Autonomous Vehicle Outlook

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Autonomous Vehicle Channel | Market Analysis

Authoritative Semiconductor & Microelectronics Intelligence Platform

Leveraging a unique reverse engineering competency, we reveal innovations in technology products that provide advanced technical and market analysis to organizations that will help guide them to make fact-based technology and intellectual property decisions.

Reverse Engineering

We help decision makers in semiconductor, system, financial, and communication service provider companies make more informed decisions on their product roadmaps with competitive technical intelligence.

We help supply chain and procurement professionals to more effectively negotiate with suppliers and understand true costs of technology products.

We collaborate with IP professionals in global technology companies, licensing entities and legal firms to plan strategies on the assertion/defense of their patent portfolios and licensing negotiations.

Market Analysis

We help business and technology leadership de-risk strategic investment and procurement decisions with visibility into semiconductor manufacturing, silicon demand, and capacity.

We enable more informed decision-making for product and market strategy with curated insight into the performance, application, and functionality across individual SoCs and aggregated across market segments.

This is all supported by building out stronger products from acquisitions (The Linley Group, VLSI and most recently with Strategy Analytics. Read more about Strategy Analytics here).

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We help competitive analysis teams at OEMs and component suppliers to understand design philosophies and BOM costs through deep-dive hardware teardowns of consumer electronics devices. This is delivered through the world's largest library of independent and nonbiased teardowns.

We help supply chain and category management teams to understand pricing and lead-time trends for the commodity electronic components that engineers are selecting for new designs.

Core Questions for Autonomous Vehicles

What are the key applications motivating development?

What are the essential technologies that will enable success?

What regulatory framework best serves the needs of society and industry?

Who wins? Who is winning? Why?

Applications*:

*Not including military, mining, agricultural, etc.

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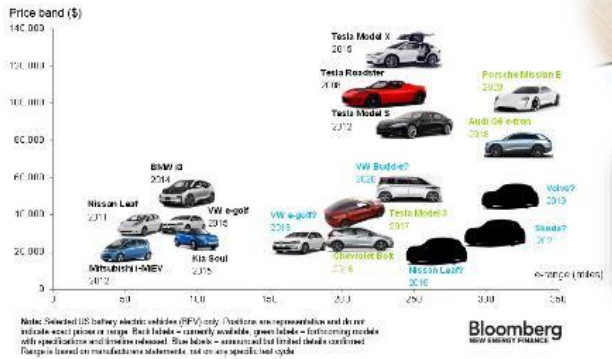
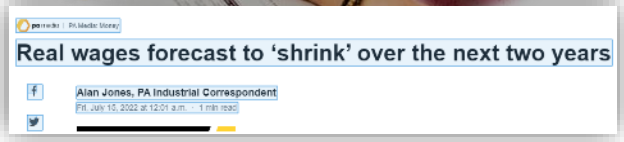
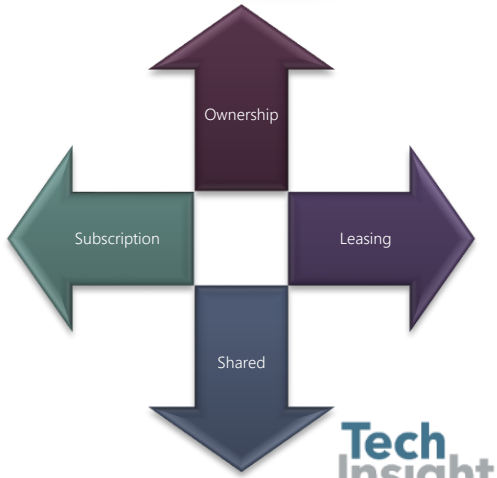
Two more considerations:

Economic context:







TODAY'S AGENDA - AVS

01 **Architecture / Software Impact Assessment**
ECU Consolidation / Domain and Zonal Architecture Trends / Software Strategies

02 **ADAS Demand Trends**
General Overview/ Forecast for ADAS, Sensors and Semiconductors

03 **Autonomous Vehicles Update**
Forecast Scenarios Through 2050 / Hurdles for AV Development

04 **Conclusions / Q&A**

TODAY'S AGENDA - AVS

01 Architecture / Software Impact Assessment

02 ADAS Demand Trends

03 Autonomous Vehicles Update

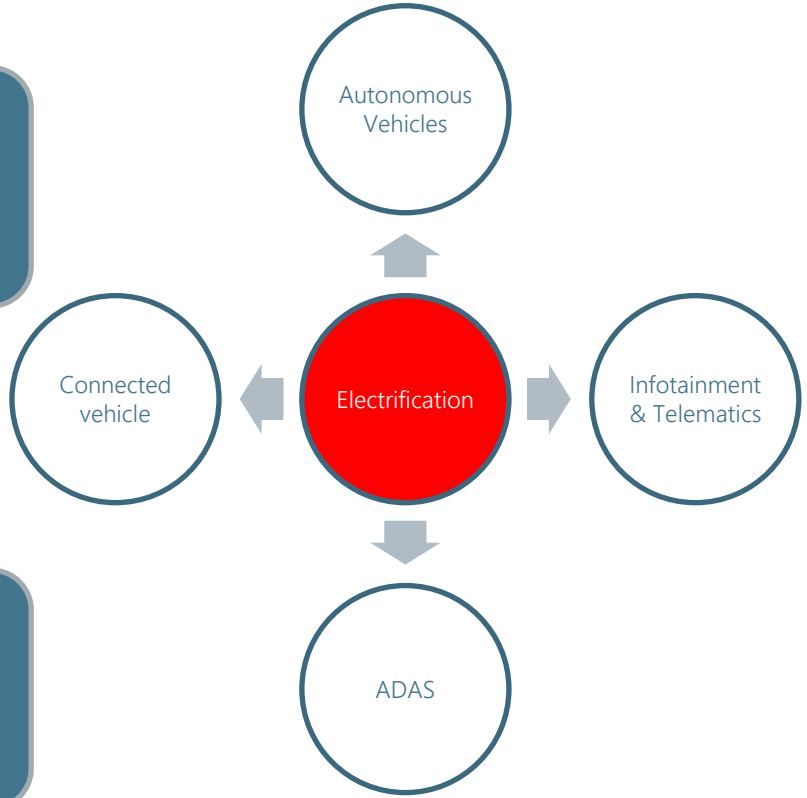
04 Conclusions / Q&A

Automotive Industry Key Trends

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.

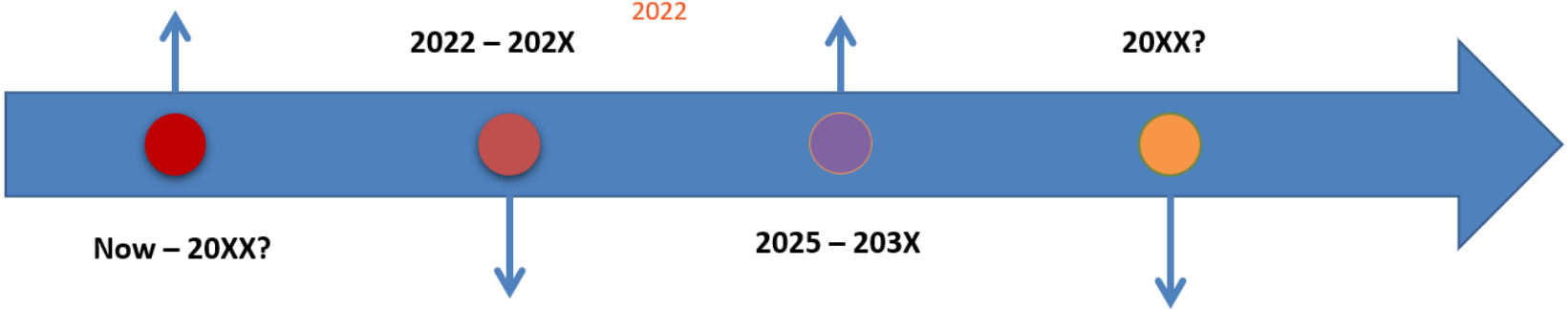


ADAS Centralized Processing

Distributed EE Architecture (limited domain consolidation, primarily via CDCs, some ADAS DC). Will continue to exist in the market for many years yet

Location or zone-based EE Architecture (select, premium OEMs begin shift to zone-based architecture. L2+ and higher likely to be zone or domain based). Aptiv launching with European OEM in 2022

Major Tier 1s told SA that centralized processing is a core trend – high speed backbones (Ethernet, etc. needed)



Domain Controller Architecture (number of CDCs increases, ADAS DC growth in luxury vehicles – L2+ systems are a driver. All eyes on VW MEB centralized compute implementation

