

Creating Exceptional UIs through Valuable Real-time Behavioral Insight Gained from Percepio and Crank Software

JUNE 9, 2020



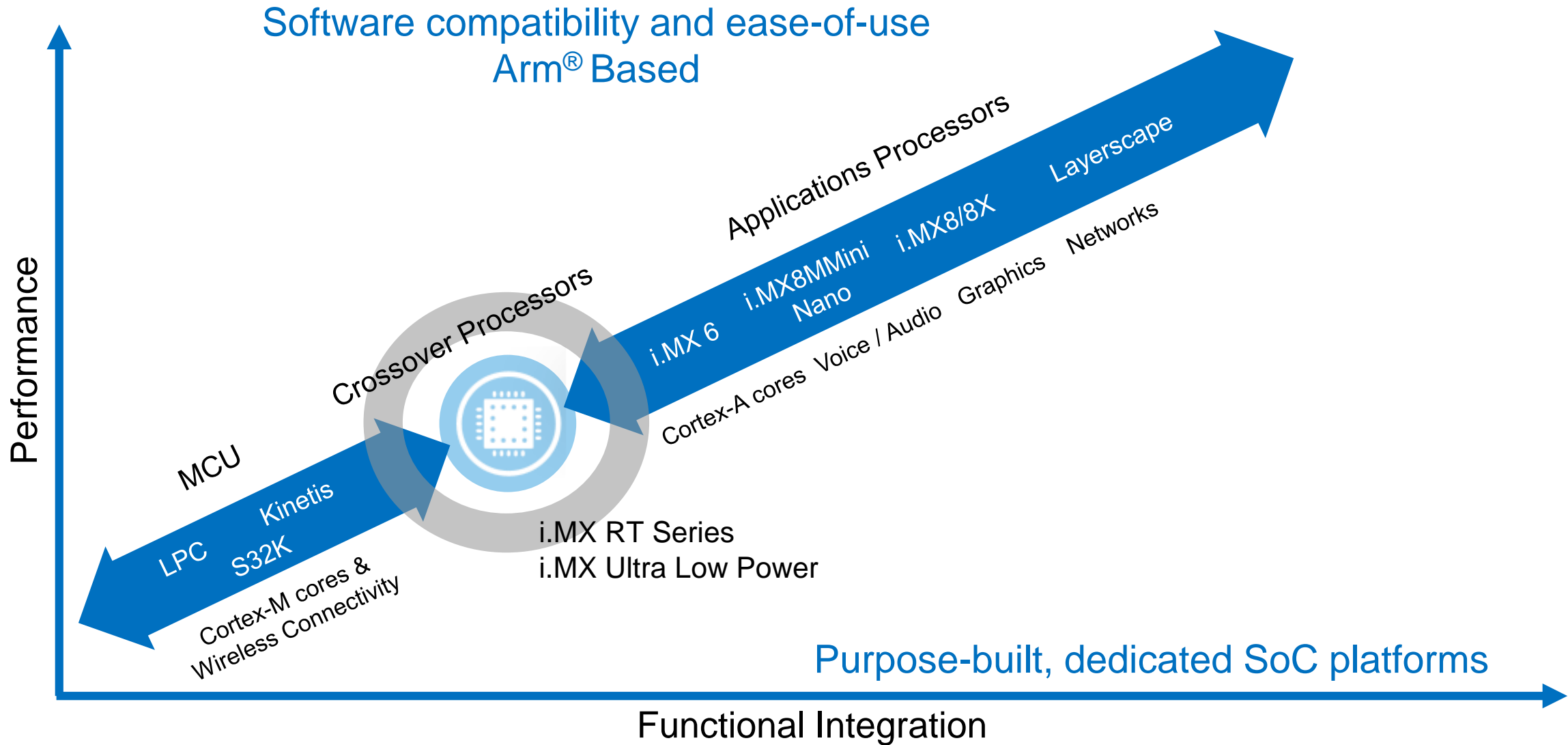
SECURE CONNECTIONS
FOR A SMARTER WORLD

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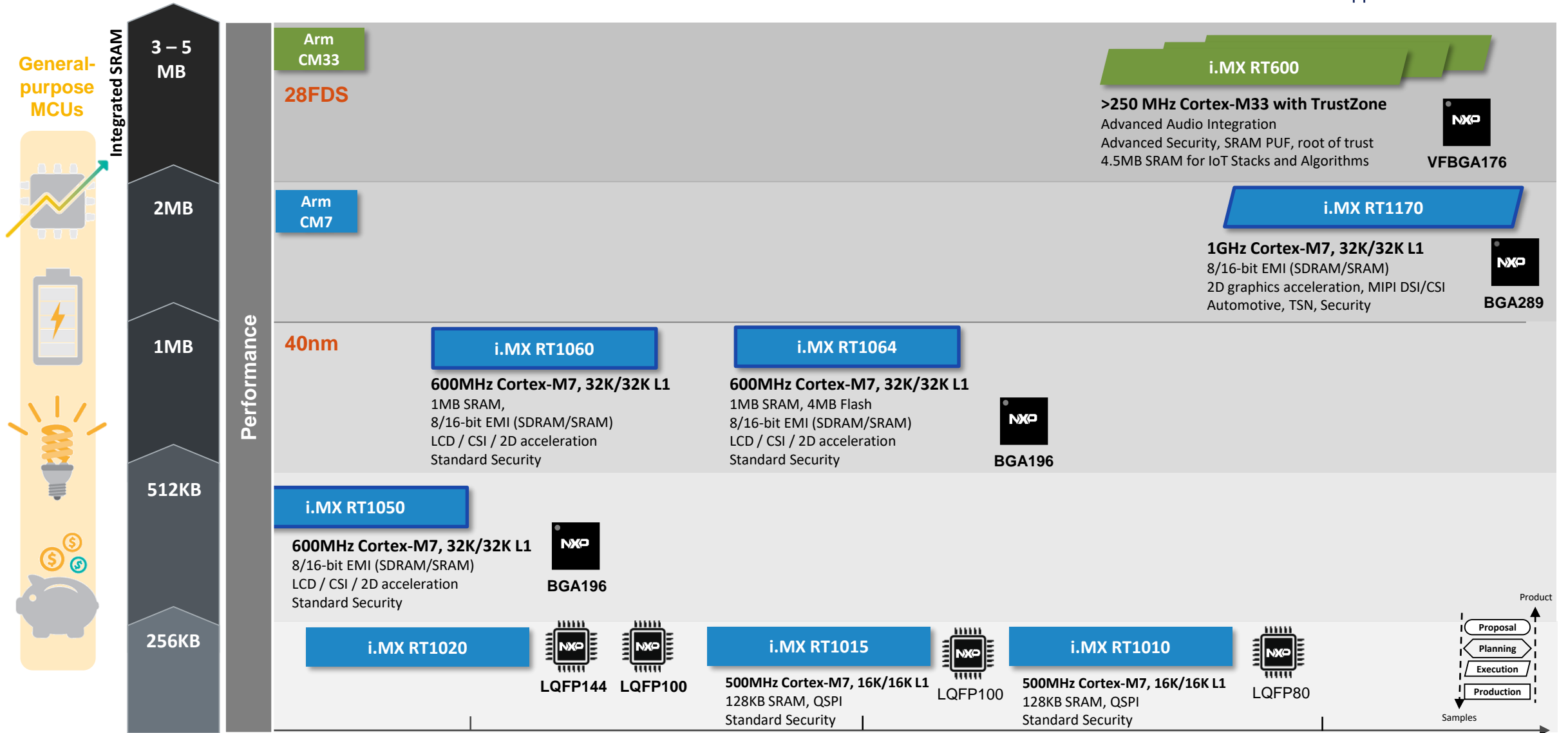
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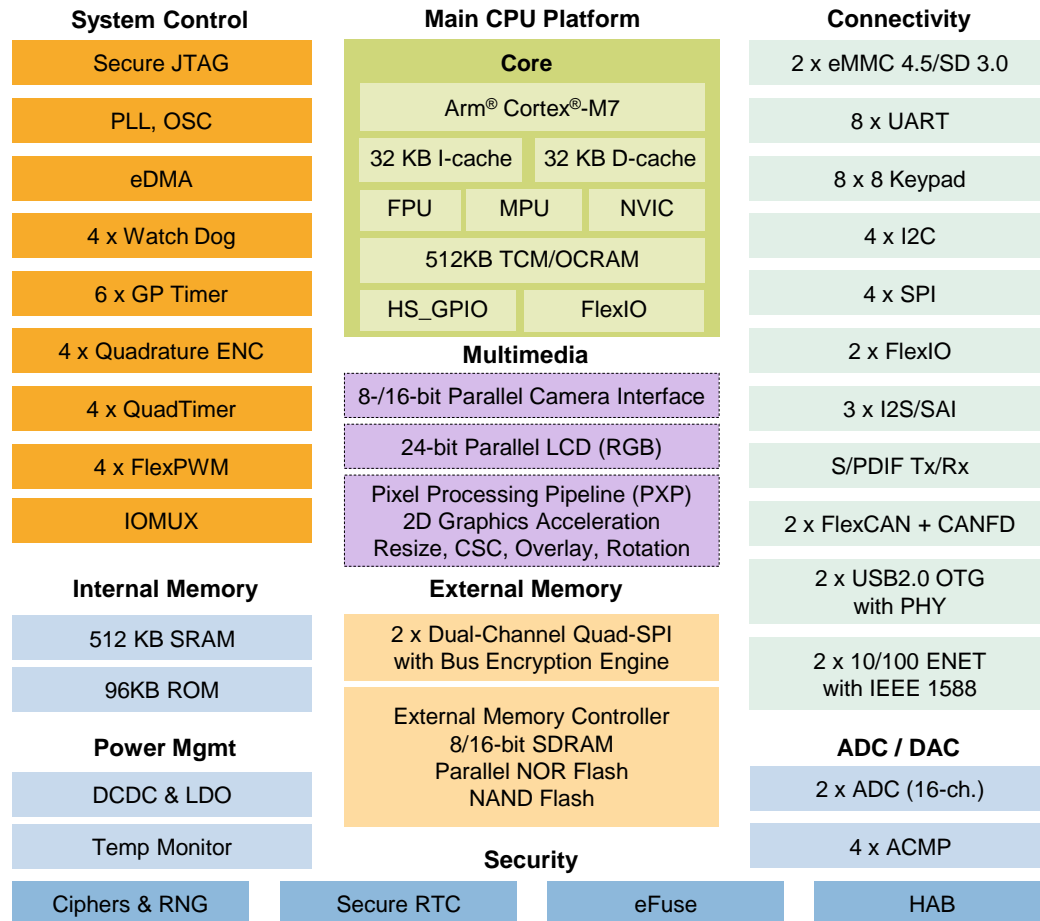
NXP SCALABLE PROCESSING CONTINUUM



