New Technologies for UAV/UGV

Charles Bergan
VP, Engineering
Qualcomm Research
Qualcomm Technologies, Inc.

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Qualcomm Research is a division of Qualcomm Technologies, Inc.
30 years of driving the evolution of wireless

#1 fabless semiconductor company

#1 in 3G/4G LTE modem

#1 in wireless semiconductors

Source: Qualcomm Incorporated data. Currently, Qualcomm semiconductors are products of Qualcomm Technologies, Inc. or its subsidiaries IHS, Jan. '16 (wireless ASSP/ASIC total); Strategy Analytics, Dec. '15 (modem, AP), The McLean Report, Mar. '16 (fabless semiconductors)
Building a better drone

Snapdragon Flight based drone could condense 7 separate circuit boards totaling 189 cm² into a single, 23.2 cm² circuit board.
Computer Vision and Machine Learning

Autonomous visual navigation for drones/robots/IoT
Realizing mmWave for mobile broadband IOT

5G solutions

Smart beamforming & beam tracking
Increase coverage and minimize interference

Tighter interworking with sub 6 GHz
Increase robustness and faster system acquisition

Phase noise mitigation in RF components
For lower cost, lower power devices
Enabling Immersive Mobile Virtual Reality

- **6-DOF**
  - High Rate 6-DOF pose generated by fusing camera and high rate IMU accelerometer and gyroscope data utilizing an extended Kalman Filter
  - Power and performance optimized to run on the Hexagon DSP

- **High Quality VR Content Capture**
  - Power and performance optimized on device algorithms for
    - Real-time dynamic stitching and warping
    - Multi-Sensor synchronization for color and white balance
    - Intrinsic and extrinsic calibration

- **Optimized VR Video Streaming**
  - Flexible multi-resolution streaming framework optimized to maximize visual quality and reduce bandwidth for streaming high-res VR video
Low power image sensor and processor
Always-on computer vision: <1mW active end-to-end total power at 30 FPS*

Vision Module
Integrated vision sensor & processor, independent of main processor

Sensor
- Low Power Pixels
- Low Power Custom HW

Processor
- Low Power CPU
- Dedicated HW Blocks

Memory

CMOS Image Sensor
Very low power QVGA

Digital Processor
Programmable algorithms

Main Processor
App & OS Software

Metadata output of scene understanding

Commands/Queries

2x2x2mm form factor for entire module

Initial target markets and use cases

Smartphone and smart watch
- Face/eye-based auto-wake/sleep
- Always-on gestures

Virtual reality and laptops
- Lower power eye/gaze tracking

Smart home/building
- Higher accuracy occupancy sensing...
- ...At very low power and cost
Low-power always on processor

What is it?

Ultra-low power always ON processor
- Near Threshold Compute (50MHz @ 0.55V)
- Custom designed low-power SRAM
- High efficiency integrated PMU
- Cortex M0 + Programmable HW accelerator for Streaming workloads

Functions
- Sensor processing
- Keyword detection
- Display Control
- Power Reserve Mode

Primary Application: Wearables
- Fitness bands
- Connected Smartwatches (8x09w+low power always on processor)

Key specifications

<table>
<thead>
<tr>
<th>Metric</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Rock-bottom</td>
<td>~80µW - no retention</td>
</tr>
<tr>
<td>CPU (Sensor Processing)</td>
<td>~20-30µW/MHz</td>
</tr>
<tr>
<td>Keyword Detect</td>
<td>0.84mW</td>
</tr>
<tr>
<td>Peak GOPS</td>
<td>@ 50 MHz = 0.8 @ 200 MHz = 3.2</td>
</tr>
<tr>
<td>Memory</td>
<td>Retention: ~2µW/64KB Active (50MHz, 64KB): &lt;250µW</td>
</tr>
<tr>
<td>PMU efficiency</td>
<td>~80% (1.05V) ~70% (0.55V)</td>
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Platform - Enables Many Verticals

- Glance Digital Die
- Implants
- Hearables/Hearing Aids
- Wearables
- IoE