Developer Day

XMC technical presentation & Introduction to DAVE

Agenda

- XMC Family - XMC technical presentation

- Introduction to DAVE

XMC4000
Benchmark Peripheral Set

ARM® Cortex™-M4 & Floating Point Unit

DEBUG

System Timer

Real Time Clock

DMA

Memories

Communication

- Ethernet
- USB
- SD/MMC card I/F
- CAN
- External Memory I/F
- USIC (Serial communication)

Timer & Actuator Control

- CCU4
- CCU8
- High Resolution PWM
- Position Interface
- ΔΣ Demodulator
- ERU

Analog & Mixed Signal

- ADC
- DAC

HMI

- Capacitive Touch
- LED Matrix
- Ports

Safety/Reliability

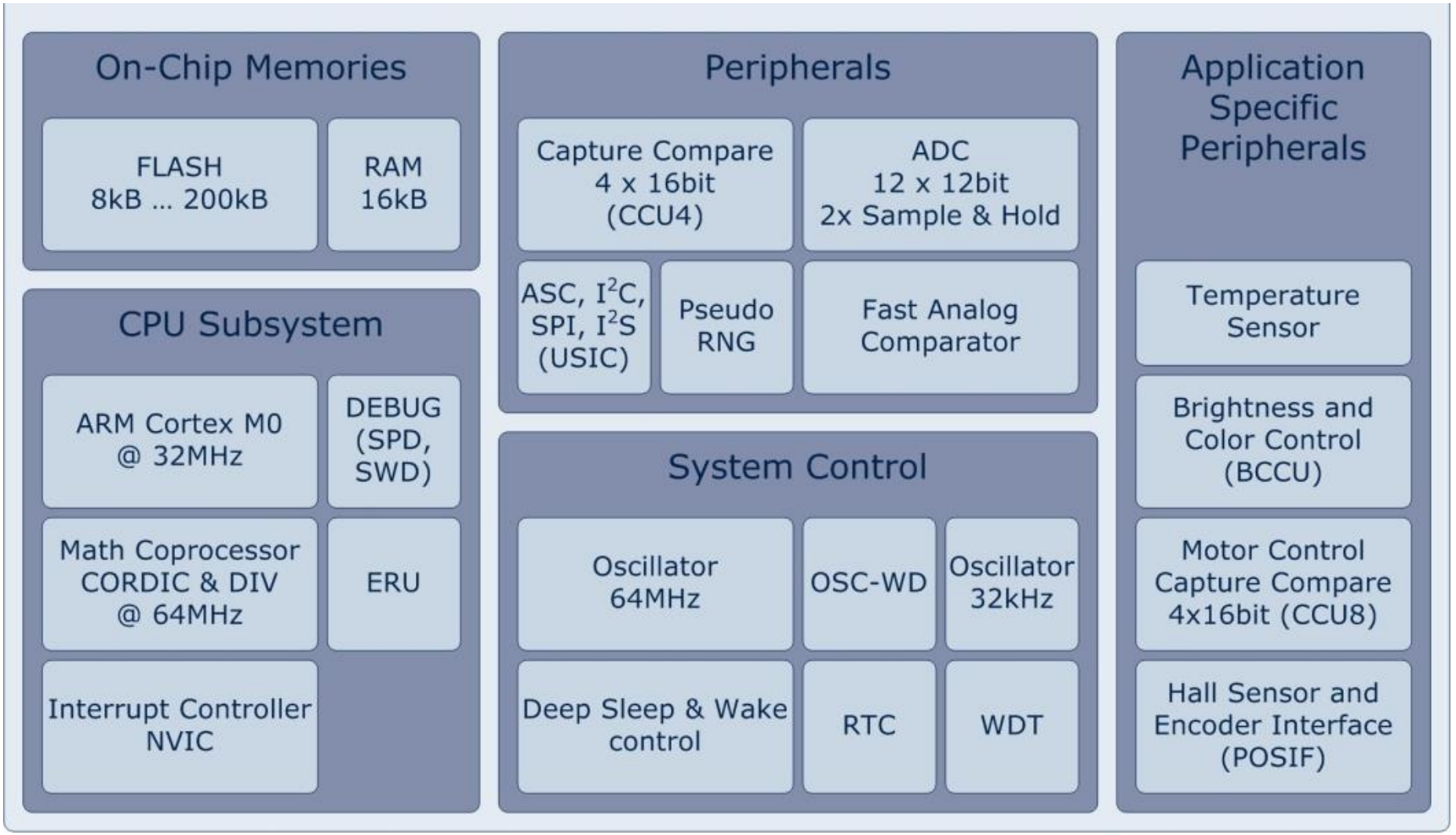
- Data protection through ECC/Parity
- CRC & Random Pattern generation

Infineon innovation

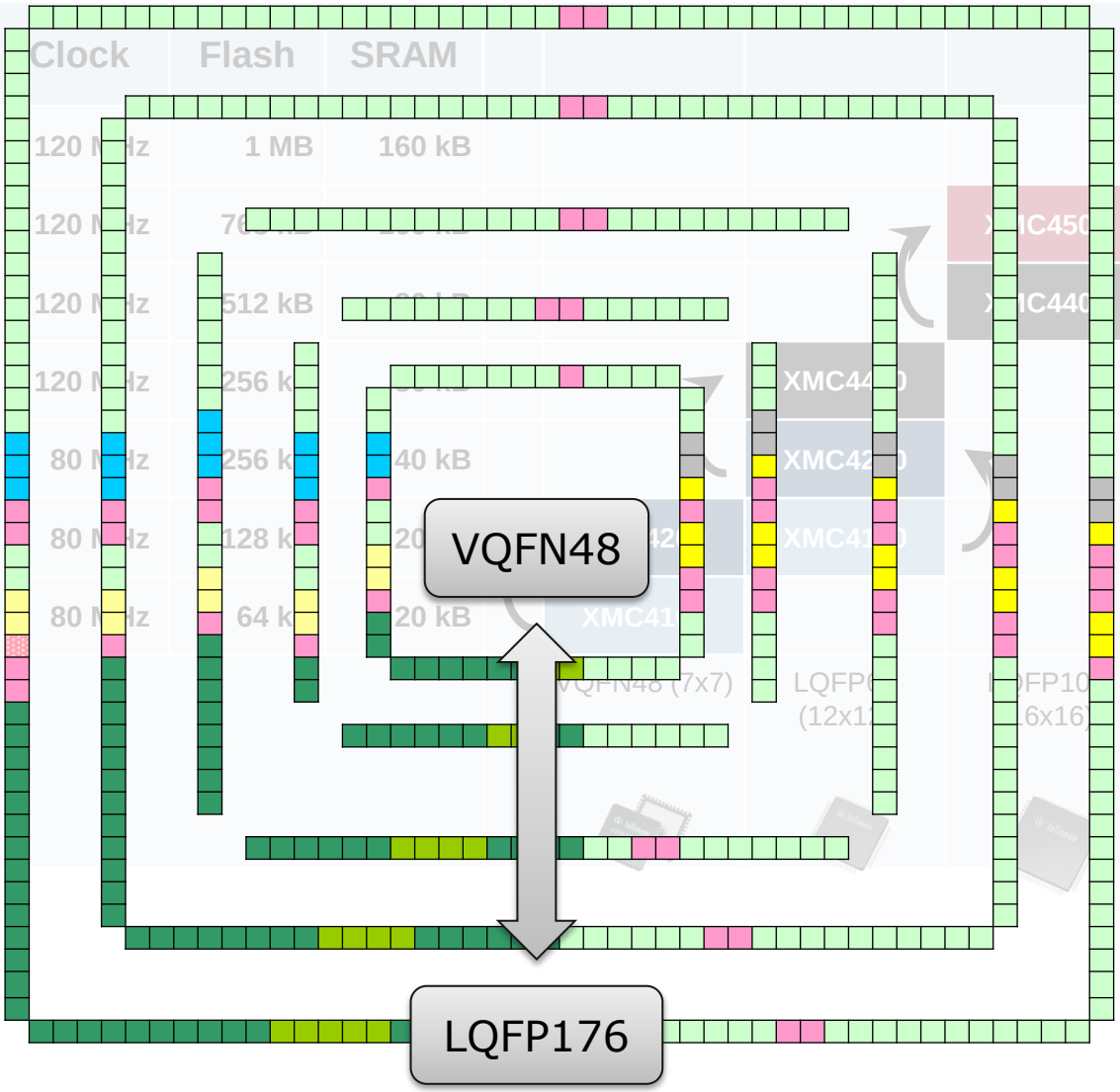
Infineon state-of-the-art

Standard

XMC1000
Feature Sets



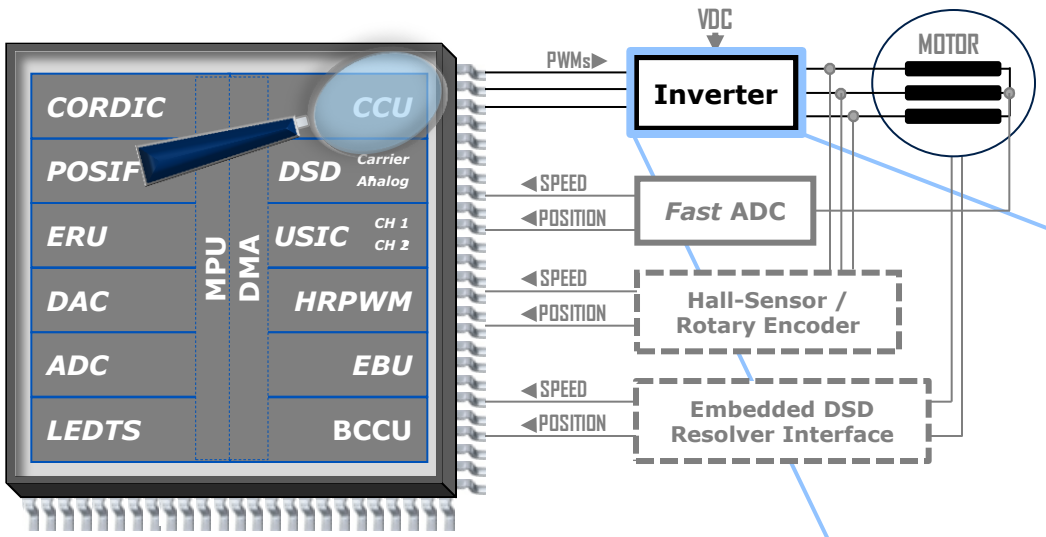
XMC scalability, Example XMC4000
Pin Compatibility and Scalable Port Mapping

