The Automotive Driver Monitoring Market:

What's Happening? Why? What's the Opportunity?

Ian Riches
VP – Global Automotive Practice
Strategy Analytics

Agenda

- One-Slide Strategy Analytics Overview
- What's the Happening, and Why?
- What Sensors will be Used?
- Where will the Value Lie?
- Conclusions / Q&A

One-Slide Strategy Analytics Overview

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Strategy Analytics Overview

- **Global market research & consultancy**
- **B2B and B2B capabilities**
- **Active across automotive, wireless and smart devices and intelligent home industry verticals**
- **Over 30 years of automotive expertise, supporting**
  - Semiconductor vendors
  - T1 / T2 suppliers
  - Car makers
  - And many more!

Ian Riches – VP Global Automotive Practice
Over 25 years' experience as automotive analyst

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What's Happening, and Why?

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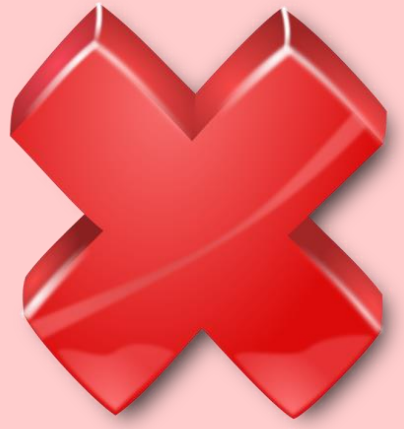
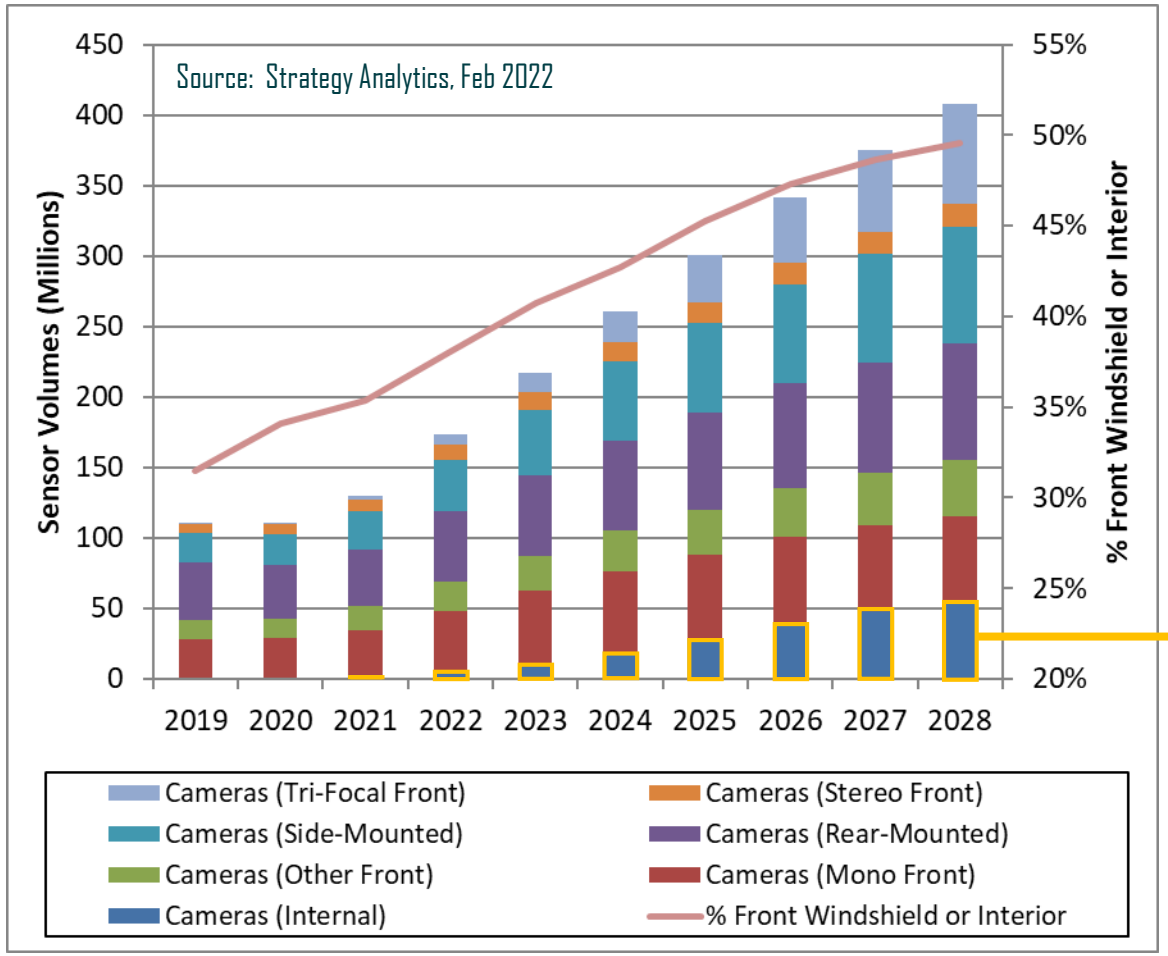
Just How Good is the DMS Market Opportunity ?

