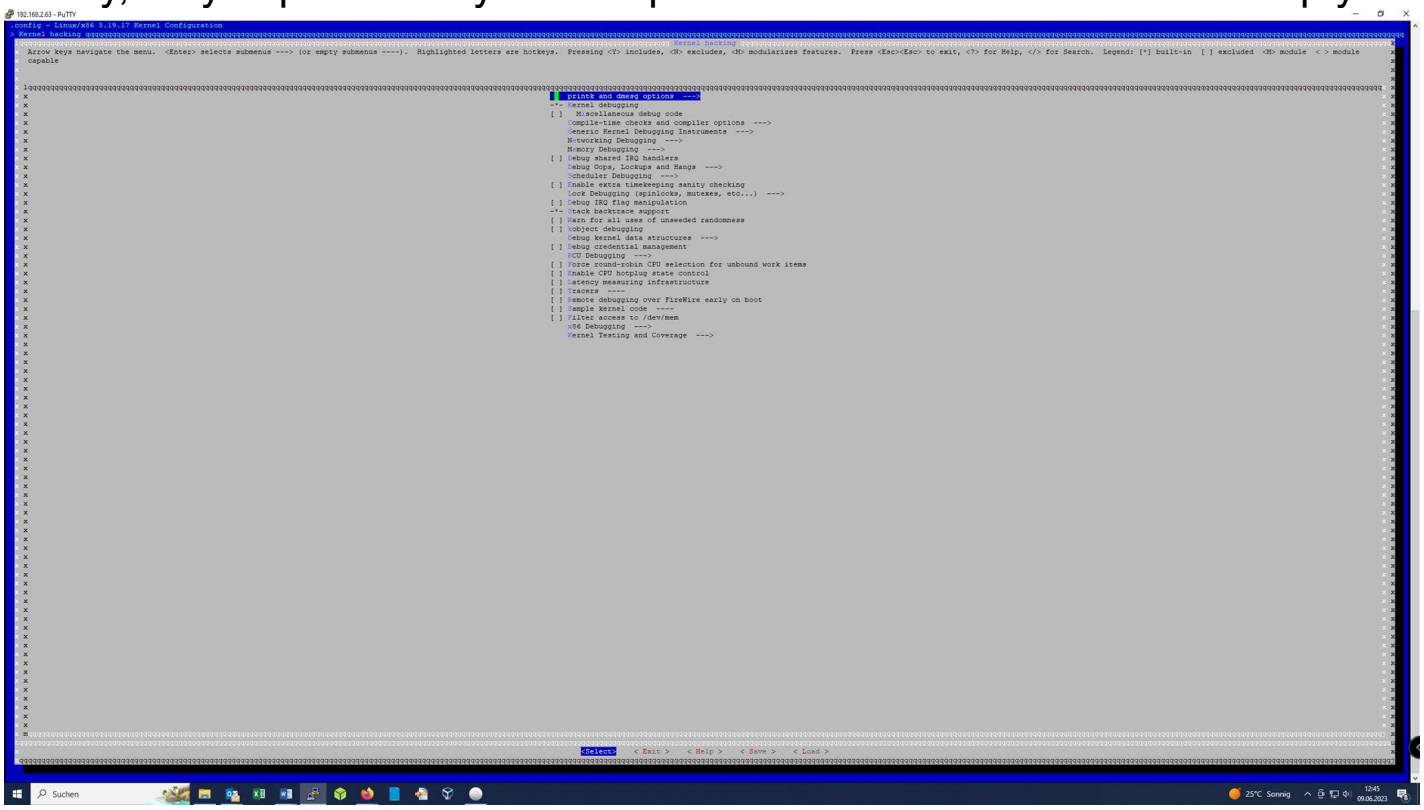
*Back to first page – Device Drivers then to Sound card support -use Y to insert the * - ENTER – Advanced Linux Sound Architecture – use Y to insert the * - ENTER*



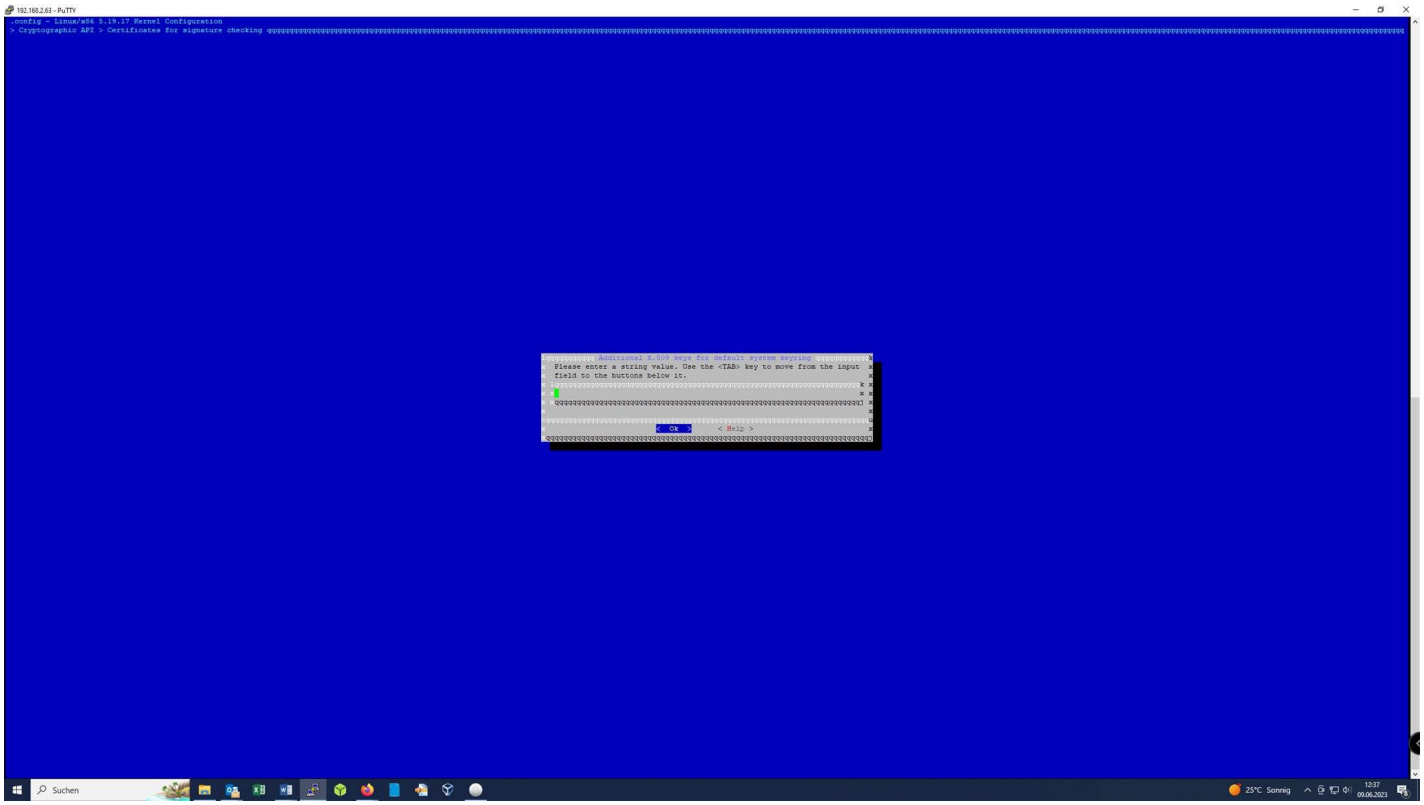
Basically no debugging overhead:

First page – look down for Kernel hacking – ENTER

Finally, very important or your compile will later die: Ensure this is empty:



This in within the first page menu – go to CRYPTOGRAPHIC APL – ENTER – then scroll down to ADDITIONAL X509 KEYS FOR DEFAULT SYSTEM KEYRING – ENTER – and clear the field - ENTER



Now, please save and continue with the following steps:
Do not think you should rename the file like I did

Once the configuration is done and saved:

make

make modules_install

make install

update-grub

reboot

Once rebooted, do

uname –r

It should show you your current Kernel version and now it should be 5.19.17.

****

If you screw up your kernel like I did many times this will get you back to where you can begin again. If you did not skip down to below the horizontal line

Please google "Mr Proper Linux"

https://unix.stackexchange.com/questions/387640/why-both-make-clean-and-make-mrproper-are-used

Why both `make clean` and `make mrproper` are used?
unix.stackexchange.com

Use these commands
make clean
make mrproper
make distclean
will clean up the mess you created and then you should
be able to compile again (In the 5.19 folder).

Then start new from scratch...and this time just do EXACTLY what Blitz advised to do. There is absolutely no room for creativity. Did I say anything about renaming something ? No.
The above is when I had to sheepishly admit I thought I was supposed to name the config file something other than the choice given

More good advice and an explanation from Blitz
We have already a new name...it is the name of the folder...linux-5.19.17...the new config file is in there, the old config file is stored somewhere completely else and wont be lost at all. No need to backup anything.

You as well have to do things EXACTLY in the sequence I described. If you miss only one step, it will not work (like the certificates).
I missed the clearing out of the certificates field the first time

If this still does not work, delete the whole 5.19. folder and start from scratch.
In my experience the cleaning process works just fine
****

So we come to one of the most important step…we now give the Kernel the command to make use of what we prepared.

We do a lot of stuff here, but most importantly we isolate the cores, activate tickless mode and use the AMD energy driver instead of the generic.

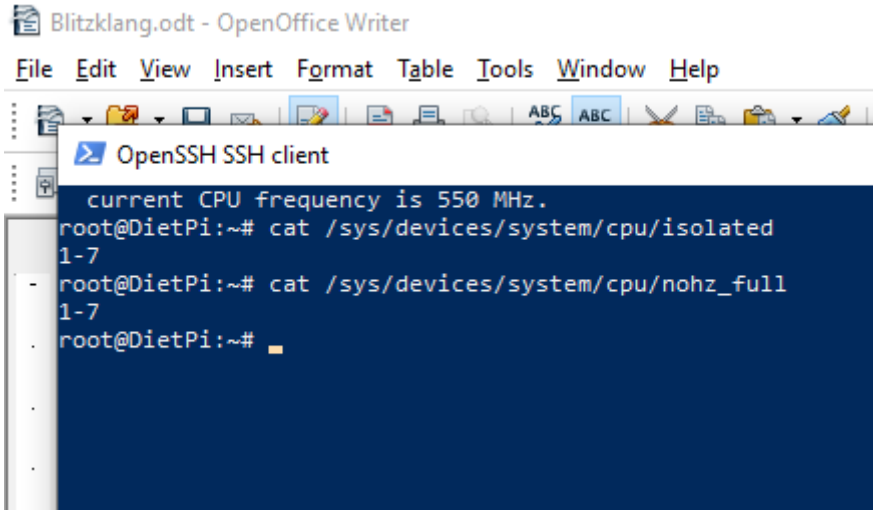
We need to change one line in your boot loader and you have to be very careful doing that or you wont have a system anymore and can start from scratch. So, PLEASE…be careful:

First let’s check your current isolation status and tickless status:

cat /sys/devices/system/cpu/isolated

cat /sys/devices/system/cpu/nohz_full

It will be probably return nothing, while when done it looks like:



So…core 1-7 are on my machine isolated and work in full tickless mode.

