IN SPRINTS TOWARDS AUTONOMOUS DRIVING.
BMW GROUP TECHNOLOGY WORKSHOPS.
AUTOMATED DRIVING OPENS NEW OPPORTUNITIES FOR CUSTOMERS AND COMMUNITY.

MORE SAFETY
MORE COMFORT
MORE FLEXIBILITY
MORE TIME

NEW MOBILITY CONCEPTS

LESS EMISSIONS
LESS ACCIDENTS
LESS TRAFFIC

CAR AS EXTENDED LIVING SPACE
The development of today’s assisted functions to tomorrow’s autonomous driving equals a technological quantum leap.

Driver  | Feet off  | Hands off
--- | --- | ---
No assistance (L 0)  | Assistance (L 1)  | Semi-automated (L 2)

Transferring responsibility from individual to machine.

Eyes off  | Attention off  | Passenger
--- | --- | ---
Highly automated (L 3)  | Fully automated (L 4)  | Autonomous (L 5)

Transfer of responsibility from eyes and attention to the machine.
BMW HAS CREATED A STRONG SETTING FOR THE DEVELOPMENT OF AUTONOMOUS DRIVING TO SHAPE THE FUTURE OF MOBILITY.
CROSS-INDUSTRIAL PARTNERSHIPS NEEDED FOR A SUCCESSFUL DEVELOPMENT OF THE AUTONOMOUS DRIVING.
FOR A FAST SUCCESS, BMW WILL DEVELOP A NON EXCLUSIVE PLATFORM FOR THE MARKET TOGETHER WITH ITS PARTNERS.
THE WINNING FORMULA IS TO ADOPT A LEAN AND AGILE MIND-SET, BOTH ACROSS THE ORGANIZATION AND WITHIN COLLABORATIONS.

Short distances, fast communication.

Interdisciplinary teamwork for common targets.

Central base for workshops, simulation and validation.

Highly efficient agile product development.

New organization models.

Scalable and open for partners.
THE CHANGE WE ARE DRIVING FORWARD IS NOT ONLY ABOUT TECHNOLOGY, IT’S ALSO ABOUT WORKING MODELS.

Today.

Focus on components and cascaded responsibility.

Tomorrow.

Focus on features with end-to-end responsibility.
CORE OF THE AUTONOMOUS DRIVING TECHNOLOGY IS THE END-TO-END ARCHITECTURE.
BMW TAKES THE SENSOR SETUP TO A NEW LEVEL TO RELIABLY DETECT ALL RELEVANT OBJECTS IN URBAN ENVIRONMENTS – TARGET SENSOR SETUP WILL CONTAIN 44 SENSORS.

Not shown: 360° Surround-View Cameras, 360° Ultrasound Coverage, 1x Rear Camera, 2x Rear Lidar, 2x Full-Range Radar.
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING ARE INDISPENSABLE TO SUCCESSFULLY UNDERSTAND AND TRAIN THE RIGHT DRIVING BEHAVIOR.

On-Board

- Perception, Sensor fusion
- Plan Execution, Motion Control

ARTIFICIAL INTELLIGENCE

- Scene Understanding
- Mission and Trajectory Planning

Off-Board

- Labeling of Training Data
- Evolution Through Training
- Simulation and Sign-off

MODEL UPDATE

FLEET DATA

BACKEND
MACHINE LEARNING BY EXAMPLE – PARKED VEHICLE CLASSIFICATION.

**Training – Backend**
- Sensors
- Labeled training-data (1000 x)

**Execution – On board**
- Sensors

**Forward Pass**
- Not Parked
- Parked

**Backward Pass**
- Learned model

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In sprints towards Autonomous Driving | December 2017.
DATA DRIVEN DEVELOPMENT REQUIRES STATE OF THE ART DATA CENTERS.

Currently ~ 85 PB storage capacity – 10x larger network gateways into INTEL than ever before.

**Data center**
End of 2017 70 PB data capacity at BMW, target capacity of 200 PB in 2019 compares with 770 km CDs.

**Storage capacity**
Ramp-up of capacity up to 200 PB until 2019, with flexibility of further capacity increase.

**INTEL Campeon**
Currently ~ 85 PB storage capacity – 10x larger network gateways into INTEL than ever before.
SAFETY FIRST: SEVERAL MILLION KILOMETERS WITHOUT ACCIDENTS TO BE COMPLETED – SIMULATION AND HUGE DATA STORAGE IS REQUIRED.
SAFETY FIRST: SEVERAL MILLION KILOMETERS WITHOUT ACCIDENTS TO BE COMPLETED – SIMULATION AND HUGE DATA STORAGE IS REQUIRED.

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WE PERFORM UP TO 2 MILLION SCENARIOS PER DAY!
FOR DATA COLLECTION AND TEST DRIVES A MODERN TEST FLEET OF 40 VEHICLES IN 2017 ON BASIS OF 7 SERIES WAS BUILD, WORLD WIDE TEST DRIVES STARTED.

Data Driven Development.

Prototypes as critical to success developing tools.

Mission: testing, developing and collecting data.
MODERN VEHICLE INTEGRATION LAB FOR VEHICLE TEST FLEET AT THE AUTONOMOUS DRIVING CAMPUS.

Perfect realization in Vehicle Integration Lab at AD Campus: Ingestion and flashing of the prototypes
BMW WILL PAVE THE WAY TOWARDS AUTONOMOUS DRIVING WITH A GO LIVE OF THE HAD AND FAD FUNCTIONS STARTING WITH THE iNEXT IN 2021.

- AD Campus Munich
- 40 HAD/ FAD test vehicles
- Integration of further partners
- Ca. 140 HAD/ FAD test vehicles
- HAD drives in US/ EU
- FAD drives MUC downtown
- HAD/ FAD starting with iNext
- HAD drives in US/ EU/ Asia
- FAD drives US/ EU/ Asia

Timeline:
- 2017: 13
- 2018: 25
- 2019: 30
- 2020: 50
- 2021: 135

In sprints towards Autonomous Driving | December 2017.
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