HIGH QUALITY 360° VIDEO RENDERING AND STREAMING

2ND ITU-T MINI-WORKSHOP ON IMMERSIVE LIVE EXPERIENCE

Louay Bassbouss <louay.bassbouss@fokus.fraunhofer.de>
www.fokus.fraunhofer.de/go/360

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Engineering a Connected World

HIGH QUALITY 360° VIDEO RENDERING AND STREAMING

- Challenges:
  - Efficient streaming of high quality 360° video content using existing content delivery networks (CDNs) and without the need for additional bandwidth comparing to traditional video streaming.
  - Playback of 360° content even on devices with limited processing resources and programmatic capabilities like TVs.
  - Scalable Solution with reduced processing load

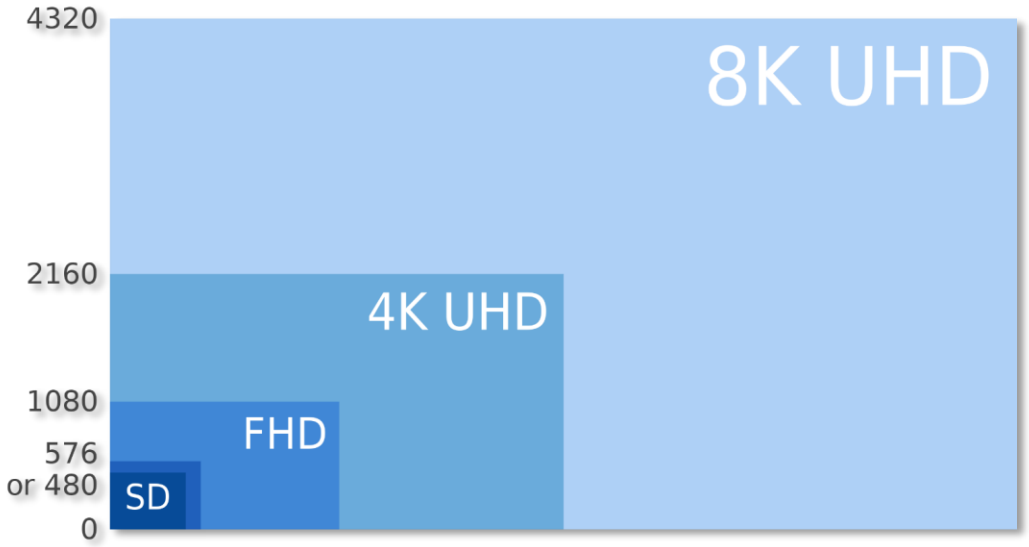
360° Video on TV ???

MITTWOCH, 4. MAI 2016 10.20 UHR

arte Fraunhofer FOKUS NAVIGIEREN OK AUSWÄHLEN BEENDEN HILFE/IMPRESSUM


360°
Die rote Taste

WHY VIDEO IS BIG, AND WILL CONTINUE TO GROW



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- 4K has arrived / HD is commodity
  → 6-25 Mbit/s per single receiver
- two 4K livestreams congest a 50Mbit/s VDSL connection
- Olympics 2020 will be filmed and broadcast in 8K (in Japan)
- YouTube/FB recently started to support mobile live video streaming
- VR/360 adds an order of magnitude
  → **10-16x !!!**

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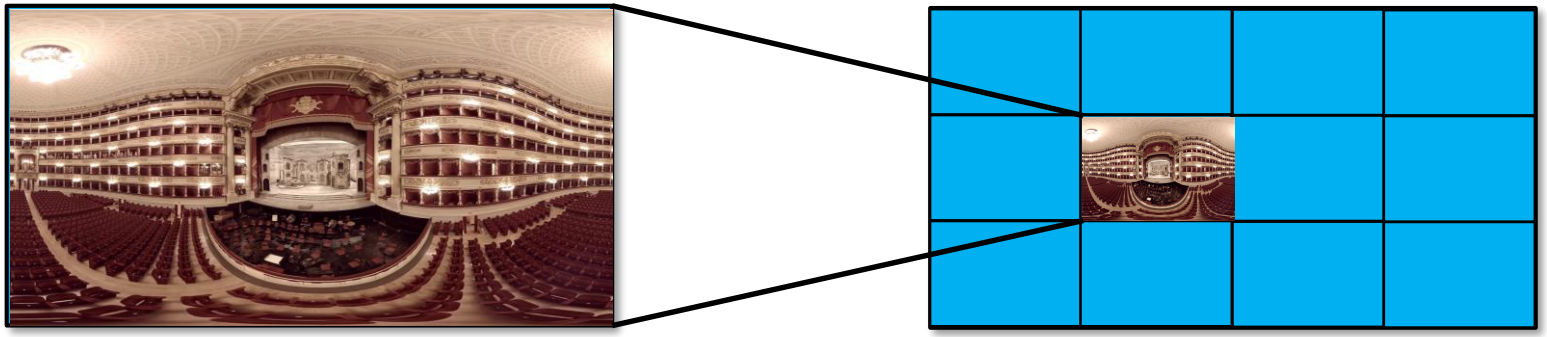
4K RESOLUTION FOV?

