SXOS and atmosphere sharing emunand + android 10 accessing FAT32

Document version: 1.0 - 04/27/2021 (A)   // First version.
Document version: 1.1 - 04/27/2021 (A)   // Changed backing up and restoring procedures.
                                          // Added Tools & Software: section before Steps:
                                          section and removed Tools: section at the end.
                                          // Fixed credits.

Introduction:

In a GBATemp thread I started (the tutorial *Quickest (I think) way to convert Atmosphere style microsd+emunand to SXOS style microsd+emunand*), fellow user *lordelan* explained the problems leading to the impossibility of having SXOS and atmosphere share the same emunand when using them on a switch which also has android 10 installed.

Basically, the problem is the combination of these three facts:

- android 10 requires a GPT partition layout, which uses sectors 1,2,… to describe the partitions.

- SXOS hidden partition style emunand is stored in the fixed sectors 1 (TX NAND mark) and starting on sector 2 (actual emunand contents).

- Atmosphere can describe SXOS hidden partition style emunands and use them, but it needs the contents to be contiguous and it doesn't support referencing a file based SXOS emunand (of course some modifications to atmosphere could give this support and maybe some FAT32 file descriptor trickery would also do the trick, but that would be more work, I think).

So, the trick that turned out to be possible was: what if…

- We create an SXOS file based style emunand STRUCTURE and arrange file data in the FAT32 partition so that the file entries are describing data for each file, yes, as it would be the case for a file based SXOS emunand, BUT we also make sure that data is contiguous on disk.

- We create a hekate+atmosphere emummc.ini to use a hidden partition style emunand that uses sector=<sector where the "Ordered and Contiguous" file based SXOS emunand contents start>.

And, after some research and testing, we got it working :)

Tools & Software :

EmuTool https://github.com/TheyKilledKenny/Emutool/releases
HDD Raw Copy Tool https://hddguru.com/software/HDD-Raw-Copy-Tool/
Minitool Partition Wizard Free https://www.partitionwizard.com/download.html
Active @ Disk Editor https://www.disk-editor.org/index.html

SX OS 3.1.0 and SX GEAR 1.1 https://sx.xecuter.com/ (or elsewhere)
hekate https://github.com/CTCaer/hekate/releases
Atmosphère https://github.com/Atmosphere-NX/Atmosphere/releases
switchroot android 10
https://forum.xda-developers.com/t/rom-unofficial-switchroot-android-10.4229761/

Steps:

1. Creating a backup of your previous emunand and files (optional):

- Power off the switch, extract the SD card and put it on the PC.

- Start EmuTools:

    - Choose your current emunand type in Select Source and select the drive or partition where your emunand is stored.

    - Choose SXOS File in Select Target and select the <destination folder where you want the backup to be stored>.

    - Click start and wait until the transfer is complete.

- Close EmuTool and copy the Nintendo contents from SD:\Emutendo\ or SD:\emuMMC\HPE0\Nintendo\ to the <folder you want the backup to be stored>.

2. Partitioning and installing Android and/or Linux (optional, if you don't have it already):

- Prepare SD with hekate files and Android an/or Linux install files

- Boot hekate and enter its boot menu (maintain Vol- pressed when booting).

- Go to Tools > Partition SD Card:

    - Create Android and/or Linux space; you don't need emunand space, at least for the shared emunand that we will be creating, this emunand will reside into the FAT32 partition. NOTE: It seems that the amount of space you set for Android is not honoured, it seems 4 extra GB are added. If you choose, for example, a 16GB space, it creates a 20GB space instead. So you can subtract 4GB to the amount you want and use that number. Not that this is important at all, consider this a small bonus.

    - Flash Android and/or Linux.

- Complete installation of Android and/or Linux in TWRP, etc.

3. Creating the "Ordered and Contiguous" file based SXOS emunand:

- Power off the switch, extract the SD card and put it on the PC.

- Start Minitool Partition Wizard:

    - Select the FAT32 partition on the SD card and format it as FAT32 and 32KB Cluster size.

    - Apply changes.

- Close Minitool Partition Wizard.

- Put *ONLY* SXOS 3.1.0 boot.dat file and your license.dat on the root of the SD card.

- Unmount the SD card and insert it in the switch.

- Power the switch on to enter SXOS boot menu (maintain Vol+ pressed when booting).

- Go to Options > EmuNAND > Create EmuNAND and choose files on microSD.

