One microcontroller platform. Countless solutions. XMC4000.

International Press Conference
Am Campeon, January 23, 2012

Peter Bauer, CEO
Peter Schäfer, VP & GM, Microcontrollers
Stephan Zizala, Senior Director, Industrial & Multimarket Microcontrollers

Infineon

One microcontroller platform. Countless solutions. XMC4000.

- Infineon's solutions for industrial applications: Peter Bauer
- Infineon's microcontroller activities: Peter Schäfer
- XMC4000, Infineon's new industrial microcontroller family: Stephan Zizala
- Questions and answers

One microcontroller platform. Countless solutions. XMC4000.

- Infineon's solutions for industrial applications: Peter Bauer
- Infineon's microcontroller activities: Peter Schäfer
- XMC4000, Infineon's new industrial microcontroller family: Stephan Zizala
- Questions and answers

Major challenges of the 21st century

Population explosion

Growing megacities

Limited energy resources

Emerging markets

We focus on three areas with highly attractive future perspectives

Energy Efficiency

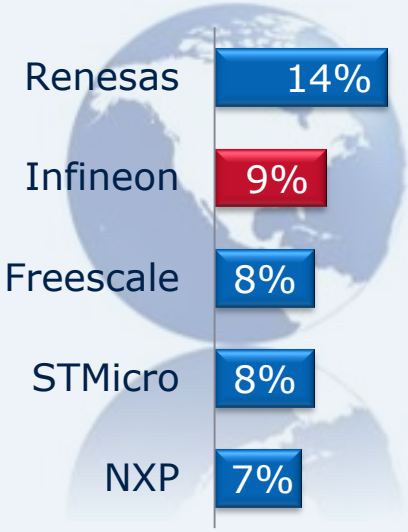
Mobility

Security

Infineon holds Top Positions in All Target Markets

Automotive

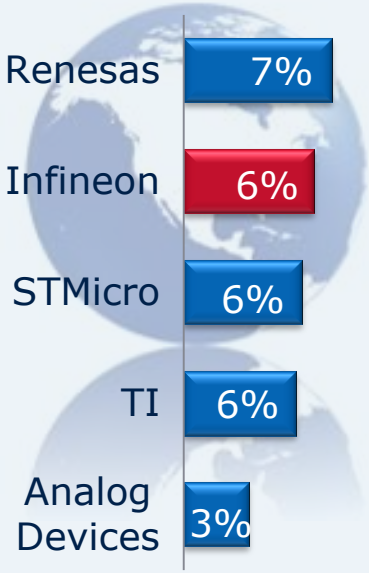
#2



Calendar Year 2010.
Source: Strategy Analytics, April 2011.

Industrial

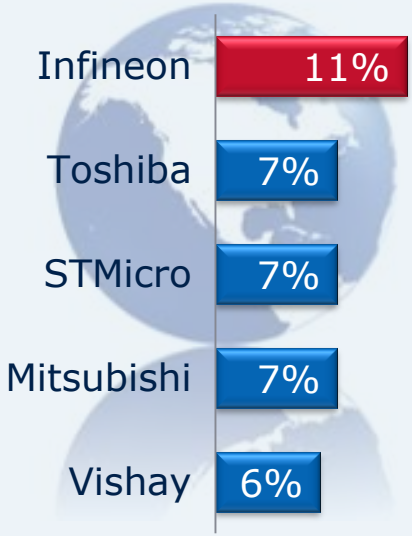
#2



Calendar Year 2009.
Source: Semicast, July 2010.

Power

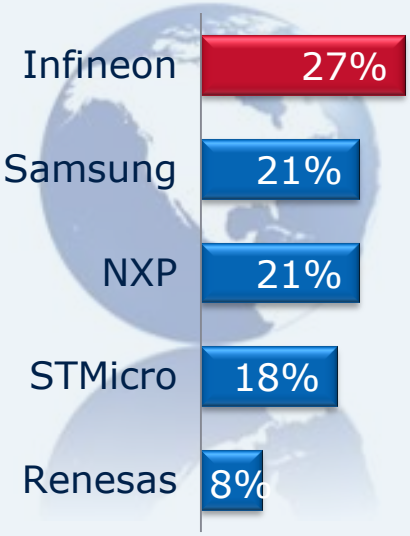
#1



Calendar Year 2010.
Source: IMS Research, August 2011.

Chip Card

#1

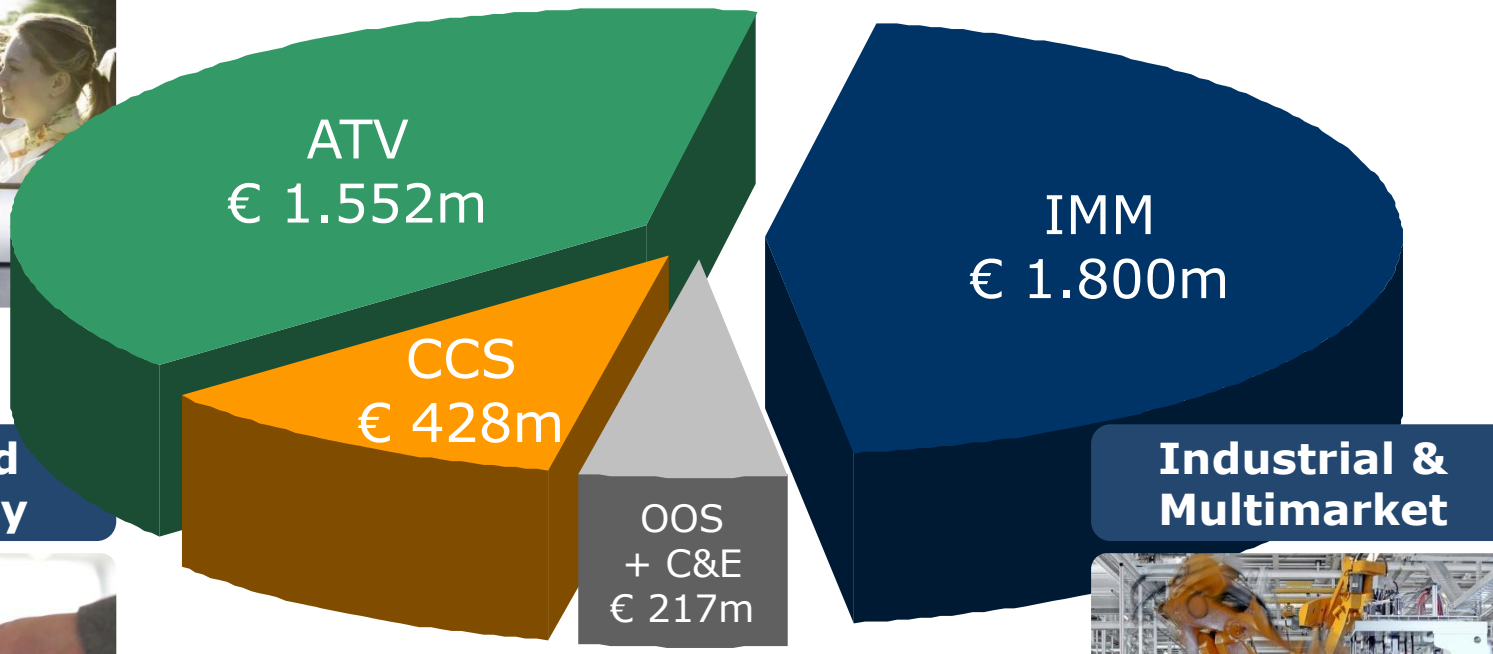


Calendar Year 2010.
Source: IMS Research, August 2011.

