

Tue, 21 January 2025  
Weekly Newsletter



NEWSLETTER #888



## MUNICH LIGHTING WORKSHOP



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CONFERENCE · EXHIBITION

February 19-20, 2025 | Motorworld Munich

## Editorial

### HD Light: A Total Change



Seven years ago, in 2018, Hector organized a DVN Workshop in Munich with the theme of **Digital Light**. There were presentations from automakers and set makers showing and telling how they imagined it would look and work.

Mercedes' first HD lamp was announced a few weeks later on the S-Class Maybach. Audi's e-tron was launched the next year in 2019, the first HD lamp in serial production. Who imagined how it would change our company organizations and our lighting industry? Digitalization had started, spreading from the consumer industry into automotive displays and then into vehicle lighting. Historically, lighting performance on the road was linked to light source performance and set maker skills to design a good optical system. With digital lighting, electronic function development including algorithms and software became key enablers. Functional development and software came from set makers and automakers.

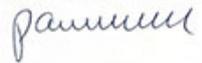
HD lighting function development began to improve the resolution of ADB matrix solutions. No longer single LEDs are addressed by ECU channels or LEDS switches, but the HD light distribution is created by images, which are calculated by software algorithms on the basis of sensor information. Enhanced ECU calculation power is needed to create the images of the light distribution and offers nearly endless freedom to optimize and adapt the light distribution for low beam, high beam and ADB to different driving situations. This is pushing the performance and comfort for the driver to the top and also offers the opportunity to reduce glare to other road users.

With HD modules, road projections are feasible and can assist the driver during nighttime. HD technology for main lighting functions is a key to the highest safety levels and new lighting functions. Thanks to these new possibilities, designers can create nice welcome and farewell features to demonstrate the uniqueness of the equipped vehicle's lighting system. UX exterior lighting was on the way.

All these things have happened in only seven years' time. So, I look in the mirror and try to summarize the developments of those years. Next month in Munich there'll be a dedicated session about ADB and projection, including 10 lectures. [Registration](#) is open.

**Paul-Henri Matha**

DVN Chief Executive Officer and Lighting General Editor



# In Depth Lighting Technology

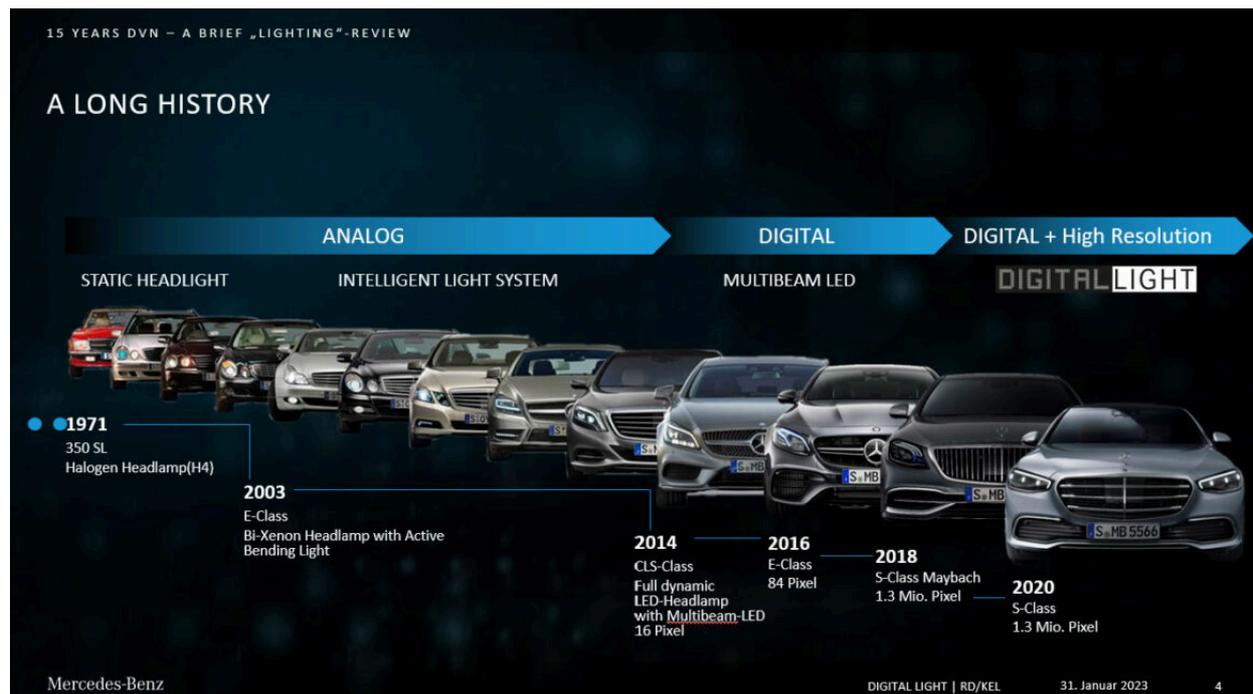
## HD Lighting Status: January 2025



**By Paul-Henri Matha**

At the 2018 Geneva Motor show seven years back, the Mercedes Maybach was the first car equipped with high-definition (HD) headlamps. Then Audi launched their e-tron with HD lamps. Both these pioneering cars had lamps made by Marelli.

HD headlamps are those with over 1,000 pixels, or a resolution finer than  $0.1^\circ$ . Before HD technology, the maximum resolution for ADB was around 1 degree, achieved with solutions like single-row matrix or multi-row pixel.



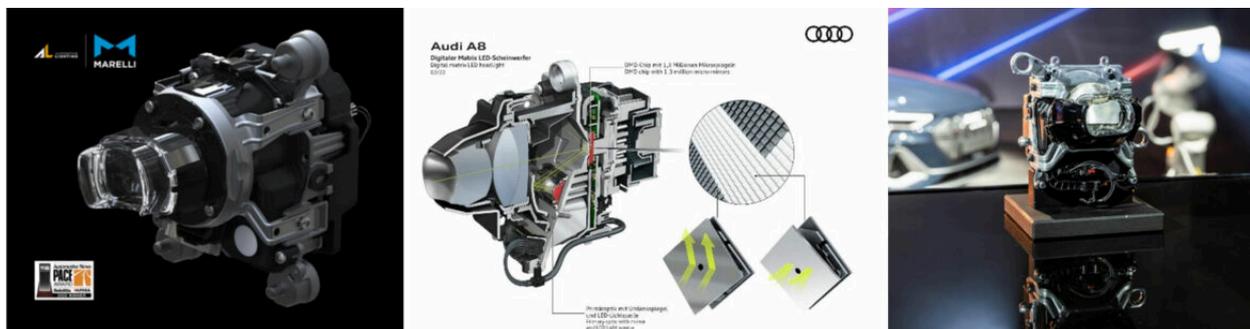
From Mercedes presentation @ DVN Paris 2023

With HD technology, the resolution can be made much finer, with two major goals: increase safety in ADB mode by making the shadows smaller and more precisely aligned with other road users' eyes, and the ability to project symbols or text on the ground and on the wall.



## DLP Technology

This technology was initially possible with DLP technology from Texas Instruments, already known for consumer applications (projectors). The first automotive DLP module was developed by Marelli for Mercedes and Audi, and got the Automotive News Pace award in 2020.

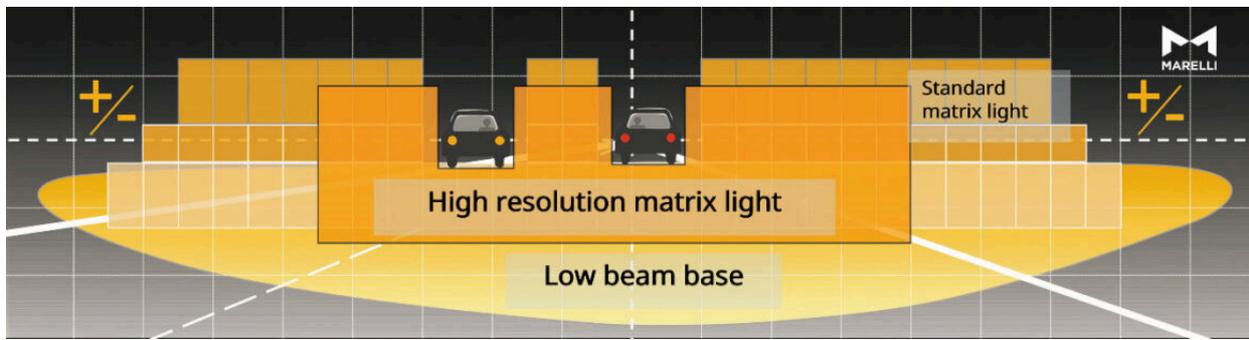


It was quite large—183 mm deep.



2024 Mercedes E Class DLP unit (A2MAC1 image)

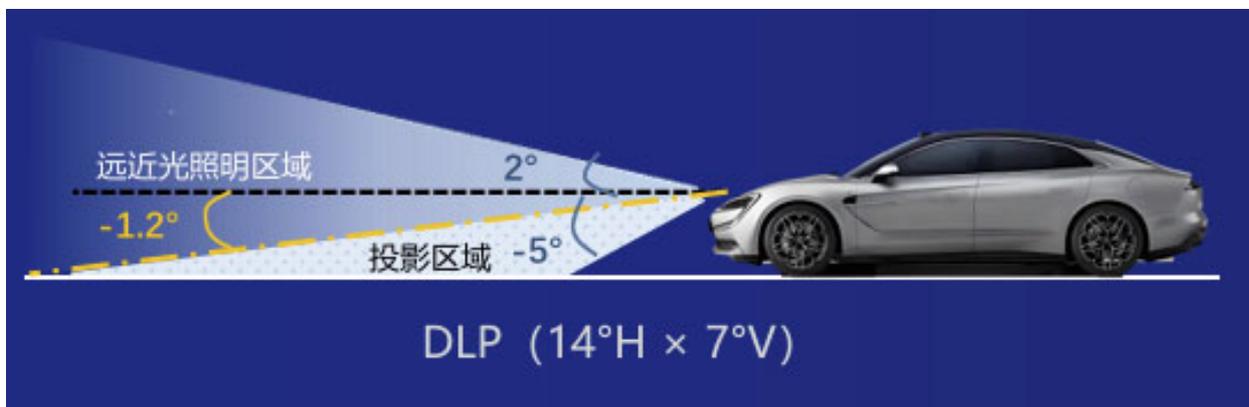
With a 0.55-inch, 1.3-megapixel DMD chip, the possible HD area was  $14^{\circ}\text{H} \times 7^{\circ}\text{V}$ .  $I_{\text{max}}$  was 50 kcd. The rest of the low and high beams were produced by a second module, such as a bi-matrix, to reach the width and height requirements of the beam patterns.