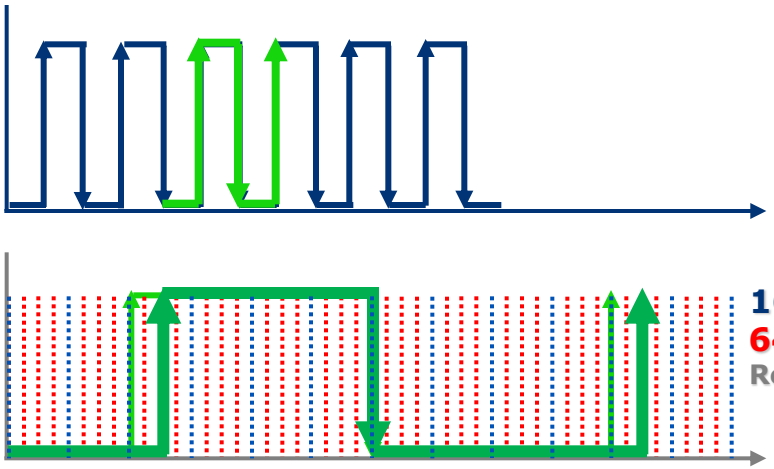


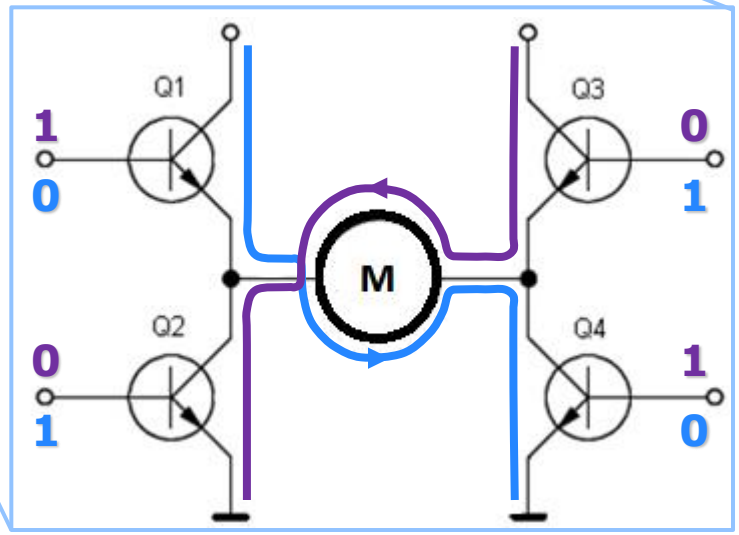
- Late change during development & market introduction
- Easy layout generation for PCB variants with placement options

Analog
Analog Ref.
Debug
USB
XTAL, RESET
Supply

Capture Compare Unit – various HW support capabilities

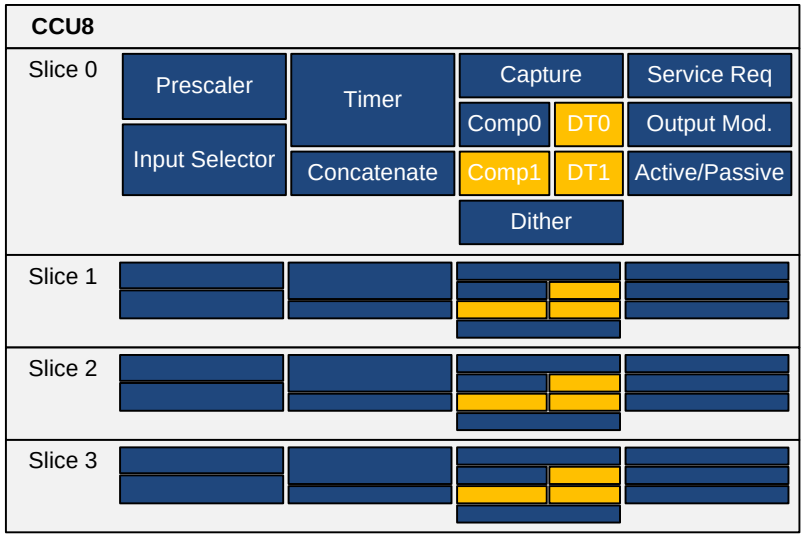


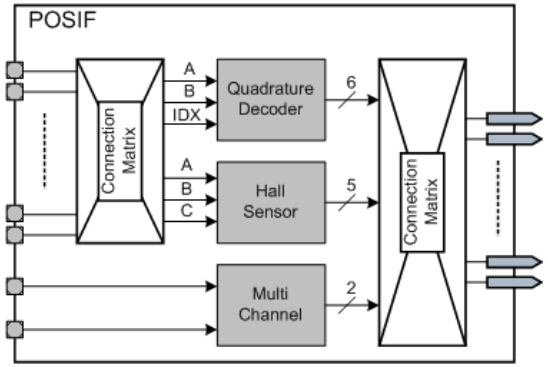




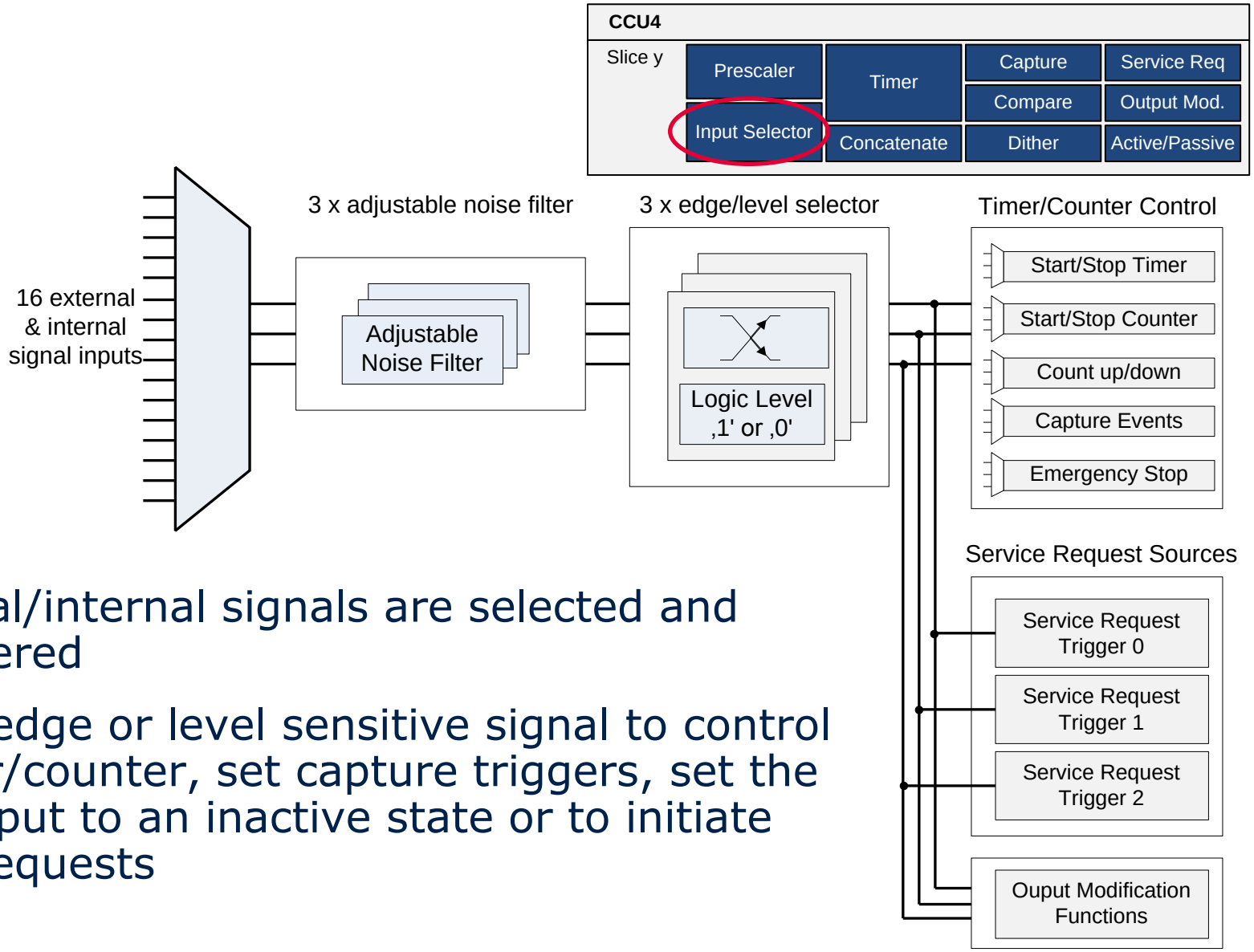
Capture Compare Unit

- Timer modules with 4 identical timer slices
  - ¬ independent or concatenated 16...64Bit timer resolution
- All types of PWM signals
  - ¬ individuals dead times
  - ¬ dithering for PWM
- Diverse capture triggers
- CCU8 can drive 3-level-inverter
- POSIF - position & speed interface
  - ¬ hall sensor & encoder interface
  - ¬ control signals for CCU
  - ¬ quadrature encoder





