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Free-of-charge graphic software framework optimized for STM32 TouchGFX

ST MDG Korea

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Agenda

1 The TouchGFX solution

2 TouchGFX Designer
New Design

3 TouchGFX latest features

4 Low-cost solution

5 Demonstration

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The TouchGFX solution

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High-end UI with limited hardware performance

TouchGFX GUI library

Delivered as an X-Cube-TouchGFX Package

TouchGFX DESIGNER

PC GUI-builder and -simulator

TouchGFX GENERATOR

Configure and generate a TouchGFX project

TouchGFX ENGINE

Optimized and hardware accelerated graphics library

STM32 software
TouchGFX GUI software

TouchGFX Designer

Easy development
Develop great GUIs effortlessly with the WYSIWYG GUI builder, the TouchGFX Designer.
Create Anything
The structure and flexibility of TouchGFX gives the Developer control to easily create unique UI designs

➔ The technology behind

- Run on PC-simulator or your target HW
- Combine your user-code with TouchGFX Designer generated code
- Create your own software elements with existing widgets.
- Design your own widgets.
- GUI written in C++.
- The Model-View-Presenter pattern gives way for easy interfacing with other C/C++ application components.

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STM32 software
TouchGFX GUI software

TouchGFX Generator

Faster UI project generation and low-level development
Easy configuration of:

- Memory
- Framebuffers
- Display resolution
- Color depth

Select your preferred IDE
Change to other RTOS or no RTOS

➔ The technology behind

- CubeMX plugin to configure and generate TouchGFX Abstraction Layer (AL) for their STM32-based hardware.
- **TouchGFX AL** enables available graphics HW acceleration and optimization
- **IDE independent**
  Works smoothly with CubeIDE, IAR Workbench, ARM Keil

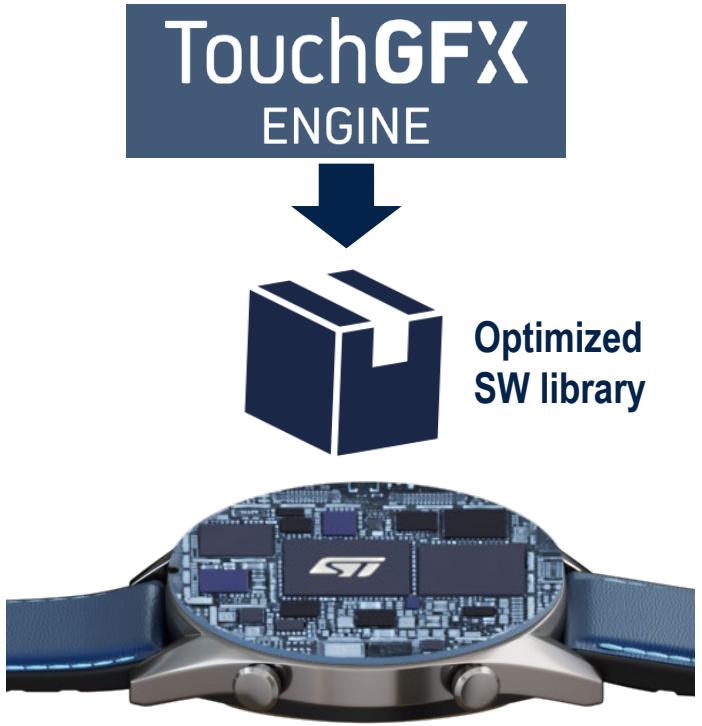
STM32 software
TouchGFX GUI software

TouchGFX Engine

Maximum Performance
The TouchGFX Engine technology enables you to achieve the highest level of smartphone GUI performance on STM32 devices

➔ The technology behind

- **Optimized for Minimum MCU Load and Memory Footprint**
  Compile and Run time Analysis
  Utilization of STM32 hardware acceleration
- **Advanced Rendering Algorithms**
  Optimized visible surface determination algorithm and customized invalidation techniques minimize the number of drawn pixels
- **Advanced Graphical Objects**
  Draw lines, circles, custom shapes, and graphics, or apply scaling and 3D rotation to images at runtime with highly optimized and memory efficient widgets



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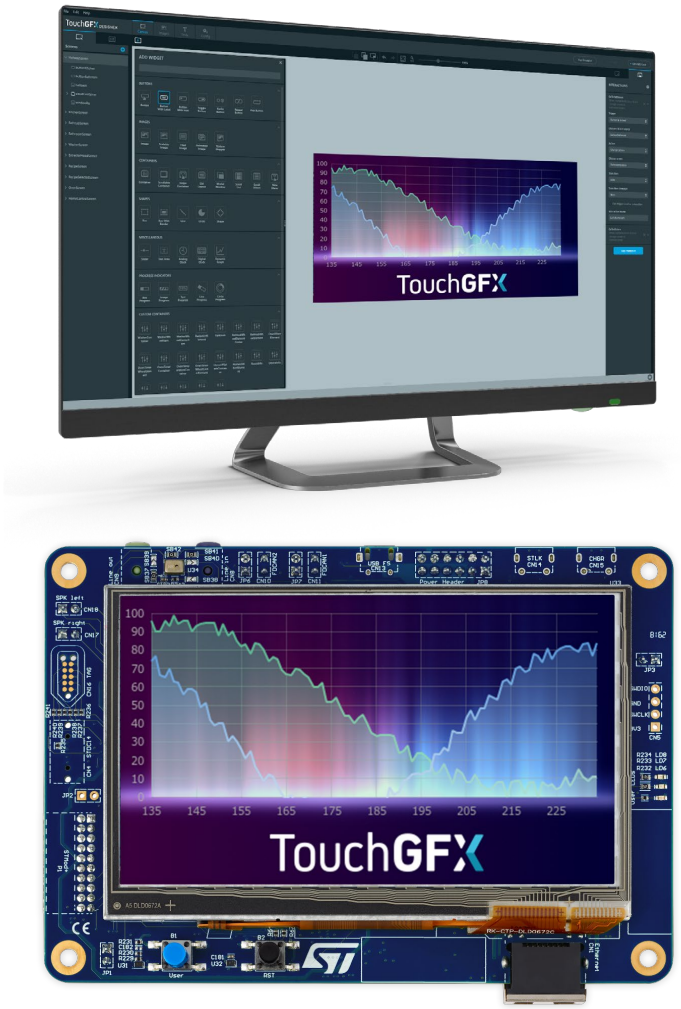
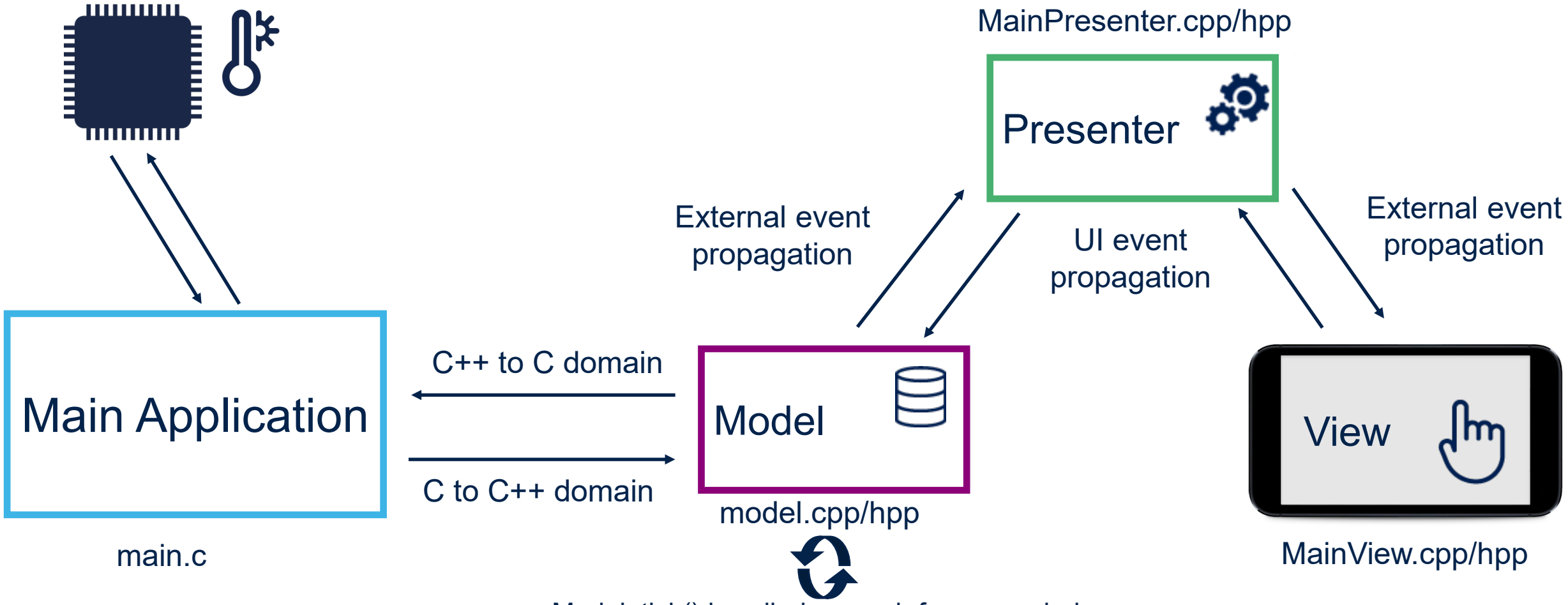
Getting started