## Legalities

From January 2023, after around five years of discussion in GTB and GRE, UN R149 was updated with the 01 series of amendments to include four road projection symbols. These projections must be just below the low-beam cutoff, at or below 1.2 degrees down from horizontal.

So, if the headlamp is at 80 cm height, road projections can be seen at 8 m from the car, as shown by BYD during DVN Shanghai 2024 (here at 5° down from H):



### Annex 16

#### Symbols and patterns for the use as Driver Assistance Projections and Explanations of the Warnings/Highlights

| Symbols and Pattern | Use case                    | Conditions and remarks  |
|---------------------|-----------------------------|---|
|                     | Slippery road warning       |   |
|                     | Risk of collision warning   | Triggered when the relative speed is larger than 30 km/h and Risk of Collision Time is less than 1.4 s.<br>Flashing at 4.0 Hz +/- 1.0 Hz allowed. |
|                     | Wrong way warning           | Activated when the vehicle is entering a one-way road or a highway in opposite direction.<br>Flashing at 4.0 Hz +/- 1.0 Hz allowed.               |
|                     | Lane keeping assist warning | Activated if the vehicle unintentionally exits its lane.  |

The Driver Assistance Projection according to UN Regulation No. 48, paragraph 6.22.9.3.2., may be part of the driving-beam light distribution within a zone limited by the following angles:

vertically: - 1.2° and below

horizontally: ± 25°

The Driver Assistance Projection may be produced by modifying the beam pattern in the zone defined above, where the luminous intensity in any point of the entire driving beam shall not exceed the maximum value (IM) according to paragraph 5.1.4.2. and not less than the minimum intensities prescribed in Table 13 Part B.

## Relevant section of UN R149-01

At GRE in October 2024, it was decided to add the predicted-trajectory symbol soon:



This figure is showing an example of the basic quadrilateral shape of the Driver Assistance Projection for predicted trajectory, as seen from the driver's perspective of a car in straight forward motion. The dashed lines are not part of the projection. They are a representation of the lines delineating the lane on which the vehicle is travelling, and only added to clarify the image and lateral boundaries of the predicted trajectory projection.

### Predicted trajectory

This shape may change when adapted in conformity with the requirements in paragraph 5.35.12.

In China, from 1 July 2025, all road projections—considered part of ADB—will be accepted under the new Chinese national standard GB4599-2024, without a restricted list of symbols as in UN R149.

## DLP applications

After seven years, DLP solutions are now on a lot of different vehicles:

- Mercedes; over 10 models starting in 2018, from Marelli (Gen1 and Gen2 C-class) and ZKW

15 YEARS DVN – A BRIEF „LIGHTING“-REVIEW

The FEATURES are AVAILABLE from „Entry Luxury“ to „Top-End Luxury“

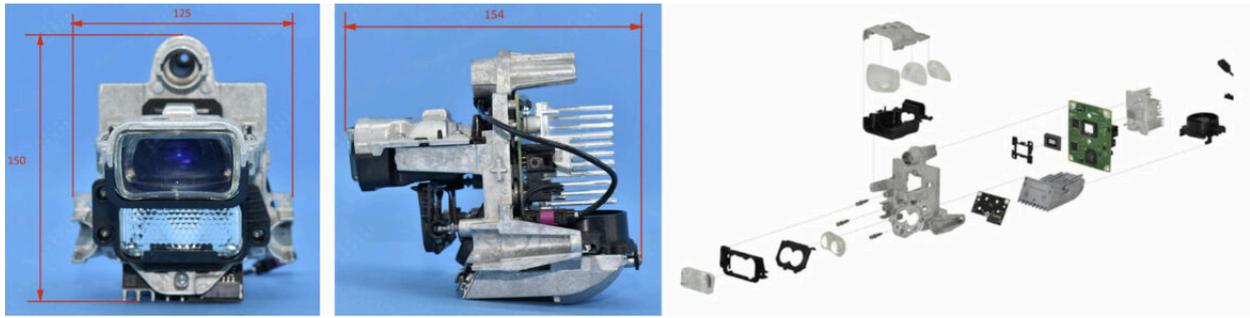
Mercedes-Benz

DIGITAL LIGHT | RD/KEL

31. Januar 2023

from Mercedes presentation @ DVN Paris 2023

The Mercedes GLC module from ZKW is 154 mm deep:



2023 Mercedes GLC module (A2MAC1 image)

- Audi: 2019 e-tron, 2021 A8, 2022 Q8 e-tron—2021, 2022 Q8 e-tron; from Marelli (Gen 1)



- 2019 Wey VV6 & VV7, from Mind

Field of view  $14^\circ \times 7^\circ$ ,  $I_{\max}$  75 kcd



- 2021 Hippi X and Z from Hasco Vision



Hasco Vision DLP mk6 (from DVN Paris 2023)

- 2022 IM L7 and LS7, from Hasco Vision



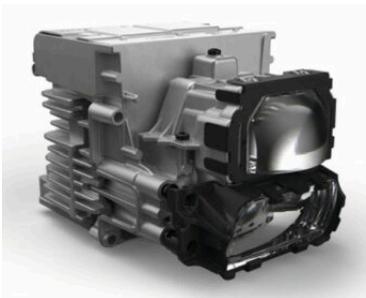
Hasco Vision DLP mk7 (from DVN Paris 2023)

- 2022 Range Rover, from ZKW



ZKW MirrorZ, 150 mm deep

- 2024 Volvo eX90 and Polestar 3, from ZKW



- 2024 BYD U7 and N9, from BYD Fudi



BYD DLP with  $14^\circ \times 7^\circ$  FoV (from DVN Shanghai 2024)

- 2024 Cadillac Celestiq, from SL



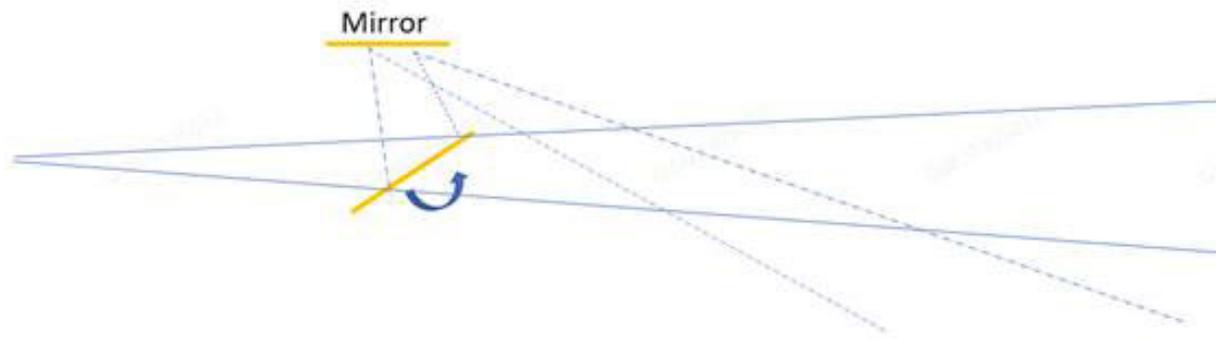
- 2024 Changan Deepal S05, from Huawei



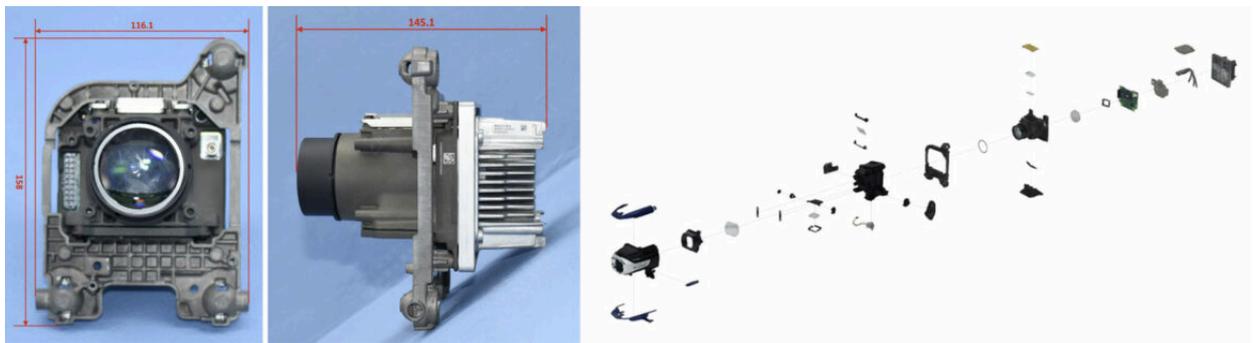
- 2024 Aito M9 and S800 Maestro, from Huawei / Xingyu



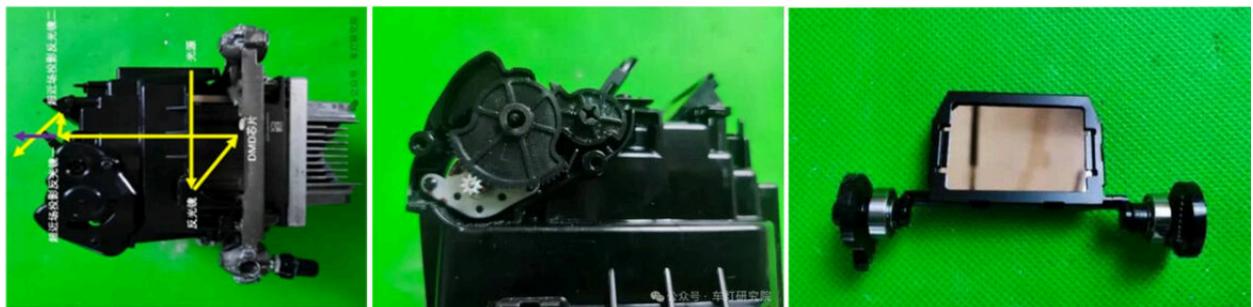
The main focus in China with DLP application is on interaction and near-field projection. For example, on the Aito M9, an additional reflection has been added to enable near-field projection at 3 metres, compared to the classical solution between 7 and 8 metres ahead of the car.