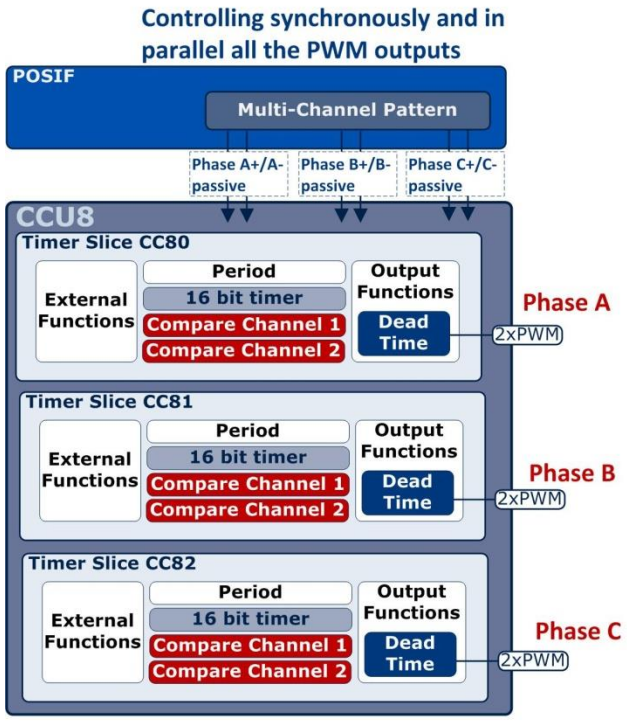
Capture Compare Unit – Input Signals

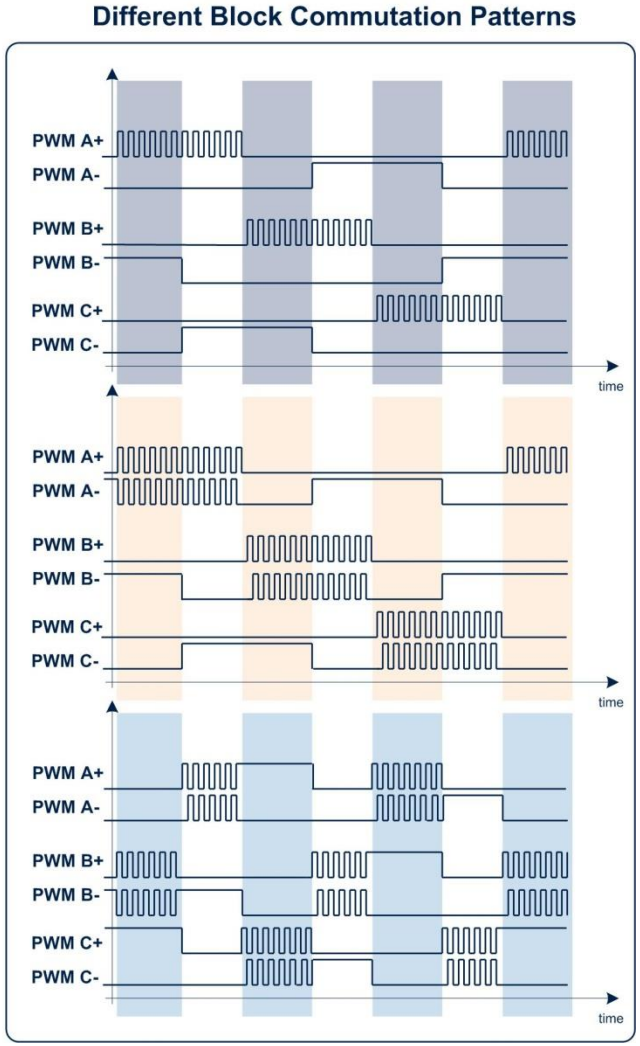


- 3 external/internal signals are selected and noise filtered
- Used as edge or level sensitive signal to control the timer/counter, set capture triggers, set the PWM output to an inactive state or to initiate service requests

Application Example
PWM for Motor Control

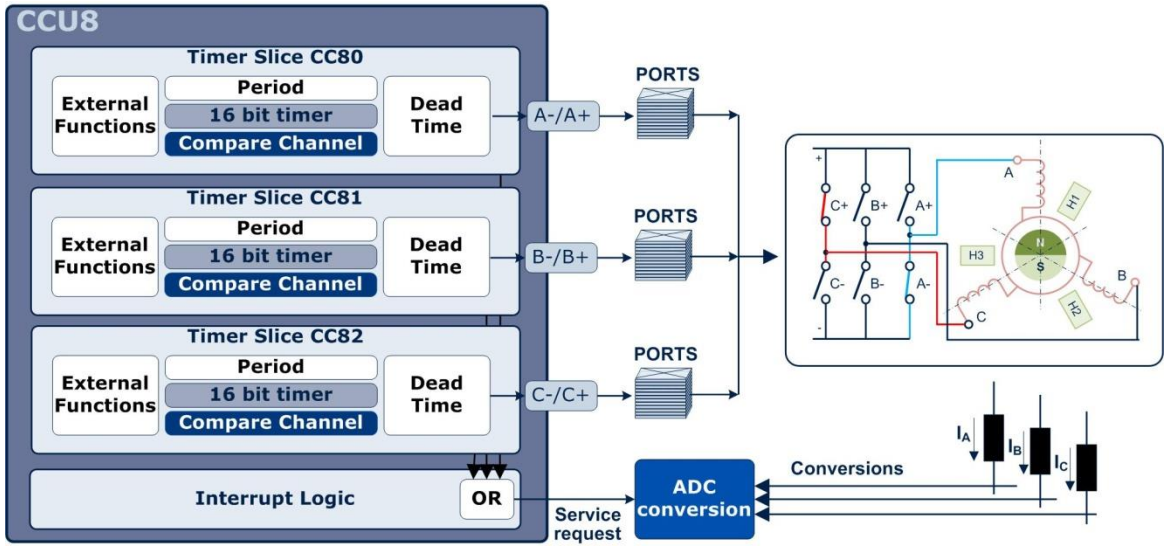
- Several block commutation pattern schemes can be controlled by the CCU8
- Link between CCU8 and POSIF interface gives flexibility for any type of output pattern generation.





Application Example Block Commutation PWM Generation: Timing Diagram

Application Example
ADC triggering with Service Requests



Overview

It may be necessary in some applications to generate several ADC conversion triggers synchronized with a PWM signal.

In a motor control application it may be necessary to measure several shunt currents in each PWM cycle.

The CCU8 offers a way to compress all the conversion triggers to the ADC via just one signal. This enables a better optimization of resources and connectivity.

In Brief

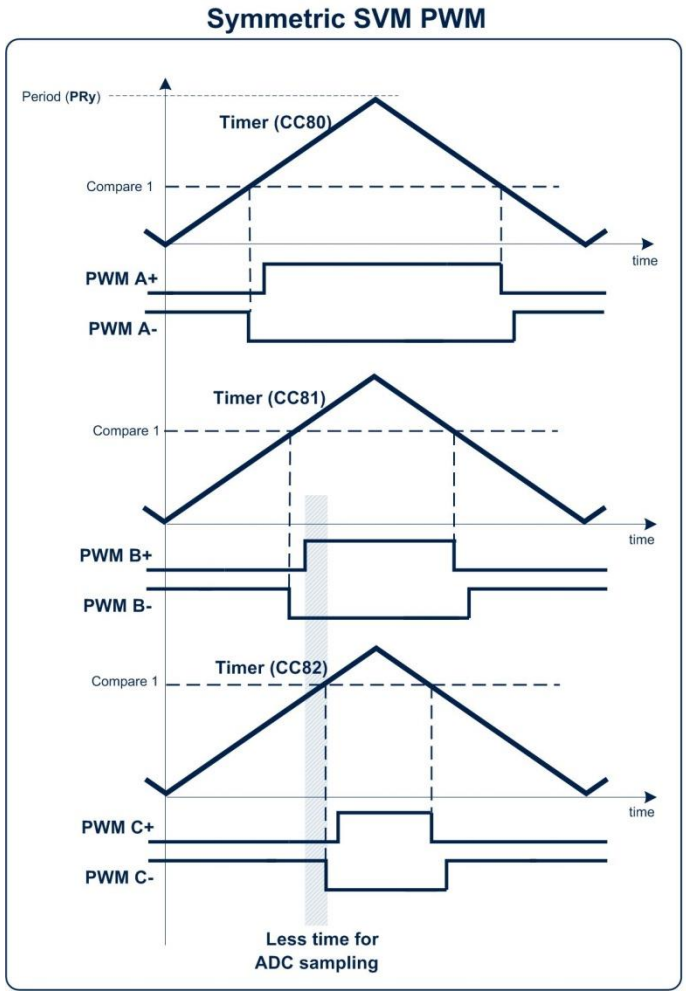
- Using the Service Requests to compress ADC triggers

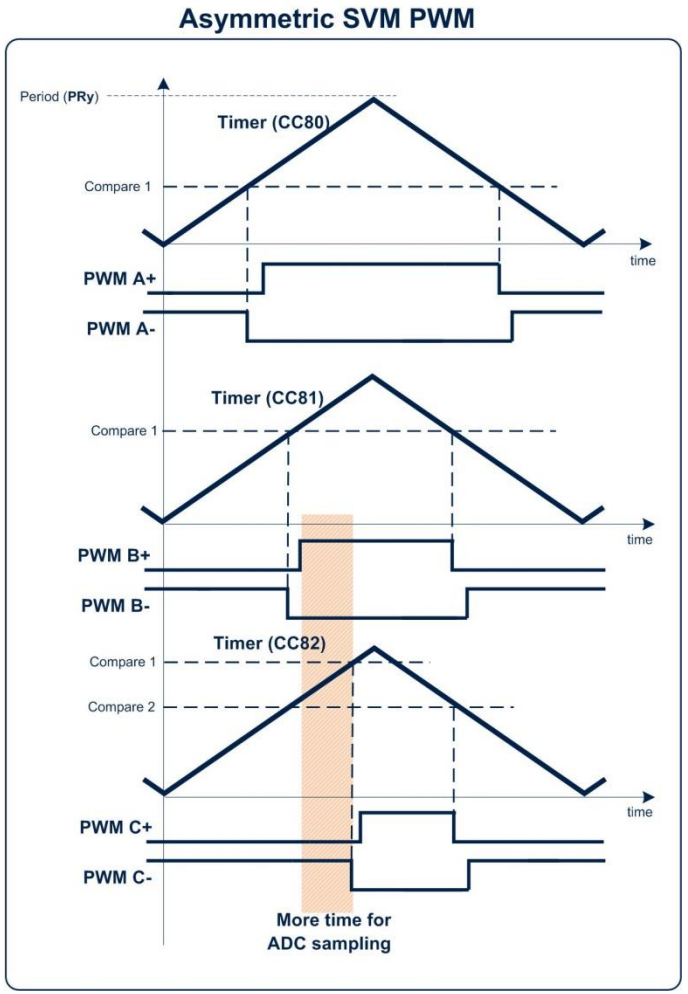
Application Example
PWM for Motor Control

SVM pattern generation can be done in a **symmetric or asymmetric way**

In asymmetric fashion one timer per phase is needed.

Asymmetric way gives more flexibility for sampling shunt currents via the ADC.





