Future of Autonomous Vehicles

12 Key Business Streams to generate >$200Bn by 2030

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SAE Definition for Various Levels of Automation

Features within each level of automation will drive adoption within use cases in ownership and usership

ADAS Market: Product Segmentation, Europe and North America, 2018

Technology	SAE L0	SAE L1	SAE L2	SAE L3	SAE L4	SAE L5
Adaptive Cruise Control		●	●	●	●	●
Parking Helper L1		●				
Active Lane Centering		●	●	●	●	●
Parking Helper L2			●	●	●	●
Highway Pilot L2			●	●	●	●
Traffic Jam Pilot				●	●	●
AD System L3				●		
AD System L4 - Highway					●	
AD System L4 - City					●	
Parking Valet					●	●
AD System L5						●

LEVELS OF AUTOMATION	
L0	**NO DRIVING AUTOMATION** Driver drives the vehicle, vehicle can provide assist features.
L1	**DRIVING AUTOMATION ASSISTANCE** Either steering or braking assist, but not simultaneously.
L2	**PARTIAL DRIVING AUTOMATION** Steering and braking assist together as support feature only, human driver to supervise.
L3	**CONDITIONAL DRIVING AUTOMATION** Automation of full driving task with human fallback; driver to respond promptly when alerted.
L4	**CONDITIONAL DRIVING AUTOMATION** Full automation in pre-determined conditions; human to drive when system not engaged.
L5	**FULL DRIVING AUTOMATION** Vehicle drives itself always unless the human intends to drive.

SAE Definition for Various Levels of Automation

Development and deployment of AD features for

Autonomous Driving SAE Levels: Priority By Use Case, 2025-2030

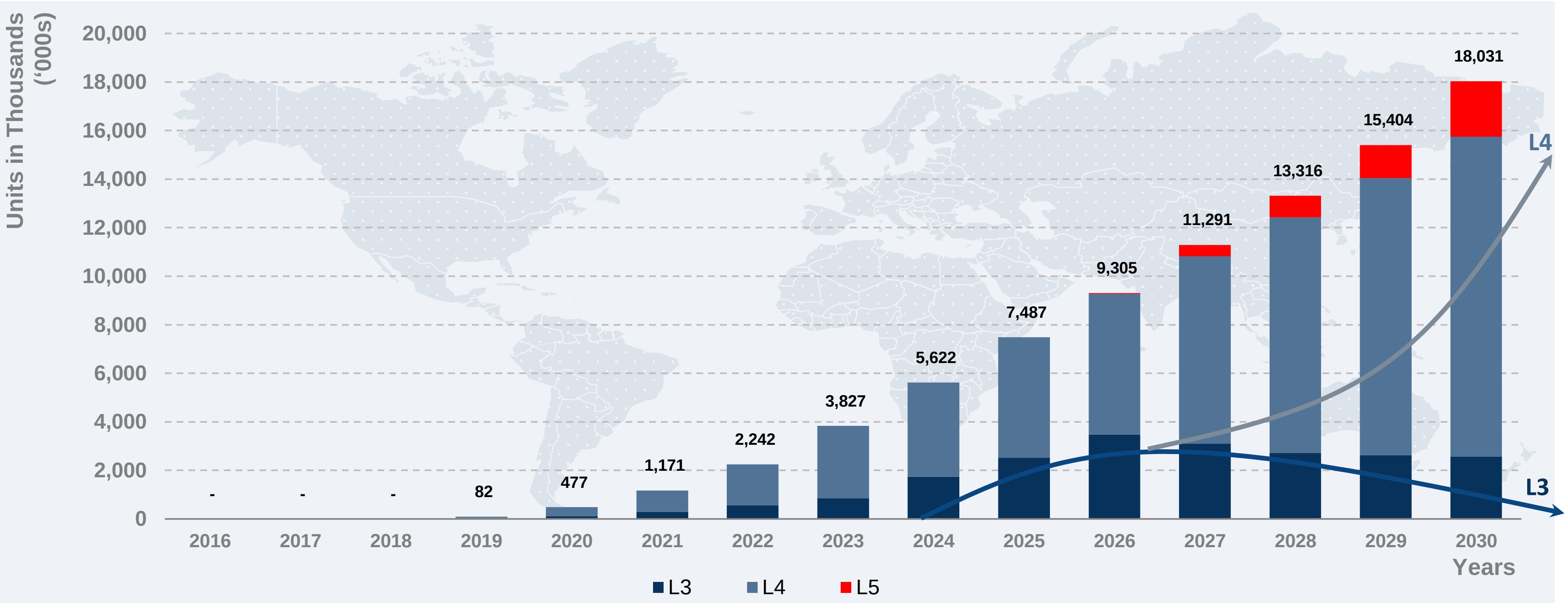
Technology	Automated Driving System L3	Automated Driving System L4 (highway)	Automated Driving System L4 (City)	Parking Valet	Automated Driving System L5
SAE L3	✓				
SAE L4		✓	✓	✓	
SAE L5				✓	✓
Ownership	High	Medium	Medium	High	
Usership					
Robo Taxis	Low	Medium	High	Low	
Shuttles	Low	Low	High	Medium	
Car Sharing	Medium	High	Medium	High	
Ride Sharing	Medium	Medium	Medium	Medium	

