

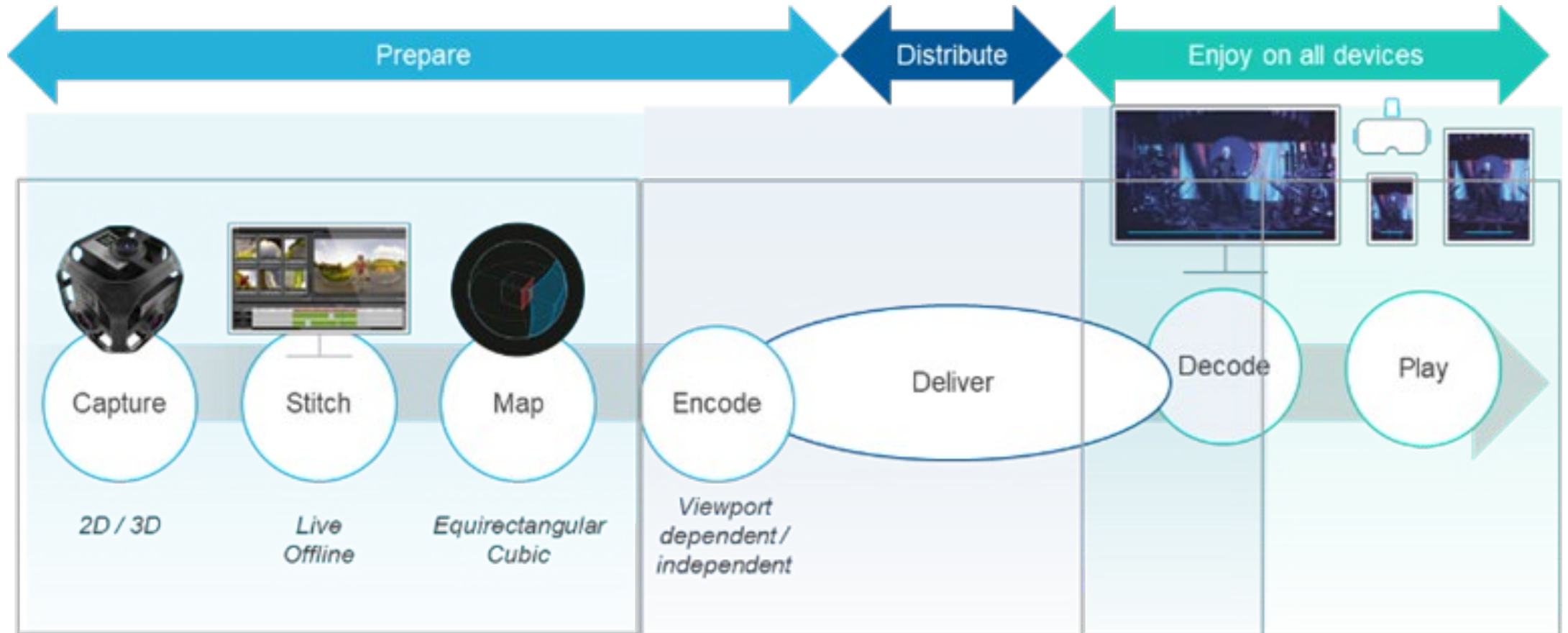
360 8K Viewport-Independent VR

Thierry Fautier
VP Video Strategy
Harmonic

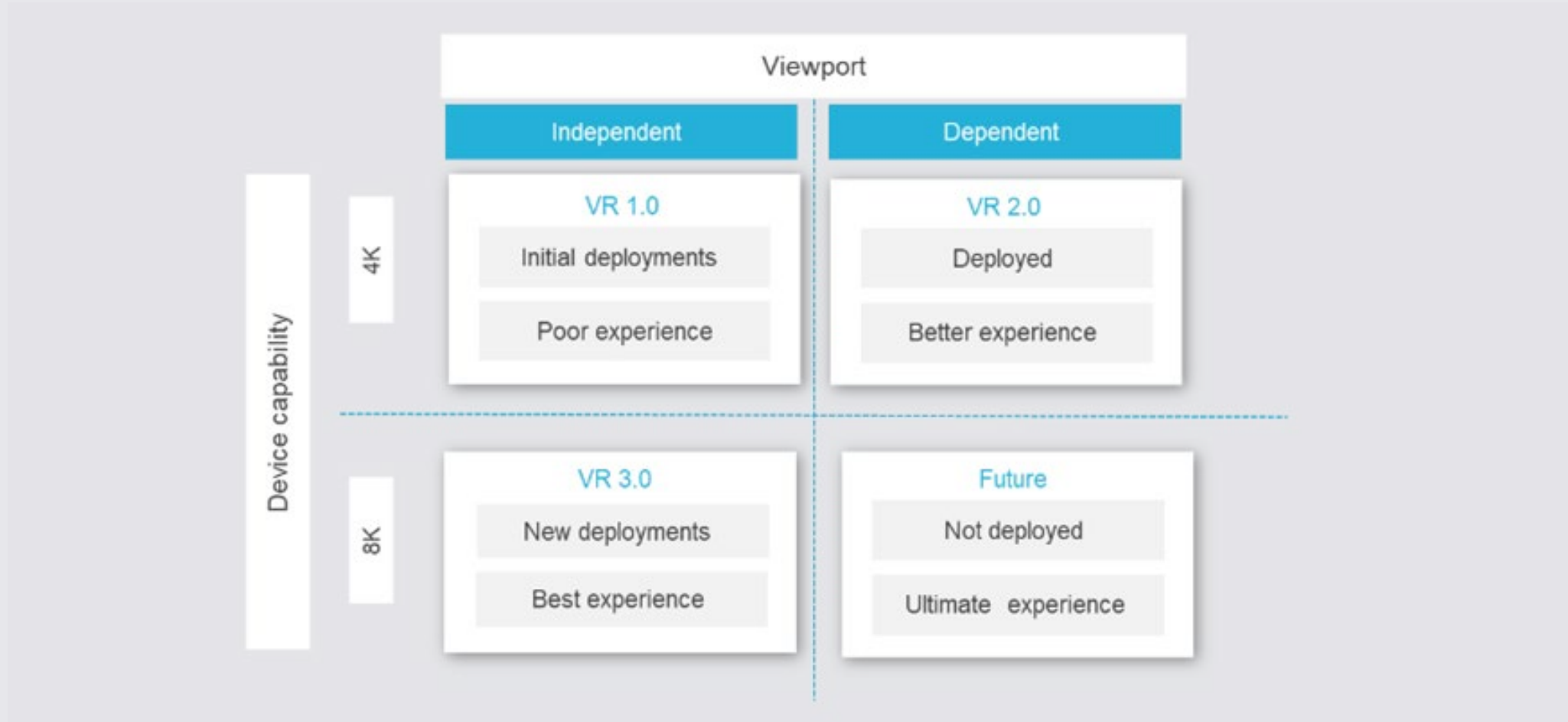
Agenda

| | | | |
|--|---|--|---|
| 1 8K viewport independent description | 2 Technical parameters used in the trial | 3 Power consumption measurement | 4 Viaccess-Orca secured player (VO Player) |
| 5 SVA trial description | 6 SVA trial results | 7 Conclusion | 8 Next steps |

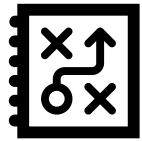
VR Workflow



VR Phases



Viewport Independent Attributes



100% OTT Compatible Workflow

- CENC support
- Low latency support
- DAI support
- Seamless CDN integration
- Seamless analytics integration



