



ADAS and AV Sensors: What's Winning and Why?

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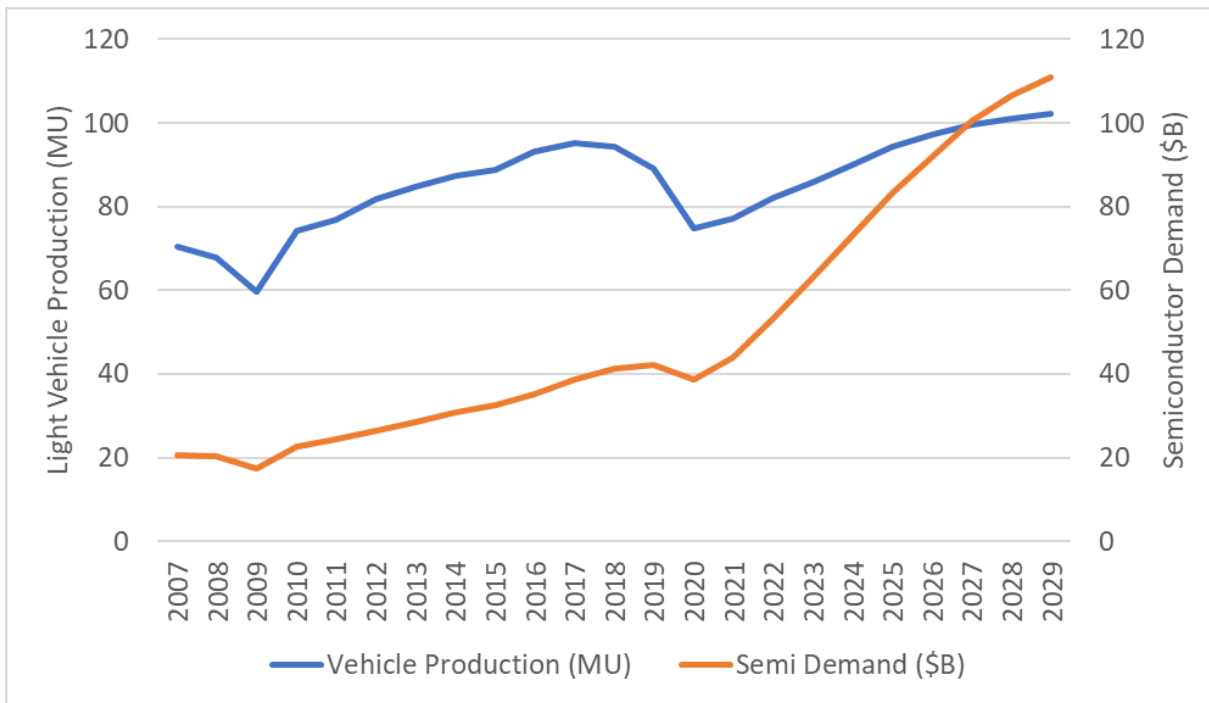
TechInsights

Agenda

- Why is Vehicle Architecture Change Important?
- What About Compute Platforms?
- What Does ADAS Sensor Demand Look Like?
- How Does it Look Long-Term?
- Conclusions
- Q&A

Why is Vehicle Architecture Change Important?

Vehicle Production & Semi Demand Were Tracking Closely...



