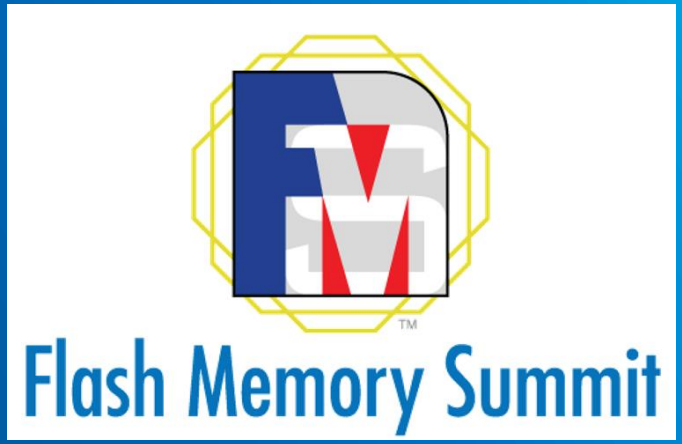

NVME INTEGRATION ON AUTOMOTIVE PLATFORM

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

Flash Summit 2019

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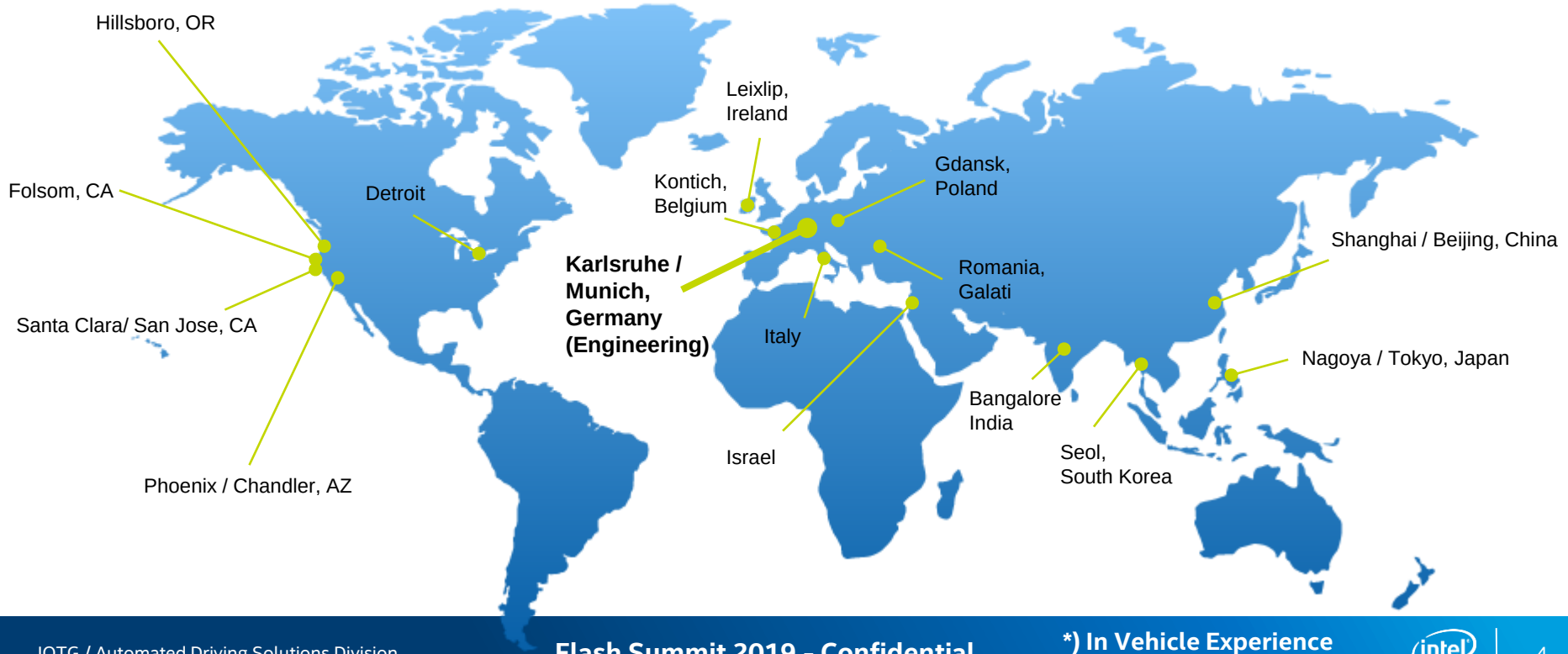
INTEL AUTOMOTIVE WORLDWIDE:

AUTONOMOUS DRIVING L2 UP TO L4/L5 + IVE*



*) In Vehicle Experience

CONSOLIDATED COMPUTING POWER AND DATA STORAGE

STEREO CAMERA

CENTRAL PROCESSING UNIT

IN – TIRE SENSORS

RADAR (long range)

CONNECTIVITY

LiDAR

HIGH-PRECISION MAP

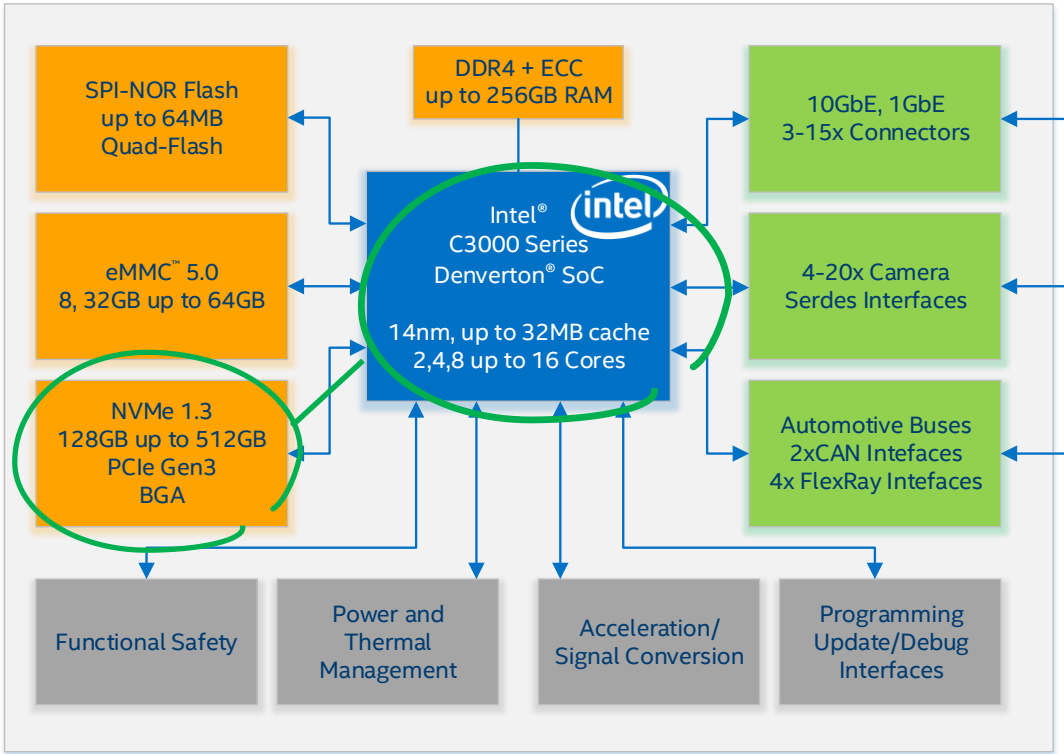
DRIVER CAMERA

TOP VIEW SYSTEM

RADAR (short range)

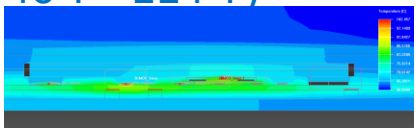
Memory landscape on AD Reference Platform

- 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

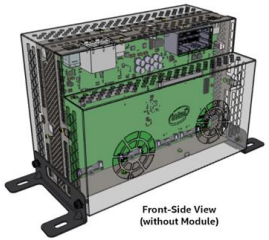


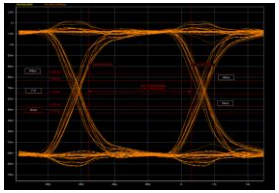
NVMe trend in automotive

- 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

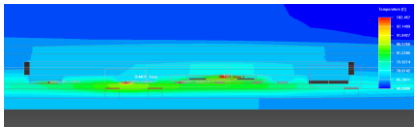
NVMe platform integration





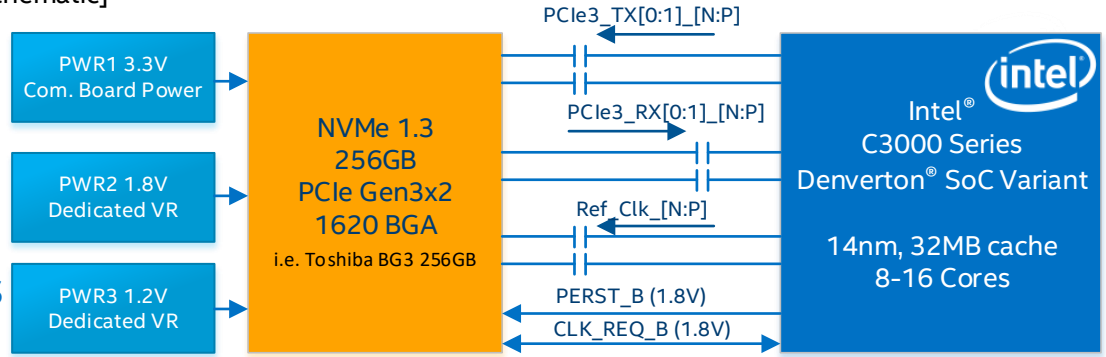
Flash Memory Summit

- adjust. voltage sources
- active air/liquid cooling
- sideband signals
- support power saving states
  - throttling
  - thermal balancing

