ARCTICLINK 3 S2 SENSOR HUB SOLUTION

IoT Summit 2015

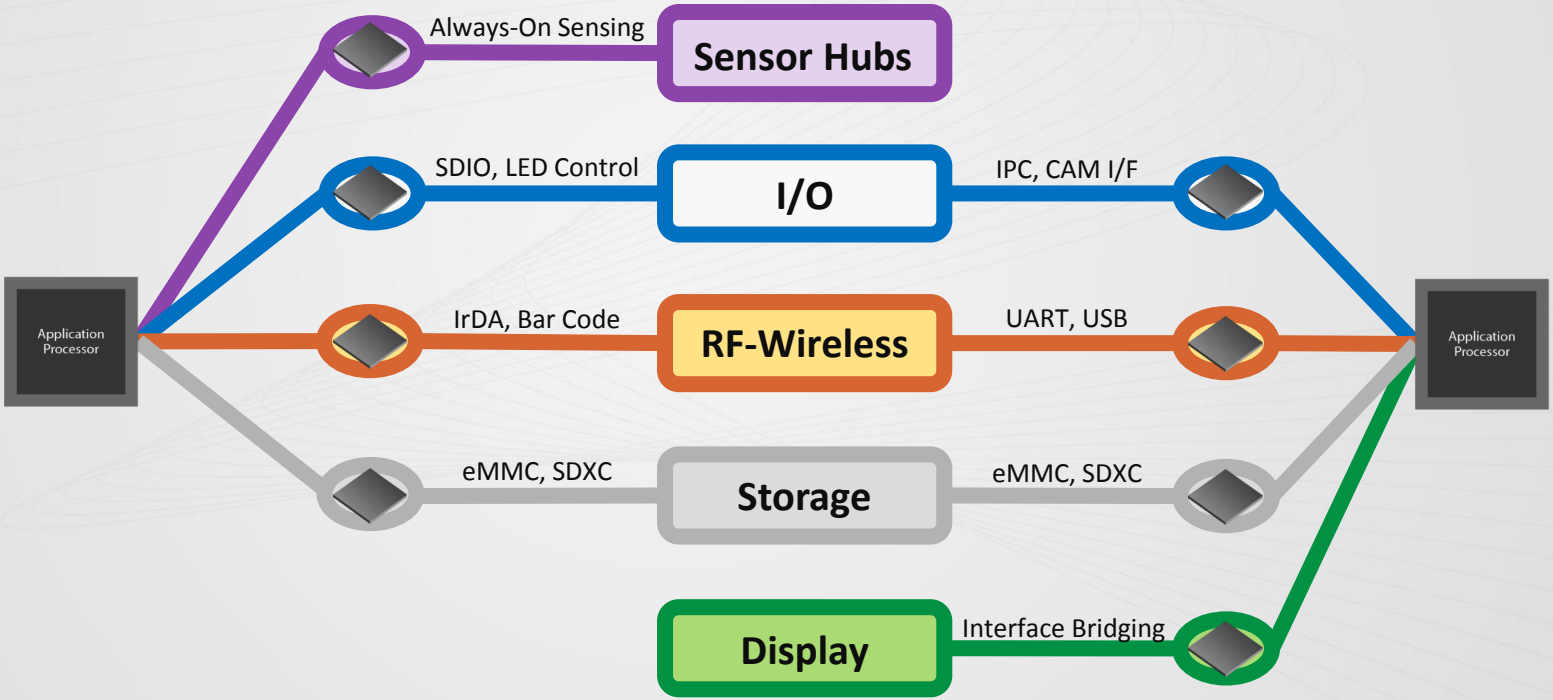
CORPORATE BACKGROUND

Large, High Growth Markets	• Smartphones, Wearables, Tablets and Mobile Enterprise • TAM 1.6B+ units in 2017 • CAGR 10%+
Top Tier Customer Adoption	SAMSUNG, KYOCERA, hp, HUAWEI, htc, ZTE中兴, NOKIA, PANTECH
Disruptive Technology	• Mobile-specific ultra-low power, in-system reprogrammable & instant-on, non-volatile architectures • Hard logic building blocks for scalable approach
