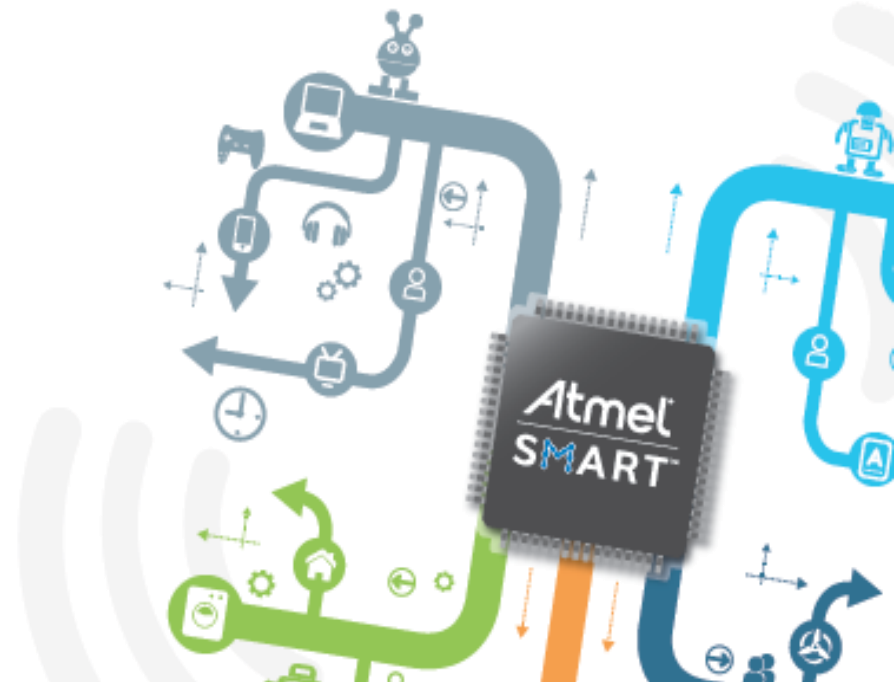


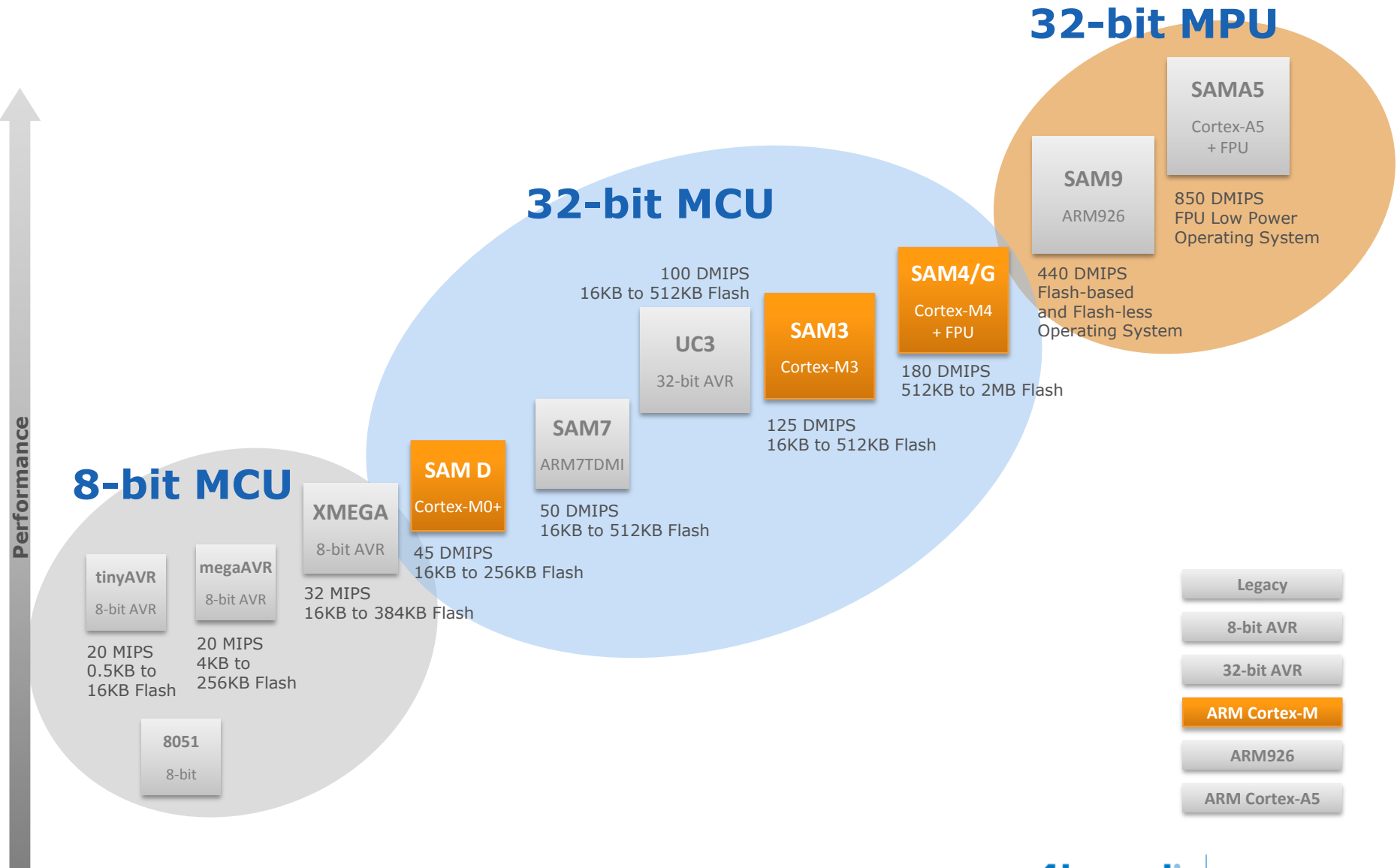


Atmel Technology Live SAM D

Atmel® | SMART™ ARM® Cortex-M0+ based MCU



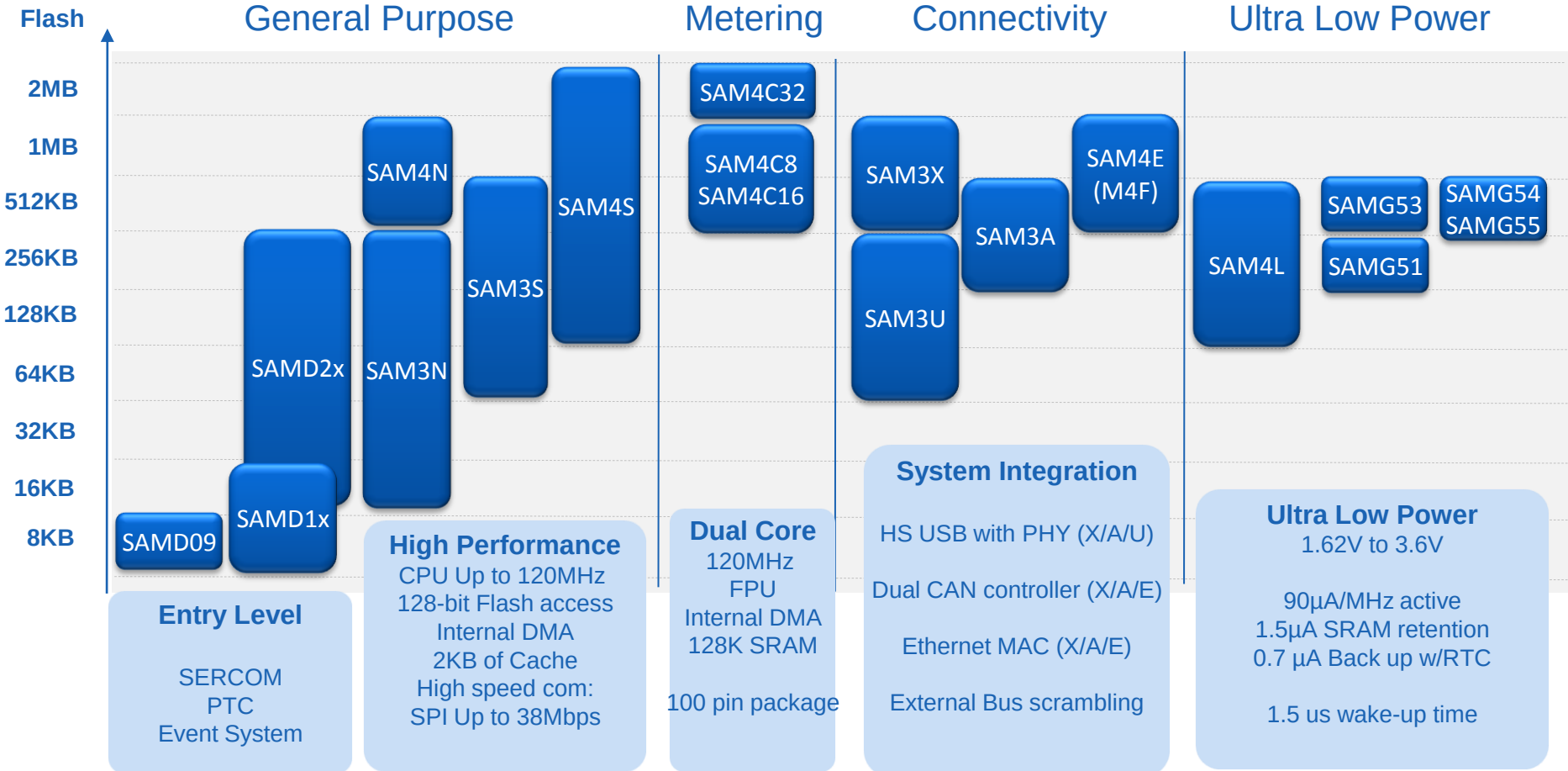
Atmel | SMART™ MCU Product Offering



Atmel | SMART™ ARM Cortex based 32-bit MCU

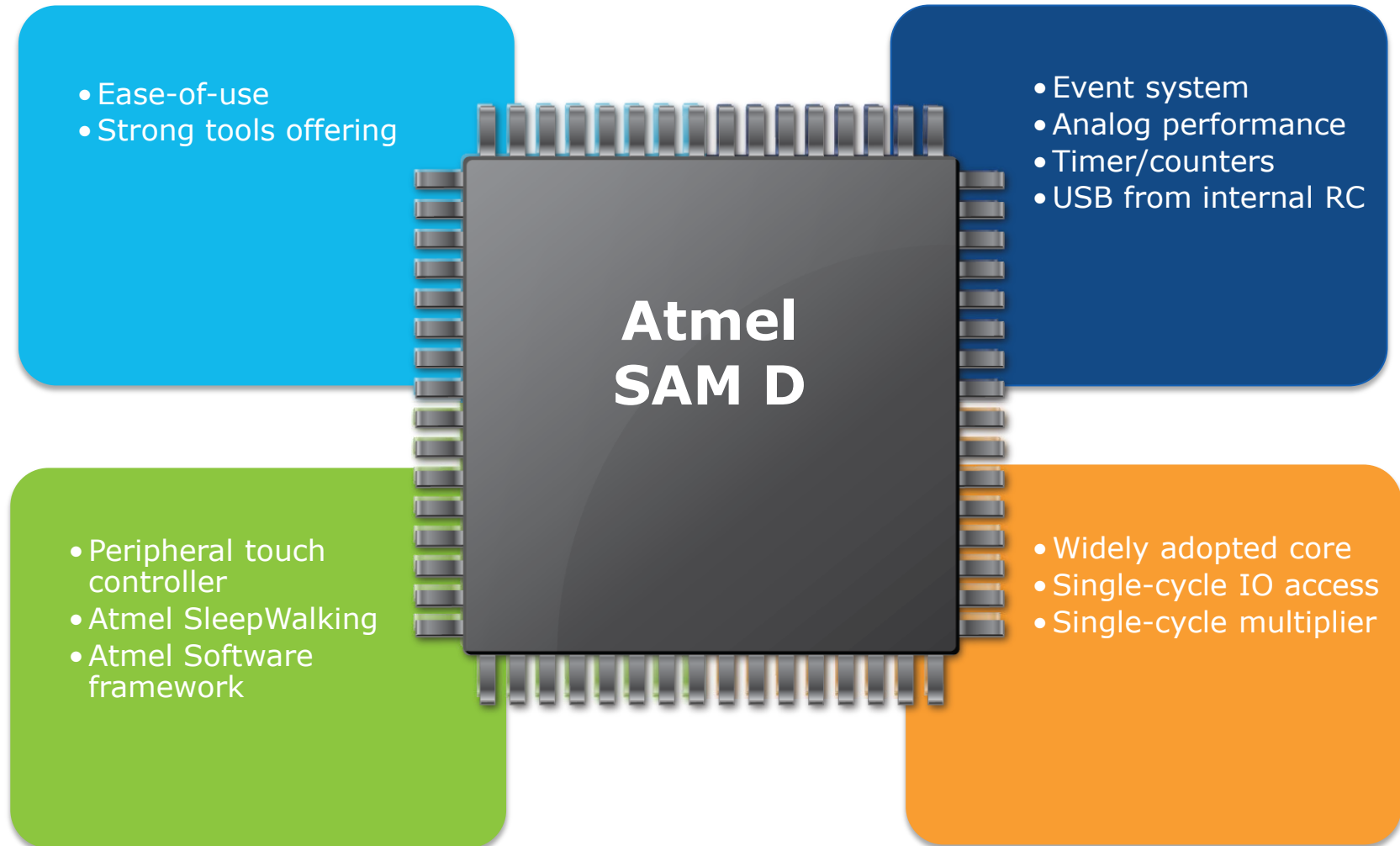
Flash: 8kB to 2MB – Package: 14 to 144 pins

M0+	M3/M4	M3	M4	M4F	M3	M3	M4F	M4	M4F
48MHz	..100MHz	64MHz	120MHz	120MHz	96MHz	84MHz	120MHz	48MHz	48MHz



Introduction to Atmel SAM D family

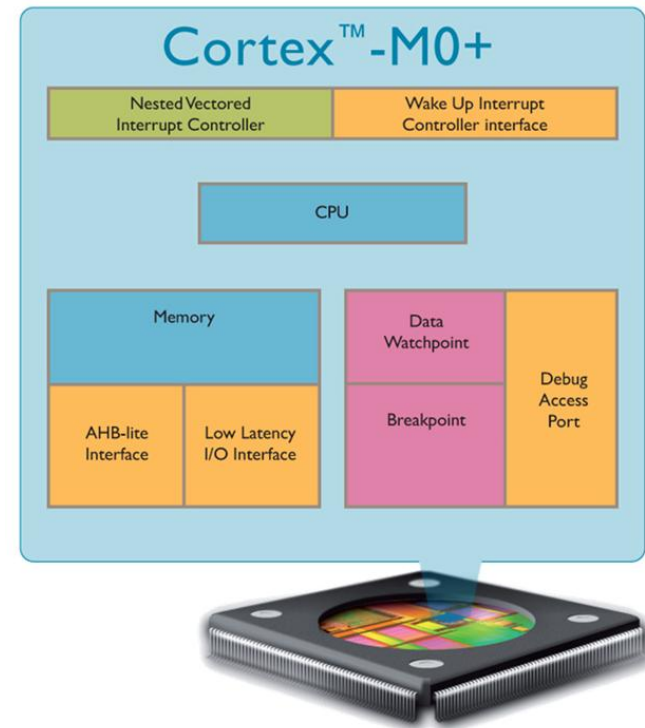
Combining the best of Atmel MCUs with ARM Cortex-M0+



Introducing Atmel SAM D Family

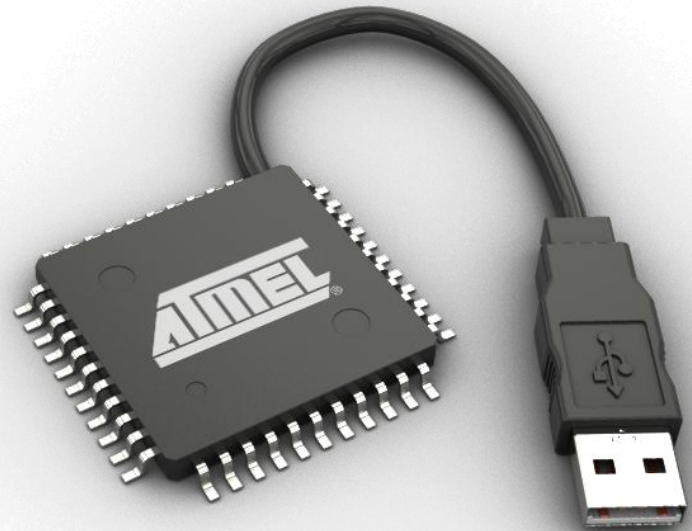
Powerful and Efficient Products

- Atmel SAM D Product Family
 - 48MHz operation
 - Up to 2.14 CoreMark®
 - Down to 70µA/MHz
 - ±2% 8MHz int RC oscillator
 - 1.62V-3.63V
 - 4 product Series
 - 35 pin/memory/feature combinations
