

**BMW
GROUP**

INVESTOR & ANALYST DAYS 2024

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DIGITAL PRODUCT STRATEGY

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WHAT DO YOU EXPECT FROM A CAR?



DIGITALIZATION ADDRESSES THE OVERALL COMPANY.

Consistent digitalization to exploit potentials in all business segments.

Business Processes



- Smart logistics
- Innovative automation & assistance systems
- Virtualization
- Quantum computing
- Catena-x automotive network

Focus today

Products



- Unique user experience
- Safe, comfortable and innovative driving experience
- Car as a best managed device
- Central enablers: Stable software platforms, SW/HW integration, safety & security, consistent partner integration

Customer Interaction



- Digital customer experience
- Digital aftersales upgrades
- Digital personalization of the vehicle
- Digital financing process at financial services

FOCUS ON CUSTOMER CENTRICITY

**DIGITAL IS AN
ESSENTIAL PART OF
OUR BMW GROUP
PRODUCT STRATEGY.**



**PORTFOLIO OF
STRONG CHARACTERS**

KEY ELEMENTS OF THE BMW DIGITAL STRATEGY ENABLE STATE-OF- THE-ART DIGITAL EXPERIENCE.



A SEAMLESS USER INTERFACE

20+ years of BMW iDrive
BMW Operating System
8.5 (Linux) / 9 (AOSP)

PERFECTLY ASSISTED

40+ Driver Assistance
features
L2 hands-off up to
130km/h (DE/US/CAN)

3RD PARTY CONTENT

Alexa, Youtube,
Bundesliga, XPERI,
3rd Party App Store,
Amazon Fire TV, etc.

ALWAYS CONNECTED

5G, My BMW App,
BMW Maps,
Digital Key Plus

FULLY UPDATEABLE

Largest upgradeable fleet
(> 8 million vehicles)
>120 features & quality
upgrades
All functional domains,
all drivetrains

TARGET PICTURE DIGITAL CAR STRATEGY.

The inspiring **overall digital experience** blends seamlessly into every driving moment and combines them into the ultimate driving experience.

The vehicle becomes an intelligent, **always up-to-date companion.**

Driving dynamics are combined with assisted driving in a unique and consistent way.

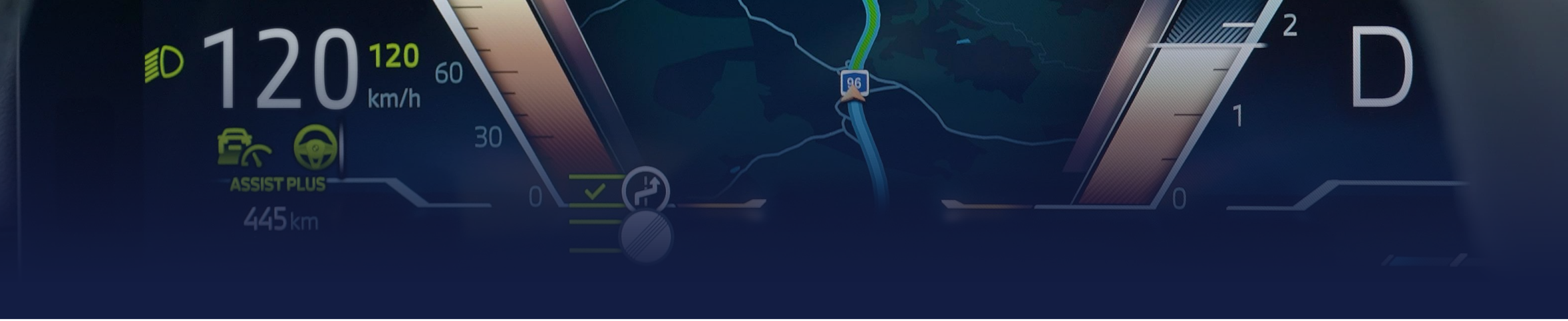


FUTURE BECOMES PRESENT.

A joyful user experience
by the BMW Group.



OFFERING OUR CUSTOMERS A SAFE, COMFORTABLE AND INNOVATIVE DRIVING EXPERIENCE.



Automated
Valet Parking

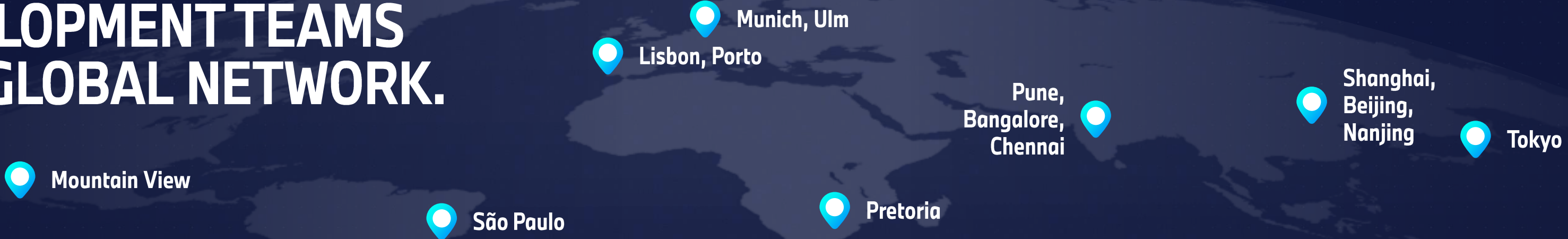
First OEM with
L2* and L3
@ **BMW 7 Series**
in **ONE** vehicle

First L3 Offer
@ **BMW 7 Series**

First OEM with L2*
@ **BMW 5 Series**

L2* @ **BMW 7,
X5, X6, X7, XM, iX**

OUR DEVELOPMENT TEAMS WITHIN A GLOBAL NETWORK.



2002
BMW Car IT

- Ramp-Up**
- Human-Machine Interface.
 - Gateway/Body Domain.
 - Driving Assistance.

2011
ConnectedDrive
Lab Shanghai

2012
BMW Car IT
Ulm

2017
Autonomous
Driving Campus

2018
Critical
Techworks

2019
Cross-company
BizDevOps

2021
BA
Techworks

2024
JV with
Tata

> 8,500
IT and software experts

OUR DIGITAL CAR STRATEGY CLEARLY DEFINES OUR LONG-TERM DIRECTION AND PUTS US AHEAD OF THE COMPETITION.



Our overall digital experience blends seamlessly into every driving moment

Unique UI that connects the driver with the vehicle and the outside world naturally, intuitively and multimodally.



Our driving experience strategy is a distinctive combination of self-driving and being driven

Connecting sheer driving pleasure with the comfort of automated driving and keeping the driver in the flow.



Anchoring "Pick & Choose" strategy and maintaining control

Our ecosystem openness enables customers to access content in a variety of ways.



Shift towards cross-generation platform

Selectively deeper design of hardware is key to stabilizing and professionalizing our SW development.



We develop software globally - integrated into the vehicle development process

We are positioned worldwide and apply the best expertise wherever it is available.

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HOLISTIC DIGITAL EXPERIENCE

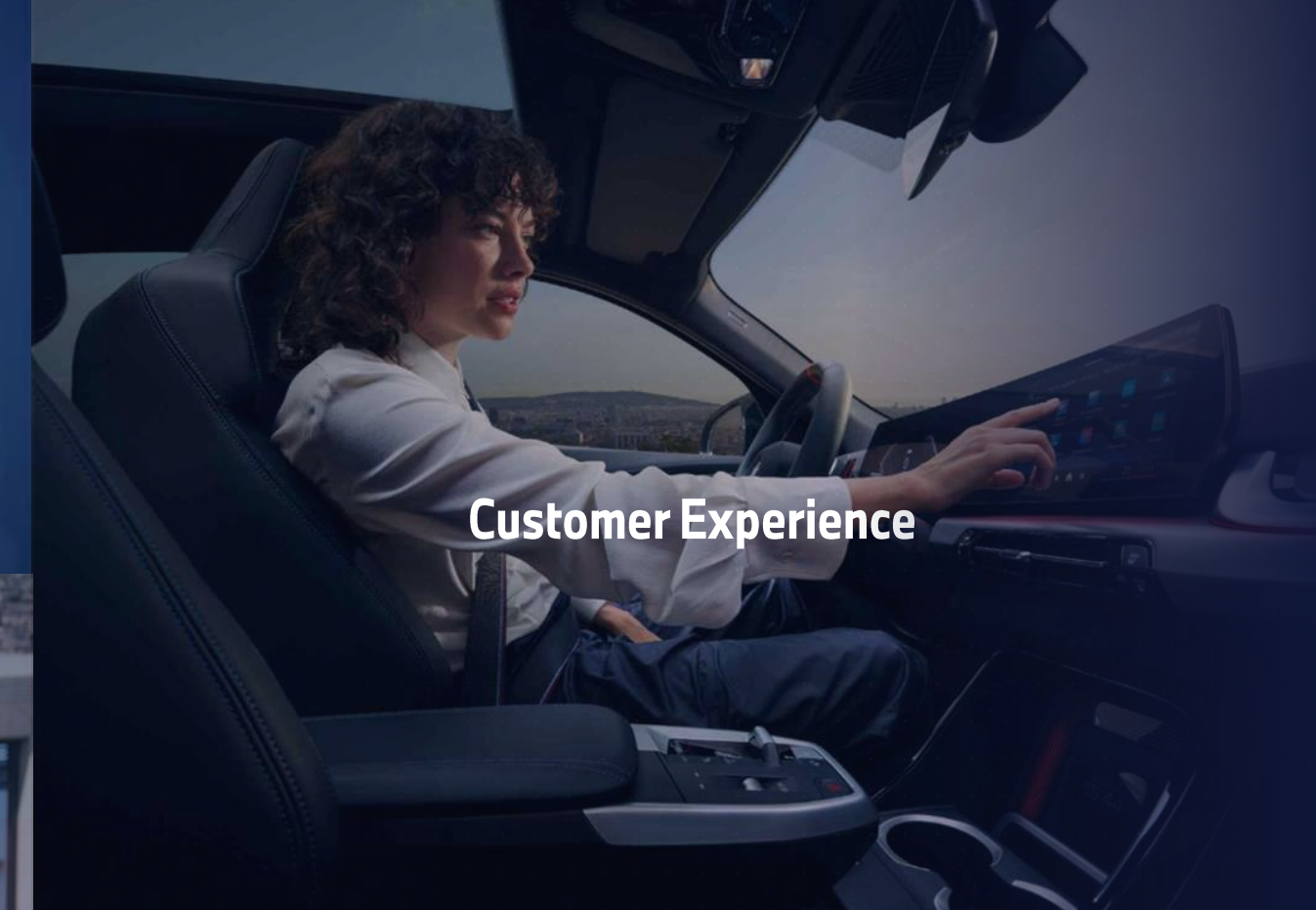
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TURNING CHALLENGES INTO OPPORTUNITIES.

We are constantly observing external factors for our digital Customer Experience.