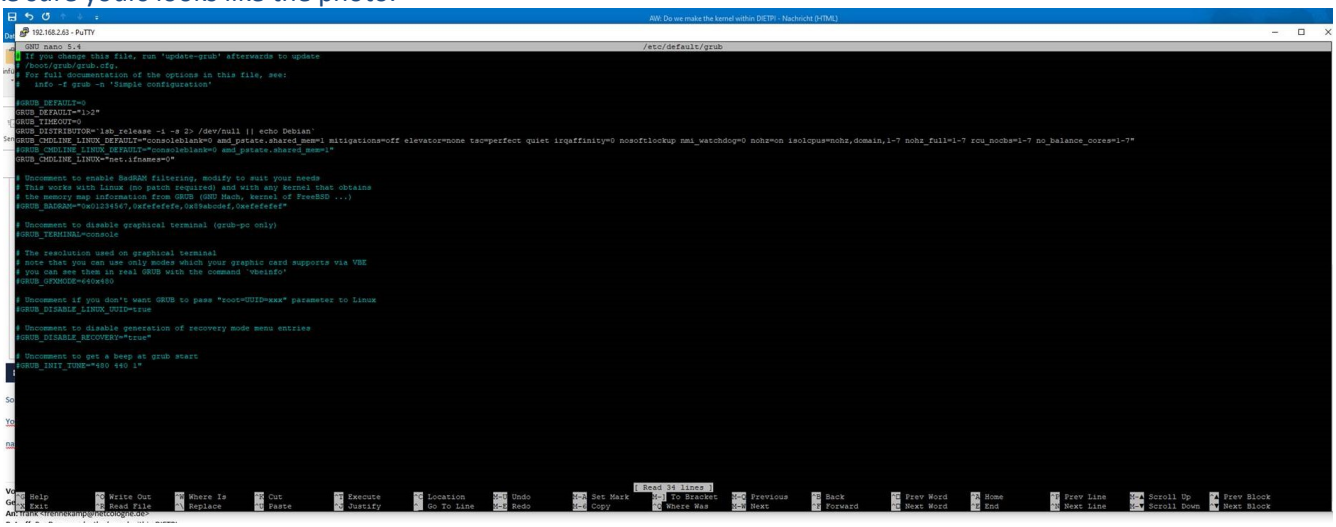
We activate that now with

nano /etc/default/grub

Yours may look different, that is fine… change **ONLY THE** GRUB_CMDLINE_LINUX_DEFAULT **LINE with the below – copy the below text and replace what is on this line with this completely**

GRUB_CMDLINE_LINUX_DEFAULT="consoleblank=0 amd_pstate.shared_mem=1 mitigations=off elevator=none tsc=perfect quiet irqaffinity=0 nosoftlockup nmi_watchdog=0 nohz=on isolcpus=nohz,domain,1-7 nohz_full=1-7 rcu_nocbs=1-7 no_balance_cores=1-7"

Make sure yours looks like the photo.



Save the conf file.

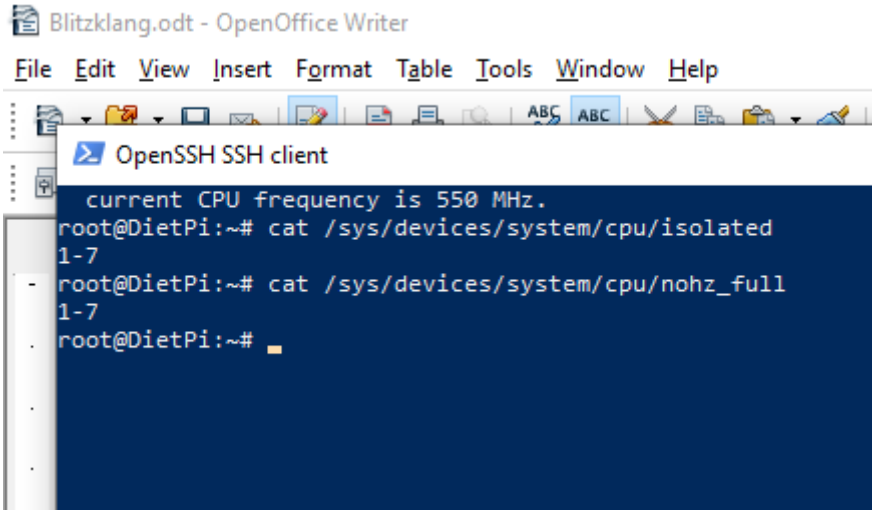
Now we will ask DIETPI to update the file by typing

update grub ENTER

and then
reboot ENTER

Check your isolation status and tickless status and run cpufreq-info as before.
cat /sys/devices/system/cpu/isolated