Fully Centralized Processing Architecture (future proposed architecture; unknown if auto industry will actually embrace this approach)

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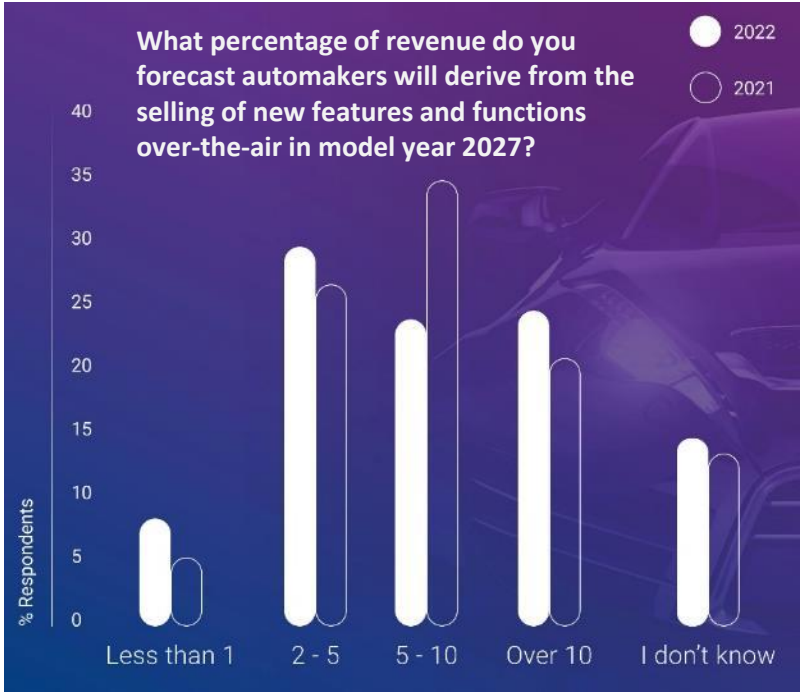
$450B OTA Software Market to Play For?

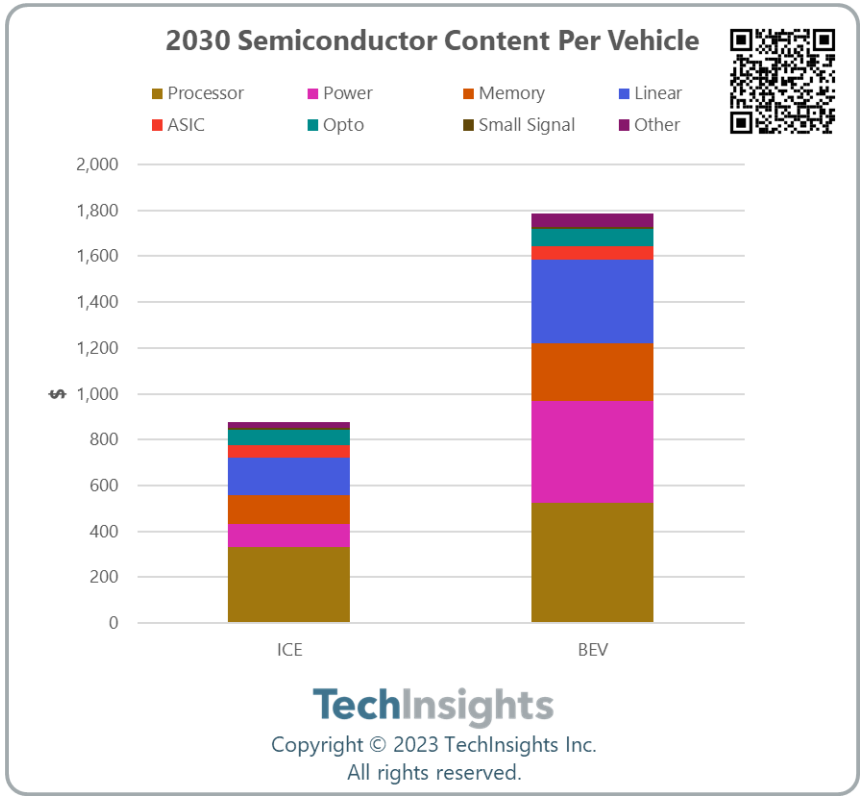


Source: 2022 Automotive Software Survey

- Our survey suggests OEMs could make an additional 10% of revenues from selling features OTA in 2027
- 100 million cars x $45k per car x 10% = $450B

Key question: How do I get my fair share (or more!) of this $450 billion ?

How Big is the Difference in 2030?



- Compared to a conventional gasoline model, a 2030 Battery Electric Vehicle will have:
  - 2.0 x the overall semiconductor content
  - 1.6 x the processor content
    - 1.9 x the content for the most powerful SoCs
    - 0.6 x the content of 8-bit microcontrollers
  - 4.4 x the power semi content
  - 2.2 x the linear content
  - 2.0 x the memory content
- Huge opportunities in power semiconductors, especially wide band-gap materials such as SiC and GaN
  - More modern EV platforms mean overall higher processor usage due to new architectures with Zonal/Domain controllers
  - Higher linear usage is mainly analog-to-digital converters (ADC) in battery packs

Source: Derived from Automotive Semiconductor Demand Forecast 2021 to 2030 - July 2023

TODAY'S AGENDA - AVS

Autonomous Vehicles Service 2023 Update

01 Architecture / Software Impact Assessment

02 **ADAS Demand Trends**

03 Autonomous Vehicles Update

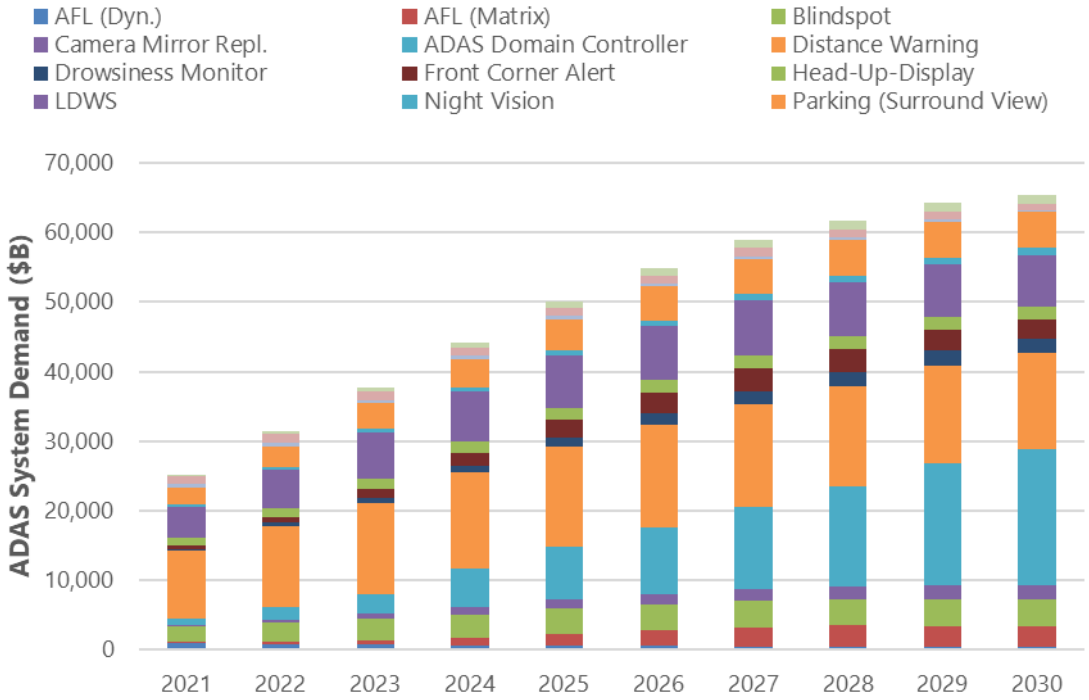
04 Conclusions / Q&A

OEM ADAS split into Safety and Convenience Applications

- NCAP Mandate/ "soft mandate" 5-star requirements drive low-end ADAS
  - Large volumes but incredibly strong cost pressure from OEMs
- Consumers expect safety systems as standard equipment
- Governments mandating what was "Advanced" a few years ago (AEB, LDWS/LKA)

- ADAS features that can be sold as an option or option/subscription
  - Recurring subscription revenue a goal of many OEMs
- This is where so-called L2+ systems and L3 systems are today
  - Ford, GM, NIO, Tesla and Volvo charge a subscription fee for L2+ solutions

Global ADAS Demand $65B by 2030



- This is the TAM for T1 suppliers
- Unprecedented dip in 2020
- Best combination of growth/size remains in Distance Warning
  - AEB is the key feature in that category
- ADAS domain controller at 21+% penetration in 2030

