

Software Standardization in Synergy with High Integration Semiconductor Technology for optimized Partitioning

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Automotive Power – Application Engineering
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Never stop thinking

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Infineon Automotive Business

Addressed Applications

- **Powertrain:** Engine management, transmission, hybrid drives
- **Safety & Vehicle Dynamics:** ABS/ ESP, suspension, steering, airbag, TPMS
- **Body & Convenience:** Lighting, door module, HVAC
- **Infotainment:** Dashboard, car radio, telematics, navigation, multimedia

Core competencies

- 40 years of system expertise with broad application competence and industry commitment
- Innovative product, technology and IP portfolio, covering the complete control cycle
- Own production sites for automotive semiconductors
- Automotive Excellence™: Most comprehensive quality program in the industry

Product Range

- **Sensors:** Pressure, temperature, and magnetic; Wireless Control ICs
- **Microcontrollers:** 8-bit, 16-bit, 32-bit TriCore®
- **Power:** MOSFETs, IGBTs, voltage regulators, smart power, system ICs



Automotive Semiconductor Solutions

Combining sensing, computing and actuating



		Sense	Compute	Actuate
Powertrain <ul style="list-style-type: none"> - Diesel Engine Mgmt. - Gasoline Engine Mgmt. - Transmission Control - Starter / Alternator 		<ul style="list-style-type: none"> • Pressure Sensors • Magnetic Sensors 	<ul style="list-style-type: none"> • 16 bit μC • 32 bit TriCore® (μC + DSP) 	<ul style="list-style-type: none"> • MOSFETs • IGBTs • Regulators • Transceivers • Smart Power • System ICs
Safety Management <ul style="list-style-type: none"> - ABS / Traction Control - Suspension - Airbag + Restraint Systems - Power Steering - Tire Pressure Monitoring 		<ul style="list-style-type: none"> • Pressure Sensors • Magnetic Sensors • RF ICs 	<ul style="list-style-type: none"> • 8 bit μCs • 16 bit μCs • 32 bit TriCore® (μC + DSP) 	<ul style="list-style-type: none"> • Diodes • Transistors • MOSFETs • Regulators • Transceivers • Smart Power • System ICs
Body & Convenience <ul style="list-style-type: none"> - Light Control - Heating, Ventilation, Air Condition - Door & Seat - Smart Battery Terminal 		<ul style="list-style-type: none"> • Magnetic Sensors • Temp. Sensors • RF ICs 	<ul style="list-style-type: none"> • 8 bit μCs • 16 bit μCs 	<ul style="list-style-type: none"> • Diodes • Transistors • MOSFETs • Regulators • Transceivers • Smart Power
Infotainment <ul style="list-style-type: none"> - Telematics - Navigation - Multimedia - Car Audio - Dashboard 			<p>Microcontrollers, Wide Range (GSM/GPRS) and Short Range (Bluetooth, WLAN) communication solutions, GPS, High Frequency ICs, CAN Transceivers, Multimedia Cards, Power ICs, Security ICs</p>	

