

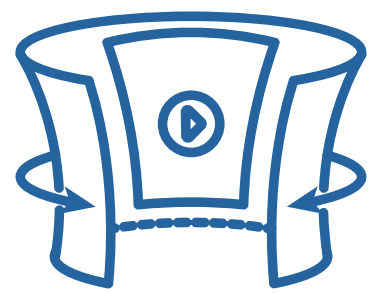
# STREAM: Scalable telepresence with real-time enhanced multimedia



## Abstract

**STREAM** enhances **real-time immersive telepresence for Extended Reality (XR) applications**, significantly improving multimedia efficiency, realism, and interoperability. Leveraging advanced multimedia technologies, **STREAM achieves over 50% bandwidth reduction for 4K XR video streaming** by integrating Versatile Video Coding (VVC/H.266) within the open-source GStreamer framework, facilitating **seamless multimedia streaming directly within browsers using WebAssembly (WASM)**. These advancements foster more accessible and immersive XR experiences, enabling higher-quality interactions with reduced network resources.

## Objectives



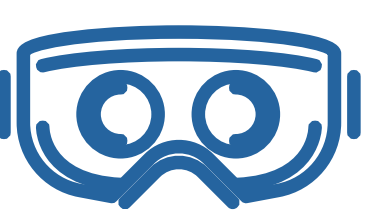
Reduce bandwidth demands for 4K XR telepresence **using advanced video codecs** (VVC/H.266).



Enable cross-platform compatibility by **integrating VVC within GStreamer** and supporting **browser-based execution with WASM**.



Ensure **real-time communication** suitable for interactive XR applications **via WebRTC and WebTransport**.



Implement **alpha channel support** for advanced video layering and immersive XR compositing.

## Technical approach



**Codec integration and optimization:** VVC/H.266 integrated into GStreamer, achieving significant bitrate reduction without quality loss.



**WebAssembly (WASM) integration:** GStreamer cross-compiled for browser environments using Emscripten, allowing native multimedia performance in browsers without additional installations.



**Real-time transport protocols:** Dual-protocol approach (WebRTC & WebTransport) ensures robust streaming compatible with various browser environments and XR platforms.



**Alpha channel support:** Enabled advanced compositing for XR environments (e.g., background removal, depth layering), enhancing visual realism and immersion.

## XR impact and benefit

- ➔ Enables **higher quality, scalable XR telepresence experiences** at significantly lower bandwidth.
- ➔ Promotes **cross-platform XR accessibility** without compromising performance or visual fidelity.
- ➔ Facilitates faster and simpler deployment of immersive XR experiences, **supporting European innovation** in virtual collaboration technologies.

## Results and validations

### Bandwidth Efficiency (KPI achieved):



Over **50% bandwidth reduction** verified by perceptual quality testing (VMAF metrics).



User studies confirm **no perceived visual quality degradation** between H.264 and VVC/H.266 encoded streams.

### XR Application Demonstrations:



Native (**Linux + WebRTC**) and browser-based (**WASM + WebTransport**) XR streaming demos.



GStreamer-based streaming pipeline **validated in controlled testing conditions**, ensuring stability and high visual fidelity critical for XR interactions.