Strong Ecosystem	QUALCOMM, MEDIATEK, Texas Instruments, pixelworks, mipi alliance, ANALOG DEVICES, amlogic, BROADCOM, NORDIC SEMICONDUCTOR, SAMSUNG, MARVELL, mobeam, MEMS INDUSTRY GROUP, ST, BOSCH
Corporate	• NASDAQ: QUIK, HQ in Silicon Valley; R&D: Sunnyvale, Bangalore, Toronto • Field Sales and Support: South Korea, Japan, China, Taiwan, UK • Employees – 97; Technical Staff – 53

QUICKLOGIC OFFERS THE BEST OF BOTH WORLDS

In-system, Reprogrammable Logic

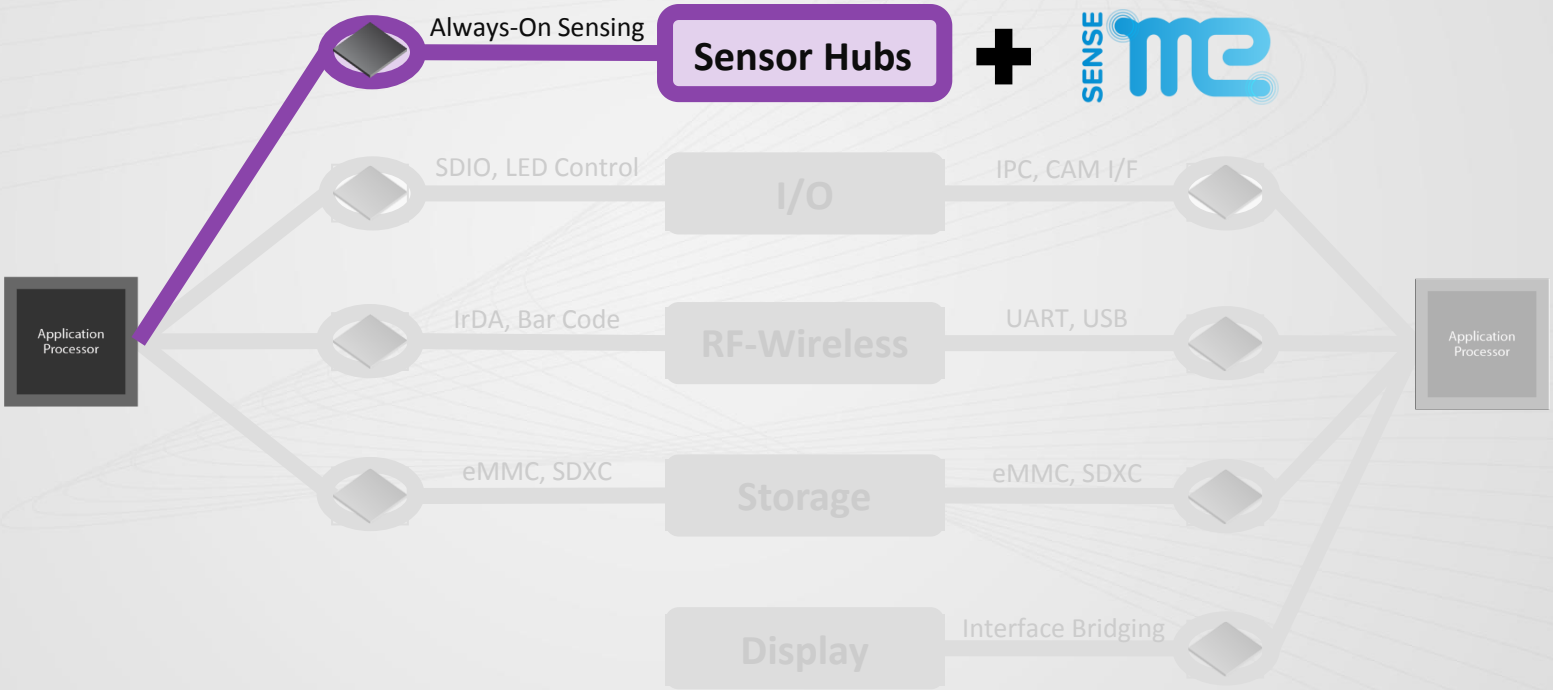
**Non-volatile,
Instant-on Programmable Logic**