cat /sys/devices/system/cpu/nohz_full

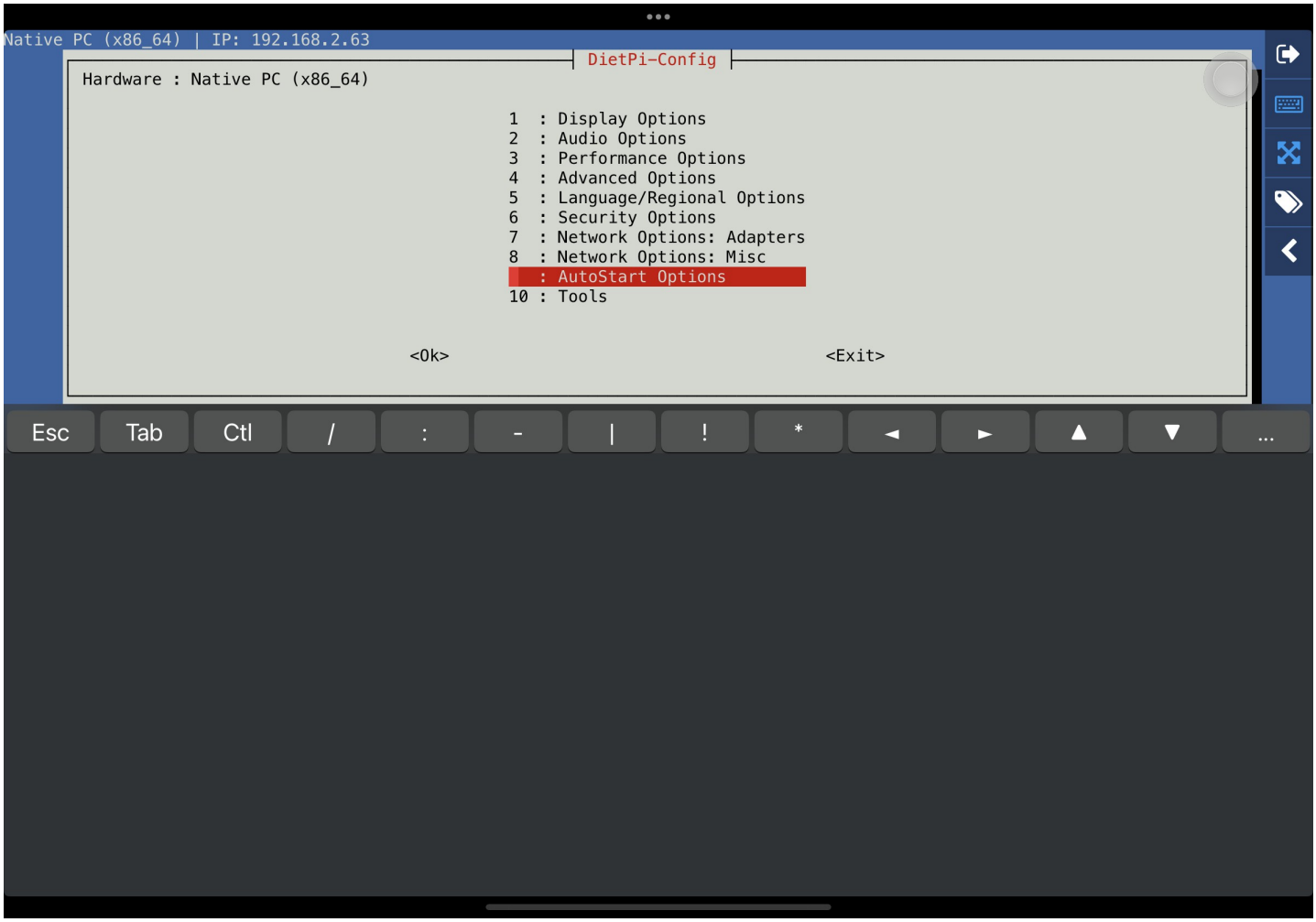


NOW...core 1-7 on your machine is isolated and works in full tickless mode.

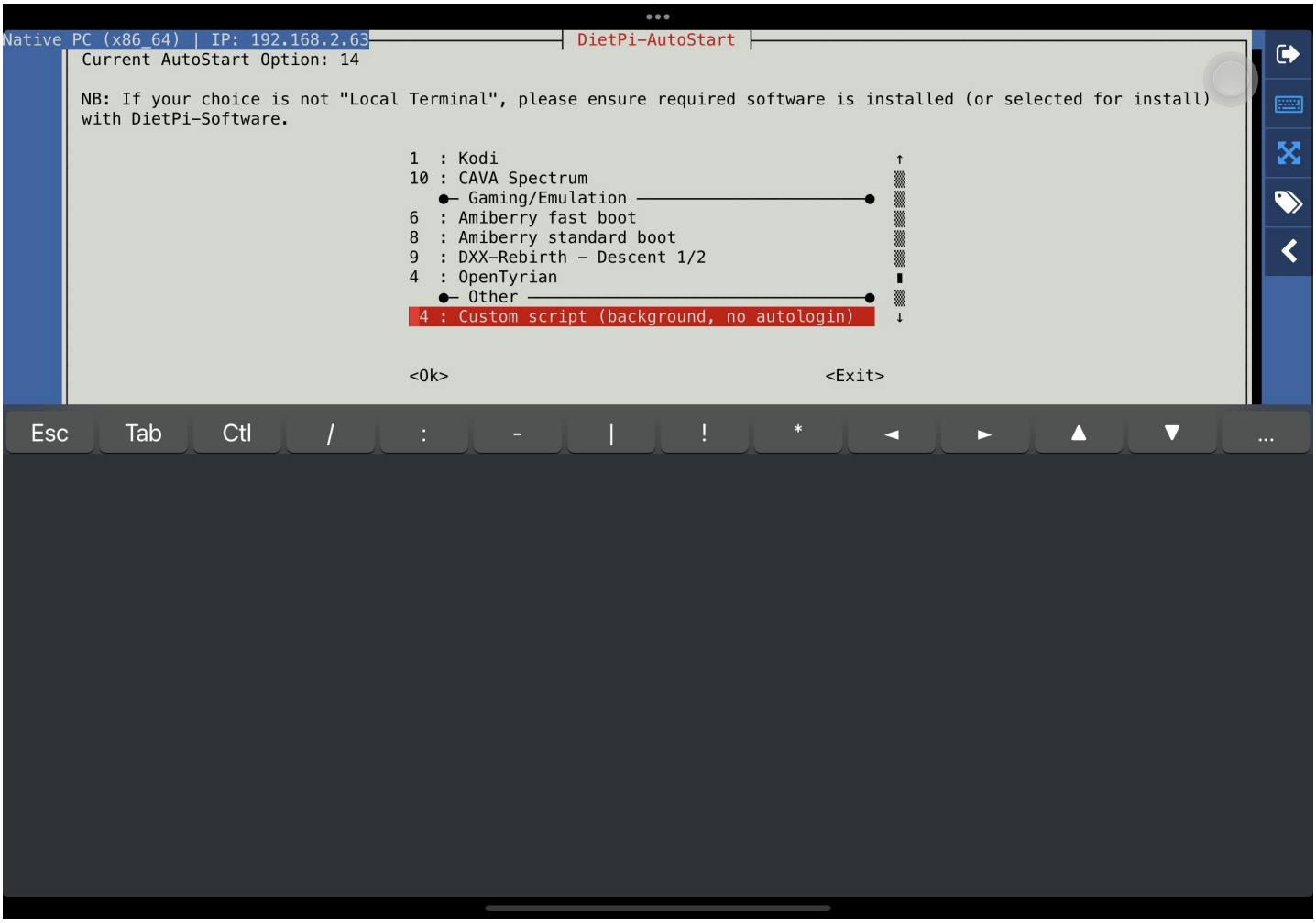
If this is what you see we are now in business