I.MX SERIES MCU ROADMAP



i.MX RT1060 MCU BLOCK DIAGRAM



 Available on certain product families

Specifications

- Package: MAPBGA196 | 10x10mm², 0.65mm pitch (130 GPIOs)
- Temp / Qual: -40 to 105°C (Tj) Industrial / 0 to 95°C (Tj) Consumer

High Performance Real Time system

- **Cortex-M7 up to 600MHz**, 50% faster than any other existing M7 products
- 20ns interrupt latency, a **TRUE Real time processor**
- 512KB SRAM + 512KB TCM/OCRAM

Rich Peripheral

- Motor Control: Flex PWM X 4, Quad Timer X 4, ENC X 4
- 2x USB, 2x SDIO, 2x CAN + 1x CANFD, 2x ENET with 1588, 8xUART, 4x SPI, 4X I2C
- **8/16-bit CSI interface and 8/16/24-bit LCD interface**
- **PXP 2D Graphics Acceleration**
- 2x Quad-SPI interface, with Bus Encryption Engine
- Audio interface: 3x SAI/ SPDIF RX & TX/ 1x ESAI

Security

- TRNG&PRNG(NIST SP 800-90 Certified)
- 128-AES cryptography
- Bus Encryption Engine: Protect QSPI Flash Content

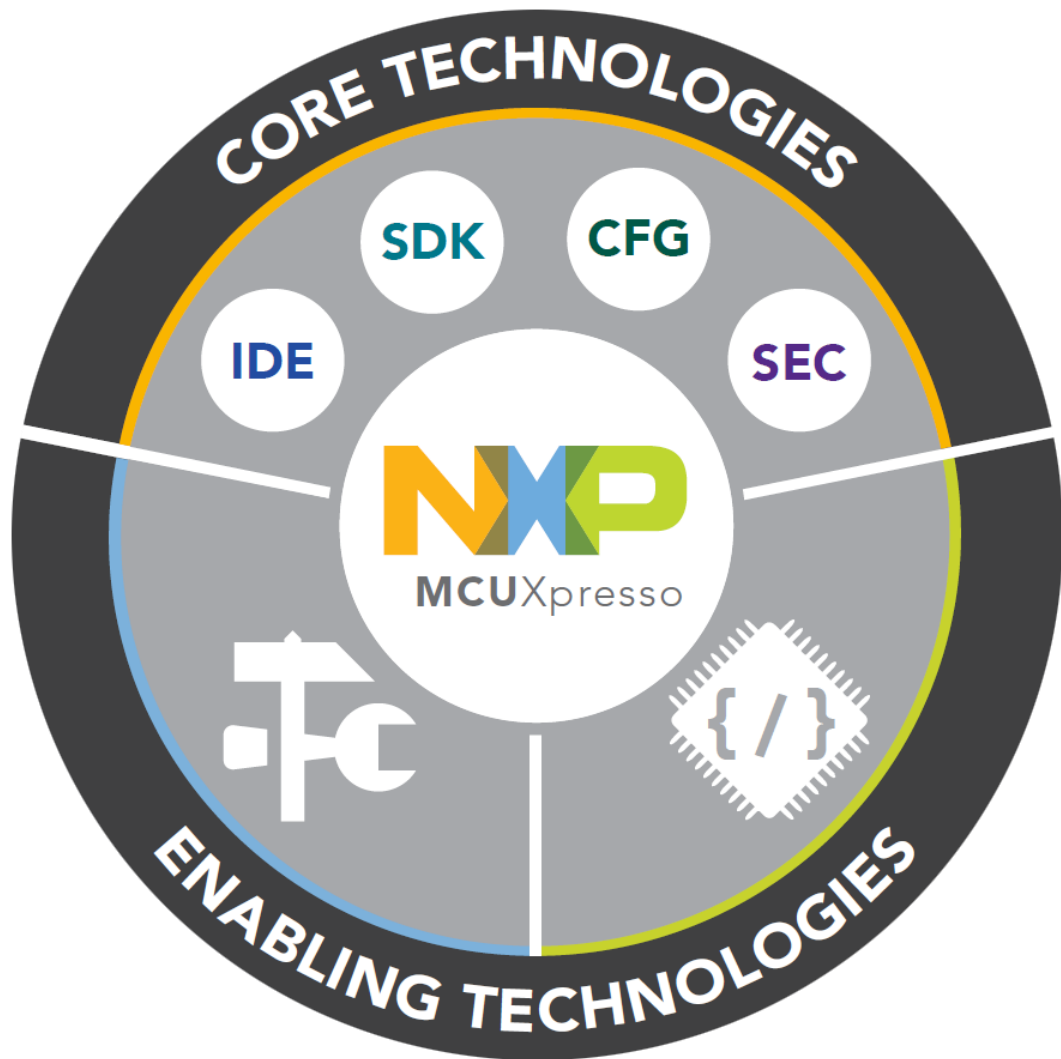
Ease of Use

- **MCUXpresso with SDK**
- FreeRTOS

Low BOM Cost

- Competitive Price
- Fully integrated PMIC with DC-DC
- Low cost package, 10x10 BGA with 0.65mm Pitch
- SDRAM interface

