



Audible Enclaves and PAL Technology

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Sound waves are **longitudinal**, propagating through **compression and rarefaction**, but they also spread due to **diffraction**, leading to **dispersion** (which **increases with frequency**), making **precise sound delivery** to a **specific individual difficult in noisy environments**.

- However, **audible enclaves** and **parametric array loudspeakers (PAL)** solve this by focusing sound into **narrow beams**, ensuring **only the intended listener hears it**.
- **Audible Enclaves (AE):** These are **focused pockets of sound** created using **2 high-frequency waves** that are individually inaudible but produce **audible sound at specific locations** through **nonlinear interactions**.
 - This ensures **precision sound delivery** without external disturbance, enhancing **privacy and customization**.
- **PAL:** PAL uses **high-frequency ultrasonic waves modulated with an audio signal** to create a **highly directional sound beam**, ensuring only targeted listeners hear the audio.
 - By **self-demodulating** in the air, they generate focused sound while preventing unwanted dispersion.
- **Applications of PAL and AE:** PAL and AE find applications in **museums, retail, public announcements**, immersive entertainment, assistive technology, and **security**, offering **precise audio** without disturbing surrounding areas.

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