Deliverable

Revision	Date	Author	Organisation	Description
Project Acronym:		**VRTogether**		
Grant Agreement number:		762111		
Project Title:		*An end-to-end system for the production and delivery of photorealistic social immersive virtual reality experiences*		

D5.8 - Documentation and technical fact sheets v2

Revision: 1.2

Authors: Susana Otero (i2CAT), Ana Revilla (Entropy), Iván Rodríguez(i2CAT)

Delivery date: M24

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 762111

Dissemination Level		
P	Public	x
C	Confidential, only for members of the consortium and the Commission Services	

Abstract: This deliverable is a compilation of all printed material produced so far, used for dissemination and communication purposes. In addition to the items compiled in D5.7, this deliverable includes new printed materials produced in the second year: 5 posters, 1 commercial fact sheet, 1 technical fact sheet. These materials were used in the different commercial and scientific events, such as ICT 2018, MMM 2019, ICT Open 2019, IEEE VR 2019, CERTH-ITI Open Day 2019, NEM 2019, ACM MMsys 2019 and IBC 2019.

0.1	14/11/2018	Susana Otero	i2CAT	First release
1.1	17/09/2019	Iván Rodríguez	i2CAT	First draft of second iteration
1.2	27/09/2019	Pascal Perrot	Viaccess-Orca	Final review

EXECUTIVE SUMMARY

This document is a compilation of printed dissemination material (including technical information). In this second release, the materials provided in D5.7 are supplemented by updates to these documents (project image, commercial fact sheet), as well as newly created ones (5 posters and 2 technical fact sheets).

This wide range of printed communication materials have been produced to present the project and its outcomes. Contents have been specifically created to meet the needs of each channel/audience, always with a clear and appealing approach.

The materials have been used in the global events where the VRTogether project has been showcased, including ICT 2018, MMM 2019, ICT Open 2019, IEEE VR 2019, CERTH-ITI Open Day 2019, NEM 2019, ACM MMsys 2019 and IBC 2019.

Fact sheets were created with different approaches (technical, general info, commercial, etc.). In order to give detailed explanations of the developments achieved at various dissemination events. Initial versions were focused on general information about the project (i.e.: scope, objectives, and technologies to be developed) and technical insights of the pilots. Subsequent versions were later developed to present the achievements of the project and its current status.

Furthermore, a series of posters providing detailed information on specific topics was developed during this second year. An initial poster featuring a description of the first pilot, an overview of the configuration modes and a diagram showing the platform architecture was followed by a range of posters, each taking a different approach to the project, to support dissemination at public events.

The material is accessible and downloadable through the project website: http://vrtogether.eu/project-outcomes/dissemination-materials/

CONTRIBUTORS

First Name	Last Name	Company	e-Mail
Susana	Otero	I2CAT	susana.otero@i2cat.net
Iván	Rodríguez	i2CAT	ivan.rodriguez@i2cat.net
Pascal	Perrot	Viaccess-Orca	pascal.perrot@viaccess-orca.com

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1. INTRODUCTION

This document is a compilation of the printed dissemination materials (including technical information) produced within the VRTogether project from M14 to M24.

The document is mainly structured in two parts. A first part lists all the documents produced during the second year of project. The list provides also a brief description of the document. The second part of the document provides the documents.

2. PROJECT DOCUMENTATION

2.1. List of material

Name	Version	Description	Release date	Author
Logo	1.0	A logo that was initially used in internal documents and later would be improved.	2017 October 17	Entropy
Logo	2.0	Different formats of multi colored and dynamic logo	2017 November 12	Entropy
Project image	1.0	A stock image to have a recurrent resource to be used in the several dissemination materials that transmits the project concept.	2017 November 29	i2CAT
Project image	2.0	A stock image emphasizing the social side of the project.	2017 November 29	i2CAT
Poster	1.0	A poster that introduces the project and its objectives. This poster was used in order to present the project ImmersiaTV during the workshop "Collaboration Towards the Future of Media" (organised by the EU) in Brussels on October 10th, 2017. It shows the project objectives and milestones	2017 October 10	i2CAT
Poster	2.0	An A1 poster featuring a description of the first pilot, an overview of the configuration modes and a diagram showing the platform architecture. It has been displayed at VRTogether's lab nodes, as well as in events such as CERTH-ITI Open Day 2019 and NEM 2019.	2019 January 21	i2CAT
Poster Social VR	3.0	An A1 poster presenting a general overview of the project, focused on the pipelines, platform characteristics and products. It was displayed at VRTogether's booth at IBC 2019.	2019 July 19	i2CAT
Poster Products	3.0	An A1 poster detailing the actual exploitation opportunities, including 2 end-to-end products, 2 main components and 1 evaluation service. It was displayed at VRTogether's booth at IBC 2019.	2019 July 19	i2CAT
Poster Technological Innovations	3.0	An A1 poster detailing the platform architecture and the specific innovations in terms of technology	2019 July 19	i2CAT
Poster Pilots	3.0	An A1 poster detailing the roadmap and each of the pilots, as well as the evaluation methodology.	2019 July 19	i2CAT
Commercial Fact sheet	1.0	An item that introduces the project and has been frequently used in the more initial phase of period 1: IBC 2017, NEM Summit 2017, MMSYS2018 and TVX 2018	2017 November 29	i2CAT
Commercial	2.0	A flyer with a more commercial bias that can	2018	Entropy,