THE MCUXPRESSO ECOSYSTEM



- > **Core Technologies from NXP**
 - MCUXpresso IDE
 - MCUXpresso SDK
 - MCUXpresso Config Tools
 - MCUXpresso Secure Provisioning Tool
- > **Enabling Software Technologies**
 - Run time software libraries and middleware
 - Enable customers to focus on differentiation
 - From NXP and partners
- > **Enabling Tools Technologies**
 - Partner IDEs
 - Debug Probes
 - Development Boards
 - From NXP and partners

MCUXpresso Software and Tools

UNIFIED SUITE OF
TOOLS FOR EASY
DEVELOPMENT
WITH NXP MCUs



MCUXPRESSO SOFTWARE AND TOOLS ADDITIONAL WEB RESOURCES



MCUXpresso Software and Tools Overview Page:
<https://www.nxp.com/mcuxpresso>

MCUXpresso Software and Tools Community Site:
<https://community.nxp.com/community/mcuxpresso>



[Website /
Community](#)



[Website /
Community](#)



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Community](#)

Support devices

[Supported Devices Table \(Community Doc\)](#)

Graphics overview

[GUIs on NXP Microcontrollers](#)

A woman with blonde hair in a ponytail, wearing glasses and a white button-down shirt, is shown in profile. She is holding a smartphone in her left hand and pointing with her right index finger at a large, glowing digital display. The display shows a complex network diagram with various nodes and connections. The background is dark with some blurred orange lights.

ACCELERATING TOMORROW'S EMBEDDED UI EXPERIENCES

TODAY'S SPEAKERS

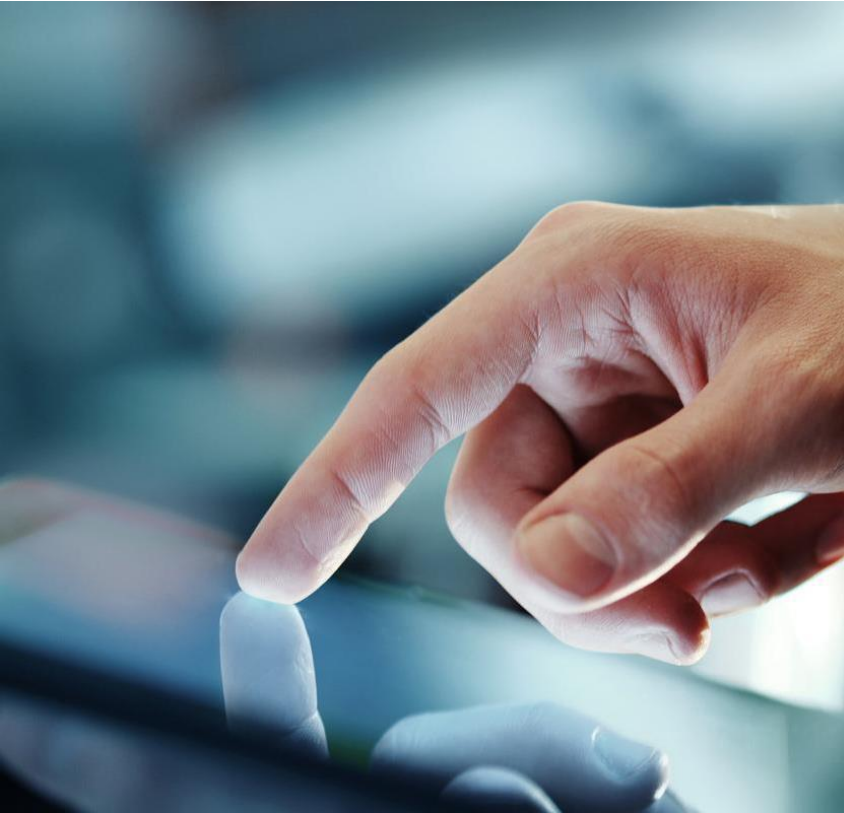


Scott Snider
Product Marketing Manager
Crank Software



Garry Clarkson
Field Application
Engineer
Crank Software

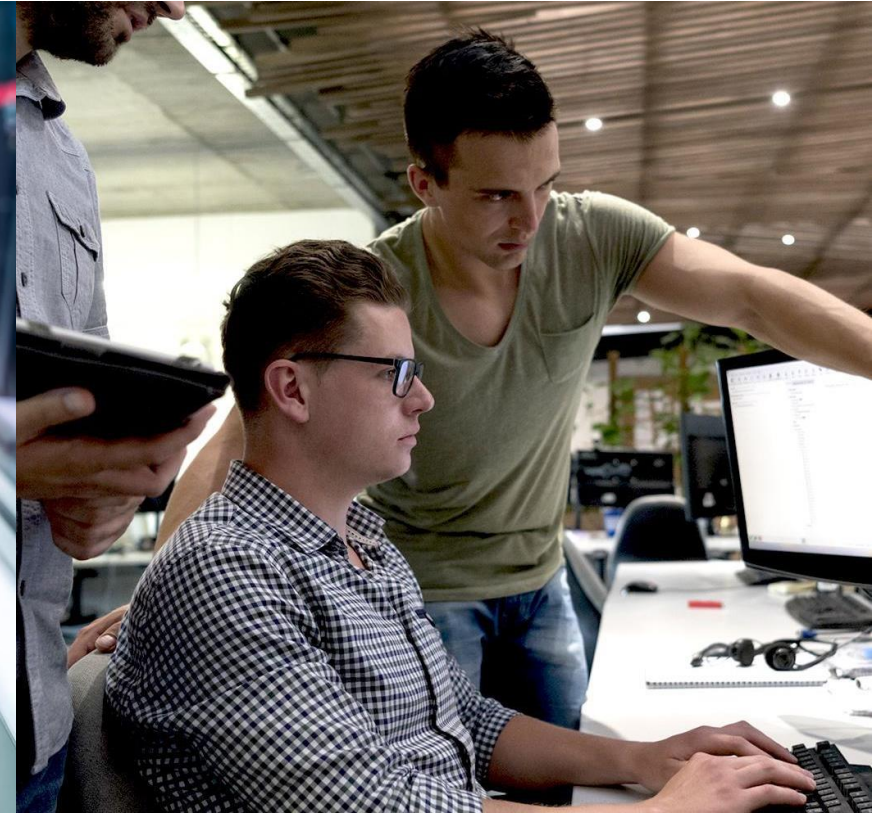
Challenge: Consumer GUI expectations are higher than ever



