Solving the Multiview Problem

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Who is Tiledmedia Anyway?

- VR Streaming company started in 2017
- ClearVR: extremely high-resolution, 8K+, tiled, “viewport-adaptive” VR
- Tokyo and Beijing Games (NBCU, CCTV), English Premier League, European Champions League (Sky, BT Sport), Qatar World Cup Final, Baseball in Korea (LG U+), Indian Premier League Cricket (Jio), CBA Basketball and WTT Table Tennis (Migu/China Mobile)
- Now launching “Mosaic Multiview”

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9TO5Google

YouTube TV Multiview lets you watch up to 4 games, in preview for March Madness

Abner Li | Mar 14 2023 - 9:36 am PT | 1 Comment

Macworld

APPLE MAC IPHONE IPAD APPLE WATCH APPLE TV AUDIO ACCESSORIES SOFTWARE BEST PICK

iOS 16.5 beta teases a new 'multi-view' sports feature for Apple TV app

The feature appears to be similar to ESPN+'s MultiCast.

By Michael Simon
Executive Editor, Macworld | MAR 29, 2023 10:11 AM PDT

Image: Foundry

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Multiview Streaming: A Wicked Problem

- Limited number of streams
- Switching: sluggish, discontinuities, audio drops, FOMO
- Inflexible
- Expensive to scale
- Very hard to deploy cross-device

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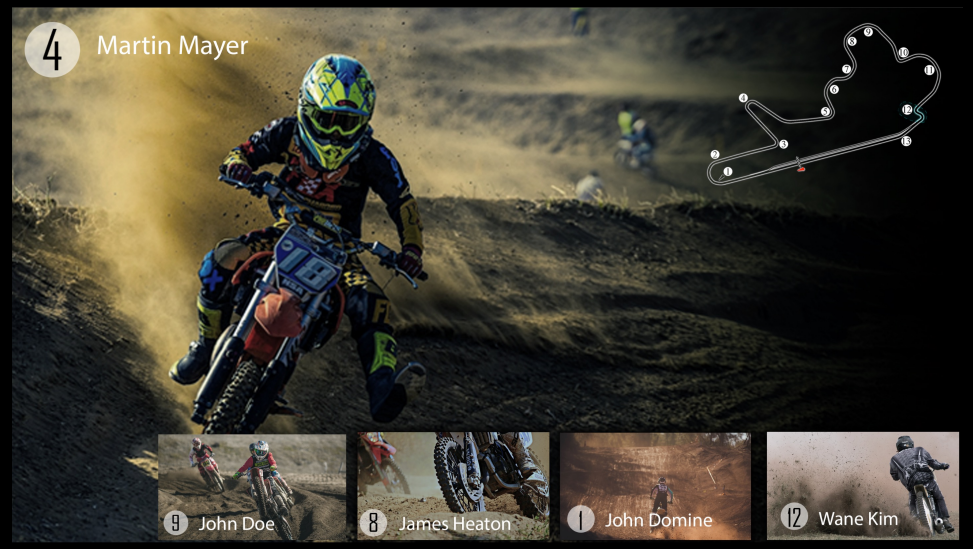
What if You Could:

- Switch instantaneously
- Watch with continuous audio
- Switch A and V independently
- See video thumbs for all feeds
- Follow your favorite athlete …
  - … or more than one
  - without losing the director's cut
  - with instant focus switching, adding your own choices in addition to the director's cut