Fact sheet		be used in order to reach and engage the industrial stakeholders	September 13	i2CAT
Commercial Fact sheet	3.0	A slight update of v2.0. This accordion-fold brochure presents the project and its objectives, provides an updated overview of the pilots and lists VRTogether's potential products and main features. It was distributed at IBC 2019.	2019 September 6	Entropy, i2CAT
Technical fact sheet	1.0	Design of a general document that explains the main technical aspects of the first Pilot and the demo shown. It has been used during IBC2018.	2018 September 13	Entropy
Technical Fact sheet Web pipeline	2.0	An A4, double-sided fact sheet showing the key features of the end-to-end web-based framework. It was distributed at IBC 2019.	2019 July 24	i2CAT
Technical Fact sheet Volumetric video	2.0	An A4, double-sided fact sheet showing the key features of the volumetric video production system. It was distributed at IBC 2019.	2019 September 6	i2CAT
Roll up	1.0	A roll up designed to grasp visitors' attention during the IBC2018 and inviting them to test the demo. It contains a market-oriented claim, the members of the consortium and the EU flag.	2018 October 29	i2CAT

3. LOGO

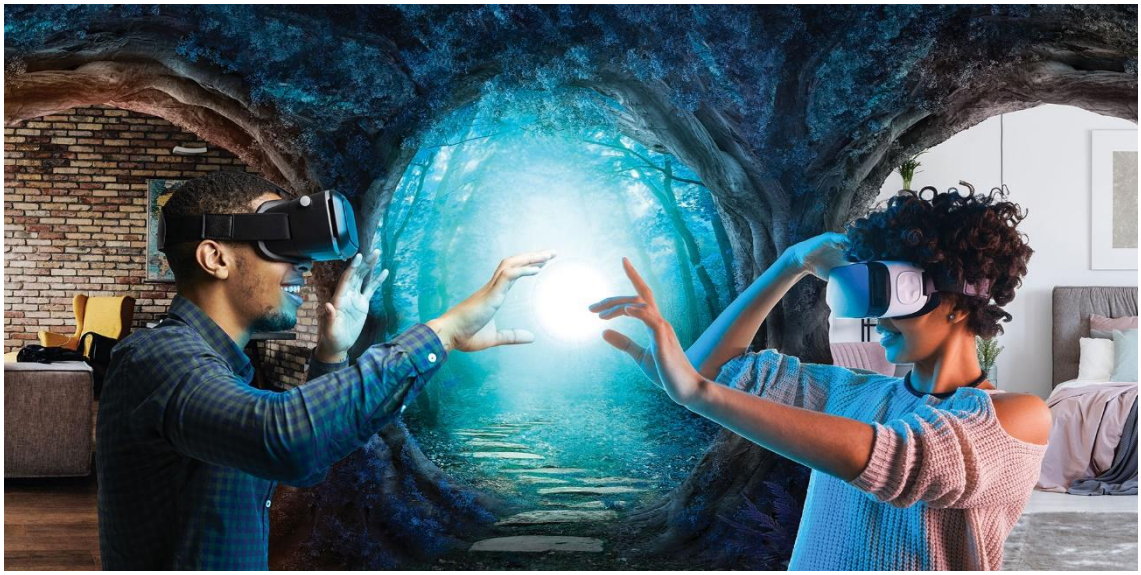
3.1. v1.0

3.2. v2.0

4. PROJECT IMAGE

4.1. v1.0

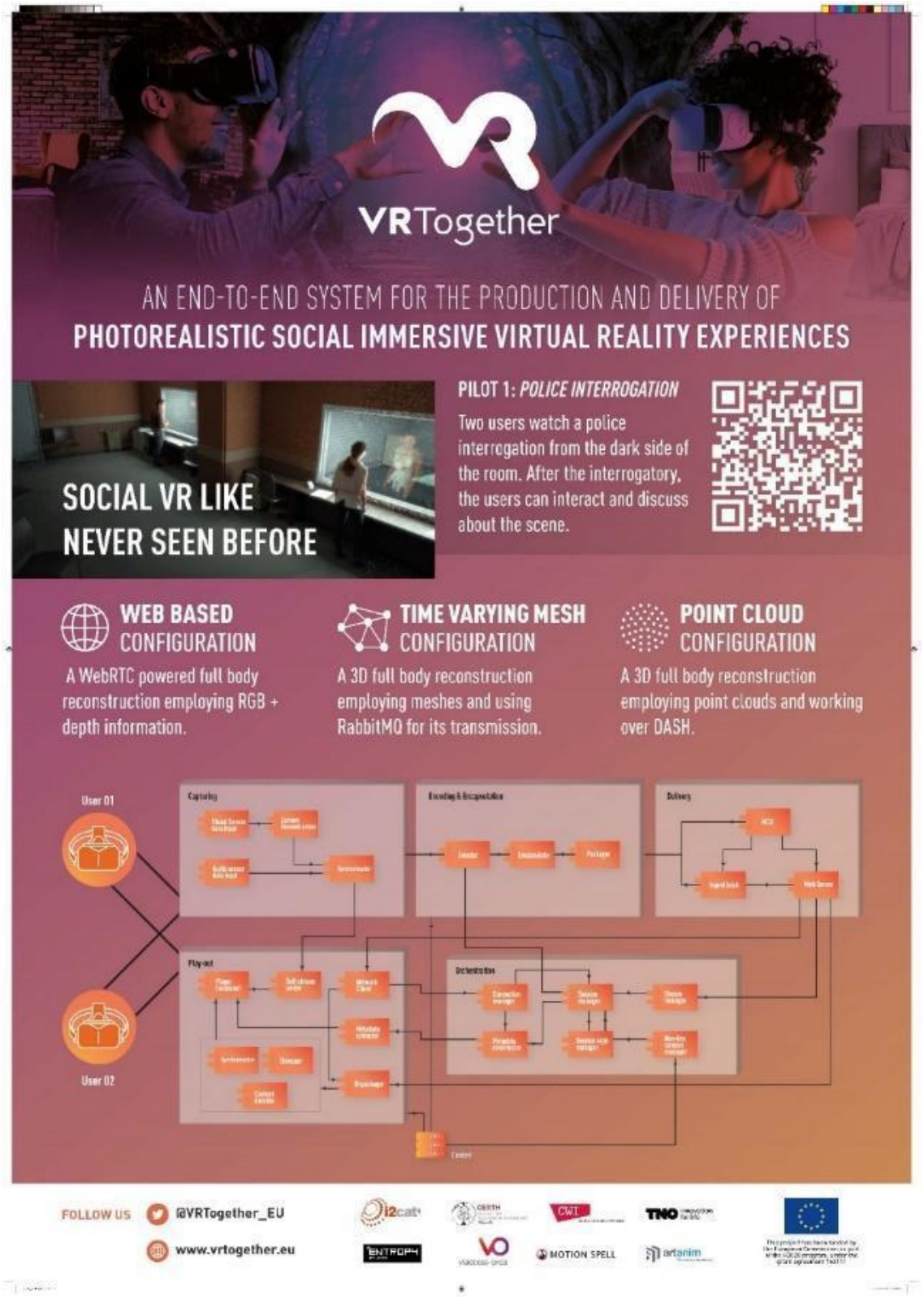
4.2. v2.0



5. POSTER

5.1. v1.0

5.2. v2.0


VRTogether
AN END-TO-END SYSTEM FOR THE PRODUCTION AND DELIVERY OF
PHOTOREALISTIC SOCIAL IMMERSIVE VIRTUAL REALITY EXPERIENCES
SOCIAL VR LIKE NEVER SEEN BEFORE
PILOT 1: POLICE INTERROGATION
Two users watch a police interrogation from the dark side of the room. After the interrogatory, the users can interact and discuss about the scene.
WEB BASED CONFIGURATION
A WebRTC powered full body reconstruction employing RGB + depth information.
TIME VARYING MESH CONFIGURATION
A 3D full body reconstruction employing meshes and using RabbitMQ for its transmission.
POINT CLOUD CONFIGURATION
A 3D full body reconstruction employing point clouds and working over DASH.
User 01
User 02
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5.3. v3.0