Smartphone experiences have elevated expectations



Hardware technology constantly evolving



Project assigned short deadlines



SOLUTION

Storyboard software

- Built upon two decades of UI design and development experience
- Decouples front-end UI from back-end logic
- Well-defined data model and events API connecting them together
- Provides hardware agnostic framework – working across MCUs and MPUs
- Enables collaborative (parallel) workflow for designers and developers



MEDICAL



INDUSTRIAL



AUTOMOTIVE



SMARTHOME



ABOUT CRANK SOFTWARE

Built Upon
20+ YEARS
GUI Design & Development
Experience



Global Partner
Network



Extensive
Partnership
Ecosystem



Privately Held
Canadian
Company



Awarded
Company of
the Year



Most
Innovative Software
2020



Industry Recognized
Award-winning UIs



How Storyboard helps



**ACCELERATE
DEVELOPMENT**



**EMBRACE
ITERATIONS**



UI FLEXIBILITY



How Storyboard helps



ACCELERATE DEVELOPMENT

- Import from Design tools
- Integrated animation tool
- Prototype simulate without hardware



EMBRACE ITERATIONS

- Make changes without impacting progress
- Re-import modified Photoshop design files
- Compare, select, & merge changes



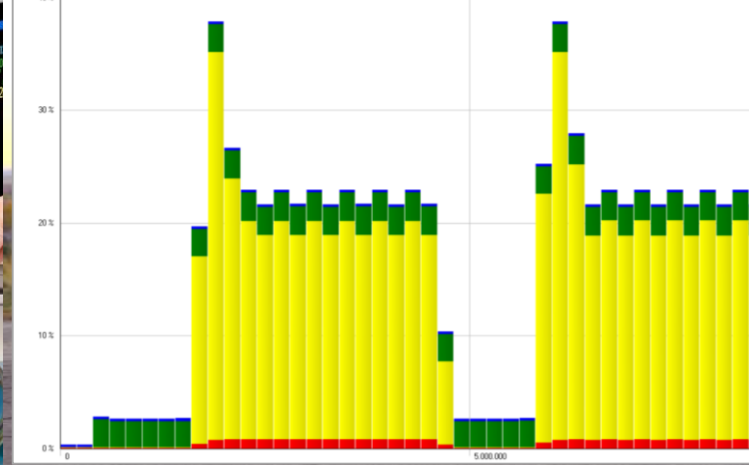
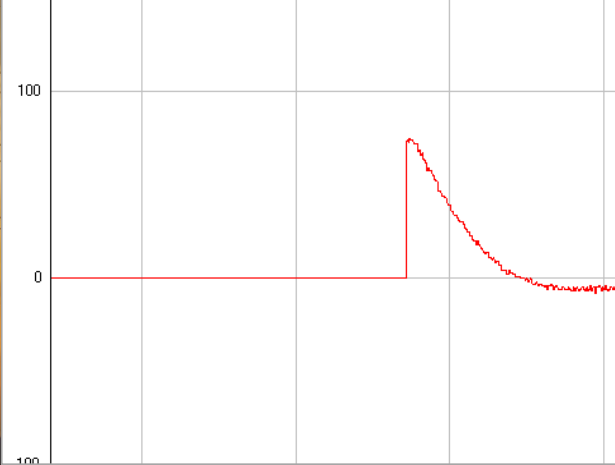
UI FLEXIBILITY

- Scalable from low-power MCUs to powerful MPUs
- Portable to a switched-out hardware and OS
- Reuse UI development across different product lines



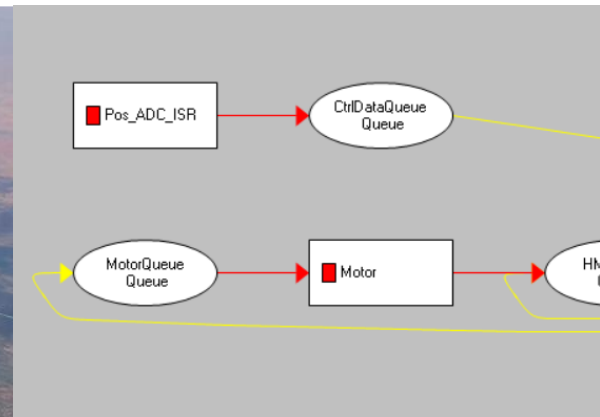
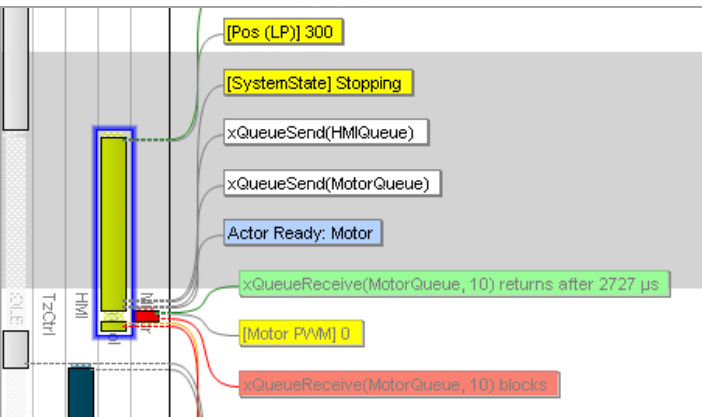
What makes Storyboard different

- Not a code generation framework
- Low barrier to entry for software development
- Front-end UI design is decoupled from the back-end logic
- Embraces design change and eases iterative development
- Rendering technologies for acceleration
- Built to leverage board features that drive performance



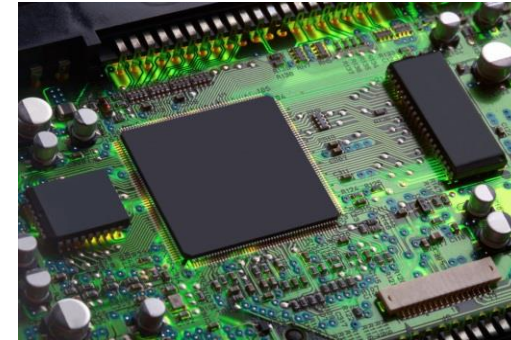
Visual Trace Diagnostics

Tracealyzer In the Lab, DevAlert In the Field



Source code is not the full picture

```
if (liczba_binarny[0] == 0)
    ulamek_binarny[0] = 0;
    counter = 1;
    counter_c = 1;
}
for (int i = 0; liczba != 0; i++) {
    int bit = Math.abs(liczba % 2);
    liczba = liczba / 2;
    binarna[i] = bit;
    counter_c++;
}
ulamek = Math.abs(ulamek);
for (int i = 0; ulamek != 0; i++) {
    if (ulamek_binarny[i] == 0)
        ulamek_binarny[i] = 1;
        ulamek = ulamek / 2;
    }
}
```

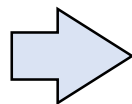
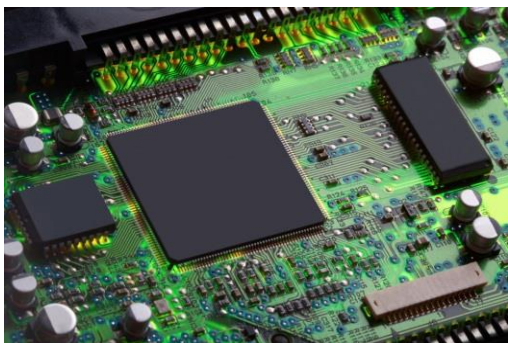


The runtime behavior is what ultimately counts

Depends on dynamic effects, e.g. variations in timing and interference between tasks

Not visible in the source code! Runtime monitoring is needed...

