# Enhancing the User Experience with TouchGFX Advanced Graphics on the STM32

Mike Hartmann
Product Marketing

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# 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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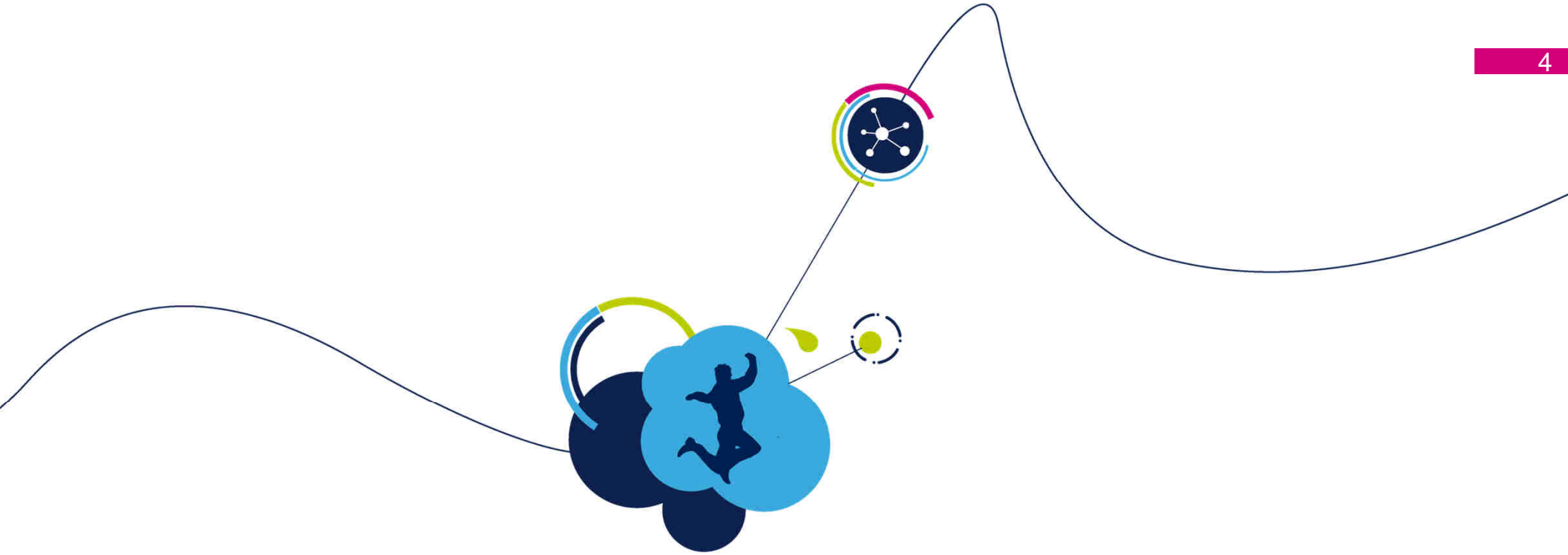

# Advanced Graphics STM32 Portfolio

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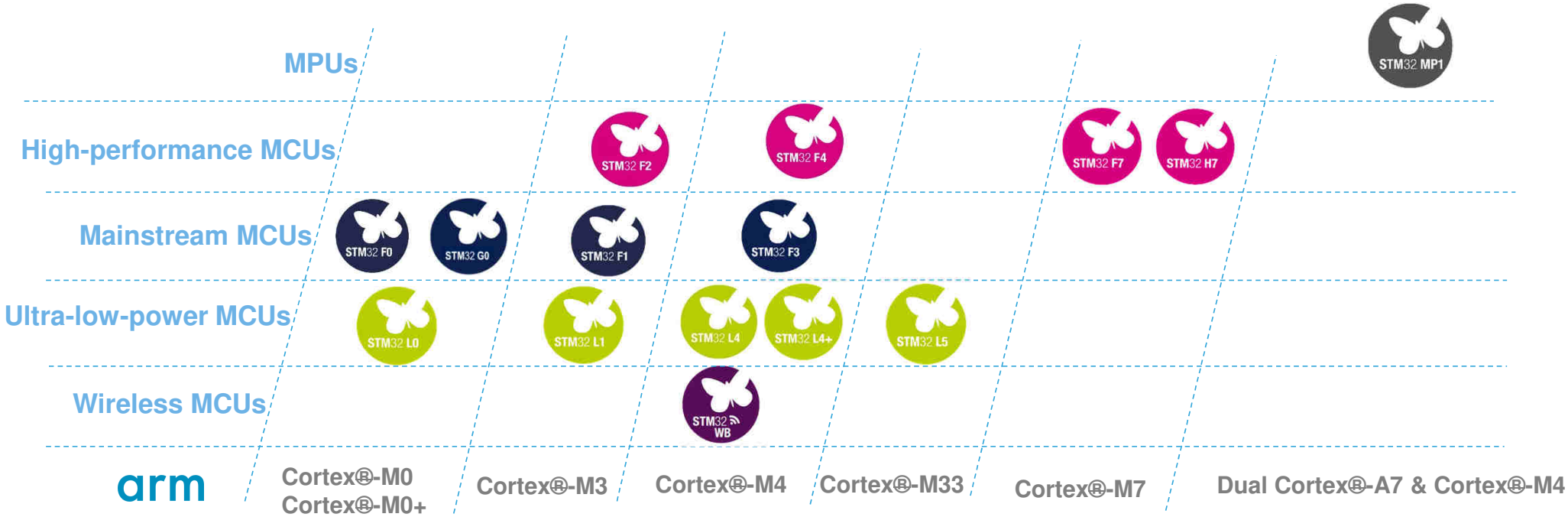
# STM32 Portfolio