Easy integration into 8K capable clients

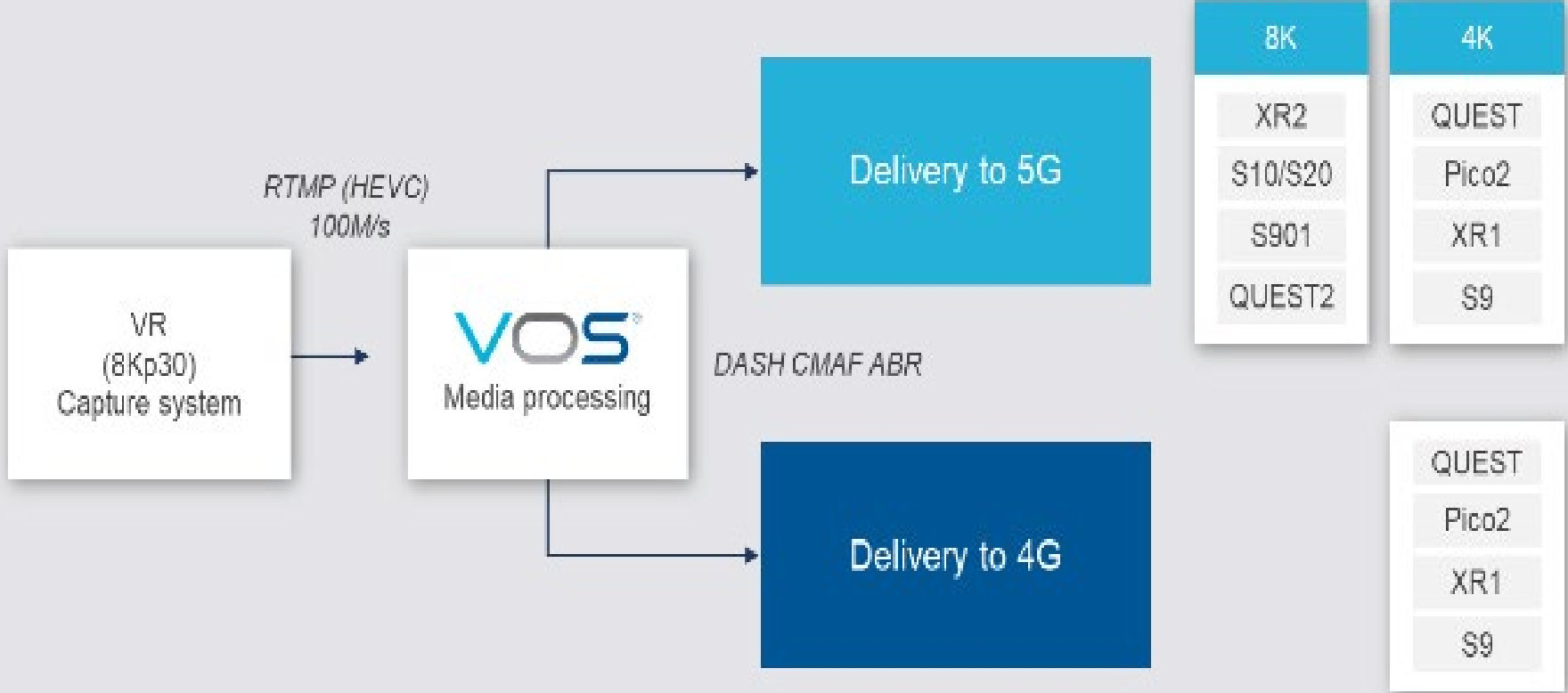
- HMD (i.e. Oculus Quest 2, etc.)
- 5G phones

VR Technology Comparisons



| Features | 4K viewport independent | 4K viewport dependent | 8K viewport independent |
|--------------------------|---|---|---|
| Standard based | OMAF 1.0 | OMAF v1.0/OMAF v2.0 | Extension of OMAF 2.0 |
| Quality | No lag in any network conditions Limited (HD) perceived resolution | Lag in stressed network conditions Limited ABR support | No lag in any network conditions Reduced resolution on 4G |
| Decoder performance | 4K decoder required | 4K+ decoder required | 8K decoder required |
| Decoder base | All head-mounted displays (HMDs) | All high-performance 4K HMDs/phones | Gear VR/S10 (deprecated) , Skyworth v901, Qualcomm XR2, Oculus Quest 2 S10/S20 phones |
| Protocol | OMAF 1.0/DASH | OMAF 2.0 | OMAF 2.0/DASH |
| Latency | 5-7s | 20-30s | 5-7s |
| DRM integration | Standard | Non-standard/complex | Standard |
| Multi-client integration | Standard | Non-standard/complex | Standard |
| DAI | Standard | Non-standard/complex | Standard |
| Bitrate (top profile) | 10-15 Mbps | 20 Mbps | 35 Mbps |
| Analytics | Use OTT analytics | Develop custom analytics | Use OTT analytics |
| CDN independent | Yes | No | Yes |
| Visual experience | Poor | Good | Good |

