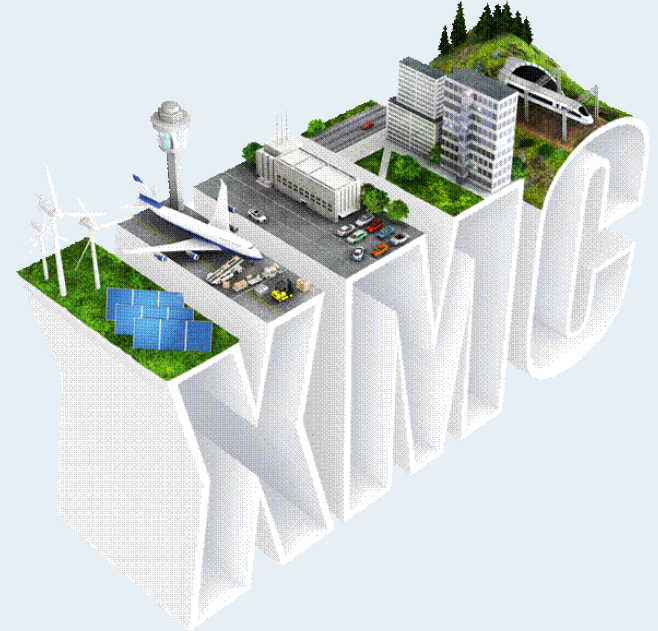


One microcontroller platform. Countless solutions. XMC.

Embedded World, Nuremberg
February 28 – March 1, 2012



Peter Schäfer, Vice President & General Manager, Microcontrollers
Stephan Zizala, Senior Director, Industrial & Multimarket Microcontrollers



One microcontroller platform. Countless solutions. XMC.



- Infineon's solutions for industrial applications

- Infineon's microcontroller activities

- XMC4000, Infineon's latest industrial microcontroller family

We focus on three areas with highly attractive future perspectives



Energy Efficiency








Mobility



Security

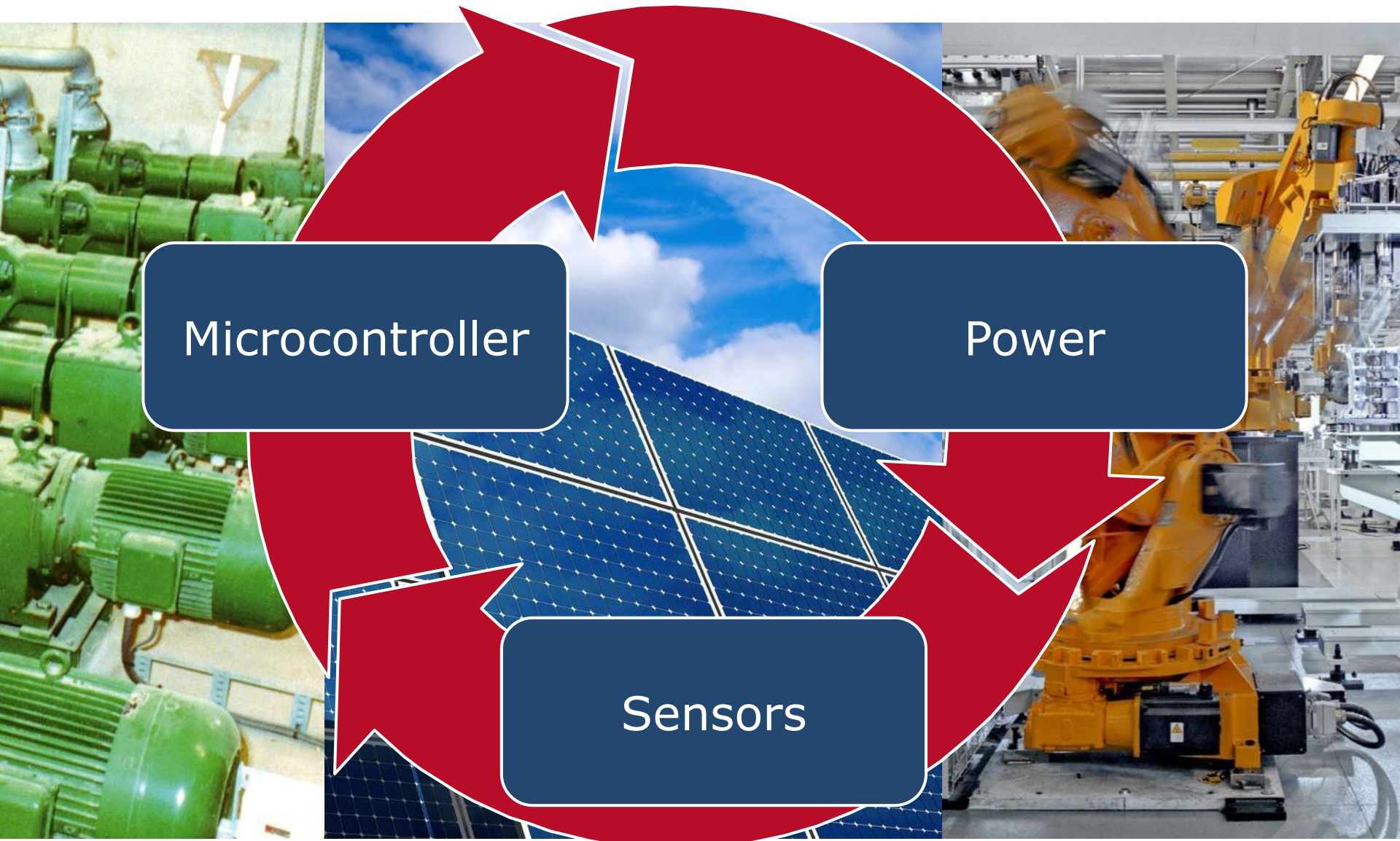


Significant electric energy savings are possible already today

	Electricity consumption	Saving potential	Application examples
Consumer power supply	Others 14%	1% ... >90%	 
Computing power supply	Information & Comm. 10%	>>1%	
EC-Ballast Daylight dimming HID, LED, ...	Lighting 21%	>25%	
Factory automation, Process engineering, Heavy industry, Light industry, ...	Motors 55%	25% ... >40%	
Transportation: Train, bus, car, ...			
Home appliances: Fridge, washing machine, air conditioning, ...			

Sources: ZVEI, Infineon, 2008.

Infineon's industrial microcontrollers, power and sensor components complement each other



One microcontroller platform. Countless solutions. XMC.



