



DISRUPTING MOBILITY.

THE BMW ADAS PROGRAM.

**BMW
GROUP**

THE NEXT
100 YEARS 



Rolls-Royce
Motor Cars Limited



THE TALK TOUCHES UPON THREE TOPICS.

1

STRATEGIC APPROACH

2

**TECHNOLOGICAL
CHALLENGES**

3

THE ROAD AHEAD

STRATEGY NUMBER ONE > NEXT: CONNECTED & SELF-DRIVING ARE KEY FOR BMW. BOTH ARE CLOSELY INTERTWINED.

Technology/Innovation Leadership

Future field: Digitalization



Connectivity



Autonomous driving



Artificial intelligence

Future field: Powertrain technology



Efficient Dynamics NEXT



Electro-mobility



Hydrogen

Strategic Partnerships

1 DAY

700 million
GPS positions

4 million BMWs with
RTTI

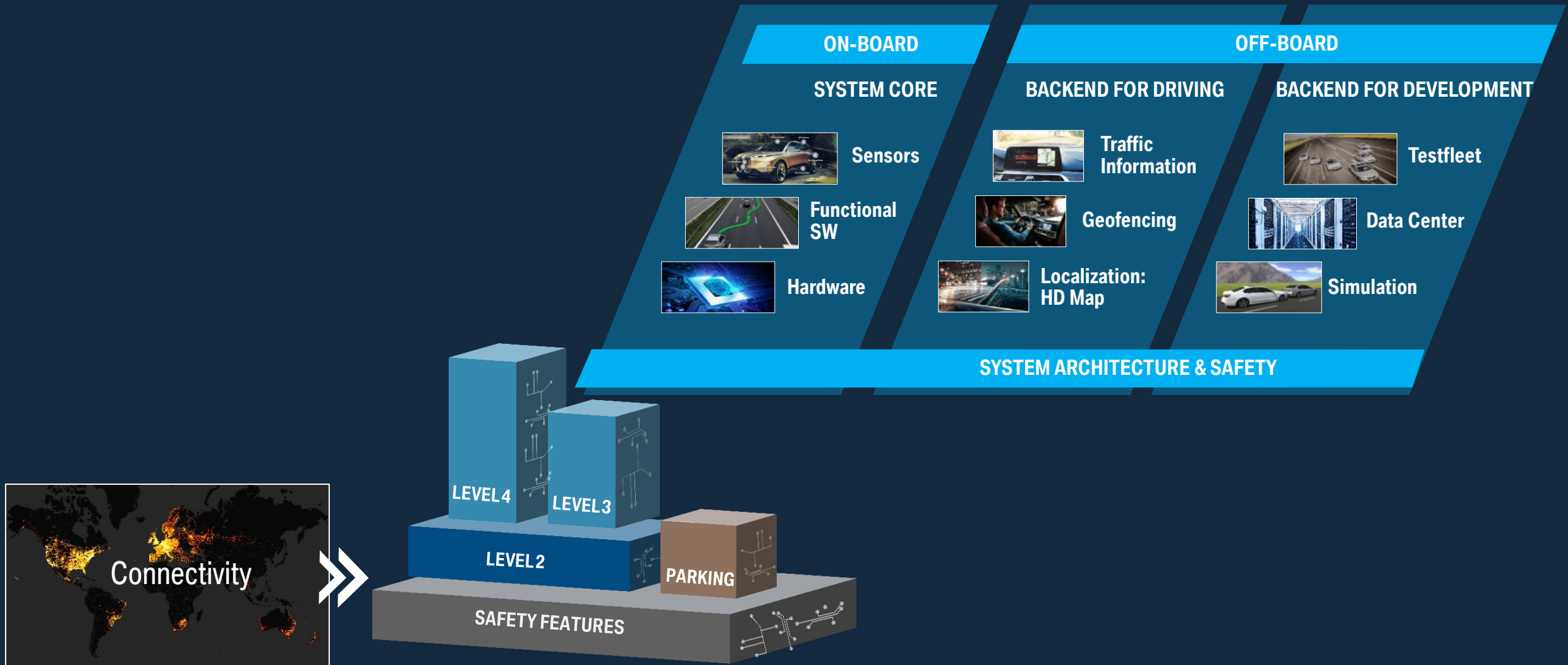
Traffic sign
collection: **25 million**
signs each day...

