Special Report on 8th DVN Conference

DVN 8th “Sensing & Applications” Conference (19-20 November 2025): Nearly 150 participants and 45 speakers, including managers and CTOs, gathered in Wiesbaden to discuss L2+, L3/4 applications and key sensing technologies such as vision, radar, lidar, IR, and gated cameras. The event provided valuable networking opportunities and updates on market, regulation, and technology trends.

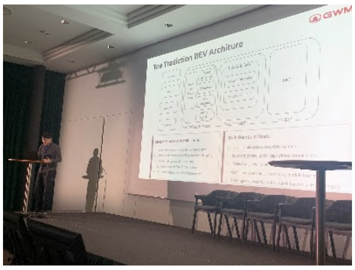
To resume:

- Passenger cars in the EU are prioritizing L2+ (Highway NOA) and L2++ (Urban NOA), as L3 remains costly, with limited ODD and greater OEM responsibility.
- L4 truck systems are projected to launch in the US sunbelt from 2027–28, creating market opportunities for FMCW lidar technology.
- High-definition radars (8x8 to 48x48 channels) will enhance AEB performance and ODD in L2+/L3/L4 systems.
- Lidar is expanding rapidly in China for NOA and preparing for L3 uses, with BSD solid-state lidar emerging.
- Advances in ODD, safety, and cost-effectiveness are expected through affordable HD radars, lidars, and IR cameras, significantly improving AEB and ODD performance.

Session 1: Applications L2+ L3 and Robotaxis

Chairman: Eric Amiot, DVN

GWM (Great Wall Motors):



Peng Yan Lun presented “Evolution of Autonomous Driving Technology». In a context of Level 2 autonomy's 50% penetration in China, he addressed challenges like rare scenarios and sensor noise management and noted the move to E2E neural network planning and lightweight models without detailed maps. The importance of decision transparency through unified reasoning models (VLA) was also emphasized.

Why Now Is Optimal for L2 Autonomy: By 2024, over half of new vehicles in China feature L2+ driver assistance; it has become common rather than premium. Advanced perception methods reduce reliance on high-definition maps, widening adoption across regions and car models. Sensor and domain controller improvements make sophisticated driver assistance affordable for nearly every vehicle.

Autonomy Stack Development: Traditional modular systems use rule-based filters but struggle to scale and generalize. Two-stage end-to-end models mix modular perception with neural planners for smoother driving but face complexity and information loss. One-stage end-to-end architectures process all input data through a single network, enabling joint optimization and personalized driving. VLA (Visual and Actions Model) unifies perception, planning, and actions, accepts voice commands, explains decisions, and enables policy control via language.

Sensor Strategy Evolution: Hand-crafted rules for sensor noise are labour-intensive and less effective. End-to-end learning now automatically manages sensor noise, boosting reliability.

User Benefits & Performance: VLA handles complex scenarios, supports voice commands, and enhances safety by anticipating risks. Integrated end-to-end models raise miles per intervention, with continued improvement expected.

VALEO:

Dr. Benazouz Bradai compared LiDAR sensors, HD radar and cameras in the context of L2 and L3 levels, highlighting that the driver's responsibility shifts from 100% to the system depending on the level of autonomy. He presented the NECE R157 regulatory requirements for ALKS systems, including object detection at 150 m at 130 km/h.

Context & Motivation: The presentation addressed sensor needs for Level 3+ automated driving, where vehicles assume full driving responsibility. Safety and reliability are critical in complex and edge-case scenarios.

Regulatory & Functional Requirements: Regulations require at least 150m detection range and strong resolution. Systems must avoid missing hazards, and standards call for redundant, independent subsystems for safety.

Experimental Findings: Valeo's third-gen LiDAR enables high-speed, long-range small object detection. Combined with HD radar and thermal cameras, systems meet detection requirements across conditions.

I4Research:

Luc Bourgeois presented tests of more than 70 L2 vehicles in China, highlighting the collaboration with major players such as Huawei, Bosch and Nissan. He gave an overview of the Chinese market with a strong presence of NEV brands and LiDAR suppliers, as well as processors dominated by Nvidia and Tesla. The lack of LiDAR penalizes Tesla in some detection tests.

Company Overview: Shanghai-based, established in 2022**.** Well-organized, aligned with China's N2++ implementation**.** Mission: Test and analyze all L2+ automated driving systems (ADS) in China.

Core Activities: Tests all L2+ solutions for technical performance and user experience**.** Maintains a database of over 40,000 km test data across 70 cars**.** Conducts 70 standardized scenarios in major cities.

Market Insights: Categorizes ADS by function level (low, medium, high)**.** Tracks sales statistics by provider, LIDAR supplier, ECU manufacturer**.** Notes high-level ADS common in BEVs, concentrated among few brands

Technical Analysis: Provides detailed car reports on distance, interventions, risk, and performance**.** Assesses active safety and advanced features like memory driving, valet parking. Monitors OTA updates to match results with software versions

Comparative Insights: Benchmarks cars and ADS configs, highlighting strengths and weaknesses**.** Delivers scenario-based, structured performance reports

AUMOVIO:

Bernd Hartmann presented an approach focused on Level 4 (L4) autonomous driving for road transport, with a business model based on a per-kilometre service. The system integrates multiple sensors (camera, radar, LiDAR) and provides backup strategies in the event of a failure, including safe vehicle shutdown.

Aumovio is a recent spin-off from Continental's automotive sector, now fully independent. Aumovio has over 90,000 employees, 100 locations, and annual sales exceeding $20 billion. The company focuses on automotive innovation, especially in autonomous driving technologies.

Market Focus & Business Models: Passenger Cars: Integration of Level 2+ parking and cruising functions.

Trucking (Service Sector): Focus on driverless trucking in the U.S., addressing key industry pain points: High accident rates (100,000/year on U.S. interstates)**.** Driver shortage (1.2 million drivers needed in the next decade)**.** Limited operation time due to driver rest requirements.

Partnership with Aurora Innovation: Aumovio and Aurora are partnering to deliver scalable, safe, industrialized driverless trucking. Aumovio manufactures Aurora driver hardware kits, which are installed by OEMs (PACCAR, Toyota, Volvo) and supported by industry leaders like Nvidia, Ryder, Uber Freight, FedEx, and others. Industry-first, mileage-based hardware-to-service model. Customers pay per mile for autonomous trucking services, creating recurring revenue for both partners.

Technical Highlights: Trucks equipped with over 40 multimodal sensors (LiDAR, radar, cameras) and high-performance compute units. Redundant systems ensure safety and reliability. Multi-stage calibration process—intrinsic, extrinsic, and ongoing online calibration for sensor health and accuracy.

Operational Model: Aurora makes Driver software, hub-to-hub driverless operation, software updates. Aumovio makes Hardware kit delivery, maintenance, and lifetime service. Regular scheduled maintenance and refurbishment at Aumovio's facility in New Braunfels, Texas.

Expansion Plan: Initial operations in Texas (Houston to Dallas), expanding west to El Paso and Arizona (Phoenix), with plans to scale across the US.

APTIV:

Gabor Vinci analyzed regional trends in penetration of L2 and L3 systems, noting China's dominance, Europe's progress towards L2+, and the caution of the Japanese and Korean markets. He insisted on the importance of the robustness of ADAS, the increase in complexity and cost linked to the redundancy required for L3, and the modularity of software architectures to integrate third parties. Improving perception via AI is a major focus.

Company Overview: Advanced Safety & User Experience. Employees: ~19,000 worldwide. Focus on central solutions, cockpit, and user experience systems

Market Situation & Trends: L2 and L2+ systems will dominate adoption through 2030. L2++ hands-off systems are growing, led by China. OEMs cautious on L3+ due to cost and liability issues.

Regional Insights: China leads in ADAS, especially L2++ and hands-free. Europe accelerating L2+; L3 growth limited. North America focuses on high-level comfort systems. Japan, South Korea, India have more a Conservative approach.

Key Market Needs: Scalable, affordable ADAS solutions. Multi-sensor robustness (night, weather). Regulatory demands (US AEB, NCAP ratings).

Technical & Strategic Focus: Vertical integration with open APIs and containerized software. Modular architecture supports third-party features. Cost-efficient cameras for L2, new architecture for hands-free. Sensor fusion enhances reliability.

Product Liability & Market Challenges: L3 systems limited by cost and liability transfer to OEMs. Wider acceptance requires broader operational domains and lower costs

Recent & Upcoming Solutions: Deployments for Blue Cruise, BMW Driver System, Jeep Driver Assist, Jeep L2 Plus. Future is ML-based perception/fusion, improved prediction, flexible OEM strategies.

Q&A on Session 1:

Q1: How Many Lidars are needed for L3 ?

Lost cargo is biggest issue LiDAR solves. Side lidar needed for urban pilot (intersections), front lidar sufficient for highway pilot.

Q2: Why didn't China market use thermal camera yet ?

Didn't use it because Tesla didn't use it yet! As safety becomes priority, thermal might be more popular – helps for lots of motorcycles in bad weather.

Q3: Is cleaning needed to Lidar?

Aumovio has cleaning for its pods anyway and that covers the lidar. Valeo has solutions. Becomes required for L3/L4. For L2, driver can be responsible.

Q4: Why are robotrucks launched in US ?

Aumovio is focused on US market for now. Will launch in other parts of the world, but US sunbelt region is easier. Very narrow roadworks lanes are challenging. Winter conditions are also a big challenge.

Q5: How long can Tesla pursue a vision only approach?

Tesla has filed patents for its own radar, so Valeo thinks that is coming. Tesla is not focused on robustness – yet!

Session 2: Applications, Market, Regulation

Chairman: Eric Amiot, DVN

WIDEYE:

Raed El Makhour addressed solutions for integrating LiDARs into the bodywork, in particular via high-quality optical glass with specific treatments for the roof, windshield or pillars, with examples from BMW, Audi, Toyota and several Chinese manufacturers. The switch from plastic to glass is driven by ease of heating and durability. Challenges remain for integrations in windshield is emerging, with models expected in China as early as 2026 and globally from 2028 .

