



**Sensors**  
Converge

# Jump Start Your Low-Power IoT Sensors Application Development

June 20–22, 2023 | Santa Clara, CA

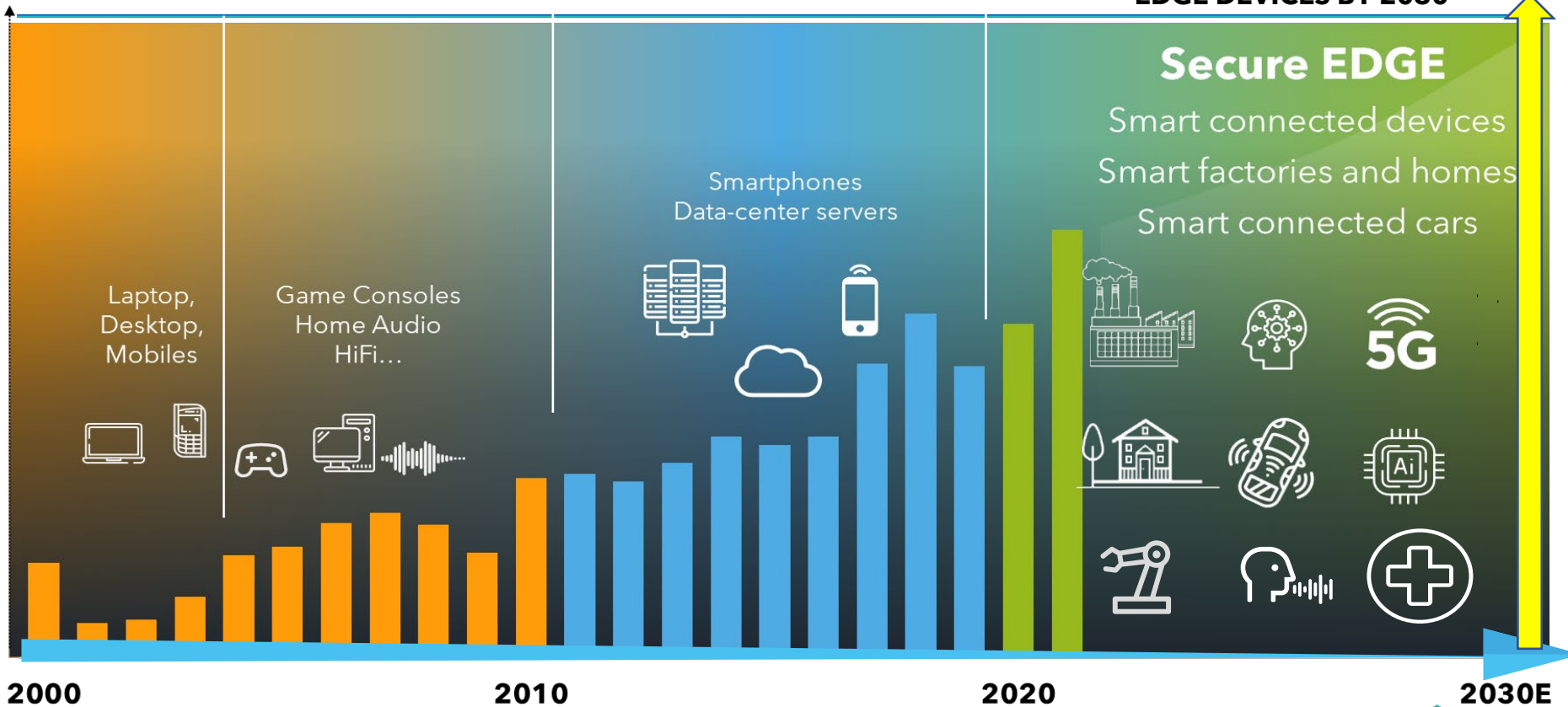
#SensorsConverge

# RISE OF THE SECURE EDGE

## MACROTRENDS DRIVING WAVES OF SEMI GROWTH

> 75 BILLION CONNECTED SECURE EDGE DEVICES BY 2030

Semiconductor TAM



2000

2010

2020

2030E

#SensorsConverge

Source: I.H.S., McKinsey 2022

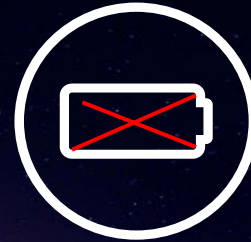
# WHY LOW-POWER DESIGNS ARE CRITICAL FOR EDGE DEVICES



**> 75 billion  
connected  
devices**



**> 25 billion  
battery operated  
devices**



**> 78 million  
batteries will be  
discarded daily**



**Effective power  
management in edge  
devices is the key**



# RISE OF TECHNOLOGY FOUNDATION FOR EDGE DEVICES

**SENSE**



Everything  
**Aware**

**THINK**



Everything  
**Smart**

**CONNECT**



Everything  
**Connected**

**ACT**



Everything  
**Efficient**

 Everything **safe AND secure**

 Easy to implement **scalable system solutions**

 **Low-power AND sustainable**

# KEY CONSIDERATIONS FOR LOW-POWER IOT APPLICATIONS

---

## Low-Power Operation:

- ❑ Integrated PMU
- ❑ Reduced power modes
  - Sleep, Deep-Sleep, Power Down, Deep-Power Down modes
- ❑ Configurable wake-up options
- ❑ Low-power consumption (nAmp to uAmp)
- ❑ Quick wake-up time (transition to active mode)

## Embedded Functions:

- ❑ Fully configurable, completely autonomous solution
- ❑ Programmable thresholds, timers
- ❑ Reduces bandwidth, latency and computational requirements
- ❑ Interrupt mode
- ❑ No complex algorithm, low-code, low-memory

