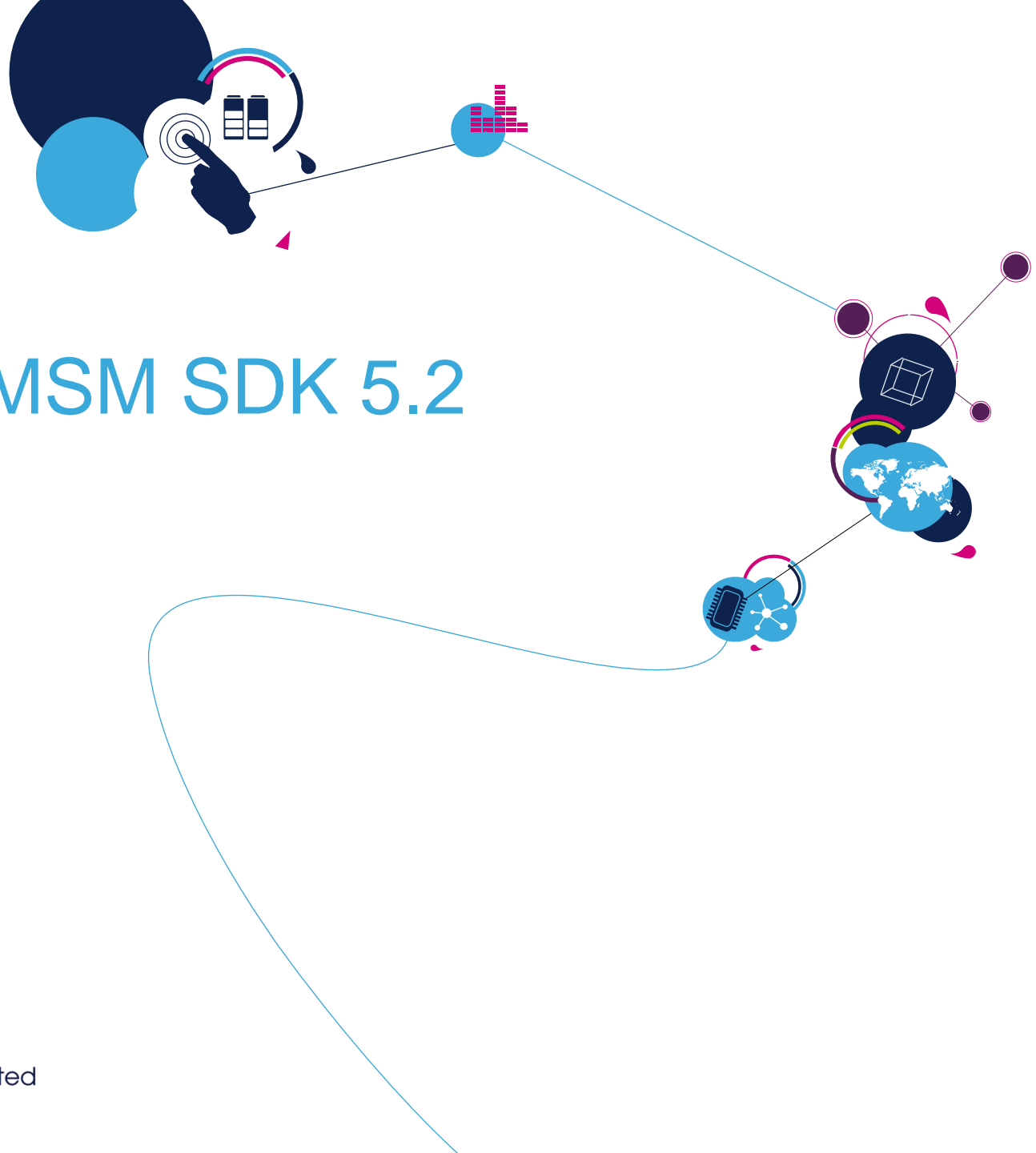


# STM32 PMSM SDK 5.2 training

T.O.M.A.S. team

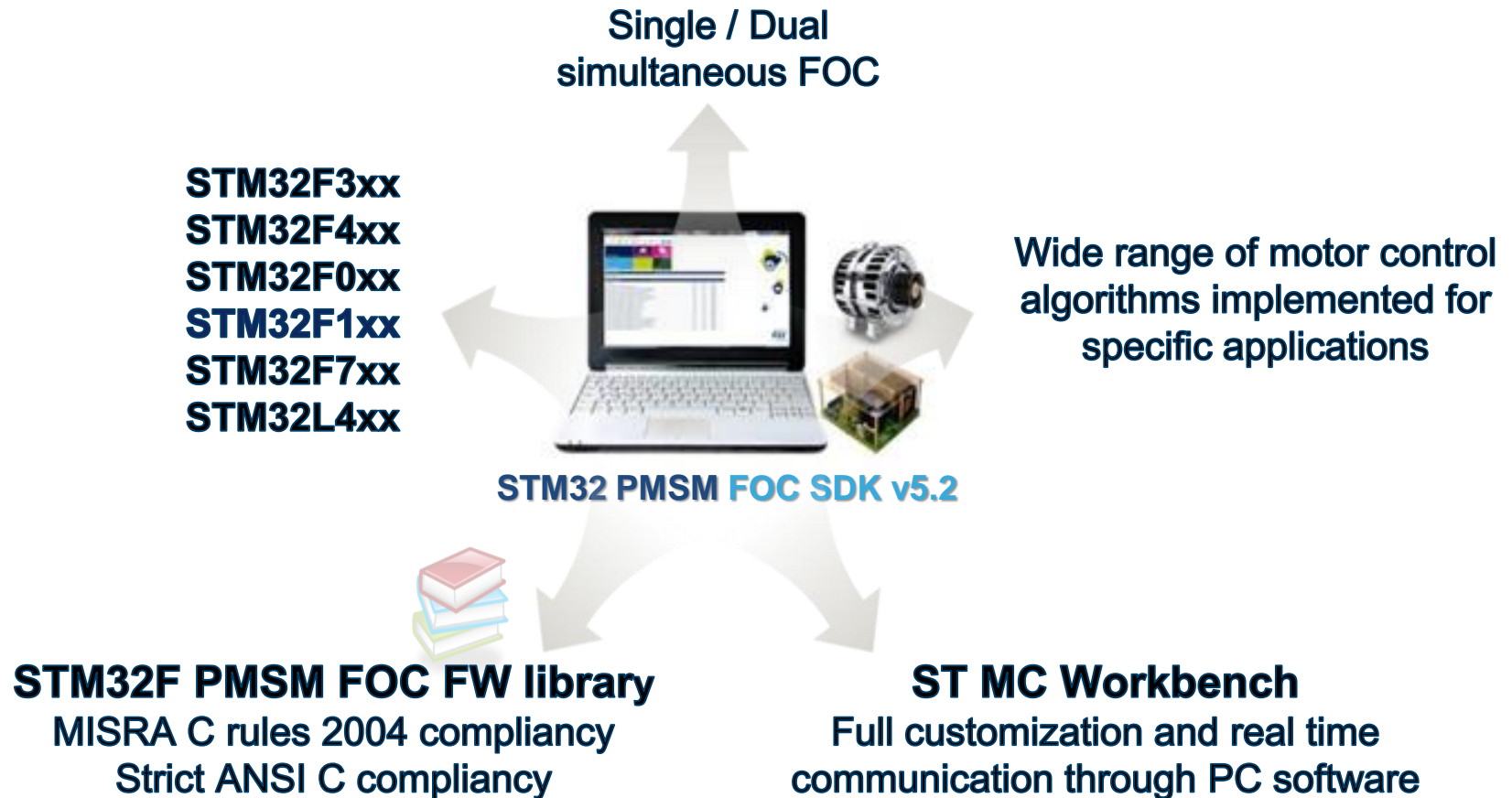


# STM32 3phase PMSM MC library overview



# STM32 MC SDK v5.2

- **X-CUBE-MCSDK** - includes the **PMSM FOC FW library** and **ST MC Workbench (GUI)**, allowing the user to evaluate ST products in applications driving single or dual Field Oriented Control of 3-phase Permanent Magnet motors (**PMSM**), featuring **STM32F3xx**, **STM32F4xx**, **STM32F0xx**, **STM32F1xx**, **STM32F7xx**. **STM32L4xx**