 - 8KB to 256KB Flash
 - 14-64 pin packages



Atmel SAM D family

- Event system
- SERCOM modules configurable as I2C, USART or SPI
- Full Speed USB
 - Device from int RC oscillator
 - Embedded host
- Capacitive Touch HW engine
- 12-bit 350ksps ADC with gain stage
- 10-bit 350ksps DAC
- DMA Controller
- I2S
- Fractional PLL
- Timer/Counters

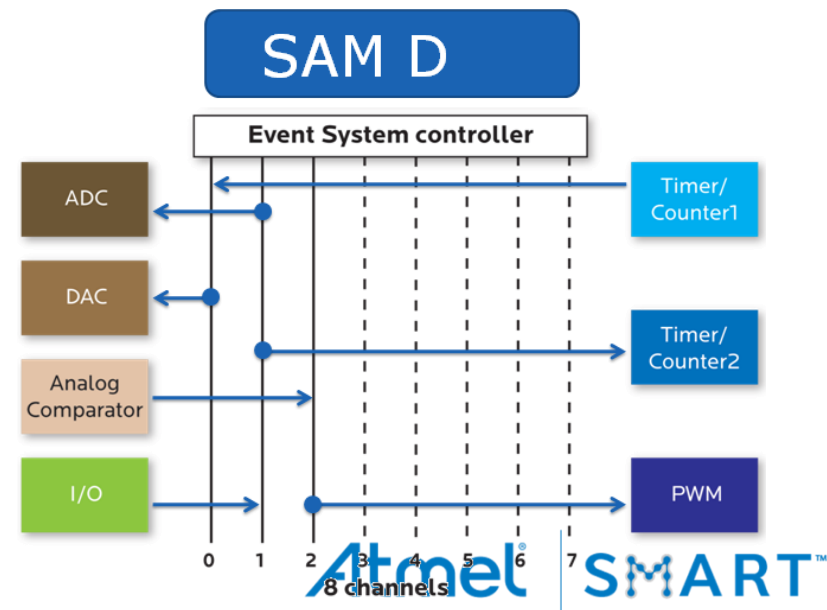


Peripheral Event System

Bringing the Innovation of Atmel AVR XMEGA to the Atmel SAM D Series

- Inter-peripheral Communication
 - CPU independent
 - Eight independent channels
 - Synchronous and Asynchronous
- Latency-free Event Handling
 - Safe fault protection
 - 100% predictable reaction time
- Advantages
 - Accurate timing
 - Efficiently offloading CPU
 - Reduced power consumption

Peripheral Events
GPIO
Timer /Counter
Asynchronous Timer (RTC)
Analog Comparator
ADC
DAC
Peripheral Touch Controller