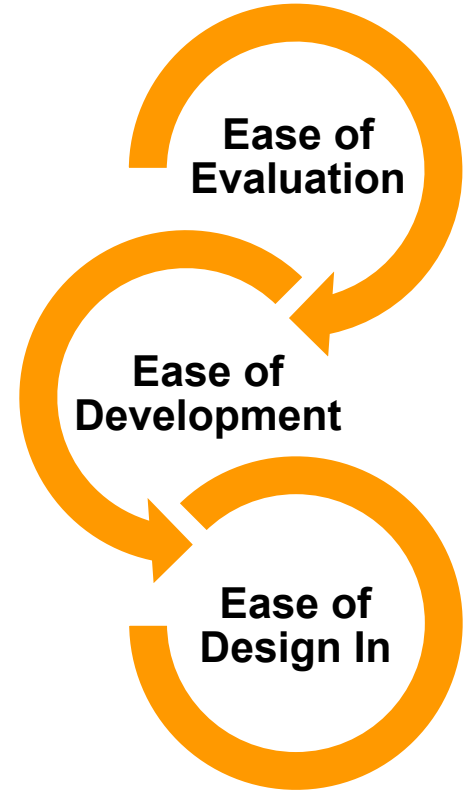
# KEY CONSIDERATIONS FOR LOW-POWER IOT APPLICATIONS

## Enablement Ecosystem:

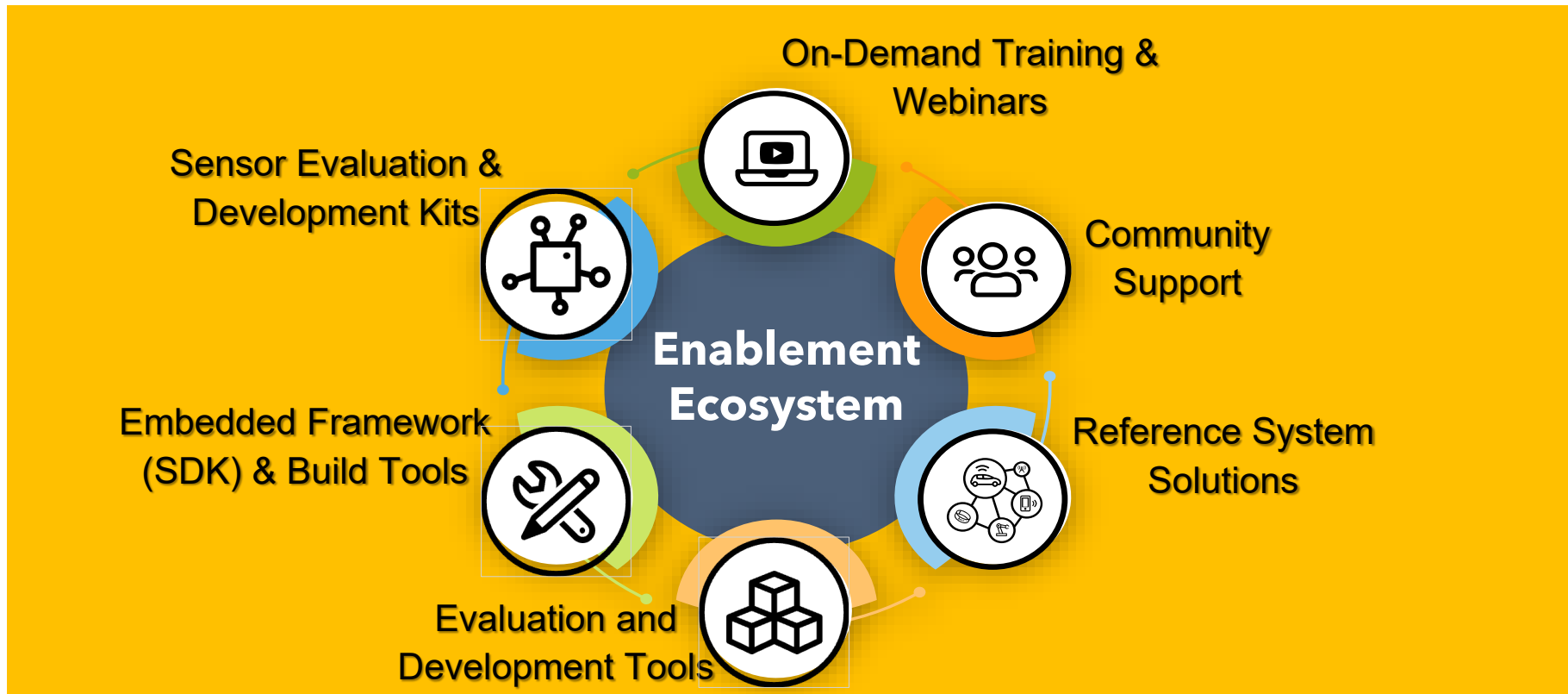
- ❑ Hardware & software enablement ecosystem with rapid development kits
- ❑ Helps in improving ease-of-use and quick evaluation.
- ❑ Accelerate end user development
- ❑ Improve OOB (Out Of Box Experience)

### Key Takeaways

- ✓ Ease of evaluation, development and design prototyping.
- ✓ Reference out-of-box examples showcasing low-power operation.
- ✓ Increase customer's confidence, help jump-start their development.

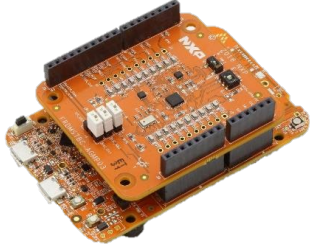


# ENABLEMENT ECOSYSTEM



# RAPID DEVELOPMENT KITS

## Demo Kit (Shield + MCU)



Complete Solution for 'Out of Box' sensor demonstration, evaluation and development