140 million
driven **kilometres**



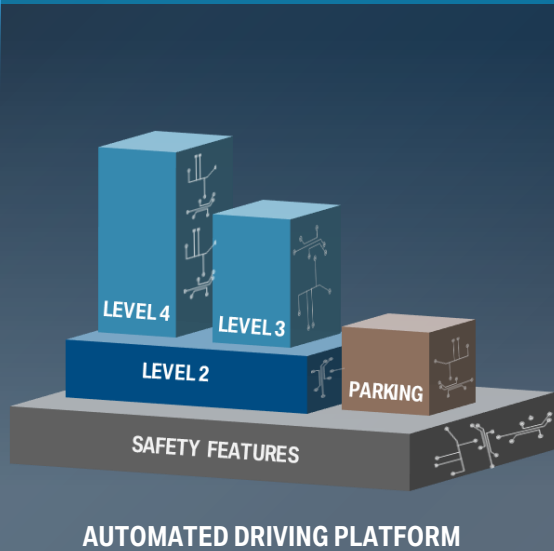
12 MILLION CONNECTED BMW ON THE ROADS.

WHAT: THE BMW ADAS SYSTEM.



HOW: BMW STRATEGIC ADAS APPROACH WITH FOUR MAIN PILLARS.

MODULAR & SCALABLE PLATFORM



Saving up to 25% of one-time costs through reuse of content like sensors and SW.

STRATEGIC PARTNERSHIPS



Bringing together the best players from OEM, Tier1, Tech and Start-Up world.

NEW WAYS OF WORKING



Agile SW development, virtual development & validation.

REGULATION & STANDARDIZATION

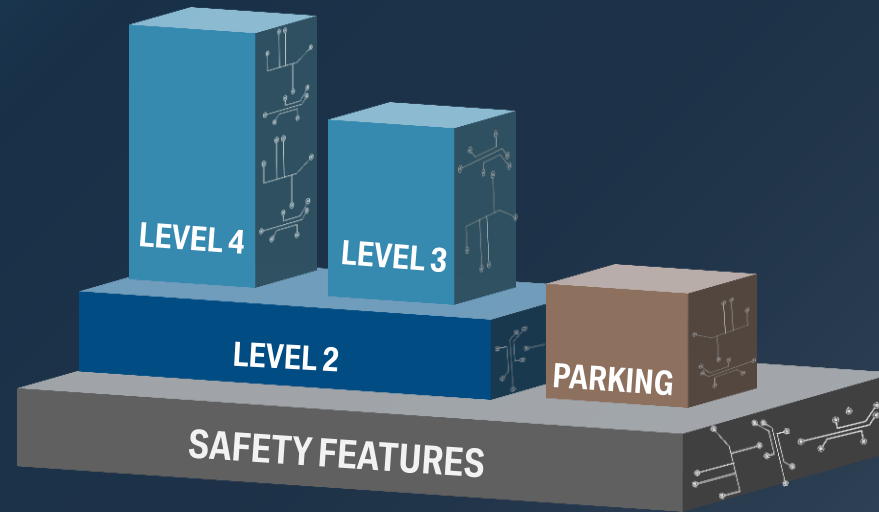


Jointly define the state of the art of technology.

WHAT ARE THE KEY BENEFITS OF A MODULAR & SCALABLE PLATFORM?

CORE CHALLENGE: AUTOMOTIVE INDUSTRY COMBINES HIGH VOLUMES AND HIGH VARIANCE.

Increases **REUSE OF DEVELOPED CONTENT** like sensors & SW across different levels & generations.



Allows **REUSE OF TOOLS & PROCESSES** across generations.