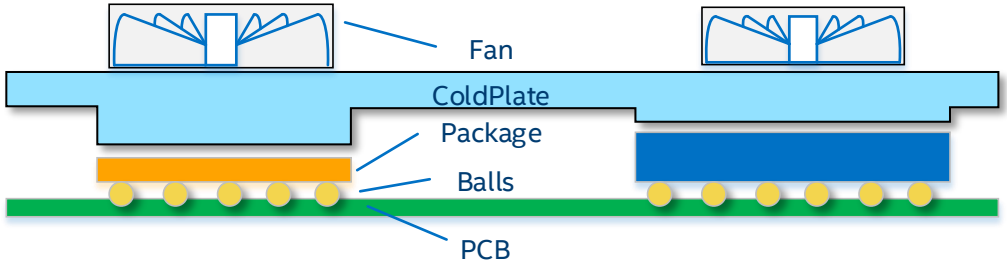


- FBGA153, 16x20mm, pitch 0.8mm

[Schematic]

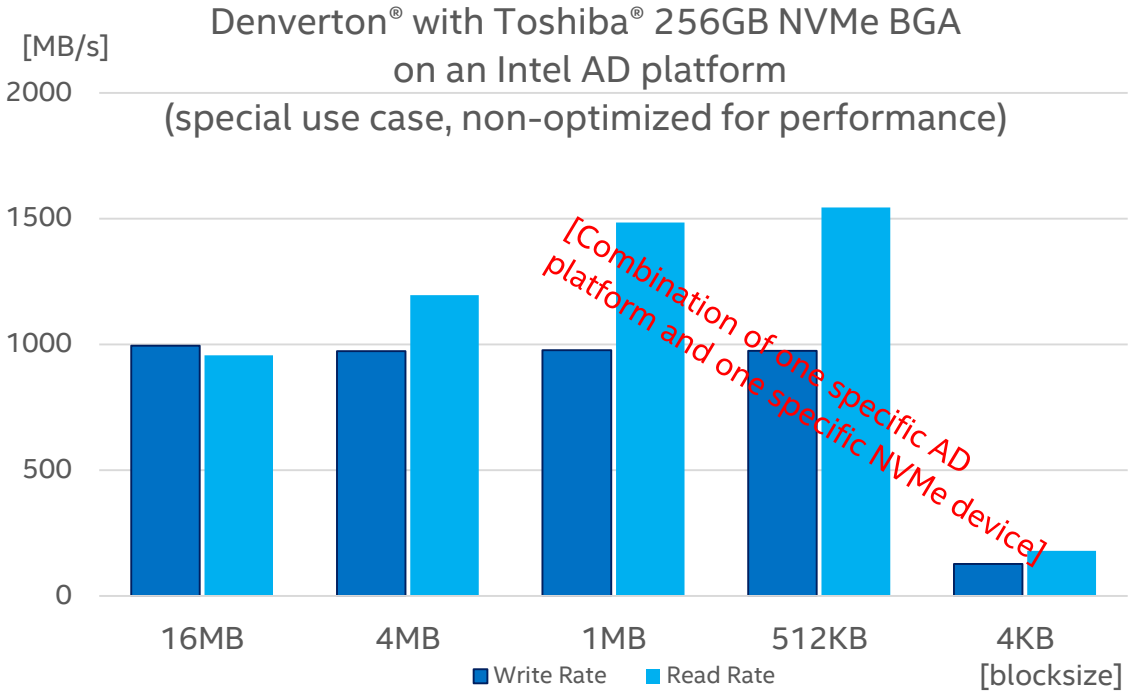


[Cross Sectional View]



