NXP 4D IMAGING RADAR
READY FOR DEPLOYMENT NOW

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ADAS / AD SENSING TECHNOLOGIES

**KEY MEASUREMENT**

- **RADAR**: Distance, speed
- **CAMERA**: Angle, pattern, color
- **LIDAR**: Angle, distance

**ENVIRONMENTAL SUSCEPTIBILITY**

- **RADAR**: RF interference
- **CAMERA**: Rain, fog, snow, ice, night, glare, dust, smog, NLOS
- **LIDAR**: Rain, fog, snow, ice, light, dust, smog, NLOS

**AREAS TO IMPROVE**

- **RADAR**: Angle
- **CAMERA**: Distance, speed, false image targets
- **LIDAR**: Cost, long-range targets, robustness, high maintenance, mass producibility, aesthetics

**Mature**
- Inexpensive
- Highly complementary
  - L1 ~ L5

**Sensing redundancy**
- L4 ~ L5
4D HIGH IMAGING RADAR USE CASE EXAMPLES
EXTENDING L2+ TO MORE DEMANDING DRIVING SCENARIOS

Highway pilot

- Long-range (LRR) mode for automatic cruise control (ACC)
- Medium-range (MRR) mode for lane-change assist (LCA)

Urban pilot

- Very fine feature resolution: curb-stone detection
- Reliable vulnerable road user detection & classification
**4D IMAGING RADAR - BIG TECHNOLOGY LEAP**

NXP 4D Imaging Radar spans L2+ to L5

**LEVEL 2+**
Conditioned Automation

- Fine point clouds enable standalone 360° sensing and environmental mapping
- Complement by camera
- Minimizing lidar usage for L2+ ~ L5
- Assuming majority workload for future sensor suites

**LEVEL 3 TO 5**
High/Full Automation

- Mobility as a service

Higher Automation

Accelerated Growth

<table>
<thead>
<tr>
<th>RADAR</th>
<th>5+</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAMERA</td>
<td>6-8</td>
</tr>
<tr>
<td>LIDAR</td>
<td>0-1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RADAR</th>
<th>6-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAMERA</td>
<td>6-8</td>
</tr>
<tr>
<td>LIDAR</td>
<td>1-3</td>
</tr>
</tbody>
</table>

Mobility as a service

- 4% of cars ’30
- ~43% of cars ’30

Highway Pilot

Urban Pilot

NXP 4D Imaging Radar spans L2+ to L5

PUBLIC 3
Weather robustness + 4D high resolution = fundamental sensing technology across all AD levels
Fast growth with advanced corner & front sensors

Modest growth of full automation but potential for 10+ high performance sensors per vehicle

Imaging radar may eliminate the need of Lidar in L2+

Standalone 360° surround sensing reduces Lidar to 1x only for redundancy
**4D Imaging Radar Bifurcation Requires Optimization for Use Case**

**Scalable S32R4X Architecture: Easy Scaling and Migration**

**Radar Product Family**

<table>
<thead>
<tr>
<th></th>
<th>4D Imaging Radar</th>
<th>Long-Range Radar</th>
<th>Corner Radar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMAGING RADAR</strong></td>
<td>S32R41 MCU</td>
<td>S32R45 MCU</td>
<td>S32R1 MCU</td>
</tr>
<tr>
<td><strong>77 GHz</strong></td>
<td>1-Chip</td>
<td>1-Chip</td>
<td>1-Chip</td>
</tr>
</tbody>
</table>

**NXP 4D Imaging Radar**

- Tailor-made high-performance processors
- Delivers fast, powerful and efficient processing
- Unparalleled scalability on common architecture
- Maximized software reuse for platform development - from advanced corner to 4D imaging radar
- Performance boost beyond raw HW capability
  - Advanced radar processing software unleash the full hardware potential
4D IMAGING RADAR BIFURCATION REQUIRES OPTIMIZATION FOR USE CASE
SCALABLE S32R4X ARCHITECTURE: EASY SCALING AND MIGRATION

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IMAGING RADAR BIFURCATION
VOLUME SEGMENT VS. TOP-PERFORMANT

4D Imaging Radar

VOLUME (2-MMIC)
CLASSIC (4-MMIC)
PERFORMANT (6-8 MMIC)

