Cris Pavloff, BMW Group Technology Office USA, 7/15/14.

ON THE WAY TO HIGHLY AUTOMATED DRIVING.

CHALLENGES, OPPORTUNITIES, AND KEY TECHNOLOGIES.

BMW GROUP
Research and Technology

THE TRANSITION BETWEEN PARTIALLY AND HIGHLY AUTOMATED DRIVING REPRESENTS A MAJOR STEP.

STEP CHANGE

Driver only	Assisted	Partially automated	Highly automated	Fully automated
Driver performs longitudinal **AND** lateral control at all times.	Driver performs longitudinal **OR** lateral control at all times.	Driver must actively monitor the system at all times.	**Driver no longer needs to actively monitor the system.**	**Longitudinal and lateral control tasks are performed entirely by the vehicle, within specific applications. The driver does not need to monitor the system.**
e.g. Speed Limit Info	e.g. Parking Assistant	e.g. Traffic Jam Assistant	**Longitudinal and lateral control tasks are performed by the vehicle (for a certain period of time and/or in specific situations).**	
No actuated assistance systems.	The other (longitudinal or lateral) control task is performed by the vehicle.	Longitudinal and lateral control tasks are performed by the vehicle (for a certain period of time and/or in specific situations).		

Regulated by law and introduced into the market.

Not regulated by law and under research.

(Source: BASt Working Group 2012)

HIGHLY AUTOMATED DRIVING WILL INCREASE SAFETY, COMFORT AND EFFICIENCY FOR BOTH THE DRIVER AND THE TRAFFIC SYSTEM.

IMPROVED TRAFFIC AND DRIVING SAFETY.

Vehicle can see and react to hazards that a human driver may not be able to.

INCREASED DRIVING COMFORT.

Gaining valuable time by delegation of driving tasks.

IMPROVED DRIVING EFFICIENCY.

Time and fuel savings through optimized driving strategy.

FROM RESEARCH TO REALITY: BMW'S HISTORY IN DRIVER ASSISTANCE SYSTEMS LAYS THE FOUNDATION FOR HIGHLY AUTOMATED DRIVING.

HIGHLY AUTOMATED DRIVING ON THE MOTORWAY.

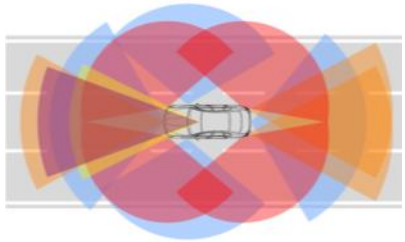
FUNCTION.

- Observes all traffic rules.
- Speed 0 – 80 mph (130 km/h).
- Remains in the lane.
- Overtakes slower vehicles.
- Cooperative characteristics at merging entrances to the motorway.
- Highly automated changes between motorways.
- In appropriate situations the driver can delegate all driving tasks to the car.

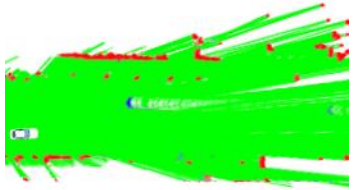
MASTERING THE BASIC TECHNOLOGIES IS THE FIRST STEP TOWARDS HIGHLY AUTOMATED DRIVING.

BACKEND / COOPERATIVE ITS (INTELLIGENT TRANSPORT SYSTEM)

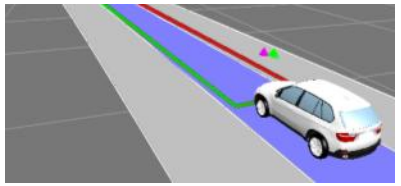
SENSORS



ENVIRONMENTAL MODEL



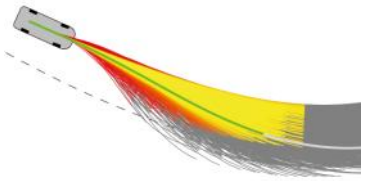
Representations



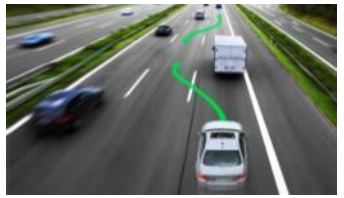
Localization

VEHICLE CONTROL

HIGHLY AUTOMATED DRIVING FUNCTION



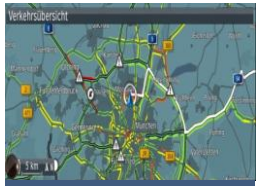
Trajectory Planning



Driving Strategy

E/E ARCHITECTURE AND ECUs

COOPERATIVE ITS IS AN ESSENTIAL PART OF OUR ARCHITECTURE. HIGH DEMANDS ON ACCURACY, AVAILABILITY AND PENETRATION.

