Advanced Driver Assistance Systems (ADAS) Application

Michael Mi, P.Eng, MBA
Director, Product Development

Motor Coach Models

J4500 Coach – Private

J4500 Model

- Targets the mid-range to luxury segments
- J Model #1 selling coach in NA private market

D Coach – Public

D Model

- Targets the mid-range segment
- "Buy America" compliant
- D Model is the #1 selling coach of all time in NA

Pre-Owned Coach

- Trade-in option to support new coach sales
- Coaches are refurbished at NFI/MCI service centers and various 3rd parties

New Coach Model – D45CRT-LR

New D Model

- New D model to replace the current D
- Accessibility on a whole new level

New Coach Model – J3500

J3500 Model

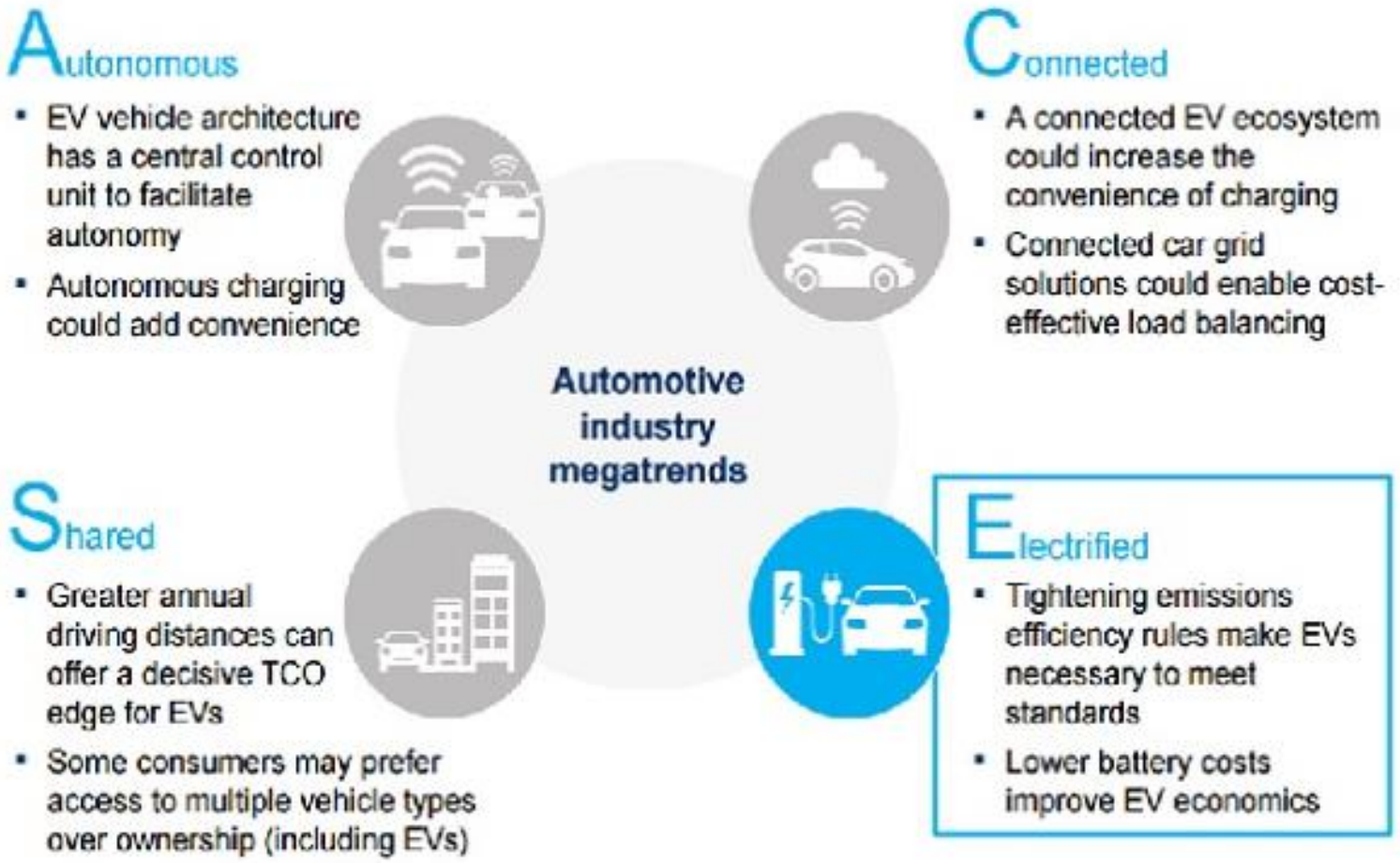
- Targets the mid-range segment
- "Buy America" compliant
- D Model is the #1 selling coach of all time in NA