Special Glass Solutions for Lidar Integration: Light-up Covers: High optical quality, automotive-grade glass with features like anti-reflective coating, water-repellent coating, and heating. **Glass Trims:** Similar glass used on B-pillars, roofs, fenders, and bumpers, supplied directly to OEMs. **Windshield Products:** Designed for seamless integration of sensors (visible cameras, Lidar) into exterior car sets.

Market Trends: Shift from Plastic to Glass: High-end Lidar systems are moving from plastic to glass for better performance, heating compatibility, and durability. **China Leads in Roof Integration:** Since 2018, China has seen rapid adoption of roof-mounted Lidar, with 85–90% of new cars featuring this setup. Global OEMs are following this trend. **Emerging Windshield Integration:** Windshield-mounted Lidar is starting in China (SOP 2025) and expected to surge globally by 2028.

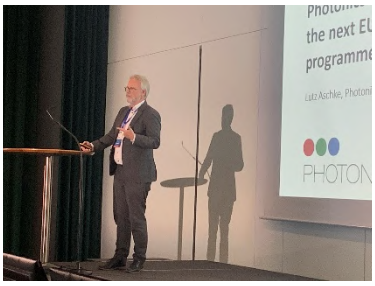
Integration Solutions: Bumper: Usage is declining. **Roof:** Rapid growth, especially in China, replacing bumper installations. **Windshield:** Emerging trend, with global adoption expected to increase significantly by 2028.

Technical Focus:

- **Laminated Safety Glass:** Ensures high optical quality and durability.
- **Advanced Coatings:** Anti-reflective and heating options for enhanced performance.

Outlook: Two Scenarios Expected: Roof and Windshield Stabilization: Both integration sites will coexist long-term. **Windshield Overtaking Roof:** Windshield integration may eventually surpass roof installations.

PHOTONICS 21:



Lutz Aschke presented **Photonics 21**, a European public-private partnership representing the photonics community, with around 4,000 members from research, industry, and innovation agencies. Its main mission is to gather and communicate the priorities of the photonics sector to the European Commission, influencing research and innovation funding programs.

Key Points of presentation:

Role & Structure: Photonics 21 represents the photonics community through working groups under Belgian law, not as a company or industry association.

Strategic Importance: Photonics is vital for Europe's competitiveness, particularly in mobility, AI, defence, healthcare, manufacturing, and communications.

Funding & Advocacy: The group seeks €2 billion in funding to attract greater private investment, shapes the upcoming FP10 programme (2028), and pushes for stable, long-term funding.

Challenges & Priorities: Key issues include AI, lasers, quantum communication, medical networks, and advanced manufacturing. For mobility, priorities are high-res light sources, Li-Fi, and photonic automotive components.

Community Engagement: Membership is free and open, with annual meetings and working groups ensuring democratic input.

Policy Influence: Photonics 21 works closely with EU institutions to influence funding calls but does not set allocation amounts.

Outlook: Future frameworks may become more flexible and competitive, but stable RTO funding remains essential.

HYUNDAI:

Youhoon Park presented studies about the performance of LiDARs behind the windshield, testing various treatments, curvatures, and contamination impacts, with favorable results for low-iron glass and AR coatings.

Hyundai Motor Company is developing high-transmittance sensor glass for LiDAR integration behind the windshield, focusing on improving cleaning systems and aerodynamic design. The project involves testing various glass samples, optimizing factors like thickness, curvature, and contamination resistance. Key technologies include anti-reflection (AR) coatings, low-ion glass, and adjusting glass angles to maximize LiDAR transmittance. Contamination significantly reduces LiDAR performance, making an effective cleaning system essential for reliable autonomous driving. Tests confirmed that wiper blades can restore sensor performance, but their movement must be synchronized with vehicle speed to avoid obstructing LiDAR detection.

RENAULT:

Javier Ibanez-Guzman highlighted the importance of geographical location in the design of ADAS, as behaviours and distances between vehicles vary by region, which requires specific datasets for training the systems.

Global Driving Challenges: Driving behaviours and safety standards vary significantly across regions due to cultural, cognitive, demographic, and environmental factors. Only 7% of global road safety issues are being addressed, with 5.5 million people killed or disabled in traffic accidents annually, mostly in low-income countries.

Regional Differences: Road conditions and driving norms differ widely (e.g., orderly roads in Berlin vs. chaotic systems elsewhere). Regional variations impact user experience, safety, and pricing of automotive systems.

Data-Driven Approach: Renault collected diverse datasets worldwide to compare driving conditions and behaviours objectively. Lack of standardization in datasets presents challenges for fair comparisons.

Technology & Adaptation: AI and end-to-end solutions (e.g., Hybrid Nets) show promise but struggle to adapt across different regional datasets, highlighting the need for localized approaches. Operational Design Domain (ODD) must be customized to include geographic and cultural factors for effective deployment of Advanced Driver Assistance Systems (ADAS).

Uncertainty & Logic: Uncertainty is inherent in intelligent vehicle systems; fuzzy logic can help manage this but measuring uncertainty remains complex. Monitoring ODD and matching vehicle capabilities to local conditions is essential for safety and reliability.

Practical Implementation: Renault successfully trialled ODD monitoring in production vehicles, enabling real-time adaptation to local driving environments.

Conclusions & Recommendations: Regional driving variations must be integrated into ADAS design. Addressing global road safety challenges, especially in the Global South, is critical for future progress.

YOLE:

Pierrick Boulay presented the figures for the L2+ market with 2.6 million systems in China, 1.6 million in the United States and 0.8 million in Europe. The L3 remains limited to 20,000 vehicles worldwide. Chinese manufacturers are establishing themselves in Europe via R&D centers to circumvent tariff barriers. The development of 4D radars and the falling costs of LiDARs are significant trends.

The presentation discussed the evolution and market trends of automotive sensors, focusing on imaging radar and LiDAR, especially in the context of Level 2 (L2) and Level 3 (L3) autonomous driving systems.

The US leads in innovation, China rapidly replicates and scales, and Europe adapts these technologies. The largest markets for advanced driver assistance systems (ADAS) are in China, with significant growth expected in L2 and L3 vehicles by 2025-2026.

Chinese OEMs are expanding into Europe, bringing suppliers and establishing R\&D centers, which marks a shift in the global automotive supply chain.

Sensor configurations are becoming more complex and affordable, with entry-level vehicles in China now featuring multiple radars and cameras. High-end systems may include over 20 sensors per vehicle.

Radar technology has advanced from basic 3D to high-resolution 4D imaging radar, increasing object detection capabilities and reducing costs through design optimization and higher production volumes.

LiDAR technology is also evolving, with new generations offering greater range and resolution at lower costs, thanks to innovations in sensor design and integration.

Sensor fusion (combining data from cameras, radar, and LiDAR) is essential for higher levels of autonomy, especially in challenging urban environments.

The presentation highlighted the **need for robust sensor suites** and fusion to enable safe and reliable autonomous driving, particularly as regulatory and market demands increase.

UNECE:

Francois Guichard presented the regulatory work underway to harmonize the technical frameworks for automated vehicles, with a new regulation expected in 2026. This regulation introduces a multi-pillar assessment (audits, track and road tests, in-service monitoring) and covers cybersecurity, data protection and OTA updates. It aims to bridge regional disparities and facilitate overall homologation.

UNECE is based in Geneva and focuses on vehicle regulations, working with international agreements like the Vienna and Geneva Conventions. The organization operates through three main multilateral agreements, notably the 1958 and 1998 agreements, which set frameworks for vehicle regulations globally.

Key Drivers of Change: Environmental urgency**,** Geopolitical shifts**,** Technological breakthroughs, Social demands**.** These factors are reshaping mobility and the regulatory landscape.

Regulatory Frameworks: 1958 Agreement: Framework for UN (ECE) regulations, widely adopted in the automotive sector. **1998 Agreement:** Includes countries like the USA, Canada, and Korea, focusing on self-certification. **Third Framework:** Pertains to periodic technical inspections (PTI) outside Europe.

Recent Developments: UNECE is now addressing automation and connectivity in vehicles, driven by mandates from transport ministers. The organization has expanded its stakeholder base beyond traditional OEMs to include suppliers and representatives from various regions. Leadership is now more globally diverse, with co-chairs from Japan and China.

Multi-Pillar Assessment Approach (2024) : Pillar 1: Auditing – Evaluates company processes and capabilities. **Pillar 2: Testing** – Includes traditional tests, simulation, and credibility assessments. **Pillar 3: In-Service Monitoring** – Ongoing monitoring and reporting once vehicles are in use. This approach addresses the complexity of automated and connected vehicles.

Regulatory Updates: New regulations for Level 2, 3, and 4 automated driving systems (ADS) are being developed. The upcoming global technical regulation for ADS is expected to be adopted in June 2026. Existing regulations have been reviewed and amended to accommodate new vehicle categories (e.g., autonomous vehicles with or without passengers).

Data and AI Considerations: Data is central to new regulations, especially regarding cybersecurity, software updates, and in-service monitoring. UNECE is working on technology-neutral guidance for AI in vehicles, with deliverables expected by June 2026. There is ongoing discussion about data protection and privacy, with potential for harmonized approaches in the future.

Environmental and Social Aspects: Regulations now cover innovations like brake-by-wire, steer-by-wire, battery management systems, and electric trailers. The organization is adapting to new stakeholders and shifting geopolitical influences.

Q&A on Session 2:

Q1: How is UN responding to US AEB Regulations?

US is learning from these regulations and looking on how to improve its own.

Q2: Will there be standards for reporting accidents ?

Yes, the regulation will contain some standardized elements that have to be reported.

Q3: How will we deal with gap between regional and UN regulations ?

The initiative is for truly global regulations – which we didn't have for ADS in the past. This will help for economies of scale.

Q4: Are mechanical standards for impact the same for lidar glass as well as windshields?

AGC – Yes and in some cases requirements are stricter. On the side, requirements might be relaxed.

Q5: Can one glass be used with all lidars ?

