Create a Wearable Device Using the **WaRP Reference Platform**: Go from Concept to Product as Fast as the Market Is Changing

AMF-CON-T0752

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External Use

What Is A Wearable Device?

- Products that enhance the user's experience as a result of being worn through sensing, connectivity and processing of data

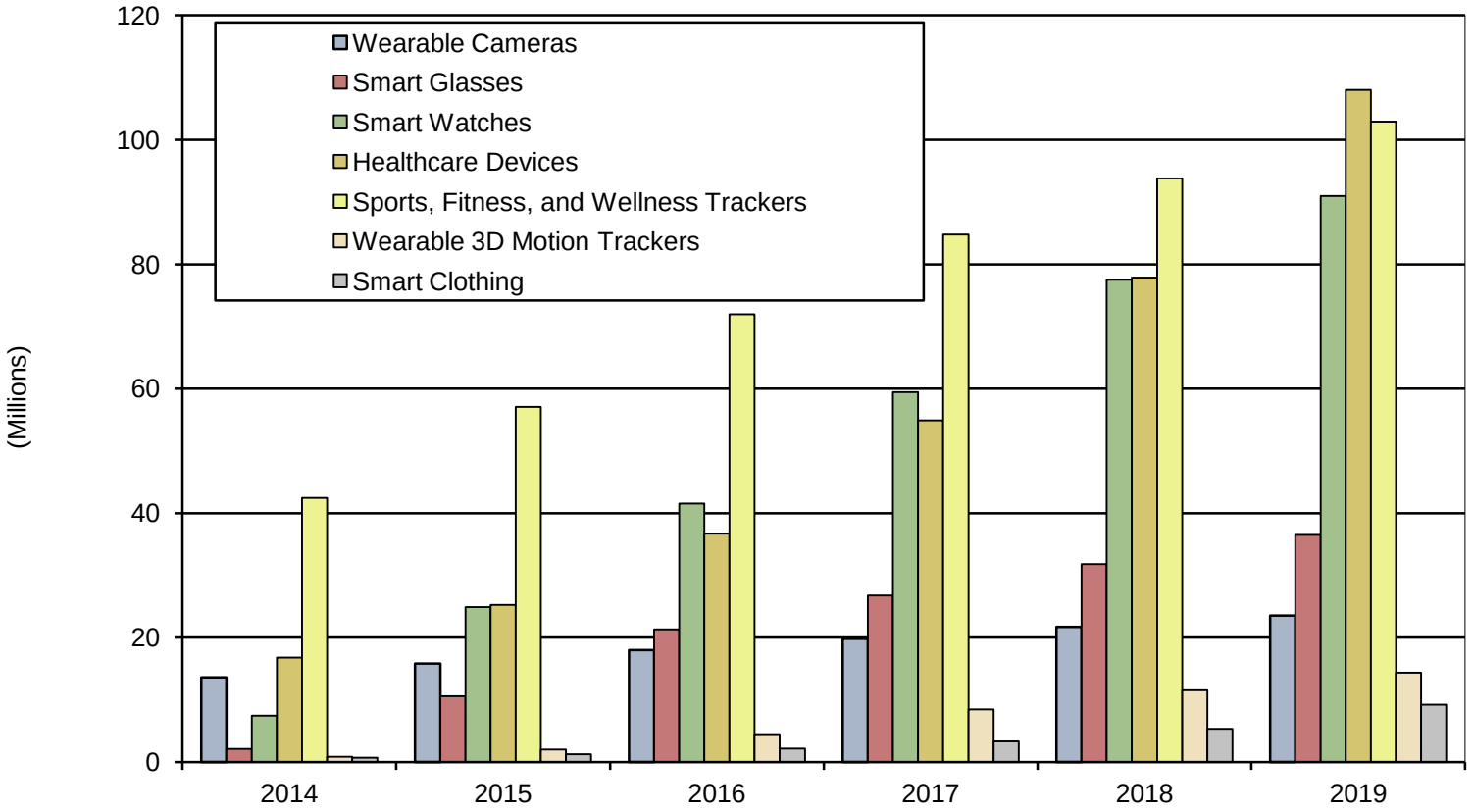
Key Technology Market Trends for Wearables:

- Miniaturization
- Low power
- Connectivity
- Multiple sensors

Wearable Market Forecast

By 2019

- 455M devices will be sold generating $46.5B of revenue
- Healthcare devices will be the biggest category (121 M)
- Smartwatches generate the most revenue, $21B



Sources: ABI Research, Credit Suisse Equity Research

Wearable Market: Segmentation

Vertical	Categories
Fitness & Wellness	Sports & Heart Rate Monitors Pedometers, Activity Monitors Smart Sport Glasses Smart Clothing Sleep Monitors Emotional Measurements
Healthcare & Medical	CGM (Continuous Glucose Monitoring) ECG Monitoring Pulse Oximetry Blood Pressure Monitors Drug Delivery (Insulin Pumps) Wearable Patches (ECG, HRM, SpO2)
Infotainment	Smart Watches Augmented Reality Headsets Smart Glasses Wearable Imaging Devices
Industrial & Military	Hand-worn Terminals Augmented Reality Headsets Smart Clothing

Wearable's Challenge

Power, space and usability are key

- **Form Factor**
- **Power Consumption & Charging**
- **Usability**
- **Cost**

WaRP – WearAble Reference Platform

Creating Wearable Innovation

WaRP
Wearable Reference Platform

Key development challenges	• Form factor, battery life, cost & usability
Ecosystem	• Over 20 partners
Scalable	• Modular architecture to enable rapid platform evolution
Open Source	• Community drives innovation