Revenue split by Division

Full FY 2011 revenue: EUR 3.997m

Automotive



Chip Card & Security

Industrial & Multimarket

OOS: Other Operating Segments
C&E: Corporate and Eliminations

We focus on three areas with highly attractive future perspectives

Energy Efficiency

Mobility

Security

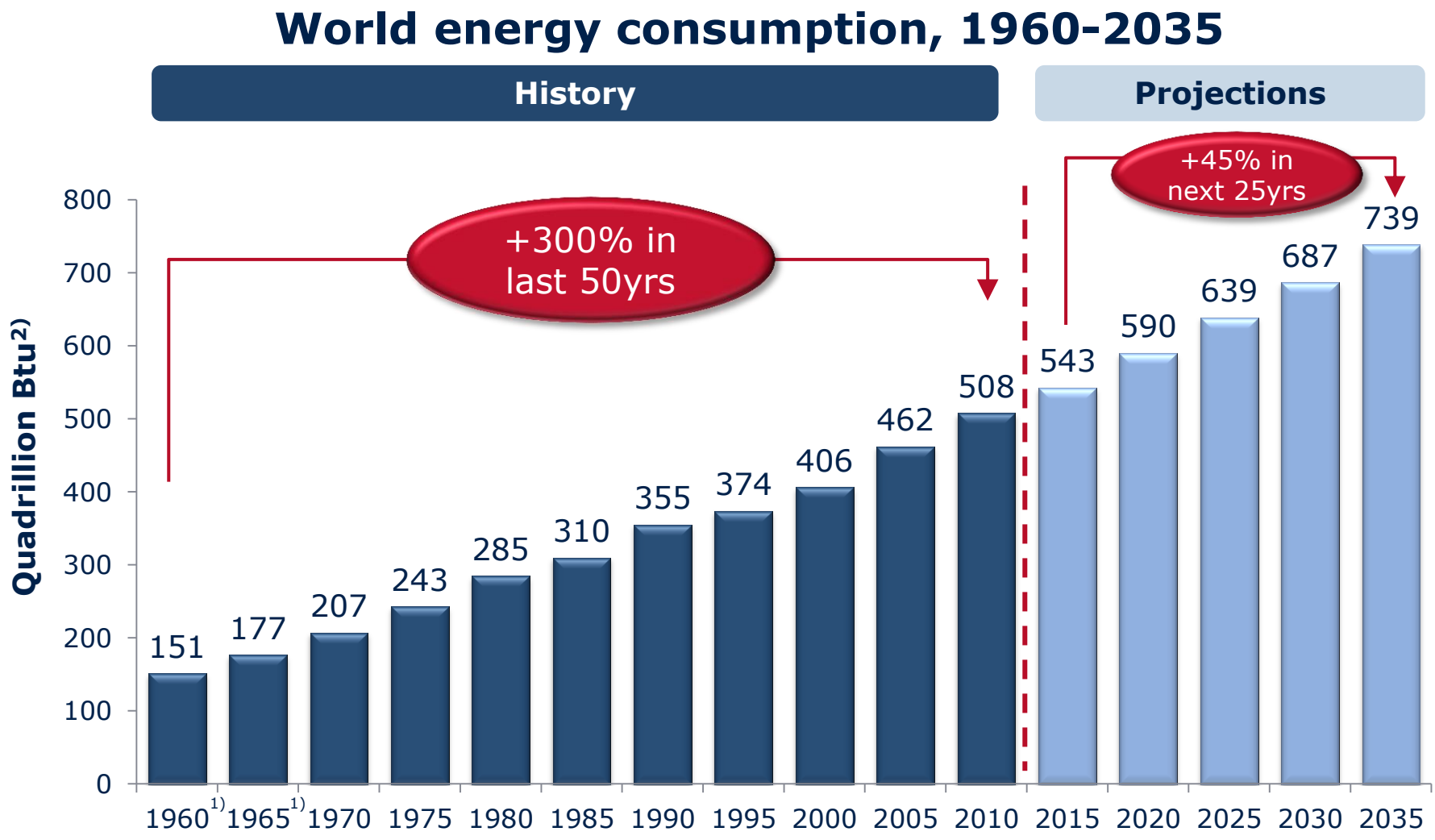
Automotive

Industrial Power Control

Power Management & Multimarket

Chip Card & Security

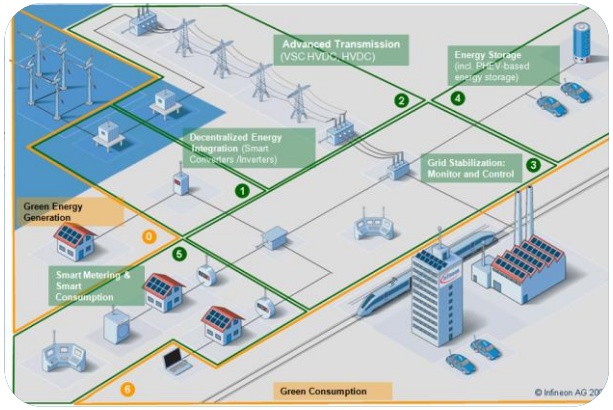
Energy efficiency is a key driver for innovation



Sources: Energy Information Administration (EIA), International Energy Outlook 2005, 2010
1) Infineon estimates based on EIA 2005
2) British thermal unit (Btu): 1 Btu = 1.05506 kJ

Infineon's Energy Efficiency focus in the Smart Grid

Smart Grid leading semiconductor offering

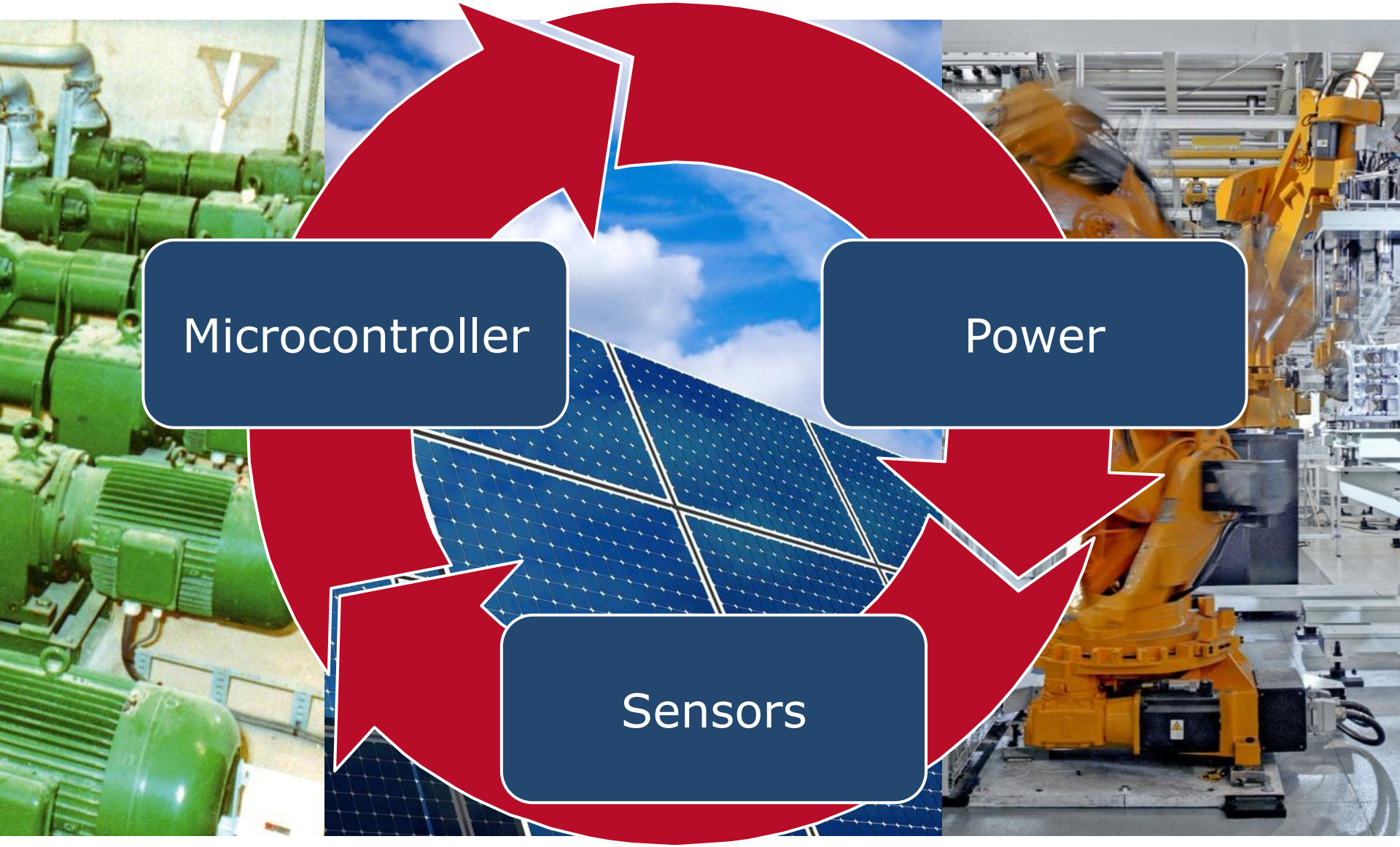


- Energy generation
- Advanced transmission and distribution
- Efficient consumption
- Electric Vehicles
- Security