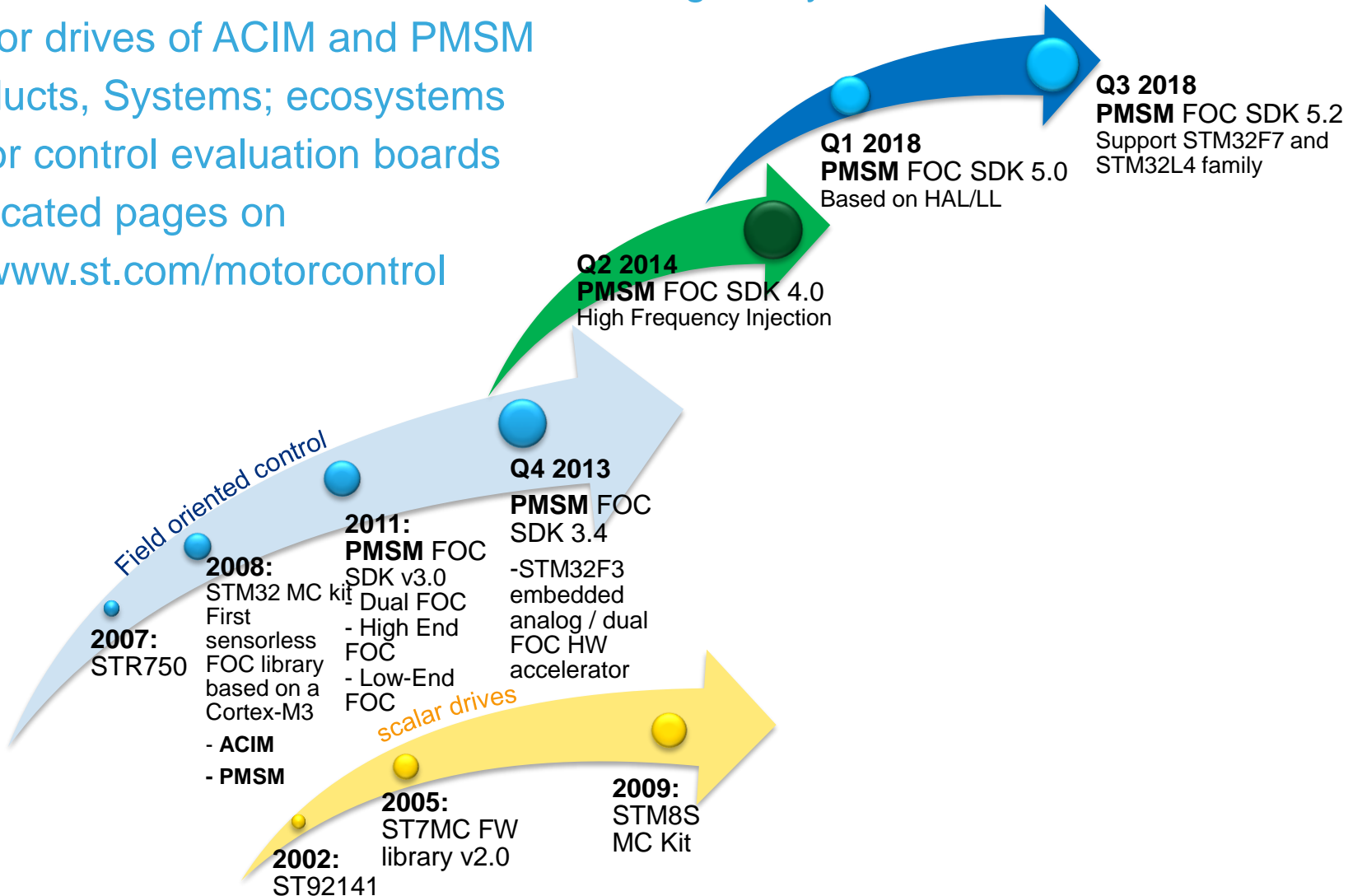


# 16 years of 3-phase motor drives @ ST

ST is focusing 3-phase motor control since 2002

- Scalar drives of ACIM and Permanent Magnet Synchronous Motors
- Vector drives of ACIM and PMSM
- Products, Systems; ecosystems
- Motor control evaluation boards
- Dedicated pages on

