TouchGFX

Enhancing the User Experience with TouchGFX Advanced Graphics on the STM32

Mike Hartmann

Product Marketing

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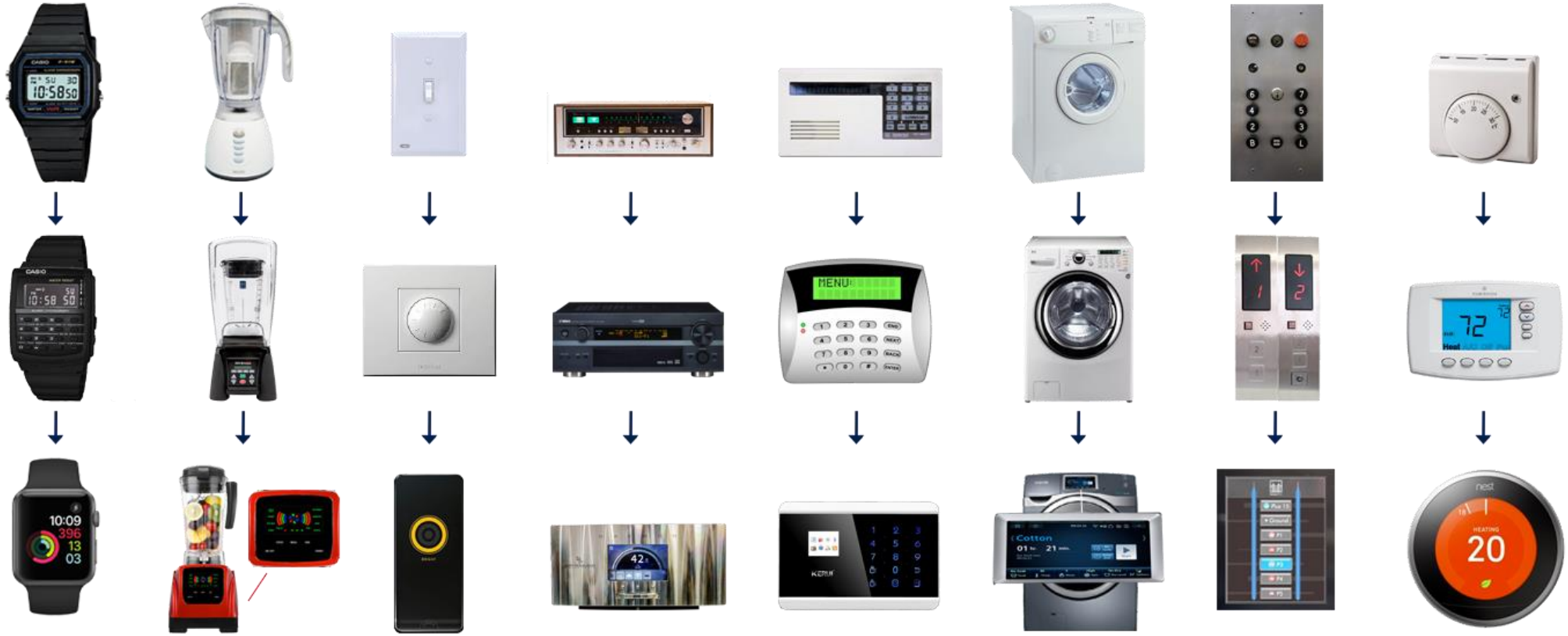
Santa Clara Convention Center - Mission City Ballroom
Santa Clara, CA

Accelerating the HMI of Things



Enabling high-end user experience in embedded devices

Smarter and richer devices requiring Advanced Graphic User Interfaces

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STM32 Graphics Offering

Enabling Enhanced User Experience in Embedded Devices

- Advanced Graphics STM32 Portfolio
- STM32 Graphics Software and Tools
- Reference Designs and Worldwide Support
- Extended Graphic Ecosystem

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Advanced Graphics STM32 Portfolio

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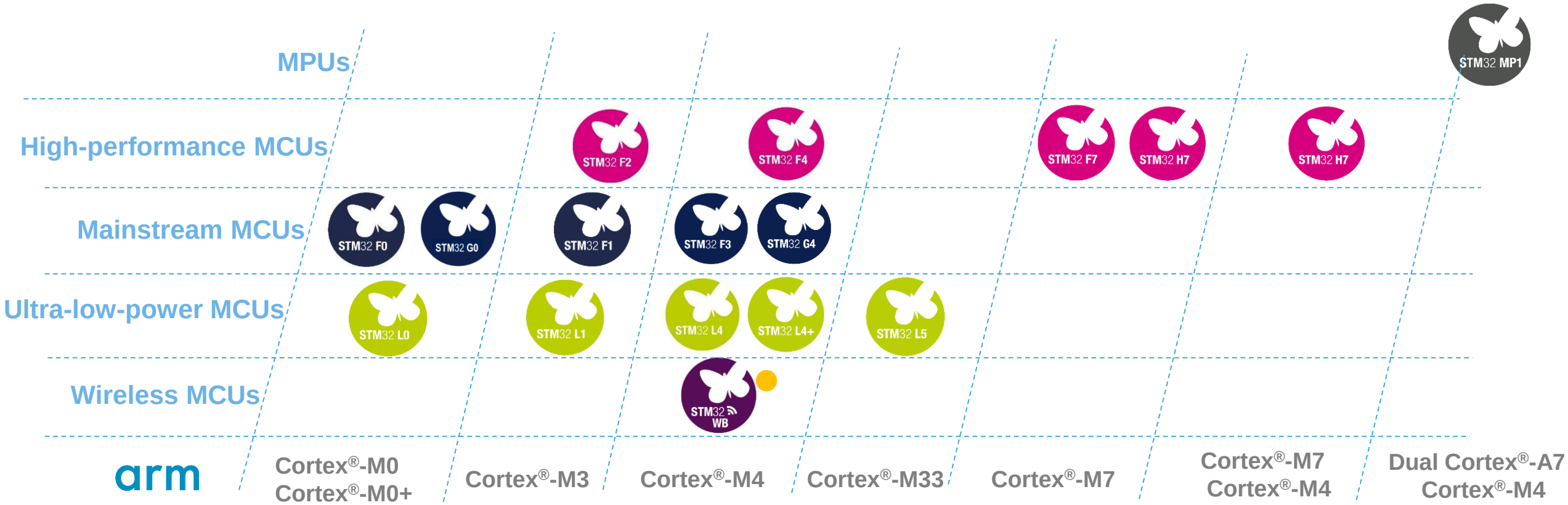
STM32 Portfolio