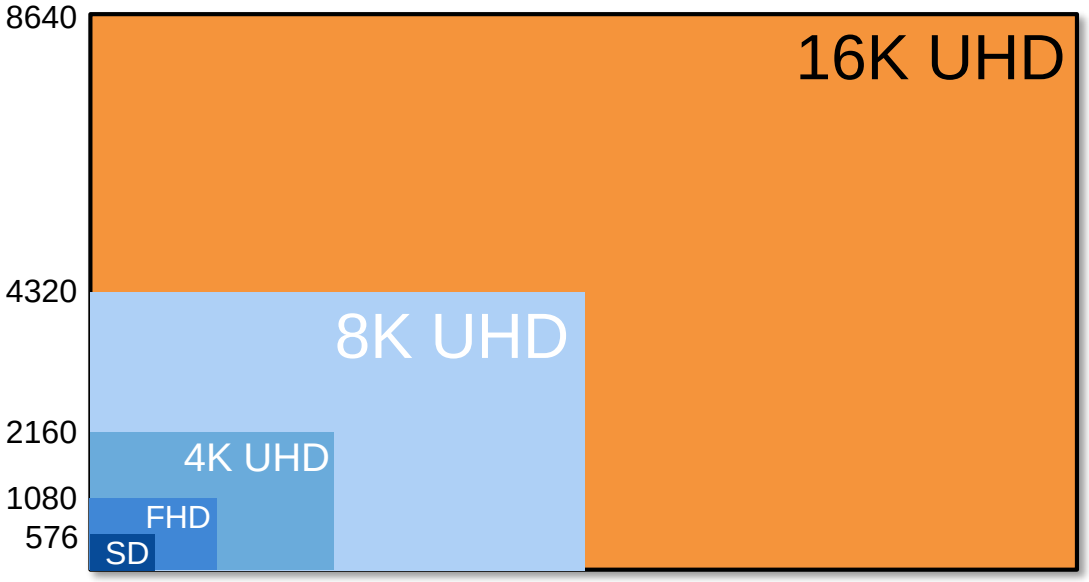


4K - 20 Mbit/s Stream

16K - ~300 Mbit/s Stream

Size ratio FOV ←→ Full 360° Video 1:12

4K FOV → 16K SOURCE



- To get 4K FOV, 12K Video or higher is required
- 4k video bandwidth = 16-20 Mbit/s
- 16k video bandwidth= 320 Mbit/s
- 6k,10k and 12k are not industry standard.
- 2k(FHD),4k,8k are standard resolution.

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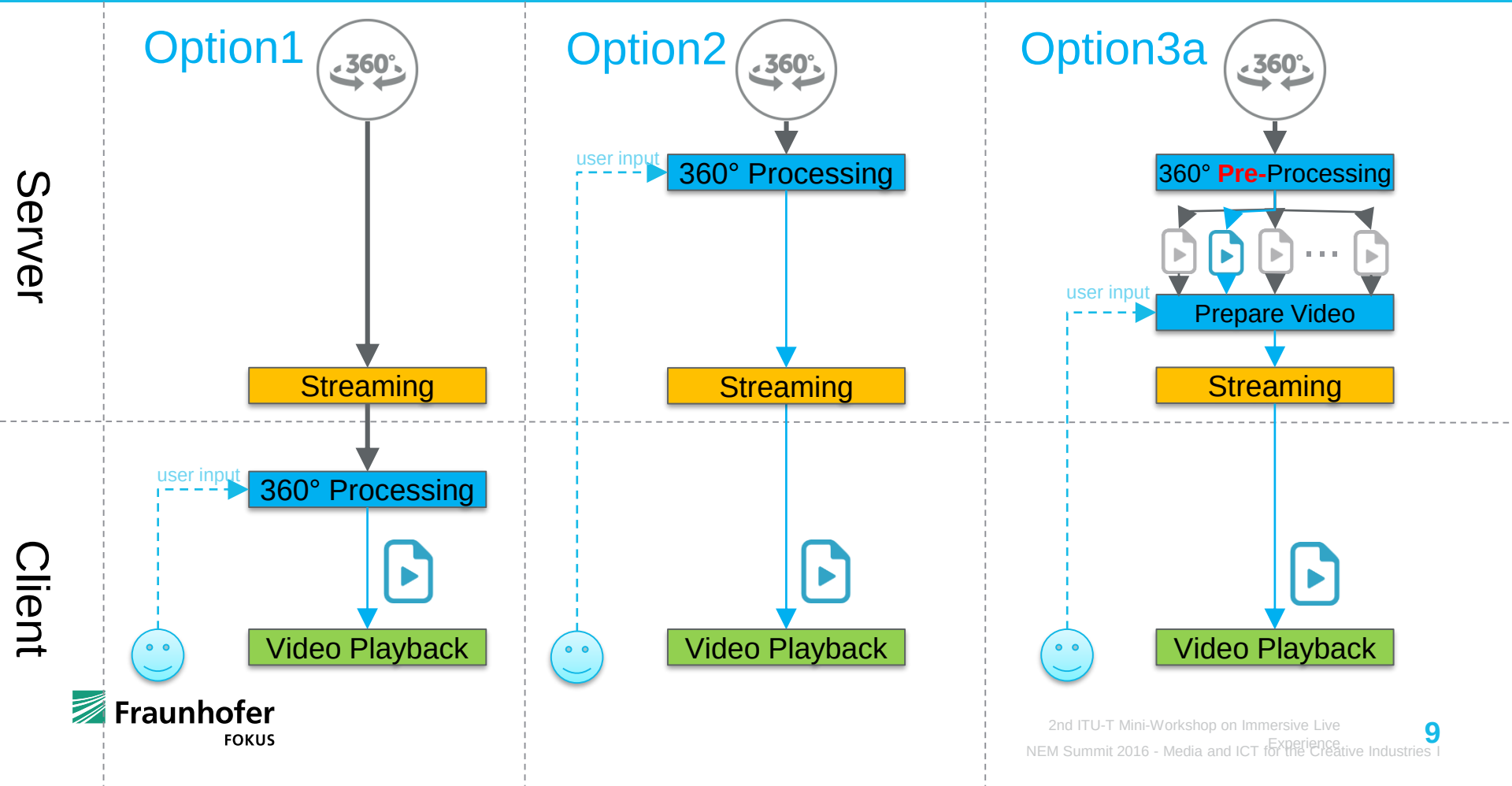
360° STREAMING AND VIDEO PROCESSING OPTIONS