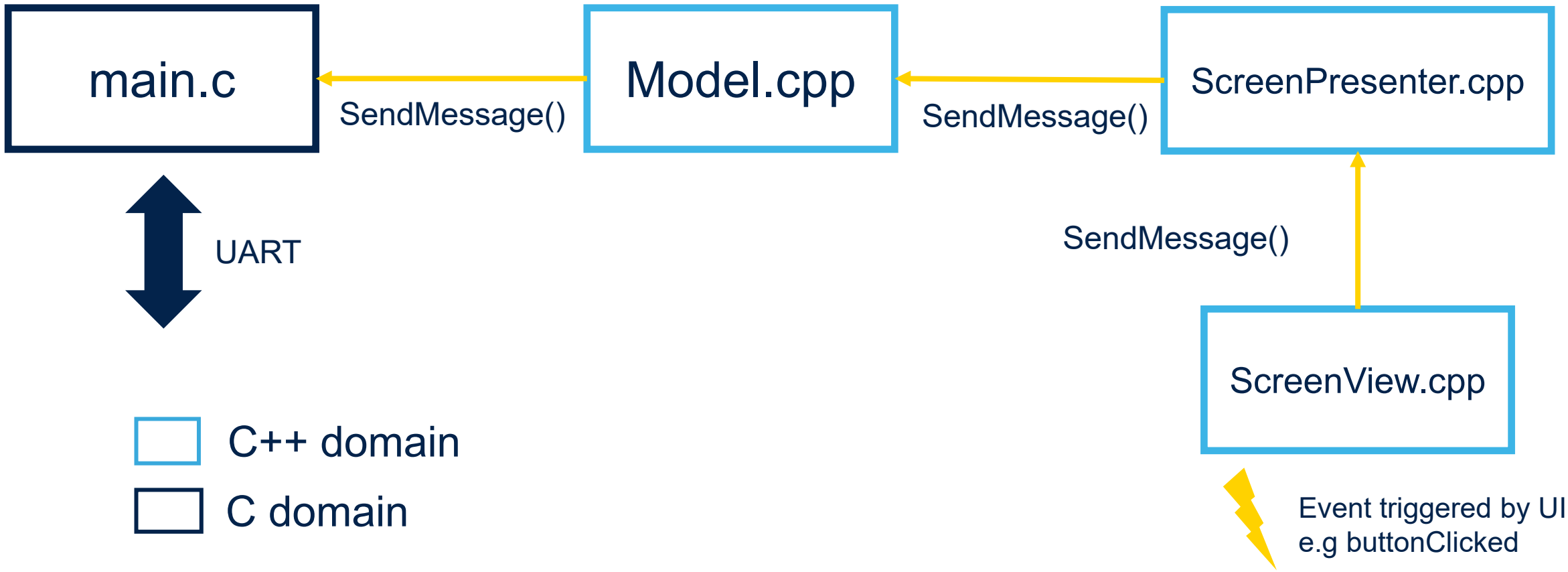
1. select the MCU and pick the associated developer kit
2. Open TouchGFX Designer
3. Find your display kit
4. Create/select a demo
5. Flash your display kit

Video: TouchGFX Designer: Design, Implement, Run!

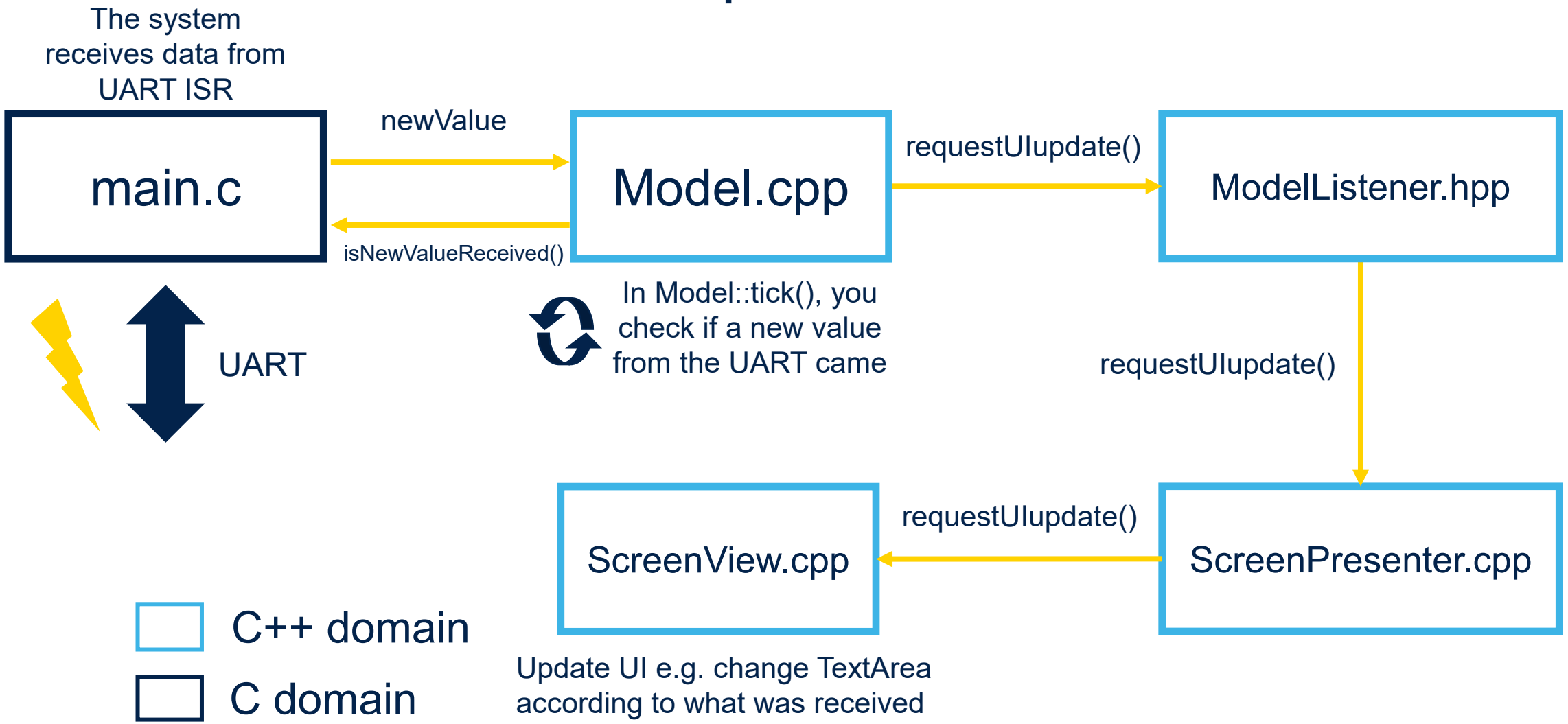
Model-View-Presenter



UART example – Overview - UI to Backend

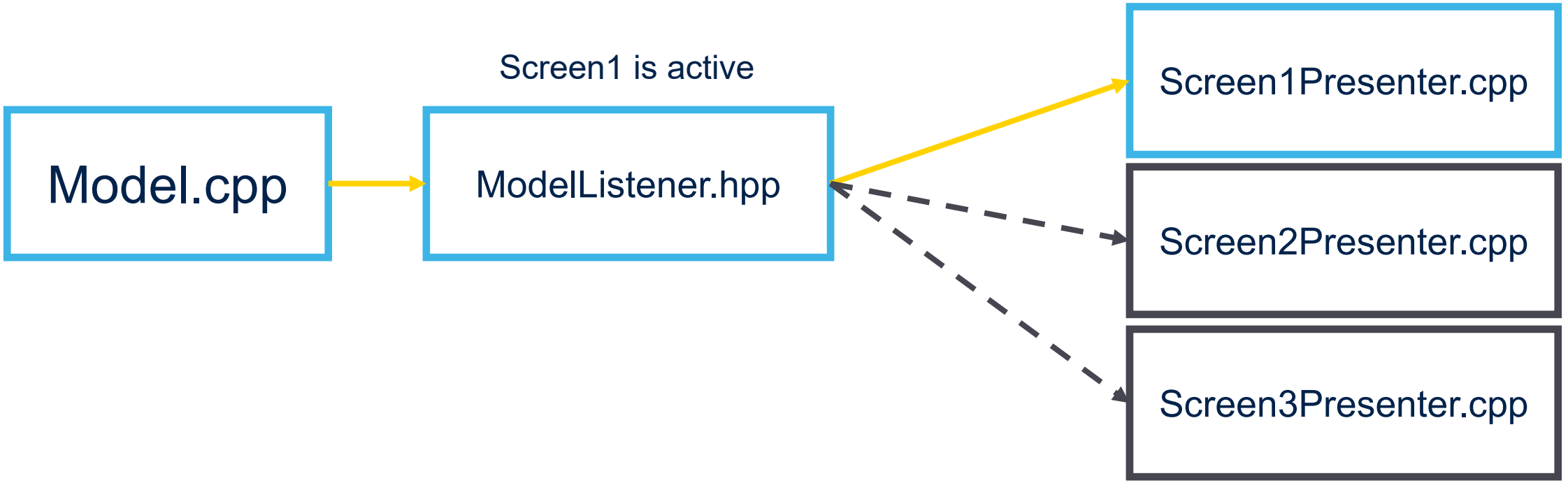


UART example – Overview – Backend to UI

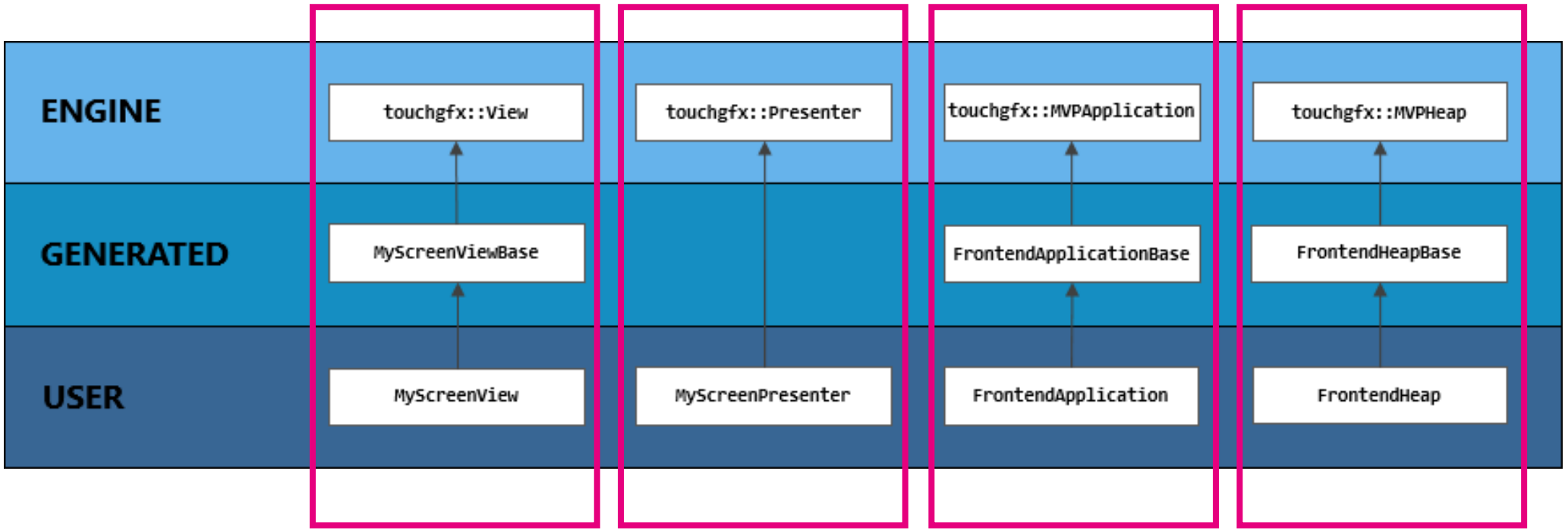


What's the ModelListener ?

- The Model has a pointer to the currently active Presenter. The type of this pointer is an interface (ModelListener) which you can modify to reflect the application-specific events that are appropriate.



