

Qualcomm Research

# New Technologies for UAV/UGV

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Why Wait™

**30**

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years of driving  
the evolution of  
wireless

**#1**

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fabless  
semiconductor  
company

**#1**

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in 3G/4G  
LTE modem

**#1**

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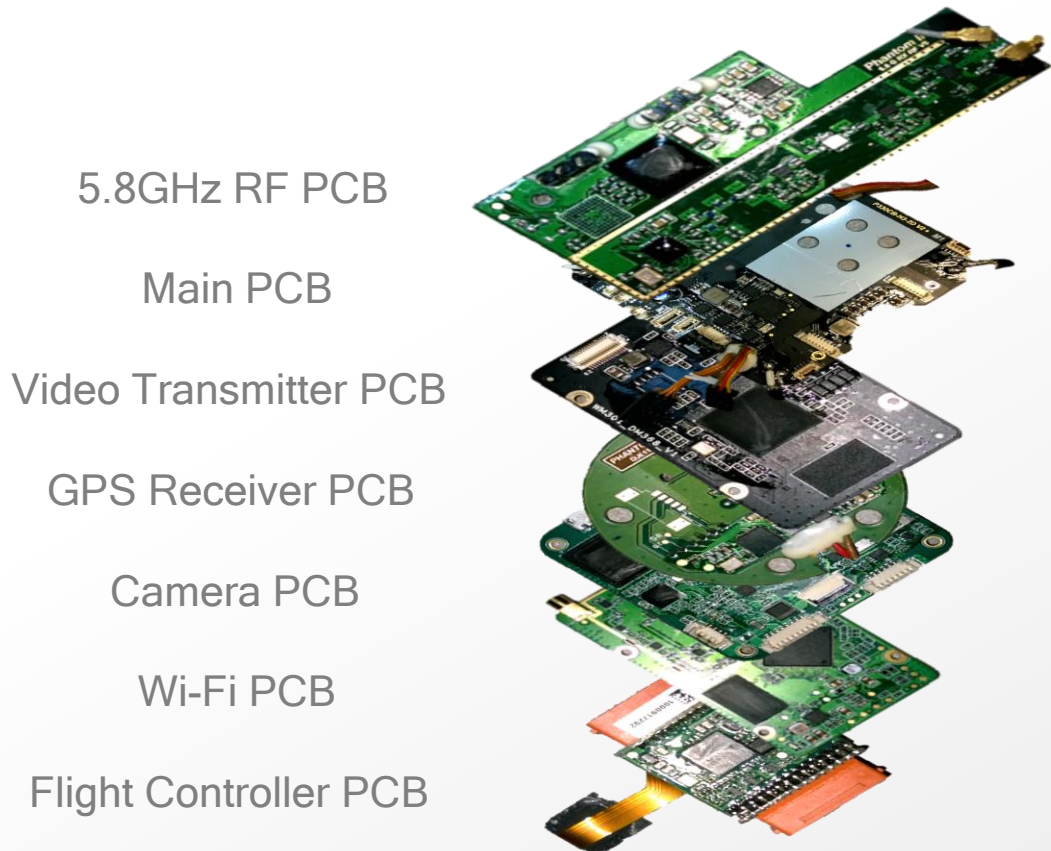
in wireless  
semiconductors

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 McClean Report, Mar. '16 (fabless semiconductors)



# Building a better drone

Snapdragon Flight based drone could condense 7 separate circuit boards totaling 189 cm<sup>2</sup> into a single, 23.2 cm<sup>2</sup> circuit board