## Demonstration Kit (Shield + MCU)

- Officially supported combination of a Sensor Shield board and an Arduino® development MCU board.

## Shield Board



Evaluation Boards, pin compatible with most Arduino and FRDM development boards

## Shield Board

- Pin compatible across most Arduino® development MCU boards.
- Pins available as test points for evaluating pin signals such as VDD, GND, I<sup>2</sup>C, SPI, INT etc.

## Breakout/Click Board



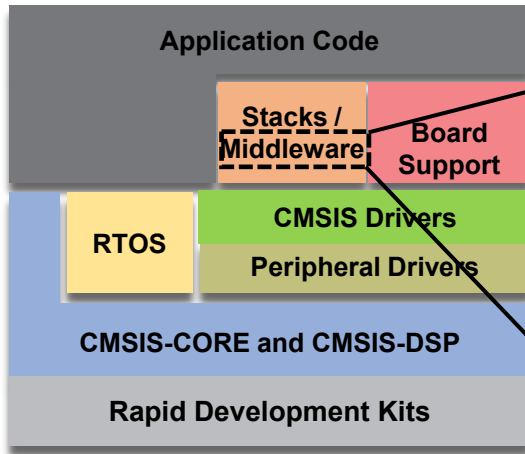
Boards for product prototyping, can be easily wired to host MCU

## Breakout/Click Board

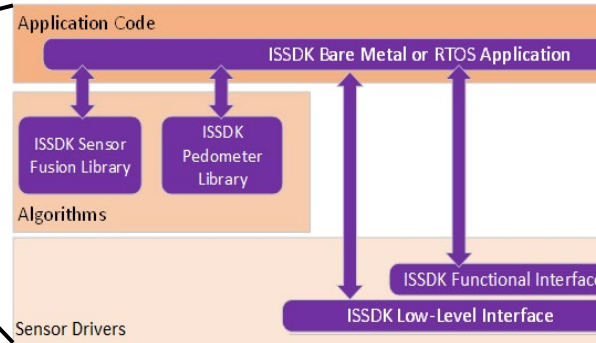
- Small form factor design or mikroBUS™ based design, ideal for product prototyping.



