CAN FD in ST Powertrain Microcontroller Products

Paul Fox

Automotive Microcontroller Marketing

life.augmented

Automotive Microcontroller Market Trend
Next generation MCU for Powertrain

Powertrain market trends are driving the MCU

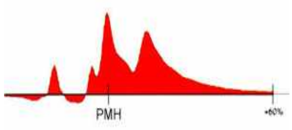
- Segregation between developing and developed markets
- Increased diversity of powertrain configurations
  - Gasoline PFI, GDI, Diesel DI, HCCI?
  - Hybrid : is coming in addition to diesel/gasoline
    - light hybrid (start/stop), mild hybrid till ability to run in zero emission mode.
  - Exhaust post 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

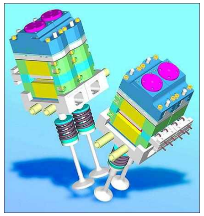
Automotive Microcontroller Market Trend

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 4Cylinder 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

INNOVATION

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

INNOVATION

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

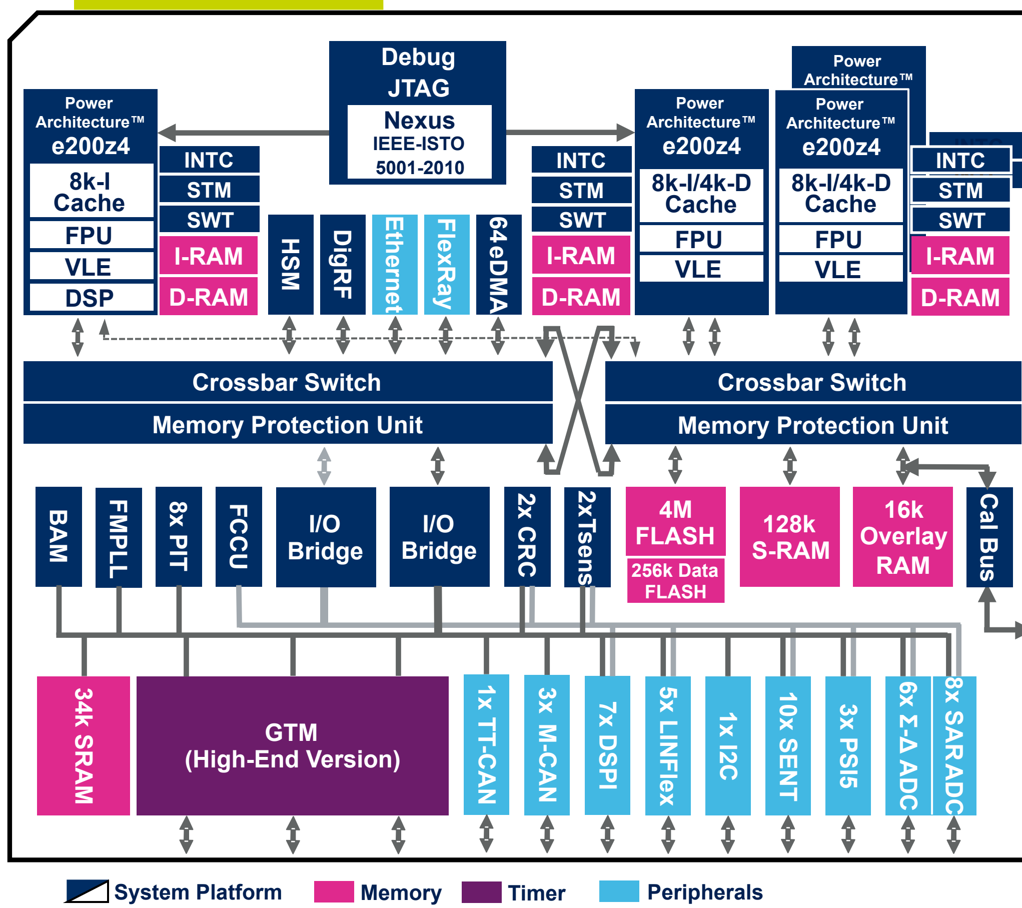
Example: McKinley – 4M SPC57EM80

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)

Available



- Most of the pripherals 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

life.augmented

CAN improvements

- 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 availabilty
- Low effort to migrate to CAN FD, rather than implementing a new standard
- STMicroelectronics has implemented CAN FD in new powertrain devices

Thank You !