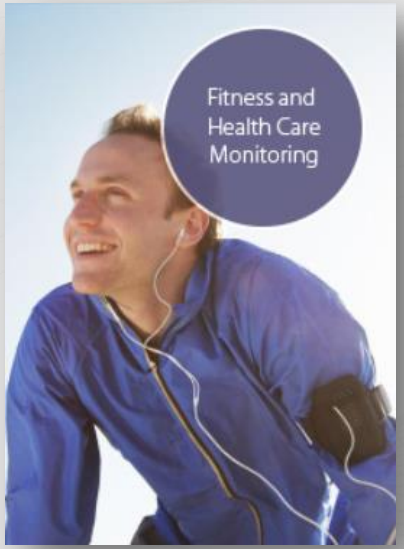
HARDWARE AND ALGORITHMS ARE ONLY THE START

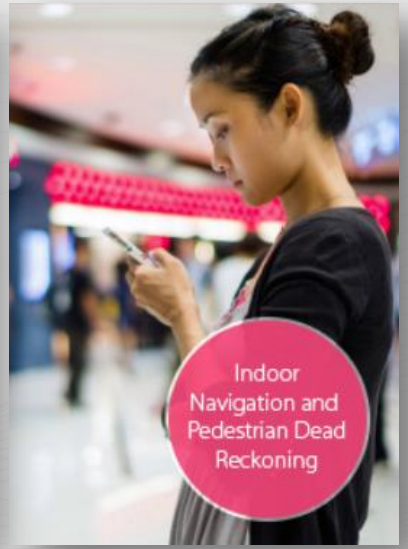
In-system, Reprogrammable Logic

Non-volatile,
Instant-on Programmable Logic



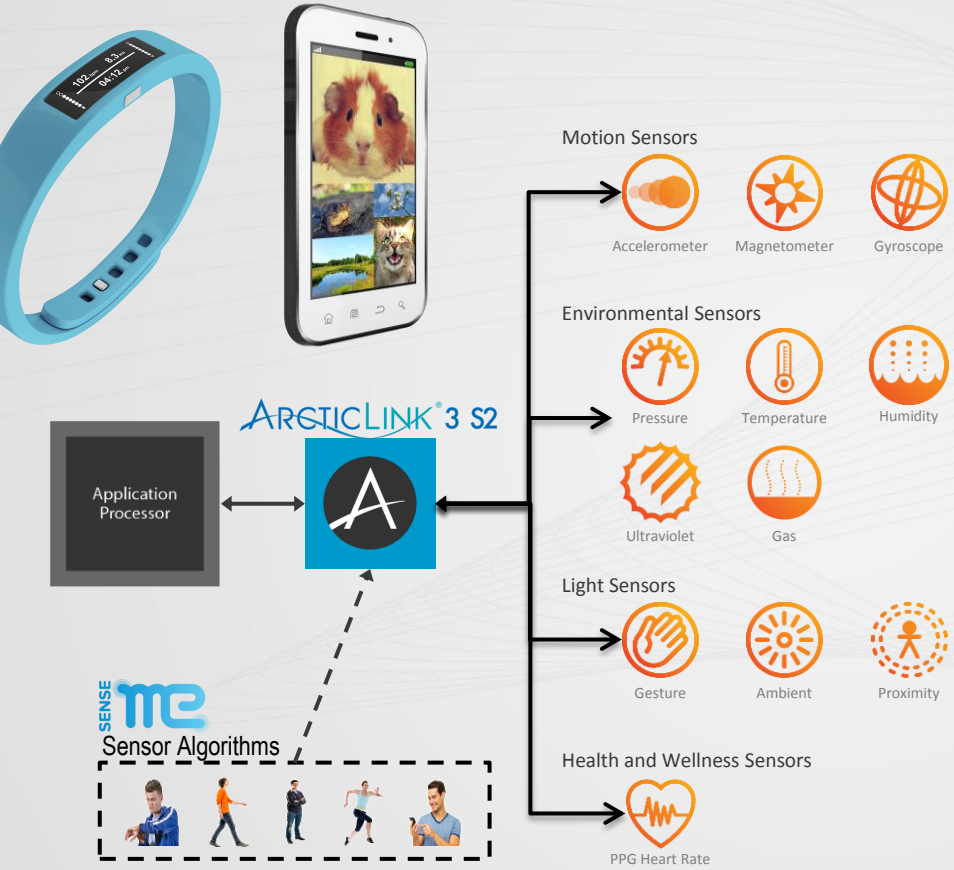
ENABLING “SMARTER” SMARTPHONES & WEARABLES