The DLP module is 145 mm deep and has a second mirror and a stepper motor to add (or not) this additional reflector to move the projection from 8 to 3 metres. It's an arrangement similar to the bi-xenon and bi-halogen solenoid actuator 20 years ago to generate a low and high beam from a single projector.



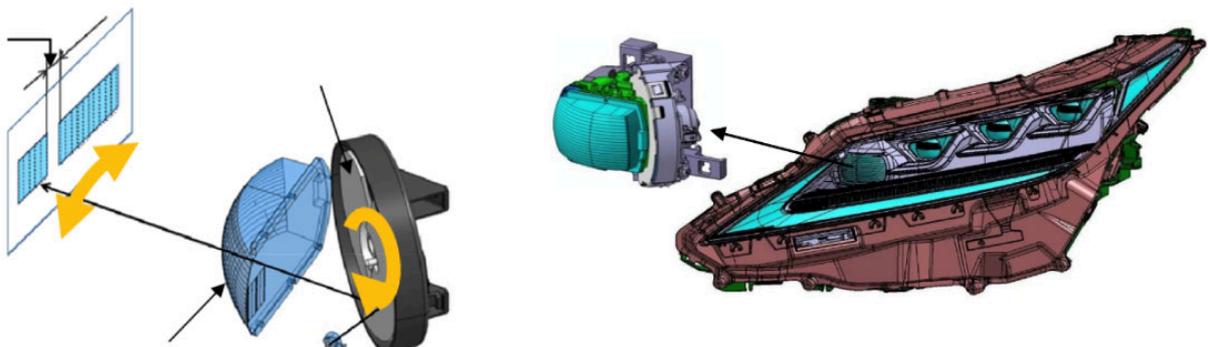
A2MAC1 images



DengdengSchool images

### Other technologies

BladeScan is a Koito technology available on Lexus models from 2019. It offers an attractive reduced dark zone but cannot project symbols.

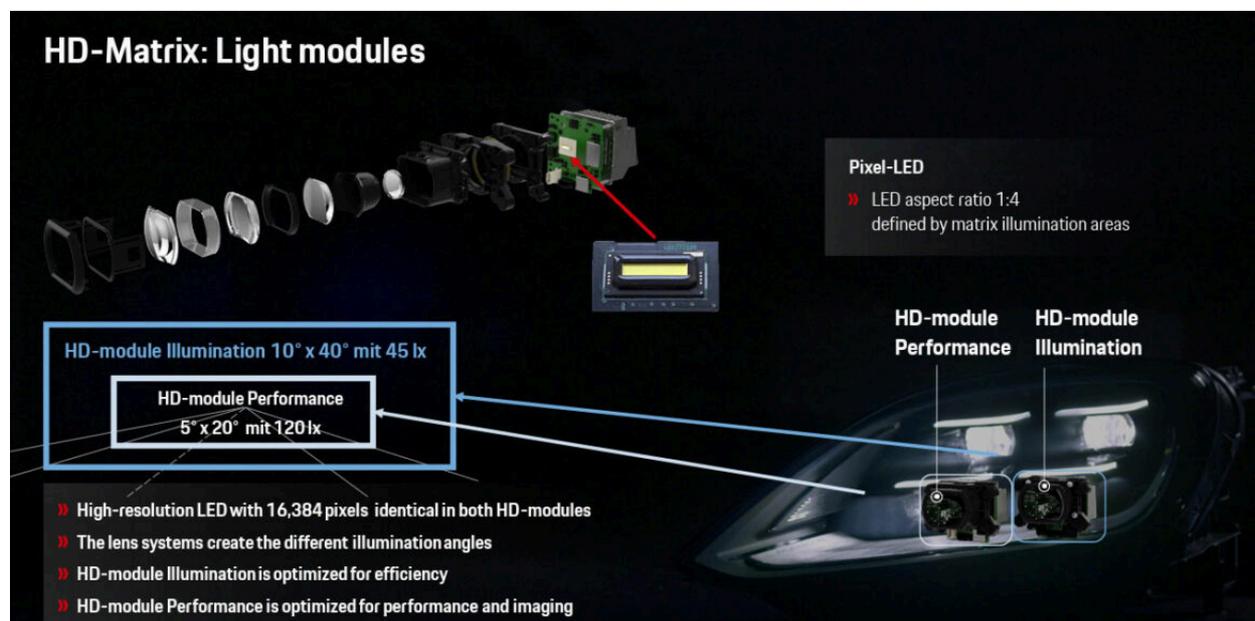


## MicroLED

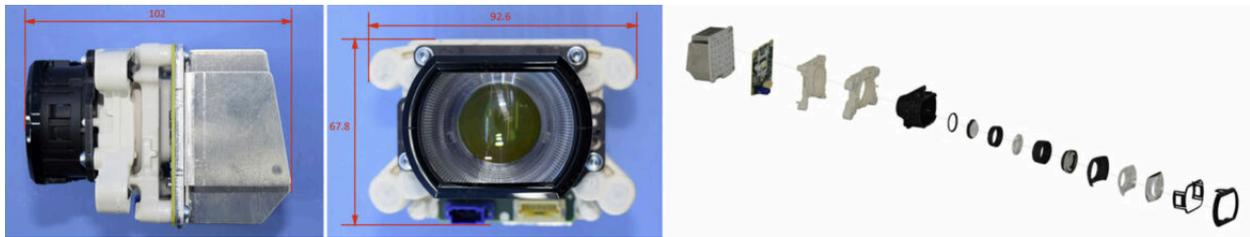
From 2023, microLED technology is also available. The first introduction was done by Porsche, Forvia Hella, and Nichia on the Porsche Cayenne.



HD lighting is done by 2 HD modules with a FoV  $40^{\circ}\text{H} \times 10^{\circ}\text{V}$  with 28,125 cd, and  $20^{\circ}\text{H} \times 5^{\circ}\text{H}$  with 75 kcd.



The modules are much smaller, just 102 mm deep. Find more information from our [DVN field trip to Porsche R&D](#) and our [Cayenne night drive](#).



The second  $\mu$ LED introduction was done by Marelli and ams Osram. Compared to DLP, this technology offers lower cost, smaller module size, lower power consumption (about half!), and a bigger FoV of  $18^\circ\text{H}$  or  $24^\circ\text{H} \times 6^\circ\text{V}$ .

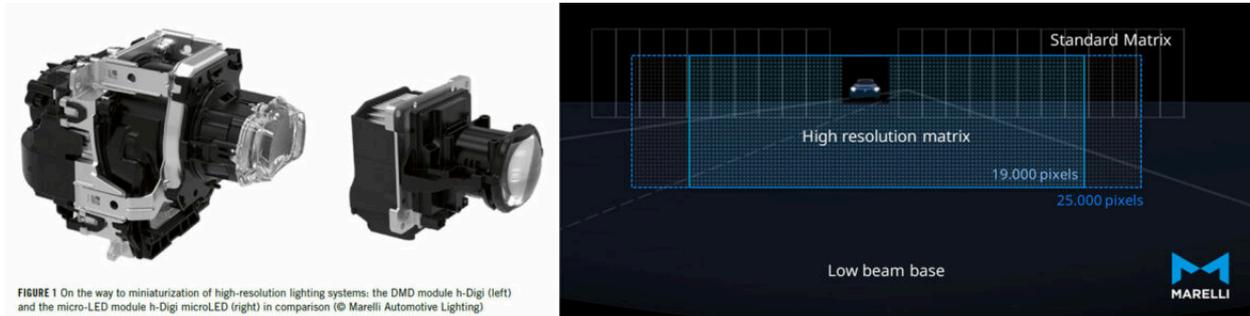
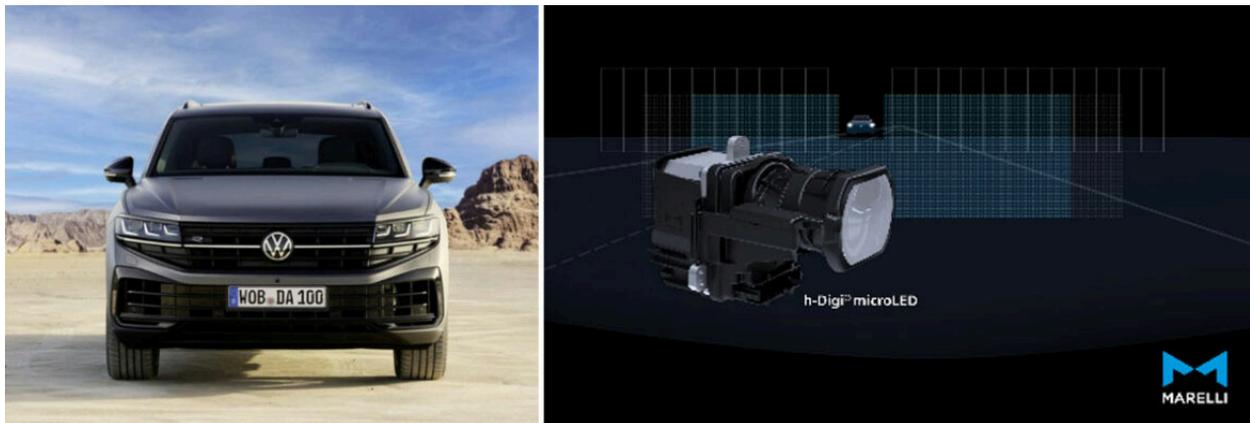


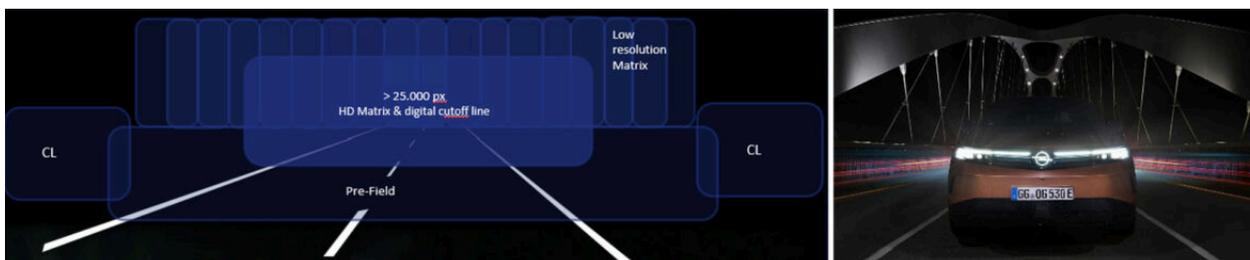
FIGURE 1 On the way to miniaturization of high-resolution lighting systems: the DMD module h-Digi (left) and the micro-LED module h-Digi microLED (right) in comparison (© Marelli Automotive Lighting)

As with DLP, the  $\mu$ LED HD module is supported by a second module, a bi-matrix for example, to provide the full low and high beam, as described by Stellantis during SIA VISION 2024 on their Opel Grandland (lighting produced by Marelli).