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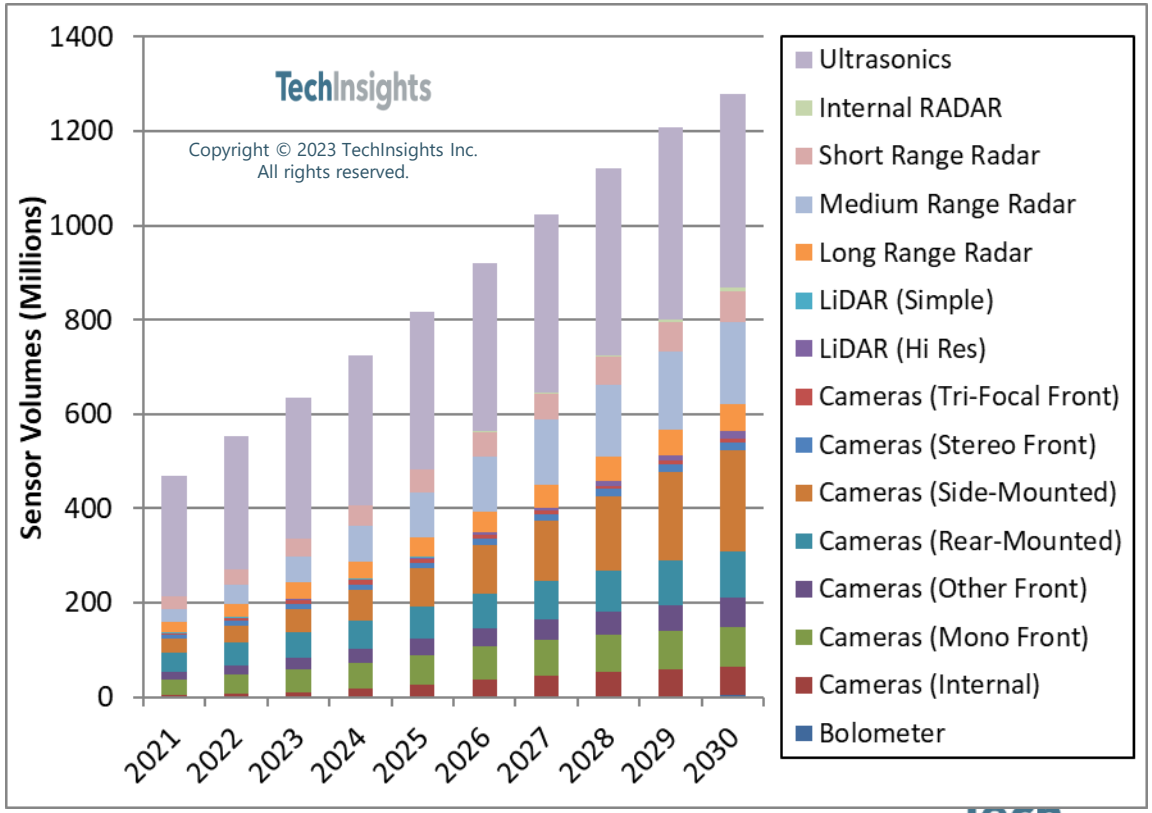
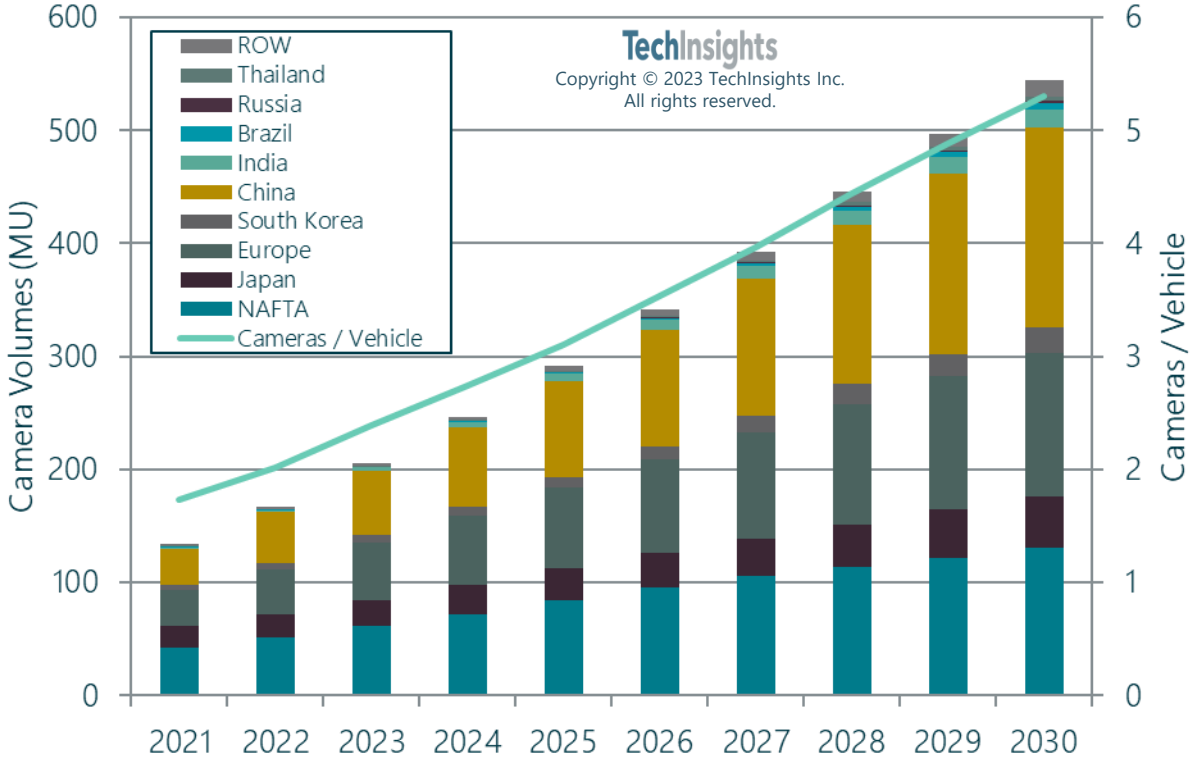
> 1 Billion ADAS Sensors by 2028

- Growth for almost all sensor types
- Fastest growth in cameras is for internal units for DMS/OMS
- LiDAR and bolometer markets still expected to be very small in unit terms relative to other sensors



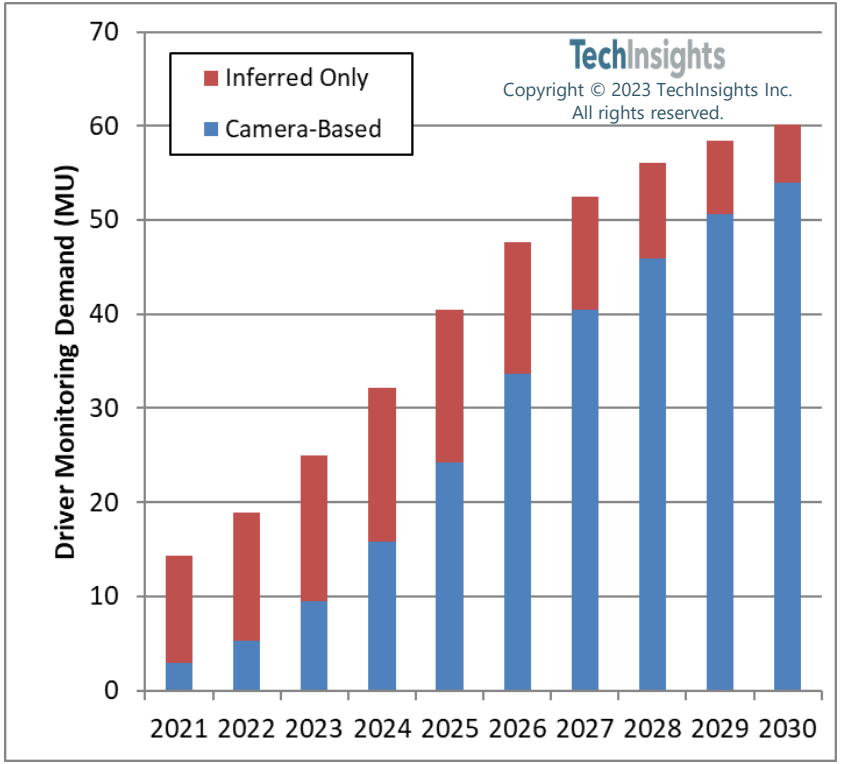
> 400 Million Cameras by 2028

- Average number of cameras per vehicle continues to grow
- Cameras are the base sensor for most ADAS applications
- Machine vision technologies now starting to be applied to other cameras as well…