No, it has to be developed with a specific lidar in mind in conjunction with the OEM.

Q6: Will windshield lidar replace roof ? Yes, it is coming (as lidar units shrink).

With L3 be limited to specific ODDs in China ? Highway pilot in traffic jam will be the first use case.

Q7: Can virtual simulation replace actual road tests ?

Yes, there are some cases that are too dangerous to test on the track or road.

Q8: Did Renault consider different sensor sets ?

yes, everything is normalized.

Q9: Did AGC look at thermal sensors ?

Yes, we have a team looking at that.

Q10:What are the differences between US and EU regulations ?

US is not working on cybersecurity and a couple of other parts covered by the UNECE draft.

Panel 2– will L2+ stay mainstream or will the market shift to L3 ?

How many sensors are needed for L2+ systems?

Mobileye is using cameras and sometimes radars. Valeo states it depends on the ODD. NOA Urban needs a lot more capability than NOA Highway. Greatwall basic set up is 7 cameras and 1 lidar. Liability may drive extra sensors to reduce false positives and negatives.

Do we have L2+ systems on trucks?

For L4 Aumovio has more than 40 sensors – for L2 it would be comparable to passenger vehicles.

Do we see L3 coming soon?

NXP sees penetration driven by the cost. When L2+++ technologies are proven, this may become level 3. Mercedes already has it, GM is targeting 2028, Mobileye has partnerships with Toyota. Cost is what is constraining volumes today – and safety. The system architecture is very different from what we have today – you need redundant ECUs, actuators and power supply.

Is thermal camera an added sensor or does it take away something else?

Mobileye is evaluating all sensors and will see if it is needed to work everywhere and all the time – but it is not in the near roadmap. Valeo offers this as an option and has an SOP in 2027/2028 to provide redundancy in low visibility. Increases safety for several critical situations, even for L2 systems.

Session 3: Radar Systems For L2+, L3/4 Applications

Chairman: Dr Jürgen Dickmann, DVN

The radar session highlighted advances in imaging and 4D radars.

MOBILEYE:

Eligo Detada is an Experienced executive in automotive radar technology, leading the development of advanced perception systems for autonomous and assisted driving. Expert in integrating radar, camera, and LIDAR solutions to enable safe, reliable, and hands-off highway driving, he presented Mobileye's activities in the domain of radars.

Key Achievements about HR radars: **Radar-Based Perception Systems:** Led the design and deployment of single and multi-radar solutions capable of detecting static and dynamic objects, pedestrians, and hazards with high confidence. Mobileye has developed a high-resolution radar with thousands of virtual channels, capable of detecting pedestrians at more than 240 m and static objects in complex environments, with a low probability of false detections. **Product Portfolio Leadership:** Oversaw the development of ADAS (Advanced Driver Assistance Systems) and full autonomous driving platforms, including the "Supervision" (eyes-off), "Chauffeur" (consumer autonomous), and "Drive" (robotaxi) solutions. **Custom Silicon Development:** Initiated and managed the creation of proprietary RFICs and processors to meet unique performance requirements, achieving high angular resolution and ultra-low phase noise. **Highway Driving Innovations:** Addressed challenges such as low-reflection object detection, time-critical events (e.g., late cut-in/cut-out), and complex environments like tunnels and construction zones. **False Detection Minimization:** Developed unique dense array architectures and processing algorithms to ensure high detection probability with minimal false positives. **Real-Time Processing:** Enabled up to 20 frames per second for timely response to critical events.

Notable Use Cases: Detection of pedestrians and hazards at long range**.** Reliable operation in tunnels and construction areas**.** Performance in low-visibility conditions (e.g., fog)**.** Real-time hazard identification and response

ARBE:

Coby Marinko – CEO & Co-founder, Arbe is an Innovative technology leader with over eight years of experience in radar and autonomous driving solutions. Founder of a company that designs high-performance, affordable imaging radar systems for automotive, defence, and robotics applications. Proven track record in product development, market adaptation, and strategic partnerships with global industry leaders. Arbe has designed a proprietary radar chipset with 24x12 channels, targeting a production price of $150, with applications in defense, trucks, and smart cities. Processing at 20 frames per second and managing tunnel reflections are challenges addressed.

Key Achievements: Founded Abe Robotics (now Abe), pioneering advanced radar solutions for drones and automotive sectors. **Developed proprietary high-end chipset** for massive MIMO imaging radar, enabling full free-space mapping and high channel count (48x48 channels). **Achieved cost-effective production goals**, targeting $150 per radar unit, making technology accessible for passenger vehicles. **Secured partnerships** with leading tier-one suppliers (Magna, Hiring), a premium European truck manufacturer, and major OEMs in China. **Collaborated with NVIDIA** and Horizon Robotics for platform integration and data fusion.

Technical Expertise: Imaging radar design and development**.** Massive MIMO chipsets**.** Real-time free-space mapping**.** Data fusion with camera and LiDAR**.** Low-power processor architecture**.** Automotive safety and autonomous driving (L2/L3)**.** Urban and highway scenario solutions**.** Weather and environmental robustness

Leadership & Vision: Led company pivot from drone to automotive applications based on market needs. Advocated for high-resolution, low-latency radar as essential for safe autonomous driving. Emphasized affordability and reliability as key factors for mass adoption. Fostered open platform compatibility with major SOC providers.

BOSCH:

Torge Keuter presented Bosch's radar solutions, including the use of AI for raw radar data processing and 4D radars with multiple antennas to improve angular resolution and object detection at 300m.

Market Segmentation and Customer Needs: The automotive market is divided into three main segments: **Entry Segment**: Traditional families seeking safe, reliable, and affordable commuting solutions, especially in challenging weather. **Mid Segment**: Frequent commuters who value assistance systems for long-distance travel to reduce driver fatigue. **High-End Segment**: Technology enthusiasts who desire the latest and most advanced driving systems (Level 2++ and Level 3 automation). Despite different requirements, safety is a non-negotiable core across all segments.

Bosch's Approach to Radar: Bosch does not view radar as just hardware but as an integrated system, including **In-house designed SOC** (System on Chip) for better control and leveraging 25+ years of radar expertise. **Flexibility** in offering hardware, embedded software, and functions tailored to diverse customer needs. **Radar data is used to enrich maps**, aiding localization in poor GPS conditions. Emphasis on long-term reliability—radar must function properly even after years and potential repairs.

Software-Defined Cars and AI: The transition to software-defined vehicles relies on high-quality sensor data as the foundation for AI and neural networks. The safety backbone remains essential, even as AI-based solutions evolve. Scalability is crucial: systems and sensors must be reusable across segments to avoid redundant development.

Future Trends in Radar Technology: The next step is moving from classical perception (point cloud) to AI-based perception, and eventually to lower-level interfaces that preserve more raw data for AI processing. There is a trade-off between monolithic (large, high-performance) sensors and cooperative models (multiple smaller sensors working together). Cost, integration, robustness, and scalability will determine the optimal approach for mass adoption of Level 3 systems.

Key Takeaways: Independence in design and supply chain is vital for resilience. Real-world performance in challenging conditions is a priority. The future of radar involves deeper AI integration and flexible sensor architectures to meet diverse and evolving automotive needs.

FORVIA:

Dietmar Stapel explained the importance of radar in autonomous driving at **Forvia Hella**, one of the world's largest radar providers with more than 20 years of experience,

Limitations of current sensors: Cameras and lidars have weaknesses (sensitivity to glare, darkness, weather conditions, high cost, need for cleaning). Standard 3D radars are robust but offer limited resolution.

High-Resolution 4D Radar Advances: Addition of a **fourth dimension**: height, allowing the height of objects (tunnels, panels, etc.) to be measured. Use of **larger antennas** for better angular resolution. Creation of a dense 4D point cloud, providing accurate data on the position, speed and height of objects.

Key benefits: Works in all weather conditions. Allows you to clearly distinguish between objects (large/small, surmountable or not). Direct speed measurement, essential for safety. Ability to detect hidden objects or behind other vehicles thanks to radar reflections.

Market Trends: Needs vary by region (Asia, Europe, United States) and automakers (OEMs). Requirements include sensor configuration, data output, interface, and cost. The proposed solution is scalable, ranging from 8x8 to 32x32 antenna channels.

Use cases: Example of a complex scenario where high-resolution radar can distinguish a pedestrian from a vehicle parked 190 meters away, demonstrating the ability to separate objects even in difficult situations.

Conclusion: Radar technology is considered essential for autonomous driving. High-resolution radar is a key factor in achieving high levels of autonomy (up to level 4). The proposed solution is robust, scalable and tailored to the specific needs of customers.

TU-Ilemenau:

Professor Thomas Dallman from **TU-Ilemenau** discussed advanced signal processing methods and the use of distributed antenna arrays to improve radar resolution, as well as the importance of vehicle-to-vehicle communication to enrich radar images, especially in critical intersections.

Background & Context: The research is conducted at a university with a strong background in the automotive sector. Focus is on the evolution of radar sensing technology for autonomous vehicles, particularly as the industry moves from Level 2/3 to Level 4/5 automation.

Key Research Questions: What advancements are needed for Level 3+ and Level 4/5 vehicle automation? How can radar sensor performance be improved to meet future requirements? What are the challenges in testing and validating new sensor technologies?

Technical Challenges & Solutions: Sensor Performance: Higher angular resolution is needed, which typically requires more (virtual) antenna elements. This leads to integration challenges due to sensor size constraints. **Distributed Aperture:** Placing radar heads at different locations on the vehicle can ease integration but introduces synchronization and ambiguity issues. **Advanced Signal Processing:** Signal processing can compensate for hardware limitations, but robustness is a concern. Deep learning and AI approaches show promise for high-resolution detection and ambiguity reduction, even with simulated data. AI can perform simultaneous detection, parameter estimation, and classification, improving overall system performance.

Validation & Testing: Current validation focuses on frequent or relevant scenarios, but rare or extreme cases (the "long tail") are often missed. Specific challenges include precipitation (rain, hail, snow), dense urban environments, and unusual vehicle shapes. New projects (e.g., the BMW E-funded "Control" project) aim to address these gaps by modelling and validating sensor performance under varied conditions.

