



VR is meant to be mobile

Qualcomm® Snapdragon™ VR Technologies

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Qualcomm Snapdragon is a product of Qualcomm Technologies, Inc.



Qualcomm Technologies announcements



Snapdragon 835 VRDK for application developers

- **Motivation:** New VR development hardware and software supports ISV early VR app development (expected 2Q'17); facilitates content availability for commercial HMDs based on Snapdragon 835 (anticipated 2H'17)
- **Hardware:** Mobile, standalone HMD (head mounted display) built with Snapdragon 835
- **Software:** Virtual reality software development kit; works with HMD



HMD Accelerator Program for OEMs

- **Motivation:** Help manufacturers reduce engineering costs and commercialize HMD quickly
- **Reference Design:** Access to Snapdragon HMD design files, BOM/PVL, and quality tests
- **ODM Partnership:** Access to validated ODMs offering comprehensive Snapdragon HMD solutions



Leap Motion and Qualcomm Technologies

- **Motivation:** Relationship further advances VR content development in ecosystem
- **Innovation:** Demonstration of Snapdragon 835 with Leap Motion's cutting-edge hand tracking technology designed to render precise movement of user's hands and fingers for VR HMDs with very low latency



HMD Accelerator Program



Mobile VR/AR technology will continue to evolve

Devices will become sleeker, lighter, and more fashionable

Google
Cardboard



Slot-in
Smartphone
Device



Standalone
HMD



Sleek
HMD

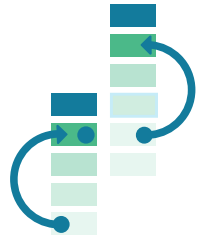


What's next?



Commercialize VR HMDs quickly with fewer resource restraints

HMD Accelerator Program - Goals



Commercialization

Allow OEMs to quickly design and manufacture standalone VR HMDs

High Quality

Provide means for OEMs to track performance, monitor KPIs and promote them

Scale & Harmonization

Standardizing a platform for the whole value chain to build on top and garner critical scale for VR to flourish



Flexible, consistent approach to product development

HMD Accelerator Program - Pillars



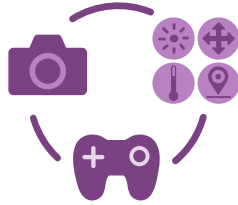
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Product
Reference
Design



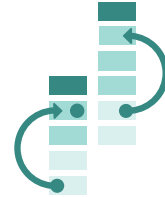
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ODM
Partners



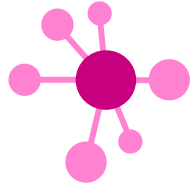
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Component/
Peripherals/
Technology
Partners



4

Performance
and Quality
Metrics/Testing



5

Marketing
Support

A comprehensive, robust VR reference design

Reference Design based on the Snapdragon 835 platform



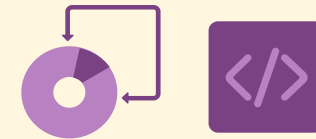
Snapdragon 835 Platform



Key components selection
(camera, sensors, display)



Product/HW Design Files
(schematics, BOM, layout files,
thermal design guidelines)



**VR SW Services
and SDK**

(6DoF, Sensor Fusion,
ATW, Single-Buffer Rendering,
Unity plug-in, etc.)



VR HMD Sample Units
(anticipated availability 2Q17)

ODMs supported on the Snapdragon 835 Platform

Experienced ODMs with strong track record of success



Snapdragon 835 VR HMD



First ODMs Part of HMD Accelerator Program



Estimated 2H17



OEM HMD Launches

Cutting-edge components optimized for reference design

Component and technology vendors



Camera

To be announced



Sensors

To be announced



Display

To be announced



Lenses

To be announced



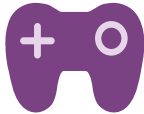
Eye Tracking

To be announced



Hand Tracking

To be announced

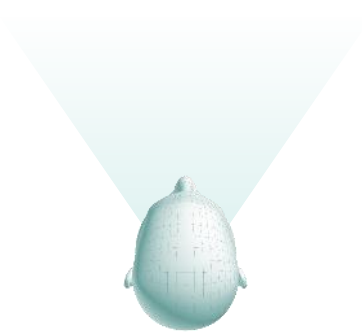


Controllers

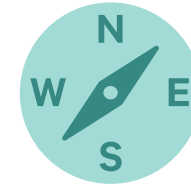
To be announced

Best practices for successful deployment

Performance and Quality Metrics / Testing



Motion to Photon Latency



3DoF and 6DoF Accuracy



Power



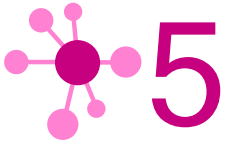
VR UI & App Launcher Latency



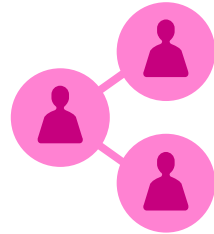
BT/WLAN Throughput

Marketing support

Marketing support for OEMs and partners who participate in the program



Press and Media activities

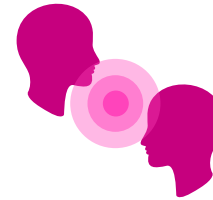


Social Media



Event marketing

- Product showcase at Qualcomm Technologies events
- Joint speakerships at Qualcomm Technologies and/or partner events