Note: Technologies mentioned here are not an exhaustive list of L3, L4 and L5 functions. **Impact:** ● High ● Medium ● Low

18 Million Highly Automated Vehicles (L3/4/5) Globally by 2030

L3 to peak at 35% of total autonomous car market by 2026; L4 to enter ownership.

Global Autonomous Driving, Market Volumes, 2016-2030

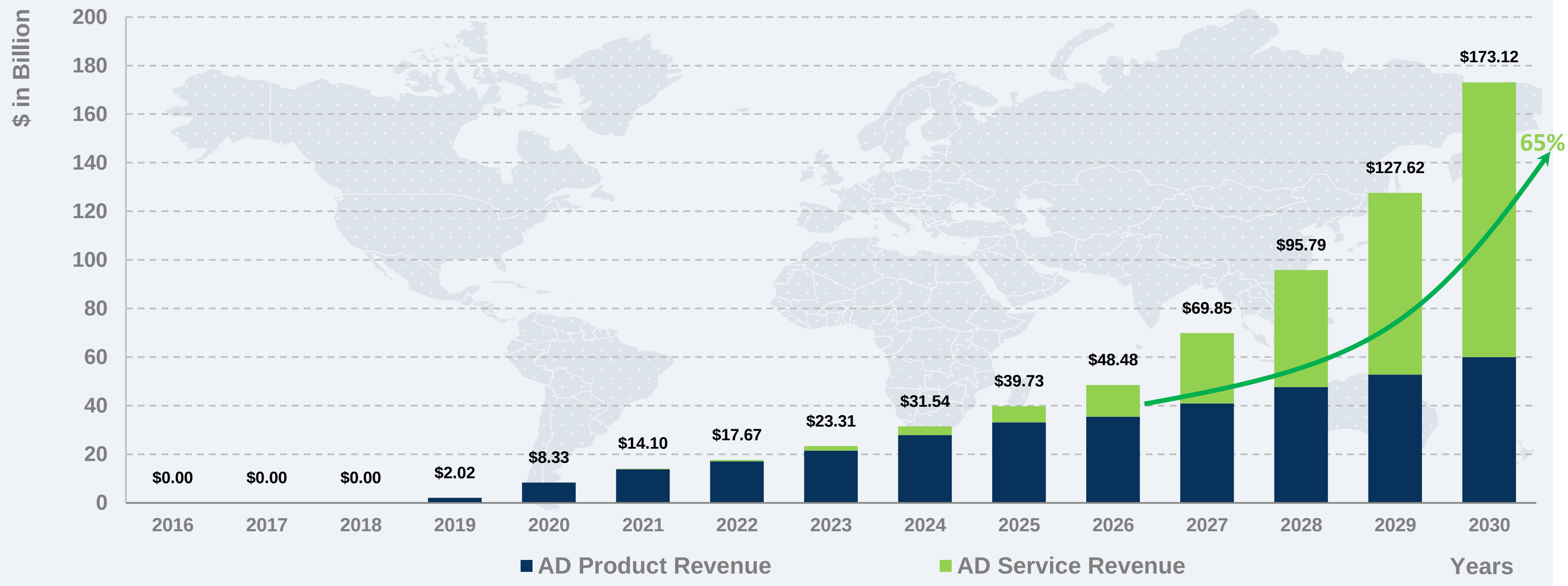


Source: Frost & Sullivan Analysis

AD Services to Account for 65% of Revenues by 2030

60% of ADS to be led by Shuttle Services, with China contributing an overall 50% to ADS revenues.