Different Scenarios For 8K VR ABR Delivery



Interoperability Table



| Device | Video format | Chipset | Player | Mode |
|--------------------|--------------|-------------|---------------|--------------|
| Galaxy S10 | 8Kp30 | SDM 855 | Viaccess-Orca | Magic window |
| Gear VR/Galaxy S10 | 8Kp30 | SDM 855 | Viaccess-Orca | HMD |
| Skyworth v901 | 8Kp30 | Exynos 8895 | Native player | HMD |
| Qualcomm XR2 | 8Kp60 | SDM 865 | Viaccess-Orca | HMD |
| Oculus Quest 2 | 8Kp60 | SDM 865 | Viaccess-Orca | HMD |
| Galaxy S20 | 8Kp60 | SDM 865 | Viaccess-Orca | Magic window |

Formula 3 8K Encoding Profiles



| Profiles | Resolution | Frame rate (fps) | Average video bitrate (Mbps) | Max video bitrate measured over chunk duration (Mbps) |
|------------------|------------|------------------|------------------------------|---|
| 8K Cap 42 Mbps | 7680x4320 | 25 fps | 28.6-32 Mbps | 42.6 Mbps |
| 4K Cap 25 Mbps | 3840x2160 | 25 fps | 16.6-18.3 Mbps | 26 Mbps |
| 4K Cap 15 Mbps | 3840x2160 | 25 fps | 10.2-12.1 Mbps | 15.5 Mbps |
| 1080p Cap 8 Mbps | 1920x1080 | 25 fps | 3.6-5 Mbps | 6.3 Mbps |
| 1080p Cap 5 Mbps | 1920x1080 | 25 fps | 2.2-3.6 Mbps | 4.9 Mbps |
| 720p Cap 3 Mbps | 1280x720 | 25 fps | 1.3-2.4 Mbps | 2.9 Mbps |

Power Consumption



| Source | Device | | |
|--------|------------|---------|---------|
| | Galaxy S10 | Gear VR | Chipset |
| 4K | 100 | 100 | SDM 855 |
| 8K | 60 | 60 | |

| Source | Device | | |
|--------|------------|---------|---------|
| | Galaxy S20 | Quest 2 | Chipset |
| 4K | NA | 58 | SDM 865 |
| 8K | NA | 55 | |