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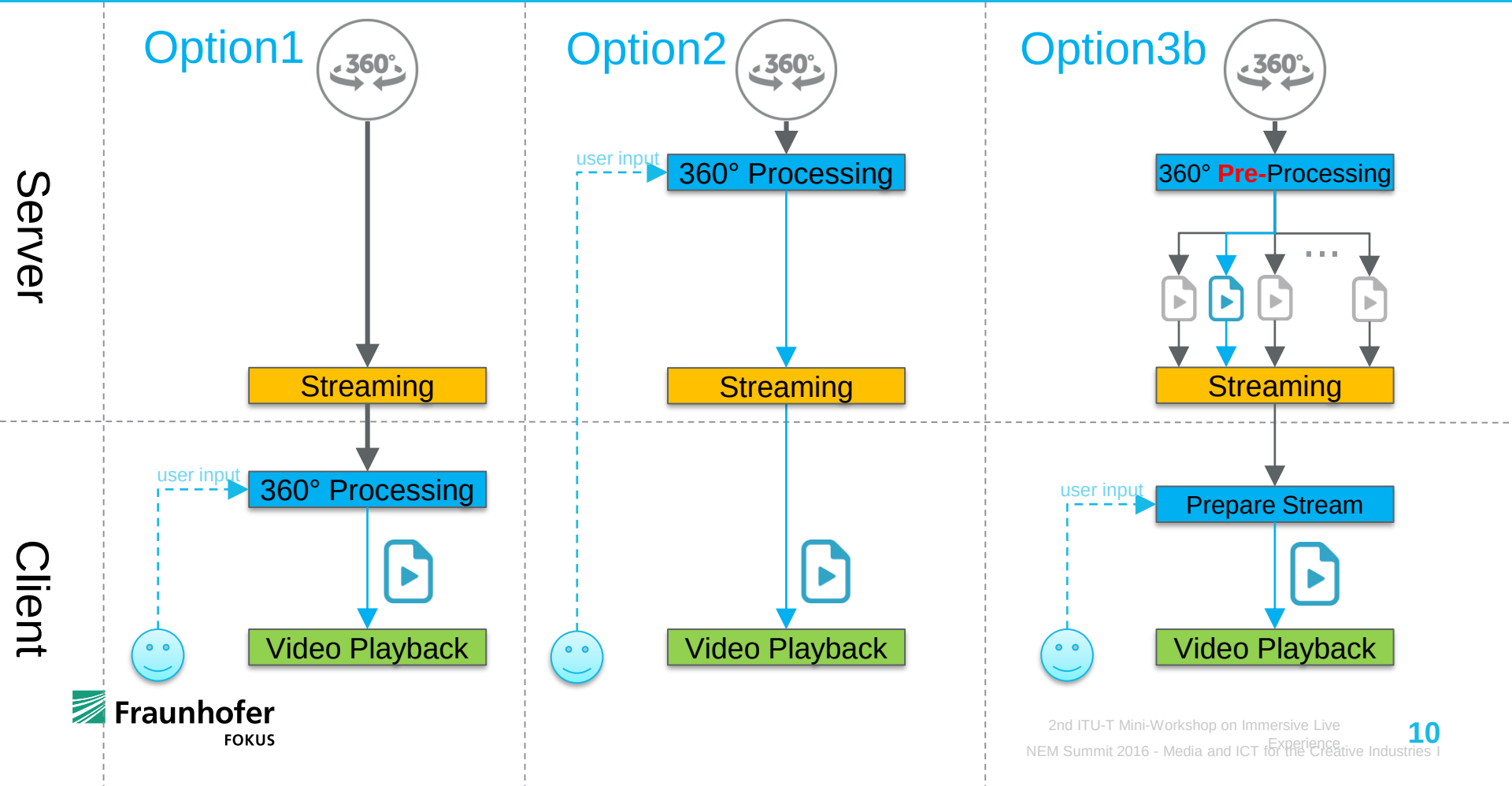
360° STREAMING AND VIDEO PROCESSING OPTIONS