Smart Meter: new upcoming portfolio of dedicated ICs

- Electric metering controller
  - Highly integrated, based on ARM® Cortex™-M0
- Gas, water and heat metering controller
  - Very low power, dedicated flow peripherals
- Smart Grid communication – PLC and RF
  - Highly flexible, software configured

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



We focus on our target markets: New microcontroller family for energy efficiency in industrial systems

Focus Areas

- Energy Efficiency
- Mobility
- Security



Core Competencies

- Analog/Mixed Signal
- Power
- Embedded Control
- Manufacturing Competence

Our Target Markets

- Automotive
- Industrial Electronics
- Chip Card & Security



XMC4000 with a ARM® Cortex™-M4 core

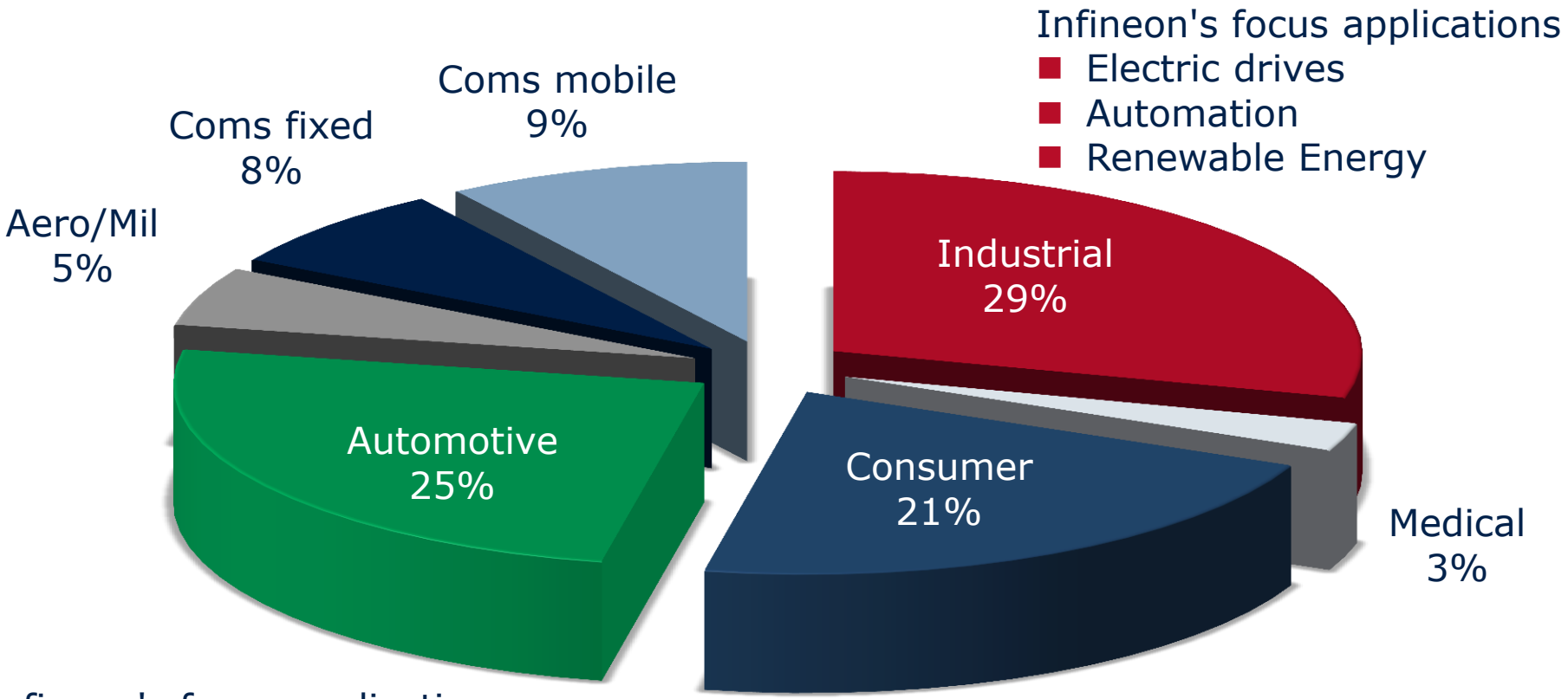
- A new 32-bit microcontroller family for industrial applications
- Leveraging Infineon's more than 30 years of industrial and peripheral experience with a wide-spread core

One microcontroller platform. Countless solutions. XMC4000.

- Infineon's solutions for industrial applications: Peter Bauer
- **Infineon's microcontroller activities: Peter Schäfer**
- XMC4000, Infineon's new industrial microcontroller family: Stephan Zizala
- Questions and answers

Infineon targets automotive and industrial microcontroller markets

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



Source: IMS Research, 2010

Infineon is 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
- World leading automotive suppliers use Infineon's 16-bit or TriCore™ 32-bit microcontrollers:
  - Powertrain: electrical vehicle drive train, engine management, transmission
  - Safety: airbags, braking, chassis domain control, electrical power steering, suspension
  - Body: body control modules, gateways, HVAC
- Proven track-record in high automotive quality with leading edge embedded flash technologies

Source: *Strategy Analytics 2011, **IMS Research

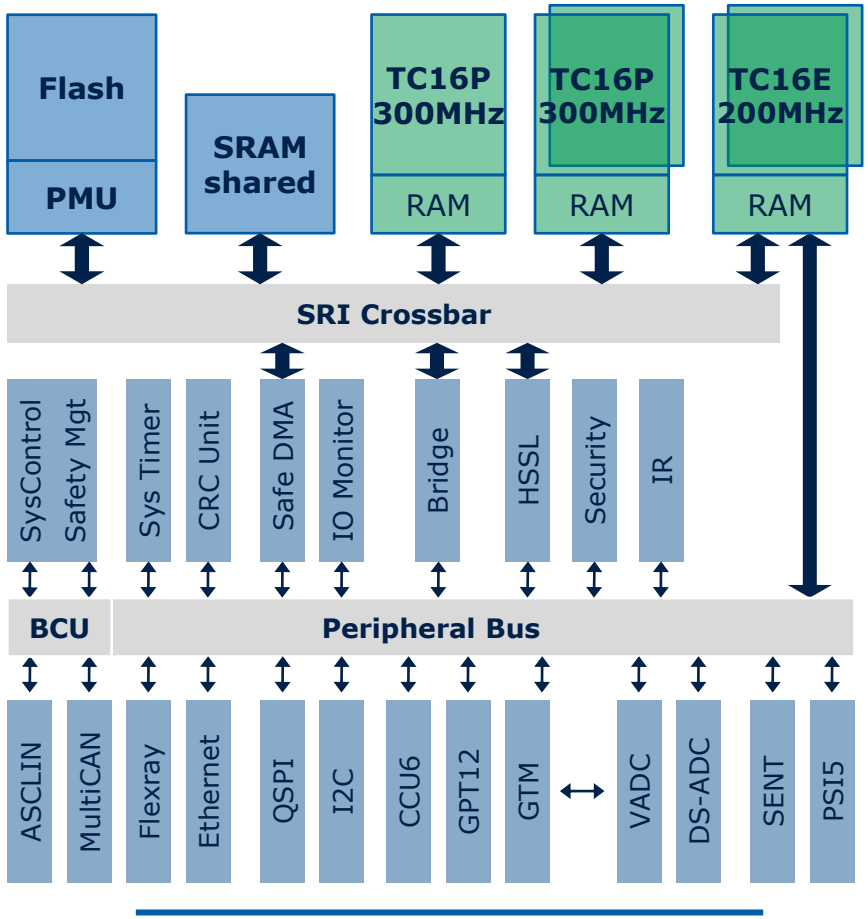
Next Generation TriCore™ based Multi-Core architecture for automotive powertrain and safety

