



# An Interactive Sound Dystopia: Real-Time Audio Processing in NieR:Automata

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# ► Topics

- The role of real-time audio processing for sculpting distinctive game soundscapes
- Maximizing the interactive potential of the medium
- Furthering sound designer's stylistic choices with real-time audio





# ➤ Outline

- Spatial Audio Effects
  - 3D Audio / Interactive Reverb
- Electronic Effects
  - Hacking Transitions / lo-fi
- Other Audio Effects
  - Voice Changer / And More!







# ➤ Spatial Audio Effects

- Reverb, Occlusion, 3D Audio
  - Similar to shading for graphics
  - Enhances immersion
  - Creates a collective sound atmosphere
- Focus points for this talk
  - 3D Audio Simulation
  - Interactive Reverb



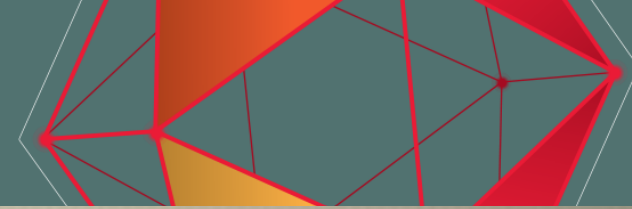


# 3D Audio

- Creating a 3D sound atmosphere regardless of playback environment
- Effects carefully adjusted to preserve design and protect original audio
- Effects with a low CPU cost that can be used on almost any sound







