

THE POWER OF OPERATING SYSTEMS AND MIDDLEWARE

The first comprehensive global comparison and evaluation of Middleware Initiatives based on their future strategies.

Decoding the success formula for Software Defined Vehicle Transformation



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Breaking down barriers in driving innovation of the future middleware

60+ Players and their strategy in a major comparison

18 Interviewed OEMs, Tier-1 suppliers and Tech-entrants

Comparing current key objectives of automotive open source middleware initiatives

4 Major open-source middleware initiatives in the automotive industry are comprehensively assessed

Learn the strategic success factors.

Open source as a game changer

Open source represents a decentralized, collaborative working model for solving problems and providing architecture, standards and methodologies.

Collaboration is the guiding principle

Brand differentiation through specific features can be ensured with little effort at the human-machine interface.

EE-Architecture characterized by high integration

A service-oriented architecture and standardized APIs manages the complexity and enables integration of software functions.

OEMS AND TIER-1 SUPPLIERS FOCUS ON DEVELOPING THEIR OWN SOFTWARE AND MAINTAINING AN OPEN O.S STANDARD

Player Software Strategy



- Player Software Strategy
- Consortium/Alliance
- Operating System
- Partnerships
- Conclusion

Building own SW platform

Some OEMs are launching their own Operation Systems for their automotive software to enable easier OTA updates

- The launch of an own OS enables them to ensure compatibility between automotive hardware and software which enhances vehicle performance
- Some of the OEMs building their own OS are given below:

BMW	CARIAD	VW
HYUNDAI	TOYOTA	TESLA
NIO	VOLVO	GM

OEM turning into Software powerhouse

OEMs and Tier-1 suppliers are developing dedicated subsidiaries to serve their need of automotive software and middleware

- TOYOTA** Toyota founded Woven Planet Holdings in Jan. 2021 for automotive software and autonomous driving software

- MERCEDES** Mercedes is developing its campus in Sindelfingen as a future software hub for its MB.OS development

- BOSCH** Bosch has pooled its basic vehicle software, middleware, cloud services, and development tools under its subsidiary ETAS. It has also pooled its software and electronics expertise for vehicle architecture into division called Cross-Domain Computing Solutions

- STELLANTIS** Stellantis launched initiatives with Foxxcon, Qualcomm, and Amazon to accelerate time to market for new digital products and upskill Stellantis' global workforce

Establishing open source standard

OEMs & Tier-1s are supporting the use of open-source software as it can enable them avail services from multiple while also serving others

- BMW** BMW, being the founding member of COVESA, is involved in pushing forward an open source standard for connected vehicles

- TESLA** Tesla is willing to open software for self driving to other OEMs through licensing





- HYUNDAI** Hyundai is making the best use of open sources, including the Linux-based COVESA, it will develop a software platform that is customized to provide connected car services

- GREAT WALL** Great Wall Motor has joined the Open Invention Network Community (OIN), to open source software (OSS) as an enabler of electronic vehicle systems

TRADITIONAL OEM, NEW OEM, TIER 1 SUPPLIER HAVE COME TOGETHER IN PAST CREATING AN IMPACTFUL TECHNOLOGY ALLIANCE



Consortium/Alliance - Excerpt

				
GOAL	Standard automotive SW Specs	Open Source Reference Implementation	Open Technology Platform	Linux based open source Platform
ARCHITECTURE/ CLOUD	Open Architecture	Arm related SW Architecture	Different Architectures Cloud-native	Linux Cloud-native
SECURITY SAFETY	Focus	Key requirements for Architecture	Developed by Communities	Certified Security
SW STACK	Implemented by Members	Blueprints on functional level	Overall Governance	Enterprise-grade support
BUSINESS MODEL	Non-profit – Members Licensing model	ARM -Ecosystem	Non-profit, large Development Community	Licensing models for Lifetime
PROCESSES	Standardized Infrastructure	Tooling for SOAFEE Framework	Some	Safety-certified Tools & Infrastr. - Maintenance

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COMPANIES ARE STRIVING TO CREATE STANDARDIZED OS BUT AT THIS POINT, NO ONE-SIZE-FITS-ALL APPROACH EXISTS