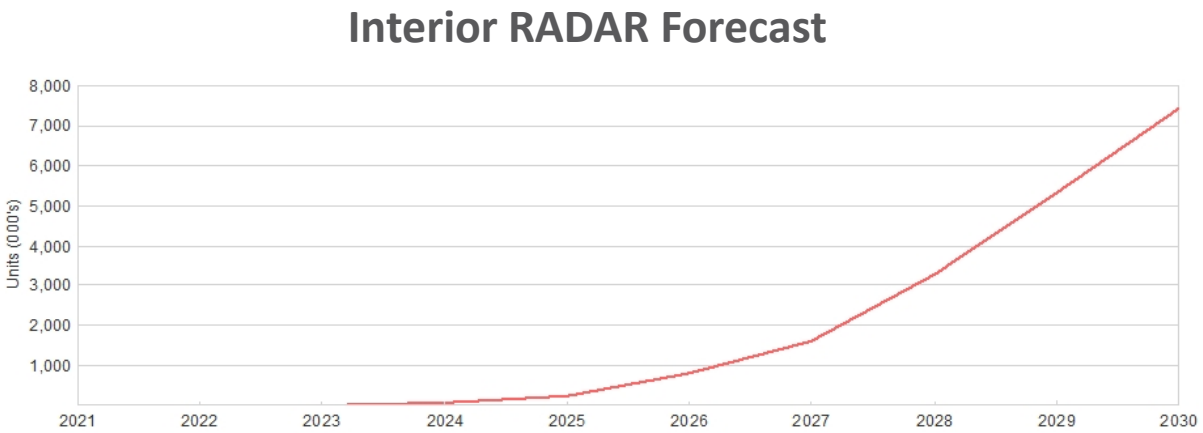
Driver Monitoring

- TechInsights sees the market following three generations:
  1. Solutions on dedicated hardware – this is where we are now. $20 is cost target for 2D monocular camera-based system
  2. Solutions that are effectively "software only", and which are hosted on a shared ECU
  3. Transition from DMS to multi-seat ODS
- Conventional camera remains the preferred approach. ToF-based sensors remain niche for now (costly, bulky, lack of resolution vs. camera based solutions), RADAR emerging.
- For Gen 1 & Gen 2 the KEY task is driver monitoring
  - 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, and OEMs need to be wary of re-creating feature sets which are better implemented on wearables at a lower price
  - "Every OEM is asking for emotion analysis, but no-one seems to know what they want to do with it" – EU-based algorithm vendor



Occupant Monitoring Systems – RADAR Emerging

- OMS sensors incorporated in a growing number of vehicles, still a small market
- Changing NCAP or NHTSA regulations may boost in-cabin RADAR applications
- OEMs familiar with and understand camera-based OMS
- Low-cost solutions are sought to meet NCAP
- CES 2023 - In-cabin RADAR solutions from: Asahi Kasai, Bosch, HL Klemove, Infineon, Murata, Garmin, NXP and VinFast/Vayyar.
- Many solutions are fusing camera and RADAR data



Source: Bosch

Other Automotive OEM Sensor Suite

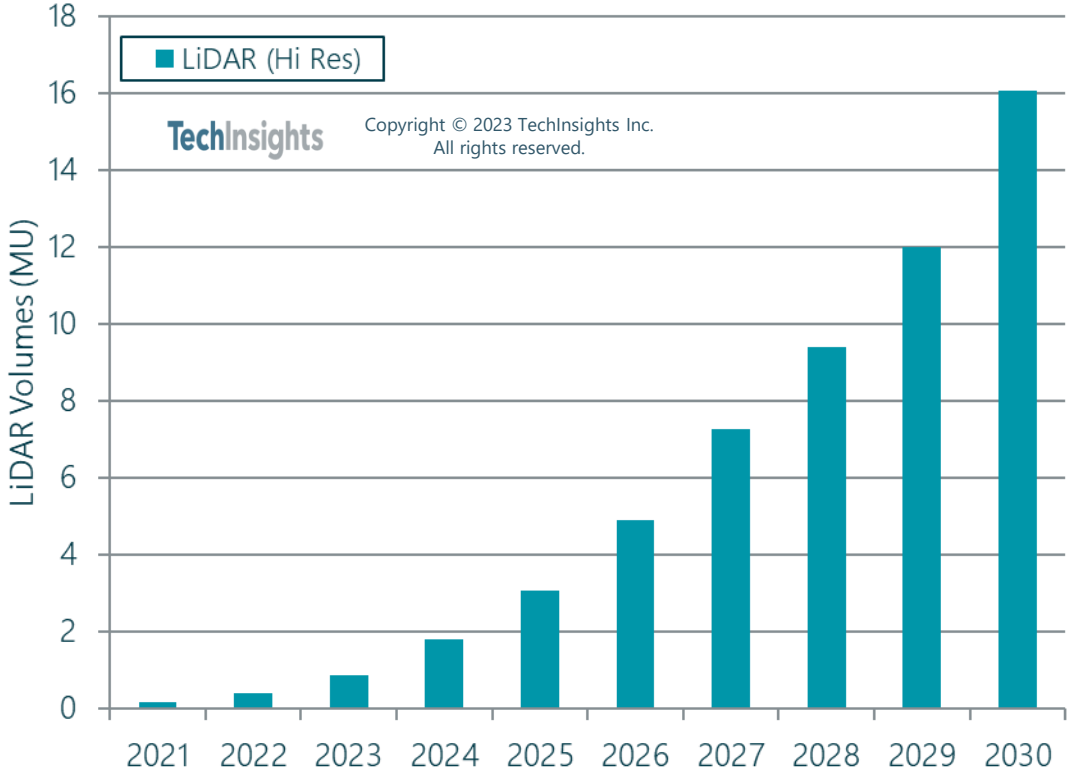
- Toyota Teammate Advanced Drive - Stereo camera (Denso) , RADAR (Denso), 4X LiDAR (1 Denso/Luminar, 3 Continental), DMS, HD Map, HUD, 4G connectivity, OTA updates
- Honda Sensing Elite - L3 system in the Japanese market Legend model incorporates two cameras, 5X LiDAR, 5 RADAR, DMS, HD map
- GM Ultra Cruise - cameras, radars and LiDAR (Cepton) "Approximately 70% more" sensors than used by Super Cruise
- Mercedes-Benz DRIVE PILOT L3 sensor suite includes stereo forward camera, 4x surround cameras, LRR, 4x SRR, LiDAR, 12x ultrasonic, DMS, Moisture sensor, microphones
- Lucid – DreamDrive – 32 sensors including Camera, RADAR, LiDAR and ultrasonic
- NIO - Aquila Super Sensing – 33 sensors including: LiDAR, 7x 8MP cameras, 4x surround view cameras, DMS, 5x RADAR, 12x ultrasonic, GPS, IMU and V2X.
- Xpeng – "L3 Autonomy Ready" 2x LiDAR, 14x cameras, 12x ultrasonic sensors, and 5x millimeter-wave radars
- Polestar 4 - Pilot Assist- 12X camera inc. DMS, 5X RADAR, 1X LiDAR; 12X Ultrasonic, 3X EyeQ 6 High, REM map

Systems lacking LiDAR – SAE L2 Systems

- Nissan ProPILOT 2.0 - 7 cameras in total including trifocal windshield Camera (ZF/Mobileye), 5X Radar, 12x Ultrasonic, DMS, HD Map
- Fisker Intelligent Pilot- surround-view 4x camera suite, a camera-based driver-monitoring system, ultrasonic technology, and a Digital-Imaging Radar by Uhnder