The first application was done by VW on the Touareg and Tiguan models with 1:3 ratio; [DVN did a night drive](#) of that system.



A second application was on the Opel Grandland, which [DVN also night-drove](#).



With 1:4 ratio and a  $24^\circ\text{H} \times 6^\circ\text{V}$  field, this concept provides a larger horizontal field of view for ADB, and  $I_{\text{max}}$  of 75 kcd.

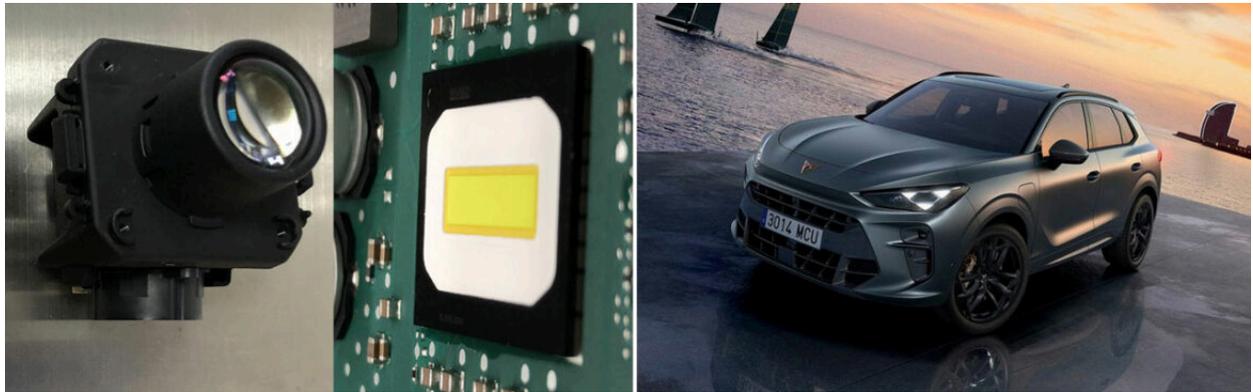
## μLED applications

As of January 2025, microLED headlamps are now on a lot of different vehicles:

- Porsche 911, Cayenne, Taycan, Panamera by Forvia Hella, 16 kilopixels
- VW Touareg, Tiguan, Tayron by Marelli, 19 kpx
- SAIC-VW Tiguan Pro and Teramont by Hasco Vision, 25 kpx



- Opel Grandland by Marelli, 25 kpx
- Cupra Terramar by ZKW, 25 kpx and  $24^{\circ}\text{H} \times 6^{\circ}\text{V}$  field with one HD on left headlamp



- Cupra Leon, Formentor by Hella, 16 kpx and  $24^{\circ}\text{H} \times 6^{\circ}\text{V}$  field with one HD on left headlamp



- Nio ET9 by Marelli, 25 kpx



Other lighting suppliers have mentioned their impending  $\mu$ LED entries as well:

- Mind: 25.6 kpx,  $I_{max}$  95 kcd,  $24^\circ \times 6^\circ$  FoV; SOP 2025
- Valeo: 16 to 25 kpx, module size  $106 \times 138 \times 177$  mm (as published on Valeo website)
- Koito: 16-kpx module demonstrated at CES 2025



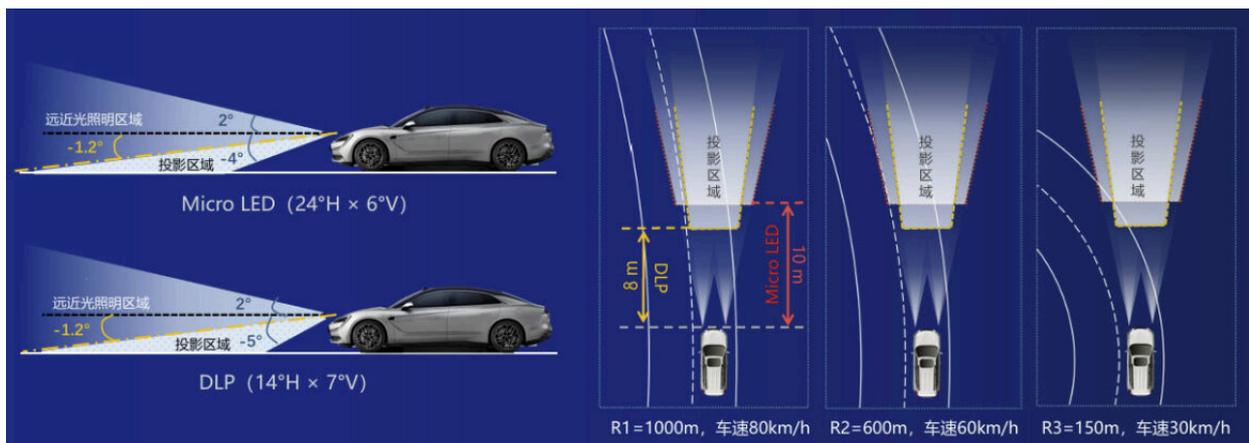
Koito demo at CES 2025



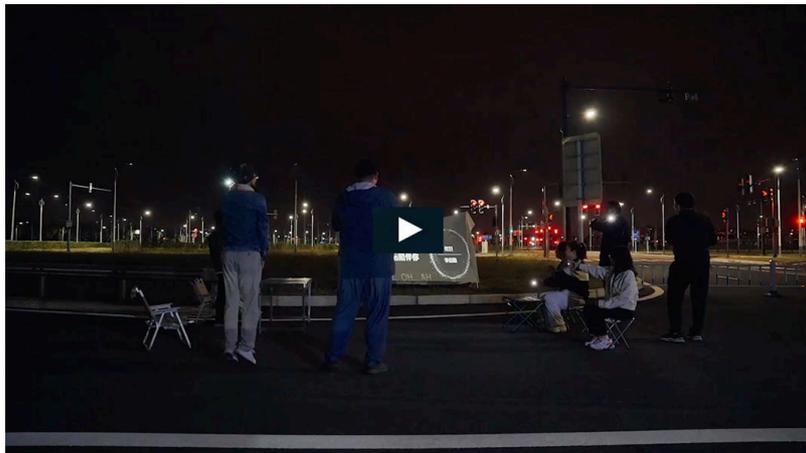
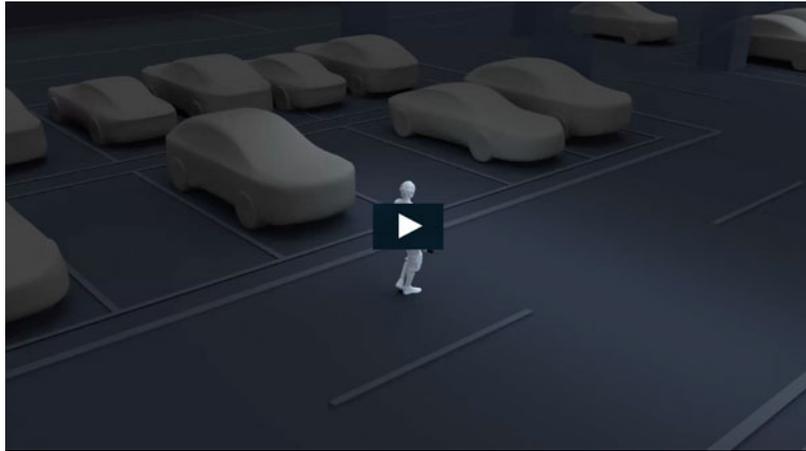
Valeo's  $\mu$ LED module (Valeo image)

## Market overview

In China, we can currently see some concerns about near-field microLED projections especially in static condition when vehicle is parked, in low speed manoeuvres, and on curvy roads as shown here. While DLP offers a 7-degree vertical field,  $\mu$ LED presently offers a shorter 6-degree vertical FoV. And resolution for symbols and video displays is still better with DLP.

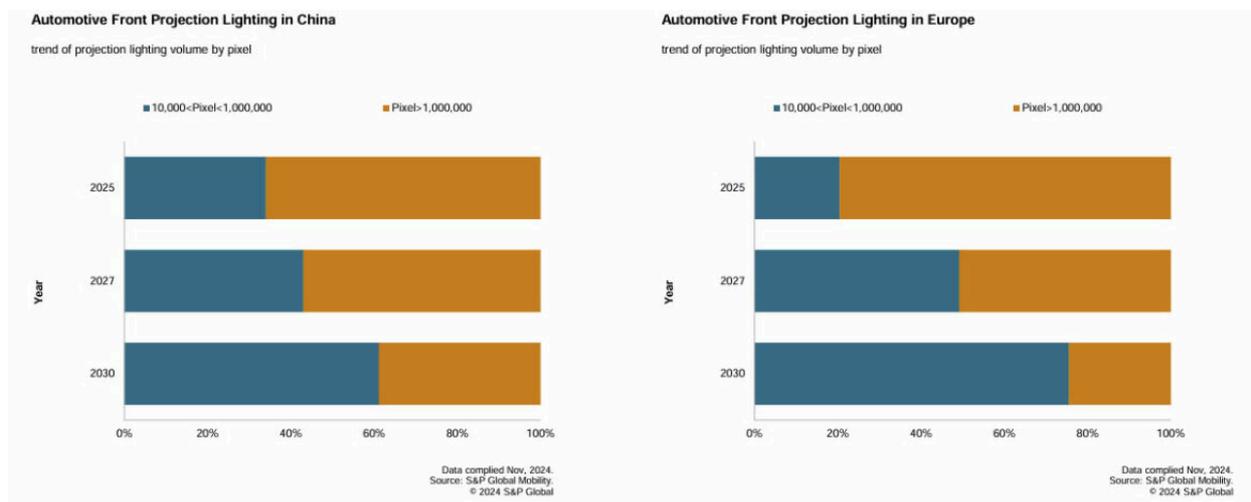


Huawei have also shared some scenarios with the need for nearfield projection during DVN Shanghai Workshop 2023, with projection distance as close as 2 metres from the car.