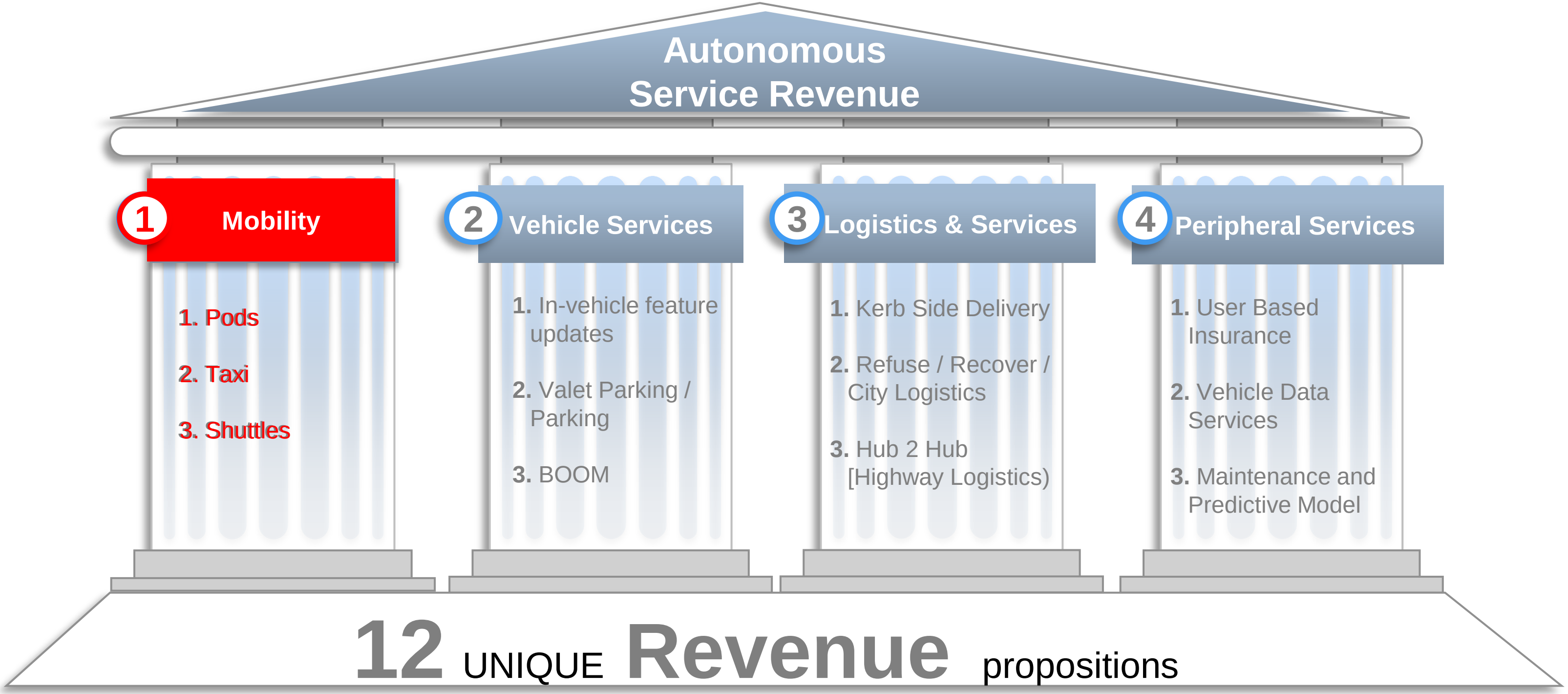
Global Autonomous Driving, Market Revenue, 2016-2030



Source: Frost & Sullivan Analysis

Hotspots: 12 Revenue Opportunities for Key Stakeholders

Represents 65% of Overall Autonomous Market in 2030; 12 streams to cover $200 Bn in revenue.