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

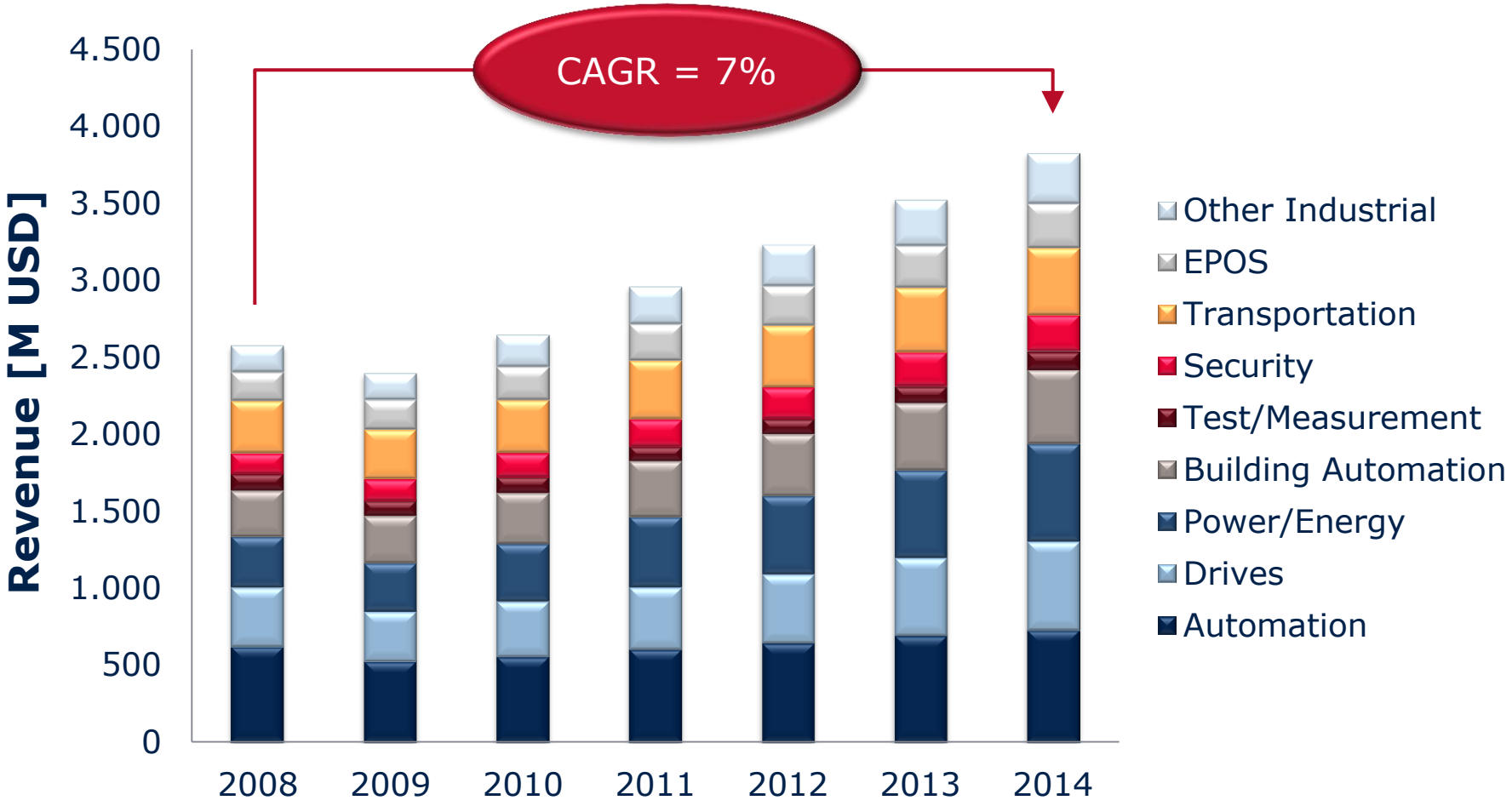
- Introduction of TriCore™ 1.6 multicore architecture
- 1000 DMIPS and more application performance
- Advanced power management technologies, e.g. integrated DC/DC converter
- Protection system for software/hardware isolation including registers, CPU and bus



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

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

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

Families

Key successes

Automation
Renewable energy
Medical
Safety



Industrial drives
Transportation
Solar inverters

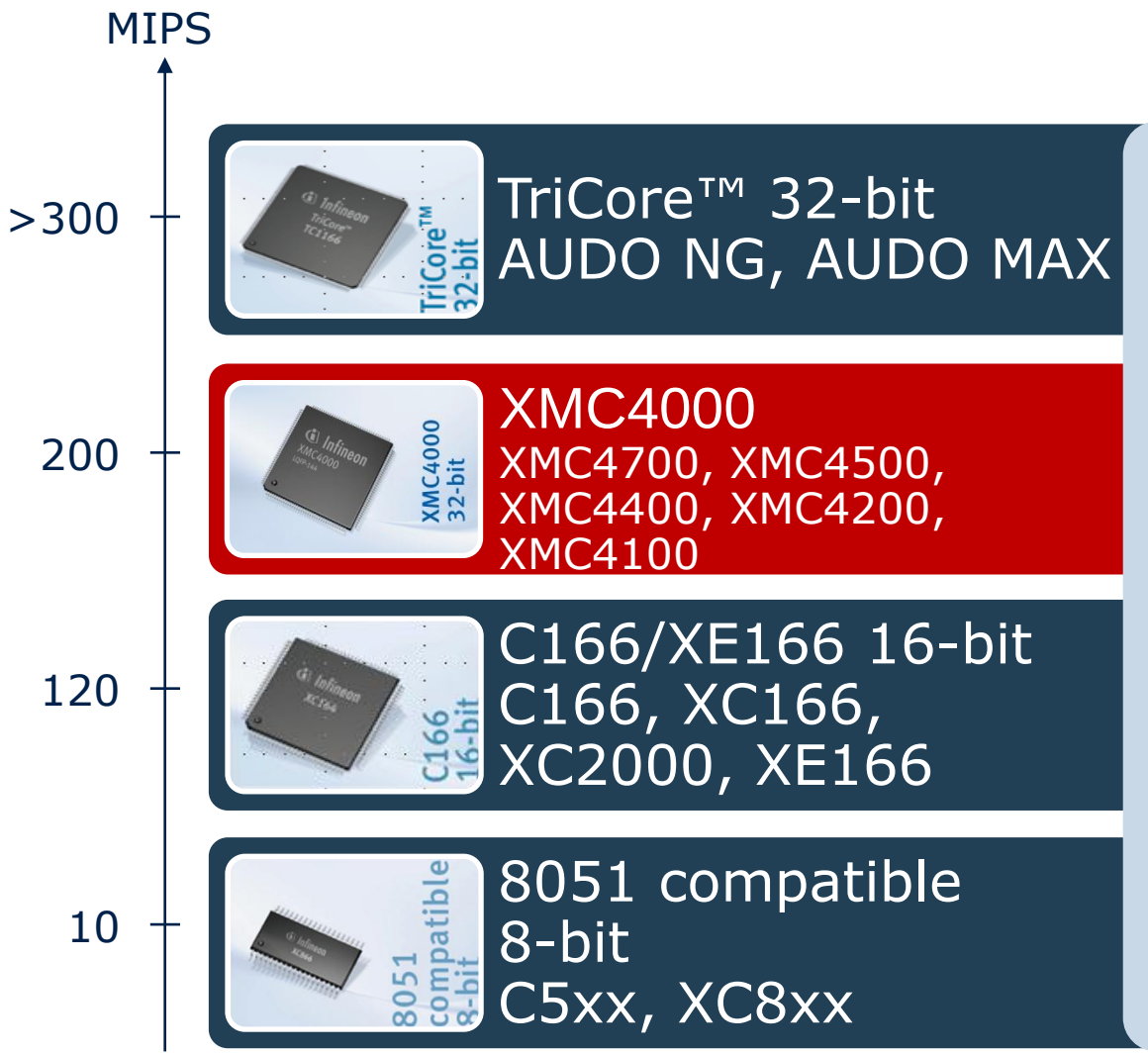


Consumer drives
Lighting
Appliances



*Source: IMS Research, 2010

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



XMC4000 provides

- Higher performance than C16x with higher clock frequencies
- Larger addressable memory space for object-oriented programming
- Benefits of the wide-spread ARM® Cortex™-M4 processor
- Evolution of Infineon's peripherals

One microcontroller platform. Countless solutions. XMC4000.