15 Product Series / More than 50 Product Lines



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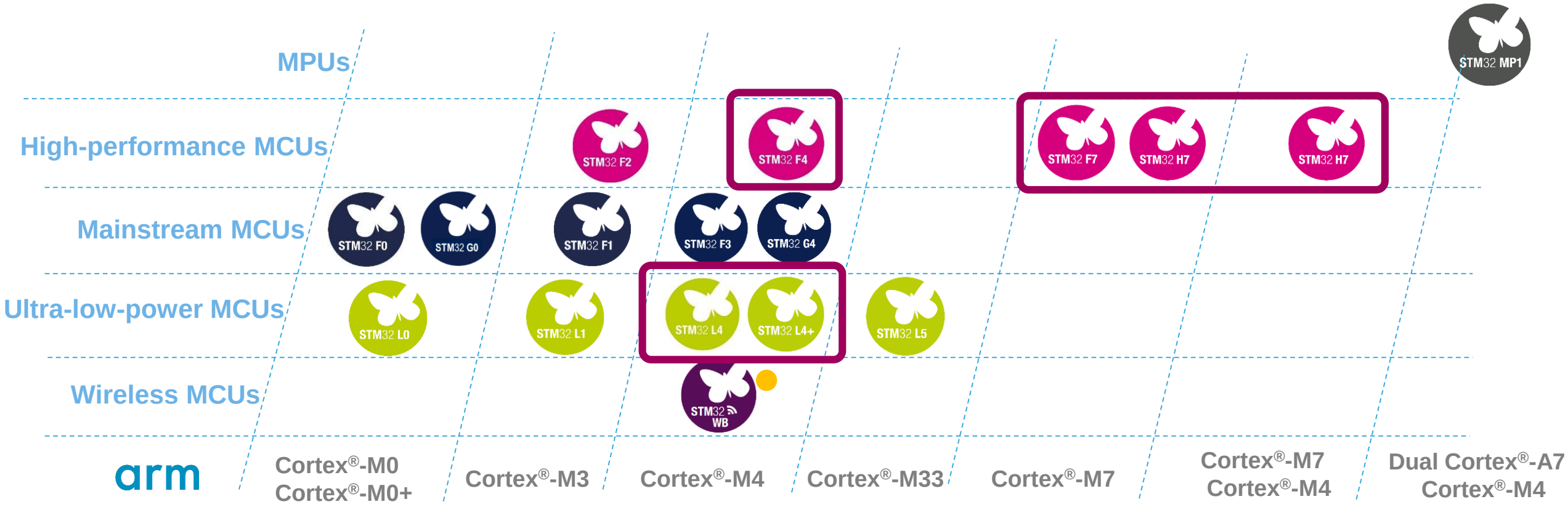
STM32 Portfolio

15 Product Series / More than 50 Product Lines



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STM32 Graphics Feature Matrix

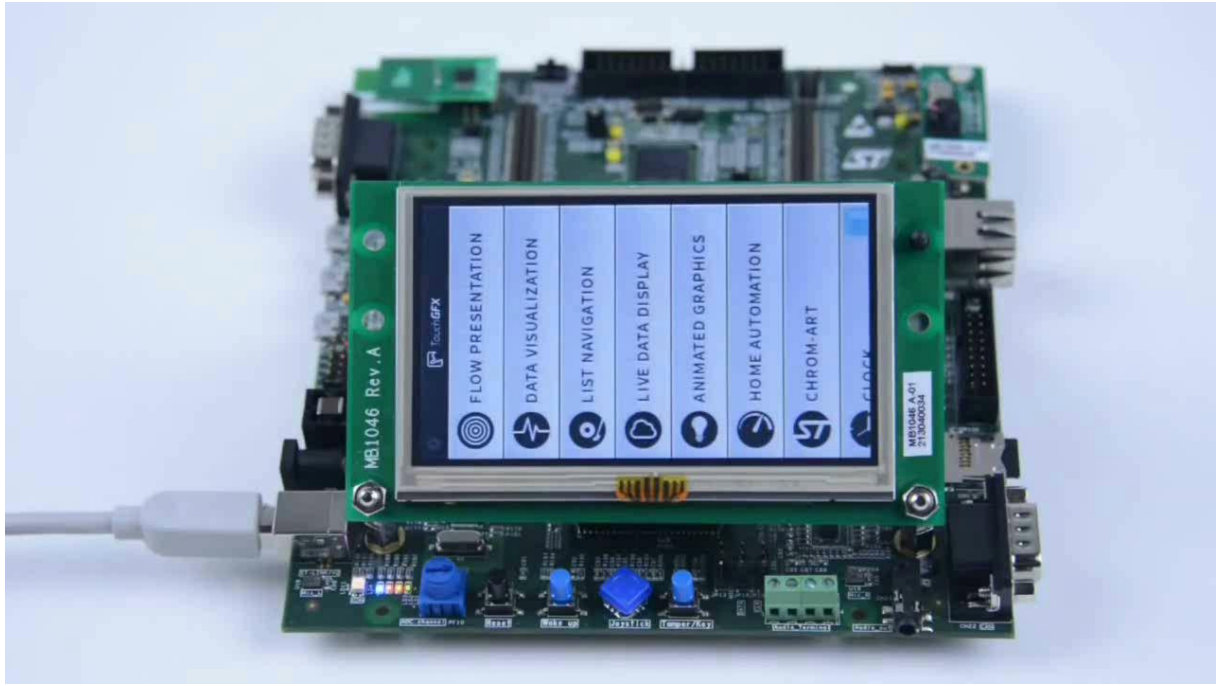
Device	Core	Flash	RAM	Display Controller	Chrom-ART	Other Optimization
STM32H7x7	M7 @ 480MHz M4 @ 240MHz	1MB to 2MB	1MB	TFT, DSI	✓	JPEG
STM32H7x5	M7 @ 480MHz M4 @ 240MHz	1MB to 2MB	1MB	TFT	✓	JPEG
STM32H7x3	M7 @ 480MHz	1MB to 2MB	1MB	TFT	✓	JPEG
STM32H750	M7 @ 480MHz	128KB	1MB	TFT	✓	JPEG
STM32F7 Advanced	M7 @ 216MHz	1MB to 2MB	320KB to 512KB	TFT*, DSI*	✓	JPEG*
STM32F750	M7 @ 216MHz	64KB	320KB	TFT	✓	
STM32F469	M4 @ 180MHz	512KB to 2MB	384KB	TFT, DSI	✓	
STM32F429	M4 @ 180MHz	512KB to 2MB	256KB	TFT	✓	
STM32F427	M4 @ 180MHz	1MB to 2MB	256KB		✓	
STM32L4+	M4 @ 120MHz	1MB to 2MB	640KB	TFT*, DSI*	✓	Chrom-GRC*
STM32L496	M4 @ 80MHz	512KB to 1MB	320KB		✓	