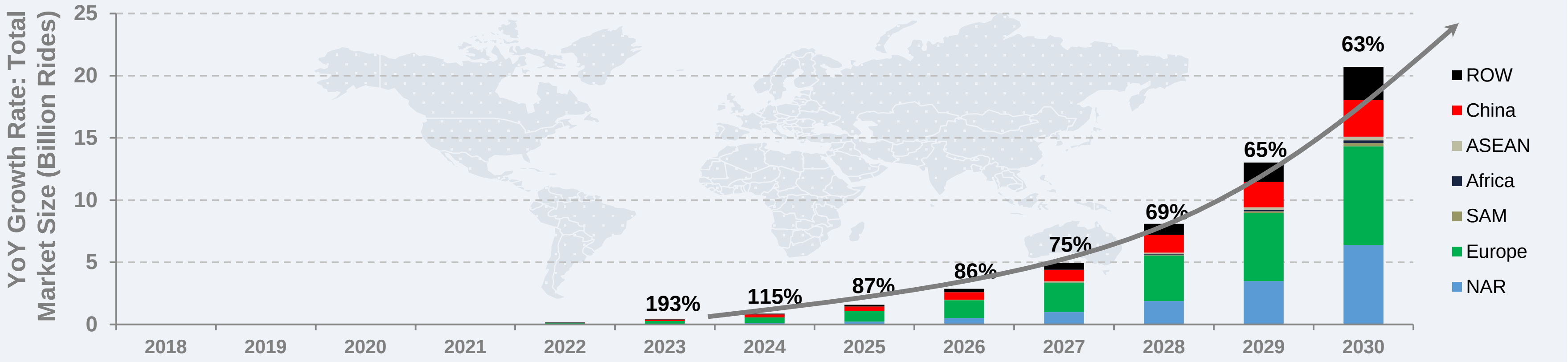


Source: Frost & Sullivan Analysis

Shared Mobility: Shuttles (By Rides) $74.42 Billion By 2030!

Based on a weighted average of the fare ($3.6 per autonomous trip) globally.

Expected YoY Global Penetration Rate Of Autonomous Shuttles by Number of Rides, Global, 2018–2030



Today fare per Ride is estimated at $3.9: Constitutes of: 15% Operator Profit = $0.6 30% Labor Cost =$1.2 35% Operation Cost (Insurance, parking) = $1.4 20% Maintenance Cost (Service, Fuel) = $0.8

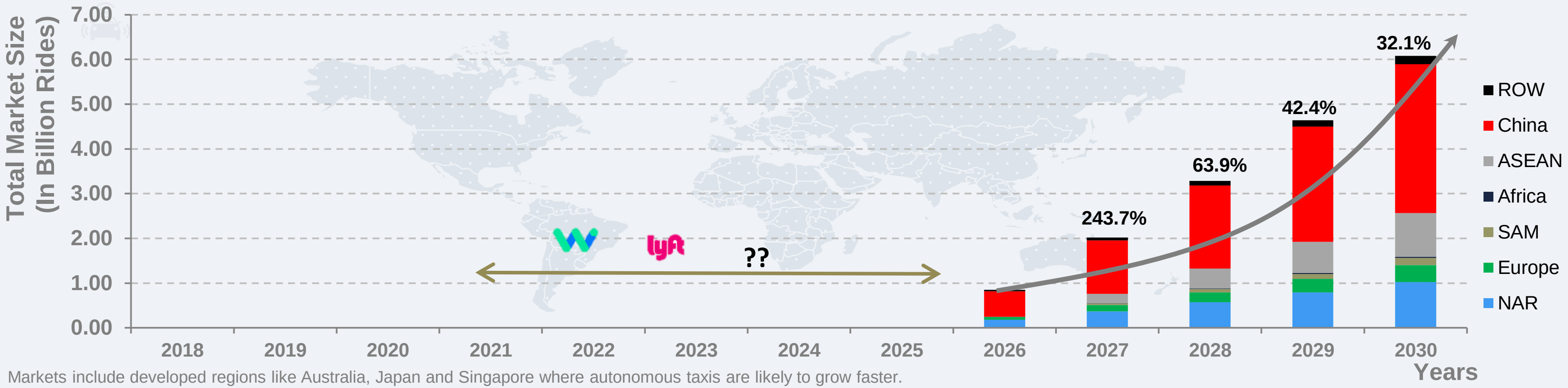
	2018	2023	2025	2027	2028	2029	2030
Total Estimated Number of Trips (in Billion)	0	0.41	1.59	4.92	8.09	13.02	20.7
Global Average Fare per ride for a certain length (in US$)	NA	3.13	3.16	3.32	3.41	3.5	3.9
Autonomous Rides Penetration	0	5.7%	11.4%	19%	22.9%	26.8%	30.7%
Value ($ Billion)	0	1.25	5.04	16.38	27.63	45.61	74.5

