environment, but also immerses the players to think over the plot and characters' intents which extends to further discussions in non-mediated environment—the reality.

V. Appealing audio—8-bit music, Tone Filter

Besides dynamics, the study by Huiberts shows that the appeal of specific sounds and music tracks engages in players' participation in games.[170] The appealing audio sometimes doesn't contribute to the feeling of presence, but instead enhances the "vibe" of the game which 'makes the player want to play more, while at the same time making him/her happy'.[171] Kohata mentioned in GDC 2018, that in order to fully present the world of 《NieR: Automata》, they added some electronic effects to enhance the whole atmosphere, including music transition during the hacking sequences and the Lo-Fi effects.[172] In this section, we'll take a close look at the sound implementation on hacking, while the Lo-Fi effect will be elaborated in chapter 7.

Figure 23. Screen **transition of Hacking**
(from left : normal, process, hacking in)
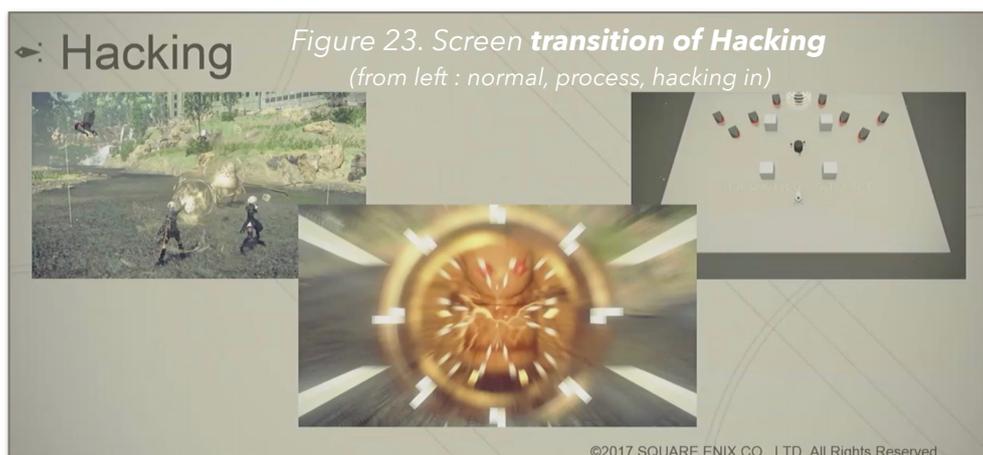
For Ueda Masami, the implementation director of 《NieR: Automata》,the most important thing was to make the music flow naturally, and continue to be pleasant for the players no matter how many times these tracks have repeated.[173] When the players start the route B, they play the role of 9S, who is the scanning model of YoRHa and defeats the enemies by hacking into their electrical circuits. Thus, when the hacking

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[170] Huiberts, *op. cit.,* p.66

[171] Huiberts, *op. cit.,* p.67

[172] See footnote 104.

[173] Taura, *op. cit.,* p.9

section begins, the visual changes from the 3-dimensional environments to the 2-dimensional screen, as shown in Figure 23.[174] Following the visual change, the soundtrack gradually devolves into an 8-bit chip version when entering the hacking sections. Instead of using cross-fading, 'the original track is gradually bit-crushed into square waves to smooth the transition', said by Kohata. This "bit-crushed" process is made by **Tone Filter**, the plugin developed by Ueda who was inspired by the previous game's soundtrack <*Legend of Nier: 8-Bit Heroes*> and therefore proposed to use 8-bit sounds in the hack scenes.[175]

The process begins with converting the chosen music pieces from stereo into mono for the DSP processing. As Figure 24 illustrates, a 48-tone range (four octaves) filters out the mono signal as a **sine wave**. At this stage, any very low, very high and subtle tones are cut out. Next, they adjust the level of each tone and apply the distortion to this range, aiming to change its waveform into a **square wave** (a harsher sound associated with classic game consoles).[176] Then, they drop out noise that occurred during the previous stage. Finally, this processed tone range is mixed back in with the original track, after which other spatial effects (e.g., reverb) are added accordingly. There are 2 points that Kohata and Ueda emphasised. **Firstly**, the Tone Filter system generally operates one
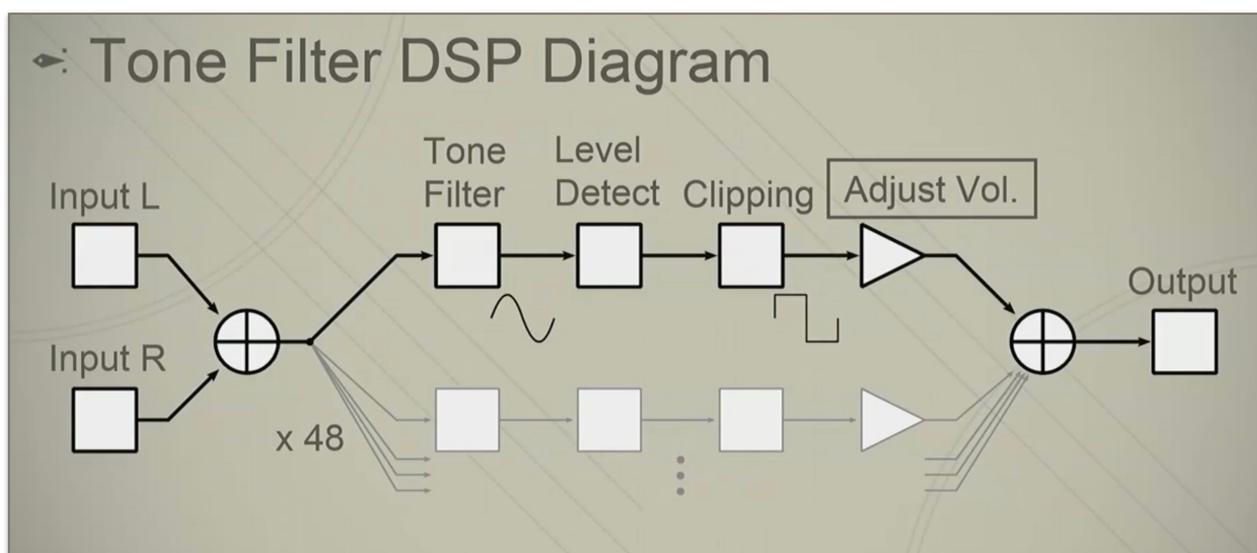