Common Architecture
L2+ ↔ L5

TEF82XX
S32R41 MCU
DSP and Acc. Proc. Core

TEF82XX
S32R45 MCU
DSP and Acc. Proc. Core

TEF82XX
S32R45 MCU
DSP and Acc. Proc. Core

TEF82XX
S32R45 MCU
DSP and Acc. Proc. Core

Premium Radar SDK
S32R4X Boosting Performance with 3-in-1 Imaging Radar for L2+ through L5

NXP 4D Imaging Radar

Maximum awareness: concurrent 3-in-1 sensing
Simultaneous multi-mode scan: wide, mid and far in 4 dimensions
Concurrent use of transmitters plus adv. coding and algorithms

Maximum efficiency for <1° resolution
Up to 192 virtual channels and 12x efficiency gain
Smart and lean design vs. ordinary antenna count scaling

Long-range Radar 77 GHz
Front and rear higher performance

Corner Radar 77 GHz
Multiple small modules

4D Imaging Radar spans L2+ to L5

Simultaneous multi-mode sensing up to 300 m

Enabling mass adoption of L2+
Premium Radar SDK
• Advanced algorithms for
  - Interference mitigation
  - MIMO waveform
  - High angular resolution
  - etc.

• Optimized implementation allowing customer improvement

• Regular releases to expand with new algorithms

Customer evaluation available NOW
4D IMAGING RADAR

Radar Antenna Board
Beam Shaped Co-prime
MIMO Sparse Array

Radar Transceiver Board
4x Cascaded TEF8232 Transceivers

Imaging Radar MPU Board
Imaging Radar MPU S32R45
(SPT/LAX/Cadence BBE32EP)
NXP4D IMAGING RADAR
APPLYING AN EFFICIENT TOTAL SOLUTION APPROACH

Purpose-made Radar acceleration:
64x Arm® A53 equivalent

Advanced MIMO waveforms

Gen2 RFCMOS:
2x link RF budget

3-in-1 sensor antenna design

Super-resolution & sparse array algorithms

(Radar acceleration: 64x Arm® A53 equivalent)
NXP 4D IMAGING RADAR IS READY TO HIT THE ROAD
STANDARD VS HIGH-RESOLUTION PROCESSING

Hi-Res Processing vs Standard Processing
<table>
<thead>
<tr>
<th><strong>Conventional ADAS Radar</strong></th>
<th><strong>Imaging Radar</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Array type</strong></td>
<td>Uniform Array sometimes with very few holes</td>
</tr>
<tr>
<td><strong>Baseline algorithm</strong></td>
<td>Beamforming, FFT</td>
</tr>
<tr>
<td><strong>Selectively applied algorithm</strong></td>
<td>Classic Super Resolution – MUSIC, ESPRIT, DML, etc</td>
</tr>
<tr>
<td><strong>Number of targets</strong></td>
<td>limited to 2 to 3 per cell</td>
</tr>
<tr>
<td><strong>Compute platform</strong></td>
<td>on SPT(FFT accelerator) and general-purpose processors</td>
</tr>
</tbody>
</table>
Automotive production Grade 1 solutions from a proven automotive Radar supplier

Products in the market place now!

S32R45 is a 32-bit automotive radar microprocessor unit (MPU) based on Arm® Cortex®-R52 and Arm® Cortex®-M4 cores. Focused on advanced high resolution long-range front or rear radar sensors, providing imaging radar resolution capabilities. The high performance radar processing and power efficiency enable the latest ADAI’s radar applications with a dedicated processor suitable for volume adoption, while also covering industrial and consumer applications where dedicated high performance radar processing is required.

Designed to satisfy the latest security requirements through its HSE security engine, and meeting ASIL ISO26262 ASIL B/D requirements, the S32R45 is the complete device for high performance radar processing.

For additional information and sample availability, contact NXP support.
We Recommend the Driving Automation and Radar Training Academy

- Visit additional classes on this topic [nxp.com/drivingautomationacademy](http://nxp.com/drivingautomationacademy)
Q&A
TECHNOLOGY SHOWROOM

JOURNEYS BY DESIRED ENGAGEMENT
Self-guided tour
Live-streaming at set times
Guided tours

JOURNEYS BY DESIRED FOCUS
Low Power Innovations
Advanced Analog
Connectivity
Edge & AI/ML
Safety & Security

60+ VIRTUAL DEMOS
Focus on system solutions
Set up along NXP verticals

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