Code structure



View

Visual appearance of the UI

Presenter

The logic of the UI
Connects the Model and the View

Frontend Application

Takes care of the transitioning between screens

Frontend Heap

Makes sure the right amount of memory is allocated

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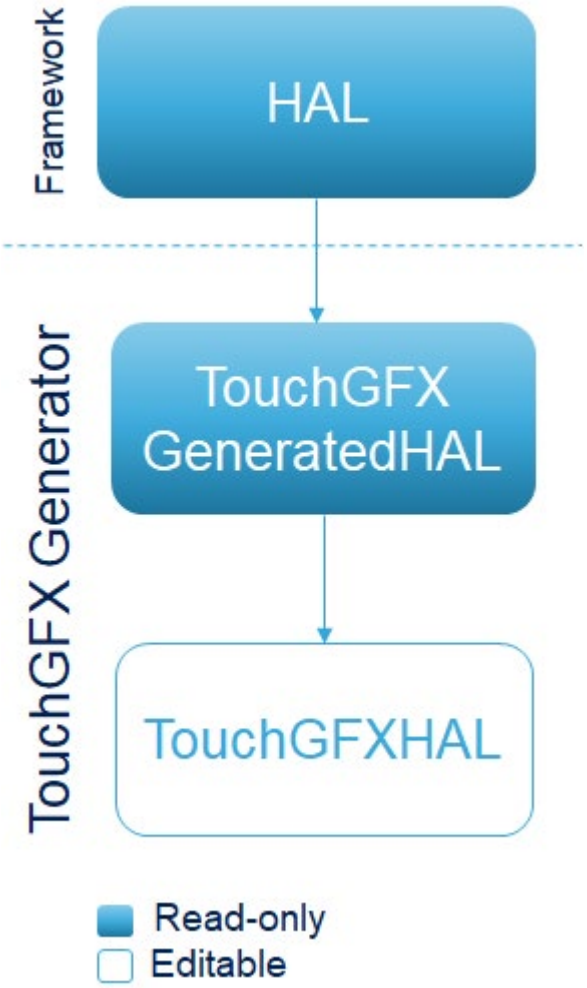
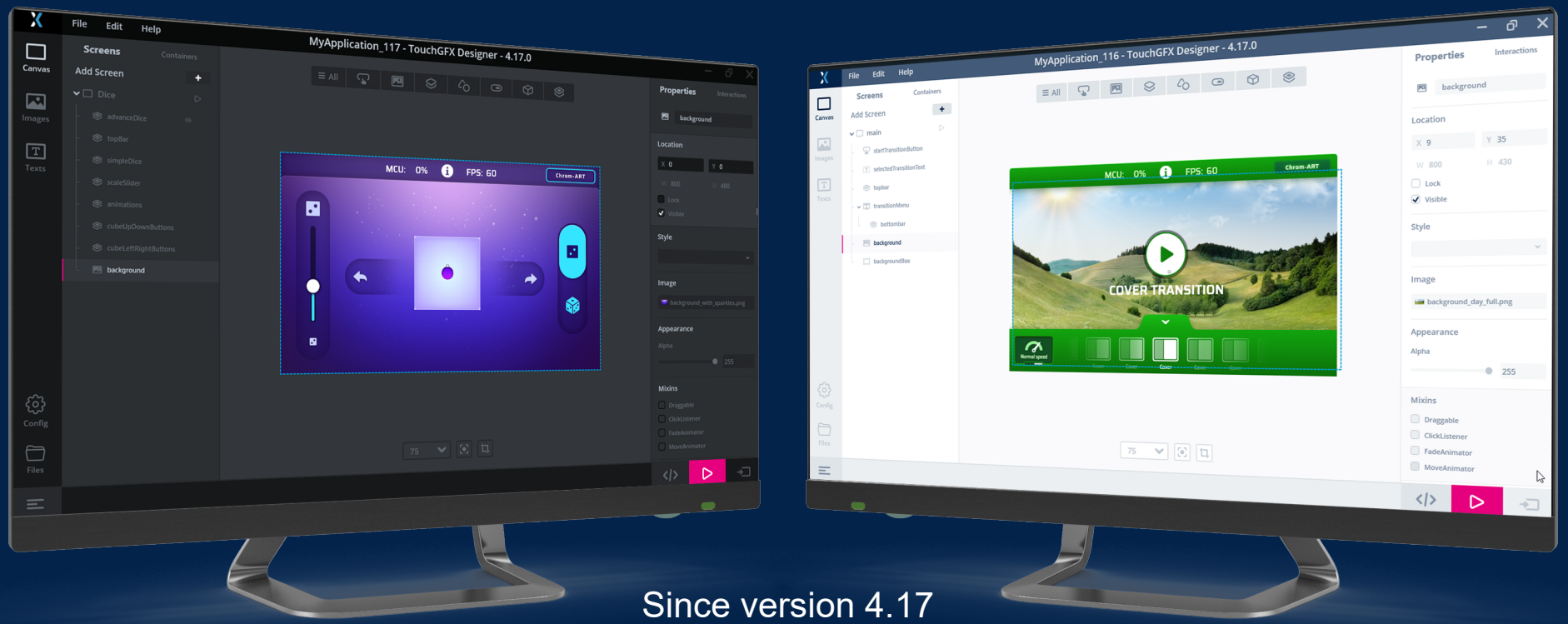
TouchGFX Abstract Layer (AL)

- Abstract layer roles
  - Collect input (Touch coordinates, Buttons)
  - Update the Scene
  - Render the Scene to the framebuffer

- The TouchGFXHAL is responsible for :
  - Display – MCU synchronization
  - Transfer to display
  - Framebuffer control and access
  - Monitoring the rendering process



TouchGFX Designer – New Design



Since version 4.17

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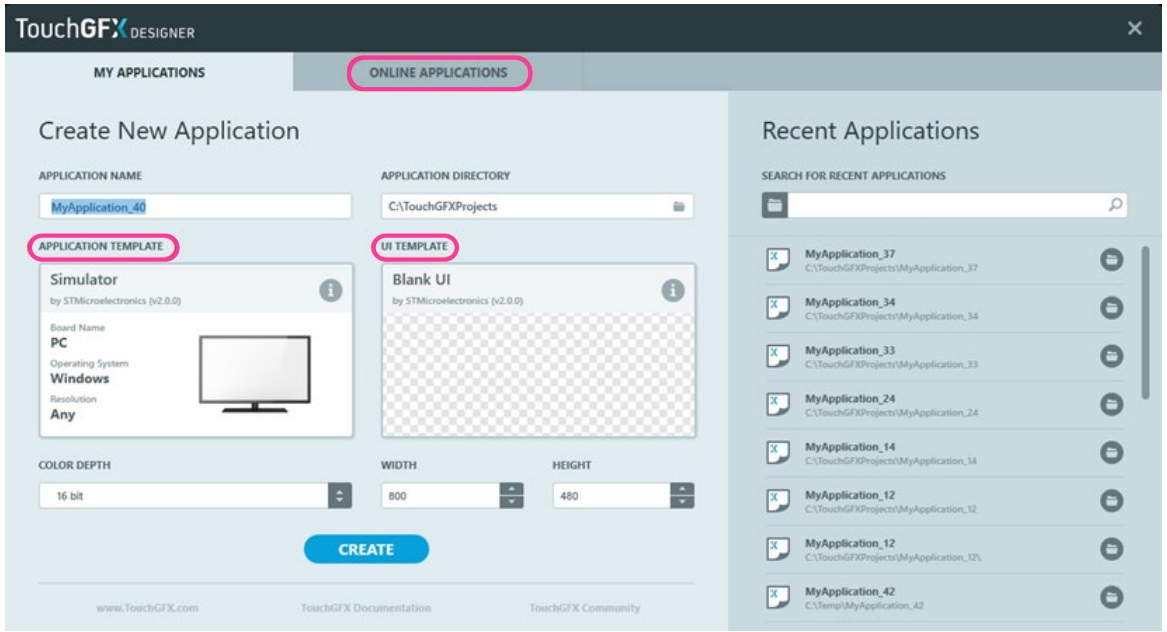
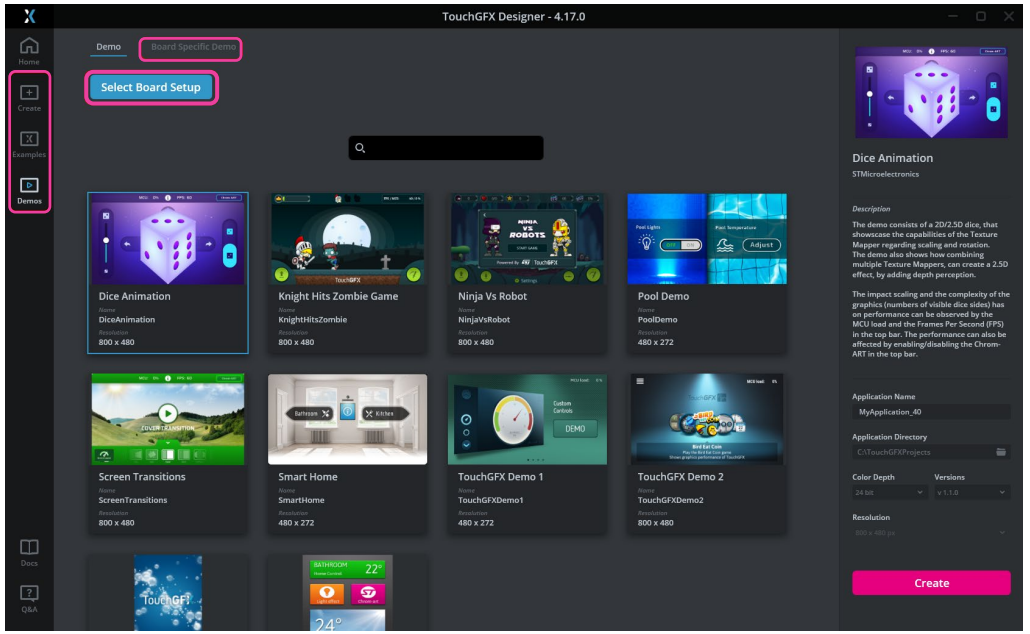
New terminologies