Technology



Customers' Choice

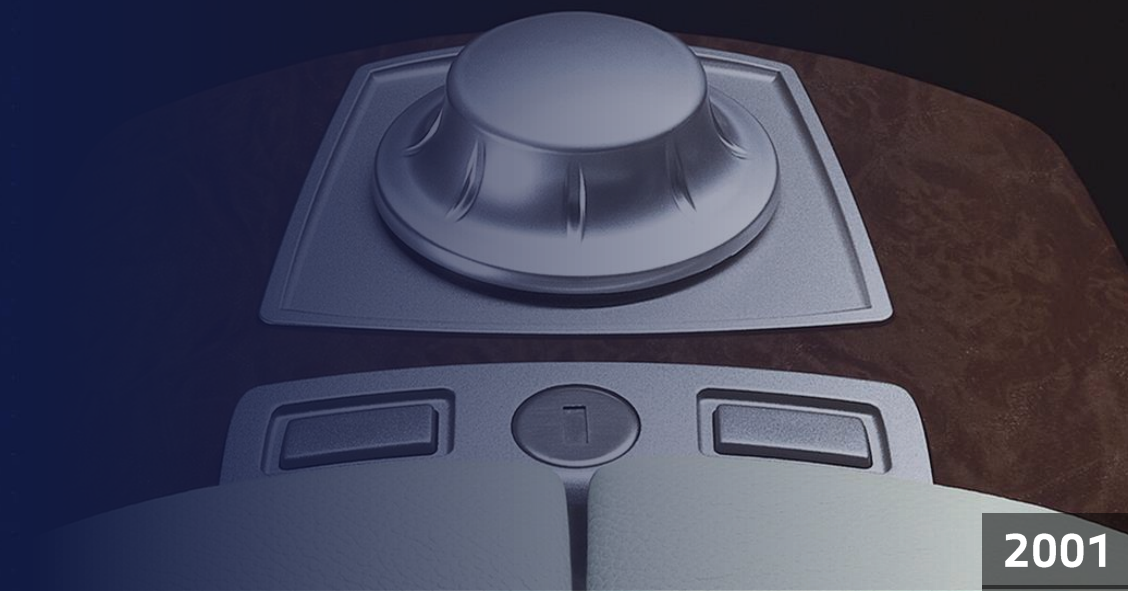


New Players

Customer Experience

UNIQUE USER INTERFACE.

Connects driver with vehicle and outside world: naturally, intuitively and multi-modally for more than 20 years.



2001
2023



2002
2024

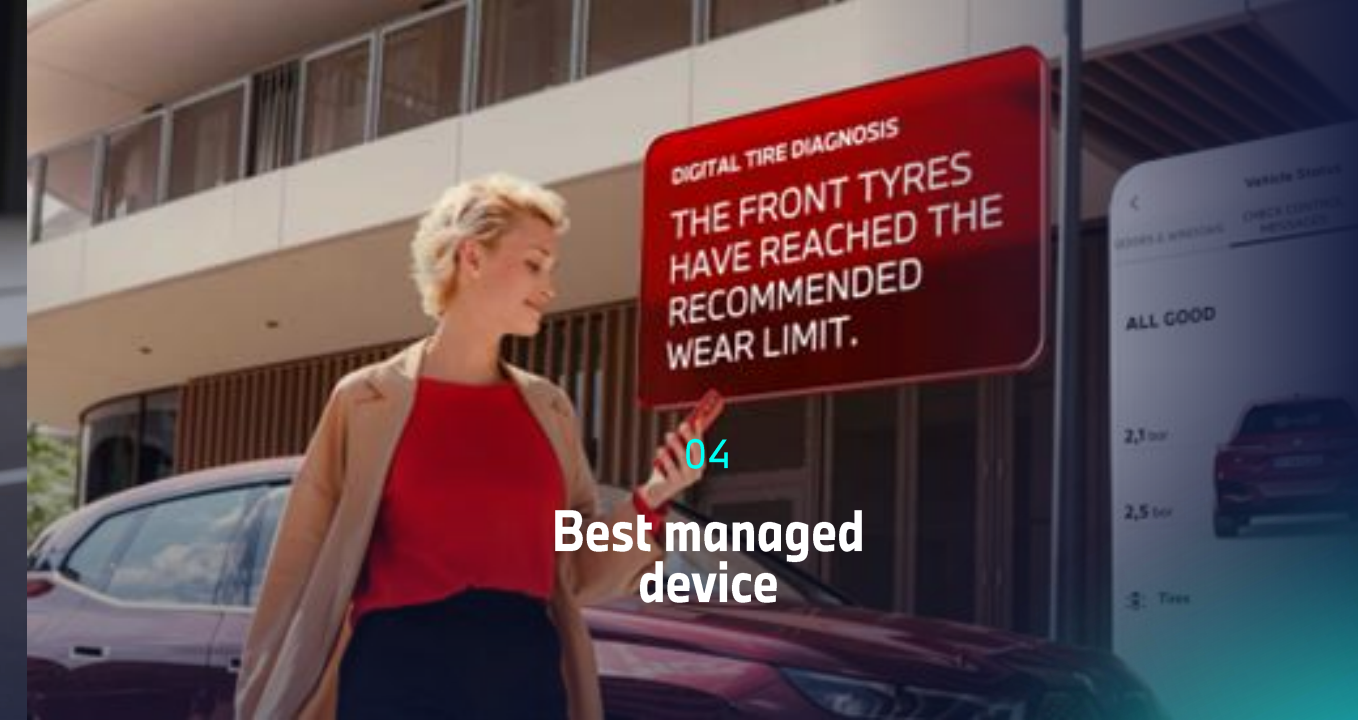
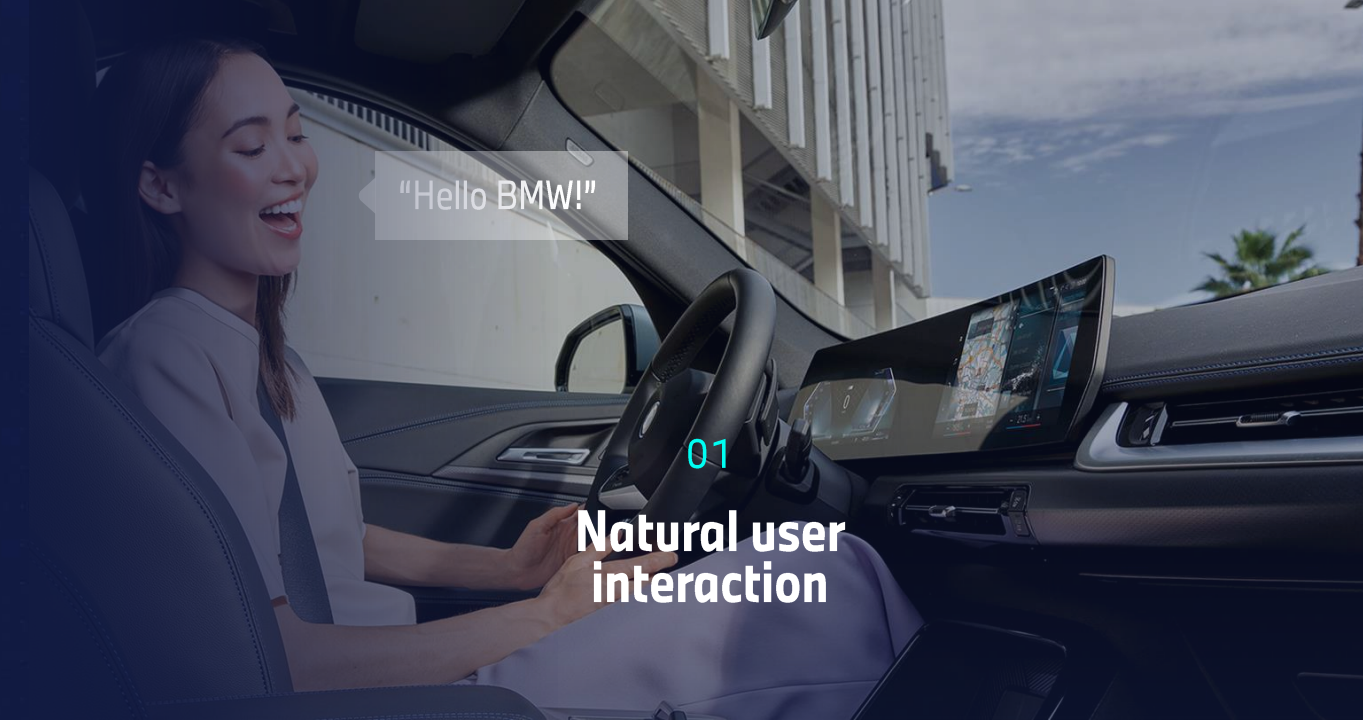


2003
2025



UI/UX – THE IMPORTANT DIFFERENTIATOR.

An outstanding digital
experience will impact
customer decisions.



CONTENT IS KEY.