- NOTE: Formatting and using only the minimal files when creating this file based SXOS emunand is vital. I have done some testing here and the risk of getting a physically non-contiguous file set is way bigger (almost certain) when not using a clean/"unoperated" FAT32 partition. While we don't have a program to create this or rearrange these files on the partition we must do this this way.

4. Obtaining the starting physical sector number for BOOT0.bin (and, thus, the starting physical sector number for the whole file based SXOS emunand) and confirming it is "Ordered and Contiguous":

- Power off the switch, extract the SD card and put it on the PC.

- Start Active @ Disk Editor:
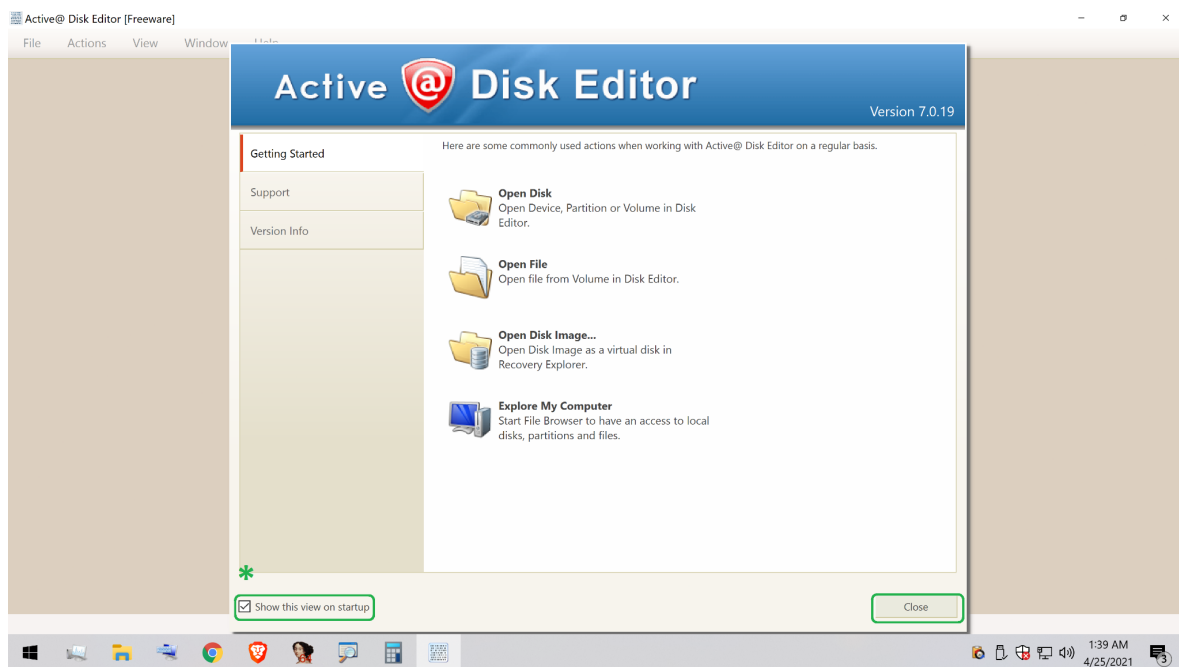
- Click on Close if the initial window appears (optionally uncheck the Show this view on startup checkbox so that it doesn't bother you anymore).
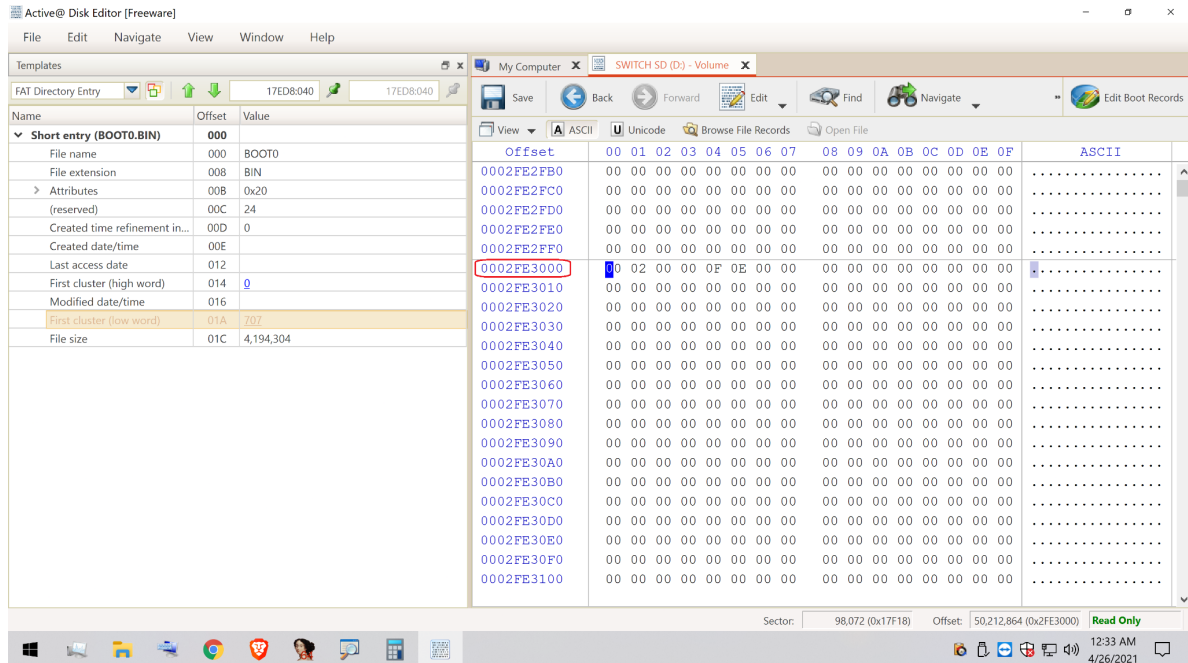
- Obtaining the **<logical offset of BOOT0.BIN>**:
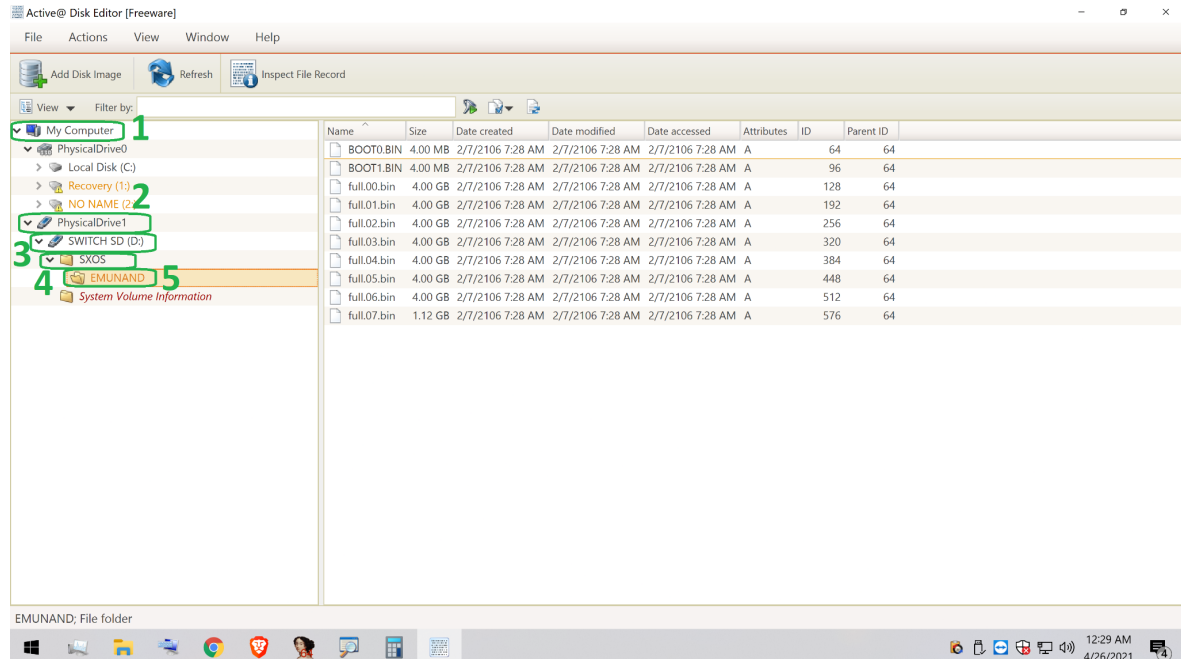
- (1) Click on My Computer tab.