## 15 Product Series / More than 50 product lines

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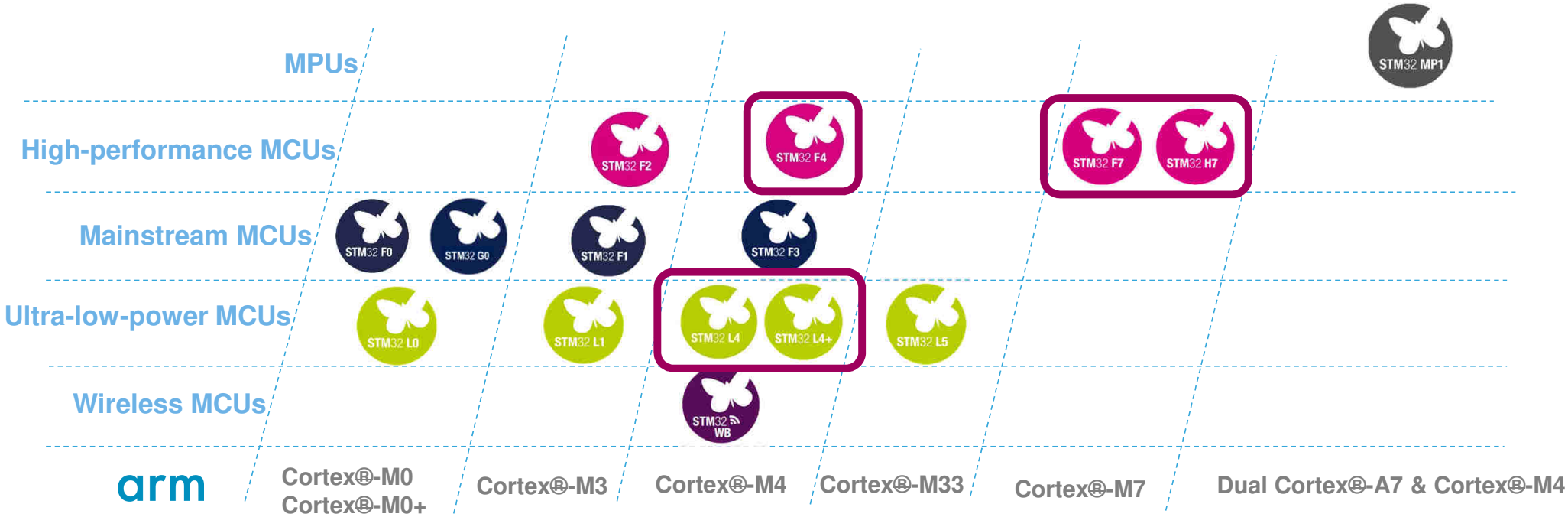
# STM32 Portfolio



## MCU Products with Advanced Graphics Capability

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# STM32 Graphics Feature Matrix



| Device | Core | Flash | RAM | Display Controller | Chrom-ART | Other Optimization |
|---|---|---|---|---|---|---|
| STM32H7x3 | M7 @ 400MHz | 1MB to 2MB | 1MB | TFT | ✓ | JPEG |
| STM32H750 | M7 @ 400MHz | 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