* optional on select devices

STM32 Chrom-ART™ Accelerator

Efficient 2D graphic acceleration for high-end transitions and effects

- DMA2D – 2D Image Copy
  - Mem-to-mem DMA transfer with programmable rectangle area
- Alpha Blender
  - per-object alpha
  - per-pixel alpha
- Pixel Format convertor
  - **Input/output**: ARGB8888 / RGB888 / RGB565 / ARGB1555 / ARGB4444
  - **Input-only**: A4 /A8 alpha bitmap for glyphs, L8 for 256 colors CLUT



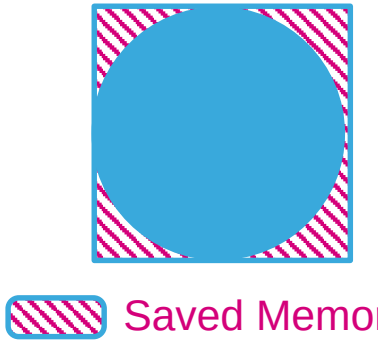
2-10% CPU load with Chrom-ART™
80-100% without

Chrom-GRC™ for Memory Optimization

Chrom-GRC™

- Graphic Resource Cutter for non-square displays
- No modification or special management at SW level

➔**Saving up to 20% of RAM footprint for framebuffer**



Saved Memory

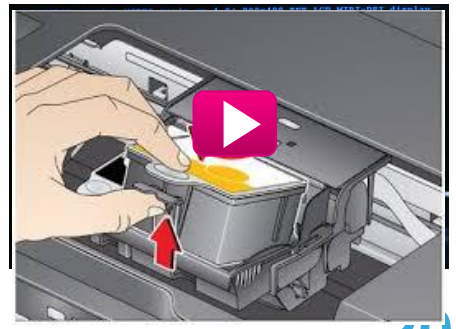
- **For 360x360 round display**
  - @16bpp **~205kBytes** (vs.253kBytes)
  - @24bpp **~307kBytes** (vs.380kBytes)
- **For 400x400 round display**
  - @16bpp: **250kBytes** (vs.312kBytes)
  - @24bpp: **372kBytes** (vs.469kBytes)

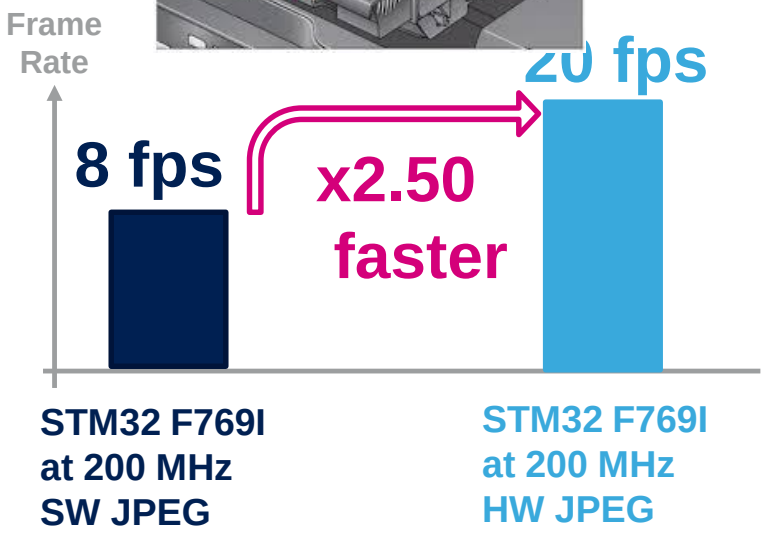
STM32 JPEG Codec

MJPEG video acceleration for branding and tutorial videos

HW JPEG accelerator

- Fast and simple hardware JPEG compression and decompression
- Full management of JPEG headers
- Supporting motion JPEG videos
  - ➔**Saving CPU load for MJPEG management**
  - ➔**Enhancing branding and user experience**
    - ➔**Branding animations at startup**
    - ➔**End-product embedded tutorials**





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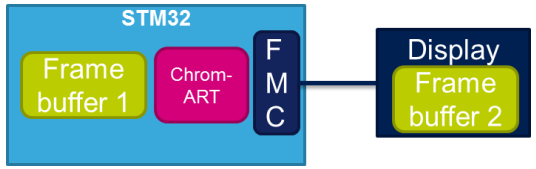
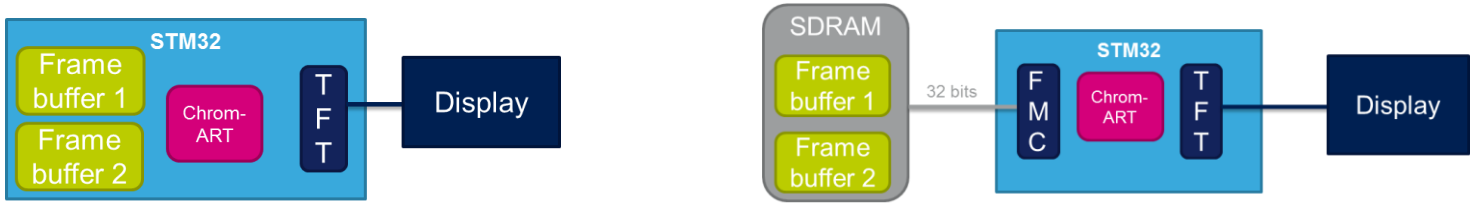
STM32 Display Interfaces

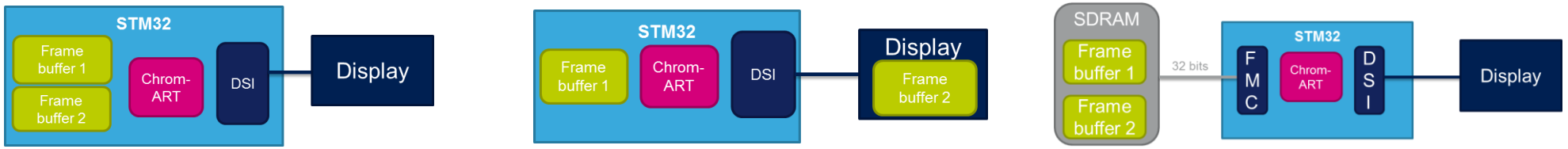
- Intel 8080 and Motorola 6800 LCD interfaces for small resolutions