CPU

ADC

DAC

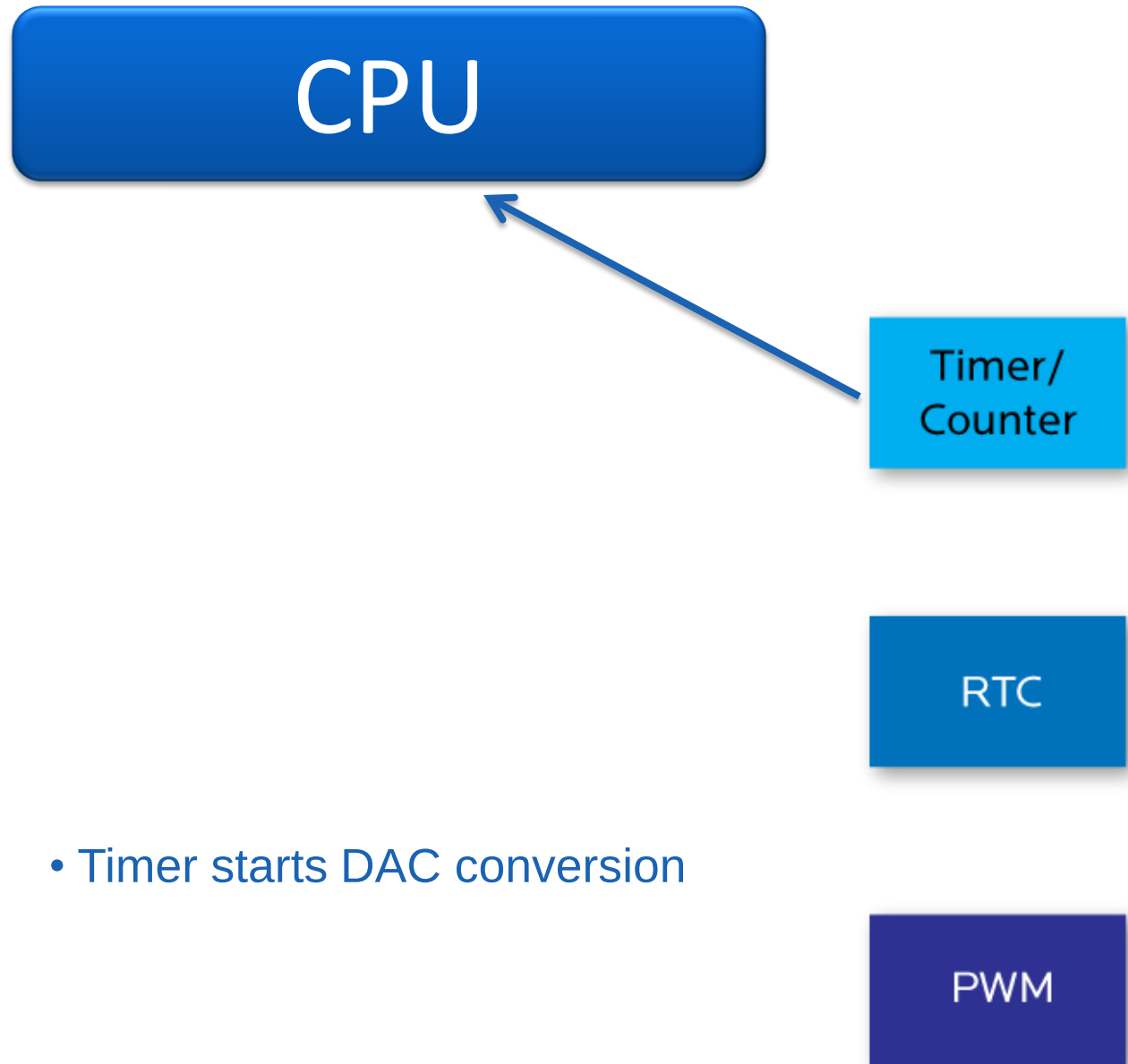
Analog
Comparator

I/O

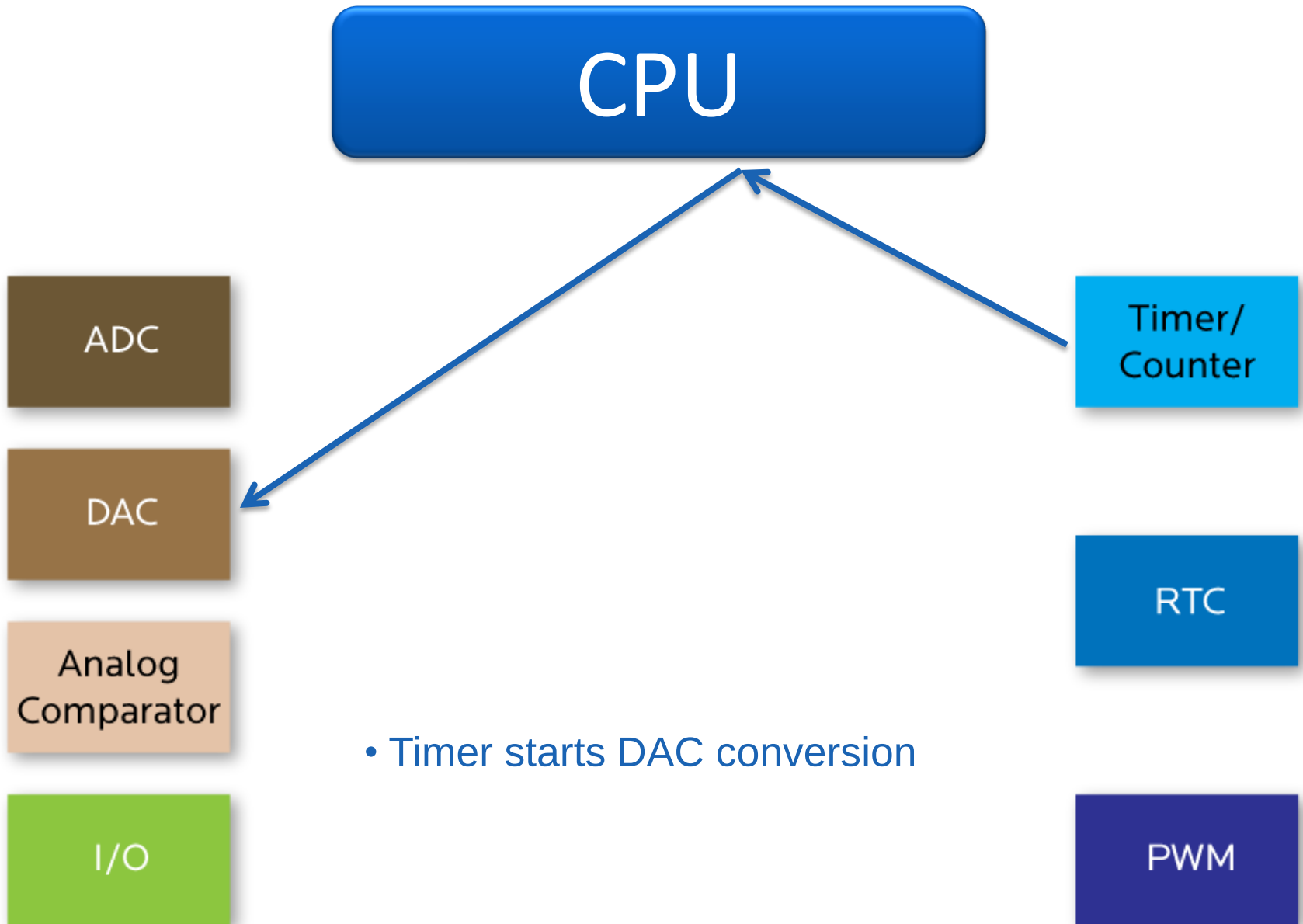
Timer/
Counter

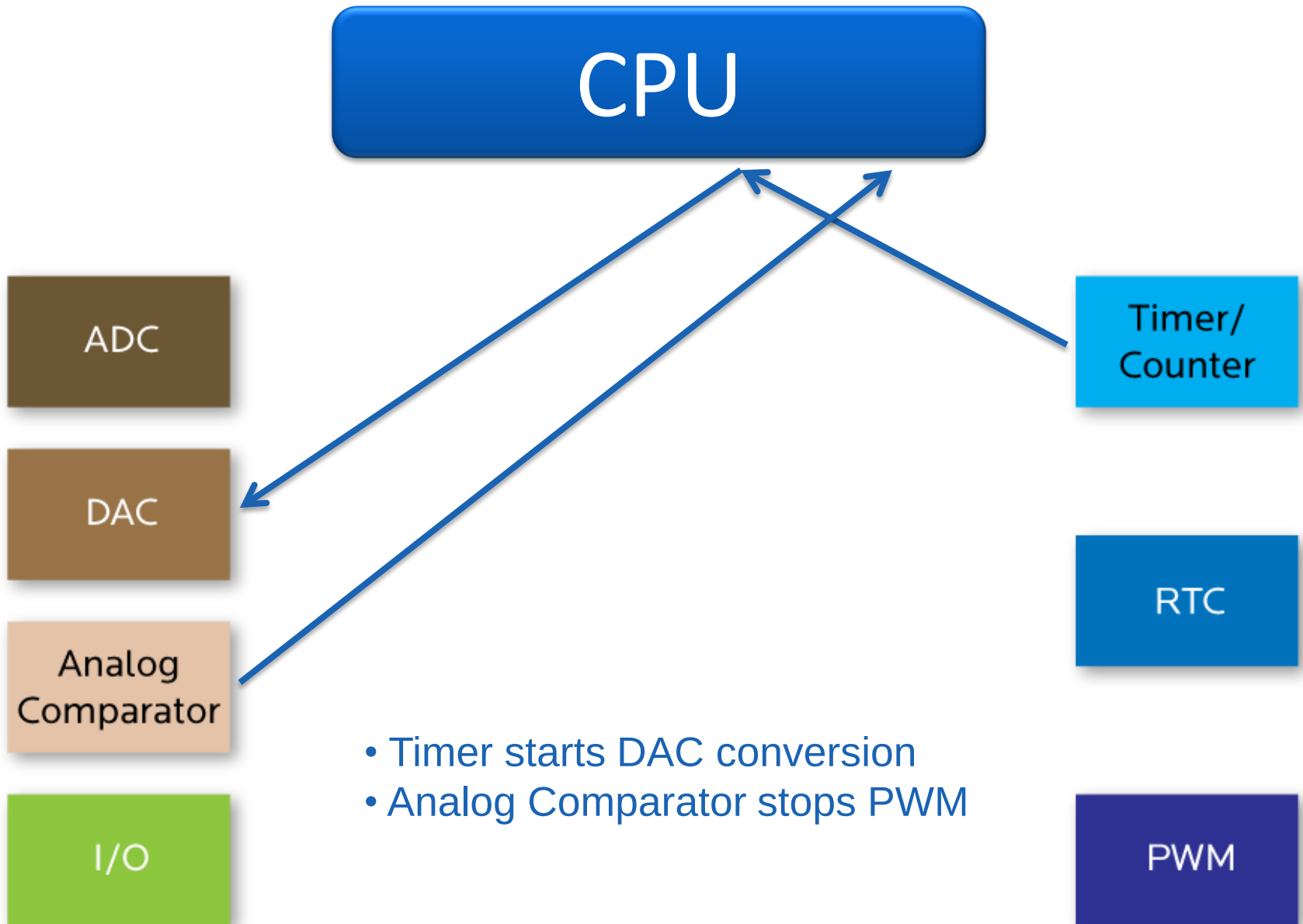
RTC

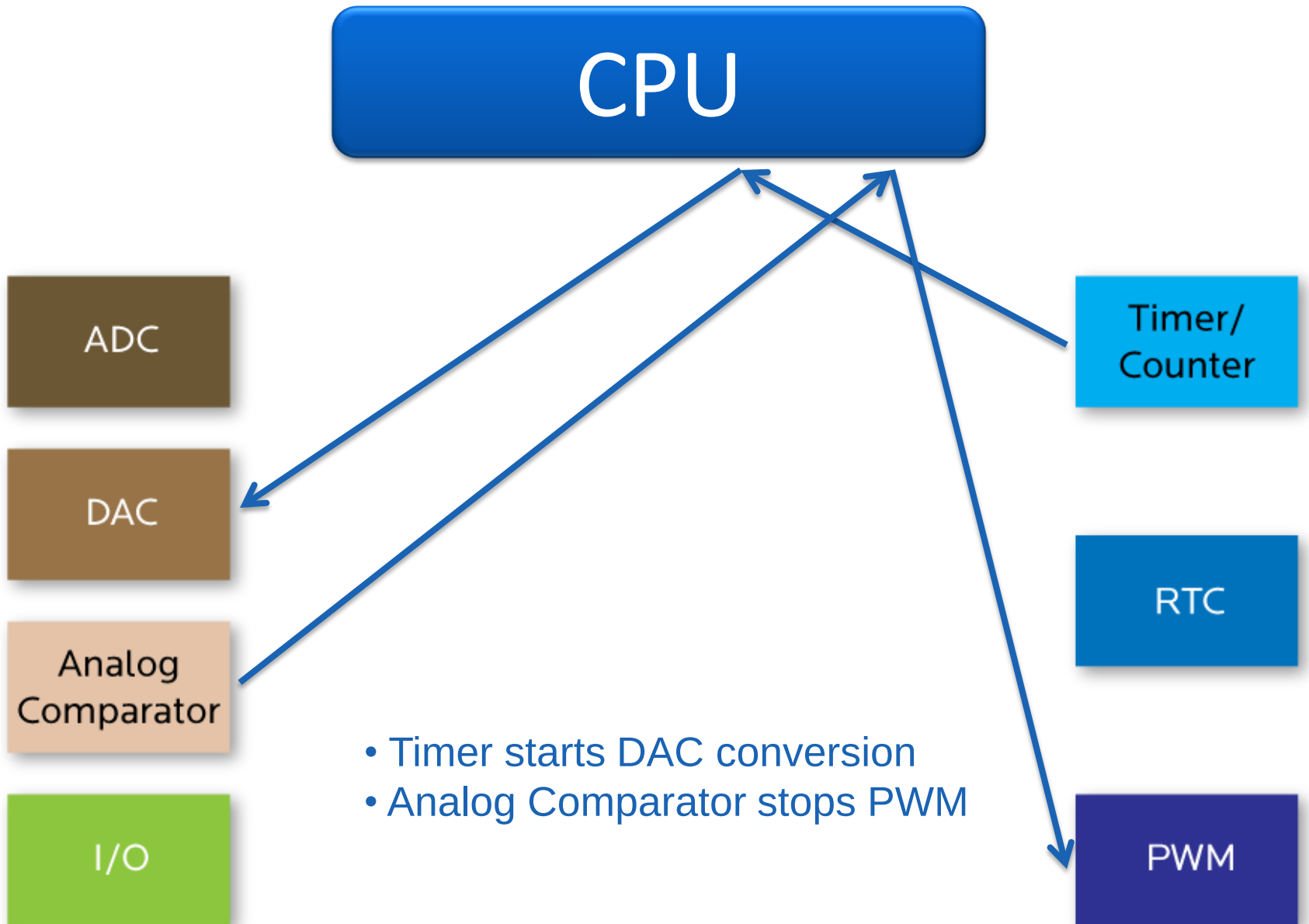
PWM