5.3.1. Social VR

5.3.2. Products

5.3.3. Technological Innovations

5.3.4. Pilots


AN END-TO-END SYSTEM FOR THE PRODUCTION AND DELIVERY OF
PHOTOREALISTIC SOCIAL IMMERSIVE VIRTUAL REALITY EXPERIENCES
VRTogether
A coherent storyline across 3 pilots
1
Feeling of being there (presence) and of being there together (togetherness)
Two users watch a police interrogation of a murder suspect from the dark side of the room. During the experience, the users can interact and talk about the scene while seeing each other in a photo-realistic quality 3D representation.
COMING SOON
2
Live media and scalability
Four users are placed in a TV news studio where the presenter is giving an overview of the news of the day. When the murder is being reported, users are holo-ported to the crime scene where a journalist relates the details of the murder.
The final pilot will conclude the presented story, with users being able to interact with objects and characters in the scene, driving the scenario through their interactions.
3
Interaction and 6DoF
Users are able to interact remotely in a shared VR world
All their actions are delivered in real time
A 3D reconstruction of the users body is provided
You can see the other users interacting as themself
EVALUATION METHODOLOGY
Objective Metrics
– Performance Metrics
– Users' behavior (gestures, head movements)
Subjective Metrics
– Questionnaires
– Semi-structured interviews
DEPLOYMENT
– Collaborative User Lab Inter-connected nodes in Greece, The Netherlands & Spain
– Scientific & Industrial events
PILOTS
VRTogether is assembling an end-to-end workflow for Social Virtual Reality content production. Development updates are presented through three pilots, three episodes of a great story about a murder investigation. The storyline exploits the uniqueness of the project, a team composed of technical and artistic experts, by creating a new experience that makes the most of the writing possibilities.
WATCH PILOT 1
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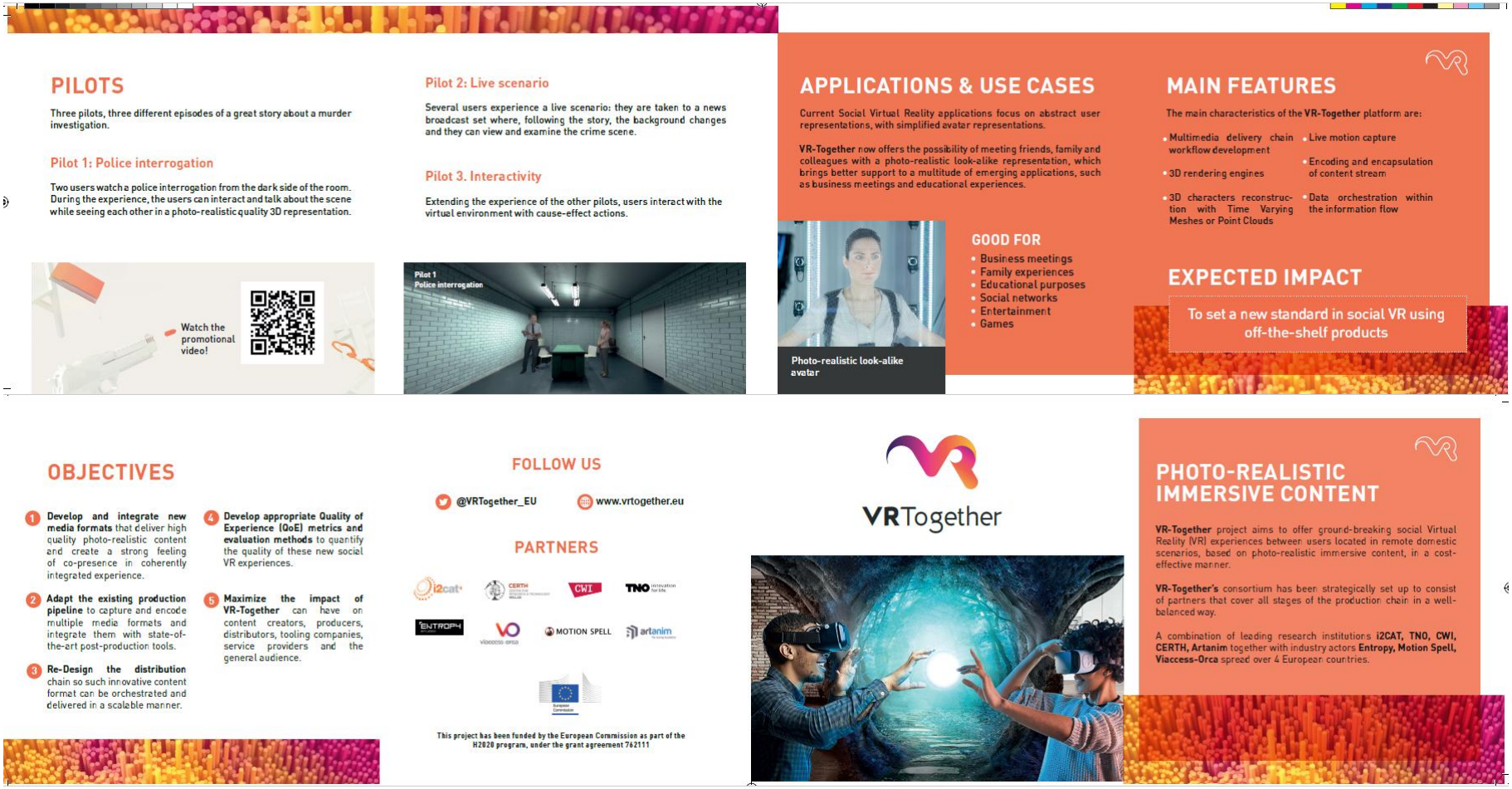
6. COMMERCIAL FACT SHEET