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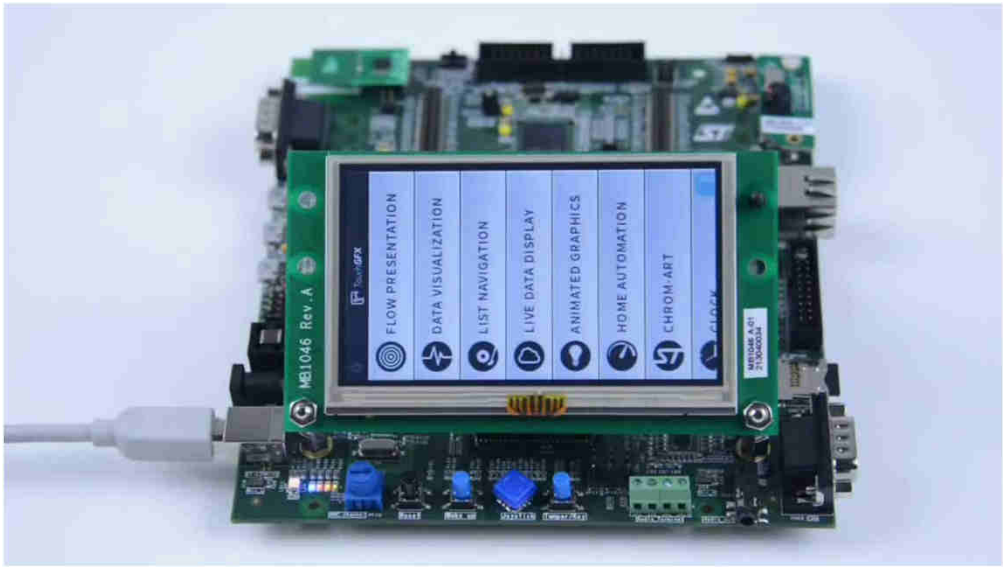
# STM32 Chrom-ART™ Accelerator

## 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

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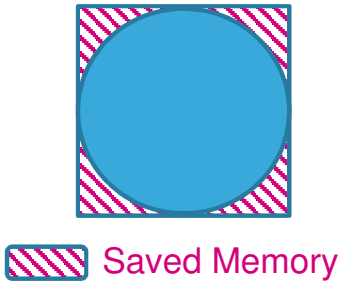
# STM32 Chrom-GRC™

## 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)

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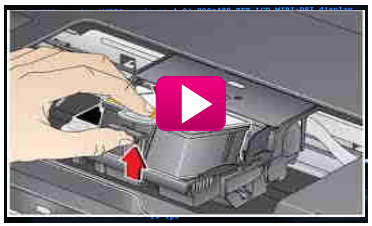
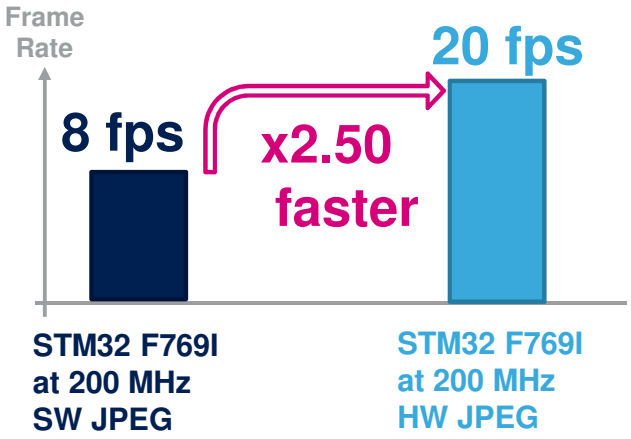
# STM32 JPEG Codec

## 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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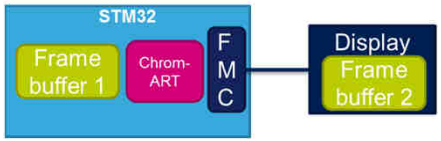
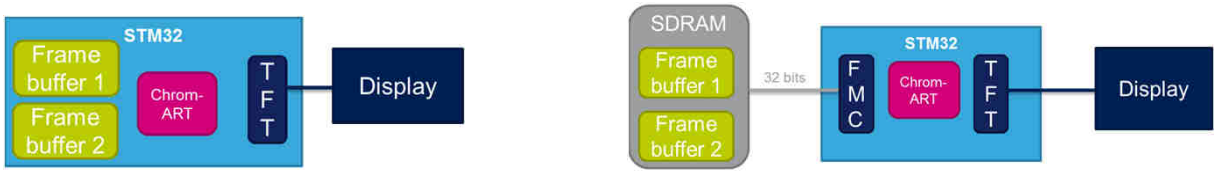
# STM32 Display Interfaces

