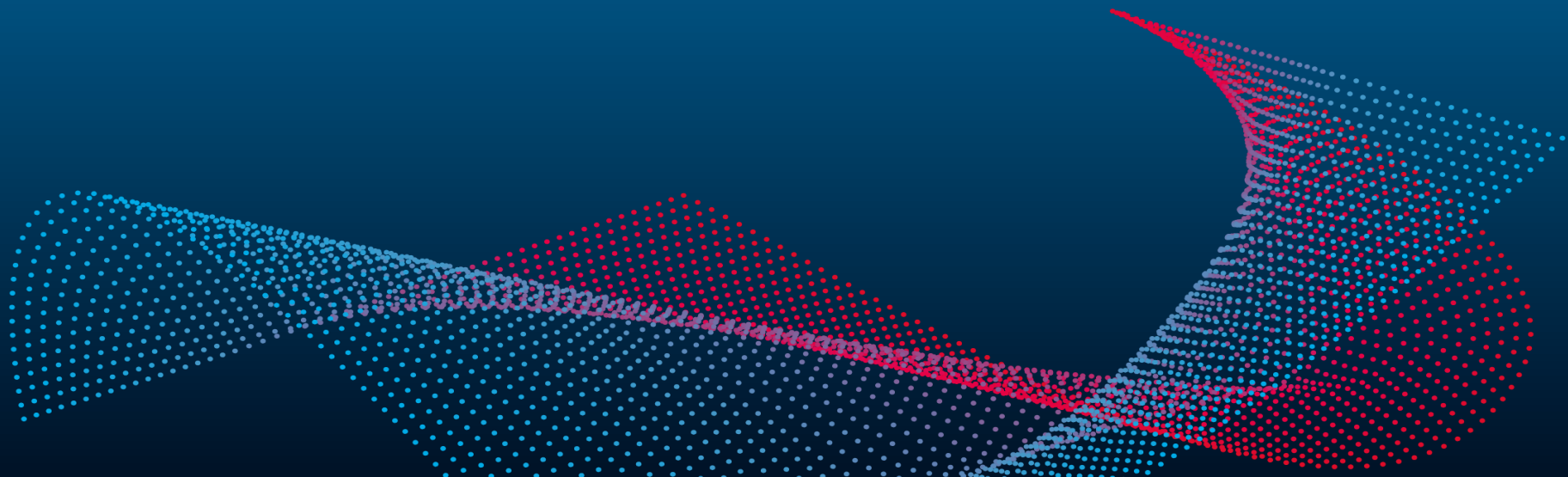
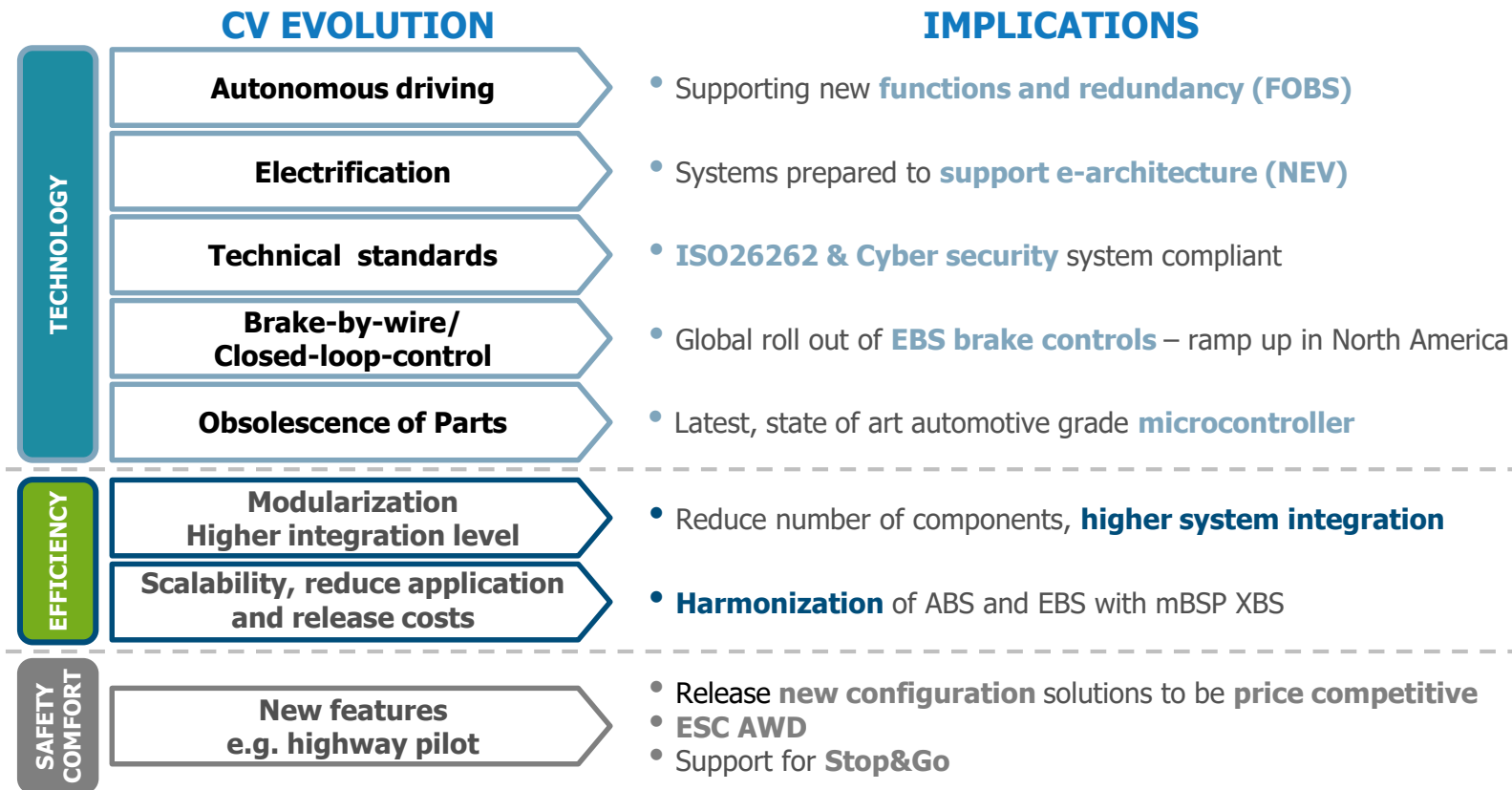