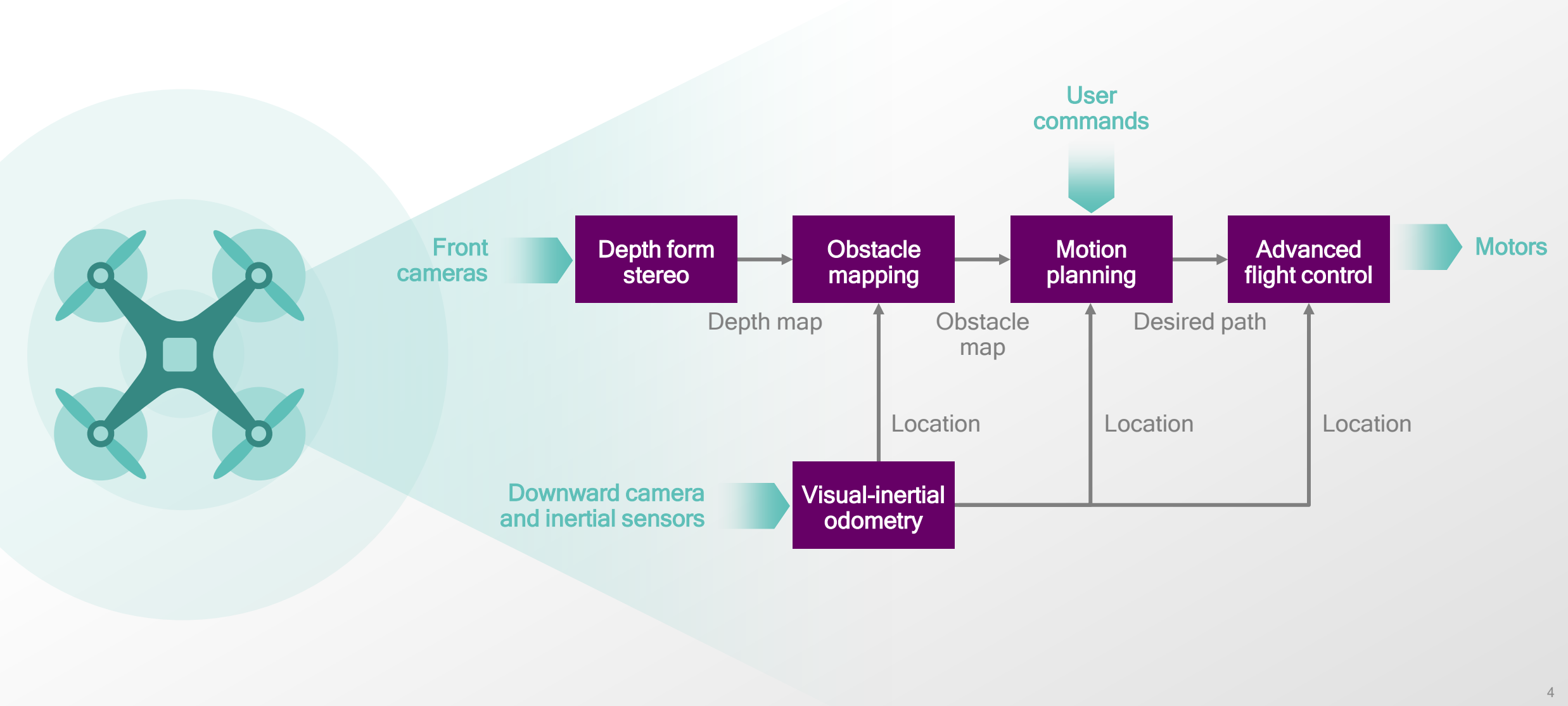
## Snapdragon Flight



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puts it all into one

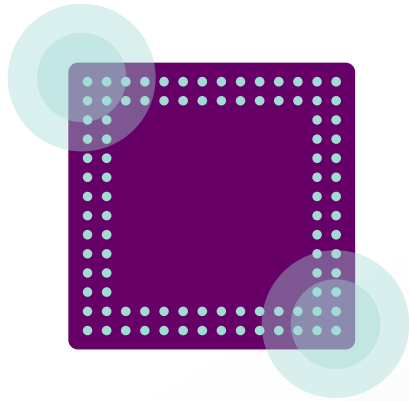
# Computer Vision and Machine Learning

## Autonomous visual navigation for drones/robots/loT



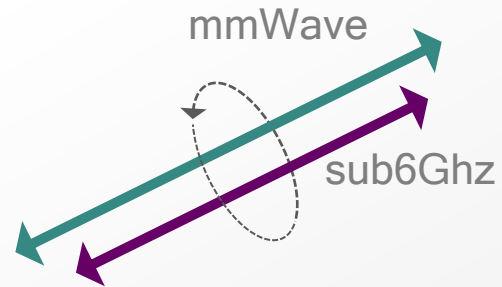
# Realizing mmWave for mobile broadband IOT