6.1. v1.0

6.2. v2.0


PILOTS
Three pilots, three different episodes of a great story about a murder investigation.
Pilot 1: Police interrogation
Two users watch a police interrogation from the dark side of the room. During the experience, the users can interact and talk about the scene while seeing each other in a photo-realistic quality 3D representation.
Watch the promotional video!
Pilot 2: Live scenario
Several users experience a live scenario: they are taken to a news broadcast set where, following the story, the background changes and they can view and examine the crime scene.
Pilot 3. Interactivity
Extending the experience of the other pilots, users interact with the virtual environment with cause-effect actions.
Pilot 1
Police interrogation
APPLICATIONS & USE CASES
Current Social Virtual Reality applications focus on abstract user representations, with simplified avatar representations.
VR-Together now offers the possibility of meeting friends, family and colleagues with a photo-realistic look-alike representation, which brings better support to a multitude of emerging applications, such as business meetings and educational experiences.
Photo-realistic look-alike avatar
GOOD FOR
Business meetings
Family experiences
Educational purposes
Social networks
Entertainment
Games
MAIN FEATURES
The main characteristics of the VR-Together platform are:
Multimedia delivery chain workflow development
3D rendering engines
3D characters reconstruction with Time Varying Meshes or Point Clouds
Live motion capture
Encoding and encapsulation of content stream
Data orchestration within the information flow
EXPECTED IMPACT
To set a new standard in social VR using off-the-shelf products
OBJECTIVES
1 Develop and integrate new media formats that deliver high quality photo-realistic content and create a strong feeling of co-presence in coherently integrated experience.
2 Adapt the existing production pipeline to capture and encode multiple media formats and integrate them with state-of-the-art post-production tools.
3 Re-Design the distribution chain so such innovative content format can be orchestrated and delivered in a scalable manner.
4 Develop appropriate Quality of Experience (QoE) metrics and evaluation methods to quantify the quality of these new social VR experiences.
5 Maximize the impact of VR-Together can have on content creators, producers, distributors, tooling companies, service providers and the general audience.
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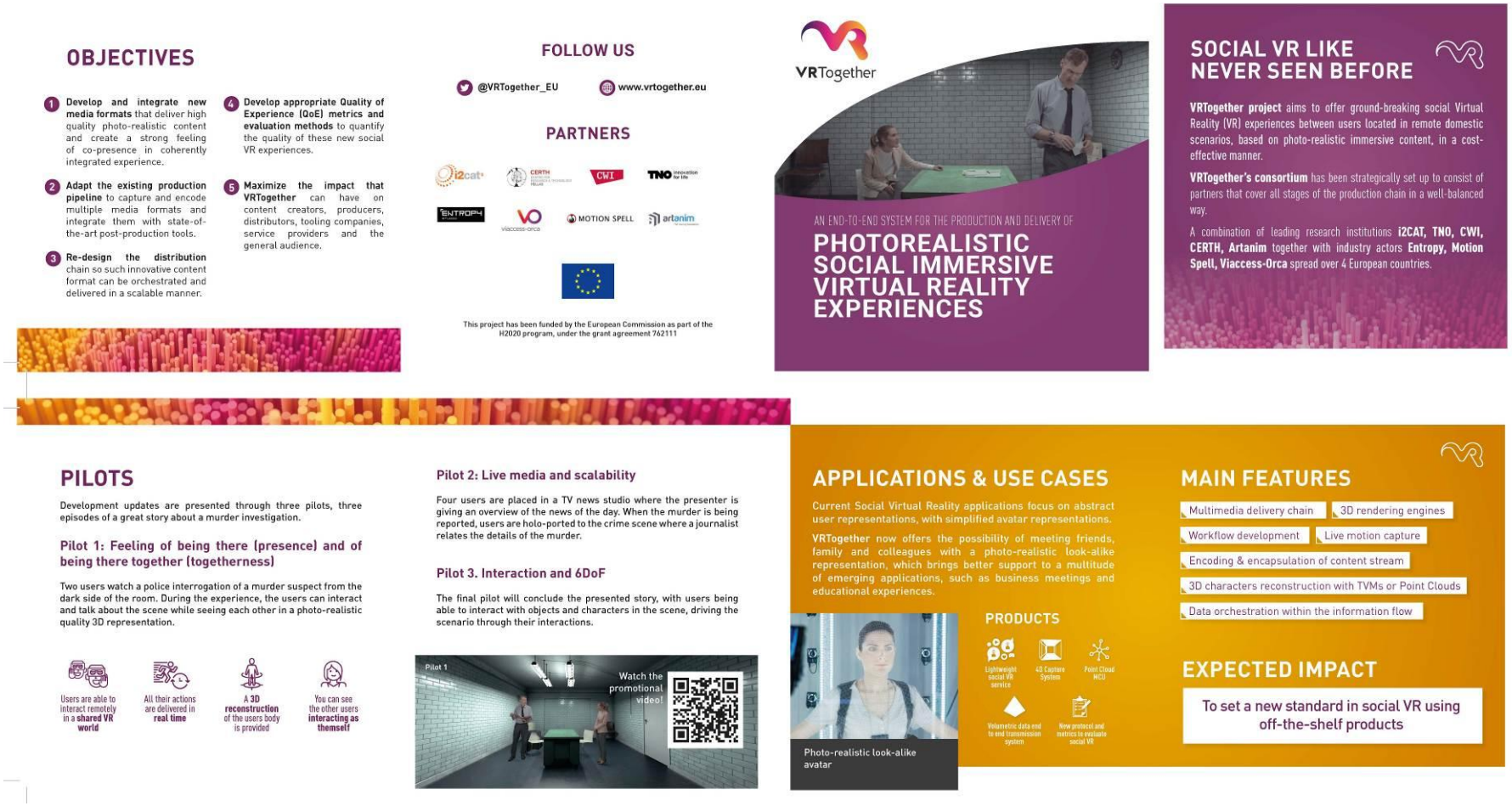
PARTNERS
i2cat
CERTH
CWI
TNO
ENTROPY
MOTION SPELL
artanim
This project has been funded by the European Commission as part of the H2020 program, under the grant agreement 762111
VRTogether
PHOTO-REALISTIC IMMERSIVE CONTENT
VR-Together project aims to offer ground-breaking social Virtual Reality (VR) experiences between users located in remote domestic scenarios, based on photo-realistic immersive content, in a cost-effective manner.
VR-Together's consortium has been strategically set up to consist of partners that cover all stages of the production chain in a well-balanced way.
A combination of leading research institutions i2CAT, TNO, CWI, CERTH, Artanim together with industry actors Entropy, Motion Spell, Viaccess-Orca spread over 4 European countries.

