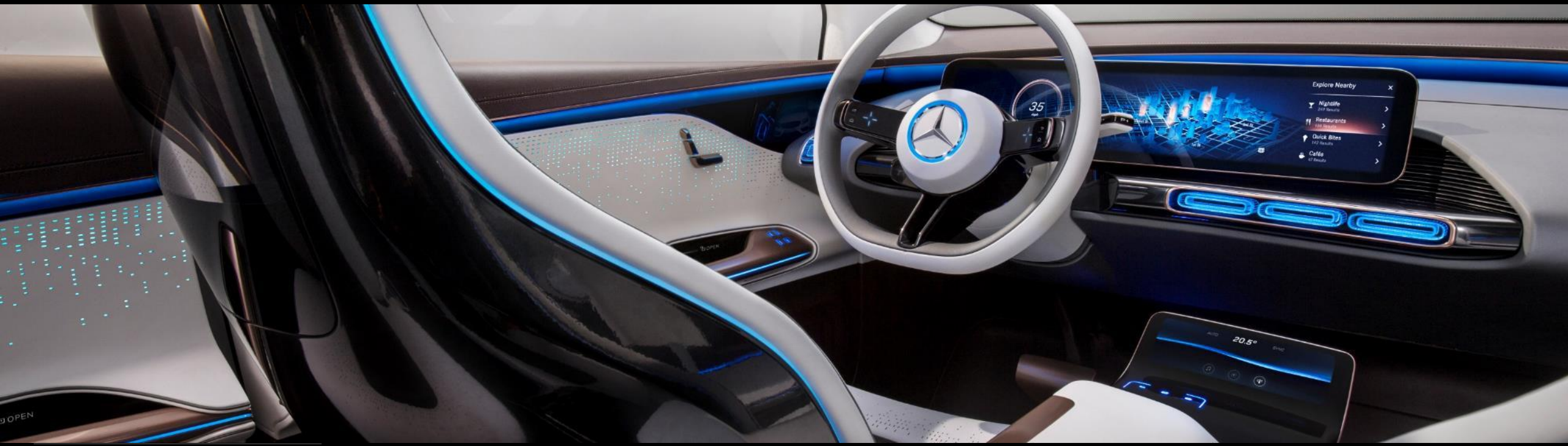


Flash Memory Summit

Requirements for Non-volatile Memory in Automotive Applications

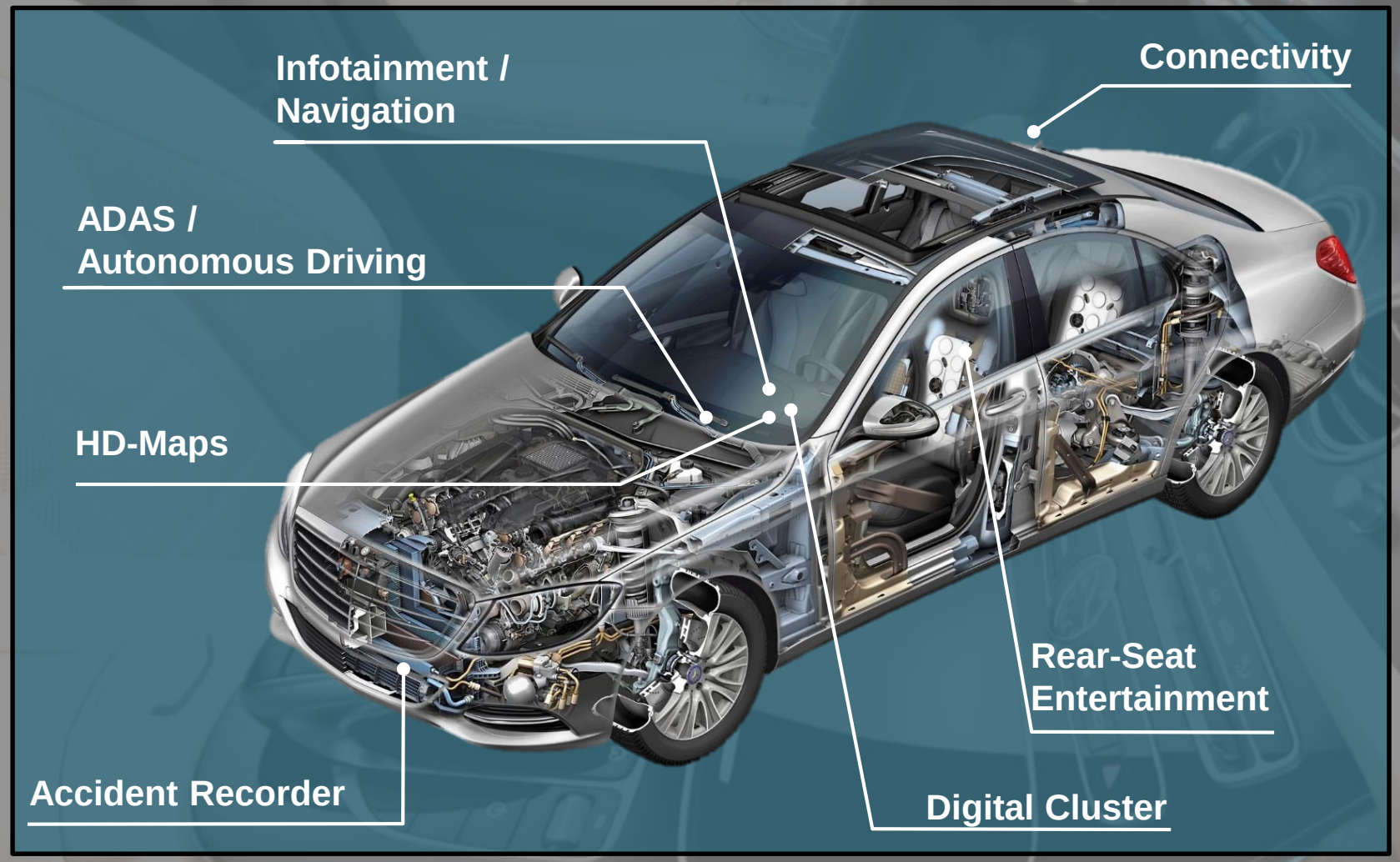
Michael Huonker, Daimler AG Research & Development

Santa Clara CA, August 2017

Mercedes-Benz

The best or nothing.

NVM Storage in Infotainment



Infotainment	64 – 512 GB
Digital Cluster	4 - 32 GB
Rear-Seat Entertainment	16 - 64 GB
Connectivity	4 - 16 GB
ADAS / Autonomous Driving	8 - 16 GB
HD-Maps	8 - 512 GB
Accident recording	8-64 GB