### Bandwidth comparison: H.264 vs H.266

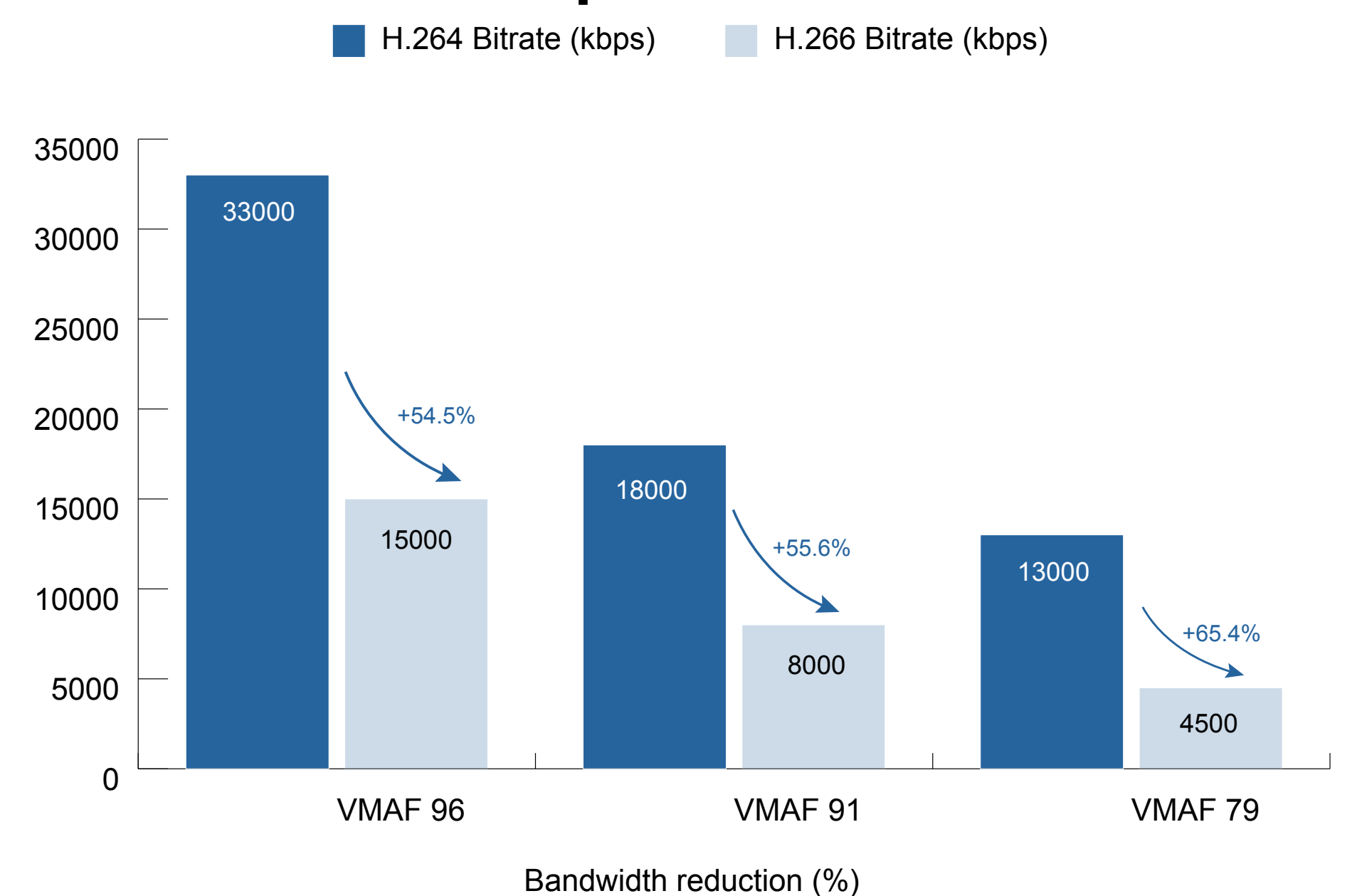


Fig.: VMAF results

### References (selection)

Netflix Tech Blog. Toward a practical perceptual video quality metric (2016): <https://netflixtechblog.com/toward-a-practical-perceptual-video-quality-metric-653f208b9652>  
ITU-T Recommendation H.266. Versatile Video Coding (VVC) (2020): <https://www.itu.int/rec/T-REC-H.266>  
GStreamer Project: <https://gstreamer.freedesktop.org>