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Block Diagram

WaRP
Wearable Reference Platform
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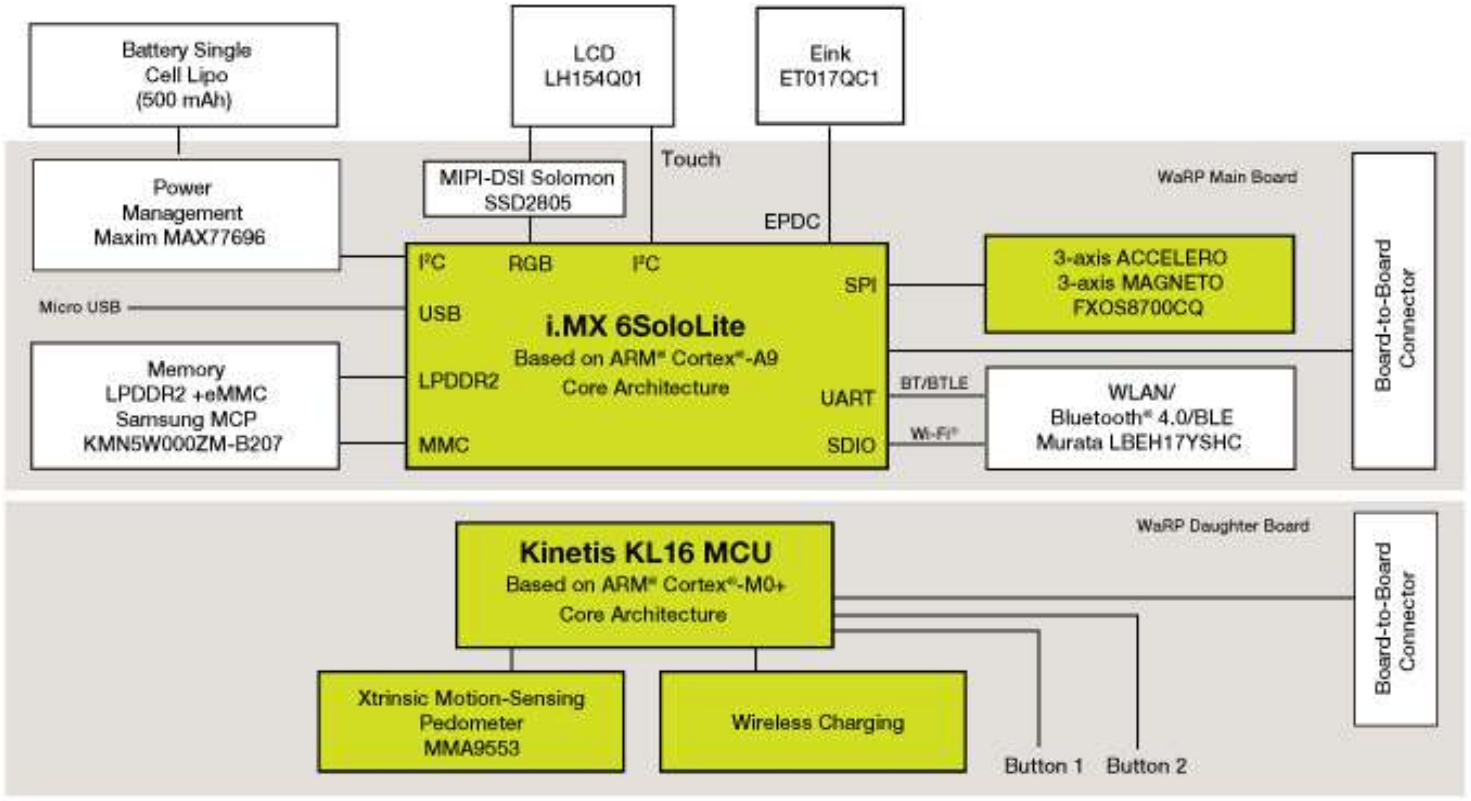
Wearable Reference Platform (WaRP) with Standard Daughter Board

Main Board PCB
38 mm x 16 mm
(1.4”x 0.6”)

Daughter Board
42 mm x 42 mm
(1.65” x 1.65”)



Freescale Technology

freescale™

Designed to be able to productize

Market Segmentation

Multi Function

Type 2
High Performance, multiple usage models

HLOS based
Android, Android Wear

Connectivity
BLE

4G

Type 1
Always On, specific usage

RTOS based
ThreadX, Free RTOS

Fixed Purpose

WaRP Architecture

WaRP
Wearable Reference Platform

Small Form Factor	• Main board 38 x16 mm
Battery Life	• Key components selected for power mgmt capabilities • Hybrid Architecture: ARM® Cortex®A9 main compute engine and Cortex-M0+ sensor hub • Wireless Charging
Usability	• Hybrid architecture to allow improved user experience • Flexibility: LCD & E-Ink displays, Wi-Fi & BT 4.0 module • Android 4.3 for ease of development
Cost	• $149 sales price for the WaRP kit • Low cost BOM • Open Source Hardware & Software

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Bill of Materials – Open Source

Wearable Reference Platform

Comment	Description	Designator	LibRef	Qty	Value	Footprint	Part No.
2450AT07A0100	Johanson Technology Inc 1mm x 0.5mm 2.4GHz Ultra Mini Chip Antenna	ANT1	2450AT07A0100	1		2450AT07A0100	2450AT07A0100
Coax RF		ANT2	Coax RF	1		W.FL-R-SMT-1	W.FL-R-SMT-1
Header 2	Header, 2-Pin	BAT	Header 2	1		Small Solder Pads	
CapacitorSM	Capacitor	C1, C4, C7, C11, C15, C56, C61, C75, C76, C77, C81	CapacitorSM	11	22uF	0603 (1608) Cap High Density	GRM188C80G226MEA0D
CapacitorSM	Capacitor	C2, C8, C9, C13, C18, C20	CapacitorSM	22	4.7uF	0402 (1005) Cap High Density	C1005X5R0J475M050BC
CapacitorSM	Capacitor	C3, C5, C6, C10, C12, C14, C16, C17, C19, C22, C23, C25, C26, C28, C29, C30, C31, C37	CapacitorSM	18	0.22uF	0201 (0603) Cap High Density	C0603X5R0J224K030BB
Capacitor	Capacitor	C34, C35, C119, C120	Capacitor	4	8pF	0201 (0603) Cap High Density	C0603C0G1E080D030BA
CapacitorSM	Capacitor	C38, C39, C40, C41, C44, C46, C47, C48, C52, C53, C54, C57, C58, C59, C62, C63, C64, C65, C68, C70, C91, C94, C95, C109, C110, C111, C113, C114, C116, C121, C134	CapacitorSM	31	0.1uF	0201 (0603) Cap High Density	GRM033R60J104ME19D
CapacitorSM	Capacitor	C42, C55, C60, C66, C67, C69, C71	CapacitorSM	7	0.01uF	0201 (0603) Cap High Density	GRM033R70J103KA01D
CapacitorSM	Capacitor	C50, C51, C79	CapacitorSM	3	4.7uF	0603 (1608) Cap High Density	GRM188R60J475ME19D
CapacitorSM	Capacitor	C74, C82, C84, C85, C87, C88, C93, C106, C107, C123, C124, C126, C127, C131, C132	CapacitorSM	15	1uF	0201 (0603) Cap High Density	C0603X5R0J105M030BC
CapacitorSM	Capacitor	C78, C80, C86, C122, C133	CapacitorSM	5	2.2uF	0402 (1005) Cap High Density	LMK105BJ225MV-F
CapacitorSM	Capacitor	C83, C96, C98, C102, C104, C125	CapacitorSM	6	1uF	0402 (1005) Cap High Density	C1005X5R1V105M050BC