- **Over 70% CAGR unit growth in the number of internal cameras fitted to vehicles over 2021 to 2026**

- **Time-limited market window for dedicated processing hardware**
- **Long-term prospects only viable for sensors + illumination, and the software algorithms**



Internal Cameras Growing FAST!



- **Auto camera market will see CAGR of unit 21% over 2021 to 2026**
- **For internal cameras, annual unit growth is MUCH higher at 70%**
- **NCAP* regulations and increasing automation are driving this growth**
- **Strategy Analytics expects 51M light duty vehicles to be fitted with a camera-based DMS** in 2028**

* NCAP = New Car Assessment Program, e.g. https://www.euroncap.com/

** DMS = Driver Monitoring System

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Euro NCAP Roadmap 2025

'Driver fatigue and distraction can be major factors in accident causation and can be detected directly by eye-monitoring sensors, for example, or indirectly by identifying driving behaviors which are characteristic of an impaired driver.'

* UNECE = United Nations Economic Commission for Europe
https://unece.org/transport/vehicle-regulations

- For initial compliance, it is likely that systems inferring driver capability from the movement of the host vehicle will be sufficient
  - Such inferred systems sense vehicle movement from existing on-board sensors, such as accelerometers, steering angle sensors and front windshield cameras.
- However, members of the UNECE* safety committee believe that the test protocols from Euro-NCAP will be tightened to include direct monitoring of the driver's eyes and face movements, now likely in 2023

What Sensors will be Used?

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What Sensors For DMS?

- **Strategy Analytics believes conventional 2D imagers, with IR illumination, will dominate the market in the short/ medium term:**
  - Huge pressure on hardware cost
  - Safety function of DMS typically requires a resolution above that offered by today's ToF images to detect eye movements & gaze direction
- **Other sensors under consideration:**
  - Time-of-flight
  - Structured light
  - RADAR
  - Ultrasonic
- **Ultimately, these will succeed or fail based on future legislation and how much value they add for the consumer via *additional features***
  - E.g. personalization; health monitoring etc.

Where will the Value Lie?

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DMS Will Become Part of The Software-Defined Car