With the latest evolution of the regulations, the market for HD headlamps will continue to grow; according to S&P Global, it may reach a market of 8 million units per year in 2030, over half of which for the Chinese market.

Moreover, they see a difference between DLP and microLED equipment rates between Europe and China, due to the importance of HD for ADB in Europe versus importance of HD for interaction and road projection in China. They predict a 2030 share of 80 per cent  $\mu$ LED and 20 per cent DLP in Europe, versus a China-market mix of 60 per cent  $\mu$ LED and 40 per cent DLP.



from S&P presentation @ DVN Shanghai 2024

## Technical evolution

Technology is evolving fast and already some updated proposals are coming into the market to improve performance and address the concerns:

- **DLP:** the latest 0.55-inch DMD + DLPC231 permits extended FoV of  $20^{\circ}\text{H} \times 10^{\circ}\text{V}$  and  $I_{\text{max}}$  over 78 kcd. This will improve ADB width and also projection in the near-field area. This proposal was mentioned in BYD's presentation at DVN Shanghai to solve their current issues for projection and curvy roads.

Another 0,46-inch DMD chip also permits price reduction with similar performance: FoV  $14^{\circ}\text{H} \times 7^{\circ}\text{V}$ ,  $I_{\text{max}}$  around 62.5 kcd, and 0.9 megapixels. Hasco Vision presented at DVN Shanghai their new DLP including this chip, with an even higher  $I_{\text{max}}$  over 78 kcd.



from BYD presentation (left) and Hasco Vision (right) @ DVN Shanghai 2024

- **MicroLED:** LED suppliers Nichia and ams Osram are working to increase the resolution with 100 kilopixels to improve road projections resolution and perhaps FoV. At the same time, to reduce the cost and simplify ADB system and especially EE architecture, LED makers are working on a 4-kilopixel solution that will still provide high resolution ADB performance with UART-over-CAN protocol instead of LVDS.
- Some tier-1s are also working on autofocus or image shift strategies to have a clear picture when projected on the road or wall no matter the distance, including a time-of-flight sensor.

Fast steering mirror for headlight beam steering (MR-15-30)



- Compact
- Fast
- Large FOV (100°)
- Robust (>1B cycles)

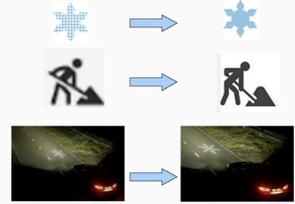


optotune

Extended pixel resolution (XPR) for road writing



- The XPR can improve resolution for road writing
- Sharp images can be produced using a high native  $\mu$ LED array, but there is increased cost in terms of price and power consumption.
- Optotune's XPR can increase the resolution of smaller  $\mu$ LED arrays, limiting the cost and power consumption
- Established technology already mass produced for the AV / Cinema projectors industry



optotune

Optotune's concepts

A specification alignment among all stakeholders could help tier-2 lighting suppliers

Conclusion and outlook

To conclude and extend to other application, we see also other application of HD technology in automotive lighting applications:

- Side projection with DLP (0.30-inch chip on Zeekr X)



- Interior projection with DLP on Aito M9 for video (ALPD Technology)
- Exterior projection for video application with DLP and RGB laser



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# Lighting News

## DVN Interview: BrightView Technologies

LIGHTING NEWS

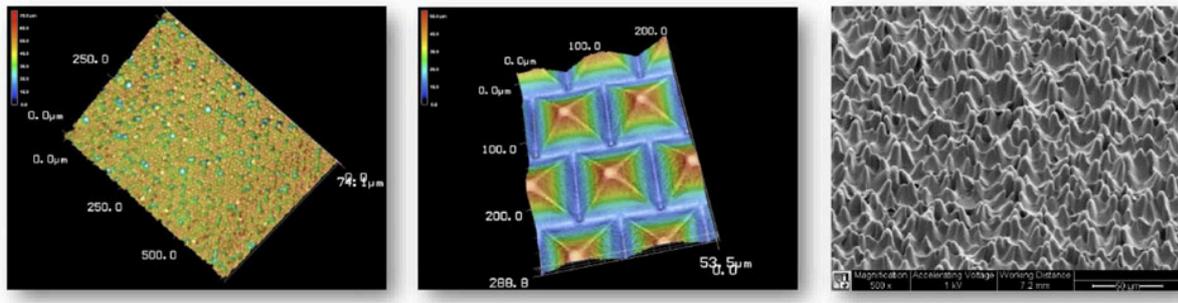


I sat down with Mike Murphy, the Chief Commercial Officer at BrightView Technologies, during the DVN Shanghai event. As BrightView just joined DVN a few months ago, I wanted to learn more about who they are, what they do and what they think about the automotive lighting market.

**Paul-Henri Matha for DVN: Hello Mike, it's nice to meet you! Can you start by sharing a bit about BrightView?**

**Mike Murphy:** Hi Paul-Henri, it's great to meet you, too! Thanks for taking the time to speak with me. Let me explain a little about BrightView.

BrightView Technologies, based in Durham, North Carolina, United States, designs and mass produces film products, which incorporate microlens arrays—also called 'computational optics'—into their surface. Computational optics are micro-sized (one millionth of a metre) structures that manage light propagating through a film for a wide range of applications. With best-in-class technology, unparalleled speed in product development, and an extensive array of materials and form factors, BrightView creates the fundamental building blocks powering major technology trends such as artificial intelligence, high-acuity displays, AR/VR, 3D image sensing, and advanced automotive functionality.



Computational optic structures in polymer films

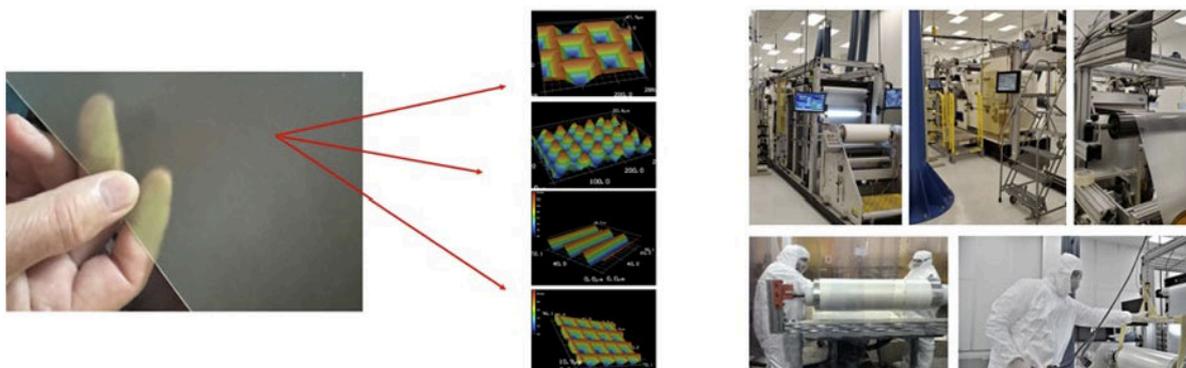
**DVN: Where did the idea come from to enter the automotive business, especially lighting?**

**M.M.:** BrightView’s origins stem from the commercial lighting sector, building strong capabilities in managing the light from LED point sources. Over the years, this effort helped BrightView branch into adjacent markets such as consumer display, AR/VR, and sensing. Interestingly, the automotive industry aligns with all of these segments, so there is a lot of synergy with our technology and business. For example, attributes of efficient light management—including low cost, size, weight and creative optical outputs—are all benefits in the design of innovative vehicle displays!

**DVN: Can you give us more details about your computational optics products?**

**M.M.:** Our computational optics products are sophisticated polymer films which are designed to perform the optical function required, depending on the use case. For example, the consumer and enterprise display industries have been utilizing the benefits of film-based computational optics products to enable the performance required for flat-panel displays—including high brightness, uniform field of view, and more. The consumer and enterprise display industries are demanding and cost-conscious markets, and computational optics films have enabled complex optical problems to be resolved, yielding the manufacture of high-performance, cost-effective displays. This capability has been picked up by the automotive industry, and computational optics films are now being used in a wide range of motor vehicle applications, such as lighting, sensor systems (including lidar) and displays.

The manufacturing process at BrightView is very similar to the high-volume microelectronics industry, using grayscale lithography processes to create the tooling for high-volume computational optics film production. Grayscale lithography enables the creation of micro- and nanostructures with varying height gradients, enabling the fabrication of surfaces with complex topographies. The process is well established and generates consistent, high-performing computational optics film products in high volume over a wide range of polymer substrates, which can meet the exacting standards of the automotive industry.



Computational optics film structure, BrightView’s roll-to-roll film manufacturing process

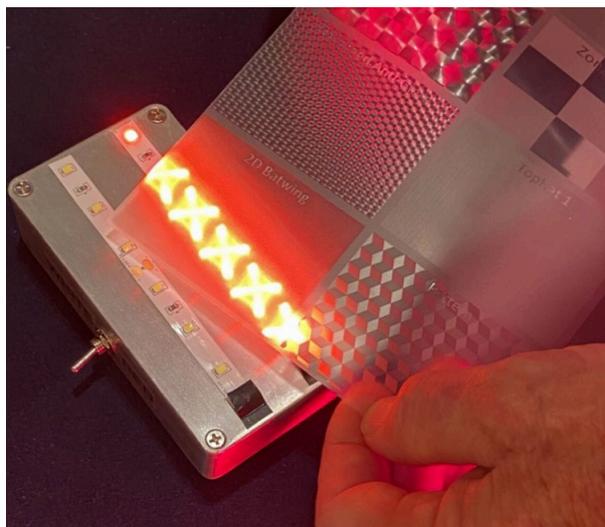
## DVN: What about vehicle lighting applications?