Comparative Analysis of Operating System

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Traditional OEMs	<ul style="list-style-type: none"> Almost all top players have been developing their own OS 		
New Players	<ul style="list-style-type: none"> New OEMs like Rivian & NIO aiming to develop their own OS New OEM and few traditional OEM's will use Google's Android Auto for the OS in the car The default inclusion of Google Maps on the platform gives a greater strategic advantage 		
Chinese Auto-makers	<ul style="list-style-type: none"> Chinese automakers have been collaborating with Huawei's Harmony OS Huawei's cockpit capabilities will be open through APIs which will allow OEM to develop new functionalities 		

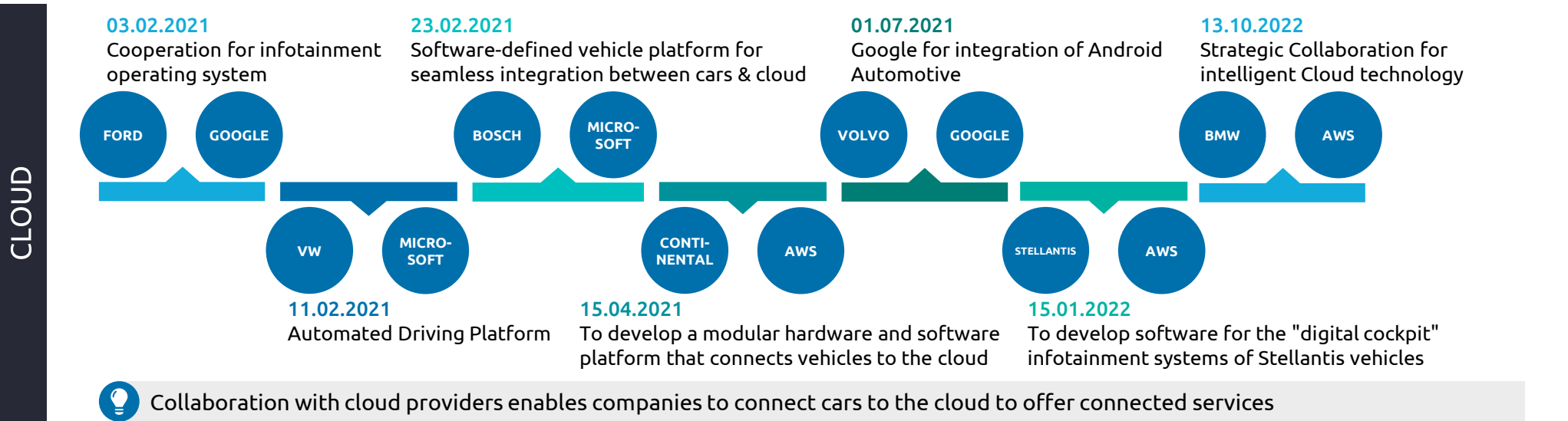
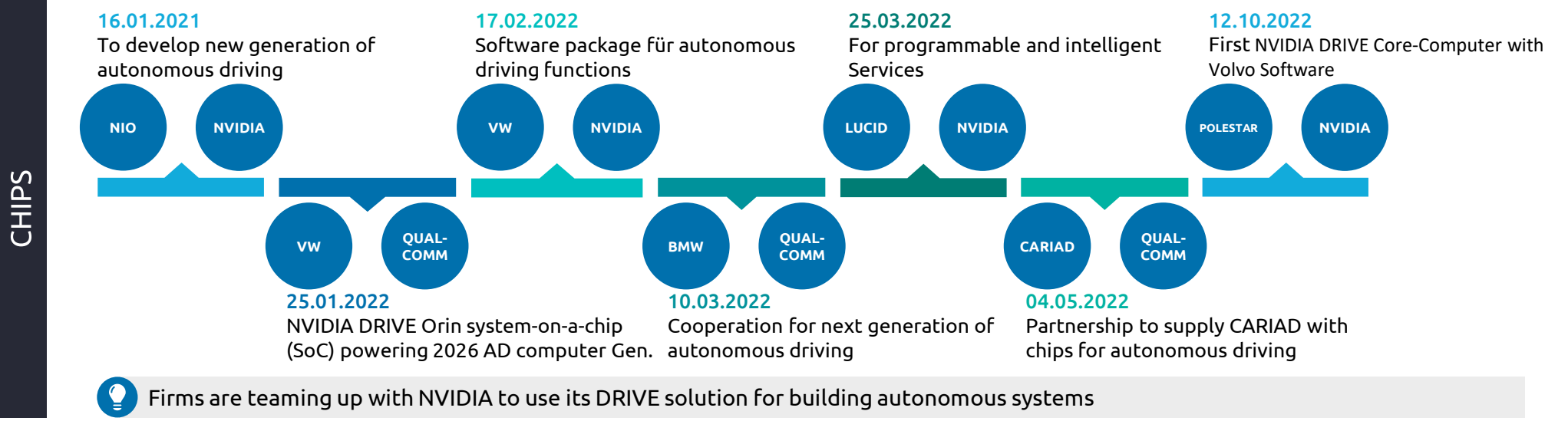
Key Insights: Since software is a critical point in the industry, traditional OEMs are seen developing their own OS, while few new OEMs have joined the list. As each builds its own ecosystem, most new OEM joiners are still collaborating with tech giants for OS.