- (2) Select and unfold (double click) the PhysicalDrive# corresponding to the SD card (you will know which one because of the icon, which is shown as a small USB drive, and also because you will see SWITCH SD partition into it).
- (3) Select and unfold the SWITCH SD partition.
- Navigate to SXOS (4) > Emunand (5) and make sure you see those files on the right panel.
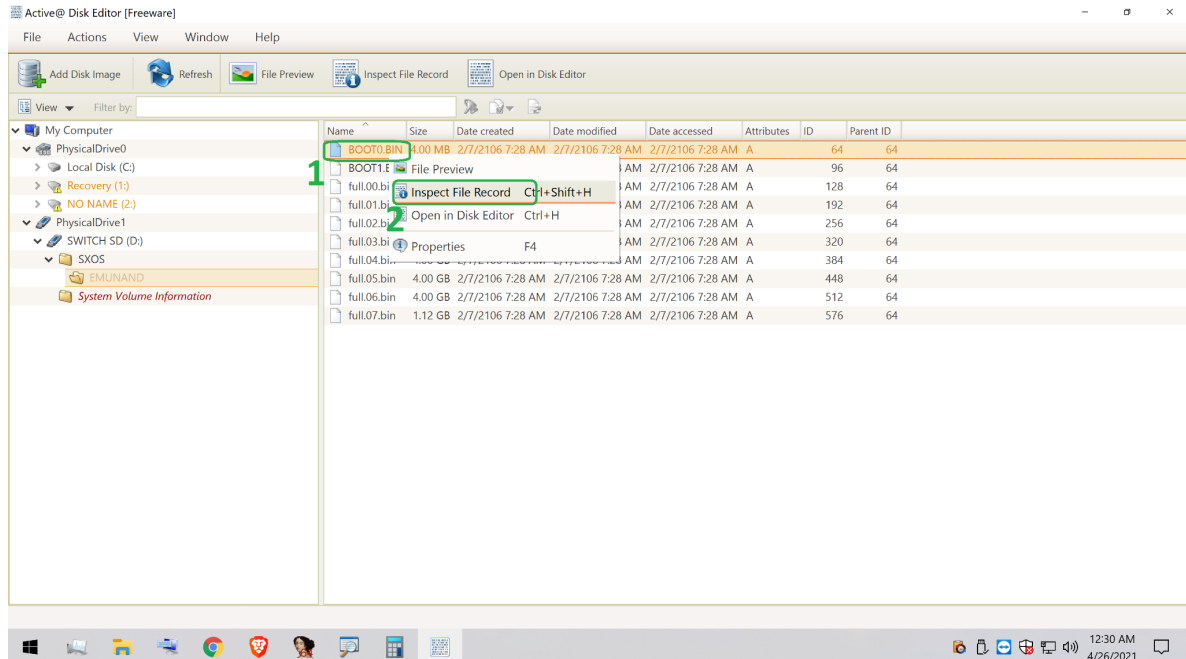
- (1) Right click on BOOT0.BIN and (2) choose Inspect File Record.
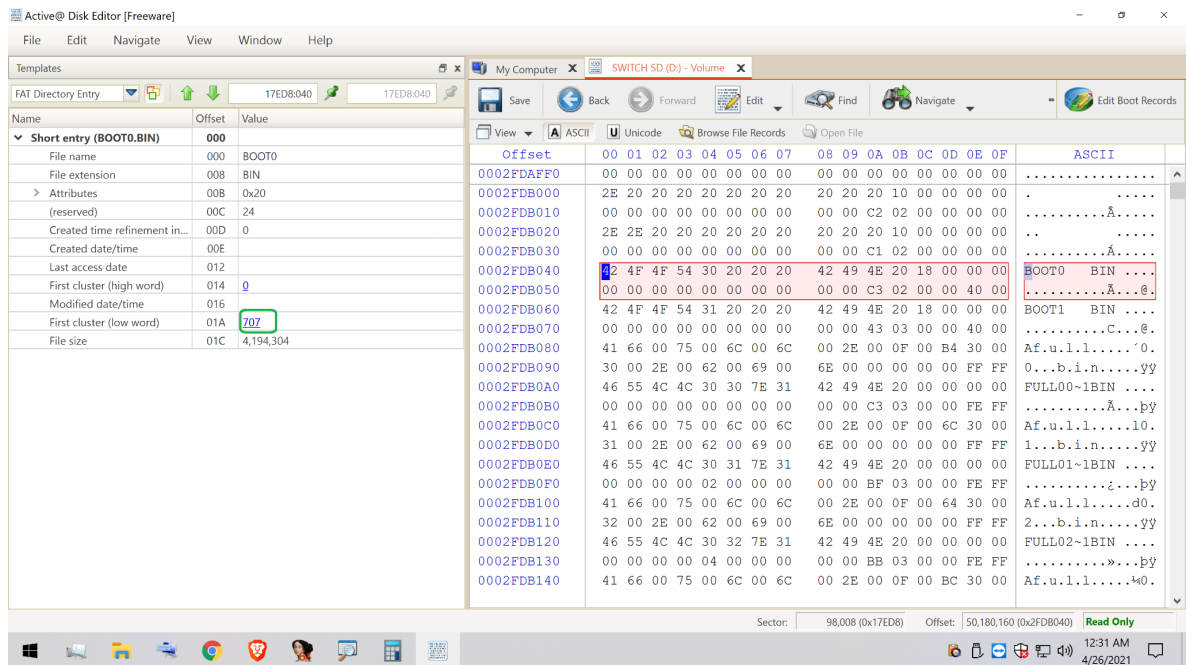
- Click on the blue underlined number in the Value column of the First Cluster (low word) row on the left panel.