Co-marketing

- Qualcomm Technologies executive participation at launch event
- Co-branded marketing assets for promotion (testimonials, blogs, etc.)



Marketing tool kit

(images, logos, templates, etc.)

Qualcomm® Snapdragon™ VR Development Kit (VRDK)



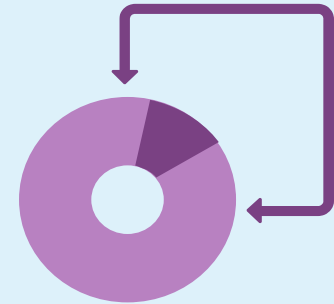
Snapdragon VR Development Kit (VRDK)

Early access to VR head mounted display (HMD) supported by upgraded VR software development kit (SDK) that works in combination with the HMD

Snapdragon VR HMD



Snapdragon VR SDK



Snapdragon VRDK

Advanced VR features designed to optimize applications and simplify development



System on Chip (SoC)
Snapdragon 835 Processor

Display
AMOLED WQHD
~2MPix per eye

Cameras & Other Sensors

- Six degrees of freedom (6DoF) motion tracking:
 - Two monochromatic, one mega pixel (1280x800) global shutter cameras & fisheye lens
 - Inertial measurement unit with fast interface
Snapdragon 835 integrated sensor core
- Eye Tracking:
 - Two monochromatic VGA global shutter cameras



Memory

DRAM: 4GB LPDDR4
Flash: 64GB UFS

Connectivity

Wireless: Wi-Fi, Bluetooth
Other: USB3.1 type C (power)

Audio

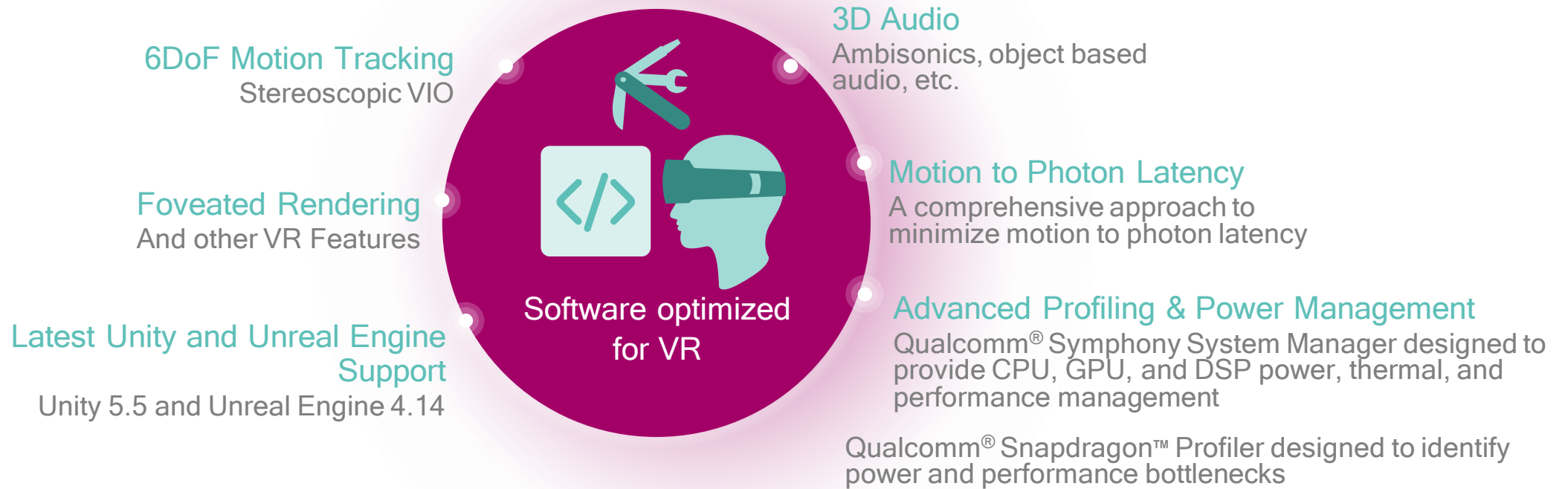
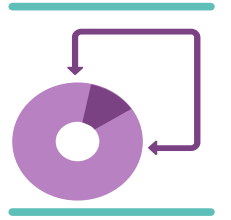
Integrated WCD9335 CODEC