Gaming - Airconsole



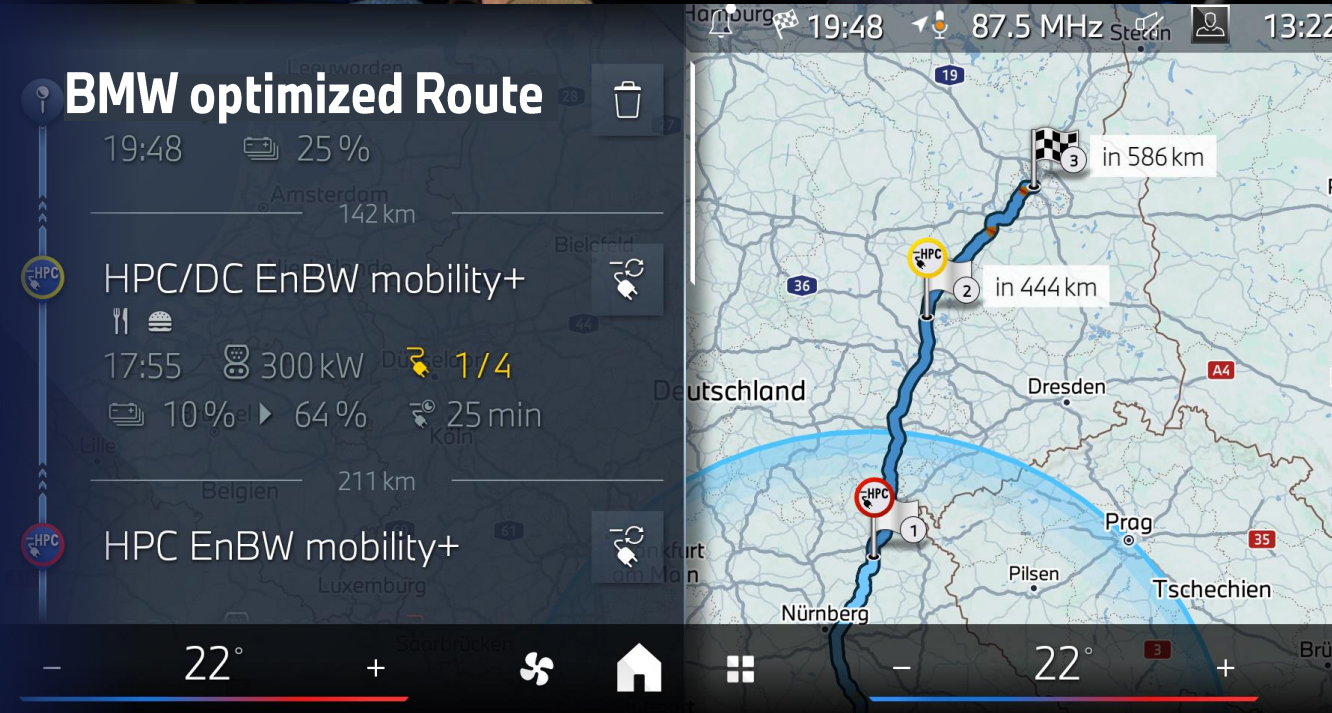
Video - Xperi



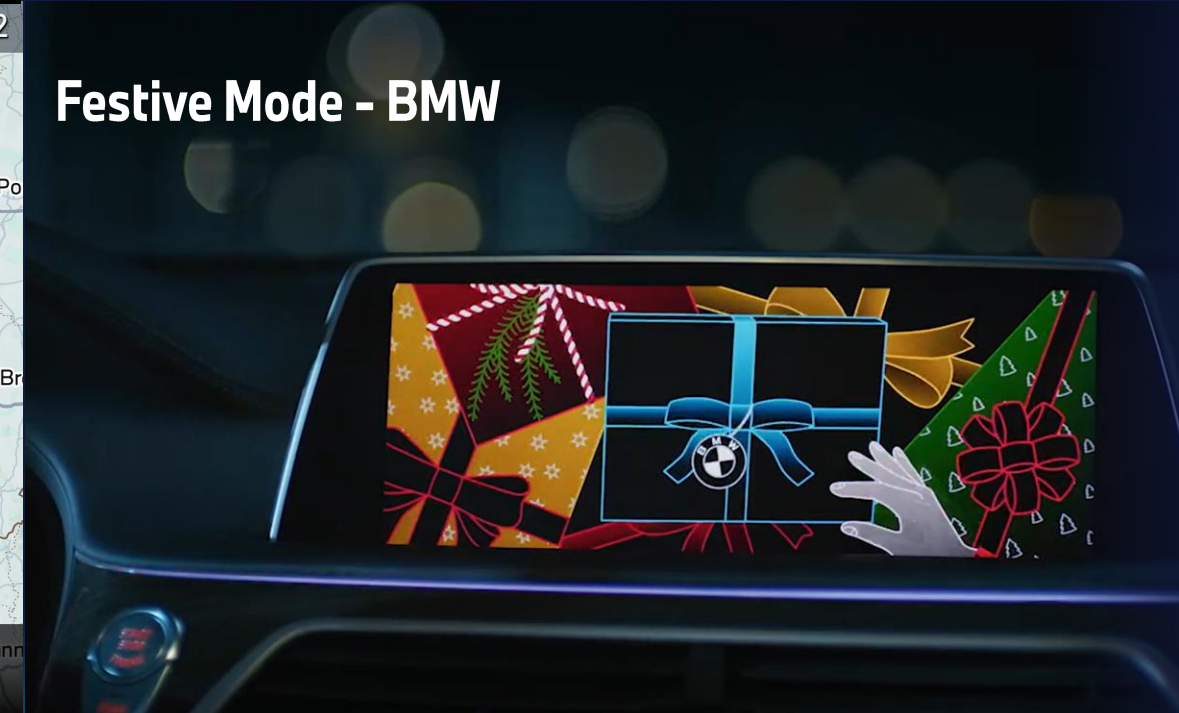
Gaming - Airconsole



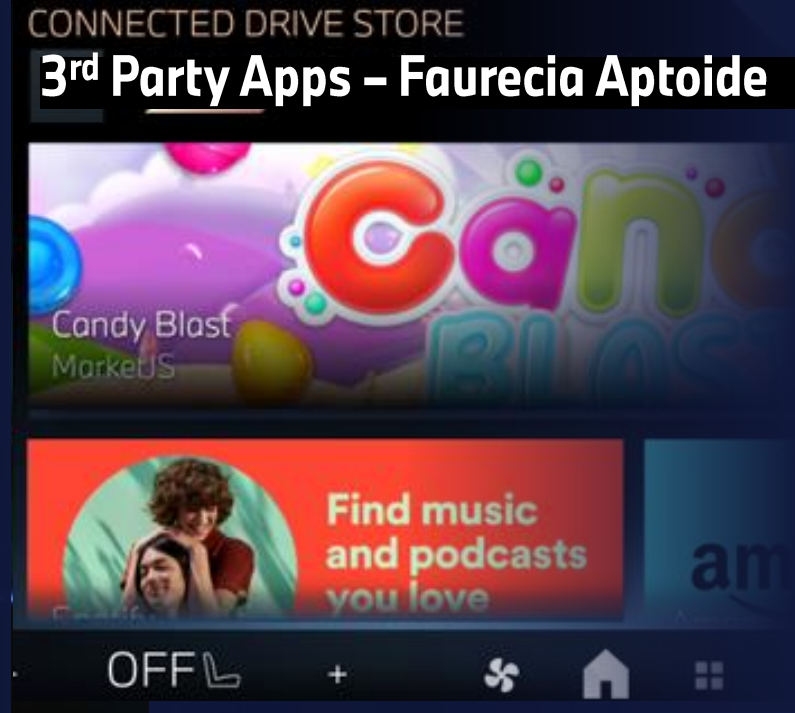
BMW optimized Route



Festive Mode - BMW



3rd Party Apps - Faurecia Aptoid



CHINA-SPECIFIC ECOSYSTEM.

70% software code by China for China.

Baidu 百度

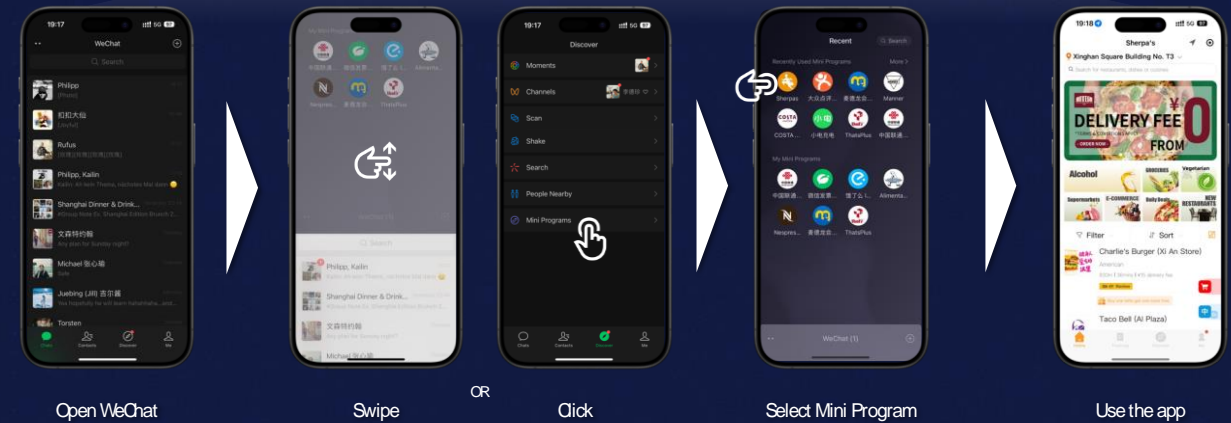
- Baidu Map 530 m.
- QIYI
- Tik Tok 1000 m.
- Pinduoduo 849 m.
- 京东

Alibaba.com

- Alipay 900 m.
- 淘
- Taobao 920 m.
- 盒马
- 天猫精灵
- 音乐
- Amap 730 m.

Tencent 腾讯

- WeChat 1260 m.
- QQ Music 800 m.



PICK THE BEST. OUR APPROACH ACROSS THE TECH STACK.



Make

State-of-the-art innovations

Fast iteration & re-use

Buy

Cost synergies
(cross-industry re-use)

„Pick-the-best“ approach

Open Source

„Standing on the
shoulders of giants“

Leveraging existing
ecosystems

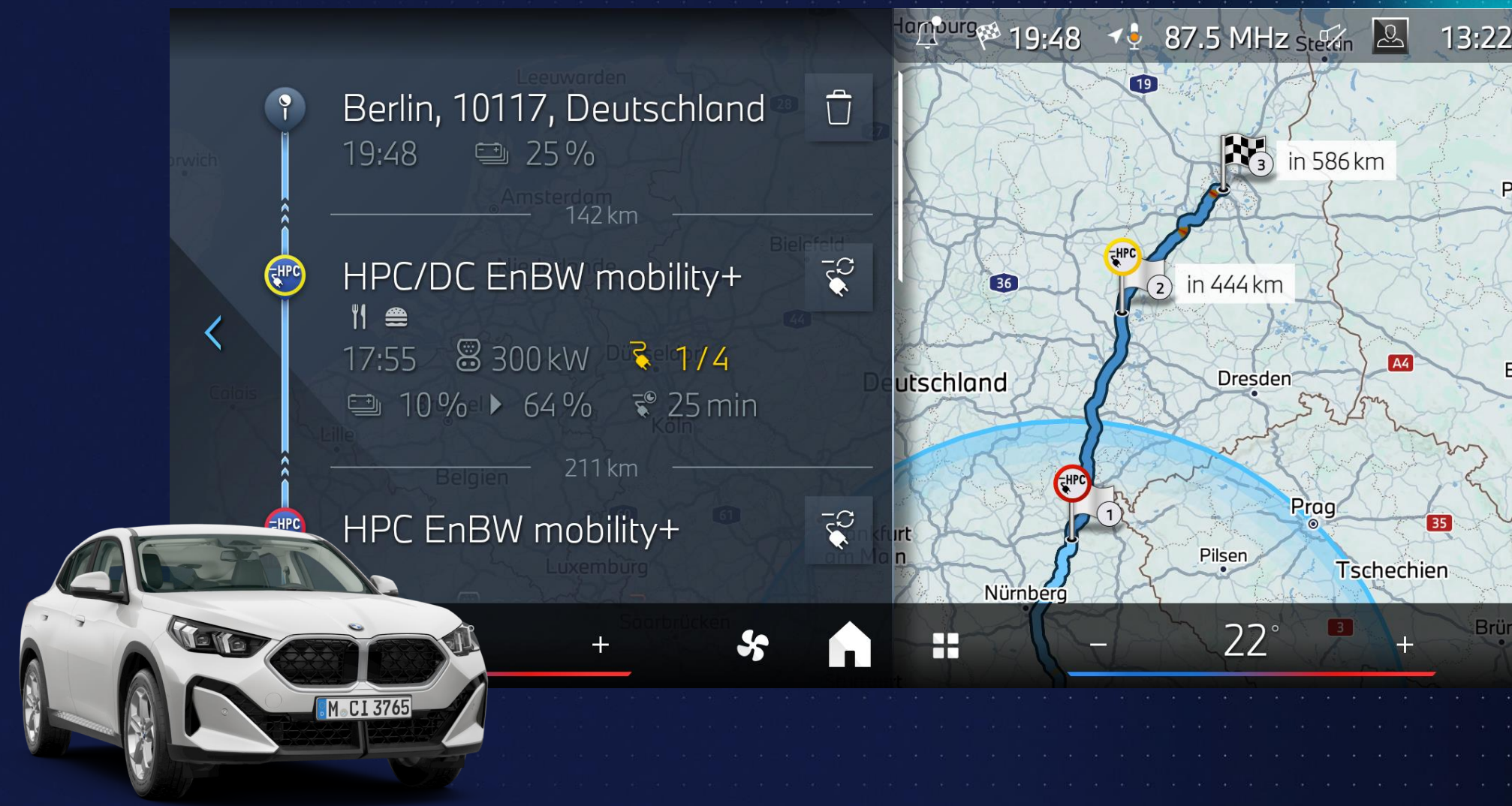
Partner

Innovations by co-
development

Shaping and establishing
industry standards

BMW CHARGING OPTIMISED ROUTE - BEST IN CLASS.

Peace of mind on all-electric
long-distance journeys.



BMW CONNECTIVITY. BEST MANAGED DEVICE.

THE DIGITAL EXPERIENCE
REQUIRES CONNECTED CARS.