- TFT controller for medium resolutions (up to XGA) and new generation MiP low power displays



- MIPI-DSI interface for medium resolutions, high pixel density GUI, mainly consumer today



STM32 Graphics Software and Tools

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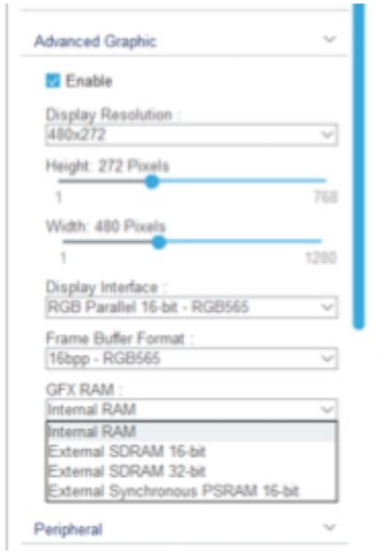
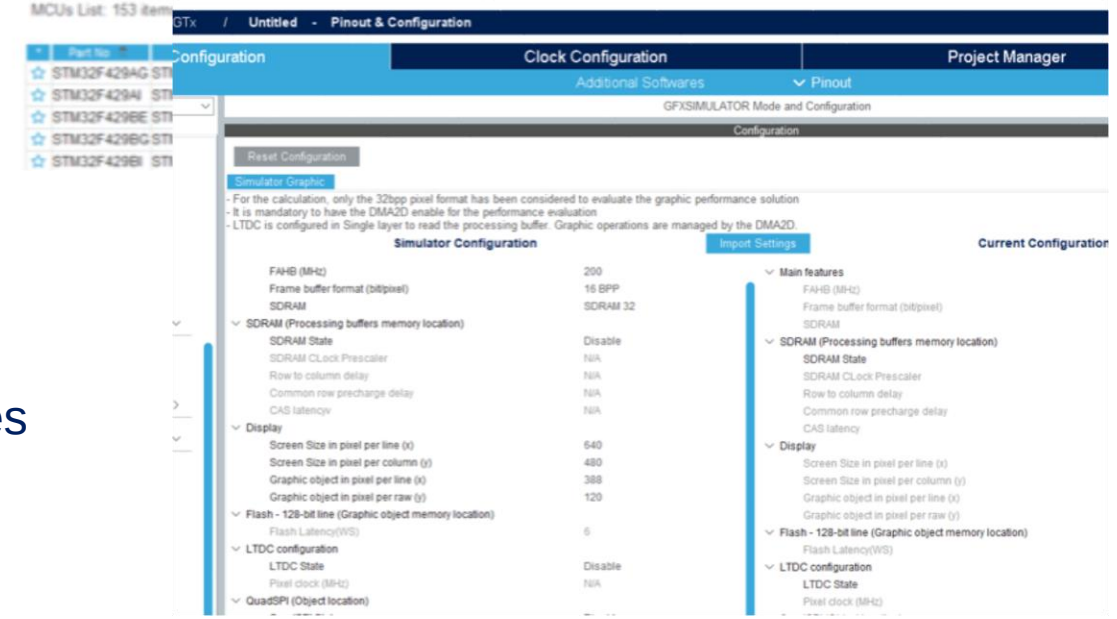
Free State-of-the-art
Graphic Software and Tools

Find the best STM32 fit with our Graphic Selector and Simulator added in CubeMX

- CubeMX **Graphic Selector**
  - Select your STM32 based on
    - Display resolution
    - Color depth
    - Memory interfaces
    - Expected performance





- CubeMX **Graphic Simulator**
  - Fine tune your architecture and configuration
  - Simulate expected performance based on your choices

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TouchGFX Graphics Framework

Now Part of the STM32 Ecosystem

TouchGFX is a software framework written in C++ that unlocks the graphical user interface of STM32 hardware.

The technology lets you create high-end GUIs that fully live up to today's smartphone standards at a fraction of the cost.

TouchGFX is integrated with the STM32Cube ecosystem.

TouchGFX is FREE with STM32!

TouchGFX Graphics Framework

Unbeatable GUI Performance on STM32

TouchGFX

TouchGFX Designer
Graphic development PC tool

TouchGFX

TouchGFX Engine
Embedded graphic library

Maximum Performance

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

Create Anything

The structure and flexibility of TouchGFX gives the Developer control to easily create unique UI designs

Easy to Use

TouchGFX combines a WYSIWYG designer, auto code generation and a PC-simulator with the efficiency and flexibility of the C++ language

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TouchGFX

TouchGFX Designer

Intuitive Approach to GUI Development

From Idea to Prototype

A simple drag n' drop approach combined with ready-to-use high quality sample graphics enable you to create stunning prototypes in minutes with no need for advanced design and programming skills or TouchGFX knowledge.

From Prototype to Product

TouchGFX Designer supports you throughout your entire UI project by simplifying the process of creating the visual design and layout of your screens and custom controls. Your TouchGFX application code is automatically updated with the changes done in the Designer.

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TouchGFX Designer

Accelerates GUI Creation - No Programming Skills Needed for Prototyping

- **Structure:** TouchGFX Designer lets you create multiple screens while providing a clear view of screen content.
- **Widgets:** Wide selection of widgets like Swipe container, Scrollable list etc.
- **Interactions:** Add dynamic interactions to create a user-friendly application.
- **Custom Container:** Create custom reusable controls for your application
- **Text Handling:** Multiple alphabets and scripts, such as Latin, Cyrillic, Arabic, Chinese, and Japanese.