ALL AT LOWER POWER

THE ARCTICLINK 3 S2



- Always-on, Always-aware at 128uW (@ 1.1V)
- SenseMe sensor algorithms
- Best-in-Class Performance; connects to 12 different sensor types concurrently
  - Sensor QVL available
- Lollipop-compatible; Android 4.x/5.0 and RTOS device drivers available

ARCTICLINK 3 S2 HIGH-LEVEL FEATURES

Performance

- Best In-Class Performance
- Always-on Sensor Capability
- As low as 128uW @1.1V (or 140 µW @1.2V) active power consumption
- Lollipop-compatible; 8 KB Batched Sensor Events

Compatibility

- Forward-Compatible with AL3S1 and future devices
- Customer-developed, FFEAT-based Intellectual Property from S1 can be re-used on S2
- Pin-identical to AL3 S1 – no PCB change required

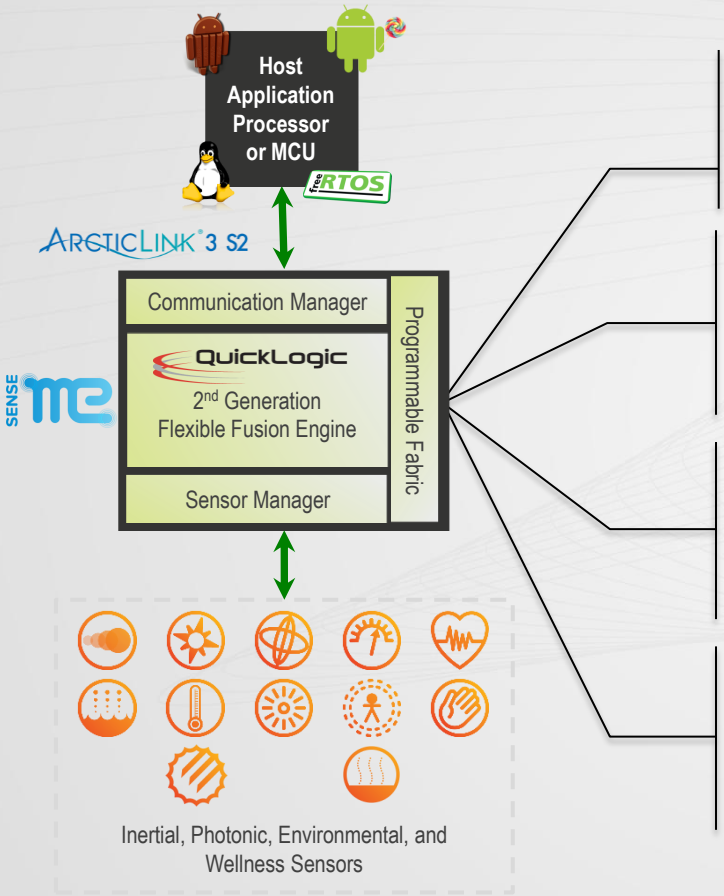
Hardware Acceleration

- Hardened Building Blocks Optimized for Size, Usability, and Power Consumption
  - 32 x 32 multiplier (x2)
  - I^2C Master
  - On-chip oscillators