Exciting results for autonomous driving apps

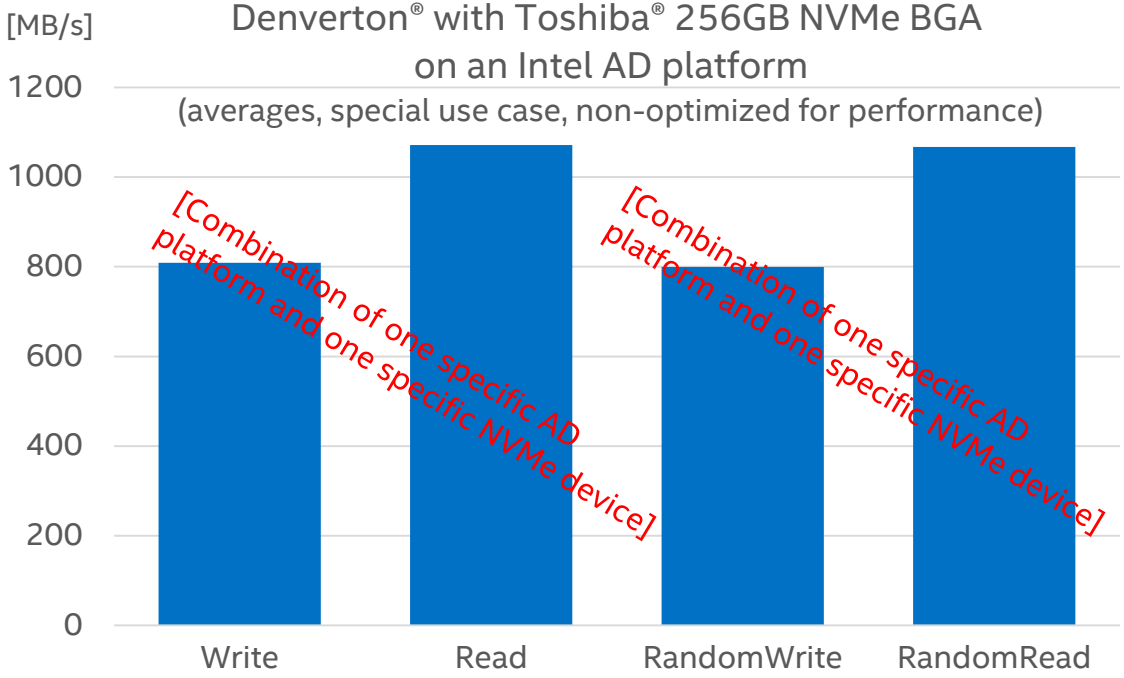
- Proof of Concept Test Measurement
  - 2GB file
  - Ext4 with option noatime
  - 4K aligned partition
  - PCIe Gen3 x2 Link, Payload Size 128Byte
  - 4.14 Linux kernel
  - Real time threads w/o irq balancing
- No Benchmark data as setup is non-optimized
- High write performance observed



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

No impact of access mode and polling mode

- Proof of Concept Test Measurements



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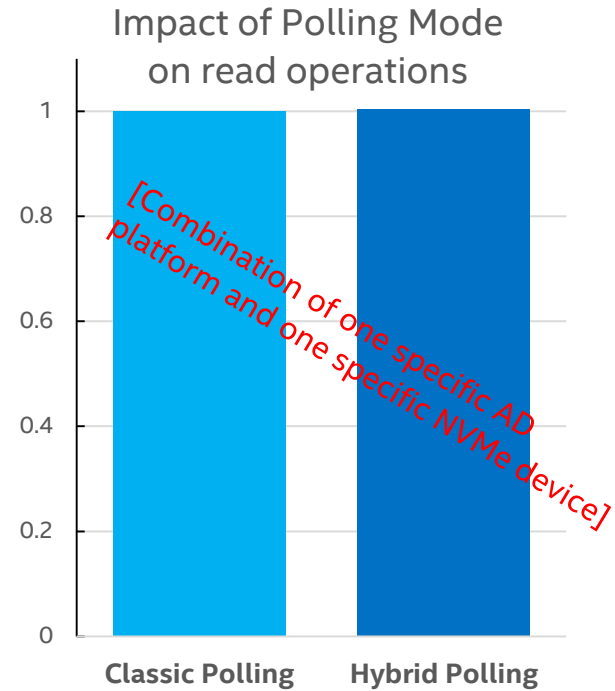

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Question and Answers

Thank you!

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Automated Driving Solutions Division
ASD/IOTG, 08/22/2019

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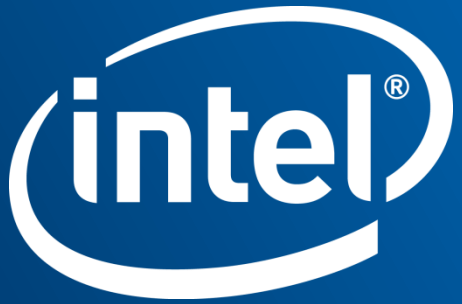
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