- Take note of and save the hexadecimal number (make sure the Offset column on the right panel is in hexadecimal mode, you will see alphabet letters in the column if that's the case and you won't see any alphabet letter if the column is in decimal mode; you can change mode by clicking anywhere in this column) just next to the cursor (the small vertical blue rectangle). We will be referring to this number (value 0x0002FE3000 in this example) as **<logical offset of BOOT0.BIN>**.

- Obtaining the **<physical offset of FAT32 partition>**:
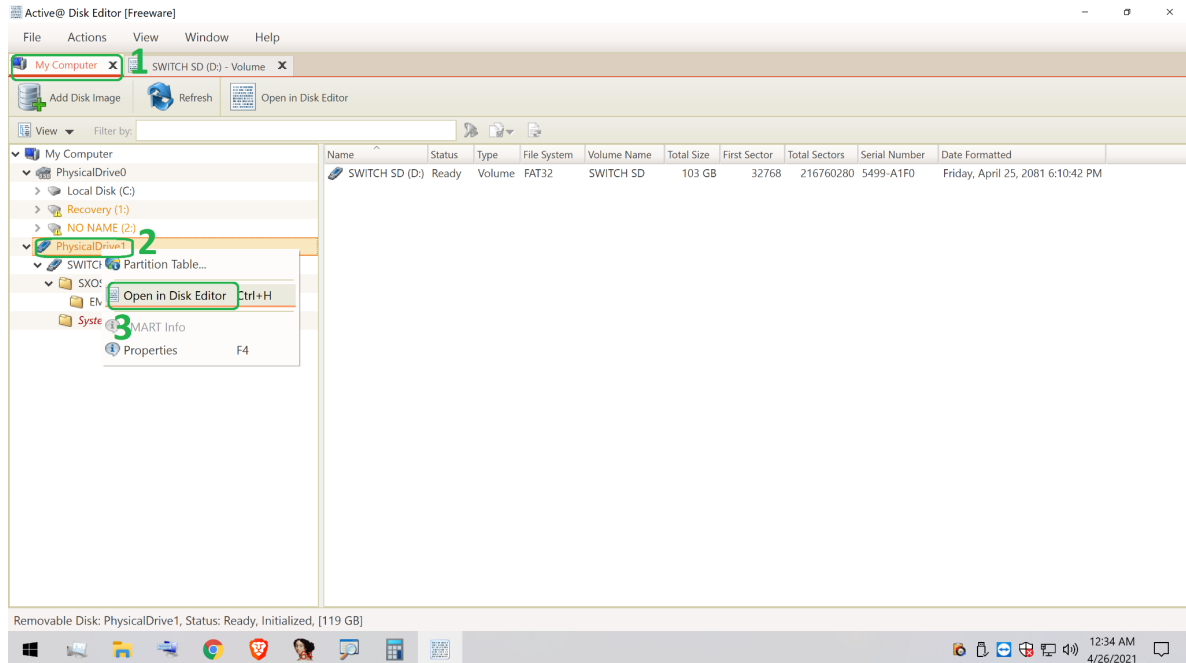
- (1) Click on My Computer tab.
- (2) Select the PhysicalDrive# corresponding to the SD card (the same you used before), right click on it and (3) choose Open in Disk Editor.
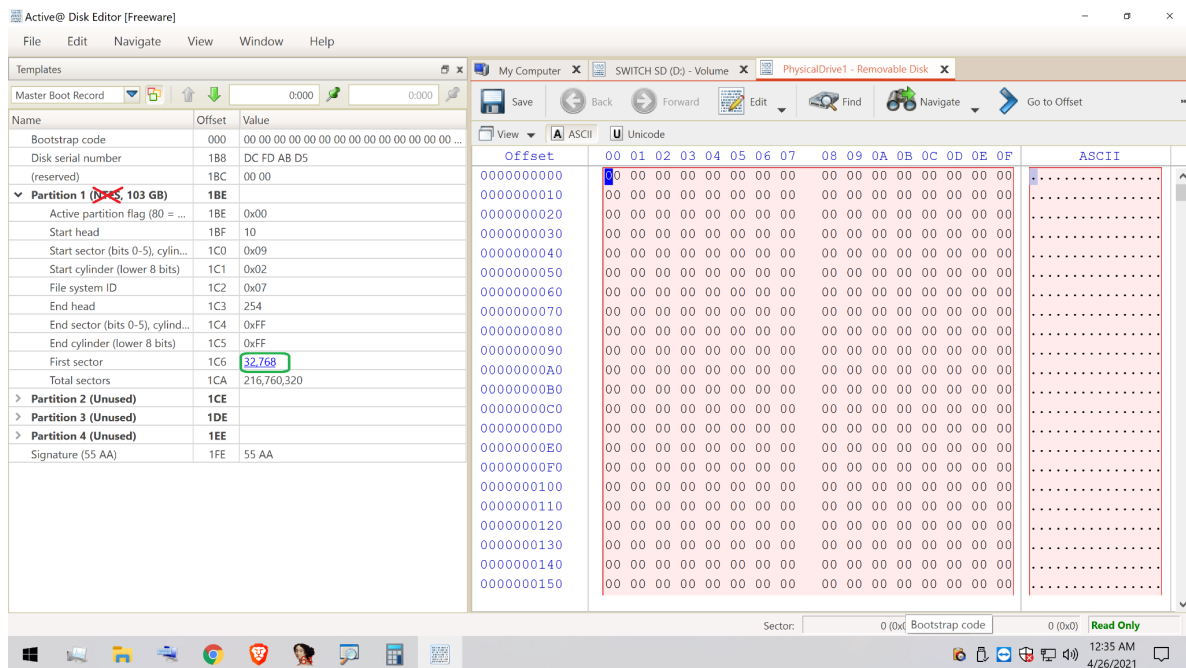
- Click on the blue underlined number in the Value column of the First sector row on the left panel (in the unfolded Partition#, it should already be unfolded for you