Source: Frost & Sullivan Analysis

Shared Mobility: Automated Taxi (By Rides): $38.61B by 2030!

China and North America being the major markets.

Expected YoY Global Adoption Rate Of Autonomous Taxis by Number of Rides, Global, 2018–2030



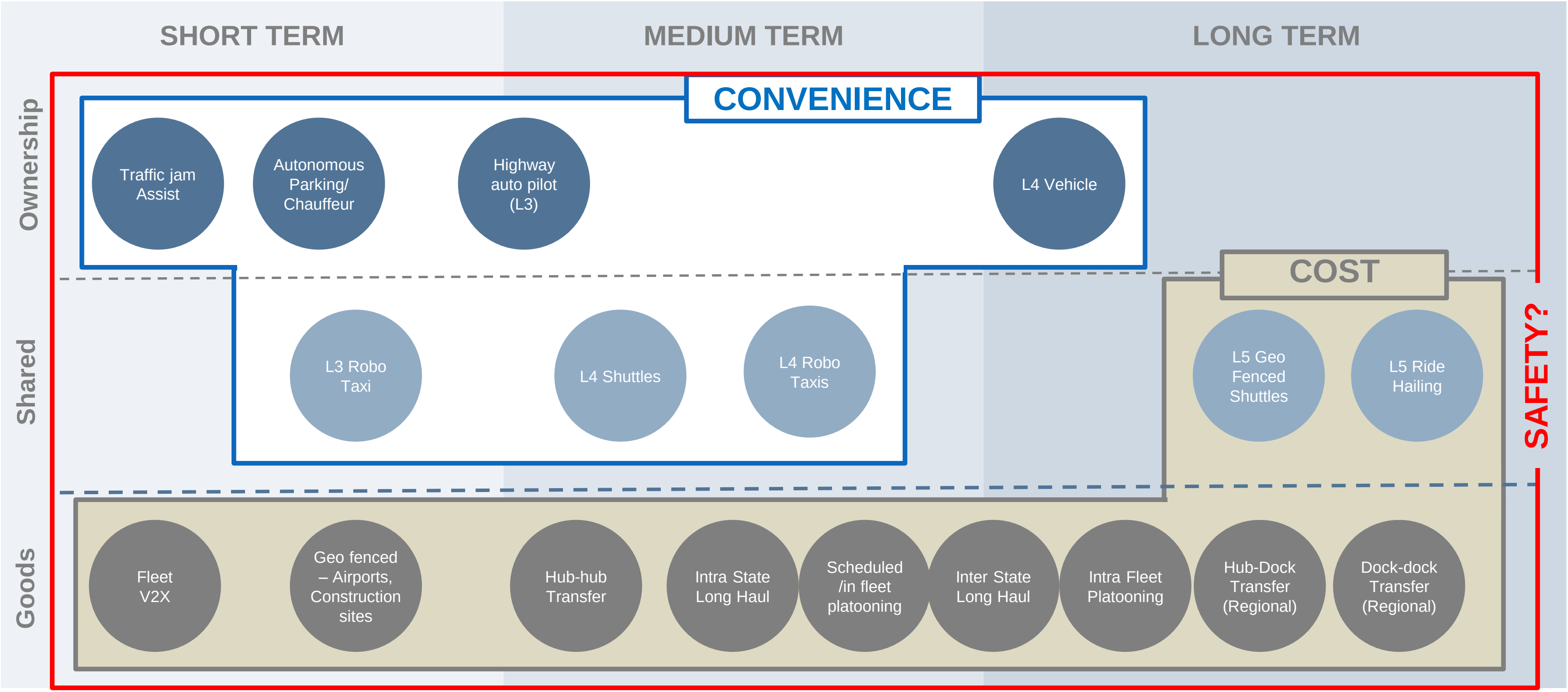
Markets include developed regions like Australia, Japan and Singapore where autonomous taxis are likely to grow faster.
The average cost per trip by 2030 is expected to be around $3.64 estimating 30-40% of the total to be driver costs.