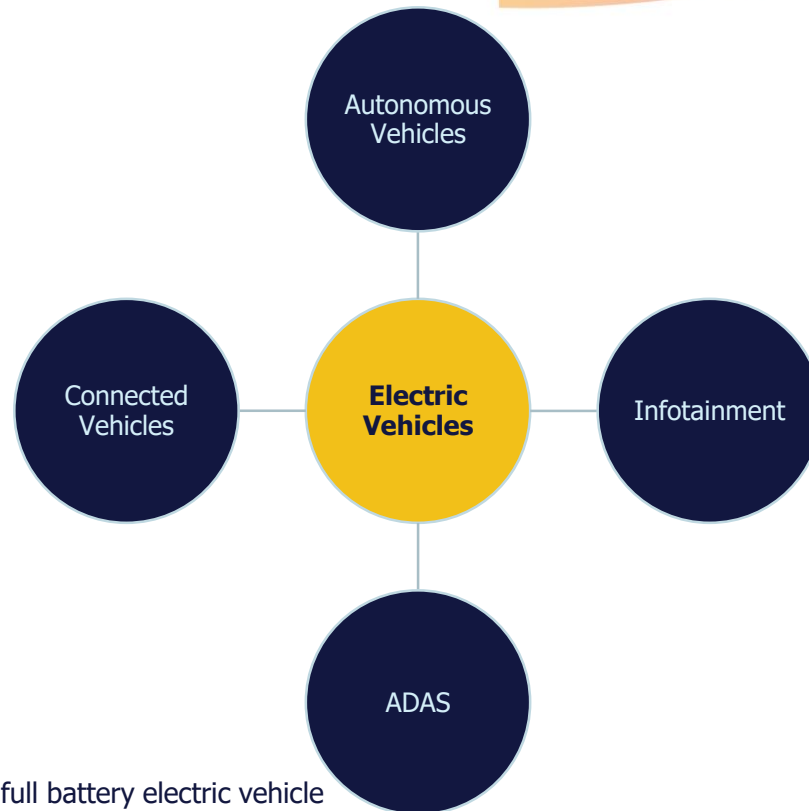
- Prior to 2018/9, growth had come fairly evenly from more cars and more semiconductors per car
- Now, growth is primarily about more content per vehicle
- So what happened?
 - **Electric Vehicles**
 - Focus by carmakers on higher-margin models
 - Some chip price increases

Why the Step Change With Electric Vehicles?

New xEV platforms are at the leading edge of technological change

- This is because they are new platforms and not specifically because they are xEV
- Move to xEV bringing its own opportunities also, driving power electronics content and move towards wide bandgap technologies

Will underpin adoption of ADAS/automated driving, telematics and 5G connectivity.



Note: xEV = any type of electrified model, from mild hybrid through to full battery electric vehicle

New Platforms Bring New Architectures

- **Legacy Architectures**

- 1 new feature = 1 new “box” in the vehicle
- Connected via CAN at up to 1 Mbps

- **New Architectures**

- Features consolidated into powerful central or domain controllers
- Zonal controllers will aggregate sensor input and control outputs
- All connected via Ethernet

NO COMMON VISION OF THE FUTURE HAS EMERGED YET!!!

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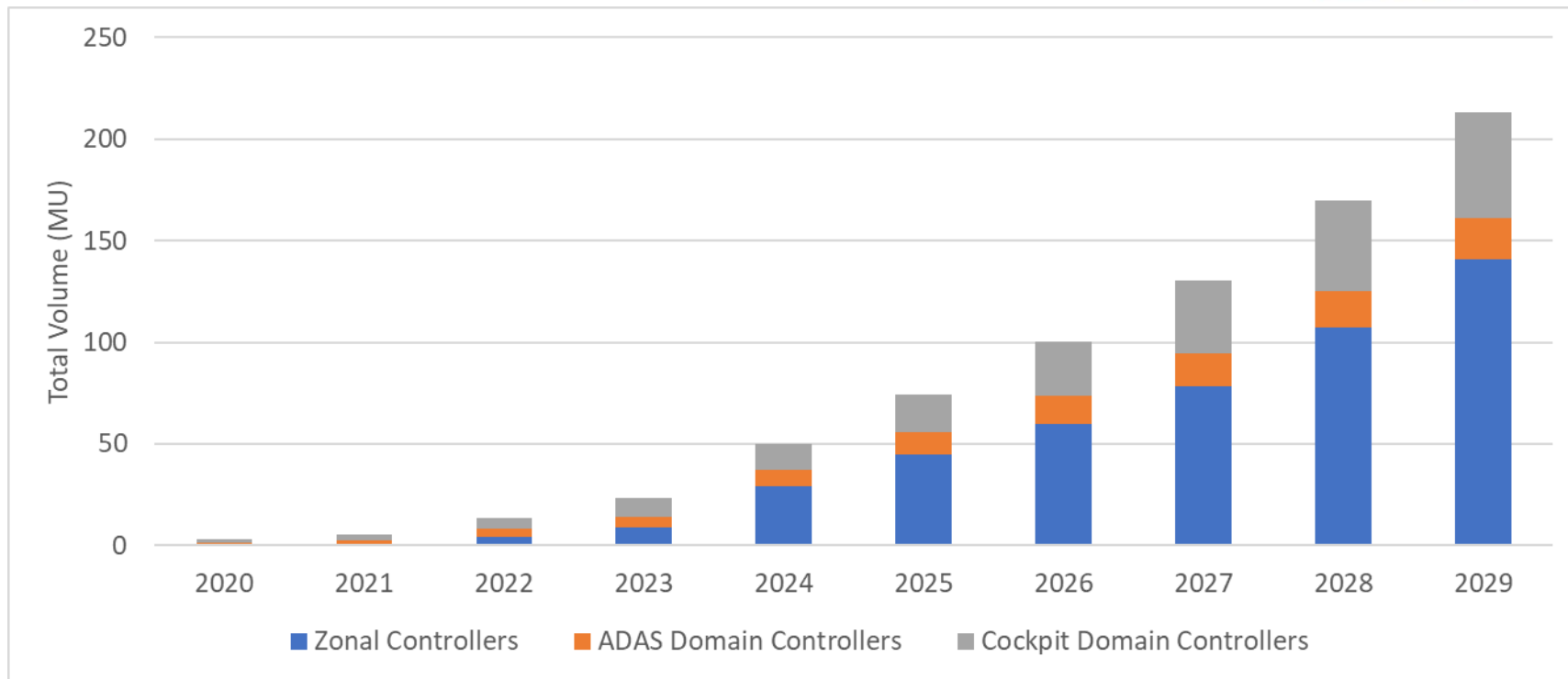
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SENSORS WILL NEED TO CONNECT IN A VARIETY OF WAYS FOR YEARS...