**M.M.:** Vehicle lighting is often called the 'new chrome'—a term initially coined by Volkswagen. Computational optics films enable low-profile, low-weight and high-performance exterior and interior lighting systems which are low in energy consumption and material usage. These films are being used to homogenize LED lighting arrays for smooth light output profiles and complex optical patterns, giving the automakers a broader range of lighting solutions to differentiate their EV model range. Many of the techniques being leveraged in lighting stem from the back- and edge-lit display industry, yielding established technologies with a solid supply chain to support volume requirements. Computational optics films can be laser- or die-cut and thermoformed into different shapes with little or no change in optical performance. This opens the use of these films in a wide range of interior and exterior automotive lighting applications.



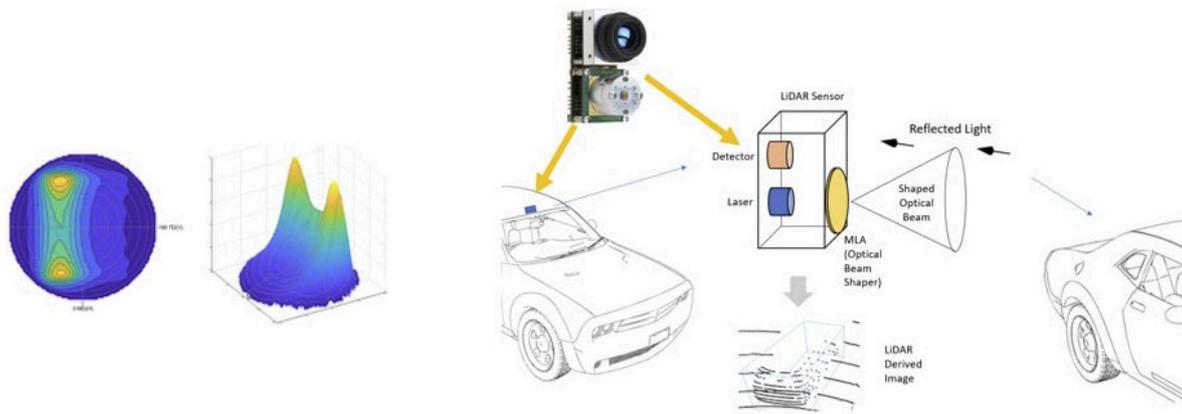
Computational-optics films generating different lighting outputs

## DVN: Do you see other automotive applications evolving?



Mockup shown at DVN Shanghai 2024

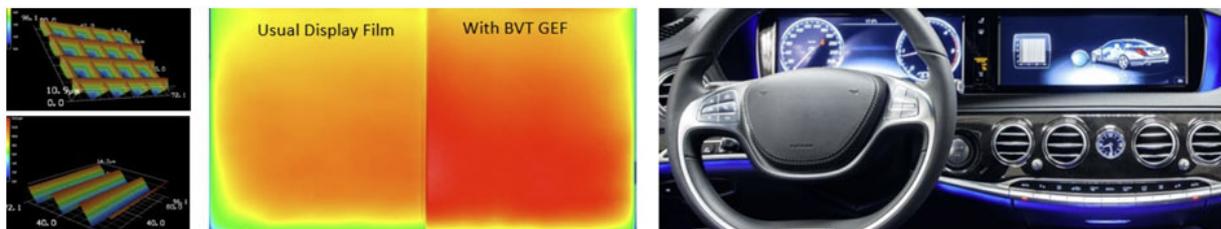
**M.M.:** Yes! Modern vehicles have a wide range of sensor systems, and notwithstanding the drive towards autonomous vehicles, the need for a wide range of sensor types is essential for the safe performance of the vehicle. Lidar sensing has been well known for many years, and the recent utilization of computational optics films within the sensing units has enabled specific optical beam shapes to be generated. Whether enabling object sensing or gesture control within the vehicle, the capabilities of computational optics films directly influence the efficiency of optical sensors and take advantage of their low-cost capabilities.



Lidar optical beam shaping with computational optics films

Automotive displays are growing rapidly, and the range of display types within a modern vehicle is enormous. Whether leveraging flat panel infotainment displays, instrument clusters, regular or panoramic head-up displays, computational optics films enable the high optical performance required. Flat panel, edge-lit or back-lit displays leverage the capabilities developed within the consumer and enterprise display industries and the advantages that engineered computational optics films can bring. For example, brightness is a very important parameter for a motor vehicle, and as a result, BrightView has developed innovative Gain Enhancement Films (GEFs) which increase the light output from an edge-lit display by about 30 per cent. This translates into direct electrical energy savings, which is key for the EV industry.

HUDs are increasingly available on vehicles, and with computational optics films their optical performance can be enhanced with better uniformity and brightness. Using these films in HUD designs can significantly reduce the optical complexity and component count, which can be passed on as a cost benefit and weight savings to the automaker. Another applicable area is pillar-to-pillar displays across the entire dashboard of the vehicle. They mainly use back-lit display approaches, but these have a high brightness and uniformity requirement that can only be achieved using computational optics films. There may be angle bending or privacy needs, and engineering the computational optics structures can achieve this required optical performance within the film—reducing complexity, component cost and weight while maintaining the desired low-profile footprint.



BrightView's GEF in an automotive application

BrightView's unique computational optics film products bring mature technology to the automotive industry that is enabling a quantum leap in capabilities for lighting, sensing and display. As a leading optical film solutions provider, BrightView is excited to educate DVN members and followers on the vast capabilities of computational optics—in addition to the impact that the technology is beginning to have on the automotive industry.

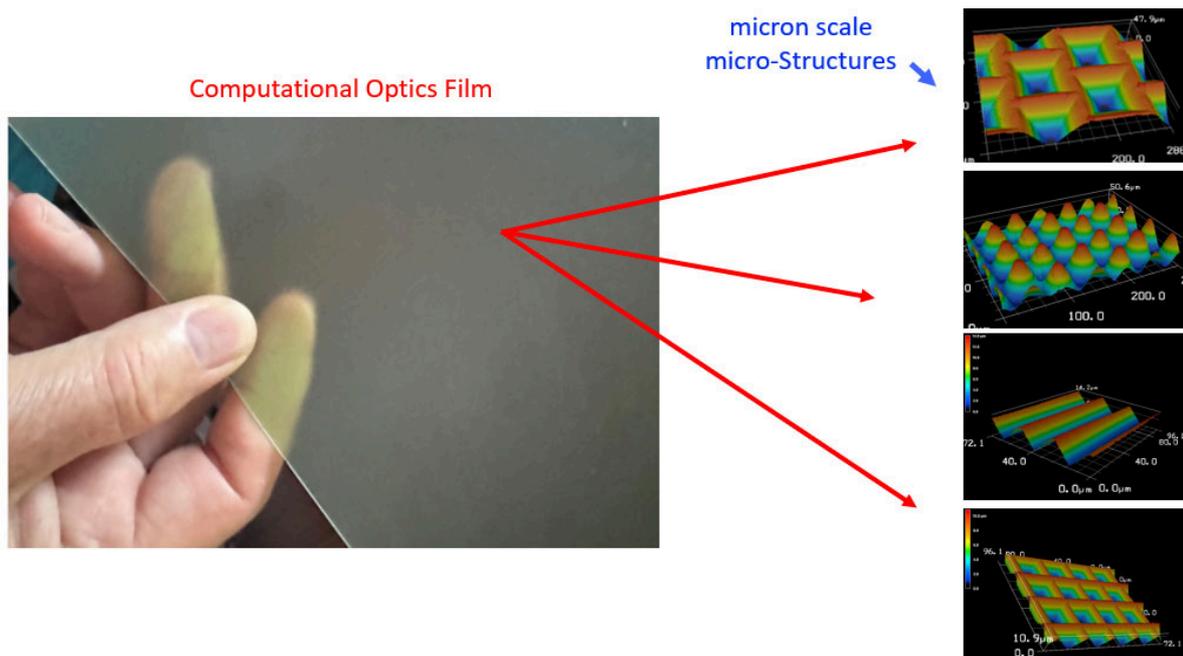
**DVN: How do you calculate the optical performance you want on the room, a 2D film and on a 3D film in the lamp? What curvatures and shapes can you handle?**

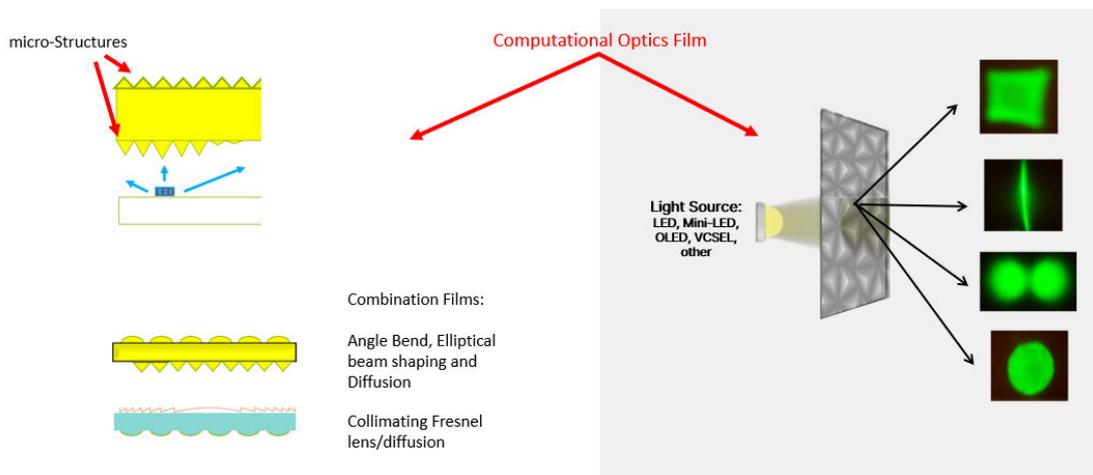
**M.M.:** Our design process typically begins with a deep dive into the optical functionality required by the customer. Rather than specify lenses, our world-class optical design team asks the client to outline the optical input and desired optical output. With our in-house proprietary software, we create a design of experiments (DOE) for the computational optics structure. Once the DOE is transferred to our greyscale photolithography system (called E2), we create a matrix of test blocks or prototypes. What is unique about our process is that our speed allows us to design empirically and experimentally, rather than just using simulations. We can often create prototypes faster than we can simulate in software such as LightTools. After measuring the optics of the test blocks, and often providing multiple samples to our customer, together we select a final design and then create a full-size primary tool, again using our E2 system. Using our post-processing steps, we create generational tooling from this primary tool to ensure long-term consistency and stability in the process. The generational tool is then used on our large scale, roll-to-roll photoreplication line to create the final mass-production product. From start to finish, this process can take as little as 5-7 days but typically it is a few weeks to go from concept to production.