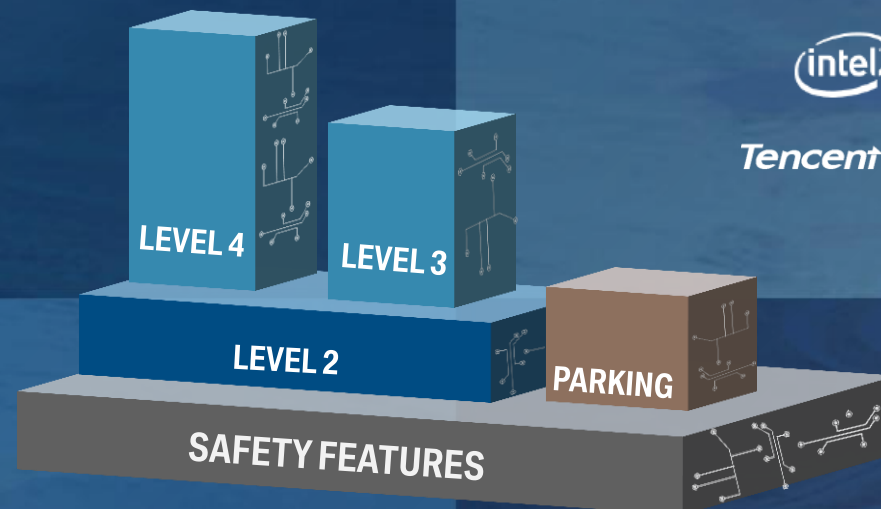
Facilitates **TESTABILITY OF INDIVIDUAL** modules.

FLEXIBILITY: different speeds/requirements in the three Geo-regions.

Allows **REUSE OF COLLECTED DATA** across generations.

➤ SCALABILITY & MODULARITY ENHANCE PRODUCT QUALITY & SAVE UP TO 25% OF OVERALL ONE-TIME COSTS.

PARTNERSHIPS WITH LEADING TECH COMPANIES ARE KEY TO MASTER THE CHALLENGE OF AUTONOMOUS DRIVING.



Technology Partners



SCALABLE & MODULAR
AUTOMATED DRIVING PLATFORM



OEMs

Component Partners

WITH AGILE PRODUCT DEVELOPMENT WE DELIVER A PRODUCT INCREMENT EVERY 2 WEEKS.

1. STRATEGIC APPROACH



OEM's

SPRINT
2 weeks

Technology &
Component Partners



HANDLE COMPLEXITY | FAIL FAST, LEARN FAST | GAIN SPEED.

DATA DRIVEN DEVELOPMENT AND TESTING ARE KEY TO AUTONOMOUS DRIVING.

ON-BOARD

OFF-BOARD

AUTONOMOUS DRIVING VALUE STREAM



OUR LARGE, FAST INCREASING CONNECTED FLEET CONSTITUTES A COMPETITIVE ADVANTAGE.

AT OUR **AUTONOMOUS DRIVING CAMPUS**, WE BUNDLE ALL COMPETENCES TO SOLVE THE TECHNOLOGICAL CHALLENGES.

1. STRATEGIC APPROACH

ON-SITE TEAM:

1,800 internal & external experts



VEHICLES:

~100 test vehicles for Automated Driving



DATA:

200+ PB of storage
+ additional Data Center in China



WHERE DO WE STAND TODAY?

L1

DRIVER ASSISTANCE

L2

PARTIAL AUTOMATION



- 43 features of advanced driver assistance system on the road – available for customers.

⇓
TODAY

L3

CONDITIONAL AUTOMATION



- Software architecture fixed.
- Software Platform integration ongoing.
- Technical safety concept in development.

- Testing on public roads worldwide.
- Data infrastructure established, further extension to China signed.

⇓
**2021:
HIGHWAY AUTO MODE**

L4

HIGH AUTOMATION



- Pre-industrialization of prototypes (Pre-Series).
- Base functionalities integrated.
- Evaluation and development ODM ecosystem with partners.

⇓
**2021: PILOTFLEET
URBAN AUTO MODE**

L5

FULL AUTOMATION

AGENDA.

