How We Made 12K VR Streaming at Regular Bandwidth a Reality
普通带宽下的12K高清VR视频直播

Changyin (CY) Zhou
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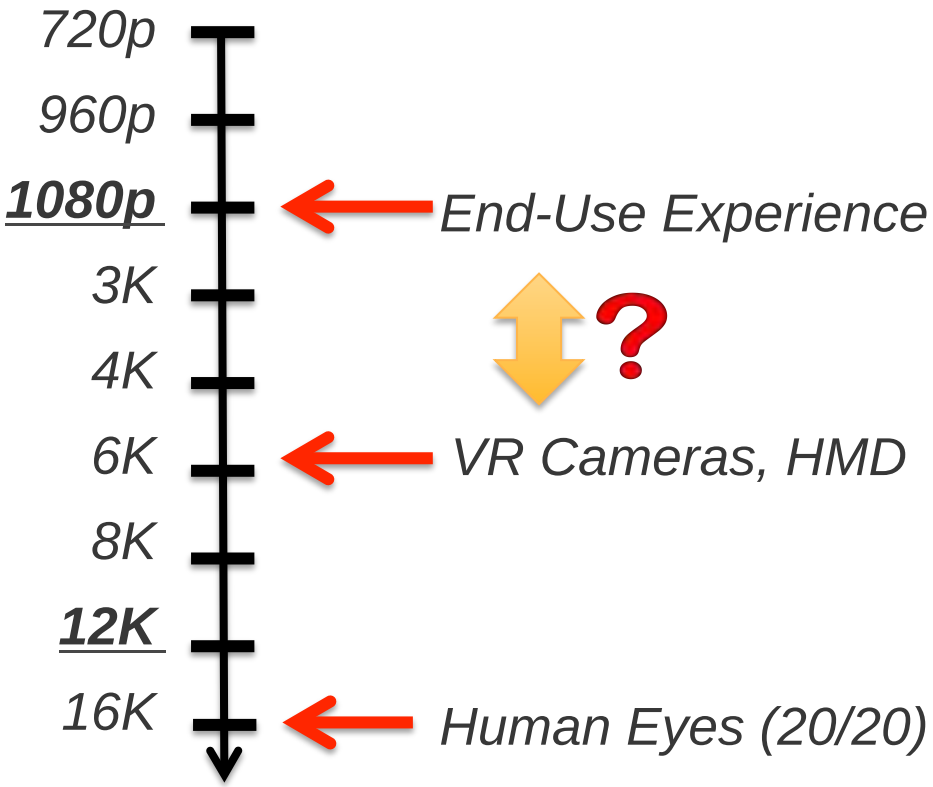
Where is VR Heading & Where are We?

