Qualcomm® Snapdragon™ Sensors Core (SSC) Features for Linux Android

80-NH058-1 Rev. J

August 6, 2018

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Revision history

Revision	Date	Description
A	May 2013	Initial release.
B	December 2013	Numerous changes were made to this document; it should be read in its entirety.
C	February 2014	Numerous changes were made to this document; it should be read in its entirety.
D	January 2016	Added Android Lollipop features.
E	March 2016	Numerous changes were made to this document; it should be read in its entirety.
F	March 2016	Numerous changes were made to this document; it should be read in its entirety.
G	May 2016	Numerous changes were made to this document; it should be read in its entirety.
H	February 2018	Numerous changes were made to this document; it should be read in its entirety.
J	August 2018	Numerous changes were made to this document; it should be read in its entirety.

Contents

1 Introduction

This document describes the features available on the Qualcomm® Snapdragon™ Sensor Core (SSC). The sensor features available are chipset-specific.

1.1 Conventions

Function declarations, function names, type declarations, attributes, and code samples appear in a different font, for example, `cp armcc armcpp`.

1.2 Technical assistance

For assistance or clarification on information in this document, submit a case to Qualcomm Technologies, Inc. (QTI) at https://createpoint.qti.qualcomm.com/.

If you do not have access to the CDMATech Support website, register for access or send email to support.cdmatech@qti.qualcomm.com.

2 Features

The sensor features that are available are based on a specific chipset.

2.1 Feature table

Chipset family/ Feature mapping	MSM8960/ MSM8064	MSM8974/ MSM8x26	MSM8994/ MSM8992	MSM8952/ MSM8976/ MSM8956	MSM8953/ MSM8940/ MSM8937/ MSM8917/ MSM8920	MSM8996	MSM8998	SDM660/ SDM630	SDM670/ SDM710/ SM6150	SDM845	SM8150
Processor (configuration)	**DSPS**	**aDSP without µImage**	**aDSP with µImage**			**Dedicated Island**		**Island shared with audio**	**Island shared with audio**	**Dedicated Island**	
SSC software framework	**DDF/SMGR/SAM**		**DDF/SMGR/SAM2.0**			**DDF/SMGR/SAM2.0**			**SEE**		
Data Acquisition Engine (DAE) for Accel/Gyro and Mag sensors											√
Absolute Motion Detection (AMD)	√	√	√	√	√	√	√	√	√	√	
AMD (using CCD)											√
Relative Motion Detection (RMD)	√	√	√	√	√	√	√	√	√	√	√
Sensors Fusion running on SSC		LA 2.0 and later	√	√	√	√	√	√	√	√	√
Qualcomm Gyro Calibration (QGyroCal)	√	√	√	√	√	√	√	√	√	√	√
Qualcomm Magnetometer Calibration 1.0 (QMagCal 1.0)		LA 2.0 and later	√	√	√	√					

Chipset family/ Feature mapping	**MSM8960/ MSM8064**	**MSM8974/ MSM8x26**	**MSM8994/ MSM8992**	**MSM8952/ MSM8976/ MSM8956**	**MSM8953/ MSM8940/ MSM8937/ MSM8917/ MSM8920**	**MSM8996**	**MSM8998**	**SDM660/ SDM630**	**SDM670/ SDM710/ SM6150**	**SDM845**	**SM8150**
Processor (configuration)	**DSPS**	**aDSP without µImage**	**aDSP with µImage**			**Dedicated Island**		**Island shared with audio**	**Island shared with audio**	**Dedicated Island**	
SSC software framework	**DDF/SMGR/SAM**		**DDF/SMGR/SAM2.0**			**DDF/SMGR/SAM2.0**			**SEE**		
Qualcomm Magnetometer Calibration 1.5 (QMagCal 1.5)							√	√	√	√	√
FIFO-enabled Sensor Support		LA 2.0 and later	√	√	√	√	√	√	√	√	√
µImage (micro-Image support			√	√	√	√	√	√	√	√	√
Island Mode						√	√	√	√	√	√
Magnetometer FIFO Support						√	√	√	√	√	√
SPI in Island Mode						√	√	√	√	√	√
Basic Gestures	√	√	√	√	√	√	√	√	√	√	√
Facing	√	√	√	√	√	√	√	√	√	√	√
Double-Shake						LA 2.0 and later	√	√	√	√	√
Pedometer		√	√	√	√	√	√				
Pedometer 2.0								LA 2.0 and later	√	√	
Pedometer 2.0 (using CCD)											√
Batching support		LA 2.0.1 and later	√	√	√	√	√	√	√	√	√