What About Compute Platforms?

Millions Of Domain & Zonal Controllers to Come



ADAS/AV COMPUTE PROVIDERS

Autonomous/Gaming/Server ⇔ Scale Down to ADAS



IVI / Smartphone ⇔ Digital Chassis ⇔ Leverage Arriver software stack



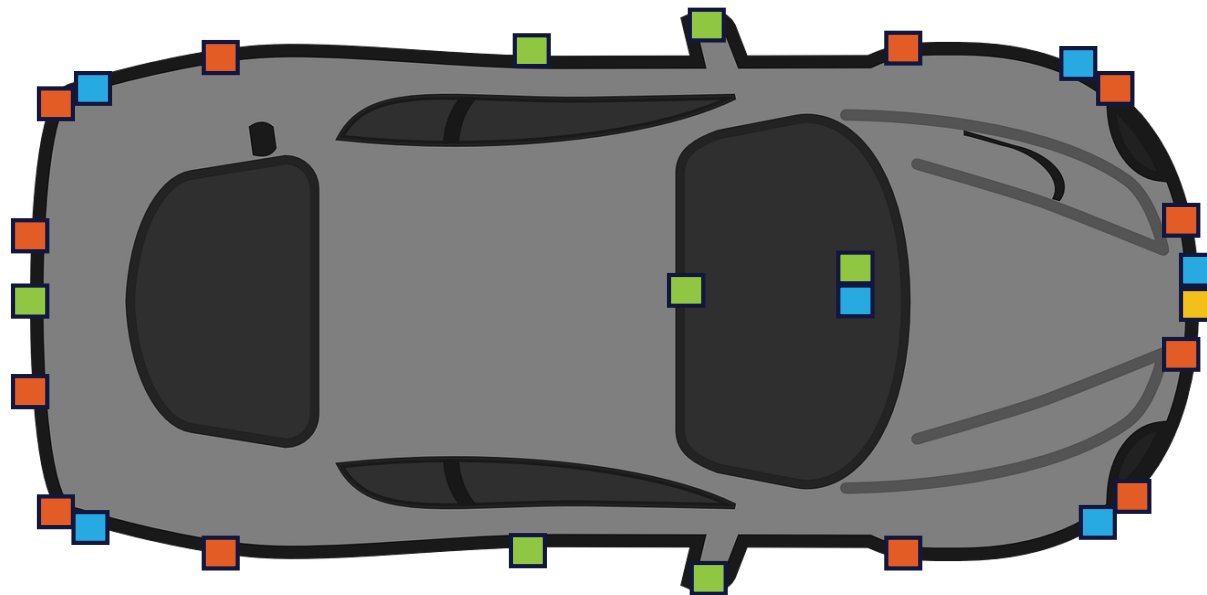
Dominant in ADAS ⇔ Vertically Integrated ⇔ Scale up to Autonomous