A full bill of materials will be provided on WaRPboard.org for product development

Reference Design Comparison for Wearables

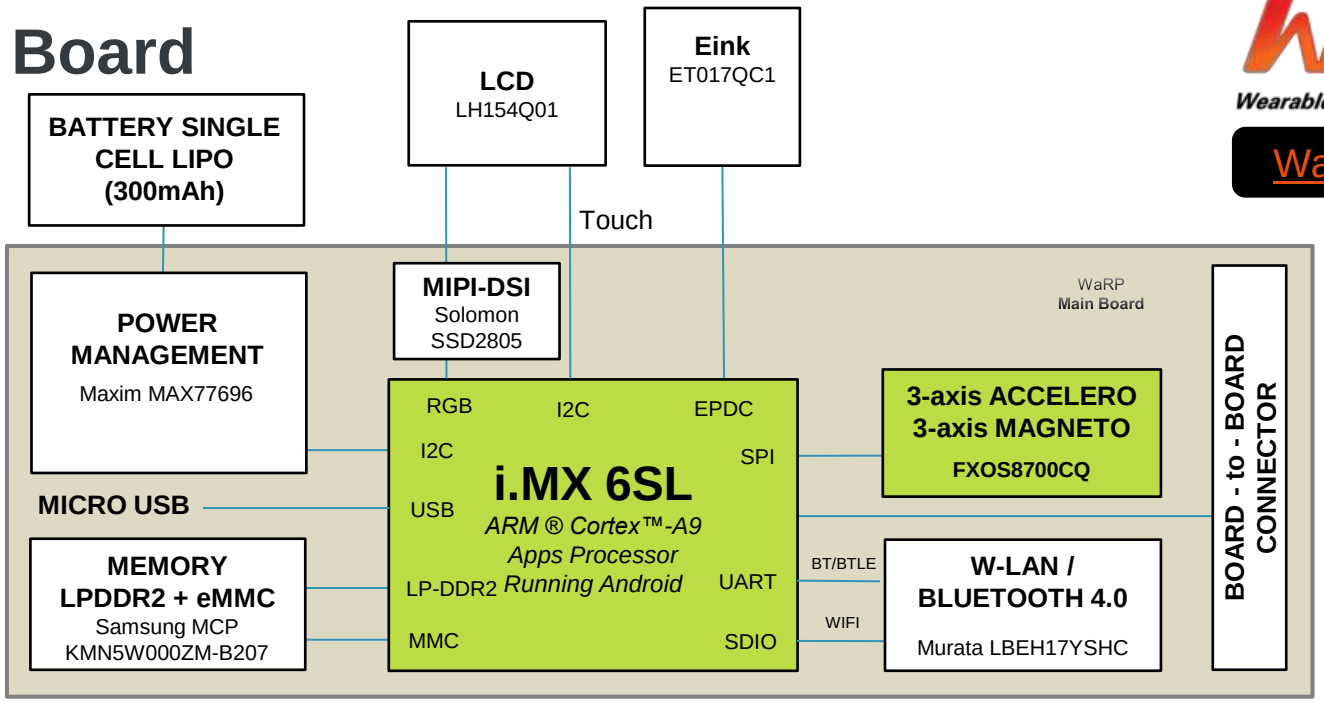




	Raspberry Pi	Arduino Uno	Beagle Bone Black	ToQ	WaRP
Wearable Form Factor	3.4” × 2.2 ”	2.7” x 2.1”	3.4” x 2.1”	Yes – Smart Watch	1.4” x 0.6”
Battery Life	DC power	DC or Battery	DC Power or USB	Mirasol Display	300 MhA battery
Scalability	Arduino compatible	Shields	Capes	None	Daughter cards
Cost	$25	$110	$45 -$89	$399	$149
Open Source		Creative Commons	Creative Commons		Creative Commons
Productizable					

