Infineon

A Fast Powertrain Microcontroller

Hot Chips 16

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Infineon technologies

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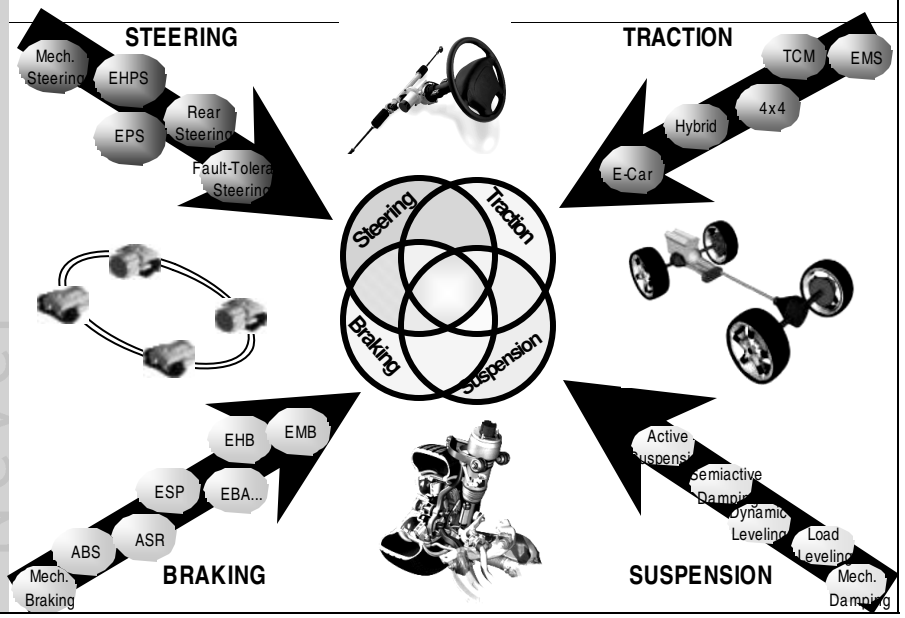
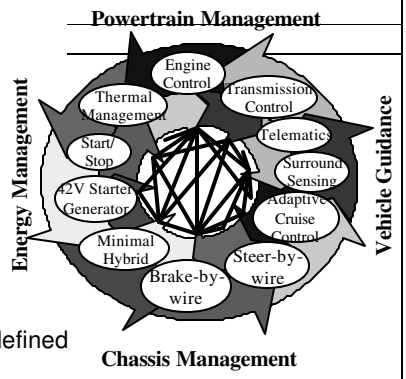
Trend:

Global Chassis Control:
Functions within Vehicle Dynamic & Powertrain Grow Together