Programmability

- Programmable fabric for additional features
- Ideal for deployment of smart connectivity technologies such as LED control and TV remote control

ARCTICLINK 3 S2 ULTRA-LOW POWER SENSOR HUB



Communication Manager

- Communicates with host applications processor/MCU through SPI interface

2nd Gen Flex Fusion Engine (Patents Pending)

- Finite State Machine + CISC-Arithmetic Logic Unit
- In-system reconfigurable for use in different context and applications

Sensor Manager

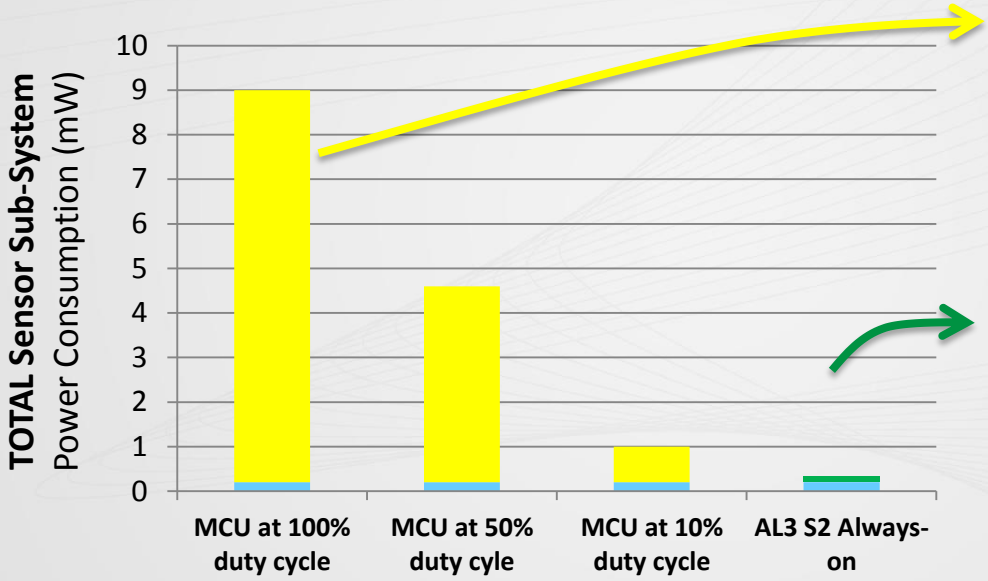
- Autonomous initialization and sampling eliminates AP/MCU load
- Supports up to 12 physical sensors concurrently

Programmable Fabric

- Allow implementations of IR remote control, PWM control of display or LEDs, IrDA bar code transmission, and others technologies for lower BOM cost and less PCB space

LOW POWER ENABLES ALWAYS-ON

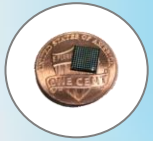
- The ArcticLink 3 S2 platform enables always-on sensor capability at a fraction of the power of competing MCU solutions



Component	Manufacturer	Active Power (mW)
SAMG53 MCU (assumes 48MHz)	Atmel	8.80
Accel	Bosch	0.2
Total		**9.0**

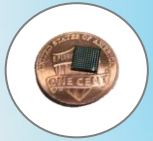
Component	Manufacturer	Active Power (mW)
AL3 S2 Sensor Hub	QuickLogic	0.128
Accel	Bosch	0.2
Total		**0.34**

ARCTICLINK 3 S2 PRODUCT OFFERINGS



Customer Specific Standard Products (CSSP) Solutions

- One design → One OEM
- Customer-specific designs using ArcticLink 3 S2 silicon
- Enables device-specific set of sensor algorithms
  - QuickLogic-developed
  - 3rd-party developed and/or
  - OEM-developed
- Developed in conjunction with QuickLogic or "black-boxed" at customer site
- Programmable Fabric available