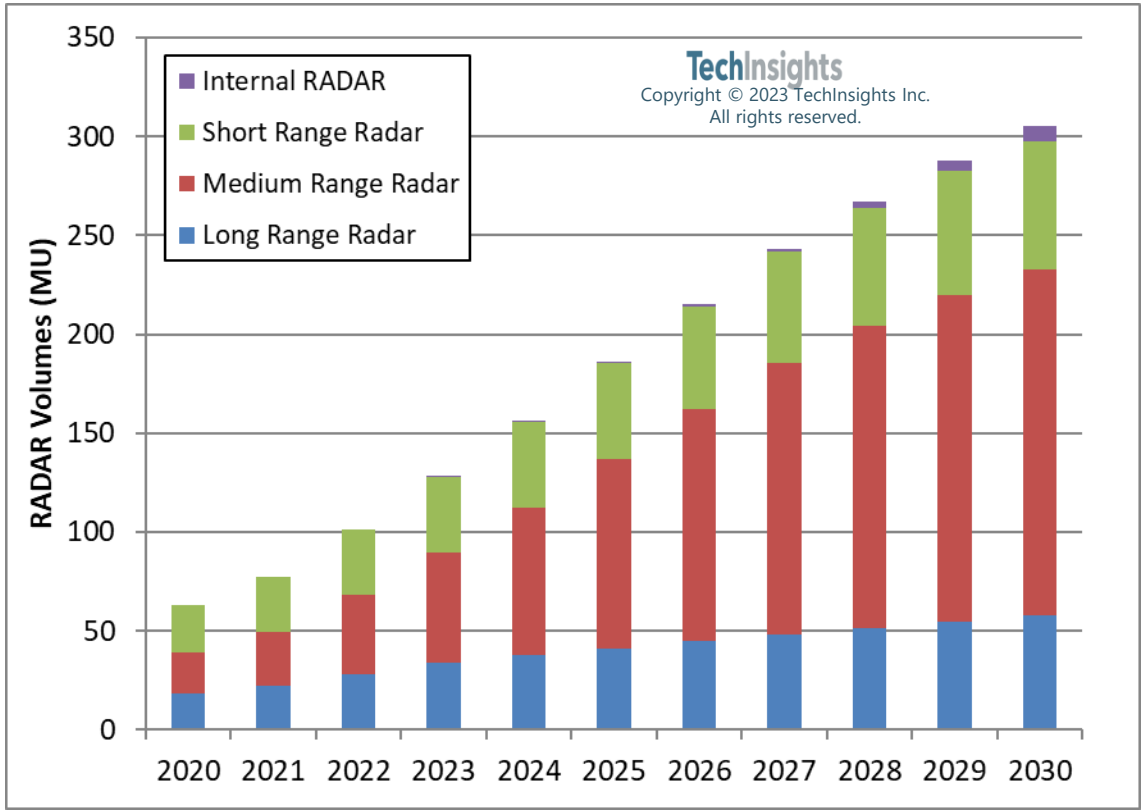
Lidar growth analysis

- Rapid growth expected in next-gen devices for automated driving
  - Growth was downgraded in 2020, but outlook has been stable since
- Market still emerging – many technologies not mature
- Fitment rates of Hi-Res LiDAR MUCH higher on luxury sedans and SUVs
  - Multiple LiDAR sensors being fitted to some vehicles
  - Many launches now expected in the next few years



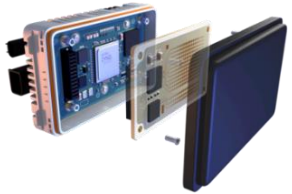
RADAR Forecast

- RADAR's death greatly exaggerated!
- Strong growth throughout the forecast period
- MRR leading growth
- RADAR still a core sensor for distance warning applications
- In-cabin RADAR emerging



What about imaging radar?

- TechInsights does not have a specific forecast for imaging RADARs, but it is expected that conventional 2D RADARs will be phased-out in automotive in favor of imaging RADARs over the forecast period to 2029.
  - Strong potential for use in interior monitoring – but seeing little true OEM commitment to date.
  - The earliest deployment in an exterior ADAS application will be LRRs for ACC and AEB, as the improved elevation sensing in imaging RADAR will be a key benefit in reducing false positive and negative readings.
  - L2+ and above applications will see further potential in using imaging RADAR in corner applications as well
- In China, low-volume deployments of imaging RADAR started in late 2022
  - SAIC/RISING AUTO R-Series ZF Imaging RADAR SoP 2022
  - NIO is using NXP 4D imaging RADAR
  - Mature market regions more likely during the mid-2020s. (2024 Cadillac Celestiq)
  - The cost premium and increased performance will see initial demand from the premium vehicle sector
- Mobileye/Valeo Partnership
- We are seeing significant use of AMD/Xilinx in this (and LiDAR) applications



Continental ARS540 LRR with Xilinx UltraScale+ MPSoC
(source: Continental)

What about 5G?

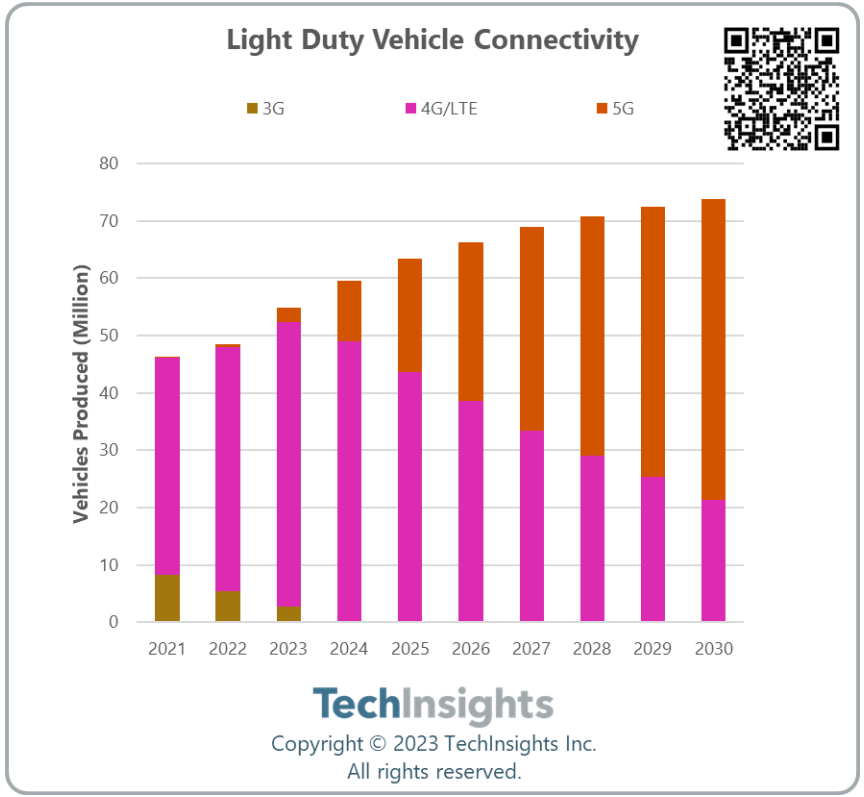
A. Enhanced Mobile Broadband - eMBB
B. Ultra Reliable Low Latency Communications - URLLC
C. Massive Machine Type Communications - mMTC
D. Network Slicing
E. C-V2X

Why is 5G important?

A. Safety relevance
B. Future proofed
C. Enhanced performance for safety, infotainment
D. Multi-modal communications
E. Tele-operations
F. Satellite?

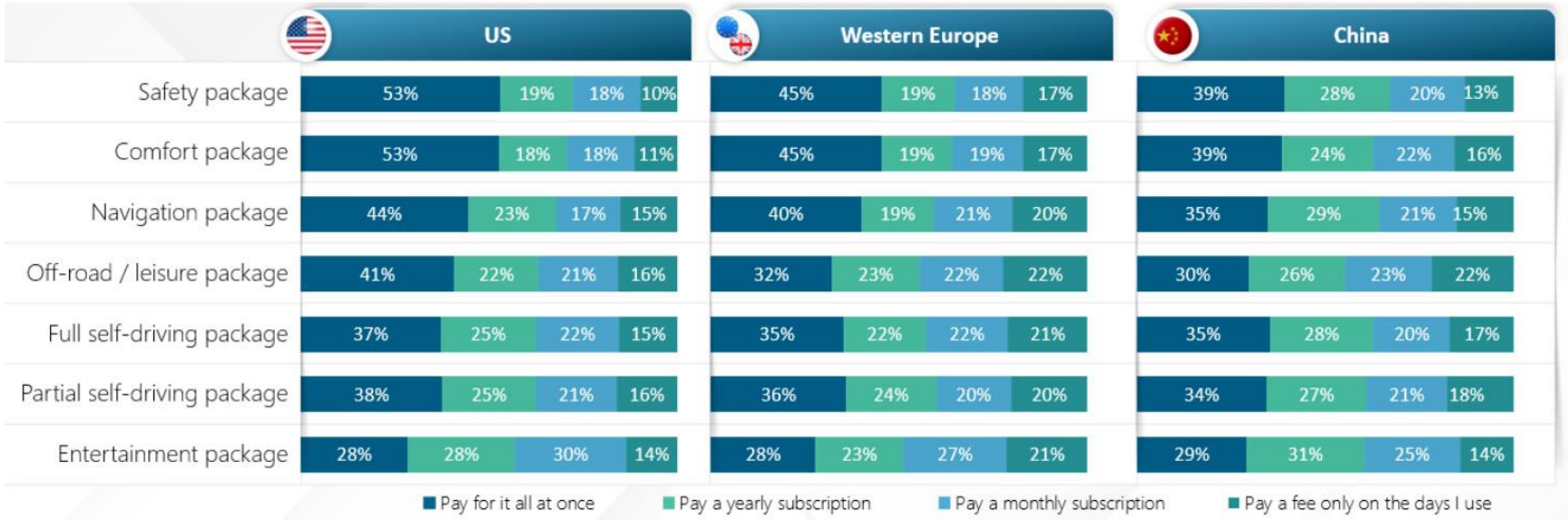
The Software-Defined Car is Built on Connectivity…

- Well over half of vehicle produced globally are now connected
- There is an increasing need for a connection mediation gateway capable of managing connectivity based on:
  - Type
    - Wi-Fi, LTE/5G, Satellite (LEO or GEO)
  - Application
    - Safety, streaming…
  - Availability/Quality of signal
    - Intermittent connectivity is a big problem for data uploads/downloads to vehicles in motion
  - Cost
    - Do I need this data transfer now? Or can it wait and be cheaper later on?