I/O

Trackpad on right side
3DoF controller support

Snapdragon VRDK

Advanced VR features designed to optimize applications and simplify development



Stereoscopic 6DoF Motion Tracking

Stereo Visual Inertial Odometry (VIO) for rapid, robust and accurate 6-DoF pose



6-DoF poses are generated by sensor fusion of stereo camera features and high rate IMU accelerometer/gyroscope data



Stereo camera data

Captured from tracking camera image sensors at ~30 fps

Accelerometer & gyroscope data

Sampled from external sensors at 800 / 1000 Hz

Snapdragon "VIO" subsystem



Camera feature processing

Inertial data processing

Qualcomm® Hexagon™ DSP algorithms

- Camera and inertial sensor data fusion
- Continuous localization
- Accurate, high-rate "pose" generation & prediction

6-DoF position & orientation (aka "6-DoF pose")



New frame accurately displayed

Benefits of Stereo over Monocular 6DoF

Instant accurate scene depth

Faster initialization

Better performance with quick rotational motions

Greater tolerance to camera occlusion & darker environments



Foveated rendering reduces pixel processing

The human eye can only see high resolution where the fovea is focused

- Foveated rendering helps developers minimize power consumption, while improving performance and visual quality
- Rather than rendering the whole display at max resolution, render at highest resolution only where the eyes are focused
- APIs that enable the developer to render a max resolution region within the desired foveation focal point, and then define how the effective resolution decreases for the rest of the viewport



High resolution throughout the entire viewport (frame)

□ High resolution

□ Low resolution



Foveated rendering with eyes being focused on the paraglider

Realistic audio voice enhances the VR experience



Immersive Audio for VR

- 3D Audio SDK for utilizing low latency, object-based audio, high order ambisonics, HRTF and other features
- Boost audio quality with Snapdragon Audio+, Dolby, DTS, MPEG-H, etc.

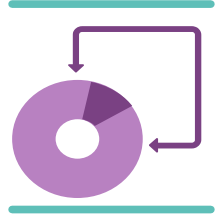


Voice for VR

- Voice Activation to start the VR HMD's voice UI without having to press any buttons
- Qualcomm® Fluence™ noise suppression to improve speech recognition and improve voice activation accuracy

Identify performance & power bottlenecks in your app

Qualcomm® Snapdragon™ Profiler



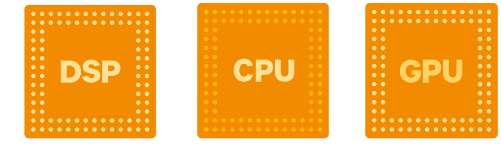
Helps Developers Optimize VR apps



Major Host OS Platforms
PC • Mac • Linux



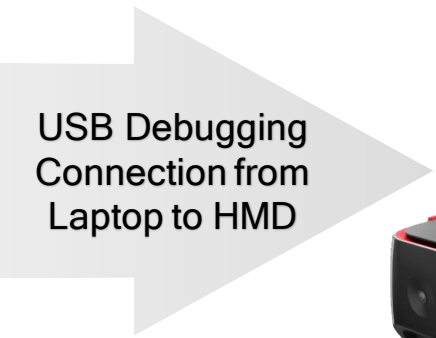
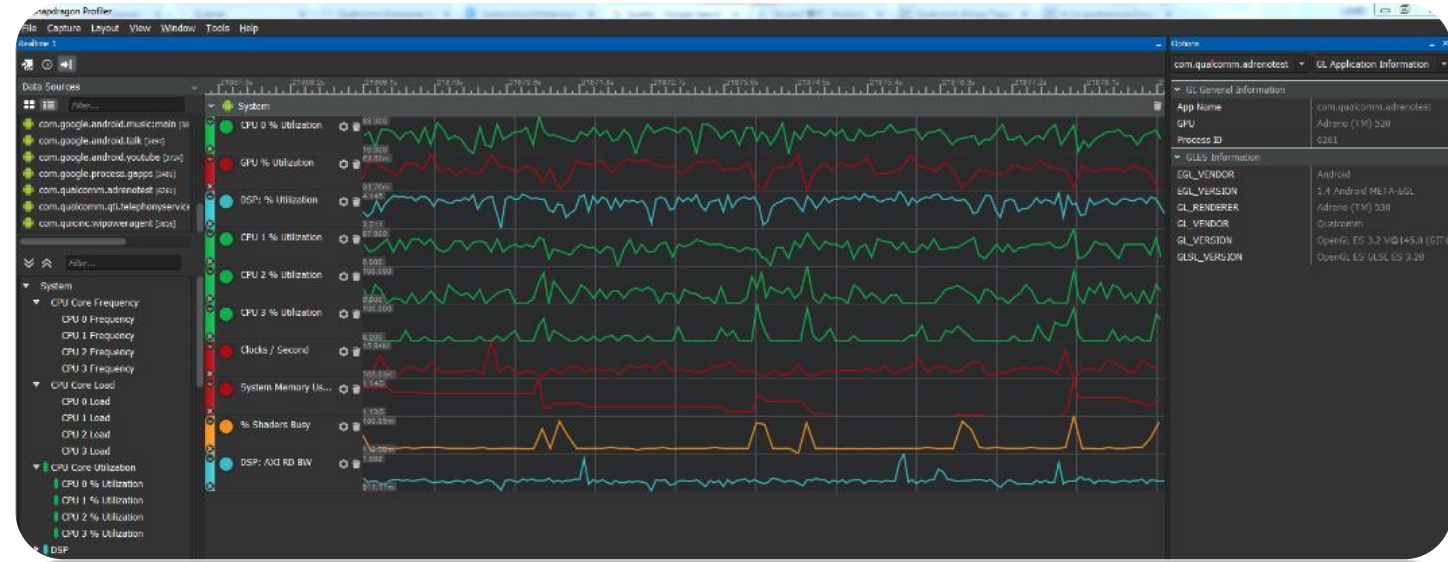
Android VR Targets