Future Directions: Integrated Communications and Sensing: Leveraging 5G/6G base stations for networked sensing, expanding the field of view beyond the ego vehicle. **Standardization and Collaboration:** Ongoing work in standardization and multi-partner projects to advance the field.

US/CN Trade War Impact by Dr. Jurgen Dickmann, DVN.

Security threats, trade uncertainty, regulatory overlaod, skills shortage, consumer trust are all issues slowing AD adoption.

China clearly wants to grow through exports, cars are the latest battle ground, US is pushing back with security concerns, trade fairness and tariffs. China for China will work in China, but EU cars using Chinese components will be subject to tariffs. EU Tier1 developing products in China will be subject to EU rules. US is shutting down trans shipments from Mexico and other countries as well. Medium term solution is localization of entire products and supply chain. Control of the complete software stack will be critical for EU OEMs in the future. Components production for ADAS will have to move back to EU.

Q&A on session 3

Q1: Radar to Radar Interference?

Fusion solves this problem

Q2: Mobileye and Arbe differences?

Mobileye's radars were developed internally by the dedicated perception team, which provided extensive requirements and valuable input for system design. The chipsets were engineered using distinct methodologies, each offering unique advantages and disadvantages. While these approaches may appear similar, we are confident that Mobileye achieves superior performance.

There is a room for both radars in the market to solve the same markets, Arbe believes performance is equal and has some advantage on the price and power, ME has advantage of integration in the entire stack. But if you take the Nvidia stack you might prefer Arbe.

Q3: What about higher frequencies?

The use of higher frequencies (up to 140 GHz) is considered promising for improving resolution. The main challenges are range, energy consumption and especially regulations, which do not yet allow these frequencies for the automotive industry. Manufacturers are monitoring regulatory and technological developments, but no solution is yet ready for the market. Arbe is looking at 140GHz, improves resolution but problem is with the range (with power efficiency). Regulation of frequency band also needs to be solved.

Q4: How big does the antenna area need to be?

The size of the radar antenna must be optimized to ensure performance, cost, and integration into the vehicle. Discussions with competitors show that current solutions are already competitive.

Q5: What is optimum solution?

It must be a combination of distributed approach with multi channels – synchronization cost if the issue.

Q6: What about end-end modes?

Can be applied to any segment, the sensor can supply a point cloud in either case. End-end works better with higher resolution point cloud. End-to-end learning is seen as a trend, but requires very dense point clouds for reliable perception. Everyone agrees on the importance of point cloud density for security and performance. Validating end-to-end solutions remains a major challenge.

Session 4: Vision, AI and Perception software, localization

Chairman: Dr Jürgen Dickmann, DVN

VALEO:

René Karsten, Valeo presented a modular and scalable 360° perception solution, integrating cameras, radars, ultrasound and DMS, with the aim of maximum safety and cost reduction, particularly for motorcycles.

Mission & Pillars: **Safety First:** Valeo's top priority is protecting lives, aiming for zero accidents through advanced safety technologies. **Robust Mobility:** Focus on accessible, comfortable solutions that enhance driver experience across all levels of autonomy. **Environmental Sustainability:** All innovations contribute to sustainable mobility.

Problem Statement: **Autonomous Systems:** Increasing levels of autonomy (Level 2+) are beneficial but often expensive due to complex sensor setups. **Market Needs:** Customers and OEMs seek affordable safety solutions that meet varying regulations and offer unique selling points.

Valeo Smart Safety System (VSS 360): **Scalable & Affordable:** Designed to make safety accessible for all, with cost-effective, scalable configurations. **Centralized Hardware:** Uses a smartphone camera as central compute, installed behind the windshield, integrating up to 12 ultrasonic sensors, 4 corner radars, and optional driver monitoring systems. **Eliminates ECUs:** All functions integrated into a single hardware platform, reducing complexity and cost. **Global Standards:** Compliant with worldwide standards and ready for upcoming regulations (e.g., EMFS 127 in the US). **Fast Time-to-Market:** Achieves mass production readiness in 12–14 months.

System Configurations: **Basic:** Covers emergency braking, cruise control, auto high beam, lane keeping, and basic parking sensors. **Mid-Trim:** Highly configurable, adding radars and sensors to meet regional regulations. **Max Configuration:** Includes full sensor suite for advanced safety and redundancy.

Performance & Achievements: **Proven Safety:** Demonstrated significant incident reduction in forward, lateral, and reversing scenarios. **Industry Recognition:** Achieved five-star safety ratings with Japanese OEMs and Lincoln Co; platinum status for light commercial vehicles. **Expansion:** Extending solutions to two- and three-wheelers, targeting entry-level markets with affordable safety systems.

Software & Integration: **Virtual Integration:** Advanced sensor fusion and automatic testing enable rapid development and upgrades. **Tailored Solutions:** Scalable for entry-level and mid-market segments, not just premium vehicles.

SUNNY:

Ian Montandon from **Sunny**, described an under-vehicle surround camera developed by iNet aims to cover blind spots for autonomous parking and off-road driving, with integrated cleaning and lighting systems.

Company Background: Sunny group: Vertically integrated optics manufacturer for mobile phones and automotive sectors. Market leader in mobile phone camera modules, lenses, and automotive camera lenses. Supplier of 8-megapixel ADAS cameras, shipping over 4 million units.

Underbody Camera Concept: Design: Panoramic camera mounted under the vehicle, just in front of the front wheels. **Function:** Provides a 360-degree view beneath and around the vehicle.

Key Use Cases: Valet Parking Safety: Ensures nothing (children, animals, objects) is under the vehicle before moving, especially when the vehicle is out of sight. Aims to prevent accidents and save lives. **Adaptive Suspension Enhancement:** Improves road surface detection for systems like Mercedes' "magic carpet." Fuses underbody and ADAS camera data to create a 3D road model for smoother rides.

Off-Road Driving: Real-time feed for "transparent bonnet" functionality, improving over delayed video systems. Superior to current solutions (e.g., Hummer's 200-degree camera) due to higher pixel density and panoramic view.

Technical Specifications: Lens: Panoramic, enabling a 360-degree horizontal field of view with a 3-megapixel sensor. **Resolution:** Effective 2.5 megapixels for the panoramic image, focusing pixels where needed. **Features:** Optional motorized retraction for protection. Integrated illumination for low-light conditions (e.g., garages). Cleaning system for reliable operation.

Output & Display: Real lab images demonstrate clear detection and classification of small objects (e.g., pets) under the vehicle. Sufficient image quality for driver display, both for safety and off-road navigation.

ARCSOFT

Prof. Feng Chen from **ARCSOFT** has explained the benefits of data fusion between interior (DMS) and exterior (ADAS) cameras to reduce false alarms and improve responsiveness to driver distractions. The company specializes in image processing, computer vision, and optical perception, with over 30 years of experience and products used globally, including in more than 5 million cars in China.

The focus is on fusing Driver Monitoring Systems (DMS) and Advanced Driver Assistance Systems (ADAS) to improve safety and user experience.

Current issues with ADAS include too many false alarms, confusing alerts, and unexpected system takeovers, leading drivers to disable these features.

Regulatory bodies and consumer advocates (such as Eureka and DICAP 26) are pushing for better integration of DMS and ADAS to enhance safety, especially through programs like the Safe Driver Engagement Program. The fusion of DMS and ADAS allows the system to adjust sensitivity based on the driver's state (attentive, drowsy, distracted, or unknown), improving responses to potential collisions (frontal and lane departure).

DMS can inform ADAS when a driver is paying attention to specific areas outside the vehicle, allowing the system to adjust warnings and vehicle behaviour accordingly. Conversely, ADAS can help DMS by prompting immediate warnings if a driver is distracted in critical situations, even before standard time thresholds are met.

Effective fusion requires camera calibration for universal coordinate systems, enabling precise tracking of where the driver is looking, both inside and outside the vehicle. **The goal is to create safer, more user-friendly** systems by dynamically adjusting to the driver's attention and environment, reducing accidents and improving trust in automated safety features.

ZENDAR

Zendar has adopted an AI approach to radar, generating a 4D semantic spectrum that allows for the classification and prediction of obstacles and passable areas, surpassing the limitations of traditional target-point-based models.

<u>**Overview:**</u> **Zendar** has introduced a new, AI-driven approach to radar technology. Challenged the traditional "point target model" in radar, which assumes the world is made up of point-like targets (corner reflectors). Proposed modelling the world as real objects (vehicles, pedestrians, road boundaries, obstacles) instead of points.

<u>**Key Innovations:**</u> **AI-First Lens:** Replaced traditional signal processing with AI models to interpret radar spectrum data. **Spectrum-Centric Approach:** Utilizes the full, dense, multi-dimensional radar spectrum, rather than reducing it to a sparse point cloud. **Hardware Compatibility:** Designed to work with existing 4x4 radar sensors and standard vehicle architectures (100 Mbps Ethernet), requiring no hardware changes. **Efficient AI Models:** Developed lightweight AI models (2-3 TOPS) suitable for most automotive ECUs.

<u>**Practical Demonstration:**</u> Showcased AI-generated outputs: drivable areas, obstacles, and object classification (vehicles, pedestrians) in real time. Demonstrated robust performance in challenging conditions (e.g., fog, bridges, complex road boundaries).

<u>**Impact & Learnings:**</u> Overcame traditional radar limitations (resolution, dynamic range, stationary object detection, classification) by discarding the point cloud model. Enabled accurate detection and classification of stationary and moving objects, and differentiation of road boundaries. Supported scalable, affordable automotive platforms by minimizing sensor, compute, and data requirements.

<u>Conclusion:</u> Strong evidence that a spectrum-to-AI approach is superior to point cloud-based radar. Encouraged industry adoption of this new paradigm for more scalable and effective radar sensing.

