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
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
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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
- Renesas: 14%
- Infineon: 9%
- Freescale: 8%
- STMicro: 8%
- NXP: 7%

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

**Industrial**

- #2
- Renesas: 7%
- Infineon: 6%
- STMicro: 6%
- Analog Devices: 3%
- TI: 6%


**Power**

- #1
- Infineon: 11%
- Toshiba: 7%
- STMicro: 7%
- Mitsubishi: 7%
- Vishay: 6%


**Chip Card**

- #1
- Infineon: 27%
- Samsung: 21%
- NXP: 21%
- STMicro: 18%
- Renesas: 8%

Revenue split by Division

Full FY 2011 revenue: EUR 3.997m

- ATV: €1.552m
- CCS: €428m
- IMM: €1.800m
- OOS: Other Operating Segments
  - C&E: Corporate and Eliminations
  - €217m
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

World energy consumption, 1960-2035

History

Projections

+300% in last 50yrs

+45% in next 25yrs

Quadrillion Btu

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
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Infineon targets automotive and industrial microcontroller markets

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

- Automotive: 25%
- Consumer: 21%
- Industrial: 29%
- Medical: 3%
- Aero/Mil: 5%
- Coms fixed: 8%
- Coms mobile: 9%

Infineon's focus applications:
- Electric drives
- Automation
- Renewable Energy

Infineon's focus applications:
- Powertrain
- Safety
- Body

Source: IMS Research, 2010
Infineon is 3rd largest automotive microcontroller supplier world-wide*

**Families**

- AUDO NG
- AUDO FUTURE
- AUDO MAX
- C16x
- XC16x
- XC2000
- C500
- XC800

**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]

CAGR = 7%

Source: IMS Research, 2010
No. 3 market position in 2009 for C166 architecture in 16-bit industrial microcontrollers*

Families

AUDO NG
AUDO FUTURE
AUDO MAX

C16x
XC16x
XE16x

C500
XC800

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

<table>
<thead>
<tr>
<th>MIPS</th>
<th>TriCore™ 32-bit AUDO NG, AUDO MAX</th>
<th>XMC4000 provides</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;300</td>
<td>XMC4000 XMC4700, XMC4500, XMC4400, XMC4200, XMC4100</td>
<td>- Higher performance than C16x with higher clock frequencies</td>
</tr>
<tr>
<td>200</td>
<td>C166/XE166 16-bit C166, XC166, XC2000, XE166</td>
<td>- Larger addressable memory space for object-oriented programming</td>
</tr>
<tr>
<td>120</td>
<td>8051 compatible 8-bit C5xx, XC8xx</td>
<td>- Benefits of the wide-spread ARM® Cortex™-M4 processor</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>- Evolution of Infineon's peripherals</td>
</tr>
</tbody>
</table>

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One microcontroller platform.
Countless solutions. XMC4000.

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XMC4000 key applications are industrial drives, renewable energy, automation

Industrial Drives
MCU/DSC market size: USD 360 million

Power & Energy
MCU/DSC market size: USD 375 million

Automation
MCU/DSC market size: USD 556 million

Source: IMS 2010
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

- USB
- SPI
- CAN
- I2C
- SD/MMC
- UART
- 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
Reliability: quality, long-term supply, commitments

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
XMC4000 is benchmark for Actuator Control & Analog, Industrial Communication and Embedded Safety

**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

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

**HMI**
- Capacitive Touch
- LED Matrix
- Ports

**ARM® Cortex™-M4 & Floating Point Unit**
- Debug
- System Timer
- Real Time Clock
- DMA

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

<table>
<thead>
<tr>
<th>CPU Frequency @ 125 °C</th>
<th>Flash</th>
<th>SRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>2.5MB</td>
<td>512kB</td>
</tr>
<tr>
<td>120</td>
<td>1MB</td>
<td>160kB</td>
</tr>
<tr>
<td>120</td>
<td>768kB</td>
<td>160kB</td>
</tr>
<tr>
<td>120</td>
<td>512kB</td>
<td>80kB</td>
</tr>
<tr>
<td>80/120</td>
<td>256kB</td>
<td>40/80kB</td>
</tr>
<tr>
<td>80</td>
<td>128kB</td>
<td>20kB</td>
</tr>
<tr>
<td>80</td>
<td>64kB</td>
<td>20kB</td>
</tr>
</tbody>
</table>

- **XMC4000**
  - 80/120 256kB 40/80kB
  - 80 128kB 20kB
  - 80 64kB 20kB
  - VQFN48 (7x7)
  - LQFP64 (12x12)
  - LQFP64 (12x12)
  - LQFP100 (16x16)
  - LQFP144 (22x22)
  - LFBGA144 (10x10)
  - LFBGA225 (13x13)

- **XMC4100**
  - 80 64kB 20kB

- **XMC4200**
  - 80/120 256kB 40/80kB
  - 80 128kB 20kB

- **XMC4300**
  - 80/120 256kB 40/80kB

- **XMC4400**
  - 120 768kB 160kB
  - 120 512kB 80kB

- **XMC4500**
  - 120 768kB 160kB
  - 120 512kB 80kB

- **XMC4700** (in def.)
  - 180 2.5MB 512kB
XMC4000 is optimized for inverter control in electric drives and renewable energy systems (1)

- Simultaneous and fast phase current measurement
- Additional measurement of input currents, temperature, etc.
- Galvanic isolated phase current measurement

Requirements for higher energy efficiency

Solution with XMC4000

- 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)

- 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 development tool-chain

Connection Matrix

January 23, 2012

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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