Main Board

Main Board

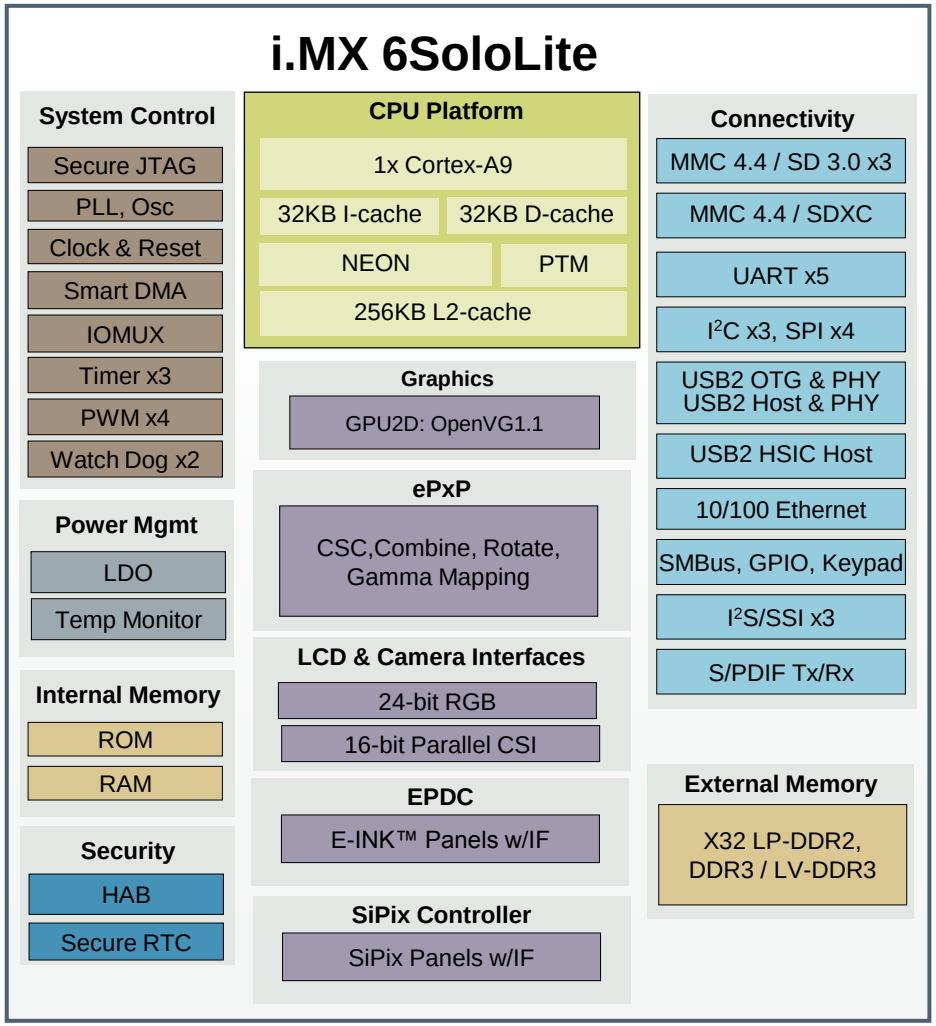


Main Board PCB size:
38 mm x 16 mm
(1.49”x 0.55”)

Designed to be able to productize

i.MX 6SoloLite Multimedia Processor

- **Specifications**
  - CPU: 1x ARM® Cortex®-A9 @ 1GHz
  - Core Voltage: 1.1V
  - Package: 0.5mm 13x13 MAPBGA
- **WaRP Use Case**
  - Idle: 4.9 mW, Suspend 0.93 mW
  - Clock/power gating
  - Dynamic voltage & frequency scaling
  - x32 LP-DDR2 & managed NAND
  - EPD /LCD Controller & 2D GPU
  - *Interfaces: UART for BT, SDIO for Wi-Fi, SPI for the accelerometer*



WaRP Main Board Components

Component	Use Case	Reason Selected
Freescale MCIMX6L7DVN10AB	Main compute engine – connectivity, data processing, user interface. Runs Android.	Small footprint (13x13mm), eInk display support, low power apps processor
Murata LBEH17YSHC Wireless Module	Wi-Fi® (802.11 b/g/n) – connect to cloud Bluetooth® – tether to smartphone/tablet	Small form factor (7x7mm) single module. market tested (cell phones), low power
Micron MCP	LP-DDR2 – low power system memory 4GB eMMC for storage	Small tightly coupled design, saves up to 40% board space, consumes less energy
Eink EPD (ET017QC1) and LCD (LH154Q01) display options	Graphic User Interface - options for both interactive highly visual displays (LCD) to constant always-on notification displays using monochrome e-ink	E-Ink panel - lowest power display technology, LCD panel – most broadly used 1.5” high density display with touch in wearables
Maxim MAX77696 PMIC	System Power Management IC	Regulators from 2.6V to 5.5V Dual Input Battery Charger Supports both E-Ink and LCD displays
Xtrinsic FXOS8700CQ 6DOF eCompass Sensor	Direction awareness & Motion detection – included on main board to allow it to be a standalone wearable compute platform	Low noise, low offset 3-axis accelerometer + magnetometer eCompass sensor enabling <5º absolute heading accuracy and ±0.1º resolution performance
Single cell lipo battery	Power source	Provides highest energy density

Daughter Board

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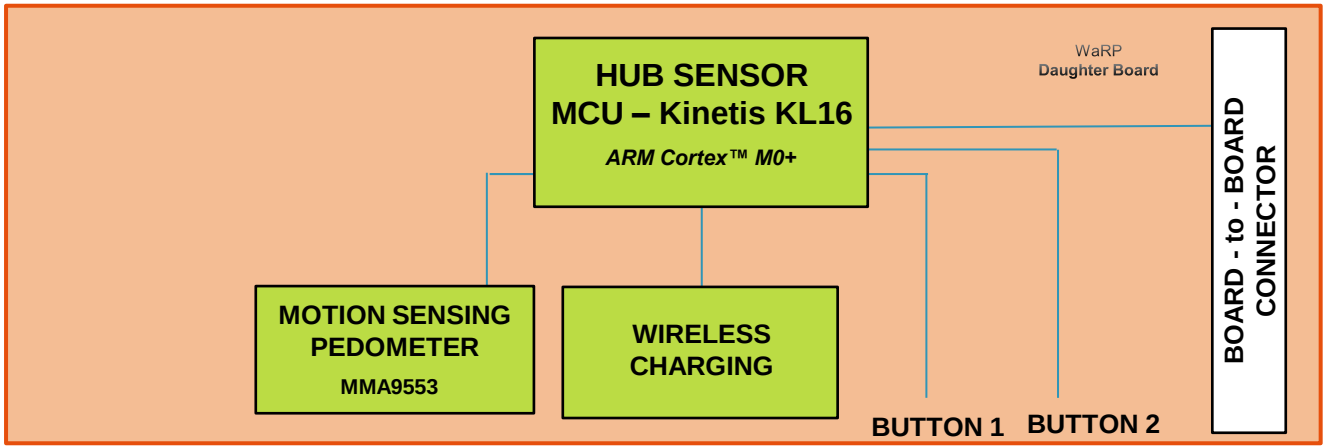
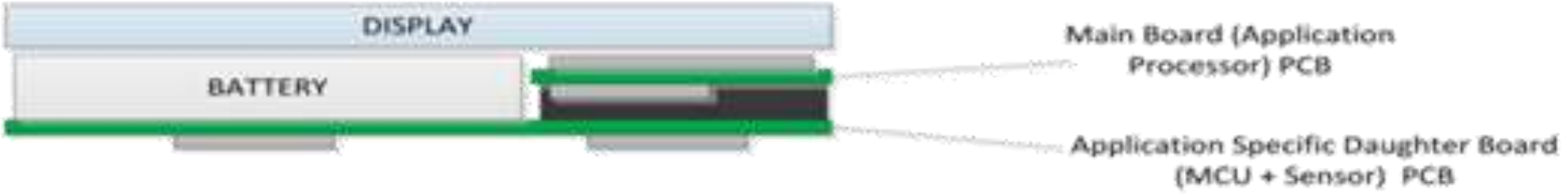
Daughter Board PCB size:
42 mm x 42 mm
(1.65” x 1.65”)