# Simple 3D



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Direction Test

Bank

Event

Azimuth

Elevation

Speed

Axis Azimuth

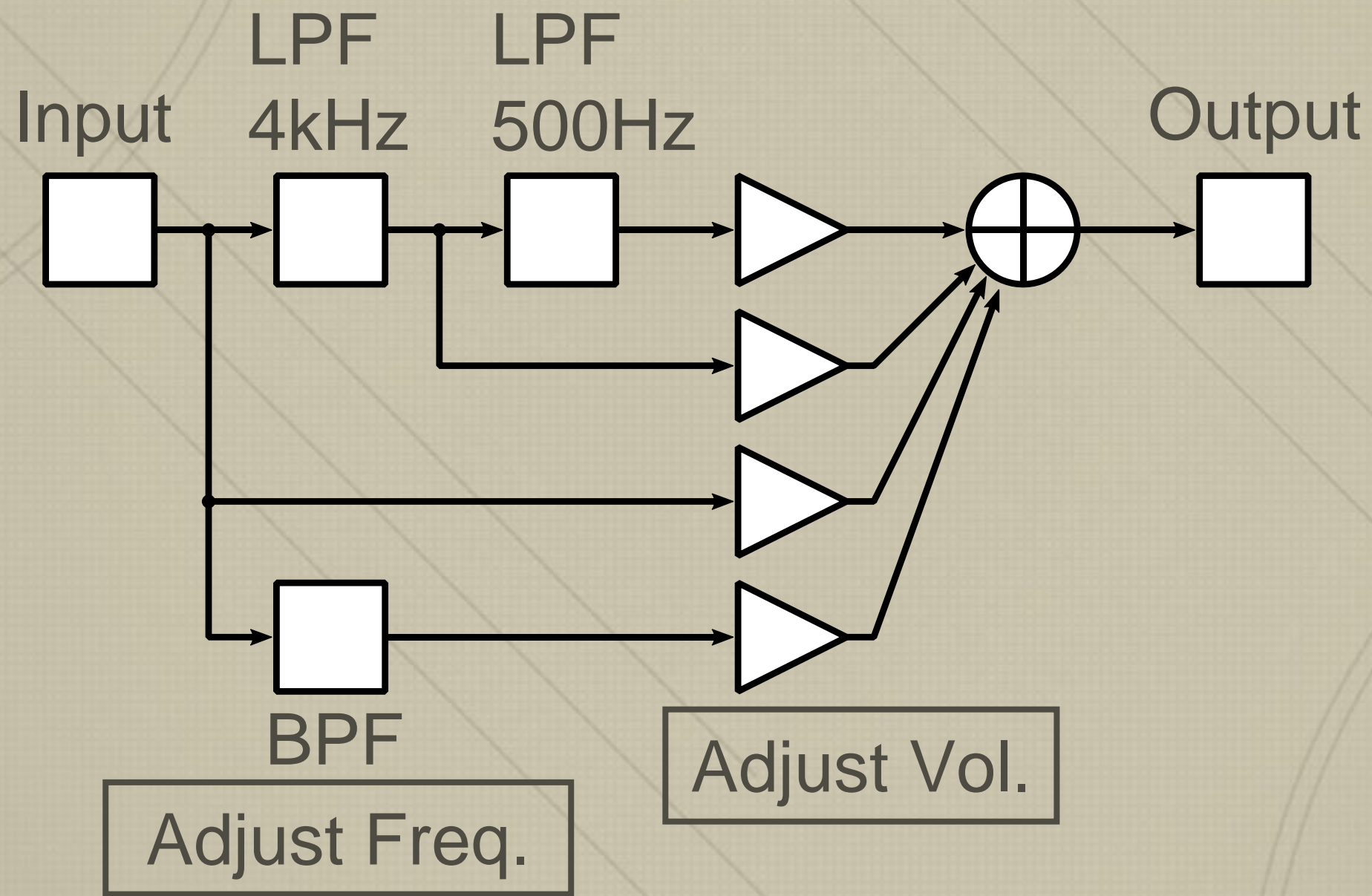
Axis Elevation







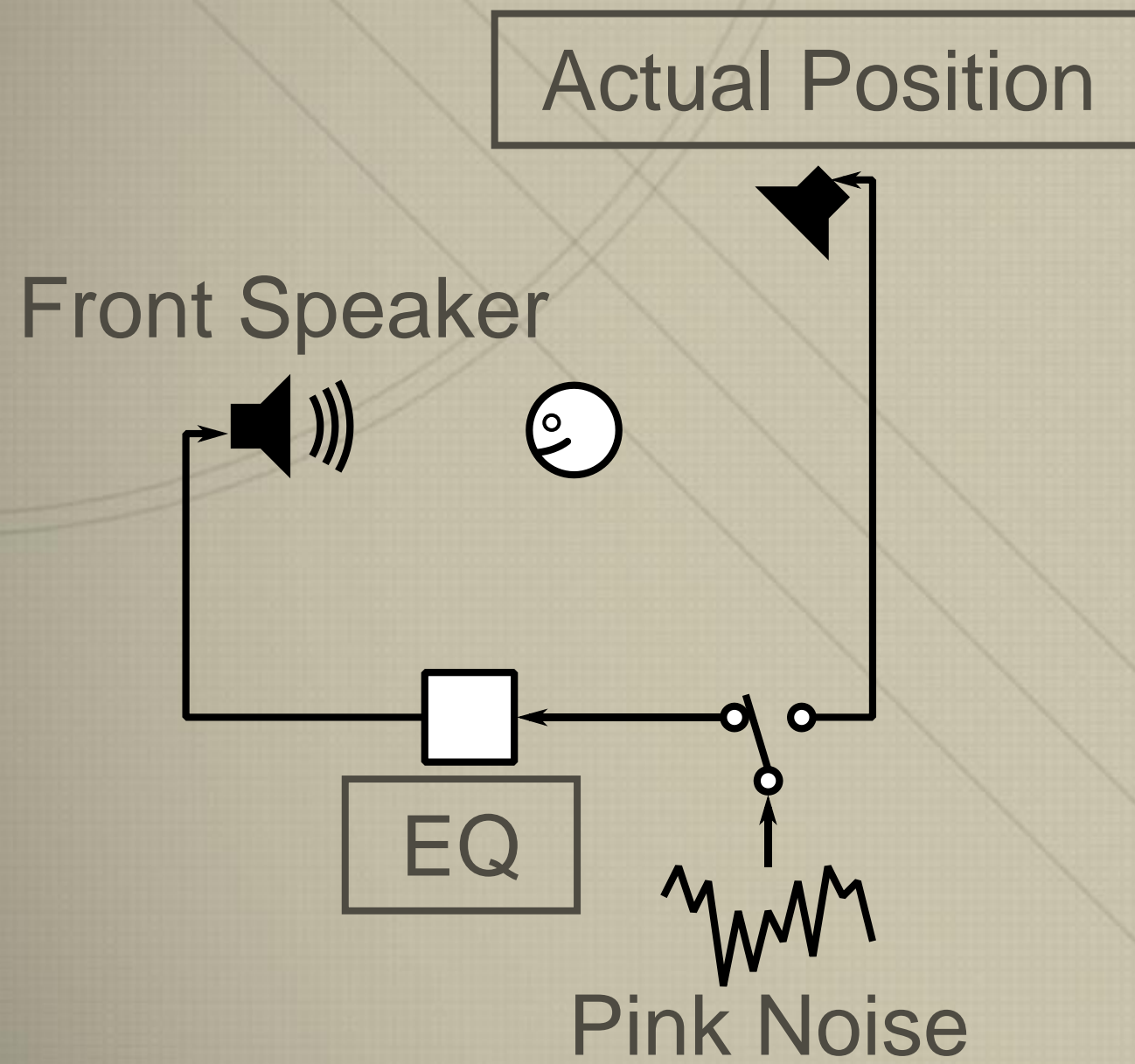
# Simple 3D DSP Diagram







# Subjective EQ



- Set up EQ for front audio
- Calculate how position effects sound