**Industry (Re) Focus on
High Level ADAS (L2+, L3)**

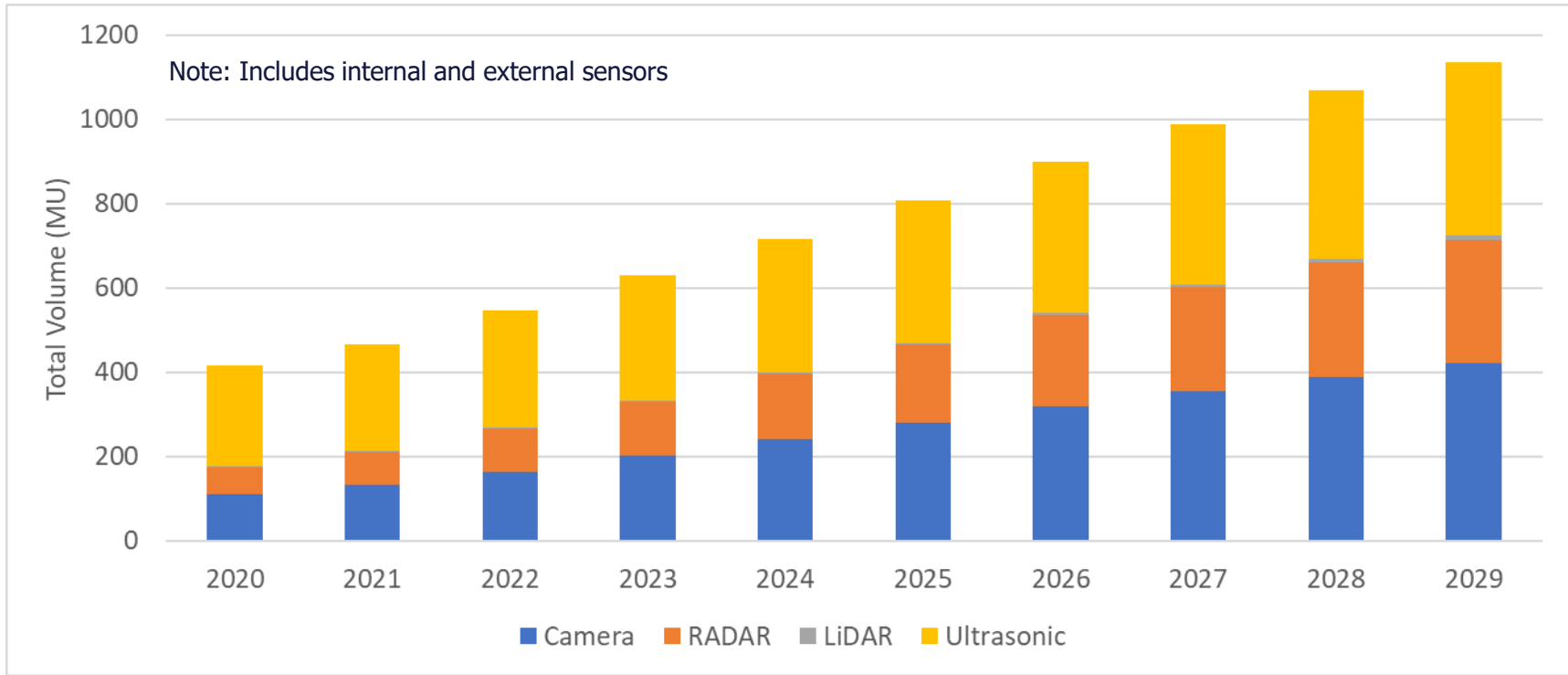
What Does ADAS Sensor Demand Look Like?

Typical Sensor Usage

- Ultrasonic
- Camera
- RADAR
- LiDAR



LiDAR Volumes to Remain Small to 2029!



LiDAR Market Consolidation



- Merger completed February 2023 - Extensive intellectual property portfolio with 173 granted and 504 pending patents, backed by over 20 years of combined experience in lidar technology innovation
- Cash balance of approximately \$315 million as of February 2023
- Focus has turned away from automotive applications



- September 2022 - Ibeo Automotive Systems GmbH has filed for insolvency and the Hamburg insolvency court has granted insolvency proceedings in self-administration - further growth financing could not be secured.
- December 2022 - Microvision acquires Ibeo - The acquisition brings together MicroVision's MAVIN hardware and Ibeo's perception software to be integrated into MicroVision's perception ASIC.