Example: Body & Convenience Solutions

Decentralized intelligence for more convenience



Key trends

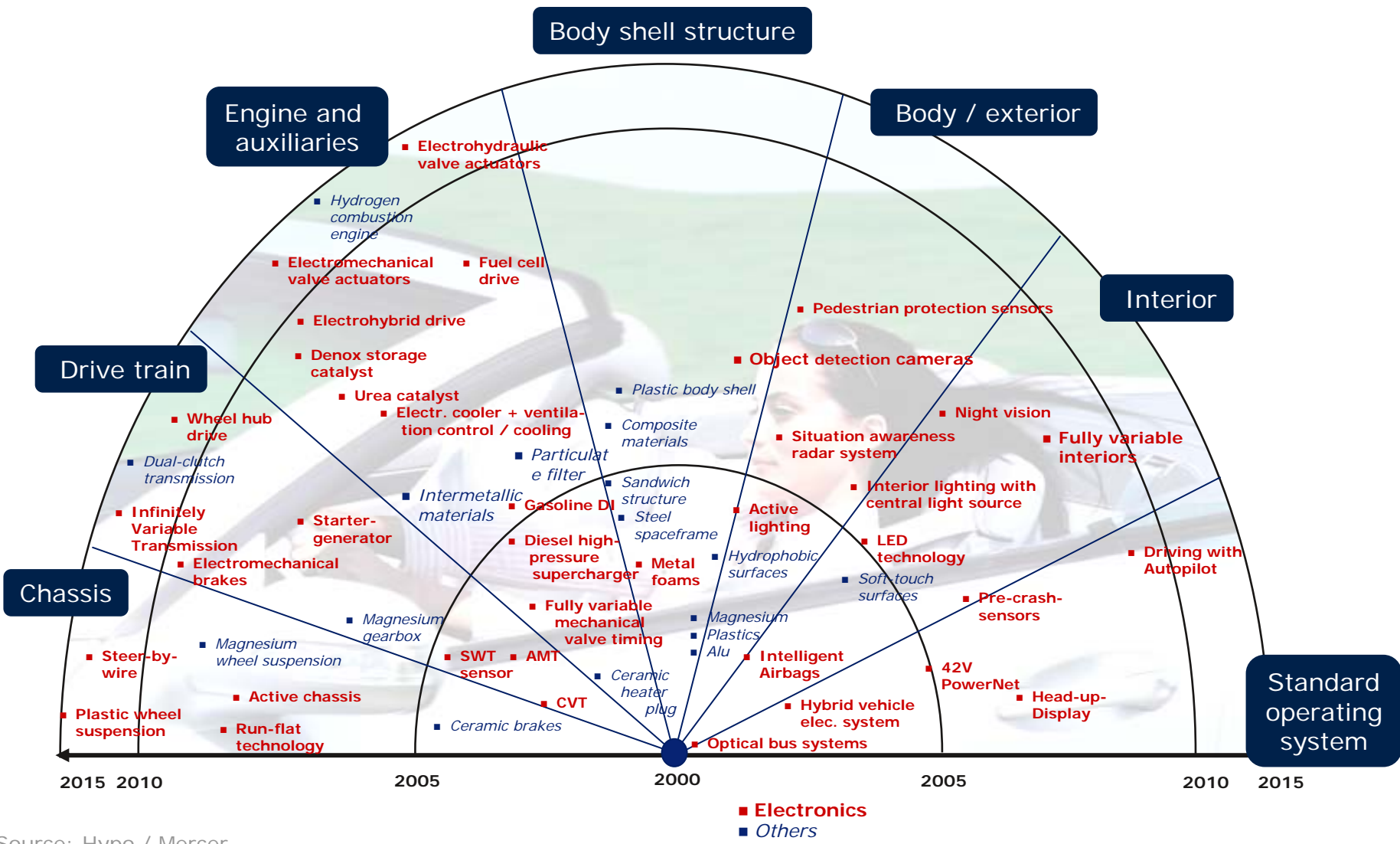
- Move to decentralized functions (Intelligent LIN slaves)
- Reduced weight and power dissipation ("silicon vs. heat sink"; relays replacement)
- LED drives new light architectures & drive
- Growing market for bi-directional RKE* solutions, multi-channel transceivers and combined RKE & TPMS** receivers
- Flexible combination of Power and Control

Infineon's offering:

- Covering the full control loop: sensors, microcontrollers and power ICs
- Flexible partitioning: Discrete vs. Integrated Power solutions
- Elimination of fuses via advanced protection features
- Intelligent failure management due to optimized diagnosis processes
- Leader in Chip-on-chip devices for high current applications
- Addressed Applications:
 - Power operated systems (seat, door, sunroof, wiper)
 - Heating, Ventilation, Air Conditioning (HVAC)
 - Lighting
 - Security Systems (RKE, Alarm, Immobilization)
 - Smart Battery Terminal

Automotive Innovations Schedule

90% of automotive innovations are driven by electronics (HW & SW)



Source: Hypo / Mercer

Driving Forces in Automotive Electronics

market
more functionality

innovation

system cost



§§ legislation §§

innovative power
saving mechanisms

time to market

How do we meet the Trends Motivation for High Integration Semiconductors



- reduction of amount of electronic components by high integration products means reduction of
 - complexity of external circuits and amount of external interconnects → increase of quality of ECU
 - probability of failure caused by environment, package or electrical characteristics
 - costs for purchasing and logistics
 - PCB size
 - weight
 - power consumption