- Infineon's solutions for industrial applications

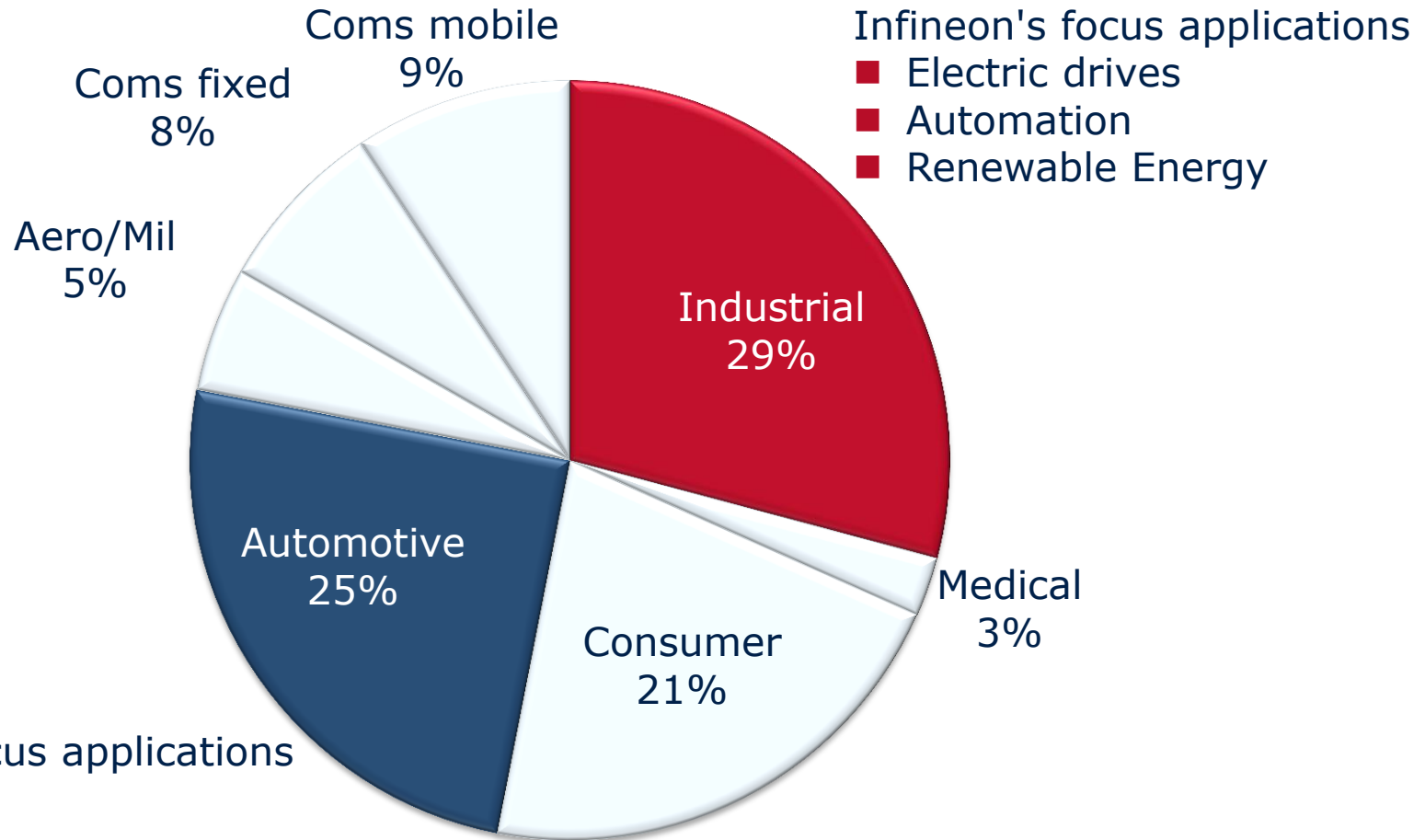
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Infineon targets automotive and industrial microcontroller markets



World-wide MCU and DSC market in 2010: USD 13bn



Source: IMS Research, 2010

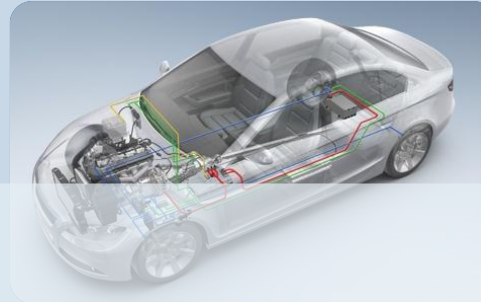
Infineon is the 3rd largest automotive microcontroller supplier world-wide*



Families



Key successes



- **TriCore™ market share in automotive embedded 32-bit: 28% in 2010****
- **Almost every 2nd new car has a TriCore™ microcontroller in engine, transmission or electric drive train control**



Source: *Strategy Analytics 2011, **IMS Research

Next Generation TriCore™ based Multi-Core architecture for automotive powertrain and safety

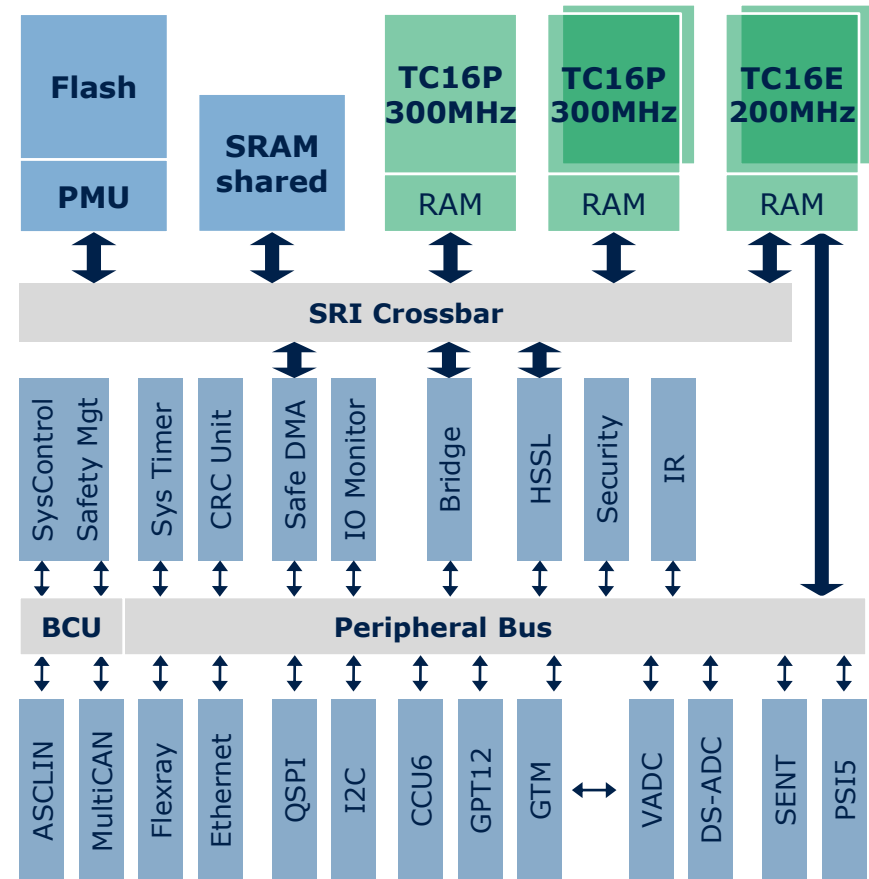


The Task

- Provide 1.5 times the application performance compared to previous generation
- Increase performance-power ratio by more than 30%
- Provide means for stronger software encapsulation
- Meet ASIL-D requirements of ISO26262