Transparency and communication are fundamental; we keep clients informed at every stage, ensuring a seamless transition from concept to a fully-realized optical solution that not only meets but exceeds their expectations.

**DVN: What is the density of the optical structures you can provide? How do you define the microlenses on a customer specification, or do you have your own specification?**

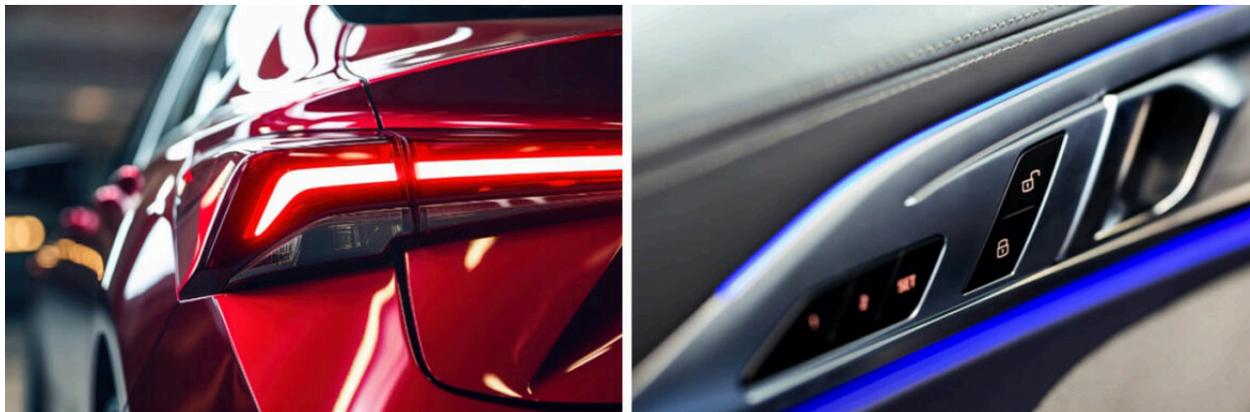
**M.M.:** Our computational optics designs are micron-level structures, and the application ultimately governs structure size and density. You cannot see the structures with the naked eye, so you will need a microscope. These microstructures appear as a slight haze to the film surface, but there will be millions of structures per square inch.





Computation Optic film structure and optical output examples

**DVN: Film integration in lamp is always complex. You need a very accurate position of the film on the holder, reflector and housing. How to you work with set maker to guarantee the position?**



Computational Optics films in exterior & interior lighting applications

**M.M.:** Typically, for lighting applications, our computational optics products do not need precise alignment with the optical source. But there are exceptions; for example, in the display industry, you may need to position certain microstructure regions on the film relative to an optical source, and the use of fiducials readily facilitates that.

**DVN: What does your cycle time look like?**

**M.M.:** Our development cycle times are very fast. Tooling can be manufactured within 24 hours following the modelling and assessment phase. Overall, it would normally take around four to six weeks to go from initial design discussions with a customer to prototype. 'Down-selection' for production tooling would follow. Production can start immediately upon selection and will typically follow a 2-week lead time depending on order size.

**DVN: What else can you tell us about the films?**

**M.M.:** Our manufacturing process is applicable across a wide range of polymer materials, but for the automotive industry, this is mainly polycarbonate that is selected as the substrate. Our computational optic structures are then written into a proprietary UV-cured photopolymer. Manufacturing is a low-touch, high-volume roll-to-roll process, which means our pricing is competitive. We have been successfully supplying the high volume and cost-sensitive industries of consumer display and commercial lighting for some years now. Many of our customers are in Asia, including China.

# MiniLED Control Technology: A Brief Discussion

## LIGHTING NEWS



As miniLEDs are becoming more and more prevalent for automotive applications, it is a good time to discuss the various possibilities to control these new applications from electronic side.

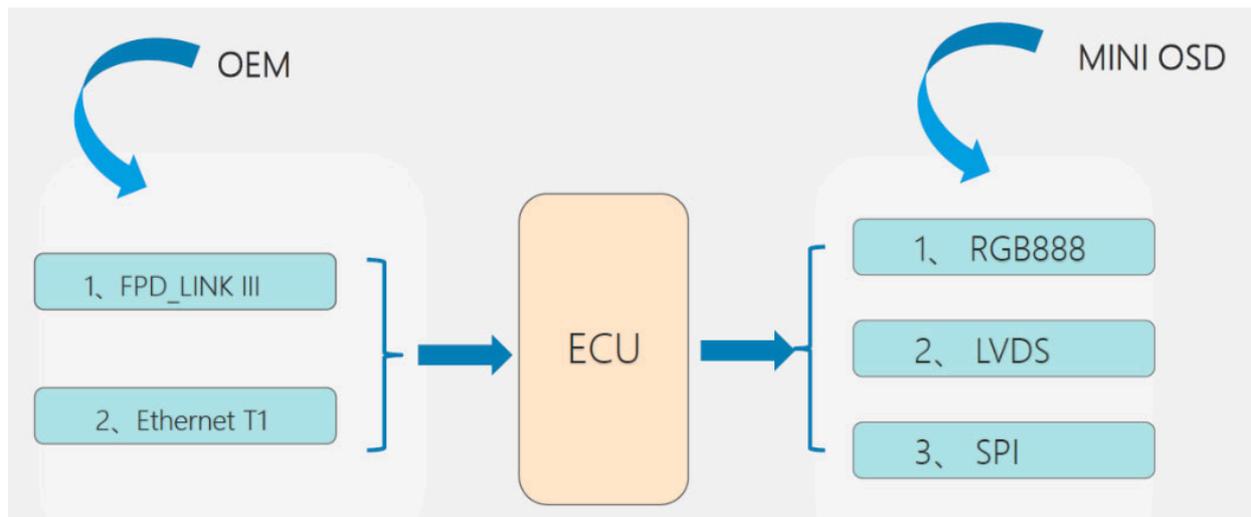


Examples of vehicle applications for miniLEDs include lighting products like interactive grilleboards or rear illuminated panels and interior projection lights, and displays used in the interior of the car in dashboards, rear seat entertainment, interior mirrors, and other smaller applications in steering wheels and door panels.



Therefore, different communication channels are implemented in different car applications. Anrui, in their presentation at DVN Shanghai 2024, compared the most popular ones with advantages and disadvantages. It is important to have a look at the communication interface provided by the automaker, on the vehicle, and the

communication interface between the controlling electronics (ECU) and the miniLED application.



FPD-Link was created in 1996 as high-speed digital video interface, and has become over years a standard for connecting graphic processors with video screens. With the introduction of FPD-Link III, it is even possible to have a bidirectional communication interface on the same differential pair.

Especially for automotive applications like navigation systems, in-car entertainment and advanced driver-assistance systems, FPD-link III has become the de facto standard due to the very reliable and EMI resistant communication protocol.

Ethernet T1S has become more and more standard for high-speed automotive communication channels due to its scalability and very reliable and EMC resistant wiring and protocol. The wide usage of Ethernet on the consumer side is also providing chipsets and connectors on high volumes by different suppliers worldwide and with this enabling competitive costs.

Especially by implementing central domain electronics, the Ethernet communication interfaces will enable stable and standardized connections to Ethernet backbones.

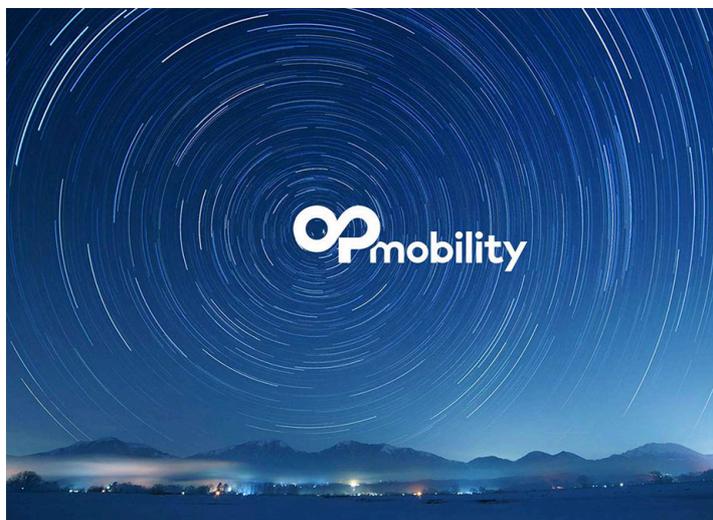
Concentrating on the connection between ECU and display the difference is mainly regarding cost and EMC, as the RGB888 interface is mainly affected by the high number of BASE data lines and the TTL level transmission stability. Difference between LVDS and SPI depends more on the needed distance to be bridged resulting in a more stable connection by using LVDS for long distances. For displays with a very high pixel count, LVDS could also be the right solution. Cost wise, SPI is the best solution as chip set, connector and cable are cheaper than for LVDS implementation. So, let's have a look at the alternatives:

| Communication interfaces   | Connector pins to Display | Maximum Length communication interface to Display | EMC reliability                    | Scalability | Max Data transfer rate ECU-display | Costs     |
|----------------------------|---------------------------|---|------------------------------------|-------------|------------------------------------|-----------|
| FPD-Link III—RGB888        | 20                        | < 0,5 m   | Medium                             | Low         | 800MBps per line                   | Very High |
| FPD-Link III - LVDS        | 10                        | < 3,0 m   | High                               | High        | < 655MBps                          | High      |
| Ethernet T1—High speed SPI | 4                         | < 0,5 m   | High for short distance connection | High        | Max 30-60 MBps                     | Medium    |

This comparison shows that when the connection between the ECU and the miniLED application is less than 0.5m, Ethernet T1 combined with SPI on application side offers a lot of advantages to control the miniLED application. In most applications, this can be realized by implementing the ECU to the display.

