VR is meant to be mobile
Qualcomm® Snapdragon™ VR Technologies

Tim Leland
Vice President, Product Management
Qualcomm Technologies, Inc.

Game Developer Conference: February 2017

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
Mobile VR/AR technology will continue to evolve

Devices will become sleeker, lighter, and more fashionable
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

1. Product Reference Design
2. ODM Partners
3. 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

- KPIs
- Motion to Photon Latency
- 3DoF and 6DoF Accuracy
- Power
- Test Methodology
- Tools
- 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 VRDK

Advanced VR features designed to optimize applications and simplify development

- **System on Chip (SoC)**
  - Snapdragon 835 Processor

- **Display**
  - AMOLED WQHD
  - ~2MPix per eye

- **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

- **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
Snapdragon VRDK

Advanced VR features designed to optimize applications and simplify development

- 6DoF Motion Tracking
  Stereoscopic VIO
- Foveated Rendering
  And other VR Features
- Latest Unity and Unreal Engine Support
  Unity 5.5 and Unreal Engine 4.14
- 3D Audio
  Ambisonics, object based audio, etc.
- Motion to Photon Latency
  A comprehensive approach to minimize motion to photon latency
- Advanced Profiling & Power Management
  Qualcomm® Symphony System Manager designed to provide CPU, GPU, and DSP power, thermal, and performance management
  Qualcomm® Snapdragon™ Profiler designed to identify power and performance bottlenecks

Software optimized for VR
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

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

Qualcomm Hexagon is a product of Qualcomm Technologies, Inc.
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
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
Thank you

Follow us on:  

For more information, visit us at:  

www.qualcomm.com & www.qualcomm.com/blog

All data and information contained in or disclosed by this document is confidential and proprietary information of Qualcomm Technologies, Inc. and/or its affiliated companies and all rights therein are expressly reserved. By accepting this material the recipient agrees that this material and the information contained therein is to be held in confidence and in trust and will not be used, copied, reproduced in whole or in part, nor its contents revealed in any manner to others without the express written permission of Qualcomm Technologies, Inc. Nothing in these materials is an offer to sell any of the components or devices referenced herein.

©2017 Qualcomm Technologies, Inc. and/or its affiliated companies. All Rights Reserved.

Qualcomm, Snapdragon and Hexagon are trademarks of Qualcomm Incorporated, registered in the United States and other countries. Other products and brand names may be trademarks or registered trademarks of their respective owners.

References in this presentation to “Qualcomm” may mean Qualcomm Incorporated, Qualcomm Technologies, Inc., and/or other subsidiaries or business units within the Qualcomm corporate structure, as applicable. Qualcomm Incorporated includes Qualcomm’s licensing business, QTL, and the vast majority of its patent portfolio. Qualcomm Technologies, Inc., a wholly-owned subsidiary of Qualcomm Incorporated, operates, along with its subsidiaries, substantially all of Qualcomm’s engineering, research and development functions, and substantially all of its product and services businesses, including its semiconductor business, QCT.