and should be Partition 1; also, don't get confused by that NTFS text I dashed with the red X, that is a bug og Active @ Disk Editor, it seems, the partition is a FAT32 partition as we already know).
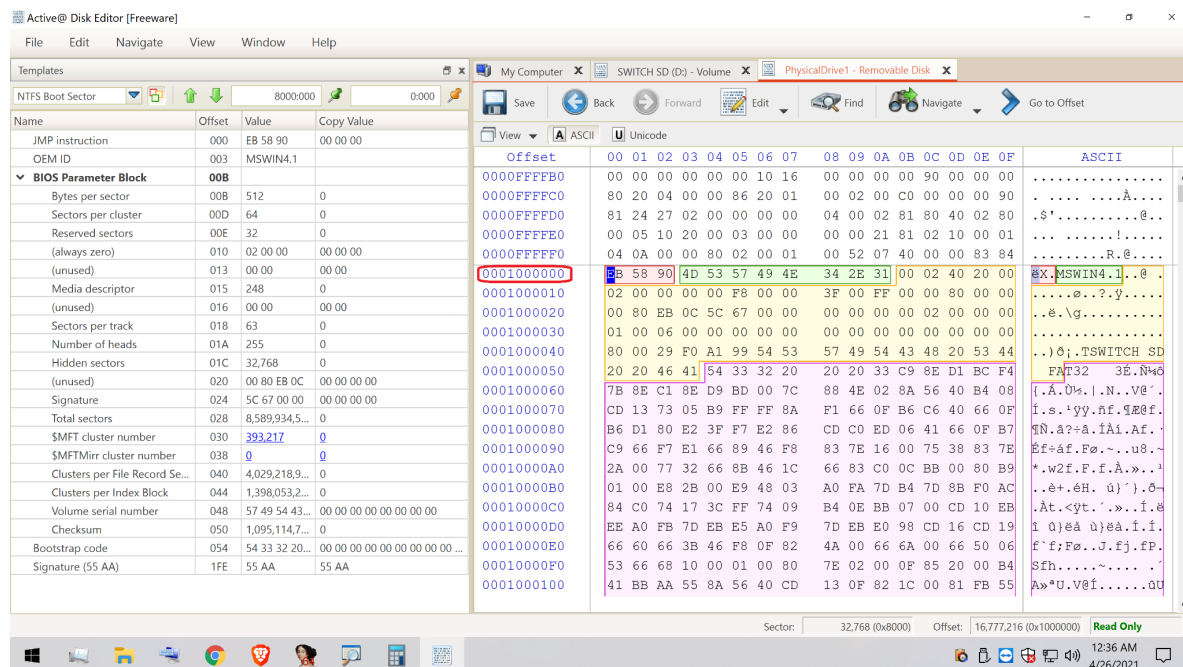
- Take note of and save the hexadecimal number (make sure the Offset column on the right panel is in hexadecimal mode) just next to the cursor (the small vertical blue rectangle). We will be referring to this number (value 0x0001000000 in this example) as **<physical offset of FAT32 partition>**.