- Seen as early leader in the LiDAR market – failed to bring solutions to market that met target specifications
- SPAC listing in February 2022 - stock prices were down 99.63% YTD (November 2022)
- Filed for Bankruptcy in December 2022

Rivals Differ on Sensor Suite

"We are convinced that redundancy is the right approach for L3 automated driving and beyond – by using the best-in-class Lidar tech...in combination with RADAR and Cameras" – Mercedes-Benz CTO, Markus Schäfer - Feb. 2023



Mercedes-Benz

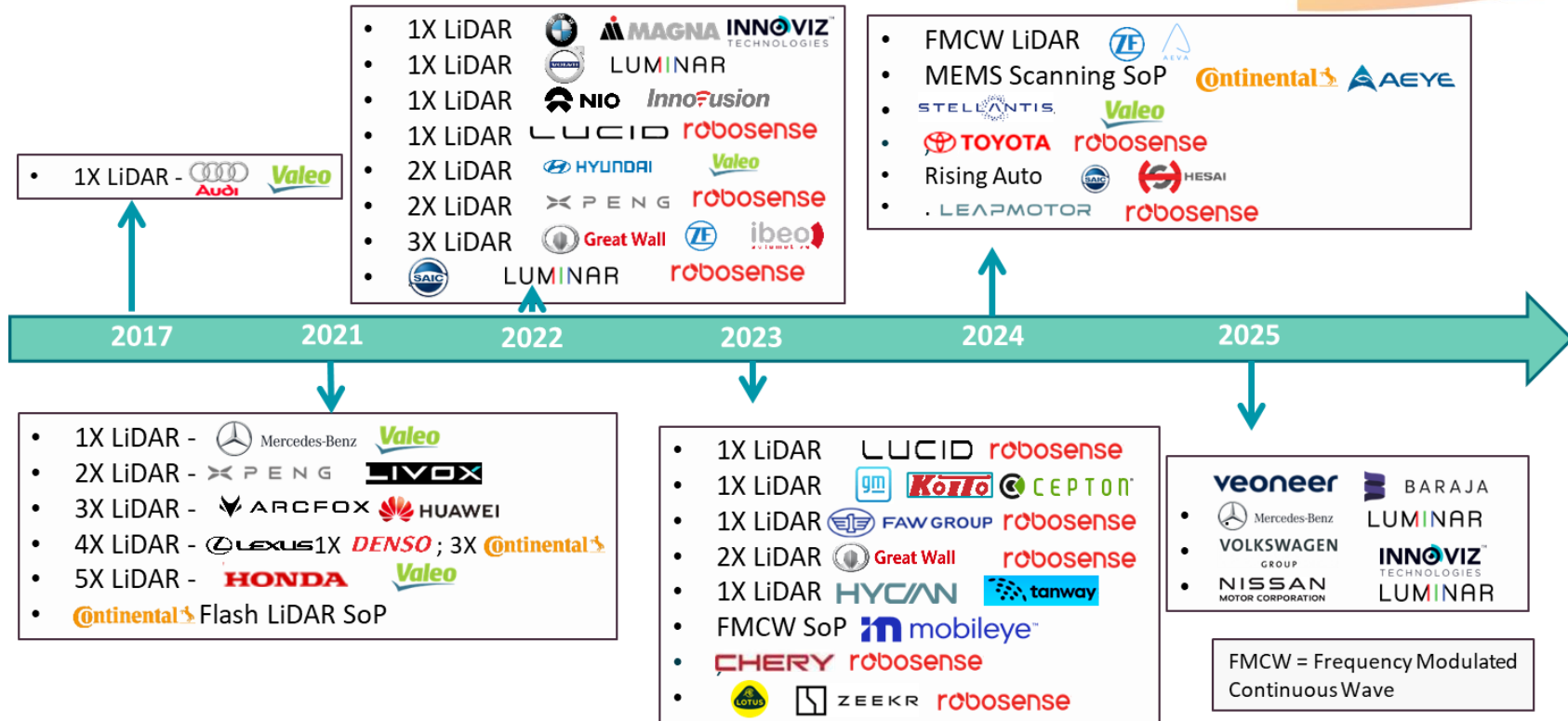


T E S L A



"Pure vision, especially when using explicit photon count, is much better than radar+vision, as the latter has too much ambiguity – when radar & vision disagree, it is not clear which one to believe." Elon Musk – Dec. 22, 2021

LiDAR *Is* Coming – But Will Take Time...



How Does it Look Long-Term?