- Top view with battery attached
- Bottom View – Charging Coil



Daughter Card Components

Component	Use Case	Reason Selected
Kinetis KL16 - MKL16Z128VFT4	Sensor Hub, system power and application manager to maximize battery life and hosts wireless charging.	Always active so needed low power MCU. Scalability to add or change function of daughtercard
Xtrinsic MMA955xL 3-Axis Accelerometer	Pedometer features	Intelligent Motion Platform with embedded libraries for pedometer. Power management features and low power modes
Vishay 5W Charging Coil	Charging	Supports Chi standard, small size and is broadly available
Wireless Charging Software	Innovative charging technologies are critical to the adoption of wearables	Chi compliant wireless charging embedded software for 5Watts – configurable

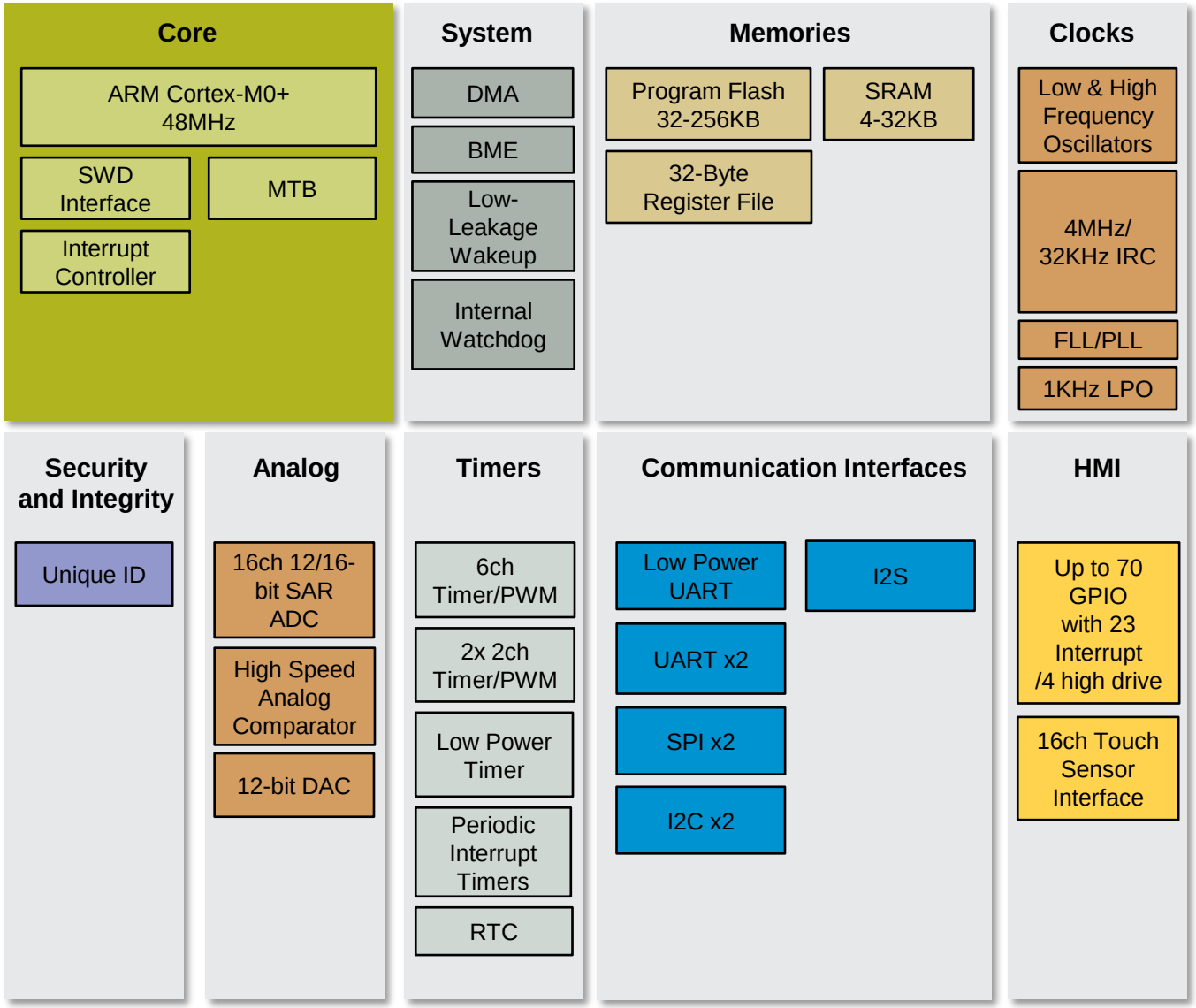
Kinetis L Series MCUs: KL16 Block Diagram

Specifications

- CPU: 1x ARM Cortex-M0+ @ 48MHz
- 32QFN 5x5x1/0.5mm

WaRP Use Case

- UART for communication to the main board
- PWM for buzzer (notifications)
- I2C to motion detector sensor
- SPI to E-Ink display for power management
- GPIO for buttons



Wireless Charging Receiver

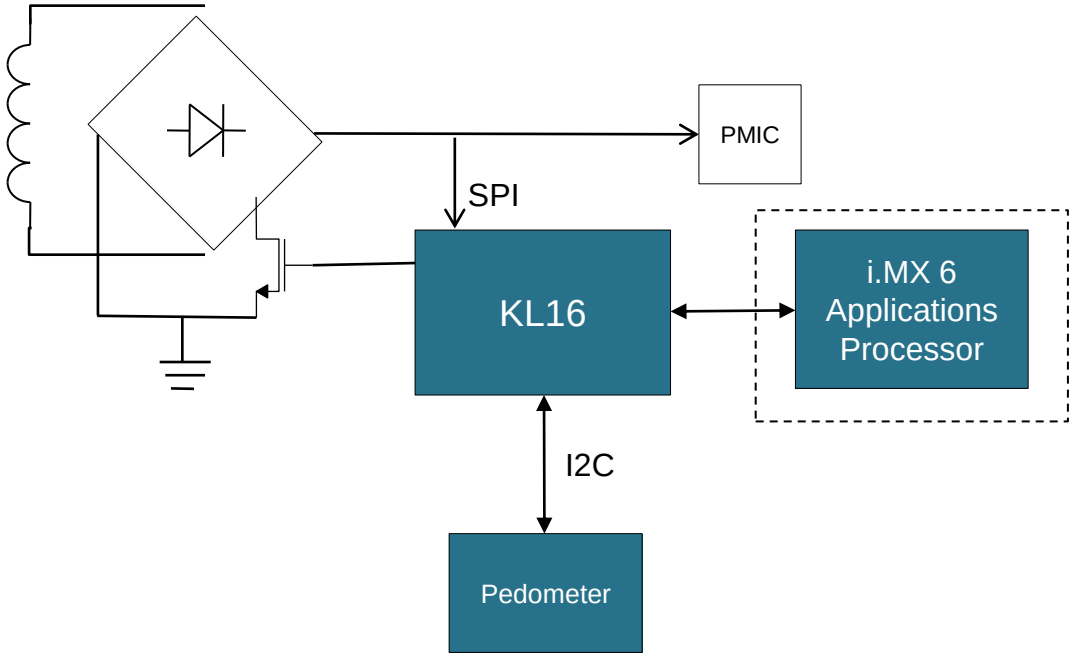
- Charge without the bulky micro-USB connector to minimize form factor

topology to offer flexibility over ASICs

- Implements a discrete
- Uses commercially available Kinetis

  KL16 & charging coil

- Uses the latest industry standard – Chi standard - software provided in library format