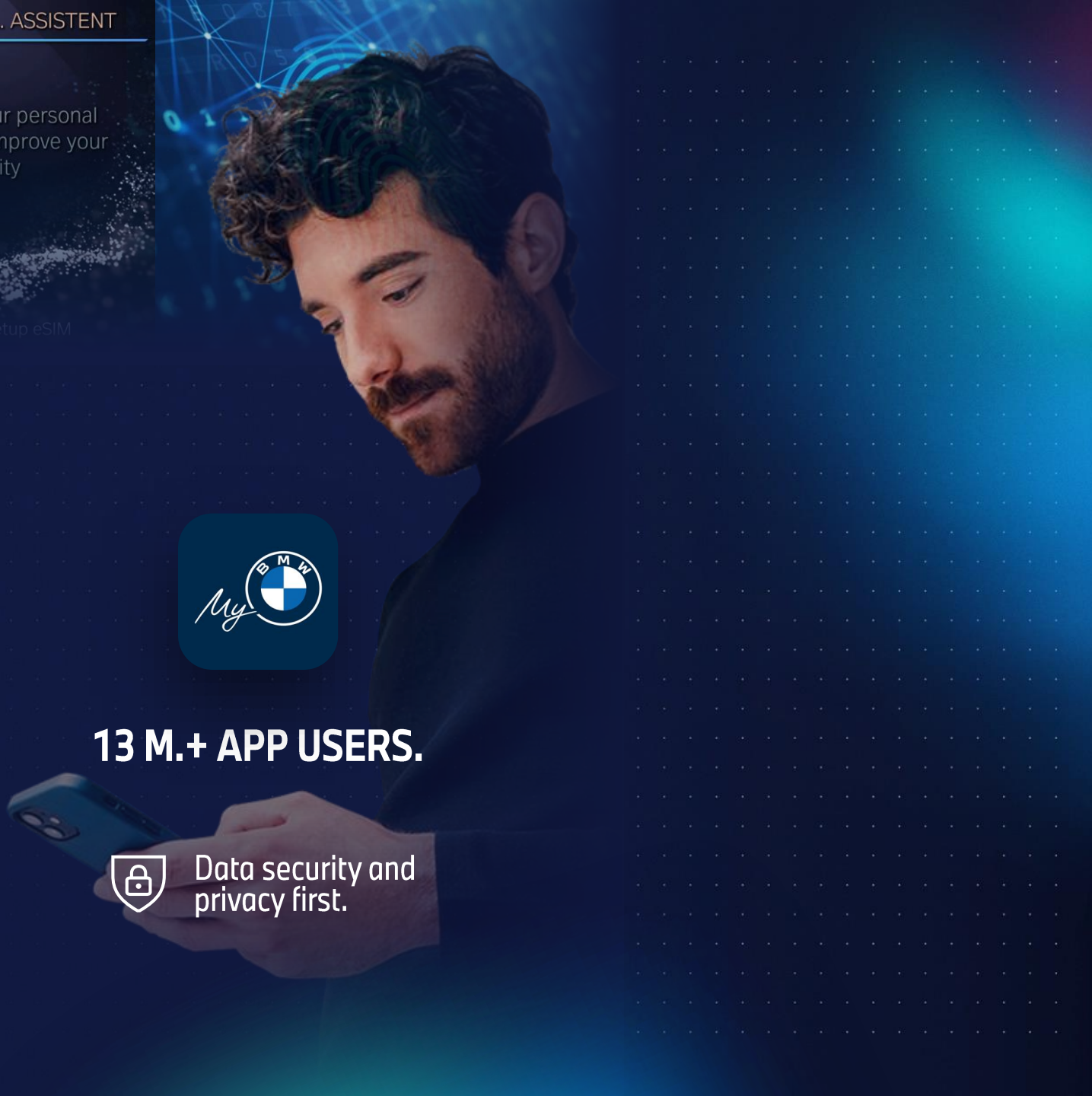
5G 5G connectivity.

22 M. VEHICLES CONNECTED TO
BMW CLOUD WORLDWIDE.

>8 m. fully
upgradeable over-the-air.

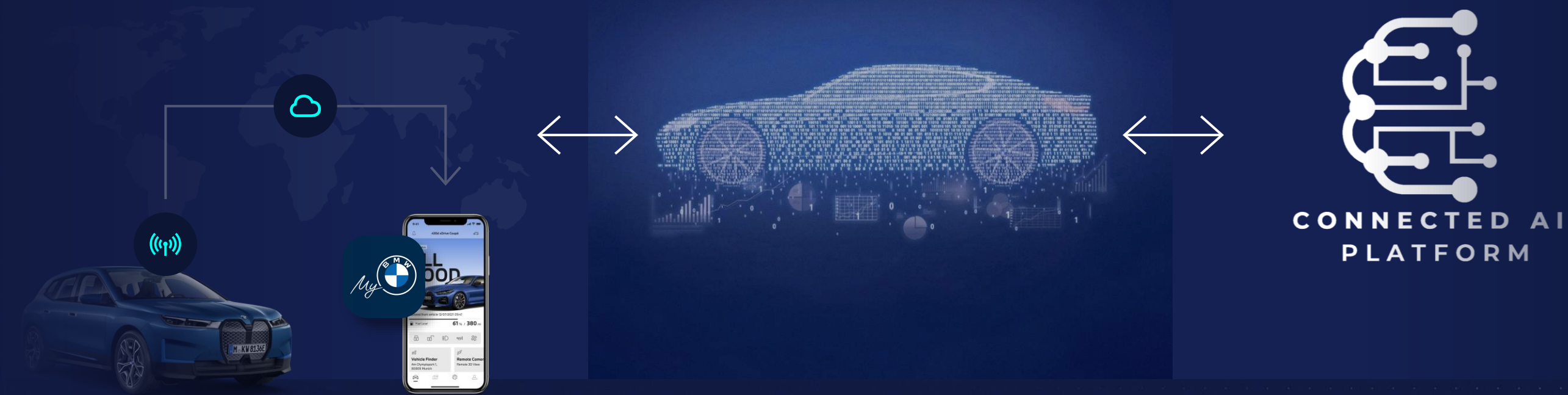
13 M.+ APP USERS.

Data security and
privacy first.



THE CONNECTED VEHICLE IS BASED ON A POWERFUL CLOUD-BACKBONE.

A flexible data collection infrastructure and a future-proof AI platform.



Scalable, world-wide cloud platform

- World-wide 24/7 availability
- Boosts reliability, dynamic scalability and stability
- Focus on customer functions

Flexible, compliant data collection

- 100% compliant
- Flexible, standardized and efficient data collection platforms in the vehicle and in the cloud

AI platform in the cloud and vehicle

- Platform for model training / execution and GenAI
- Productive in the cloud since 2023; in the vehicle as of 2025
- Enabler for data-driven use cases (e.g. Proactive Customer Care)

ALL IS NOTHING WITHOUT DATA.

Connected Vehicle Platforms.

THESE FIGURES ARE
EXPECTED TO **TRIPLE** OVER
THE NEXT TWO YEARS.

22M.+

Connected
vehicles

8M.+

Fully upgradable
vehicles

12B+

Requests
per day

1.100+

Microservices

165TB

Data sent to
fleet per day

99.95%

Reliability

THE NEW BMW iDRIVE.

We offer an interactive,
integrated system for the
ultimate UI/UX experience.



BMW Panoramic
Vision

BMW 3D Head-Up
Display

Connected Vehicle Backend
& 24/7 Operations

Central Display

Multifunction
Steering Wheel

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SOFTWARE-DEFINED VEHICLE AND ITS ELECTRONICS FOUNDATION

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BMW's SOFTWARE-DEFINED VEHICLE IS THE DELIVERY PLATFORM TO OUR DIGITAL CUSTOMER PROMISE.

Five pillars are key to realizing the SDV potential.



Scalability of hardware and software layers leverages development across segments.



Updateability keeps features and platforms fresh over generations.



Evolutionary code-base across generations ensures feature continuity and software re-use.



'Platformization' de-couples function development from fast-moving enablers.

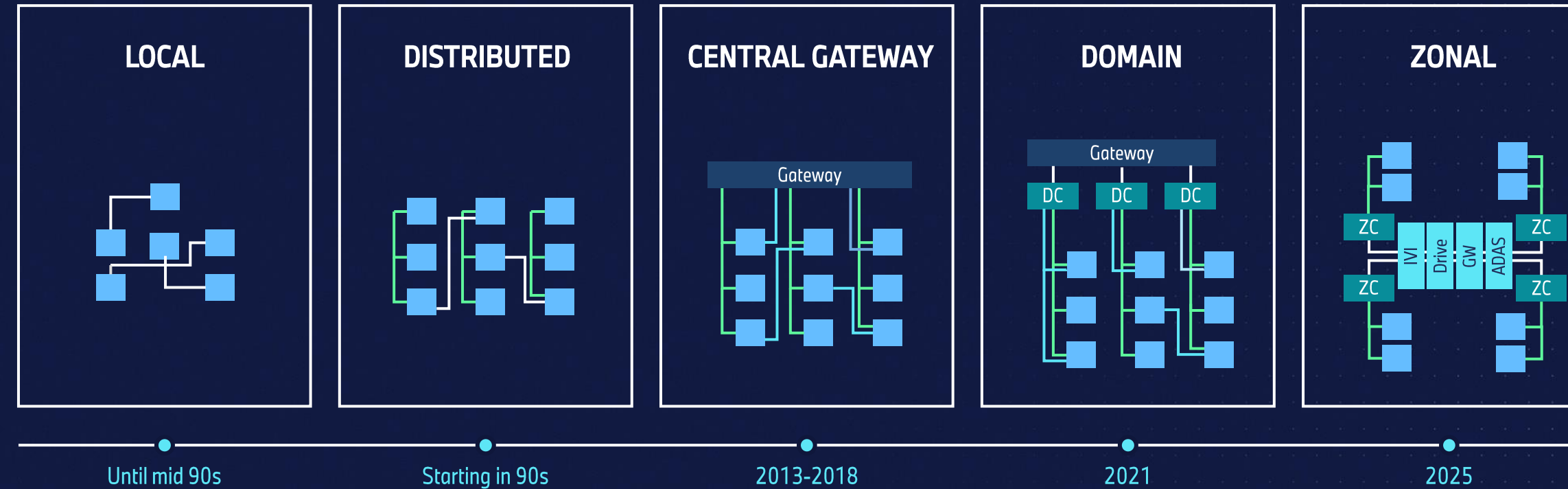


Globalization of developer network effectively uses independent contributions.



THE EVOLUTION OF BMW's E/E ARCHITECTURE.

Neue Klasse: Zonal architecture with centralization of performance compute.



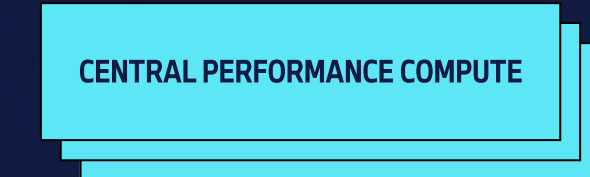
A zonal architecture with central performance compute platforms is key for SDV and an innovation driver for the semiconductor industry.

NAVIGATING ZONAL ARCHITECTURES: THREE TIERS OF ECUs.

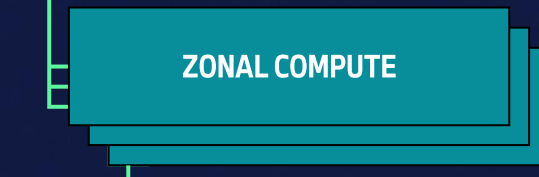
Central performance compute, zonal compute and peripherals.