Quick Recap on Levels of Autonomy



SAE J3016™ LEVELS OF DRIVING AUTOMATION™

Learn more here: [sae.org/standards/content/j3016_202104](https://www.sae.org/standards/content/j3016_202104)

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	SAE LEVEL 0™	SAE LEVEL 1™	SAE LEVEL 2™	SAE LEVEL 3™	SAE LEVEL 4™	SAE LEVEL 5™
What does the human in the driver's seat have to do?	You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You are not driving when these automated driving features are engaged – even if you are seated in “the driver’s seat”		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	

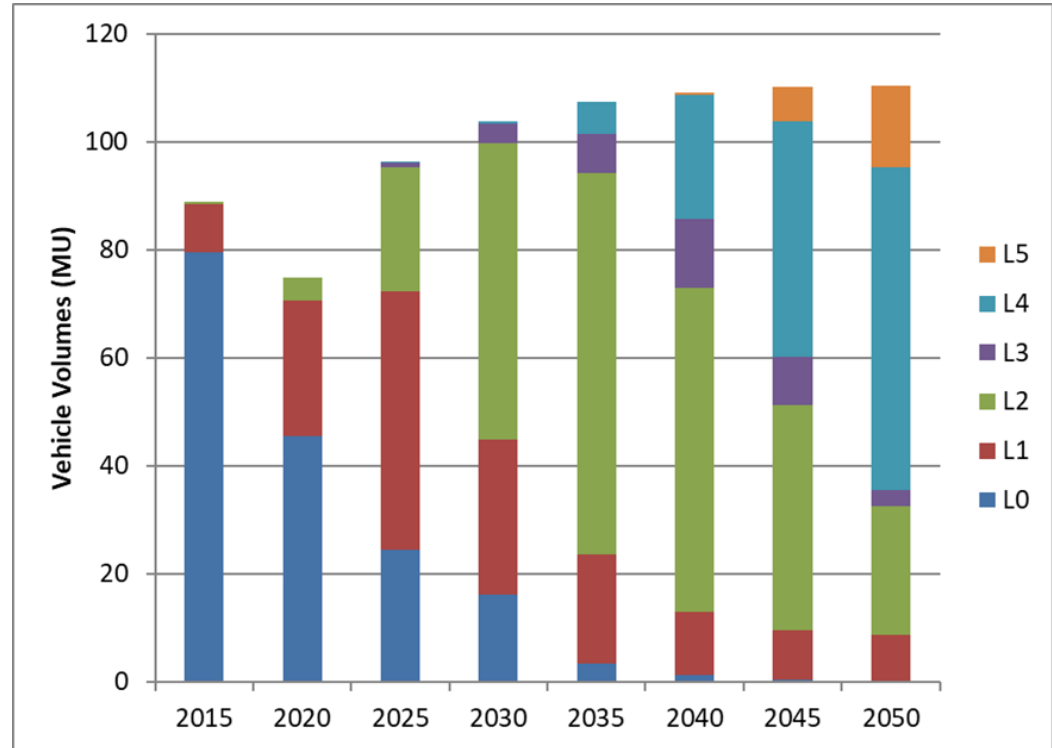
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	These are driver support features			These are automated driving features		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering OR brake/acceleration support to the driver	These features provide steering AND brake/acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met	This feature can drive the vehicle under all conditions	
Example Features	<ul style="list-style-type: none"> • automatic emergency braking • blind spot warning • lane departure warning 	<ul style="list-style-type: none"> • lane centering OR • adaptive cruise control 	<ul style="list-style-type: none"> • lane centering AND • adaptive cruise control at the same time 	<ul style="list-style-type: none"> • traffic jam chauffeur 	<ul style="list-style-type: none"> • local driverless taxi • pedals/steering wheel may or may not be installed 	<ul style="list-style-type: none"> • same as level 4, but feature can drive everywhere in all conditions

- In L0 to L2, the human driver is 100% responsible for supervising the driving task
- In L3, the human driver may be asked to retake control
- In L4, under suitable conditions, the human driver will never need to supervise
- In L5, the human driver will never need to supervise under any condition or circumstance