- achievement in total
 - reduced system cost
 - higher quality

Space Constraints leading to Single Chip Integration

Higher Integration Level in Every Application
due to Space Constraints



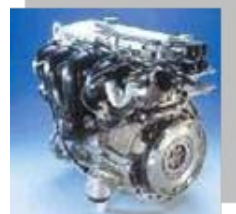
More Functionality in Smaller Packages



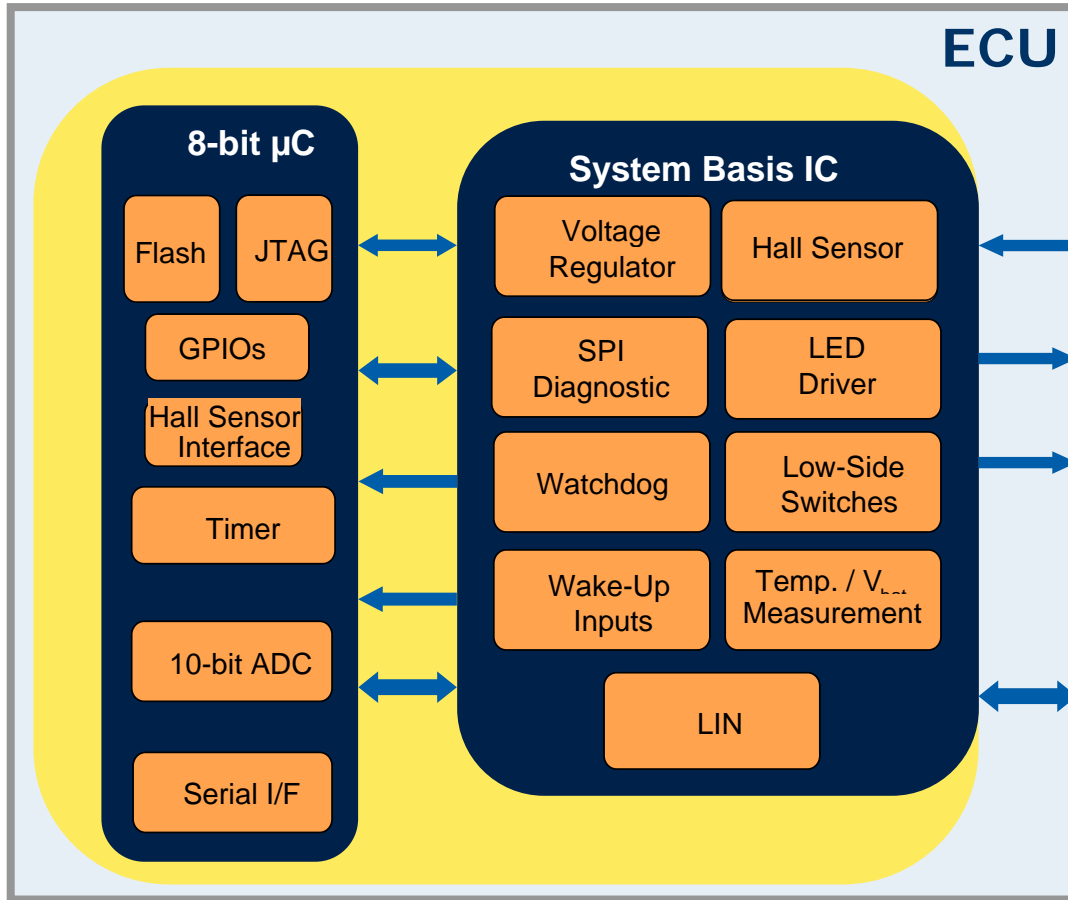
Single Package Solution



Single Chip Solution

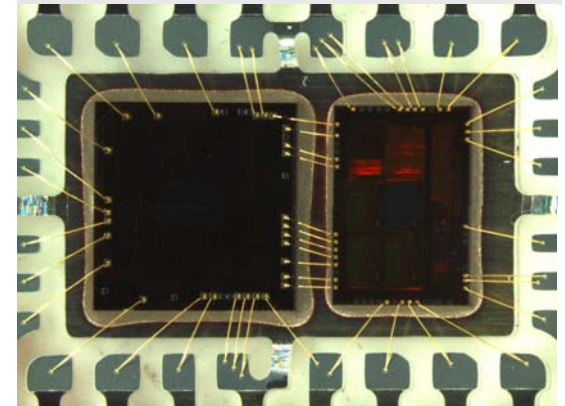
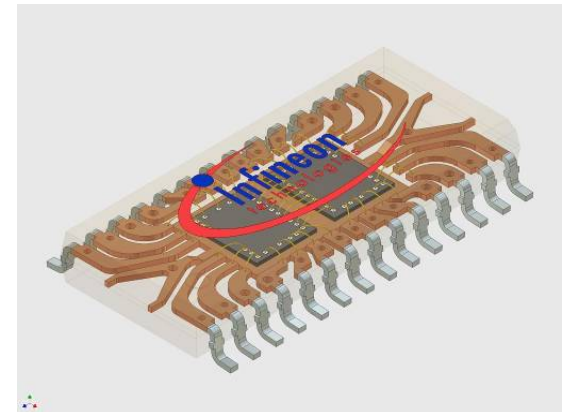


