

TRACER: Modular Open-Source Framework for Real-Time XR Collaboration

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Data management in distributed XR productions has become a major topic ever since more and more digital elements were introduced into traditional workflows for filmmaking, experiences and presentations. Virtual productions, VR multi-player games and AR applications demand for open, software agnostic and future proof pipelines.

We introduce **TRACER** (Toolset for Realtime Animation, Collaboration & Extended Reality), a software agnostic communication infrastructure and toolset for plugging open-source tools into a production pipeline, establishing interoperability between open source and proprietary tools, targeting real-time collaboration and XR productions, with an operational layer for exchanging data objects and updates including animation and scene data, synchronization of scene updates of different client applications (Blender, UE, Unity ...), parameter harmonization between different engines/renderers, unified scene distribution and scene export which stores the current state of the scene.

TRACER foundation, a modular, open-source C# framework handling

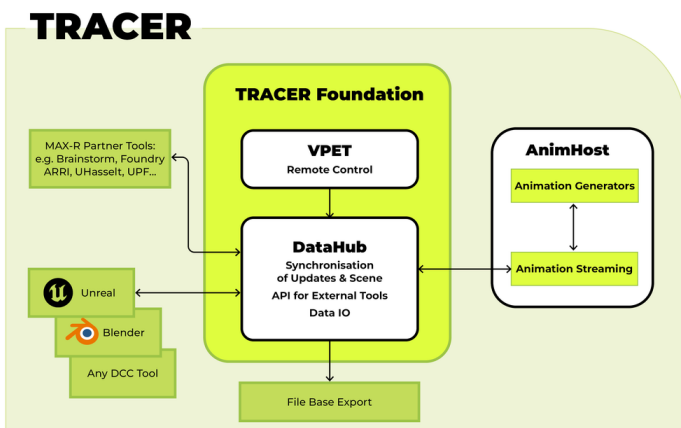


Figure 1: Overview of TRACER

scene operations, input methods, UI, animation and communication between various clients, is the core of the toolset. It is easily extensible by adding new modules. Compact and efficient protocols unify scene transfer and real-time updates across different DCC applications and game engines like Blender, Unity, Unreal Engine etc. All networking is based on netMQ / zeroMQ.

Along with the core and a basic set of modules a multitude of example implementations, integrations and extensions has been developed.

VPET [2], the Virtual Production Editing Tool is a tablet based app to visualize 3D scenes in AR and edit various aspects like object position, rotation, scale, light parameters, cameras and now even animations with an intuitive interface. Based on an initial implementation of VPET, the fundamental functionalities were made available for more general XR applications resulting in the TRACER foundation, through a re-factoring and reimplementing. VPET 2.0 now serves as a sample implementation in the TRACER foundation framework.

Along with VPET being a remote control for 3D scenes and beyond, a number of native scene providing plugins has been developed. Plugins for Blender, Unreal Engine, Unity 3D plugin for TRACER make it possible to distribute an authored scene directly to other TRACER clients like VPET, while changes to the scene are shared with all clients synchronously.

DataHub is another central component of the TRACER ecosystem. Being the connecting link between all instances, the DataHub has the ability

to distribute and store incoming data and therefore act as a scene server and event recorder providing this data for potential post production steps. This makes it possible to store and load complete scenes, as well as their changes over time. Changes in the scene get redistributed to all connected clients.

With technologies like marker-less, video-based motion capturing and AI-generated character animation, pipelines for animated movies are transforming. Movie Productions utilising game engines for rendering demand for interactive and real-time animation directing capabilities that can be driven by artists and directors. While AI-based human character animation generators exist in research, their applied usage in animated movie production is sparse. The interactive nature combined with the demand for artist controllability asks for new user interfaces and pipelines.

AnimHost connects animation generators (such as AI deep neural networks trained on motion capturing databases, video-based, low-cost motion capturing and many more) to DCC applications, on-set tools like VPET or renderers in general. It is functionally independent of the animation receiving app and provides an intuitive interface to support new solvers, with a focus on real-time scenarios. Animations can be directed either in Blender or VPET for now. A simple walking path in form of a spline enriched with additional information like look-at rotations can be defined, based on which AnimHost generates a full-body bone animation for the given character. Just like DataHub, AnimHost is implemented as a Desktop application within the Qt framework. To evaluate this development the 3d short film production "Survivor"¹ has been initiated.

Examples include virtual productions, the origin of VPET and the concepts behind TRACER, while more recent implementations provide a variety of applications. For example, "Fate of the Minotaur" [1], a VR multi-player game, utilizes TRACER incl. DataHub as backend realizing collaborative player interactions with the game's world. Another application are "Digital Locations". Location Scouts can explore potential shooting locations digitally in VR/AR and in the browser, plan logistics or even use the digital representation in productions. TRACER provides a simple interface to load arbitrary scenes into VPET or other TRACER based applications through scanning a simple QR code².

Compared to other solutions for 3D production pipelines like Nvidia Omniverse, the presented TRACER framework provides a comprehensive set of tools to specifically address modern XR production pipelines and is available open-source. All components can be obtained from our GitHub repositories³. The modularity and applicability in games, virtual productions and XR in general sets it apart from multiplayer SDKs like Photon Fusion making it a valuable companion in research and production. While Open Sound Control (OSC) is also an open-source network protocol, it is mainly targeting real-time musical performances.

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[1] A. Dahn, L. Plichta, S. Spielmann, E. Schäfer, and J. Blönnigen. Fate of the minotaur: A scalable location based vr experience. In *ACM SIGGRAPH 2024 Immersive Pavilion*, SIGGRAPH '24. Association for Computing Machinery, 2024. doi: 10.1145/3641521.3664406.

[2] S. Spielmann, V. Helzle, A. Schuster, J. Trottnow, K. Götz, and P. Rohr. Vpet: virtual production editing tools. In *ACM SIGGRAPH 2018 Emerging Technologies*, SIGGRAPH '18. Association for Computing Machinery, 2018. doi: 10.1145/3214907.3233760.

¹<https://research.animationsinstitut.de/survivor>

²<https://research.animationsinstitut.de/digitallocations>

³<https://github.com/FilmakademieRNd>