Human Eyes, 60 Pix / Deg

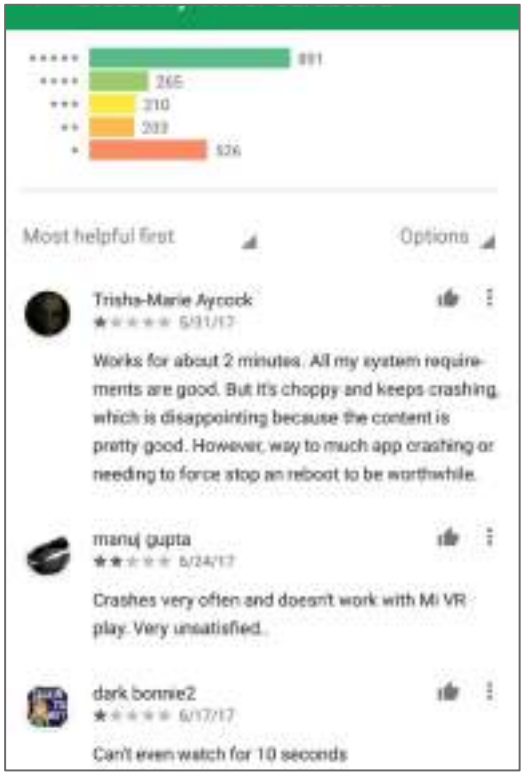
~16K Res Per Eye

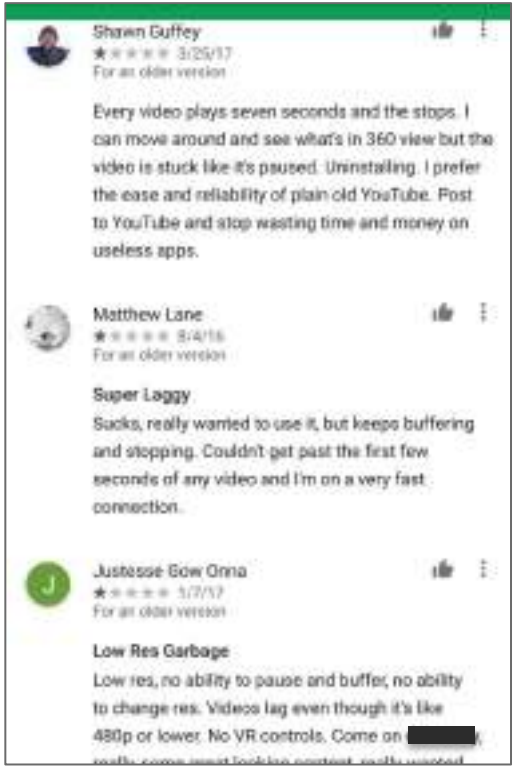


VR Resolution Explosion, Driven by the Needs.

Huge Quality Loss During Delivery and Rendering.

What You Pay





What You Get

Huge Quality Loss During Delivery and Rendering.

What You Pay

?

> Works for about 2 minutes. All my system requirements are good. But it's choppy and keeps crashing, which is disappointing because the content is pretty good. However, way to much app crashing or

> **Super Laggy**
> Sucks, really wanted to use it, but keeps buffering and stopping. Couldn't get past the first few seconds of any video and I'm on a very fast connection.

> **Low Res Garbage**
> Low res, no ability to pause and buffer, no ability to change res. Videos lag even though it's like 480p or lower. No VR controls. Come on [redacted],

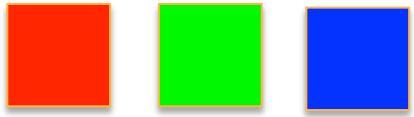
What You Get

Changyin (CY) Zhou, Co-Founder & CEO, Visbit

Ph.D. in Computer Science, Columbia University

Research background: *Vision & Graphics & AR/VR & Video*

Previously: *Google X, Google / Microsoft / Nvidia Research*



It is All about PIXELs.

Computation as A Lens

HDR+ (2013) at Google X

HDR+:

Take a burst of shots, and merge into one high-quality photo.

<u>Process ~100M Pixels in ~1 sec</u>

We do everything so fast that users do NOT need to know it.

Fast Computation & More Pixels & the Better

Computation as A Lens

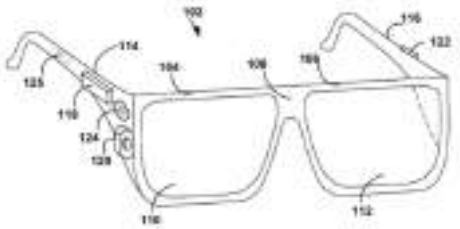
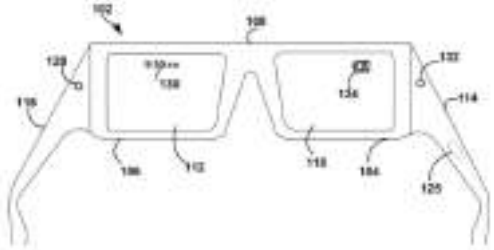


FIG. 1A



Super-Hero Vision at Google X

Look-through Push-button Slow-Mo:

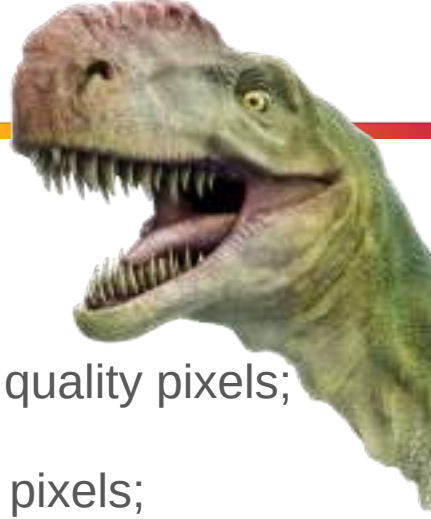
Provide real-time vision enhancement without the delaying from storage media.