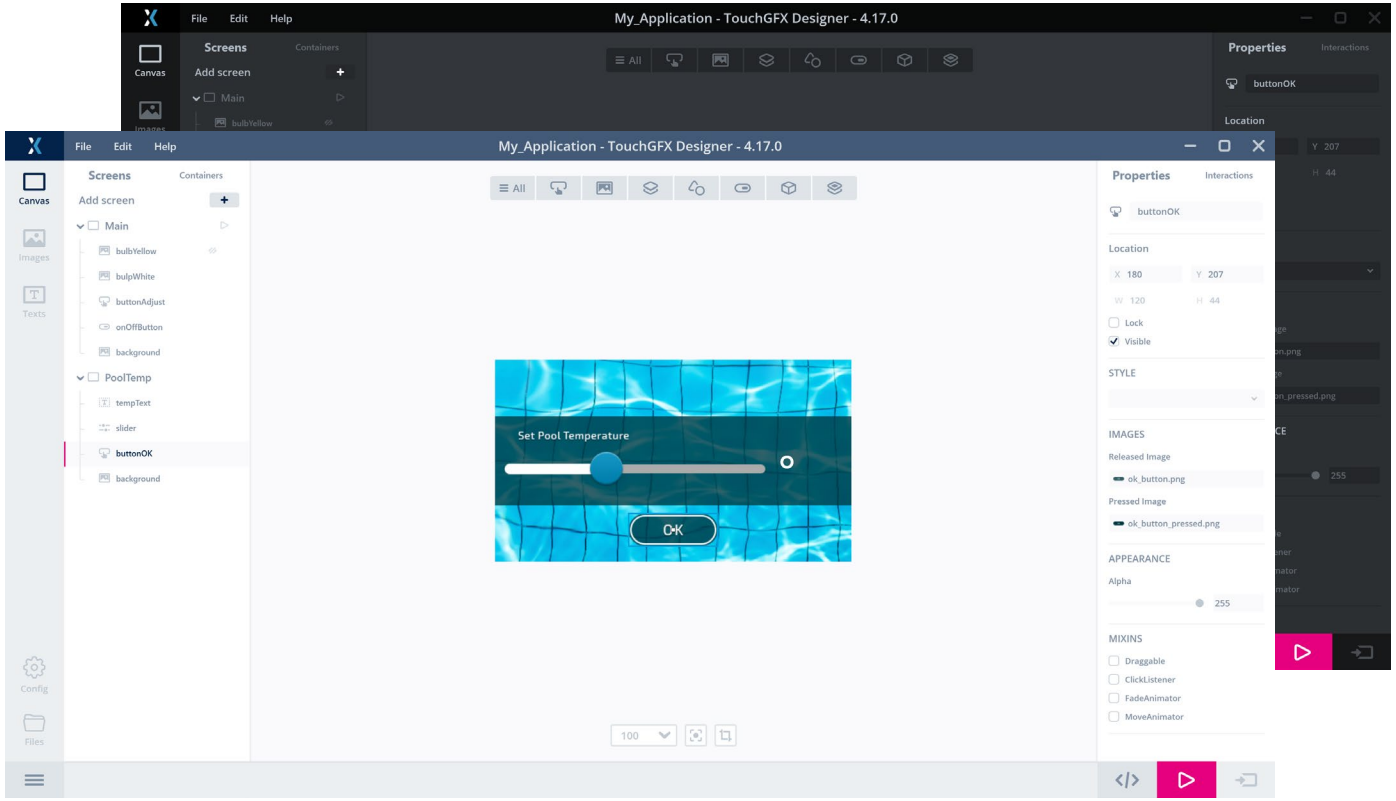
- New terminologies
  - Application Templates (AT) → **TouchGFX Board Setup (TBS)**
  - UI Template → Example and Demo tabs
  - Online Applications → Board Specific Demos



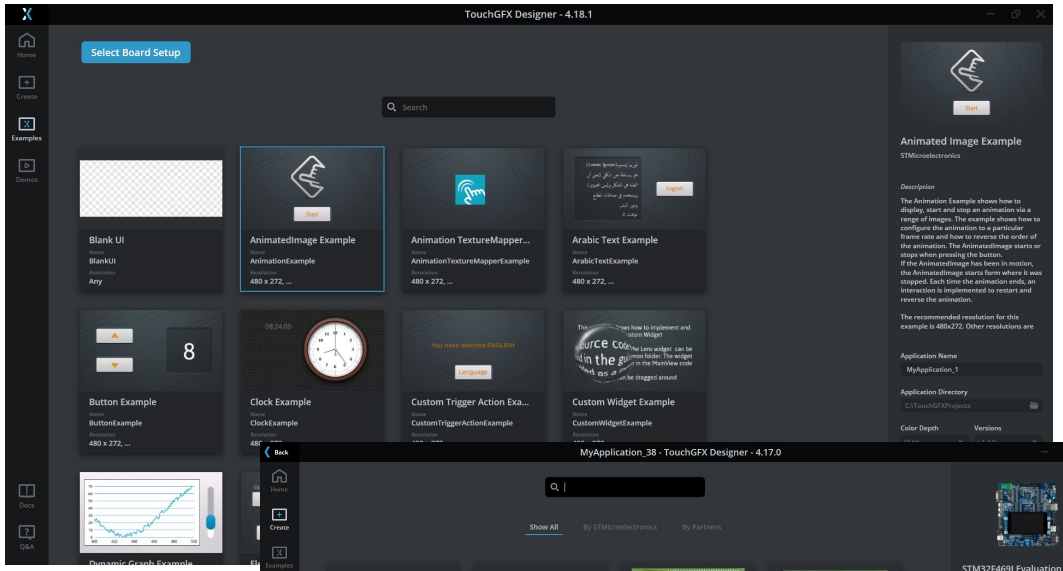


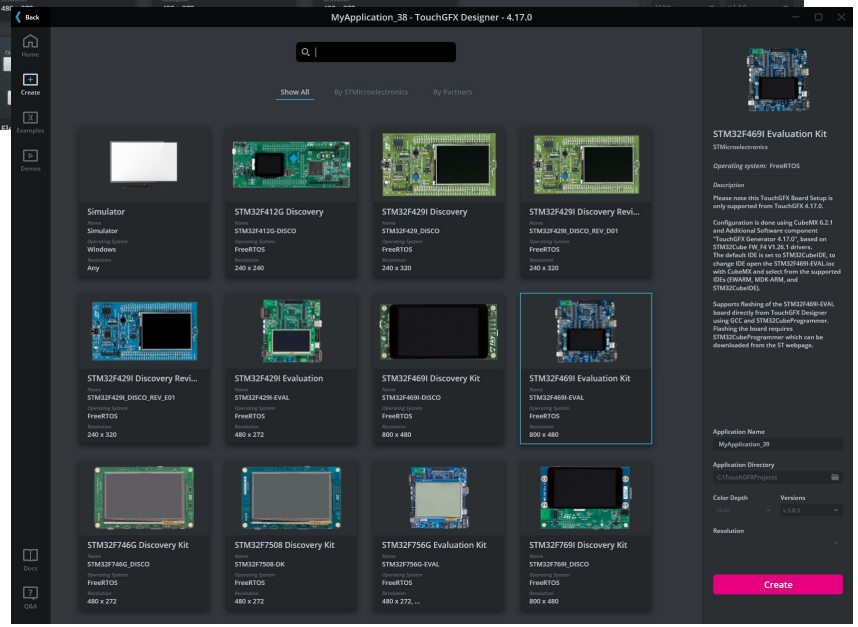
From TouchGFX 4.17

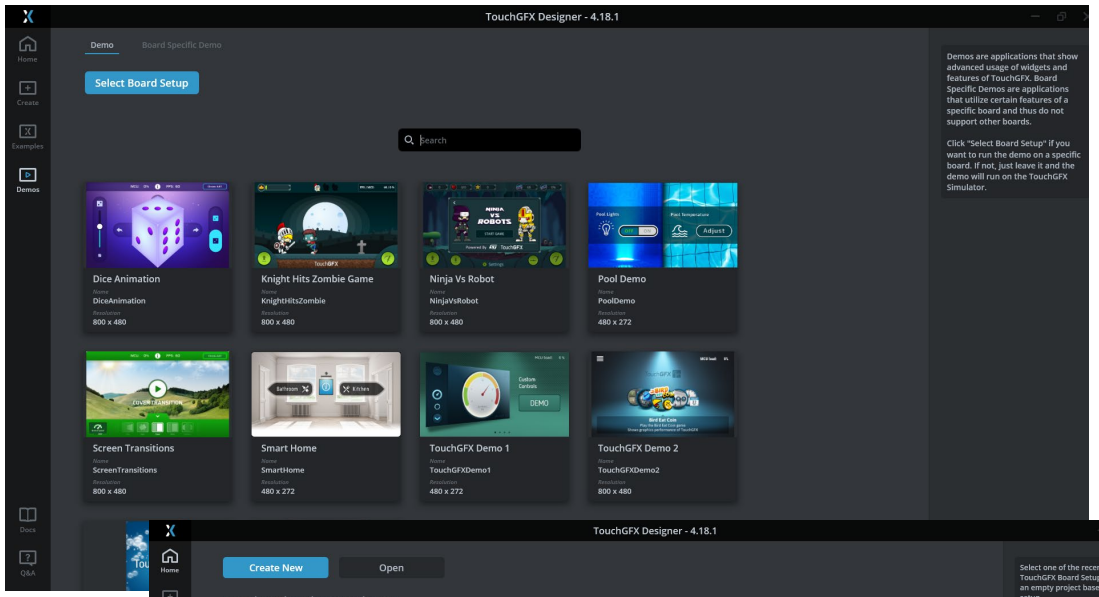
- Designer Redesign
  - Easier-to-use
  - Modern Design
  - Color theme