	2018	2025	2026	2027	2028	2029	2030
Total Estimated Number of Trips (in Billion)	**0**	**0**	**0.85**	**2.02**	**3.28**	**4.64**	**6.08**
Global Average Fare per ride (in US$)	NA	0	4.3	6.2	6.3	6.3	6.4
Autonomous Trips Penetration	0	0	0.6%	1.4%	2.1%	2.9%	3.7%
Value ($ Billion)	0	0	3.64	12.52	20.53	29.24	38.61

Source: Frost & Sullivan Analysis

Use Cases Driving Autonomous Adoption

Convenience driver in ownership and usership. Cost primary driver in logistics.

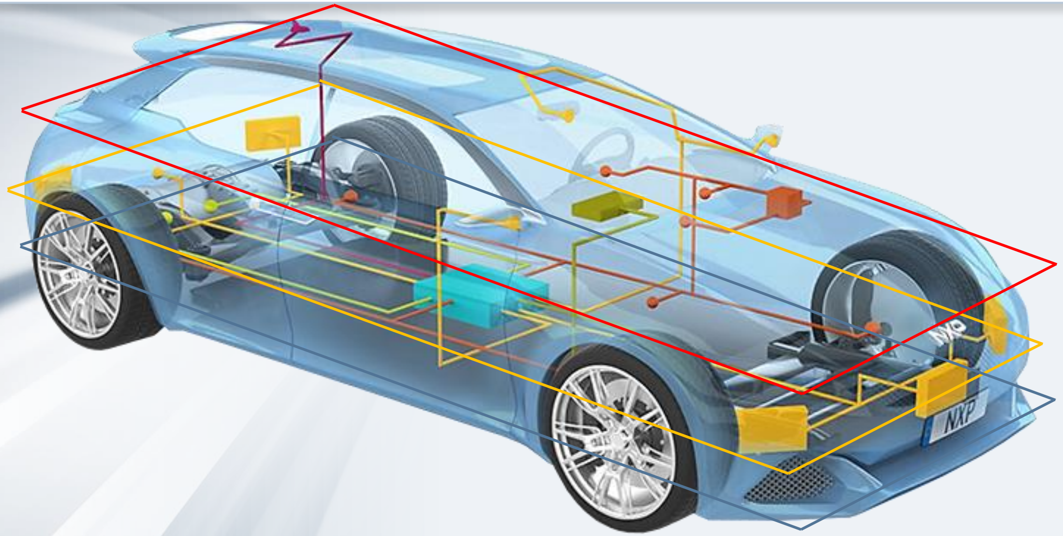


Future Of Vehicle Platforms & Architectures

CASE Convergence will lead to 3 Platforms as Building Blocks for AD Development

Vehicle Platform (Electric)

1. Diagnostics and Vehicle Health Monitoring
2. Electrical Power Systems
3. Backup Autonomous Driving System
4. Redundant Braking and Steering Systems