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TouchGFX

TouchGFX Code Generation

Realization of any GUI design made easy

- TouchGFX Designer generates and maintains performant C++ code
- Flexible software architecture makes the developer able to easily add his own code
- Developer can use preferred IDE

```
/*********** THIS FILE IS GENERATED BY TOUCHGFX DESIGNER, DO NOT MODIFY ***********/
#include <gui_generated/screen1_screen/Screen1ViewBase.hpp>
#include <touchgfx/Color.hpp>
#include "BitmapDatabase.hpp"
#include <texts/TextKeysAndLanguages.hpp>

Screen1ViewBase::Screen1ViewBase() :
    flexButtonCallback(this, &Screen1ViewBase::flexButtonCallbackHandler)
{
    box1.setPosition(0, 0, 480, 272);
    box1.setColor(touchgfx::Color::getColorFrom24BitRGB(255, 255, 255));

    flexButton1.setBoxWithBorderPosition(0, 0, 373, 73);
    flexButton1.setBorderSize(16);
    flexButton1.setBoxWithBorderColors(touchgfx::Color::getColorFrom24BitRGB(0, 102, 153), touchgfx::Color::getColorFrom24BitRGB(0, 153, 204), touchgfx::Color::getColorFro
    flexButton1.setBitmaps(Bitmap(BITMAP_BLUE_BUTTONS_ROUND_EDGE_LARGE_ID), Bitmap(BITMAP_BLUE_BUTTONS_ROUND_EDGE_LARGE_PRESSED_ID));
    flexButton1.setBitmapXY(6, 8);
    flexButton1.setIconBitmaps(Bitmap(BITMAP_BLUE_ICONS_CALENDAR_32_ID), Bitmap(BITMAP_BLUE_ICONS_CALENDAR_32_ID));
    flexButton1.setIconXY(85, 25);
    flexButton1.setText(TypedText(T_SINGLEUSEID1));
    flexButton1.setTextPosition(2, 24, 373, 73);
    flexButton1.setTextColors(touchgfx::Color::getColorFrom24BitRGB(10, 10, 10), touchgfx::Color::getColorFrom24BitRGB(161, 30, 30));
    flexButton1.setPosition(54, 100, 373, 73);
    flexButton1.setAction(flexButtonCallback);

    add(box1);
    add(flexButton1);
}

void Screen1ViewBase::setupScreen()
{

}

void Screen1ViewBase::flexButtonCallbackHandler(const touchgfx::AbstractButtonContainer& src)
{
    if (&src == &flexButton1)
    {
        //Interaction1
        //When flexButton1 clicked call virtual function
        //Call mymethod
        mymethod();
    }
```

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TouchGFX

TouchGFX Engine

Optimized for STM32 Hardware Resources and Acceleration

Optimized for Minimum MCU Load and Memory Foot Print

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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TouchGFX

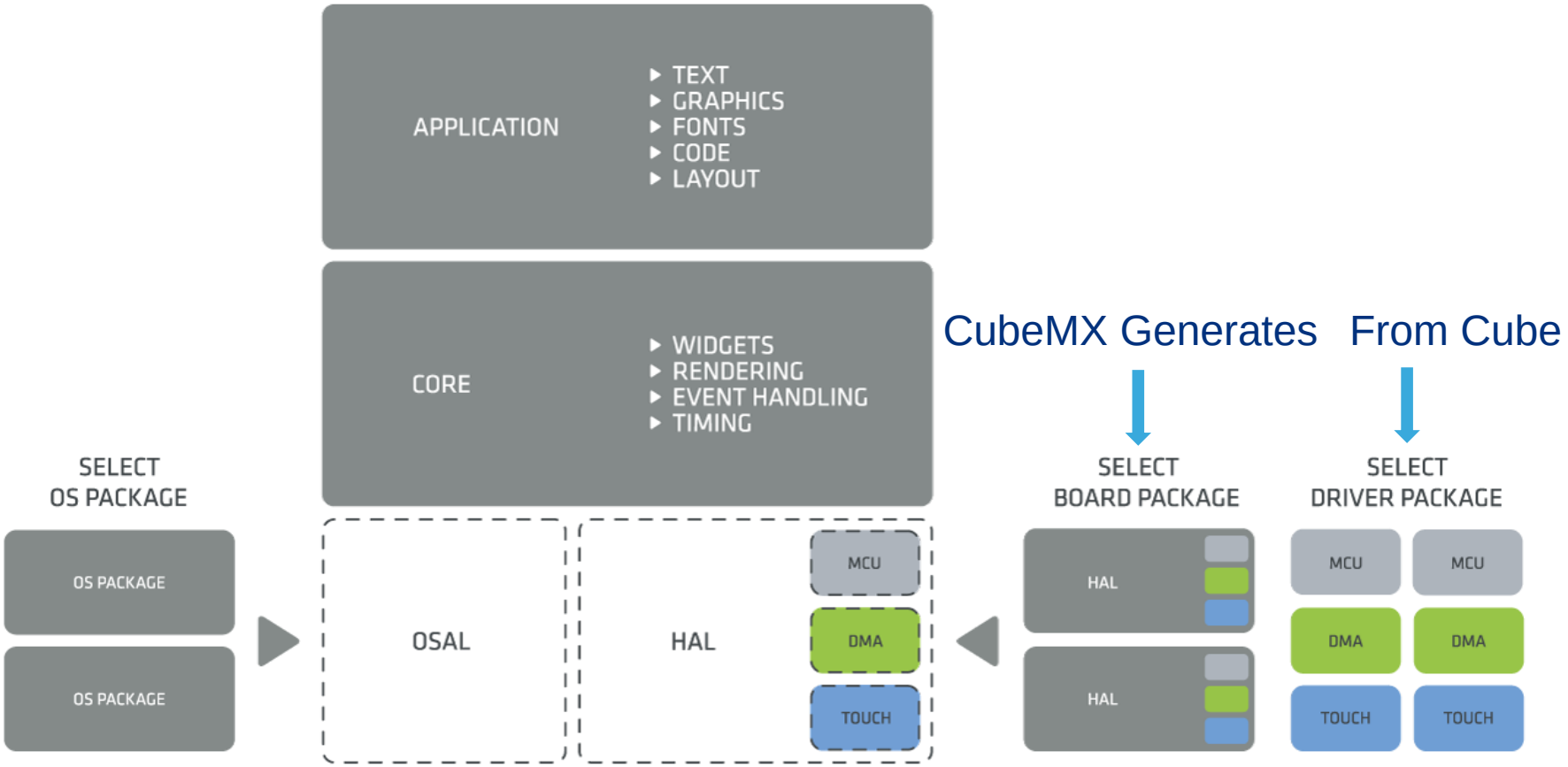
TouchGFX Framework

Optimized for Memory Resources

- **Internal RAM for Library: 11-35 kB**
  - 10-20 KB for Framework data structures and GUI task stack
  - 1-15 KB for Widgets used by the Screens
- **Internal/External RAM for Framebuffers:**
  - Memory usage depends on display resolution, color depth and the number of framebuffers (1,2 or 3)
  - Example: 480x272, 16 bit color, 2 framebuffers: 480x272 x 2 bytes x 2 = 520 KB
  -
- **Internal/External Flash for Library: 21-221 kB**
  - 20 kB (framework)
  - 1-200 kB (screen definitions, GUI logic)
- **Internal/External Flash for Assets:**
  - Depends on the total size of the graphical elements, typically 1-20 MB