Use duration (8K vs 4K): -40% for S10 mobile, -5% on Quest 2

VR VO Player Device Support

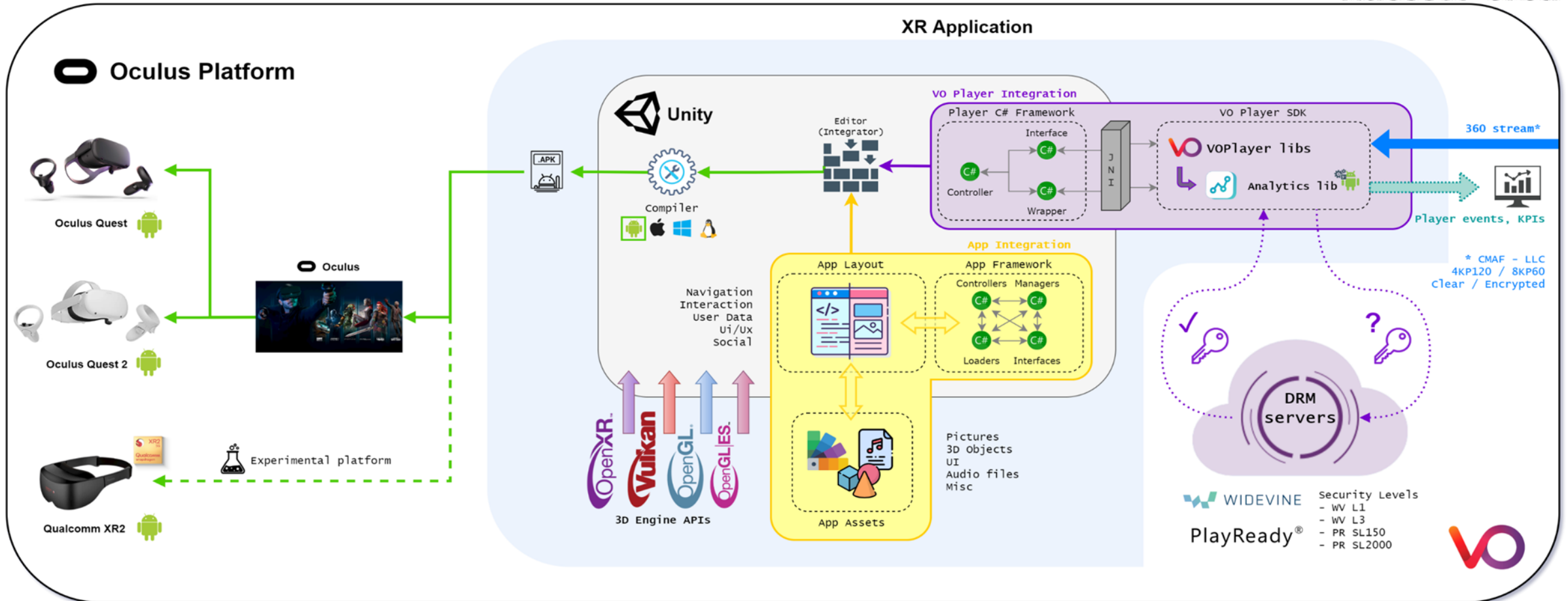


| Devices | Usage | Mode | Platform |
|-----------|-------------|--------------|------------------|
| STB | Stand-alone | Magic window | Android |
| Smart TVs | Stand-alone | Magic window | Android |
| PC | Stand-alone | Magic window | Web |
| Tablet | Stand-alone | Magic window | Android |
| Mobile | Stand-alone | Magic window | Android |
| | Plug to HMD | VR | Android |
| HMD | PC tethered | VR | WebXR |
| | Stand-alone | VR | Android – Oculus |