- Adjust EQ to recreate sound position through front speaker





# ► Interactive Reverb

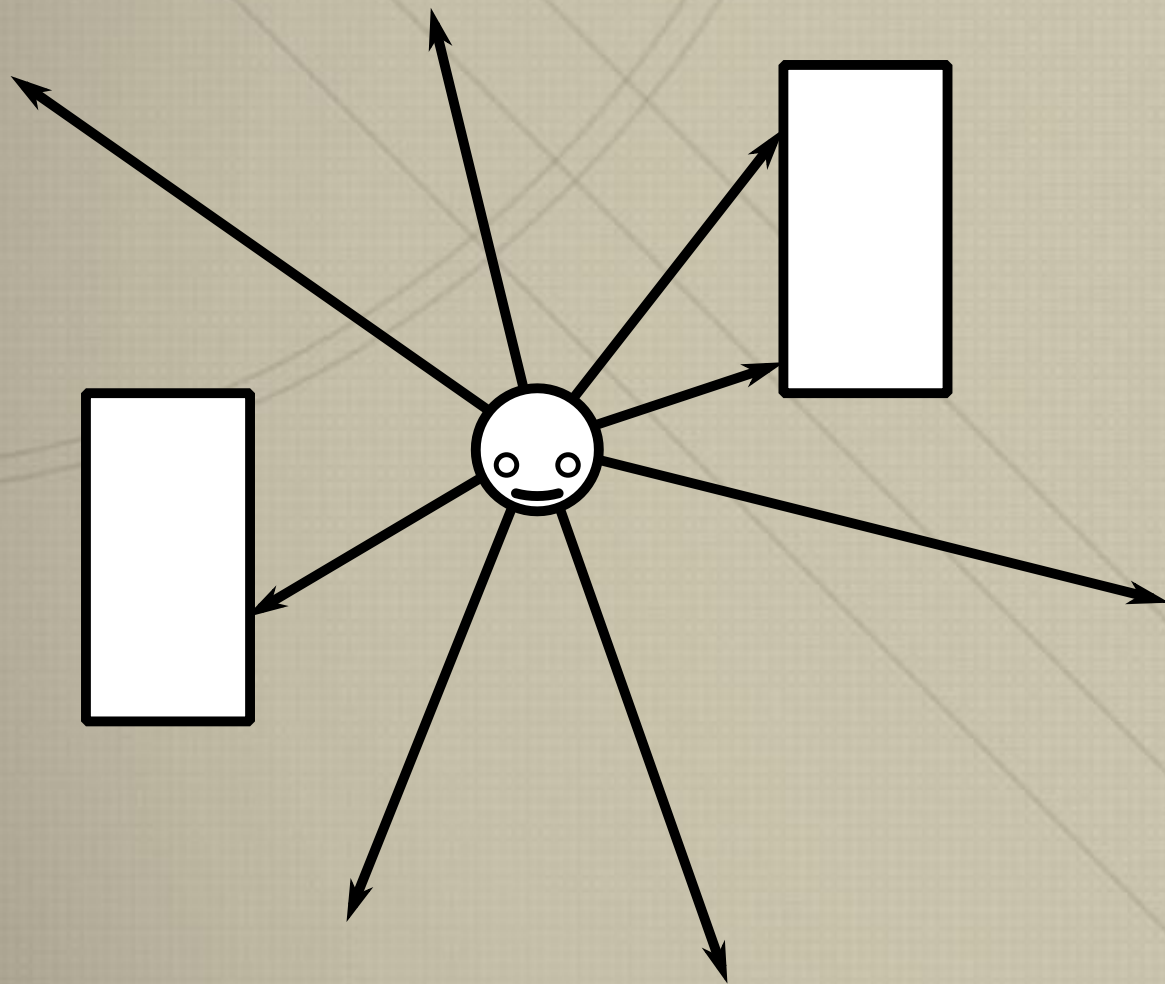
- Analyzes surrounding terrain; adjusts reverb accordingly
- Continuously adjusts multiple parameters
  - Stronger, longer reverb depending on direction
  - Levels & quality differ depending on terrain composition
  - Supports real-time geographic change