Current Approaches Fall Short

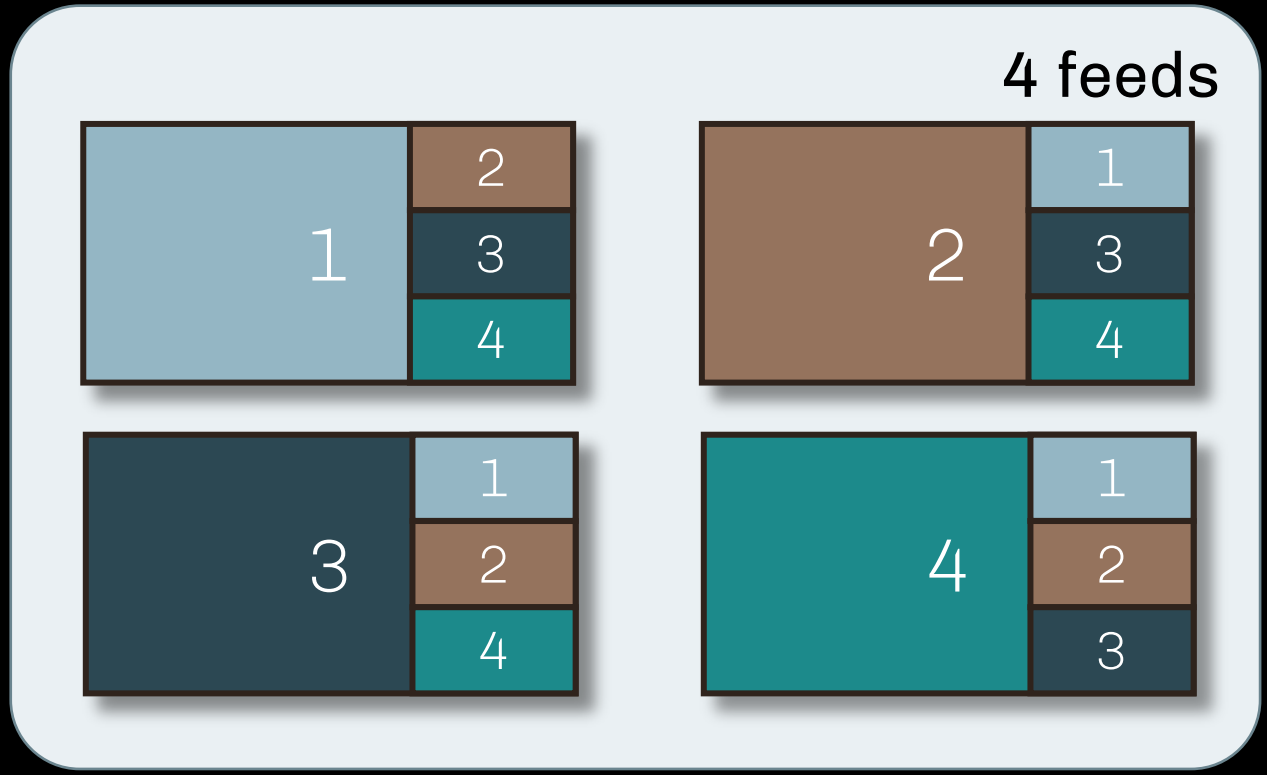
1. Many Encodes
2. Many Decoders
3. Cloud/Edge processing

Many Encodes

Encode all permutations

- ✅ Fairly simple to build, deploy
- ✅ Scales if amount of feeds is low

- ❌ Hard to seamlessly switch A and V
- ❌ Slow to switch
- ❌ Combinatorial explosion
- ❌ Offering both PiPs *and* thumbnails requires insane amount of encodes