ECU Component System in Package



Advantages

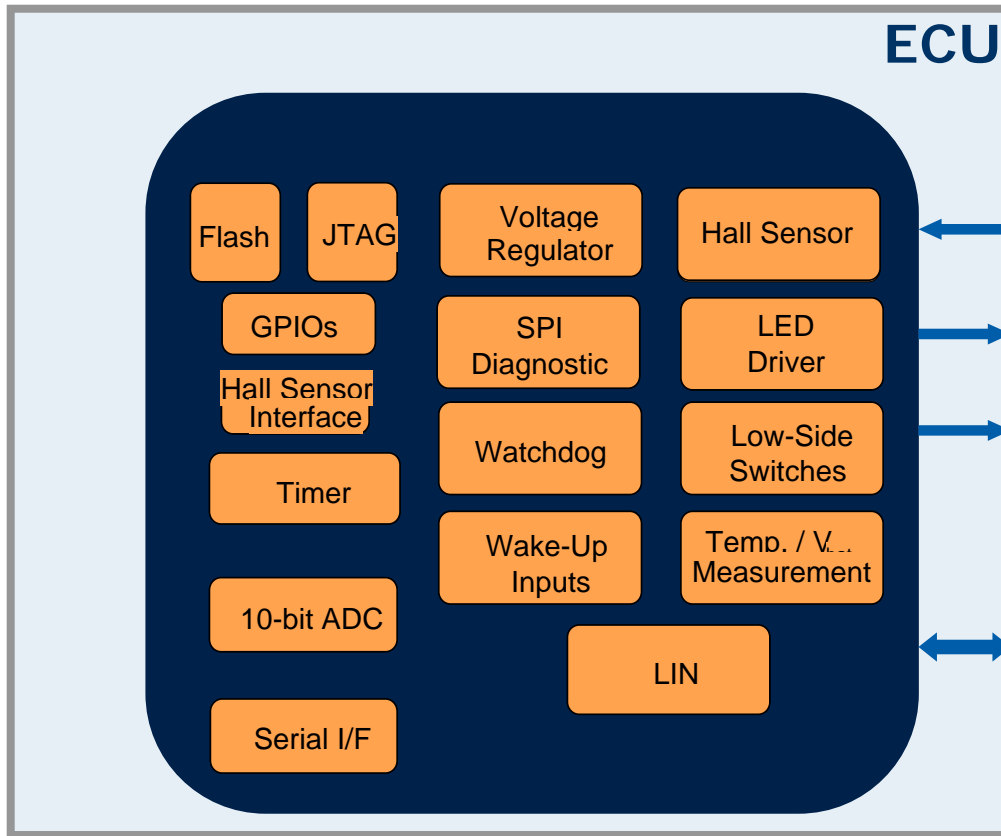
- only 1 component
- usage of optimized technology per part
- no external connections



Disadvantages

- additional pads for internal interconnects
- restricted flexibility

... to ECU on a Chip with Next Generation of SPT



- **faster time to market**
- **lower power consumption**
- **higher reliability**
- **lower system cost**

- only 1 component
- no pads for internal interconnects
- reduced power consumption
- better reliability due to less connections and smaller chip size → quality increase
- better and more internal supervision (functional safety)
- reduced board space and weight
- high speed parallel data transfer from SW to hardware