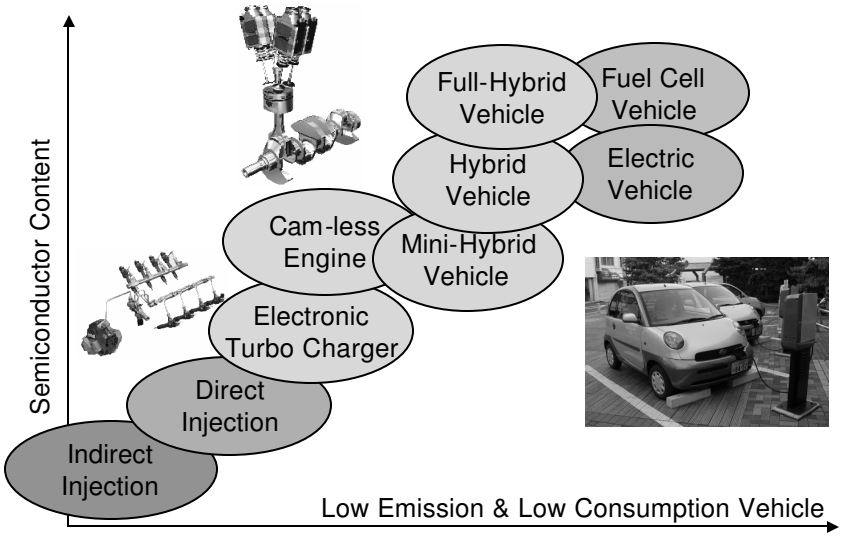


Trends: Distributed Systems in Vehicles Software

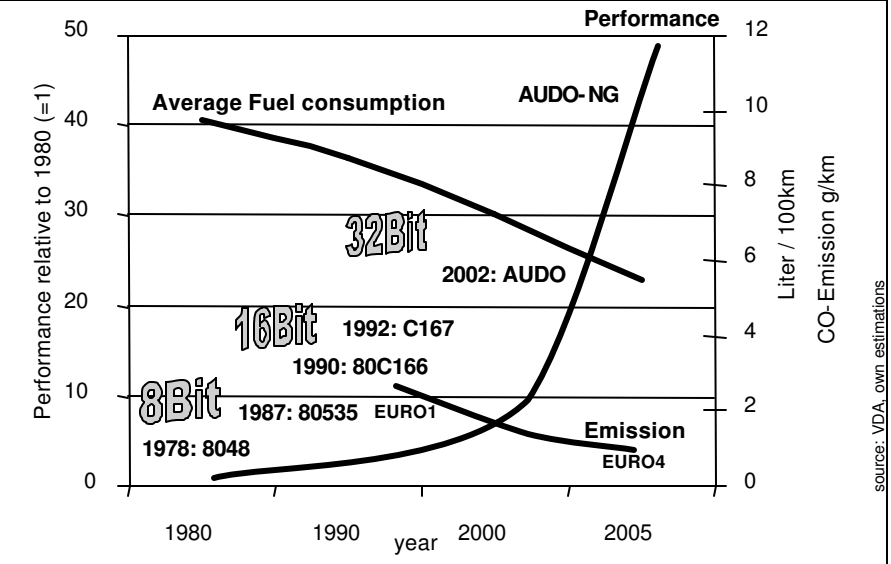


- Distributed systems in vehicles
  - Distributed smart sensors, actuators, computation
  - New opportunities for scalability, flexibility, reusability, composability
  - Infineon is member of the FlexRay consortium
- Software will play an increasing role
  - Vehicle's "Drive & Feel" will become increasingly defined by algorithms and software
    - i.e. SW will become a significant element in brand differentiation
  - Software complexity increases and will be a compilation of different vendor's contributions
    - A change in SW development methodology will occur
    - New SW interfaces will become standard, encapsulation will be needed
  - Infineon is member of the AutoSAR development partnership

Powertrain Trends



Less Fuel Consumption and Cleaner Engines - Driving Forces for Higher Performance



source: VDA, own estimations

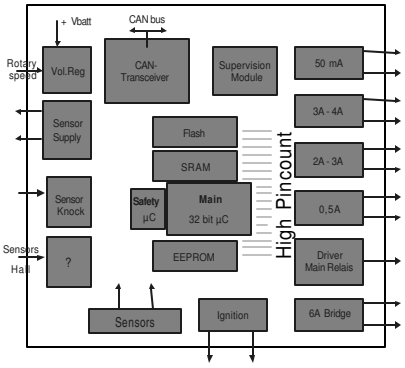
Year of introduction : Infineon Microcontroller Type