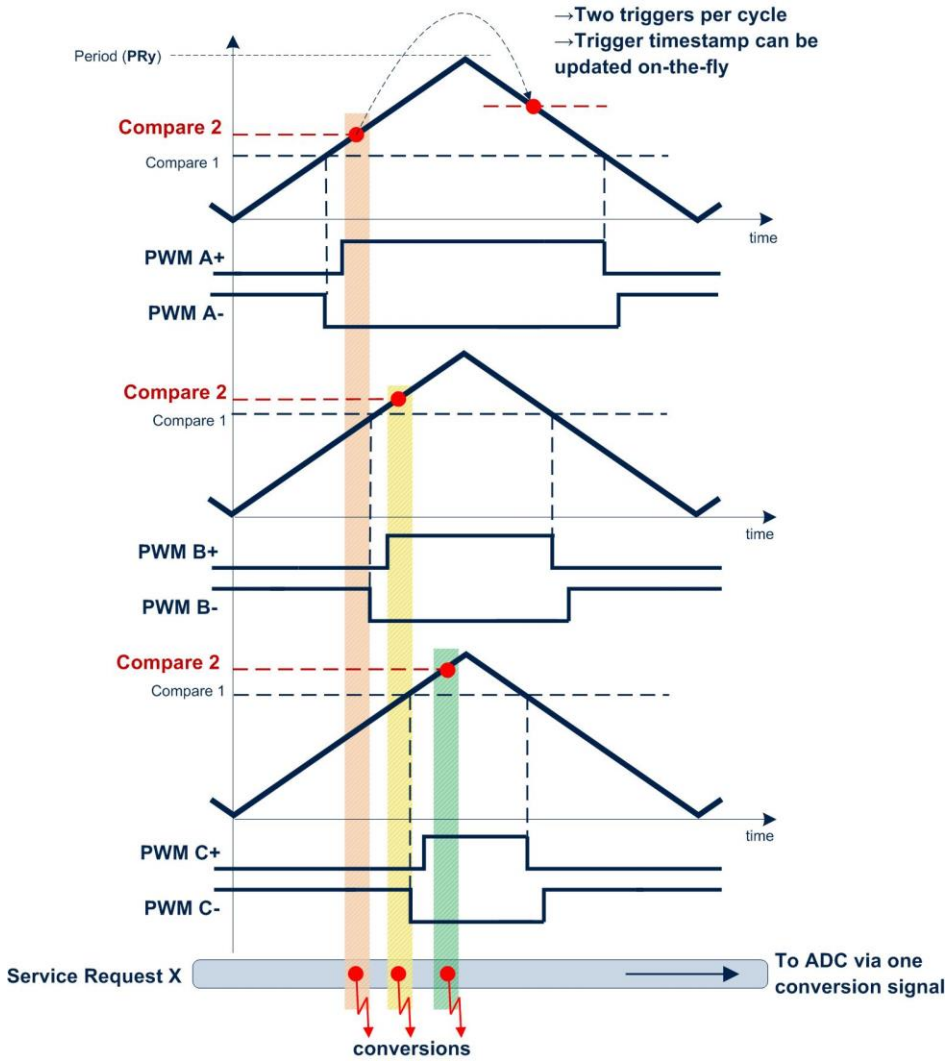
Application Example SVM Pattern Generation: Timing Diagram

Application Example
Signal Compression with Service Requests

In this example, we are using **the second compare of each Timer Slice to trigger a delayed conversion trigger** to the ADC.

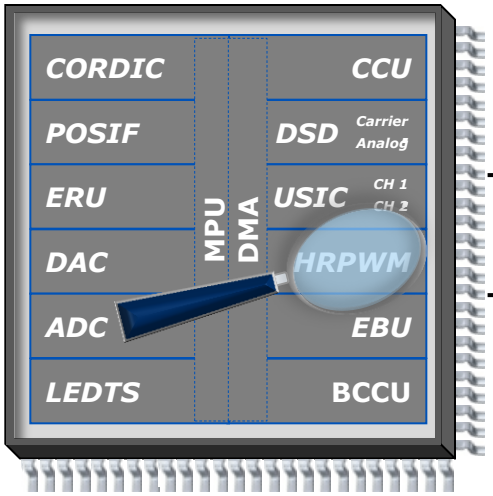
All the triggers are grouped together in a Service Request line.

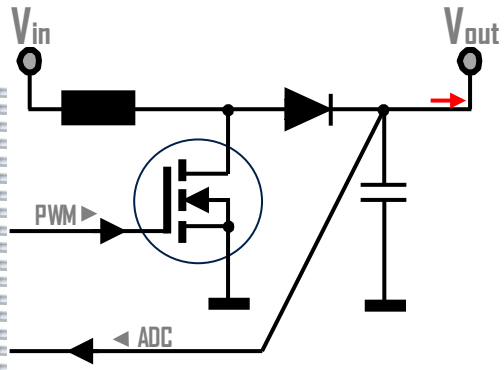
Additionally, **the conversion timestamp for the second 180° part of the signals can also be used to trigger a conversion**. This timestamp can be different from the first one.

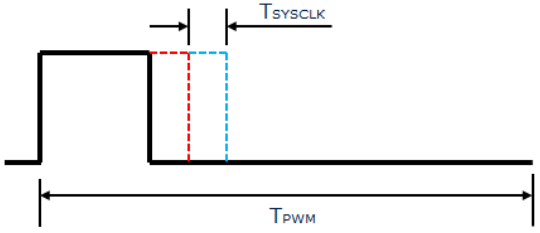


Application Example Grouped Conversion triggers: Timing Diagram

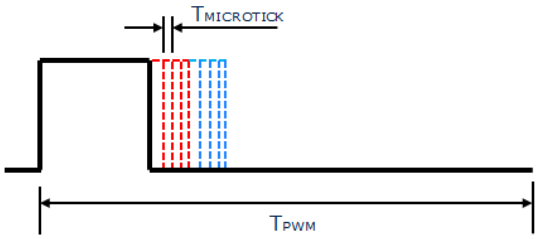
HRPWM vs PWM







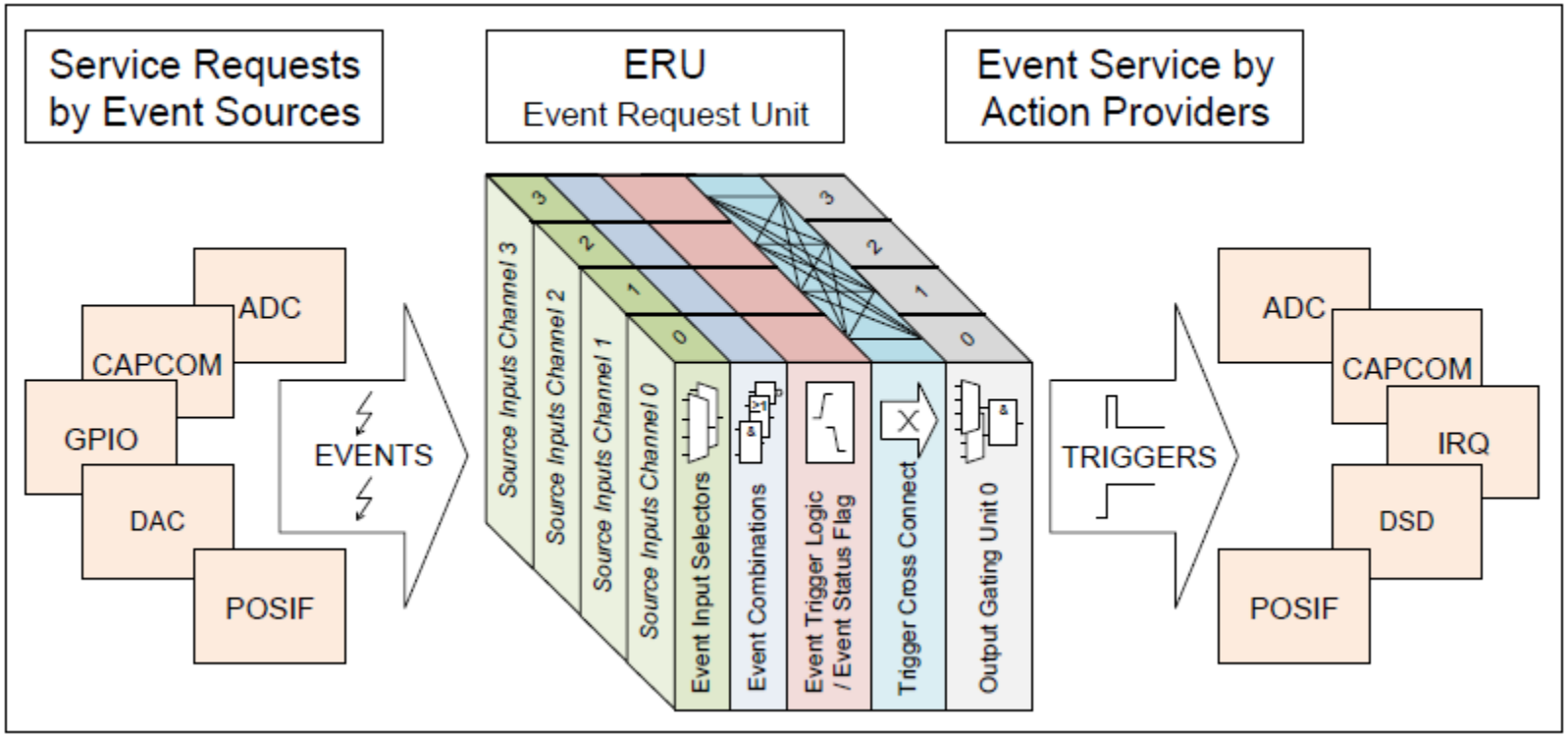
CONVENTIONAL PWM



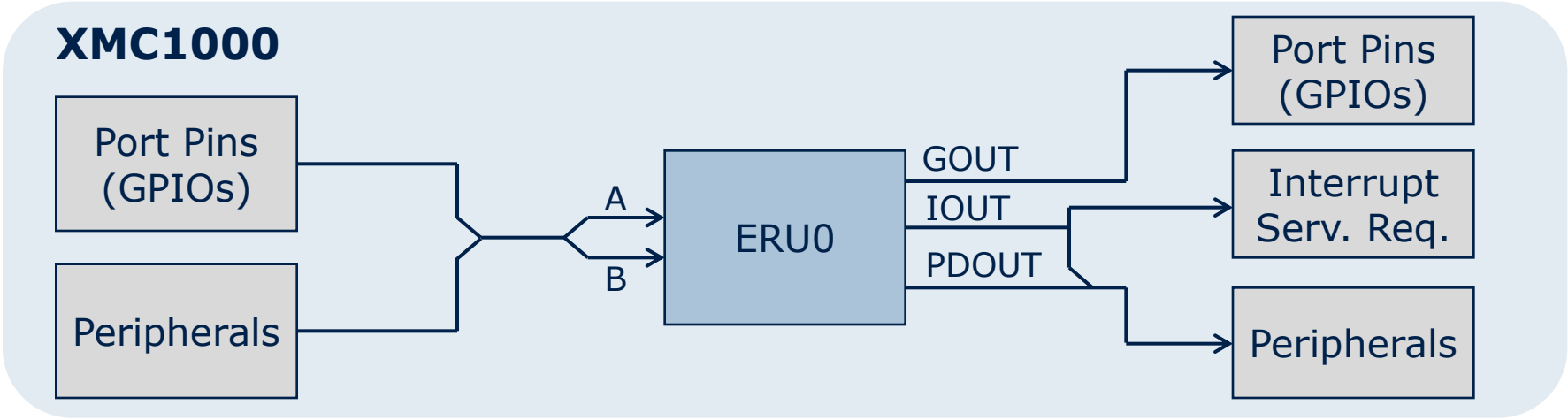
HIGH RESOLUTION PWM

- A digital PWM module with enhanced resolution up to picoseconds (microticks).
- Conventional PWM resolution is limited up to MCU clock frequency, typically in Nanoseconds range
- HRPWM resolution is capable of up to 150ps.