Solution

- Introduction of TriCore™ 1.6 multicore architecture
- 1000 DMIPS and more application performance
- Advanced power management technologies, e.g. integrated DC/DC converter
- Protection system for software/hardware isolation including registers, CPU and bus



Core: Single/Dual/Triple TC16E/P configuration
80-300MHz, lockstep capable
Flash: 512kB – 8MB
SRAM: 56kB – 2.5MB

No. 3 market position in 2009 for C166 architecture in 16-bit industrial microcontrollers*



Families

AUDO NG
AUDIO FUTURE
AUDIO MAX

TriCore™
32-bit

C16x
XC16x
XE16x

C166
16-bit

C500
XC800

8051 compatible
8-bit

Key successes

Automation
Renewable
energy
Medical
Safety



Industrial
drives
Transportation
Solar inverters



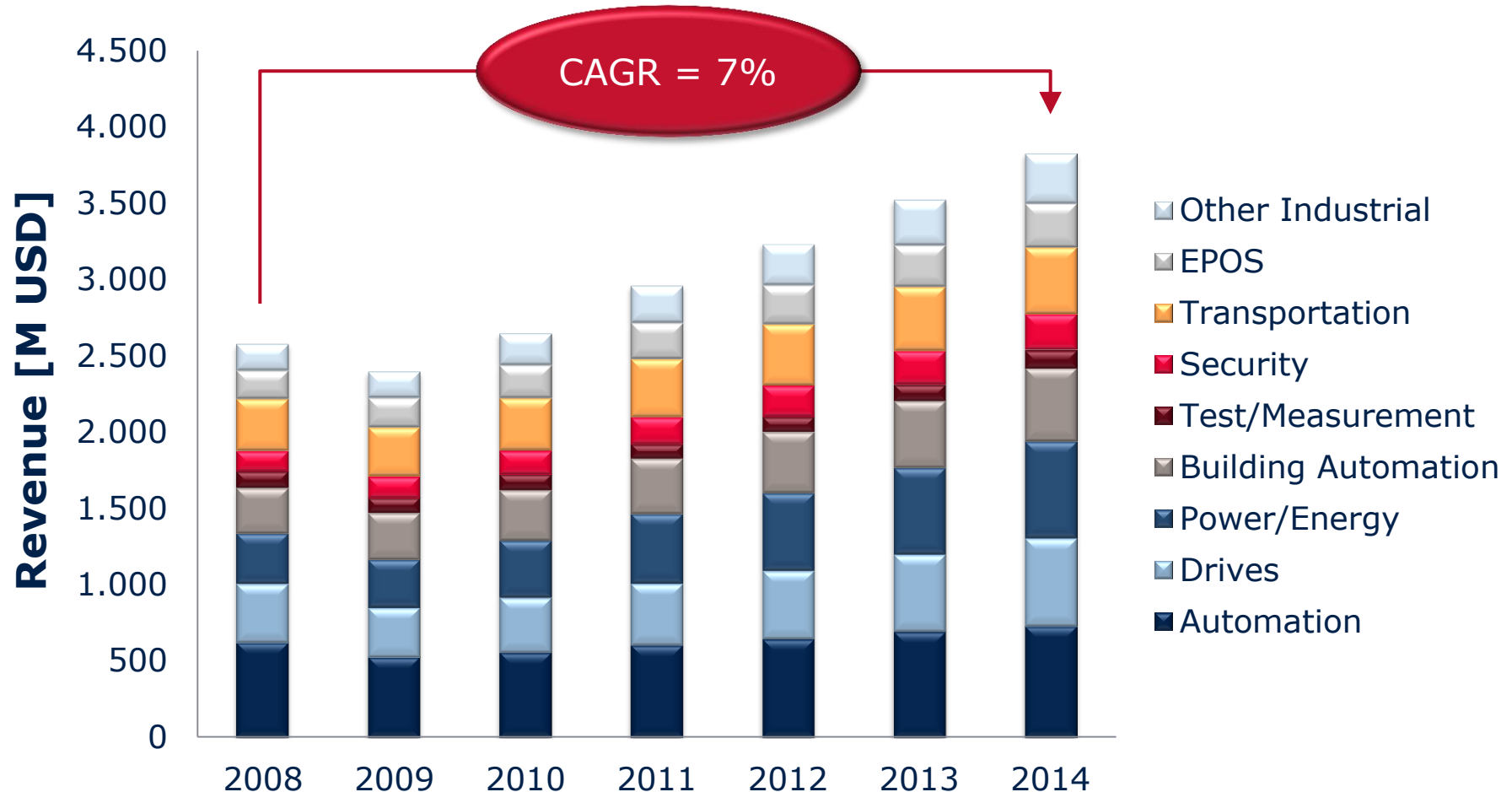
Consumer
drives
Lighting
Appliances



*Source: IMS Research, 2010

World-wide industrial microcontroller and DSC market growth with 7%

World-wide Industrial Microcontroller and DSC Market w/o Smart Cards [M USD]



Source: IMS Research, 2010

Infineon's microcontroller portfolio: optimized for automotive and industrial applications



One microcontroller platform. Countless solutions. XMC.



- Infineon's solutions for industrial applications

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XMC4000 target markets and key trends

**Industrial Drives
MCU/DSC market:
USD 360 million
(IMS, 2010)**

**Power & Energy
MCU/DSC market:
USD 375 million
(IMS, 2010)**

**Automation
MCU/DSC market:
USD 556 million
(IMS, 2010)**



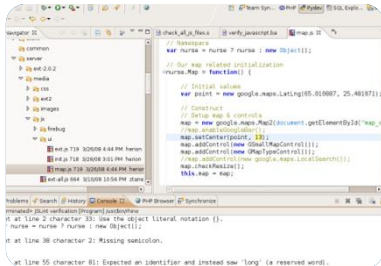
Trend 1: energy efficiency

- Advanced algorithms driving need for higher performance
- Efficient inverter control requiring ADCs and timer innovations



Trend 2: connectivity

- Real-time connectivity within the system
- Consumer connectivity to the world



Trend 3: software complexity

- Software complexity in embedded systems grows faster than Moore's law. However, software development productivity improves slower than hardware development productivity. (ITRS 2007)

One microcontroller platform.
Countless solutions. XMC4000.



**Infineon
C166 core**

**Powerful
peripherals**

**High real-
time
performance**

**DAVE™ for device configuration
+ free 3rd party compiler/debugger**

Reliability: quality, long-term supply, commitments

One microcontroller platform. Countless solutions. XMC4000.