- Infineon's solutions for industrial applications: Peter Bauer
- Infineon's microcontroller activities: Peter Schäfer
- **XMC4000, Infineon's new industrial microcontroller family: Stephan Zizala**
- Questions and answers

XMC4000 key applications are industrial drives, renewable energy, automation

Challenge #1: Energy efficiency

- Advanced algorithms driving need for higher computing performance
- High-efficient inverter control requiring leading edge ADCs and timers

Challenge #2: Connectivity

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

I2C

SPI

UART

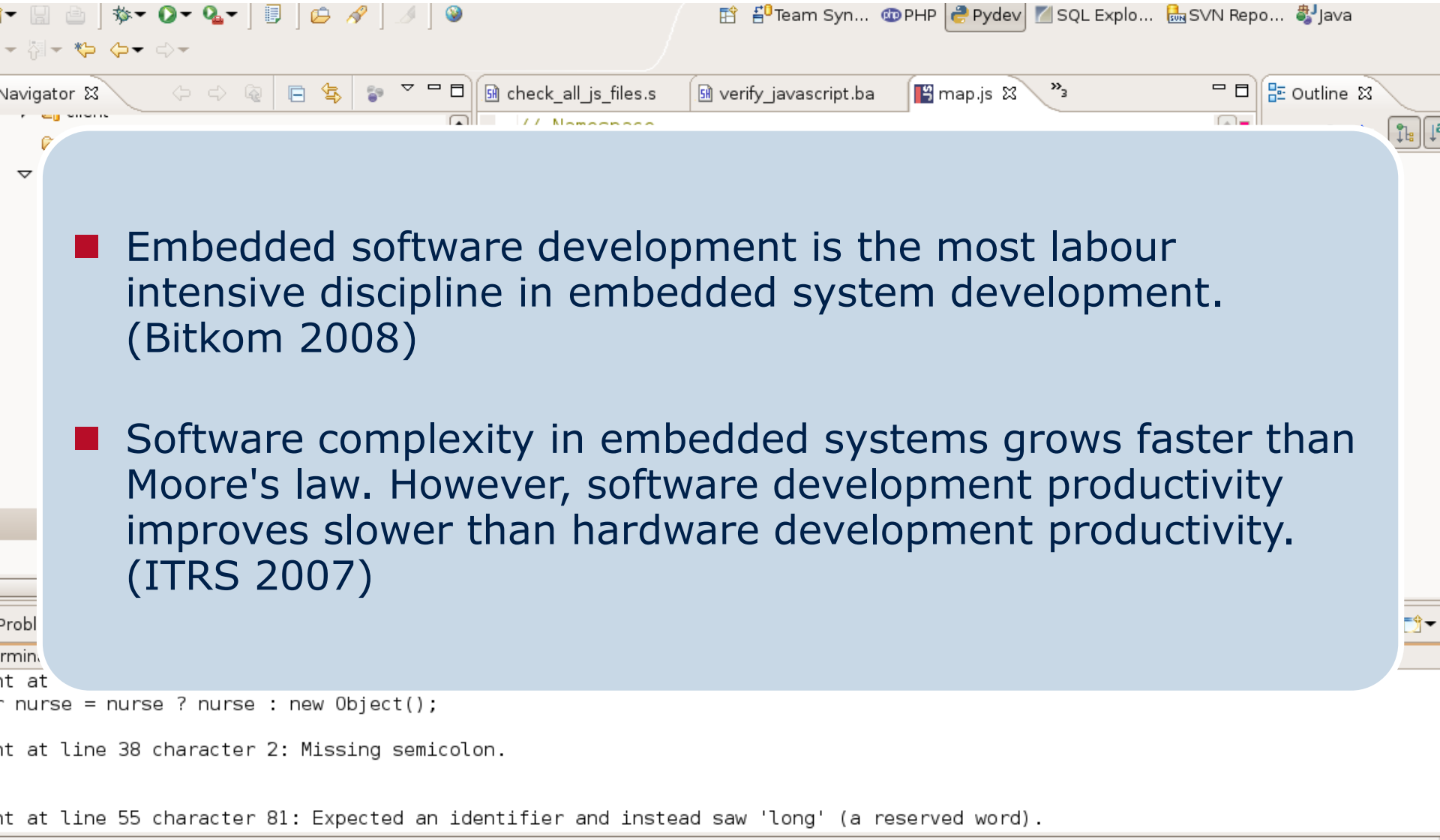
USB

SD/MMC

CAN

Ethernet

Challenge #3: Software complexity



- Embedded software development is the most labour intensive discipline in embedded system development. (Bitkom 2008)
- 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 is benchmark for Actuator Control & Analog, Industrial Communication and Embedded Safety

ARM® Cortex™-M4 & Floating Point Unit

DEBUG

System Timer

Real Time Clock

DMA

Memories

Communication

Ethernet

USB

SD/MMC card I/F

External Memory I/F

CAN

USIC (Serial communication)