FUNCTIONALITY

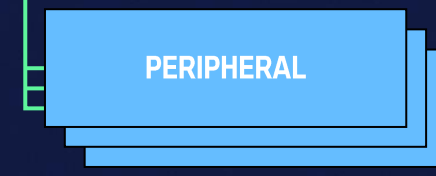
E/E SYSTEM BUILDING BLOCKS



CENTRAL PERFORMANCE COMPUTE



ZONAL COMPUTE



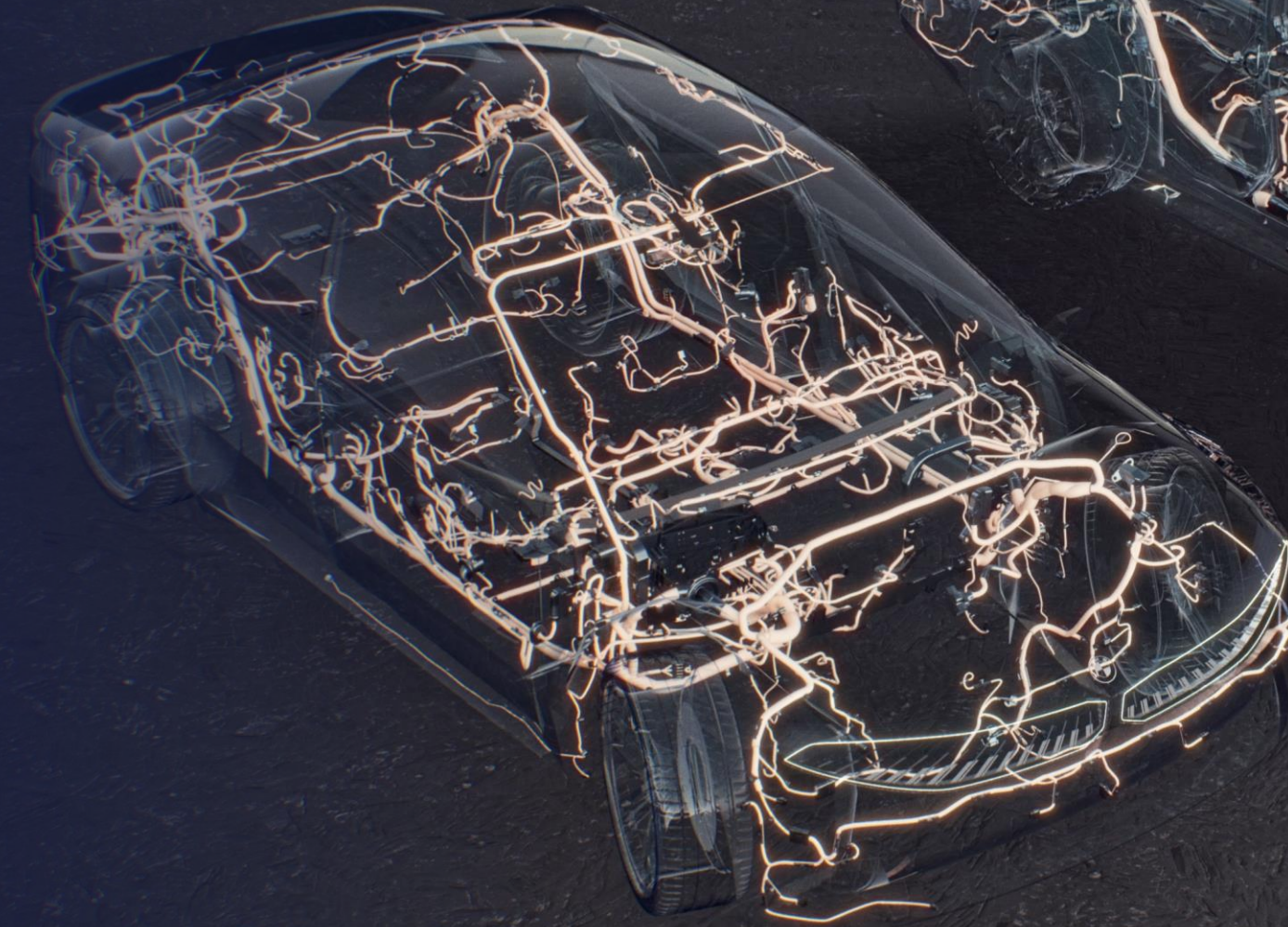
PERIPHERAL

- **Central compute platforms** with hundreds of kDMIPs per platform.
- **Differentiated domain requirements:** Safety vs. open POSIX systems.
- Regular **hardware updates** while maintaining **software compatibility**.
- Software integration and creation in **BMW Group Make**.
- **Smart energy distribution and management** for zones.
- Safe **real-time OS computers** with tens of kDMIPs per zone.
- Separation of **Gigabit Ethernet from signal-based peripherals**.
- **Physical de-coupling** of peripherals in separate zones (e.g. roof).
- **Sensors and actuators** with limited processing power.
- Safe **self-contained real-time** operations with single-digit kDMIPs.
- **Industry standard components**, spec based development.
- **No function logic** and typically limitation to single task.

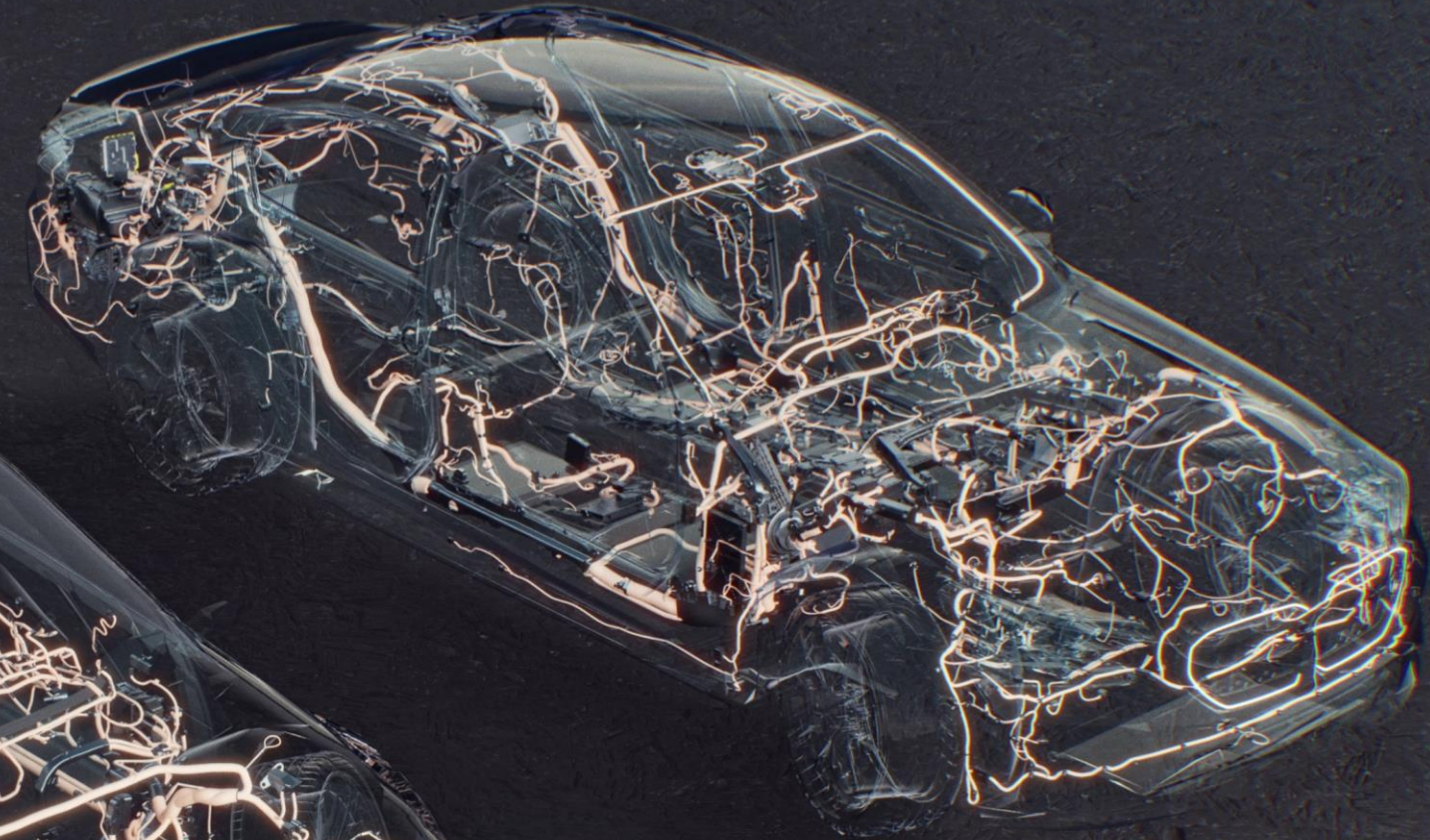
BMW E/E ARCHITECTURE. FROM TODAY TO NEUE KLASSE.

Central performance compute,
zonal compute and peripherals.

BMW NEUE KLASSE

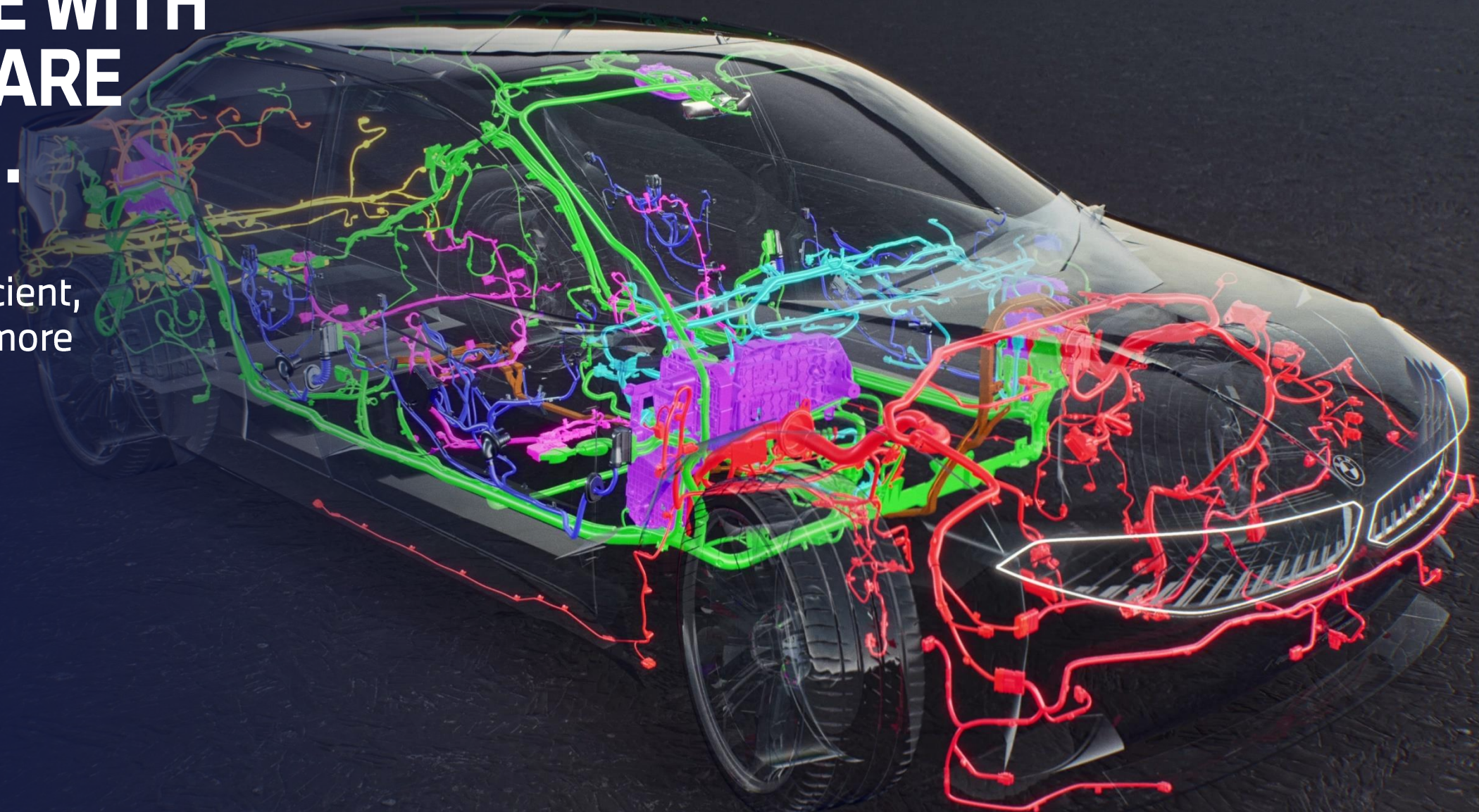


BMW i5



NEUE KLASSE WITH NEW HARDWARE FOUNDATION.

Consolidated, more efficient,
and, at the same time, more
powerful thanks to new
technologies.



Increased performance and functionality.
+20% energy efficiency.

Full zonalization of wiring harness.