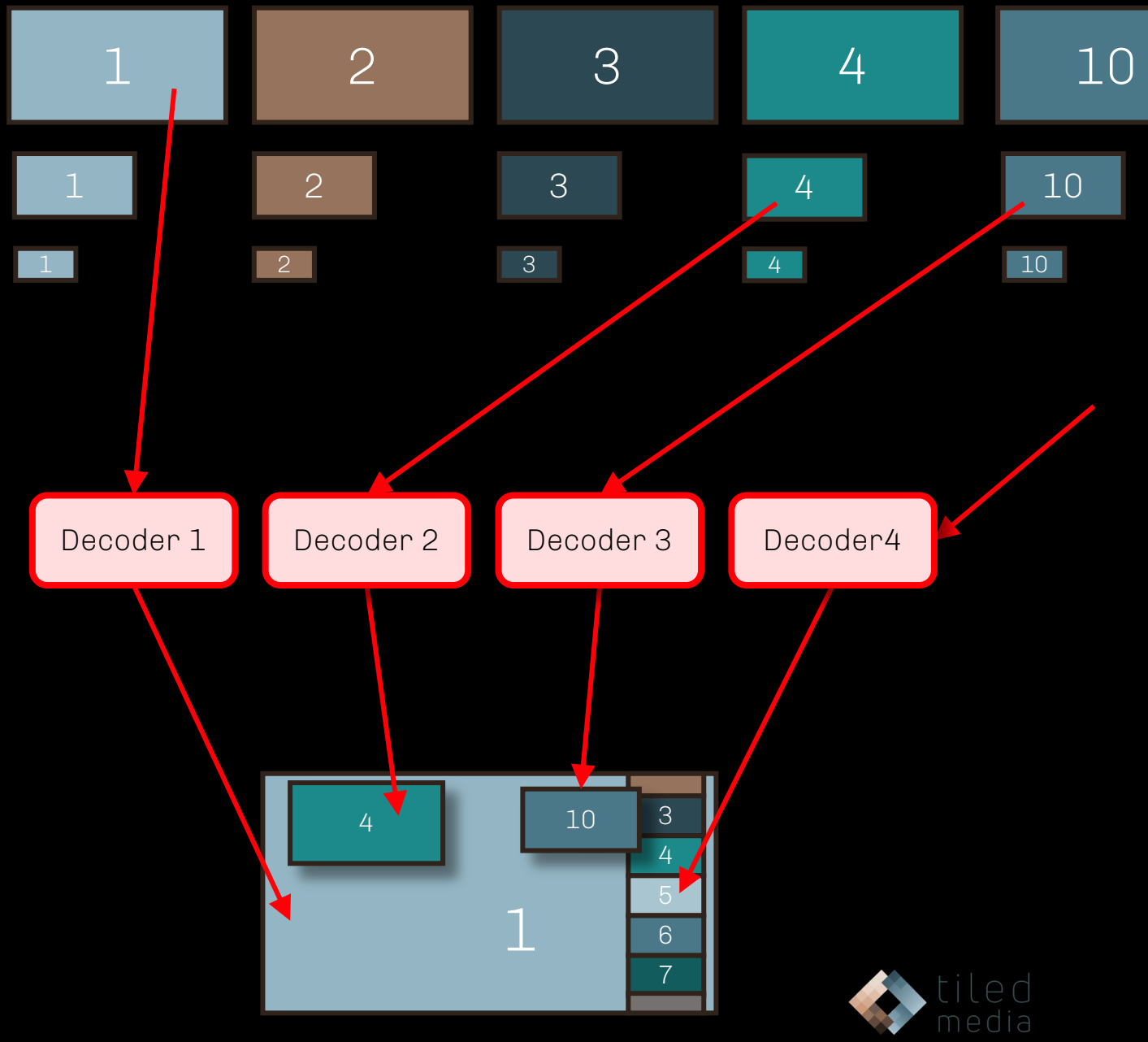


Many Decoders

Use separate decoders for different streams

- ✅ Allows client-side interaction
- ✅ Scales well to many users

- ❌ Hard to deploy cross-device;
- ❌ Audio and Video sync is a nightmare
- ❌ Independent players fight for ABR bandwidth



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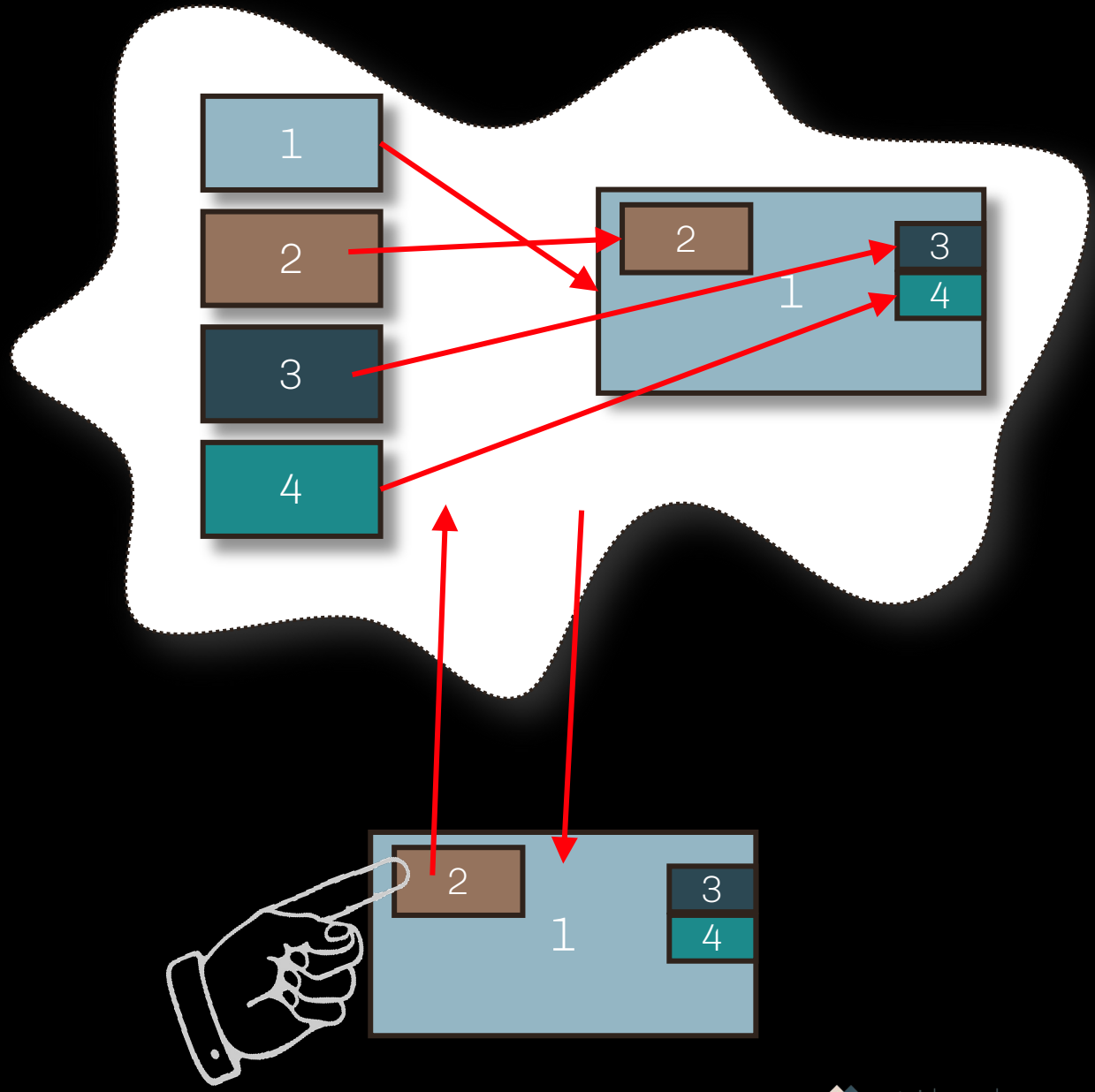
Cloud/Edge Processing