Timer & Actuator Control

CCU4

CCU8

High Resolution PWM

Position Interface

ΔΣ Demodulator

Analog & Mixed Signal

ADC

DAC

HMI

Capacitive Touch

LED Matrix

Ports

Safety/Reliability

Data protection through ECC/Parity

CRC & Random Pattern generation

Infineon innovation

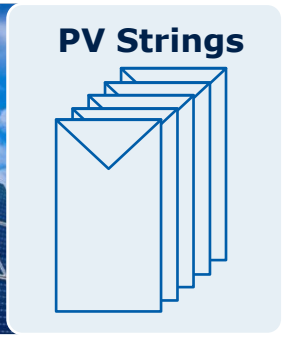
Infineon state-of-the-art

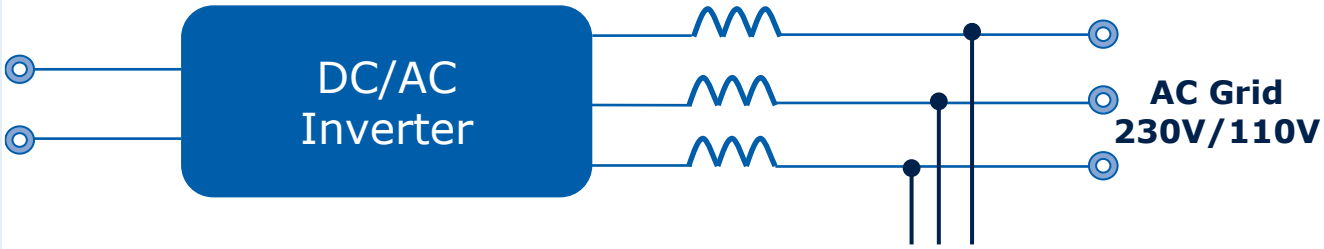
Standard

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

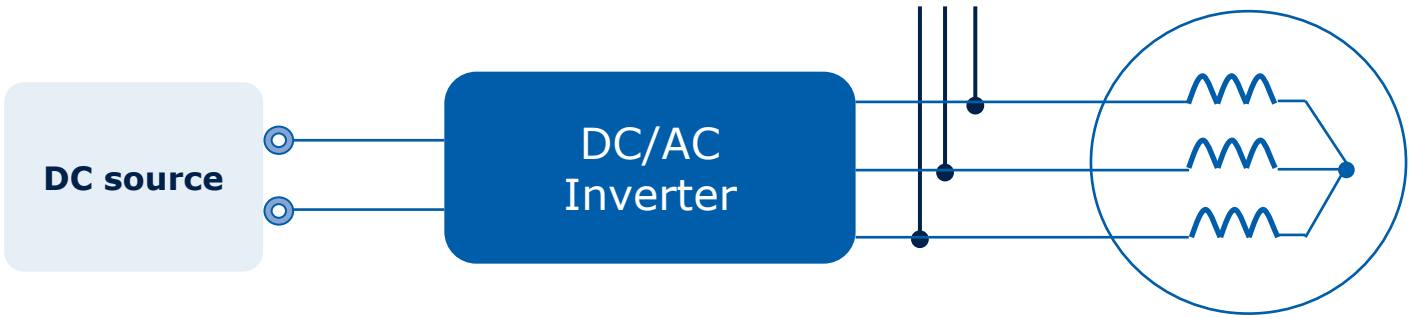
CPU Frequency @ 125 °C	Flash	SRAM	VQFN48 (7x7)	LQFP64 (12x12) LFBGA64 (in def.) (5x5)	LQFP64 (12x12)	LQFP100 (16x16)	LQFP144 (22x22)	LFBGA144 (10x10)	LQFP176 (26x26) LFBGA225 (13x13)
180	2.5MB	512kB						XMC4700 (in def.)	XMC4700 (in def.)
120	1MB	160kB					XMC4500	XMC4500	
120	768kB	160kB				XMC4500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

XMC4000 is optimized for inverter control in electric drives and renewable energy systems (1)

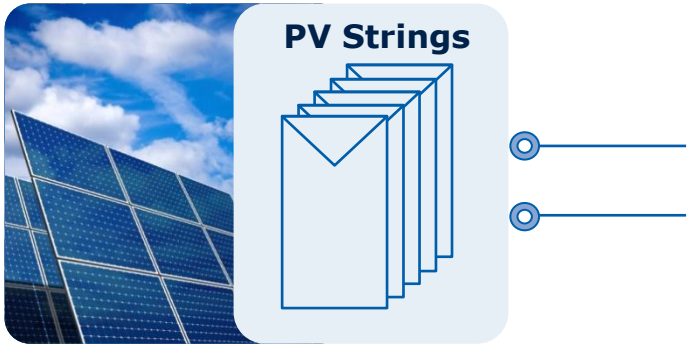


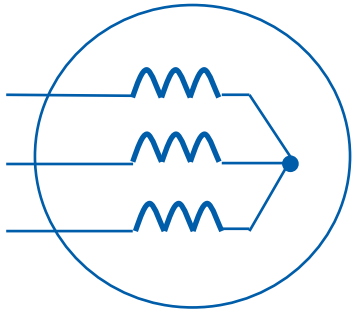


Requirements for higher energy efficiency	Solution with XMC4000
■ Simultaneous and fast phase current measurement ■ Additional measurement of input currents, temperature, etc. ■ Galvanic isolated phase current measurement	■ 4 fast 12-bit ADC modules with 3.5 million samples per second ■ Autonomous post-processing of ADC for increasing accuracy and offloading CPU ■ ΔΣ Demodulator interface eliminating need for external interface IC



XMC4000 is optimized for inverter control in electric drives and renewable energy systems (2)

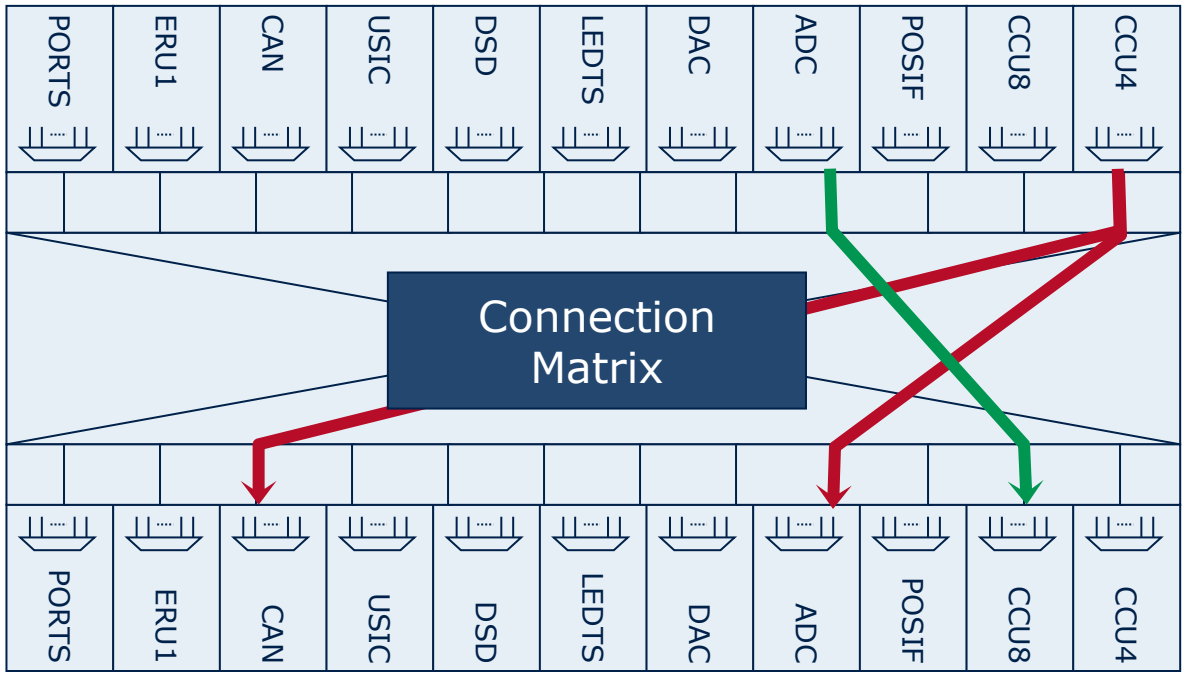




Motor

Flexibility of XMC4000 to support multiple applications

- Input-/Output trigger signals between hardware peripherals can be programmed by software
- Optimized trade-off between flexibility and usability
- Supported by develop-ment tool-chain



XMC4000: a comprehensive and industry's most flexible set of connectivity peripherals

- Consumer connectivity for system administration and maintenance
- Real-time optimized connectivity on control level
- Autonomous peripherals to offload CPU and allow fast reaction: data buffering and filtering
- Flexible peripherals to allow a wide range of use cases: software defined serial communication channels

	XMC4100	XMC4200	XMC4400	XMC4500	XMC4700*
SD/MMC				✓	✓
USB	FS DEV	FS DEV	FS OTG	FS OTG	HS OTG
IEEE 1588 Ethernet			1x	1x	2x
CAN	1x	1x	2x	3x	3x
Serial channels (UART, SPI, Quad-SPI, I^2C, I^2S)	4x	4x	4x	6x	6x
Ext. memory interface (SDRAM, SRAM, Burst-Flash, NAND-Flash, NOR-Flash, Memory-Mapped-IOs, …)				✓	✓