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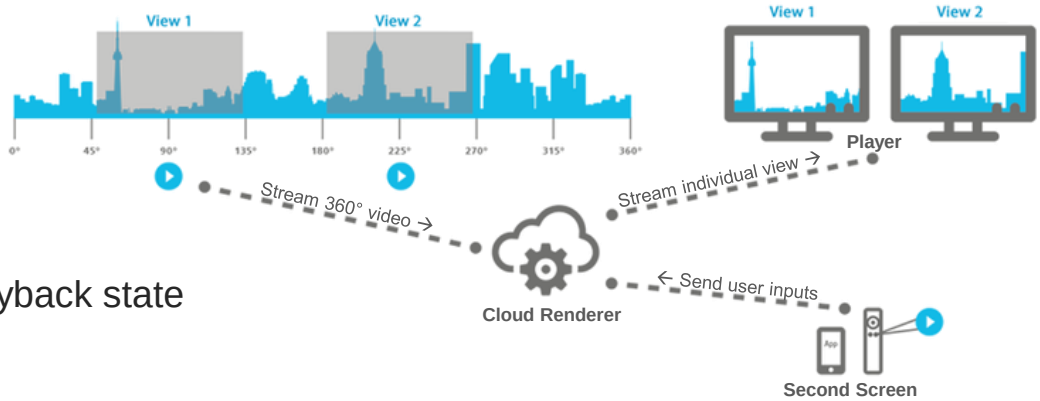
ADVANTAGES AND DISADVANTAGES

	Option1	Option2	Option3a	Option3b
Additional Storage	No	No	Yes	Yes
360° Video Processing on Client	Yes	No	No	No
360° Video Processing on Server	No	Yes	No[1]	No[1]
Bandwidth	High	Low	Low	Low[2]
Motion-to-Photon Delay	Low	Medium[3]	Medium[3]	Medium[4]
CDN usage	Yes	No[5]	No[5]	Yes
Example Target Devices	Head Mounted Displays	Low Capability Devices e.g. HbbTV	Low Capability Devices e.g. HbbTV	Medium Capability Devices e.g. Chromecast
Interaction Types	- Motion Sensors - Touch/Mouse	- TV RC - Keyboard - (Touch/Mouse)	- TV RC - Keyboard - (Touch/Mouse)	- TV RC - Keyboard - Touch/Mouse

360° VIDEO CLOUD STREAMING SOLUTION

How it works



360° Video Cloud Renderer & Streamer:

- renders any kind of 360° content and streams only individual view to clients
- offers REST API to control view and playback state

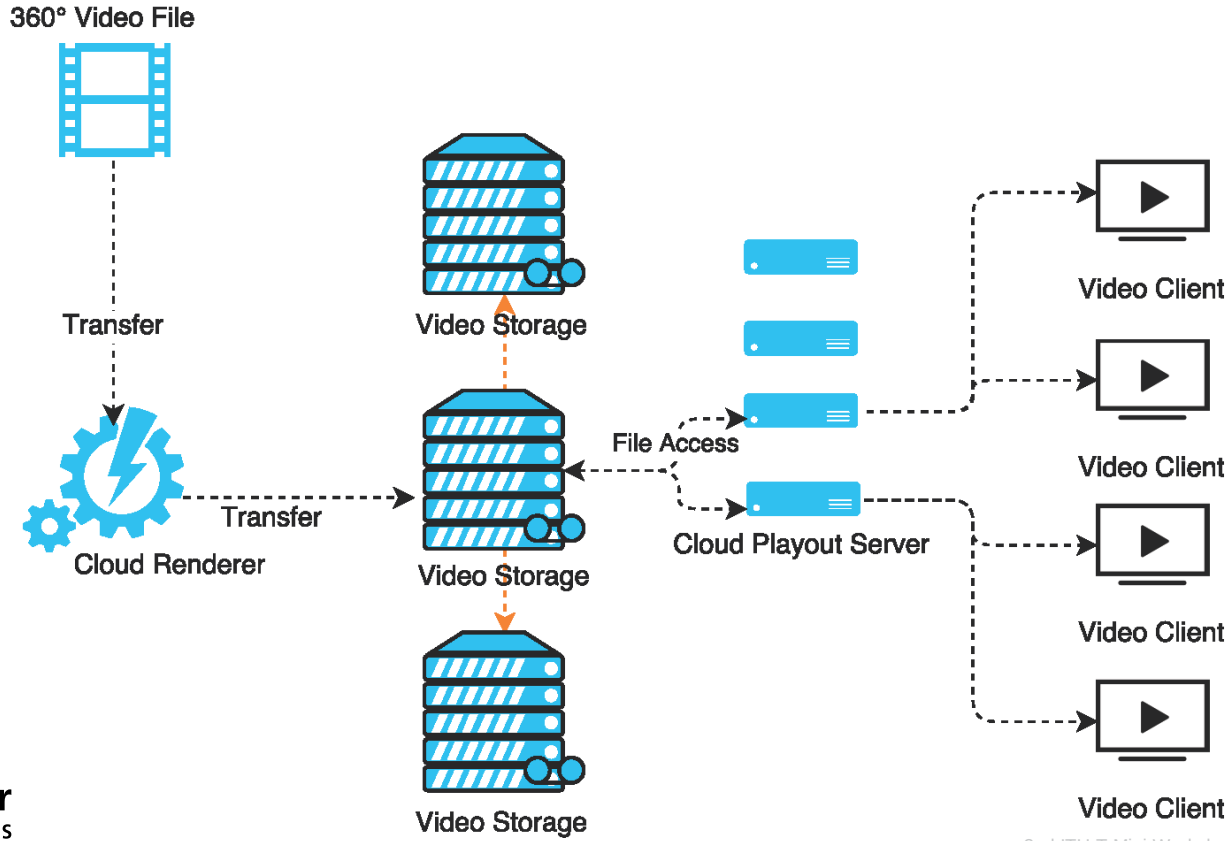
360° Video Player:

- enables mobile devices, Smart and Hybrid TVs to provide 360° experience through usual video playback from the cloud

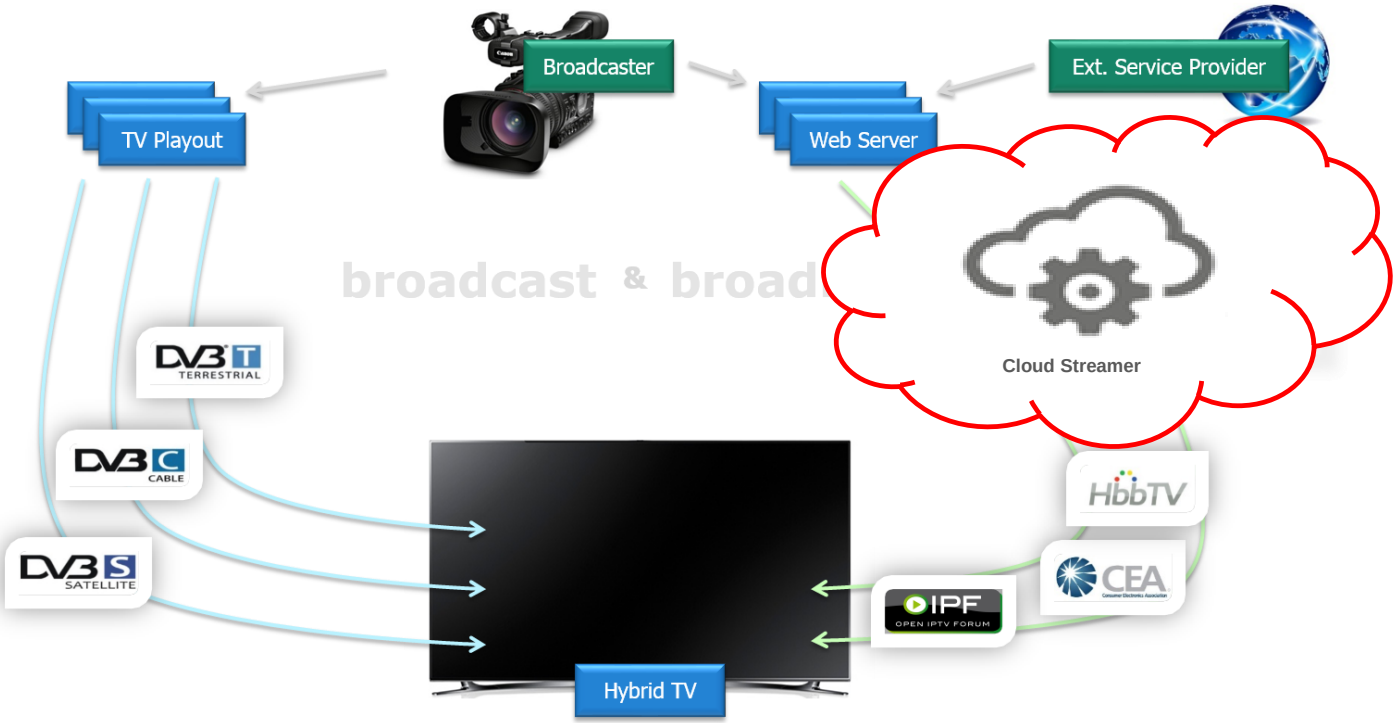
360° Second Screen App:

- acts as a smart remote control for the 360° video player
- provides smart interaction through touch, gestures, device orientation, etc.