#1 Motor Coach Share

Active Canada/US Motor Coach Fleet ~55,500 units

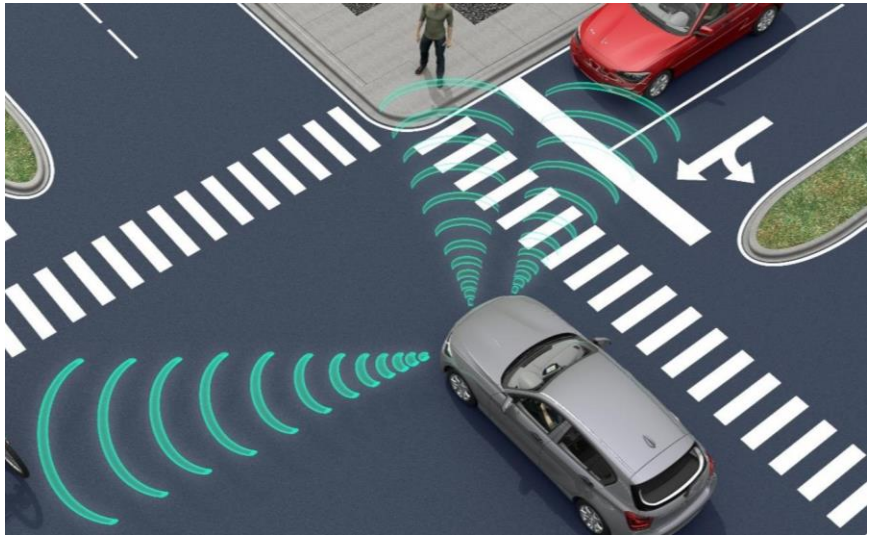
Average Age of the Motor Coach Fleet: US and Canada = 9 years
Source: ABA Motor Coach Census, published February 2016

Industry Megatrends: ACES



SOURCE: McKinsey Sustainable Mobility Initiative

Advanced Driver Assistance Systems (ADAS)



- ADAS: Systems developed to automate/adapt/enhance vehicle systems for safety and better driving.
- Safety features are designed to avoid collisions and accidents by offering technologies that alert the driver to potential problems
- Or, to avoid collisions by implementing safeguards and taking over control of the vehicle.

Advanced Driver Assistance Systems

Passive Advanced Driver Assistance System (ADAS):

- Provide driver alerts in hazardous situations.

Active Advanced Driver Assistance System (ADAS):

- Connected to the respective actuators like power steering or electric brakes - can take control over the vehicle in such a situation if the driver does not react to the warning alert.