[www.st.com/motorcontrol](http://www.st.com/motorcontrol)

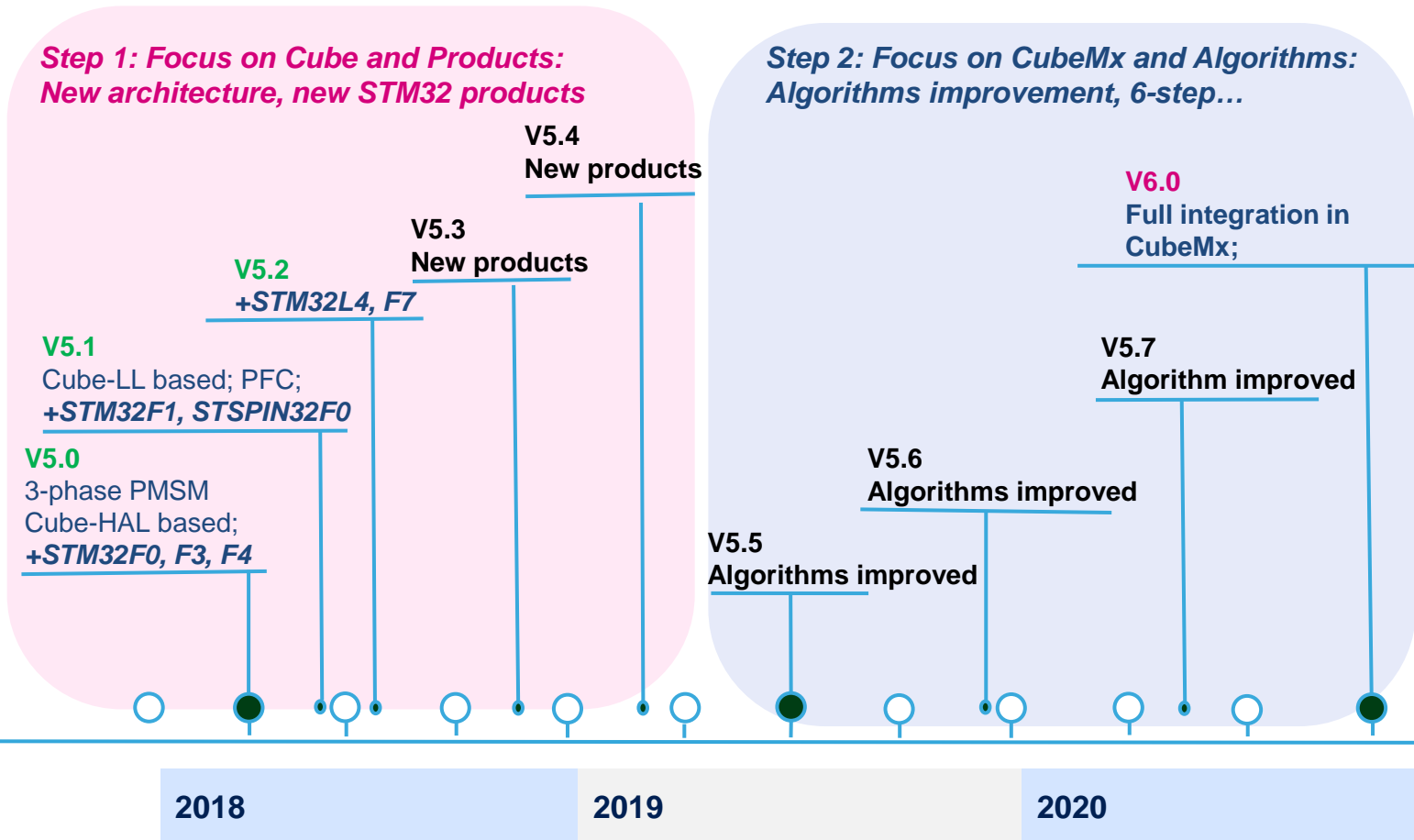




# Motor Control SDK – Roadmap

**Step 1: Focus on Cube and Products:**  
*New architecture, new STM32 products*

**Step 2: Focus on CubeMx and Algorithms:**  
*Algorithms improvement, 6-step...*



# Motor Control Offer @ ST

*Efficient motor control solutions*

## Motor Control

Motion Control  
Industrial  
Drives



Robotics, HVAC,  
pumps, CNC.

Home  
appliances



White Goods,  
Refrigerators,  
Room air conditioning

New  
applications



Fitness,  
Healthcare,  
Pedelec and more

## A complete offer of ST devices

(IPMs) SLLIMM™

Diodes

Power  
transistors

Gate Drivers

Control  
unit

AC switches

Sensors

Motor driver ICs

Power  
Management



## Motor Control libraries



# FOC single or dual motor for higher performance

- **Target applications:**

- Wide range from home appliances to robotics, where:
  - Accurate and quick regulation of motor speed and/or torque is required (e.g. in torque load transient or target speed abrupt variations)
  - CPU load granted to motor control must be low, due to other duties



**STM32F103**   **STM32F3xx**   **STM32F4xx**   **STM32F7xx**   **STM32L4xx**



Games



Industrial motor drives



Fitness, wellness and healthcare

And much much more...



