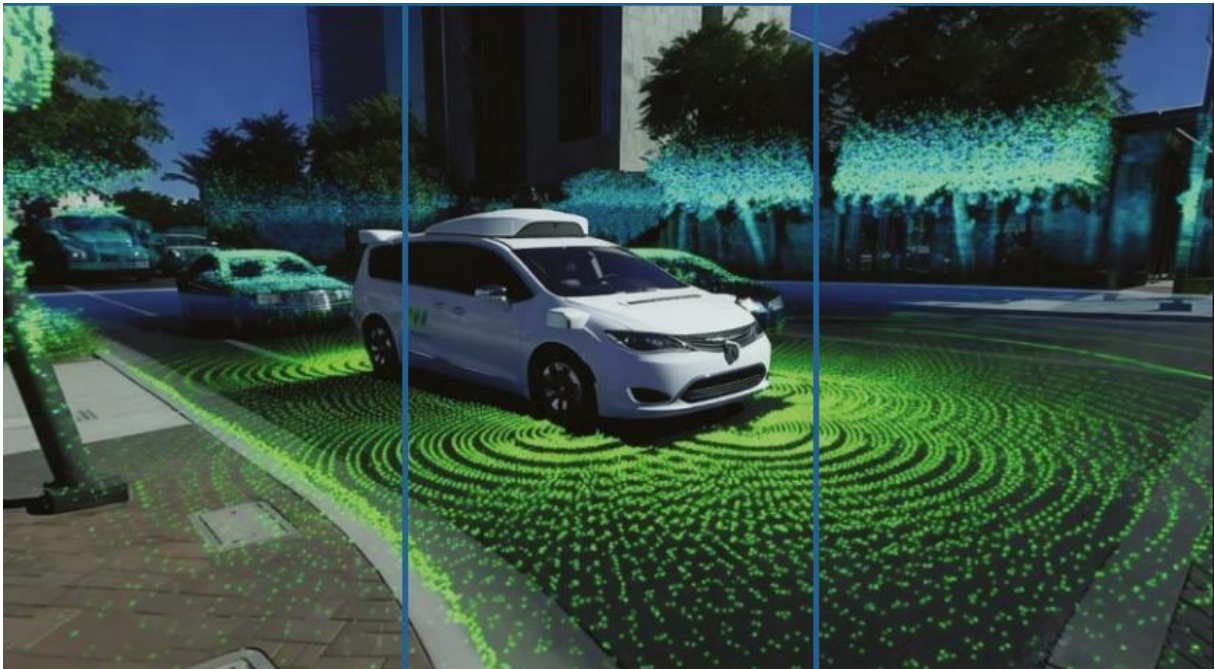


DVN - 2026 / AEB & L2+,L4 Safety Assessment Workshop

(Detroit)

March 25, 2026





DVN - 2026 / AEB & L2+,L4 Safety Assessment Workshop (Executive Summary)

DVN held its 2026 AEB Workshop in Southfield / Detroit, Michigan on March 25th, at the headquarters of Marelli NA.

Around 60 people from OEMs, Agencies (MnDOT), Tier1's and technology suppliers attended.

Among OEMs & Agencies: Ford, GM, STLA, Honda, Nissan, Hyundai-Mobis, MnDOT

We had demo cars from Compal, driving around showing some impressive thermal cameras and object classification demos.

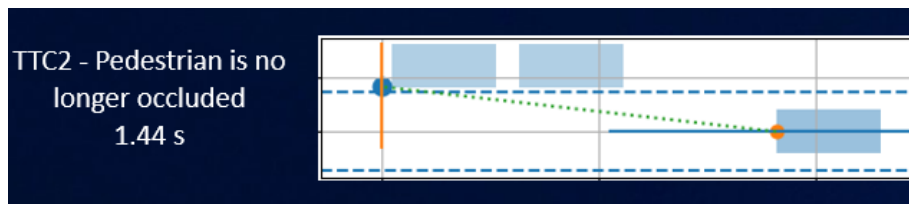
We will make presentations that we are allowed to distribute available to members and attendees. Hereafter the executive summary.