Runtime Monitoring



```

lmc      inro
184140   000100fc -> write r31
184141   100a8   IncrementCounterBy1 add      %r0,
184141   0000002e -> write r0
184142   100ac   IncrementCounterBy1+0x04 extb
184142   0000002e -> write r0
184143   100b0   IncrementCounterBy1+0x08 j_s
184144   100fc   main+0x30   stb      %r0,[%r1]
184144   2e -> write mem [0x011000]
184145   10100   main+0x34   ldb      %r0,[%r2]
184145   5a <- read mem [0x011001] -> writ
184146   0000005a -> write r0
184147   10104   main+0x38   bl_s      IncrementC
184147   00010106 -> write r31
184148   100b4   IncrementCounterBy2 add      %r0,
184148   0000005c -> write r0
184149   100b8   IncrementCounterBy2+0x04 extb
184149   0000005c -> write r0
184150   100bc   IncrementCounterBy2+0x08 j_s
184151   10106   main+0x3a   sth      %r0,[%r2]
    
```

```

19.319] Context switch on CPU 0 to Control
19.330] xQueueReceive(CtrlDataQueue, 100) return
0.253] OS Ticks: 8109
1.253] OS Ticks: 8110
1.270] Context switch on CPU 0 to Pos_ADC_ISR
1.281] xQueueSendFromISR(CtrlDataQueue)
1.290] Context switch on CPU 0 to Control
1.868] xQueueSend(MotorQueue)
1.878] Actor Ready: Motor
1.889] Context switch on CPU 0 to Motor
1.900] xQueueReceive(MotorQueue, 10) returns s
1.934] xQueueReceive(MotorQueue, 10) blocks
1.954] Context switch on CPU 0 to Control
1.965] xQueueReceive(CtrlCmdQueue, 0) timeout
1.977] xQueueReceive(CtrlDataQueue, 100)
1.990] xQueueReceive(CtrlCmdQueue, 0) timeout
    
```

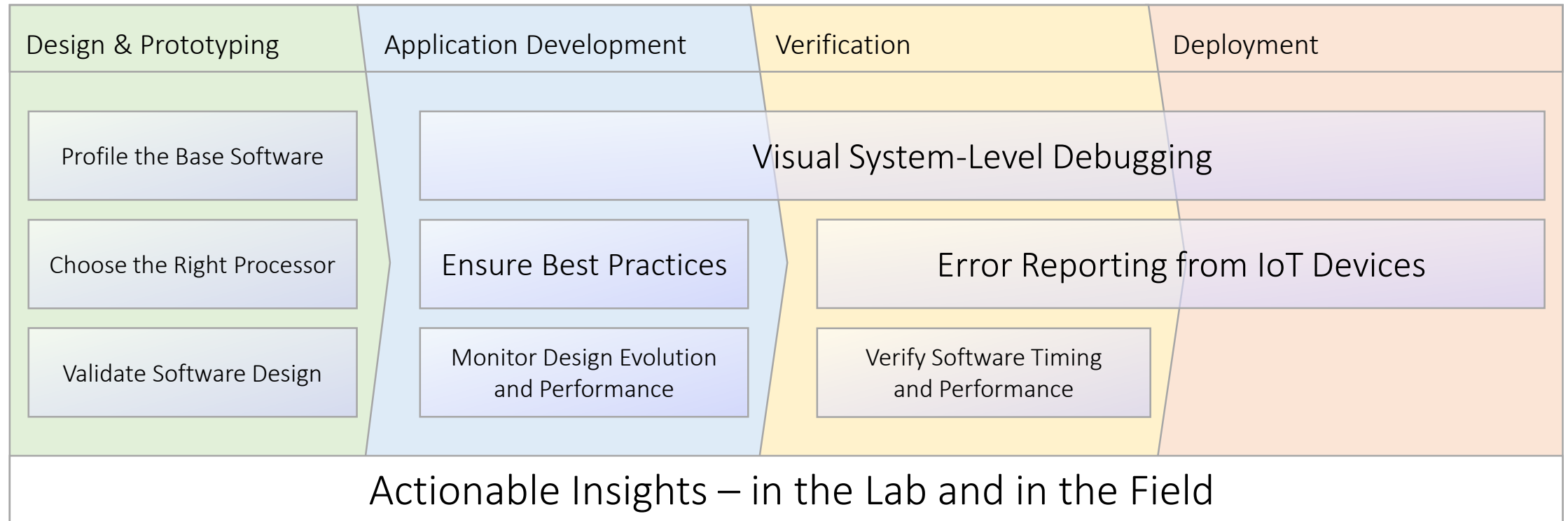
```

ivc] Starting key provisioning...
ivc] Write root certificate...
ivc] Write device private key...
Svc] Write device certificate...
Svc] Key provisioning done...
Svc] Starting WiFi...
nr Svc] WiFi module initialized.
[WS-MAIN] WiFi connected to AP AndroidAP.
[WS-MAIN] Attempt to Get IP.
[WS-MAIN] IP Address acquired 192.168.0.51
[WS-LED] [Shadow 0] MQTT: Creation of dedicated MQTT
[WS-LED] Sending command to MQTT task.
[MQTT] Received message 10000 from queue.
[MQTT] Looked up a7sw0r7rvpirn.iot.us-east-1.amazonaws.com
[MQTT] MQTT Connect was accepted. Connection established
[MQTT] Notifying task.
[AWS-LED] Command sent to MQTT task passed.
    
```

	Instruction Trace	Software Event Trace	Application Logging
Producer	Processor core	Software	Software
Abstraction Level	Low	Medium	High
Overhead	None	Minor	Depends on method
Special HW needed	Yes	No	No

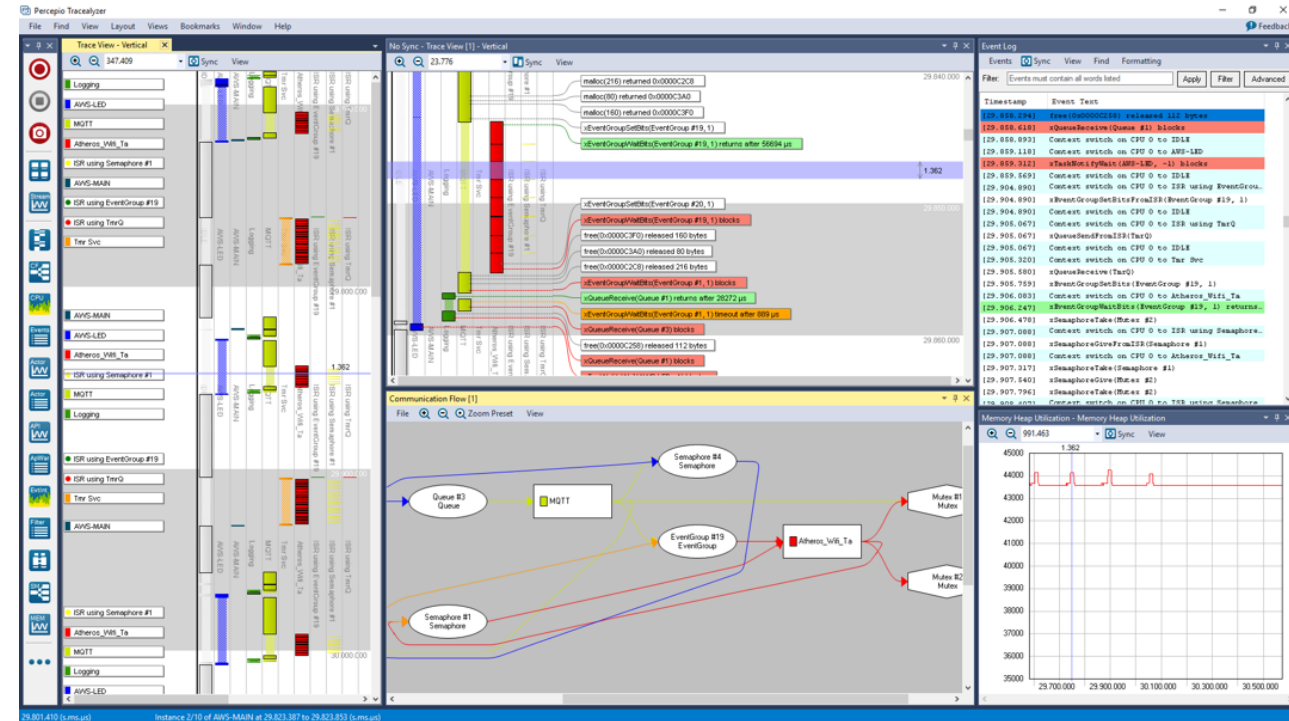
Visual Trace Diagnostics (VTD)

Runtime Monitoring -> OS-Aware Data Model -> Bespoke Visualization enables...

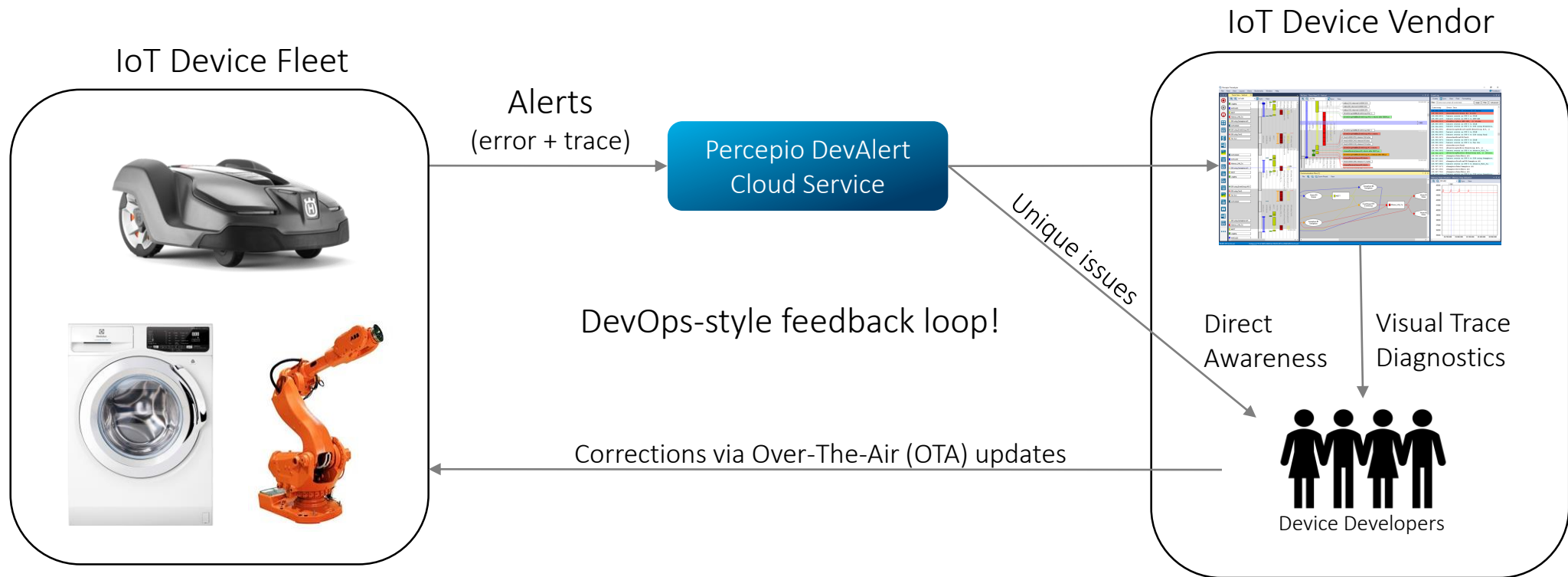


Percepio Tracealyzer® – VTD in the Lab

- Developed since 2004, 4th generation
- 30+ views at multiple abstraction levels
 - Spot issues in overviews
 - Detailed views reveals the cause
- Live streaming or snapshots
- Supported operating systems
 - FreeRTOS, SafeRTOS, μ C/OS-III
 - Arm Keil RTX5
 - ThreadX /Azure RTOS
 - Linux
 - VxWorks
 - IntervalZero RTX64
 - ...



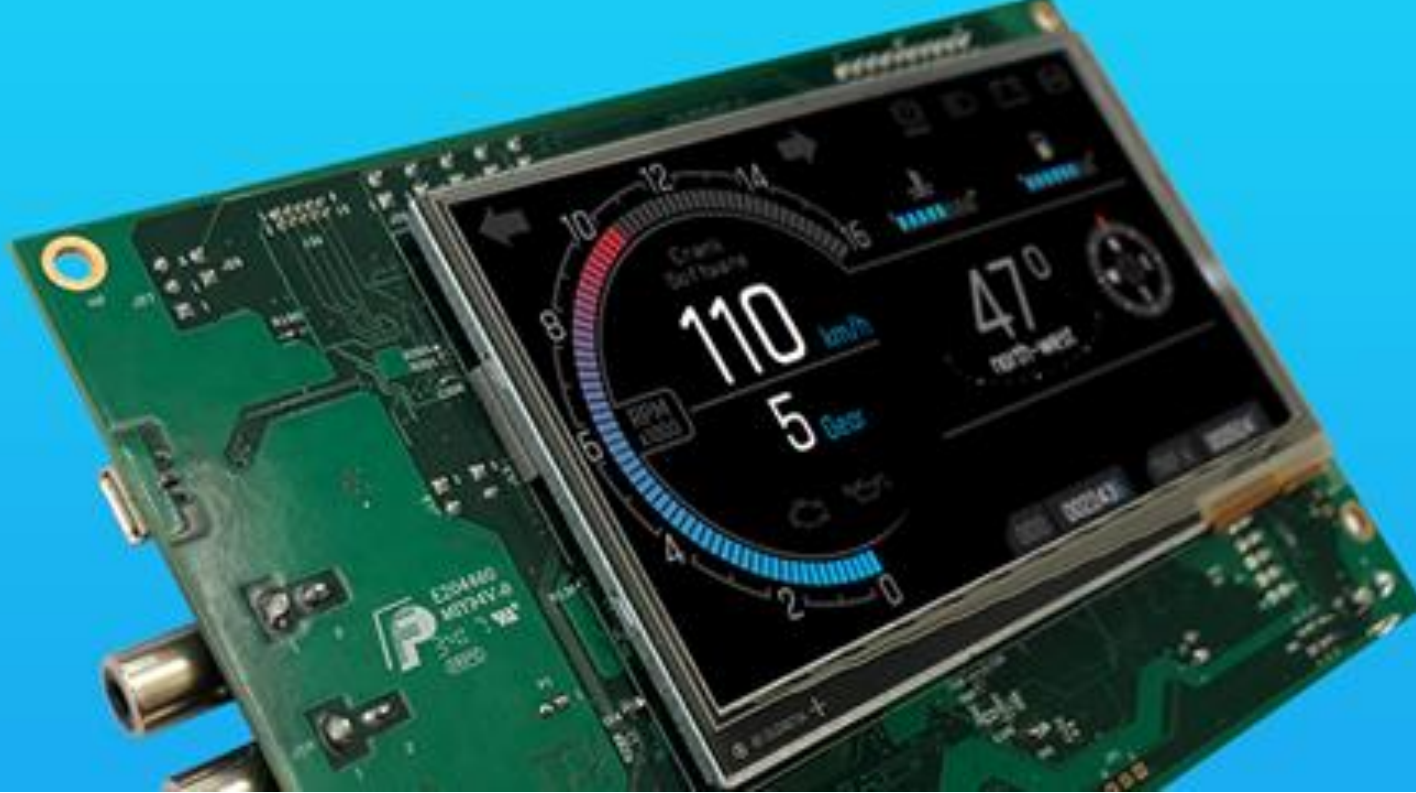
Perceprio DevAlert™ – VTD in the Field



Connected devices allows for automatic error reporting

- Direct awareness allows for quick reaction (OTA update) before most users even notice
- Tracealyzer makes it easier to analyze and fix the problem
- Feedback to testing, to avoid that similar bugs are missed in the future

Asserts
Hard faults
Stack overflow
Out of memory
Proactive warnings



Storyboard Demo

Demo Application

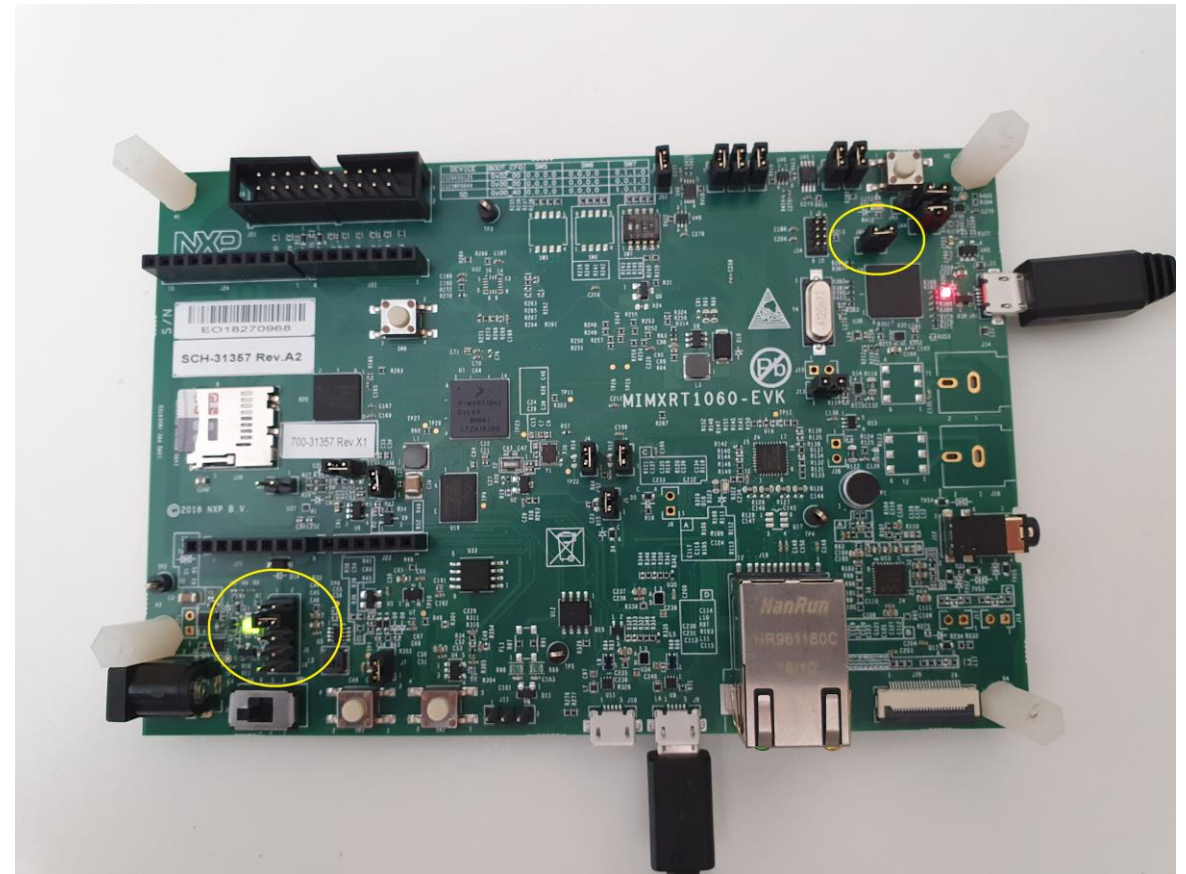
The screenshot shows the Crank Storyboard IDE interface. The main canvas displays two storyboard screens: 'homeScreen' and 'energyScreen'. The 'homeScreen' features a central white t-shirt icon, a 'Normal Wash' button, and a 'cycle signal' indicator. The 'energyScreen' shows a 'complete' status with a star rating and a 'reset' button. The interface includes a Navigator on the left, a Properties panel on the right, a Scripts panel at the bottom left, and a Console panel at the bottom right. The Console shows a warning message: 'WARN [17.386]:Invalid or expired timer provided to cl (Info) Hardware profile: None (Info) PVRVFrame version 10.6'.

Trigger Event	Action	Model Element
autoResetEvent	Screen Transition: homeScreen	application
goToHomeScreen	Screen Transition: homeScreen	application
gre.animate.complete.IDLE_loop	Animation: IDLE_loop	application
gre.animate.complete.TRANSITION_ho...	Screen Transition: washingScreen	homeScreen
gre.animate.complete.WASHING_outer...	Lua: CBStopDrumAnimation()	washingScreen
gre.animate.complete.WASHING_outer...	Screen Transition: energyScreen	washingScreen
gre.animate.complete.WASHING_outer...	Lua: CRStonDrumAnimation()	washingScreen

Overview

- White Goods demo – Washing Machine
- Resolution 480x272 RGB565
- Capacitive Touchscreen
- FreeRTOS
- MCUXpresso IDE
- Smooth animations with PXP hardware acceleration
- Storyboard Virtual Flash Filesystem
- C/C++ Resource Header Export

Storyboard on the NXP i.MXRT1060EVK



- Checkout the LPC-Link2 Configuration : Add high speed flashing and advanced debugging with real-time SWO trace
<https://support.cranksoftware.com/hc/en-us/articles/360042093231-RT1060-Enabling-faster-flashing>

