DAIMLER

Autonomous Mobility at Daimler Buses

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Daimler Buses

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Autonomous Driving – we’re well on our way

2013:
Mercedes-Benz
Bertha-Benz Drive

2014:
Mercedes-Benz
Future Truck FT2025

2015:
Mercedes-Benz
F015

2015:
Freightliner
Inspiration Truck

2015:
Mercedes-Benz
Actros Highway Pilot

July 2016:
Presentation
Mercedes-Benz Future Bus

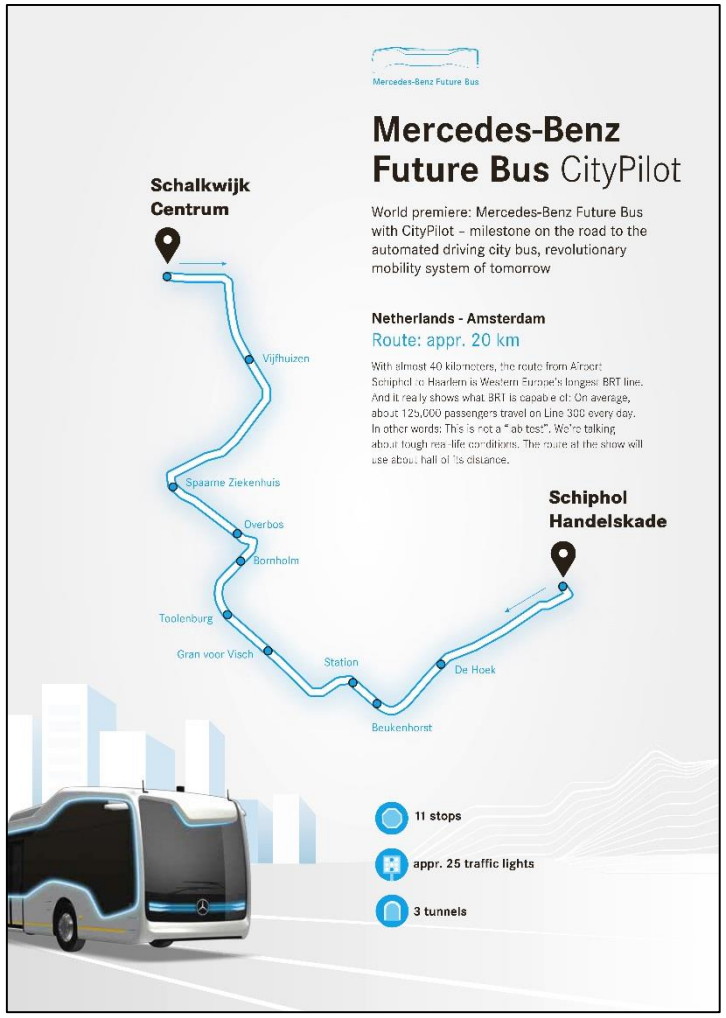
Step by step into the future – SAE J3016 levels of autonomous driving