VR VO Player Architecture



viaccess-orca

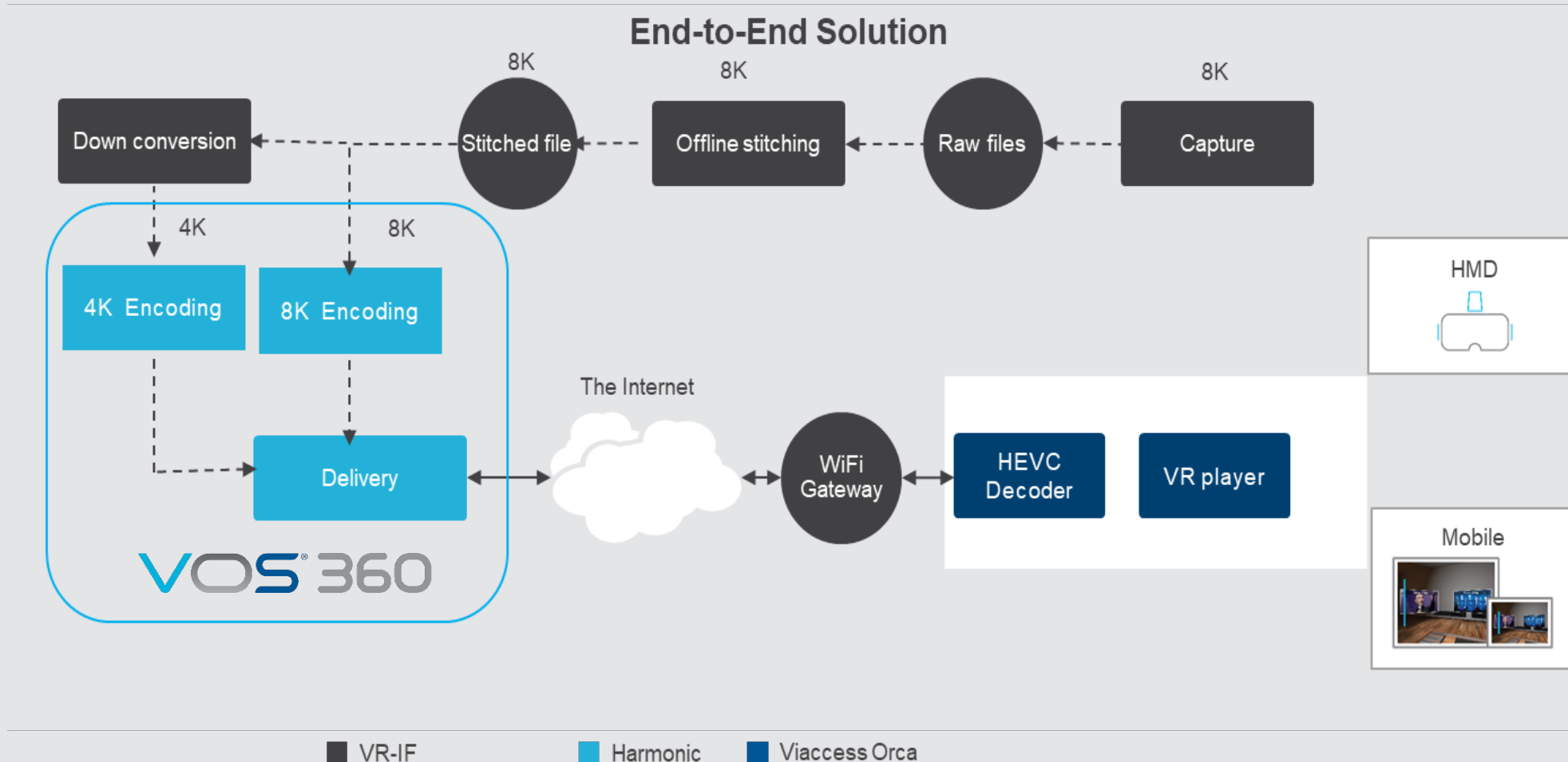


VR SVA Trial Participants



| Role | Company | Details | Note |
|-----------|--|---|--------------------------------------|
| Content | VR-IF | F3 content 4K and 8K | Alternate 4K and 8K source |
| Encoding | Harmonic | Encoding and packaging of content to different formats for 4K and 8K viewport | |
| Networks | Orange 10G Spectrum 400M FiOS 1G | Commercial services | |
| CDN | Qwilt | CDN that can support open caching | Open caching not tested in the paper |
| Devices | Viaccess-Orca Lumen Verizon | Quest 2 Galaxy S10 | Alternate 4K and 8K source |
| Player | Viaccess-Orca | Embedded player in Viaccess-Orca Secure Player, sample Unity app for Oculus Quest 2 and Android devices | Alternate 4K and 8K source |
| Analytics | NPAW | Youbora test suite integrated in Viaccess-Orca Player | |

Trial Workflow



VR SVA Trial Results



| Scenario | Network | Average bandwidth | Throughput | Subjective score | Objective score |
|----------|----------|-------------------|------------|------------------|-----------------|
| 4K/HMD | Spectrum | 15.9 Mbps | 23.9 Mbps | 3.0 | 3.8 |
| | Orange | 15.9 Mbps | 69.1 Mbps | 3.5 | 3.86 |
| | FiOS | 13.8Mbps | 23.5 Mbps | 3.5 | 6.4 |
| 4K/Phone | Orange | 15.9 Mbps | 26.7 Mbps | 4.25 | 3.84 |
| 8K/HMD | Spectrum | 26.1 Mbps | 36.6 Mbps | 4.5 | 4.5 |
| | Orange | 27.7 Mbps | 67.7 Mbps | 4.5 | 4.62 |
| | FiOS | 21.3 Mbps | 25.9 Mbps | 4.5 | 7.1 |
| 8K/Phone | Orange | 14.2 Mbps | 26.5 Mbps | 2.5 | 2.37 |

VR SVA Trial Takeaway



- All very high-speed networks provide a consistent result
- Verizon FiOS gets the highest objective score
- On HMD 4K vs. 8K:
 - 35% increase on the subjective score
 - 15% increase on the objective score
- On mobile
 - On 4K content, good objective score
 - On 8K content, bad experience due to client limitations

Conclusion



We have demonstrated an OTT compatible workflow

- CENC support
- Low latency support
- DAI support
- Seamless CDN integration
- Seamless analytics integration



Easy integration into 8K capable clients

- HMD (i.e. Oculus Quest 2, etc.)
- 5G phones

Significant improvement on HMDs using 8K, 4K good for mobile

Next Steps



Finalize FiOS trial:

- Fix
 - Improve ABR ladder climbing
 - Fix DRM issues on Quest 2
- Test: More diverse content to test 4K vs. 8K
- Networking: Open Caching impact on QoE



Migrate trial to 5G network (with Open Caching)