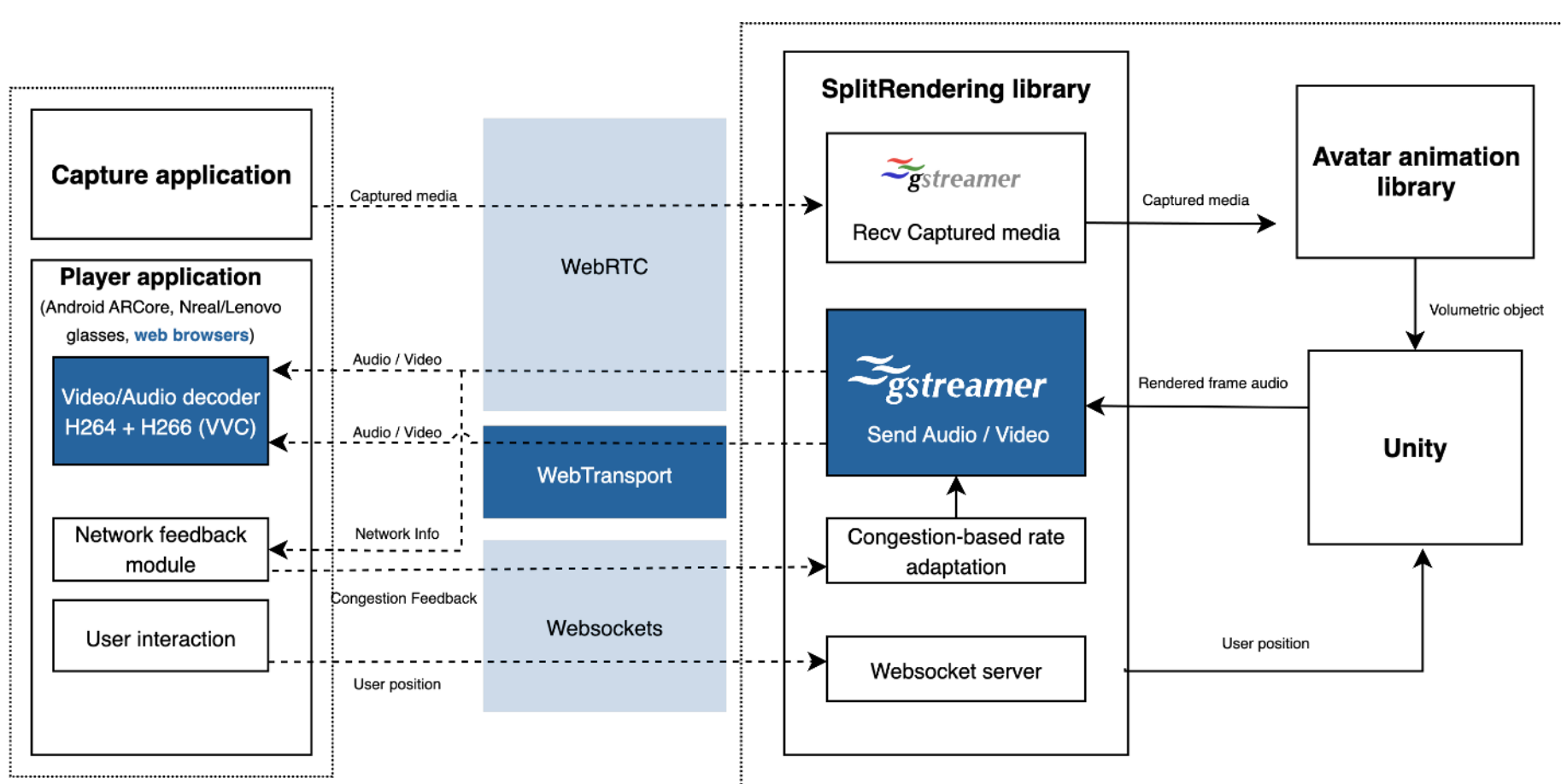


Fig.:STREAM on Spirit architecture



**Contact:**  
Mónica Barroso  
Fluendo  
mbarroso@fluendo.com

Learn more:

