

DESIGN YOUR NEXT GRAPHICAL UI FOR INDUSTRIAL HMI APPLICATIONS USING NXP'S i.MX RT1170, GUI GUIDER AND LVGL

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AGENDA

- NXP and Industrial HMIs
- Graphics software for NXP MCUs
- Introduction to LVGL
 - Features
 - Using LVGL with NXP devices
- GUI design made easier with GUI Guider
 - Overview of GUI Guider by NXP

Industrial HMIs



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2007

A PIVOTAL POINT FOR EDGE COMPUTING

“A WIDESCREEN IPOD WITH TOUCH CONTROLS; A REVOLUTIONARY MOBILE PHONE; AND A BREAKTHROUGH INTERNET COMMUNICATIONS DEVICE.”

“AN **IPOD**, A **PHONE**, AND AN **INTERNET COMMUNICATOR** ... ARE YOU GETTING IT? THESE ARE NOT THREE SEPARATE DEVICES. THIS IS ONE DEVICE, AND WE ARE CALLING IT ... **IPHONE**.”
-STEVE JOBS



USER INTERFACE EVOLUTION



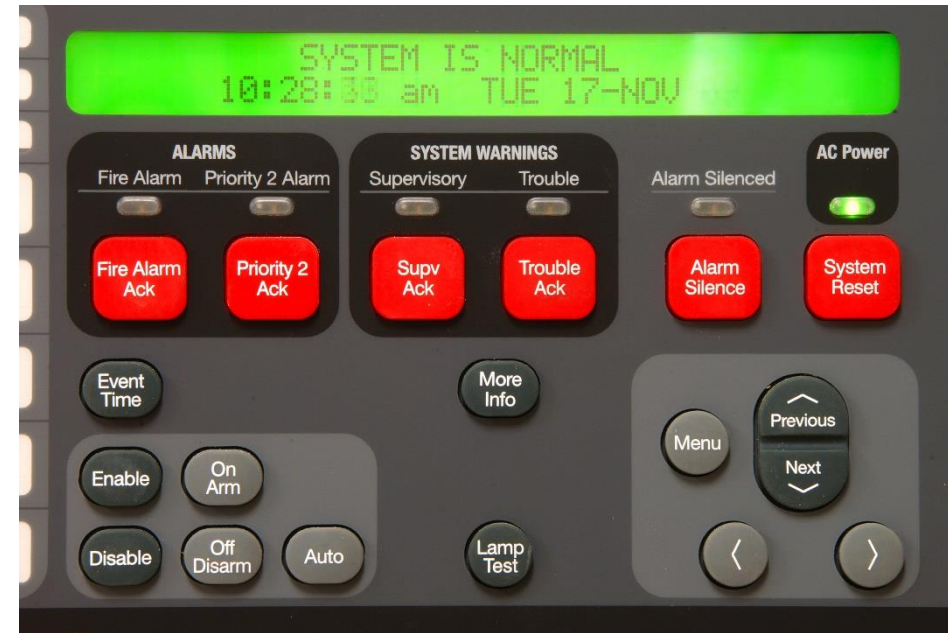
USER INTERFACE EVOLUTION



USER INTERFACE EVOLUTION



USER INTERFACE EVOLUTION



USER INTERFACE EVOLUTION



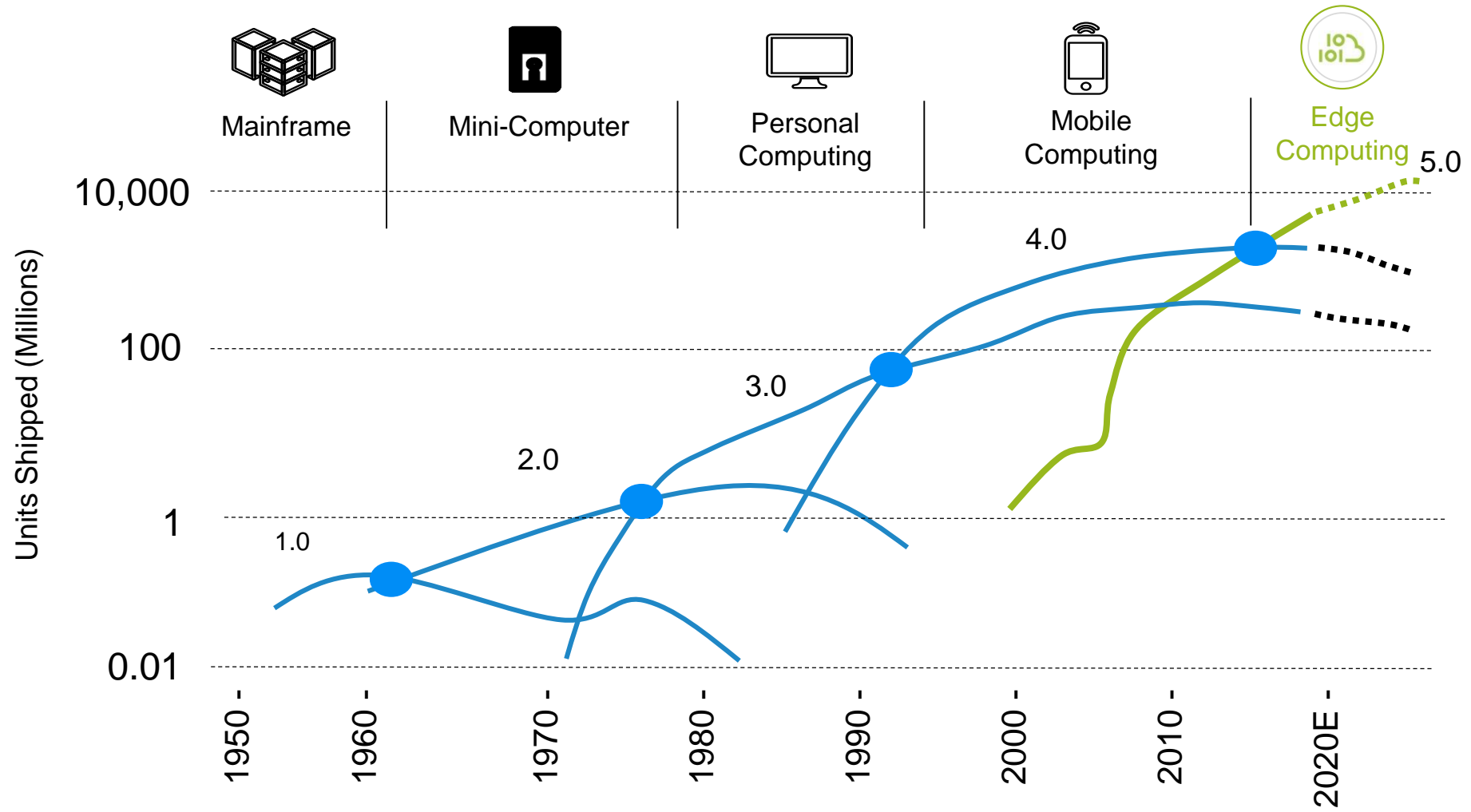
USER INTERFACE EVOLUTION



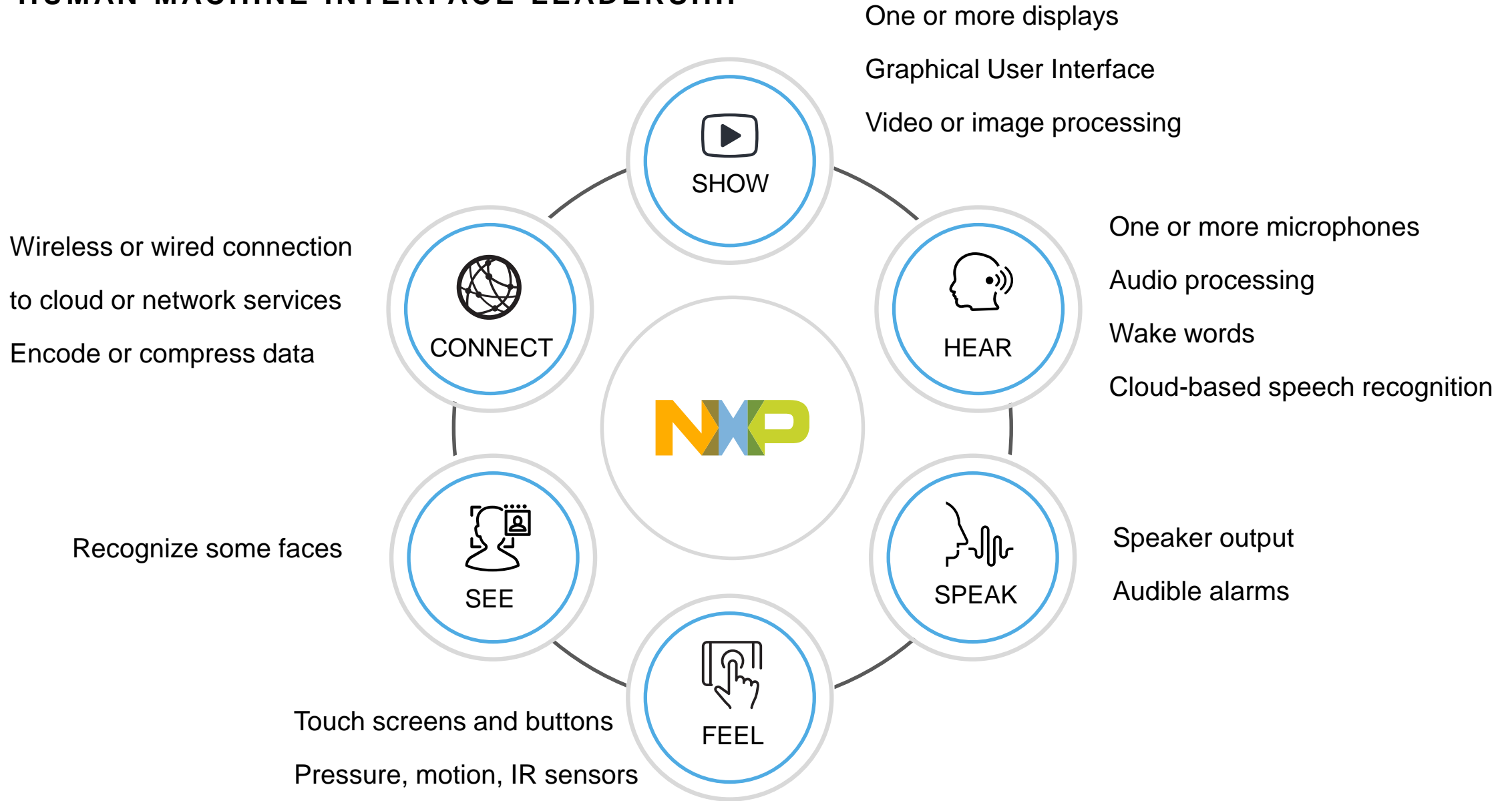
USER INTERFACE EVOLUTION



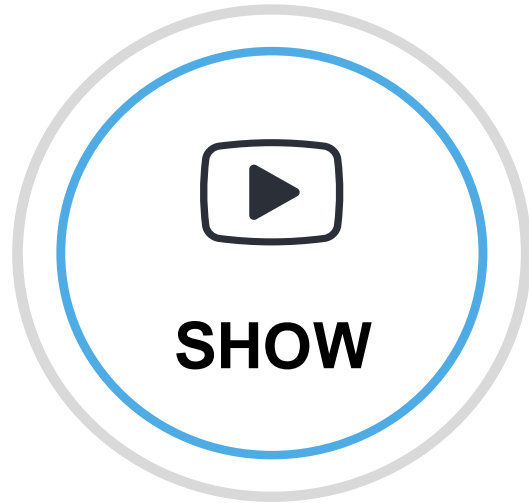
5TH WAVE OF COMPUTING – AGE OF EDGE COMPUTING



NXP HUMAN MACHINE INTERFACE LEADERSHIP



NXP'S LEADERSHIP IN GRAPHICS



NXP ADDRESSES A BREADTH OF HMI DISPLAY OPTIONS WITH MCUS AND MPUS



Simple graphic elements

- Limited animations
- Low resolution
- Basic color
- Low power devices

Multiple controls and screens

- Complex animations and screen transitions
- Full color
- High resolution
- Dedicated graphics hardware

ENTRY LEVEL UI

ADVANCED UI

INTRODUCING I.MX RT1170 | ULTIMATE EDGE PROCESSING MICROCONTROLLER

High Performance per Watt; Low Cost of Ownership

Performance

1 GHz Arm® Cortex®-M7 with 512 KB TCM
400 MHz Cortex-M4 with 256KB TCM
6468 total CoreMarks

Advanced Security

Secure Boot
High-Performance Crypto
Inline Encryption Engine (IEE)
On-The-Fly AES Decryption (OTFAD)
Tamper Detection

Rich Integration

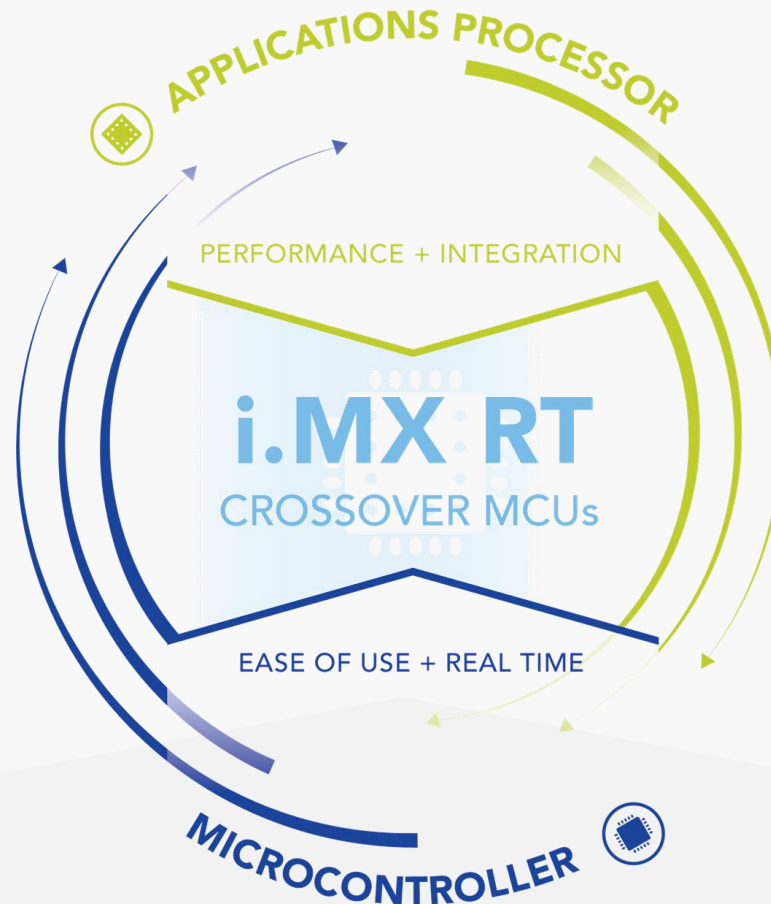
2MB SRAM
2D GPU and 2D Accelerator
MIPI CSI / DSI
2 x 1Gbps Ethernet

Low Power

28nm FD-SOI Process
Optimized for both active power & leakage power

Machine Learning at the Edge

Increased Accessibility & Security



IoT

Smart home
Consumer audio
Emerging consumer & retail

Industrial

Factory automation
Power & energy
Building control
Aerospace, defense & transportation
Healthcare

Automotive

In-vehicle HMI
Two-wheel motorcycle/scooter cluster

Graphics Software for NXP MCUs









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GRAPHICS MIDDLEWARE COMPARISON

PROVIDER / PRODUCT	TYPE	BUSINESS MODEL	UI DEVELOPMENT TOOL	OPTIMIZATION	MCUXpresso SDK INTEGRATION
	Free	Free pre-compiled libraries via NXP MCUXpresso SDK (source code license available from SEGGER)	AppWizard	-	✓
	Free	Open source	GUI Guider	PXP, VG Lite	✓
 GUI Solutions by TARA Systems	Premium	Developer seats, volume-based product line license	Embedded Wizard Studio	PXP, VG Lite	✓
	Premium	Developer seats, volume-based product line license	Storyboard Designer	PXP, VG Lite	✓
 The Qt Company	Premium	Developer seats, volume-based product line license	Qt Design Studio, Qt Creator	PXP, VG Lite	-
	Free	Free via NXP MCUXpresso SDK (with Azure RTOS ThreadX only)	Azure RTOS GUIX Studio	-	✓

LVGL



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LVGL OPEN-SOURCE GRAPHICS LIBRARY

- LVGL is a free and open-source graphics library providing everything necessary to create rich embedded GUIs
- High-level UI technology
 - Use with any microcontroller or display
 - RTOS, External memory and GPU supported but not required
 - Scalable to operate with little memory (80 kB Flash, 12 kB RAM)
- Powerful building blocks
 - API includes over 30 customizable widgets
 - Set widgets' appearances with styles
 - Heavily inspired by CSS
 - Styles can be animated when widgets change states
 - Themes are available to help accelerate GUI design
- Support for advanced graphics effects such as animations, anti-aliasing, opacity, and smooth scrolling



USING LVGL ON NXP DEVICES

SDK Builder
Generate a downloadable SDK archive for use with desktop MCUXpresso Tools.
Developer Environment Settings
Selections here will impact files and examples projects included in the SDK and Generated Projects

Host OS: Windows, Apple, Linux
Toolchain / IDE: IDE, KEIL, All

Filter by Name, Category, or Description... [Select All] [Unselect All]

Name	Category	Description	Dependencies
<input type="checkbox"/> IoT Sensing SDK	Middleware	IoT Sensing SDK (ISSDK) provides sensor drivers and reference examples for NXP's IoT sensors	
<input type="checkbox"/> JPEG library	Middleware	JPEG library	
<input type="checkbox"/> LittleFS	Middleware	LittleFS filesystem stack	
<input checked="" type="checkbox"/> LVGL	Middleware	LVGL Open Source Graphics Library	
<input type="checkbox"/> lwIP	Middleware	Lightweight IP open-source TCP/IP stack	
<input type="checkbox"/> mbedTLS	Middleware	mbedtls SSL/TLS library	MMCAU
<input type="checkbox"/> MCU Boot	Middleware	MCU Bootloader source code	

Selection Details
MIMXRT1170-EVK
i.MX RT1170 Evaluation Kit
[Download SDK] [Additional Details]

SDK Details
SDK Version: 2.9.0 (released 2021-02-09)
SDK Tag: REL_2.9.0_RT1170_RFP_DOC

Documentation
[API Reference Manual](#)
[Getting Started Guide](#)
[Release Notes](#)
[Change Log](#)

Web: 2.19.3, Builder: 2.19.3 | Privacy Policy | Terms of Use | Contact
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- Use the online MCUXpresso SDK Builder to build a new SDK for a supported platform
- Select Optional Middleware and include LVGL
- Or download an SDK directly within MCUXpresso IDE – LVGL will be included automatically

LVGL – SUPPORT FOR NXP HARDWARE ACCELERATION

PXP

- PXP acceleration support is available in the MCUXpresso SDK starting with version 2.8.2
- Features:
 - RGB565 color format
 - Area fill + optional transparency
 - BLIT + optional transparency
 - Color keying + optional transparency
 - Recoloring (color tint) + optional transparency
 - RTOS integration layer
 - Default FreeRTOS and bare metal code provided

VG Lite *

- VG Lite acceleration support is available in [LVGL GitHub repository](#)
 - Coming soon in the MCUXpresso SDK
- Features:
 - RGB565 color format
 - Area fill + optional transparency
 - BLIT + optional transparency

* Note that only aligned buffers will be processed by the GPU

NXP MCU FAMILIES WITH LVGL SUPPORT

	Core	Frequency	Memory	Graphics Acceleration	Display Interface / Controller	Resolutions	
High Performance	i.MX RT1170	Cortex-M7 and Cortex-M4	1 GHz / 400 MHz	2 MB SRAM 2x Quad/Octal Mem Interface 8/16/32-bit EMI	PXP GPU	eLCDIF LCDIFv2 MIPI-DSI	Up to WXGA 1366x768
	i.MX RT500	Cortex-M33 and Fusion F1 DSP	200 MHz / 200 MHz	5 MB SRAM 2x Quad/Octal Mem Interface	GPU	MIPI-DSI	Up to XGA 1024x768
	i.MX RT106x	Cortex-M7	600 MHz	512 KB SRAM 8/16-bit EMI	PXP	eLCDIF	Up to WXGA 1366x768
	i.MX RT105x	Cortex-M7	600 MHz	512 KB SRAM 8/16-bit EMI	PXP	eLCDIF	Up to WXGA 1366x768
Mainstream	LPC546xx	Cortex-M4	220 MHz	512 KB Flash, 200 KB RAM Up to 32-bit EMI	–	LCDIF	Up to XGA 1024x768
	LPC54S/540xx	Cortex-M4	180 MHz	360 KB RAM Up to 32-bit EMI	–	LCDIF	Up to XGA 1024x768
Power Optimized	LPC55S69	Cortex-M33	150 MHz	320 KB RAM, 640 KB Flash	–	SPI	Up to FWVGA 854x480
	K28	Cortex-M4	150 MHz	1 MB SRAM, 2 MB Flash 32-bit EMI	–	SPI or 8080 parallel with FlexIO	Up to FWVGA 854x480

Note: - LCDIF, eLCDIF, and LCDIFv2 include parallel RGB display interface.
 - This table is not a comprehensive list of supported NXP microcontrollers.

GUI Guider



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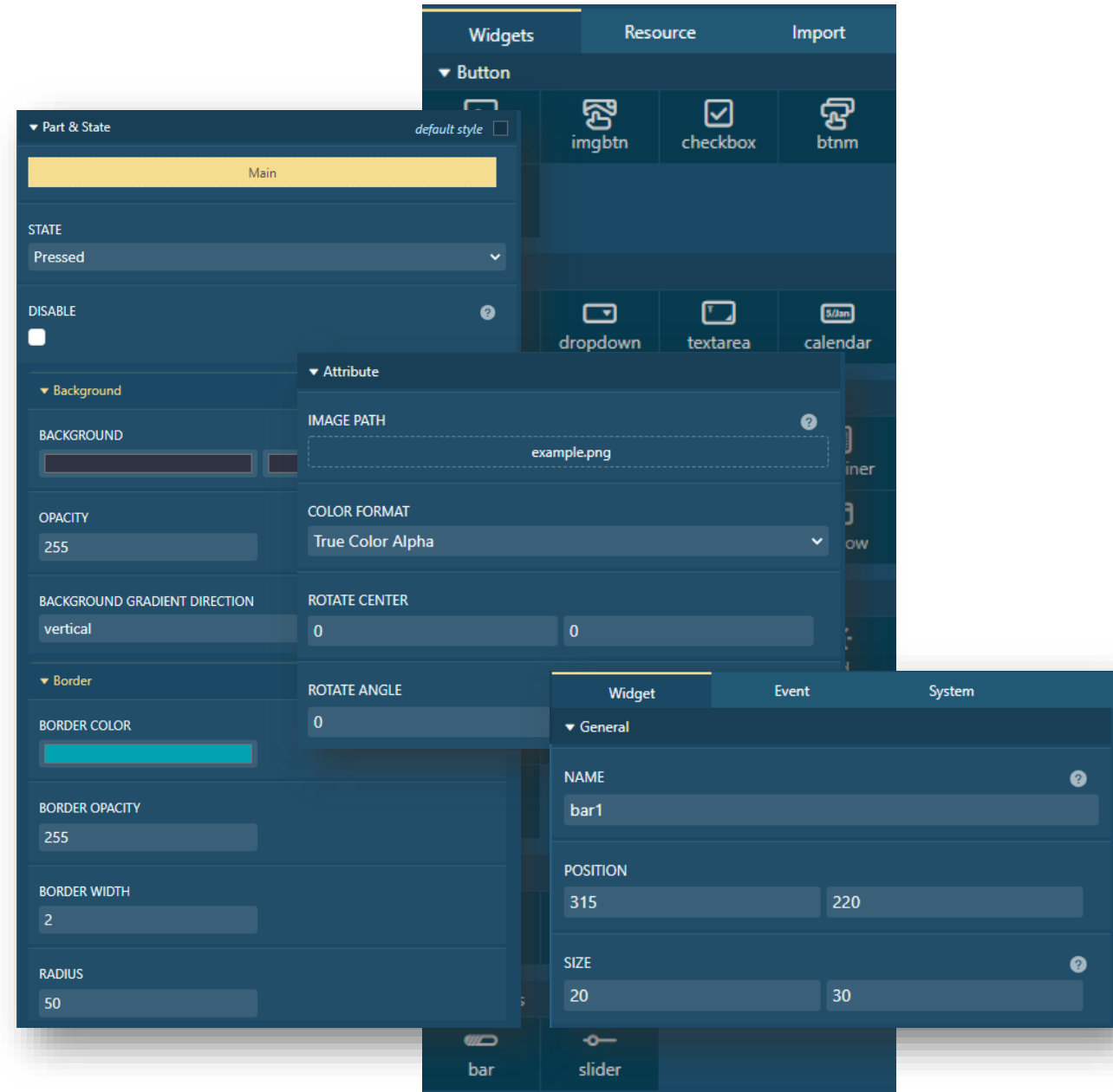
GUI GUIDER

- New tool from NXP for developing ready-to-run GUIs with open-source LVGL graphics library
 - Download from www.nxp.com/gui-guider
- Free for use with NXP devices only
- Includes built in support for the following devices (but can be used without a template):
 - i.MX RT1050
 - i.MX RT106x
 - LPC54628
 - LPC54018/S018
 - i.MX RT1170 (coming soon)
 - i.MX RT500 (coming soon)



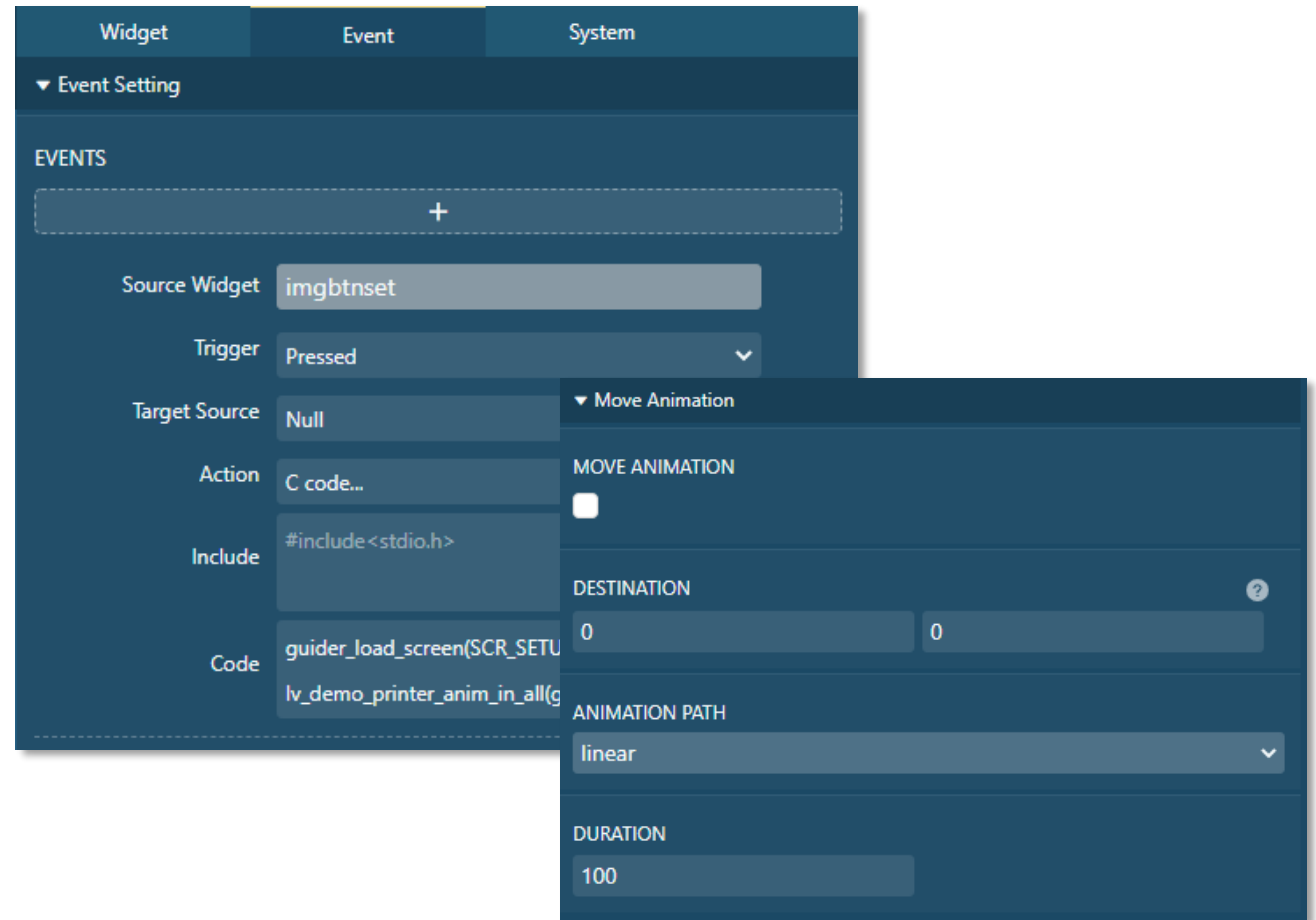
EASILY CUSTOMIZE GUI APPEARANCE

- Drag-and-drop programming with automatic code generation
- More than 30 LVGL widgets supported
- Modify widget properties for a unique look and feel
- Use widgets in combination with custom images and fonts