Braking Redundancy Solutions



DRIVERS FOR EVOLUTION OF BRAKING SYSTEMS



mBSP XBS: Best-Value and Future-Oriented Braking System

Scalability

Global scalable up to AL5 braking system – always same base platform

Autonomous Driving

FOBS ready, supporting autonomous driving up to AL5 w. Redundant CMAx

Cost Competitiveness

TCO reduced vs. current systems:
less brackets, piping, installation cost
optional removal of soft differential lock enabled

mBSP XBS™

4 Devices

1 ECUs



Advanced Standard BST 1p



APCV
AVP+



CMAx



TCM

Cybersecurity

Ready to meet future CV standard
SAE J1939-91C for SecOC
Developed in line with ISO/SAE 21434
Stinger as interim

ISO 26262

HW and SW designed following state-of-the-art principles

ASIL D

Ensuring functional safety according highest safety standards

mBSP XBS (mBSP 2.0)

To provide Best value + Future oriented braking system at minimum costs

Div. CVCS solution: mBSP XBS

4 devices
1 ECUs

Advanced
Standard



BST 1p



APCV
AVP+



CMAX



6 devices

5 ECUs EBS3

3 ECUs ABS8



BST 2p

dFBM



AxMo 1C

FAVP



ESCM

ESCM



AxMo2C

RAVP



ECU

ECU



TCV

PV+ABS

Benefits for Customer

- **Best cost & more secured system**, as number of components & ECUs significantly reduced
- **Global scalable up to AL5** braking system – always same base platform
- **TCO reduced** vs. current systems (brackets, piping, SW-diff lock, installation cost)
- **Reduced application and release costs** on worldwide platforms
- **Harmonizing** between ABS and EBS
- **Integrated μ -split and brake / steering blending**
Support of 3rd party active steering system