Key Take Aways

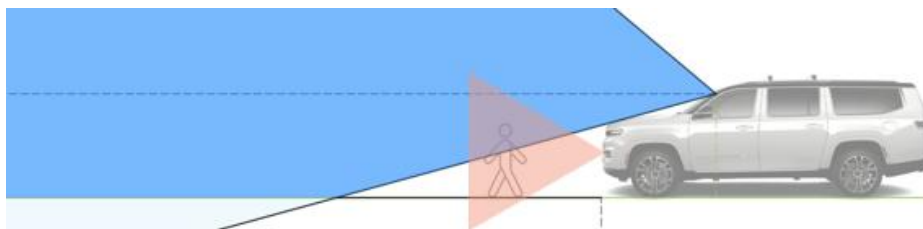
Meeting the AEB/FMVSS127 requirements of NHTSA by 2029 is still a huge challenge.

The industry is not comfortable with some of the use cases (high speed) and no reasonable solution is ready in time for a 2029 implementation. The expectation is there will be some adjustments done by NHTSA (max speed or schedule)

-STLA shows the 50kph test with an occluded Pedestrian requires “immediate braking action with 1g” because of a very short TTC, when latency constraints and brake build / friction parameters are taken into account: the top speed clearly challenges system performance.



- a second issue is when the Pedestrian is not fully seen either at low speed (only upper body is seen due to the camera mounting position) or for PAEB tests in low beam mode with no streetlight (for some tests, the camera will only see the legs of the PED). A dual sensor set-up is then required, using typically Camera & radar based on current technologies and cost targets. We have seen significant improvements of the radar perception Software (i.e. Perceiv.ai), which can lead to an affordable solution.



- a third issue is the false braking risk: IR cameras can support a superior detection of Pedestrian in all light/weather conditions and could greatly help here, but might apply only to high end cars due to a significant on-cost (presentations of Compal, Flir, Lynred)

Challenge	Solution	Outcome
Nighttime PAEB detection limits	Thermal imaging fused with other sensors	+36% AP at night, fewer false negatives.
Phantom braking from over-sensitivity	Robust multi-modal perception & safe exploration in simulation	Lower false-positive rate, better UX.

- New opportunity: Marelli and ams Osram, have presented a future low-cost solution with a near IR illumination low-cost add-on in the headlamp, to see the full body of the pedestrian without adding any visible light above the horizon (not allowed by the lighting standards). But it

the solution (illumination + modifications of existing cameras) might take some time before it is on the shelf.

Deployment of new AEB features is a significant challenge in EU / US / China

DVN/I4research: There is not only FMVSS127 coming as a challenge in the US, the AEB legal deployment is speeding up in China, starting in Jan 2027 for all new models and one year later for all models ... with typical use cases for stationary vehicles or Pedestrians as stringent as NCAP 2026. So we can expect a significant and worldwide improvement of road safety in the next years, incl. higher speed requirements.

Ansys: simulations are getting more and more important to support validations and type approvals. The Chinese AEB regulation will allow simulations to be used in up as much as in 67% of the use cases, pending the demonstration of the accuracy of the simulations. Ansys claims they achieve 97% accuracy with their simulation tools which apply to Radar, Camera, IR, Lidar.

Achieving L2+,L4 Safety Targets

Autoware: The key-point is to solve the “long tail scenarios”, especially the unknown edge cases. Accidents show that sometimes the sensing performance is enough, but the AI control software is not robust. There are different concepts, some are based on object classification, adding a risk of confusion in “unknown use cases” leading to potential accidents. Autoware, which is developing an open-source Software for L4,5 applications, thinks their “Sense Seg” solution based on important objects detection whatever the object is, will reduce the risk of confusion and doesn't require any training for the classification.



VALEO: new safety features are also coming to support L2+,L4 deployment – i.e adaptive warning based on driver gaze - based on its Panovision projected display. 5G-V2X can also be used for non-line-of-sight sensing. C-V2X from a pedestrian's cell phone might also be used to indicate to a vehicle before line-of-sight and Valeo is working with Verizon on this. Valeo also announced a central compute win with GM leading to a \$250M investment in a factory in Texas.