# ➤ Raycast



- Raycast player's surroundings
- Multiple rays per frame, directions random
- Temporarily records collision points
- Uses collision points to determine distance / reverb level / filter level

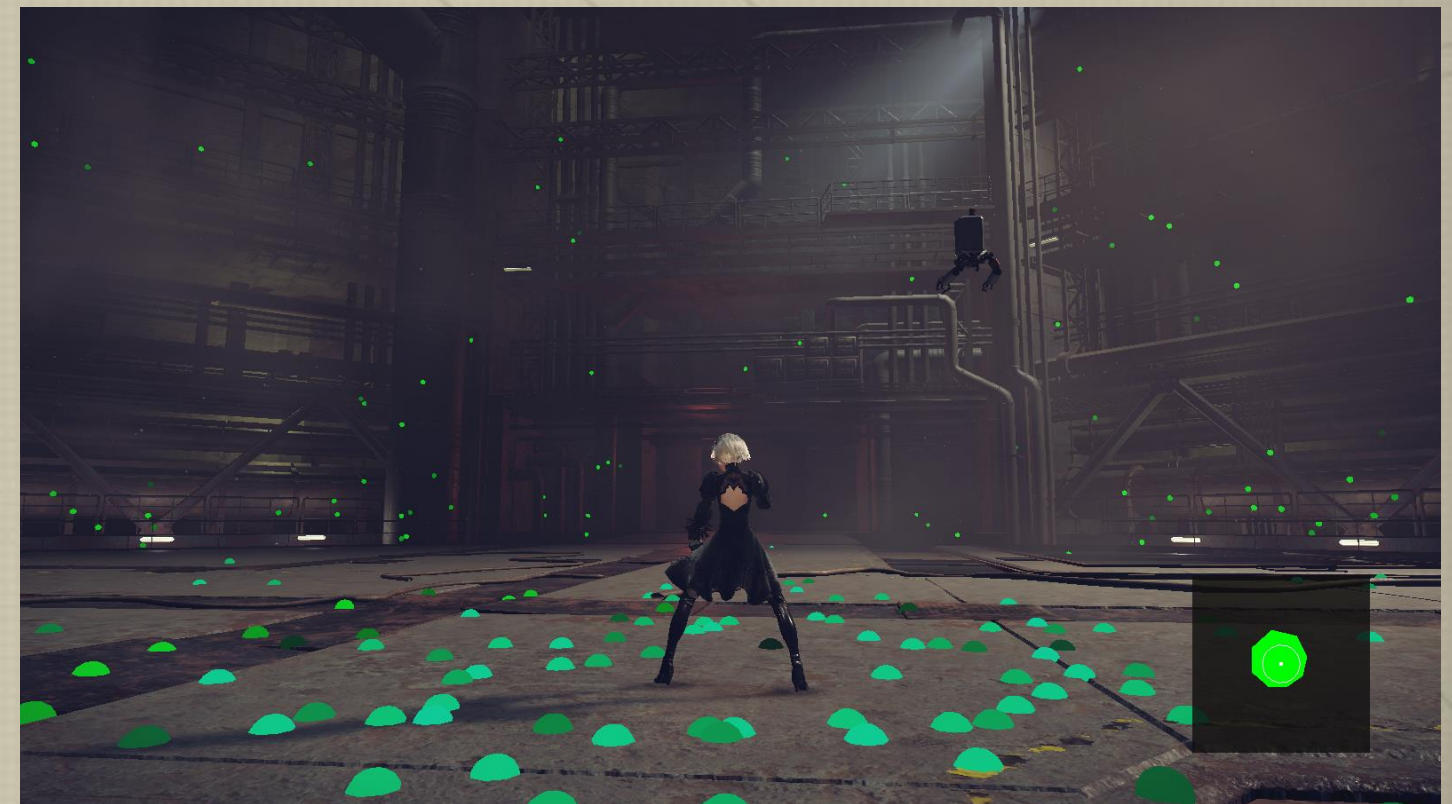






# ➤ Raycast

- Visualization of raycast collision points
- Narrow vs. wide spaces



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## ➤: “K-verb”

- Use terrain data from raycasts to make reverb
- Reverb should stay in world location rather than “stick” to the screen direction
- Prioritize delivery of satisfying sound over accuracy of simulation
- Keep performance costs as low as possible