- Calculating **<starting sector of BOOT0.bin>**:

    - **<starting sector of BOOT0.bin>** =
        (**<physical offset of FAT32 partition>** + **<logical offset of BOOT0.BIN>**) / 0x0200

        (0x0001000000 + 0x0002FE3000) / 0x0200

        0x0001FF18

- Confirming it is "Ordered and Contiguous" (optional, very unprovable that the file set is not "Ordered and Contiguous", maybe do this only if the result of the whole process is bad):

- The steps done for obtaining **<logical offset of BOOT0.BIN>** must be repeated for all the files in SD:\SXOS\Emunand\, then the numbers must be subtracted and the differences of the obtained numbers must be:

  - From BOOT0.BIN to BOO1.BIN: +0x0000400000
  - From BOOT1.BIN to full.00.bin: +0x0000400000
  - From full.00.bin to full.01.bin: +0x00FFFE0000
  - From full.01.bin to full.02.bin: +0x00FFFE0000
  - From full.02.bin to full.03.bin: +0x00FFFE0000
  - From full.03.bin to full.04.bin: +0x00FFFE0000
  - From full.04.bin to full.05.bin: +0x00FFFE0000
  - From full.05.bin to full.06.bin: +0x00FFFE0000
  - From full.06.bin to full.07.bin: +0x00FFFE0000

  Anything not complying with this means the files are not "Ordered and Contiguous" so you can't use this file based SXOS emunand for atmosphere.

5. Adding hekate+atmosphere+sigpatches and describing file based SXOS emunand at /SXOS/Emunand/ as a hidden partition based SXOS emunand in emummc.ini:

- Add hetake, atmosphere and sigpatches files to the root of the FAT32 partition on the SD card.

- Create the Emutendo folder on the root of the FAT32 partition on the SD card.

- Create the emuMMC folder on the root of the FAT32 partition on the SD card, create the emummc.ini into that folder and put this into it:

  [emummc]
  enabled=1
  sector=<starting sector of BOOT0.bin, **0x0001FF18** in this example>
  id=0x0000
  nintendo_path=Emutendo

6. Restoring backup of your previous emunand and files (optional but NOTE: Needless to say this restore should only be done AFTER the file based SXOS emunand creation is complete):

- NOTE: at least for this step, use sx gear 1.1 boot.dat, not the normal 3.1.0 SXOS boot.dat. This is vital since the normal boot.dat breaks some hardware initialization so, if you chainload hekate from it, things like USB won't work properly and we need the USB functionality to create the emunand backup.

- Boot hekate and enter its boot menu (maintain Vol- pressed when booting).

- Go to Tool > USB Tools:

  On the switch:

  - Press Read-Only ON button (not drawn as a button but just text, but it is indeed a button) and make sure it says Read-Only OFF.

  - Press on emu RAW GPP (BEWARE: DON'T PRESS eMMC RAW GPP, PRESS emu RAW GPP) button.

  - Connect the USB-C cable from the switch to the PC (it may ask for a minimum battery level so charge it enough if so).

  On the PC:

  - Open a command line window (cmd.exe) and navigate to the folder <where you have your emunand backup stored>\sxos\emunand\

  - Create a single rawnand.bin file from full.xx.bin files:

    copy /b full.00.bin+full.01.bin+full.02.bin+full.03.bin+full.04.bin+full.05.bin+full.06.bin+full.07.bin rawnand.bin

    NOTE: this is a single line command, but it doesn't fit here. Here it is again in a smaller font:

    copy /b full.00.bin+full.01.bin+full.02.bin+full.03.bin+full.04.bin+full.05.bin+full.06.bin+full.07.bin rawnand.bin

- Start HDD Raw Copy Tool:

  - Choose Source by double clicking the line starting with FILE and select <where you have your emunand backup stored>\sxos\emunand\rawnand.bin file. The same line will now appear as FILE   RAW RAWNAND.bin. Then click on the Continue >>> button.