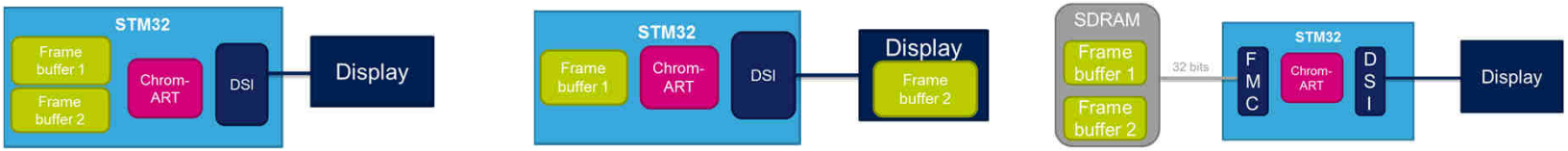
- Intel 8080 and Motorola 6800 LCD interfaces for small resolutions




- 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

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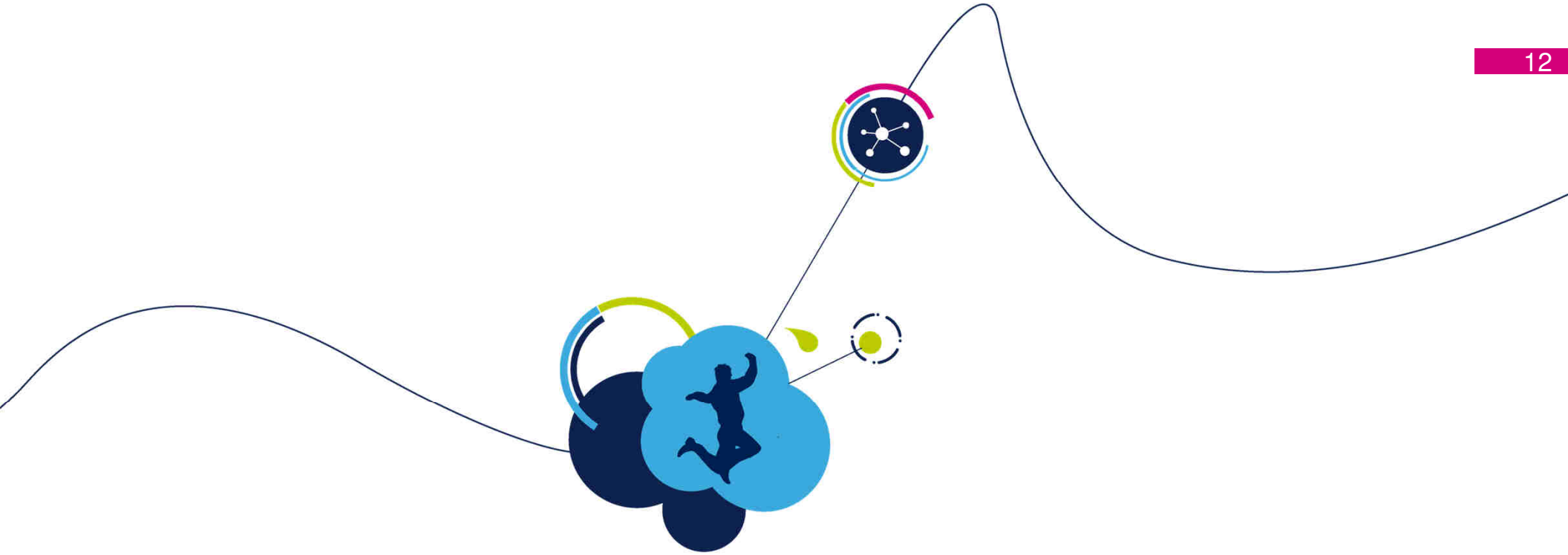

# STM32 Graphics Software and Tools

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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!


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# 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