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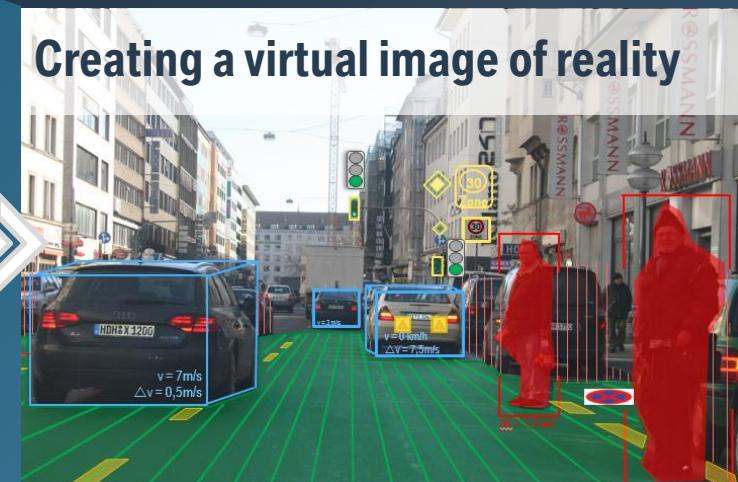
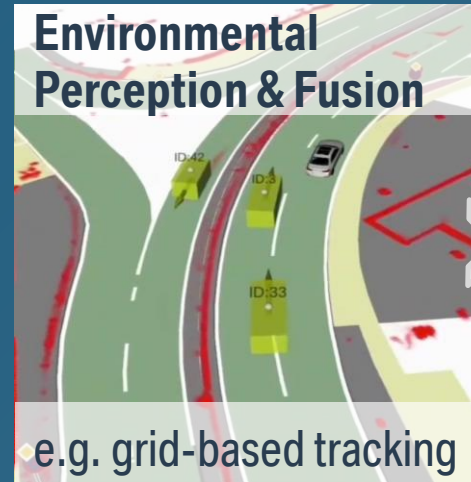
THE ROAD AHEAD

WE ENSURE A SAFE 360° ENVIRONMENTAL PERCEPTION BY USING CAMERA, RADAR AND LIDAR.

New challenges – increasing resolutions & data rates



- High performance computing & storage req.
- Real-time data processing
- Advanced algorithms
- Standardization & industrialization



Scalable L2-5 Heterogeneous Sensor Setup

➤➤ **APPROACH MAXIMIZES SAFETY WITH 360° COVERAGE, REDUNDANCY, RELIABILITY & INTEGRITY.**

SAFETY FIRST: MORE THAN 240 MILLION KILOMETERS IN TESTING AND DEVELOPMENT TO BE COMPLETED.

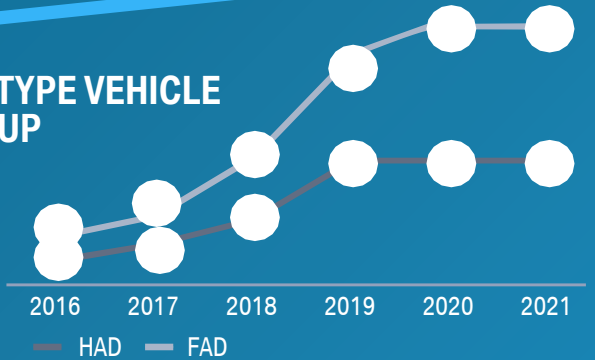
DRIVING SIMULATION & SW IN THE LOOP



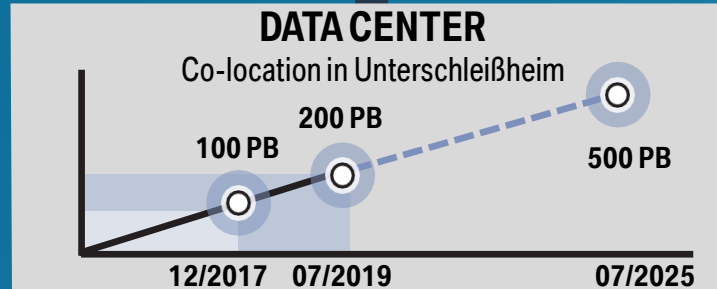
CONSIDERATION OF PROBABILITY OF OCCURANCE
REPRODUCIBILITY OF USE CASES:
REQUIRED > 95 %