Driver responsible

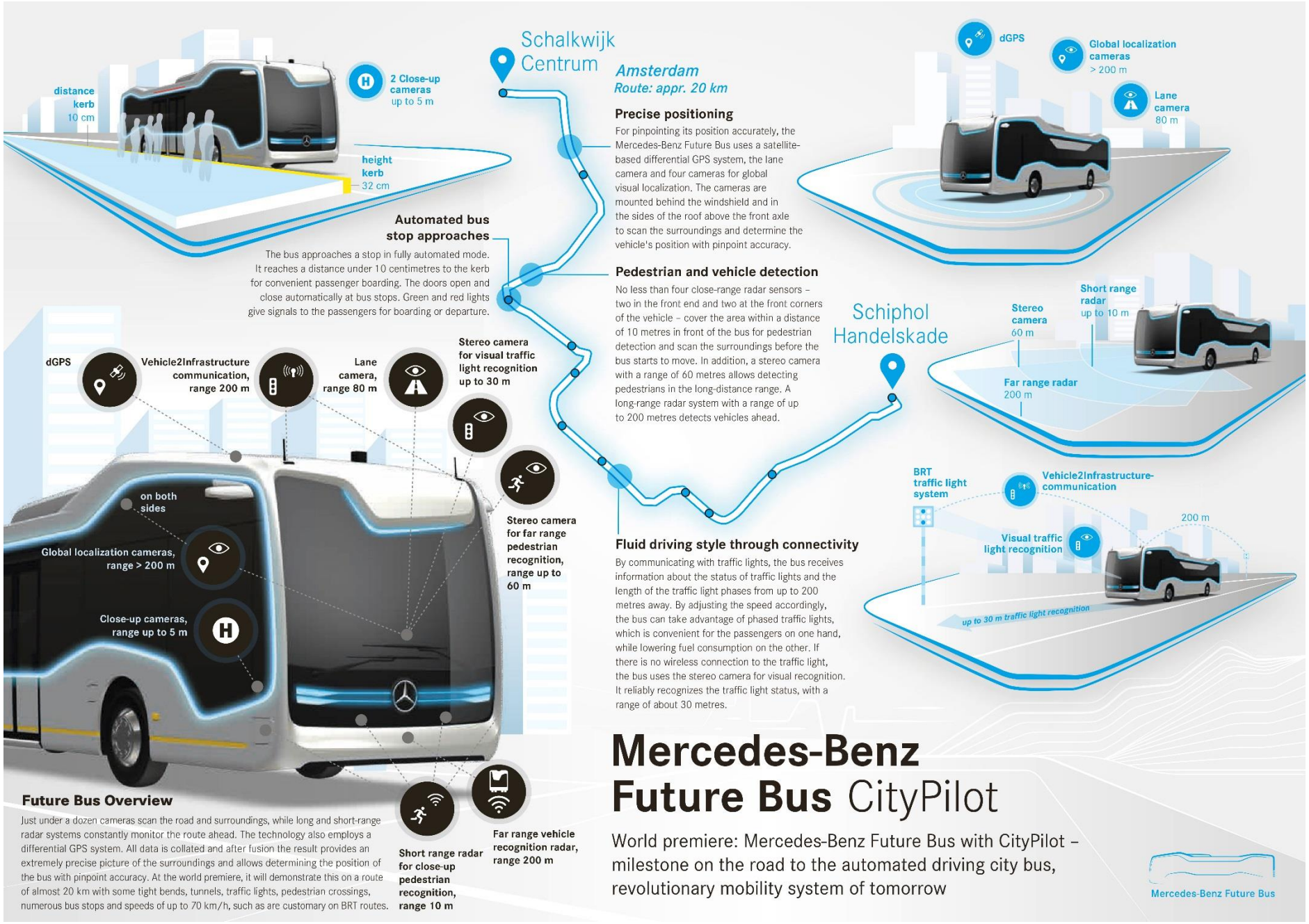
Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
Driver performs lateral and longitudinal control at any time	Driver performs lateral or longitudinal control	Driver has to monitor the system **permanently**	Driver has **not** to monitor the system **permanently**	No driver required in specific applications	From **“start" to “destination“,** no driver is required
					
Manual	**Driver Assistance**	**Partial Automation**	**High Automation**	**Full Automation**	**Autonomous**