WaRP with Medical Daughter Board

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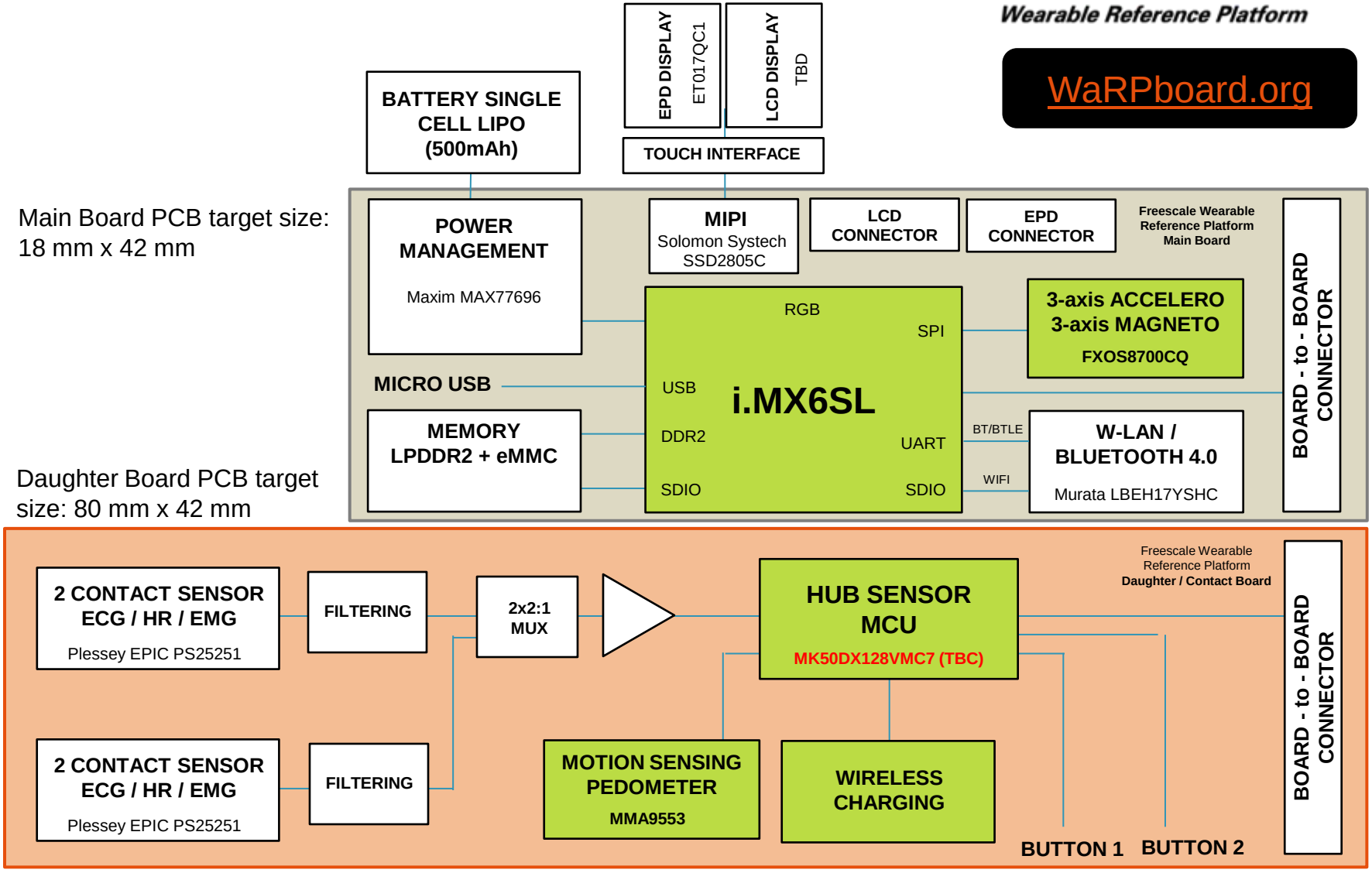
Main Board PCB target size:
18 mm x 42 mm