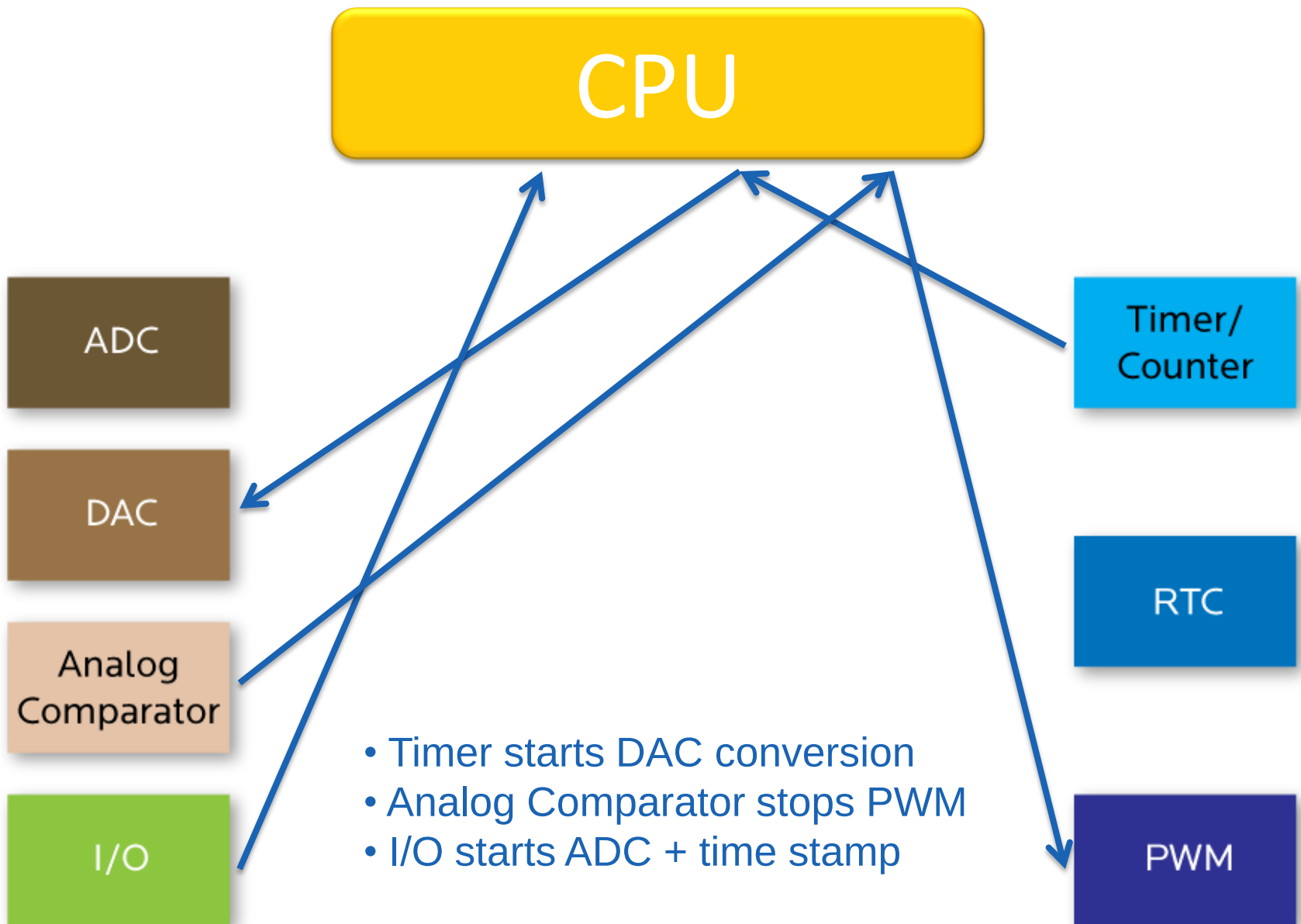


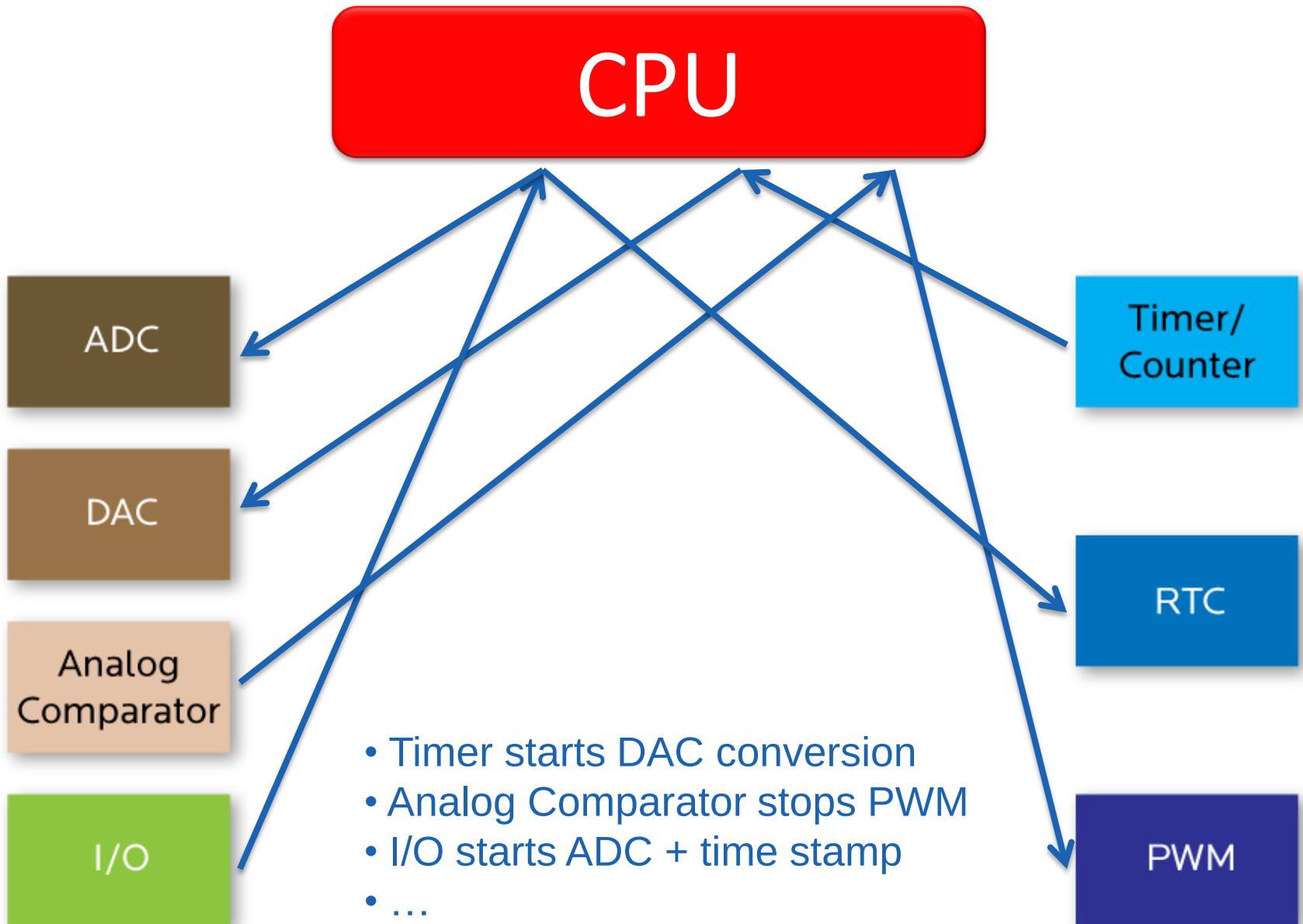
- Timer starts DAC conversion











CPU

Overload

- Timer starts DAC conversion
- Analog Comparator stops PWM
- I/O starts ADC + time stamp
- ...

