GTM – Much more than a timer

BOSCH

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GTM History

Increasing supply chain risks influence semiconductor market and Bosch business

Electronic control unit suppliers must reduce dependency on single semiconductor supplier:

- One measure – effort reduction to adopt complex driver SW to different timer systems as IFX GPTA and FSL TPU
- First idea – use one of the existing timers in the µController of the semiconductor supplier – everybody would like to give timer IP license but nobody to take IP license 😕
- ***GTM idea was born:***
  - Set up new timer to have same timedIO (capture, compare and compute module) IP in several µController
  - The limitations of the existing ones should be removed
  - Know-How protection of Tier1
  - Time critical functionality located in GTM (deterministic execution) and other parts running on different Cores as TriCore, PowerPC, ARM

GTM was born because of supply chain risk mitigation and Know-How protection

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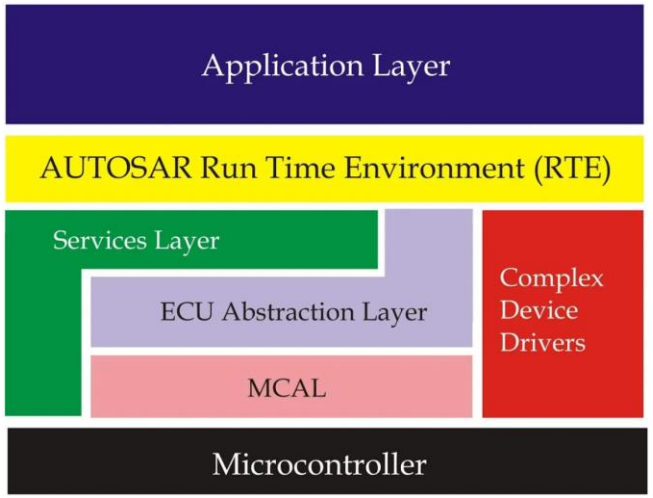
Support supply chain risk mitigation

Service layer with Mem-Stack, Com-Stack and Security covered by SW

Covered by Tier2 SW



Covered by GTM VHDL IP

Advantage:
- Time dependent functionality completely covered in GTM – TIM, TOM, ARU, MCS
- Not real time part of SW driver in C-Code run on main µC Core outside GTM – low effort compilation for different cores
- Result: Same complex driver running with same real time behavior on µController from different vendors
- Service layer with Mem-Stack, Com-Stack and Security covered by SW

Reduce effort in embedded control projects to support µController multi-supplier strategy

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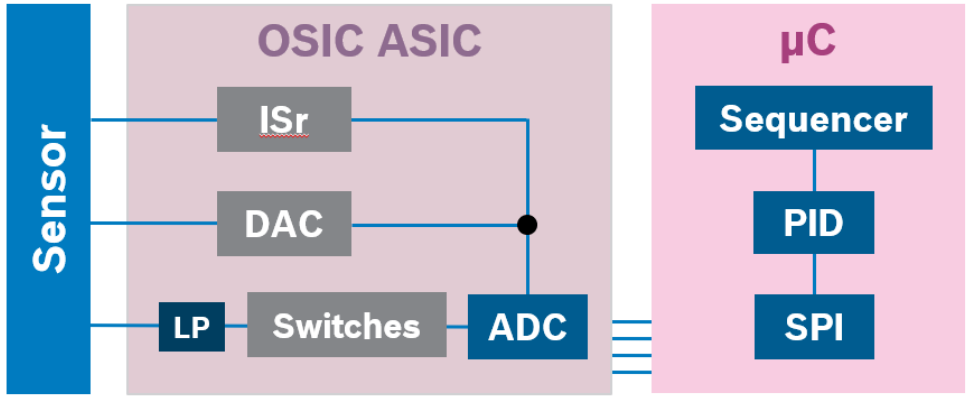
Functionality beyond timer – Supporting different partitioning

- New options of partitioning between µC and Mixed Signal High Current/-Voltage devices
- Examples: Oxygen Sensor (expert presentation today afternoon), valve control circuit, …



Advantage:
- 200MHz MCS Core to unload main core
- Digital logic more expensive in Mixed Signal process
- Higher flexibility by core in µC compared to state machine in Mixed Signal
- Smarter logistics and faster startup because core is part of µController