ADD EVENTS AND ANIMATIONS

- Use events and actions to define GUI behavior
- Option for custom action code
- Animate widget properties and transitions



BUILT IN SUPPORT FOR NXP DEVELOPMENT BOARDS

- Several NXP development boards fully supported in GUI Guider
- Option to enable/disable hardware acceleration
- Reference demo examples available



MULTIPLE WAYS TO SIMULATE GUI BEHAVIOR



GUI Guider simulator for quick evaluation of GUI appearance and behavior



Run GUI application directly on supported target development board

USE SEAMLESSLY WITH MCUXPRESSO SOFTWARE AND TOOLS



GUI Guider



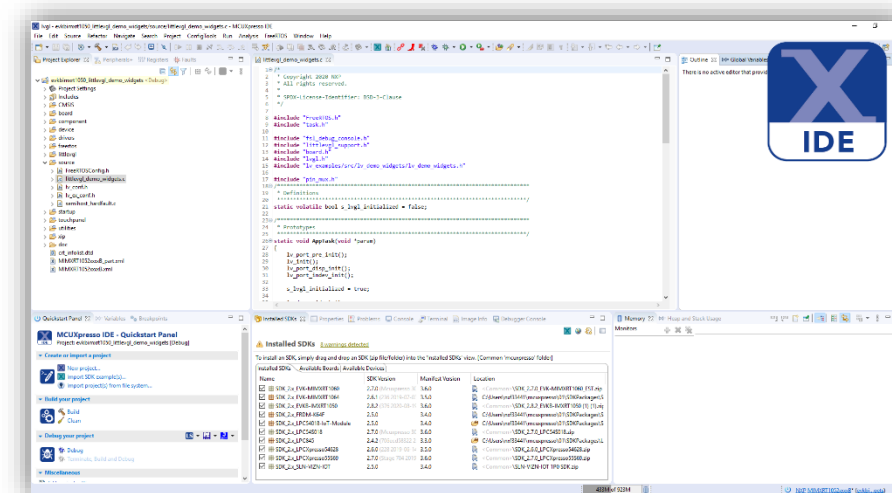
AppData > Local > Temp > 8 > myprinter > export

Name	Date modified	Type
custom	12/19/2020 6:28 PM	File folder
generated	12/19/2020 6:28 PM	File folder
source	12/19/2020 6:28 PM	File folder

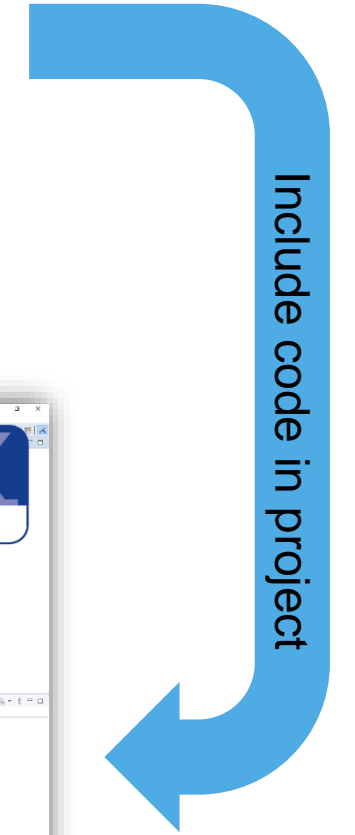
Generated Code



Target Board



MCUXpresso IDE





GET STARTED NOW

1. Explore i.MX RT1170 Crossover MCUs

- <https://www.nxp.com/IMXRT1170>

2. Download GUI Guider

- Website: https://www.nxp.com/gui_guider
- Training: https://www.nxp.com/guider_training

3. Learn more about LVGL

- NXP Website: <https://www.nxp.com/lvgl>
- Online community: <https://forum.lvgl.io/>
- LVGL blog: <https://blog.lvgl.io/>
- Learn LVGL: <https://lvgl.academy/>



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