In 2025 on board storage >1TB

Our View on NVM Memory Trends in Infotainment

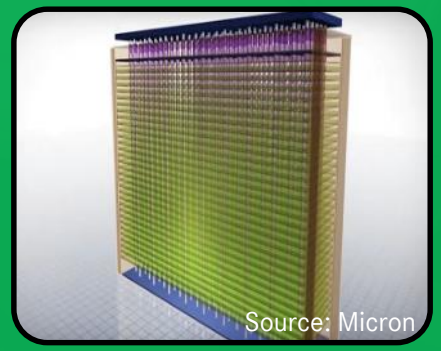

Source: Toshiba

Flash technology replaces HDD

Higher Speed

Almost same cost

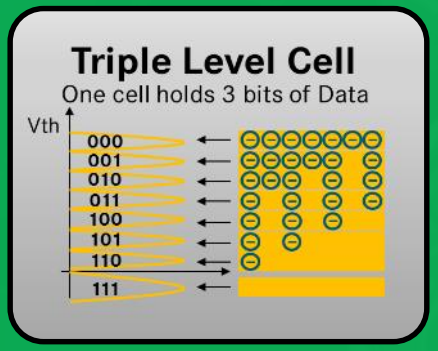
Mainstream technology


Source: Micron

3D-Cell Technology

Cell shrink stopped in 2D planar technology

Capacity increase only possible with 3D technology

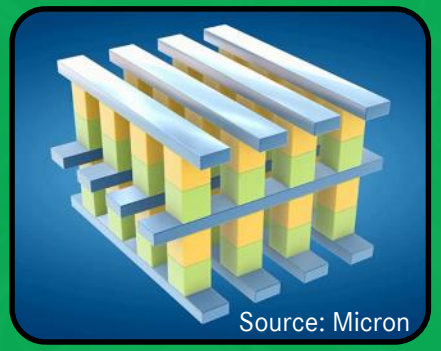


Triple Level Cell Technology

3D allow more electrons per cell

Capacity per die increases

Price advantage over planar technology

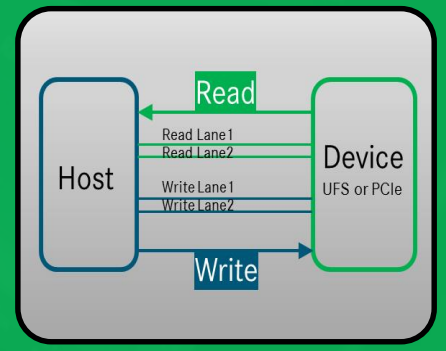

Source: Micron

Persistent Memory

New memories: X-Point, SCM and MRAM

No endurance problem

BUT: Reliability not yet proven



Emerging NVM Interfaces

eMMC bandwidth no longer sufficient

Move to serial high speed Interfaces: UFS or PCIe

Requirements of Infotainment Systems on Flash Memory

Fast System Startup

High Read Speed: New interfaces UFS, PCIe

Short initialization time after power up

Early Adoption of New Technology

No time gap between Automotive and CE

Latest technology: 15 nm planar, 3D, TLC

Quality

Quality: 0 ppm target, 8d reports

Mercedes-Benz MBN-10527 Specification

2nd source with standard interfaces

Energy Efficiency

Limited system cooling capacity

Shared power budget for SoC, RAM, Flash Memory, Amplifier, Interfaces, etc.