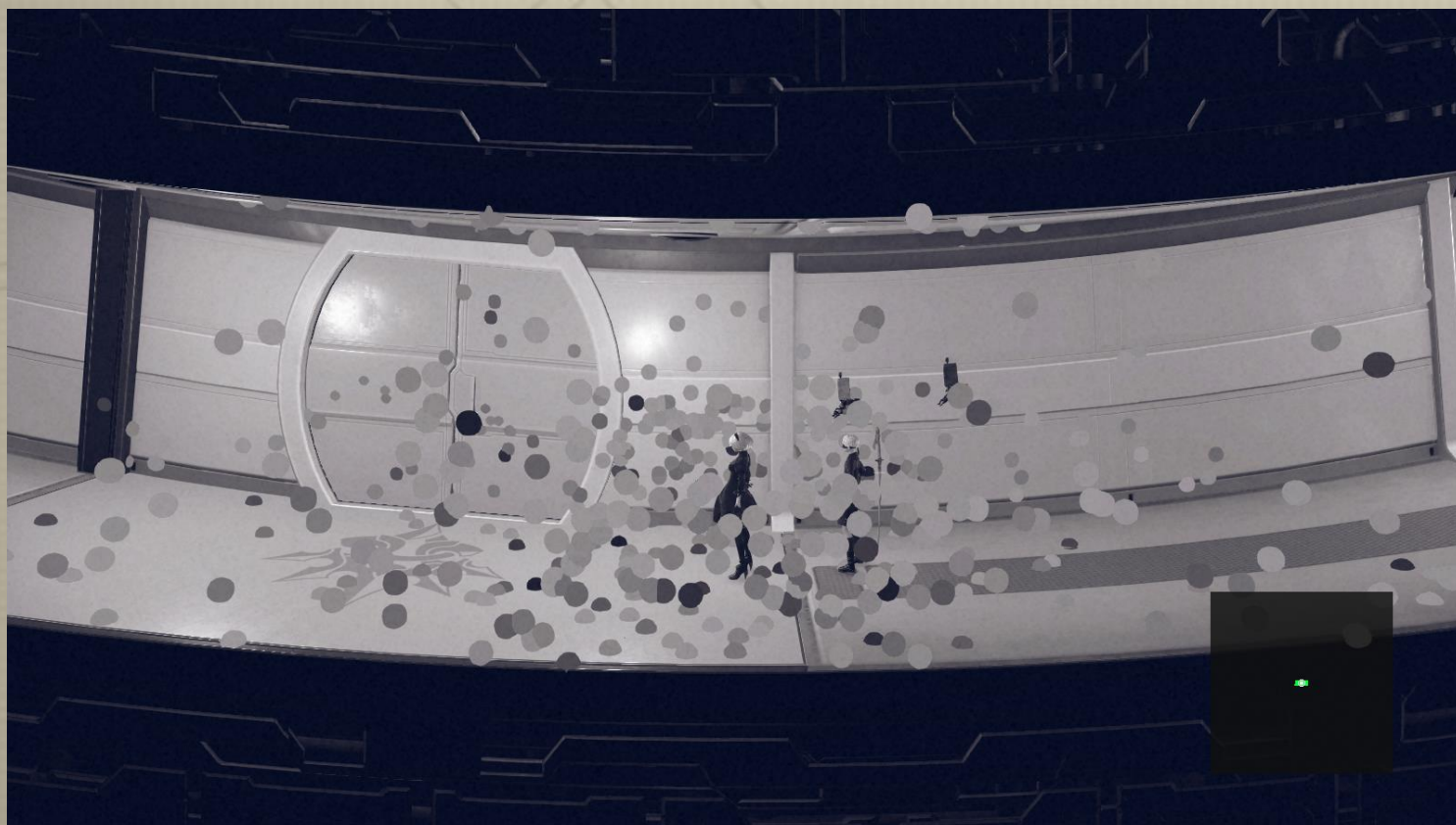






# ◀: “K-verb”

- Compare sounds in different-sized spaces

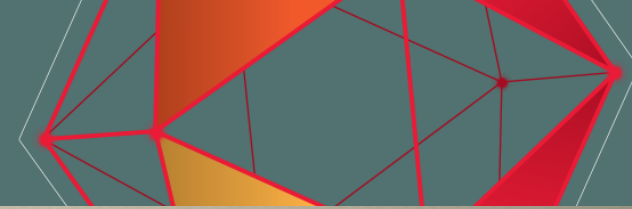


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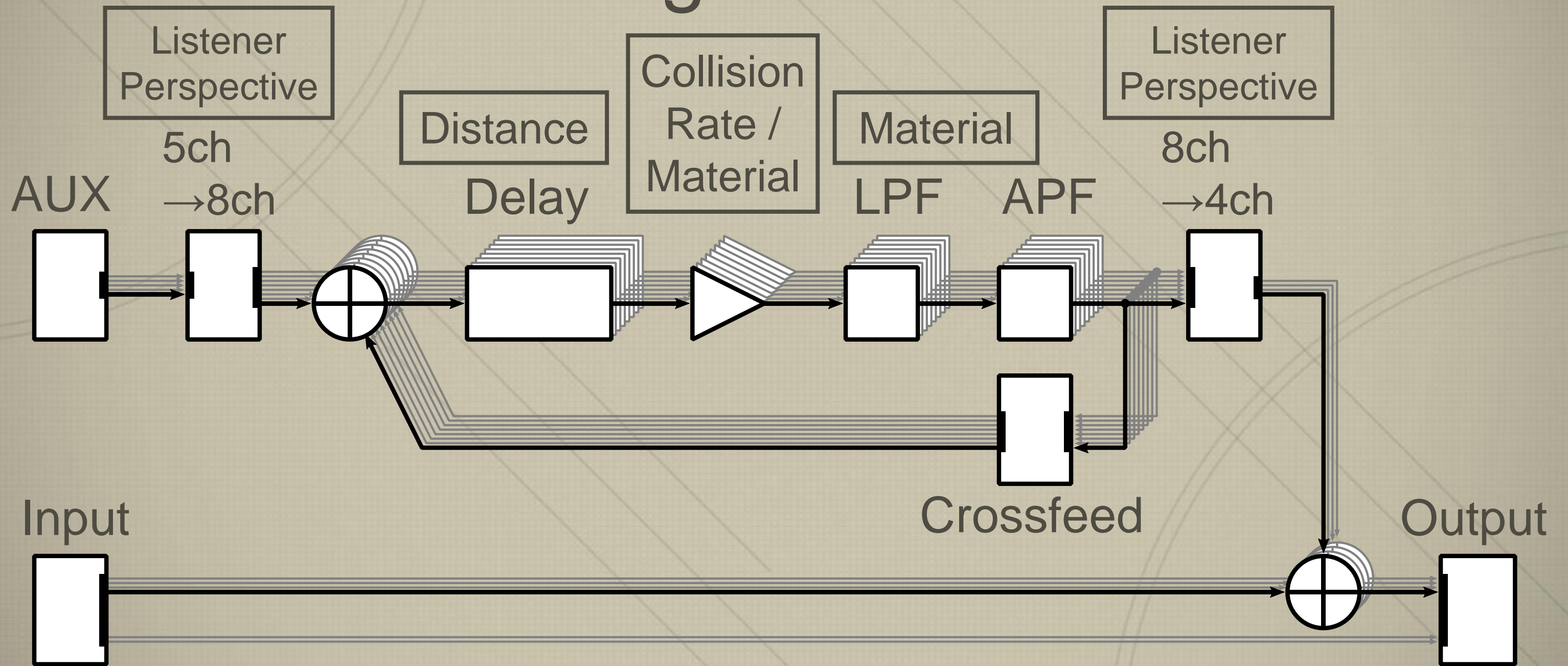