Heterogeneous Processor Profiling Support



Plug and Play

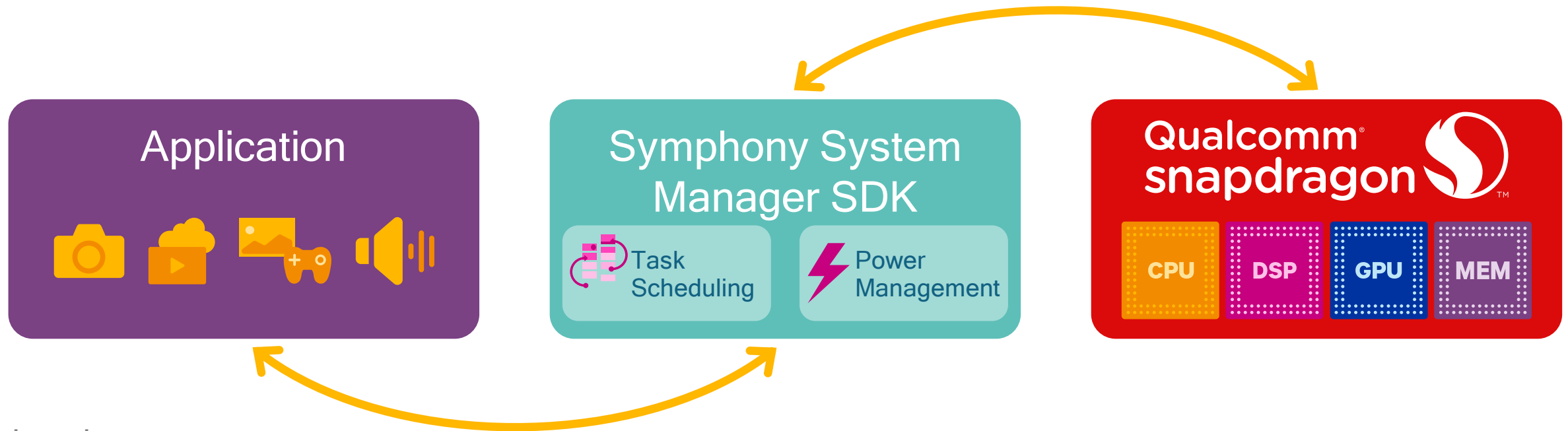
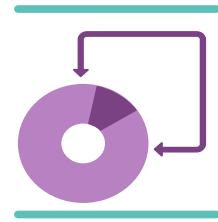


USB Debugging Connection from Laptop to HMD



High performance with low power consumption

Qualcomm® Symphony System Manager SDK



Designed to:

Simplify heterogeneous computing, providing developers with more control over heterogeneous systems within SDM835 (CPU/ GPU/ DSP)

Optimize VR application power usage using Power Management APIs

Symphony interfaces and other tools are available to OEMs as part of the Qualcomm Technologies' OEM directed tool suite

Reach into mobile VR

Combination of Snapdragon 835 mobile platform with Leap Motion's cutting-edge hand tracking technology further advances VR content development

Incredibly fast

Very low latency and processing power

Unprecedented range

180 x 180 degree tracking beyond arm length



Qualcomm®
snapdragon 

LEAP
MOTION



Thank you

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