SAM D

Event System controller

ADC

Timer/
Counter

DAC

Solution

RTC

Analog
Comparator

I/O

PWM

0 1 2 3 4 5 6 7

8 channels

SAM D

Event System controller

ADC

DAC

Analog
Comparator

I/O

Timer/
Counter

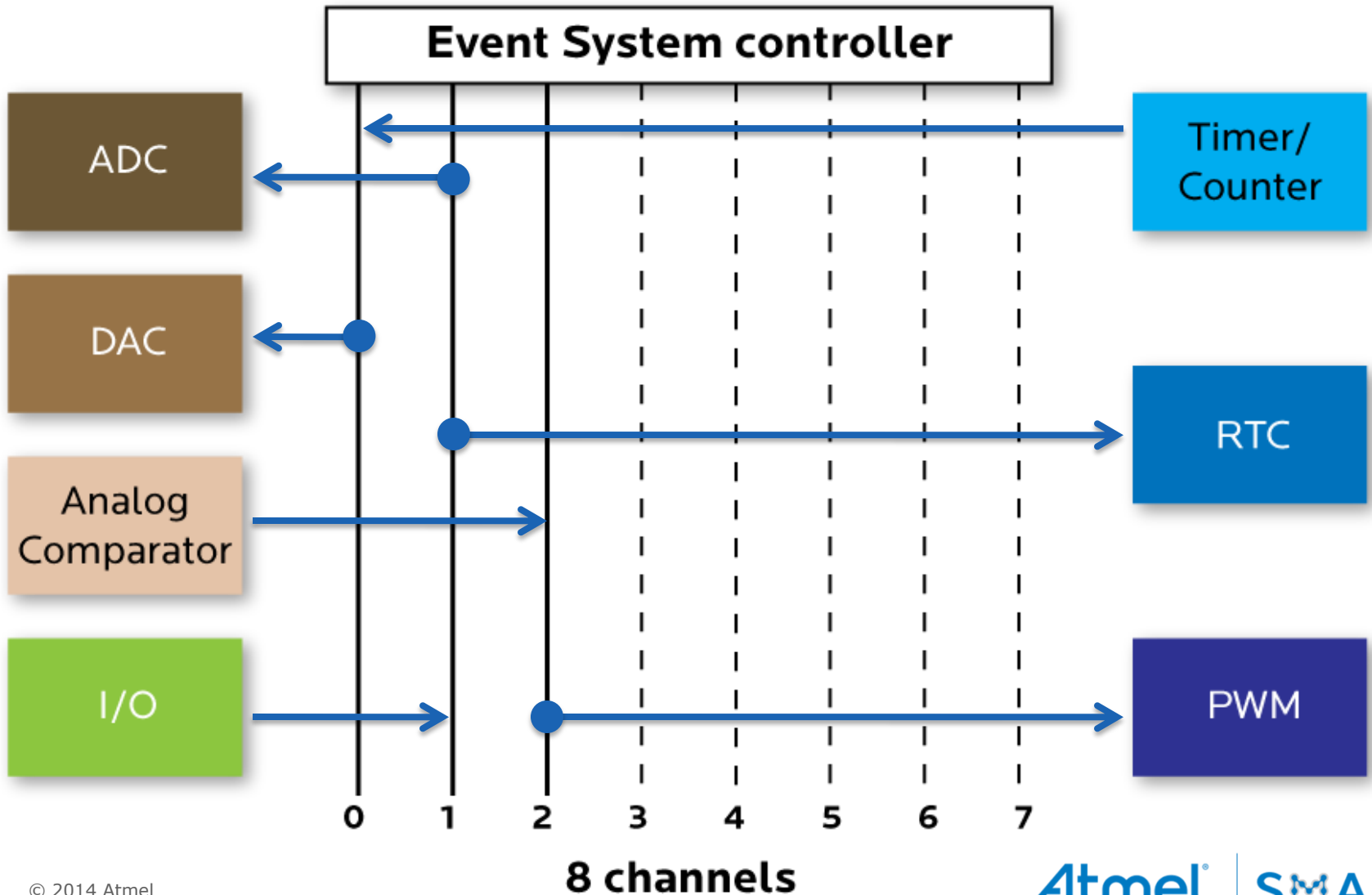
RTC

PWM

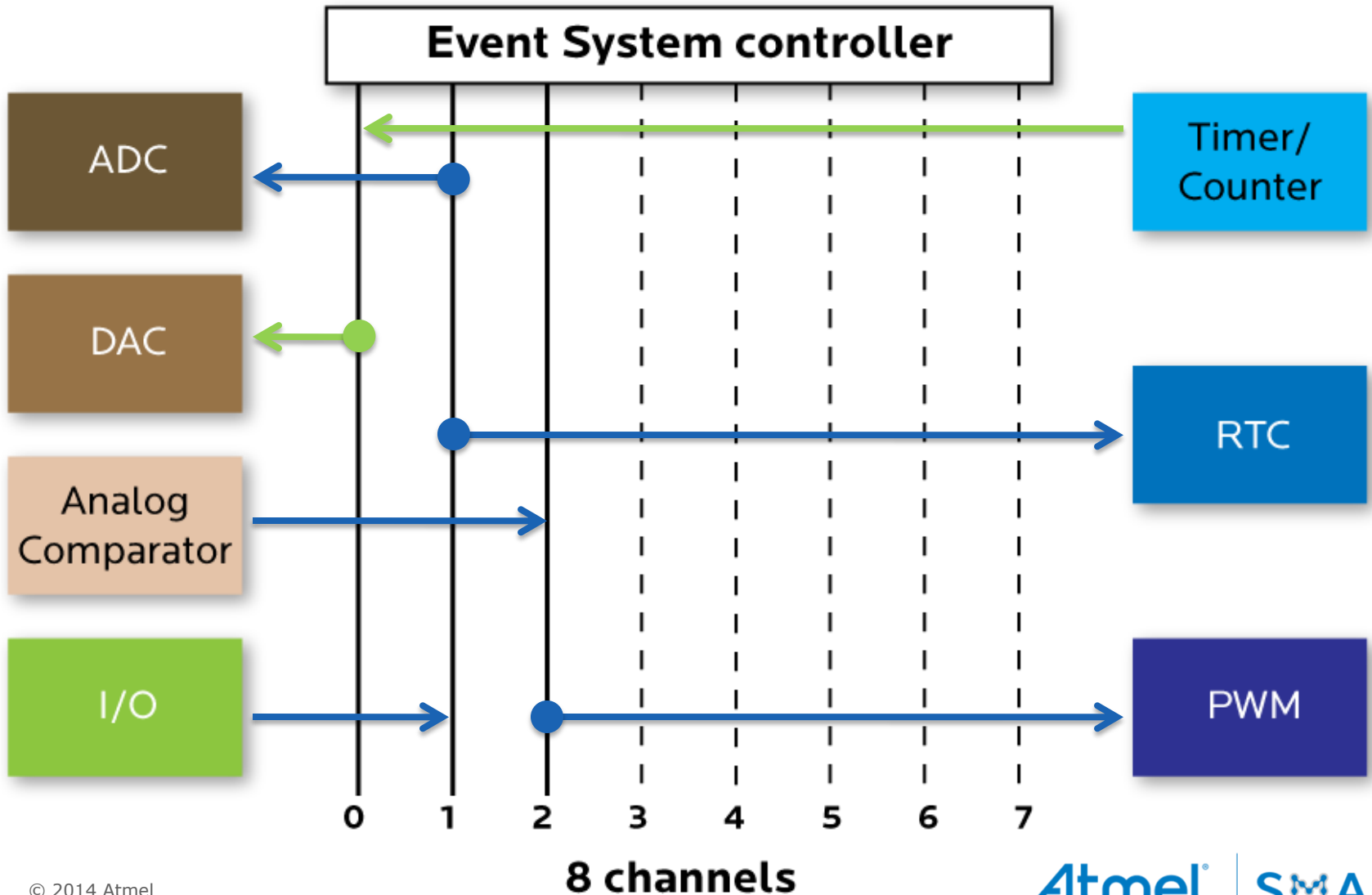
0 1 2 3 4 5 6 7

8 channels

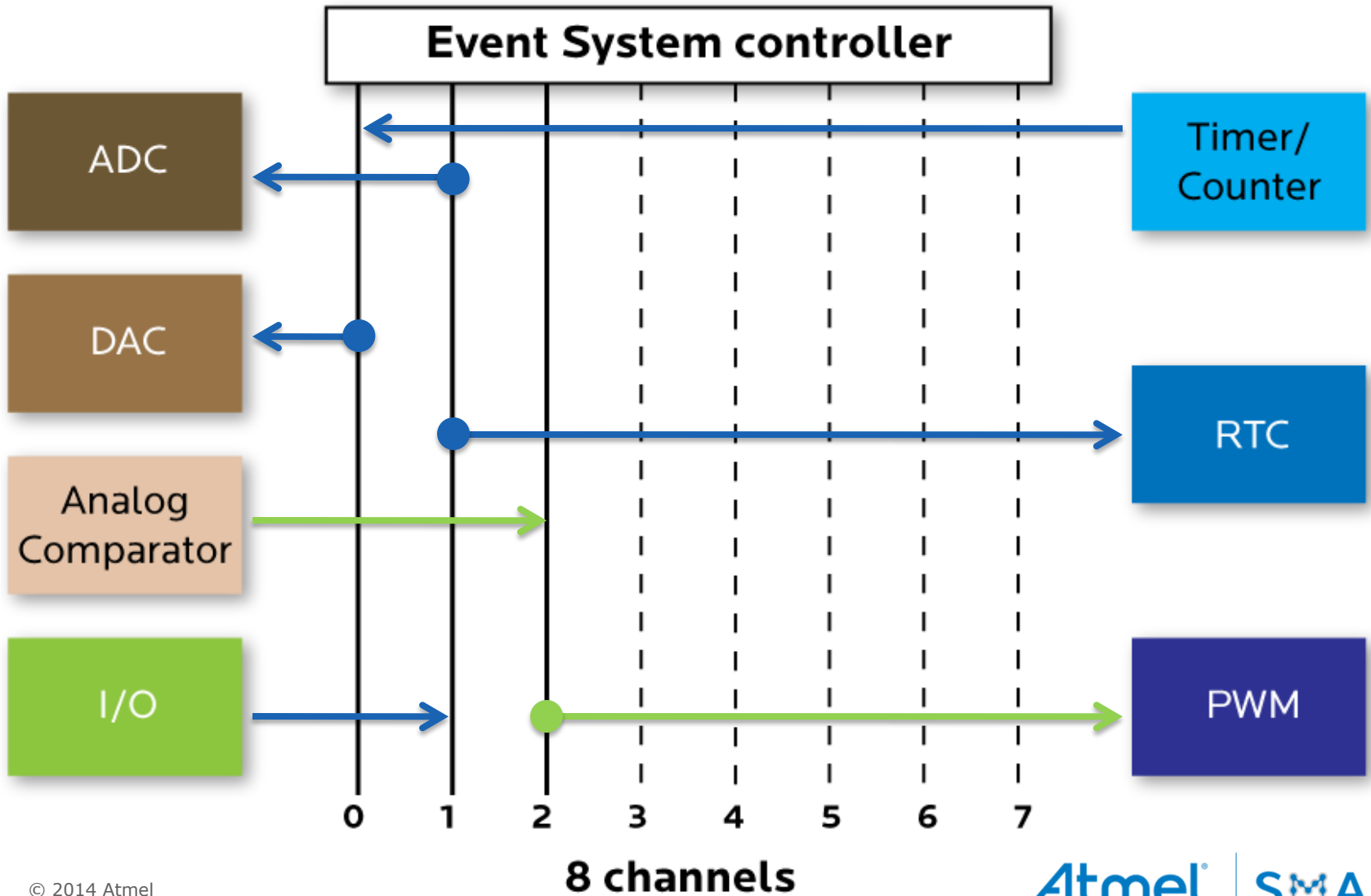
SAM D



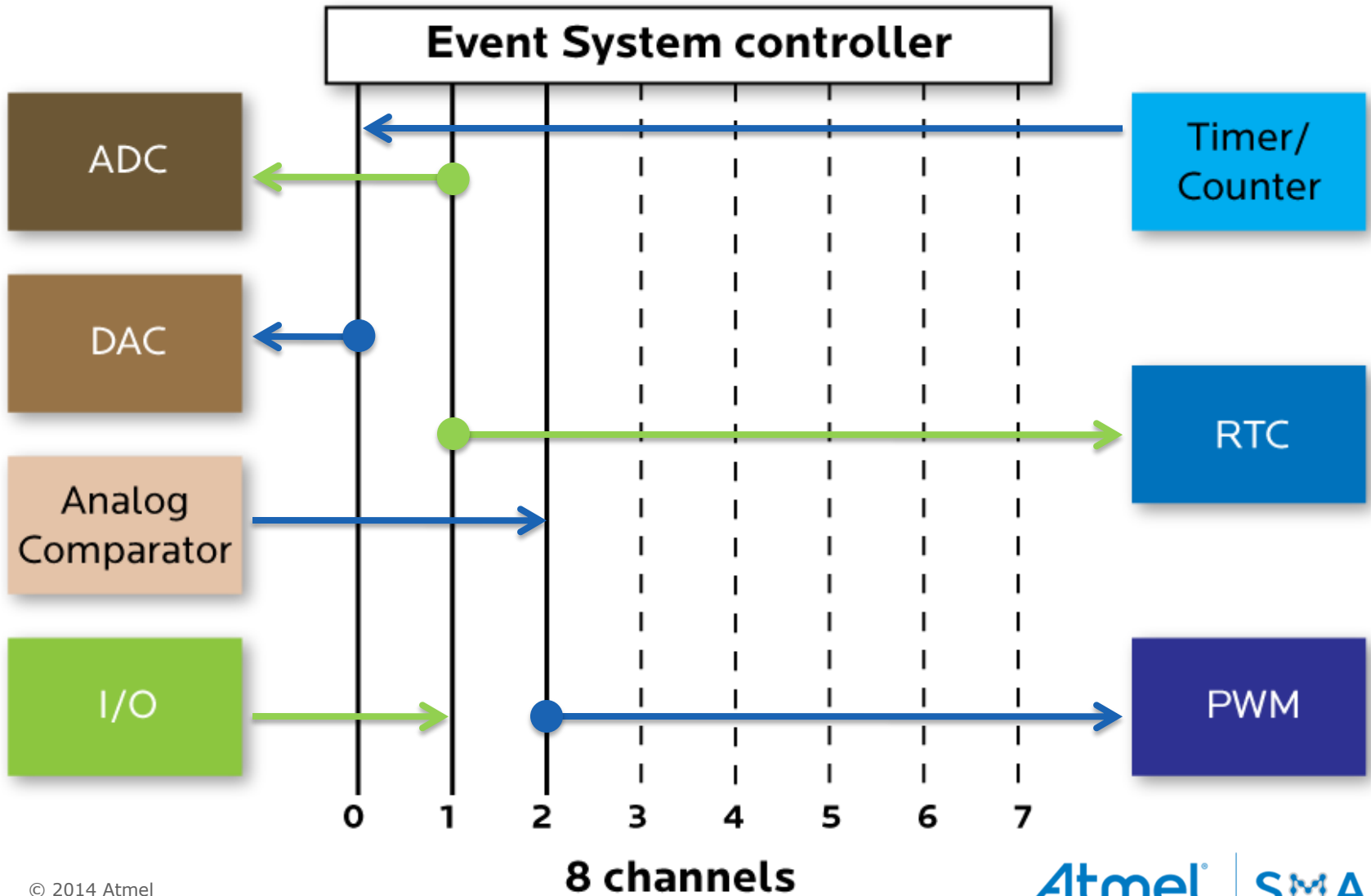
SAM D



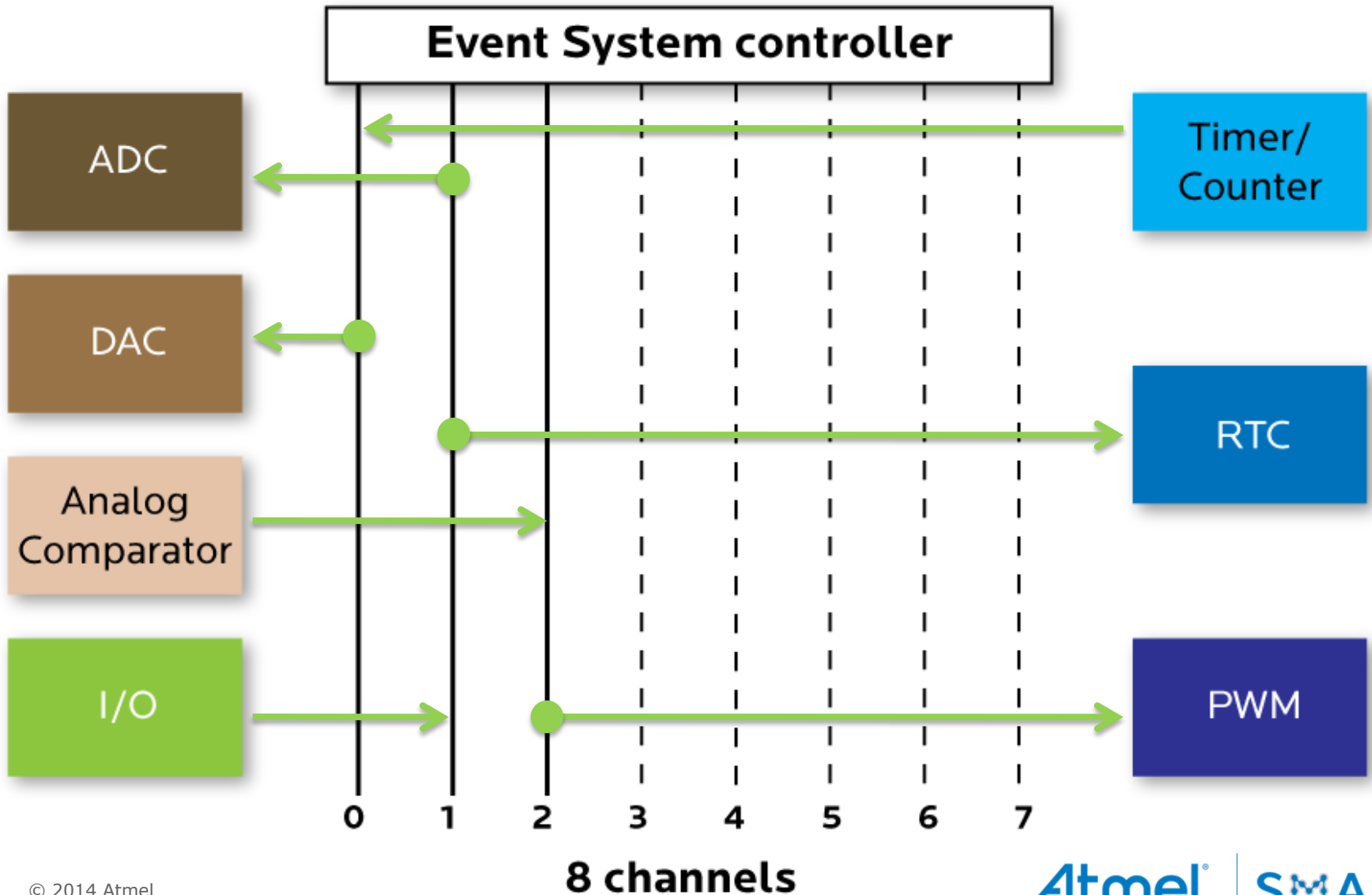
SAM D



SAM D



SAM D

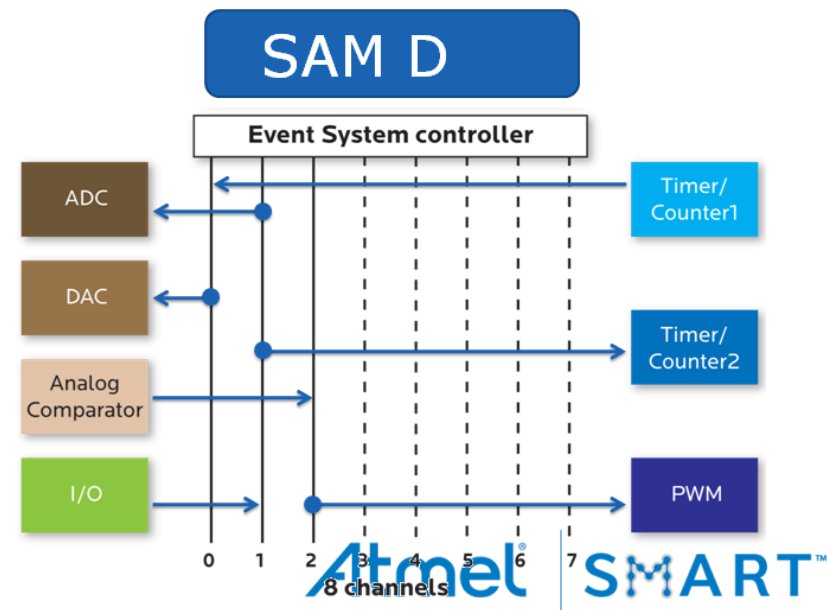


Peripheral Event System

Bringing the Innovation of Atmel AVR XMEGA to the Atmel SAM D Series

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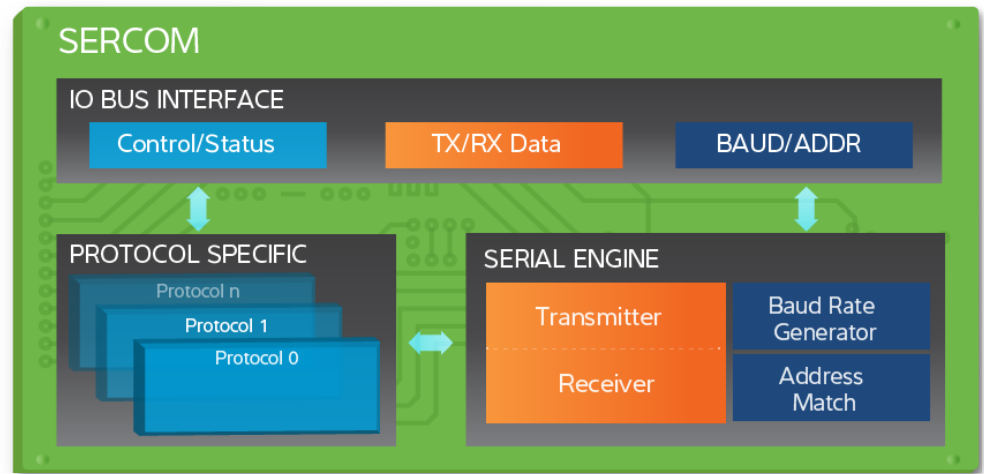
Peripheral Events
GPIO
Timer /Counter
Asynchronous Timer (RTC)
Analog Comparator