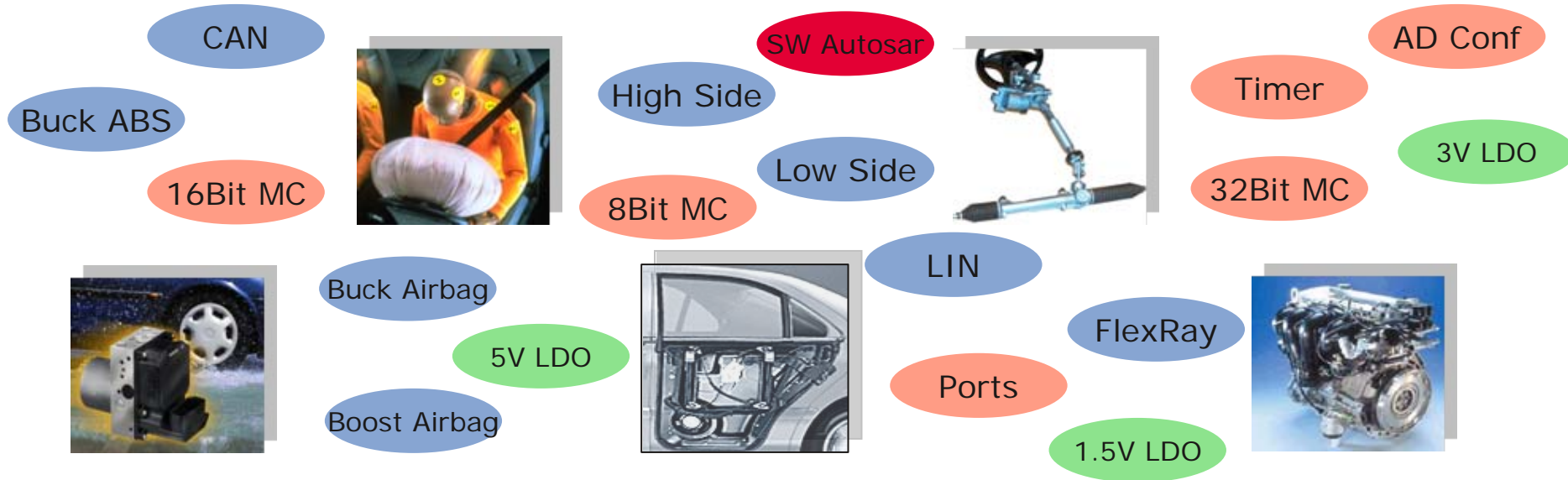
High Integration - Outlook

Trend

- Electronic Systems in cars and complexity of the ECU systems will grow furthermore

Solutions

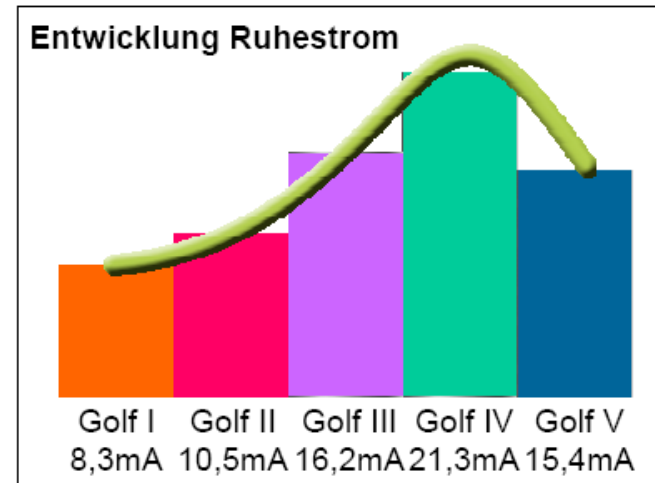
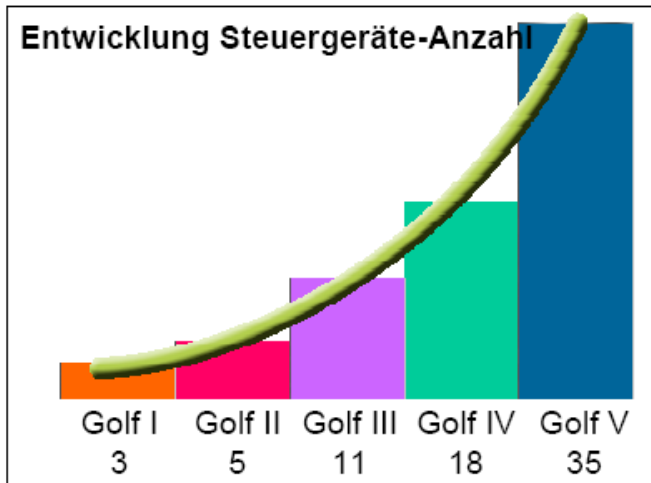
- reduction of component amount and variety with high integration new Smart Power Technology (SPT)
- standardization, abstraction and adaptations are transferred to the software level - AUTOSAR
- quick Implementation by proven Modules "out of the Box"



Example: Power Consumption of Electronics

■ The Problem:

- Number of ECU's are increasing
- Power consumption requirement is decreasing



Source: VW, 9thInternational Automobile Electronics Conference, June 05

■ System Solution: SPT High Integration Technology

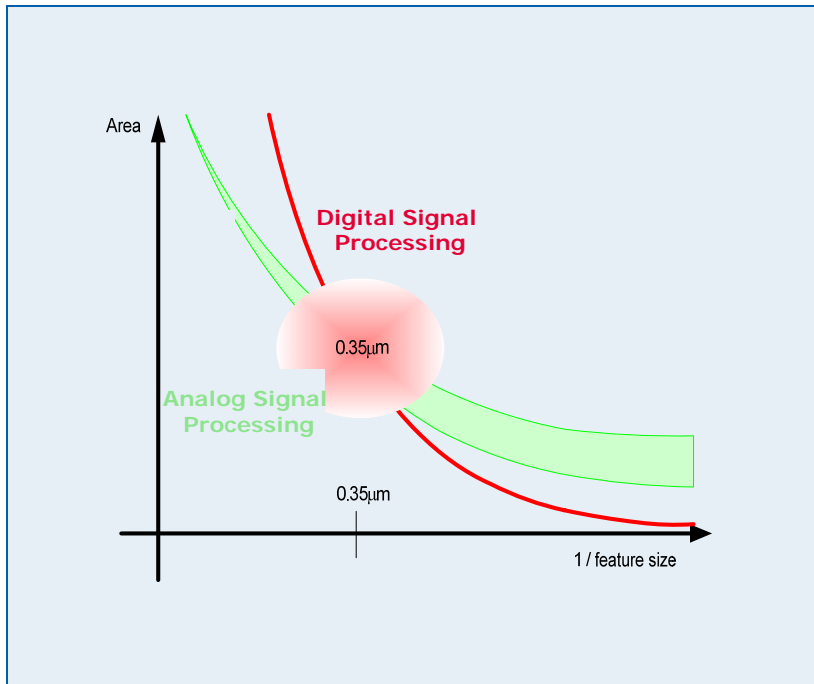
Solution for Power Consumption of Electronics

System Solution is SPT High Integration Technology with several key features:

- Intelligent system architecture
 - Reduction of I/O Driver currents – “everything’s integrated”
nearly all interactions occur chip internally
- Intelligent Performance Control - reduce average power to conserve long term battery life:
 - Clocking Technologies
free programmable frequency and selectable low power oscillators vs. high frequency clock, depending on tasks
 - power saving modes on several levels
running, idle, powerdown, deep sleep, etc. – minimize run execution
 - power segmentation – power only modules if required and with minimum voltage –
separate independent VRegs
 - intelligent autonomous power peripherals
operate without the need of microcontroller part
 - high amount of intelligent and scalable software (AUTOSAR)
 - ... and high degree of digitalization

Why is next Generation SPT so Efficient?

Trend: from Analog to Digital



New functionalities

- secured protection
- non linear functionalities
- free configuration
- self-test
- self calibration
- recovery-functionalities

Digital Processing:

- Experience shows better area efficiency of digital implementations below 0.35μm
- Digital concepts are better suited for future scaling
- Testability of digital processing is higher, Test times decrease

Advantages

- improved functionalities
- higher reliability
- longer lifetime – less stress for components

Conclusion

- simpler
- smaller
- scalability increase

Enabling Innovation

Standardization
Software

Specialized Products
High Integration



Contradiction?