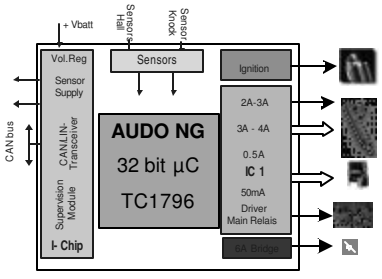
EUROx=European Emission Standards

Optimized Partitioning for Powertrain

Today - Example Conventional Engine Management

Tomorrow Optimized Chip Set by Infineon

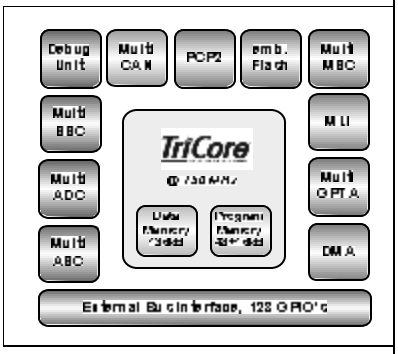




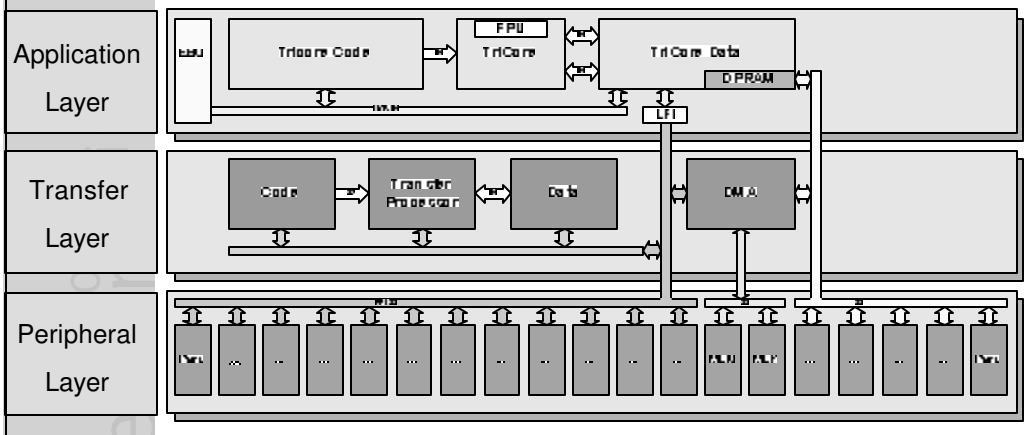
=> Saves System Costs

AUDO-Next Generation (NG): TC1796 -
At a Glance

- 32-bit superscalar TriCore® V1.3 CPU
- 32-bit Peripheral Control Processor (PCP2)
- Multi-channel DMA controller
- Powerful & flexible peripheral set
  - 2.5 x GPTA® (flexible timer array)
  - MultiCAN (4 nodes)
  - 2x ASC and 2x SSC Interfaces
  - 2x µS-Bus Interfaces (MSC)
  - Multi-Processor Interface (MLI)
  - Multi-channel ADCs, FAST ADC
- On-chip Memory:
  - 2.1 MByte Flash Memory (partially supports EEPROM emulation)
  - 192 kByte SRAM, 16 kByte Program Cache
  - 48 kByte SRAM for PCP2
- Digital Port Supply Voltage 2.3V - 3.3V
- Full automotive temperature range
- Package: P-BGA 416

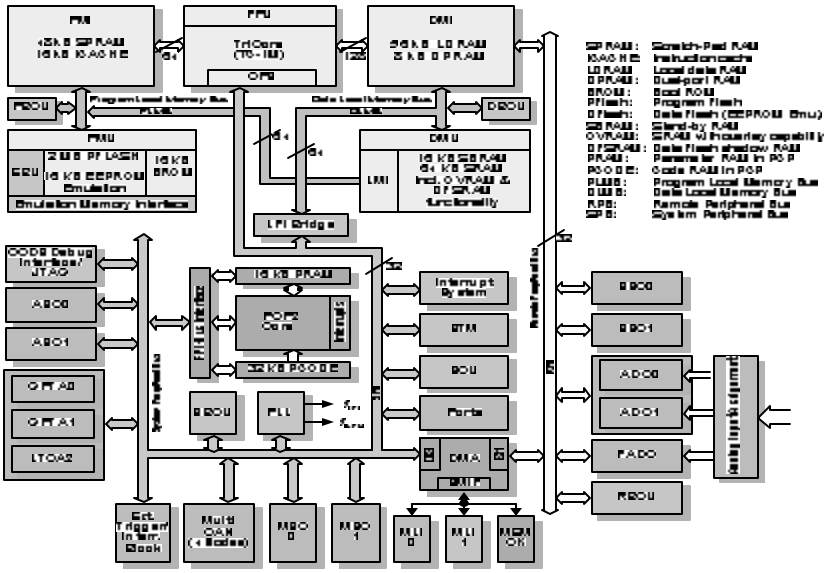


AUDO-NG: TC1796 -
The Three Layer Implementation



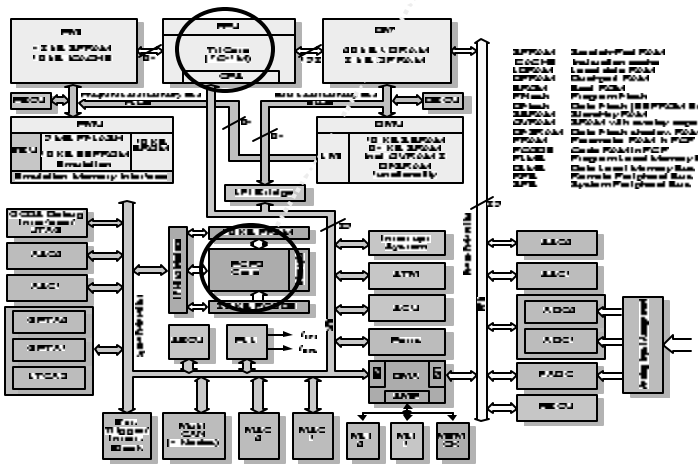
To allow the right function partitioning with clear interfaces, Infineon has design the three layer approach.