ADC
DAC
Peripheral Touch Controller



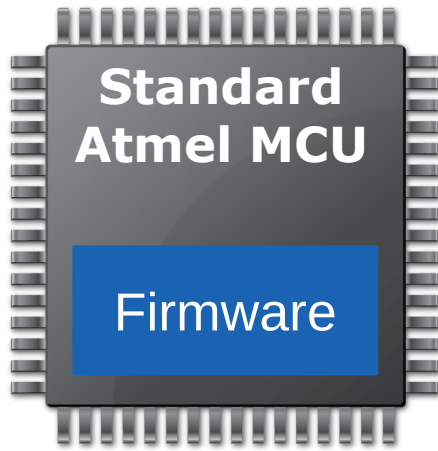
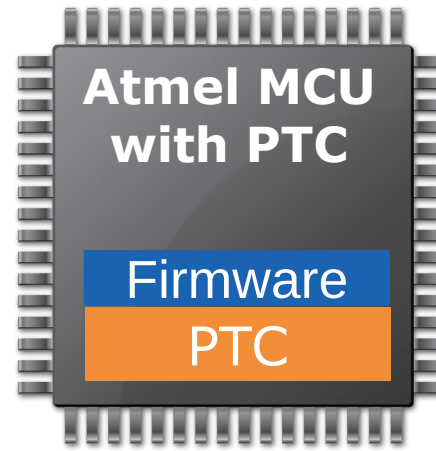
Serial Communication Module (SERCOM)

Highly Flexible Multi-interface Communication Module

- Configurable as
 - I2C
 - SPI
 - USART
- Supporting PM/SMBus & IrDA
- Double-buffered Reception
- IO Pin multiplexing
- Reconfigurable from software
- Wake-up from All Power Modes
 - I2C address match
 - SPI data reception
 - USART start detection



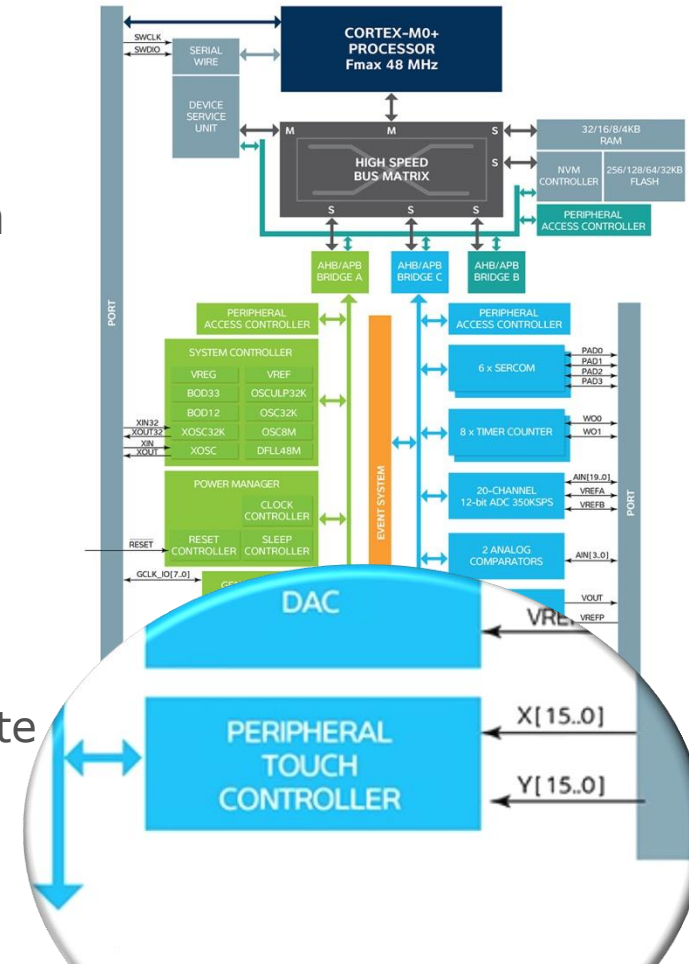
Peripheral Touch Controller (PTC)



- All firmware solution
 - Constraints when used with timing critical application code
 - Requires tuning to work in noisy environments
- ✓ Dedicated hardware touch controller
 - ✓ Works great with any application code
 - ✓ Easily passes 10V conducted immunity tests