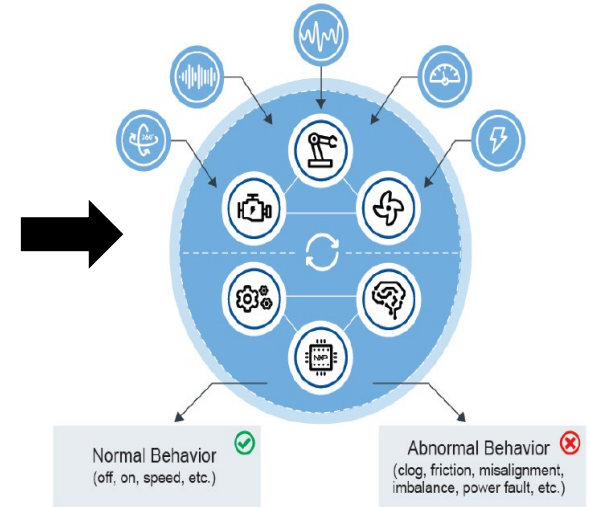
# EMBEDDED FRAMEWORK AND BUILD TOOLS



**MCU SDK**



**Sensors SDK**



**Reference Examples**

## **Key Benefits to End Users:**

- ❑ **Open Source:** Sources are released under BSD-3 clause open source.
- ❑ **Portability:** CMSIS compliance enabling easy porting across broad range of Arm® Cortex®-M core based MCUs.
- ❑ **Quality:** Production-grade quality, reference out-of-box examples.
- ❑ **Tools Integration:** Integrated with SW & Tools for quality user experience.

# EVALUATION AND DEVELOPMENT TOOLS

**FreeMASTER FXLS896x 3-axis Accelerometer Demo**

FXLS896x 3-axis Accelerometer Demo      FXLS896x Register Page

FXLS896x Sensor DataSheet: Quick Reference

FXLS896x Sensor Register Map

Register Name	Address	Access	Size	Data
IN1_STATUS	0x00	R	0x08	0x01
TEMP_OUT	0x01	R	0x08	0x00
MEM_LSB	0x02	R	0x08	0x00
MEM_MSB	0x03	R	0x08	0x00
OUT_X_LSB	0x04	R	0x08	0x00
OUT_X_MSB	0x05	R	0x08	0x00
OUT_Y_LSB	0x06	R	0x08	0x00
OUT_Y_MSB	0x07	R	0x08	0x00
OUT_Z_LSB	0x08	R	0x08	0x00
OUT_Z_MSB	0x09	R	0x08	0x00
MEM0	0x0A	R	0x08	0x00
MEM1	0x0B	R	0x08	0x00
MEM2	0x0C	R	0x08	0x00
MEM3	0x0D	R	0x08	0x00
MEM4	0x0E	R	0x08	0x00
MEM5	0x0F	R	0x08	0x00
MEM6	0x10	R	0x08	0x00
MEM7	0x11	R	0x08	0x00
MEM8	0x12	R	0x08	0x00
MEM9	0x13	R	0x08	0x00

Register Bit-Fields Details

Bit-7	Bit-3	Bit-2	Bit-1	Bit-0
WAKE_PM1[0]	WAKE_PM2[0]	SLEEP_PM1[1]	SLEEP_PM2[0]	LE_LB
ANIC_TEMP	F_READ			

Register Bit-Fields Description

Description

WAKE\_PM1[0]: 00 - Low Power mode, 01 - High Performance mode, 1x - Flex Performance mode.

SLEEP\_PM1[1]: 00 - Low Power mode, 01 - High Performance mode, 1x - Flex Performance mode.

LE\_LB: 0 - Little Endian, 1 - Big Endian.

ANIC\_TEMP: 0 - TEMP\_OUT register content is not included in axis increment address range, 1 - TEMP\_OUT register content is included in axis increment address range.

F\_READ: 0 - Normal read mode, 1 - Fast read mode.

Buttons: Read, Write, Read All, Save Config, Load Config.