<table>
<thead>
<tr>
<th></th>
<th>XMC4100</th>
<th>XMC4200</th>
<th>XMC4400</th>
<th>XMC4500</th>
<th>XMC4700*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD/MMC</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>USB</td>
<td>FS DEV</td>
<td>FS DEV</td>
<td>FS OTG</td>
<td>FS OTG</td>
<td>HS OTG</td>
</tr>
<tr>
<td>IEEE 1588 Ethernet</td>
<td></td>
<td>1x</td>
<td>1x</td>
<td>2x</td>
<td></td>
</tr>
<tr>
<td>CAN</td>
<td>1x</td>
<td>1x</td>
<td>2x</td>
<td>3x</td>
<td>3x</td>
</tr>
<tr>
<td>Serial channels (UART, SPI, Quad-SPI, I²C, I²S)</td>
<td>4x</td>
<td>4x</td>
<td>4x</td>
<td>6x</td>
<td>6x</td>
</tr>
<tr>
<td>Ext. memory interface (SDRAM, SRAM, Burst-Flash, NAND-Flash, NOR-Flash, Memory-Mapped-IOs, ...)</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* 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.

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- 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

<table>
<thead>
<tr>
<th></th>
<th>Low-end</th>
<th>High-end</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>XMC4100</strong></td>
<td><strong>XMC4200</strong></td>
</tr>
<tr>
<td><strong>System Performance</strong></td>
<td>ARM® Cortex™-M4</td>
<td>Floating Point Unit</td>
</tr>
<tr>
<td>Core</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU frequency (at 125 °C)</td>
<td>80 MHz</td>
<td>80 MHz</td>
</tr>
<tr>
<td>Co-proc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash size</td>
<td>128 kB</td>
<td>256 kB</td>
</tr>
<tr>
<td>RAM size</td>
<td>20 kB</td>
<td>40 kB</td>
</tr>
<tr>
<td>Cache</td>
<td>4 kB</td>
<td>4 kB</td>
</tr>
<tr>
<td>POSIF</td>
<td>1x</td>
<td>1x</td>
</tr>
<tr>
<td>CCU4 (4ch)</td>
<td>2x</td>
<td>2x</td>
</tr>
<tr>
<td>CCU8 (4ch)</td>
<td>1x</td>
<td>1x</td>
</tr>
<tr>
<td>High-resolution PWM (150ps)</td>
<td>1x</td>
<td>1x</td>
</tr>
<tr>
<td>ADC 12-bit</td>
<td>2x</td>
<td>2x</td>
</tr>
<tr>
<td>Delta/Sigma Demodulator</td>
<td>4x</td>
<td>4x</td>
</tr>
<tr>
<td>DAC</td>
<td>2x</td>
<td>2x</td>
</tr>
<tr>
<td>IEEE 1588 Ethernet MAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USB</td>
<td>FS DEV</td>
<td>FS DEV</td>
</tr>
<tr>
<td>SD/MMC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serial channels (UART, SPI, I²C, I²S)</td>
<td>4x</td>
<td>4x</td>
</tr>
<tr>
<td>Ext. Memory I/F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAN</td>
<td>1x</td>
<td>1x</td>
</tr>
<tr>
<td>Touch Button</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

* Under definition
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**
- Altium
- Atollic
- Keil
- IAR Systems
- Wind River

**HW Debuggers**
- Hitex
- PLS
- iSystems
- Lauterbach

**Flash Programming**
- Hitex
- PLS

**RTOS and middleware (TCP/IP/USB stacks, CAN, ...)**
- CMX
- Express Logic
- FreeRTOS
- HighTec
- Keil
- Micrium
- Segger
- SEVENSTAX
- Thesycon

**Training and Consulting**
- Hitex
- Microconsult
# Key values for our customers

## Market need

<table>
<thead>
<tr>
<th>Energy efficiency</th>
<th>New Industrial MCU family</th>
<th>DAVE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Most advanced PWM, timers and four 12-bit ADC for efficient drives</td>
<td>Fast and easy access to advanced algorithms via graphical programming</td>
</tr>
<tr>
<td></td>
<td>High-resolution PWM and control logic for solar inverters</td>
<td>Open for customer enhancements</td>
</tr>
<tr>
<td></td>
<td>ΔΣ-Demodulator to save an ASIC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Real-time optimized system: powerful peripherals working autonomously and fastest eFlash</td>
<td></td>
</tr>
</tbody>
</table>

## Connectivity

<table>
<thead>
<tr>
<th></th>
<th>Complete set of industrial standard connectivity peripherals: including Ethernet, USB, SD/MMC, CAN, SPI, UART, I²C</th>
<th>Drivers and stacks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Open for 3rd party software integration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operating system integration</td>
</tr>
</tbody>
</table>

## Reduce time-to-production and software cost

<table>
<thead>
<tr>
<th></th>
<th>Scalable family</th>
<th>High-level programming</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Widest application coverage by best configurability</td>
<td>Component based programming enabling software re-use</td>
</tr>
<tr>
<td></td>
<td>Trusted and industry-proven product quality, reliability, long-term supply</td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>DAVE™ 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free, easy and open</td>
</tr>
<tr>
<td>Best peripherals and flexibility for scalable industrial systems</td>
</tr>
<tr>
<td>XMC4000</td>
</tr>
<tr>
<td>Industrial standard core and connectivity</td>
</tr>
<tr>
<td>graphical programming environment</td>
</tr>
</tbody>
</table>
Infineon is a key enabler of sustainable society

Environmental benefits

CO\textsubscript{2} savings enabled through our products \(^{(1)}\)
4,655,000 tons CO\textsubscript{2}

Environmental burden

Our CO\textsubscript{2} burden \(^{(2)}\)
1,000,000 tons CO\textsubscript{2}

Infineon enables a net ecological benefit of more than 3.6 million tons of CO\textsubscript{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.