1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020 2030 2040

Benz Patent Motorwagen

Ford Model T

1932 Ford with Flathead V8

Volkswagen Beetle

Bendix Electrojector / Bosch D-Jetronic

ABS Braking

Stability Control

Apple iPhone

Tesla Model S

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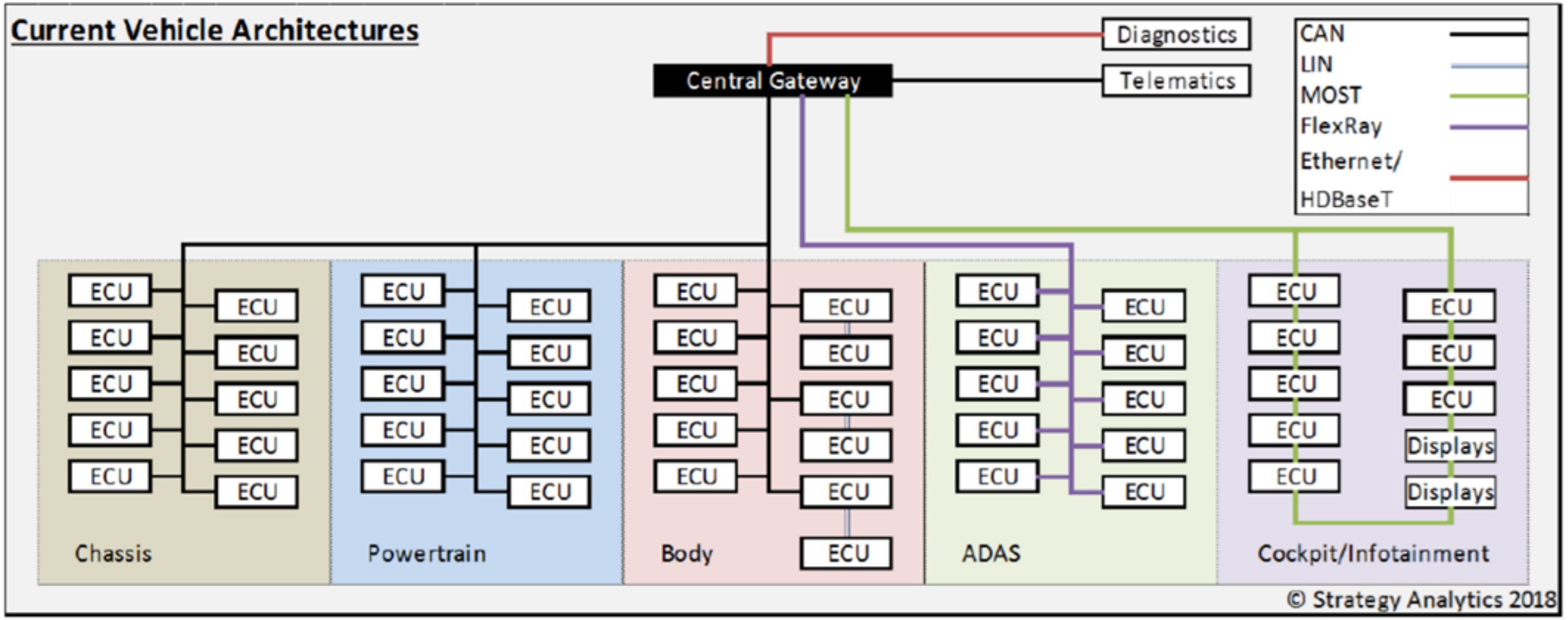
Vehicle Architectures are CHANGING!



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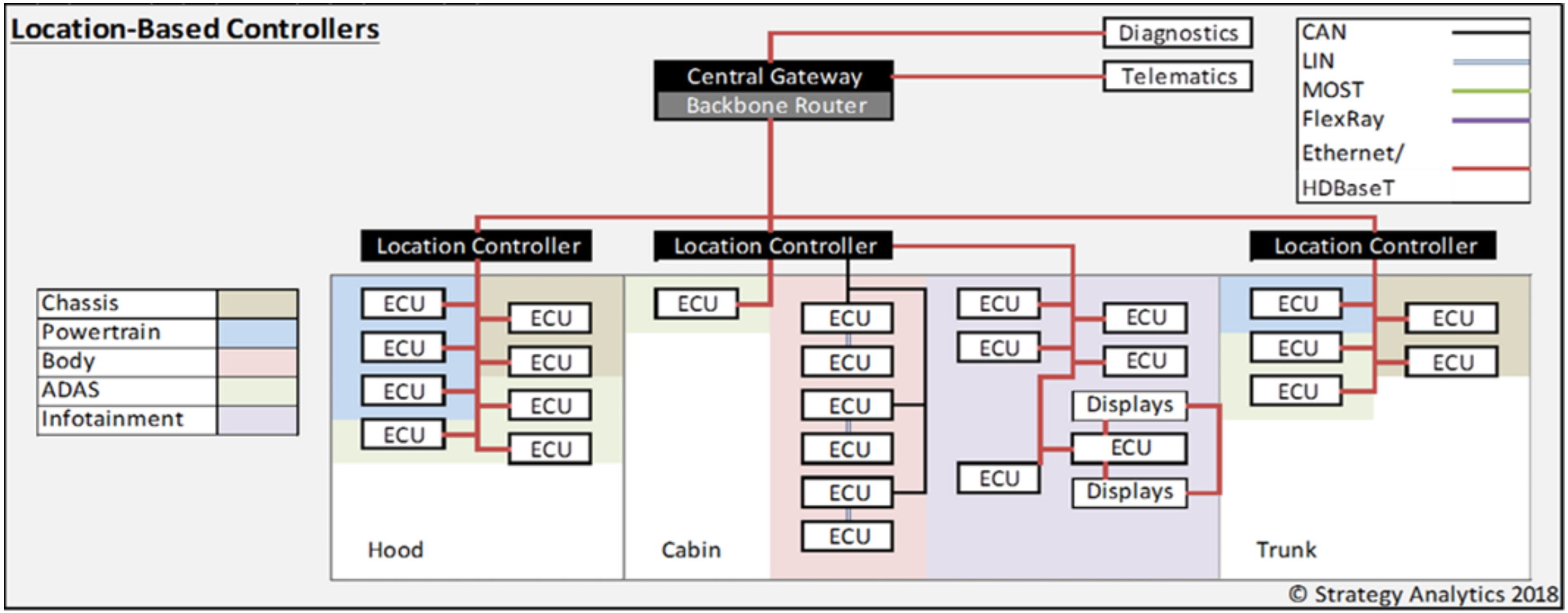