For each user, encode current layout in the cloud

- ✅ Optimizes bandwidth
- ✅ Allows all possible lay-outs

- ❌ Sluggish
- ❌ Extremely expensive to scale



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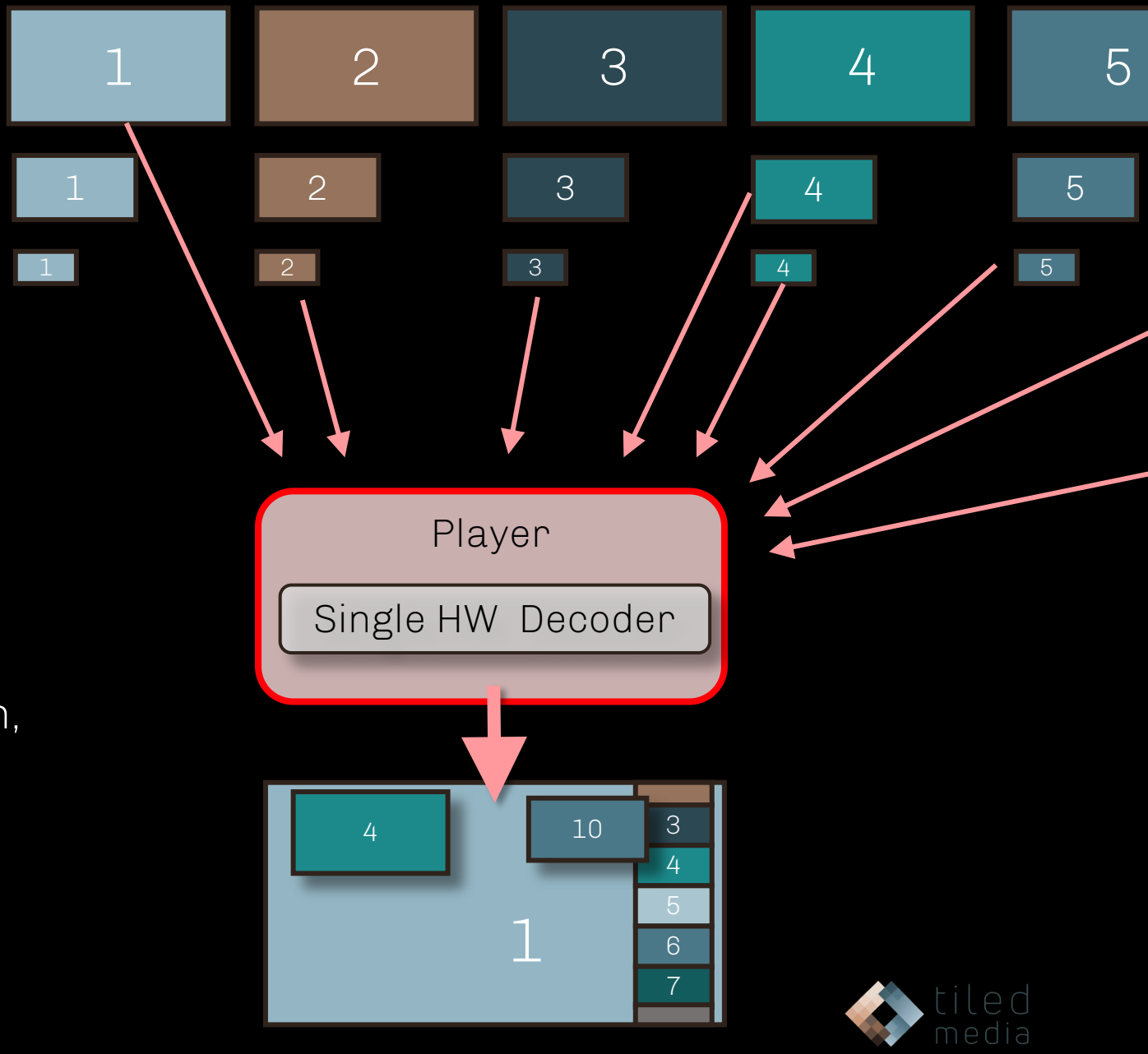
Tiled Multiview