AUDO-NG: TC1796 -
Block Diagram



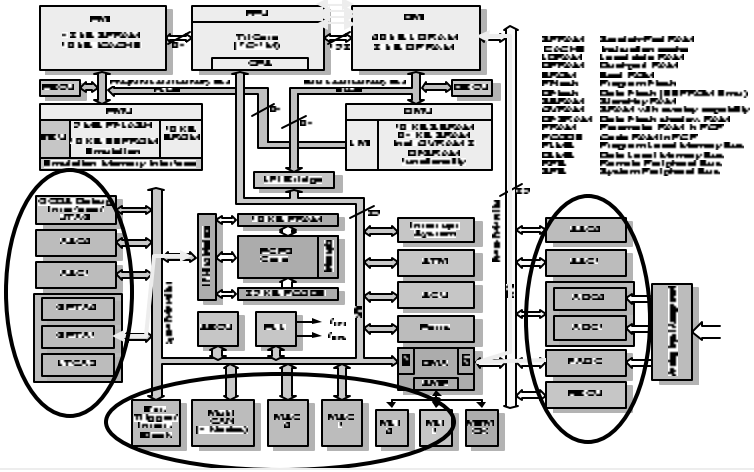
Instruction Level Parallelism

- TriCore can execute up to 3 instructions in parallel per cycle
- In parallel, the PCP executes its own instructions



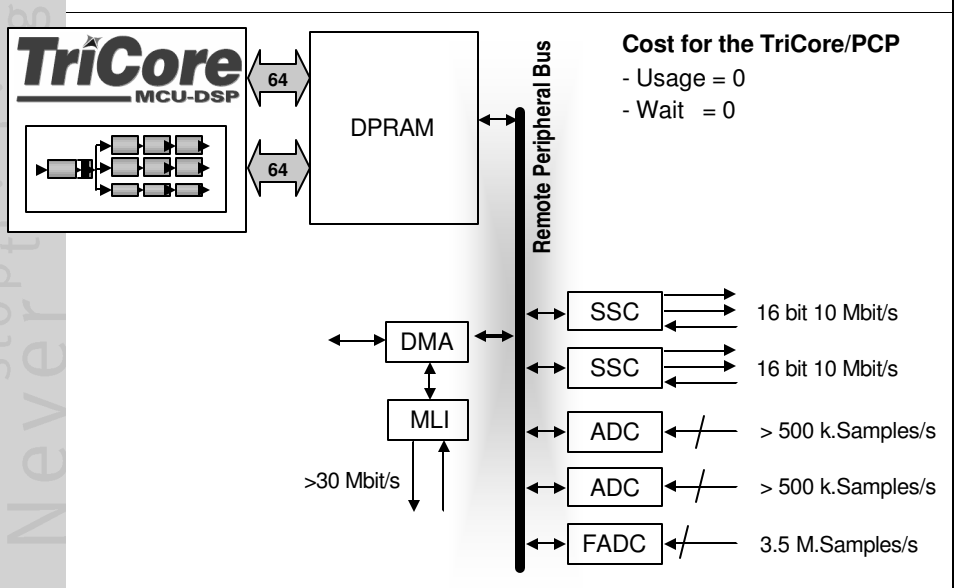
Data Level Parallelism

- TriCore's packed arithmetic allows to process up to 4 data per instruction
- In parallel, the PCP processes e.g. data from the GPTA
- The DMA unit transfers data e.g. from the FADC
- Intelligent peripherals handle data in parallel

