TECHNICAL AUDIO SYSTEMS CASE STUDY

Scalable Remote Explosion Audio

A middleware-driven distance treatment for clarity, realism, and mix stability in large battles

Disclosure This case study is intentionally generalized. Project names, character classes, content names, internal object identifiers, exact distances, authored values, production budgets, and proprietary implementation details have been removed or abstracted.

Summary

A large-scale multiplayer combat mix needed explosions to remain intelligible beyond immediate engagement range without allowing distant impacts to reproduce with the same brightness, weight, and prominence as nearby events. I developed a reusable Wwise treatment that coordinates dry attenuation, distance filtering, a restrained distant-field reverb return, and voice relevance. The design preserves close impact while turning remote explosions into darker environmental evidence of combat.

Contribution

- Designed the distance-based behavior and reusable authoring architecture.
- Created separate dry and distant-field signal paths while preserving positional direction.
- Developed filtering and reverb strategies to control transient density and low-frequency accumulation.
- Applied the shared treatment across the relevant projectile-explosion families.
- Profiled single events and clustered battle conditions to validate readability and scale.

1 The systems problem

A close explosion and a remote battlefield report should not occupy the mix in the same way. In a dense encounter, dozens of similar full-band impacts can overlap before their low-frequency bodies and reverberant tails have decayed. The result may be loud without being informative: transient definition collapses, low frequencies appear to pulse or flange, and remote activity competes with the player's immediate actions.

Failure mode	Audible consequence	Required behavior
Full-spectrum playback at long range	Remote impacts sound too close and compete with foreground combat.	Remove detail and weight progressively as listener distance increases.
Independent long tails on many impacts	Reverb accumulates into a diffuse wash and weakens direction.	Use one restrained distant-field return with controlled decay and bandwidth.
Unmanaged low-frequency overlap	Repeated explosions create a cloud that can sound phasey or unstable.	Reduce remote low-frequency contribution in both the dry signal and wet return.
Every event treated as equally important	Distant or redundant reports displace useful nearby feedback.	Use hierarchy limits and distance-weighted relevance so less useful voices yield first.
One treatment placed on a broad combat bus	Unrelated impacts, ambience, or specialty weapons inherit the wrong behavior.	Apply the system only to eligible explosion families through shared authoring assets.

Design objective

Create a perceptual handoff rather than a simple fade. Nearby explosions should remain immediate, directional, and detailed. At greater range, the dry report should become quieter and darker while a controlled environmental tail carries the event without turning it into foreground information.

2 Distance treatment architecture

The solution uses the middleware's built-in emitter-to-listener distance as the common control source. A shared attenuation configuration coordinates level, low-pass filtering, high-pass filtering, and the user-defined auxiliary send. No separate gameplay parameter is required for the core distance response.

Distance region	Dry signal	Filtering	Distant return
Near field	Retains impact body and directional definition.	Little or no filtering.	Off or effectively inaudible.
Transition	Begins a controlled reduction without a sudden step.	High-frequency detail starts to soften; low-end cleanup begins gently.	Introduced gradually behind the dry source.
Remote field	Functions as evidence of combat rather than a foreground hit.	More aggressive bandwidth reduction supports distance and reduces buildup.	Provides the broad environmental signature.
Outer edge	Approaches inaudibility smoothly.	Strongest filtering, with no abrupt tonal switch.	Fades out before or with the source endpoint.

Signal flow

1. A positioned explosion enters the shared distance treatment.

2. The dry path retains normal three-dimensional routing and follows its authored level and filter curves.

3. A separate user-defined send rises only when the source enters the intended distant region.

4. The send feeds a dedicated wet-only return with short, dark reverberation and cleanup EQ.

5. The dry and wet paths recombine downstream while unrelated ambience and specialty impact systems remain independent.

Why the paths remain separate

The dry signal communicates location. The distant return communicates scale and surrounding space. Keeping those responsibilities separate makes it possible to darken and broaden the remote signature without sacrificing the directional information carried by the original emitter.

3 Reverb and spectral control

The distant return is not intended to simulate every local environment. Its job is narrower: provide a controlled, repeatable battlefield tail that becomes audible only after the source has moved beyond the near field. Existing environmental reverbs can continue to describe the listener's immediate space.

Return component	Generalized treatment	Reason
Early reflections	Minimized or disabled.	Avoids imposing the same small-room signature on open terrain and varied environments.
Pre-delay	Short separation before the tail.	Keeps the initial impact readable and prevents the return from masking the transient.
Decay	Short and controlled.	Allows scale without leaving long overlapping tails during rapid combat.
High-frequency damping	Darkened relative to the dry source.	Supports perceived distance and reduces bright reverberant clutter.
Low-frequency feed	Strongly reduced or excluded.	Prevents repeated wet returns from rebuilding the explosion low end.
Dry level on return	Removed.	Keeps the auxiliary bus wet-only and avoids duplicating the positioned source.
Post-reverb EQ	Low-end cleanup, mild low-mid reduction, and high-frequency rolloff.	Controls rumble, boxiness, and excessive brightness across many simultaneous events.