**ARM®
Cortex™-M4
core**

**Brand new
peripherals**

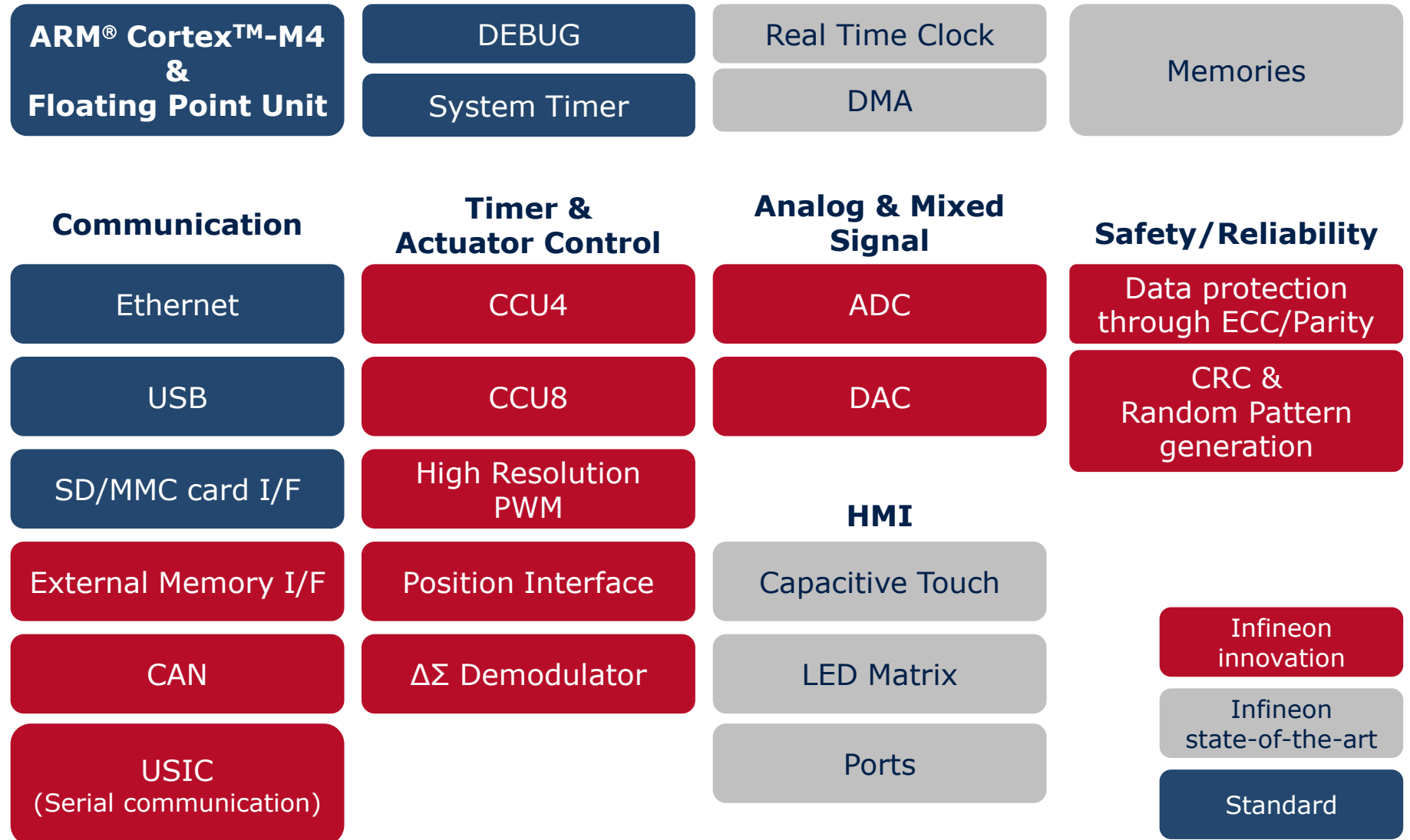
**High real-
time
performance**

DAVE™ 3: Free integrated development environment:

- **free compiler, debugger, flash loader**
- **extendable for commercial compilers and debuggers**
- **free automatic code generator**
- **operating system integration support**

Reliability: quality, long-term supply, commitments

XMC4000 brings significant peripheral innovations for industrial applications



Strong portfolio, maximised scalability

Samples of XMC4500 series available



* Under definition

		Low-end				High-end
		XMC4100	XMC4200	XMC4400	XMC4500	XMC4700*
System Performance	Core	ARM® Cortex™ M4				
	CPU frequency (at 125 °C)	80 MHz	80 MHz	120 MHz	120 MHz	180 MHz
	Co-proc	Floating Point Unit				
	Flash size	128 kB	256 kB	512 kB	1 MB	2.5 MB
	RAM size	20 kB	40 kB	80 kB	160 kB	512 kB
	Cache	4 kB	4 kB	4 kB	4 kB	6 kB
Timers	POSIF	1x	1x	2x	2x	2x
	CCU4 (4ch)	2x	2x	4x	4x	4x
	CCU8 (4ch)	1x	1x	2x	2x	2x
	High-resolution PWM (150ps) channels	4x	4x	4x		
Signal Processing	ADC 12-bit	2x	2x	4x	4x	4x
	Delta/Sigma Demodulator			4x	4x	4x
	DAC	2x	2x	2x	2x	2x
Communication	IEEE 1588 Ethernet MAC			1x	1x	2x
	USB	FS DEV	FS DEV	FS OTG	FS OTG	HS OTG
	SD/MMC				✓	✓
	Serial channels (UART, SPI, I²C, I²S)	4x	4x	4x	6x	6x
	Ext. Memory I/F				✓	✓
	CAN	2x	2x	2x	3x	3x
	Touch Button	✓	✓	✓	✓	✓