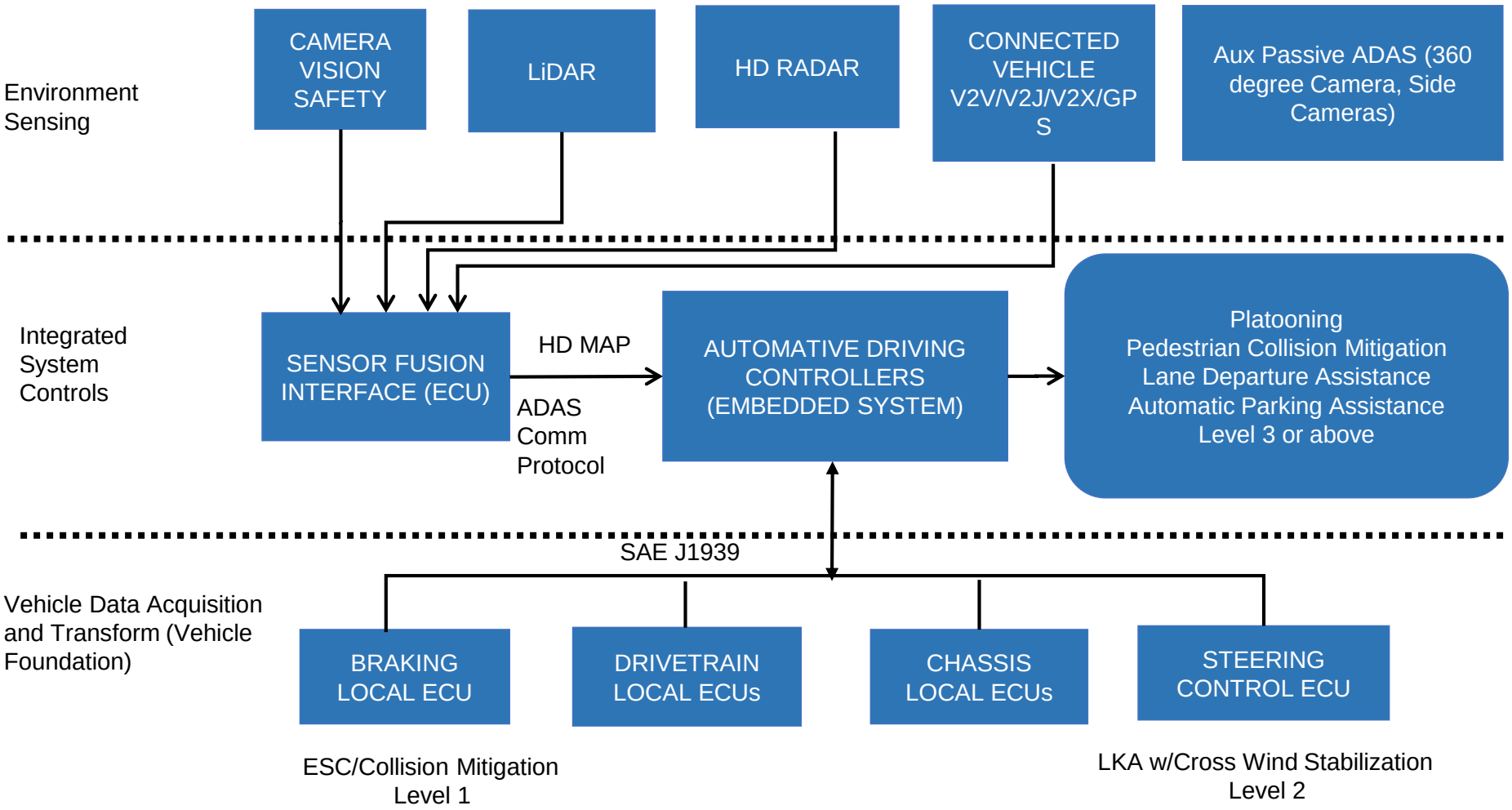
SAE Automation Levels (SAE J3016)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