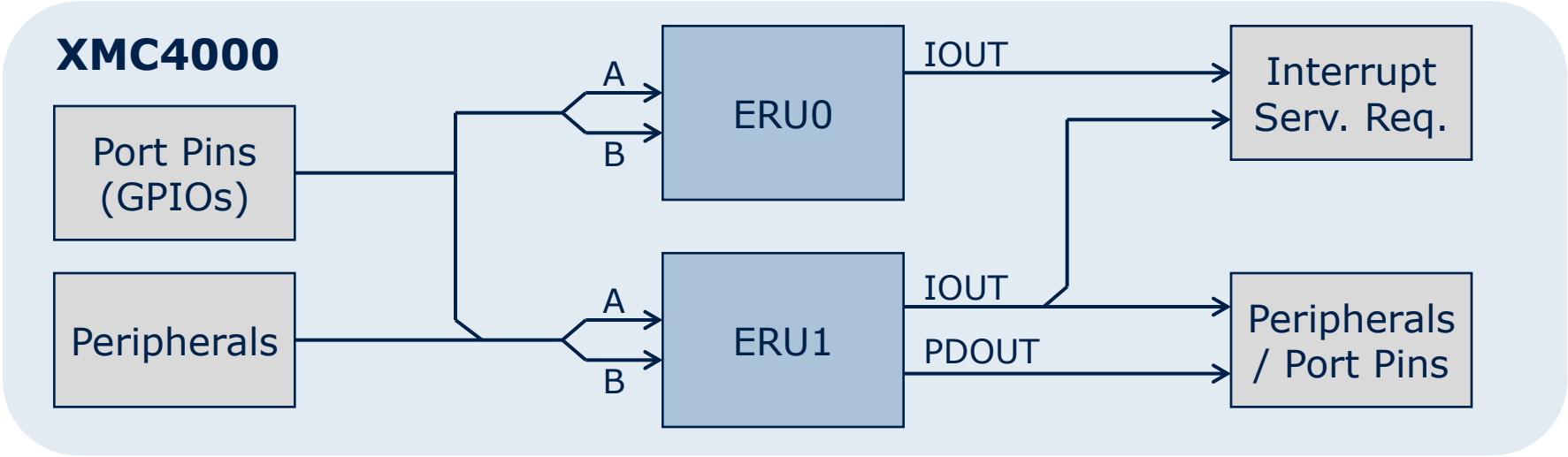
ERU – Event Request Unit



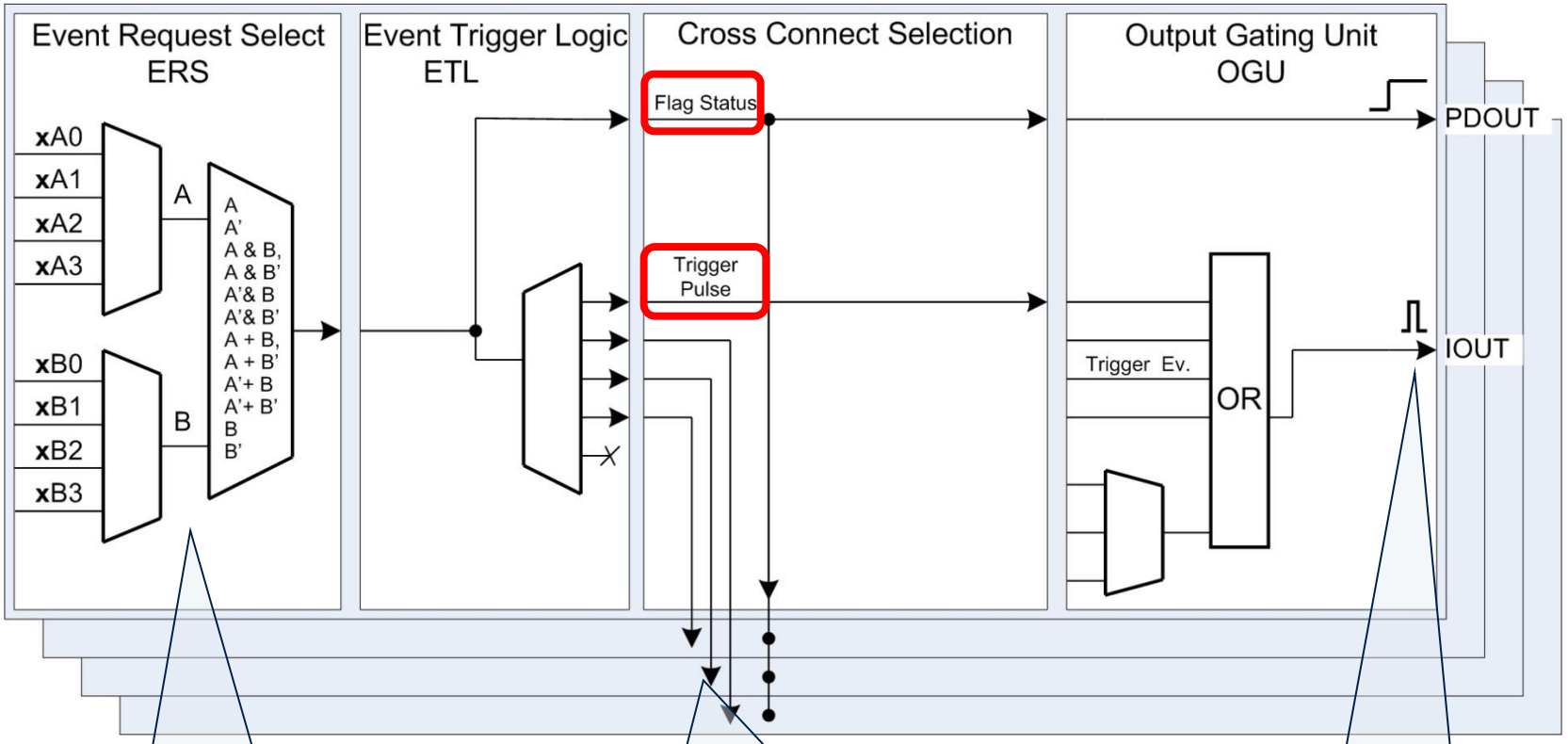
ERU Interconnects Overview



The ERU interconnects modules



ERU - Simplified

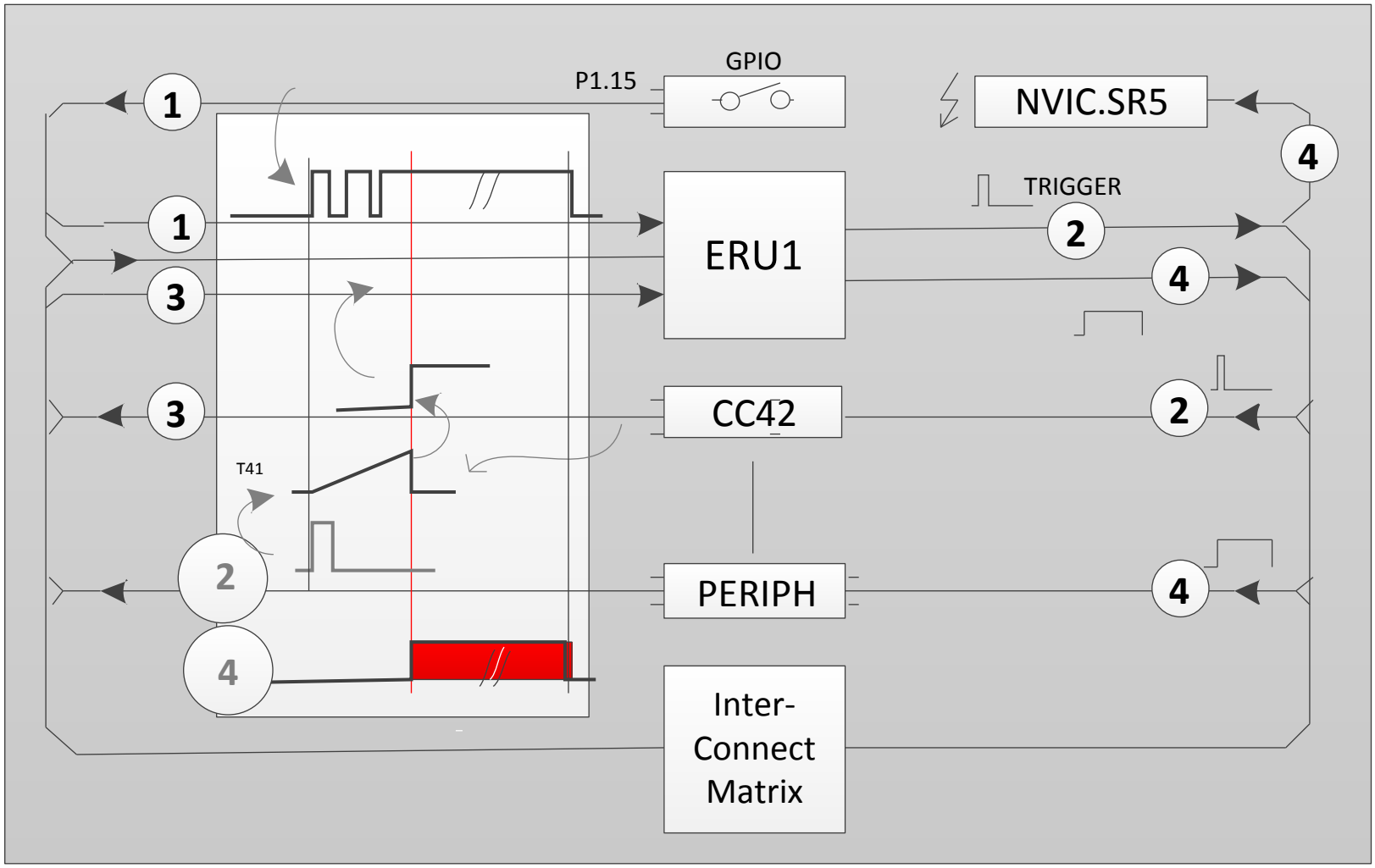


Max two input signals can be selected and combined

Signals can be routed to other 3 OGUs

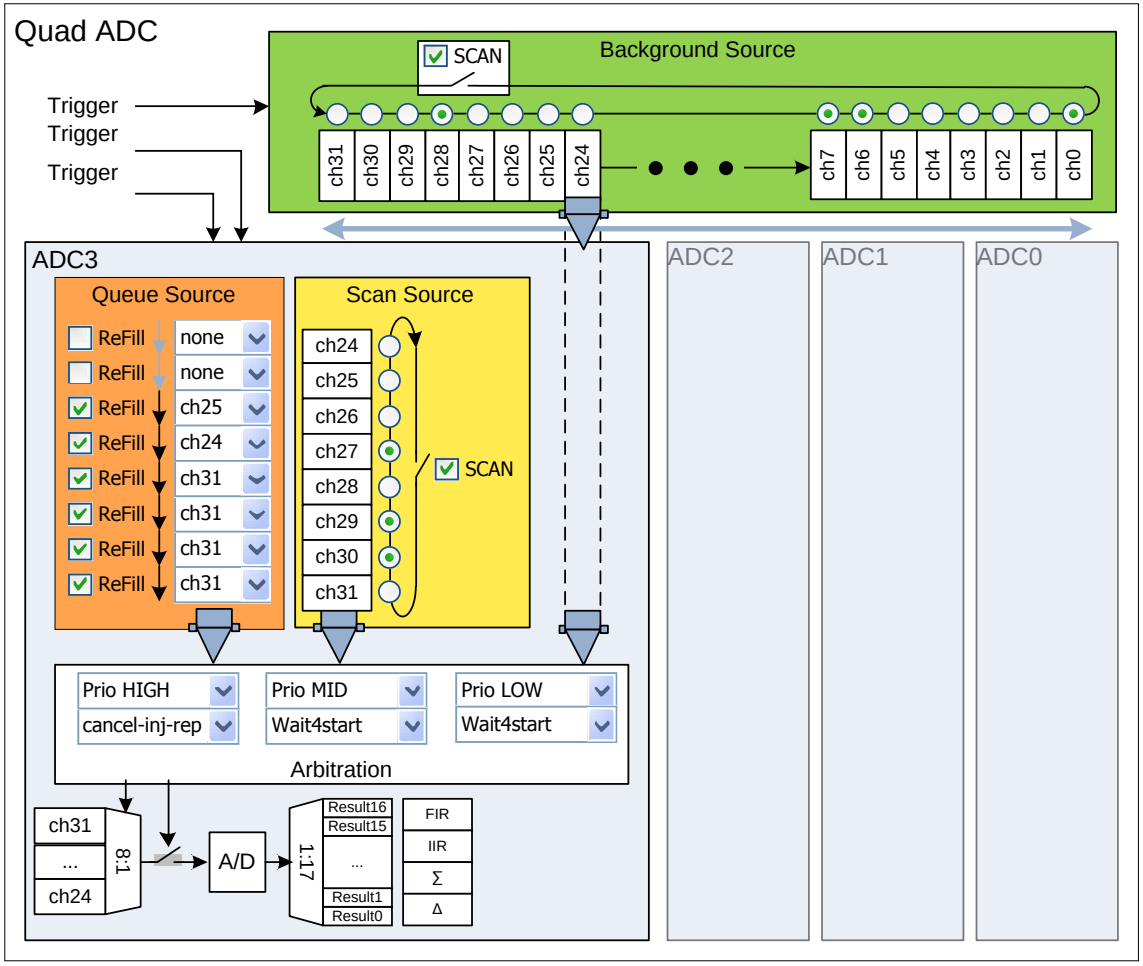