How Will The Market Evolve ?

- **Strategy Analytics sees the market following three generations:**
  1. Solutions on dedicated hardware – this is where we are now
     - E.g. NXP i.MX 8 is used by supplier Smart Eye (14 OEM customers)
     - $20 is cost target for 2D monocular camera-based system in volume
  2. Solutions that are effectively "software only", and which are hosted on a shared ECU, e.g. ADAS domain controller or cockpit domain controller
  3. Transition from DMS to multi-seat Occupant Detection Systems (ODS)
- **Conventional camera (2D monocular cameras, used in conjunction with NIR LEDs) remains the preferred approach.**
  - ToF-based sensors remain niche for now (costly, bulky, lack of resolution vs. camera based solutions), as will RADAR and other solutions.
- **For Gen 1 & Gen 2 the KEY task is driver monitoring – "are the eyes on the road?"**
  - Everything else (ID, emotion, health) is secondary. There is potential here to add value and allow OEM to increase margin via optional features – but these are not the core tasks
  - Be wary of recreating features which are better implemented on wearables at a lower price

Where Does The Value Lie?

- **Ultimately, this is a software-driven market**
  - Developers of combined h/w and s/w products typically tell us that they have had approaches from carmakers to sell their algorithms as a standalone
- **Hardware choices (sensor and processor) will ultimately be made based on the requirements of the software and the value it can add to the vehicle**
- **Automotive software-as-a-product (SaaP) market is still immature**
- **Multiple approaches still in play for externally-purchased software**
  - Costs loaded up-front for "engineering services"
  - One-off license fee per vehicle
  - Subscription model
- **Software HAS to become productized, with milestones and release schedules independent of individual OEM SoPs**
  - At present, we estimate the software portion of DMS cost to be in the range of $5
  - Total system cost $20-$50

Conclusions

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Conclusions

- **Driver Monitoring Systems are one of the fastest growth areas in automotive electronics in general, and for camera usage in particular**
  - Strategy Analytics forecasts 51m camera-DMS equipped vehicles to be produced in 2028
- **The key driver for this growth is NCAP "encouragement", followed by anticipated legislation, with Europe in the lead**
- **Ultimately, this is a software-driven market. The "mandated" DMS feature is the over-riding concern for most automakers.**
  - After legislation has been satisfied, carmakers are also looking for value-add features that they can charge the customer for to run on the same hardware platform
- **Vehicle architecture changes mean that dedicated SoC growth opportunities for this function will start to fade from ~2025**
- **Strategy Analytics expects 2D CMOS imagers, with IR illumination to dominate the volume market throughout the 2020s**

Any Questions?

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Resource Slide

Freely-available information

Blogs

https://www.strategyanalytics.com/strategy-analytics/blogs/automotive/autonomous-vehicles

https://www.strategyanalytics.com/strategy-analytics/blogs/automotive/in-vehicle-ux

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