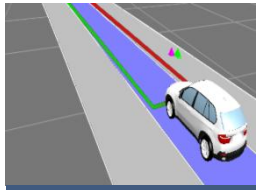


Real-time information

Variable traffic signs

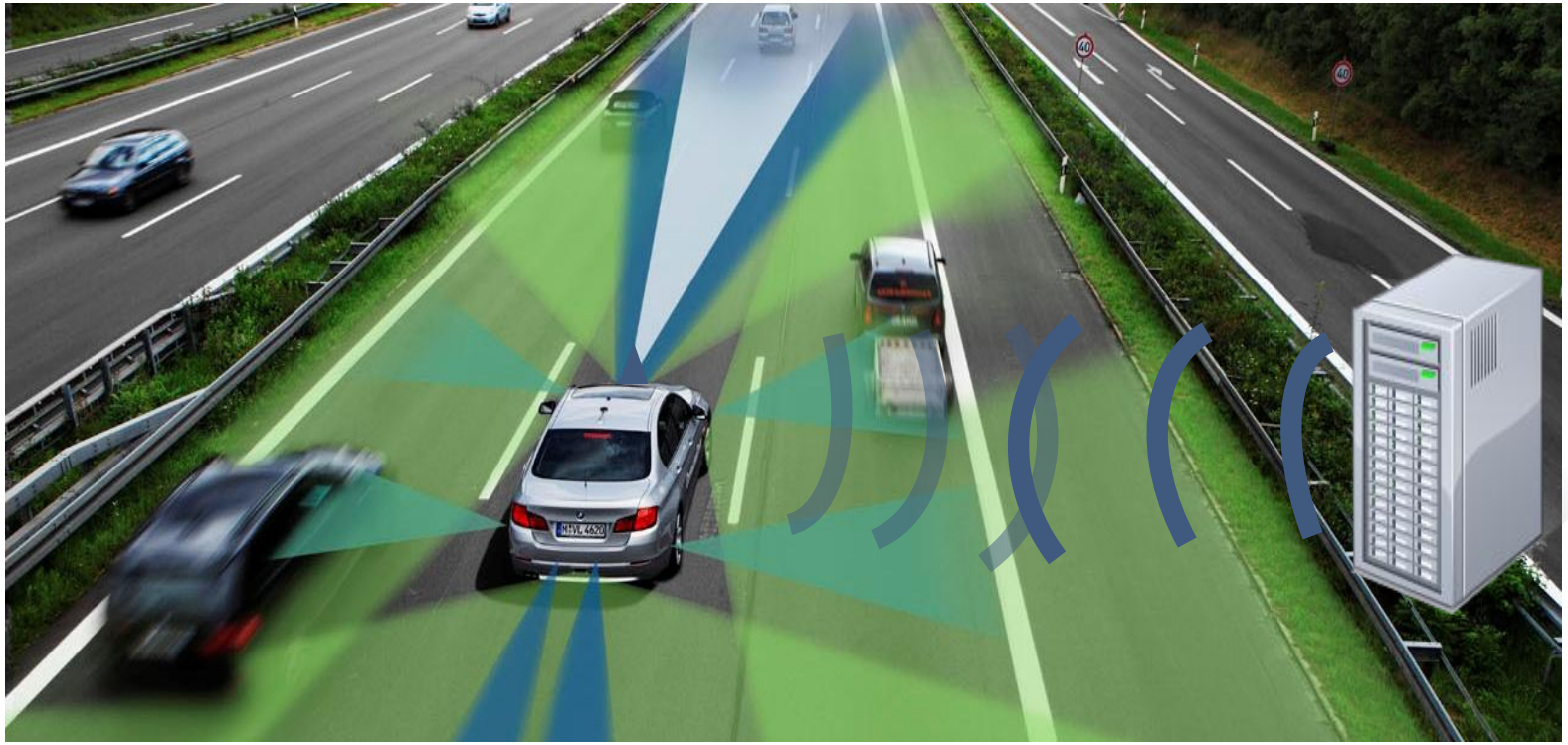
Traffic conditions

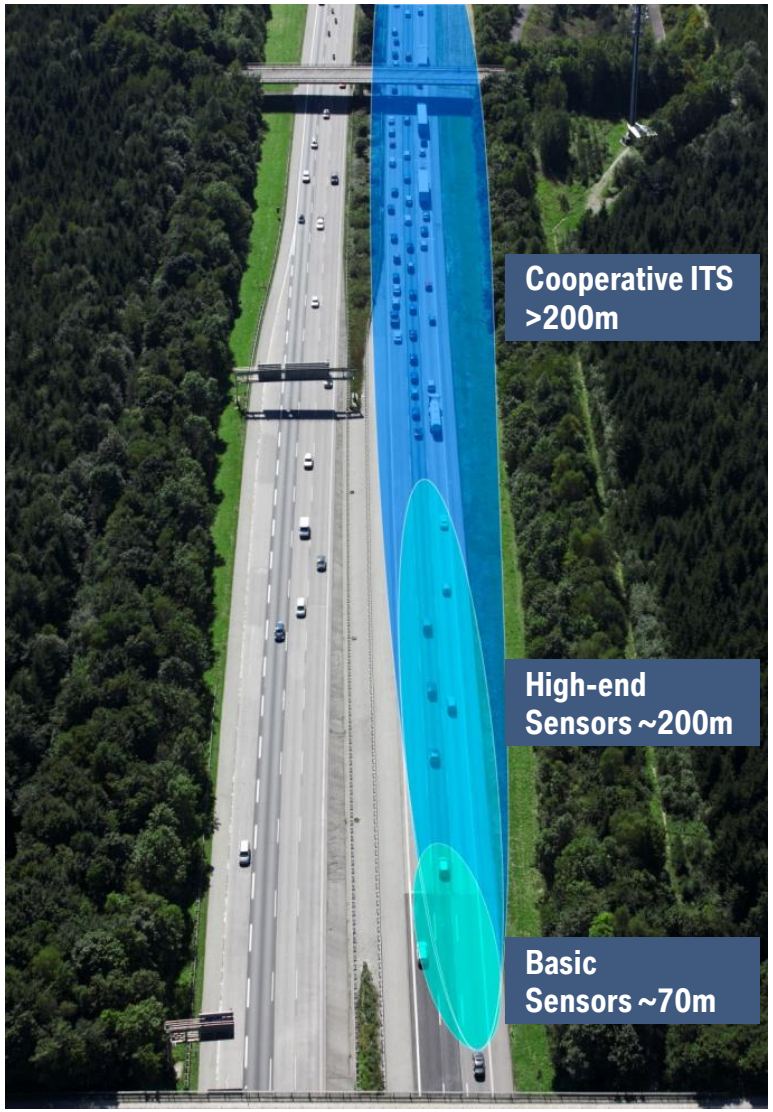
Road work



High-precision digital maps and positioning

Weather conditions

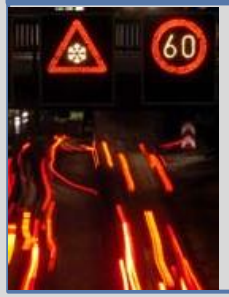




INFRASTRUCTURE IS VERY IMPORTANT FOR HIGHLY AUTOMATED DRIVING.

CONNECTED CAR + CONNECTED INFRASTRUCTURE FOR MAXIMUM BENEFIT AND USERS/DRIVERS ACCEPTANCE

DYNAMIC TRAFFIC MANAGEMENT



- Dynamic traffic signs
- Traffic lights
- Road work

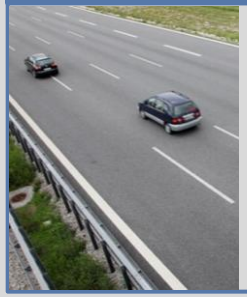
REAL TIME TRAFFIC INFORMATION

- Traffic jams
- Emergency vehicles
- Impassable road segments

MAPS AND LANDMARKS

- Curvature
- Sign positions
- HD map

PHYSICAL INFRASTRUCTURE



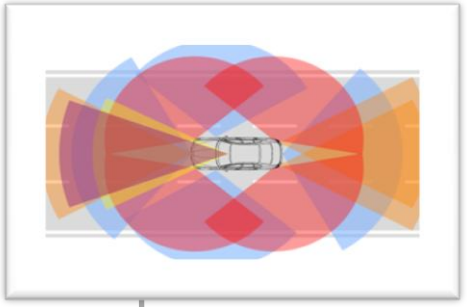
- Lane markings
- Signage
- Road boundaries
- Road friction
- Damage

REQUIREMENTS & BENEFITS OF GOOD ROAD INFRASTRUCTURE

- Make valuable information available for the public.
- Ensure wide coverage for a seamless users experience.
- Provide common interfaces and real-time data.
- **Good infrastructure will ease blockages to the adoption and rollout of highly automated driving.**

STARTING FROM 2020, THE FIRST HIGHLY AUTOMATED DRIVING FUNCTIONS COULD BE OFFERED TO OUR CUSTOMERS.