PROTOTYPE VEHICLE BUILD-UP



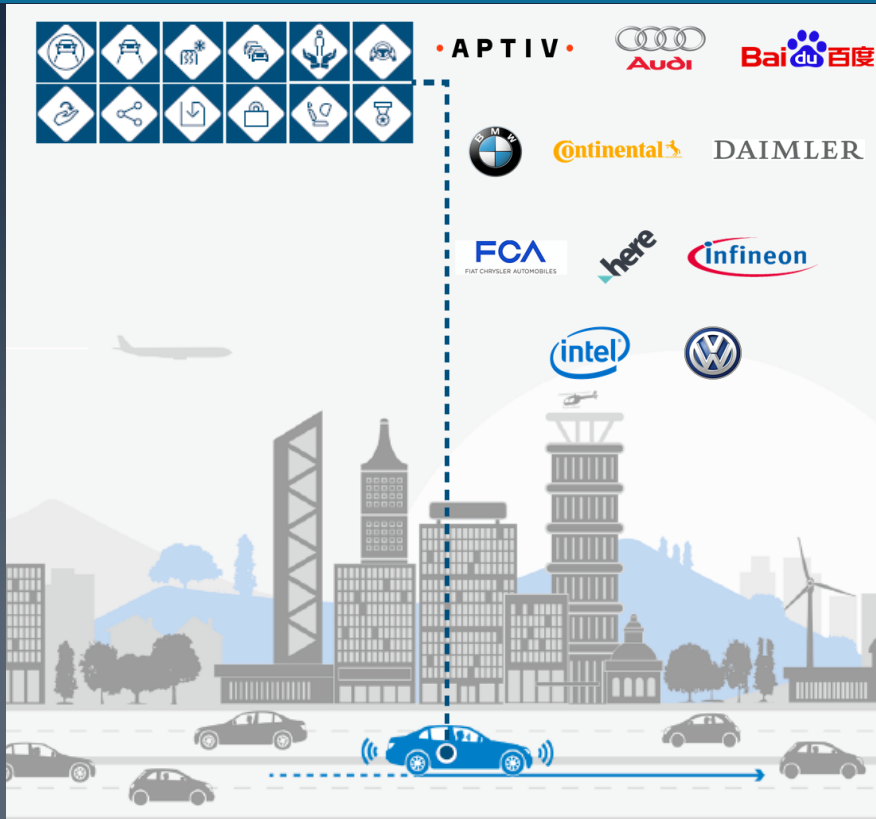
FAD: 8TB/H = 64TB/DAY; 5 DAYS RUNNING
HAD: 12TB/H = 96TB/DAY; 5 DAYS RUNNING



PRAGMATIC REGULATION NEEDED TO ALLOW A RELIABLE EVOLUTION OF TECHNOLOGY.

THE WHITE PAPER 'SAFETY FIRST FOR AUTOMATED DRIVING' IS A BIG STEP TOWARDS STANDARDIZATION.

WHITE PAPER



APPROACH AND BENEFITS

- Safety Vision based on **Twelve Safety Principles**
- Focus on **Safety by Design**
- Consider **Legal Frameworks** and **Safety Standards**
- Derive **Capabilities** of Automated Driving from **Dependability Domains**
- Top level goal „**Safer than the average human driver**“ with consistent **traceability** to the elements of the system.
- **Validation & Verification** of the overall Automated Driving System

» FOR MORE DETAILS FOLLOW THE PRESENTATION OF THE WHITE PAPER LATER TODAY.

AGENDA.

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**TECHNOLOGICAL
CHALLENGES**

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THE ROAD AHEAD

OUR TECH STACK WILL BE AMONGST THE FEW 'SURVIVORS'.

WHAT WE EXPECT...

- **Consolidation of tech stacks:** Only a few platforms will prevail in the long-term.
- **Key skills for success:** System integration & automotive security competencies are mission-critical.
- **Down to earth:** Announcements of competitors are already postponed or cancelled.
- **Out of money:** Some companies run out of money.
- **Reality check:** Profitability expectations of ODM business become more realistic/critical.

...AND WHAT TO DO.

- **Be persistent:** Long breath is needed to succeed!
- **Stay flexible:** Modular tech stacks are essential to account for different adoption speed and regulation in geo-regions.
- **Keep calm:** Don't scale or invest too early into immature technology!
- **Act together** in standardization and regulation topics → white paper.
- **Stay curious:** It's an innovation field, you can learn & adjust every day.
- **Join forces:** Cooperation helps to generate critical mass and leverage new technology. → Cooperation with Daimler

OUTLOOK: BMW AND DAIMLER WILL JOINTLY DEVELOP THE NEXT GENERATION OF AUTONOMOUS DRIVING.

STRATEGIC GOALS ...



Enlarge the footprint of the Automated Driving Platform.



Develop a **state-of-the-art** solution.



Maximize **synergies** and share **R&D costs**.



Ensure the highest **quality and safety** for customers.



Accelerate the **time to market**.

... AND SCOPE OF COOPERATION



- Next generation of technologies for **driver assistance** systems: **highly automated driving** on highways and **parking**.
- **Flexible** and **scalable** platform from Level 1 to 4.
- Technology to be market **ready by 2024**.
- Open for **further cooperation**.



EXCITING TIMES AHEAD – WE SHAPE THE FUTURE OF MOBILITY!