Stream only the feeds you see, at the resolution that you see them

- ✅ Tiling-enabled HEVC encodes
- ✅ Fetch required feeds from CDN
- ✅ Merge into single bitstream
- ✅ Decode merged bitstream
- ✅ Position individual feeds on the screen, ready to be moved, resized etc.



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Quick Demo

You can download the demo in iOS & Google Play app stores.
Look for the “Tiledmedia Player”

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Picture-in-Picture
Main Feed
Picture-in-Picture
Video Thumbs
BEIJING 2022
VEXX

What you
see in the UI

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What you see in the UI

What is streamed

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What you see in the UI

What is streamed

What is decoded (single decoder)

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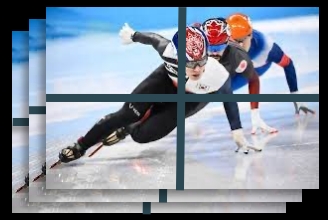
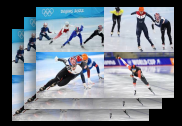
What you see in the UI

What is streamed

What is decoded (single decoder)

What is encoded





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Tiled Stream Format

Encode each feed into independent, fully standards-compliant, CMAF HLS streams

Use any HEVC encoder, with these parameters:

- Same IDR interval and GOP structure among all encodes
- Common HEVC tile size among all encodes and ABR levels (add padding where needed)
- Tiles *don't* need to be independently decodable (don't need motion-contrained tiles as in VR)
- Motion vectors *do* need to be restricted to *picture* boundaries
- Temporal motion vector predictors need to be disabled
- Framerate must be harmonized across all feeds
- May want to encode multiple thumbnails together as composite stream for efficiency

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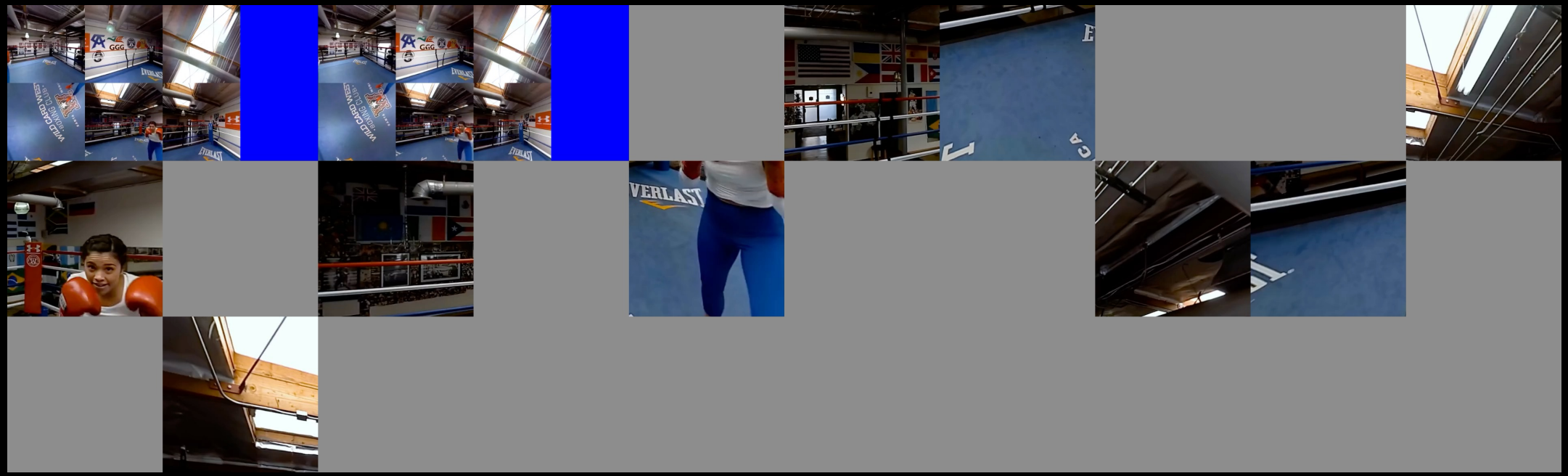