XMC4000 Microcontrollers – key peripheral innovation for electric drive control

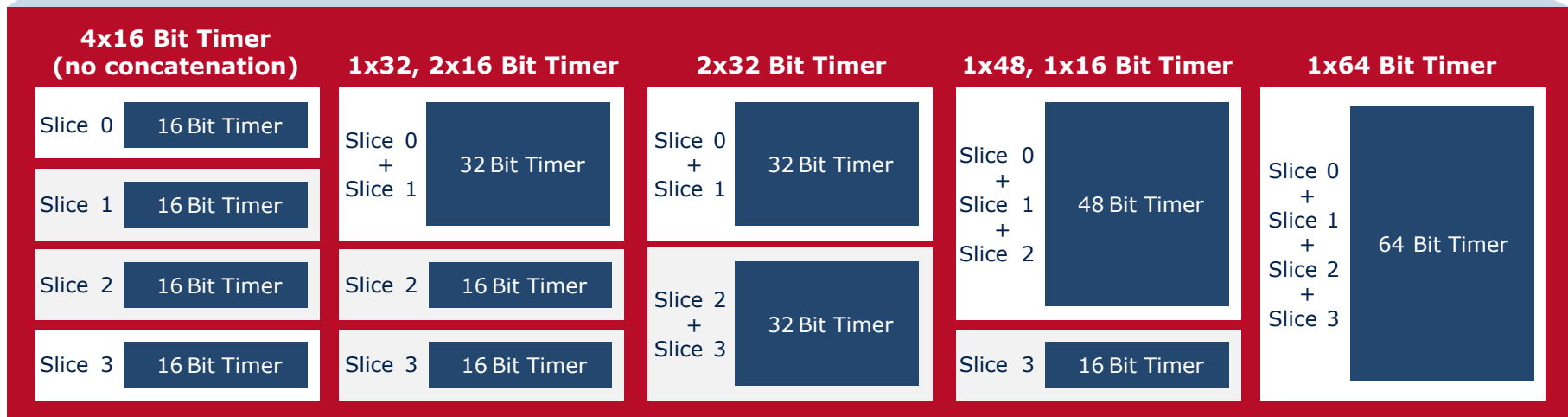


Application Problem	Key System Feature	XMC4000 Advantage
PWM Generation	Flexible PWM generation for any kind of inverter topology 3-level PWM generation	CCU4, CCU8 with highest flexibility for PWM control
Current Measurement	Simultaneous phase current measurement	Quad-ADC with time-triggered & synchronized conversion
	Galvanic isolated phase current measurement	Delta Sigma Demodulator with advanced filter and integration features
Position Detection	Rotor position detection via multiple & independent pathes	Quadrature decoder with advanced velocity analysis support and resolver interface

CCU4, CCU8: highly flexible timers optimized for industrial applications

Each CCU4 timer module comprises 4 identical timer slices

CCU 4					
Slice 0	0	Prescaler	Timer	Capture	Service Req
		Input Selector		Compare	Output Mod
				Concatenate	Dither
Slice 1	1				
Slice 2	2				
Slice 3	3				

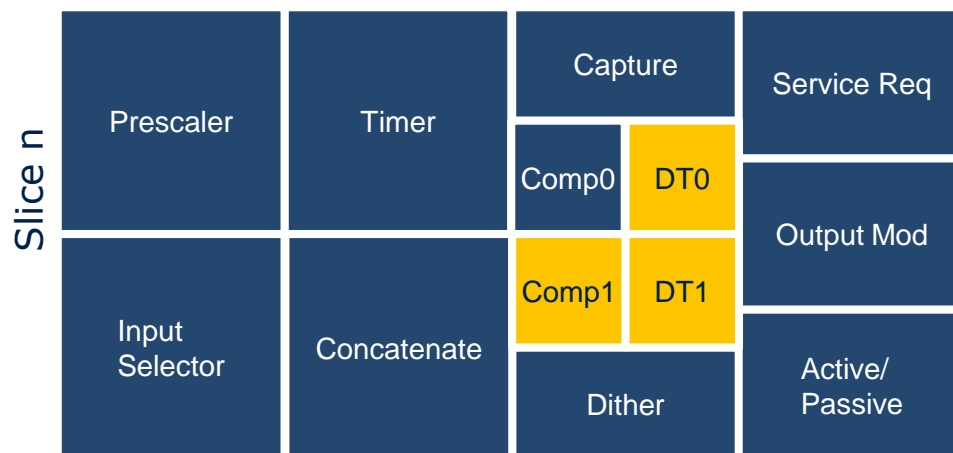


CCU8: all PWM types and 3-level inverters are supported

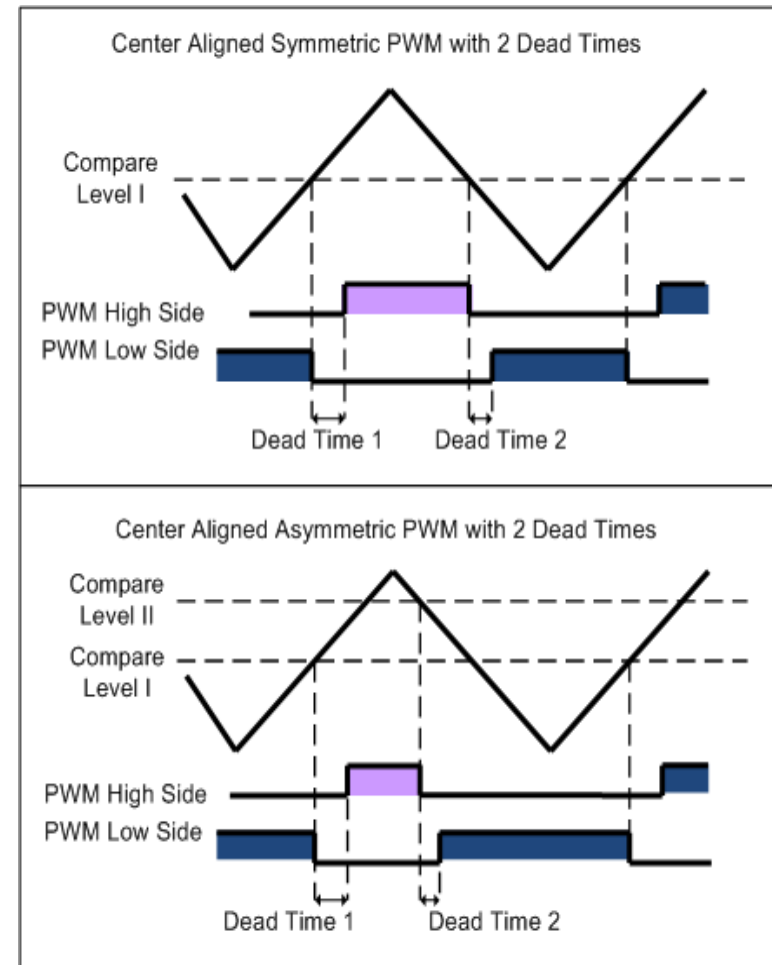
CCU8 slice = CCU4 slice plus

- One additional compare channel
- Different dead time for rising & falling edge
- Automatic asymmetric PWM generation feature