Source: Automotive Infotainment & Telematics - Systems & Features Q3 2023

...and Connectivity Drives Subscriptions



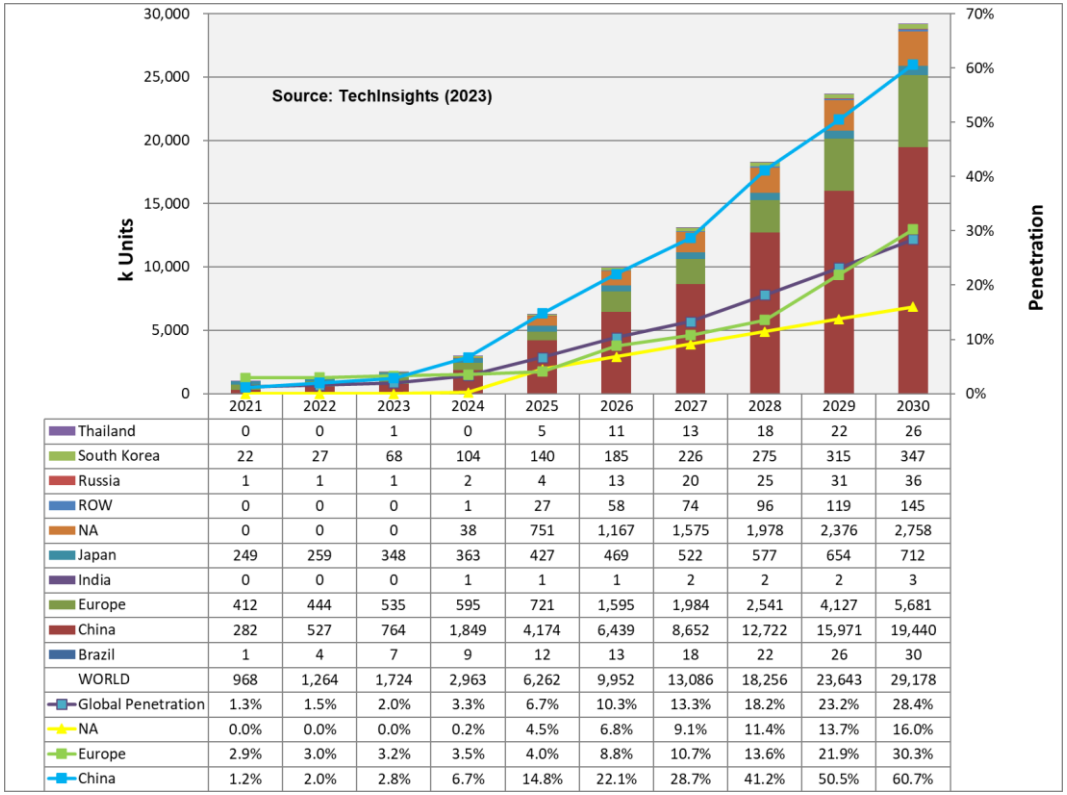
- Some consumers are very open to the subscription model – especially younger ones

Source "In-Vehicle Feature Subscriptions: They Can Work if Done Right"

TechInsights

V2X Forecast

- Forecast without EU or US mandate
  - 968k shipments in 2021 to 29.2M in 2030
  - C-V2X will dominate with 27M units vs. 1.2M DSRC shipments in 2030
  - Mandates in the works but timelines remain in flux
  - Without mandates, V2X will continue to flounder
- 90% of V2X deployments will be in China over the next 3-4 years
- V2X should follow closely with 5G implementation in vehicles – Ford in US?



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Thailand	0	0	1	0	5	11	13	18	22	26
South Korea	22	27	68	104	140	185	226	275	315	347
Russia	1	1	1	2	4	13	20	25	31	36
ROW	0	0	0	1	27	58	74	96	119	145
NA	0	0	0	38	751	1,167	1,575	1,978	2,376	2,758
Japan	249	259	348	363	427	469	522	577	654	712
India	0	0	0	1	1	1	2	2	2	3
Europe	412	444	535	595	721	1,595	1,984	2,541	4,127	5,681
China	282	527	764	1,849	4,174	6,439	8,652	12,722	15,971	19,440
Brazil	1	4	7	9	12	13	18	22	26	30
WORLD	968	1,264	1,724	2,963	6,262	9,952	13,086	18,256	23,643	29,178
Global Penetration	1.3%	1.5%	2.0%	3.3%	6.7%	10.3%	13.3%	18.2%	23.2%	28.4%
NA	0.0%	0.0%	0.0%	0.2%	4.5%	6.8%	9.1%	11.4%	13.7%	16.0%
Europe	2.9%	3.0%	3.2%	3.5%	4.0%	8.8%	10.7%	13.6%	21.9%	30.3%
China	1.2%	2.0%	2.8%	6.7%	14.8%	22.1%	28.7%	41.2%	50.5%	60.7%

OEM V2X (C-V2X and DSRC) Activities outside China

OEM	Technology	Regional V2X Focus	Deployments?	Example Car Models
Audi	C-V2X	U.S., Europe	US 2024-25?	N/A
BMW	C-V2X	U.S., Europe	Europe: Planned (2021) - delayed	Europe: iX
Ford	C-V2X	U.S.	Will follow 5G adoption	F150?
General Motors	C-V2X	U.S.	2025+?	Cadillac
Honda	C-V2X	U.S.	Not Announced	N/A
Hyundai-KIA	C-V2X	U.S., Korea	Not Announced	N/A
Mercedes-Benz	C-V2X	Europe	China: Planned (2025)	N/A
Nissan	C-V2X	U.S.	Not Announced	N/A
Subaru	C-V2X	U.S., Japan	Not Announced	N/A
Toyota	C-V2X, DSRC	Australia, China, Europe Japan	Japan: Deployed (DSRC), China: Pilot (C-V2X), Australia: Pilot (Both)	Japan: Crown
Volkswagen	DSRC	U.S., Europe	Europe: Deployed	Europe: Golf, ID. vehicles

C-V2X Deployments in China

Models	Technology Providers	Functions
SAIC GM Buick GL8 Avenir	Quectel automotive-grade communication modules AG15 and AG35 with optional V2X intelligent transportation technology for 10,000RMB; Qualcomm 9150 C-V2X and Qualcomm Snapdragon X5 LTE modem	EBW, CLW, AVW, ICW, SLW, SVW, HLW, GLOSA
Ford Edge Plus, Mondeo, F-150 Raptor, EVOS, Mustang Mach-E	Qualcomm 9150 C-V2X and Qualcomm Snapdragon X5 LTE modem	EBW, AVW, ICW, SVW, HLW, CLW, SLW, GLOSA
Human Horizons HiPhi X	Qualcomm Snapdragon 5G platform (SA515M), Lenovo Connect, Quectel AG550Q	Smart-road capable of V2X driving in Yancheng, Jiangsu province
SAIC **Roewe** Marvel R	5G V2X i-BOX by DIAS Automotive Electronic Systems Co., Ltd. Optional V2X and ADAS "R-Pilot" packet for 30,000RMB, Huawei Balong 5000, China Mobile	Covers 17 5G V2X application scenarios such as traffic light information push, stop and start guidance, curve speed warning, ICW, etc.
SAIC Audi A7 L 55 TFSI	Huawei MH5000, Huawei Balong 5000, China Unicom	5G communication as standard equipment and is set up with V2X functions for networked mobility.
GAC AION V	Huawei 5G communication module MH5000, optional V2X function packet costs 9600RMB; Huawei MH5000, Huawei Balong 5000, China Unicom	ICW, DNPW, VRUCW etc.
FAW Hongqi E-HS9	C-V2X Smart Antenna co-developed with Neusoft, Quectel automotive-grade communication modules AG15 and AG35, Qualcomm 9150 C-V2X and Qualcomm Snapdragon X5 LTE modem	FCW, Blind Spot Alert, ICW, etc.
Great Wall Motor WEY Mocca	Based on Great Wall's "Smart Coffee Platform" with Qualcomm 8155 chip, Quectel AG550Q	FCW, ICW, LCW, ROW, EBW, etc.
NIO ET7/ET5	5G-V2X including 5G-TBOX and 5G-VBOX provided by JOYNEXT	FCW, VRUCW, Traffic Light Information Push etc.
BYD Han EV	Huawei 5G communication module MH5000	V2X system includes roadside units that connect traffic lights, cameras, and speed limit signs.
Xpeng P7	u-blox F9 high precision GNSS	Smart Charging
BMW iX	5G-NR Uu Samsung/HARMAN 5G TCU	Risk assessment and blind spot information