6.3. v3.0


OBJECTIVES
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3 Re-design the distribution chain so such innovative content format can be orchestrated and delivered in a scalable manner.
4 Develop appropriate Quality of Experience (QoE) metrics and evaluation methods to quantify the quality of these new social VR experiences.
5 Maximize the impact that VRTogether can have on content creators, producers, distributors, tooling companies, service providers and the general audience.
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VRTogether
AN END-TO-END SYSTEM FOR THE PRODUCTION AND DELIVERY OF
PHOTOREALISTIC SOCIAL IMMERSIVE VIRTUAL REALITY EXPERIENCES
SOCIAL VR LIKE NEVER SEEN BEFORE
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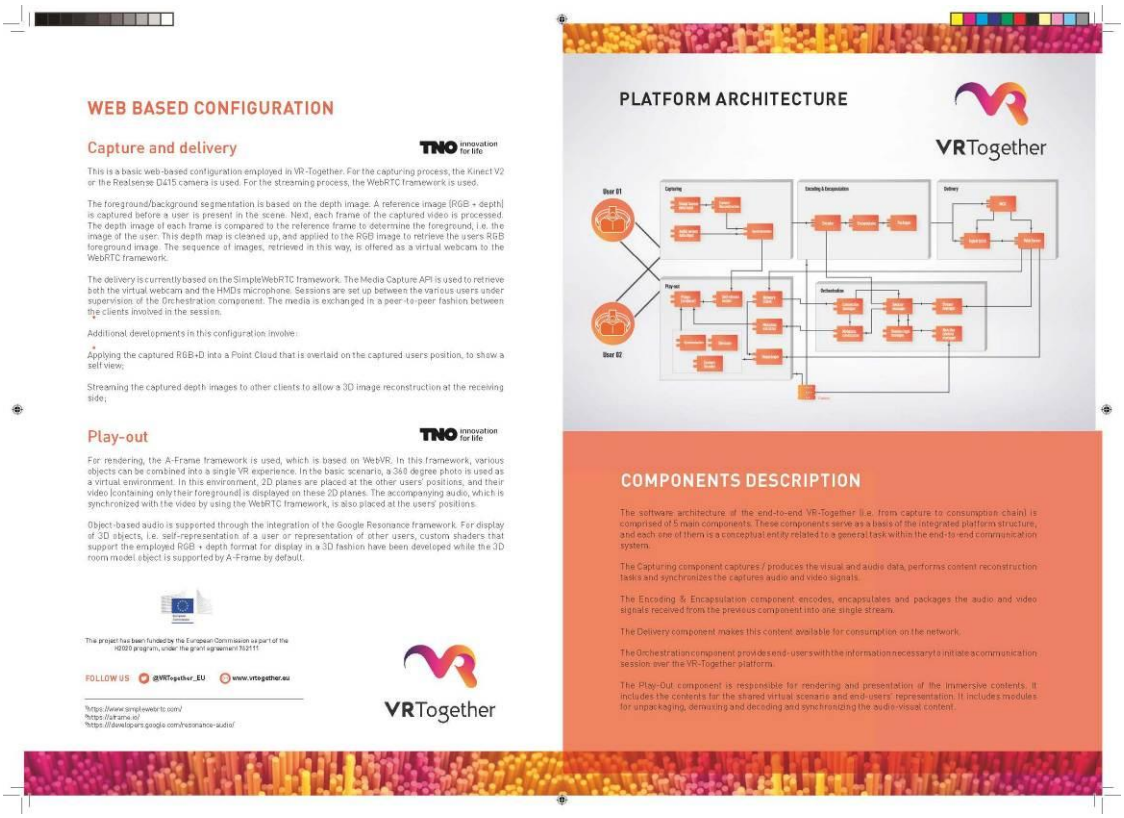
PILOTS
Development updates are presented through three pilots, three episodes of a great story about a murder investigation.
Pilot 1: Feeling of being there (presence) and of being there together (togetherness)
Two users watch a police interrogation of a murder suspect from the dark side of the room. During the experience, the users can interact and talk about the scene while seeing each other in a photo-realistic quality 3D representation.
Users are able to interact remotely in a shared VR world
All their actions are delivered in real time
A 3D reconstruction of the users body is provided
You can see the other users interacting as themself
Pilot 2: Live media and scalability
Four users are placed in a TV news studio where the presenter is giving an overview of the news of the day. When the murder is being reported, users are holo-ported to the crime scene where a journalist relates the details of the murder.
Pilot 3. Interaction and 6DoF
The final pilot will conclude the presented story, with users being able to interact with objects and characters in the scene, driving the scenario through their interactions.
Pilot 1
Watch the promotional video!
APPLICATIONS & USE CASES
Current Social Virtual Reality applications focus on abstract user representations, with simplified avatar representations.
VRTogether now offers the possibility of meeting friends, family and colleagues with a photo-realistic look-alike representation, which brings better support to a multitude of emerging applications, such as business meetings and educational experiences.
Photo-realistic look-alike avatar
PRODUCTS
Lightweight social VR service
4D Capture System
Point Cloud MCU
Volumetric data end to end transmission system
New protocol and metrics to evaluate social VR
MAIN FEATURES
Multimedia delivery chain
3D rendering engines
Workflow development
Live motion capture
Encoding & encapsulation of content stream
3D characters reconstruction with TVMs or Point Clouds
Data orchestration within the information flow
EXPECTED IMPACT
To set a new standard in social VR using off-the-shelf products