CCU8

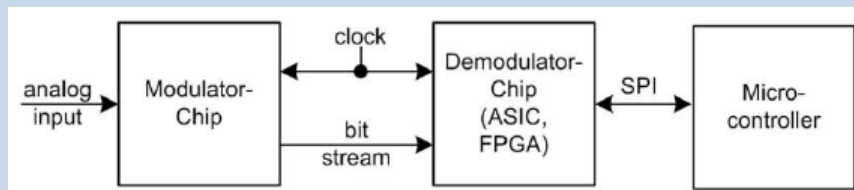


High and low side PWM schemes with 2 dead times

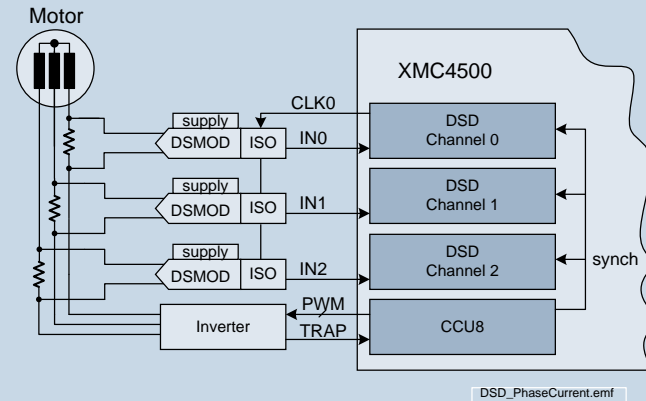


$\Delta\Sigma$ Demodulator application example: saving BOM cost by integration

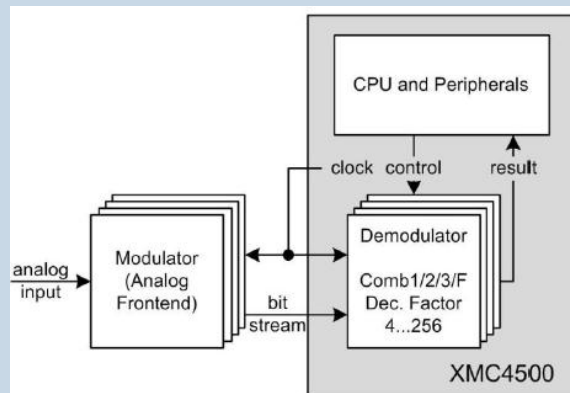
Conventional approach



Application example



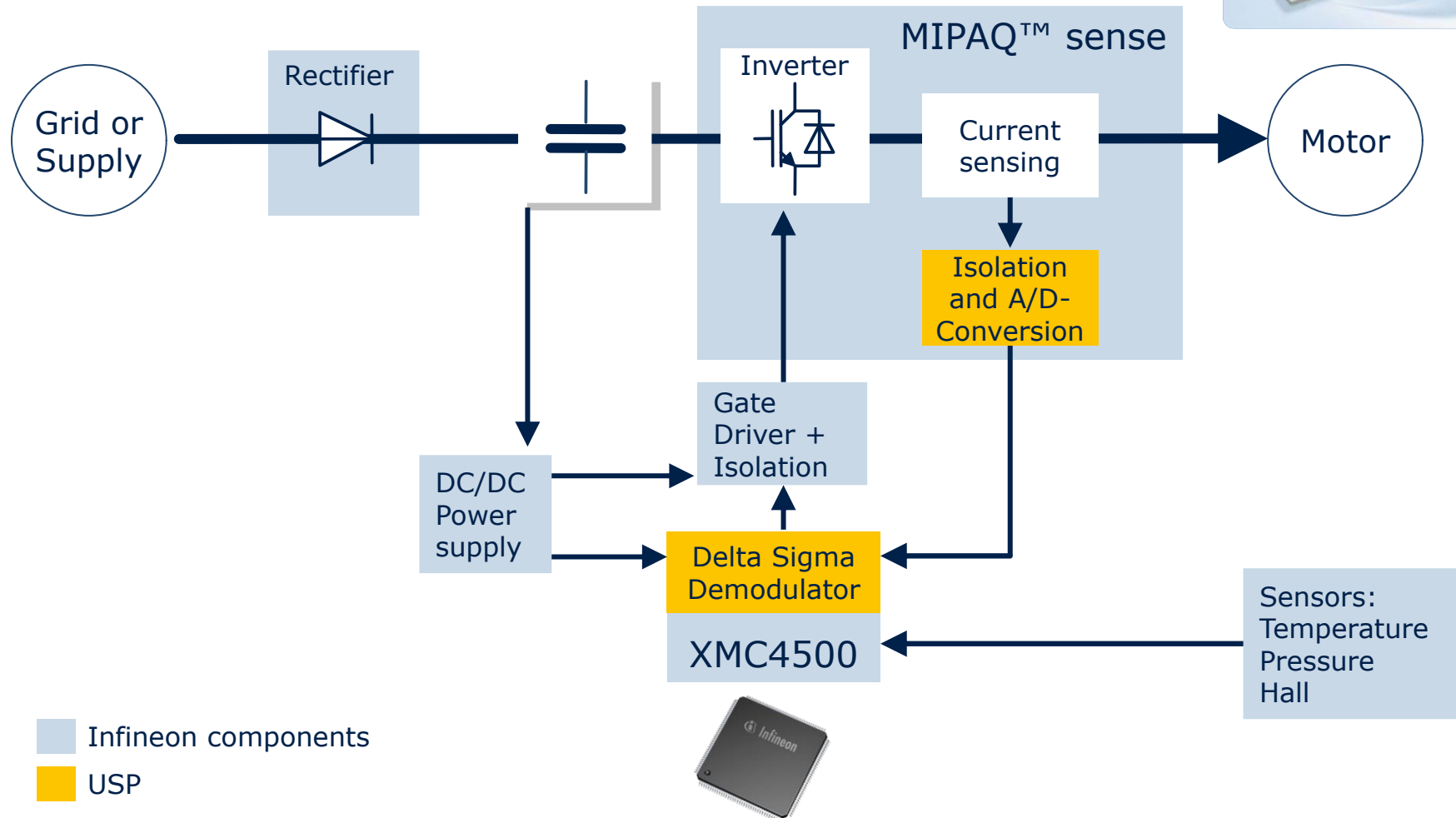
New approach: saving 1 IC



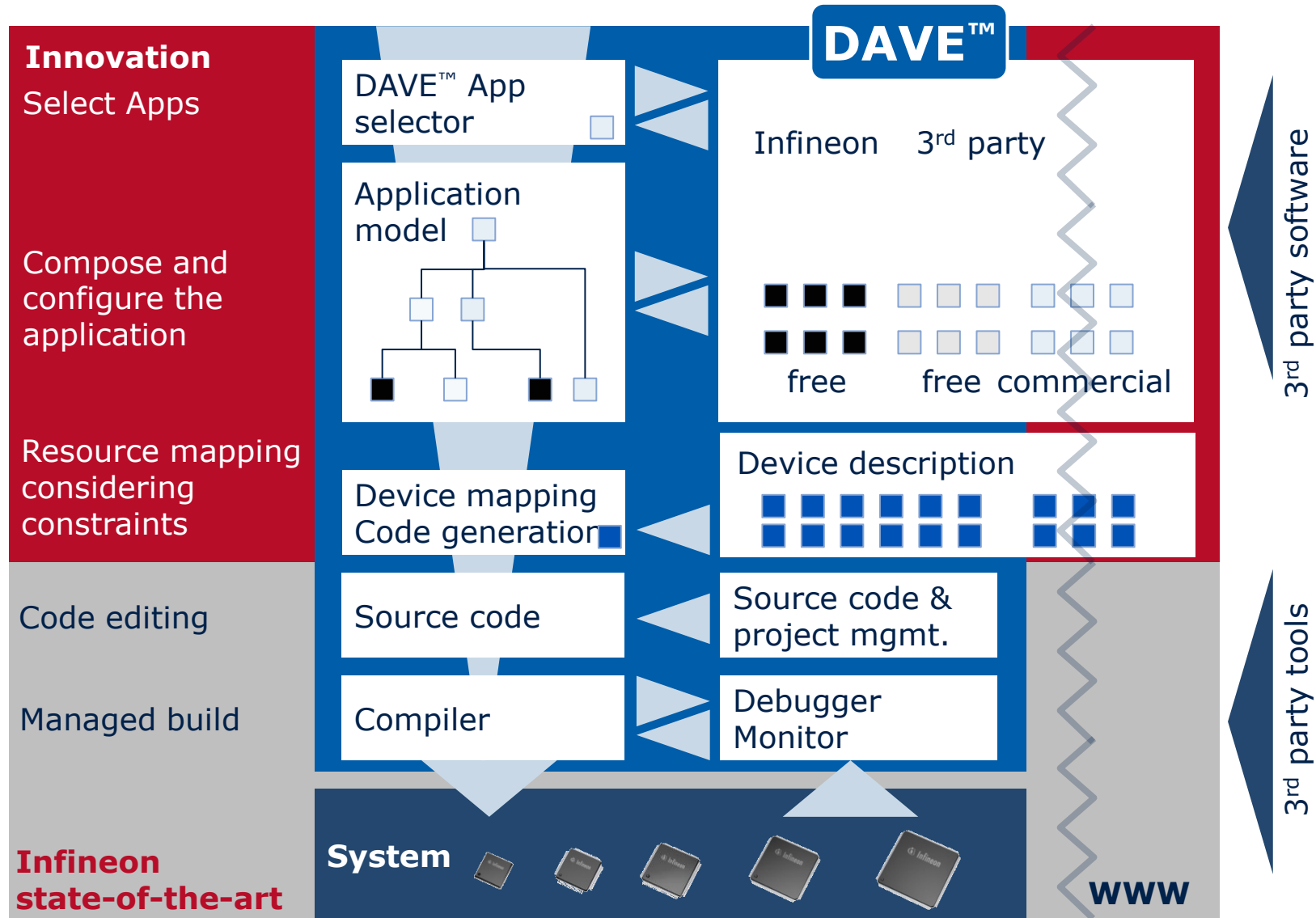
Features of new approach

- external $\Delta\Sigma$ modulator with galvanic isolation allows direct shunt measurement at "hot phase"
- wide dynamic range allows high resolution at all load conditions
- noise free sampling due to PWM synchronization and integrator window control
- comparator function for overcurrent detection and normal filter for current measurement
- simultaneous sampling for exact phase current measurement

Infineon offers highest integration with XMC4500 and power module MIPAQ™ sense



DAVE™ 3 is free, extensible and enables component based programming to save effort



XMC4000 Ecosystem



IDE,
C-Compilers,
Debuggers,
Analysis Utilities

- Altium
- Atollic
- Keil
- IAR Systems
- Wind River

Debuggers

- Hitex
- PLS
- iSystems
- Lauterbach
- Segger
- Keil

Flash
Programming

