



Some Immersive Challenges

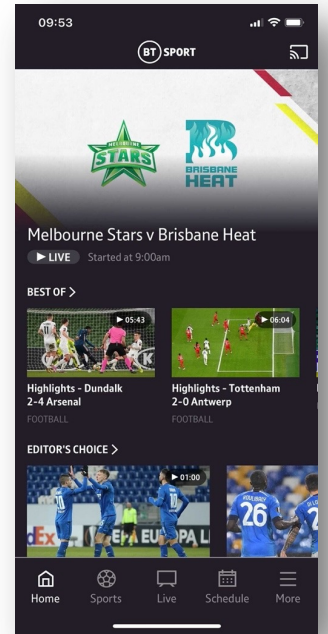
*MPEG/Khronos/3GPP Workshop
29-30 September 2021*

*Streamed Media in Immersive
Scene Descriptions*

A Few Example Deployments

BT SPORT - Premier League to Mobile Devices

- Live English Premier League match every Saturday; Champions League as well (today :-)
- Tiled VR streaming to enable 8K VR360 on devices with a 4K decoder
5 streams in 8K VR360 to BT Sport Ultimate users (4 cameras + director's cut)
- Jumbotron gives access to TV feed and commentary
- BT Sport App deployed for iOS & Android



LGU+ - Baseball with Friends

- Live 8K VR with 3 cameras
- Social – chat with friends
- Transcoding and distribution powered by Amazon
- Live + Catalog of on-demand content
- Headsets and mobile devices



Stageverse

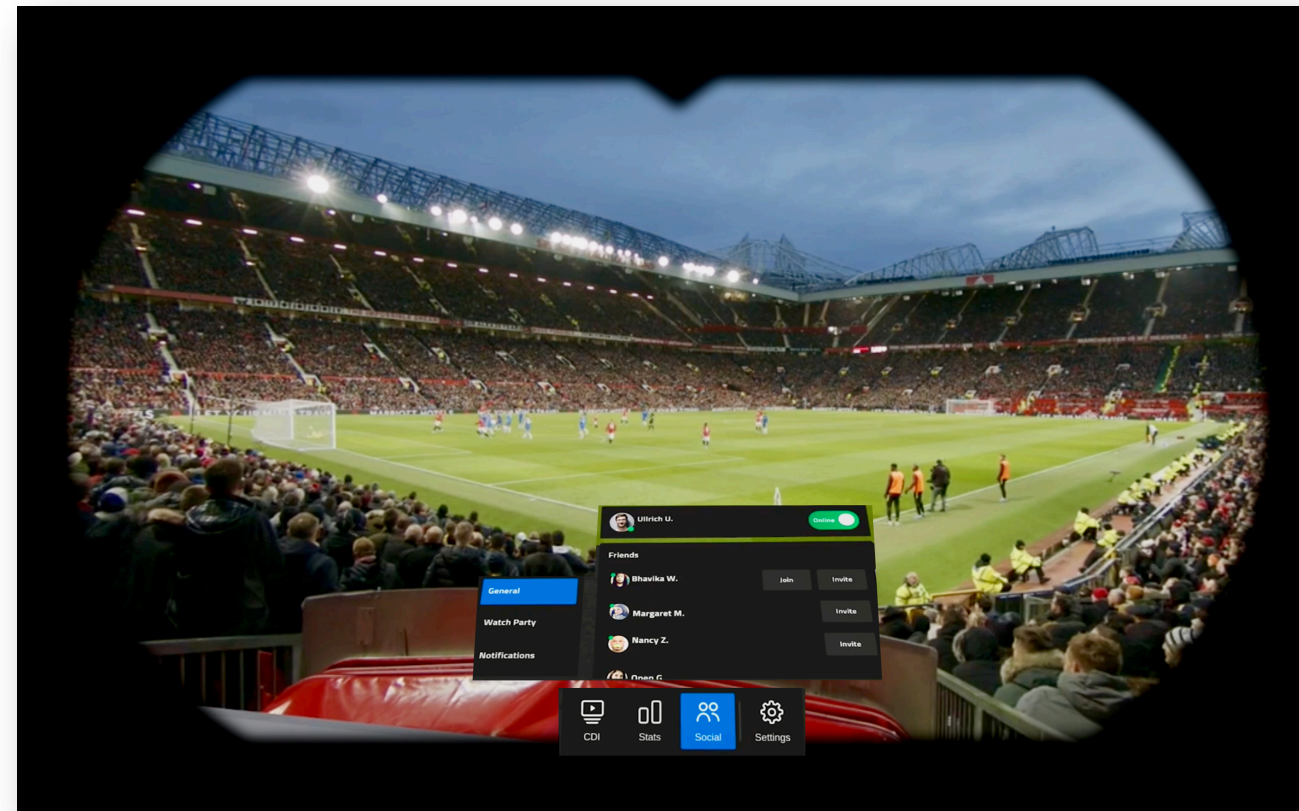
- Amazing Social Concert Experience
- Launched with Scheduled on-demand play-out of Muse concert
- Immersive video in a virtual world
- Video registration with 16 (sixteen!) VR360 viewpoints
- ClearVR tiled streaming enables highest quality at lowest bitrates and broadest reach