Chipset family/ Feature mapping	MSM8960/ MSM8064	MSM8974/ MSM8x26	MSM8994/ MSM8992	MSM8952/ MSM8976/ MSM8956	MSM8953/ MSM8940/ MSM8937/ MSM8917/ MSM8920	MSM8996	MSM8998	SDM660/ SDM630	SDM670/ SDM710/ SM6150	SDM845	SM8150
Processor (configuration)	**DSPS**	**aDSP without µImage**	**aDSP with µImage**			**Dedicated Island**		**Island shared with audio**	**Island shared with audio**	**Dedicated Island**	
SSC software framework	**DDF/SMGR/SAM**		**DDF/SMGR/SAM2.0**			**DDF/SMGR/SAM2.0**			**SEE**		
Step Count/ Step Detect (Android sensor type)		LA 2.0.1 and later	√	√	√	√	√	√	√	√	√
Significant Motion Detection (SMD) (Android sensor type)	LA 1.64 and later	√	√	√	√	√	√	√	√	√	√
Uncalibrated Magnetometer (Android sensor type)	LA 1.64 and later	√	√	√	√	√	√	√	√	√	√
Uncalibrated Gyroscope (Android sensor type)	LA 1.64 and later	√	√	√	√	√	√	√	√	√	√
Coarse Motion Classifier (CMC 2.0)			√	√	√	√	√	√	√	√	√
Tilt Detector			√	√	√	√	√	√	√	√	
Tilt Detector (using CCD)											√
Wake-up Sensors support			√	√	√	√	√	√	√	√	√
Android Hi-Fi Sensor Compliance							√	√	√	√	√

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Processor (configuration)	**DSPS**	**aDSP without µImage**	**aDSP with µImage**			**Dedicated Island**		**Island shared with audio**	**Island shared with audio**	**Dedicated Island**	
SSC software framework	**DDF/SMGR/SAM**		**DDF/SMGR/SAM2.0**			**DDF/SMGR/SAM2.0**			**SEE**		
Low Power Landscape/ Portrait (LP2)		LA 2.0 and later	√	√	√	√					
Device Orientation (Android Sensor Type)						LA 2.0.1 and later	√	√	√	√	√
Stationary Detect (Android Sensor Type)							√	√	√	√	√
Motion Detect (Android Sensor Type)							√	√	√	√	√
Uncalibrated Accel (Android Sensor Type)							LA 2.0.1 and later	LA 2.0 or later	√	√	√
Bring to Ear (BTE)									√	√	√
Tilt to wake									√	√	
Tilt to wake (using CCD)											√

3 Feature descriptions

SSC features for Linux Android include the following:

- Motion detection
- Qualcomm Sensors Fusion and sensor calibration
- Power saving
- Gestures

3.1 Motion detection

Feature	Purpose	Use case scenarios	Sensors required
Absolute Motion Detection (AMD)	▪ Reports stationary state when the device is at absolute rest, for example, on a desk or table ▪ Makes use of the accelerometer motion detect interrupt to further reduce power	▪ Conserves power by stopping services or reducing frequency of operation when a device is idle and in absolute rest state ▪ Allows sensors and other subsystems to be shut down when the device is stationary	Accelerometer
Relative Motion Detection (RMD)	▪ Reports stationary state when the device is not moving significantly with respect to gravity ▪ Uses the accelerometer motion detect interrupt to further reduce power	▪ Detects device stationary state relative to user when device is held steadily in the user's hand ▪ Used by other algorithms, for example, gestures to detect motion of interest, such as picking up phone to answer a call	Accelerometer
Significant Motion Detection (SMD)	▪ Once enabled, operates even when the device is asleep ▪ Triggers when significant motion occurs and automatically wakes up the device ▪ After notification, automatically disables itself	▪ Enables low power motion detection for navigation/ context awareness use cases to all devices to sleep when not in significant motion state ▪ Low power geofencing	Accelerometer