TOM TOM

Giovanni Giancaspro from **TomTom**, Innovative leader with deep expertise in AI-driven automotive software and map-making for automated driving. Experienced in guiding teams through the transition from legacy HD maps to scalable, affordable, and fresh mapping solutions that support the latest end-to-end AI architectures. Skilled in collaborating with OEMs and Tier 1 suppliers to integrate advanced mapping and UI solutions for Level 2+ and Level 3 automated driving systems.

He has introduced a new mapping approach called "Orbis" based on crowdsourced data (dashcam, GPS, satellite videos) to provide medium-resolution maps that can be used in automated driving, reducing reliance on conventional HD maps.

Key Skills: Automated Driving Systems (Level 2+, Level 3, Level 4)**,** AI-Driven Software Architecture**.** Automotive Mapping & Content Integration**.** Cross-functional Team Leadership**.** Strategic Partnerships with OEMs & Tier 1s**.** Product Innovation & Market Analysis**.** UI/UX for Driver Engagement**.** Data Fusion: Satellite, Dashcam, GPS, Perception Sources

Key Achievements: Successfully implemented a new mapping production process, significantly lowering costs and improving update frequency. Enabled automotive partners to deploy AI-driven solutions in complex, real-world environments by providing essential map context. Supported the convergence of navigation and automation interfaces for a seamless driver experience.

Industry Insights: Recognized the evolving role of maps in automated driving: from localization and perception support to providing critical context for AI and human drivers. Championed the need for maps that are fresh, affordable, and scalable, aligning with the demands of next-generation automotive software.

Q&A on Session 4

Sensor Integration and Technical Challenges: Integrating various sensors (cameras, ultrasonic, radar) into vehicles requires complex routing and harnessing. Recent advances allow grouping sensors for smarter camera integration, but technical challenges remain.

Two-Wheeler Safety Concepts: For two-wheelers, safety features are being explored, such as haptic feedback (vibration on handlebars or seat) and audio warnings via helmet connections. Concepts include Bluetooth-connected audio alerts for riders.

Radar AI and Business Models: The radar ecosystem is evolving, with traditional point cloud approaches being questioned. Radar AI could become a partner to camera systems, with possibilities for early fusion of radar and camera data in central ADAS processors. The industry is still determining the best integration path.

Streaming Radar and System Architecture: Current solutions involve smart sensors that process and compress radar spectrum data for central ECUs. Alternative architectures may stream raw data, potentially reducing costs and complexity. The future ecosystem for AI-driven radar data is still unclear.

End-to-End AI Models and Map Integration: End-to-end AI models are being developed to predict road layouts and interpret world representations from sensor data. Map data can inform both training and inference, with premium platforms likely to adopt these solutions first due to high computing requirements.

Flexibility and Scalability Across Car Platforms: Sensor placement (e.g., cameras) varies by vehicle, but calibration and online adjustment allow solutions to be flexible and scalable. Initial kilometers after installation are used for online calibration.

Reliability and Cleaning of Sensors: Ensuring sensor reliability (especially cameras) involves decomposition strategies and robust component design. Cleaning systems (water jets, ultrasonic cleaning) are essential, particularly for ADAS and sensors exposed to dirt and debris. Water jets are currently the most effective solution.

Vehicle-to-Infrastructure Communication: Reliable and low-latency communication is crucial for safety-relevant decisions. Platforms can transmit alerts to the cloud in under 30 seconds, but confidence depends on having enough sources to confirm events. Some incidents are transient and require rapid detection and aggregation.

PANEL 2 : New trend, vision only with AI come of raw data from all sensors ?

Chairman: Dr JüergenDickmann with Bosch, Yole, Universee, TU, SCS, NXP

The panel discussed the sustainability of L2+ in the face of the emergence of L3, the sensors needed, and the role of thermal cameras as additional sensors for redundancy and safety, especially in low visibility conditions. The cost and complexity of redundant architectures for L3 have been identified as major obstacles to its rapid adoption. Challenges related to the validation of end-to-end systems, the compression of raw data, and the need for simulation tests for dangerous scenarios were also mentioned.

Second Day:

Session 5: Lidars sensors & Manufacturing

Chairman: Heiko Leppin, Aumovio

KEYNOTE AEVA:

James Reuther from **Aeva** develops Frequency Modulated Continuous Wave (FMCW) LiDAR, a solid-state, chip-based solution for automotive and industrial use. FMCW LiDAR is presented as a next-generation alternative to traditional time-of-flight LiDAR, offering greater reliability, precision, and scalability.

Key Strengths: Integrated Solid-State Design: All photonics are chip-integrated and hermetically sealed for durability and cost-effectiveness. Custom ASICs: Proprietary chips handle advanced signal processing and ensure compliance with automotive safety standards. Major Partnerships: Collaborations with leading automotive and industrial companies, delivering thousands of units annually.

Applications: Automotive: Enables advanced driver assistance (Level 3+), supporting high-speed highway driving and large-scale OEM production. Industrial & Infrastructure: Used in automated manufacturing and smart infrastructure (e.g., traffic monitoring, security).

Advantages: Simultaneous Velocity & Range: Measures both distance and speed, unlike time-of-flight systems. Interference Immunity: Resistant to sunlight and other LiDAR signals, with micron-level precision. Long-Range Detection: Detects objects up to 500 meters, crucial for trucking and passenger vehicles. No Ghosting/Blooming: Reliable detection of small and reflective objects, even in challenging lighting. Scalable Manufacturing: Chip-scale production enables mass deployment and proven reliability.

Performance: Outperforms time-of-flight LiDAR, imaging radar, and cameras in dynamic and static object detection, especially at long range and in difficult conditions. Effective in urban environments, for both vehicles and pedestrian detection.

Research Contribution: Provides the “Aeva Scenes” dataset, a large, annotated public resource for non-commercial research.

KEYNOTE VAN JEE:

Harmeet Singh from **VANJEE** presented his company**.** A world-leading ITS and LiDAR company, listed on the Stock Exchange, headquartered in Beijing. 30 years in ITS, 12 years specializing in LiDAR. Operations in 40 countries, over 100,000 LiDAR units supplied.

VANJEE’s Mission: **Vision**: To create advanced vision systems for robotics and vehicles, enabling safer automotive operations.

Approach: Merging expertise from ITS, robotics, and automotive sectors to deliver innovative solutions.

<u>Market Status & Trends: Growth</u>: Passenger car LiDAR installations doubled in 2024, reaching 1.6 million units and a $700 million market. **Adoption**: Rapid growth, especially among Chinese suppliers; cost and necessity are still debated in some regions. **Challenges**: Cost sensitivity, integration gaps with major OEMs, and skepticism about LiDAR's necessity.

<u>LiDAR Value Proposition:</u> **Precision**: Accurate distance and measurement for detected objects. **3D Awareness**: LiDAR provides a 3D coordinate system, outperforming other sensors in difficult lighting. **Safety**: Enhances situation awareness, distinguishing between objects and informing braking decisions.

<u>Product Portfolio:</u> Long-Range Mechanical LiDAR 760: 300m range, 192 scanning channels, compact design. **Short-Range Solid-State LiDAR 750**: Designed for blind spots, wide field of view, optimized for side detection. **Combined System**: Pairing both models enables 360° vehicle awareness.

<u>Technology & Algorithms:</u> **Perception Model**: Processes real-time data for object detection and braking in under 90 milliseconds. **Key Components**: Scalar Feature Net: Converts 3D point cloud to pseudo-image. Backbone CNN: Extracts key objects. Detection Head: Classifies objects, measures distance and angle. Domain Controller: Sends information for vehicle control.

<u>Sensor Fusion & V2X: Integration</u>: LiDAR, cameras, and V2X systems work together for comprehensive, redundant, and reliable perception. **Real-World Deployment**: Systems already operational in China, enhancing safety and navigation.

<u>Industry Impact & Future:</u> Cost Reduction: LiDAR is becoming more affordable, shifting from luxury to necessity. **Readiness**: Solutions are ready for mass production, supporting L3/L4 autonomy and robotaxis. **Continuous Improvement**: Frequent product upgrades and real-time 3D perception advancements.

<u>Key Takeaways:</u> Camera-only systems are reaching their limits; LiDAR adoption is rising as costs fall and safety demands increase. The company's integrated hardware, perception models, and V2X fusion provide a strong competitive advantage. Proven track record and ongoing innovation position the company as a leader in automotive LiDAR technology.

SEYOND:

Oliver Ramoli from Seyond presented his company's view in its presentation: LiDAR Adoption and Regional Differences

<u>Key points:</u>

- The ideal LiDAR ("unicorn")—with best range, resolution, reliability, and low cost—is extremely difficult to achieve.
- The market does not require a perfect LiDAR, but rather the right LiDAR for the right mission and operational design domain (ODD).

Regional Approaches: For China: Rapid LiDAR adoption, especially in Level 2 and Level 2+ systems. Strong national push and consumer openness to new technology. Fast-moving OEMs (e.g., NIO) equip all new cars with LiDARs, driving high adoption rates. Robust domestic supply chain reduces costs and increases scalability. **For Europe:** Focus on safety, validation, and trust before scaling up. Emphasis on certified and insured Level 3 functionality. Slower, safety-first approach compared to China's scale-first philosophy.

Industry Challenges & Solutions: The main challenge is deploying systems at scale, not just achieving high performance. Manufacturability and deployment are key to driving costs down and increasing adoption. The industry is moving toward a portfolio approach: combining different LiDAR products and sensor technologies to fit specific missions and ODDs, rather than relying on a single "hero" device.

Strategic Takeaways: Fit-for-purpose solutions ("fit beats perfect") are more practical than striving for a universal LiDAR. Regional differences must be considered in product development and deployment strategies. Deployment is the new key performance indicator (KPI): more systems on the road generate more data, which further reduces costs and accelerates adoption.

ROBOSENSE:

Felix Yang from **ROBOSENSE** presented "Applications for Automotive LiDAR from L2 to L4 Autonomous Driving"

Overview: The presentation discussed the rapid adoption and technological evolution of LiDAR (Light Detection and Ranging) systems in the automotive industry, focusing on their role in enabling levels 2 to 4 (L2–L4) autonomous driving.