ARCHITECTURE



HBBTV – HYBRID APP DELIVERY

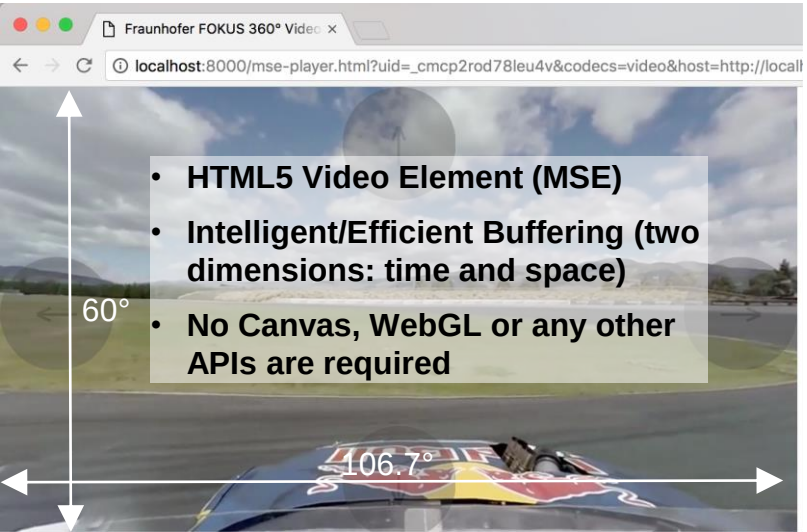


Example (Option 3b)

4k origin 360° Video, 30fps, bitrate 40053 kb/s

360° Pre-Processing

HD view port, 30fps, bitrate 2435 kb/s, segment=333ms

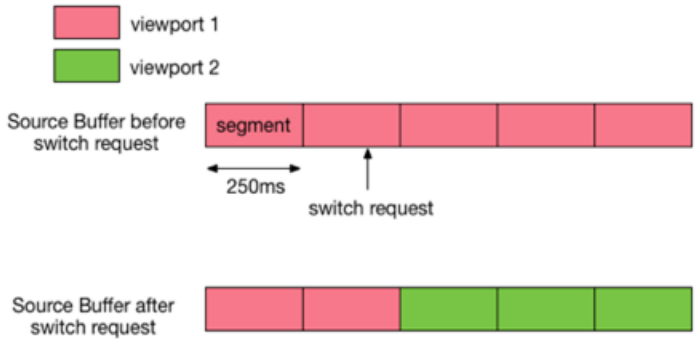


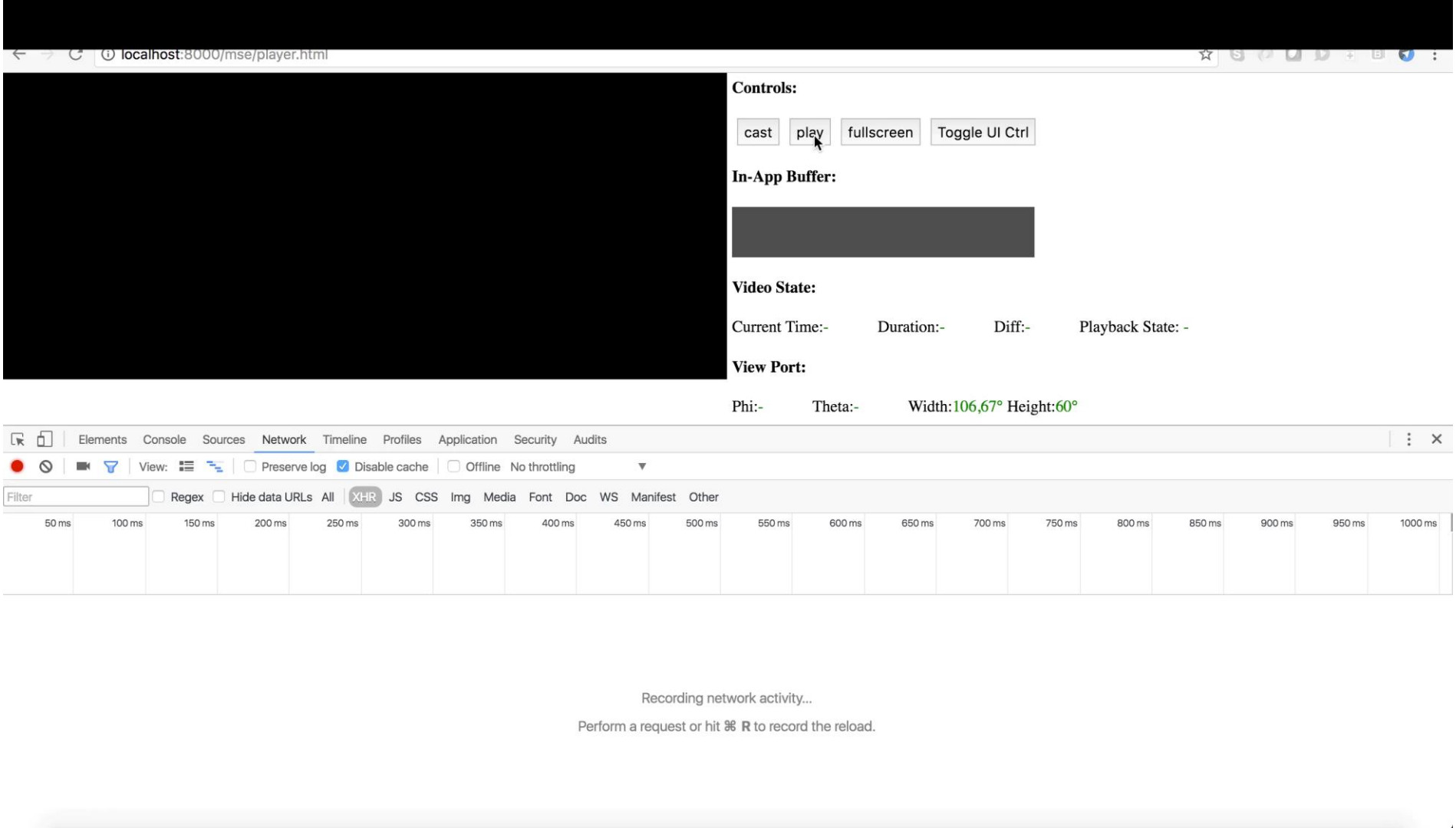
Prepare Stream (Caching)