MAINLY OEMS PARTNER FOR SW SERVICES AND O.S IMPROVEMENTS



Partnerships

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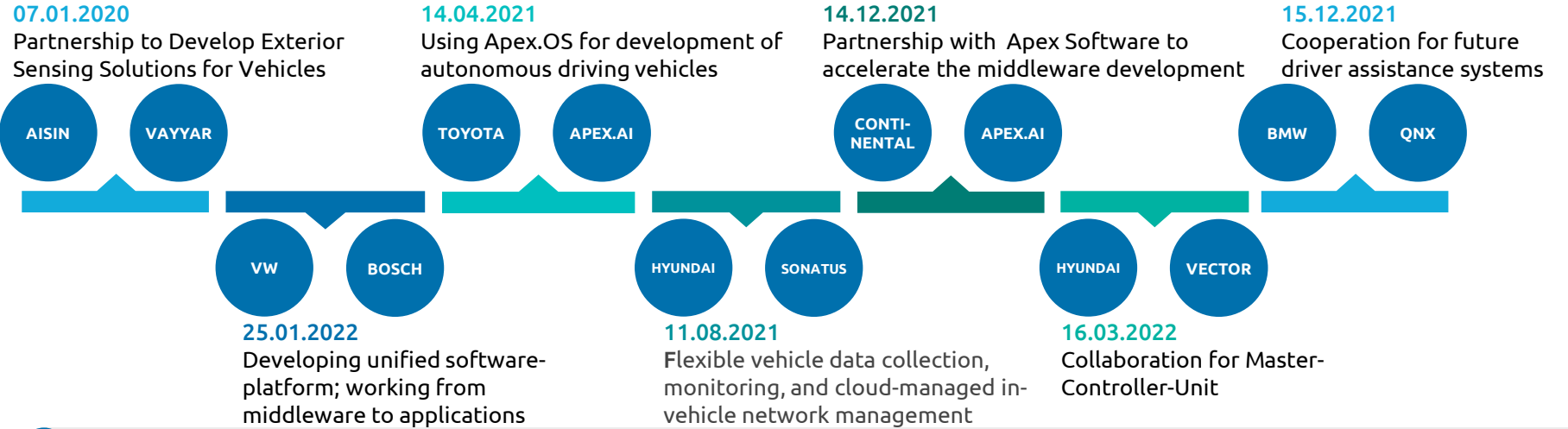