Catalog CSSP Solutions

- One design → Multiple OEMS
- "Out-of-the-box" sensor hub solutions
- Designed for specific use sensor hub functions and device form factors
- Android and RTOS drivers (Catalog CSSP-dependent) provided
- Fastest time-to-market and lowest engineering investment, but without algorithm customization
- Multiple options…

S2 CONTEXT AND GESTURE CATALOG CSSP

Lift-to-wake / Rotate-to-wake

Enhanced Gesture

Enhanced Pedometer

Running

Walking

Includes classification and individual step count

Sensor Calibration

Significant Motion Detection

Context Detection and Classification

Heart Rate

Available Now
<2.2 x 2.5mm
128µW active power

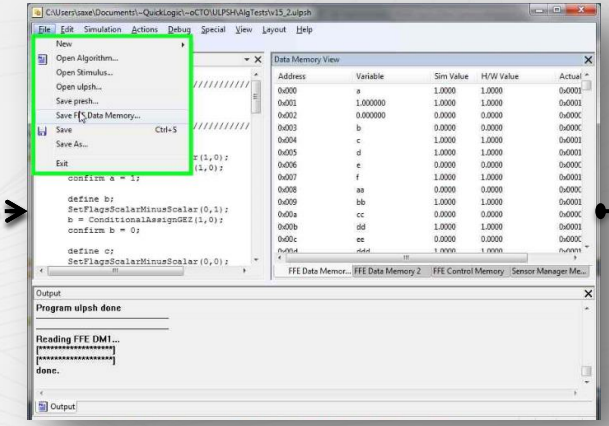
MIX-AND-MATCH ALGORITHM APPROACH

SENSE ME

Third-party Algorithms

OEM-Developed Algorithms

QuickLogic
Integrated Development Environment (IDE)



ARCTICLINK 3 S2

IDE provides software engineers an easy-to-use, familiar method for deploying algorithms to our hardware

SenseMe™ SENSOR ALGORITHMS

- Our roadmap includes algorithms for activity, gesture, location, and transport contexts; additional algorithms are under development but not shown

User Activity


Stationary


Walking


Running


Cycling


Sleeping


Heart Rate


Swimming*


On Stairs*

Distance, Speed, Calorie Counter Available

User Gesture


Tap-to-wake


Raise Hand


Twist Hand


Optical Gesture*


Double Tap Front


Double Tap Back

Device Location and Transport


Device in Pocket*


Device Not on Person


Accidental Drop


In Elevator *


In Vehicle*

*Under Development

BEST-IN-CLASS PEDOMETER ACCURACY

- Pedometer functions are the foundation of todays fitness and wellness applications
- QuickLogic's enhanced pedometer accuracy surpasses todays leading hardware

QuickLogic SENSE me

98% Accuracy

Leading Fitness Band

95% Accuracy

Leading Fitness Smartwatch

87% Accuracy

Test Results	• Test data produced by third-party, verified by QuickLogic
QuickLogic's Comprehensive Testing	• QuickLogic tests algorithms with strict standards & KPI -- test results are available and provided with each software release • Includes multiple conditions, including multiple device locations, cadence gender, age, heights

PEDOMETER - ACCURACY & FALSE STEP REJECTION

Test Scenarios	QuickLogic Accuracy (%)	Samsung Galaxy S5 Accuracy (%)
Walking, Device to Ear, Normal Speed	98.50	100.00
Walking, Device to Ear, Fast Speed	100.00	98.17
Walking, Device to Ear, Slow Speed	94.33	95.17
Walking, Device in Backpack on Shoulder, Normal Speed	99.50	98.83
Walking, Device in Backpack on Shoulder, Fast Speed	99.67	96.17
Walking, Device in Backpack on Shoulder, Slow Speed	98.83	98.17
Running, Device Strapped to Arm	99.75	93.50
Walking, Device in Hand Front, Normal Speed	98.67	99.67
Walking, Device Moved from Hand Side to In Front, Normal Speed	95.33	93.00
Average Accuracy	**98.29**	**96.96**