- Hitex
- PLS
- Segger

DAVE™ 3

- free integrated development environment
- free compiler, debugger, flash loader
- free automatic code generator
- extendable for 3rd parties
- operating system integration support

RTOS and middleware
(TCP/IP/USB stacks,
CAN, ...)

- | | |
|-----------------|-------------|
| ■ CMX | ■ Micrium |
| ■ Express Logic | ■ Segger |
| ■ FreeRTOS | ■ SEVENSTAX |
| ■ HighTec | ■ Thesycon |
| ■ Keil | |

Training and
Consulting

- Hitex
- Microconsult

A modular set of kits speeds up evaluation and development

HMI-Satellite

2

- Color OLED (160x128)
- SD/MMC card IF
- Headset Audio Codec (I2S)
- I2C I/O expander
- Touch sense buttons

COM-Satellite

3

- Ethernet RJ45
- MultiCAN
- RS485
- I2C I/O expander

ACT-Satellite

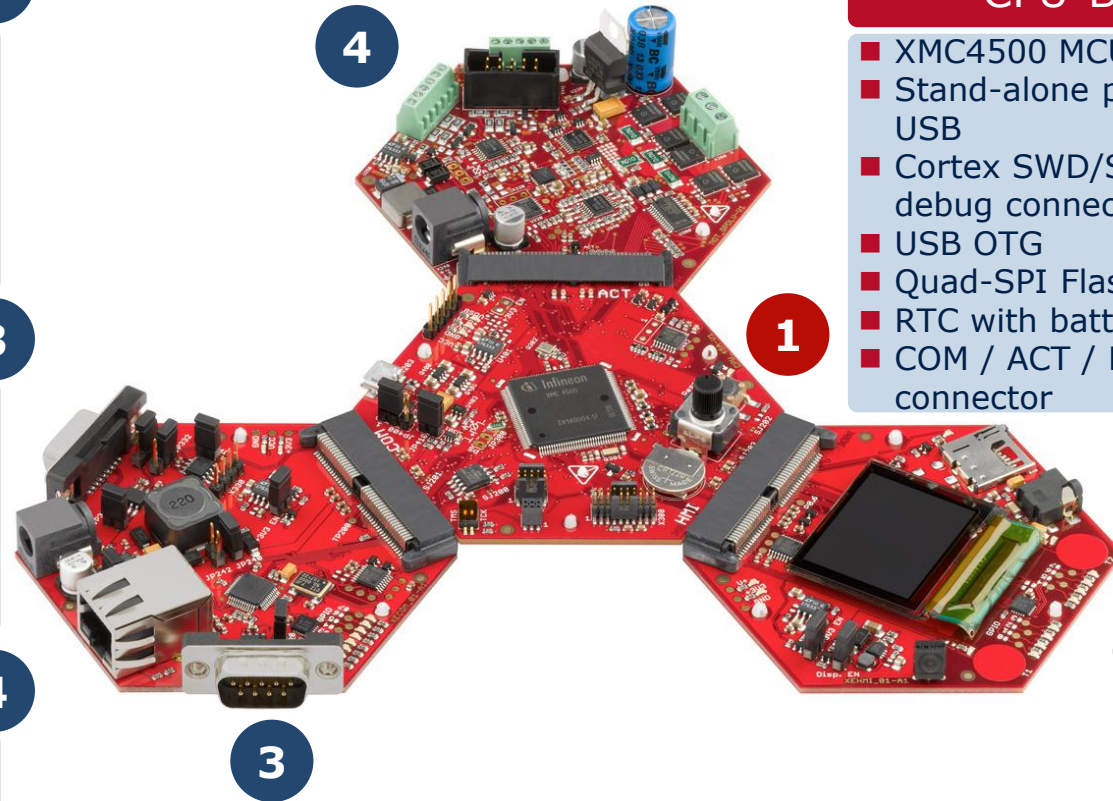
4

- Here: 3-phase motor control
- Full bridge power stage
- Resolver circuit
- Encoder interface
- Shunt current measurement

CPU-Board

1

- XMC4500 MCU
- Stand-alone powered via USB
- Cortex SWD/SWDJ/ETM debug connectors
- USB OTG
- Quad-SPI Flash memory
- RTC with battery backup
- COM / ACT / HMI connector



	CPU Board	Debugger	Satellite Cards
Basic Edition	X		
Enterprise Edition	X	X	
Application Edition	X	X	X