mBSP™ XBS – MODULAR BRAKING SYSTEM PLATFORM

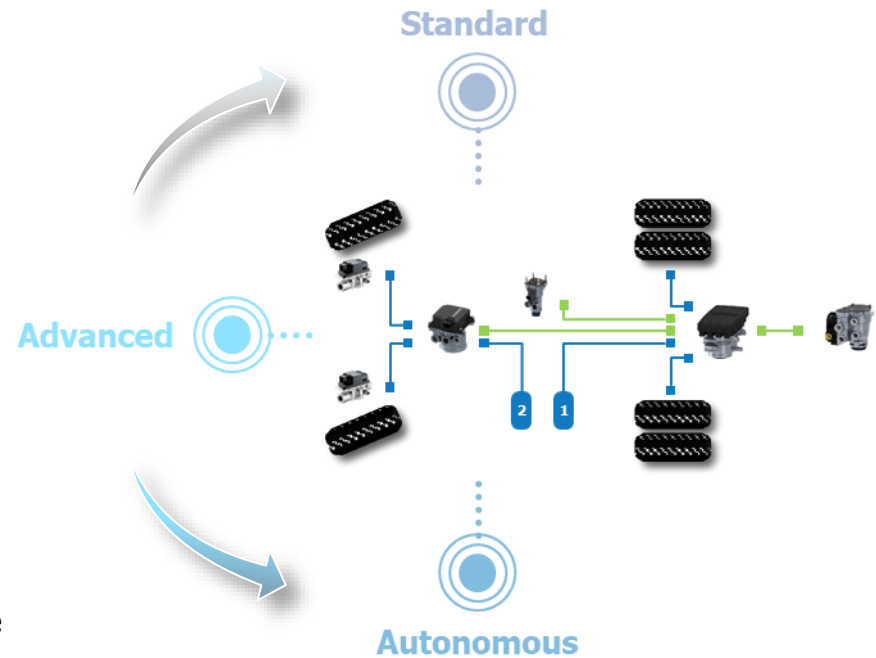
Breakthrough concept of mBSP XBS: Smart, Modular and Scalable

- “ONE” platform **combines ABS & EBS system**
- **Global Scalability** from a basic to an autonomous system
- Optimized **Energy Recuperation** for hybrid and electric vehicle
- Enables **Autonomous Driving** by fail operational architecture
- **Steer-by-brake** capability as back-up for active steering
- Fully compliant to **ISO26262** and to **Cyber-Security** standards

Value to Customer

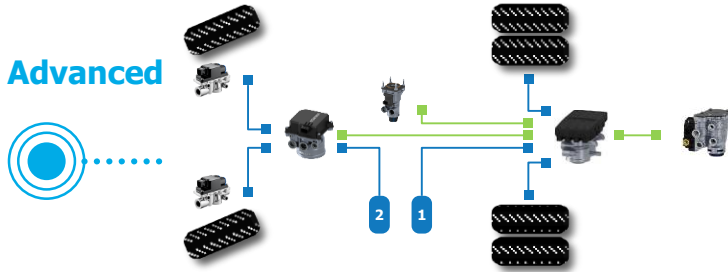
- Increasing value for OEM by **reducing development efforts**
 - **Optimized release cost** by globally scalable system
 - **Efficient application** for different regions by modularity
 - Less installation and piping effort and compact packaging
 - Potential mechanic diff lock elimination by soft lock & aWSS
- Increasing value for fleets by **reducing TCO**
 - **Optimized Energy Recuperation** levels
 - **Enhanced Safety** by increased stability on μ -split with active steering support

System Overview – Modular Setup from Standard to Autonomous



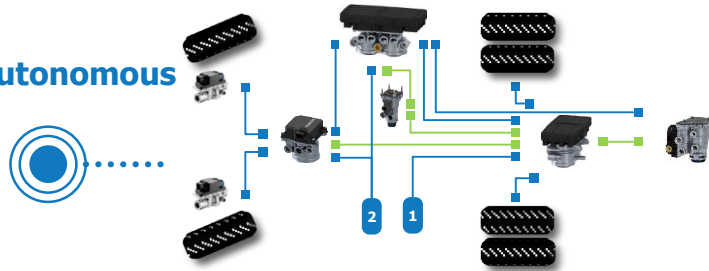
Comparison mBSP™ XBS from Advanced to Autonomous

Advanced



- Full Brake by wire with EBS like braking performance and comfort on all axles and trailer enables additional features as Soft-Lock Control, μ -Split Steering Support, Torque Vectoring, optimized recuperation support for electric vehicle
- Standalone Trailer Control Module
- Optional use of EPH

Autonomous



- mBSP™ XBS allows fail operational architecture for autonomous driving (up to level 5)
- CMAx with DMC and Steer by Brake enables steering redundancy
- Usage of EPH allows automatic Park Brake Control
- Add-on of a Redundant Module Axle Modulator (RMAx) provides in redundancy mode the independent control of rear axle and front axle / trailer incl. ABS protection
- Similar deceleration level as in fully active mode
- ABS control in FOBS mode
- 2 power supply; 2 CAN

— Electric — Pneumatic

Electro Pneumatic Parking Brake

Automatic, digital, safe and comfortable

Next generation hand brake – EPH

- Automatic, programable engage and release functionality
- Allows manual actuation via a dashboard switch
- Provides integrated anti-lock & anti-theft braking support
- Back-up braking as an essential safety feature for autonomous driving
- Unique lean valve concept in line with ISO 26262
- Seamless integration into future ZF WABCO braking systems as building block towards autonomous driving
- High vehicle safety and driver comfort
- Modern, aesthetic cockpit design
- Provides scalable design and installation flexibility