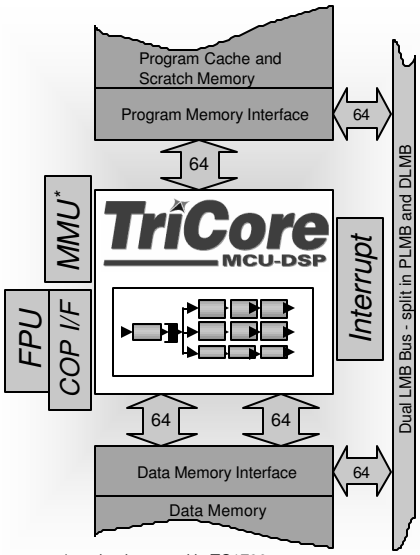


Non-Intrusive Data Transfer Capability

No Penalty for TriCore and PCP



TriCore Architecture
Designed for Embedded Real Time Applications



* not implemented in TC1796

- High performance 32-bit core
  - The first unified RISC/DSP architecture
  - 150 MHz / 4 stage superscalar pipeline
- Fast context switch mechanism
- Fast, deterministic interrupt mechanism
- Floating point unit (optional)
- Flexible coprocessor interface
  - For up to 3 coprocessors
- Optional memory management unit*
- Configurable cache and memory sizes
- Fast local memory bus system

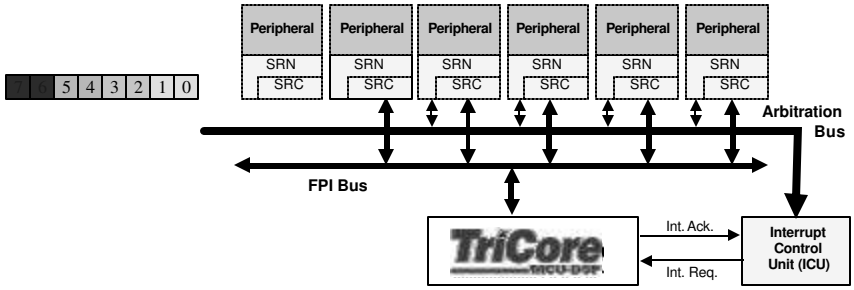
TriCore Architecture
Powerful Interrupt Service System

Features

- **Up to 4 x 255 request nodes (SRN), concurrently supported**
- **Parallel arbiter HW to select highest interrupt & clear when accepted**
- **Automatic context save during branch to interrupt routine**

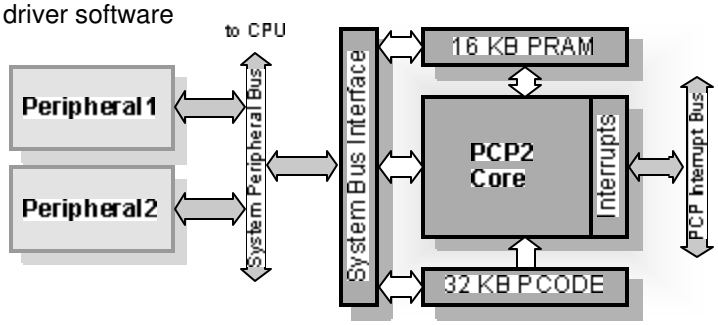
Benefits

- **Meets real-time requirements**
- **Zero software overhead**
- **Ease of programming, High flexibility**
- **Large number of SRNs**
- **Flexible grouping of request into priority groups**



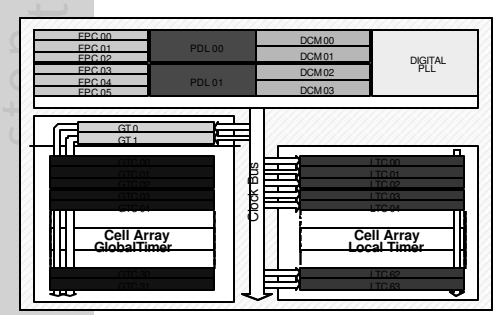
PCP2 – Peripheral Coprocessor

- PCP2 is a full 32 bit user programmable processor dedicated to communication and driver activities
- Off-loads TriCore from handling interrupt tasks (hardware arbitration & register context switch, 255 priority levels)
- Includes DMA engine
- PCP2 can run autonomously Flywheel, Injection, Ignition… driver software



Modules: GPTA – General Purpose Timer Array
Unified High Functionality and Flexibility

- Function blocks for
  - Input signal conditioning
  - and analysis
  - Digital PLL
  - Capture/Compare Cell Arrays
- Flexible timer array