IMEC: is a nonprofit organization working with public funding and partners from the industry, to develop chiplets supporting modular and scalable L2+/L4 architectures for the automotive (and robotics) industry, with SOPs by 2030.

Improvement of Sensing technologies and importance of recalibration over lifetime

Perceiv.ai: their radar AI Software shows improving freespace capabilities, many customers are interested

Forvia-Hella: is developing a portfolio of Imaging radars from 8x8 to 24 x 24 channels, which will support L2+,L4 applications.

Ascential: stressed the importance of calibration over lifetime, and the need of a standard to get dealers working properly and with a standardized process on the recalibrations. A bill is in progress on this topic.

Preparing the future of AVs

MNDOT: MN is one of about 16 states that doesn't have specific rules. Some states allow specific testing and/or deployment. So far there is a lack of federal guidance, so it is left up to the states. MnDOT presented its work to implement a regulation for AVs in Minnesota. Some tests have already been done with May Mobility the last 3 years, and Waymo has recently started. Some of the key topics include privacy and security, safety verification, liability and insurance, emergency services interaction, workforce development. There are a number of AV related bills being introduced in the current legislative session, but there are quite different approaches between republicans and democrats. Hosting AV day at the state capitol on April 14th 2026.

TeraDAR: presented its 300Ghz imaging radar. This technology should be able to propose similar detection / imaging performance as a Lidar but will work in all weather conditions, at a lower cost. The first prototype is available and the best guess for a SOP is 2029



Program (Sessions)

SESSION 1 - REQUIREMENTS & PERFORMANCE OF CURRENT SYSTEMS

MnDOT – Thomas Johnson-Kaiser, CAV Planning and Policy Manager

- *Minnesota's Approach to AV Policy: Exploring AV legislation through policy research and stakeholder engagement*

i4Research – Eric Amiot, DVN Sensing & Applications General Editor

- *AEB requirements (US vs EU/CN), AEB performance of L2+ systems in China*

STLA – Emily Robb, Senior Fellow

- *AD Sensing Innovation opportunities for multi-camera compute platforms in SDVs*

SESSION 2 - TECHNOLOGIES FOR L2 / ENTRY SYSTEMS & SCALABILITY

Marelli – Colby Childress, Optical Manager

- *The Balancing Act for Lighting Modules between FMVSS 127 and FMVSS 108*

Compal – Richard Seoane, General Manager IR

- *Infrared Completes the Safety Picture*

Teledyne FLIR OEM – John Eggert, Director Automotive Business Development

- *Advancing Safety through LWIR: Deploying ASIL-B Thermal Cameras for FMVSS 127 and Beyond*

Forvia-Hella – Andrew Bates, Vice President, Automated Driving

- *Next-Generation High Resolution Radars*

SESSION 3 - TECHNOLOGIES FOR TECHNOLOGIES FOR L2+ / L4 ADVANCED SYSTEMS

Valeo – Dirk Schulte, R&D Director, Advanced Engineering & Product Platforms

- *New Safety Features for L2 Assisted Driving: From Adaptive Warning based on Driver Gaze to V2X Pedestrian Awareness*

Autoware – Muhammad Zain Khawaja, Managing Director of Product

- *Tackling the long-tail of pedestrian AEB and collision avoidance*

Perciv.ai – Andras Palfy, Co-founder

- *AI-driven Radar-First Perception, from ADAS to Autonomy*

Teradar – Zack Bolton, Director of Business Development

- *Terahertz Vision: See the unseen*

SESSION 4 - PERFORMANCE VALIDATION & SIMULATION

Performance validation & simulation

ams-Osram – Christopher Eichelberger

- *NIR technologies to supplement lighting systems: IRED and Laser emitters*

IMEC – Jim Foresi, Director, Automotive Semiconductor R&D Center

- *Defining a Chiplet Strategy for Automotive*

Synopsys/Lynred – Lionel Bennes, Lead Product AVx

- *Reducing phantom braking and complying with FMVSS 127 through thermal imaging and simulation*