Specialized Interface

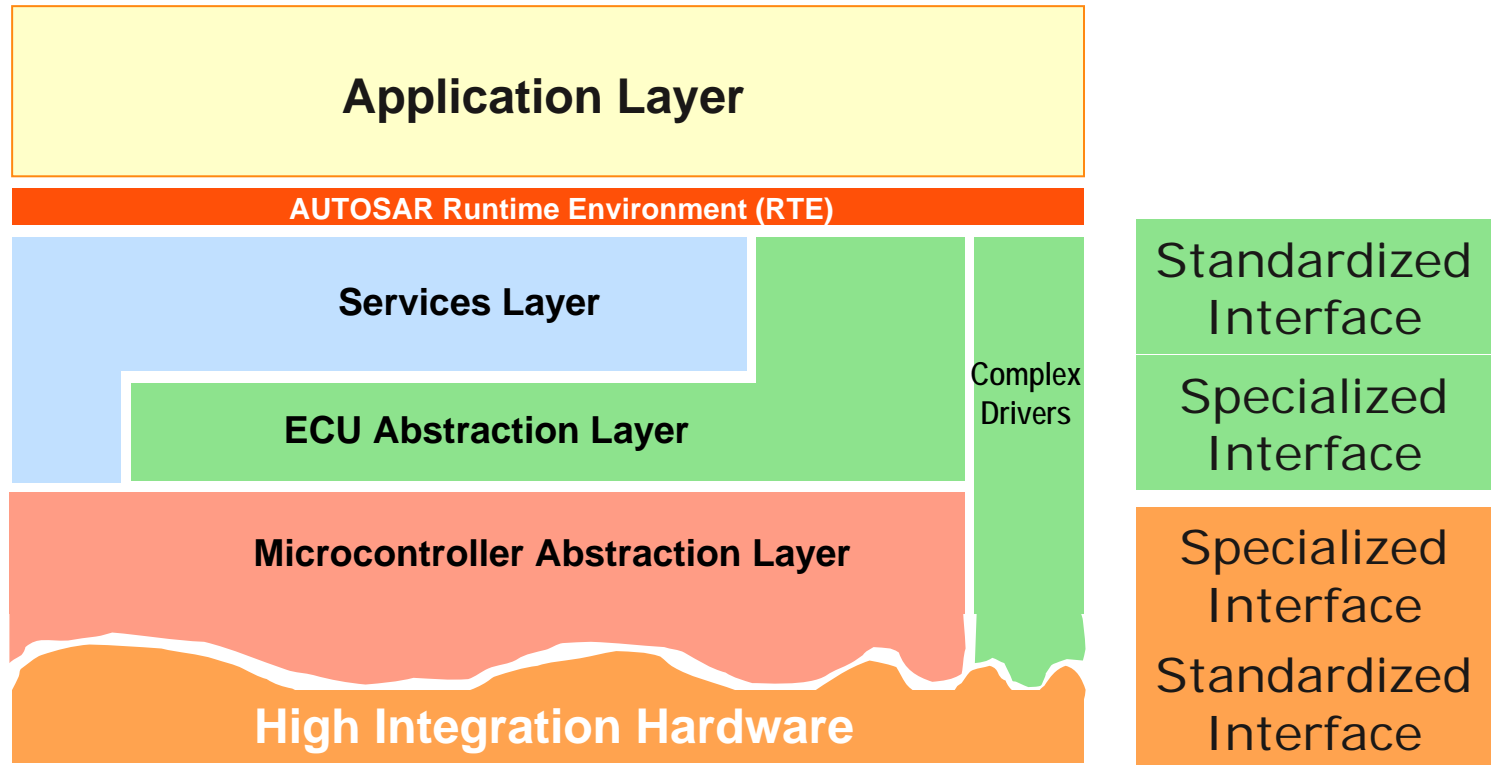


Standardized Hardware Interface



Corresponding SW Architecture: AUTOSAR

- The standardized Software approach of AUTOSAR gives us the opportunity to adapt the Hardware as close as possible to the application needs
- Easy handling and portability is guaranteed through the standardized Software Layers
- Software has “only” development cost and no “production cost”