Relationship to environmental reverb

The combat return and game-defined environmental returns are auditioned separately during tuning. If both tails become prominent, the mix can develop a level jump or doubled wash. The remote-explosion return therefore remains restrained and tonally neutral enough to coexist with changing spaces.

Mix principle

The distant return should be felt as support, not heard as a second explosion. Its send level may appear modest in isolation because the design is evaluated under accumulation, where several small sends can combine into a clearly audible field.

4 Scale and voice relevance

Extending the audible range increases the number of eligible emitters. Distance treatment alone does not prevent those sources from consuming voices, so the architecture pairs perceptual distance with voice governance.

Control	Authoring role	Battle-scale effect
Family playback limit	Caps simultaneous explosions inside the eligible hierarchy.	Prevents one effect family from dominating the entire combat allocation.
Per-emitter allowance	Restricts rapid stacking from one owner when needed.	Stops a single projectile source or character from monopolizing the family limit.
Base priority	Keeps explosions relevant without protecting every instance equally.	Allows higher-value local and player-facing feedback to remain competitive.
Distance priority offset	Reduces priority as the source approaches its outer range.	Makes remote reports the first explosion voices to yield under pressure.
Finite one-shot behavior	Terminates culled impacts rather than preserving them indefinitely.	Avoids stale explosions returning after their visual moment has passed.
Parent inheritance	Keeps child content subject to shared category policy.	Prevents each variation from creating an independent voice budget.

What the system does not do

- It does not turn ambience emitters into distance-controlled explosions.
- It does not route specialty siege impacts through the generic combat return when they already have a dedicated treatment.
- It does not replace local environmental acoustics with one universal battlefield reverb.
- It does not assume that every distant event deserves a physical voice.

5 Deployment approach

The system was proven on a limited explosion hierarchy before being expanded. Once the distance behavior and shared return were stable, the reusable configuration was applied across the relevant projectile-explosion Actor-Mixers instead of recreating curves and effects for every individual sound.

Phase	Action	Validation
Scope	Identify only the explosion families that should share the treatment.	Muting the selected parents affects no unrelated impacts, ambience, or specialty weapons.
Pilot	Apply positioning, shared attenuation, and the distant return to one representative family.	Near and remote behavior remain continuous with no routing surprises.
Tune	Balance dry falloff, filter progression, send shape, reverb tone, and return cleanup.	Single events sound plausible and clustered events remain readable.
Scale	Assign the approved shared configuration to the remaining eligible parent mixers.	Children inherit consistently without per-file curve duplication.
Govern	Add or confirm category limits, priority, and finite-event behavior.	Remote redundancy yields before local gameplay feedback.
Profile	Capture representative movement and battle-density scenarios.	No unexpected voice growth, doubled reverb, or unrelated hierarchy changes.

Why shared authoring mattered

The original content was distributed across many class and effect hierarchies. A shared attenuation asset and a common auxiliary return turned what could have become a large manual-editing task into a maintainable system. Future tuning can be made centrally and inherited by the eligible content set.

Boundary checks

Specialty impact systems and world ambience remain on separate routes. This prevents a generic combat adjustment from altering assets whose range, reverb, or voice strategy was authored for a different purpose.

6 Validation and results

Testing combined perceptual listening with Wwise profiling. The treatment was evaluated at representative near, transition, remote, and endpoint positions, first with isolated impacts and then with clusters of overlapping events.

Validation area	Evidence	Acceptance condition
Distance continuity	Dry level, filter movement, and send level while traversing the range.	No sudden tonal step, level jump, or premature disappearance.
Direction	Dry source auditioned separately from the return.	The event remains localizable even as the remote field broadens.
Spectral stability	Repeated impacts monitored for low-end and low-mid accumulation.	No sustained rumble cloud, boxy buildup, or phase-like pulsing.
Reverb accumulation	Dedicated return soloed during clustered playback.	The shared tail supports scale without masking new transients.
Voice behavior	Physical and virtual voice activity under representative density.	Redundant remote impacts yield before critical nearby feedback.
Isolation	Unrelated ambience, specialty impacts, and environmental returns compared before and after rollout.	Only the intended explosion families inherit the new behavior.

Outcome

The completed treatment was deployed across the applicable explosion Actor-Mixers. Nearby impacts retained their immediacy and direction, while remote explosions became quieter, darker, and more spatially supportive. Under clustered playback, the shared return and bandwidth control reduced the tendency toward low-frequency buildup and reverberant wash.

Transferable value

The final deliverable is not an isolated preset. It is a reusable method for separating foreground impact from distant battlefield evidence, scaling a treatment across distributed content hierarchies, and combining perceptual distance with runtime voice relevance. The same approach can support artillery, demolition, heavy weapons, environmental destruction, and other high-energy events in large interactive spaces.

Portfolio role

System design, Wwise implementation, attenuation and filtering strategy, reverb architecture, hierarchy rollout, profiling, and in-game tuning.