# OPmobility Shuffle ExCom for Faster Transformation

## LIGHTING NEWS



OPmobility have announced changes to their executive committee, as part of the group's transformation to optimize operational performance and provide customers with increasingly integrated and value-added solutions.

Christian Kopp, currently Senior Executive Vice President and President of the Exterior Business Group, will lead a new business group comprising OPmobility's exterior and lighting activities, notably to accelerate the development of a differentiated offer to meet the growing demand for integrated exterior systems.

Gérald Mentil, Executive Vice President and currently President of the Lighting Business Group, is appointed Group Chief Performance Officer; in a challenging market, he will be responsible for boosting the performance and accelerating the Group's transformation.

In addition, Hélène Dantoine is appointed Executive Vice-President, General Secretary, Chief Compliance Officer, and a member of OPmobility's Executive Committee.

Rodolphe Lapillonne, Chief Performance Officer, has decided to retire after 23 years with the Group and more than 16 years on the Executive Committee.

Christian Kopp will lead the new Exterior & Lighting Business Group, as President from 1 February 2025. This new business group will have 59 plants and 26,000 employees across 18 countries. It will enable OPmobility to accelerate the growth of their lighting business and the development of a differentiating, innovative, and connected offer to meet growing demand from automakers for value-added integrated exterior systems.

From the beginning of February, OPmobility will therefore be organized into four business groups: Exterior & Lighting, Modules, C-Power and H2-Power. This will have no impact on the Group's financial reporting.

# 2025 Detroit Auto Show

## LIGHTING NEWS



The 2025 Detroit Auto Show brought back some familiar faces, with major automakers returning to the expo.

Automakers showed off an evolution in lighting design, with front and rear lighting extending across the full width of the vehicles.

The new electric 2025 Jeep Wagoneer S EV, for example, has a sleek light bar integrated seamlessly with downward-facing lights that reflect off the painted surfaces, creating a distinctive and visually striking effect.



The new Ram 2500 has four slim light units, which are the visible thing when you look at the truck.



Similarly, the 2025 Dodge Challenger, available with electric or petrol power, has full-width illuminated bars and lit Dodge-brand "Fratzog" logos front and rear. The segmented lines in the rear design add depth and character.



The Ford Expedition Platinum has an elongated illuminated front bar, while the redesigned Ford Maverick has new projector headlamps rather than the previous reflector units.



Similarly, the refreshed Ford Explorer gets a headlamp redesign that incorporates indirect reflectors. At the rear are multifunctional lighting elements and an upgraded centre applique lamp.



Chevrolet's new Equinox and Trax continue the trend of moving the low and high beams lower and lower on the front end. The Suburban builds on the lightstyling introduced with the 2024 Traverse. The Silverado pickup has headlamp designs integrated with surrounding elements, such as the bumper.



The GMC Yukon faces the world with refined aesthetics and modern lighting elements.



Cadillac continues to feature headlamps with multiple-optic projectors arrayed vertically, and they've added grille illumination even on gasoline-powered models. Shown here are the Vistiq EV and Escalade IQ.



Toyota presented a refreshed Camry, while VW allowed visitors to joyride their VW Bus including a lit front logo and showed their updated Tiguan SUV with OLED-Look taillights.





Lincoln's redesigned Navigator features striking full-width light lines front and rear, with a prominent lit Lincoln logo up front and de-emphasized headlamps.



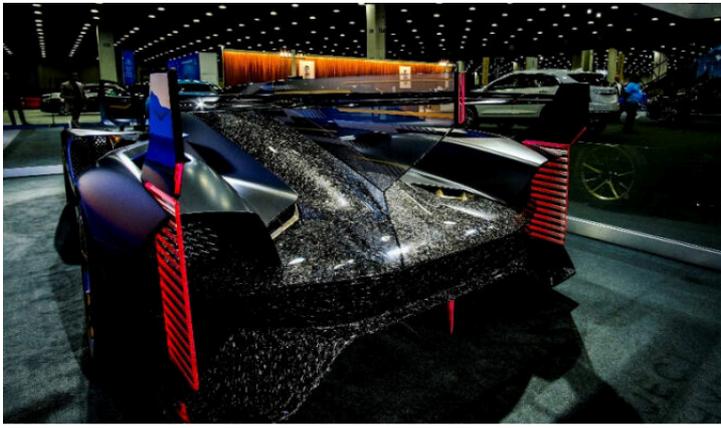
Concept cars on display included the Chrysler Halcyon, Opel Wildcat, Cadillac Opulent Velocity, and Project GTP Hypercar—all with thought-provoking lighting ideas.



Chrysler Halcyon



Cadillac Velocity (above), GTP (below)



Buick Wildcat

# GTB 136th Plenary Session

## LIGHTING NEWS



The GTB committee of vehicle lighting experts met in Salzburg, Austria from 18 to 22 November 2024 with an in-person attendance by 68 people from 14 delegations worldwide.

In addition to the plenary session, the Technical Steering Committee, the General Assembly and several working groups (WGs) also met in person.

As we previously reported, Wolfgang Huhn was unanimously elected by the General Assembly as the new GTB President; his four-year mandate started on 1 January 2025.

Main results of the session:

- Two proposals for amendment to UN Regulation 48, dealing with:

Alignment of requirements for the position in length of the side retro-reflectors to that of the side-marker lamps on semi-trailers at the value of 4 m max from the front;

Clarification of the measurement conditions of the maximum duration of the answer-back signal when flashing (3 seconds including both the ON and OFF times).

- Two small amendments to UN Regulation 149: a correction of the numbering in paragraph 4.11, and a clarification of the CoP procedure.

The above proposals were approved by GTB and will be sent to GRE-92 in April 2025.

- Signalling Road Projection:

The proposal for reversing-light road projection was confirmed in its content, but will be completed with data, to be provided by the various GTB national delegations, on accidents involving vehicles in reverse motion and vulnerable road users or other vehicles, to answer the GRE request (particularly from UK) for more evidence of the usefulness of this function.

In response to GRE comments, the proposal for direction-indicator projection will be further revised by GTB to limit the use cases to the most safety-relevant ones and to add more detailed justification.

The reversing SRP proposal will be sent to GRE-92 in April 2025. If possible, the DI proposal will also be submitted to GRE-92.

Other discussed subjects included:

- Input to GRE-IWG SLR: consideration of a proposal to simplify paragraphs 6.x.4. and 6.x.5. of R48, to avoid repetitions and to clarify the requirements for positioning and visibility angles of the various lighting and light-signalling functions. In addition, a recommendation for the technological neutrality for light sources will be sent to SLR-70 in December 2024.
- Energy efficiency: preliminary research results were presented by the TUD (Technical University Darmstadt). The researchers analysed the most significant options to reduce power consumption according to the driving environment and traffic conditions, while ensuring the same level of safety. The findings could be used to amend the requirements on the switching threshold from DRL to headlamps and for the introduction of variable intensity DRL and new ECO-class headlamps within AFS.
- ADS marker lamp: notwithstanding the unclear situation at GRE and WP.29 about the creation of an ADS marking lamp function (some contracting parties are against it; others are in favour), GTB continues preparation of the related draft 'hybrid' UN Regulation (i.e. with a structure dealing with both the characteristics of the lamp and its installation on the vehicle). The requirements on this matter already existing in some countries will be taken into consideration.

Update of the national regulatory instruments on lighting were presented by:

- China: three new GB Standards for lighting devices, mainly aligned to the series 01 of amendments to UN Regulations 148, 149, and 150, were published on 29 September 2024, with implementation date from 1 July 2025.
- Taiwan: the regulations published in January 2024 are aligned to the 00 series of amendments to UN Regulations 148, 149, and 150. They are already applicable and will be implemented from January 2025. The further alignment of the Taiwanese regulations to the 01 series of amendments will be discussed in 2025, but their publication and implementation dates are not yet scheduled.
- Korea: regarding the planned updating of the local requirements for alignment to the 01 series of amendments to UN Regulations 148, 149, and 150, publication of the related KMVSS is ongoing, with foreseen application date in 2026. Moreover, the introduction of mass production tolerance limit of 20 per cent has been delayed from 2024 to 2025.
- USA: updating work of the SAE Standard on ADS marker lamps is continuing.

Finally, the CE approved the planning for the GTB sessions in 2025:

- **Intermediate WGs and TFs session:** Torino (IT), 11-13 February 2025;
- **137<sup>th</sup> plenary session:** Lanzarote (ES), 26-30 May 2025;
- **Intermediate WGs and TFs session:** to be decided;
- **138<sup>th</sup> plenary session:** Slovenia, 10-14 November 2025 (final location to be decided);

# Driver Assistance News

## Koito Finish Buying Cepton

### DRIVER ASSISTANCE NEWS



Koito's automotive short-range lidar, co-developed with Cepton

Cepton have announced the completion of their acquisition by Koito. As a privately-held, indirect subsidiary of Koito in the United States, Cepton will continue to operate with corporate headquarters in San Jose, California.

This acquisition, effective as of 7 January 2025, marks a strategic milestone in the industrialization of Cepton's lidar technology, combining the strengths of both companies to reshape future mobility. Supported by Koito's world-renowned automotive expertise, Cepton will continue to commercialize lidar solutions with a strong focus on quality, reliability and sustainability.

Cepton CEO and cofounder Dr. Jun Pei says, "We are thrilled to join Koito as one company given the synergies between Cepton and Koito demonstrated through our years of close collaboration. The automotive industry has been trialling lidar technology for nearly a decade, and our combination with Koito comes at a critical inflection point, where trials must transition into full-scale, long-term deployment. Joining forces with Koito enables us to maximize our strengths in delivering what's of utmost importance to our OEM customers: a true balance between performance, reliability and cost".

And Koito President and COO Michiaki Kato says, "The integration of Cepton will enhance Koito's ability to strengthen our global leadership, particularly in setting industry standards for precision sensing technologies across diverse vehicle types and applications. As part of Koito's vision of 'lighting the way for our sustainable future,' we aim to make lidar an accessible technology for automakers worldwide. With the addition of the Cepton team, Koito is committed to driving a future of safe, smart and sustainable mobility."

To go further ...

## Opel Grandland Exterior Lighting

To go further ...

This Opel video shows off their new Grandland's advanced, polyvalent, highly designed lighting system.