7. TECHNICAL FACT SHEET

7.1. v1.0



WEB BASED CONFIGURATION

Capture and delivery

TNO innovation for life

This is a basic web-based configuration employed in VR-Together. For the capturing process, the Kinect V2 or the Realsense D415 camera is used. For the streaming process, the WebRTC framework is used.

The foreground/background segmentation is based on the depth image. A reference image (RGB + depth) is captured before a user is present in the scene. Next, each frame of the captured video is processed. The depth image of each frame is compared to the reference frame to determine the foreground, i.e. the image of the user. This depth map is cleaned up, and applied to the RGB image to retrieve the users RGB foreground image. The sequence of images, retrieved in this way, is offered as a virtual webcam to the WebRTC framework.

The delivery is currently based on the SimpleWebRTC framework. The Media Capture API is used to retrieve both the virtual webcam and the HMDs microphone. Sessions are set up between the various users under supervision of the Orchestration component. The media is exchanged in a peer-to-peer fashion between the clients involved in the session.

Additional developments in this configuration involve:

- Applying the captured RGB+D into a Point Cloud that is overlaid on the captured users position, to show a self view;
- Streaming the captured depth images to other clients to allow a 3D image reconstruction at the receiving side;

Play-out

TNO innovation for life

For rendering, the A-Frame framework is used, which is based on WebVR. In this framework, various objects can be combined into a single VR experience. In the basic scenario, a 360 degree photo is used as a virtual environment. In this environment, 2D planes are placed at the other users' positions, and their video (containing only their foreground) is displayed on these 2D planes. The accompanying audio, which is synchronized with the video by using the WebRTC framework, is also placed at the users' positions.

Object-based audio is supported through the integration of the Google Resonance framework. For display of 3D objects, i.e. self-representation of a user or representation of other users, custom shaders that support the employed RGB + depth format for display in a 3D fashion have been developed while the 3D room model object is supported by A-Frame by default.

This project has been funded by the European Commission as part of the H2020 program, under the grant agreement 762111

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[1]https://www.simplewebrtc.com/
[2]https://aframe.io/
[3]https://developers.google.com/resonance-audio/

VRTogether

PLATFORM ARCHITECTURE

VRTogether

COMPONENTS DESCRIPTION

The software architecture of the end-to-end VR-Together (i.e. from capture to consumption chain) is comprised of 5 main components. These components serve as a basis of the integrated platform structure, and each one of them is a conceptual entity related to a general task within the end-to-end communication system.