2013 — Development of an electronic co-pilot system with the international automotive supplier Continental.



2014

2015 — Limited field test of highly automated driving functions in Germany and Europe (BMW Group & Continental).

2016

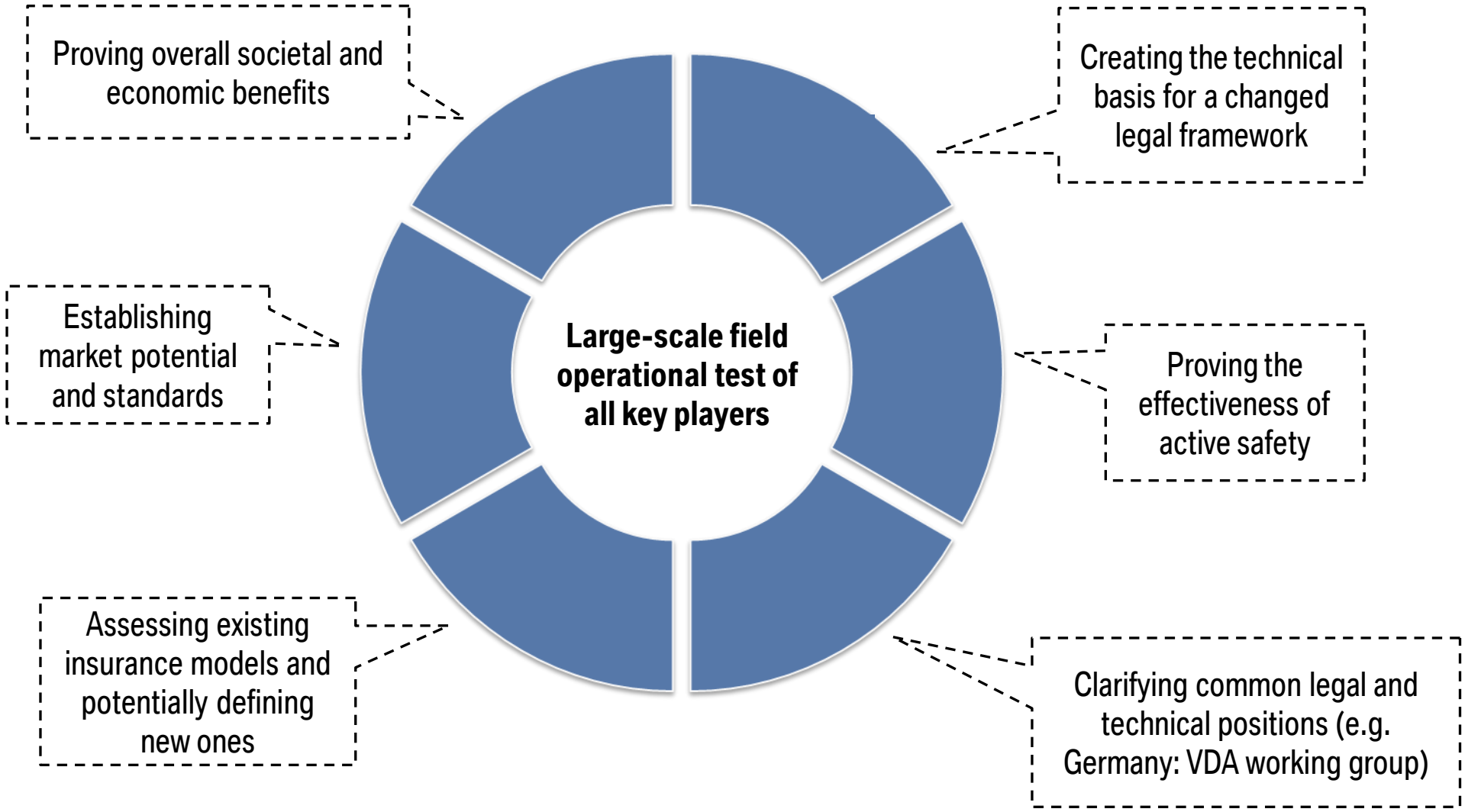
2017

2018 — Quantified benefits through large-scale field test of highly automated driving functions

2019

... — Global rollout of highly automated driving functions.

THE SUCCESS OF HIGHLY AUTOMATED DRIVING HINGES ON ALL KEY PLAYERS COLLABORATING AND AGREEING ON LEGAL & TECHNICAL STANDARDS.



THANK YOU FOR YOUR ATTENTION