Ok, lets set the frequency...

you go into dietpi-config:

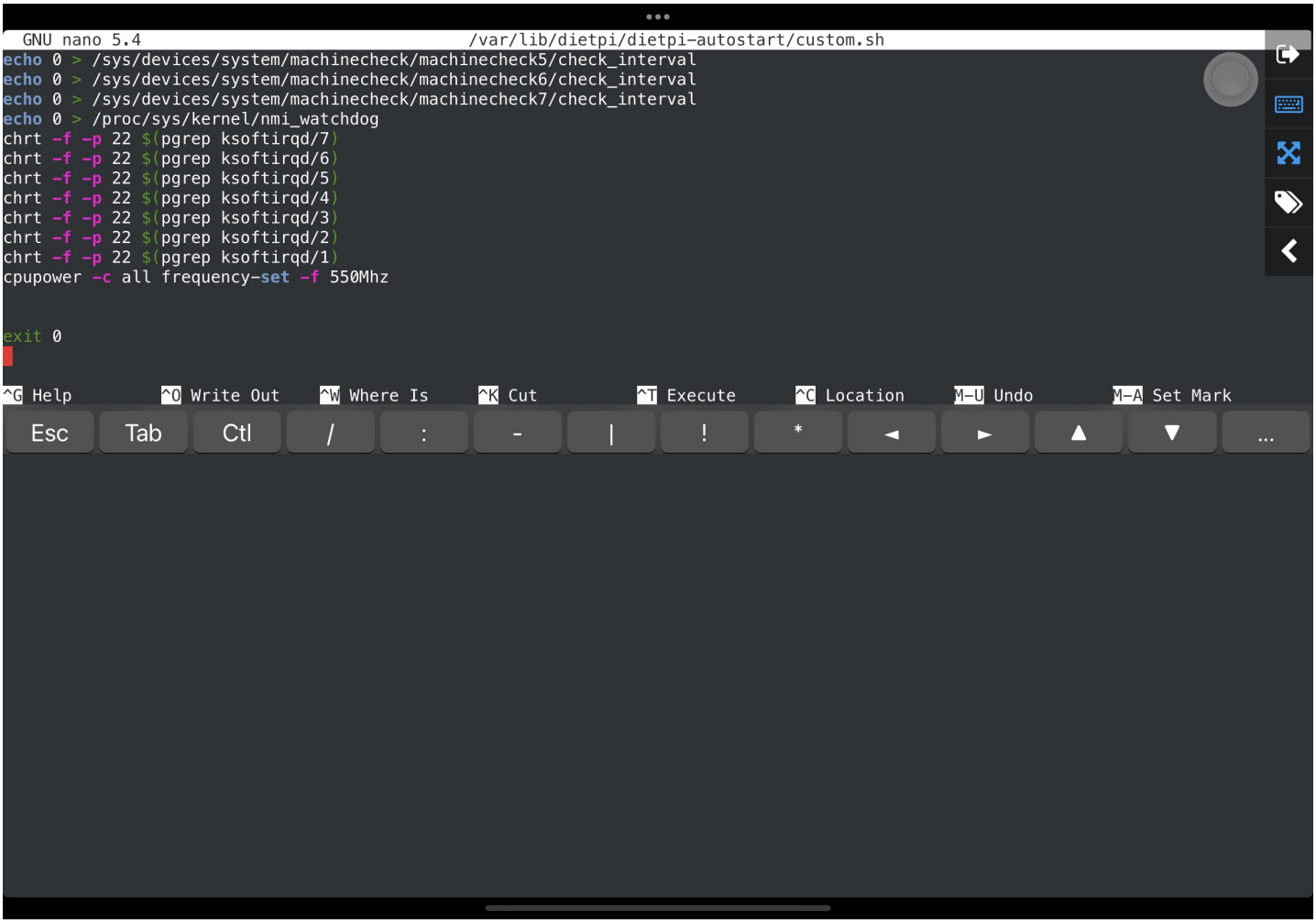


And in autostart options you select 14 – you will see that is a 14 when you get there



you insert/add for the moment *only* the line with

cpupower -c all frequency-set -f 550Mhz



Save and reboot...

please run cpufreq-info again *if it is not as shown make sure you got it right*

So lets go into the final round.