Images by Stageverse



- Focused on Headset (Oculus Quest)
- Virtual 6 DoF Skybox
 - Design tailored to event/sport
- Interface to access:
 - Camera selection (4 cameras with instant, frame-accurate switches)
 - Social viewing
 - Game and player info and stats
- Jumbotron: broadcast feed with commentary
- Enjoy the game with friends
 - Synchronised game feed across all cams
 - Voice chat (and avatars)
- Production by Sky; app by Sky and Cosm



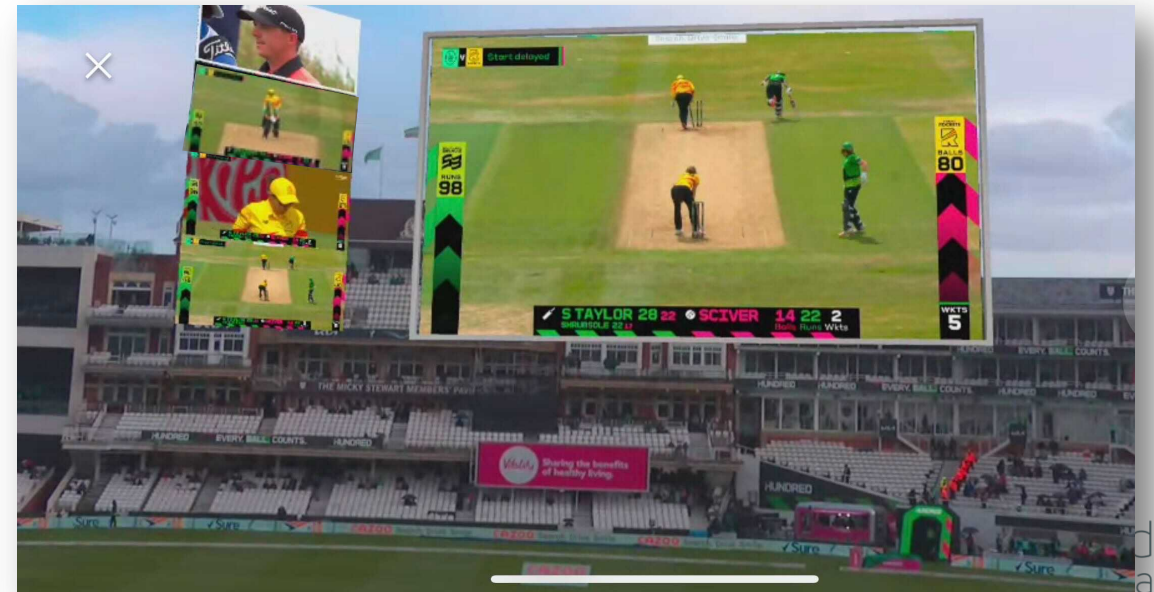


Sky Worlds
Video Clip Available at:

<https://www.oculus.com/experiences/quest/5060690107290136/>

“Mosaic” in **sky worlds**

- Used for Extreme E, Cricket, Premier League Football
- Access to up to 8 user-selectable camera feeds in up to HD resolution, with UHD immersive “backdrop”
- All retrieved at the display resolution, with near-instant switching





Sky Worlds Mosaic Video Clip Available at:

[https://twitter.com/SkySports
/status/14283771374012784
70](https://twitter.com/SkySports/status/1428377137401278470)

How ClearVR and Tiled Streaming work



Take a VR Video

viewport



You only see about 1/8 of the total picture



viewport

Cut the video in tiles



viewport

Determine which tiles are in view



Only stream the tiles in the viewport



Also stream low-resolution background

The image is a 360-degree panoramic view of a beach and lake, seen from inside a wooden pavilion. The view is divided into a grid of 12 columns and 8 rows. A central rectangular area, labeled 'viewport', is highlighted with a white border and contains a zoomed-in view of the beach and lake. To the left of the viewport is a red vertical bar, and to the right is a green vertical bar. The text 'viewport' is written in white lowercase letters inside the central rectangle.

viewport

When you turn your head ...