Home appliances



Power tools



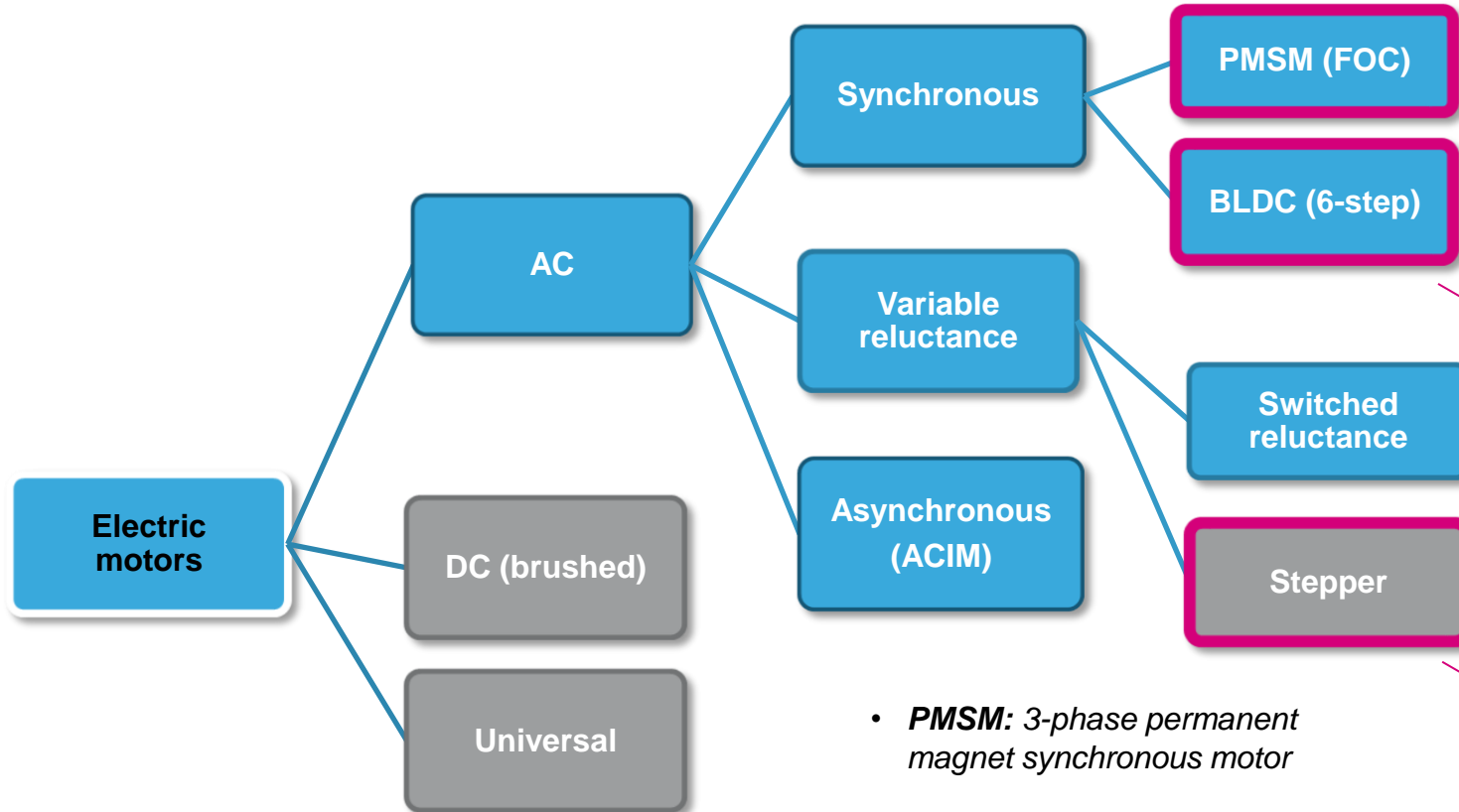
Escalators and elevators

# Electric Motor: Classification

Software Development Kit (SDK)

Software Examples

Software Examples



- **PMSM**: 3-phase permanent magnet synchronous motor
- **ACIM**: 3-phase induction motor

Limited computation need,  
Basic ADC/PWM requirements

Complex driving,  
Computation intensive,  
Requires 3-phase timer + sync'd ADC,

STM32/STM8  
solution  
offer



# Putting together: libraries..products..applications

## High-end, single and dual MC

- **FOC:** High dynamic performances
- High Frequency Injection sensorless
- Light CPU load, to make room for application specific algorithms
- Up to two motor controlled at the same time

FOC Motor control FW libraries

STM32F7xx  
217MHz Cortex-M7

STM32F4  
180MHz Cortex-M4

STM32L4  
80MHz Cortex-M4

STM32F3xx  
72MHz Cortex-M4

STM32F103  
72MHz Cortex-M3

STM32F0xx  
48MHz Cortex-M0

STM32F100  
24MHz Cortex-M3

## Medium end

- **Vector control (FOC)** algorithm for most efficient motor operations
- Silent operation thanks to sinusoidal motor current
- Cost optimized HW requirement (1shunt-resistor current reading, sensor-less operations )