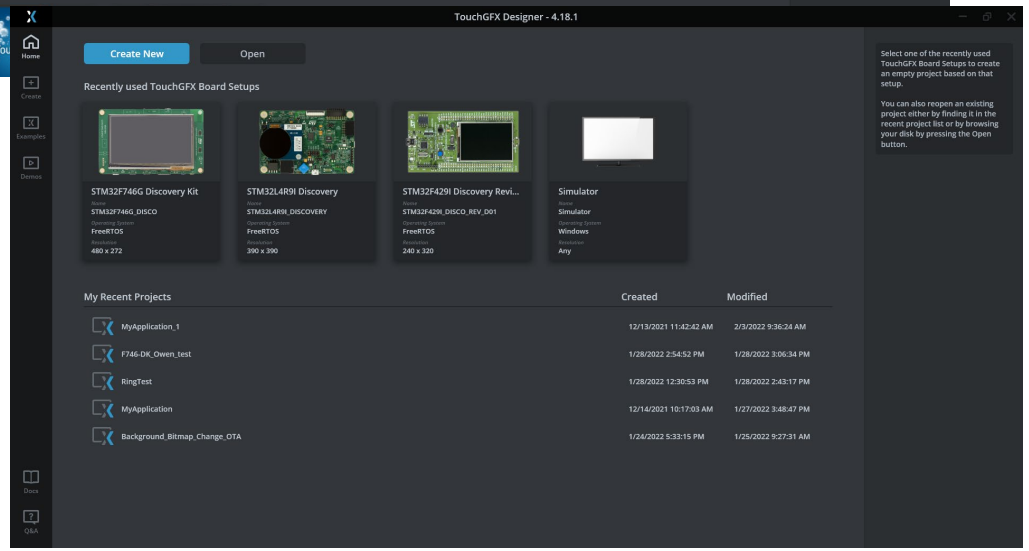


Work environment









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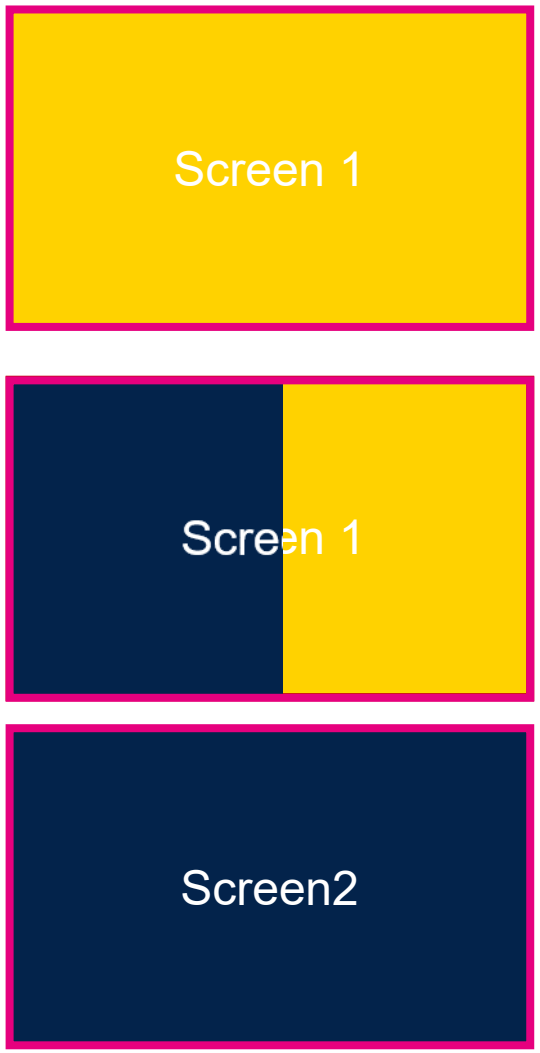
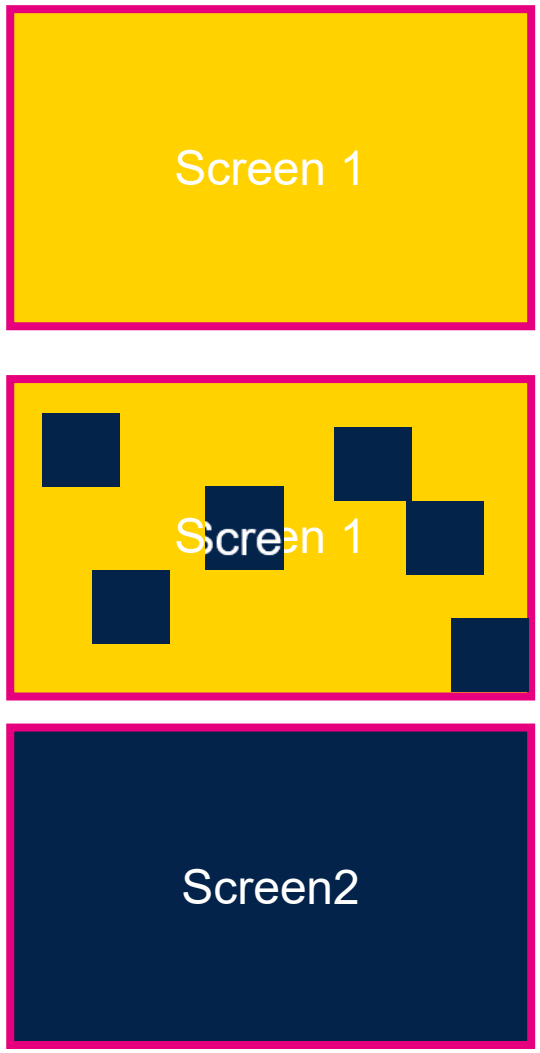
TouchGFX latest features

Wipe Transition (from 4.15)



- **No extra memory needed**
- **Only draws the pixels in the framebuffer once, and never moves any pixels**
  => Low MCU load
- **TouchGFX documentation link**

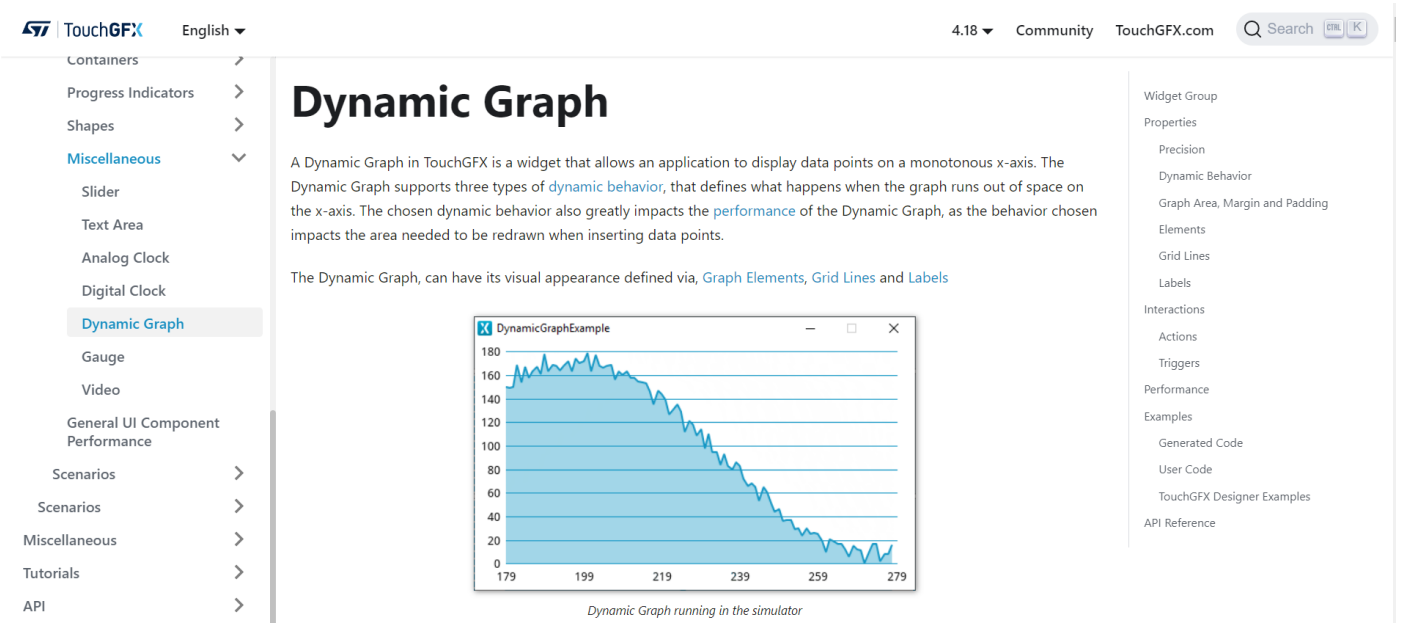
Block transition (from 4.16)



- **No extra memory needed**
- **Optimized for partial Framebuffer**
  => Low MCU load
- **TouchGFX documentation link**

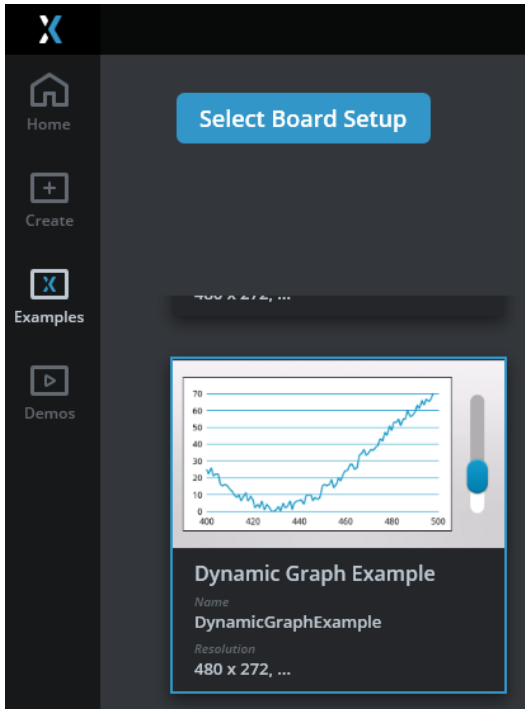
Dynamic Graph widget (from 4.15)

- 3 dynamic behaviors (Wrap and Clear, Scroll and Wrap and Overwrite)
- 6 available element types (Area, Boxes, Diamonds, Dots, Histogram and Line)
- Labels and grid lines can also be added.



Dynamic Graph running in the simulator

https://support.touchgfx.com/4.18/docs/development/ui-development/ui-components/miscellaneous/dynamic-graph



Example code in TouchGFX Designer

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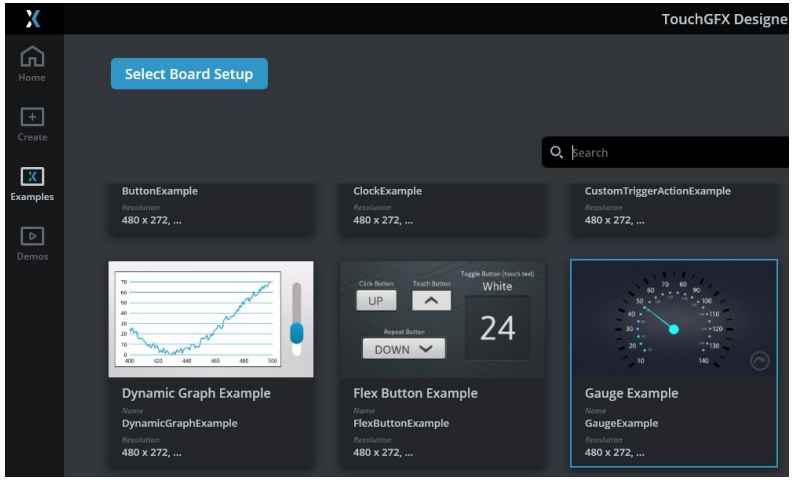
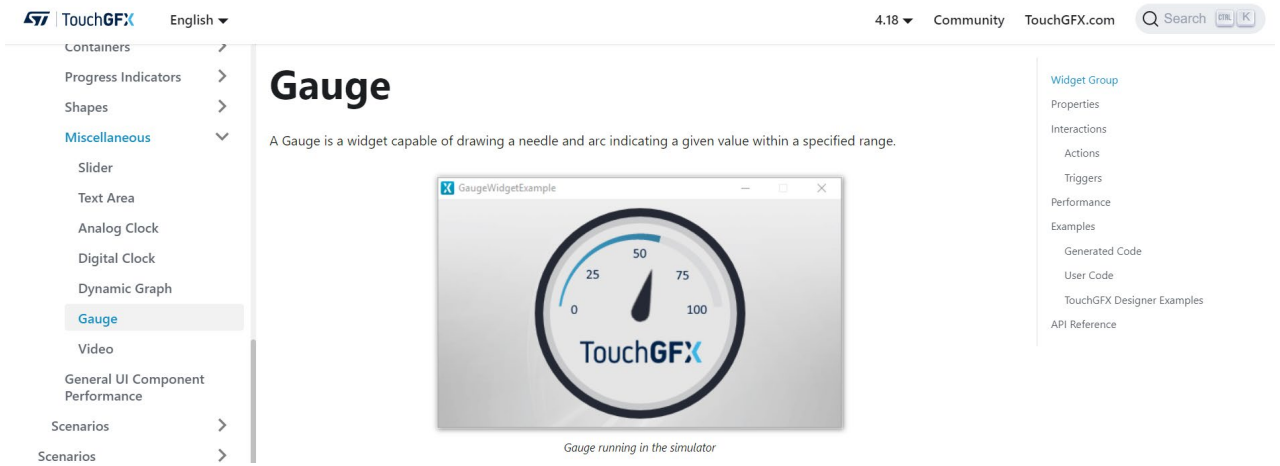
Gauge widget (from 4.16)

- Customizable gauge to indicate a value thanks to a needle and an arc indicator.