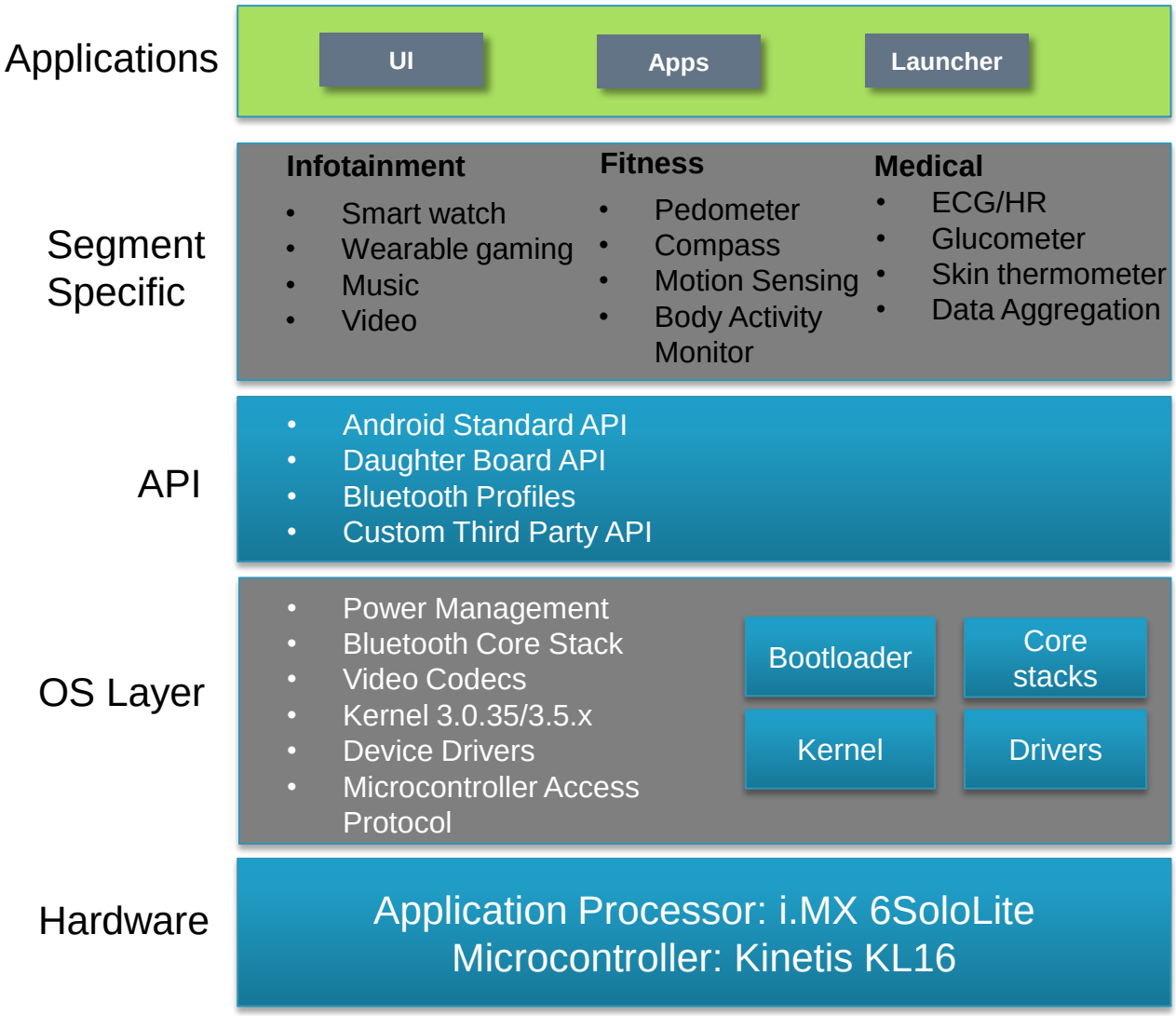
Daughter Board PCB target size: 80 mm x 42 mm



WaRP

Software Details

WaRP: Software Architecture and Completeness



..., Android?

Android was designed to be:

Connectivity	LTE to NFC On-demand and autonomously
Context Awareness	System capable of higher-level concepts, functions, and behaviors
Interactive and Intelligent	Learn behaviors based on user's response. Natural user interface: Spoken, gestures.
Extensible	Application Framework capable of performing a combinatorial set of tasks

WaRP Android Software Implementation

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Connected	Fully connected stack accessible via Java SDK Flexible recovery system for OS updates
Extensible	Large developer community can leverage full standard Android SDK & standard dev tools Open platform – two BSP versions, full open source & advanced optimized via click through license
Interactive & Intelligent	Android is only OS with an optimized & lightweight surface renderer & advanced touch human interface
Context Awareness	Extension of SDK used simple messaging system to interface with daughter card & access data from sensors

Android Wear – What's The Impact

What it is

- The released SDK includes API libraries & dev tools to build, test & debug apps for devices running Android Wear.
- Similar to the GDK for Google Glass – The Glass OS can be installed only on Google Glass and is solely owned by Google
- **Google have not released the source code** therefore cannot be ported to the WaRP board or any third party platform at this time.

What it's not

- NOT Open Source
- NOT Applicable to all wearable's – currently just Smart Watches
- NOT a stand alone OS – Android Wear still requires interoperability with phones and tablets

Launch & Community

Community

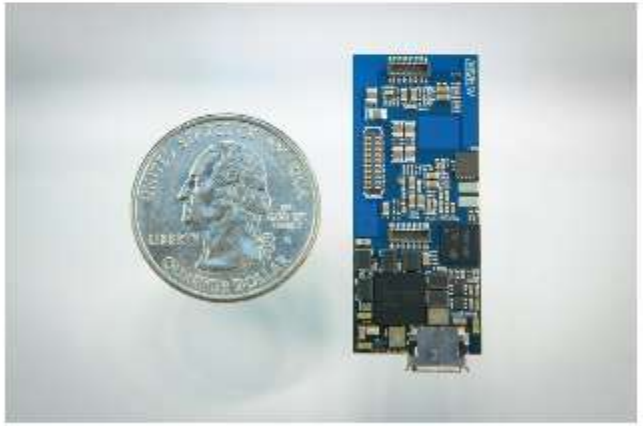
WaRPboard.org

Home | Press | Community | Technical Features | Where to Buy | About Us

WaRPboard.org is a nonprofit community based organization providing service and support for the **wea**r**a**bles **r**eference **p**latform (WaRP). The solution's hardware and software will be open sou
licensing fees are require

WaRPboard implements
wearables market. The p
with the ability to add add
architecture, the guts of the design is done on the main board with Freescale's i.MX 6SoloLite applications processor, and a secondary microcontroller, Freescale's Kinetis KL16 MCU, is implemented on the daughtercard, which is used as a sensor hub as well as a wireless charging MCU.

WaRP community can help you tackle challenges, develop quickly and innovate!



Community driven by CIrcuitco

Technical Features

WaRP Timeline Calendar

- **Available Now**
  - WaRPboard.org Website
  - Block Diagram
  - WaRPboard Google Group