Peripheral Touch Controller (PTC)

- Supports Buttons, Sliders, and Wheels
- Supports Mutual- and Self-Capacitive Touch
 - Self-(re)calibrating, no tuning needed
 - No external components needed
- Excellent conducted immunity (CI)
 - Built-in hardware filtering
 - Passes 3V CI with no external components
 - Passes 10V CI with 100K series resistor
- Low standby power consumption
 - 6 μ A scanning one channel at 200ms scan rate
- Low CPU Utilization
 - 5% CPU utilization scanning 10 channels at 50ms scan rate



Peripheral Touch Controller (PTC)

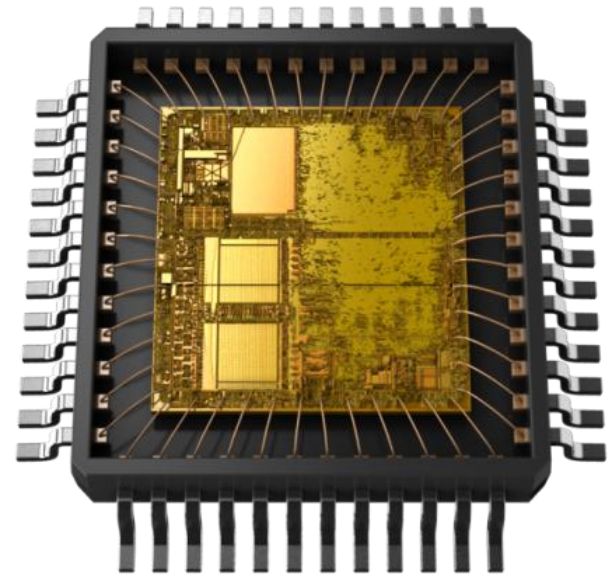
High Channel Count

Package	PTC channels Mutual Cap	PTC channels Self Cap
64-pin	Up to 256	Up to 16
48-pin	Up to 120	Up to 10
32-pin	Up to 60	Up to 6
24-pin	Up to 72	Up to 16
20-pin	Up to 42	Up to 13
14-pin	Up to 12	Up to 7