Key Points of this presentation: Market Growth: LiDAR installation in new energy vehicles has surged, with over 1 million units installed in the first half of the year, marking a 71% year-over-year increase. The total installations for the year are projected to reach 2.5 million, with an average adoption rate of 16–17% for new energy vehicles. The number of car models equipped with LiDAR has grown from 39 in 2023 to over 100 currently. **Safety and Insurance:** Insurance studies show vehicles with LiDAR have a 25% higher chance of accident emergency response and a 29% improvement in collision mitigation. Insurance companies may introduce reduced fees for cars equipped with LiDAR. **Regulations and Standards:** New regulations require ADAS (Advanced Driver Assistance Systems) to function in complex scenarios (e.g., darkness, tunnels, construction zones). LiDAR is highlighted as superior to camera-based systems for detecting unknown or untrained objects. **Technological Advancements:** Transition from analog to digital LiDAR architectures, with in-house developed SOC (System on Chip) and SPAD (Single-Photon Avalanche Diode) arrays. Digital LiDAR offers higher resolution, smaller size, lower cost, and greater reliability. **Product Portfolio: EM4:** High-resolution, long-range LiDAR. **EMX:** Cost-effective, 200-line LiDAR for L2 functions, already nominated for 32 car models. **E1** : Short-range LiDAR. **Challenges for Higher Autonomy Levels:** L3: Requires high reliability and redundancy, as liability shifts from driver to manufacturer. L4: Robotaxis and commercial vehicles need multiple LiDARs for 360° perception. **Cost Evolution:** LiDAR systems have become significantly more affordable, dropping from $80,000 a decade ago to around **$260–$1000 today**.

Outlook: The success of LiDAR will depend on system integration and adaptability for various applications. Widespread adoption is expected, with the possibility of every consumer vehicle being equipped with LiDAR soon.

SCRAMBLUX:

Mirvais Yousefi from **Scramblux** presented his company specialized in development of advanced LiDAR testing systems for automotive and robotics industries.

Key Values: **Lifecycle Testing:** Scramblux offers a LiDAR testing technique that follows the device throughout its lifecycle—from production, through deployment, to aftermarket validation. **Standardized Metrics:** Enables manufacturers to use consistent test metrics for comparing different LiDARs and monitoring performance deterioration over time. **Cost & Footprint Reduction:** The system replaces traditional tunnel-based testing, reducing factory footprint by 120 times and saving up to half a million euros per year in European settings. **Automation:** Fully automated, direct optical measurement system—"optics out, optics in"—with no interference.

Technical Capabilities: **Weather Simulation:** Can simulate environmental effects such as rain, snow, and dust within the testing chamber. **Real Data Demonstration:** Utilizes real, not simulated, point cloud data with a 3D checkerboard target for validating LiDAR performance. **Modular Design:** Core scrambling unit is adaptable for various use cases (factory, workshop, robotaxi). **High Accuracy:** Achieves 1 cm accuracy, with potential for even finer precision as development progresses. **Optical Isolation:** Advanced signal isolation techniques for robust testing across different LiDAR types.

Product Roadmap: **Alpha System:** Ready for initial customer validation. **Tiered Products:** Developing versions for Tier 1/Tier 2 suppliers, automotive factories, robotaxi validation, and aftermarket workshops. **Future Innovations:** Plans to introduce pixelized/blinking targets, motion simulation, and full 3D scene rendering for comprehensive perception stack testing.

Market Focus: **Primary Market:** Robotaxi validation and safety certification. **Secondary Markets:** Automotive manufacturing, robotics, and aftermarket workshops.

Call to Action: Invites LiDAR manufacturers and users to collaborate, test, and validate their devices with Scramblux's system.

FKA:

Amogh Sapkal from **FKA GmbH** presented the development and status of the DIN/SAE 91571 specification, which focuses on evaluating data performance of sensors (especially LiDARs) in adverse conditions.

FKA GmbH has a history of testing sensors like LiDARs and radars, including early temperature and spray tests.

After the resurgence of LiDARs due to advancements toward level 3 automation, there was a lack of harmonized testing strategies. This led to collaboration with OEMs, tier ones, and LiDAR manufacturers to develop standardized test methods and KPIs.

The previous specification, DIN/SAE 91471, released in 2023, focused on ideal conditions for LiDAR performance evaluation. **The new spec**, **DIN/SAE 91571**, expands testing to adverse weather (rain, fog, wet roads) and contamination (dust, frost, water droplets, spray, etc.), as well as interference scenarios and cleaning system performance. **For the first time**, the spec includes point cloud level evaluation and combines neuro NCEP tests with adverse conditions. **The spec is expected to be voted on by the end of November** and released next year. **Key findings indicate** that LiDAR sensor performance is especially challenged by smaller droplet sizes, suggesting a need for redundancy or support from other sensor technologies.

Q&A on Session 5:

Q1: Why is noise (range precision) characteristic worse with FMCW?

FPGA sampling rate was lower, but this improves with Aeva's ASIC. 1um possible.

Q2: Where do lidar spec requirements come from?

For L3 moving to 500 lines, for L4 need 360-degree lidar perception. Specs are a combination of what customer needs and what the best fit to the requirements are.

Q3: Will FMCW come to China?

Maybe the next generation of lidar but depends on the suppliers of photonic chipsets and ASICs. Pricing is one key factor so is probably more than 5 years out. Aevas discussion with US and EU OEMs indicate that this comes sooner. The ability to provide an object list from the unit is a key differentiator.

Session 6: New technologies

Chairman: Heiko Leppin, Aumovio

KEYNOTE VOYANT:

Chris Phare from **VOYANT** presented the challenges and advancements in automating physical tasks using AI, particularly focusing on LiDAR technology. The next generation of LiDAR leverages photonic integrated circuits, reducing mechanical parts and enabling solid-state designs. Frequency Modulated Continuous Wave (FMCW) LiDAR offers advantages such as long range, high resolution, sunlight immunity, and improved data quality. Integration of LiDAR components onto silicon photonic chips allows for scalable, cost-effective production. The company's approach includes on-chip beam steering and switch-based systems, enabling both 1D and 2D pixel arrays for various applications. Manufacturing challenges are addressed through advanced modeling, yield prediction, and wafer-level testing to ensure reliable, scalable production. The result is a new generation of LiDAR products (e.g., "carbon" for robotics) that promise better performance at lower costs, supporting the broader adoption of automation and AI in industry.

KEYNOTE LUMOTIVE:

Hassan Moussa, Lumotive VP of Customer Engineering and GM of Automotive. Previously led automotive LiDAR market entry elsewhere; highlights fewer industry players and changing roles among OEMs, Tier 1s, and semiconductor firms. Lumotive was founded 8 years ago with Investors: Bill Gates (initial), Amazon, Samsung, Shifted focus from LiDAR systems to general-purpose, software-defined optical chips. Technology & Products, LCM: Programmable optics for versatile applications, Metamaterials: Nanomaterial-based optical steering, Uses CMOS for scalable, low-cost chip production. Fully solid-state LiDAR—no moving parts, boosting reliability and reducing costs. Used in robotics, vehicles, infrastructure, security, defense, industrial tasks, connectivity, lighting. Lumotive supplies chips and design support. Improved reliability, fully software-defined sensors, compactness, lower cost, flexibility, and high resolutionLumotive is developing metamaterial surfaces for software laser beam control, enabling up to a 180° field of view, while Voyant is progressing towards a low-cost, robust FMCW LiDAR with integrated photonic components. Notable customers: Hokuyo (industrial), Namuga (Samsung cameras, automotive).

KEYNOTE COMPAL:

Richard Soane Compal general manager showcased IR and thermal cameras that improve night and weather detection, filling the gaps in RGB and LiDAR cameras, with low-cost integrations and increased performance in classification. Richard Soane discussed the importance of far infrared technology in improving road safety, including pedestrian detection, especially at night and in adverse weather conditions. It shows that fatal accidents involving pedestrians have risen sharply, especially at night, prompting bodies such as the NHTSA (US) and Euro

NCAP (Europe) to impose new regulations for 2026 and 2029, requiring vehicles to be able to detect and avoid pedestrians in these conditions. Far infrared, long used in the military and automotive sector, makes it possible to see through smoke, fog, rain or snow, where visible cameras and LIDARs fail. This technology detects body heat, making it easier to classify pedestrians, even partially hidden or in congested environments. Recent advances in artificial intelligence and optics have made these cameras more capable, more compact, and much less expensive (less than $100).

LYNRED:

Lynred showcased IR and thermal cameras that improve night and weather detection, filling the gaps in RGB and LiDAR cameras, with low-cost integrations and increased performance in classification. The speaker, Quentin, is a product manager discussing thermal imaging technology and its role in extending Operational Design Domain (ODD) for automotive applications. The current engineering approach involves defining the sensor suite, perception stack, planning, and control. Cameras excel at classification but struggle with ranging; radar is strong for ranging but is moving toward classification; LiDAR offers both but faces limitations in adverse conditions.

Market strategies differ: China favors radar/LiDAR, while other regions prefer camera/radar fusion.

Thermal imaging addresses these gaps by reducing false positives (phantom braking), improving detection in glare and occlusion scenarios, and enhancing time-to-collision metrics for smoother braking and avoidance. Demonstrated improvements include a 36% increase in average precision for nighttime scenarios, with significant gains in occluded and long-range detection.

Key industry drivers include:

- Euro NCAP standards (notably Tokyo 2026), which are shifting from controlled proving ground tests to real-life scenarios, emphasizing robustness and reducing false positives in real-world conditions.
- US Regulation FMVSS 127 (effective September 2029), prompted by the statistic that 77% of pedestrian fatalities in the US occur in dark conditions.
- Profitable autonomous driving features (Level 2 and beyond), with a focus on expanding ODD beyond highways and increasing system robustness.