example of raw decoder output (stereoscopic VR360)

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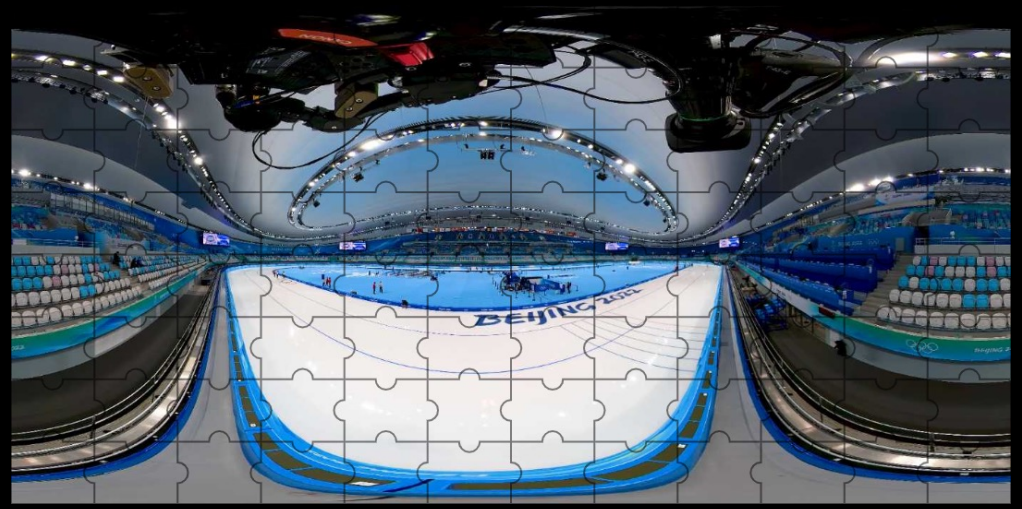
Tiling Paradigm:
Fundamentally different way of looking at video

