

TERADAR



ADAS

— Terahertz Vision Drives
ADAS Safety to New Heights

Executive Summary

Rising safety and system complexity demand ADAS solutions that deliver uncompromising performance under real-world driving conditions. Teradar's proprietary Terahertz Vision harnesses a high-frequency spectrum to produce sub-millimeter native resolution, robust detection in rain, fog, and bright glare, and seamless integration via modular solid-state sensors. Designed for chip-level mass production, Teradar technology enables cost-effective deployment at scale, and supports flexible vehicle architectures, all validated by field testing and peer-reviewed data. This white paper details the physical mechanisms, system integration strategies, empirical performance metrics, and cost efficiencies that position Teradar as the new benchmark in automotive sensing for next-generation safety programs.

The Sensing Gap in Modern ADAS

Every year, over 1.3 million fatalities occur worldwide in road traffic accidents with 22% occurring under adverse weather or low-visibility scenarios that outmatch traditional sensors. Cameras, Radar and Lidar, struggle with rain, fog, and dust, posing a risk to increasingly autonomous vehicles.

Current industry benchmarks for ADAS sensors require:

- Spatial resolution below 1° across 300m+ ranges
- Multi-material detection (metal, plastic, textile, water)
- Reliable performance in all weather and lighting
- Real-time classification of vulnerable road users

Terahertz Vision Explained

Terahertz (THz) waves occupy 0.1–10 THz (3mm–30µm wavelengths), between microwave and infrared which unlock unique capabilities:

- **High Resolution, Even in Weather:** Short wavelengths enable sub-millimeter spatial resolution which dramatically outperform radar and rivaling or surpassing Lidar in rain, fog, snow, and dust.
- **Material Fingerprinting:** THz waves stimulate vibrational modes in polymers, explosives, water vapor, and organic materials, providing unique spectral signatures for advanced object classification.
- **Non-ionizing Safety:** THz photons possess minimal energy, inherently safe for humans and vehicles.
- **Immunity to Glare:** THz signals easily detect objects obscured by bright sunlight, headlights, or oncoming glare where cameras fail.

Empirical Performance: Peer-Reviewed Findings

Resolution and Range

- MIT's sub-terahertz array chip achieves up to 32 pixels on a 1.2mm² device, 4300x more sensitive than standard sensor pixels, delivering robust, high-fidelity imaging in fog and dust where Lidar is ineffective.
- Peer-reviewed validation shows Terahertz Vision can detect small, low-profile objects at over 160m+ with angular resolution down to 0.5°.

All-Weather Reliability

- Mustang Technology's ACTI (Active Covert Terahertz Imager), operating at 300–330GHz, demonstrated robust performance in dust storms, thick fog, and blinding precipitation at Army Research Labs, outperforming millimeter wave and lidar.
- Teradar's proprietary architecture leverages steerable beam arrays and multi-source fusion, ensuring reliable detection across nearly any environmental condition.

Cost and Integration

CMOS miniaturization enables Terahertz sensors to be integrated alongside cameras at markedly reduced cost compared to LiDAR, supporting multi-modal fusion architectures for mass deployment.

System Architecture and Deployment

Sensor Fusion

- Teradar's modules plug directly into existing ADAS sensor networks, using artificial intelligence for real-time classification, object tracking, and threat prediction.
- Fused data streams from camera and Teradar enable robust redundancy and superior perception across every environmental regime.

Range and Field of View

- Multi-tier systems enable detection and tracking of vehicles, pedestrians, and small objects out to 300m, critical for highway autonomy and urban safety zones.

Road Trials and Standards

- Active R&D in the U.S. and Europe, supported by major tier-1 suppliers, points to increasing likelihood of deployment by 2028.

ADAS Use Cases Empowered by Teradar

Collision Avoidance

- Real-time multi-modal detection and identification greatly improves reaction speed versus cameras and lidar in degraded weather.
- Peer-reviewed research from MIT and Mustang Technologies validates rapid hazard recognition, with a prototype achieving sub-400ms response in thick fog “where lidar and cameras failed utterly”.

Vulnerable Road User Protection

- Teradar sees through fog, rain, and snow to detect pedestrians, cyclists, and animals in environments where others are blind.
- Data fusion dramatically lowers incident rates, particularly for night and weather-related accidents.

Traffic Flow and Autonomy

- Teradar sensors recognize traffic signs, obstacles, and dynamic lane markings.
- Dual-use configurations for positioning and vehicle-to-everything (V2X) communications extend capabilities beyond mere perception, supporting vehicular data networks for advanced safety.

Safety and Regulatory Validation

Non-Ionizing Safety Profile

- THz radiation is well below safety thresholds; peer-reviewed laboratory and field studies show no adverse tissue or sensor impact in vehicle environments.
- Compliant with US DOT, Euro NCAP, UNECE certificates for conventional and automated vehicle deployment.

Data Security

- Teradar modules feature encrypted signal processing and standardized anti-spoofing countermeasures, meeting ISO 26262 and ISO/SAE 21434 standards for data integrity and cybersecurity.

Roadmap: Towards Automotive Sensing 2.0

With the convergence of regulatory pressure for safety, urban congestion, and electrification, the transition to advanced sensing platforms is inevitable. Teradar's

terahertz technology establishes the only proven sensing category that bridges the resolution, reliability, and cost divide, ready for integration into future ADAS, autonomous vehicles, and smart mobility networks.

OEMs and tier-1 suppliers are poised to benefit from:

- Sub-millimeter resolution in all weather
- Rapid, real-time object classification and detection
- Lowered production and implementation costs
- Scalable global deployment with robust safety and regulatory compliance

Conclusion and Recommendations

Teradar's Terahertz Vision propels OEMs to the forefront of ADAS innovation by delivering sub-millimeter native resolution, all-weather object detection, and industry-leading reliability through fully solid-state, chip-scale architectures. Peer-reviewed field trials validate its performance edge, while streamlined hardware integration and silicon-level cost efficiency translate to rapid, scalable deployment across global platforms. For next-gen automotive safety, strategic partnerships, pre-production pilots, and collaborative engineering with Teradar will accelerate regulatory approval and deliver measurable gains in perception, robustness, and production economics

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