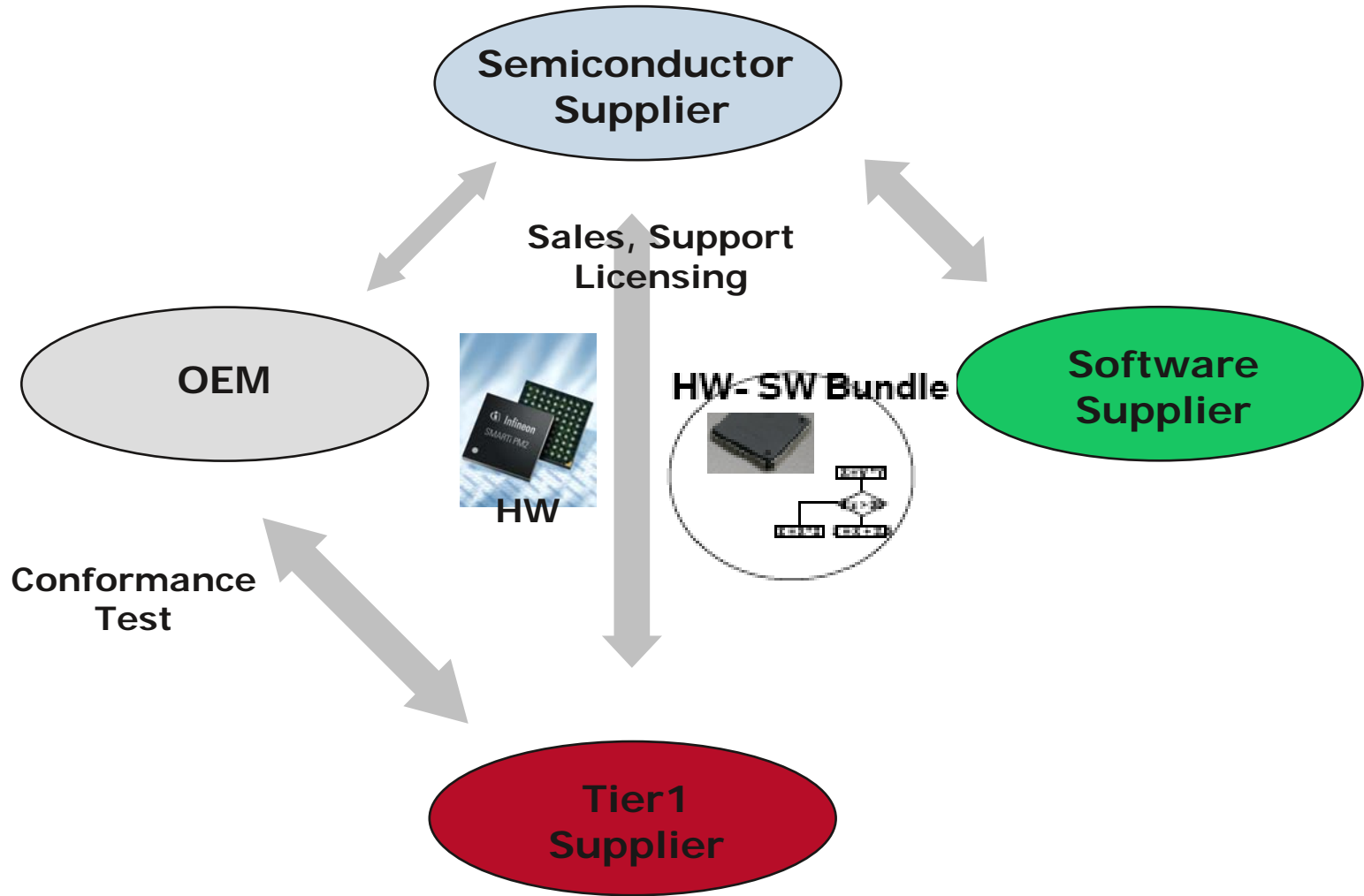
Standardization / AUTOSAR Targets with High Integration Hardware

- Implementation and standardization of basic system functions as an OEM wide "Standard Core" solution
- Scalability to different vehicle and platform variants
- Transferability of functions throughout network
- Integration of functional modules from multiple suppliers
- Consideration of availability and safety requirements
- Redundancy activation
- Maintainability throughout the whole "Product Life Cycle"
- Increased use of "Commercial off the shelf hardware"
- Software updates and upgrades over vehicle lifetime

- Way of Software Integration with Standard Tools and Comfortable Configuration Tools (Basis is the usage of Standard HW Blocks, e.g. standard microcontrollers)
- Basic Software for control of all high integration hardware functions
- Functional and standardized SW to application

- Standard Peripherals (SPI, UART, Timer functions) are easily reused from existing AUTOSAR layers
- Specialized Peripherals are reflected within complex AUTOSAR drivers with standardized interfaces (e.g. fast AD converters, special power saving modes, Power Switches, Transceivers)
- high amount of digitalization is considered in a high degree of flexible programming – either standard drivers or complex drivers – depending on real time requirements or availability

New Requirement Management From OEM's to Semiconductor Supplier



Trend

- Electronic Systems and complexity of the ECUs will grow furthermore

Solutions

- Amount of electronic components can be reduced despite this fact
→ solution: high integration
- Variety of electronic components can also be reduced
→ solution: standardization, abstraction and adaptations are transferred to software level
- Quality of the systems will increase by usage of 100% proven and tested components and reduction of external connections / environmental influences
→ usage of high integration parts
- Cost of the systems can be significantly reduced

Conditions

- To maximize benefit for the automotive industry, a close cooperation between OEMs, Tier1 and silicon suppliers is required
 - strengthen application specific development on component level
 - implement software layers already during development phase of semiconductor components
- Focus on application specific innovation

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