PDOUT: Level Sig.
IOUT: Pulse Sig.

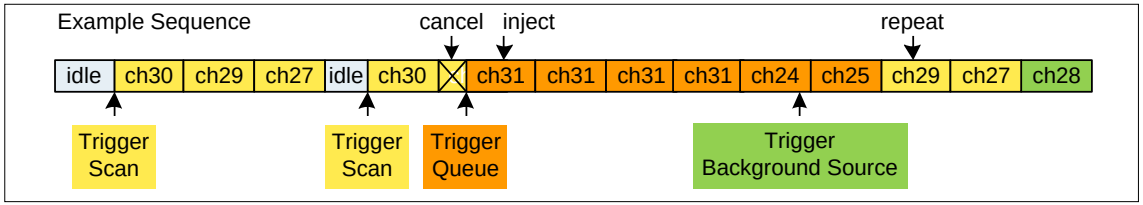
ERU – Use Case ”Debouncing Filter”



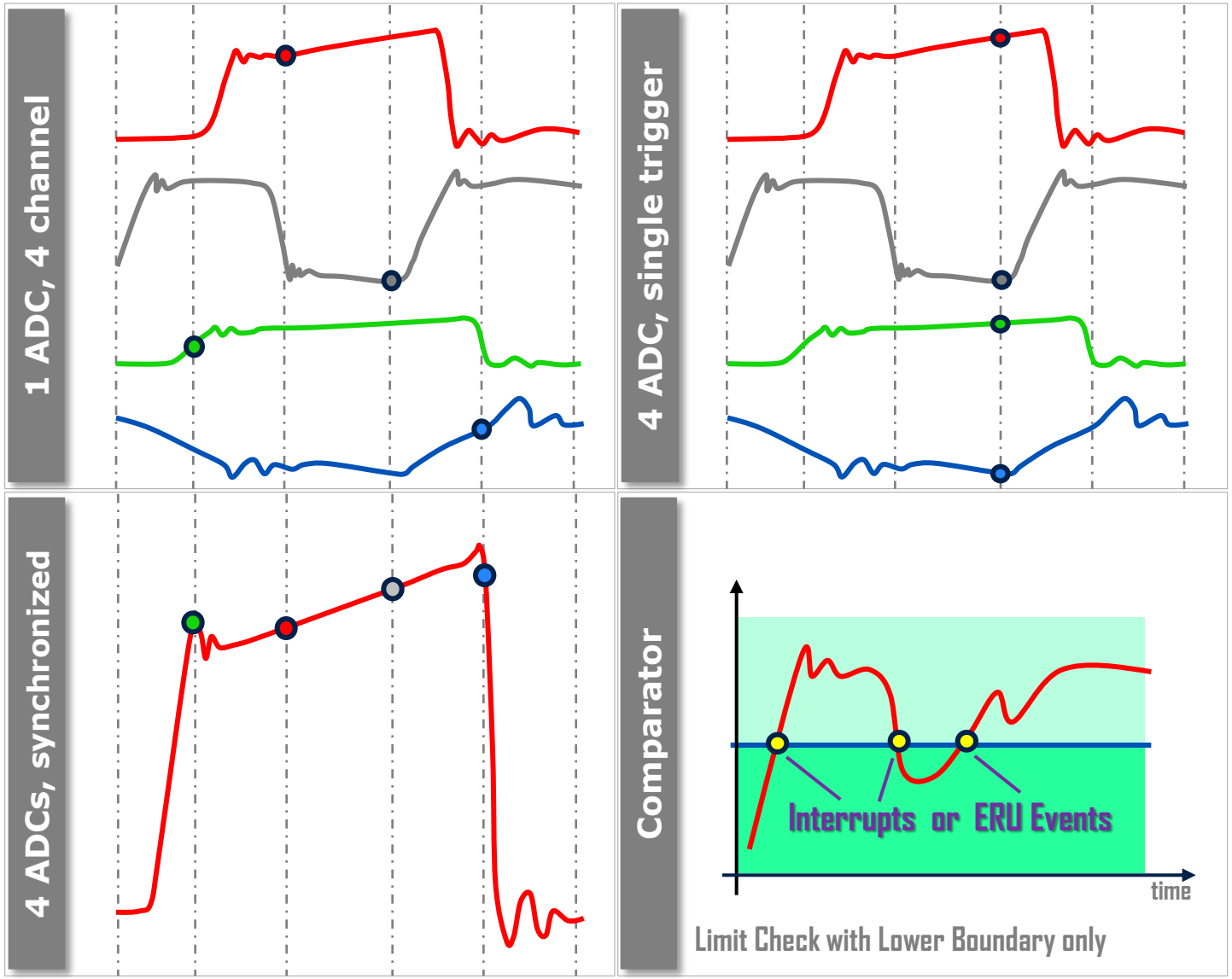
ADC – Trigger Sources

- Queue Source
- Scan Source
- A Background Source
- Filtering for every adc
- Various priorities
- Sync in parallel or in a consecutive
- Boundaries for limit checking