TouchGFX Application Components

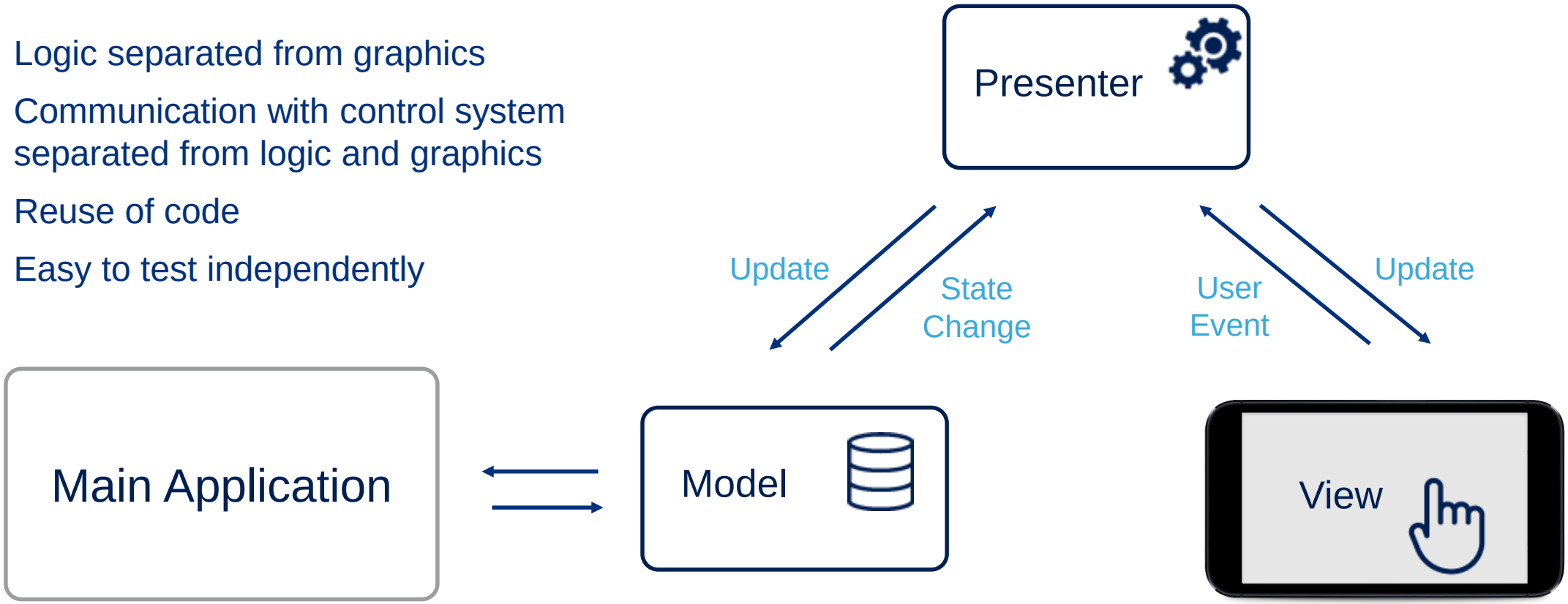
Software Layers – Low-Level Application Templates available for all STM32 display kits



TouchGFX Framework

Model-View-Presenter Software Architecture

- Logic separated from graphics
- Communication with control system separated from logic and graphics
- Reuse of code
- Easy to test independently



Reference Designs and Support

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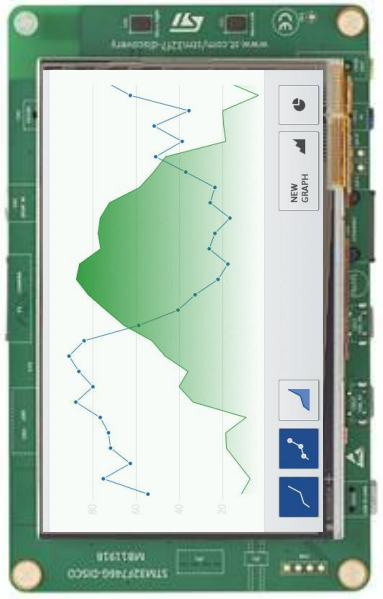
STM32 Discovery Boards

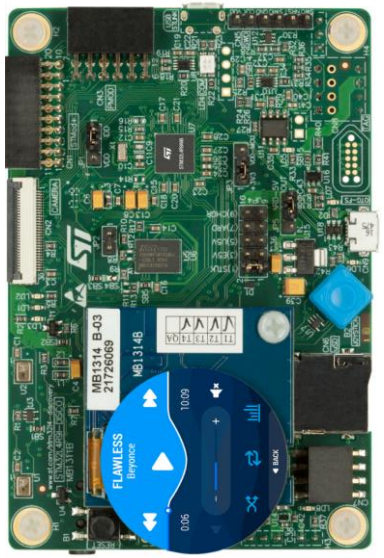
32F429IDISCO
STM32F429
320x240
QVGA LCD
64 MBits SDRAM

32F469IDISCO
STM32F469
800x480
WVGA LCD
128 MBits SDRAM
128 Mbit QSPI Flash
Arduino Uno



32F746GDISCO
STM32F746
480x272
WQVGA LCD
64 MBits SDRAM
128 Mbit QSPI Flash
Arduino Uno

32F769IDISCO
STM32F769
800x480
WVGA LCD
128 Mbits SDRAM
512 Mbit QSPI Flash
Arduino Uno



32L4R9IDISCOVERY
STM32L4R9
390x390
AMOLED
16 Mbits PSRAM
512 Mbit OctoSPI Flash
Arduino Uno

32F750GDISCO
STM32F750
480x272
WQVGA LCD
64 MBits SDRAM
128 Mbit QSPI Flash
Arduino Uno

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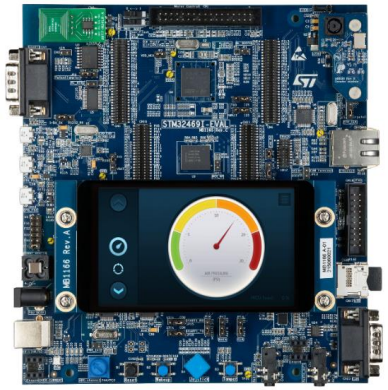
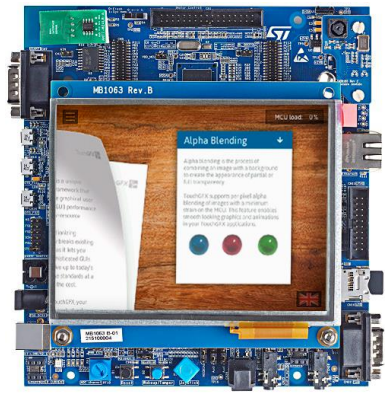
STM32 Evaluation Boards