New Features

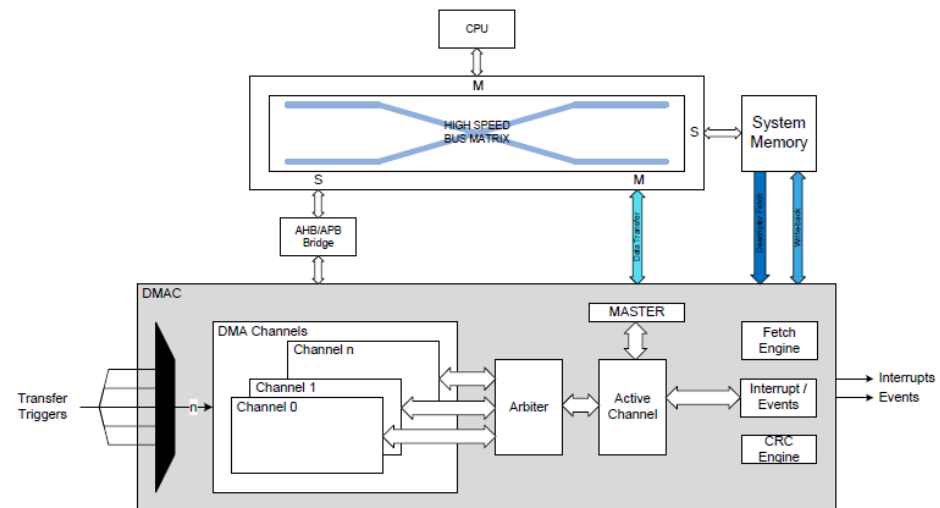
Added to SAMD09/10/11/21



Direct Memory Access - DMA

Available in SAM D09, D10, D11 and D21

- Supports Data Transfers
 - Peripheral to Peripheral
 - Peripheral to Memory
 - Memory to Peripheral
 - Memory to Memory
- Transfer triggers
 - Software
 - Event System
 - Peripherals
- 12 Channels
 - Suspend/resume support for each channel
 - PingPong Operation with Event System
- 3 priority levels
- Flexible Addressing modes
 - Static
 - Programmable increment
- 1- 64KB data transfers
- Connected to
 - ADC,DAC,I2S,SERCOM,T/C,T/CC
- CRC support on transfers
 - CRC-16 (CRC-CCITT)
 - CRC-32 (IEEE 802.3)



Full Speed USB

USB Device in SAM D11, USB Device and Host in D21

- Supports USB Full (12Mbit/s) and Low speed (1.5Mbit/s)
- No Need for external components
 - On-chip transceivers with built-in pull-ups and pull-downs
 - On-Chip USB serial resistors
 - USB Full Speed device operation from internal RC oscillator
- No endpoint/pipe size limitations
 - Uses Device SRAM as communication buffer
- Built-in DMA with multi-packet and double bank
- Supports feedback endpoint
- If USB is not needed, USB pins can be configured to GPIO



Inter IC Sound Controller - I2S with FPLL

Available in SAM D21

Bidirectional, synchronous, digital Audio link to external audio devices

- 2 independent Serializers configurable as receiver or transmitter
- 32-, 24-, 20-, 18-, 16-, and 8-bit mono or stereo format
- 16- and 8-bit compact stereo format
 - left and right samples packed in the same word to reduce data transfers
- Peripheral DMA channels, separate for each Serializer, allow a continuous high bit rate data transfer without processor intervention
 - Audio CODECs in Master, Slave, or Controller mode
 - Stereo DAC or ADC through dedicated I2S serial interface
 - Multi-slot or multiple stereo DACs or ADCs, using the TDM format
 - Mono or stereo MEMS microphones, using the PDM interface
- Fractional Digital Phase locked loop enables synchronization of data for USB to I2S streaming without audio glitches from a single crystal

Enhanced Timer/Counter Unit (TCC)

Perfect for SMPS, Lighting and Motor application fields

- Up to 96 MHz native resolution
- 4,5, 6 bit dithering resolution improvement (freq. & pulse width)
- 2 to 4 independent Output Comp/Input Capture channels per TCC
- Circular buffers for asymmetrical Push-pull control
- Advance capture features (for zero crossing detection).

Fault handling

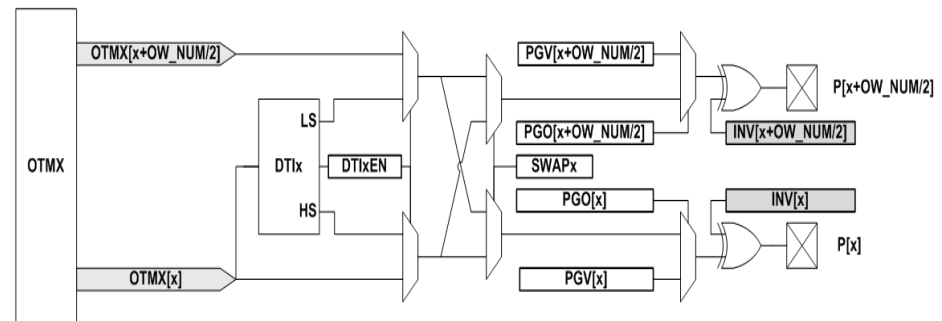
- Connected to Timer/Counter output and WeX input
- Fast, synchronous and asynchronous fault triggering
- Flexible configuration with multiple fault sources
- Handle recoverable and non-recoverable fault modes

Waveform extension

- Output matrix support
- DTI unit
- SWAP function
- Pattern generator

Advantages

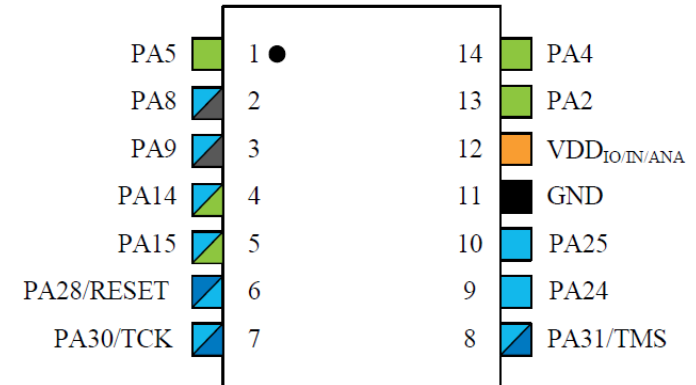
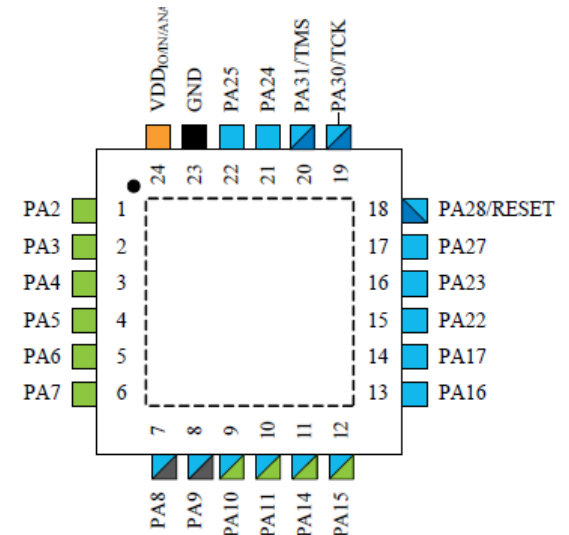
- Optimized functionality for advanced PWM and waveform output
- Full **autonomous** support of critical power switching applications



High GPIO pin count on small packages

Available in SAM D09, D10 and D11

- Only 2 pins used for Power and GND
 - Even when running USB Device!
- Reset can be used as GPIO
- Up to 22 GPIO on 24 pin QFN
- Up to 18 GPIO on 20 pin SOIC
- Up to 12 GPIO on 14 pin SOIC



- For reference:
 - ST only has 15 GPIO on QFN20 (STM32F030) = less functionality
 - And need 5 external components = \$\$ + Board space

Other Improvements

Available in SAM D09, D10, D11 and D21

- SERCOM
 - I2C increased from 1MHz to 3.4MHz
 - Autobaud on UART
 - LIN support
 - SMBus/ PMBus support
 - IrDA support up to 115.2bkps
- CPU
 - Added Micro Trace Buffer

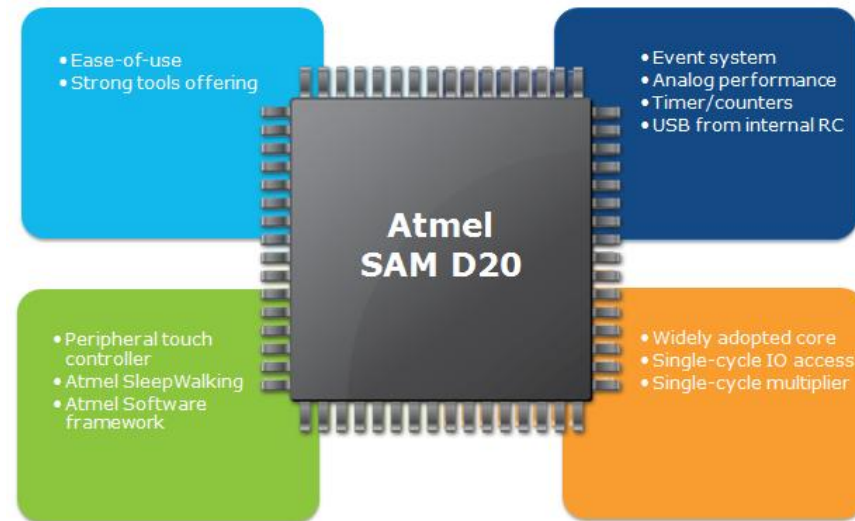
SAM D Atmel | SMART CM0+ Family Overview

SAM D Family Features	SAM D09	SAM D10	SAM D11	SAM D20	SAM D21
Cortex M0+	8KB Flash	8-16KB Flash		16-256KB Flash	32-256KB Flash
Event System					
SERCOM					
PTC(*)	14 pins	14, 20 and 24 pins		32, 48 and 64 pins	
12-bit 350 ksps ADC					
10-bit 350 ksps DAC*	6-ch DMA				12-ch DMA
2xAnalog Comparator*					
32-bit RTC w/Calendar	1x T/C for Control				3x T/C for Control
Serial Wire Debug					
BOR and POR					
Internal RCs			FS USB Device		FS USB H&D
Watchdog					
High GPIO Count					I ² S

* = not on D09

Atmel SAM D summary

- SAM D Combining the best of Atmel AVR® MCUs with ARM CM0+
 - Peripheral intelligence
 - Event system and DMA
 - SERCOM
 - Full Speed USB embedded Host and Device
 - Peripheral Touch Controller
 - Large GPIO count
 - Short design time
-
- Everything is compatible!





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