Traditional

Foundational element: video frame



Tiled

Foundational element: tile

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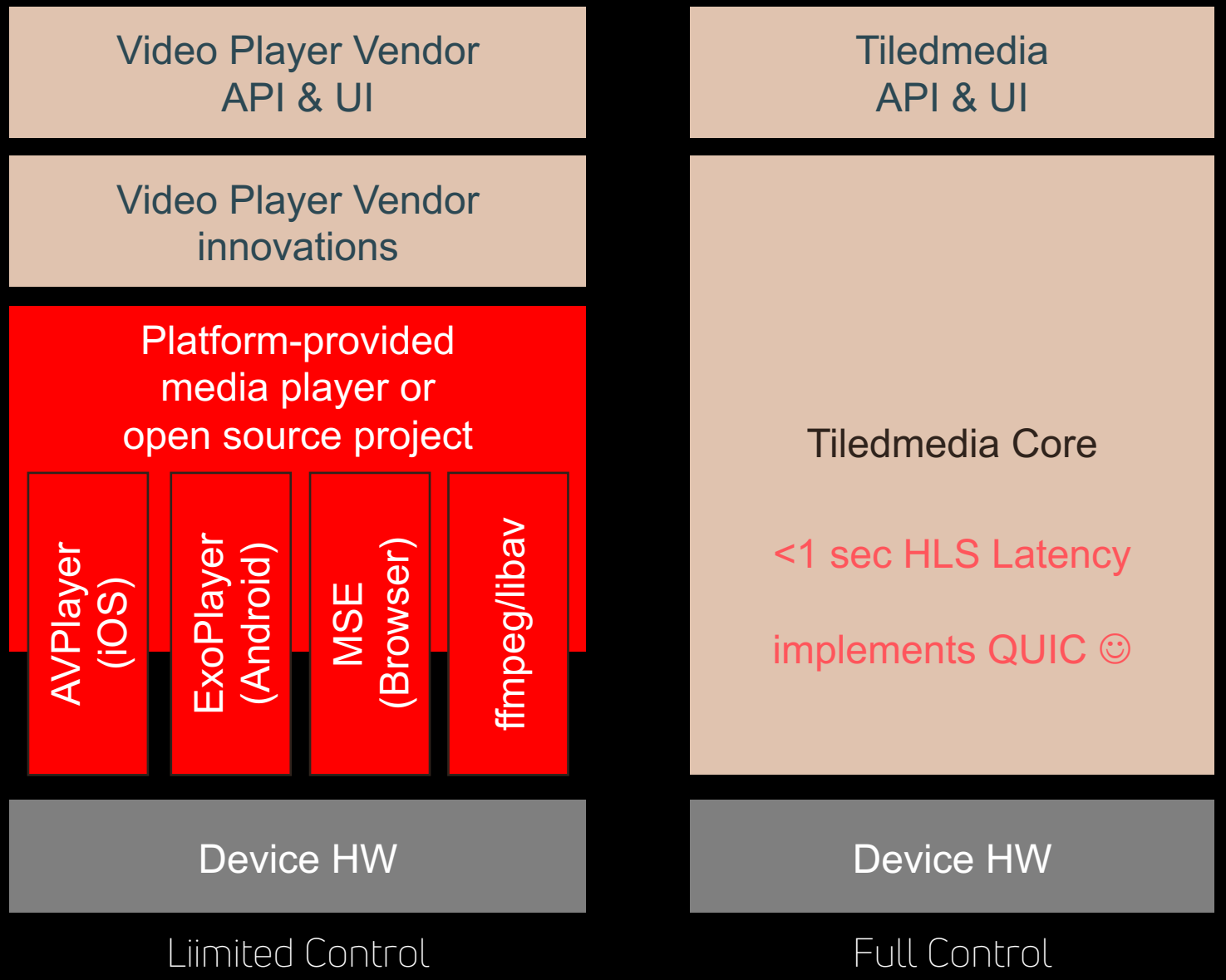
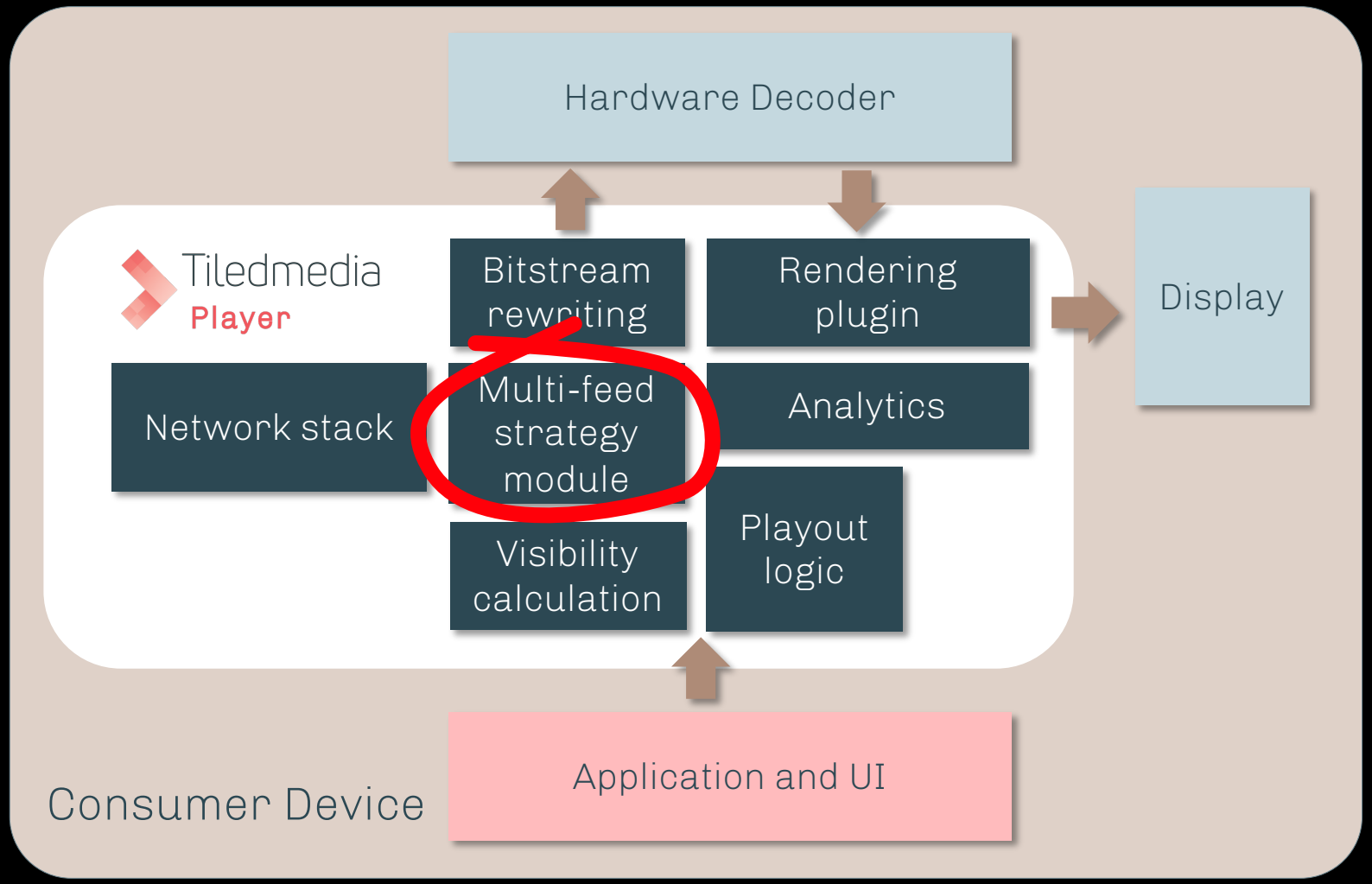