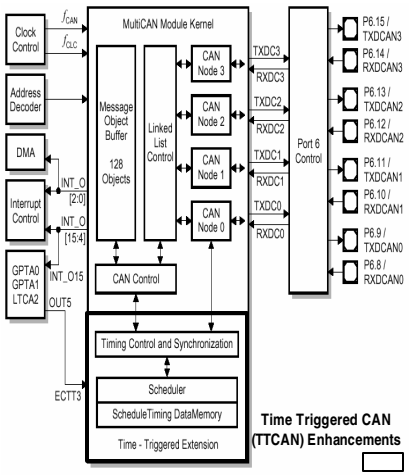


- **Highly functional structure:**
  Largely autonomous operation requiring low or no SW overhead
  - ➢ Main CPU not loaded with highly repetitive tasks
- **Permits optimized use** of timer cells
  - ➢ **Scalable** functionality avoids functional overhead
  - ➢ Maximizes system functionality

Architecture driven by needs for:
- 8-cylinder combustion engines
- 3-phase AC-motor

Modules: MultiCAN
Feature Set and Module

- CAN functionality conform to **CAN specification V2.0 B active** (compliant to ISO 11898)
- **4** independent **CAN nodes** available
- **128** independent **message objects** (message objects are shared by the CAN nodes)
- Data transfer rate up to **1MBaud**, individual programmable for each node
- Flexible and powerful message transfer control and error handling capabilities to offload CPU
- Automatic **gateway mode** support
- **16** individually programmable **interrupt outputs**
- **CAN Analyzer Mode** for bus monitoring
- Time-Triggered CAN (**TTCAN**) support



Modules: Fast ADC
Application Example: Knock Detection

- Remove expensive external filters

  Reduce system cost
- Allow better utilization of the input signal range
- Allow better signal diagnosis

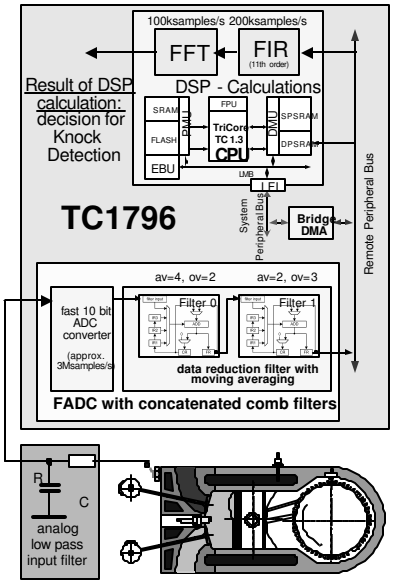
  Self test, explore signal consistency
- High sampling frequency

  Up to 3.5 M sample/s with 10 bit resolution
- Configurable HW differential amplifier

