CAN FD in ST Powertrain Microcontroller Products

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Automotive Microcontroller Marketing
Automotive Microcontroller Market Trend
Next generation MCU for Powertrain

Powertrain market trends are driving the MCU

• Segregation between developing and developed markets
• Increased diversity of powertrain configurations
  • Gasoline PFI, GDI, Diesel DI, HCCI?
  • Hybrid: is coming in addition to diesel/gasoline
    • light hybrid (start/stop), mild hybrid till ability to run in zero emission mode.
  • Exhaust post treatment, turbo technologies also increase the configurations
  • Electric propulsion
• More scalable and standardized MCU products are needed from very low end cost driven derivatives to super integrated performance
Automotive Microcontroller Market Trend
Next generation MCU for Powertrain

Powertrain market trends are driving the MCU

• Increased number of sensors / actuators in combustion engines for emission demanding countries
  • New types of analog acquisitions:
    • In-cylinder pressure, crank position sensor with higher precision and faster synchronization
  • Different sensors / actuator interfaces
    • SENT, PSI5, LIN
  • I/O serialization is helping to reduce MCU package pin count
    • Microsecond bus between MCU and ASSP
• New actuators
  • Valve train electrification
Microcontroller in Powertrain – Requirement Shift
Example: MCU requirement for 4 Cylinder GDI Engine Management control

**MCU in Y2005**

**ST10F276**

- 16Bit
- 64MHz ST10 Single CPU
- MAC Unit
- 832Kbyte Flash Memory
- 68k RAM
- CAPCOM / PWM Module
- Serial Interface: 2xUSART, 2xSPI, 2x I2C
- QFP144

~40DMIPS Performance
180nm Technology, ST-Rousset 8”
~9Mio Transistors
Users Manual: 230pages

**MCU in Y2010**

**Monaco**

- 32Bit
- 80MHz PPC-Z3 Main CPU
- Floating Point Unit
- 1.5Mbyte Flash Memory
- 94k RAM
- eTPU Timer Module
- Serial Interface: 2xSCI, 2xSPI, 2xCAN
- QFP144/176

~80DMIPS Performance
90nm Technology, ST-Rousset 8”
~28Mio Transistors
Users Manual: 800pages

**MCU in Y2015**

**McKinley**

- 32Bit
- 2x200MHz Z4d Main CPU
- Floating Point Unit
- 200MHZ Z4d IO CPU
- 4Mbyte Flash Memory
- 304k RAM
- High-end GTM Module
- Serial Interface: 2xFlexRay, 1xEthernet, 3xM-CAN, 1xTT-CAN, 5xLINFlex, 1xI2C, 7xDSPI, 10xSENT, 3xPSI5
- eQFP176/BGA292

~500DMIPS Performance
55nm Technology, ST-Crolles 12”
~106Mio Transistors
Users Manual: 5000pages

COMPLEXITY INCREASE
Increased Device Complexity

Key drivers

• New market requirements
  • Safety
  • Security
  • Multicore processing
  • SW standardization
  • New calibration concepts
  • New Networking

• Legacy or customer specific requirements
  • Peripherals / Interfaces
  • Timer modules
Example: McKinley – 4M SPC57EM80
Block Diagram

I/O
- Generic Timer Module (High-End Version)
- 32 Inputs, 88 Outputs
- Dual Channel FlexRay (10MB/s), 64 buffers
- 3 x M-CAN (with full FD CAN support)
- 1 x TT-CAN
- 5 x LINFlex
- 7 x DSPI including 2 x μSB
- 1 x Ethernet
- 1 x I2C
- 10 x SENT
- 3 x PSI5
- 1x LFAST (Interprocessor bus)

- Most of the peripherals are small, but the added device complexity results in large die size
- Effort has to be standardized so not to add additional device complexity when going for higher performance
- FD CAN is a good example
FD CAN advantages
CAN Evolution

- Close the bandwidth gap between CAN and other high bandwidth IF’s
- Avoid increased system cost
- Use existing network topologies on physical layer
- Provide an upgrade path so not a totally new protocol
• To overcome the current data rate limitation on classical CAN networks the CAN spec can be changed in two directions:
  • Increase the baud rate
  • Increase the number of data bytes per CAN frame

• Stay compatible with today technology on CAN physical layer
  • Existing CAN transceiver shall be compatible with future improvements on CAN spec

The Robert Bosch GmbH has translated these requirements into the new specification „CAN with Flexible Data-Rate“ called CAN FD
Conclusion

- CAN FD is a good approach to deal with increased bandwidth requirements in Automotive networks while maintaining existing protocols.

- CAN FD could close the gap between standard CAN and higher bandwidth protocols (e.g. FlexRay):
  - Will depend on the overall device and tool availability.

- Low effort to migrate to CAN FD, rather than implementing a new standard.

- STMicroelectronics has implemented CAN FD in new powertrain devices.
Thank You !