Key values for our customers

Market need	New Industrial MCU family	DAVE™ 3
Energy efficiency	<ul style="list-style-type: none"> ■ Most advanced PWM, timers and four 12-bit ADC for efficient drives ■ High-resolution PWM and control logic for solar inverters ■ $\Delta\Sigma$-Demodulator to save an ASIC ■ Real-time optimized system: powerful peripherals working autonomously and fastest eFlash 	<ul style="list-style-type: none"> ■ Fast and easy access to advanced algorithms via graphical programming ■ Open for customer enhancements
Connectivity	<ul style="list-style-type: none"> ■ Complete set of industrial standard connectivity peripherals: including Ethernet, USB, SD/MMC, CAN, SPI, Quad-SPI, LIN, I2C, I2S, UART 	<ul style="list-style-type: none"> ■ Drivers and stacks ■ Open for 3rd party software integration ■ Operating system integration
Reduce time-to-production and software cost	<ul style="list-style-type: none"> ■ Scalable family ■ Widest application coverage by best configurability ■ Trusted and industry-proven product quality, reliability, long-term supply 	<ul style="list-style-type: none"> ■ High-level programming ■ Component based programming enabling software re-use

XMC4000: Combination of Infineon know-how with the benefits of widespread core



Microcontroller Know-how

- >30 years automotive and industrial microcontroller experience
- Innovative application specific peripherals
- Highly configurable and flexible
- Fast flash

Quality and reliability

- High-performance Flash technology
- Extended temperature range on selected products (125 °C)
- Long product life time (min. 15 years)

DAVE™ 3 Development Environment

- Based on 10 years experience with DAVE™
Next generation of DAVE™ with enhanced functionality
- Free tools
- Auto-code generation making powerful hardware easy to use
- Open to 3rd parties

Schedule

- Now: samples of XMC4500 series, evaluation kits, 3rd party tools
- March: DAVE™ 3 for download
- May 2012: volume production start of XMC4500 series
- Q4 2012: samples of XMC4400, XMC4200 and XMC4100 series

One microcontroller platform. Countless solutions. XMC.



One microcontroller platform. Countless solutions. XMC.



- Infineon's solutions for industrial applications

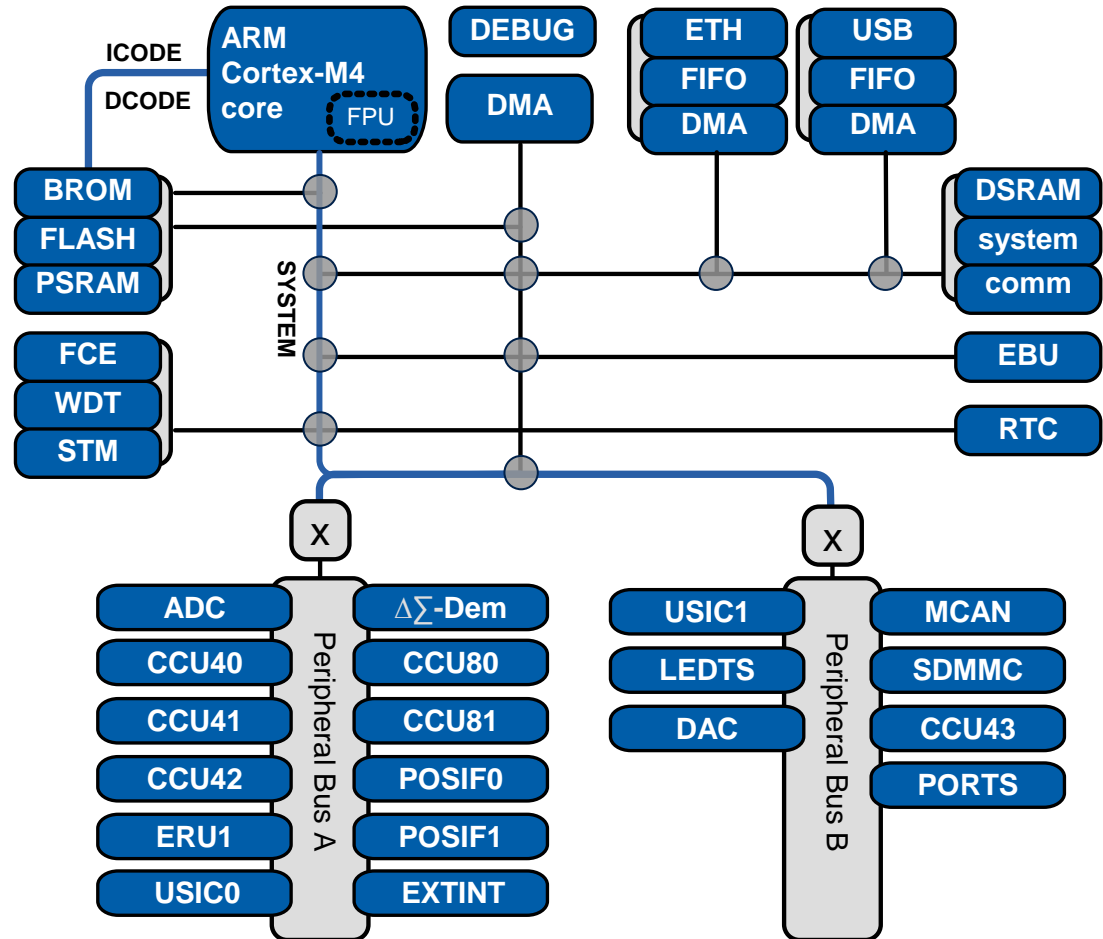
- Infineon's microcontroller activities

- XMC4000: Infineon's latest industrial microcontroller family

- Backup

XMC4000 Architecture is optimized for best-in-class real-time control

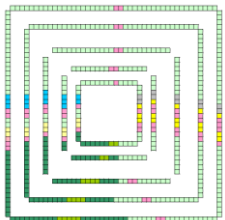
- DSP instructions
- Floating Point Unit (single precision)
- Bus matrix with separate busses for code, data, system
- Fast interrupt response time and task switching



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

XMC4000 scales with 5 product series in 8 packages, from 64kB to 2.5MB flash

CPU Frequency @ 125 °C	Flash	SRAM								
180	2.5MB	512kB							XMC4700 (in def.)	XMC4700 (in def.)
120	1MB	160kB						XMC4500	XMC4500	
120	768kB	160kB					XMC4500			
120	512kB	80kB					XMC4400			
80/120	256kB	40/80kB		XMC4200	XMC4400					
80	128kB	20kB	XMC4200	XMC4100						
80	64kB	20kB	XMC4100							
			VQFN48 (7x7)	LQFP64 (12x12) LFBGA64 (in def.) (5x5)	LQFP64 (12x12)	LQFP100 (16x16)	LQFP144 (22x22)		LFBGA144 (10x10)	LQFP176 (26x26) LFBGA225 (13x13)





ENERGY EFFICIENCY MOBILITY SECURITY

Innovative semiconductor solutions for energy efficiency, mobility and security.