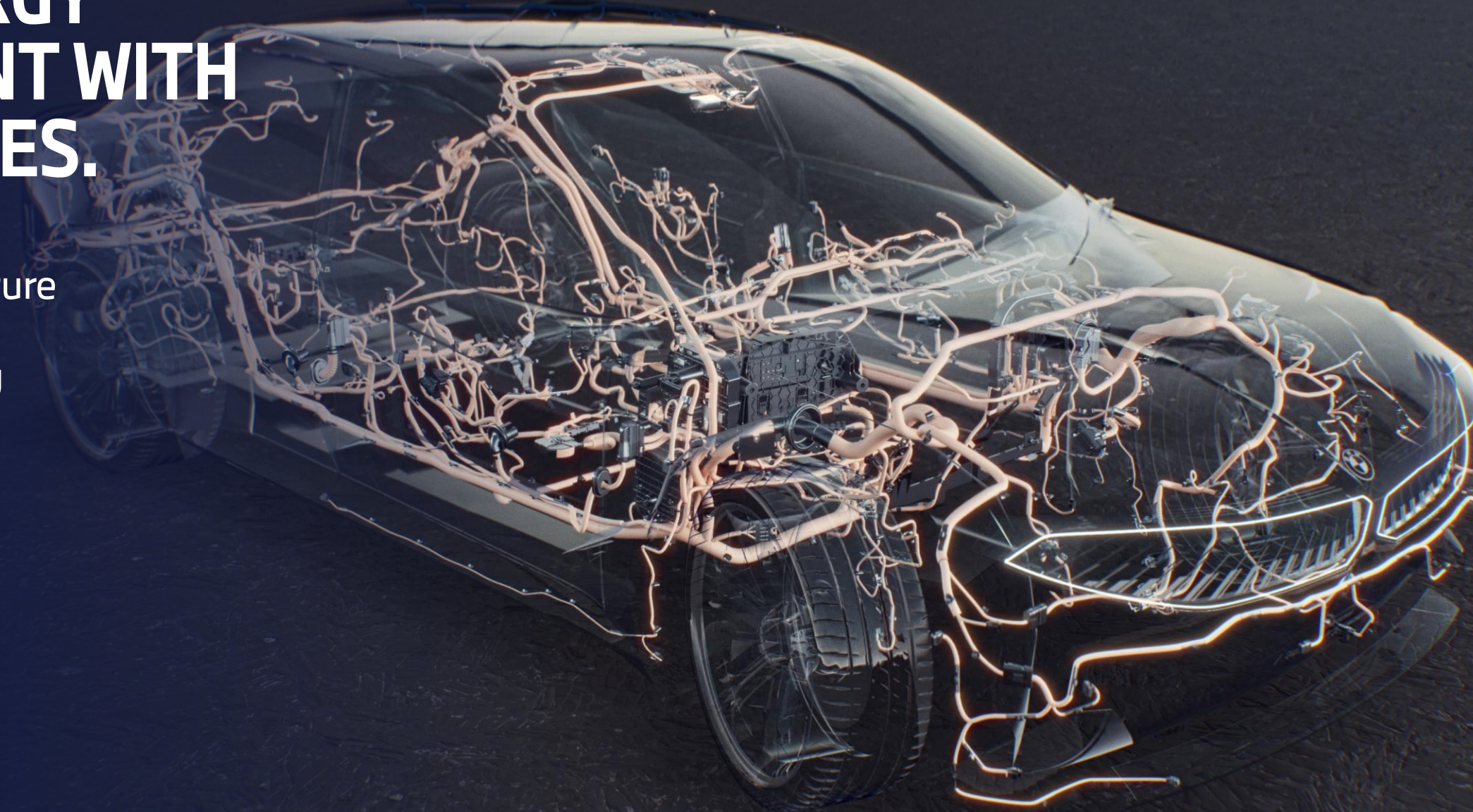
- 30% weight reduction
- Variant reduction by factor 3.000
- Increased diagnostics capability and security
- Automated production of wiring harness
- Drastic cost reduction through zonal architecture and automation

Centralization and intelligent computing.

- Two collocated central performance computers
- Increased performance, decreased complexity
- Future-proof with headroom for hardware upgrades
- Smart on-/offboard data processing
- Optimized energy consumption.

SMART ENERGY MANAGEMENT WITH SMART eFUSES.

With our zonal architecture
we also introduce
Smart eFuses replacing
traditional fuses.



Advantages of eFuses

- Significantly faster power switching
- Reduced need for maintenance and servicing (self-healing)
- Saves raw materials and weight (as physical cables can be reduced)
- **Lower system energy consumption and increased safety**

Digitally designed power modes

- Driving, Parking, Living, Charging
- Diagnosis, Service, Production
- Remote Software Upgrade

LEADING THE PATH TO NEXT GENERATION E/E ARCHITECTURE.

Co-development and (setting) standards in the right technical fields is key.

**BMW GROUP IS PUSHING FURTHER
STANDARDIZATION.**

eFuse standardization
(joint initiative by BMW Group and Infineon)

OPEN Alliance
(initiated by BMW Group)

Automotive SerDes Alliance
(initiated by BMW Group)

IEEE 802.3 TF for 10BASE-T1S
(Initiated and supported by BMW employees)

UCIe
(BMW Group joined in March 2024)

**PRE-COMPETITIVE COOPERATION
ON AUTOMOTIVE CHIPLETS WITHIN
IMEC ACP.**

BMW and IMEC signed MoU for evaluation of BMW **participation in IMEC ACP.**

THE DIGITAL CAR TECH STACK.

We are in control over the tech stack across domains and layers – for several generations already.

¹ UI: User Interface.
² ADAS: Advanced Driver Assistance System.
³ CPU/GPU: Central Processing Unit / Graphics Processing Unit.

OFFBOARD

Connected Platform

GEN 3

Cloud and edge

ONBOARD

> 22 million BMW Group vehicles connected to BMW Cloud.

Software applications.
 Functionality and features

Software platforms.
 Operating system and middleware

Shared Service Layer.
 Standardized functions, diagnosis, updates, security, data management, etc.

Hardware.

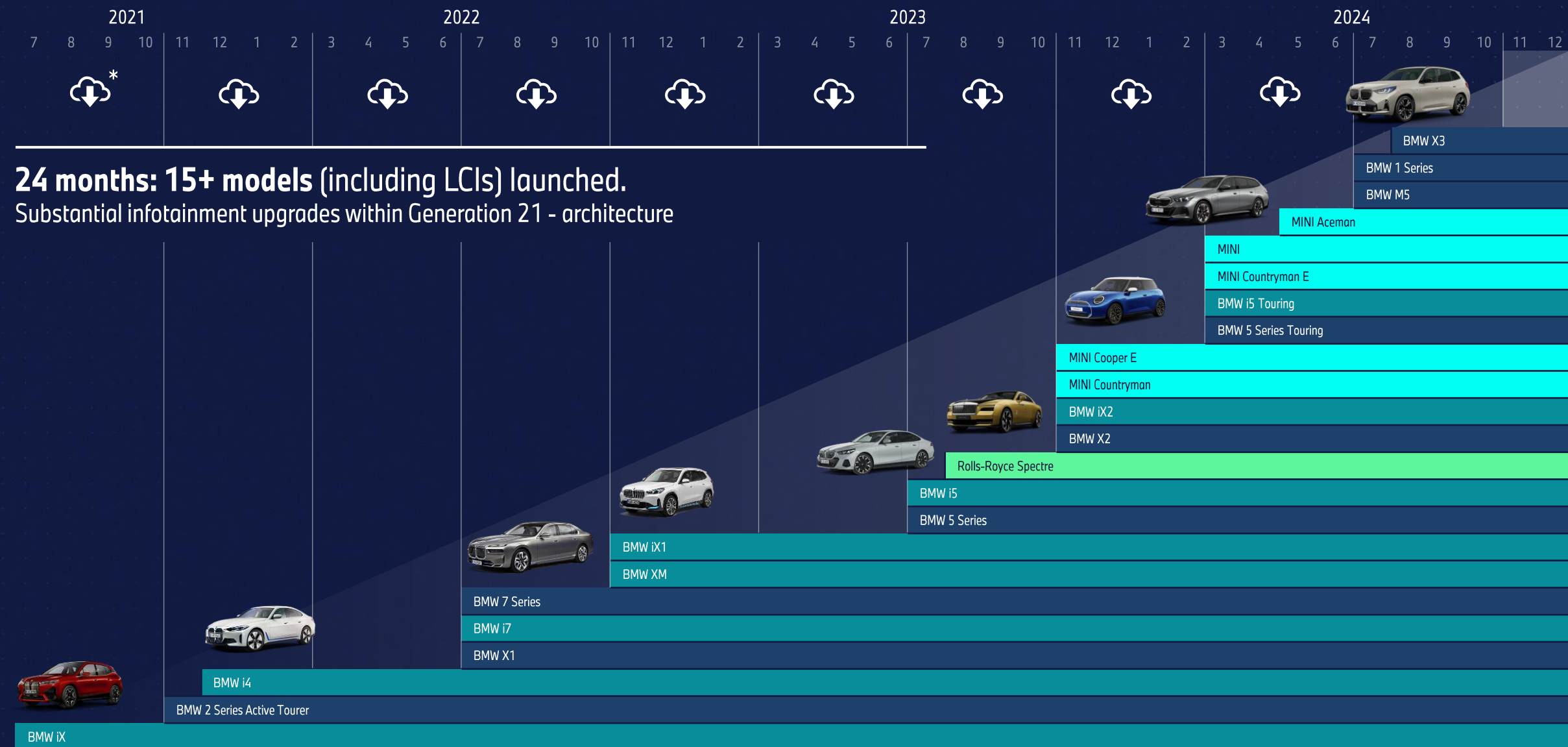


BMW / M / MINI / RR UI ¹			GEN 6	3	3	3	
Journey services	GEN 3	Driving assistance	GEN 3	Vehicle functions	GEN 4		
Infotainment OS	GEN 6	ADAS OS ²	GEN 3	Driving OS	GEN 4		
AI Core on the edge							
Remote Software Upgrade							GEN 2
Crowd Data Collector							GEN 3
Automotive Security							GEN 3
Performance CPU/GPU ³				Micro-Controller			

RAPID COVERAGE OF THE PRODUCT RANGE: REALITY = PLAN.

We reliably deliver strong: Launching new products and developing the future simultaneously.

- All-new BMWs
- All-new BMWs (EV)
- All-new MINIs
- All-new Rolls-Royce



OVER-THE-AIR (OTA) UPGRADE.

Upgradeability as essential enabler to keep the whole fleet up-to-date and secure.

LARGEST OTA FLEET

8+ M.
and counting

45+
models

3 brands
(BMW, MINI, RR)



ALL FUNCTIONAL DOMAINS



- Infotainment
- Drivetrain
- ADAS
- Charging
- Security

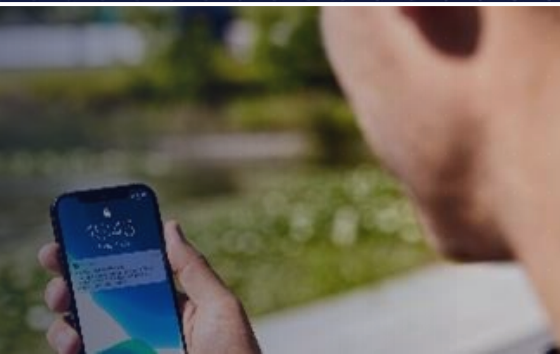
ALL POWERTRAINS

BEV	
PHEV	
ICE	

ALWAYS FRESH (over-the-air)