STM32429I-EVAL
- STM32F429
- 480x272 WQVGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash

STM32439I-EVAL
- STM32F439
- 640x480 VGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash



STM32469I-EVAL
- STM32F469
- 800x480 WVGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash
- 512 MB QSPI Flash



STM32756G-EVAL
- STM32F756
- 640x480 VGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash
- 512 MB QSPI Flash

STM32769G-EVAL
- STM32F769
- 800x480 WVGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash
- 512 MB QSPI Flash

STM32743I-EVAL
- STM32F769
- 800x480 WVGA LCD
- 256 MB SDRAM
- 128 MB NOR Flash
- 512 MB QSPI Flash

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TouchGFX

TouchGFX Reference UI Templates

Examples in TouchGFX Designer - Free to use on STM32

TouchGFX DESIGNER

Choose a UI Template

All | Examples | Demos | Matching UI Templates

AnimatedImage Example
by STMicroelectronics (v1.1.0)
Start

Line and Circle Example
by STMicroelectronics (v1.1.0)

Pool Demo
by STMicroelectronics (v1.1.0)
Pool Lights
OFF ON
Pool Temperature
Adjust

ProgressIndicato
by STMicroelectronics (v1.1
1.25%

Text Example
by STMicroelectronics (v1.1.0)
Text Example
In TouchGFX it is easy to use static texts and dynamic texts.
Dansk
TouchGFX
Counter: 17

TextureMapper Example
by STMicroelectronics (v1.1.0)

TouchGFX Demo 1
by STMicroelectronics (v1.1.0)
Custom Controls
DEMO

TouchGFX Demo
by STMicroelectronics (v1.1

SELECT CANCEL

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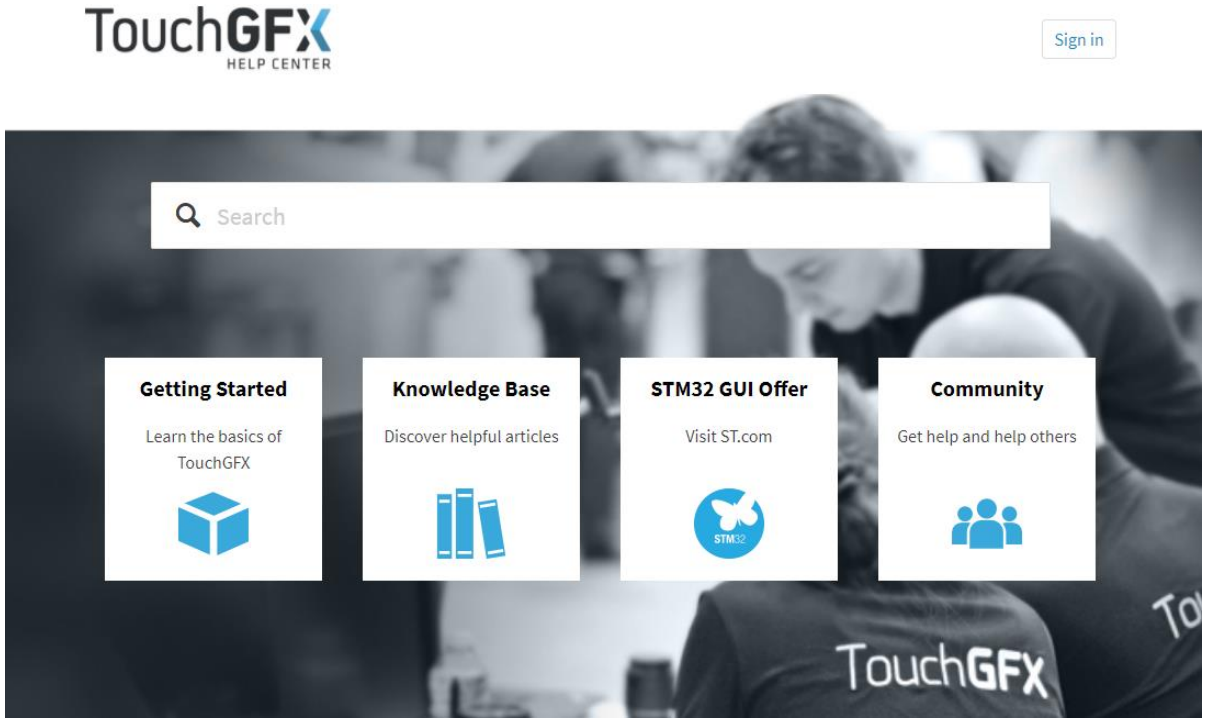
TouchGFX

Getting Started with TouchGFX on STM32

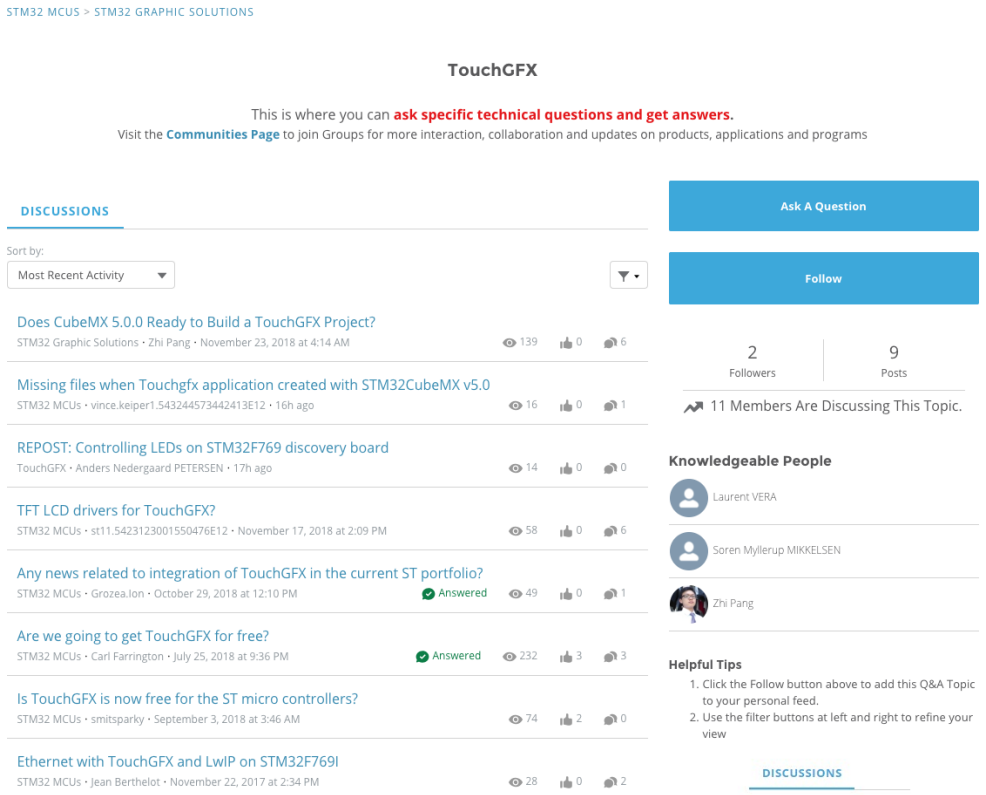
Starting your Graphics Project with TouchGFX