SENSELIGHT:

Joachim Tiedeke presented the concept of SenseLight, an innovative sensor based on vehicle light. The author, who has more than 40 years of experience in sensors (radar, cameras, ultrasound), explains that SenseLight uses the components already present in the headlights to detect the environment in 360°, without the need for additional space or hardware. This sensor measures distance, speed, object size and visibility, with high sensitivity and a range of up to several hundred meters. It works in all weather conditions and can detect multiple objects simultaneously. SenseLight stands out for its simplicity of integration, its low cost (comparable to ultrasonic but with better performance), and its adaptability to the needs of automatic driving. Thanks to technological advances (LEDs, MOS, SEPMs), it is possible to manufacture this sensor with standard components, making the solution accessible and economical for car manufacturers. The author concludes by inviting interested parties to request brochures or to contact him for more information.

BRIGHTWAY VISION:

Walter Hagleitner said that Gated imaging cameras significantly improve the detection of objects, especially vulnerable road users such as pedestrians, compared to conventional RGB cameras. 65% of the time, visibility is limited (night, fog, rain, etc.), making it crucial to use the right technologies for year-round automated driving.

For Brightway, the radar works in all weathers but offers low resolution. LiDAR has a better resolution but remains limited. RGB cameras are effective in good weather. Gated cameras perform well day and night and in bad weather.

The gated camera sends light pulses synchronized with the shutter, capturing only reflected light from a certain distance. This allows "slices" of images to be created at different distances and then combined to get a complete image up to 250 meters. Gated imaging makes it easy to remove the foreground or background, making it easier for neural networks to recognize objects and estimate distances. Gated cameras outperform conventional HDR cameras in bright light, snow, or glare conditions, providing a clear view where other cameras fail. In snow conditions, gated imagery can distinguish the road, curbs, and trees, whereas snow obscures these elements in a conventional image. For the trucking industry, the ability to see backwards (retro-reflection of road markings) is essential and is only possible with gated imagery. Gated imaging also improves daylight contrast and can be combined with an RGB image. Advanced applications: creation of 3D depth maps from multiple slices, long-distance object detection (up to 100 meters), and vision in tunnels or garages where conventional cameras are ineffective..

Q&A on Session 6

Chairman: Heiko Leppin, Aumovio

Q1: How does IR camera work in Sun ?

Only 1/10th of a degree difference is needed. It works best when you car is moving.

Q2: What is the depth resolution and range of gated cameras ?

Daimler could do 5% accuracy. Units are in production for security applications but not automotive yet.

Q3: We cannot see the snow in the images?

The demos remove the snow from the image, but it could be detected.

Q4: What wavelength is used for illumination in gated imaging ? What about interference ?

We use 808nm today. Multiple systems would just increase the background illumination and low probability of direct interference due to low duty cycle.

Q5: Do you need active illumination ?

Yes ! But can make slices in daylight by subtracting the illuminated image.

Q6: How did AI See separate sensor versus perception stack performance ?

Ground truth was measured with Lidar. Then sensors were run with the algorithms at the same time.

Do we have a cost estimate for gated cameras ?

The key components (laser and imager) are similar to lidar and in the range of $100. Could be less when scaled.

Panel 3 Key factors of AD developments

Chairman: Heiko Leppin, Aumovio

Affordable Sensors & Easy Integration: The mass deployment of autonomous driving (AD) sensors depends on reducing costs and simplifying integration. Advances in technology and materials (e.g., coatings, films) are making this more feasible.

Integration Challenges: Integration costs can match sensor costs. Innovative solutions, such as placing sensors within existing car lights, help address space and cost issues. Designers often resist adding sensors due to limited space, so creative integration is essential.

Regional Differences: European OEMs focus on invisible, smart integration (e.g., behind windshields), while Chinese consumers are more open to visible sensors like LiDAR on the roof. Trends in China may influence European markets by driving down costs through higher adoption.

System Integration Complexity: The true cost of sensor integration includes not just the sensor, but also packaging, calibration, networking, ECU layers, and global homologation. System integration is often underestimated and involves significant complexity and validation efforts.

Real Estate & TCO (Total Cost of Ownership): Sensor integration is compared to real estate—space is limited. Smaller sensors and minimized form factors help, but integration must also consider serviceability and cleaning, which affect TCO. Placement (bumper, roof, windshield) impacts both damage risk and maintenance needs.

Infrared & LiDAR Integration: Infrared sensors face challenges with traditional glass, but new materials and smaller packages are improving integration. Collaboration among OEMs, LiDAR suppliers, and integrators is crucial for successful deployment and performance optimization.

Future Trends: System integration will remain a challenge due to trends like decentralization, AI, and simulation. Centralization may reduce costs (fewer ECUs, less wiring), but increases complexity elsewhere (e.g., cybersecurity, validation). Standardization could help simplify integration.

Session 7: ADAS/AD System Architecture, Validation & Simulation

Chairman: Luc Bourgeois, DVN

DEKRA:

Marcel Kolling from **DEKRA** presented a solution for reducing the volume of data collected during the evaluation phase of vehicle sensors by implementing automated pre-labelling and scenario filtering, thereby optimizing storage, processing, and cost efficiency.

Key Points of presentation:

Challenge: Sensor-equipped vehicles generate massive data volumes (e.g., 300 MB/sec, up to 2.16 PB/year per vehicle), but only a small fraction is relevant for analysis. Storing and processing all data is costly (approx. $3 million/year for storage, transfer, and compute).

Solutions: **Automated Pre-Labelling**: Use in-vehicle systems for real-time tagging (object-based, traffic sign detection, manual driver input) to identify and annotate relevant scenarios during data collection. **Data Filtering**: Only upload and process data segments with valuable content (e.g., specific traffic signs, weather conditions, pedestrian events), reducing unnecessary storage and compute costs.

Technology: Utilizes a Dynamic Run 2 system with three LiDARs, four cameras, and high-precision GNSS, fully calibrated and ready for rapid deployment. Provides live visualization, diagnosis, and tagging modules for immediate feedback and annotation. Enables scenario-based search and filtering post-collection (e.g., find all instances of “zebra crossing + pedestrian + fog”).

Workflow: Data is collected and tagged in real time. Only relevant, annotated data is uploaded for further processing. Data can be searched, filtered, and exported for analysis or statistics.

Impact: Pre-selection and online tagging can reduce data volume by 33%, saving up to $2 million in storage and compute costs without losing critical information. Enhanced ability to synchronize, diagnose, and calibrate data with real-time UI and automated modules.

KOGNIC:

Tom Dahlstroem from **KOGNIC** is an experienced professional in the data annotation and AI pipeline sector. He specializes in developing and optimizing data labelling platforms for advanced sensor systems, with a strong focus on integrating human feedback into automated and end-to-end AI workflows.

Key Skills of KOGNIC: **Data Annotation & Labeling Platforms:** Expertise in building and operating platforms for multi-sensor data (LiDAR, radar, cameras), including 3D cuboid annotation and projection across sensor modalities. **AI Data Pipelines:** Deep understanding of traditional and next-generation data pipelines, including automation, curation, and triaging of large-scale datasets. **Human-in-the-Loop Systems:** Proven ability to design workflows that leverage human feedback efficiently, balancing automation with expert judgment. **End-to-End Model Integration:** Familiar with the challenges and opportunities of end-to-end AI models, including cost management, data curation, and the convergence of annotation and triaging tasks. **Vision-Language Models:** Knowledgeable about the application of vision-language models and abstract model output evaluation (e.g., trajectory ranking, action suggestion validation). **Industry Trends:** Up-to-date with global advancements in autonomous systems, including large-scale data management and model training economics.

Conclusion: Kognic believes in the enduring value of human expertise in AI development, especially as annotation and curation tasks evolve. Advocates for workflows that combine automation with subject matter expert input to ensure high-quality, ethical, and brand-aligned AI outcomes.

SCS (Super Computing Systems)

Felix Eberli from **SCS** presented his company which is an experienced engineering leader with a strong background in automated driving technologies, sensor integration, and AI-driven automotive solutions. Over 30 years in the industry, leading projects from feasibility studies to series production, with expertise in hardware, firmware, FPGAs, GPUs, and IT security.

SCS Automated Driving History: Early work on magnetic stripe highway driving (1956) and computer-driven trucks. Participation in DARPA challenges and development of stereo processing systems for autonomous vehicles. Contributions to Mercedes Berta drive (2013) and collaborations with Google, Waymo, Zoox, and NVIDIA teams. Experience with end-to-end learning systems and Level 4 autonomous driving demonstrations (2025).

Company Leadership: Over 140 engineers based in Zurich, providing engineering services for hardware, firmware, AI, OT, and IT security. Led feasibility studies, hardware/firmware implementation, and supported series production for major automotive clients.

Key Projects: Developed stereo cameras for adverse weather, implemented semi-global matching in FPGAs. Supported radar systems for lost cargo detection and point cloud analysis. Designed engine control systems for large container ships (60 MW engines). Built data centers for high-speed sensor data processing (100+ GB/s). Created flexible record/replay systems for multi-channel camera setups.

Technical Skills: Hardware & Firmware Engineering**.** FPGA & GPU Programming**.** AI & Machine Learning for Automotive**.** IT & OT Security**.** Sensor Fusion & Redundant Systems**.** Data Center Architecture.

Industry Insights: Advocates for redundant and diverse sensor systems for safety. Emphasizes transparency and learning from accident statistics. Promotes customer awareness of system capabilities and limitations.

ANSYS:

David Auger from **ANSYS** presented the context and the role of his company in simulation activities.

Context & Motivation: New regulations in the EU require advanced safety features (e.g., electronic braking, driver monitoring systems) in vehicles. These features rely on multiple sensors (cameras, radar, lidar) that must be thoroughly tested and validated for robustness and safety. Real-world testing is insufficient due to the vast number of scenarios; simulation is essential for efficiency and coverage.

Simulation Approach: **Multi-Scale Simulation: Nanoscale:** Chip design and component integration. **Micro Level:** Stack design and performance validation. **System Level:** Integration of all components into the vehicle housing and assessment of system performance.

Real-Time Simulation: Enables testing of perception algorithms and sensor models in dynamic scenarios. Supports data exchange between teams and suppliers for collaborative development.