Sensor Registers Page

Node-RED Extension

The diagram shows a flow starting with a 'FreeMASTER Serial' node connected to a 'FreeMASTER Register' node. This is followed by a 'FreeMASTER Read' node, which then branches into several 'FreeMASTER Write' nodes for different registers. The flow concludes with a 'FreeMASTER Serial' node for output.

Node-RED Extension

## Key Benefits to End Users:

- Plug & Play Tool
- Enables Quick Evaluation
- Register bit-fields read/write
- Real-time control & monitoring

**FreeMASTER FXLS896x 3-axis Accelerometer Demo**

FXLS896x 3-axis Accelerometer Demo      FXLS896x Register Page

FreeMASTER FRDM-K22F-AGMP03 FXLS896x Demo

- This Demo is using FRDM-K22F-AGMP03 shield board having FXLS896x 3-axis Accelerometer connected to FRDM-K22F-MCU101 (order to Demo Details tab for more details).
- The Demo showcase reading of FXLS896x registers, embedded events and communicating to host using FreeMASTER serial communication driver.
- The demo also showcase updating (writing) FXLS896x registers configuration from host using FreeMASTER serial communication driver.

Accel FLOOR Selection

Full Scale Range: ± 4G

Wakeup Delay Range (in Hz): 200 Hz

Accel Offset/Noise Calculation (Offset units: g and Noise units:  $\mu\text{g}/\text{Hz}$ )

X Offset	Y Offset	Z Offset
-0.24292	-0.19427	-0.03447

Calculate Offset and Noise

Self-Test (compute STOC and ZTOF)

X STOC	Y STOC	Z STOC
120	118	87

Perform Self-Test

Power Control Selection

Accel Wake Mode: OSR

Low Power: [ ]

Temperature(DegC): 25.00

Accelerometer Data

2-axis graph showing Acceleration (g) vs Time (s) for X and Y axes.

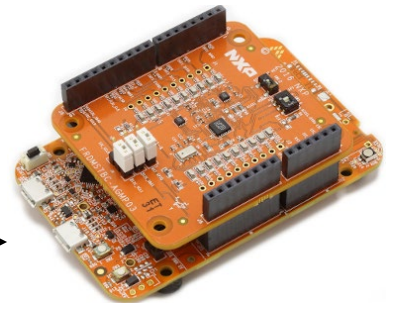
3-axis graph showing Acceleration (g) vs Time (s) for X, Y, and Z axes.

Sensor Control Page



Windows Development PC

Serial UART over USB



# TRANSFORMING FROM COMPONENTS TO SYSTEMS

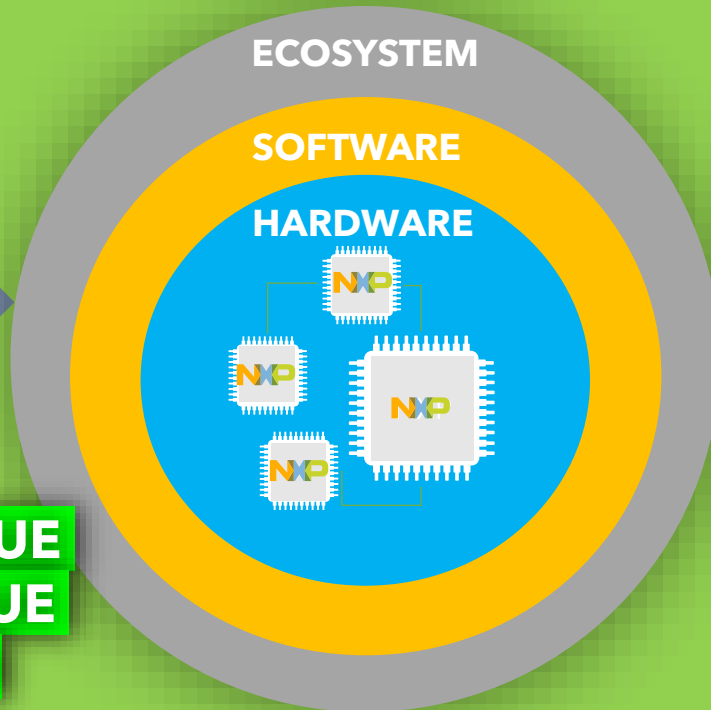
## LEVERAGE FULL POTENTIAL OF NXP'S PORTFOLIO & CAPABILITIES

COMPONENT



Growing beyond a  
Component Vendor

SYSTEM



**MAXIMIZING TRUE  
CUSTOMER VALUE  
PROPOSITION**



**Sensors**  
Converge

**Q & A**

#SensorsConverge