Motor control FW libraries

## Low-end

- **Scalar controls**
- Cost optimized overall solution

STM8S  
24MHz ST core

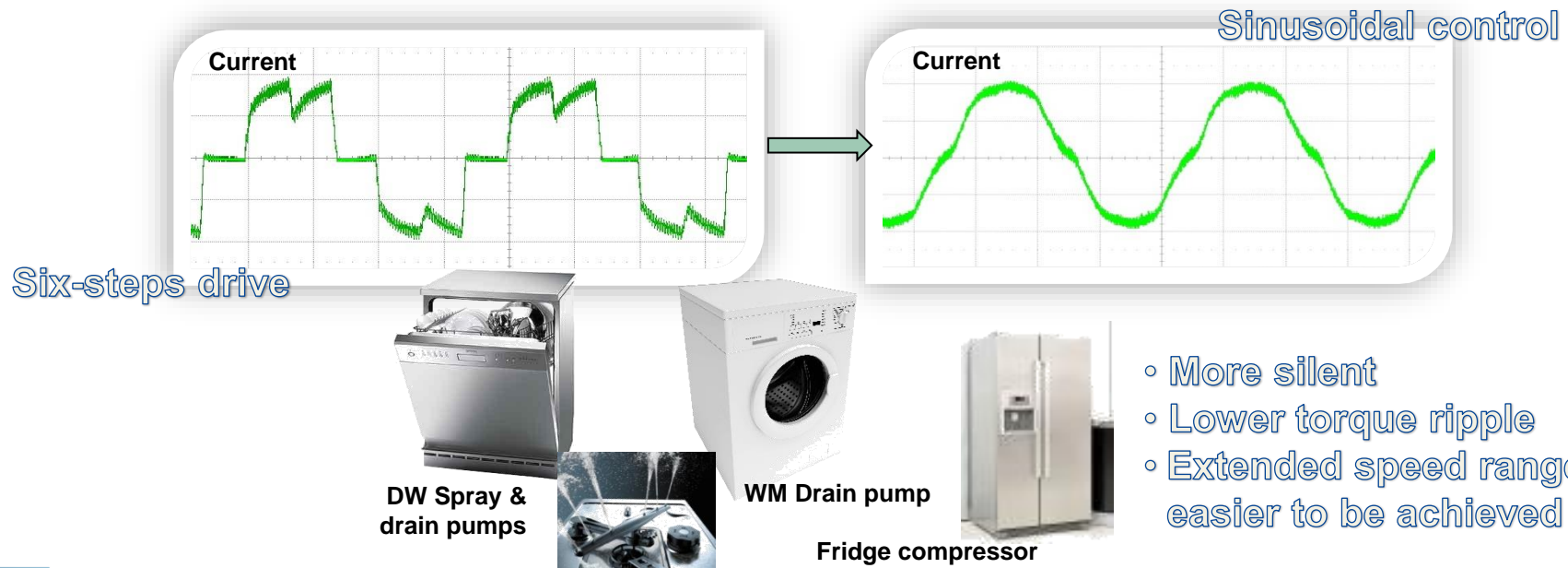


# FOC single motor for budgetary applications

## • Target applications:

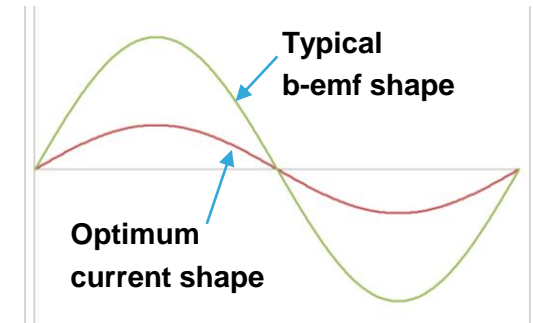
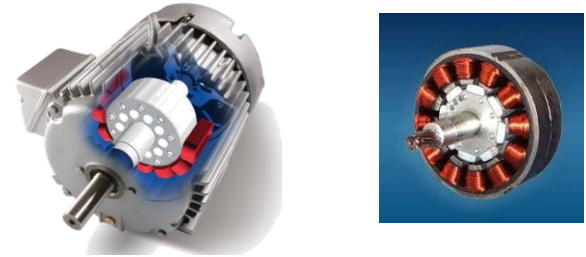
- All those applications where:
  - Dynamic performance requirements are moderate
  - Quietness of sinusoidal current control (vs six steps drive) is valuable
  - Extended speed range is required
- Particularly suitable for **pumps, fans and compressors**

**STM32F100x**  
**STM32F0xx**



- **Permanent Magnet Synchronous Motor (PMSM)**

- Stator is the same as AC IM: three phase windings
- Rotor houses permanent magnets
  - on the surface → Surface Mounted (SM) PMSM
  - Buried within the rotor → Internal (I) PMSM
- Stator excitation frequency must be synchronous with rotor electrical speed
- Rotation induces sinusoidal Back Electro-Motive Force (BEMF) in motor phases
- Gives best performances (torque steadiness) when driven by sinusoidal phase current



- **Permanent Magnet BrushLess DC motors (BLDC)**

- Like PMSM - and despite of their name - require alternating stator current
- Like in PMSM, rotor houses permanent magnets, usually glued on the surface
- Like PMSM, stator excitation frequency matches rotor electrical speed
- Unlike PMSM, rotor spinning induced trapezoidal shaped Back Electro-Motive Force (Bemf)
- Gives best performances (torque steadiness) when driven by rectangular-shaped currents