*Figure 24. **Tone Filter** DSP diagram (from the speech slide of Kohata (2018), see footnote 104)*

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[174] See footnote 104.

[175] Ueda, M. (2017, July 25). 『NieR:Automata』BGM実装の開発裏話. [Web log post] PlatinumGames official website. Retrieved from https://www.platinumgames.co.jp/dev-nier-automata/article/155

[176] *Loc. cit.*

track at one time, and the aim is not to generate different sounds but to repurpose the track into square wave by using band-pass-filter in high intensity.[177] Only by using the deconstructed tones directly, is the natural sounding transition possible. **Secondly**, the Tone Filter system may not exactly be a solution to making 8-bit music, but it focuses more on 'handling several consecutive changes'[178], which corresponds to the chief principle of the game design—seamlessness—for 《NieR: Automata》.

Figure 25. Transition by Crossfading only (without Tone Filter)

Figure 26. Transition with Tone Filter

Compared to only using cross-fading technique (Figure 25), the sounding effect adopting in the Tone Filter 'softens the switch over to 8-bit, which adds to the impression that 9S is trying to hack, but doesn't know whether he'll succeed. It also makes for a nicer connection to the 8-bit version when the hack is successful', explained Ueda.[179] Normally, this transition only occurs for 2 or 3 seconds during smoothing the process which is not easy to be noticed. But in gameplay 19, when 9S tries to hack into the Tower for the final boss (1:27:00–1:27:27), the transition lasts 27 seconds. The original soundtrack <**31.** *Song of the Ancients—Atonement*> is obviously distorted

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[177] See footnote 104.

[178] Ueda, *op. cit.,* p.3

[179] *Loc. cit.* *Figure 25, 26, 27 are translated from the same article by Ueda (2017).

before 9S can successfully hack in, which adequately informs the player of the difficulty and the uncertainty of breaking in (see Appendix #4).

However, not every track has an 8-bit version. Since 'we couldn't make 8-bit versions of every single piece from scratch, in some cases, we had to use some automatically-generated music', described Ueda. The automatically-generated music goes through the same Tone Filter DSP until the hack succeeds. The only noteworthy difference is after the hacking, as shown in Figure 27. Ueda indicated that 'instead of fading completely out, the regular version of the song lingers in the background while the filtered version continues to play over it. […] We felt that it sounded best with the filtered version at 80% with a bit of a stereo delay'.[180] After this power-consuming DSP stage, the sounds still needed 'a lot of small improvements [to be], tweaked and tested and built up, to create a quality musical experience', noted Ueda.

Figure 27. Using Tone Filter for no corresponding 8-bit music

Actually, the idea of using 8-bit music to present 9S' hacking scenes didn't appear until Ueda's proposal. Nonetheless, it turned out to be a very wise decision for 3 reasons. **Firstly**, it demonstrates the character's unique skill well by incorporating suitable sound effects. This especially takes places in rout B, where the players have already known what is going to happen. The new sound effects correspond to the different protagonists of the similar route, which gives the game a brand-new perspective to continue. **Secondly**, the 8-bit music is the new appeal among the normal soundtracks. A study by Reid found that the bit-crushed timbre of chiptune has a specific charm which 'may adhere to the stylistic conventions of video game soundtracks of the 1980s and 1990s.'[181] Thus, not

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180 *Loc. cit.*

181 Reid, G. (2018). Chiptune : The Ludomusical Shaping of Identity. *The Computer Games Journal,* 7, 279–290. https://link.springer.com/article/10.1007%2Fs40869-018-0070-y