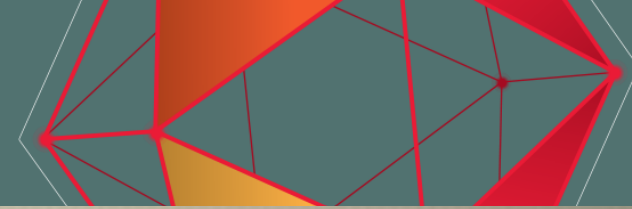




# “K-verb” DSP Diagram

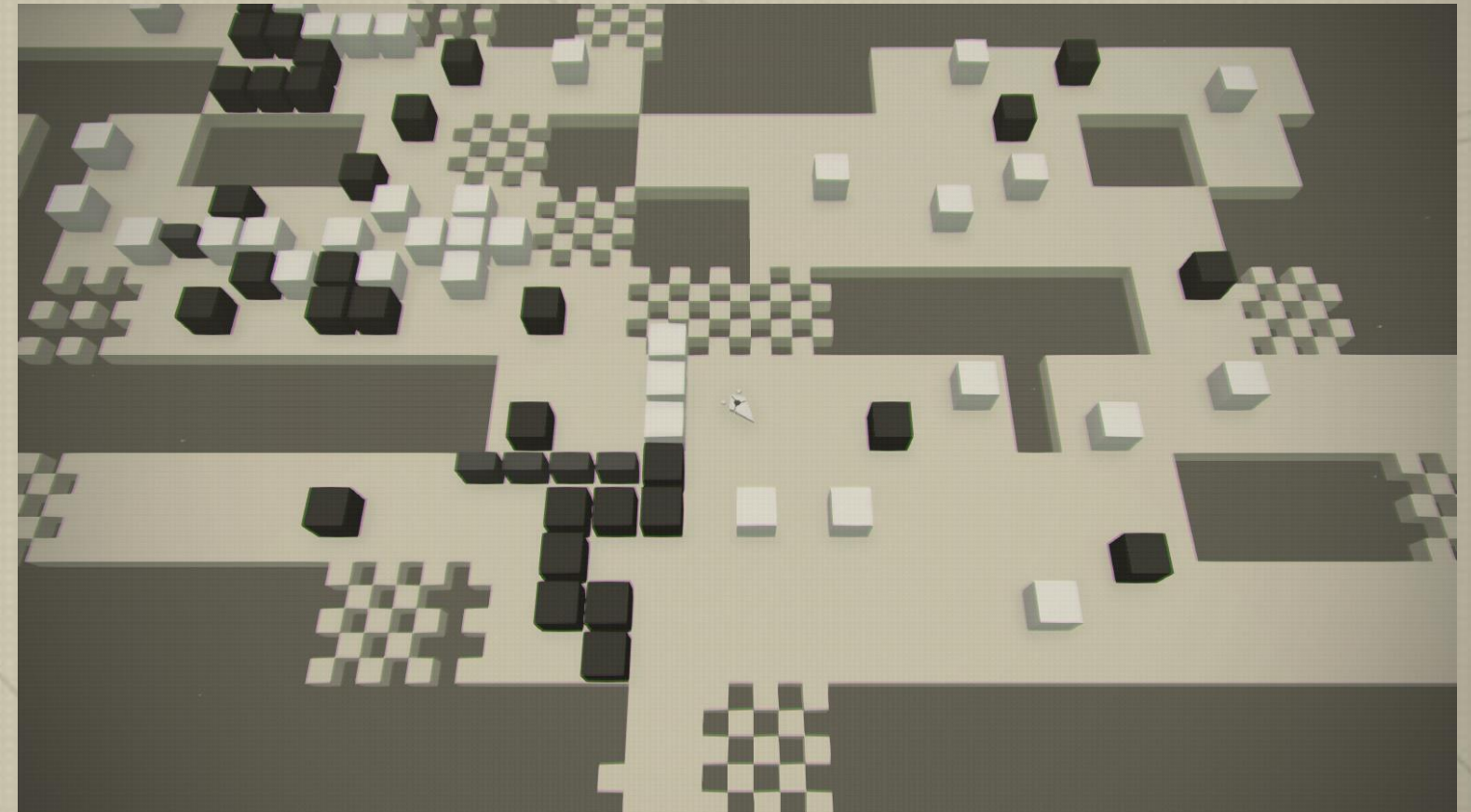






# ➤: Electronic Effects

- Hacking Transitions
- lo-fi effect



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# ➤ Hacking

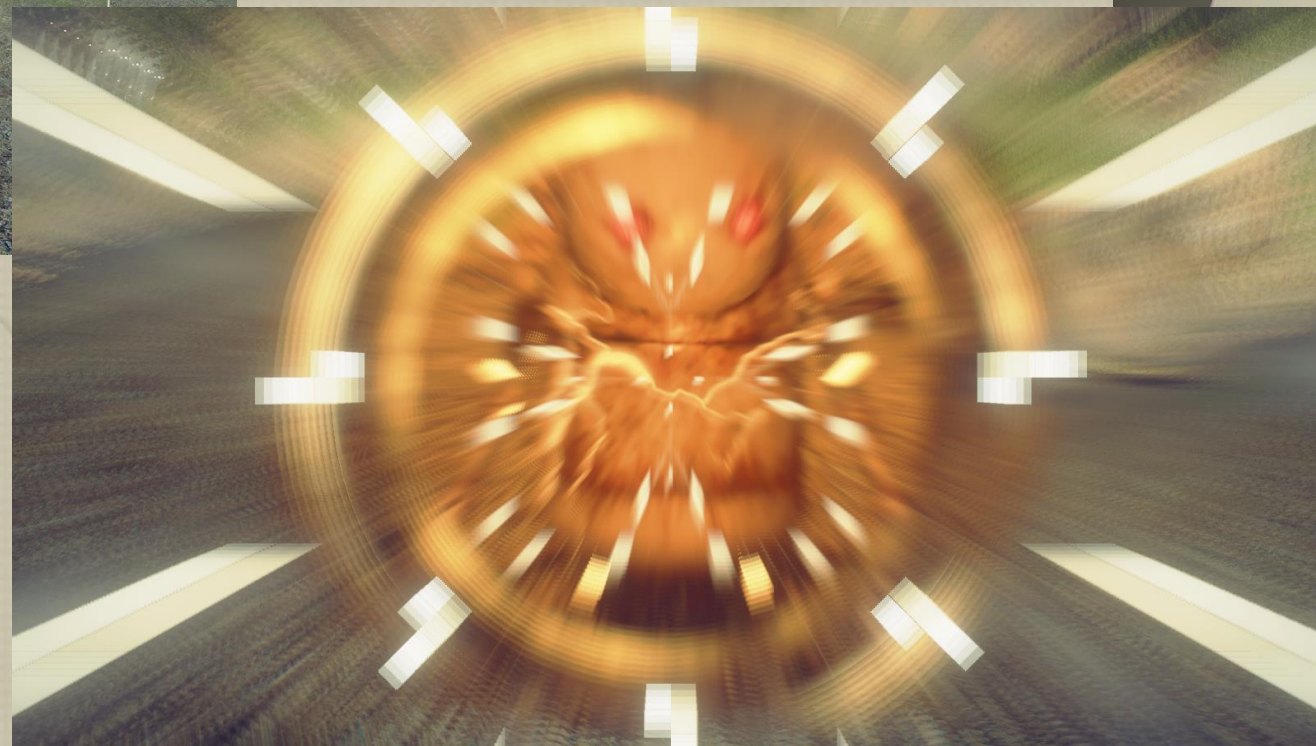
- In-game music gradually devolves into 8-bit chip sounds when entering the hacking sections
- Before cross-fading, the original track is gradually bit-crushed into square waves to smooth the transition







# ➤: Hacking



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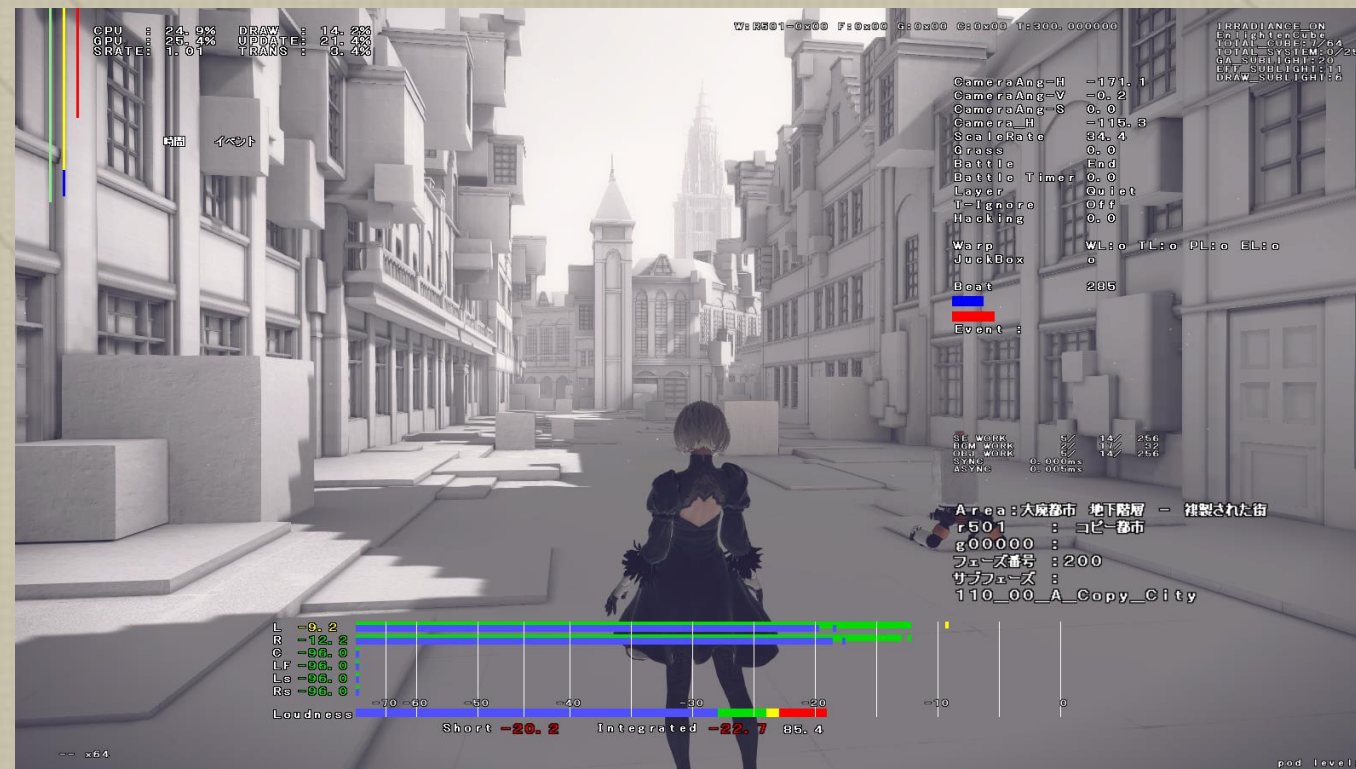






# ➤ Tone Filter Video

- Let's hear how the music switches over to an 8-bit sound during the hacking phases, comparing with effects and w/o effects.