Key Use Cases & Projects: **Simulation Chain Validation:** Projects validating the entire simulation chain, from physical experiments to numerical modeling and image quality assessment. **External Model Integration:** Connecting simulation solvers to external models (e.g., light assimilation, lens flare, and optical phenomena). **Partnerships:** Collaborations with companies like Sony to demonstrate improved sensor performance and accurate simulation of real-world conditions. **Radar and GNSS Applications:** Simulation extends to high-frequency radar and GNSS for real-time solutions.

Conclusion: The ability to connect different simulation solvers and share data across teams and suppliers is crucial. Reliable simulation requires accurate inputs and validated models to ensure trustworthy outputs. The approach enables comprehensive testing "from chip to mission," supporting the development of safe and robust automotive systems.

PERSIVAL:

Christoph Popp from **PERSIVAL presented his company and its activities.**

Company's motivation: Real-world testing for perception sensors is often not reproducible, risky, and time-consuming. Simulation offers a safer, faster, and more reproducible alternative, but must closely match reality to be credible and useful for developing automated driving systems.

Simulation Roadmap: **Define Use Case & Architecture**: Decide on simulation requirements and necessary sensory effects. **Data Collection & Measurements**: Material measurements, Analyse how LiDAR signals interact with surfaces at various angles and wavelengths. **Weather influence:** Use a weather test chamber to study effects of rain intensity, droplet size, and speed on sensor signals. **Sensor performance:** Follow SAE spec 91471 for structured LiDAR testing, using a semi-automatic test bench for high-precision, repeatable measurements. **Model Creation**: Build simulation models based on collected data to replicate real sensor behaviour. **Validation**: Compare real and simulated measurements to assess accuracy and credibility.

Tools & Software: **Sensor Model Development Library**: Core for efficient, physical ray tracing simulations. **SimSpector**: Visualizes and inspects simulated scenes and sensor data. **Avalon**: Validation tool that compares real and synthetic data, generates validation reports, and integrates with CI pipelines for continuous validation.

Validation Process: Load real and simulated data. Select relevant metrics and acceptance criteria. Automatically generate reports highlighting strengths and areas for improvement in the simulation model.

Q&A on session 7:

Q1: How do we manage lidar and thermal camera in simulation architecture? Ansys has worked with Flir on thermal camera simulation. There are many differences in the physics models between the different sensors.

Q2: Why is radar simulation not at the same level of quality? Ansys has strong expertise in radar and has a roadmap for improvements and to HD radar.

Q3: Validation Approaches?

Validation can be performed both online and offline, with flexibility to process sensor data for customer-specific requirements. Simulation is valuable but sometimes real-world data reveals unexpected effects not captured by models.

Q4: Technology Trends?

Sensor performance is rapidly advancing, especially in regions like China. Simulation and validation environments are also evolving to match this complexity but require increasingly large and accurate datasets.

Q5: Challenges?

Achieving reliable simulation and validation for post-production remains a challenge, especially as sensor technologies and system complexity increase.

Session 8: ADAS Components Sensors systems

Chairman: Martin Booth, DVN

NXP:

Huanyu Gu from **NXP** discussed the evolution and future of image radar technology in automotive applications. Image radar began series production in Europe and the US around 2022, with adoption by robotaxi services and premium car makers introducing Level 3 autonomous driving. From 2024 to 2027, China is rapidly advancing image radar, with widespread adoption in electric vehicles and robotaxi fleets, driven by new safety regulations and a strong push for innovation. By 2028–2030, image radar is expected to penetrate all regions, including Japan and Korea, with increasing deployment in next-generation passenger cars. Key challenges include balancing performance, cost, power consumption, and sensor size. China prioritizes large-scale, affordable deployment, while Europe and the US focus on premium performance. The transition from edge-based to centralized radar processing is underway, with China moving faster than other regions. NXP's new flagship image radar processor (ST2R37) offers significant improvements in channel count, efficiency, and footprint, supporting scalable systems for different markets. Use cases highlight the technology's ability to detect objects and enhance perception in complex urban and night driving scenarios. The conclusion emphasizes the need for a system-level approach to achieve high performance at the right cost and power, positioning image radar as essential for future autonomous driving.

SCHOTT:

Sandra von Fintel from **Schott**, presented her company which is specializing in **specialty glass and glass ceramics** since 1984, produces **BoroFloat 33**, a floated borosilicate glass with a very low coefficient of thermal expansion.

BoroFloat 33 stands out for its high SiO2 content (~80%), low alkaline content, and absence of alkaline earth ions, resulting in a tightly connected network structure and unique properties compared to standard soda lime glass.

Key advantages include: Exceptional thermal resistance and low thermal expansion**.** High transparency across UV, visible, and shortwave infrared ranges**.** Superior mechanical strength and scratch resistance**.** Excellent dielectric properties and chemical durability**.** Customizable thickness (0.4–25.4 mm) and tight tolerances

Applications in the automotive industry include substrates for sensors (e.g., LIDAR), protective windows for heavy trucks, micro-lens arrays, and automotive lighting. BoroFloat 33 is valued for its processability, reliability, and proven performance in demanding environments, making it a trusted material for next-generation automotive and high-tech applications.

CHASM:

Dan Skika from **CHASM** made a presentation focusing on transparent heaters, especially for LiDAR, radar, and optical cameras, as well as transparent antennas. The solution uses a 100-micron PET substrate with a rolled copper mesh, coated with carbon nanotubes to bridge conductivity gaps. The mesh design varies: 5 mm pitch for radar (low attenuation), 1 mm for LiDAR, and 100–300 microns for antennas (enabling up to 20 GHz operation). The heaters are robust, environmentally stable, and operate at 12 volts with no visible wires. The company custom-designs and simulates heaters, then partners with manufacturers for production. Transparent antennas use fine mesh pitches for high conductivity and transmission, supporting technologies like fixed wireless access for 5G. The solutions are tested with independent labs and are used by leading automotive and antenna companies.

ADAPS Photonics:

Adapt Photomics is a Shenzhen-based company specializing in advanced LiDAR and sensor chips. Supplies SIPM and solid-state LiDAR chips for automotive and consumer markets. Innovations include RGBD chips for simultaneous 2D/3D imaging and spectrum sensors for low-light imaging. Products are used in automotive, robotics, consumer electronics, and optical communications.

FORTSENSE:

Lin Feng from **FORTSENSE** said that histeam has over 20 years of experience in mixed-mode sensor IC design, including pioneering work on Android phone touch panels and mass production for mobile devices. **Shifted recently to 3D machine vision and LIDAR** technology, becoming the first to achieve SPAM SOC and ACQ100 reliability certification for high-end automotive applications in China.

<u>**Technologic Innovations**</u>: Developed SPD SOC, which reduces LIDAR costs and increases resolution. Advanced solid-state LIDAR and laser steering technologies for long-range and high-accuracy applications. Created prototypes capable of 200–300-meter range, with high precision (1–2 cm accuracy).

<u>**Production & Partnerships**</u>: Ongoing mass production of SPAP devices and collaboration with foundries for device optimization.

<u>**Outlook**</u>: New SPD SOC solutions and products (e.g., FL 63232Q) are set for release in Q1 2026, offering enhanced scanning capabilities and supporting a wide range of automotive and industrial needs.

MOCOM:

Martin Kahl from **MoCom**, part of the Khan group, specializes in developing and compounding plastic materials for automotive sensors. With 50 years of experience, five global production sites, and over 4,000 formulations, the company continues to innovate with around 1,000 new development requests annually.

Sensor Material Requirements: Key requirements include permeability for radiation (infrared, radar), environmental stability, aesthetic appearance, and functional properties like conductivity, insulation, and mechanical strength. **Applications:** **Radar:** Materials can be designed to be either transparent or blocking for radar radiation, depending on the application. **Infrared:** Used in cameras and driver monitoring systems, requiring high infrared transparency and blocking of visible light for deep black appearance. **LIDAR:** Suitable up to 1400 nm wavelength; above this, polymer behaviour becomes unpredictable.

Material Properties: Thermal Conductivity: Plastics can replace metals in heat sinks for low-energy applications, reducing CO_2 footprint. Radar Transparency/Blocking: Determined by permittivity; lower values mean better transparency; higher values mean more blocking.

Customization: Material behaviour depends on polymer selection, fillers, additives, colorants, and production process. Wall thickness and surface finish also affect performance.

Recent Developments: Infrared-transparent plastics (ALCOM LIR) achieve up to 90% transmission in the infrared range while blocking visible light. Radar-absorbing and radar-transparent materials are available for specific sensor components.

NANOVENTS:

Jifi Schirl of **Nanovents** introduced PFAS-free nanomembrane venting solutions for pressure equalization in housing and other uses. Their membranes are made from organic polymers, with multiple layers and a nanocomposite top layer that provides hydrophobic, oleophobic, and stain protection. These membranes offer high airflow, outperforming traditional PTFE-based products, and are suitable for lighting and electronic components (like sensors and control units). The advanced versions can withstand strong exterior conditions and provide significant water resistance (up to 15 meters). All products comply with upcoming European and US regulations banning PFAS/PTFE materials. The company is based in the Czech Republic, with all production and development done locally.

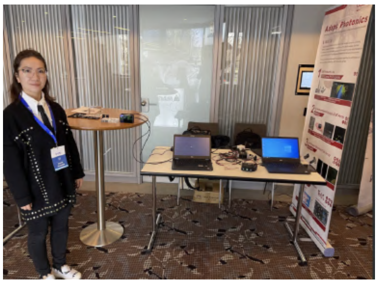
Panel 4 on Lidar vs Imaging Radar

General consensus was that camera, lidar and radar will be required for L4. Gated cameras have potential issues with depth accuracy and power (for long range illumination) . Exact sensor set will depend on OEM ODD requirements.

Close of Conference

EXHIBITORS

Booths Gallery



Adaps photonics

Persival

Fortsense

Wideye by AGC

Voyant

Magna

Schott

Compal

Neumann

Dekra

SCS

NanoVents

Nanovents

Demonstration cars

Valeo COMPAL MAGNA ZENDAR