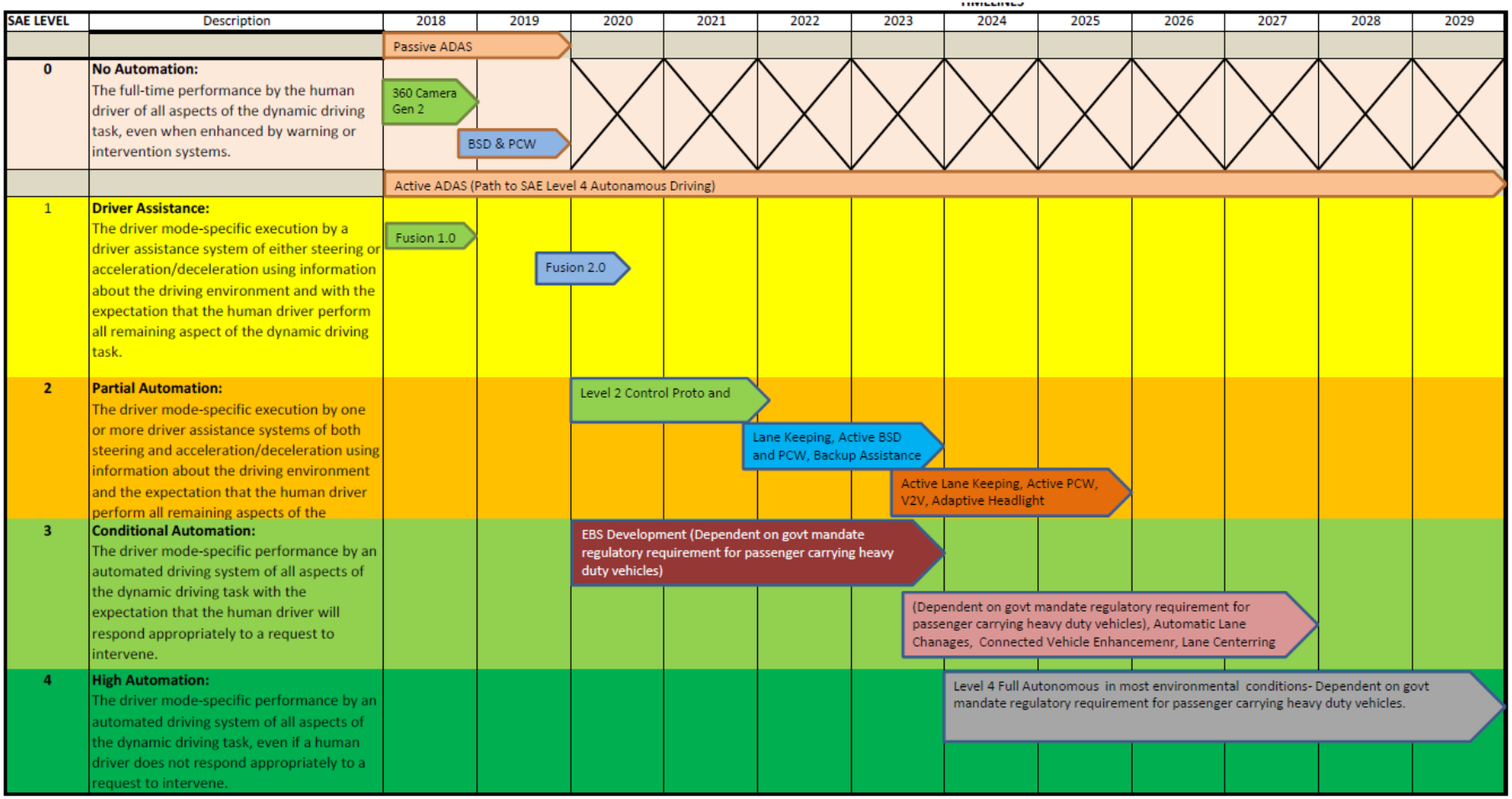
Full Automation

0	1	2	3	4	5
No Automation	**Driver Assistance**	**Partial Automation**	**Conditional Automation**	**High Automation**	**Full Automation**
Zero autonomy; the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

Automatic Driving Data Flow Architecture



MCI Automated Coach Roadmap



MCI Reliability DRIVEN™

Risks and Considerations

Concerns

- Software Glitches (unintentional errors, split second perception, algorithm)
- Technology Safety Regulator (lack of law and policy)
- V2V Communication (security complexity, under development)

Considerations

- Manage levels of automation by Phases
- Compliance with the available safety standards (e.g. FMVSS 121 brake timing, FMVSS136 ESC)
- Apply sensors redundancy
- Function safety risk management process with ISO26262 practice
- Extensive testing (time consuming)

Coach Application Example:

Forward Collision Mitigation with Lane Departure Warning and Traffic Sign Recognition