Digital Platform

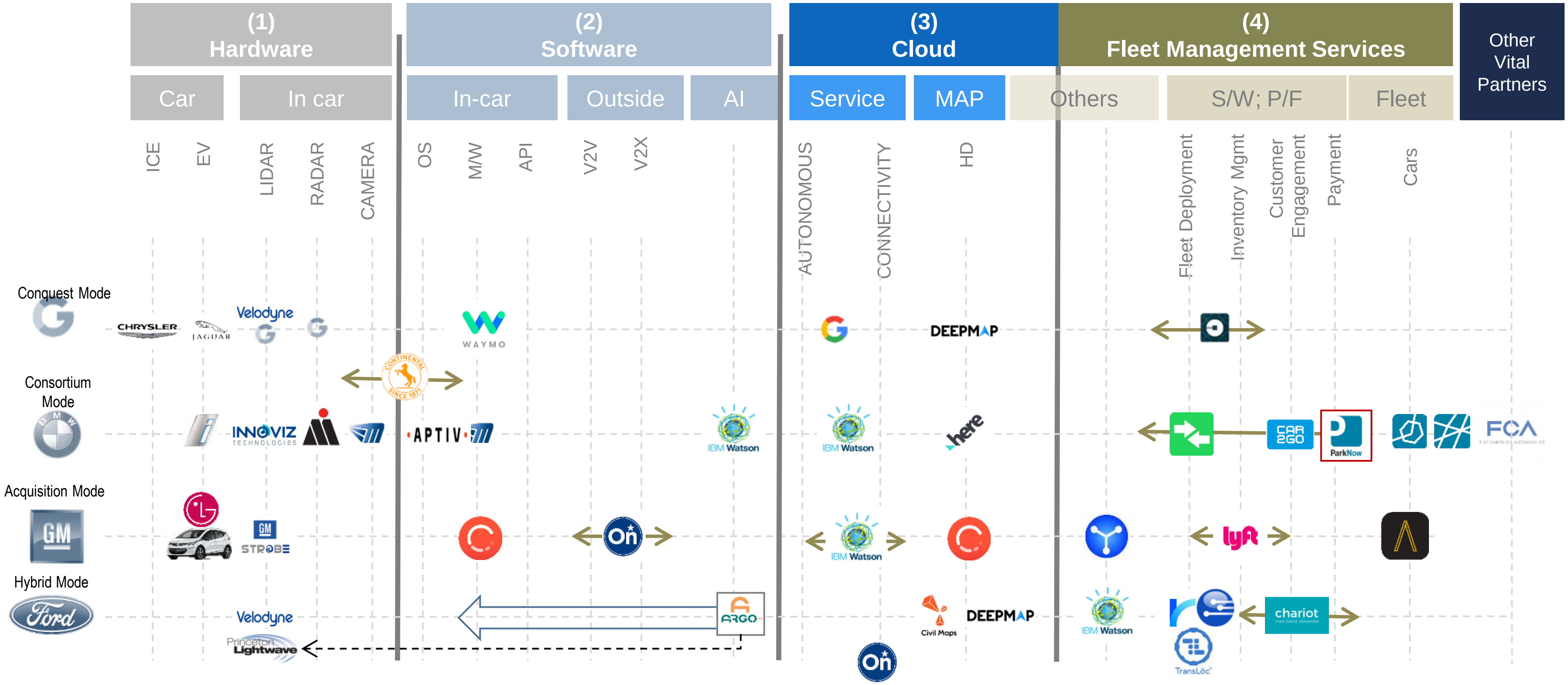
1. Ease of Use , User Delight
2. 3D Approach for the OS
3. HMI and Infotainment Features
4. 3D Car as the Menu
5. IoT Integration