Hand Control Unit

- Background illumination
- Actuation indication
- Gradual actuation via ramp in the switch
- Functional safety
- Communication to EPH Modulator via LIN interface



HCU

Signals from HCU:

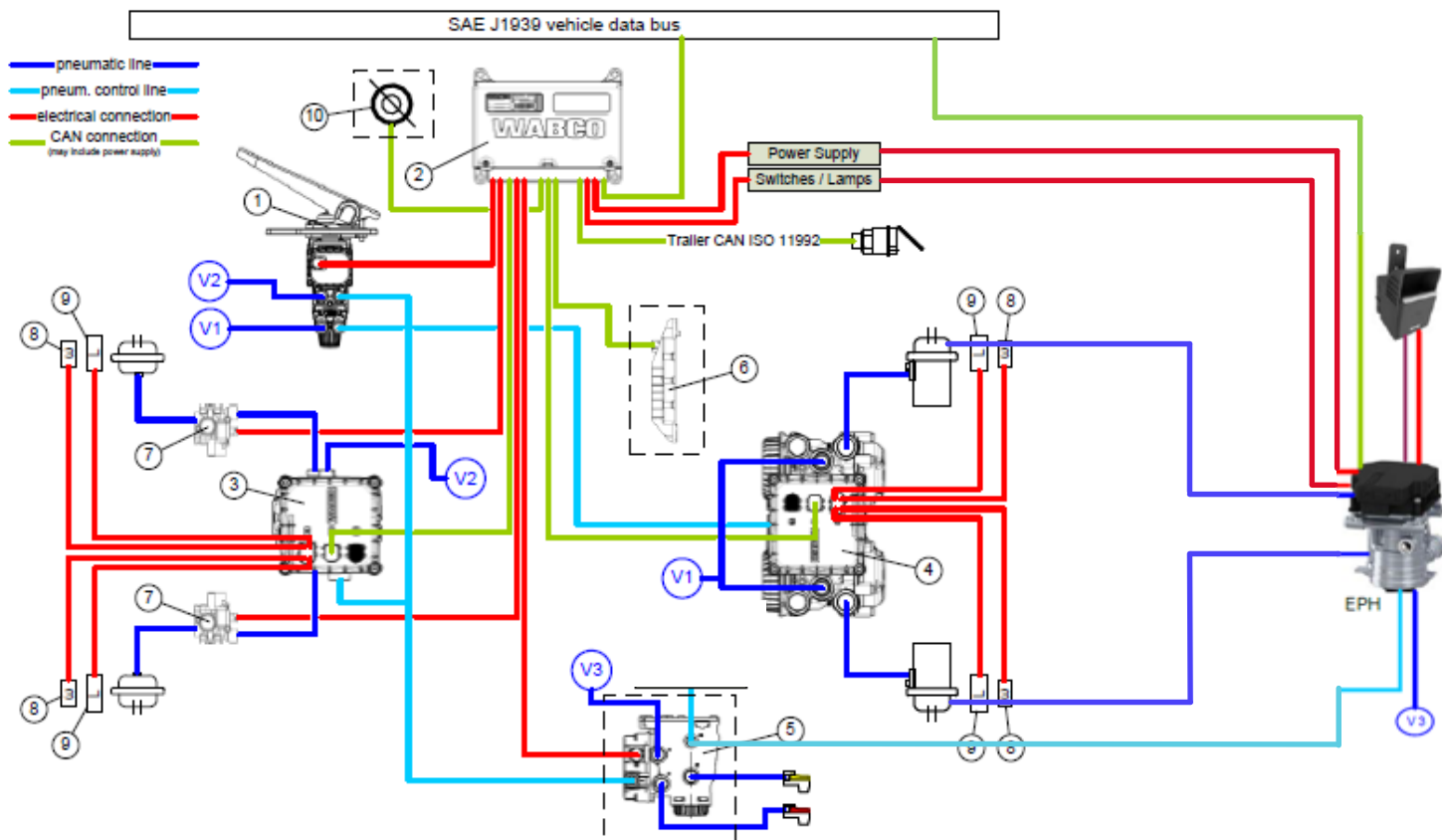
- Switch Status
- Gradual Braking
- Checksum
- Counter
- Response Error
- Diagnose Data

Signals to HCU:

- Status Led Control
- Status LED Brightness
- Background LED Control
- Background LED Brightness

Bridge solution - EPH

- EPH is acting as a backup braking system
- Brake application on rear axles and trailer
- Max. deceleration - $2.5 \sim 3 \text{ m/s}^2$



THANK YOU