False Step Test Cases					
Test Scenario	Start Step Count	End Step Count	False Steps	Time (Minutes)	Steps/Minute
Driving, Device in Cupholder	334	334	0	12	0
Driving, Device on Passenger Sear	453	453	0	11	0
User Stationary, Device in Left Hand	15	15	0	35	0
User Stationary, Device in Right Hand	15	15	0	48	0

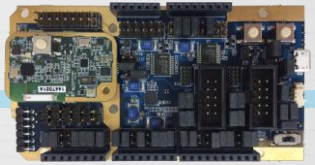
REFERENCE DESIGNS ACCELERATE TIME TO MARKET

Smartphone Evaluation Kits

Wearable Reference Designs

TAG

NORDIC SEMICONDUCTOR



Bluetooth SMART

TAG-N

SMARTPHONE EVALUATION KIT– AVAILABLE NOW

Two Boards, Multiple Implementations

- Sensor board contains ArcticLink 3 S2 sensor hub and 10 sensors, connector contains all signals and power
- USB board provides power and communications

Battery-operated

- Board can be powered on rear-mounted coin cell, allowing use as a wearable device if desired

I²C Header

- Allows easy connection of additional sensor(s)

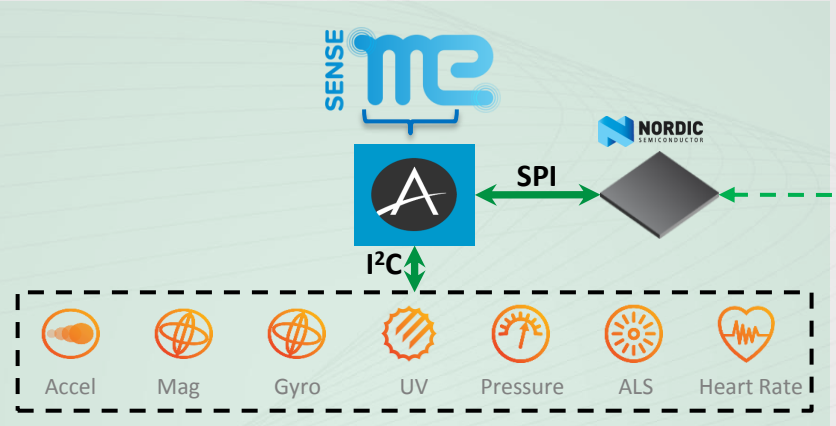
Sensor	Model
Accel / Gyro	Bosch BMI160
Mag	AK009911
Prox / ALS / Gesture	AMS TMG399x
Pressure / Temp / Humidity	Bosch BME280
Heart Rate	ADI ADPD142

USB Connector

- Allows communication with Smartphone or PC for programming, testing, and debug

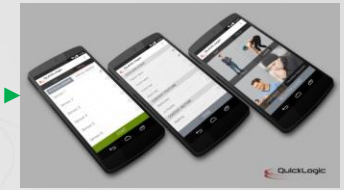
TAG™ REFERENCE DESIGN – AVAILABLE NOW

TAG



QL Android APK

Bluetooth SMART



- TAG Reference Design for Mid-level Wearables
  - Wrist-worn, battery-powered design for evaluation and testing of QuickLogic Context and Gesture algorithms
  - Data connection to smartphone via Nordic Bluetooth Smart (BLE) device on TAG system