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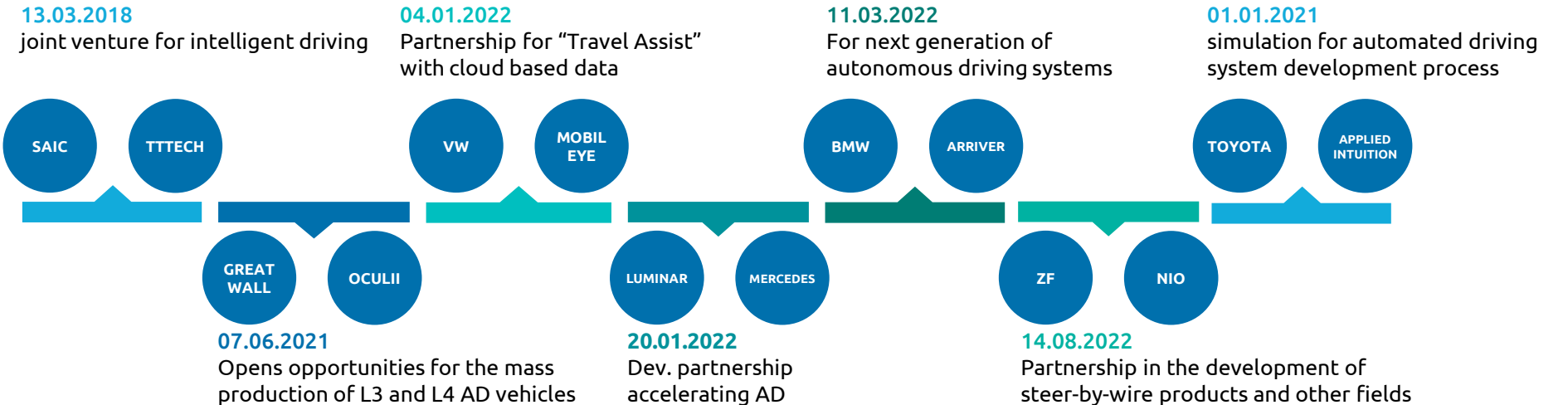
Partnerships

SOFTWARE



💡 New & Traditional OEMs partnering/collaborating with different technology/service provider to improve the capabilities of their cars

SELF DRIVING



💡 OEMs have seen partnering with tech based companies for development of Level 4 or Level 5 autonomous vehicles

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THE STUDY IDENTIFIED FOCUS OBSTACLES THAT ARE CRITICAL FOR THE FUTURE DEVELOPMENT AND DEFINED HOW TO SOLVE THEM

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Break the silo mentality



- Building **independent ecosystems** to break through those silos.
- Ecosystem defined on clear **standards** to **manage complexities**.
- Realizing a **collaborative path** of Joint Ventures & partnerships. Consortia like Eclipse, SOAFEE provide a good basis for but not yet holistic enough.

Manage the growing complexity

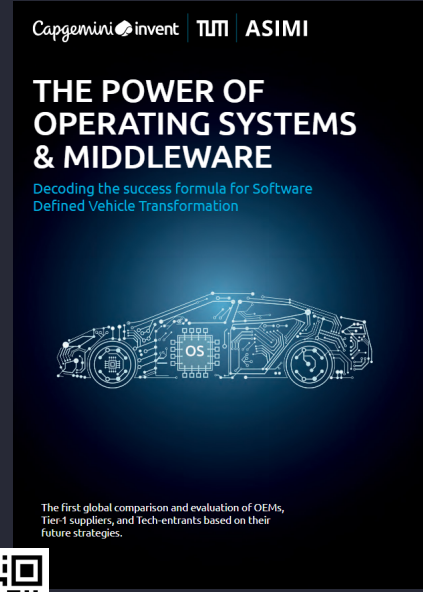


- **Single players** should not develop holistic solutions except if the target of serving others as well.
- Accomplish **architecture alignments** between OEMs, Tier 1s and Tier 2s.
- **Scarcity of skills** and extreme **pressure** of customer expectations, costs, time to market and market entrants.

Target Business & Operating models



- **Standardized** enough to enable **Scalability**.
- **Modular** enough to adapt to **Variability** of functionalities.
- **Centralized architectures** built on clear **standards**.
- **Opensource strategy** is the way forward.



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Conclusion: The Success of a Opensource strategy lies in a significant number of OEMs agreeing on a common development model for middleware, using common APIs, and adopt an operating model to deal with the influences on the open-source software stack.

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