Ascential – Bruno Moretti, President

Exhibitor



Speakers – Photo Gallery



P.H.Matha (DVN)



T.J.Kaiser (MnDOT)



E.Amiot (DVN)



E.Robb (STLA)



C.Childress (Marelli)



R.Seoane (Compal)



J.Eggert (Flir)



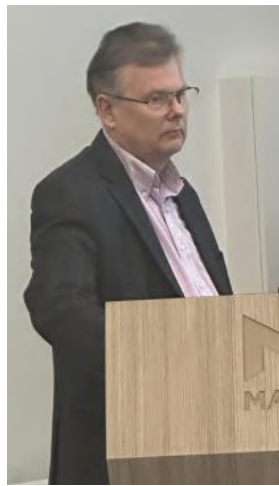
A.Bates (Forvia-Hella)



D.Schulte (Valeo)



Z.Bolton (TeraDAR)



M.Booth (DVN)



J.Foresi (Imec)



C.Eischelberger (ams-Osram)



Q.Noir (Lynred)



L.Bennes (Synopsys)



B.Moretti (Ascential)



D.Johnson (OnSemi)



M.Z.Khawajia (Autoware)



A.Palffy (Perceiv.ai)



Detailed notes

Automated Vehicles in Minnesota – Thomas Johnson-Kaiser, MN-DOT

Focused on policies and regulations for L3 and above. Covering both robotaxis and trucks. Was lead agency for May Mobility trial for first 3 years. AV tech is important to increase safety, provide greater mobility, be at forefront of technology and lead to economic growth. Governor formed advisory council and there is a team in MnDOT that has been working on this since 2018. MN is one of about 16 states that doesn't have specific rules. Some states allow specific testing and/or deployment. So far there is a lack of federal guidance, so it is left up to the states. MnDOT developing policy by looking at what other states have done. Engaged with many stakeholders, including cities and counties. Some of the key topics include privacy and security, safety verification, liability and insurance, emergency services interaction, workforce development. Waymo is now doing testing in MN. There are a number of AV related bills being introduced in the current legislative session, but there are quite different approaches between republicans and democrats. Hosting AV day at the state capitol on April 14th 2026.

AEB Requirements, Eric Amiot (for) i4 Research

AEB performance will improve everywhere. High Speed AEB and PAEB in darkness will be implemented in the US (FMVSS127) in 2029. AEB will be mandatory in China from 2027, 2028 with specifications close to E-NCAP (AEB and stationary Vehicles). IR sensors are emerging for this (BYD announced they are using it). For NOA, Lidar is being used in China, which helps for highspeed AEB. Elsewhere HD Radar. There is more attention to False positives (in the media and with regulators) in US/EU and more attention to safety risks with L2+ systems in China. L2+ is becoming the standard in China and is getting introduced on cars at <\$30K. i4 Research testing shows Huawei leading (based on risk MPI metric) followed by Horizon, Bosch/Momenta and Deep Route. Today, 64% of new China vehicles have suite of ADAS systems. AEB will be required for type approval next year and in all new vehicles by Jan 2028. Needs to work to 80km/h (for stationary vehicle) and 60km/h for child crossing. US-FMVSS will have the highest speed AEB. I4 is testing over 70 cars from major Chinese and Worldwide brands. Huawei based Luxspeed vehicle performance exceeds (speed) of Tesla model Y on AEB due to Lidar.

AD Sensing, Emily Robb, Stellantis

Meeting FMVSS (for Occluded Child Test as example) is different on the test track versus real-world. Camera latency is 33-99ms, radar 150-250ms, fusion 50ms, decision logic 10-40ms, brake build 250ms. Braking starts around 1.1 to 1.2 seconds and will fail test with standard brakes today. Low speed scenarios also pose problems (blind zone ahead for light trucks). At 10km/h, late reveal pedestrian will also fail with single camera. This drives a need for a dual sensor approach. Leveraging partial cues while pedestrian is occluded (from motion, thermal etc.) can give more time.