## 5G solutions



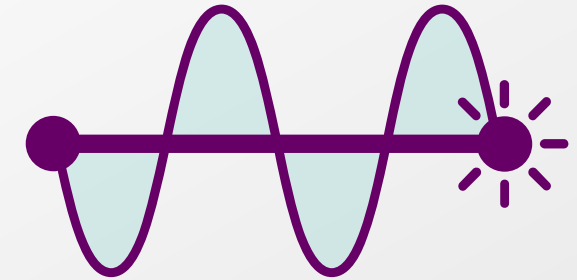
### Smart beamforming & beam tracking

Increase coverage and minimize interference



### Tighter interworking with sub 6 GHz

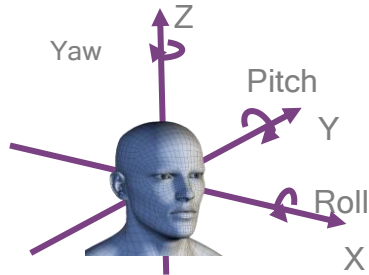
Increase robustness and faster system acquisition



### Phase noise mitigation in RF components

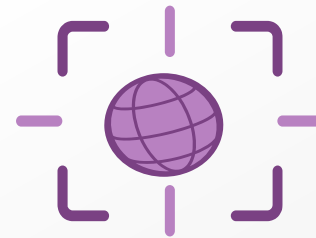
For lower cost, lower power devices

# 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

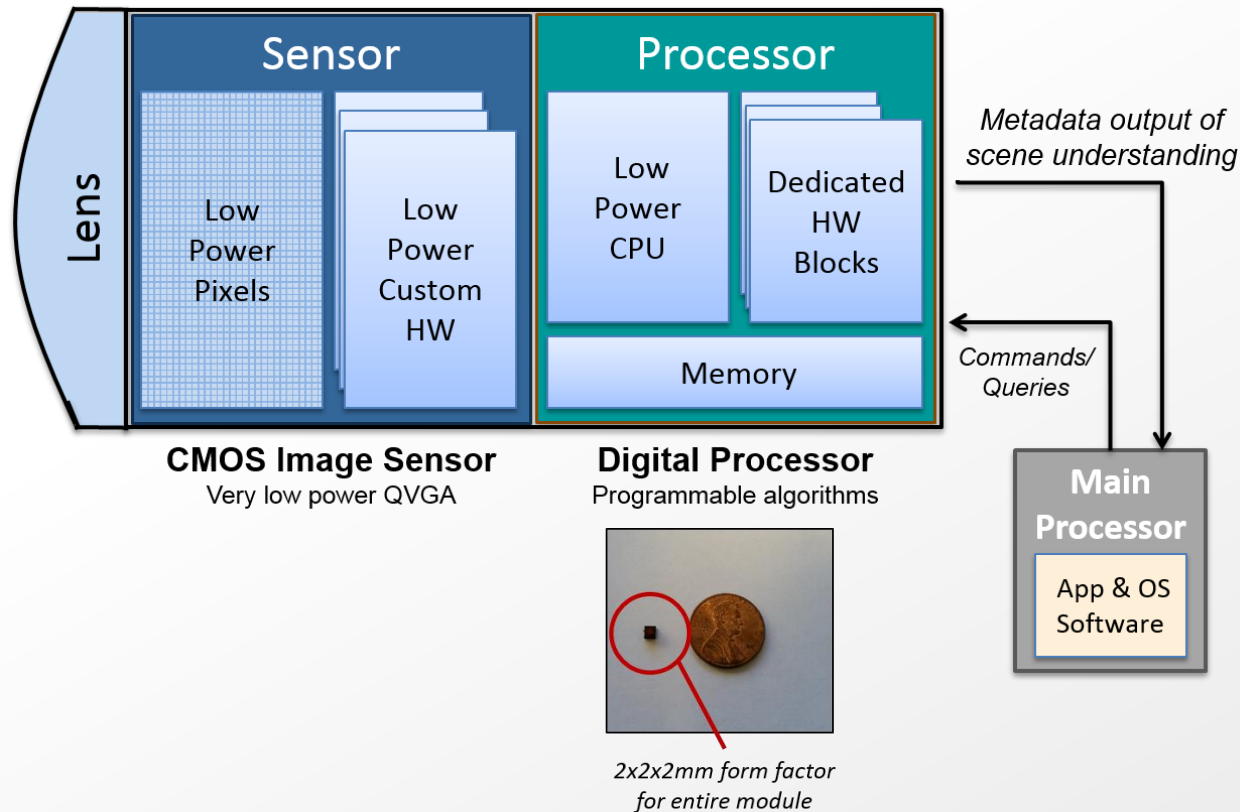
- Flexible multi-resolution streaming framework optimized to maximize visual quality and reduce bandwidth for streaming high-res VR video