Example code in TouchGFX Designer



https://support.touchgfx.com/4.18/docs/development/ui-development/ui-components/miscellaneous/gauge

Available graphic for Gauge widget

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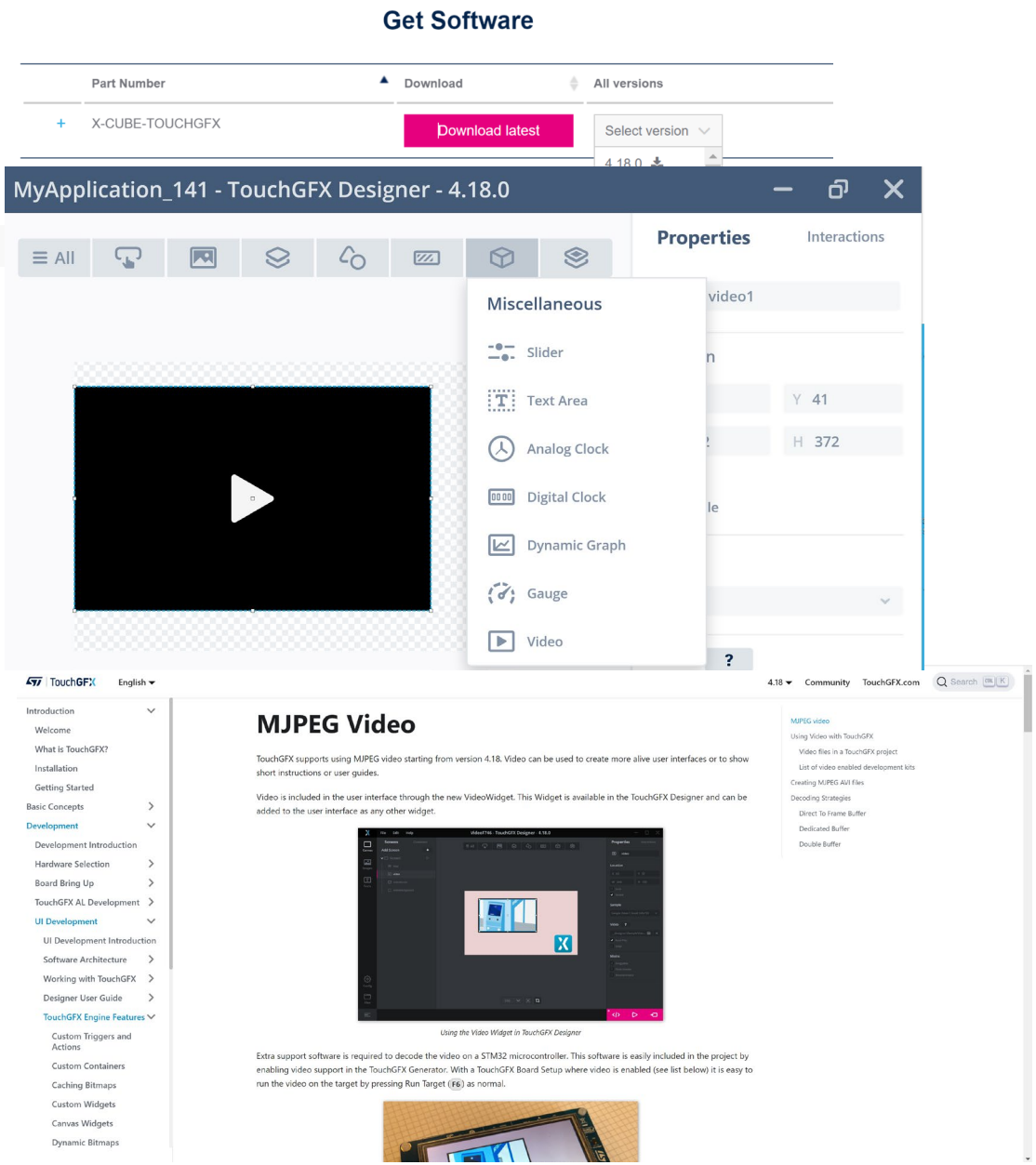
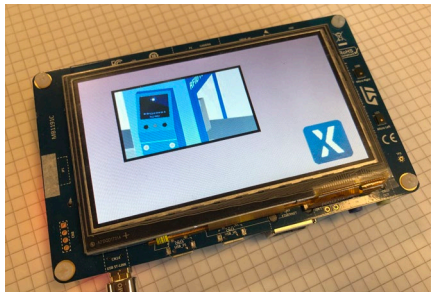
Video widget (from 4.18)



- Playback of **Motion JPEG** video files
- MJPEG video (not a video player)
  - Start
  - Pause
  - Repeat
  - Go to Frame
- Can read directly from memory



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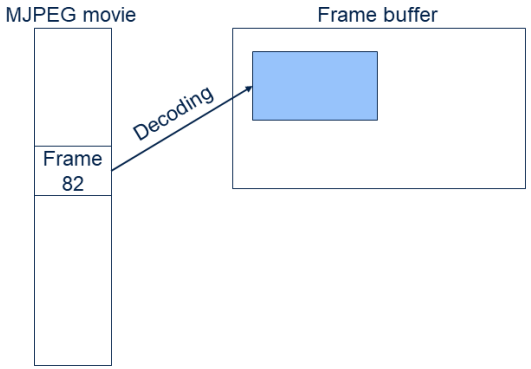
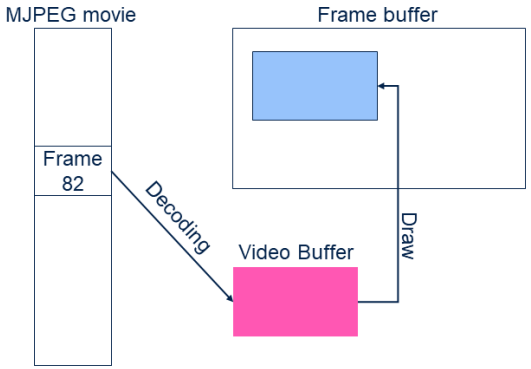
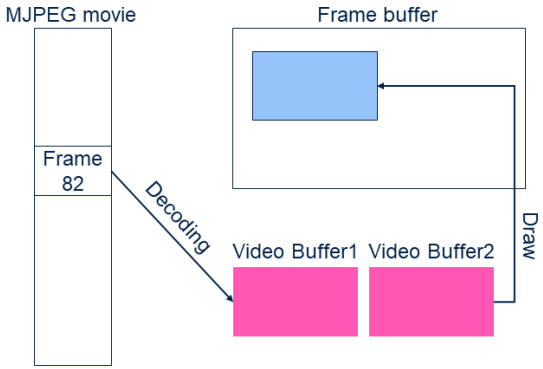
Video widget (from 4.18)

- Supports different buffering strategies
  (https://support.touchgfx.com/docs/development/ui-development/touchgfx-engine-features/video#decoding-strategies)
  - No video buffer: Render video directly to frame buffer.
  - 1 full video buffer: Decompression impact GUI thread
  - 2 full video buffers: Decompression no impact on GUI thread.







Important new features

- Generator FMC Support
- Generator Dual Core Support
- New invalidation algorithm for improved performance.
- Improved DMA2D algorithm
- New XML text database
- Export/Import translation tool
- Integration of LibJPEG in TouchGFX
- Bug fixes and small improvements

Coming soon…

- 2.5D accelerator – Neo-Chrom
- Vector graphics support
- Static Graph widget
- Import/Export custom containers and widgets
- AzureRTOS integration
- MIPI-DSI Video mode example
- More to come…

Low-Cost solution

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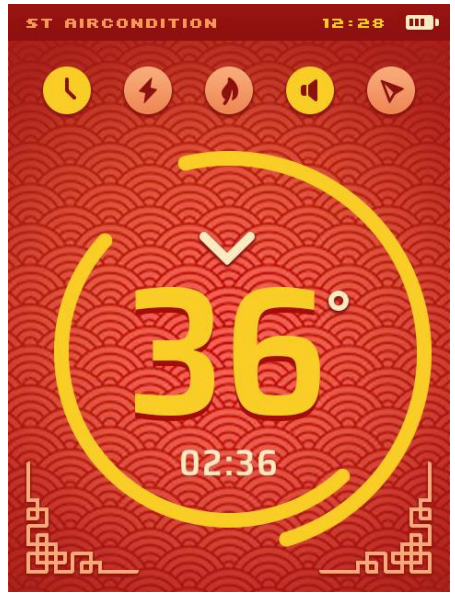
Replace segment display with modern GUI

- **Smartphone inspired User Experience**
  - Intuitive UI ensures maximum product value
  - Richer content, colors and animations
  - Flexibility **for** localization and updates
- **5 USD achieved BOM cost**