Taking debug analysis to the next level with Tracealyzer 4



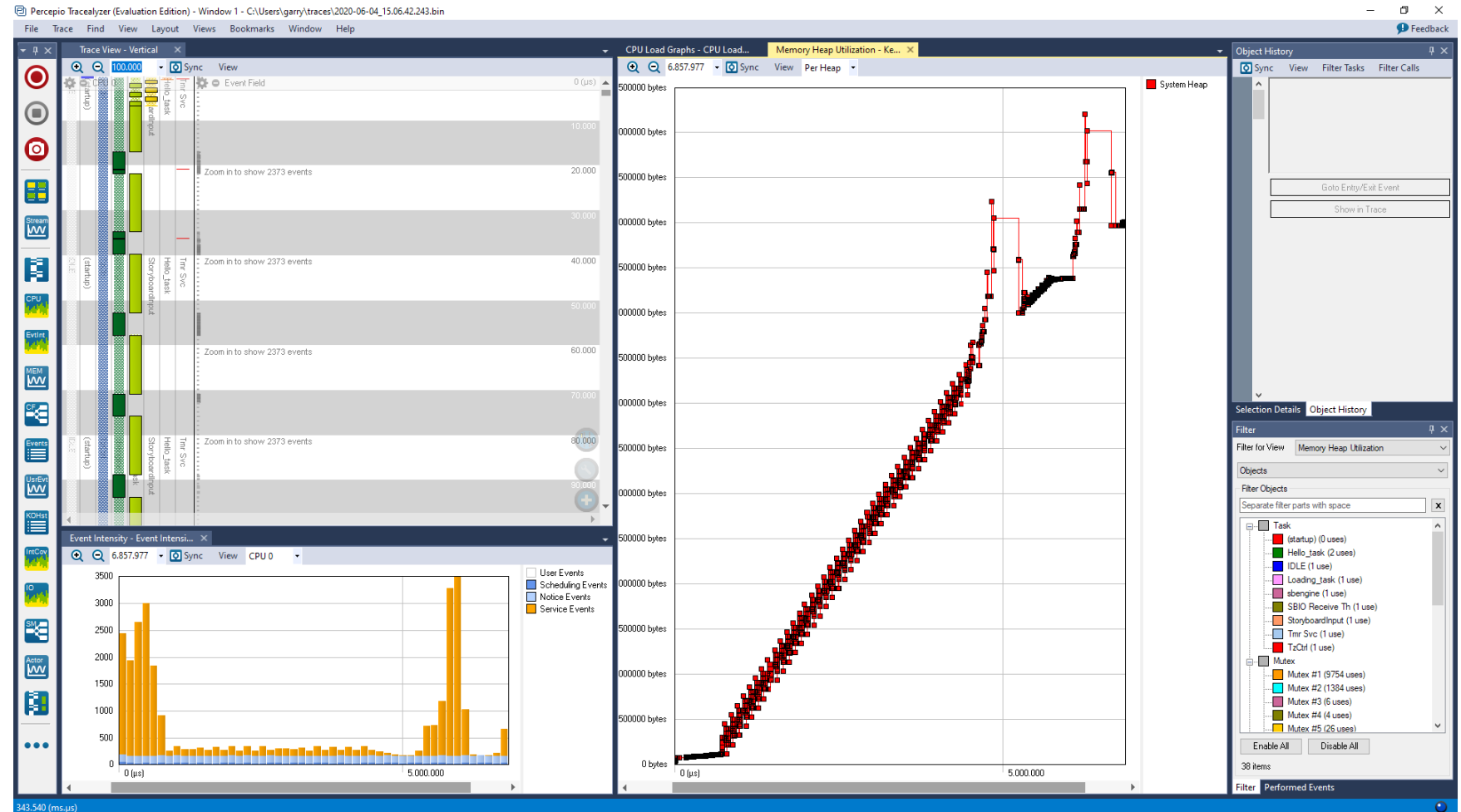
Optimize boot and start-up



Analyze UI animation and performance



Fine tuning touch responsiveness



Implementing improvements highlighted by Tracealyzer 4



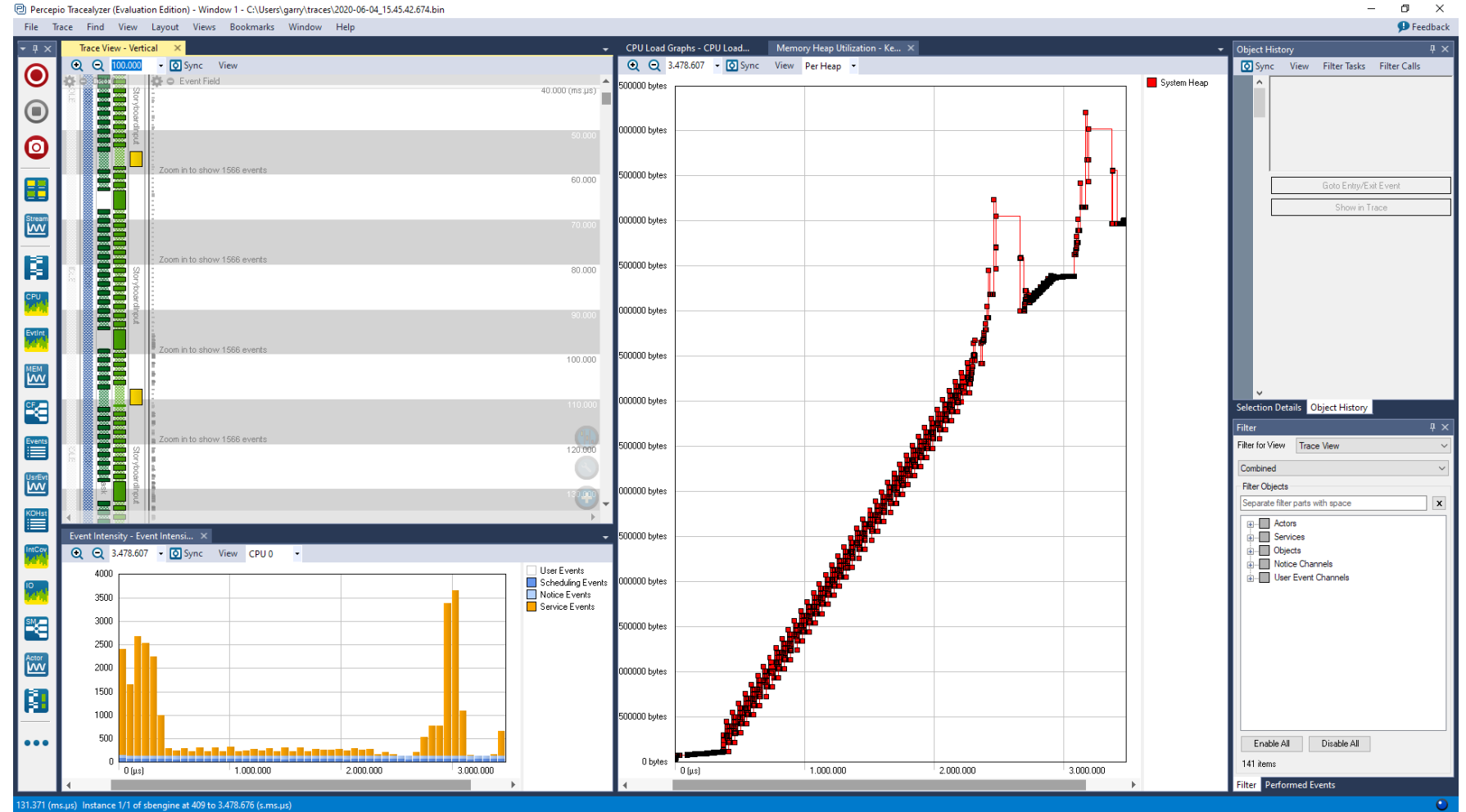
Startup much faster



Smooth animations and flow



Smooth scrolling and fast touch response



How Storyboard helps



ACCELERATE DEVELOPMENT

- Import from Design tools
- Integrated animation tool
- Prototype simulate without hardware



EMBRACE ITERATIONS

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- Compare, select, & merge changes



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KEY TAKEAWAYS & NEXT STEPS



Order an i.MX RT1060 EVK:
www.nxp.com/imxrt1060



Download Storyboard (free trial version):
www.cranksoftware.com/free-trial



Download Tracealyzer (free eval version): <https://percepio.com>



Thanks for joining

Accelerating Tomorrow's Embedded UI Experiences