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05	Conclusions / Q&A

EU & UK ADAS / AV Regulation – Series Production Passenger Vehicles

Tech Insights	SAE L2 and "L2+" Eyes-on / Hands-off	SAE L3 Eyes-off / Hands-off	SAE L4 No Driver, Geofenced	SAE L5 No Driver
European Union UNECE EURO NCAP	✓ Hands free L2 systems are permitted • NCAP Assisted Driving Assessment Grading	✓ UN WP.29/Reg. 157 – ALKS/ADS Limited to 130 km/h on divided highways without pedestrians and cyclists. • Data Storage System for Automated Driving (DSSAD) "Black Box" required to record when ALKS is activated and record lane changes. • Driver Availability Recognition System required. • Cybersecurity and Software update OTA updates compliance required.	✓ Automated vehicles in EU countries will initially be limited to individually approved routes.	✗ Not permitted.
UK	✓ Hands free L2 systems are permitted • GB vehicle type approval needed	✓ALKS (User-in-charge, UiC) enables a vehicle to drive itself in a single lane, up to (130 km/h) while maintaining the ability to return control easily and safely to the driver when required. • Self driving vehicles must be authorized & meet UNECE Regs. or GB vehicle type approval standards.	✗ Regulatory framework expected by 2025 No User-in-Charge (NUiC) licensed operator required	✗ Regulatory framework expected by 2025.
Germany	✓ Hands free L2 systems are permitted	✓ German Federal Motor Transport Authority (KBA) approval required.	✓ L4 permitted with teleoperations and liability insurance.	✗ Not permitted.
France	✓ Hands free L2 systems are permitted	✓ Level 3 autonomy allowed - speed is limited to 60km/h on divided highways w/o pedestrians and cyclists – will expand to UN 130 km/h limits. • When the ADS is engaged, users must remain in condition and in position to immediately perform a take-back in order to perform the maneuvers in order to: • (i) comply with an order to stop issued by an official or agent responsible for recording offences and bearing external and visible badges of their office; • (ii) comply with instructions given by traffic officers… • (iii) facilitate the passage of a general interest vehicle… • (iv) give way to a priority general interest vehicle.	✓ Remote operator able to intervene according to the system's conditions of use required.	✗ Not permitted.

*** Laws and Regulation subject to change; Source: Government Public Data**

USA, Canada & Mexico ADAS / AV Regulation – Series Production Passenger Vehicles

TechInsights	SAE L2 and "L2+" Eyes-on / Hands-off	SAE L3 Eyes-off / Hands-off	SAE L4 No Driver, Geofenced	SAE L5 No Driver
USA 	✓ Hands free L2 systems are permitted • Entities must report a crash if Level 2 ADAS was in use at any time within 30 seconds of the crash and the crash involved a vulnerable road user or resulted in a fatality, a vehicle tow-away, an air bag deployment, or any individual being transported to a hospital for medical treatment.	✓ SAE Level 3 automation contingent on state-level approval • Crashes involving an ADS-equipped vehicle are reportable if the ADS was in use at any time within 30 seconds of the crash and the crash resulted in property damage or injury.	✓ SAE Level 4 automation contingent on city-level and local authority approval. • Crashes involving an ADS-equipped vehicle are reportable if the ADS was in use at any time within 30 seconds of the crash and the crash resulted in property damage or injury.	✓ SAE Level 5 automation contingent on city-level and local authority approval. • Crashes involving an ADS-equipped vehicle are reportable if the ADS was in use at any time within 30 seconds of the crash and the crash resulted in property damage or injury.
Canada 	✓ Hands free L2 systems are permitted	✓ Québec and Ontario allow the general public use of SAE level 3 for vehicles that are authorized for sale and purchase in Canada. ✗ Other provinces either ban AVs (even L3) or have no legislation.	✗ Driverless AVs are not permitted in Canada for the general public, on public roads and highways. • Provinces and territories are also responsible for approving and overseeing trials of ADS equipped vehicles that take place within their jurisdiction.	✗ Driverless AVs are not permitted in Canada for the general public, on public roads and highways. • Provinces and territories are also responsible for approving and overseeing trials of ADS equipped vehicles that take place within their jurisdiction.
Mexico 	✓ Hands free L2 systems are permitted	✓ Autonomous vehicles L3 or higher sold in Mexico must: a) Have a communication interface between the vehicle and users in Spanish. b) Indicate the safety recommendations for the protection of passengers and the operation of the vehicle. c) Indicate the recommendations related to the care and maintenance of the vehicle, as well as its periodicity. d) In the event that the vehicles collect statistics and user information, this information must be treated in accordance with the provisions of the Federal Law.	✓ Autonomous vehicles L3 or higher sold in Mexico must: a) Have a communication interface between the vehicle and users in Spanish. b) Indicate the safety recommendations for the protection of passengers and the operation of the vehicle. c) Indicate the recommendations related to the care and maintenance of the vehicle, as well as its periodicity. d) In the event that the vehicles collect statistics and user information, this information must be treated in accordance with the provisions of the Federal Law.	✓ Autonomous vehicles L3 or higher sold in Mexico must: a) Have a communication interface between the vehicle and users in Spanish. b) Indicate the safety recommendations for the protection of passengers and the operation of the vehicle. c) Indicate the recommendations related to the care and maintenance of the vehicle, as well as its periodicity. d) In the event that the vehicles collect statistics and user information, this information must be treated in accordance with the provisions of the Federal Law.

*** Laws and Regulation subject to change; Source: Government Public Data**

China, Japan & S. Korea ADAS / AV Regulation – Series Production Passenger Vehicles

	SAE L2 and "L2+" Eyes-on / Hands-off	SAE L3 Eyes-off / Hands-off	SAE L4 No Driver, Geofenced	SAE L5 No Driver
China 	✓ Hands free L2 systems are permitted.	? National L3 regulations are not clear ✓ L3 allowed in Shenzhen, must be registered.	✓ L4 allowed in Shenzhen – testing allowed in Beijing, Chongqing, Shanghai, Shenzhen and Wuhan. • Insurance for entire chain of risks from design, manufacture, use, operation, data and algorithm services. • Display of an external indicator light when in fully automated mode. • Owner and manager of the vehicle shall be liable for compensation if it is the responsibility of the intelligent connected vehicle.	✗ Not permitted.
Japan 	✓ Hands free L2 systems are permitted.	✓ SAE L3 Permitted.	✓ SAE L4 requires permission from public safety commissions • Level 4 automated transportation services are intended for use under remote monitoring in depopulated areas. Service providers will be required to obtain permission to operate from the relevant prefectural public safety commissions.	✗ Not permitted.
S. Korea 	✓ Hands free L2 systems are permitted.	✓ Level 3 up to 100 km/h, which is the general maximum highway speed limit in Korea.	✓ By 2024: change car insurance, driver's license, and traffic-related laws altered to fit Level 4 automation.	✗ Not permitted.