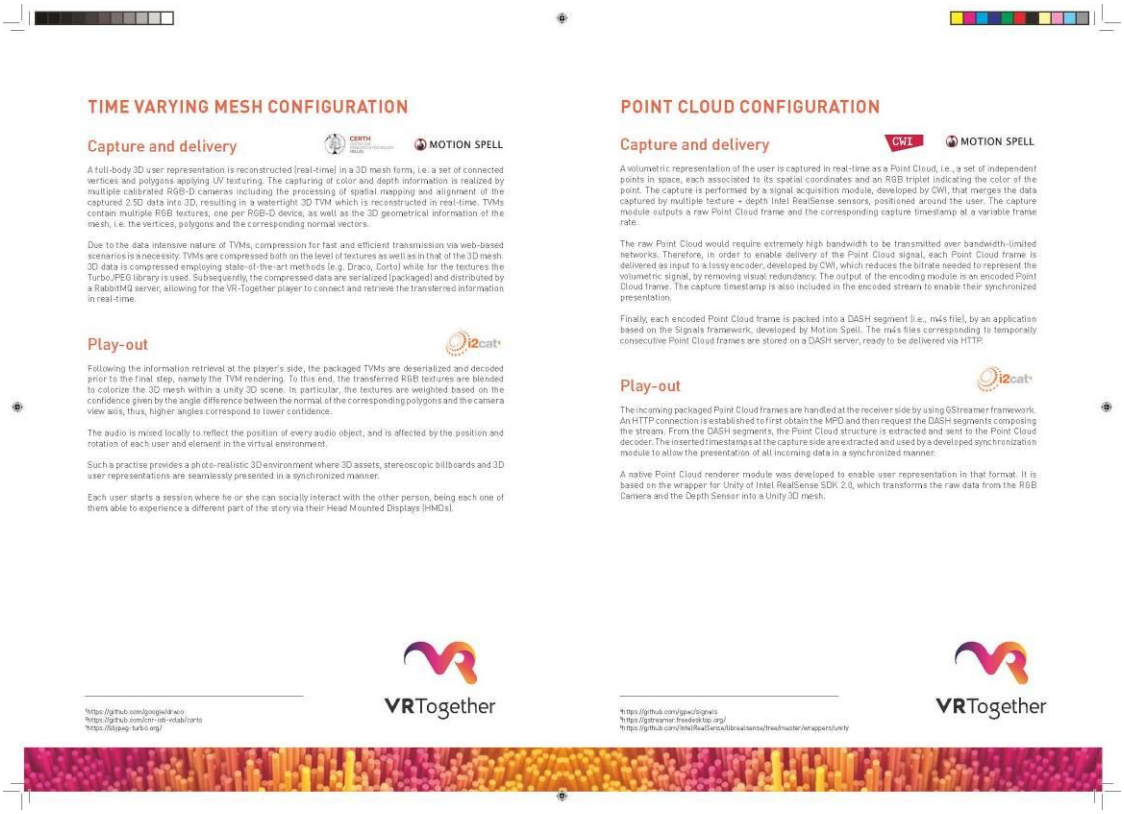
The Capturing component captures / produces the visual and audio data, performs content reconstruction tasks and synchronizes the captures audio and video signals.

The Encoding & Encapsulation component encodes, encapsulates and packages the audio and video signals received from the previous component into one single stream.

The Delivery component makes this content available for consumption on the network.

The Orchestration component provides end-users with the information necessary to initiate a communication session over the VR-Together platform.

The Play-Out component is responsible for rendering and presentation of the immersive contents. It includes the contents for the shared virtual scenario and end-users' representation. It includes modules for unpackaging, demuxing and decoding and synchronizing the audio-visual content.



7.2. v2.0

7.2.1. Web pipeline

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 761974.

END-TO-END WEB-BASED FRAMEWORK TO BUILD AND CONSUME SHARED AND SOCIAL VR EXPERIENCES

VRTogether

FEATURES

Simplified Technology Pipeline

- Use of Web-based components:
  - » WebRTC for communication.
  - » WebVR, WebGL for rendering.
  - » React, Node.js and A-Frame for UI frontend.
- Using common off-the-shelve and consumer grade equipment for capture and display.

Fully orchestrated

- Session management, with per session setup options.
- Multi-person capture and rendering management.
- Synchronisation of live and virtual content.

REAL-TIME LIVE CAPTURE

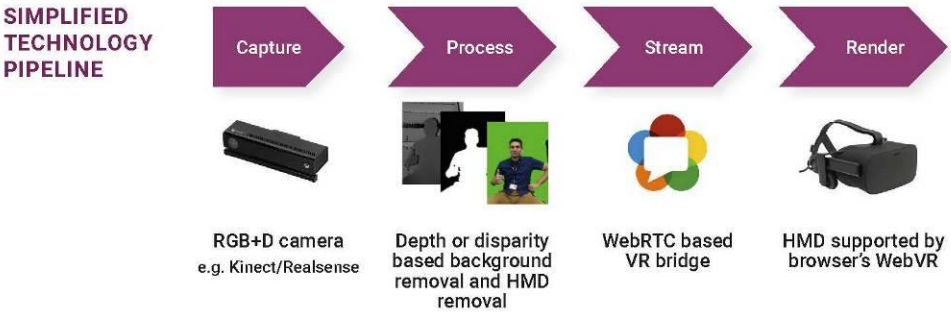
- Live 3D capture of users using RGB-D cameras (e.g. Kinect or Realsense).
- Provide self-view and HMD removal for local user.

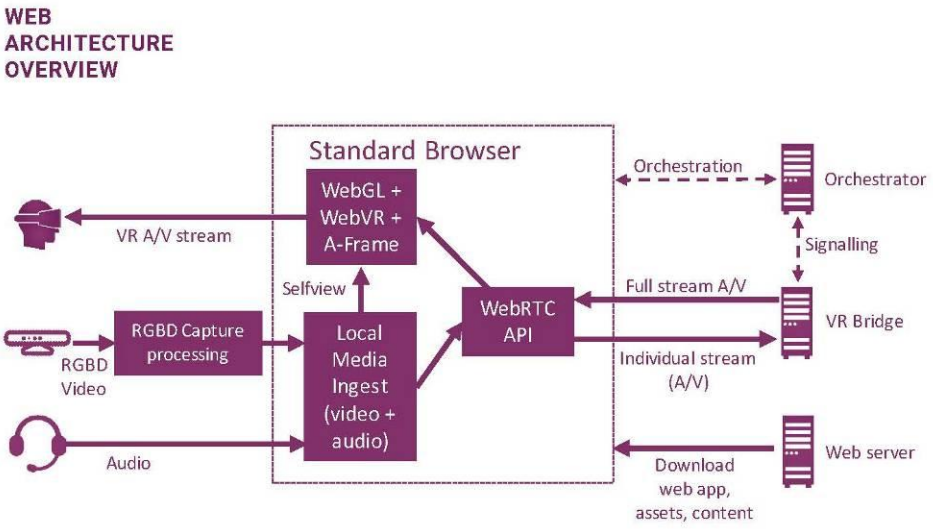
PEER-TO-PEER OR BRIDGED COMMUNICATION

- Communication service through WebRTC.
- Peer-to-peer or if needed for scalability through a VR bridge, combining all individual participant's streams in one large stream.