# 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



## 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

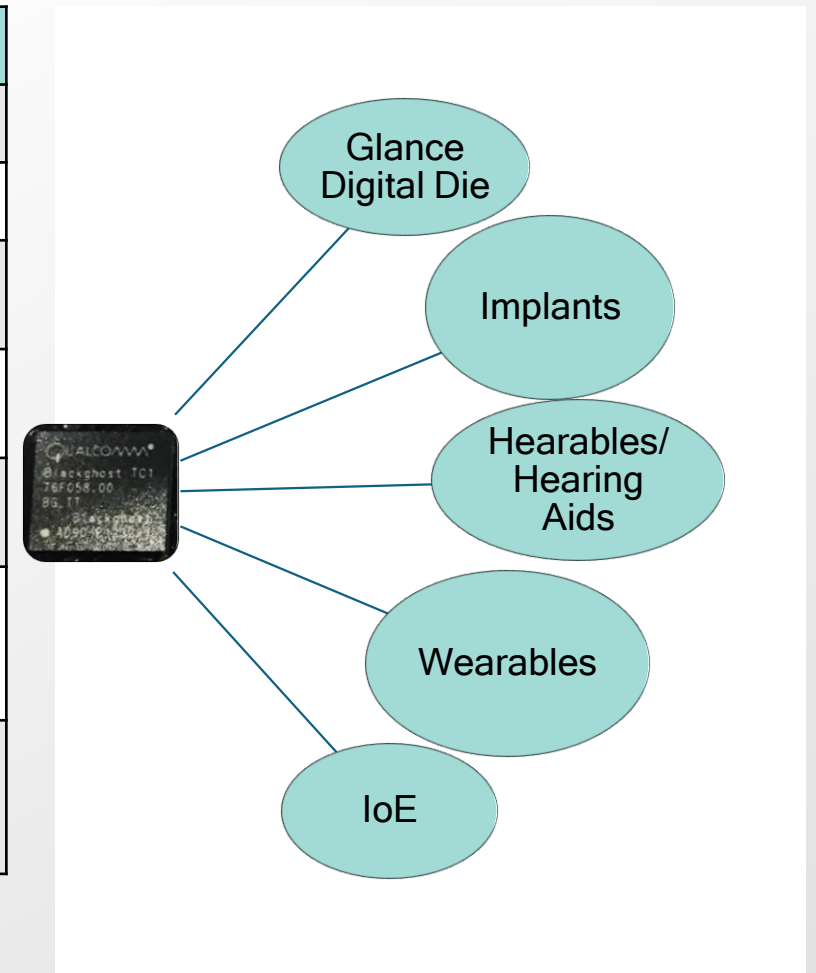
## Primary Application: Wearables

- Fitness bands
- Connected Smartwatches (8x09w+low power always on processor)

## Key specifications

Metric	Specification
Rock-bottom	~80 $\mu$ W - no retention
CPU (Sensor Processing)	~20-30 $\mu$ W/MHz
	~200 $\mu$ W (sensor algorithms)
Keyword Detect	0.84mW
Peak GOPS	@ 50 MHz = 0.8 @ 200 MHz = 3.2
Memory	Retention: ~2 $\mu$ W/64KB Active (50MHz, 64KB): <250 $\mu$ W
PMU efficiency (10 $\mu$ A)	~80% (1.05V) ~70% (0.55V)

## Platform - Enables Many Verticals





# Thank you

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