* In definition

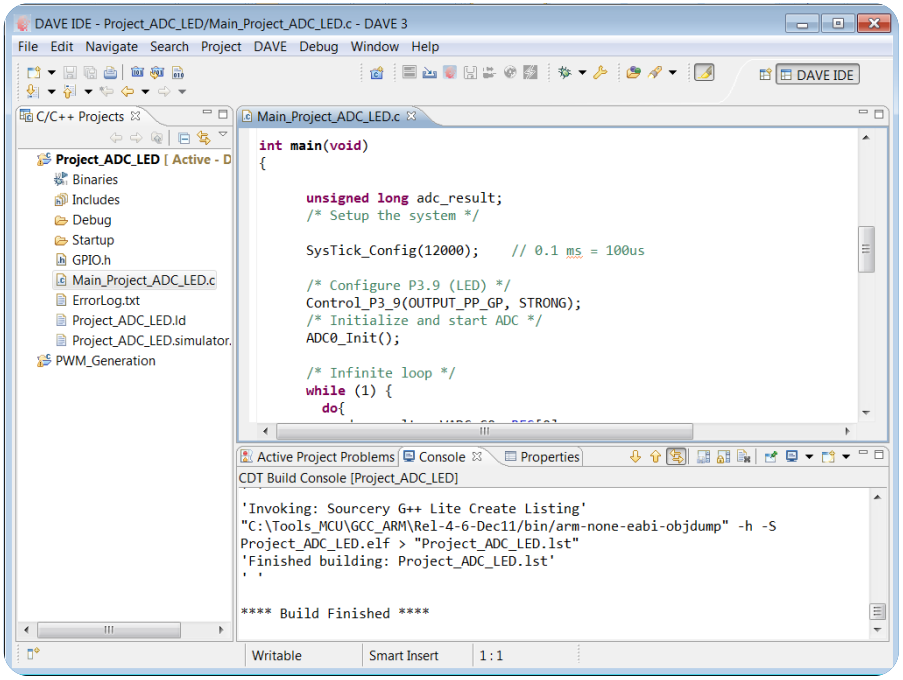
DAVE™ 3 makes powerful hardware accessible: Free IDE and code generator, open to 3rd parties

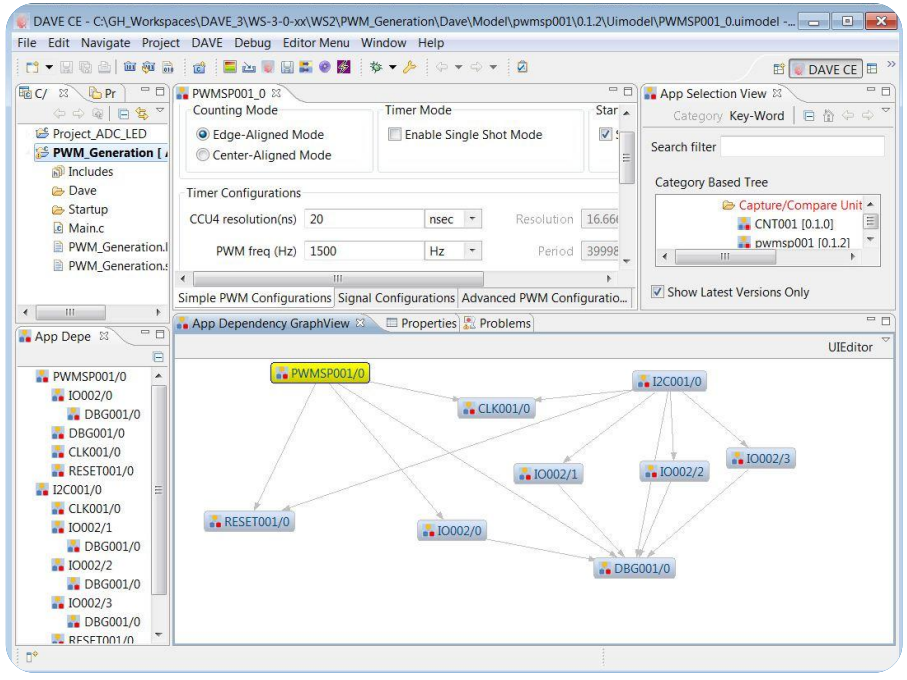
Integrated Development Environment (IDE)

- Eclipse based
- Free GNU Compiler, debugger, loader
- Free data visualization utilities
- Open for 3rd party tools (compiler, debugger) and software (operating systems, stacks) as plug-in

Auto-code generator

- Easy selection of peripheral-oriented and application-oriented DAVE Apps
- Configuration via graphical user interface
- Generated code can be used via well-documented APIs (like a library)
- Extendable by user or 3rd party Apps





Key differentiators of the XMC4000 industrial microcontroller family

Combination of Infineon key IP and know-how with all the benefits of an industry standard 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)

SW Tool DAVE™ 3

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

- March 2012: samples of XMC4500 series, evaluation kits, DAVE 3, 3rd party tools
- 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. XMC4000.

- Infineon's solutions for industrial applications: Peter Bauer
- Infineon's microcontroller activities: Peter Schäfer
- XMC4000: Infineon's new industrial microcontroller family: Stephan Zizala
- Questions and answers

ENERGY EFFICIENCY
MOBILITY
SECURITY

Innovative semiconductor solutions for energy efficiency, mobility and security.



XMC4000 Key Family Members
Strong Portfolio, Maximised Scalability

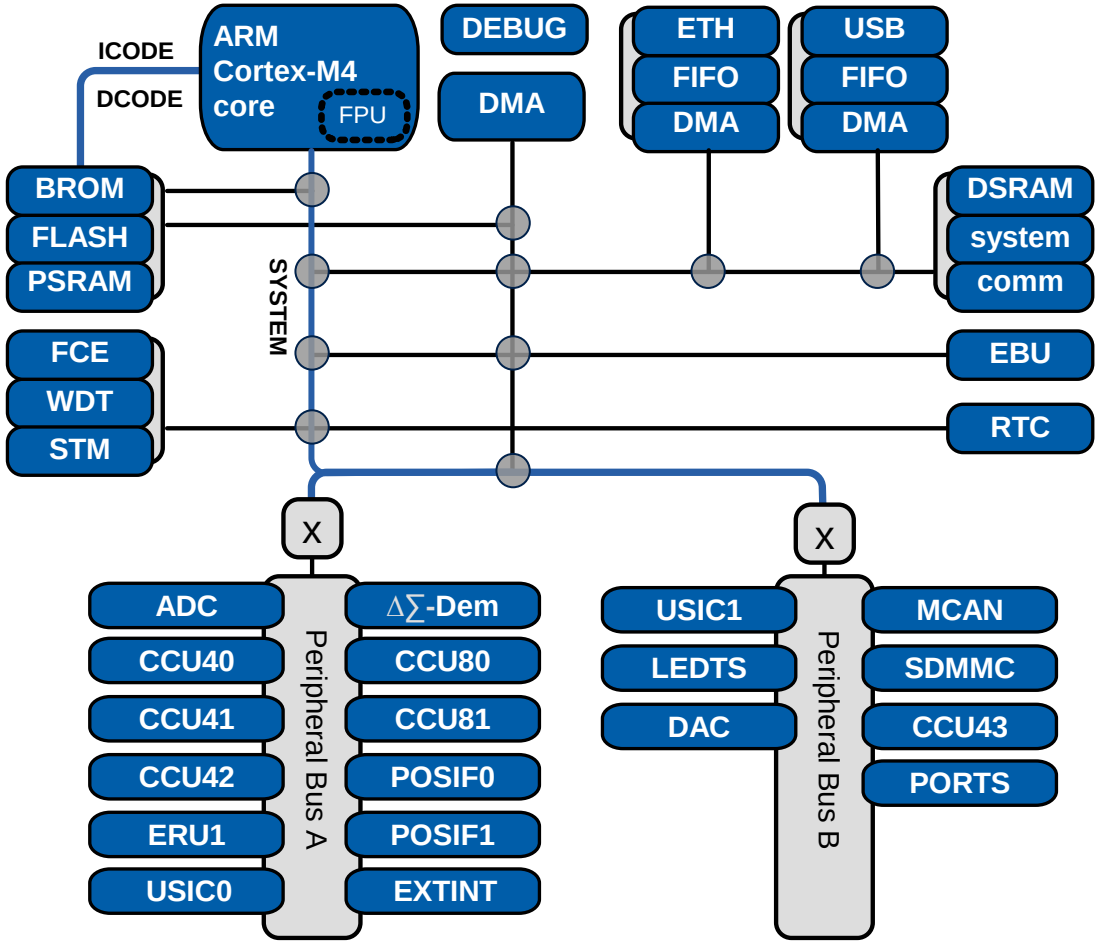
Low-end → High-end

* Under definition

		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)	1x	1x	1x		
Signal Pro-cessing	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, I^2C, I^2S)	4x	4x	4x	6x	6x
	Ext. Memory I/F				✓	✓
	CAN	1x	1x	2x	3x	3x
	Touch Button	✓	✓	✓	✓	✓