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CPU : 44.6% DRAW : 15.2%  
GPU : 106.2% UPDATE : 39.8%  
SRATE: 1.00 TRANS : 4.8%

W: R501-0x00 F: 0x00 G: 0x00 C: 0x00 T: 300.000000

IRRADIANCE\_ON  
EnlightenCube  
TOTAL\_CUBE: 7/84  
TOTAL\_SYSTEM: 0/256  
GA\_SUBLIGHT: 20  
EFF\_SUBLIGHT: 10  
DRAW\_SUBLIGHT: 5

時間 イベント  
018699 BGM\_Set\_Fx\_CopyCity  
018699 BGM\_Set\_St\_Copy  
018699 BGM\_Set\_Layer\_Quiet  
018699 BGM\_Vocal\_Off  
018699 Area\_CopyCity\_In  
018697 BGM\_CameraRTPC\_Off  
018697 Event\_Start  
018697 BGM\_Resume\_All  
018697 BGM\_Set\_St\_Copy  
018697 BGM\_Set\_Layer\_Quiet  
018697 BGM\_Vocal\_Off  
018697 BGM\_Area\_ForceCopySpot\_Off  
018697 BGM\_Area\_ForceCopyAll\_On  
018697 BGM\_CameraRTPC\_On  
018697 Movie\_End  
018595 BGM\_Pause\_Through  
018595 BGM\_Pause\_Env  
018595 BGM\_CameraRTPC\_Off  
018595 Movie\_Start  
018219 BGM\_Set\_None\_6000mm  
018219 Spot\_CopyCity\_Elevator\_Before  
018219 BGM\_Load\_Out  
018219 Load\_Out  
018219 BGM\_Area\_ForceUnitAll\_On  
018219 BGM\_Area\_Barricade\_Off  
018219 BGM\_Set\_Fx\_CopyCity  
018219 BGM\_Set\_None\_6000mm  
018219 BGM\_Area\_ForceCopySpot\_On  
018219 BGM\_Area\_ForceCopyAll\_Off  
018219 BGM\_Area\_ForceSubmerge\_On  
018219 BGM\_Area\_ForceRobot\_Off  
018219 BGM\_Area\_Barricade\_Off  
018219 BGM\_Battle\_Ignore\_On  
018219 BGM\_Stop\_SqBGM  
018219 BGM\_Duck\_Voice\_On  
018219 BGM\_Hacking\_Ignore\_Off  
018219 RouteA  
018219 Phase\_Change

CameraAng-H -6.4  
CameraAng-V 5.5  
CameraAng-S 0.2  
Camera\_H -116.1  
ScaleRate 15.4  
Grass 0.0  
Battle End  
Battle Timer 0.0  
Layer Quiet  
T-Ignore Off  
Hacking 0.0

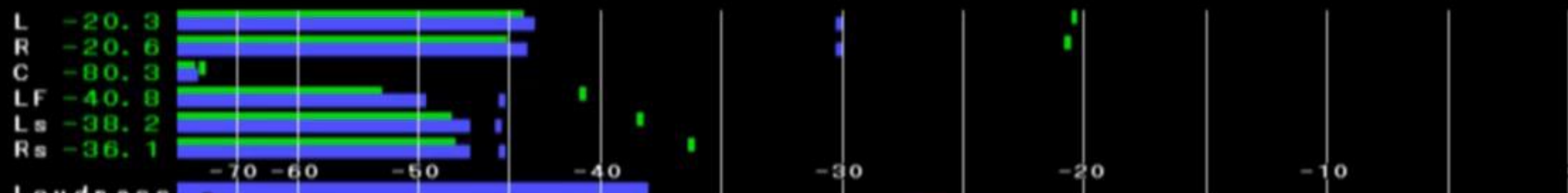
Warp WL: o TL: o PL: o EL: o  
JuckBox o

Beat 1

Event :  
ev0511 cut00 NORMAL EVENT  
F( 4.00/ 300) TF( 4.00/ 300)

SE WORK 7/ 23/ 256  
BGM WORK 6/ 17/ 32  
OBJ WORK 8/ 24/ 256  
SYNC 0.000ms  
ASYNC 0.004ms

Area: 大魔都市 地下階層 - 複製された街  
r501 : コピー都市  
g00000 :  
フェーズ番号 : 200  
サブフェーズ :  
110\_00\_A\_Copy\_City

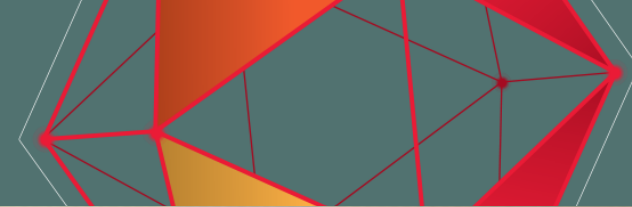


1 イベント開始リクエスト ( ev0511 )