360° Player using W3C Media Source Extensions (MSE)

- MSE 360° Player
  - Allows to implement different player algorithms similar for DASH on top of MSE
  - Available viewports can be described in the manifest (e.g. DASH SRD fields)
  - At the start of the playback the currently selected viewport is buffered. When the user triggers a switch request for a different viewport, already buffered segments are removed/replaced by segments of the new viewport.
  - Challenge:

    How to reduce delay by switching between two viewports?




localhost:8000/mse/player.html
Controls:
cast
play
fullscreen
Toggle UI Ctrl
In-App Buffer:
Video State:
Current Time:-
Duration:-
Diff:-
Playback State: -
View Port:
Phi:-
Theta:-
Width:106,67°
Height:60°
Elements
Console
Sources
Network
Timeline
Profiles
Application
Security
Audits
View:
Preserve log
Disable cache
Offline
No throttling
Filter
Regex
Hide data URLs
All
XHR
JS
CSS
Img
Media
Font
Doc
WS
Manifest
Other
50 ms
100 ms
150 ms
200 ms
250 ms
300 ms
350 ms
400 ms
450 ms
500 ms
550 ms
600 ms
650 ms
700 ms
750 ms
800 ms
850 ms
900 ms
950 ms
1000 ms
Recording network activity...
Perform a request or hit ⌘ R to record the reload.

BEST PAPER AWARD

- Best Paper Award at NEM Summit 2016 (New European Media)

Home About NEM I²C PPP NEM Summit 2016

NEM Summit 2016

The NEM Summit 2016, which was held in lovely city of Porto on 23-25 November 2016, welcomed around 150 participants from 2 European countries. The NEM Summit program accommodated three plenary and seven parallel sessions with more than 40 presentations and talks, including four panel discussions and the 22nd NEM General Assembly, as well as 15 exhibitions.

The papers accepted for presentation at the NEM Summit 2016 after the corresponding Call for Extended Abstracts are available **here**, where the complete NEM Summit 2016 program and presentation slides from almost all Summit speakers can be found.

Best paper and exhibition, NEM Art winner

- The NEM Summit 2016 Program Committee selected **the best Summit paper** entitled as **High Quality 360° Video Rendering and Streaming**, authored by **Louay Bassbouss (Fraunhofer FOKUS)**.
- Demonstration of **ImmersiaTV** – Immersive Experiences around TV, an integrated toolset for the production and distribution of immersive and interactive content across devices (i2CAT), has been selected as **the best NEM Summit 2016 exhibition**.
- The **winner of the NEM Art & Design competition** at the NEM Summit 2016 is **Adressaparken**, presented by **Andrew Perkis – Norwegian University of Science and Technology**.

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High Quality 360° Video Rendering and Streaming

Louay Bassbouss[1], Stephan Steglich[1], Martin Lasak[1]
[1]Fraunhofer FOKUS, Berlin, Germany
E-mail: [1]{firstname.lastname}@fokus.fraunhofer.de

Abstract: **This paper introduces a new solution that facilitates the deployment and consumption of immersive and interactive media by ensuring optimal network delivery and media playback. We will address in this paper two main challenges a) the efficient streaming of high quality 360° video content using existing content delivery networks (CDNs) and without the need for additional bandwidth comparing to traditional video streaming and b) the playback of 360° content even on devices with limited processing resources and programmatic capabilities.**

Keywords: 360° Video, VR, Immersive Media, Streaming, HbbTV, MSE, Cloud Rendering

1 INTRODUCTION

Immersive video has been around for some time, dating back to the "A Tour of the West" short movie from 1955 [1] and the 'Circarama' format (also known as "Circle-Vision 360°" [2]). It re-emerged a couple of times, though mostly as a showcase exhibit at trade fairs and fairground rides and often more as a spin-off of interactive VR experiences than as real-world video presentation in its own right. Only recently did the market situation change. Affordable cameras with sufficient resolution became available to allow professionals and interested amateurs to create 360° movies. Stitching software became good enough to stitch the videos and hide the seams with reasonable quality. Networks became fast enough to allow end-users to stream 360° video content to their devices. TVs, smartphones and tablets are sufficiently powerful and have the necessary sensors and quality to handle the content and react on view changes without noticeable delay. After 60 years, immersive video has reached the mass market.