- **Ordering**
  - WaRPboard.org
  - Distributors – Arrow and Avnet

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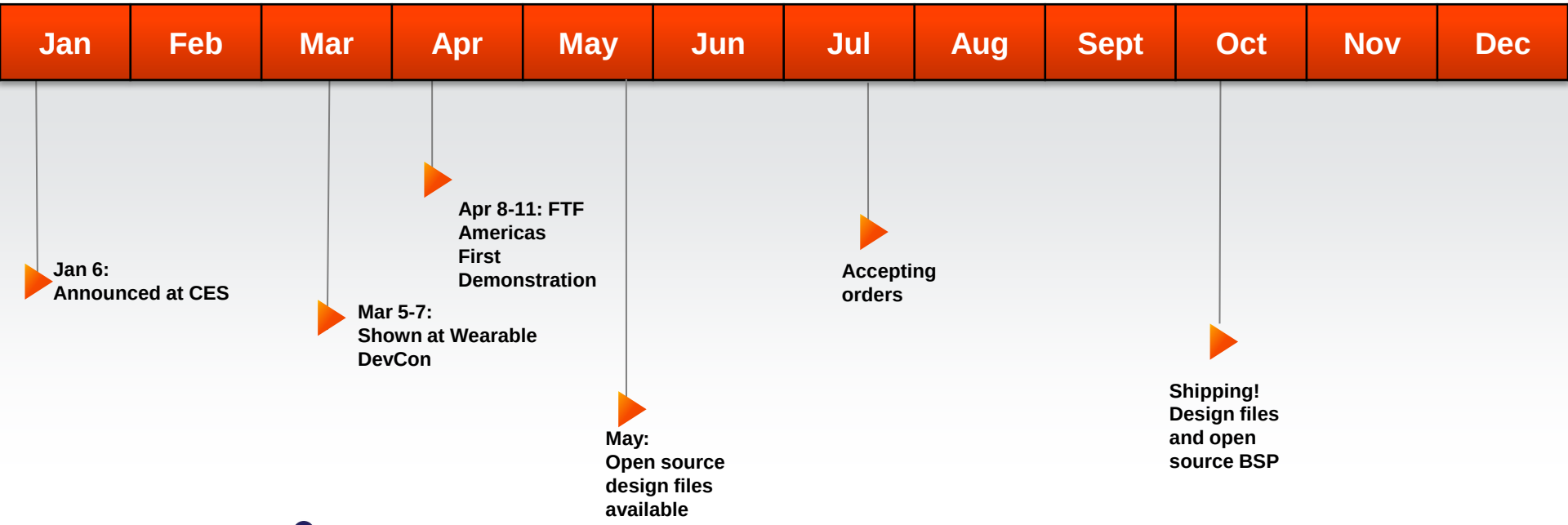
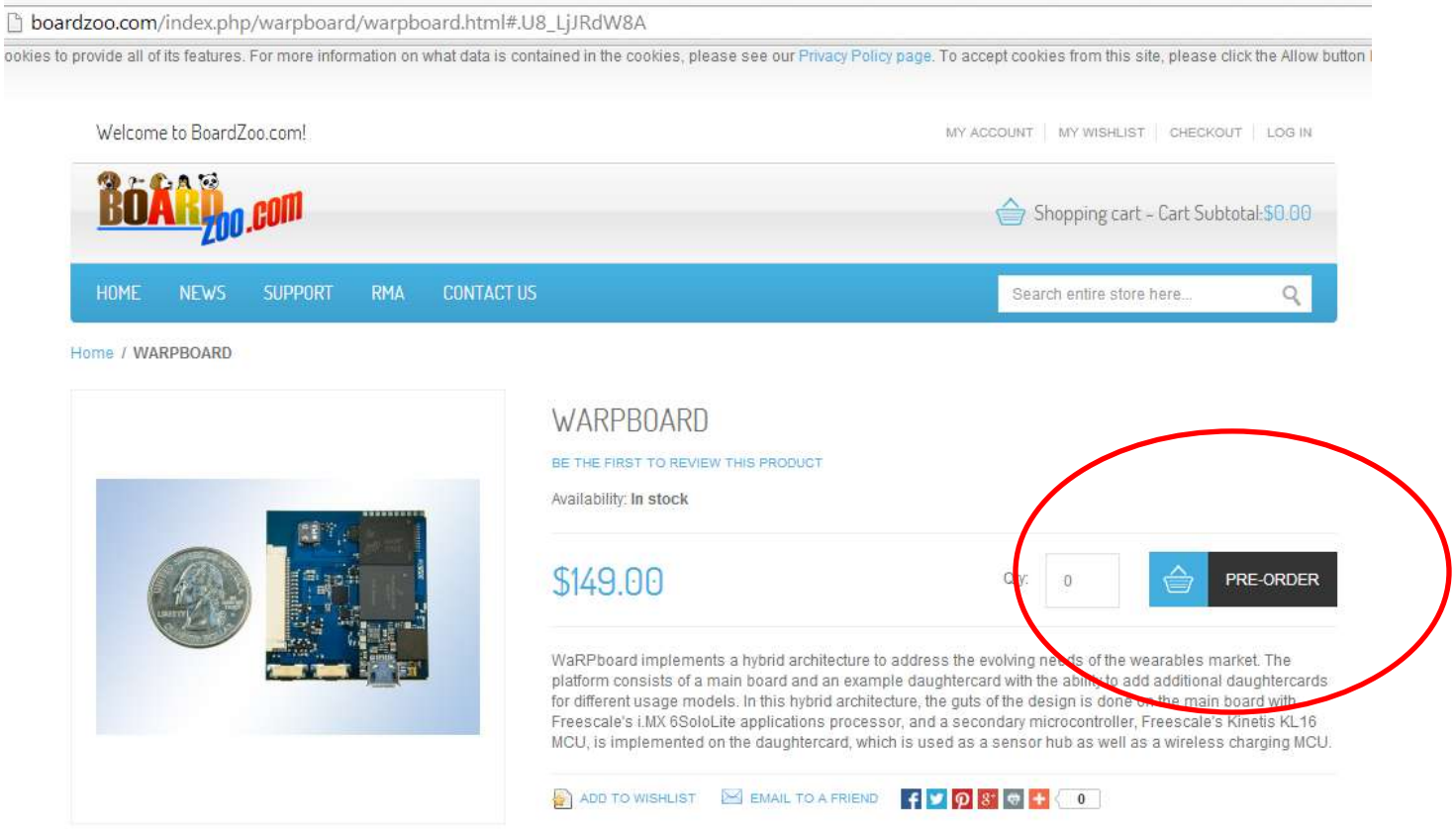


(A) Announcement, (L) Launch, (FML) Full Market Launch

Pre-Order Now http://www.warpboard.org/where-to-buy/



WaRPboard chosen as
Top Innovative Product of 2014

Embedded Computing Design

August 2014 issue, silicon category

Wearables Summary

WaRP
Wearable Reference Platform

Versatile Applications
More than just smart watches, growth in many diverse markets

Scalable, Modular and Open Source
WaRP is a scalable, modular, and open source reference platform

Productizable
Form factor board that can be productized because components are available

Available Soon
Shipping October 2014 via **warpboard.org** as well as
our through our global distributors: Arrow and Avnet.

www.Freescale.com