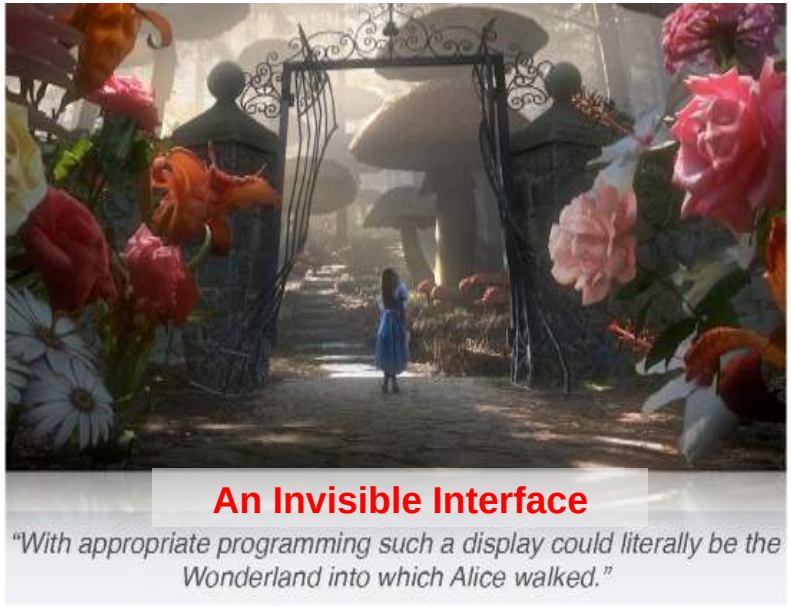
<u>Process ～600M Pixels per Second</u>

We do everything so fast that users feel a super-hero power in the reality.

Fast Computation & More Pixels & the Better

VR is a Data & Computation Monster.





To Simulate the Physical World

Challenges:

- **Capture** tons of quality pixels;
- **Process** tons of pixels;
- **Transmit** tons of pixels;
- **Render** tons of pixels;
- On **Mobile Devices**

VR is a Data & Computation Monster.

Content Creation	Distribution & Transcoder	Decoder & Renderer
		
4K-12K	720p-4K	4K-6K

Avg Internet Bandwidth ➔ ~1080p
Hardware codec ➔ 4K
CPU / GPU eye buffer ➔ 6K
Screen Resolution ➔ **6K**

Foveated Streaming is the Key.

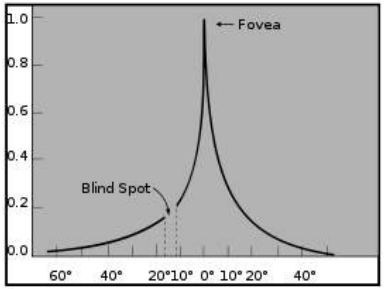
Visbit View-Optimized Streaming (VVOS)

Theoretically:

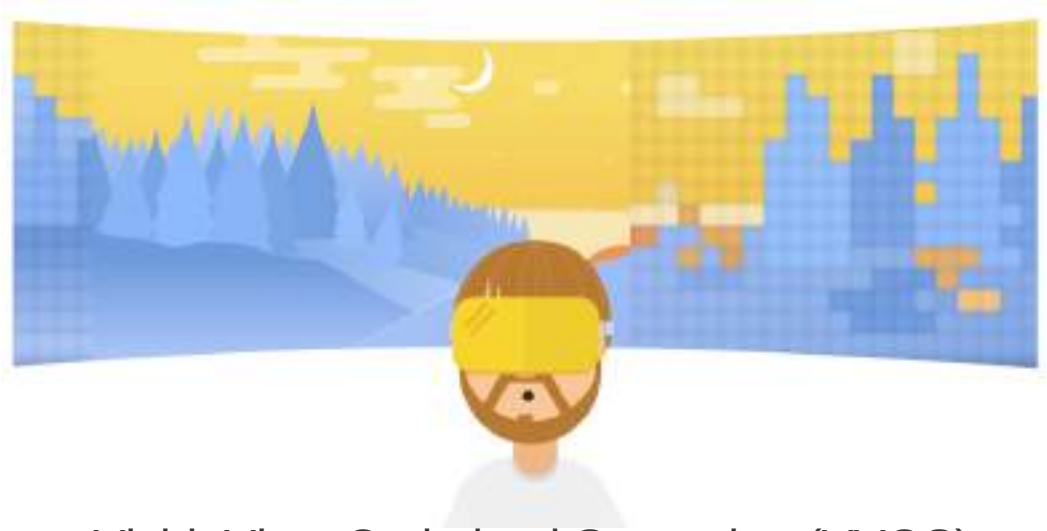
~8x efficient.