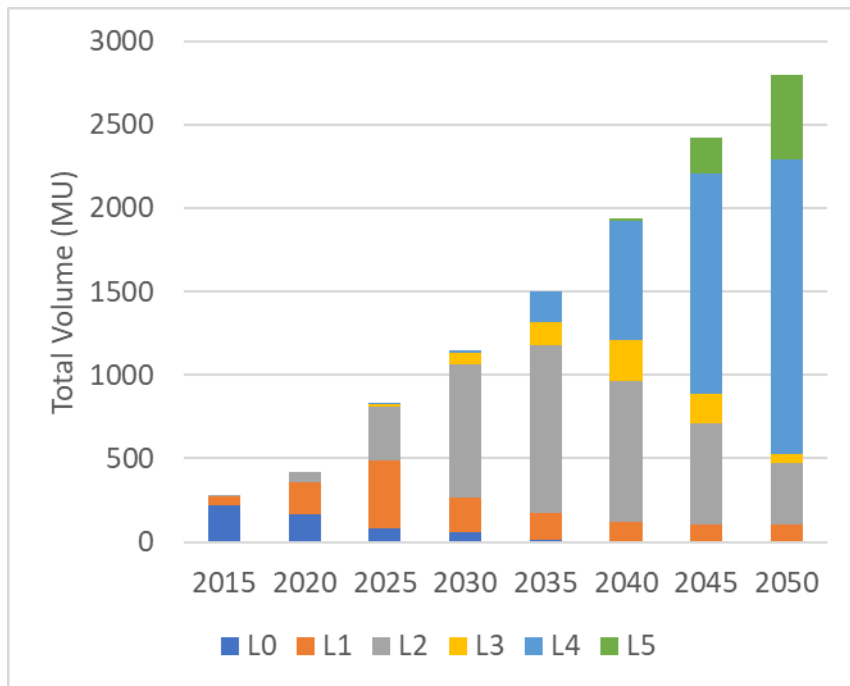
Large-Scale Deployment of AV Still YEARS Away

- L1 demand driven mainly by LKA function (now offered by almost all LDWS solutions)
- L2 ACC and auto-park systems to grow strongly during the 2020s
- L3 now emerging – but still expected to be “stop-gap” solution on the path to L4
- L4 demand has been delayed – many automakers pulling back

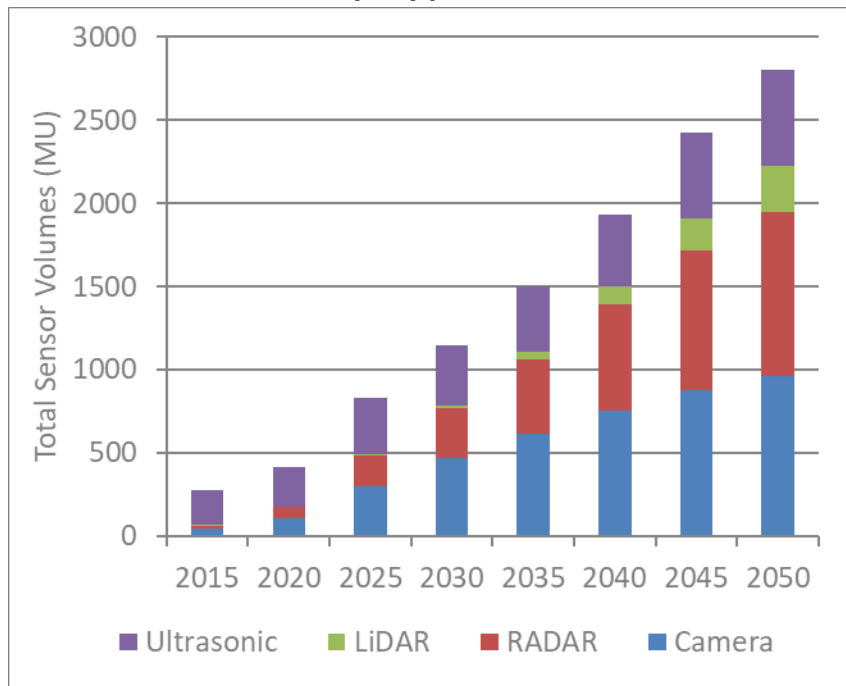


Sensor Demand L1/L2-driven Until 2030+

Sensor Demand by Level



Sensor Demand by Type



Conclusions

- New electric vehicle platforms and new architectures are accelerating the pace of change
 - No common agreement yet!
- Huge growth in the volumes of zonal and domain controllers
- Growth for all sensor types – but LiDAR will remain small by comparison
 - Vision will not exclude other sensor types
- The needs of L1 and L2/L2+ systems will dominate demand through to 2030



Any Questions?



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