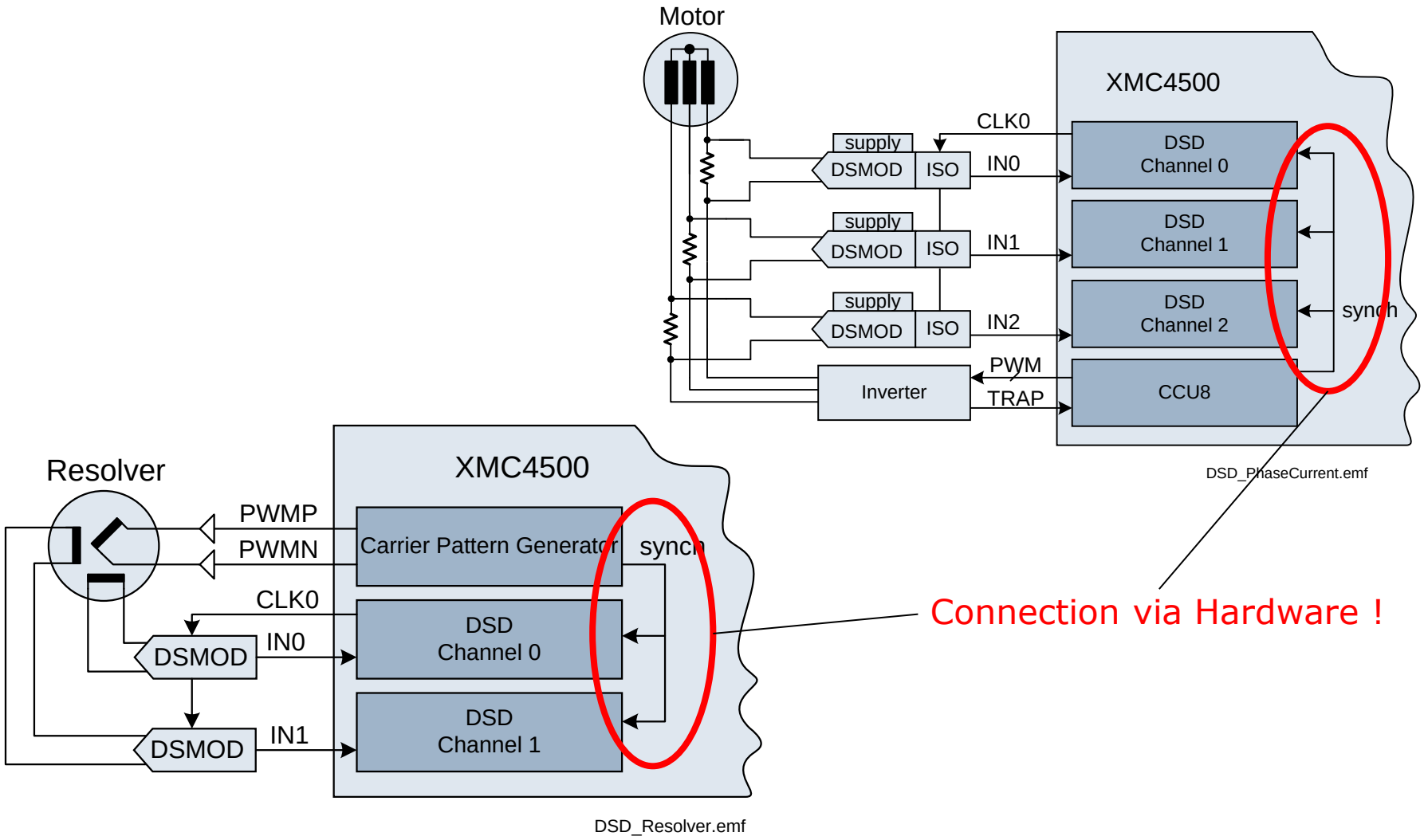




ADC – Fast, flexible, full-featured

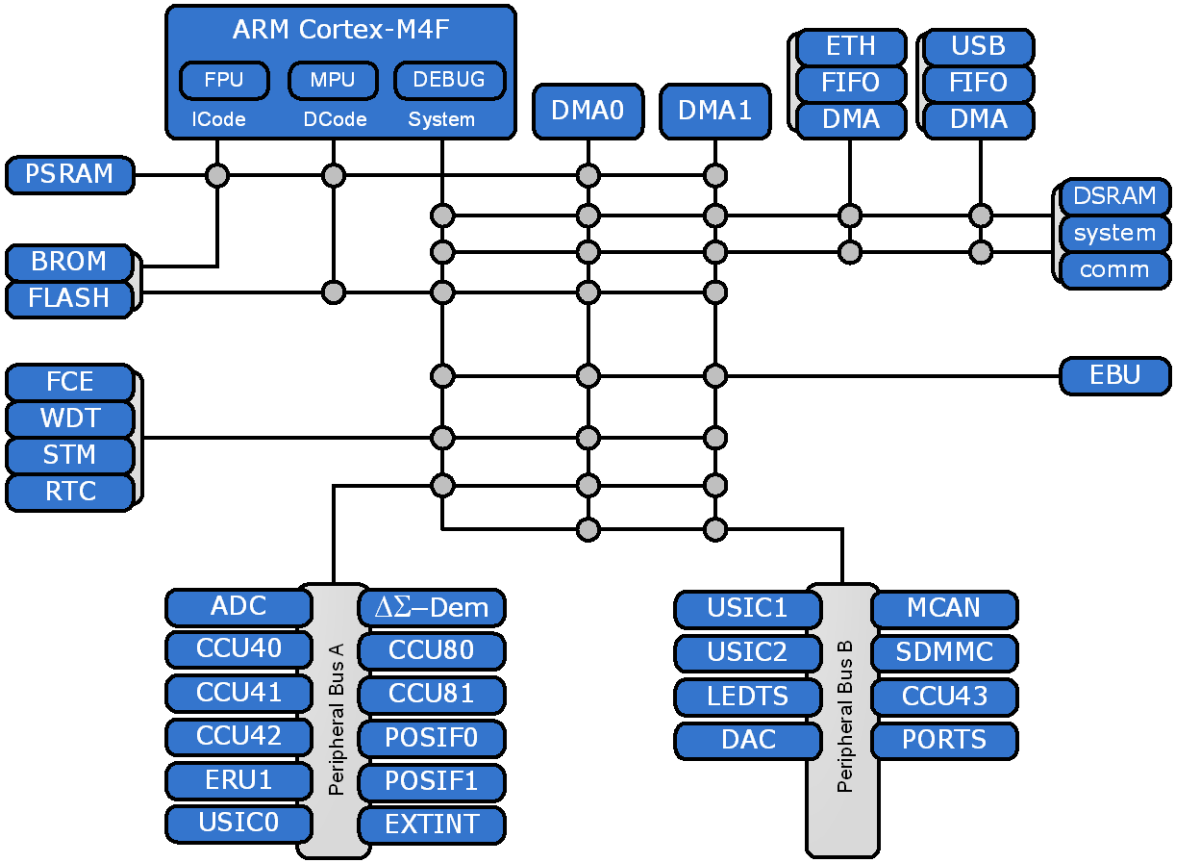


Delta Sigma Demodulator – Applications



XMC4000
Optimized for Best-in-class Real-time Control

- DSP instructions
- Floating Point Unit (single precision)
- Bus matrix with separate busses for code, data, system
- Fast interrupt response time and task switching
- Intelligent peripherals for CPU offloading
- DMA for ETH & USB



Standard core coupled with specialized peripherals.
SW-configurable to application-specific requirements

Agenda

- XMC Family - XMC technical presentation

- Introduction to DAVE

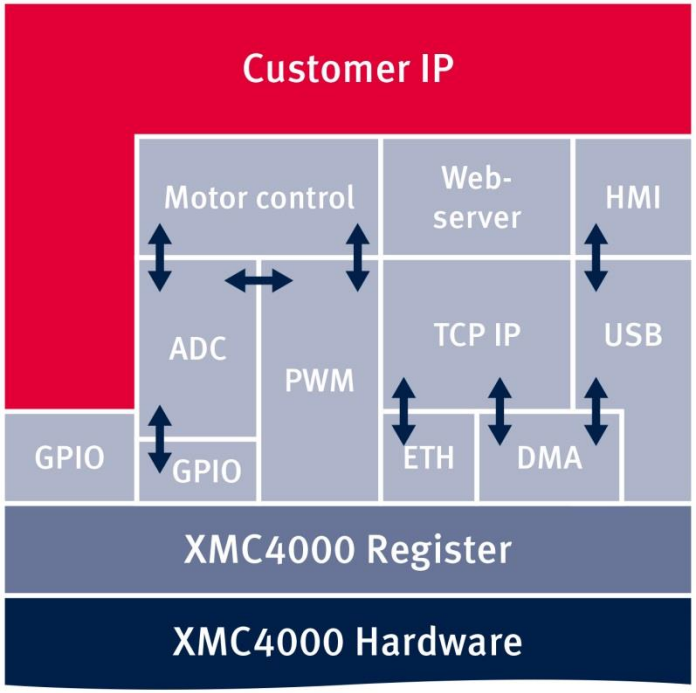
What is DAVE™?

DAVE™ in version 3 is a free development platform with two main functionalities

1. **DAVE™ is a free tool chain**
   - Eclipses based IDE
   - GNU Compiler tools
   - Debugger
   - xSPY data visualization plug-in
2. **DAVE™ generates a tailored application library**
   - Full MCU abstraction
   - Combinable SW components (DAVE Apps)
   - Graphical configuration
   - Resource management / pin mapping

What is DAVE™ good for?

DAVE™ reduces software development time and effort



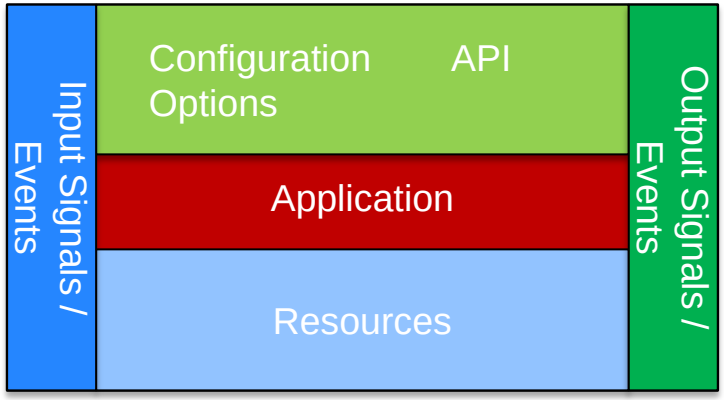
- **DAVE™ can do the everyday work**
  - Building the software library from the required application components (DAVE™ Apps)
- **Software developers have more time to focus on the important IP**

What are DAVE™ Apps?

- DAVE™ Apps are SW components or SW building blocks for a specific application use case