Robustness / Endurance

Power fail save

Temperature -40..+105 °C

Data Retention for years/months

Scalability

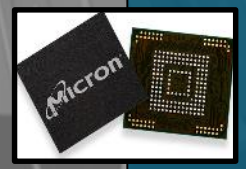
Memory sizes between 4 GB and 512 GB

Read/Write Bandwidth options 1 – 4 Lanes

Diagnosis

Health status of the device

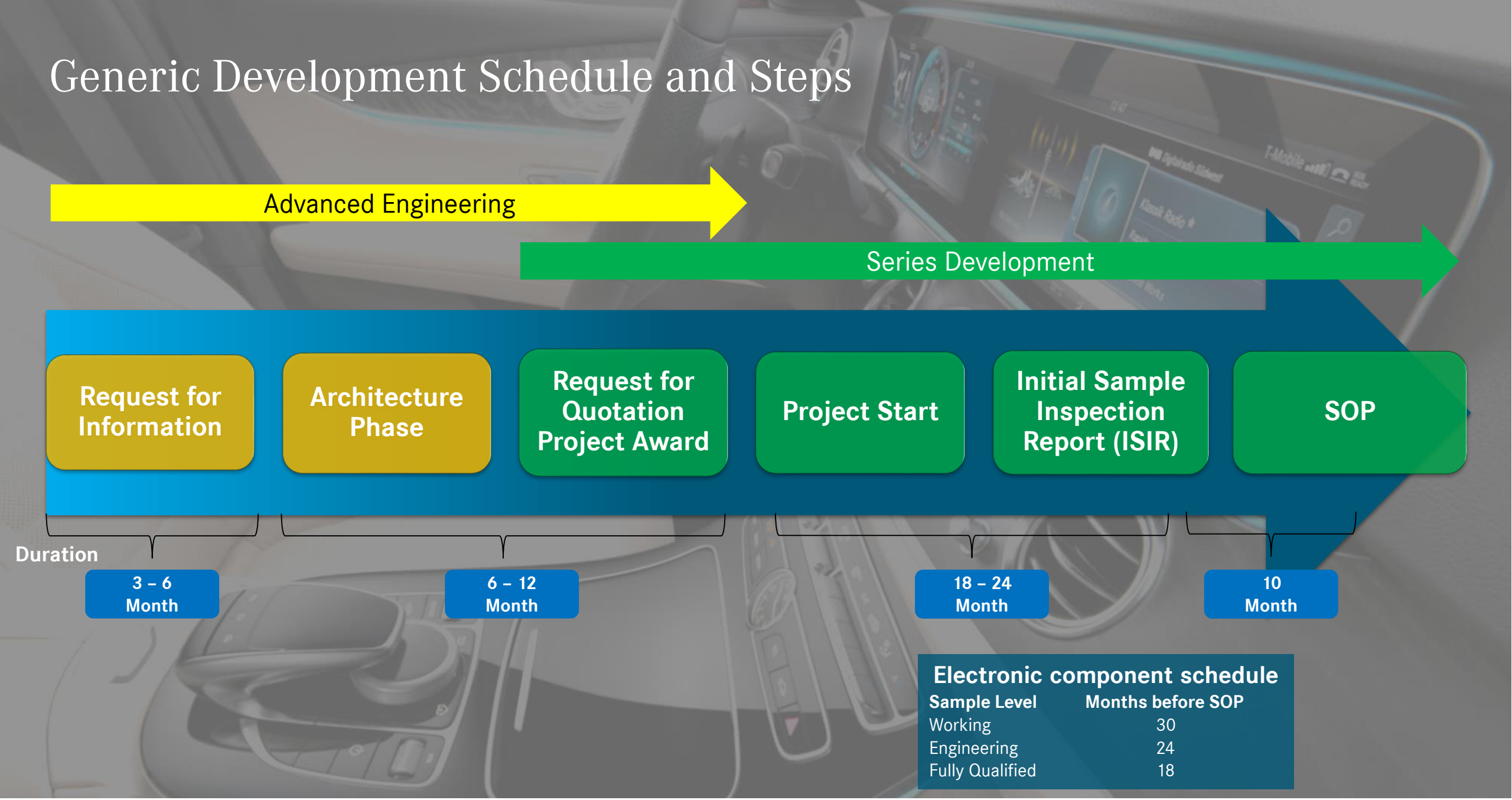
Available write budget



Package space

Direct mounted components (BGA)

Generic Development Schedule and Steps



Electronic component schedule

Sample Level	Months before SOP
Working	30
Engineering	24
Fully Qualified	18

Example for extended Automotive Requirements: UFS Diagnosis

Specific Functions for Automotive Applications required

Every part in our system has to be diagnosed and we need detailed information about the device health status.

Diagnosis is used for:

- Development
- Field diagnosis
- Failure analysis

→ JEDEC diagnosis standard is not enough

→ Common extended diagnosis commands among memory vendors needed

Extract of required Diagnosis commands

On/Off Statistics	• Power on cycles • Power on repairs
Refresh strategy	• Refresh status • Set refresh strategy
Flash profiling	• Erase count, max. erase, total Block read/write • Wear level prediction
Error logging	• Interface errors • ECC level

Quality Requirement: MBN-10527

Environment: Car

80% of the innovations driven by **semiconductors**

Number of Semiconductor devices grow rapidly

Long lifetime of unit

Harsh environment: Thermal shock, Temperature from -40..+80°C, Vibration, Long periods without power

Parameter	Consumer	Industrial	Automotive
Temperature	0 – 40 °C	-10 – 70°C	-40 – 160°C
Operation Time	2 – 5 years	5 -10 years	> 15 years
Humidity	Low	Environment	0 % - 100 %
Field Failure Rate	< 10 %	<< 1 %	0 ppm Target
Documentation	Minimal	Conditional	PPAP, 8D, PCN Management
Supply	Average 1 year	~ 2- 5 years	Up to 15 years

Targets for MBN-10527

Comparison of semiconductor manufacturers

Reduce semiconductor related design/quality/reliability/supply issues

MBN-10527 includes ISO/TS 16949 and AEC-Q

Summary

- Automotive development cycles vs. early technology adoption
  - Working/Engineering Samples 30/24M before SOP
  - Robust supply of components for whole product lifetime of 15Y
  - Long-established technologies not acceptable for new systems
  - Most advanced performance and capacity required for every car generation

→ Paradigm shift towards Automotive Industry as technology driver

- Automotive Requirements beyond consumer standard
  - E.g. for diagnosis extensions necessary
- Storage Demand in Automotive is rapidly growing