Part Number	QL-TAG-S2

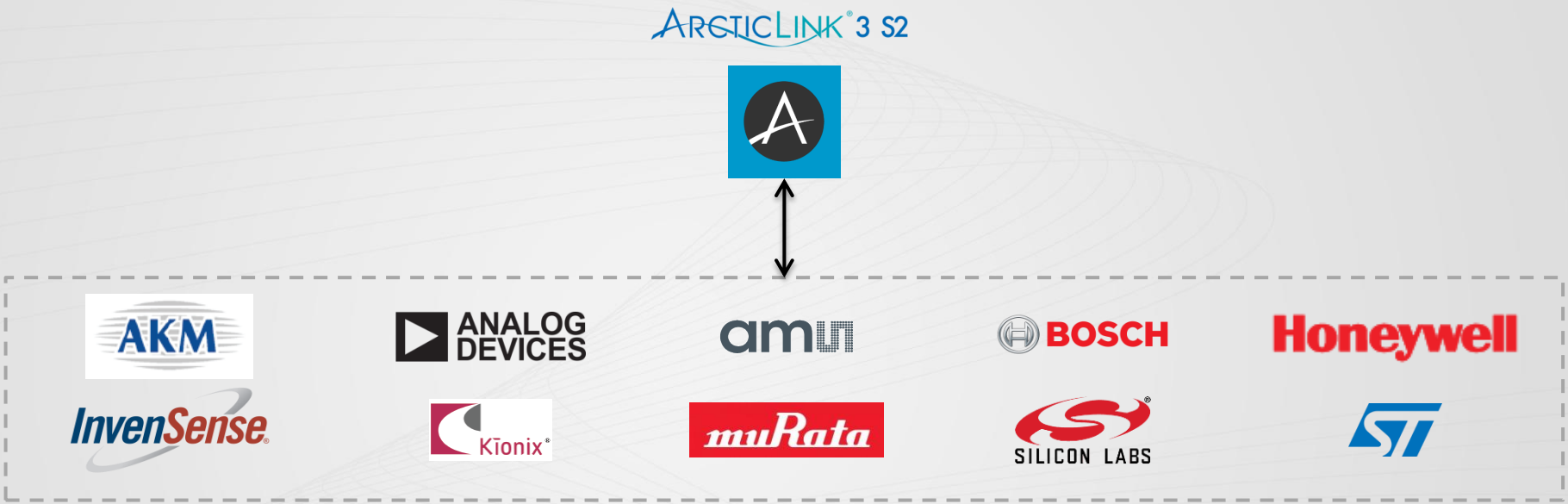
TAG-N™ FOR NORDIC– AVAILABLE NOW

QL Android APK

- TAG-N Evaluation Kit for nRF51822 Reference Design Kit
  - Direct connection to RDK from TAG-N via Arduino connector board
  - Contains SenseMe Context and Gesture Library
    - Best-in-class enhanced pedometer (differentiates walking and running, stores and provides individual step counts for each)
    - Wearable-specific gesture recognition such as rotate-to-wake and lift-to-wake

Part Number	QL-TAG-N-S2

SENSOR QUALIFIED VENDOR LIST



- The ArcticLink 3 S2 supports up to 12 sensors concurrently
- Sensor manufacturer-agnostic: abstraction between sensor driver and hardware ensures driver compatibility and zero software changes
  - Only 15 lines of code to adapt existing sensor type, new sensor model to S2

SUITE OF TOOLS FOR OEM DEVELOPMENT

Item	QuickLogic Solution
Sensor Hub Hardware	ArcticLink 3 S2
Android Lollipop Compatibility	Verified
Enhanced Sensor Algorithms Beyond Lollipop Requirements (Transport, Activity, Gesture, Device Location, etc…)	Various contexts and gestures
Customizable Sensor Algorithm Capacity (OEM or 3rd party developed)	QuickLogic, OEM, and/or 3rd party
Smartphone-specific Evaluation Kit	S2 Smartphone Eval Kit
Wearable Reference Design and Evaluation Kits	TAG and TAG-N Systems
Software Drivers	Android, Linux, and RTOS
Sensor Qualified Vendor List	All major sensor types and manufacturers
Integrating Additional Functions in Sensor Hub	Multiple Options

SENSOR HUB ROADMAP

ARCTICLINK 3 S1

First samples in Q4 2013

Production in Q1 2014

ARCTICLINK 3 S2

First samples in Q3 2014

Production in Q4 2014

4x computational capacity
4x algorithm storage
8x sensor data buffer memory
Pin-compatible
(compared to S1)

ARCTICLINK 4 S3

2015

NDA-only