STLA Active Drive Assist Plus is an L2+ system with assisted lane change and has a DMS system. Current focus is on developing next generation architectures. Software defined vehicles are organizationally complex – since you are sharing edge devices between different domains. Defining software requirements on different SoC cores is challenging. STLA Brain platform will run Autodrive and Smart Cockpit. In decentralized architecture single ECU is mapped to each sensor. In centralized architecture – one or more SoCs is mapped to multiple sensors. But this gives you more flexibility. If neural network changes it is easier to re-configure system to accommodate.

Panel 1 - Q&A

MnDOT:

Rules for accident reporting in MN are still t.b.d.

Are OEMs going to try and skirt rules by staying with L2++++ label? L3 is by far the hardest to regulate. Focusing on L4 and L5 to start. Waiting for more federal guidance on L3.

Waymo has been testing in winter weather. Regulation is being discussed (in MN) that the safety case/ODD needs to be validated in winter conditions.

STLA

OEMs are requesting AEB entirely with lighting and camera – but band of vehicles that will be able to do this is very narrow. To meet <\$100 budget, this has to be primarily a software upgrade – but perhaps it is not realistic.

How is scalability of architecture considered to keep cost down? Thermal sensor by itself exceeds the available budget.

Lighting Modules for FMVSS – Colby Childress, Marelli

Lighting is a critical part of the AEB solution. Pedestrian detection algorithms use mostly hands and face (more reflective). The amount of light available is dictated by FMVSS. Lower mounted headlights create more challenges. Optimizing beam for FMVSS 127 while meeting FMVSS 108 and getting good IHS rating is critical. Adaptive driving beam has restrictive road test to avoid glare into oncoming traffic. Every OEM has IHS requirements that have to be met. Road reflections are worse on salted roads but can increase performance. Aiming height and tolerance are also critical.

Marelli developed K-Light with integrated pedestrian beam (active in low-beam mode with no ADB). NIR can be used for pedestrian beam and useful for lower mounted vehicles. There are also new US NCAP tests coming for pedestrians on the left side of the vehicle which are even more challenging.

Infrared Completes the Safety Picture, Richard Seoane, Compal

Far IR does not put out any light. Works well in rain, fog, headlight glare. Current L3 systems have ODD limitations. IR increases the ODD. Lidar point cloud is less dense. IR camera is as small as 25x25mm making for easy integration. Ansys partnership for simulation data. Testing on delivery van at up to 70km/h. Japan bringing in new MLIT Nighttime requirements 2030, includes higher speeds and night with no streetlights. In Europe 2030 GSR Nighttime PAEB requirements coming. In the US, NHTSA is looking at increasing speed and adding bicycle and motorcycle tests for 2031. IR also works to avoid animal collisions which is another major cause of accidents.

Thermal Cameras of FMVSS – John Eggert, Teledyne Flir

More than 1M auto-quality thermal cameras shipped in cars in more than 4 generations. In testing, thermal camera has significant range advantage at night versus 8MP standard camera. OEMs were aware of thermal for animal, fog and black ice warning -but not considering for AEB or phantom braking. All OEMs were waiting to see if FMVSS 127 is delayed or changed. Thermal cameras are also quite robust to occlusions, like dust and mud.

High Resolution Radars, Andrew Bates, Forvia Hella

Current sensors have challenges in all weather. 4D radar adds height and uses antenna array for high angular resolutions. A high density point cloud allows detailed scene interpretation and provides instant velocity. Imaging radars will be used for L2+ applications and beyond (not for FMVSS127)

Panel II – Q&A

Camera suppliers are asking for more light, but while this can help, to meet the requirements is hard. Lighting improvements are part of the solution.

RGB-IR sensor with suitable lens is a possible solution and latency can be reduced with higher frame rates. Surround view cameras can also help solve occlusion problems.

If the road isn't flat, radar range of course is impacted. This has to be handled at the system level.