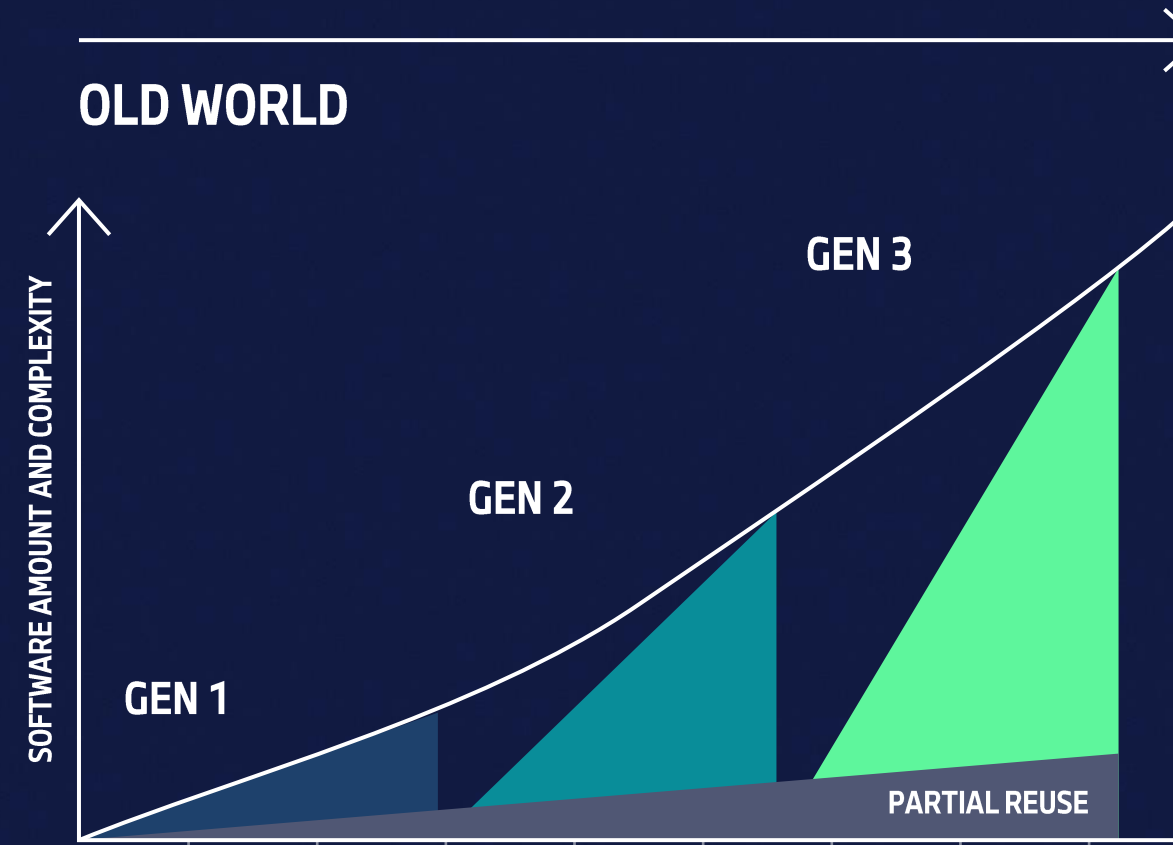


- 20 min installation time
- 120+ upgrades: features and quality improvements (since 2019)



SOFTWARE: GENERATIONS VS CONTINUITY.

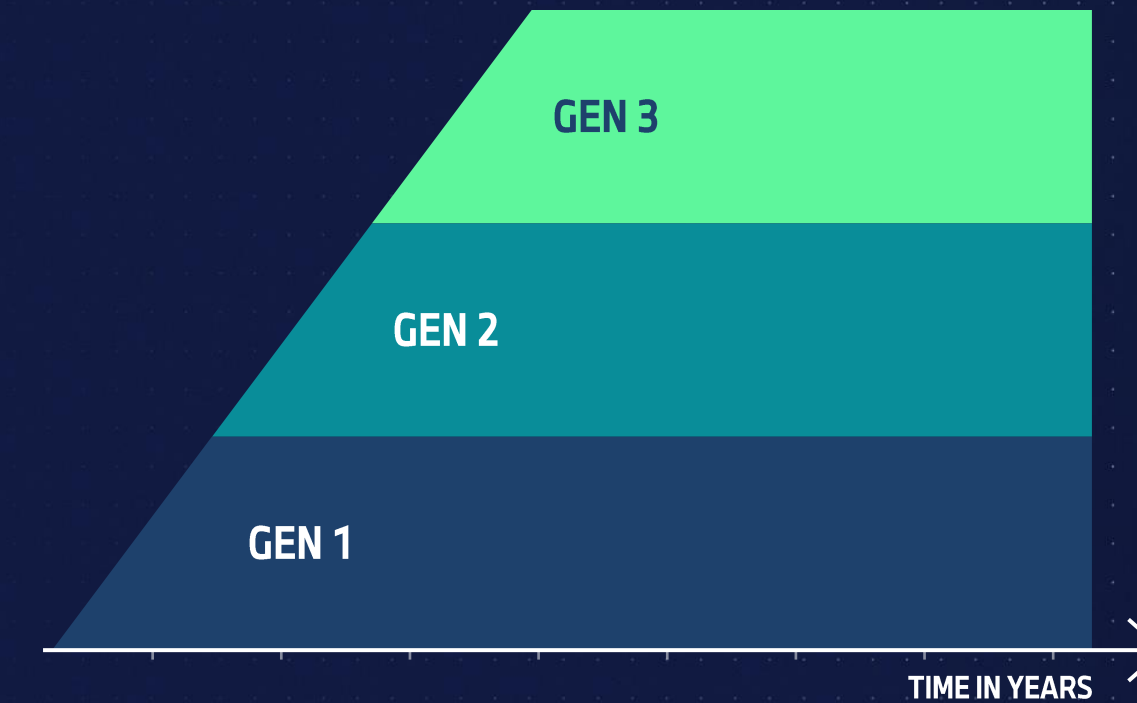
Evolutionary, scalable platforms are essential to enable software continuity and re-use.



Increasing effort across generations with increasing code size ...

New supplier constellations bring new hardware platforms with new semiconductors.

VS BMW GROUP TODAY



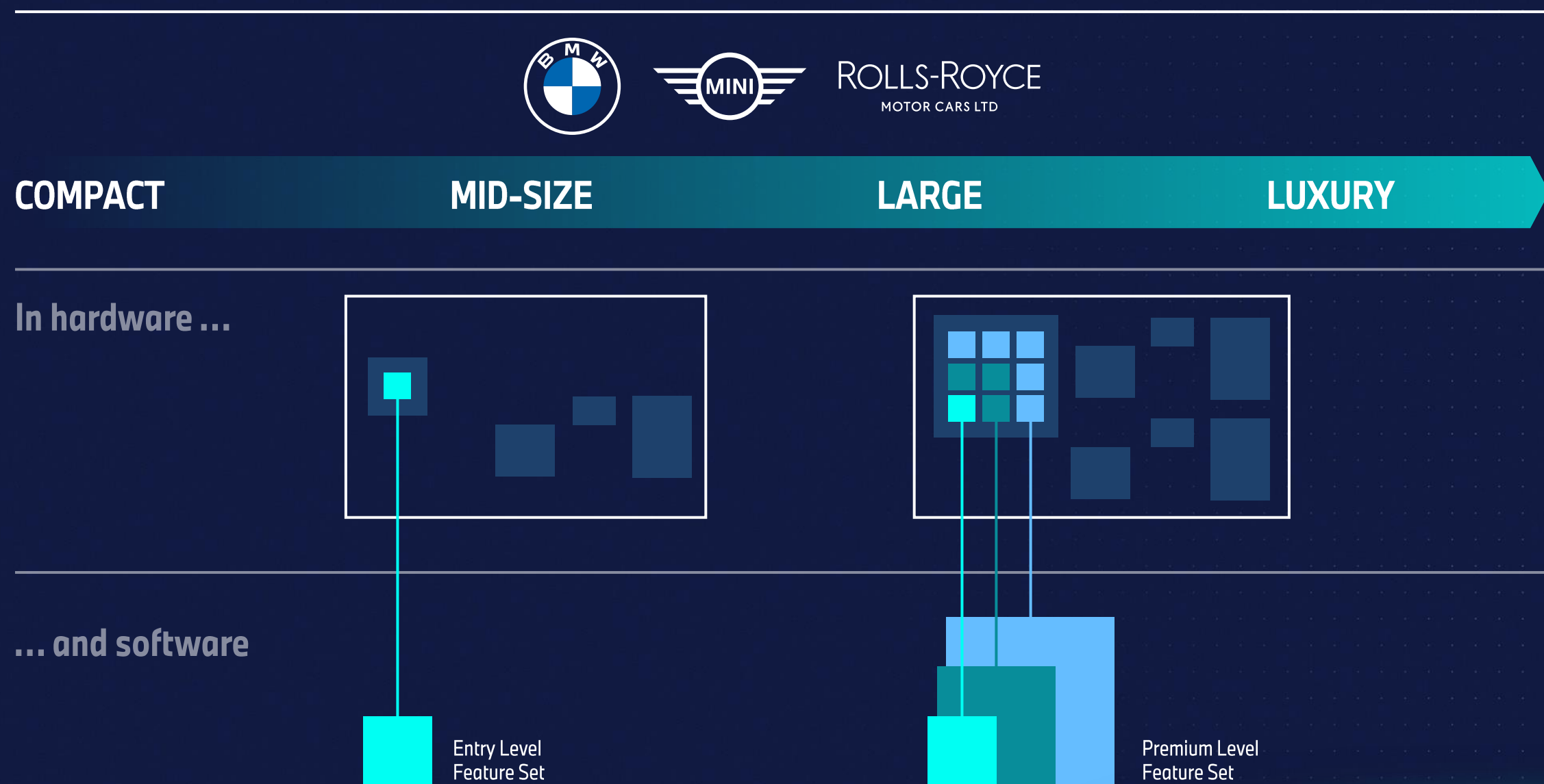
... **continuity and reuse of software.**

... **evolution of hardware & semiconductors.**

Stronger reliance on de facto standards and open ecosystems.

MODULAR AND STABLE HARDWARE PLATFORMS ENABLE SOFTWARE CONTINUITY.

Both are of utmost importance
to allow for scalability across
brand and product portfolio.



DIGITAL FOUNDATIONS. THREE ESSENTIAL ENABLERS FOR THE SOFTWARE DEFINED VEHICLE.

ONBOARD PLATFORM



→ SW Platforms for
**Infotainment, ADAS &
Body/Drive.**

OFFBOARD PLATFORM



→ Connectivity **backend**,
3rd party integration, **OTA**
upgrades and operations,
data-driven development.

DEVELOPER TOOLING



→ **Processes, methods &
tools** to enable state-of-
the-art SW development &
maintenance.

- **Already today**, these layers build the **foundations for a stable ecosystem.**
- **In future**, we expect even **more complex** requirements, and need **state-of-the-art software platforms and tooling** in order to develop upcoming functionality **more efficiently.**



IT'S NOT JUST ONE AUTOMOTIVE OPERATING SYSTEM.

We are running three main software platforms for Infotainment, ADAS and Driving/Body.