Challenge:

Latency when turn



Foveated Streaming is the Key.



Visbit View-Optimized Streaming (VVOS)

Theoretically:

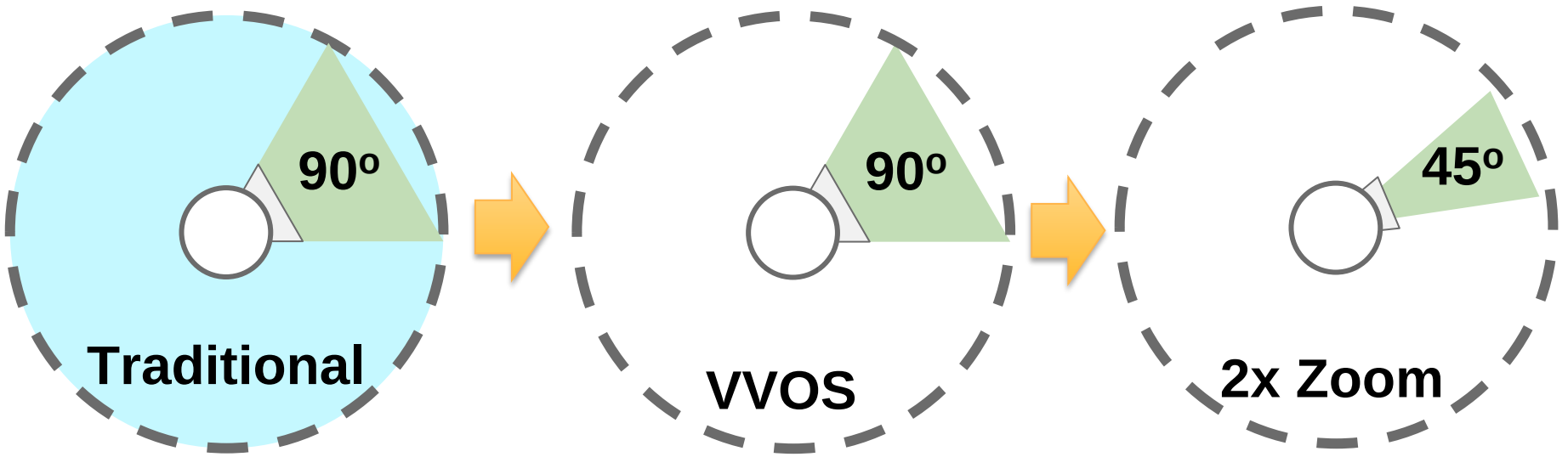
~8x more efficient

Challenge:

Latency when turn

Avg Internet Bandwidth ➔ ~1080p ➔ 12K equivalent
Hardware codec ➔ 4K ➔ 12K equivalent
CPU / GPU eye buffer ➔ 6K ➔ 12K equivalent
Screen Resolution ➔ **6K** equivalent