Eye safety from wide beam NIR lighting is a topic to be discussed with OEMs. There are certain scenarios when this cannot be turned on.

Driving with night vision may not require high beams. IR can help with higher speed driving. IR can detect over 200M versus best cameras with low beam at around 130-150M.

How can suppliers work better to solve these problems at a system level? The OEMs must push for new solutions from the inside and partnerships are directed by them. This sort of symposium is good to broaden the knowledge of the suppliers – but OEMs will dictate the solution.

HD radar currently being used for L3 and up. But as more centralized architectures come, high channel count radars will become more popular. AEB and ACC can be solved by 4x4 radars today.

Technologies for L2+/L4 Advanced Systems, Valeo – Dirk Schulte

Valeo Brain deals with everything that is related to driving automation and the software defined vehicle. OTA updates allow the vehicle to continuously improve over its life. But this brings changes to the architecture from distributed ECUs – to higher level domain controllers and in the future to centralized compute. Valeo just announced a central compute win with GM and a \$250M investment in a factory in Texas for that. More sensors are being added, and at L3 capability, lidars are getting added as well as HD radars. A very different compute architecture is again required for all these sensors. AEB is a safety feature, but new safety features are also coming. Valeo has a best-in-class integrated interior sensing system. Adaptive warning based on driver gaze is one of the new safety features – based on its Panovision projected display. 5G-V2X can also be used for non-line-of-sight sensing. C-V2X from a pedestrian's cell phone might also be used to indicate to a vehicle before line-of-sight and Valeo is working with Verizon on this.

Tackling the long-tail of AEB, Muhammad Zain Khawaja, Autoware

Autoware is an open source software project used by researchers and OEMs for automated driving. One way to solve the nighttime AEB problem is with better sensors. But an even bigger challenge is with the core AI itself. Long-tail edge cases in particular. Testing in China showed even with multiple sensors, collisions could not be prevented. Almost all OEMs failed to slow or brake for a pig crossing the road for example. The Uber/Herzberg crash was not a sensor failure – rather an AI failure – which assumed the person was a static object due to its position on the road. A human could have seen the pedestrian at almost 200M away.

Autoware's Scene-seg NN is a way for OEMs to build safer systems. The system is trained to detect every important foreground object, irrespective of what the object is and can learn to detect objects it hasn't been specifically trained to detect. It works reliably in heavy rain, snow and low light conditions at night.

AI Driven Radar Perception – Liam R. , Perciv.ai

AI perception for radar – vendor agnostic and have worked with many of the radar suppliers. Models are compute agnostic and less than 2 TOPS compute requirement. Ego track is radar-only ego-motion estimation (no GPS or IMU). Freeroad is a free space estimation that works in all weather, day or night. Can also look at height (free space). Objects, can classify objects with lidar-level performance. Perciv can also do radar/camera fusion which allows for a better 3D segmented map of the world. Can also work with raw data (range-doppler) and can almost always get better results with that. A reference kit is now available for testing.

Terahertz Vision – Zack Bolton - Teradar

Fabless chip design company for radar like vision – but pushes the envelope due to the fq. band they are working with. Camera has great resolution in good conditions, and camera and radar fusion provides better data in bad weather. Radar is not as good at predicting edges. Lidar has better angular resolution and works more like how the human mind sees. But lidar also fails in poor weather conditions and is also expensive. Ultrasonics have been around for a longtime, for parking, but have limited range.

Teradar believes there is a gap between 77GHz radar and 940nm (319 THz) Lidar. The company has around 70 employees. Teradar has 10x higher native resolution than today's radar. Already working with 5 OEMs and 3 Tier1's to bring a solution to series production by 2028. A samples had 25M range, but the B sample has over 300M range with production samples at the end of 2027.

No waveguides, photonics, external antennas – makes manufacturing simpler. 0.13 degree native resolution , 3cm accuracy, 120x30 FOV at 20Hz frame rate. Can configure for wider FOVs as well.