- **Performance-functions** with 3rd party ecosystems.
- Performance POSIX SW-Platform based on Linux / AOSP*.
- **Open-source.**
- **Performance safety-functions** for driving assistance.
- Safe POSIX SW-Platform based on QNX.
- **Commercial modular solution.**
- **Real-time-functions** for engine and chassis regulation.
- OSEK SW-Platform based on Classic Autosar.
- **Cross-OEM standardization.**

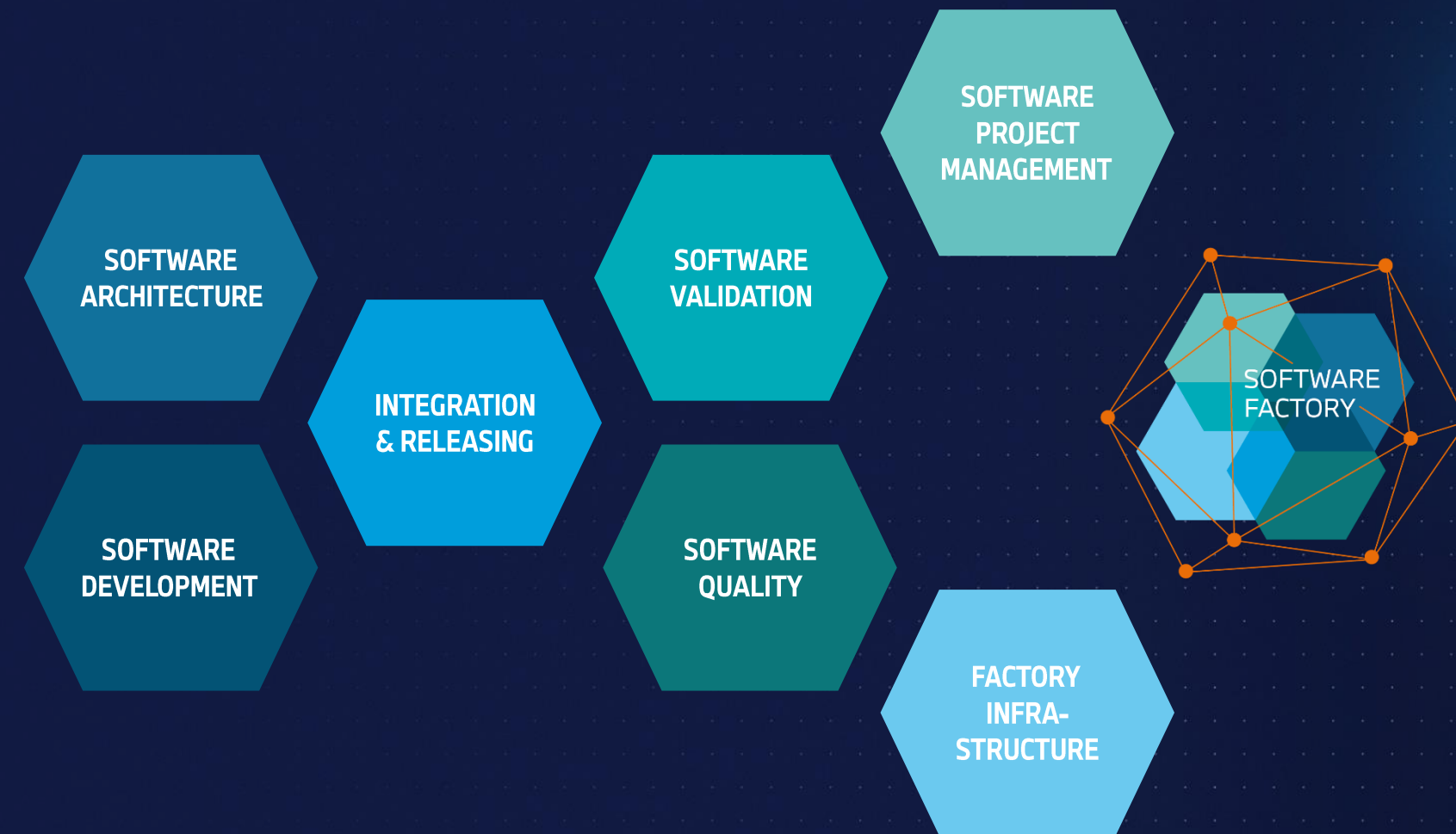
SOFTWARE PLATFORMS

*Android Open Source Project.

DEVELOPER TOOLING: BMW SOFTWARE FACTORY PROVIDES GLOBAL DEVELOPER ENVIRONMENT.

Enabling independent contributions from our global developer network.

- Harmonized processes and methods for state-of-the-art software development across all BMW Group departments.
- Professionally operated software toolchain – stable and performant, operating on AWS.
- Growth from coverage of all onboard projects to include our offboard content.



CUSTOMIZED AND 'HANDCRAFTED' TOOLCHAIN GREW RAPIDLY.

Enables delivery of increasing and more complex software – across domains and regions.

CODECRAFT REALIZED A GLOBAL SW DEVELOPMENT ENVIRONMENT FOR BMW.



CODECRAFT DELIVERS SCALABILITY



	2015	2024
# builds per day	~ 2.5k	~ 150k
# jobs per hour	~ 150	~ 14k
# CPUs in use	~ 1.0k	~ 75k (virtual)



50-100x performance in 10 years, enabling ...

... **20 min feedback** cycles reliably, despite ...

... **75% error reduction** (SiL) via shift to CI, realizing ...

... **200x SW platform complexity** (previous section).

BMW TOGETHER WITH PARTNERS HAS INITIATED A PUSH WITHIN ECLIPSE SDV TO JOINTLY DEVELOP AN AUTOMOTIVE GRADE SDV CORE STACK.



THREE JOINT WORKSTREAMS WERE SET UP.

01

Technology

Experts discuss technology of the full stack in workshops and create a map of modules and contents of the full stack.

02

Process

Expert and lower mgmt. create an alignment on how to do safety in the open source space (incl. tools, formats and methods).

03

Business

Business and series development meet to ensure a valid business model for the full stack.

DEVOPS HUBS PLAY PIVOTAL ROLE IN OUR AUTOMOTIVE SW DEVELOPMENT NETWORK.

 Mountain View


SW hubs set up as JVs with local partners designed to enable speed, productivity, and SW tech culture.

And to leverage the best talent.

 São Paulo

 Lisbon, Porto, Braga

 Munich, Ulm

 Pune, Bangalore, Chennai

 Shanghai, Beijing, Nanjing

 Tokyo

2018



A BMW GROUP & CRITICAL SOFTWARE COMPANY

- Portugal: Lisbon, Porto, Braga
- ~ 2,850 employees¹
- Automotive SW for global, Digital Company DevOps

2021



A BMW and ArcherMind Technology Company

- China: Nanjing
- ~ 640 employees¹
- Automotive SW for China & global

2024

BMW TECHWORKS INDIA

- India: Pune, Bangalore, Chennai
- JV announced in 04/24 in build-up
- Automotive SW for global, Digital Company DevOps

¹ EOY 2024 figures

CRITICAL TECHWORKS HAS BECOME THE LARGEST SOFTWARE COMPANY IN PORTUGAL.

Furthermore, Critical TechWorks acts as blueprint catalyzing our China & India hubs.

¹Source: Teamlyzer

SUCCESSFUL RAMP-UP TO MATURE SW HUB



Workforce tripling from '20-'24 (850 - 2,850 FTE). Portugal's largest SW company.



~40% of BMW i5 SW from CTW



#1 ranked IT employer in Portugal¹



94% employees 'hands on code'



Unique culture with self-managed teams

DEVELOP IN CHINA FOR CHINA



Distinct culture with 99% local employees



High-end office in heart of Nanjing's tech zone to attract best talent

BMW TECHWORKS INDIA: FURTHER SCALING SW COMPETENCE

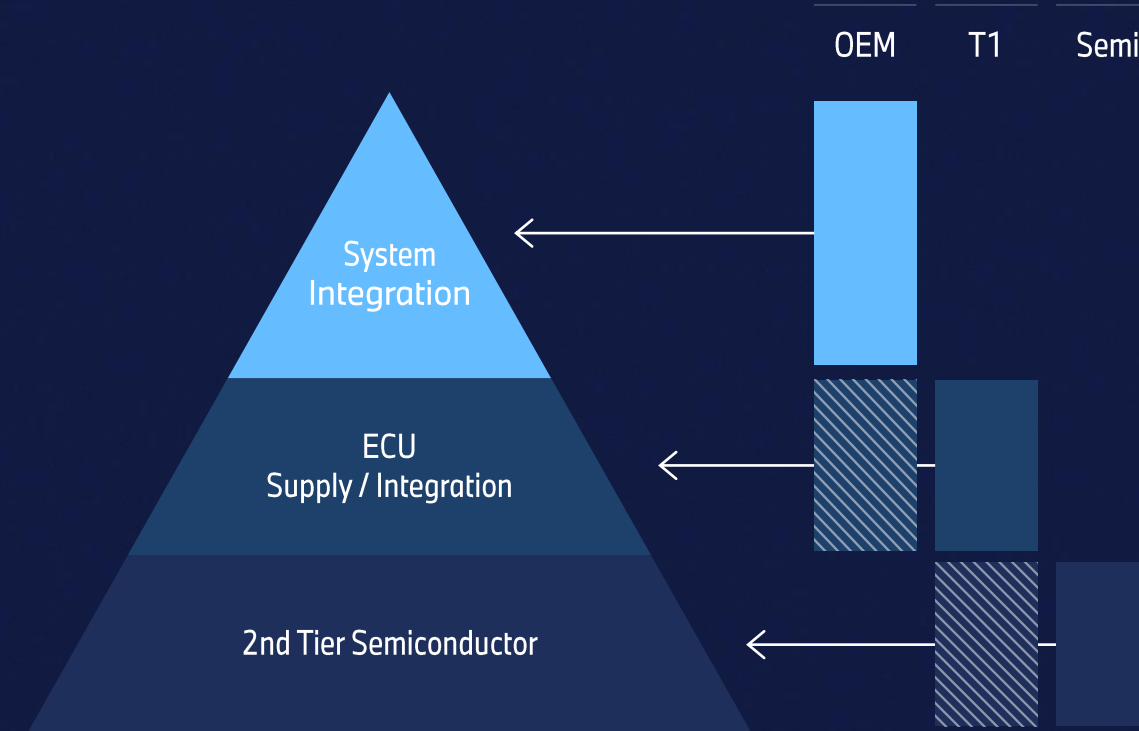


JV with TATA to ensure ideal local integration and quick scale up to four-digit number of employees in coming years

THE WORKING MODEL BETWEEN OEM AND TIER-1 CHANGES.

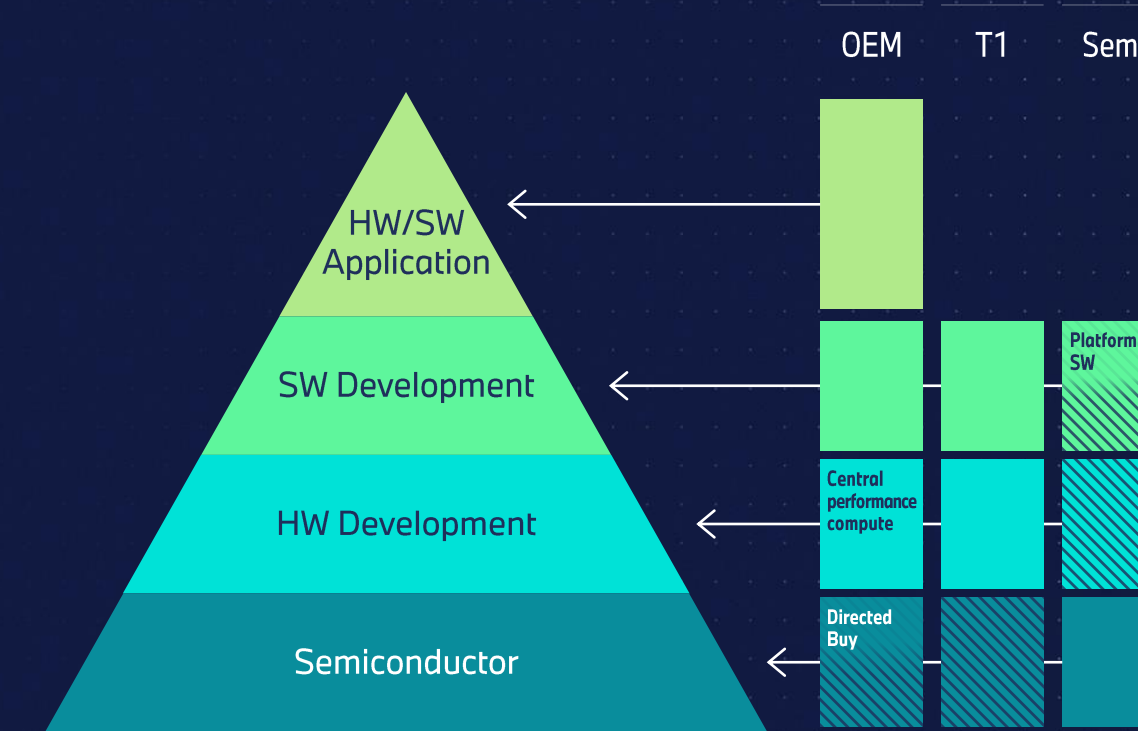
From 'contracting entity' to 'owner and integrator': OEMs need to embrace their new role, since a fundamental change takes place in the automotive ecosystem.

Classical ecosystem with ,traditional' roles



■ Fully colored: always involved
 ▨ Lined: partially involved

Tomorrow's ecosystem with new split of roles



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