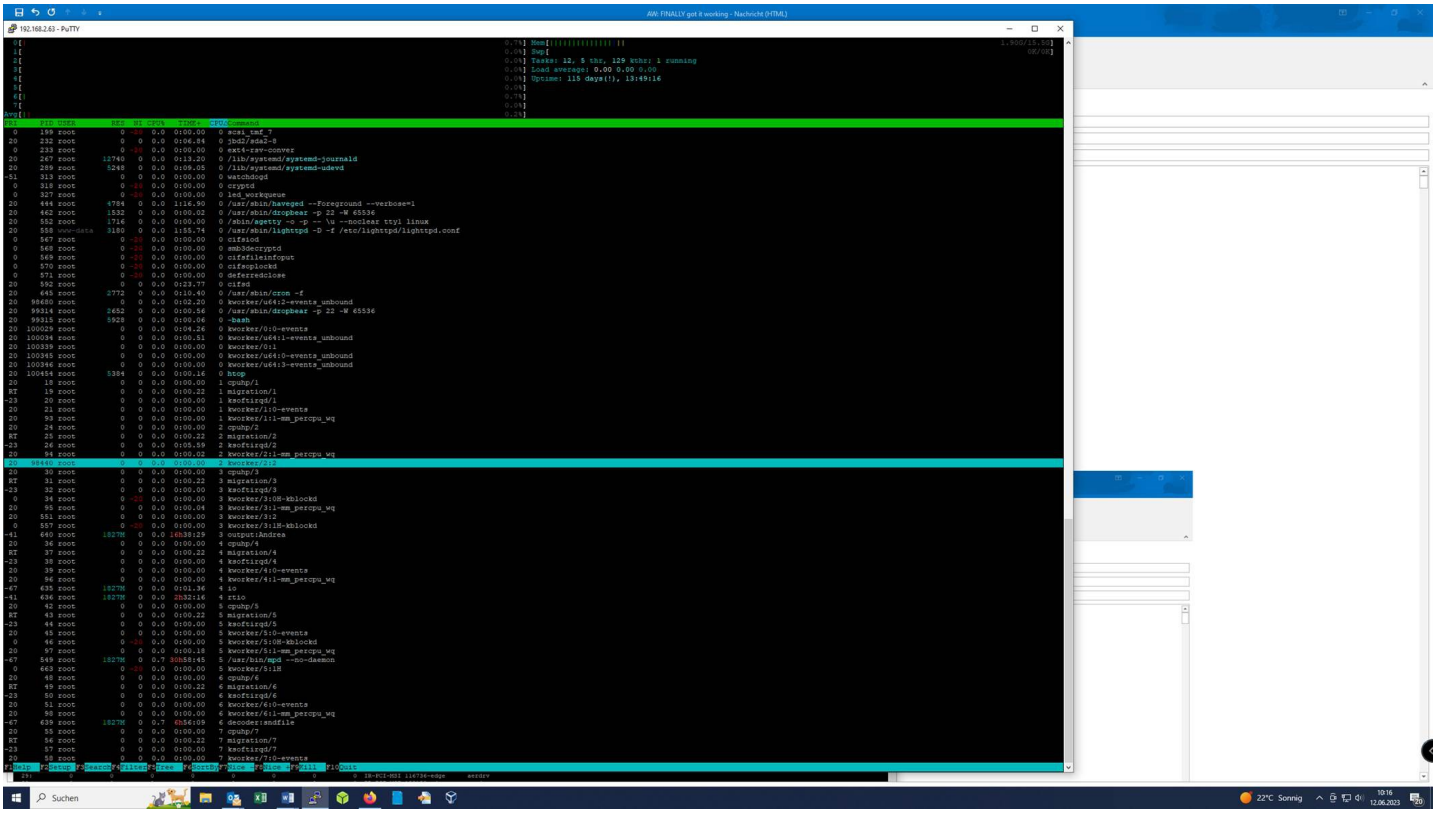
Lets remember:

We want isolated, clean CPU cores, so our audio processing is not polluted. Therefore, the CPU cores are distributed:

Core 0 – Housekeeping Core for all OS-related tasks and NON-Audio stuff
Core 1 – Reserved for LAN or SATA
Core 2 – Reserved for USB-Audio-Output
Core3-7 Reserved for MPD and its child processes

So, if you remember my HTOP screenshot in the beginning. Yours should look like that now. Please check and send me a screenshot.

It should look like this:



Well, now there is a second source of pollution besides services/apps/process: Interrupts.