Panel 3 - Q&A

Raw radar data does not significantly increase the compute requirements

Without regulators pushing some of these new technologies, adoption has to be driven by the industry. Open source is one way, but relatively new in ADAS.

Terahertz spectrum will require approval from FCC etc. but due to the limited number of users already here, this should be possible for automotive.

Dimensions: the Teradar demo unit is quite wide and this is to achieve maximum resolution so could be smaller if less resolution is required. It can also be hidden behind fascia so perhaps that is less of an issue than with camera and lidar.

NIR Technologies to Supplement Lighting – Christopher Eichelberger, AMS Osram

NIR can be used to supplement low beam. Low beams need to have less light above the horizontal, which is particularly hard with lower mounted headlights. Additional illumination is needed for camera to work better (for AEB for example). An NIR emitter is the least complicated add-on, thermal and lidar are more costly (unless you already have it), and gated imagers are a possible solution.

For a 850nm emitter pulsed at 1ms (60Hz) using AMS MIRA220 imager data, SNR=10 – around 5-20W is required for the beam pattern, but there is some light from the low beam in the pedestrian detection area, so the optical wattage can be reduced to 5-12W. High powered IREDS or VCSEL could be used. A next generation brighter IR LED is coming with improvements that is

probably the best fit and will be automotive qualified. Eye safety risk can be reduced with integration into the rest of the headlamp, NIR disabled if low beam fails and can probably pass the IEC 62471-7 spec. Design needs to start later this year to hit 2029 production assuming off the shelf product.

Chiplet Strategy for Automotive – Jim Foresi – IMEC

IMEC is a semiconductor R&D consortium working with major equipment developers and foundries to find solutions to higher compute densities. Have ASML's most advanced lithography systems and can work at the most advanced nodes. Logic nodes are scaling from finFETs to NSFETs, FSFETs, CFETs and beyond. To do 1000+ TOPS and 100Gbits per second bandwidth you need the most advanced nodes. OEMs are developing their own SoCs. Tesla is looking at their own fab beyond foundries. The most advanced silicon costs \$100M's to develop. Supply chain disruption is also a key concern. Chiplets can help solve those problems. Datacenters are starting to use chiplets and by separating functions into smaller chiplets power and performance can be optimized. The CPU can be scaled for L2 v L4 applications, yields go up, older nodes can be used for i/o, ISP and other functions. New parts of the design can be more easily accommodated without changing everything. An open-ecosystem is desirable so you can mix and match chiplets from different vendors. Large multi-chip modules are being investigated for quality and reliability. Automotive has very different requirements from data centers. Different architectures are possible. Heilbron will prototype packaged die. Mstar (Michigan Consortium) formed with GM, KLA, IMEC, UM and others with 8 seed programs. Open source (UCle) PHY for inter-chip communication. Also looking at workload optimization (for sensor fusion for example) to select chiplet architecture based on simulation tools.

Simulation to Reduce Phantom Braking – Lionel Bennes, Lynred

Extending ODD is a common need. Thermal imaging can help solve FMVSS127. False positives also need to be minimized to reduce phantom braking, rear-end accidents etc. Thermal image gives more time to react and smoother braking. Average precision (FP & FN) is improved by 36% at night. Lynred has a more than 8,000m² clean room and is IATF certified.

Synopsys/Ansys (AVxcelerate) tools allow simulation testing for FMVSS127. The 11 base scenarios expand into hundreds of test cases, and thousands if you want to include different sensor modalities and robustness. Test vehicle availability and track time is also limited. Simulation can be run with hardware and/or software in the loop. Lynred provides a physics based model of its IR sensor.

Ascential – Brunno Moretti – The Importance of ADAS Calibration

ADAS calibration has grown in complexity at the end of line and also needs to be done through the life of the vehicle in the aftermarket. A typical scan tool costs \$125K and repair shops are still using plumb-bobs. Less than good quality calibrations (after repair for example) are

common which could lead to unexpected AEB events etc. The baseline test vehicle (after 14K miles) was already out of calibration. Calibration should probably be a maintenance item.