EASY INTEGRATION OF VIRTUAL ENVIRONMENT

- Support for photo-realistic 360 video and virtual 3D environments.
- Multiple concurrent sources possible, eg. live streaming video in a virtual environment.


SIMPLIFIED TECHNOLOGY PIPELINE
Capture
Process
Stream
Render
RGB+D camera
e.g. Kinect/Realsense
Depth or disparity based background removal and HMD removal
WebRTC based VR bridge
HMD supported by browser's WebVR


WEB ARCHITECTURE OVERVIEW
Standard Browser
WebGL + WebVR + A-Frame
VR A/V stream
Selfview
RGBD Capture processing
RGBD Video
Local Media Ingest (video + audio)
Audio
WebRTC API
Orchestration
Orchestrator
Signalling
Full stream A/V
VR Bridge
Individual stream (A/V)
Web server
Download web app, assets, content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7.2.2. Volumetric video

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 761974.

END-TO-END VOLUMETRIC VIDEO PRODUCTION SYSTEM FOR IMMERSIVE VR EXPERIENCES

VRTogether

TECHNOLOGY FEATURES

Portable

- Flexible and light-weight sensor calibration.

Low-cost

- Low-specification hardware resources for multi-RGBD data acquisition.
- Off-the-shelf RGBD sensors (i.e. Intel RealSense D400 series, Azure Kinect DK).

Scalable

- Support of variant number of sensors to alter the associated equipment cost and complexity, depending on the level of geometry detail and visual quality.

VOLUMETRIC VIDEO PRODUCTION

- Real-time (online) volumetric media streaming.
- Support of live self-view representation to boost immersion.
- Content creation through volumetric media recording and post-processing.

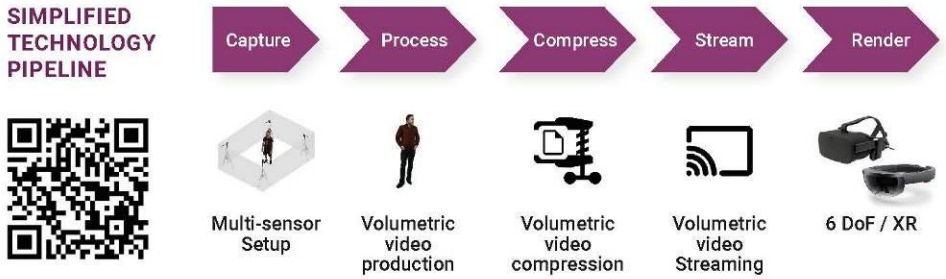
REAL-TIME VOLUMETRIC VIDEO COMPRESSION

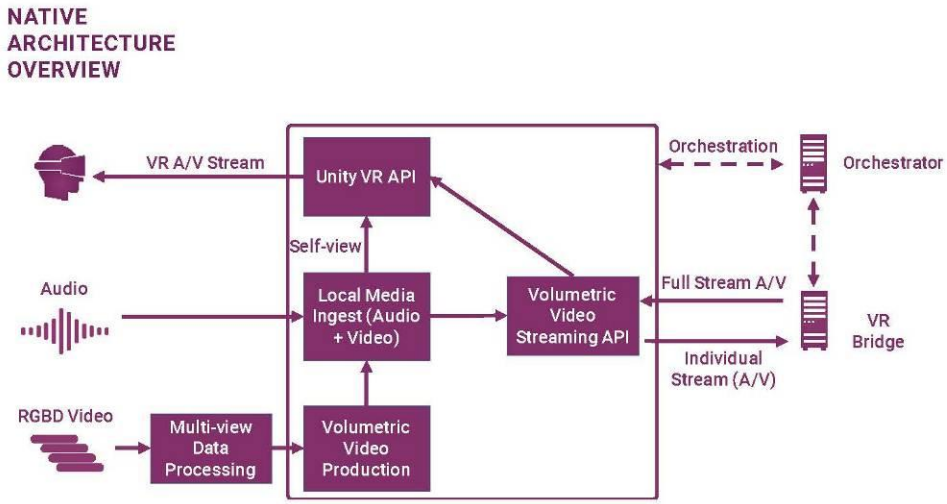
- State-of-the-art geometry libraries integration.
- Multi-view texture compression.

EASY INTEGRATION OF VIRTUAL ENVIRONMENT

- Game engine plug & play compatibility (e.g. Unity3D, Unreal Engine 4).
- Support of photo-realistic 360° and 3D environments.
- 6 Degrees of Freedom for the user.

i2cat · CERTH · CWI · TNO innovation for life · ENTROPY · viaccess-orca · MOTION SPELL · artanim


SIMPLIFIED TECHNOLOGY PIPELINE
Capture
Process
Compress
Stream
Render
Multi-sensor Setup
Volumetric video production
Volumetric video compression
Volumetric video Streaming
6 DoF / XR


NATIVE ARCHITECTURE OVERVIEW
VR A/V Stream
Unity VR API
Orchestration
Orchestrator
Self-view
Audio
Local Media Ingest (Audio + Video)
Volumetric Video Streaming API
Full Stream A/V
VR Bridge
Individual Stream (A/V)
RGBD Video
Multi-view Data Processing
Volumetric Video Production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8. ROLL-UP

8.1. v1.0