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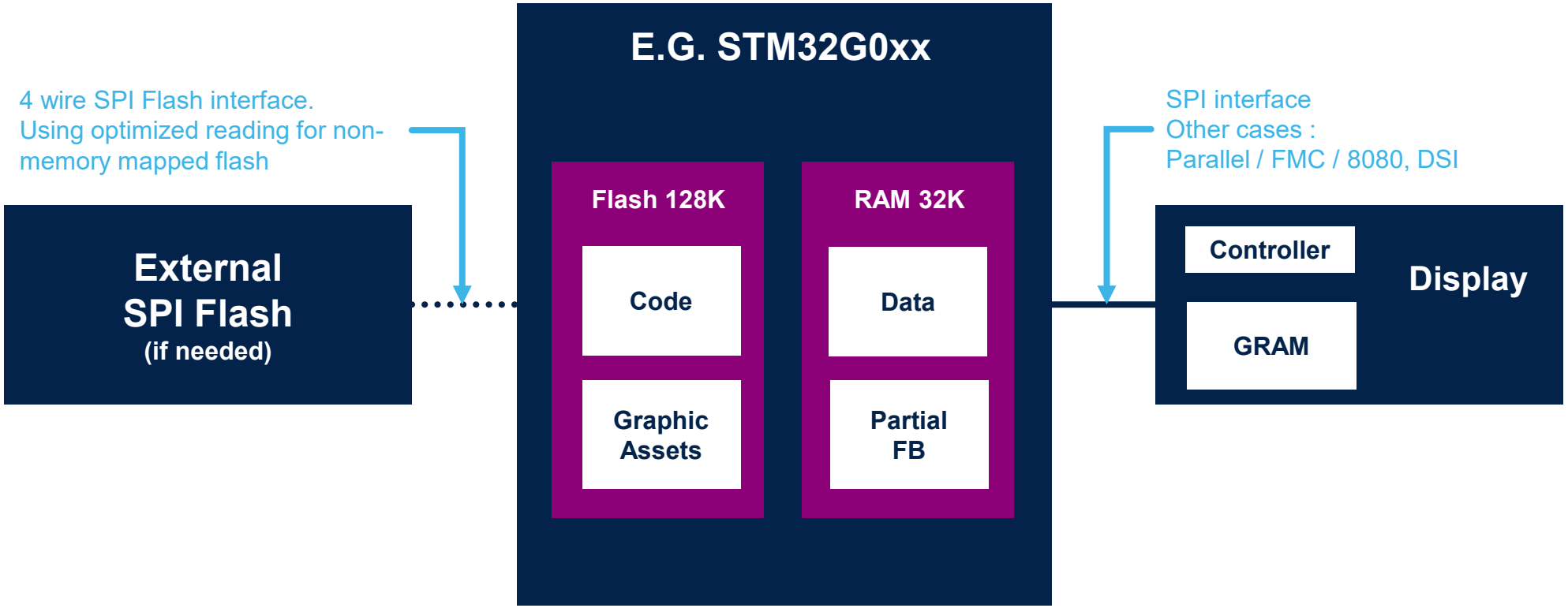
Low-cost SPI + external Flash display kit

- **X-NUCLEO-GFX01M**
  - 8 Mbytes Serial SPI Flash
  - 2.2” SPI QVGA TFT LCD
    - Resolution : 240x320 px
    - Bit depth : 16 bpp
  - Joystick for easy menu navigation

- **Out of the Box TouchGFX Designer support**
  - Supporting NUCLEO-G071RB + X-NUCLEO-GFX01M extension
    - New Application Template in TouchGFX designer
    - 3 new Board Specific demos providing full project examples in source code
- **New Generic X-CUBE-DISPLAY software package**
  - Basic drivers and hello world example
  - Allows support of the display extension by partners software solutions

Hardware Compatible with the following Nucleo boards:
NUCLEO-F030R8, NUCLEO-F070RB, NUCLEO-F072RB, NUCLEO-F091RC, NUCLEO-F401RE, NUCLEO-F410RB, NUCLEO-F411RE, NUCLEO-F446RE, NUCLEO-G071RB, NUCLEO-L053R8, NUCLEO-L073RZ, NUCLEO-L412RB-P, NUCLEO-L433RC-P, NUCLEO-L452RE, NUCLEO-L452RE-P and NUCLEOL476RG

Low-cost project ecosystem



What is appropriate for low-cost graphics ?

- Invalidating small areas
- Widgets with alpha
- Rotation
- Scaling
- Animated Image
- Box widget
- Full screen update
- RGB888
- SPI
- LTDC

- Appropriate for low-cost
- Appropriate for low-cost depending on circumstances
- NOT appropriate for low-cost

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What can help improve performance in low-cost graphics ?

- Smart UI
- DMA
- Performant external memory
- DMA2D
- Avoiding concurrent tasks
- Display with TE signal

Improves performance for low-cost

Does NOT improve performance for low-cost

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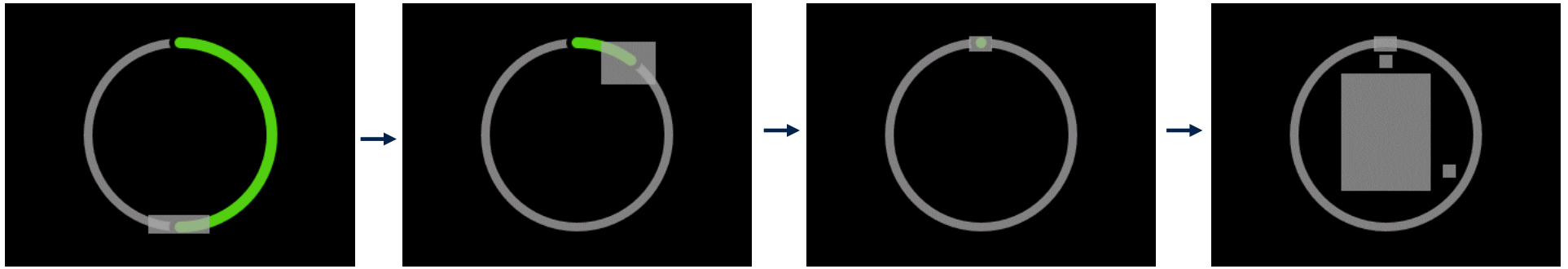
Sequential modification

- A good UI implementation method for low-cost MCUs is to **sequentially modify** widgets. You can modify many elements on the screen but not at the same time.

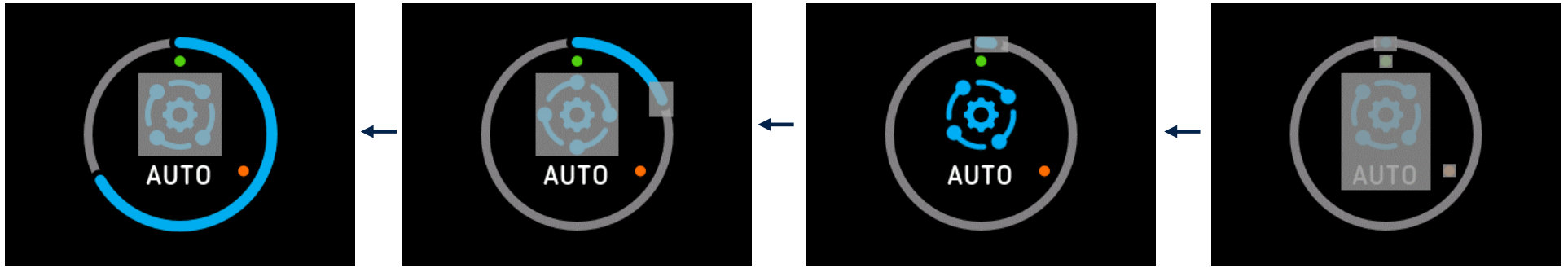


Circle reducing, only the modified part is updated

Circle reducing, only the modified part is updated

One dot remaining, we can now change the color and switch to the next mode

Fade in of the new elements : circle, dots, text and animated image



Circle expansion finished, we successfully changed to Auto mode

While expanding the circle, we start the animation

Fade in finished, now we expand the circle

Fade in of the new elements : circle, dots, text and animated image

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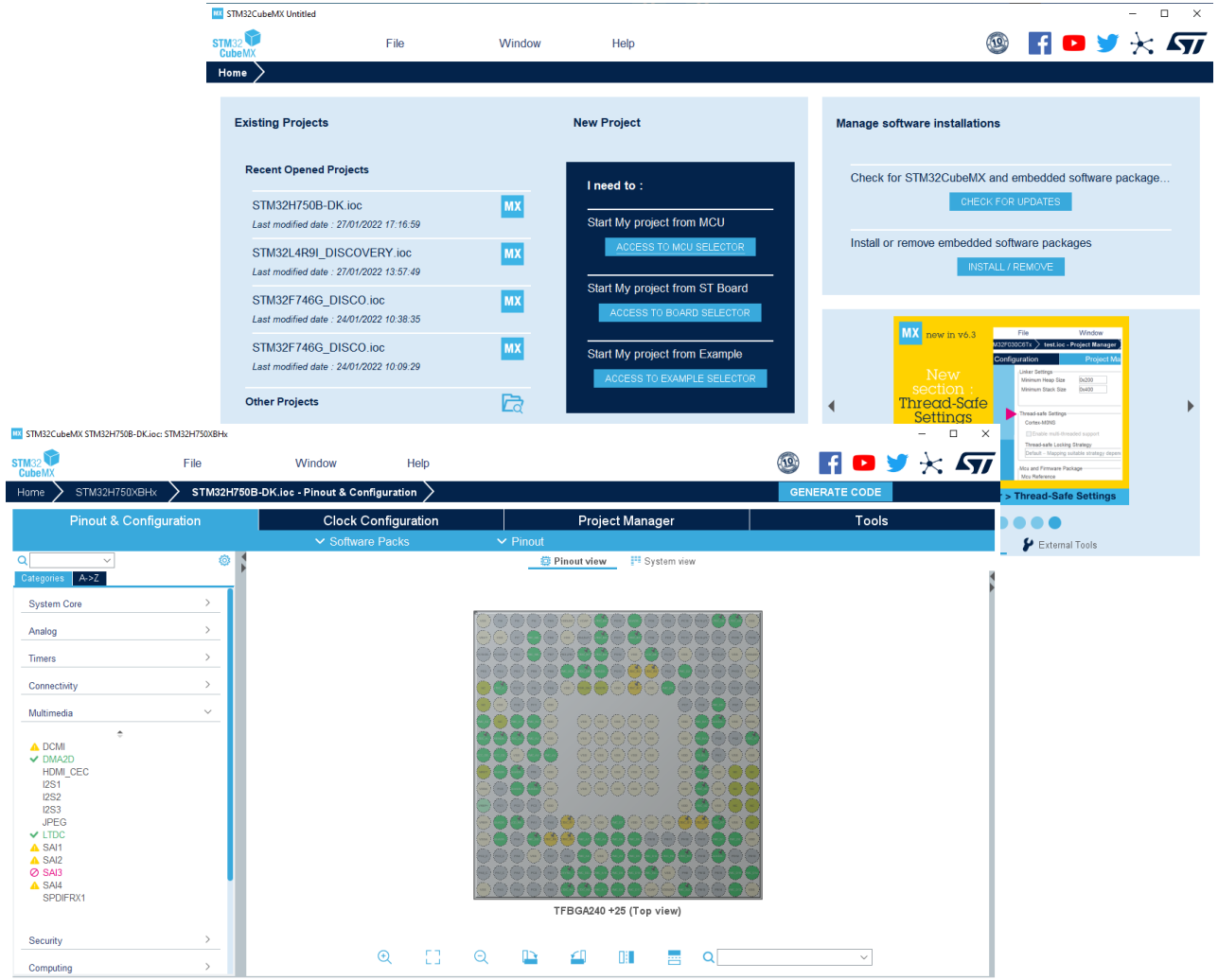
Demonstration