Video Player Vendor
API & UI
Video Player Vendor
innovations
Platform-provided
media player or
open source project
AVPlayer
(iOS)
ExoPlayer
(Android)
MSE
(Browser)
ffmpeg/libav
Device HW
Liimited Control
Tiledmedia
API & UI
Tiledmedia Core
<1 sec HLS Latency
implements QUIC ☺
Device HW
Full Control


Hardware Decoder
Tiledmedia
Player
Bitstream rewriting
Rendering plugin
Display
Network stack
Multi-feed strategy module
Analytics
Playout logic
Visibility calculation
Application and UI
Consumer Device

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Multiview Use Cases

Spatial Video Ads

Multiple
Cameras/Viewpoints

Multi-Game/Program UIs

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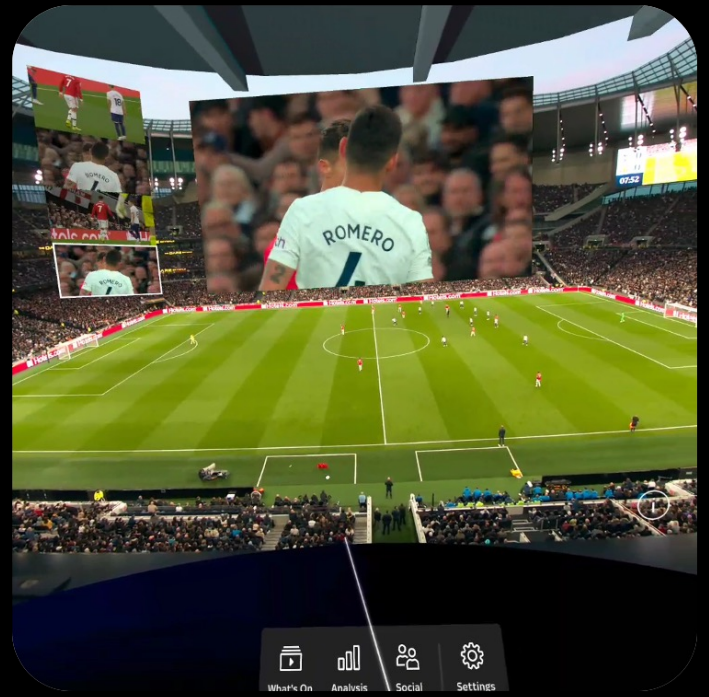
Results & Challenges/Next Steps

- Deployed in Sky Worlds; VR180 + 4 to 8 HD channels
- Tested with 20+ feeds in a ”multi-ball sport” to very good tester response



- Dealing with imperfect input – intermittent input, inconsistent/wrong timing information, different contribution paths for different streams (e.g. World Feed / ISOs / dedicated 180)
- Enabling 3rd party encoders → smarter player
- Devising the right “ABR” strategies → many options

Thanks!

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