1. **Fast TouchGFX evaluation and graphic prototyping**
   - Start with TouchGFX Designer - available as standalone package on ST.com
2. **Prototyping and development of GUI as part of complete application**
   - Start from Cube MX
     1. Install TouchGFX from your Cube package
     2. Configure your project in CubeMX using the “Graphic Selector”
     3. Launch TouchGFX from CubeMX
     4. Interoperability allows TouchGFX and CubeMX to share single project environment

STM32 TouchGFX Online Resources



TouchGFX Help Center



ST Community Forum

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Extended Graphics Ecosystem

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Extended Graphics Ecosystem

GUI Development Service Partners

TouchGFX Implementer Services

- Extended Support
- Porting
- Application Development
- Onsite Development
- Training
- Hardware Development
- Full Turnkey Solutions
- Electronic Manufacturing
- User Experience
- Graphic Design

Learn more at www.touchgfx.com/resources/implementer-services

BRESSLERGROUP
edt
EKTOS
EMBEDDED PARTNERS
EMG SOFT
itk ENGINEERING
iWave Embedding Intelligence
Mjølner INFORMATICS
PsiControl
SDATAWAY
泰辑科技 Taiji Software

Extended Graphics Ecosystem

Display and Modules Providers

EDT – Smart Embedded Display Modules

- For prototyping and production
- Display sizes:
  - 4.3” 480x272
  - 7.0” 800x480
  - 10.1” 1024x600
- All based on STM32F746
- Supported in TouchGFX Designer

EMERGING DISPLAY TECHNOLOGIES CORP.
ETEM043005XDH6

Smart Embedded®

- More information: http://www.edtc.com/sb_readmore.php?id=3
- Video: https://www.youtube.com/watch?v=mnShrk3nqCM

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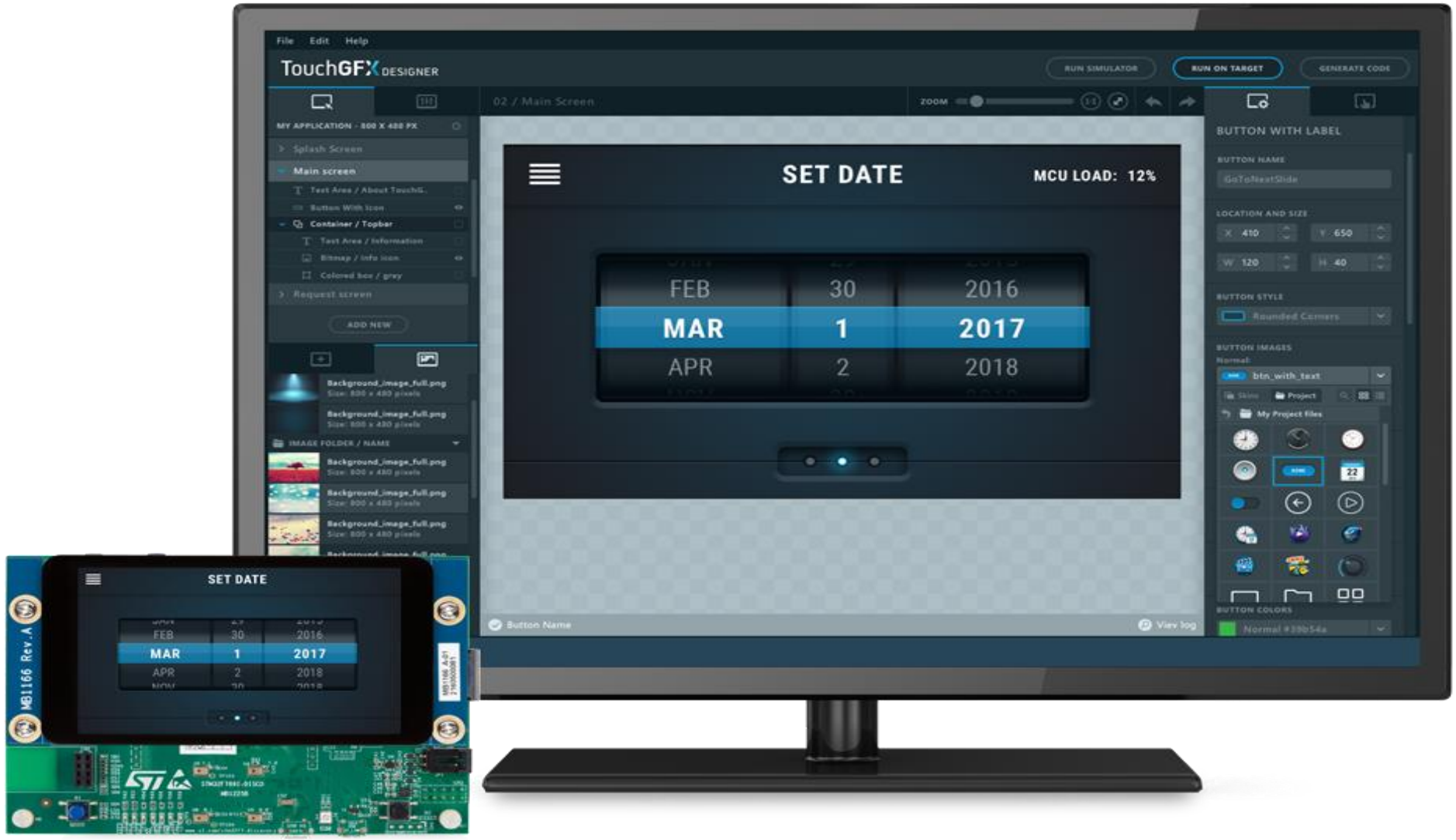
Get Started Today with TouchGFX on STM32



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