FUTURE INTERSTATES FOR AUTOMATED DRIVING

NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE
TRANSPORTATION RESEARCH BOARD
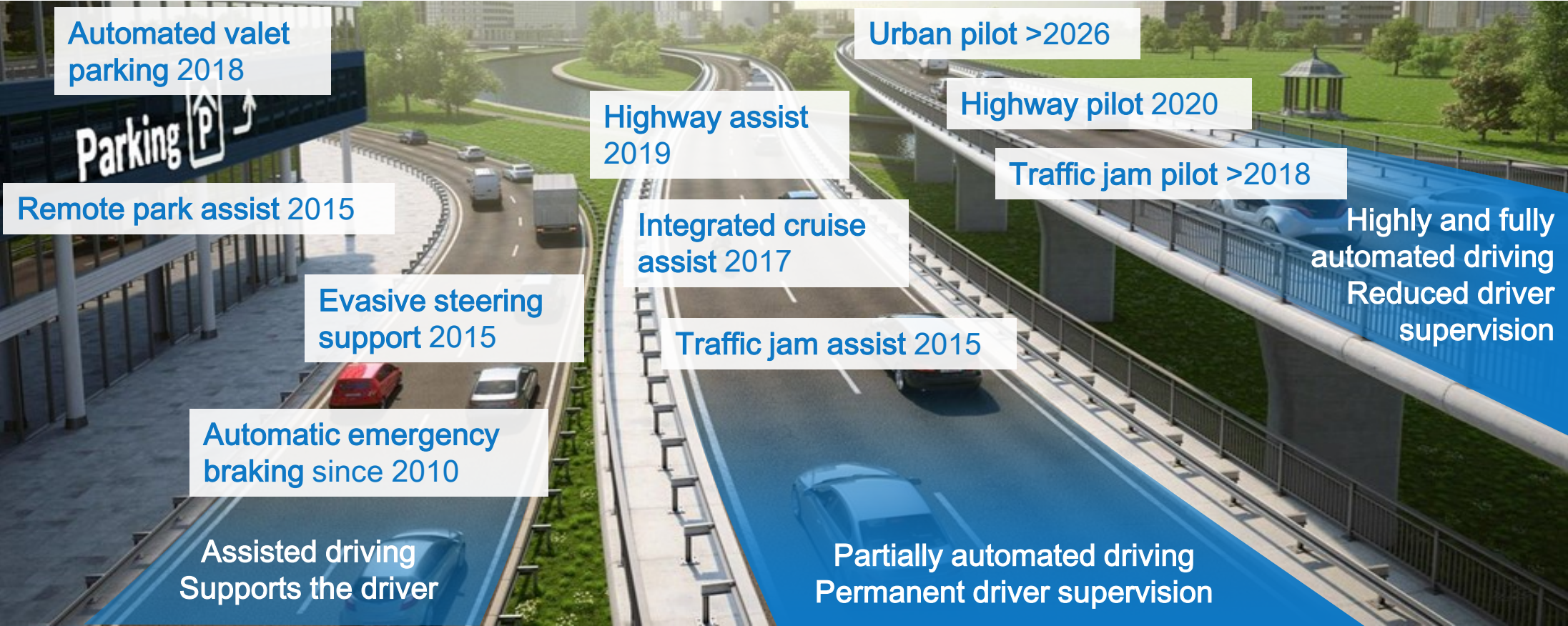
MAY 16, 2017

DUSHYANT WADIVKAR , ROBERT BOSCH LLC

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Future Interstates for Automated Driving
Focus : SAE Level 3, 4 Highway Automation

Automated valet parking 2018

Urban pilot >2026

Highway pilot 2020

Highway assist 2019

Traffic jam pilot >2018

Remote park assist 2015

Integrated cruise assist 2017

Highly and fully automated driving Reduced driver supervision

Evasive steering support 2015

Traffic jam assist 2015

Automatic emergency braking since 2010

Assisted driving Supports the driver

Partially automated driving Permanent driver supervision

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Future Interstates for Automated Driving
Key challenges for automated driving