Foveated Streaming (VVOS) Pushes 6K to 12K



Stream: 4K/4K
Render: 1K
10 Pixels / Deg

Stream: 1.5K/6K
Render: 1.5K
15 Pixels / Deg

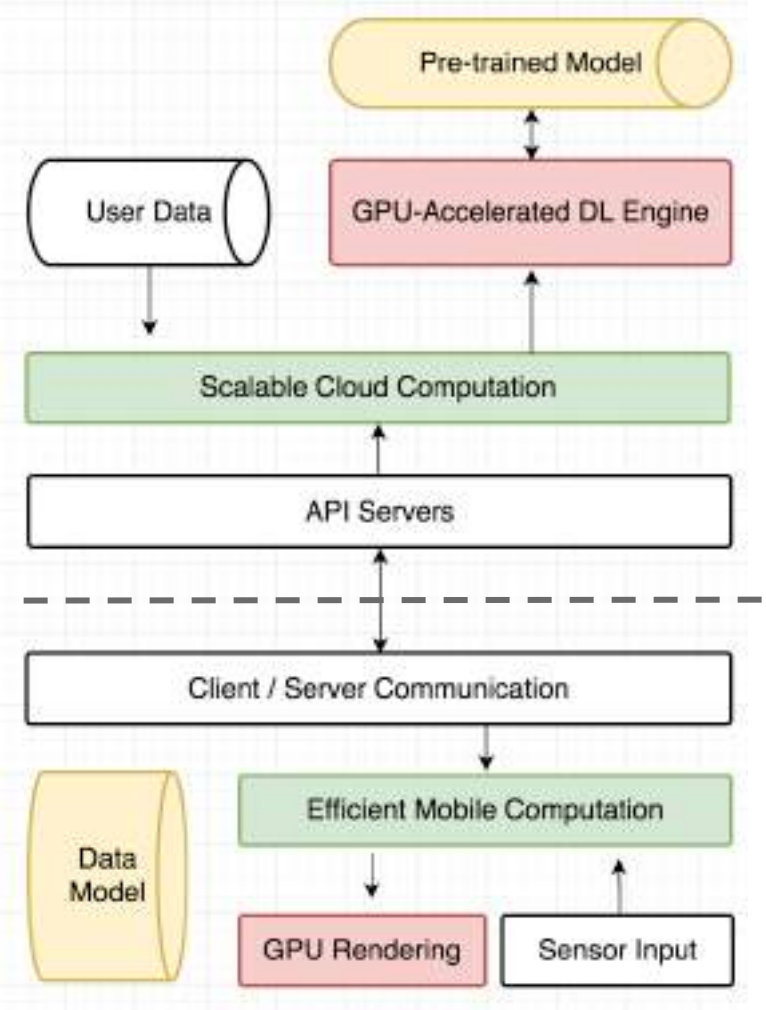
Stream: 1.5K/12K
Render: 1.5K
30 Pixels / Deg

Visbit 12K Streaming Demo

12K VR Zoom Demo Video

VR Streaming Is Complicated, if You Want to Do Well.

Download	Progressive Download	Adaptive Bitrate Streaming	Adaptive Bitrate VVOS
Easy	Easy	+ Transcoding + CDN + Dev-ops	+ Optimized Geometry + Intelligent ABR + Fragmented MP4 + View Optimization + Player SDKs
Worst	Worse	Bad	Good
Commonly used	Popular	Commonly used	New



Scalability,
Intelligence,
Extensibility

cuDNN

kubernetes

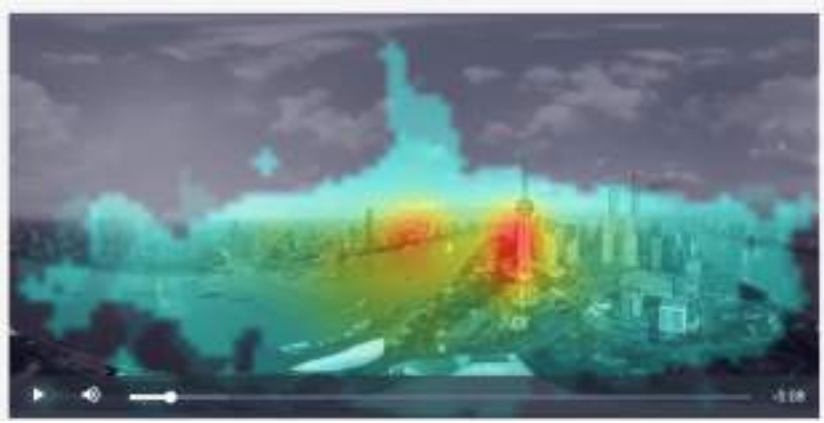
amazon web services™

NEON
Cortex-A Series
ARM MALI

Computer Vision

OpenGL|ES

VR Streaming Is Complicated, if You Want to Do Well.