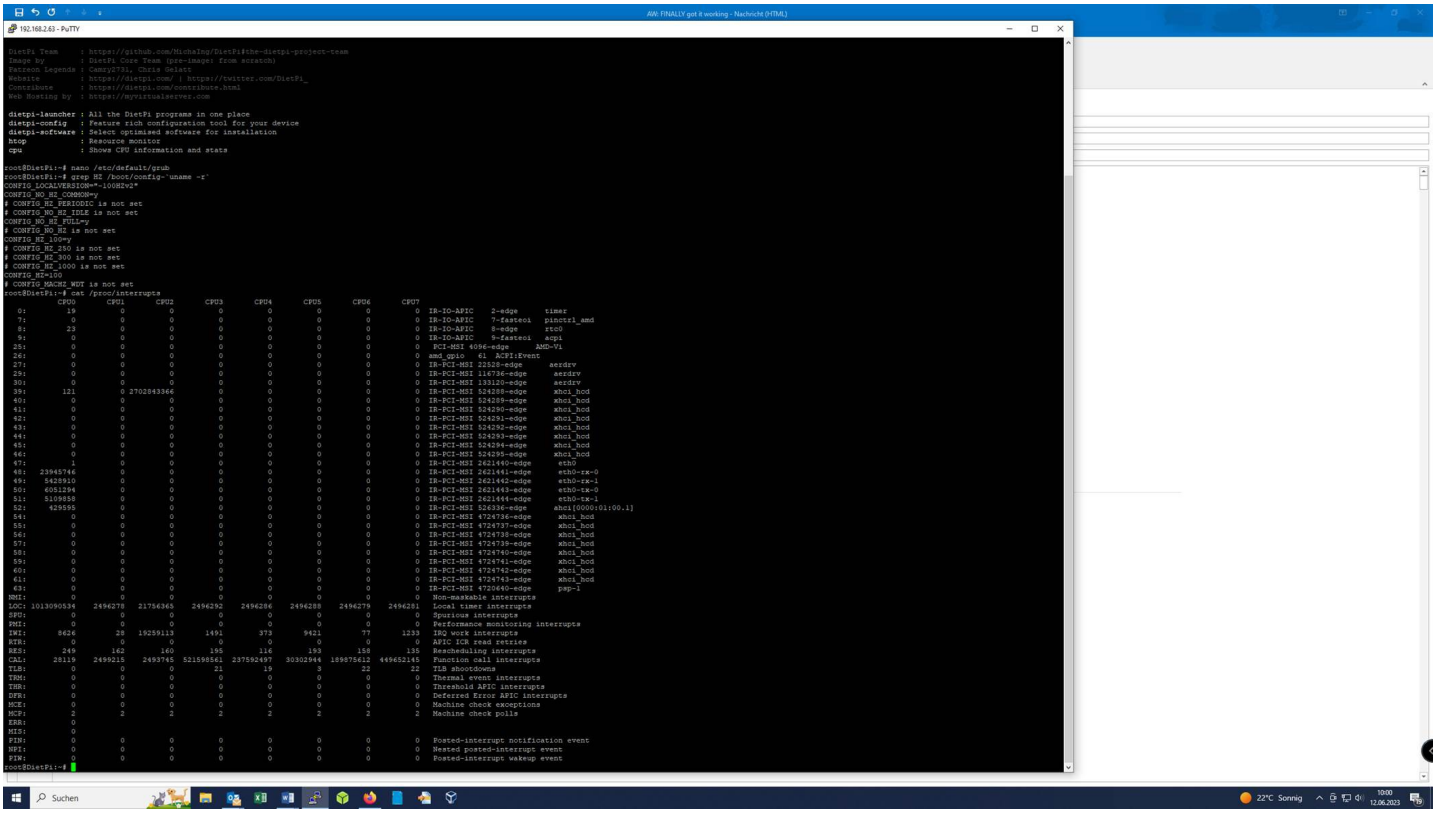
Interrupts are more hardware-near and they…well…interrupt and ask for CPU-Attention as the name says. They are not shown by HTOP.

So, we need a different tool for that to study them and they are on each PC different.

The magic scomand to show what is going on is

cat /proc/interrupts

You will see something like:



Ok, The trick is now:

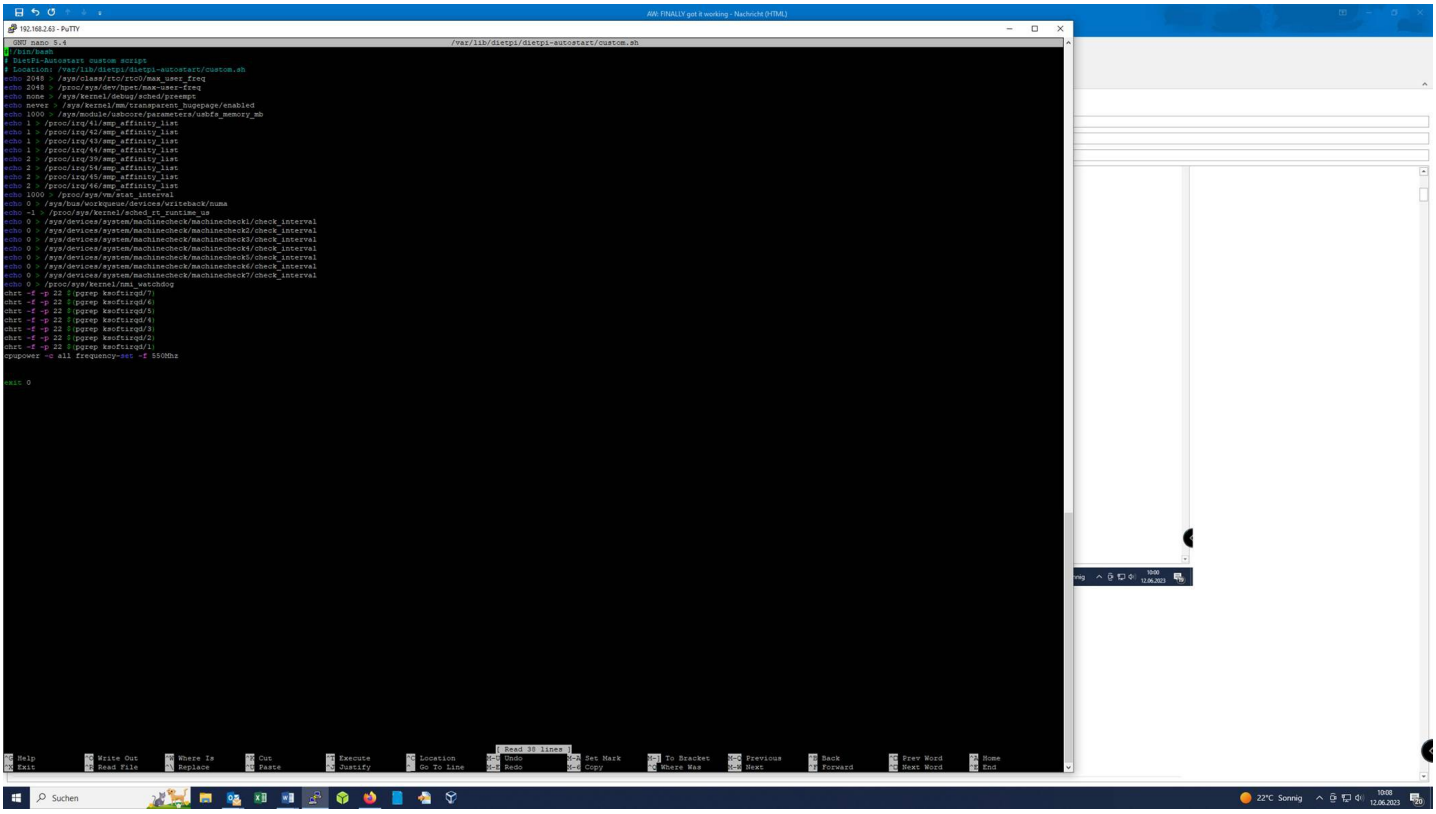
-Restart your machine without playing any music. Type the command above and make a screenshot
-Play a piece of music, make the command again and make a screenshot.
-Wait 10 sec, Play a different piece of music and make a screenshot.
-Send me those screenshots and lets analyze them.