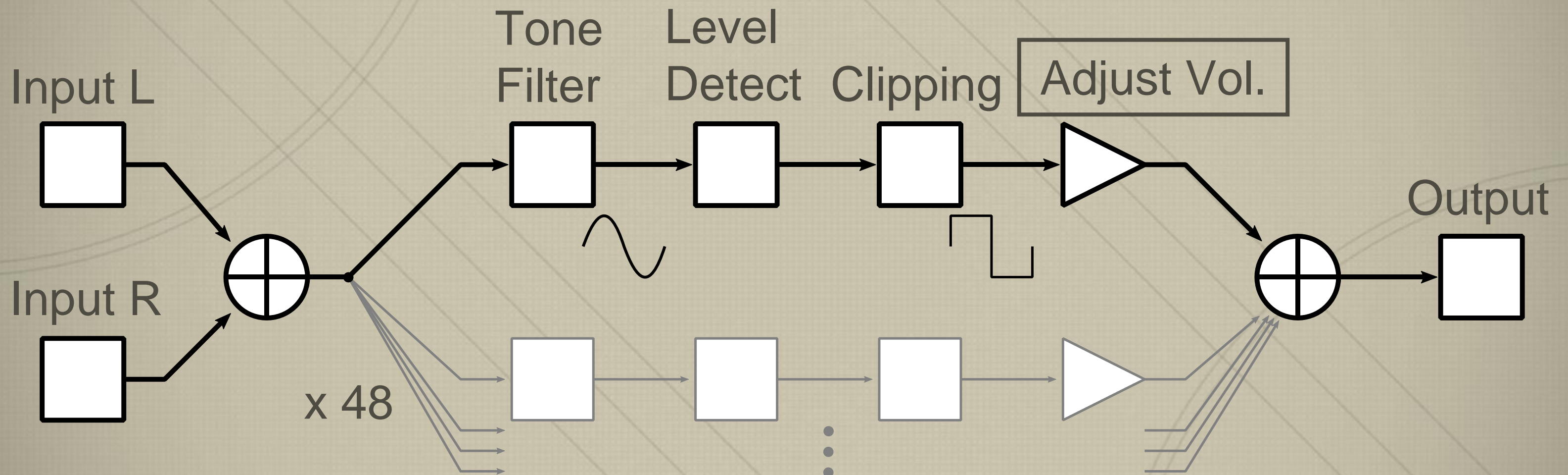
Event::requestChainReserve

fc2db38 unstable

イベント読み込みリクエスト ( ev0511 )



# ➤ Tone Filter DSP Diagram







## ➤ lo-fi

- lo-fi effects, while common, are hard to pull off without annoying the player
- Used when receiving transmissions or when the player's senses are being jammed.
- Effect created by studying the composition of old digital recording machines







## ➤ lo-fi

- Let's compare changes in music/sound when status ailments occur.



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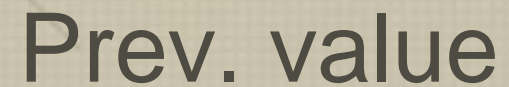


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Lv: 1



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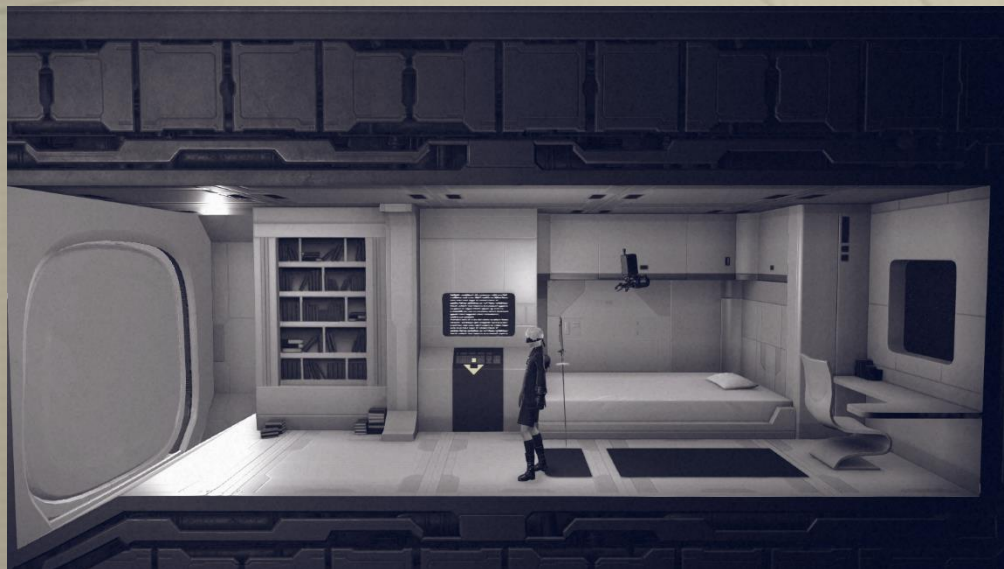






# ➤: Other Audio Effects

- Voice Changer
- Emil Music (Doppler Effect, other effects)
- Let us become gods! (Synched to music)



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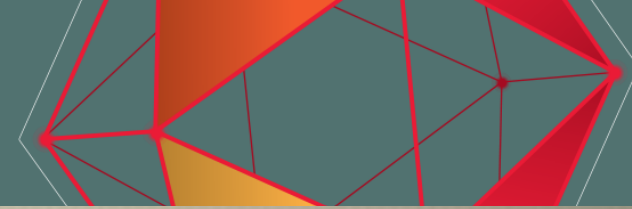


# ➤ Conclusion

- NieR:Automata sound design focused on utilizing the new capabilities of real-time audio processing that recent consoles have made possible
- Audio team crafted audio processing tools specifically for NieR:Automata to increase user connectivity
- Sound designers and engineers can maximize audio expressivity by venturing into each other's territories



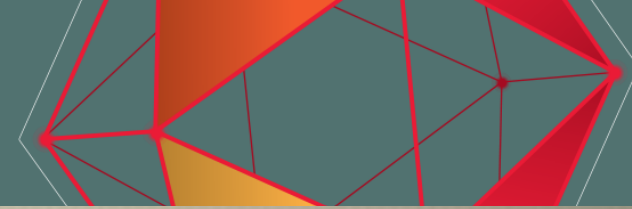




📌: Thanks







# ➤: Further Reading

## ■ Blog

- [Happy Hacking: Music implementation in NieR:Automata](#)
- [The Hands-On Sound Design of NieR:Automata](#)