3.2 Qualcomm Sensors Fusion and sensor calibration

<table>
<tr><th>Feature</th><th>Purpose</th><th>Use case scenarios</th><th>Sensors required</th></tr>
<tr><td>Sensors Fusion running on the SSC</td><td>Significantly reduces power by performing 6-axis and 9-axis sensor fusion on the SSC</td><td>Generates rotation vector, gravity vector, linear acceleration, and orientation virtual sensors</td><td>▪ Accelerometer
▪ Magnetometer
▪ Gyroscope</td></tr>
<tr><td>QGyroCal</td><td>▪ QTI designed and developed dynamic calibration algorithm for gyroscope
▪ Low power and validated across multiple gyroscope parts from different vendors</td><td rowspan="2">▪ Tracks and corrects sensor errors, for example, biases, over changing operating environments
▪ Benefits
  ▫ Ease of integration (preintegrated and tested)
  ▫ Solution works across all sensor devices
▪ Low power enables background use cases, for example, 9-axis fusion, geomagnetic rotation vector, pedestrian alignment, and so on</td><td>Gyroscope</td></tr>
<tr><td>QMagCal</td><td>▪ QTI designed and developed dynamic calibration algorithm for magnetometer running on the SSC
▪ Low power and validated across multiple magnetometer parts from different vendors</td><td>▪ Accelerometer
▪ Magnetometer
▪ Gyroscope (only for QMagCal 2.0</td></tr>
<tr><td>Uncalibrated Magnetometer</td><td>Similar to magnetic field sensor type, but hard iron calibration is not applied to the reported values; however, hard iron bias values are returned separately in the result</td><td>Allows the client to perform custom calibration using the reported uncalibrated values and hard iron bias parameters</td><td>Magnetometer</td></tr>
<tr><td>Uncalibrated Gyroscope</td><td>▪ Similar to gyroscope sensor, but gyro-drift compensation is not applied to the reported values; however, gyro-drift bias values are returned separately in the result
▪ Factory calibration and temperature compensation are still applied to values</td><td>Allows the client to perform custom calibration using the reported uncalibrated values and gyro-drift bias parameters</td><td>Gyroscope</td></tr>
</table>

3.3 Power saving

Feature	Purpose	Use case scenarios	Sensors required
Buffering	▪ Allows power optimization by reducing the application processor wake-up rate ▪ Enables the application processor to remain in a low-power Idle state until sensor batches are delivered	▪ Ideal for low-power, long-running use cases, for example, fitness, location tracking, monitoring, and so on ▪ Up to 10,000 accelerometer events	Accelerometer
FIFO-Enabled Sensor Support	Supports FIFO-enabled sensors and reduces power consumption by allowing SSC to wake up less often	▪ Significant power reduction for sensor features by reducing the wake-up rate of SSC as well as reporting rate to the sensor client ▪ Power reduction with features such as pedometer, motion classification, sensor fusion, and sensor calibration	FIFO-enabled accelerometer and gyroscope

3.4 Gestures

Feature	Purpose	Use case scenario	Sensors required
Basic Gestures	Provides the ability to detect a Push, Pull, or Shake gesture ▪ Push – Device is moved away from the user, in the direction perpendicular to the screen ▪ Pull – Device is moved toward the user, in the direction perpendicular to the screen ▪ Shake Left/Right – Device is moved left or right (in portrait orientation) ▪ Shake Top/Bottom – Device is moved up or down (in portrait orientation)	UI motion controls, for example, to control applications such as photo browsers and music players	Accelerometer
Facing	Detects whether screen is facing up or down while device is held relatively still	UI motion control, for example, to turn display on when face up and off when face down	Accelerometer
Bring to Ear (BTE)	Detects if a phone is brought to an ear	UI motion control, for example, to answer an incoming call	▪ Accelerometer ▪ Proximity

3.5 Activity monitoring/motion classification

Feature	Purpose	Use case scenario	Sensors required
Pedometer on the SSC	Reports step events and cumulative step count, as well as the estimated step rate	▪ Measures a user's step count over a time interval ▪ Distinguishes when a user is walking, running, or relatively stationary	Accelerometer
Step Count/Step Detect	▪ Step detector analyzes accelerometer input to recognize when the user has taken a step, then triggers an event with each step ▪ Step counter tracks the total number of steps since the last device reboot and triggers an event with each change in the step count	Various step detect/count tracking applications with low power	Accelerometer
Coarse Motion Classification (CMC)	Determines if a user is stationary, walking, running, driving, or fidgeting	▪ Fitness applications ▪ Optimizes geofencing by optimizing the frequency of GNSS position fixes based on user motion state ▪ Context awareness	Accelerometer

A References

A.1 Acronyms and terms

Acronym or term	Definition
AMD	Absolute Motion Detection
BTE	Bring to Ear
CMC	Coarse Motion Classifier
RMD	Relative Motion Detection
SEE	Sensors Execution Environment
SSC	Snapdragon Sensor Core