If you look at my example above you see:

-I have put ethernet even on core 0 since it is not audio relevant anymore, we use the input cache of MPD and play from ram.
-Audio-USB is playing on core 2
-All other stuff is on Core 0
-Some housekeeping interrupts which are necessary to have a functional CPU, remain on all cores.

So, how did I achieve that ?

My Autostart-script in Dietpi Option 14 looks like this:



So, you see that I send interrupt 39 (and some other USB-Interrupts) to core 2 and now it runs on core 2.

Your numbers maybe different !!! And if you use a different USB-Port, the interrupt number may change, that is why I have spec'd more than only one interrupt for core 2…different USB-ports.

The other statements which have no irq in it are optimization statements for further audio improvements which came from different other Audio-PC-Projects. You can copy them into your autostartfile.

To make it more convenient for you, here is the ascii text of my file:

```
#!/bin/bash
# DietPi-Autostart custom script
# Location: /var/lib/dietpi/dietpi-autostart/custom.sh
echo 2048 > /sys/class/rtc/rtc0/max_user_freq
echo 2048 > /proc/sys/dev/hpet/max-user-freq
echo none > /sys/kernel/debug/sched/preempt
echo never > /sys/kernel/mm/transparent_hugepage/enabled
echo 1000 > /sys/module/usbcore/parameters/usbfs_memory_mb
echo 1 > /proc/irq/41/smp_affinity_list
echo 1 > /proc/irq/42/smp_affinity_list
echo 1 > /proc/irq/43/smp_affinity_list
echo 1 > /proc/irq/44/smp_affinity_list
echo 2 > /proc/irq/39/smp_affinity_list
echo 2 > /proc/irq/54/smp_affinity_list
echo 2 > /proc/irq/45/smp_affinity_list
echo 2 > /proc/irq/46/smp_affinity_list
echo 1000 > /proc/sys/vm/stat_interval
echo 0 > /sys/bus/workqueue/devices/writeback/numa
```

```
echo -1 > /proc/sys/kernel/sched_rt_runtime_us
echo 0 > /sys/devices/system/machinecheck/machinecheck1/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck2/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck3/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck4/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck5/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck6/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck7/check_interval
echo 0 > /proc/sys/kernel/nmi_watchdog
chrt -f -p 22 $(pgrep ksoftirqd/7)
chrt -f -p 22 $(pgrep ksoftirqd/6)
chrt -f -p 22 $(pgrep ksoftirqd/5)
chrt -f -p 22 $(pgrep ksoftirqd/4)
chrt -f -p 22 $(pgrep ksoftirqd/3)
chrt -f -p 22 $(pgrep ksoftirqd/2)
chrt -f -p 22 $(pgrep ksoftirqd/1)
cpupower -c all frequency-set -f 550Mhz
```

exit and save

Have fun..I think we are done…

let's check if everything works as expected…please send me the screenshots specified above (as well from HTOP).
…and let me know what you hear…

Below is what I am using in my installation – slightly different – each system will likely require slightly different instructions

```
#!/bin/bash
# DietPi-Autostart custom script
# Location: /var/lib/dietpi/dietpi-autostart/custom.sh
echo 2048 > /sys/class/rtc/rtc0/max_user_freq
echo 2048 > /proc/sys/dev/hpet/max-user-freq
echo none > /sys/kernel/debug/sched/preempt
echo never > /sys/kernel/mm/transparent_hugepage/enabled
echo 1000 > /sys/module/usbcore/parameters/usbfs_memory_mb
echo 1 > /proc/irq/41/smp_affinity_list
echo 1 > /proc/irq/42/smp_affinity_list
echo 1 > /proc/irq/43/smp_affinity_list
echo 1 > /proc/irq/44/smp_affinity_list
echo 2 > /proc/irq/40/smp_affinity_list
echo 2 > /proc/irq/54/smp_affinity_list
echo 2 > /proc/irq/45/smp_affinity_list
echo 2 > /proc/irq/46/smp_affinity_list
echo 1000 > /proc/sys/vm/stat_interval
echo 0 > /sys/bus/workqueue/devices/writeback/numa
echo -1 > /proc/sys/kernel/sched_rt_runtime_us
echo 0 > /sys/devices/system/machinecheck/machinecheck1/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck2/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck3/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck4/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck5/check_interval
```

```
echo 0 > /sys/devices/system/machinecheck/machinecheck6/check_interval
echo 0 > /sys/devices/system/machinecheck/machinecheck7/check_interval
echo 0 > /proc/sys/kernel/nmi_watchdog
chrt -f -p 22 $(pgrep ksoftirqd/7)
chrt -f -p 22 $(pgrep ksoftirqd/6)
chrt -f -p 22 $(pgrep ksoftirqd/5)
chrt -f -p 22 $(pgrep ksoftirqd/4)
chrt -f -p 22 $(pgrep ksoftirqd/3)
chrt -f -p 22 $(pgrep ksoftirqd/2)
chrt -f -p 22 $(pgrep ksoftirqd/1)
cpupower -c all frequency-set -f 550Mhz
```

exit and save

You should now experience a very different sound. One can listen to this all the while during the conversion. That can be interesting to hear the evolution.