  - Choose Target by clicking the line starting with USB   hekate SD GPP. Then click on the Continue >>> button.

  - Click the START button, wait for the transfer to complete and then close HDD Raw Copy Tool.

- Disconnect the USB-C cable.

On the switch:

- Press the Close button (if the emu RAW GPP mount window is still showing).

- If it is not as OFF already, press Read-Only ON button (not drawn as a button but just text, but it is indeed a button) and make sure it says Read-Only OFF.

- Press on BOOT0 button that's next to emu RAW GPP (BEWARE: DON'T PRESS THE BOOT0 THAT'S NEXT TO eMMC RAW GPP, PRESS THE BOOT0 THAT'S NEXT TO emu RAW GPP) button.

- Connect the USB-C cable from the switch to the PC (it may ask for a minimum battery level so charge it enough if so).

On the PC:

- Start HDD Raw Copy Tool:

  - Choose Source by double clicking the line starting with FILE and select <where you have your emunand backup stored>\sxos\emunand\boot0.bin file. The same line will now appear as FILE   RAW BOOT0.bin. Then click on the Continue >>> button.

  - Choose Target by clicking the line starting with USB   hekate SD BOOT0. Then click on the Continue >>> button.

  - Click the START button, wait for the transfer to complete and then close HDD Raw Copy Tool.

  - Disconnect the USB-C cable.

On the switch:

- Press the Close button (if the emuMMC BOOT0 mount window is still showing).

- If it is not as OFF already, press Read-Only ON button (not drawn as a button but just text, but it is indeed a button) and make sure it says Read-Only OFF.

- Press on BOOT1 button that's next to emu RAW GPP (BEWARE: DON'T PRESS THE BOOT1 THAT'S NEXT TO eMMC RAW GPP, PRESS THE BOOT1 THAT'S NEXT TO emu RAW GPP) button.

- Connect the USB-C cable from the switch to the PC (it may ask for a minimum battery level so charge it enough if so).

On the PC:

- Start HDD Raw Copy Tool:

  - Choose Source by double clicking the line starting with FILE and select <where you have your emunand backup stored>\sxos\emunand\boot1.bin file. The same line will now appear as FILE   RAW BOOT1.bin. Then click on the Continue >>> button.

  - Choose Target by clicking the line starting with USB   hekate SD BOOT1. Then click on the Continue >>> button.

  - Click the START button, wait for the transfer to complete and then close HDD Raw Copy Tool.

  - Disconnect the USB-C cable.

On the switch:

  - Press the Close button (if the emuMMC BOOT1 mount window is still showing).

  - Press the x Close button (it will not be drawn as a button but it is actually a button) on the upper right corner of the screen.

On the PC:

- Copy the Nintendo folder contents from <folder you where you saved the backup> to /Emutendo/ on the SD card.

7. Fixing the Hybrid MBR partition info:

- Unmount the SD card and insert it in the switch.

- Boot hekate and enter its boot menu (maintain Vol- pressed when booting).

- Go to Tools > Partition SD Card > Fix Hybrid MBR. (if you did step 6. you are already in Tools section so just press Partition SD Card button and then press Fix Hybrid MBR).

- NOTE: this is needed because we formatted the FAT32 partition after the partition layout was created with hekate.

8. Enabling access to the FAT32 partition on Android (optional but convenient):

- If you haven't already, root the device with magisk.

- Go to magisk > settings icon at upper left corner > Mount Namespace Mode and choose Global Namespace.

- From now on you can access the FAT32 partition at /mnt/vendor/factory/, either directly or mounting that on boot or so (tasker, some shell script,...).

Steps for future backups and restores of your "Ordered and Contiguous" emunand + "Nintendo files":

A. Creating backups of your "Ordered and Contiguous" emunand + "Nintendo files" (optional):

- Power off the switch, extract the SD card and put it on the PC.

- Copy the Emunand folder from the SXOS folder on the SD to the <folder you want the backup to be stored>

- Copy the Emutendo folder on the SD card to the <folder you want the backup to be stored>.

B. Restoring backups of your "Ordered and Contiguous" emunand + "Nintendo files" (optional):

- NOTE: This is the exact same process as in step 6. Use that.

Credits and thanks:

First of all, thanks to fellow GBATemp user ***lordelan,*** for telling me about this limitation in the first place, for explaining it to me and for all the supportive comments while I was researching this.

Credits go to:

CTCaer for hekate
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switchroot team for ***switchroot***
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TheyKilledKenny for EmuTool

And finally, greetings to all fellow tempers ;)