Objectives

- How to configure your target in CubeMX
  - Configuration of NUCLEO-G071RB
    (Clock, SPI, UART,…)
- How to add X-Cube-TouchGFX plug-in to CubeMX
  - Enable X-Cube-TouchGFX
  - Configuration of TouchGFX
  - Organization of TouchGFX code generated from CubeMX
- How to handle TouchGFX Designer to design your UI application
  - Add and manage custom images on the screen
  - Interaction & trigger
  - Import an existing UI
- How to start from a TouchGFX Board Setup (TBS) and debug with CubeIDE
  - Adding communication between TouchGFX and a PC through UART
  - Project debugging to understand the TouchGFX loop

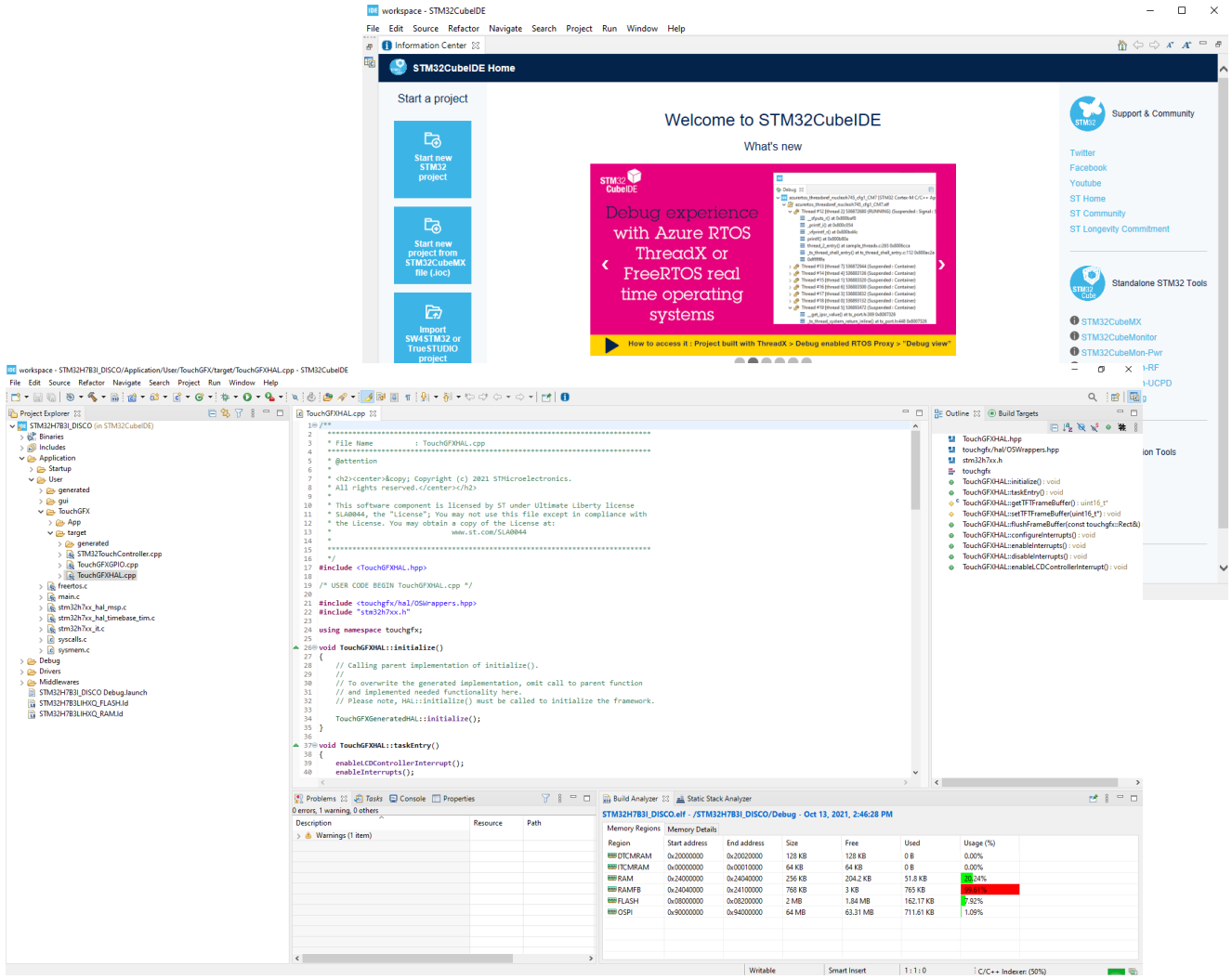
S/W Tools

- **STM32CubeMX**
  - STM32 free-of-charge MCU graphical configuration tool
  - Intuitive STM32 microcontroller and microprocessor selection
  - Generation of initialization C code
  - Multi-OS support
    Windows®, Linux®,
    and MacOS®, 64-bit only
  - Download
    https://www.st.com/en/development-tools/stm32cubemx.html



S/W Tools

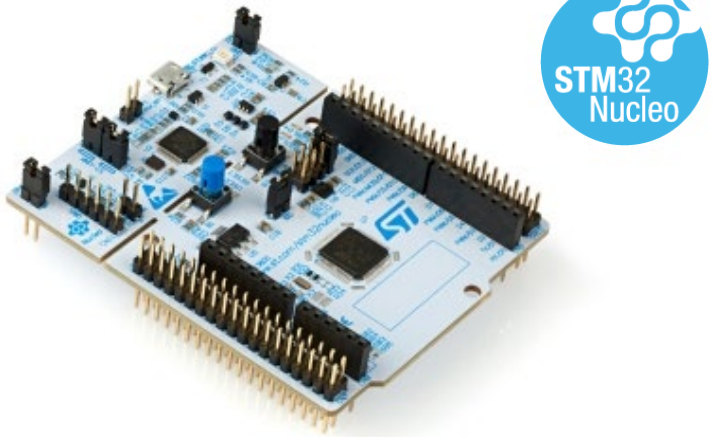
- **STM32CubeIDE**
  - STM32 free-of-charge dedicated IDE
    - C/C++ development platform with peripheral configuration, code generation, **code compilation**, and **debug features** for STM32 microcontrollers and microprocessors.
  - Based on ECLIPSE™/CDT, with support of ECLIPSE™ add-ons, GNU C/C++ for Arm® toolchain and GDB debugger
  - Multi-OS support
    Windows®, Linux®, and MacOS®, 64-bit only
  - Download
    https://www.st.com/en/development-tools/stm32cubeide.html



H/W Tools

- **X-NUCLEO-GFX01M**
  - 8 Mbytes Serial SPI Flash
  - 2.2”SPI QVGA TFT LCD – 240x320px with 16bpp
  - Joystick for easy menu navigation
  - More information …
    https://www.st.com/en/evaluation-tools/x-nucleo-gfx01m1.html

- **NUCLEO-G071RB**
  - STM32G071RB Cortex M0+ @64MHz
  - 128kB flash – 36kB RAM
  - On-board ST-LINK
  - More information …
    https://www.st.com/en/evaluation-tools/nucleo-g071rb.html



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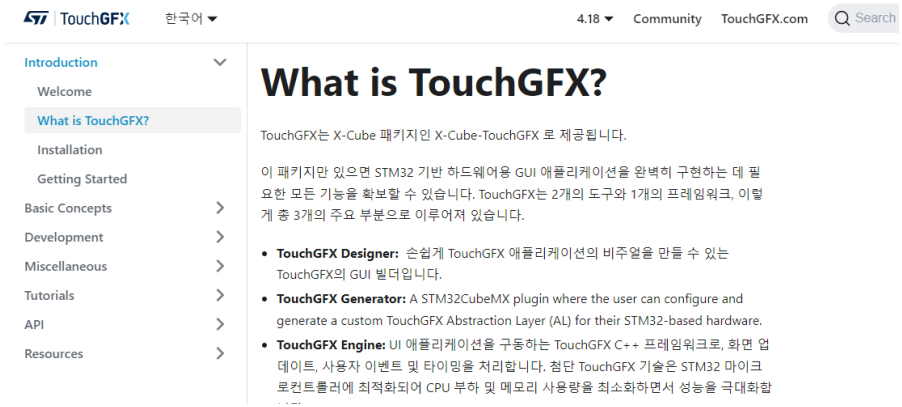
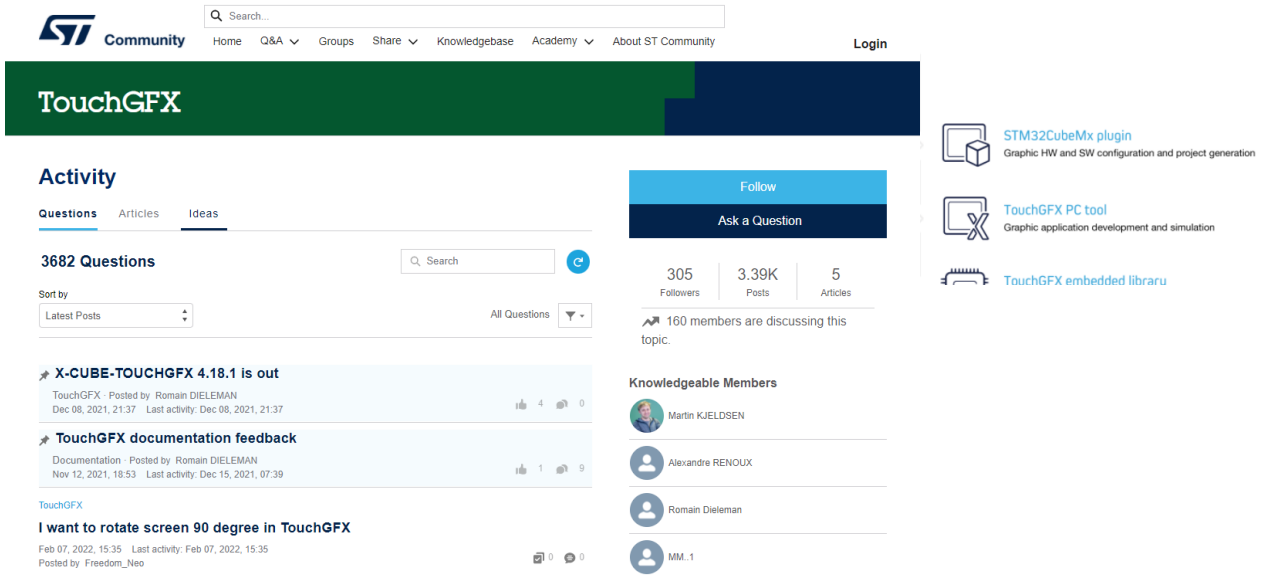
Worldwide Support

- **Documentation**
  - TouchGFX Documentation (한국어 지원 (일부))
    https://support.touchgfx.com/ko

- **Q&A**
  - ST Community
    https://community.st.com (TouchGFX)





Our technology starts with You

Find out more at www.st.com

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