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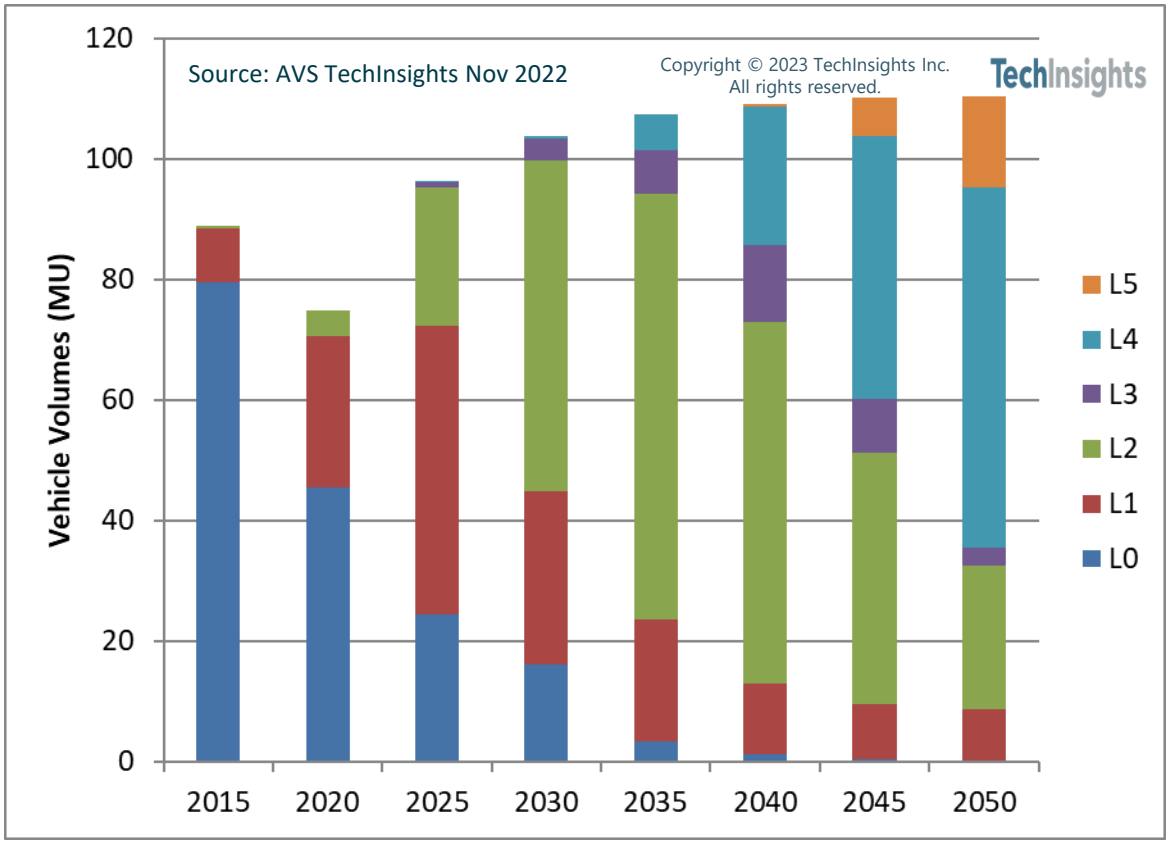
L0/L1/L2 TO DOMINATE into the 2030s

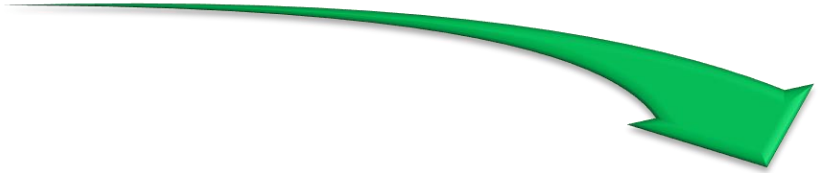


- Much ADAS (e.g. AEB) is classified as L0
- L1 demand driven mainly by LKA function (now offered by almost all LDWS solutions)
- L2 ACC and auto-park systems to grow strongly during the 2020s
- L3 now emerging – but still expected by TechInsights to be "stop-gap" solution on the path to L4
- L4 demand has been delayed in this update – many automakers pulling back

Strategies of Chip Rivals

Autonomous/Gaming/Server ⇨ Scale Down to ADAS

NVIDIA



Qualcomm snapdragon

IVI / Smartphone ⇨ Digital Chassis ⇨ Leverage Arriver

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

mobileye

Dominant in ADAS ⇨ Vertically Integrated, becoming Tier 1 ⇨ Scale up to Autonomous

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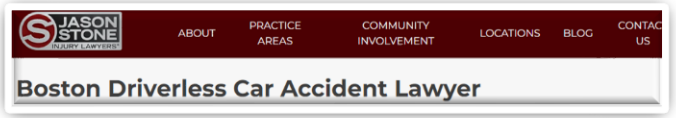
Hurdles to AV over next 3-5 years

- AV deployment Expanding Operational Design Domain (ODD) difficult and expensive!
  - The last 2% of edge case ODD is proving to be very difficult including: glare, social norms, outdated mapping detail, toll booths, water-filled potholes, overhanging vegetation, downed power lines, icing, uncooperative people, falling objects, delivery robots and common human rule-breaking (Source SAE).
- AV Scalability – Waymo fleet is still in the hundreds rather than the tens of thousands of vehicles announced a few years ago;
  - Rolling out fleets of robotaxis will be WAY more capital intensive than rolling out ride-hailing as Uber & Lyft did
- Public Acceptance – some early uneasiness with Robotaxis – Lawyers at the ready
- Potential Legislation hurdles – typically lags behind technology
- Complex Ecosystem
  - A huge amount of duplication of effort.
- Goldrush of Funding is subsiding – investors need to be in for the long haul



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Applications*:

*Not including military, mining, agricultural, etc.

TODAY'S AGENDA - AVS

01 Architecture / Software Impact Assessment

02 ADAS Demand Trends

03 Autonomous Vehicles Update

04 Conclusions / Q&A

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Thank you

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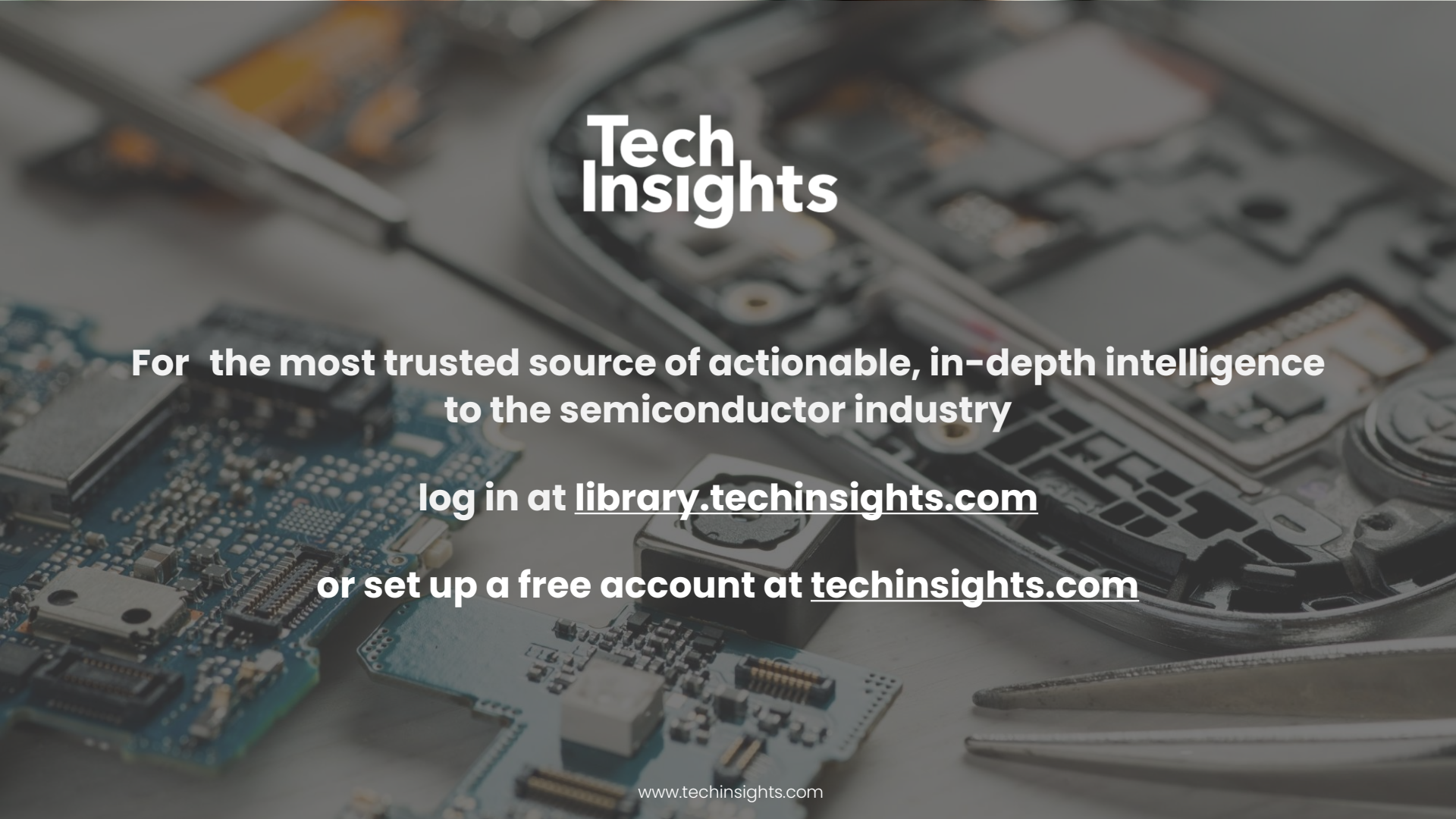
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