System responsible

The Future Bus – A successful milestone in autonomous driving by Daimler

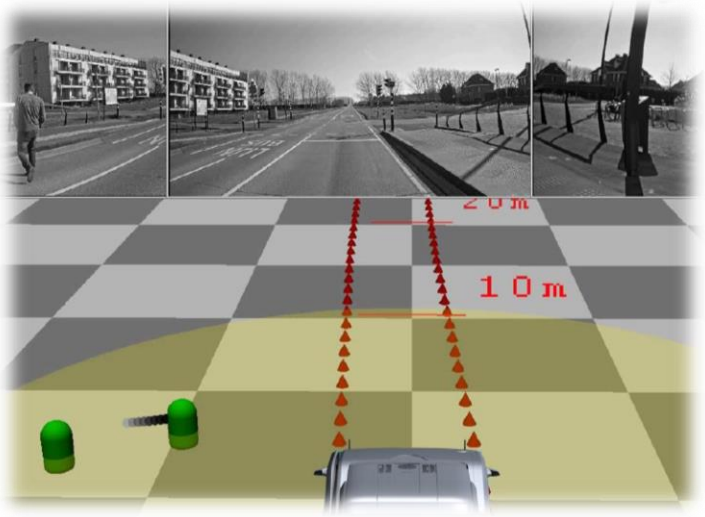


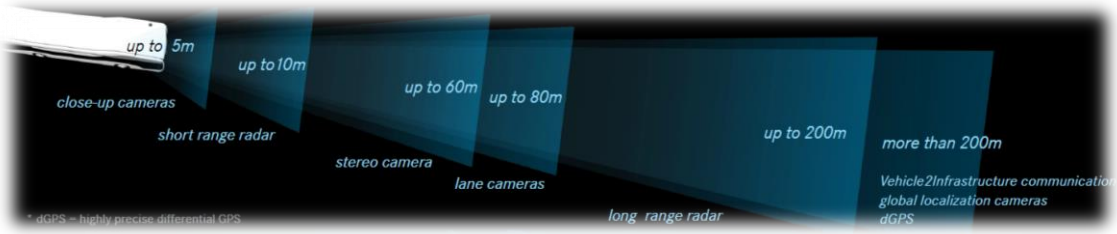
1. **Localization and driving: longitudinal and lateral control**
   - Lane cameras
   - Global localization cameras & dGPS
2. **Automated bus stop**
   - Close-up cameras
3. **Traffic light recognition**
   - Vehicle2Infrastructure communication
   - Visual traffic light recognition
4. **Obstacle recognition**
   - Far range pedestrian recognition
   - Close-up pedestrian recognition
   - Far range vehicle recognition


Schalkwijk
Centrum
Amsterdam
Route: appr. 20 km
distance kerb 10 cm
2 Close-up cameras up to 5 m
height kerb 32 cm
Automated bus stop approaches
The bus approaches a stop in fully automated mode. It reaches a distance under 10 centimetres to the kerb for convenient passenger boarding. The doors open and close automatically at bus stops. Green and red lights give signals to the passengers for boarding or departure.
Precise positioning
For pinpointing its position accurately, the Mercedes-Benz Future Bus uses a satellite-based differential GPS system, the lane camera and four cameras for global visual localization. The cameras are mounted behind the windshield and in the sides of the roof above the front axle to scan the surroundings and determine the vehicle's position with pinpoint accuracy.
dGPS
Global localization cameras > 200 m
Lane camera 80 m
Pedestrian and vehicle detection
No less than four close-range radar sensors – two in the front end and two at the front corners of the vehicle – cover the area within a distance of 10 metres in front of the bus for pedestrian detection and scan the surroundings before the bus starts to move. In addition, a stereo camera with a range of 60 metres allows detecting pedestrians in the long-distance range. A long-range radar system with a range of up to 200 metres detects vehicles ahead.
Schiphol
Handelskade
Stereo camera 60 m
Short range radar up to 10 m
Far range radar 200 m
dGPS
Vehicle2Infrastructure communication, range 200 m
Lane camera, range 80 m
Stereo camera for visual traffic light recognition up to 30 m
on both sides
Global localization cameras, range > 200 m
Close-up cameras, range up to 5 m
Stereo camera for far range pedestrian recognition, range up to 60 m
BRT traffic light system
Vehicle2Infrastructure-communication
200 m
Visual traffic light recognition
up to 30 m traffic light recognition
Fluid driving style through connectivity
By communicating with traffic lights, the bus receives information about the status of traffic lights and the length of the traffic light phases from up to 200 metres away. By adjusting the speed accordingly, the bus can take advantage of phased traffic lights, which is convenient for the passengers on one hand, while lowering fuel consumption on the other. If there is no wireless connection to the traffic light, the bus uses the stereo camera for visual recognition. It reliably recognizes the traffic light status, with a range of about 30 metres.
Future Bus Overview
Just under a dozen cameras scan the road and surroundings, while long and short-range radar systems constantly monitor the route ahead. The technology also employs a differential GPS system. All data is collated and after fusion the result provides an extremely precise picture of the surroundings and allows determining the position of the bus with pinpoint accuracy. At the world premiere, it will demonstrate this on a route of almost 20 km with some tight bends, tunnels, traffic lights, pedestrian crossings, numerous bus stops and speeds of up to 70 km/h, such as are customary on BRT routes.
Short range radar for close-up pedestrian recognition, range 10 m
Far range vehicle recognition radar, range 200 m
Mercedes-Benz
Future Bus CityPilot
World premiere: Mercedes-Benz Future Bus with CityPilot – milestone on the road to the automated driving city bus, revolutionary mobility system of tomorrow
Mercedes-Benz Future Bus

Benefits

- **Connectivity**
  - Networking with infrastructure
    - Traffic lights
    - W-lan for passengers
    - Telematics
- **Efficiency**
  - Steady driving
    - Conserving aggregates
    - Reducing fuel consumption
    - Reducing CO2 emissions
    - Shorter journey time (phased traffic lights)
  - Automated bus stop approaches
    - No more curb damages
- **Safety**
  - Reduction of human failure
  - Smooth acceleration and deceleration
  - Less Non-Crash-Accidents
  - Faster realization of critical situations
  - Early breaking for possible obstacles





Impressions Future Bus

Thank you for your attention

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