Surround sensors

highly robust

in all use cases

Perception

comprehensive 360° environment model

Decision making
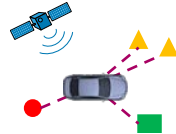
correct reasoning and decisions in all situations

Online map data

precise and up-to-date every moment

Localization

accurate and reliable vehicle position

Motion control

safe, fast and precise in all dimensions

Driver monitoring & HMI
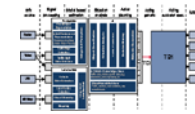
for partially and highly automated functions

Functional safety

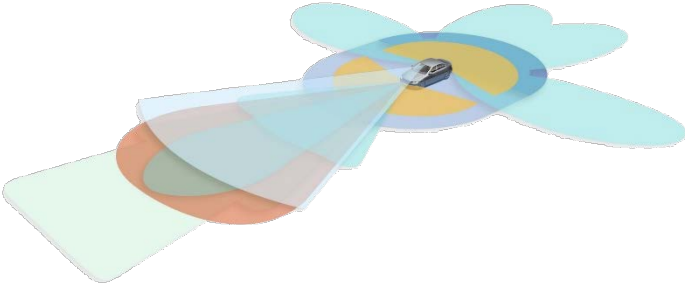guarantees high standard at reasonable effort

Architecture

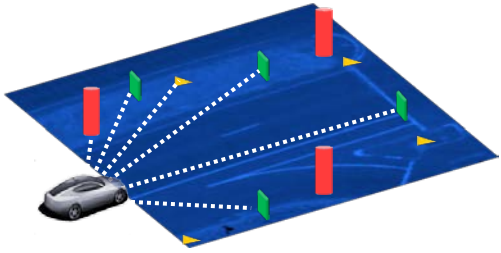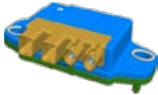supports safety, performance and cost targets

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Future Interstates for Automated Driving
Current approach
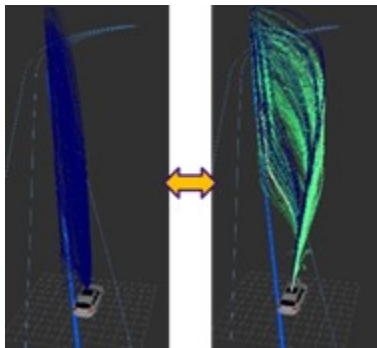
▶ Perception