New partitioning in between µController and Mixed Signal IC enables system and cost benefit

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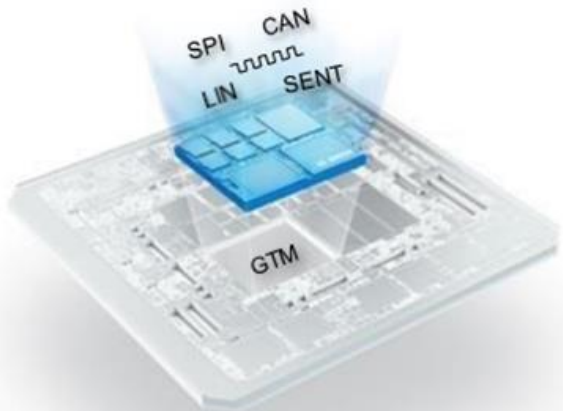
Functionality beyond timer – Interface Emulation

- ***Interface Emulation***:
  - ***Extend the number*** of interfaces (e.g. LIN, CAN, SPI, PSI5, …)
  - ***Extended functionality*** (e.g. SPI Queue, SENT Back channel enabling to support security and logistic, …)
  - ***Enable new interfaces*** (e.g. I2C, RS4xx flavors, …)



- Solution:
  - TIO module provide additional functionality for fast serial stream handling
  - MCS module with 200 MHz emulating the protocol and fulfill send and receive timing together with TIO

Higher flexibility of µController by extending number, type and functionality of interfaces

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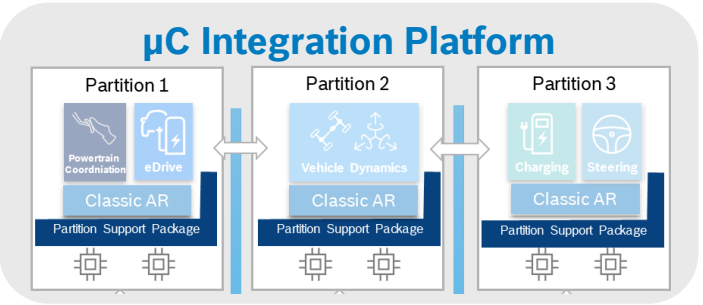
Market view and new use cases

- Usage in several embedded control areas in Bosch and Competitor application areas
- Implemented by major embedded µController supplier
  and new ones 紫光同芯微电子有限公司 TONGXIN MICROELECTRONICS CO., LTD.

- Integration platform support by usage of GTM4.x features:
  - Virtual µControllers are separated by memory protection and deterministic execution protection measures
  - Support the introduction of new embedded control EE-Architecture need
  - GTM clusters assigned to different virtual machine (Partition)
- Implementation of CAN physical intrusion detection



GTM accepted by market - Functionality in version 4.x solid base for embedded control

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Future Extensions

- Replace MCS by Standard Core (e.g RISC-V®, ARM®):
  - To be decided by community (OEM, Tier1, Tier2 - GTM interest group)
  - ARM with license and supply chain risk
- Higher frequency of Core to benefit from smaller node capabilities:
  - 400 MHz 16nm and 800 MHz below
- Faster interface to HW acceleration unit as Bosch DFA or other market solutions:
  - Benefit for motor control application
  - Enabling data based models for calculation of necessary compare output settings for actuators
- Extend GTM by standardized SAR and SD interface connection to cover timed-IO with ADC needs even better
  - SAR and SD converter trigger and data forwarding capability

Whishes for future extension 

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Summary

- GTM successful to support risk mitigation for supply chain issues – by reducing SW effort to use same AUTOSAR™ complex driver in different ECU (Electronic Control Units) running with IFX, ST and NXP µController
- Extended functionality of GTM (Deterministic execution, free selectable PWM frequency for every output channel) is key to manage complexity in applications
- Timer functionality sufficient to cover many areas of embedded control applications
- Functionality offers new partitioning in between µController and Mixed Signal chips
- TIO (timer input output) module enabling smaller footprint of GTM and supporting setup of interface emulation (CAN, SPI, …) at an appropriate speed

Let's continue together to use GTM as general timer for embedded control applications and adopt functionality to future needs for the benefit of all of us

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