Electronic Platform

1. Redundancy ECUs
2. Domain Controllers & Interfacing Units
3. Cyber Security Modules

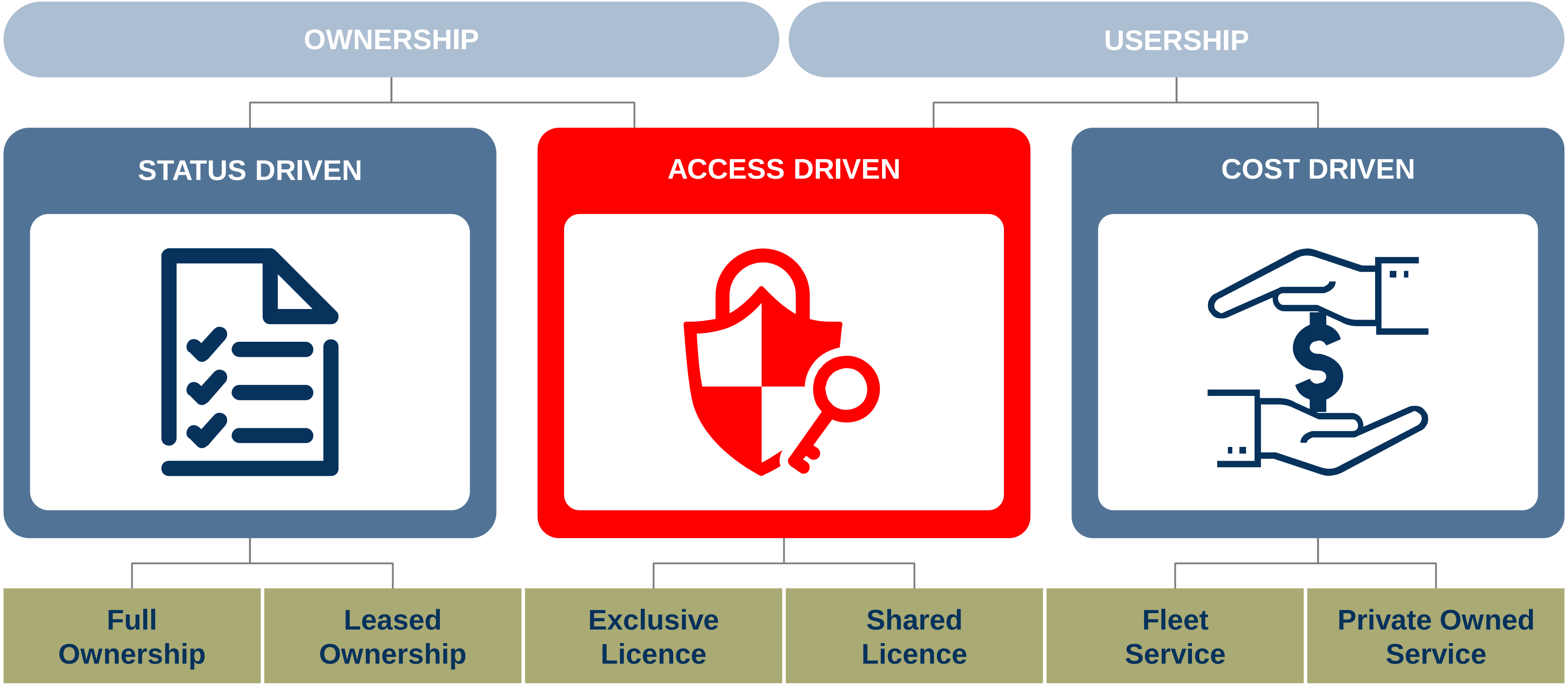
Ecosystem: Providing "Cost" and "Convenience" in Autonomous

OEMs planning foray into ecosystem via partnership / acquisition or in-house model.



Future Ownership & Usership Structures

Users to access multiple structures based on their day to day needs and travel scenarios.



Key Takeaways & Discussion Points

1 in 6 cars sold (18Mn) globally to be automated (L3, L4 and L5) by 2030
-China leading; Shuttle Programs and Automated Taxis to have biggest share of revenue pie

12 Key Autonomous Driving Based Services to Account for $200Bn by 2030
-Shuttles and Robotaxis contribute 54%.

OEMs Will Consider Options to Capitalize on future AD Service market
-Options include: Consortiums, Partnerships, Acquisitions or Hybrid

Tier 1 Supplier Role will Evolve (Integrator; H/W agnostic S/W)
-Tech partnership, acquisition or consortiums vital to develop new mobility ecosystems!

Autonomous to Disrupt Existing New Mobility Business Models
-Likely convergence of e-hailing and car sharing operations to Ride Sharing by 2025/30!

Get In Touch!

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