Most efforts in these area, however, have been aimed at the technical challenges creating and viewing of 360° video. As 360° video is starting to reach a wider audience, the need arises to pay attention to the use of such content in a realistic commercial environment. For this, two issues need to be addressed. The efficient distribution of 360° content and the added-value that it can bring content providers.

On the distribution side, almost all current solutions stream the full 360° content to the end-user device, where only about 8% is actually presented to the viewer, while the other 92% are disregarded, causing a huge bandwidth requirement. (While the actual amount depends on the video mapping (usually by "Equirectangular Projection" [3]), the video codec, viewing angle and the area looked at by the user, on average the viewer sees about 1/12 of the available sphere). This currently means that a 4k UHD (3840x2160) [11] 360° source video provides approximately HD (1280x720) [12] output video resolution for a field of view of 60° vertically and 106,67° horizontally (106,67°=60°x16/9 to keep 16/9 aspect ratio. The aspect ratio is relevant to consider on flat screens but not necessary on head-mounted displays). Figure 1 shows an example. Inversely, to allow the end user to experience 360° content in 4k UHD field of view resolution, the source 360° video must have a resolution of 11520x6480 (between 8k and 16k).

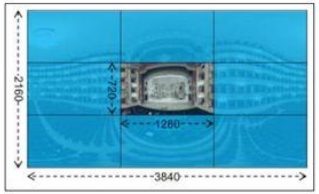

Figure 1: 4k UHD source video results in HD output field of view.

2 360° VIDEO RENDERING AND STREAMING

The key idea of the solution in this paper is to render 360° videos in the cloud and stream individual field of views to the client instead of streaming the whole video. Figure 2 shows the three possible rendering and streaming options:

1) **360° Client Rendering**: the whole source video will be delivered to the client. A 360° renderer processes the video on the target device and displays the requested field of view.
2) **360° Cloud Rendering**: the source 360° video will be live rendered on the server and only the requested field of view will be streamed to the client. The client is a simple video player. The server needs to start a session for each client.

Corresponding author: Name, Affiliation, Address, Phone, E-mail


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Red Bull

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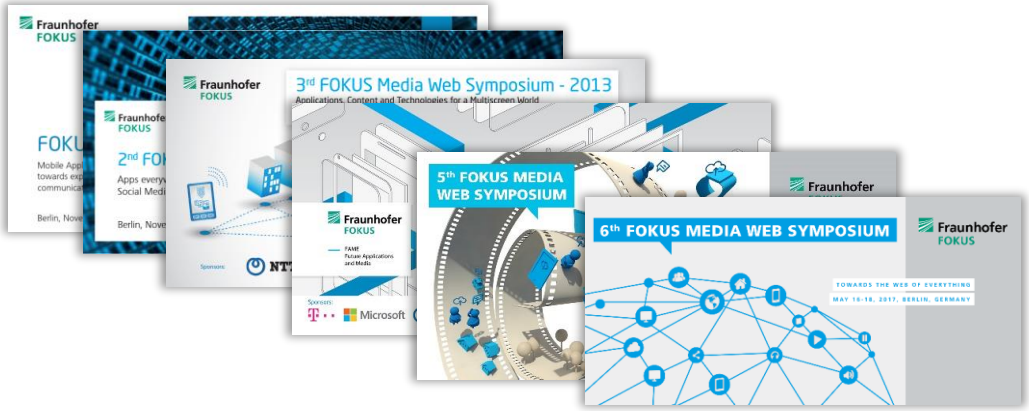

May 16-18, 2017, Berlin

6th FOKUS Media Web Symposium: Towards the Web of Everything

The 6th FOKUS Media Web Symposium focuses on the convergence of the Media Web and the Internet of Things. Within the Conference, several Workshops and Tutorials offer the latest insights in internet delivered media such as 360°/VR Streaming, multiscreen interaction, media sync, SmartTV/HbbTV, protected adaptive streaming, related standardization and market developments.

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More information at:
www.fokus.fraunhofer.de/go/360

Thank you for listening!
Questions?

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Dipl.-Ing. Louay Bassbouss

Project Manager
Future Applications and Media (FAME)
Fraunhofer Institute for
Open Communication Systems FOKUS

Kaiserin-Augusta-Allee 31 | 10589 Berlin | Germany
Phone +49 30 3463-7275
louay.bassbouss@fokus.fraunhofer.de