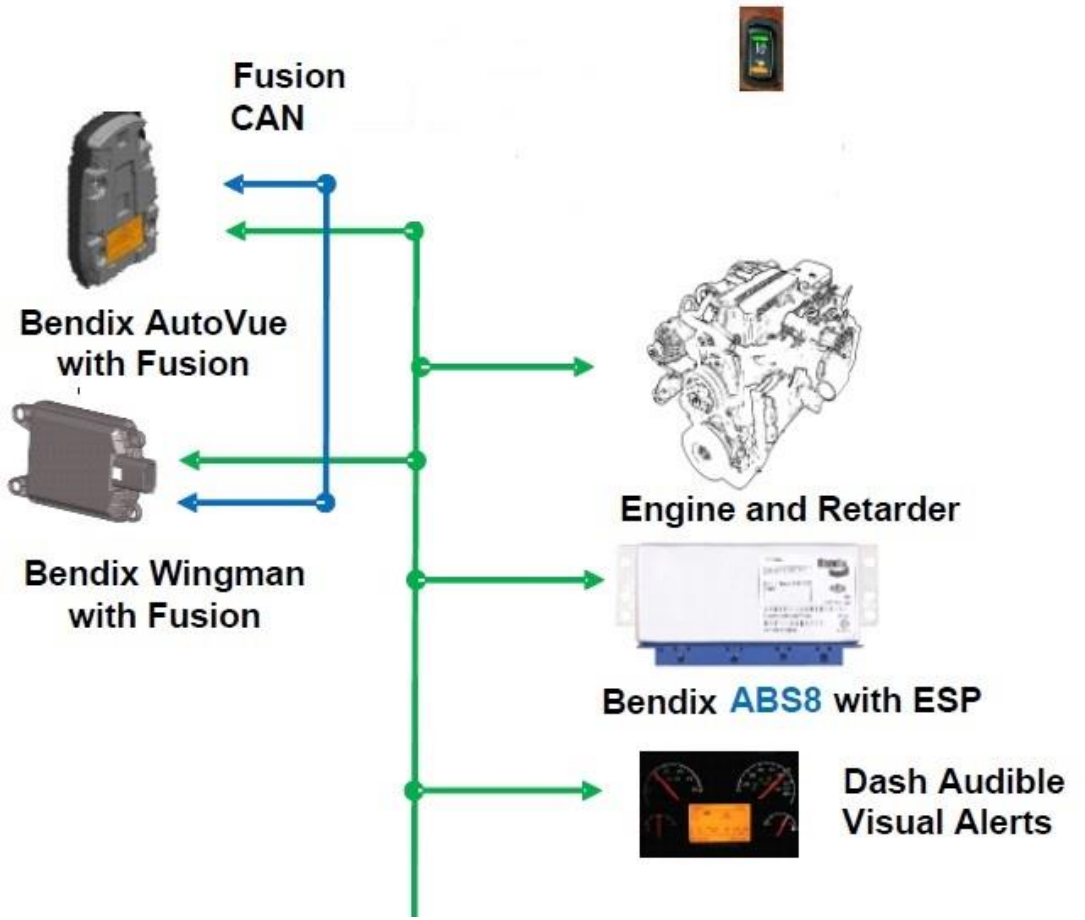
Forward Collision Mitigation with LDW and TSR

- Current second generation product for collision mitigation is an advanced safety feature which includes:
  - Electronic Stability Controls (ESC),
  - Forward Looking Radar (FLR), and
  - Forward Looking Camera (FLC).
- The FLC will provide an additional driver's aid such as Lane Departure Warning (LDW) and Traffic Signal Recognition (TSR) i.e. speed signs for both Canada and USA.
- Forward collision mitigation includes adaptive cruise controls, automatic emergency brake, and stationary vehicle braking.
- The LDW and TSR visual and audible warning are integrated to Instrument Cluster.

Forward Collision Mitigation with LDW

Bendix Fusion

- ESC/ABS ECU
- Forwarded Detection Radar (built-in ECU)
- Forward Face Camera (powered by Mobileye System-on-Chip EyeQ processor with vision algorithms)
- CAN communication interface to engine ECU
- Driver's Interface and alarms



Bendix Fusion Video

Michael Mi

Director, Product Development
Michael.Mi@mcicoach.com