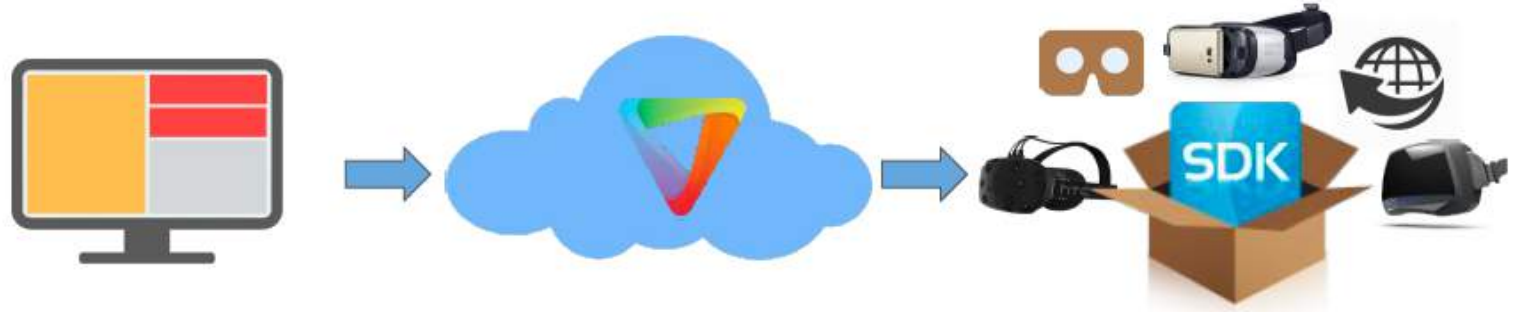


Heatmap of “Without Boundary” from Visbit BI

Instant Publish, Real-time Business Intelligence

Visbit VR All-in-One Streaming Service

Publisher Portal **VR Cloud** **VR Player (SDKs)**



- VOD & Live
- Across all mobile VR platforms;
- Fastest startup time, least choppy, high res;
- Content Protection, Access Control;
- Stereoscopic, Spatial Audio

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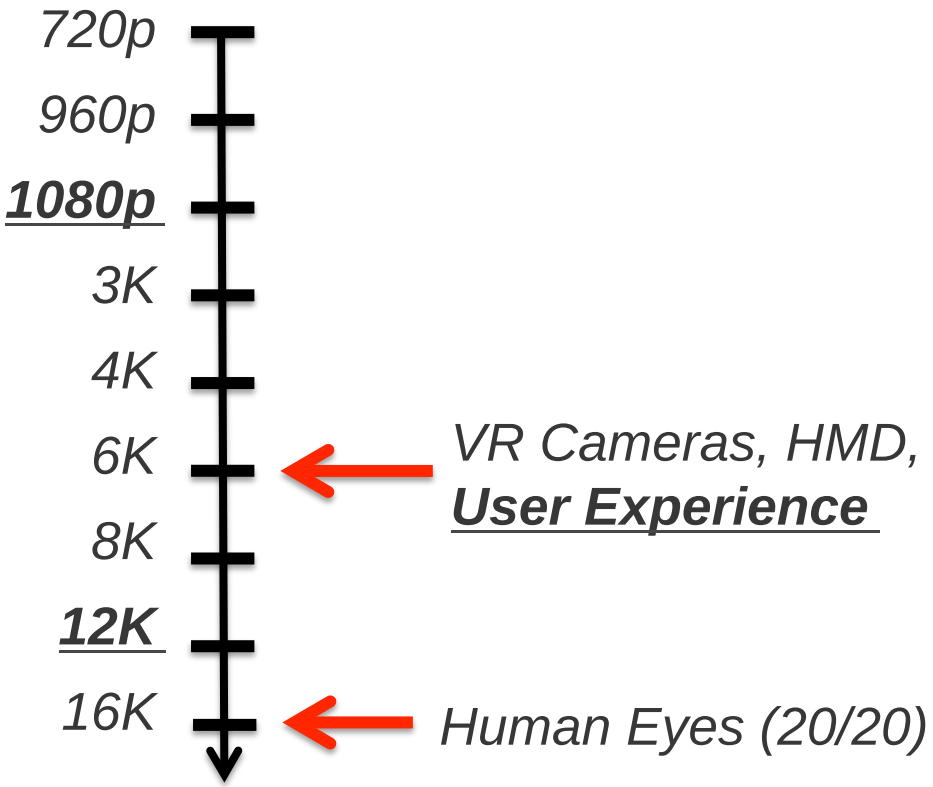

VR Resolution Explosion, Driven by the Needs.

Visbit: Quality VR Streaming Made Easy

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