Configuration e.g. to determine the initialization status

API to use the library functions in the user code



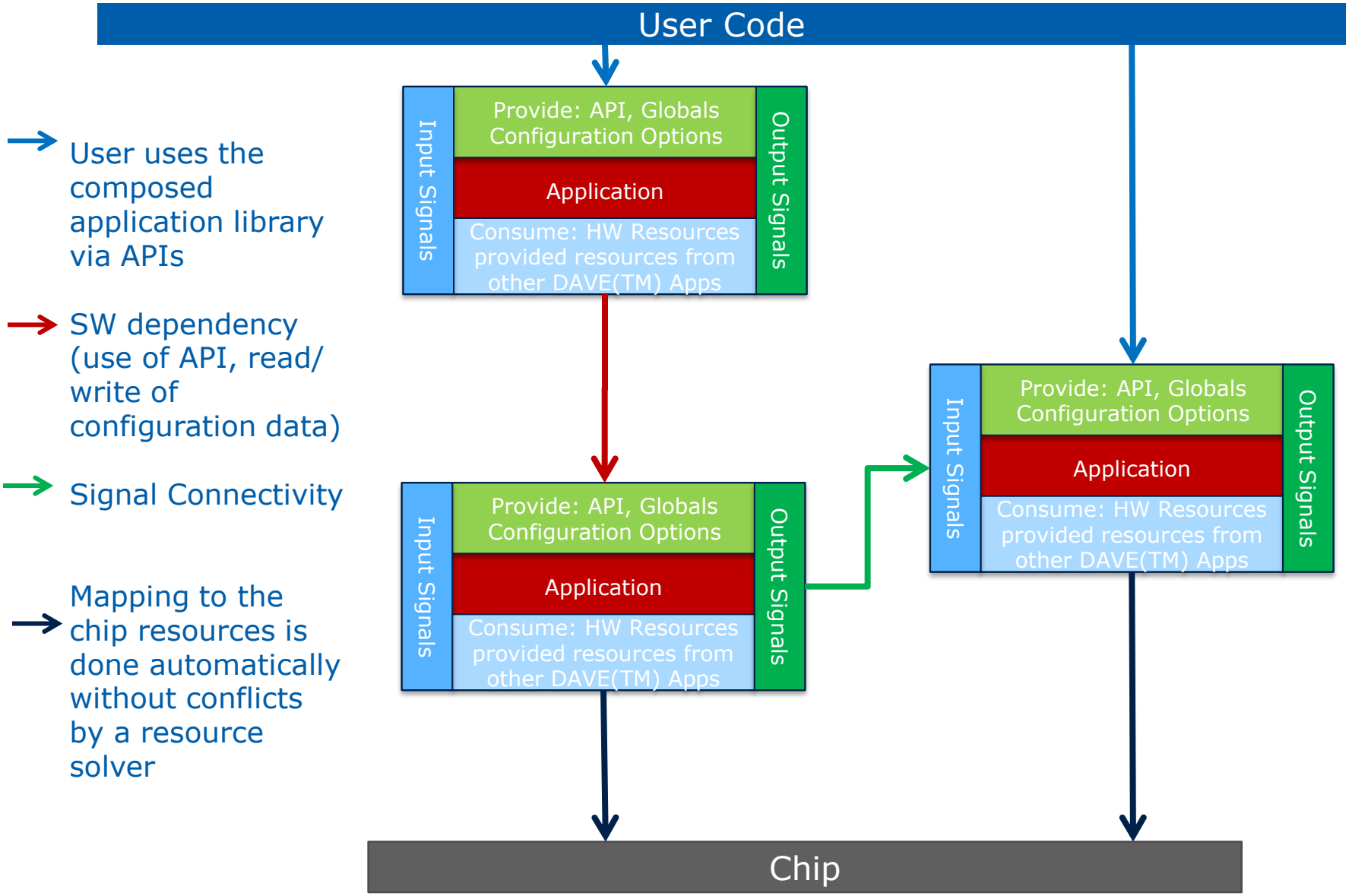
Input signal / events that triggers, enables or disables a functionality

Output Signals that can be used to trigger, or enable a functionality of another DAVE™ App

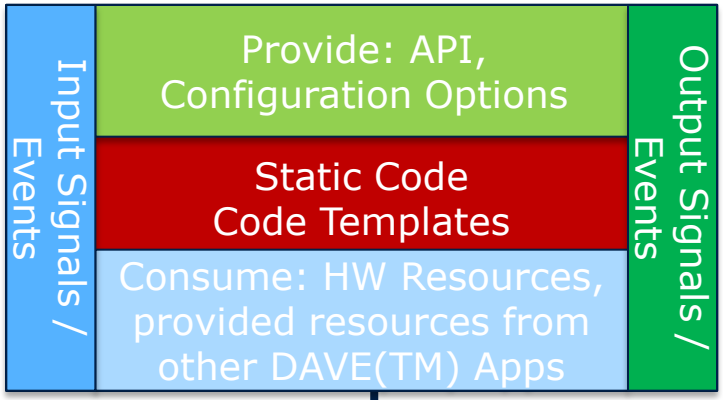
Resources that are required for the application, can be chip resources or an API of another DAVE™ App

- DAVE Apps can be flexible configured, combined and connected to build a tailored and optimized application library

Flexible Combination of DAVE™ Apps to Build the Application Library



Architecture of DAVE™ to Generate the Library Code from DAVE™ Apps



Consume one USIC channel

Code Engine (eclipse plug-in)

- DAVE™ App management
- Graphical UI
- Resource management
  - Assign USIC channel 2
- Code generation
  - Based on code templates for USIC channel 2
  - Copy of static code

Provide six USIC channels

DAVE™ Device Description
Resource and connection model of the target MCU

Generated Library

Misra 2004 compliant easy readable source code

Straight Forward Development Flow with DAVE™

Start with DAVE™

Select the suitable DAVE™ Apps form a library of > 170 DAVE™ Apps

Configure the DAVE™ Apps with a GUI and compose them as needed

Appropriate resource mapping with resource solver

Generate the software library as source code

Continue with DAVE™

Utilize the generated code via APIs

Compile, build and debug

Continue with a 3rd party tool

Utilize the generated code via APIs

Compile, build and debug

atollic

IAR SYSTEMS

KEIL An ARM® Company

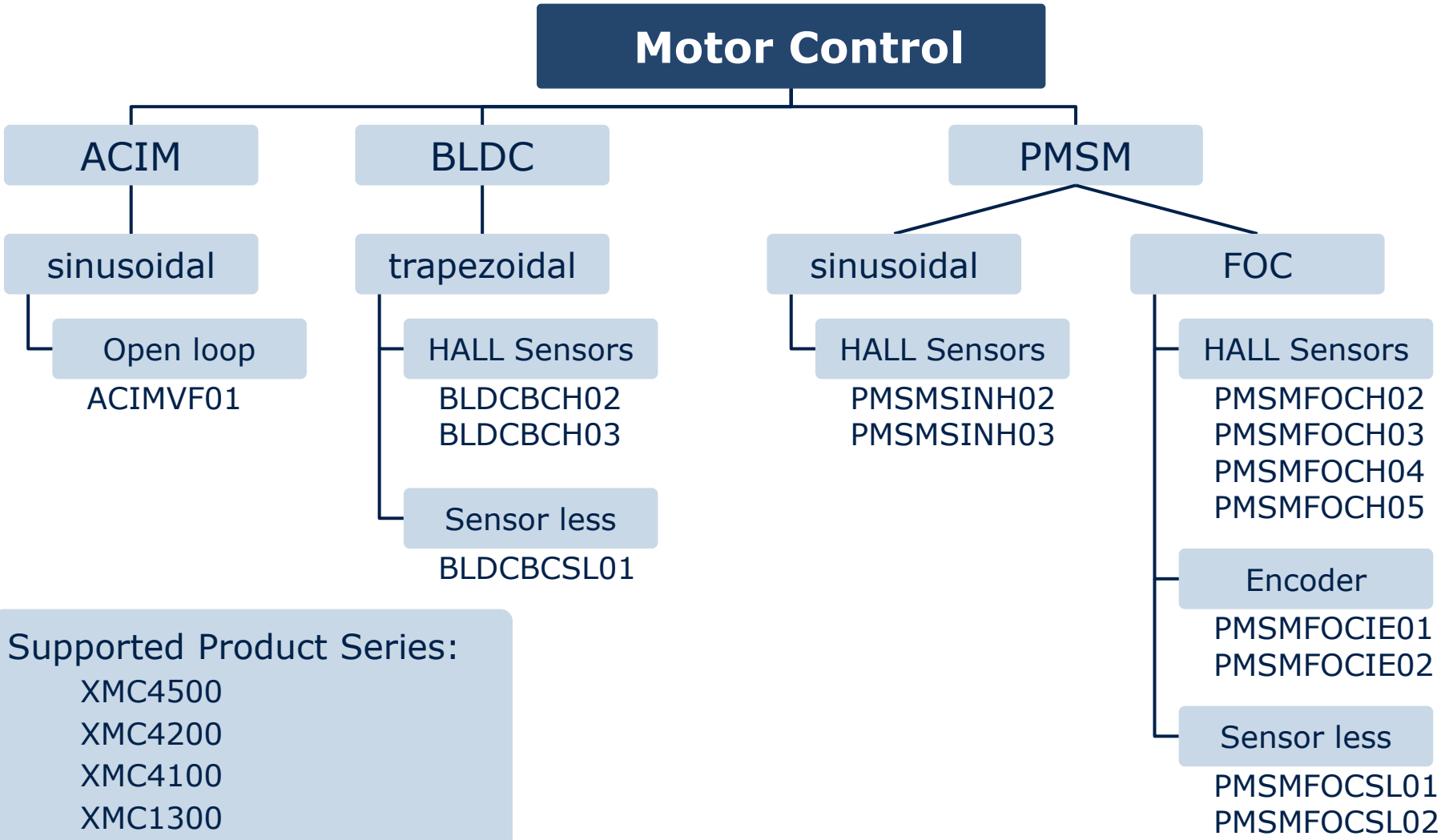
TASKING

ENERGY EFFICIENCY
MOBILITY
SECURITY

Innovative semiconductor solutions for energy efficiency, mobility and security.



Eco System
DAVE™ APPs for Motor Control



Supported Product Series:

- XMC4500
- XMC4200
- XMC4100
- XMC1300

XMC Microcontroller – Family

XMC1000 Family Feature

System

- ARM® Cortex™-M0, 32MHz
- 64MHz MATH Co-processor for advanced control loops (CORDIC / DIVIDE)
- 8KB to 200KB Flash
- 16kB RAM

Peripherals

- Analog mixed signal and timer
- Rich serial communication
- LED color control engine
- Capacitive Touch

Operating Conditions

- Temperature: up to 105°C
- Voltage: 1.8 to 5.5V

XMC4000 – Family Feature

System

- ARM® Cortex™-M4, up to 120MHz
- DSP and Floating Point Unit (FPU)
- Up to 1 MB Flash with ECC
- Up to 160kB RAM and 4kB Cache
- MPU and up to 12ch DMA

Peripherals

- Analog mixed signal and timer
- Rich serial communication
- Delta sigma Demodulator, Position Interface, High Resolution PWM, DAC
- Up to 3x CAN, USB and Ethernet
- External Bus Interface, SD/MMC
- Touch interface & LED Matrix

Operating Conditions

- Temperature: up to 125°C

Enablement

- Kits and Demoboard
- DAVE™ IDE and DAVE™ APPs
- IEC 60730 class B compliant
- Comprehensive ARM 3rd Party Ecosystem

XMC gives you the competitive advantage

XMC 32-bit Microcontroller Family

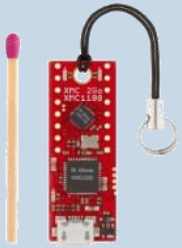
– a wide and scalable portfolio offering excellent and flexible digital and analog mixed-signal peripherals delivering outstanding real-time performance.

- Integration of powerful peripherals
- Long-term product availability until 2027
- Operate up to 125°C ambient temperature
- Real-time performance and deterministic behavior
- Scalable and code compatibility across family members
- Speed-up of time-to-production by reducing development time

LINKS:

- www.infineon.com/**XMC**
- www.infineon.com/**XMC1000**
- www.infineon.com/**XMC4000**
- www.infineon.com/**DAVE**
- www.infineon.com/**XMC-DEV**
- www.infineon.com/**IEC60730**

DAVE™ Apps



XMC 2Go

XMC4000 Application Kit