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 Ecosystem

DAVE™ 3

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

IDE, C-Compilers, Debuggers, Analysis Utilities	HW Debuggers	Flash Programming
Altium Atollic Keil IAR Systems Wind River	Hitex PLS iSystems Lauterbach	Hitex PLS

RTOS and middleware (TCP/IP/USB stacks, CAN, …)	Training and Consulting
CMX Express Logic FreeRTOS HighTec Keil Micrium Segger SEVENSTAX Thesycon	Hitex Microconsult

Key values for our customers

Market need	New Industrial MCU family	DAVE
Energy efficiency	■ Most advanced PWM, timers and four 12-bit ADC for efficient drives ■ High-resolution PWM and control logic for solar inverters ■ ΔΣ-Demodulator to save an ASIC ■ Real-time optimized system: powerful peripherals working autonomously and fastest eFlash	■ Fast and easy access to advanced algorithms via graphical programming ■ Open for customer enhancements
Connectivity	■ Complete set of industrial standard connectivity peripherals: including Ethernet, USB, SD/MMC, CAN, SPI, UART, I²C	■ Drivers and stacks ■ Open for 3rd party software integration ■ Operating system integration
Reduce time-to-production and software cost	■ Scalable family ■ Widest application coverage by best configurability ■ Trusted and industry-proven product quality, reliability, long-term supply	■ High-level programming ■ Component based programming enabling software re-use

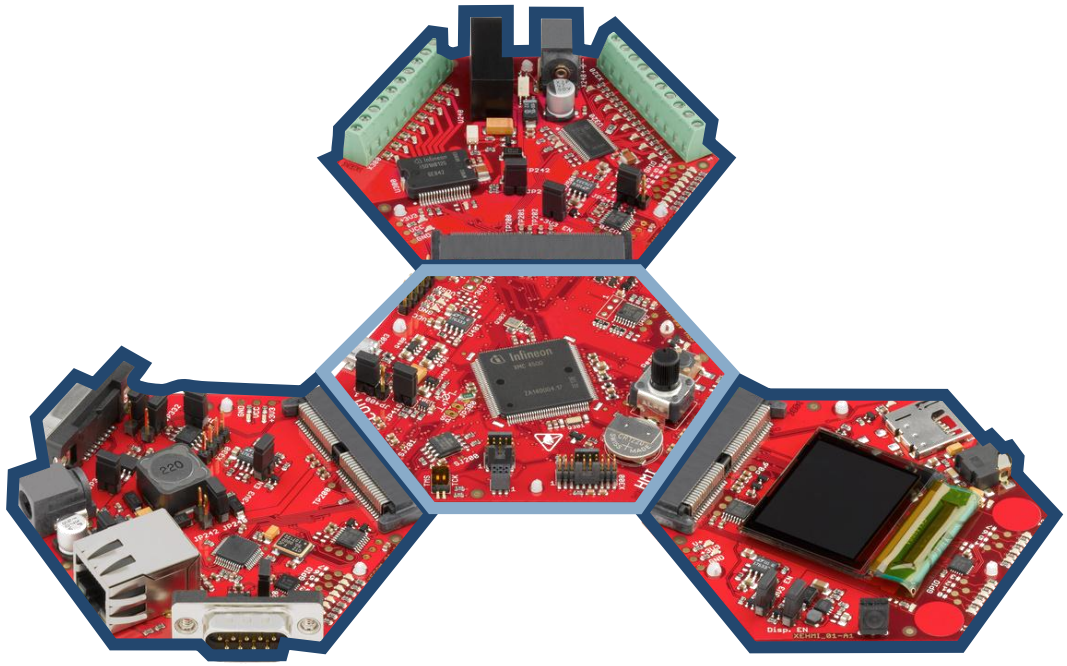
A modular set of kits speeds up evaluation and development

- Product specific CPU boards
  - for each series
  - for stand-alone product evaluation
  - for development

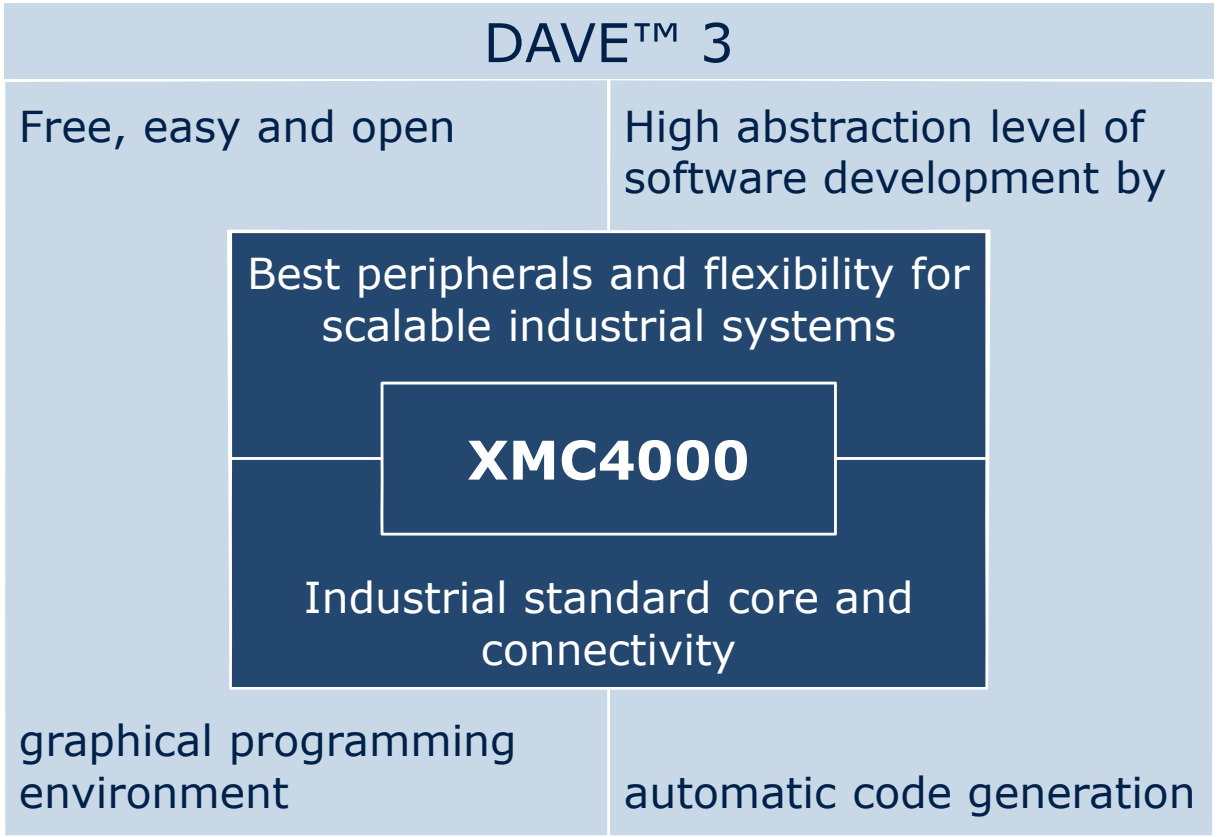
- Application specific extension boards for
  - Connectivity
  - HMI
  - Automation
  - General purpose drives
  - …

- All trainings and examples are tested with the kits and the DAVE™ 3 tool-chain

Modular concept consisting of main CPU board and a number of application-specific satellite boards



XCM4000: 32-bit microcontroller family for industrial applications



Environmental Sustainability at Infineon
Our Balance

Infineon is a key enabler of sustainable society

Environmental benefits

CO_2 savings enabled through our products [1]
4,655,000 tons CO_2

Environmental burden

Our CO_2 burden [2]
1,000,000 tons CO_2

Infineon enables a net ecological benefit of more than
3.6 million tons of CO_2 emission reduction per year!

1) Considering only Automotive products, ballast control, PC power supply, IFX controllers; real figure is higher
2) Including manufacturing, transport, travel, material, chemistry, emissions, water, waste water values are based on internal figures as well as official data

ENERGY EFFICIENCY
MOBILITY
SECURITY

Innovative semiconductor solutions for energy efficiency, mobility and security.