▶ Localization

Validation

▶ Decision Making

▶ Fail Operational

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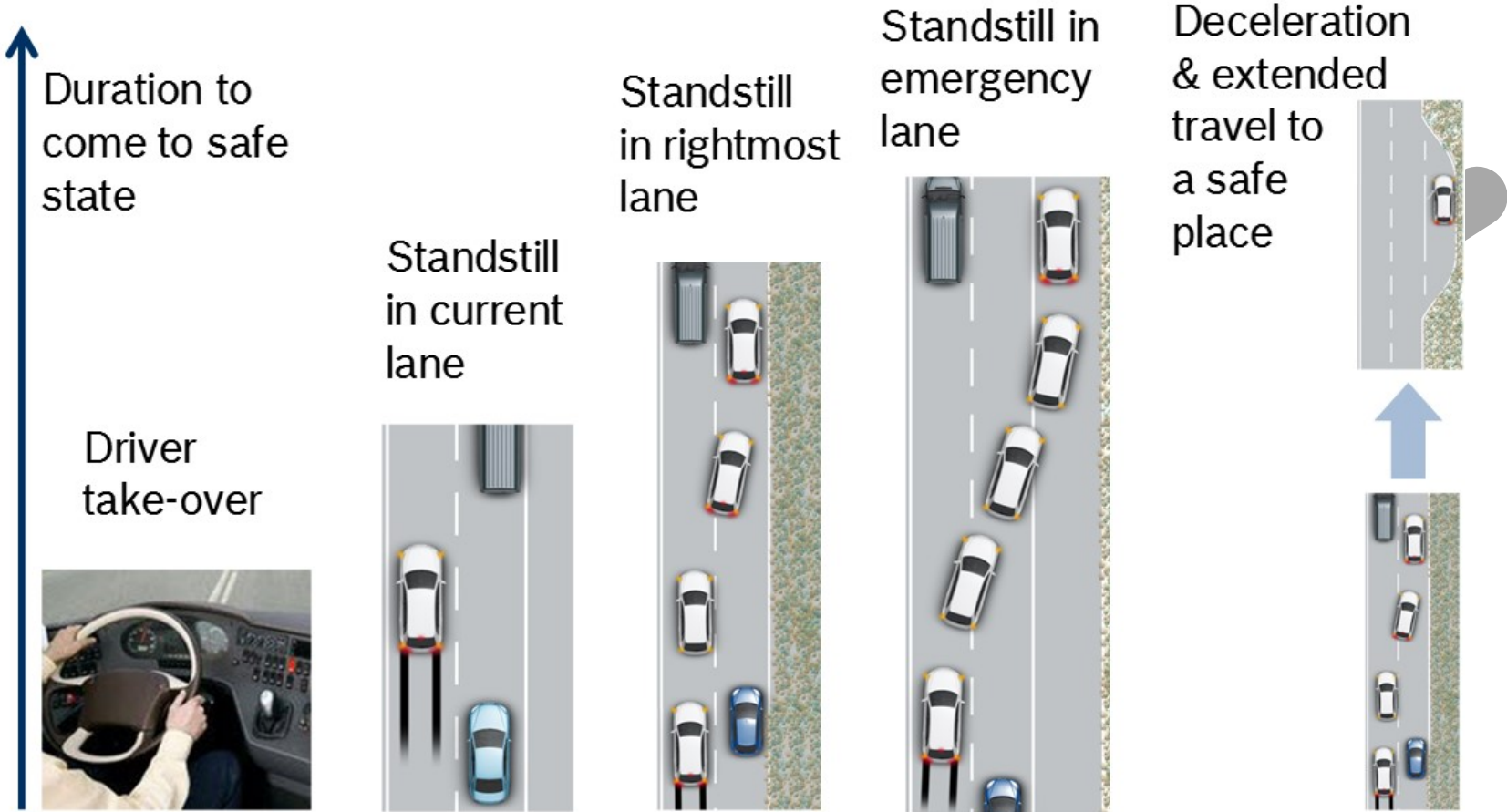# Future Interstates for Automated Driving
How can infrastructure help?

- ▶ **Digital Signage**
  - ▶ Machine readable
  - ▶ Posted periodically
  - ▶ Consistent

- ▶ **Road markings**
  - ▶ Clear
  - ▶ Machine readable attributes
  - ▶ Robust to weather

- ▶ **Standardization**
  - ▶ Within states
  - ▶ Within countries
  - ▶ Text independent symbols

- ▶ **Quality gates**
  - ▶ Approved for AD
  - ▶ Maintained routes

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Future Interstates for Automated Driving
How can Infrastructure help? – Safe harbor

Duration to come to safe state

Driver take-over

Standstill in current lane

Standstill in rightmost lane

Standstill in emergency lane

Deceleration & extended travel to a safe place

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Future Interstates for Automated Driving
Comparing on-board sensing with smart infrastructure

	Pro	Con
On board Intelligence	▪ Safer option, works regardless of infrastructure variations ▪ Fastest to market	▪ Expensive ▪ Difficult to validate ▪ Limited to premium market segment ▪ Each OEM takes a varied approach
Smart interstates	▪ Can reduce costs, complexity of autonomous vehicles ▪ Increase safety ▪ Can serve a wider audience of vehicles (level 1 and level 2)	▪ Even more expensive? ▪ Infrastructure changes take time ▪ Challenging to achieve consistency of design between states ▪ Collaboration on common signage between different areas could be effort-intensive

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Future Interstates for Automated Driving
Summary

▶ Step by step to fully automated

▶ Allow for consumer acceptance

▶ OEM, Tier1 and infrastructure to work together

▶ A combined approach of on-board technology and automated driving customized infrastructure would speed up the process

On our way to collision-free driving

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Future Interstates for Automated Driving
Thank You!

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