NVME INTEGRATION ON AUTOMOTIVE PLATFORM

Matthias Beste, Hardware Design Engineer, M.Sc. EE
Automated Driving Solutions Division ASD/IOTG, 08/07/2019

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INTEL AUTOMOTIVE WORLDWIDE:

AUTONOMOUS DRIVING L2 UP TO L4/L5 + IVE*

* In Vehicle Experience
CONSOLIDATED COMPUTING POWER AND DATA STORAGE

- LiDAR
- Stereo Camera
- Central Processing Unit
- In-Tire Sensors
- Connectivity
- High-Precision Map
- Radar (long range)
- Radar (short range)
- Driver Camera
Memory landscape on AD Reference Platform

- **E.g. Denverton® 16-core design**

- **SPI:**
  - SoC FW
  - Automotive bootloader

- **NVMe:**
  - Boot kernel
  - Operating system
  - Data

- **eMMC™ (alternative)**
Automotive platform challenges

• High performance expected but aligned to consumer market
  • Pushing emerging technologies early into Intel automotive products
• Automotive Mechanical Form Factor Design
  • Chassis, connectors, flammability, shock & vibe, EMC
• 7-10y availability of components anticipated by industry (to avoid requalification)
• AEC-Q100 Grade 2 qual. components today (-40°C +105°C / -40°F +221°F)
• Economic concept for longevity of ~15years
• Targeting ISO26262, Functional Safety Level up to ASIL-D
  • Added safety mechanisms (monitoring, feedback, watchdog, e2e protect.)
  • Usage of low FIT rates parts
NVMe trend in automotive

• Market Leaders are working on automotive devices under economic aspects
• High interest on early functional enablement on Intel® Automotive Platforms
  • Automotive features to reach AEC-Q qualification are on preparation
  • Adaptable PCB design concept to support various BGA 16 x 20mm NVMe BGAs
  • Exemplary collaboration with Toshiba Memory® Europe for early evaluation
  • Toshiba's BG3 series NVMe is enabled on an Intel AD platform as prototype
  • BG3 is designed for client PC usage, this use case is for evaluation purpose only
• Toshiba NVMe device BG3® at glance
  • DRAM less, power efficient*, matching common voltage rails (3.3/1.8/1.2)*, reliable 1.5Mh* MTTF and fast write up to 1GB/s*

*) Data from Toshiba BG3 Website
NVMe platform integration

- adjust. voltage sources
- active air/liquid cooling
- sideband signals
- support power saving states
  - throttling
  - thermal balancing
- FBGA153, 16x20mm, pitch 0.8mm
Exciting results for autonomous driving apps

- **Proof of Concept Test Measurement**
- 2GB file
- Ext4 with option noatime
- 4K aligned partition
- PCIe Gen3 x2 Link, Payload Size 128Byte
- 4.14 Linux kernel
- Real time threads w/o irq balancing
- No Benchmark data as setup is non-optimized
- High write performance observed

[Combination of one specific AD platform and one specific NVMe device]

[No Benchmark data, Shared Data Intel & Toshiba, referring to disclaimer]
No impact of access mode and polling mode

- Proof of Concept Test Measurements

Denverton® with Toshiba® 256GB NVMe BGA on an Intel AD platform

(averages, special use case, non-optimized for performance)

[No Benchmark data, Shared Data Intel & Toshiba, referring to disclaimer]
Question and Answers

Thank you!

Matthias Beste,
Hardware Design Engineer, M.Sc.
matthias.beste@intel.com

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