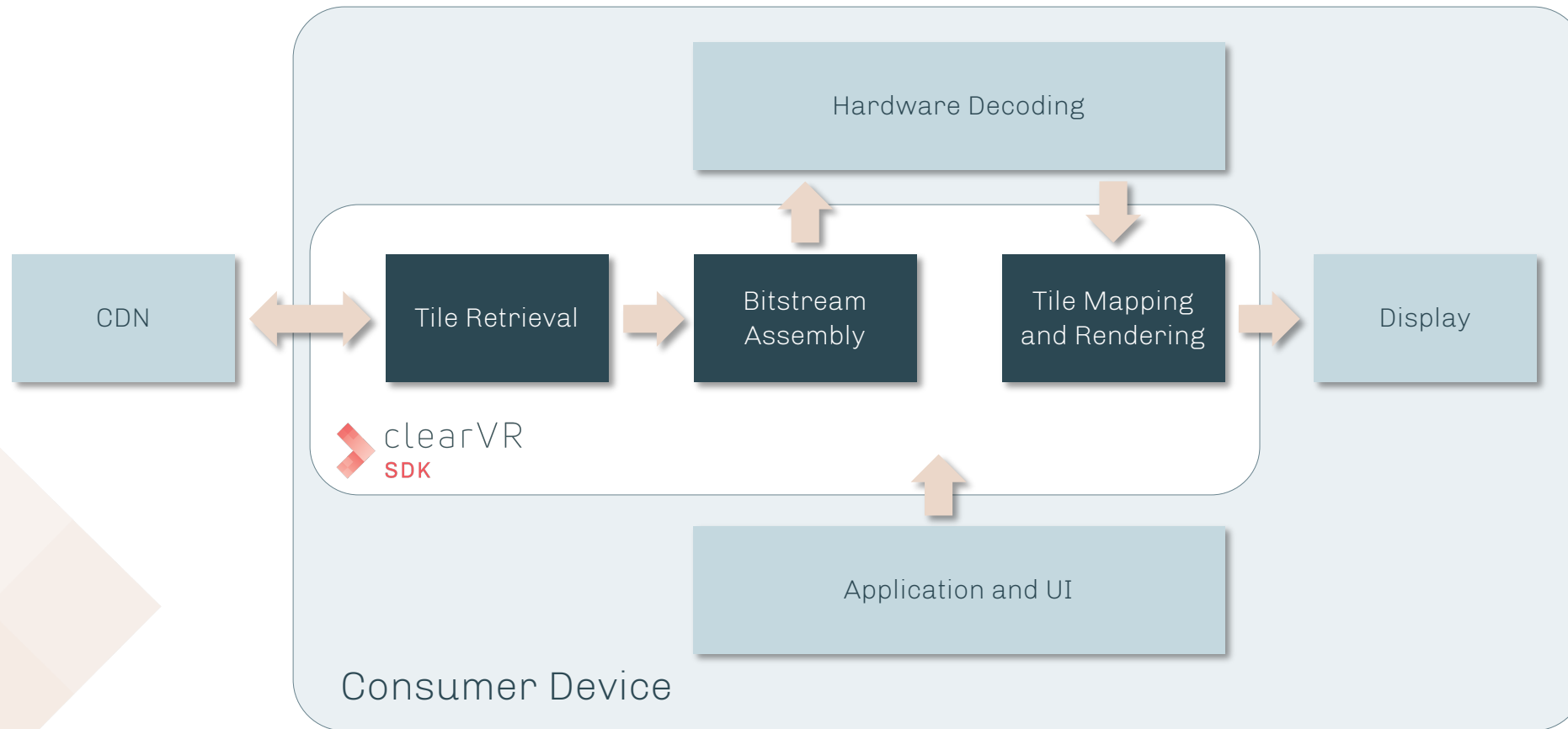
Tiledmedia Mosaic Product

- Brand new, so I don't have fancy slides. Prepare for some dense ASCII :-)
- **Tiled streaming** of HEVC-encoded video with the same principles as for tiled VR:
- **Efficient** on bandwidth and decoding resources: retrieve and decode only the pixels that the user needs, at the resolution they are displayed
- Requires only a **single decoder** to make it fully cross-platform
- Virtually **immediate**, frame-accurate switching with **seamless** audio
- A **single encode** with several representations to enable speed *and* quality
- **Client-side logic** to retrieve what's required at the proper resolution
- **No server-side** configuration or per-user processing
- Simple **http streaming** with multiple parallel multipart/byterange requests
- **Synchronised metadata** to track of which content is where in the decoded frame (position in the “sliding puzzle” - may change opportunistically)

Widest range of devices

- **VR Headsets:** Oculus Quest 1 & 2, Go, Pico, Skyworth, DPVR, Vive Focus
- **Android:** Tablets, Phones, Android TVs
- **Apple:** iPhone 6S & up; recent tablets ('17/'18 & up), AppleTV
- **PC:** Rift, Vive

Client Architecture (Video)



Requirements and Challenges

- Keeping switching time at the lowest possible minimum
- Managing decoder resources and knowing what will decode across an insane diversity of devices
- Accurate sync across disparate feeds
 - Obviously between cameras
 - Managing framerates
 - Keeping sync across users for a social experience without spoilers
- Partial Access is the Rule, not the Exception
 - Need to be able to retrieve, decode and display *any* representation of *any* stream instantly

The *Real* Challenge

- Security at a level good enough for the highest-value content (Hollywood movies, top-tier sports competitions, TV channels with original content)
- Read: Widevine L1
- While constructing bitstreams from different sources, client-side, in real-time.
(This works)
- But then manipulate textures in some secure domain - resizing, moving around with full freedom to have other layers with graphics, data, 3D environment, etc.
(Much more difficult)



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