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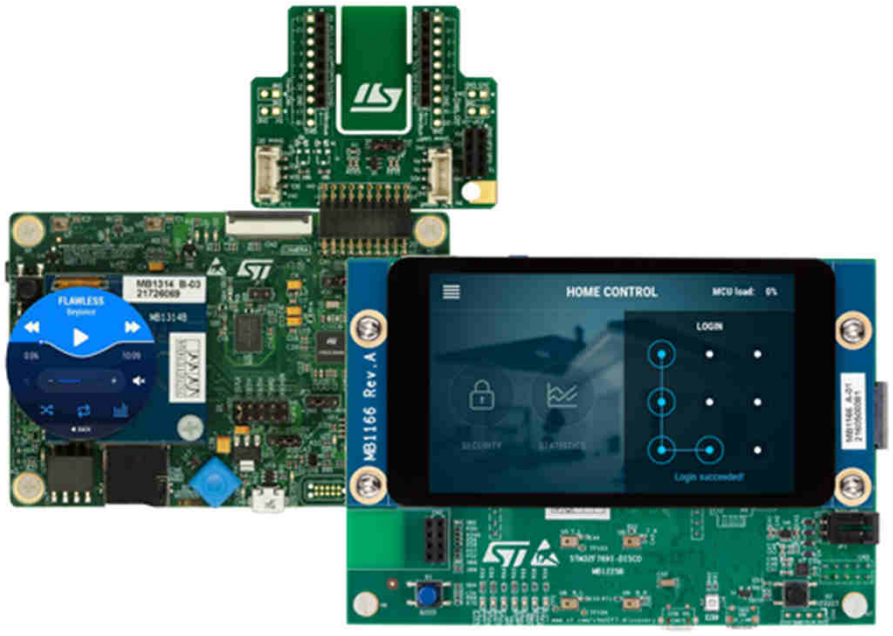
TouchGFX

# 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 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

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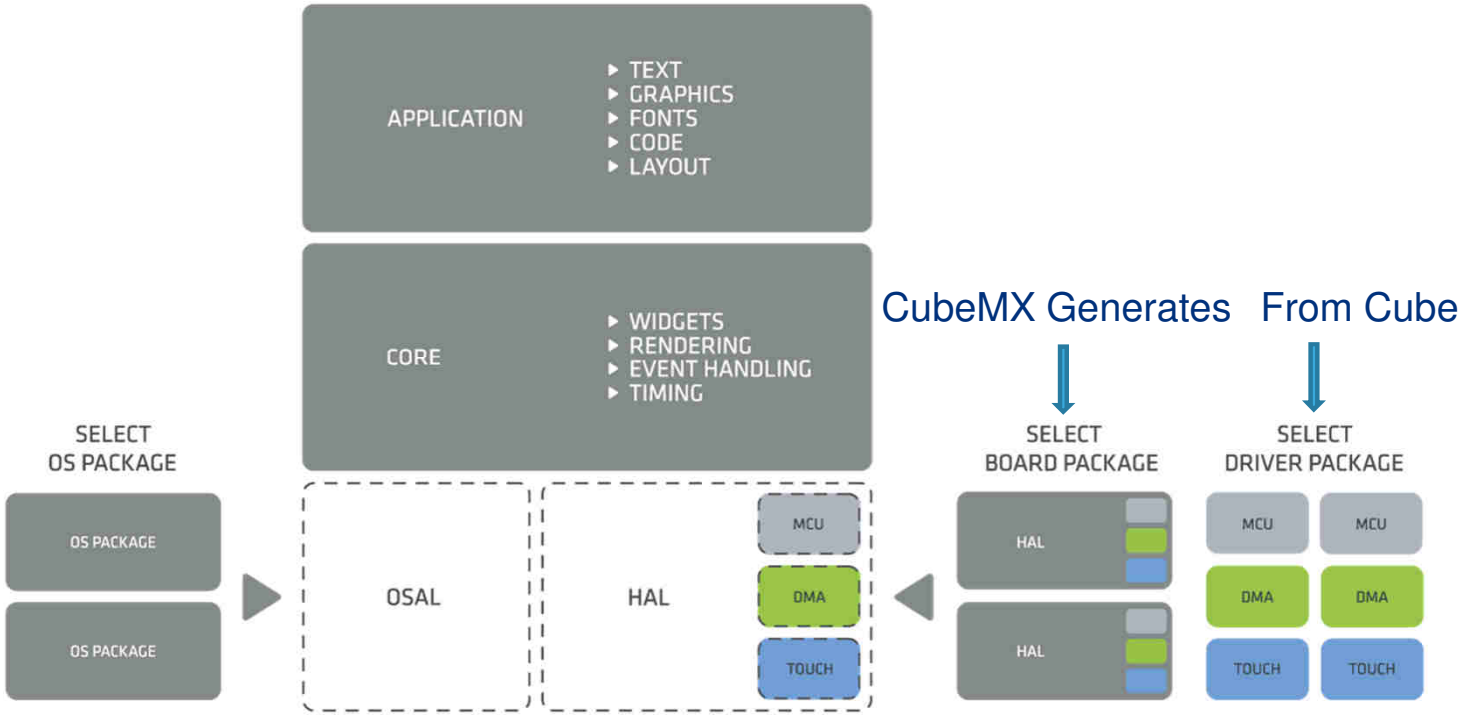
TouchGFX

# TouchGFX Application Components

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

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