  Reduce cost on external HW

  Improved common mode noise rejection
- Configurable digital data compression

  Reduce software load



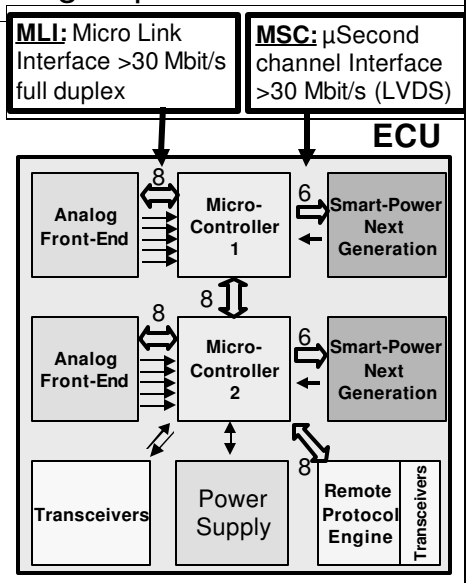
Modules: MLI / MSC

Multicore/Device Link via High Speed MLI and MSC

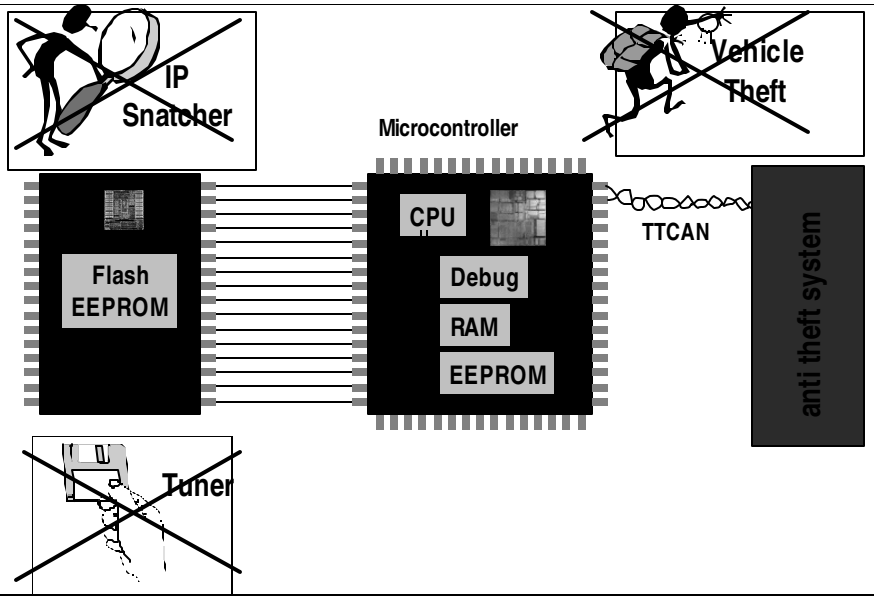
- Micro Link Interface (MLI) to connect smart companion devices
- Micro Second Channel (MSC) to primarily connect power devices
- Benefit: Highly configurable and scalable
- ⇩ the wiring on the board
- ⇩ amount of pins per package
- ⇧ the bandwidth but ⇩EMI

  Low swing and smooth edge
- Open license policy on MLI, MSC

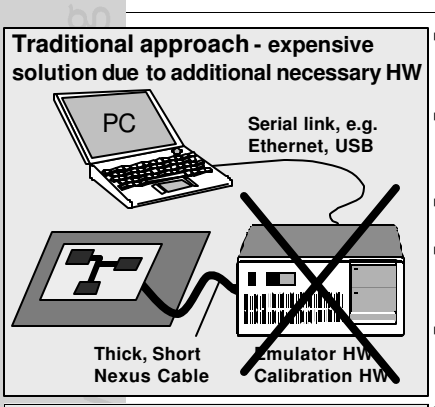
  IFX will provide
  "Open Market Specification"



Tuning Protection and Authentication



TC1796ED
Emulation Device



- TC1796ED covers complete emulator functionality, fast prototyping and calibration
- Emulation logic is next to production chip
  - On the same silicon
- High frequency capability
- High amount of traceable signals (on mask level)
- Production & emulation have the same behavior
- Easy link to standard PC e.g. USB
- TC1796 and 1796ED using the same footprint
  - No need to develop different PCB
  - Extra balls for the ED
- Tool connector on top

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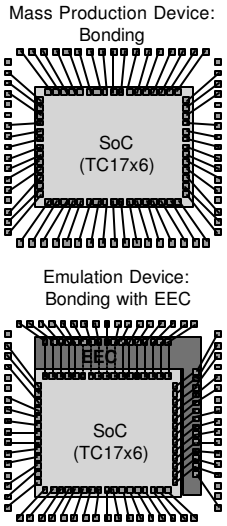
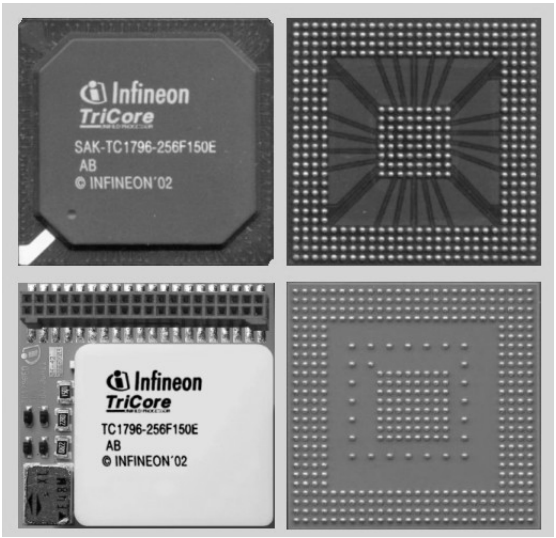
TC1796 and TC1796ED





Summary

- TC1796 serves upcoming trends in powertrain applications
  - Fullfills highest performance requirements including soft- and hard real-time
    - Intelligent peripherals
    - Optimized bus system
    - Unified CPU/DSP and peripheral coprocessor
  - Reduces system cost
  - Powerful emulation support

http://www.infineon.com/

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